SECTION INDEX

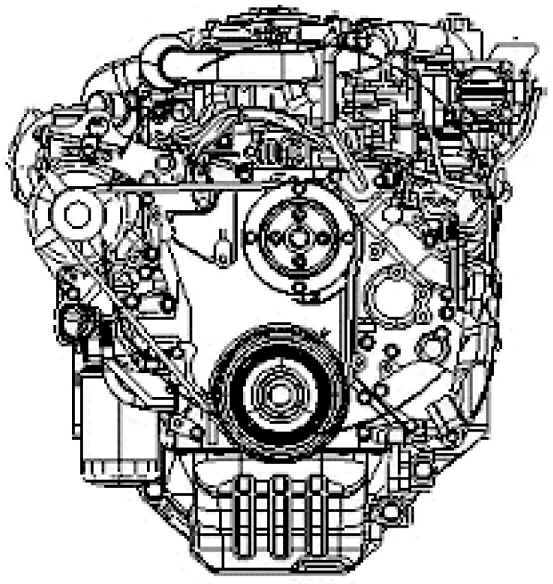
GENERAL

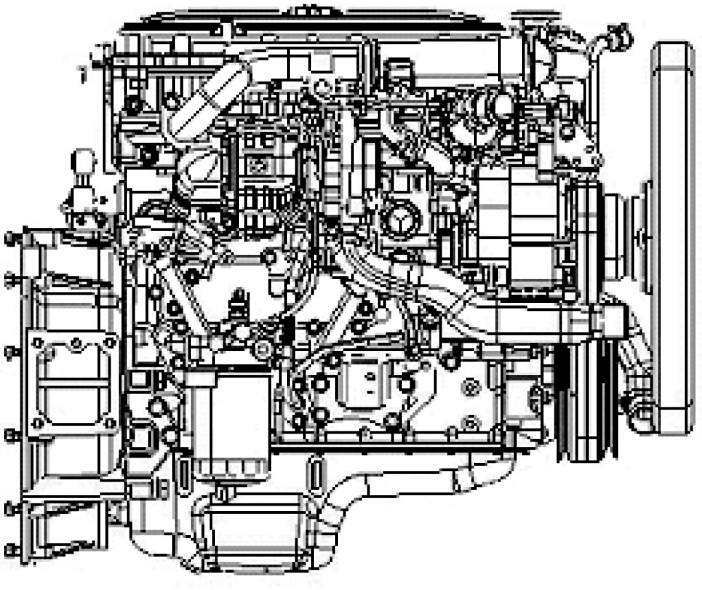
Page

SPECIFICATIONS

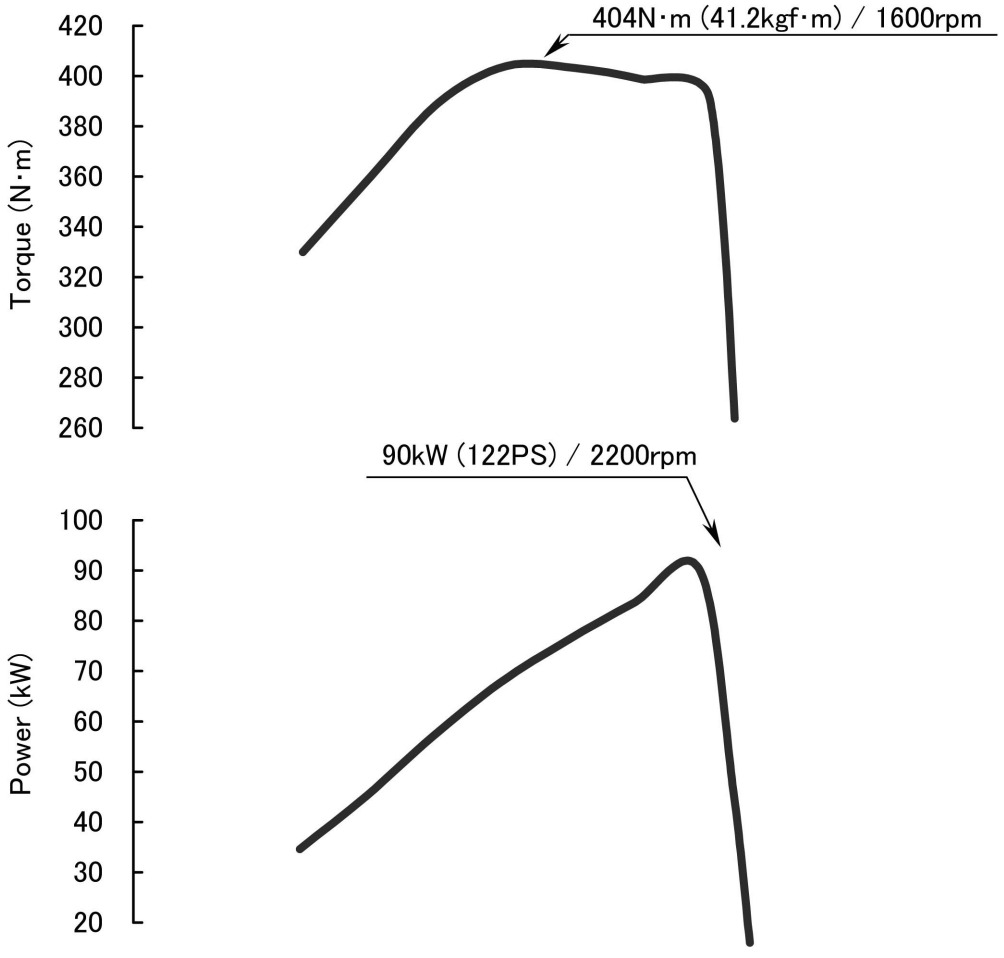
Engine model			N04C
Type			Diesel
Cycle			4 cycle
Number and arrangement of cylinders			In-line 4 cylinder, longitudinally mounted
Combustion chamber type			Direct injection
Valve mechanism			OHV gear drive
Bore × stroke		mm (in.)	104.0 × 118.0 (4.09 × 4.65)
Total displacement		cm^3 (in^3.)	4009 (244.6)
Compression ratio			18.0
Minimum fuel Consumption when fully loaded		g/kw·h (g/ps·h)/rpm	217 (160)/1600
No-load maximum speed		rpm	2290 to 2390
Idle speed		rpm	800 to 850
Engine dimensions (Length × width × height)		mm (in.)	887 × 716 × 751 (34 × 21 × 29)
Weight (Oil included)		kg (lb)	396 (873)
Intake valve open/close interval	Open		BTDC 14°
	Close		ABDC 42°
Exhaust valve open/close interval	Open		BBDC 53°
	Close		ATDC 17°

ENGINE EXTERIOR VIEWS





ENGINE PERFORMANCE CURVES



HOW TO USE THIS MANUAL

EXPLANATION METHOD

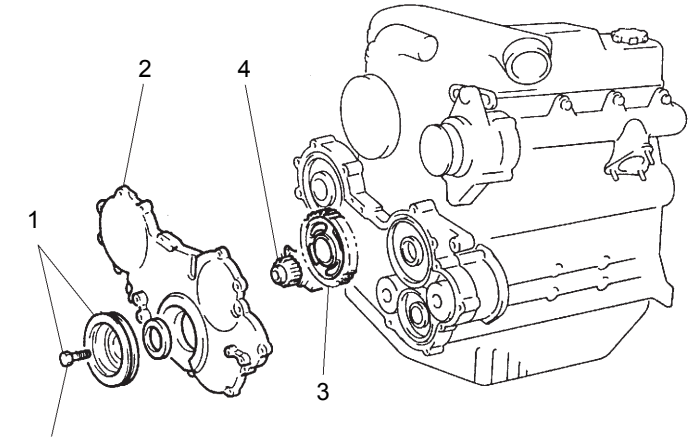
1. Operating procedure

   (1) Operating procedures are described using either pattern A or pattern B.
   Pattern A: Each step of the operation is explained with its own illustration.
   Pattern B: The entire operation is indicated by step numbers in one illustration, followed by cautions, notes, and "Point Operations".

Example of pattern B

DISASSEMBLY·INSPECTION·REASSEMBLY

Tightening torque unit → T = N·m (kgf·cm) [ft·lbf]



T = 274.59 ~ 370.69 (2800 ~ 3780) [202.6 ~ 273.5]

- The numbers may partially be omitted in the illustration.
- In the case where a part for which the tightening torque is specified is not shown in the illustration, the name of the part will be listed inside the illustration frame.

Disassembly·Reassembly Procedure

The reassembly procedure is the reverse of the disassembly procedure.

No.	Item	Disassembly	Inspection	Reassembly
1	Crank pulley W/ set bolt			
2	Timing gear cover			
3	Idle gear No.1		**[Point 1]**	
4	Oil pump ASSY			**[Point 2]**

Point Operations

Explanation of operation point with illustration

Operations that have a following explanation

[Point 1]

Inspection:
Measure the backlash.
Standard: 0.05 mm (0.0020 in.)

[Point 2]

Reassembly: Install the rotor in the position shown in the illustration.

1. How to read component figures

   (1) The component figures use the illustration in the parts catalog for the vehicle model. Please refer to the catalog to check the part name.

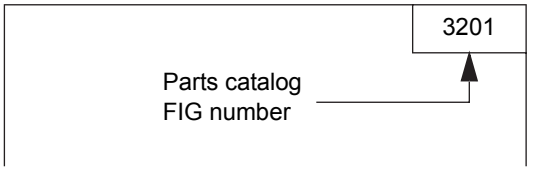
2. Matters omitted from this manual

   (1) This manual omits descriptions of the following jobs, but perform them in actual operation:

      (a) Cleaning and washing of removed parts as required

      (b) Visual inspection (partially described)

(Example)



TERMINOLOGY

Warning:
Items that may lead to an injury to either the operator or another person, and items and operation point switch, if not followed, may lead to an injury or accident.

Caution:
Items that must not be performed because doing so will result in damage to the vehicle or it's components, and items in the operation to which special attention should be paid.

Note:
Supplemental explanations for performing the operation easily.

Standard: Value showing the allowable range in inspection or adjustment.
Limit: The maximum or minimum value allowed in inspection or adjustment.

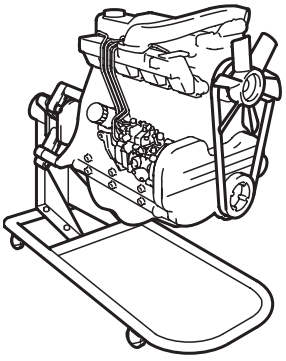
ABBREVIATIONS

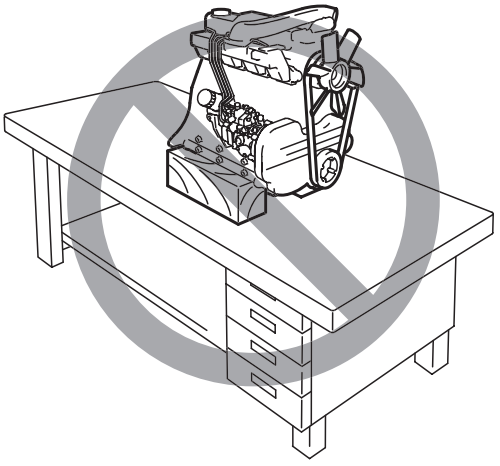
Reference symbol	Original word	Meaning
RH	Right Hand	Right hand side
LH	Left Hand	Left hand side
FR	Front	Front
RR	Rear	Rear
STD	Standard	This refers to the part size used by the maker at the time of assembly being the standard size.
O/S	Over Size	For parts that do not engage well anymore due to wear from long use, or repeated disassembly, by replacing the part that is engaged by a part of slightly larger dimensions, it's corresponding part can be reused. These parts that have larger dimensions than STD, and are referred to as O/S.
U/S	Under Size	As with the O/S parts, by replacing the engaging part with one that has a smaller hole, it's corresponding part can be reused. These parts that have smaller dimensions than STD, and are referred to as U/S.
ATDC	After Top Dead Center	After the top dead center point of the piston in the cylinder.
BTDC	Before Top Dead Center	Before the top dead center point of the piston in the cylinder.
IN	Intake	Refers to the intake system.
EX	Exhaust	Refers to the exhaust system.
SST	Special Service Tool	Special service tool
T	Torque	Tightening torque
ASSY	Assembly	A part that consists of two or more single parts or sub-assembled parts that have been assembled together into an integrated whole.
SUB/ASSY	Sub Assembly	A part in which two or more parts are joined together by welding, casting, riveting etc.
W/	With/	The following items are attached. (Example: W/ washer ... With a washer attached)
LWR	Lower	Lower

OPERATING TIPS

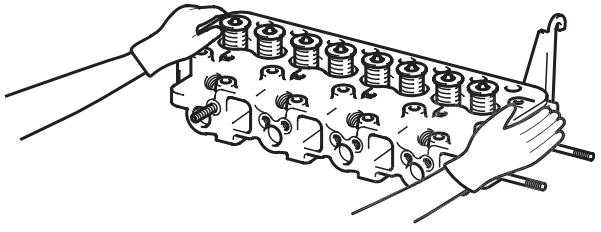
POINTS FOR WHICH SPECIAL CARE MUST BE TAKEN

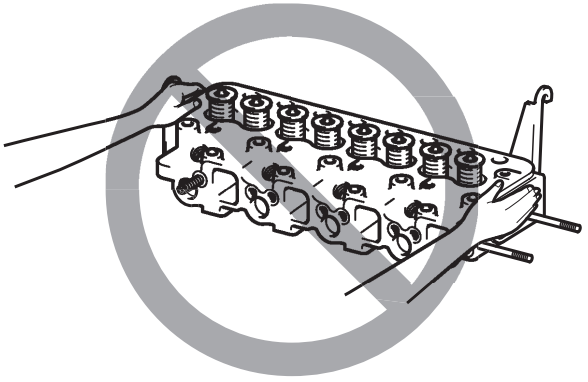
1. Always set the engine on an engine stand for carrying out assembly and disassembly of an engine. Never operate on a workbench or on the floor as this is dangerous.





2. When handling and moving the cylinder head ASSY or the cylinder block, always wear gloves and do not use your bare hands.





GENERAL INSTRUCTIONS

1. For safe operation
   (1) Wear the correct safety gear (cap, safety goggles, gloves, safety shoes).
   (2) To prevent burns, do not touch the radiator, muffler or exhaust pipe directly after stopping the engine.
   (3) Do not put your clothing or tools near to the rotating part when the engine is turning.
   (4) When the engine is not on, always have the engine switch OFF, and remove the starter key.
2. Preparation for disassembly
   (1) Prepare general tools, SSTs, measuring instruments, lubricant and parts that cannot be reused.
   (2) When disassembling a complex part, put imprints and match marks in places that will not effect the function of the part in order to facilitate easy reassembly.
3. Prevention of entry of foreign bodies
   Foreign bodies such as dust, sand and metal pieces inside the engine cause faults to occur.
   (1) Thoroughly remove sand and mud etc. sticking to the engine exterior.
   (2) Protect disassembled parts from dust with a plastic cover or similar.

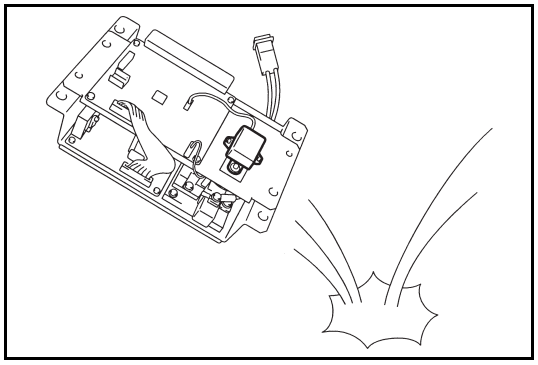
4. Prevention of damage to parts
   Damage to contact surfaces or rotating parts can cause oil leakage or burning.
   (1) To disassemble contact surfaces of parts, do not use a screw driver or such, but tap them lightly with a plastic hammer to separate them.
   (2) When clamping parts in a vice, do not clamp them directly in the vice, but between aluminum plates.
5. Washing parts
   (1) Before reassembling each part, wash thoroughly, dry by blowing them with air and apply the specified oil.
   (2) Parts that may not be washed in alkaline chemicals.
   Aluminum parts, rubber parts (O-rings etc.)
   (3) Parts that may not be washed in treated oil (kerosene, non-residue solvent etc.).
   Rubber parts (O-rings etc.)
6. Removal and installation of fuel system parts
   (1) Work area for removal and installation of fuel system parts
      (a) Work in a well-ventilated area where there are no sparks from surrounding welding equipment, grinders, drills, electric motors, or stoves.
      (b) Do not work in or near a pit that could fill up with the vapor from evaporated fuel.
   (2) Removal and installation of fuel system parts
      (a) Prepare a fire extinguisher before beginning work.
      (b) To prevent static electricity, attach an earth wire to the fuel changer, vehicle, fuel tank and so forth, and spread as much water on the floor as can be spread without causing slipping.
      (c) Do not use electric pumps or working lights as these may give off sparks or become hot.
      (d) Do not use a steel hammer as there is a possibility of a spark being generated during use.
      (e) Dispose of fuel-soaked waste cloths separately.
7. Position and orientation when reassembling
   (1) Reassemble each part with the same position and orientation from before it was disassembled.
   (2) Reassemble the correct parts in the correct order, keeping to the specified standards (tightening torque, adjustment values etc.). (Reassemble using the middle value within the range for tightening torque and adjustment values).
   (3) Always use genuine parts for replacements.
   (4) Always use new parts for oil seals, O-rings, gaskets, cotter-pins and so forth.
   (5) Before reassembling, apply seal packing for gaskets depending on their place of application, apply the specified oil or grease to the specified places for sliding parts, and apply MP grease to the lip section of oil seals.
8. Handling hose clamps
   (1) Before removing a hose, check the insertion depth of the hose, and the position of the hose clamp so that you can definitely return them to their original positions.
   (2) Replace deformed or fatigued clamps with new parts.
   (3) When reusing the hose, align the new clamp over the mark left on the hose by the previous clamp.
   (4) Adapt leaf spring clamps by applying force in the direction of tightening after attaching them.
9. Adjustment and checking operations
   Use a gauge or tester to adjust to the specified service standard.

10. Disposal of waste fluids
    When draining waste fluid from the vehicle, always drain it into an appropriate container.
    Careless discharge of oil, fuel, coolant, oil filter, battery or other harmful substances may adversely affect human health and the environment. Always collect and sort them well, and ask specialized companies for appropriate disposal.
    Also, be sure to collect or wipe up spilled waste fluids.

11. Protection of functional parts
    Before connecting the battery terminal after vehicle inspection or maintenance, thoroughly check each connector for any connection failure or imperfect connection.
    Failure to connect, or imperfect connection of connectors related to controllers, especially, may damage elements inside the controllers.

ELECTRICAL PARTS INSPECTION

1. Always disconnect the battery plug before inspecting or servicing electrical parts.
2. Pay sufficient attention when handling electronic parts.



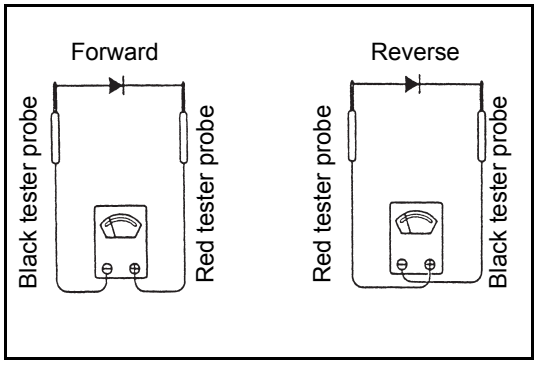
(1) Never subject electronic parts, such as computers and relays, to impact.

(2) Never expose electronic parts to high temperature or humidity.

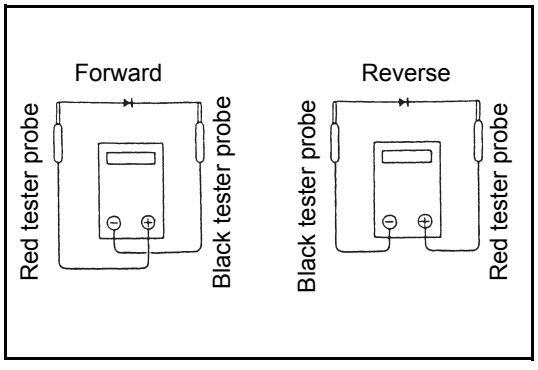
(3) Do not touch connector terminals, as they may be deformed or damaged due to static electricity.

3. Use a circuit tester that matches the object and purpose of measurement.
   Analog type: This type is convenient for observing movement during operation and the operating condition.The measured value should be used only for reference or rough judgement.
   Digital type: A fairly accurate reading is possible. However, it may be difficult to observe variation or movement.

   (1) Difference between results of measurement with analog and digital types
   The results of measurements using the analog type and the digital type may be different.
   Use the circuit tester according to its instruction manual.
   Differences between the polarities of the analog type and the digital type are described below.

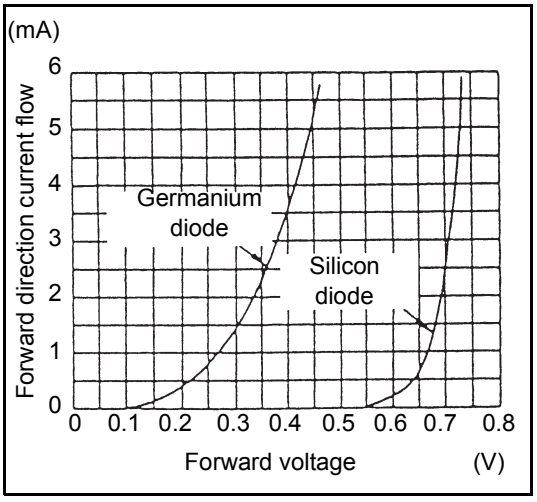


(a) Analog circuit tester
Example of measurement result
Tester range: kΩ range
Forward direction: Continuity 11 kΩ
Reverse direction: No continuity ∞



(b) Digital circuit tester
Example of measurement result
Tester range: 2 MΩ range
Forward direction: Continuity 2 MΩ
Reverse direction: No continuity 1

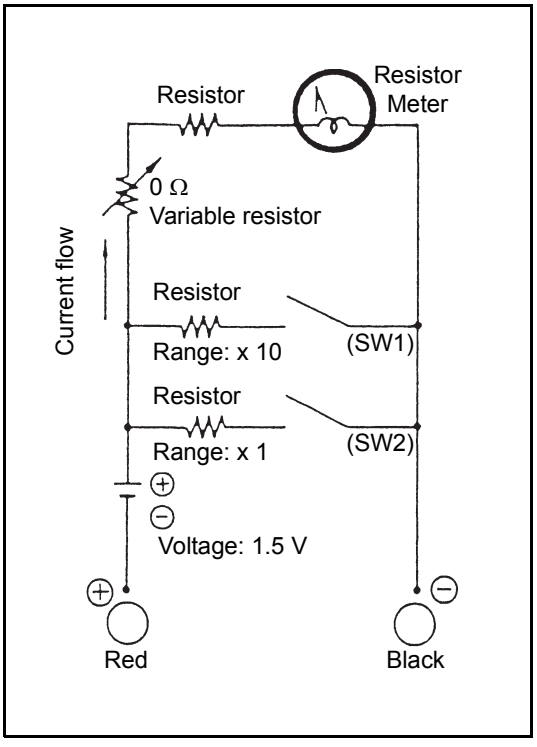
(2) Differences in results of measurement with circuit testers



The circuit tester power supply voltage depends on the tester type: 1.5 V, 3.0 V and 6.0 V.
The resistance of a semiconductor such as a diode varies with the circuit tester power supply voltage.
Diode characteristics are shown in the figure to the left.
The resistance values of the same diode measured with two types of circuit testers having different power supply voltages are different.

This manual describes the results of measurement with an analog circuit tester with a power supply voltage of 3.0V.

(3) Differences in results of measurement by measurement range.



In the analog type circuit tester, changing the measurement range switches over the internal circuit to vary the circuit resistance. Even when the same diode is measured, the measurement result varies according to the measurement range.
Always use the range described in the repair manual for measurement.

BOLT & NUT TIGHTENING TORQUES

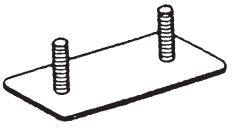
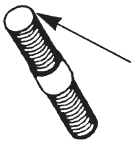
Standard Bolt & Nut Tightening Torque

Tightening torques of standard bolts and nuts are not indicated throughout the manual.
Use the procedures and table below to judge the standard tightening torque.

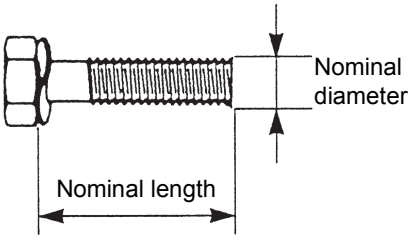
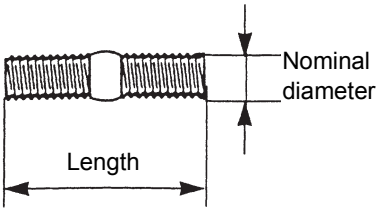
1. Judge the tightening torque for the hexagon head bolt, welded bolt or stud bolt having the standard bearing surface according to the tightening torque table by identifying the bolt strength class from the table below.
2. Judge the tightening torque for the hexagon flange bolt based on the threading diameter.
3. The nut tightening torque can be judged from its corresponding bolt type by using procedure 1.

BOLT STRENGTH CLASS IDENTIFICATION METHOD AND TIGHTENING TORQUE

Identification by Actual Part

Type	Shape and Strength class	Strength class
Hexagon head bolt (standard bearing surface)	 Number in relief or hallmark on head	4 = 4T 5 = 5T 6 = 6T 7 = 7T 8 = 8T
	 No mark	4T
	 Bolt with two raised lines on head	5T
	 Bolt with three raised lines on head	7T
	 Bolt with four raised lines on head	8T
Welded bolt		4T
Stud bolt	 No mark	4T
	 About 2 mm (0.08 in.) groove(s) on one/both edge(s)	6T

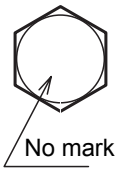
Identification by Part No.

Type	Part No.	Shape
Hexagon bolt	91611-40625 Nominal length (mm) Nominal diameter (mm) Strength class	
Stud bolt	92132-40614 Nominal length (mm) Nominal diameter (mm) Strength class	

Tightening Torque Table

Strength class	Nominal diameter mm	Pitch mm	Standard tightening torque		
			N·m	kgf·cm	ft·lbf
4T	6	1.0	5.4	55	4.0
	8	1.25	13	130	9.4
	10	1.25	25	260	18.8
	12	1.25	47	480	34.7
	14	1.5	75	760	54.9
	16	1.5	113	1150	83.0
5T	6	1.0	6.5	65	4.7
	8	1.25	16	160	11.6
	10	1.25	32	330	23.8
	12	1.25	59	600	43.3
	14	1.5	91	930	67.1
	16	1.5	137	1400	101.1
6T	6	1.0	7.8	80	5.8
	8	1.25	19	195	14.1
	10	1.25	39	400	28.9
	12	1.25	72	730	52.7
	14	1.5	108	1100	79.4
	16	1.5	172	1750	126.6
7T	6	1.0	11	110	7.9
	8	1.25	25	260	18.8
	10	1.25	52	530	38.3
	12	1.25	95	970	70.0
	14	1.5	147	1500	108.3
	16	1.5	226	2300	166.1
8T	6	1.0	12	125	9.0
	8	1.25	29	300	21.7
	10	1.25	61	620	44.9
	12	1.25	108	1100	79.4
	14	1.5	172	1750	126.6
	16	1.5	265	2700	195.3

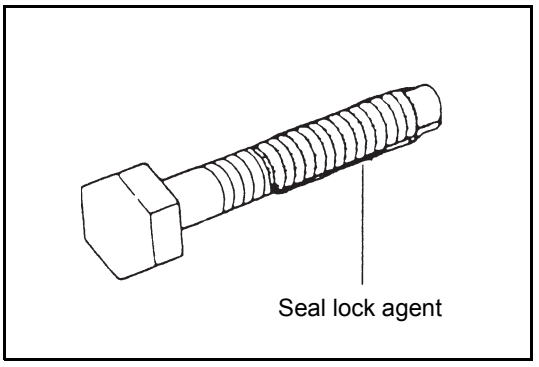
Identification by Bolt Shape (Hexagon flange bolt)

Class	4.8T	6.8T	8.8T	10.9T	11.9T
Hexagon flange bolt					
					
				—	—
					

Tightening Torque Table (Hexagon flange bolt)

Strength class	Nominal diameter mm	Pitch mm	Standard tightening torque		
			N·m	kgf·cm	ft·lbf
4.8T	6	1.0	5.5	56	4
	8	1.25	13	130	9
	10	1.25	27	280	20
	12	1.25	50	510	37
	14	1.5	78	800	58
	16	1.5	120	1220	88
6.8T	6	1.0	7.5	80	6
	8	1.25	19	190	14
	10	1.25	39	400	29
	12	1.25	71	720	52
	14	1.5	110	1120	81
	16	1.5	170	1730	125
8.8T	6	1.0	12	120	9
	8	1.25	29	300	22
	10	1.25	61	620	45
	12	1.25	110	1120	81
	14	1.5	175	1780	129
	16	1.5	270	2750	199
10.9T	6	1.0	15.5	160	12
	8	1.25	38	390	28
	10	1.25	80	820	59
	12	1.25	145	1480	107
	14	1.5	230	2350	170
	16	1.5	360	3670	266
11.9T	6	1.0	17.5	180	13
	8	1.25	42	430	31
	10	1.25	89	910	66
	12	1.25	160	1630	118
	14	1.5	260	2650	192
	16	1.5	400	4080	295

PRECOATED BOLTS (BOLTS WITH SEAL LOCK AGENT COATING ON THREADS)



1. Do not use the precoat bolt as it is in either of the following cases:
   (1) After it has been removed.
   (2) When it has been moved by tightness check, etc. (loosened or tightened)

Note:
For torque check, tighten the bolt at the lower limit of the allowable tightening torque range; if the bolt moves, retighten it according to the steps below.

2. How to reuse precoated bolts
   (1) Wash the bolt and threaded hole.
   (The threaded hole must be washed even when replacing the bolt with a new one.)
   (2) Completely dry the washed parts by blowing with air.
   (3) Apply the specified seal lock agent to the bolt threaded portion.

SI UNITS

Meaning of SI

This manual uses SI units. SI represents the International System of Units, which was established to unify the various systems of units used in the past for smoother international technical communication.

New Units Adopted in SI

Item	New unit	Conventional unit	Conversion rate*1 (1 [conventional unit] = X [SI unit])
Force*2	N (newton)	kgf	1 kgf = 9.80665 N
Torque*2 (Moment)	N·m	kgf·cm	1 kgf·cm = 9.80665 N·m
Pressure*2	Pa (pascal)	kgf/cm^2	1 kgf/cm^2 = 98.0665 kPa = 0.0980665 MPa
↑	↑	mmHg	1 mmHg = 0.133322 kPa
Revolving speed	r/min	rpm	1 rpm = 1 r/min
Spring constant*2	N/mm	kgf/mm	1 kgf/mm = 9.80665 N/mm
Volume	L	cc	1 cc = 1 mL
Power	W	PS	1 PS = 0.735499 kW
Heat quantity	W·h	cal	1 kcal = 1.16279 W·h
Specific fuel consumption	g/W·h	g/PS·h	g/PS·h = 1.3596 g/kW·h

Reference:
*1: X represents the value in SI units as converted from 1 [conventional units], which can be used as the rate for conversion between conventional and SI units.
*2: In the past, kilogram [kg] representing mass was often used in place of weight kilogram [kgf], which should be used as the unit of force.

Conversion between Conventional and SI Units

Equations for conversion

Value in SI unit = Conversion rate × Value in conventional unit
Value in conventional unit = Value in SI unit ÷ Conversion rate

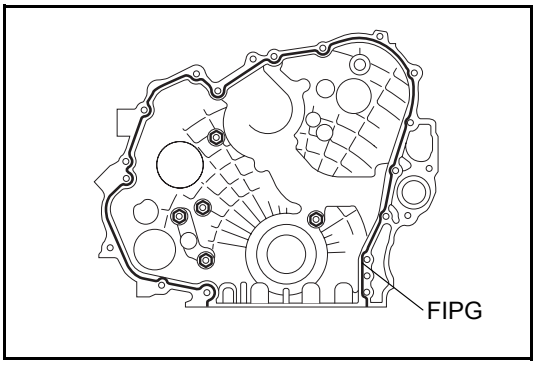
Conversion rate: Figure corresponding to X in the conversion rate column in the table above

Caution:
When converting, change the unit of the value in conventional or SI units to the one in the conversion rate column in the table above before calculation. For example, when converting 100 W to the value in conventional unit PS, first change it to 0.1 kW and divide by the conversion rate 0.735499.

HANDLING FIPG (LIQUID GASKETS)

FIPG:
08826-76001-71

Example of Application Area



Points for application method and reassembling parts.

Caution:
When removing the gasket, be careful not to let broken pieces of the gasket get inside the engine.

1. Clean the contact surfaces of every part and corresponding part with a waste cloth so that they are free of oil, moisture, and foreign objects.
2. Apply FIPG to the side of the part to be attached. Parts requiring FIPG to be applied are listed in the point operations for each section.
3. Always overlap the start and finish of the application so that there is no excess application or insufficient application.
4. Take care not to move the parts after reassembling them.
5. Reassemble within 3 minutes of finishing the application.
6. For at least 2 hours after reassembly, do not pour in coolant or lubrication oil, and do not start the engine.

TROUBLESHOOTING

Page

TROUBLESHOOTING

Engine mechanical

Condition	Malfunction description	Main inspection or adjustment areas
Engine overheating (cooling water)	Cooling water shortage	Replenish cooling water
	Defective thermostat	Replace thermostat
	Coolant leak	Repair
	Defective water pump	Repair or replace
	Defective head gasket	Replace head gasket
Engine overheating (radiator)	Blocking of radiator	Wash radiator
	Corrosion in cooling system	Clean or repair
	Blocking of the front of radiator core	Clean of radiator
	Defective radiator cap	Replace radiator cap
Engine overheating (compression pressure)	Gap of injection timing	Check injection timing
	Defective fuel injection pressure	Check fuel pressure
	Defective fuel	Replace fuel
	Defective Injection	Replace injector
Engine overheating (lubricating device)	Deterioration of engine oil	Replace engine oil
	Defective oil pump	Replace oil pump
	Engine oil shortage	Replenish engine oil
Engine oil consumption increases (piston, cylinder liner, and piston ring)	Wear-out of piston ring and cylinder liner	Replace piston ring and cylinder liner
	Piston ring damage	Replace piston ring and cylinder liner
	Defective piston ring	Replace piston ring and cylinder liner
	Defective piston ring assembly	Replace piston ring and cylinder liner
	Defective engine oil	Replace engine oil
	Misalignment of piston ring position	Reassemble piston ring
Engine oil consumption increases (valve and valve guide)	Wear-out of valve stem	Replace valve and valve guide
	Wear-out of valve guide	Replace valve guide
	Defective valve stem seal assembly	Replace stem seal
	Lubrication is oily excessive of locker arm	Clearance check of locker arm and locker arm shaft
Engine oil consumption increases (others)	Defective oil level gauge	Replace proper level gauge
	Excess engine oil is	Fill proper amount of oil
	Engine oil leakage	Repair or replace component of oil leak part
Piston burning (at driving)	Rapid engine stop	Enforce machine driving before engine stops
Piston burning (lubricating device)	Engine oil shortage	Replenish engine oil
	Engine oil deterioration	Replace engine oil
	Improper engine oil	Replace proper engine oil
	Oil pressure decrease	Check of lubricating device
	Defective oil pump	Replace oil pump
Piston burning	Abnormal combustion	Refer to the overheat section
	Cooling system	Refer to the overheat section
Engine power shortage (air cleaner)	Blocking of air cleaner element	Cleaning or replace of air cleaner element
Engine power shortage	Overheat	Refer to the overheat section

Condition	Malfunction description	Main inspection or adjustment areas
Engine power shortage (fuel system)	Defective jet of the injector	Replace injector
	Defective injector due to the carbon adhesion	Replace injector
	Air mixing with fuel system	Pull out air from fuel system
	Defective fuel filter	Replace element
	Defective fuel	Replace proper fuel
Engine power shortage	Abnormality of compression pressure	Refer to the overheat section
Engine power shortage	Piston, cylinder liner and piston ring	Refer to the overheat section
Engine faulty start (electric system)	Defective battery	Battery check
	Defective starter wiring	Replace starter wiring
	Loosening of battery cable	Replace tightening battery terminal joint or cable
	Defective starter	Replace starter assembly
	Defective start auxiliary equipment	Replace start auxiliary equipment
Engine faulty start (air cleaner)	Blocking of air cleaner element	Clean or replace air cleaner element
Engine faulty start (fuel system)	Fuel shortage	Replenish fuel and pull out air from fuel system
	Blocking of fuel system	Wash fuel line
	Air inhalation from joint in fuel system	Tighten connected part
	Blocking of fuel filter	Replace fuel filter
	Loosening of jet pipe joint	Tighten jet pump joint nut
Engine faulty start (injector)	Injector burning	Replace injector
Engine faulty start (lubricating device)	Excess viscosity of the engine oil	Replace proper viscosities engine oil
Engine failed start (other)	Piston burning	Replace piston, piston ring, and cylinder liner
	Bearing burning	Replace bearing and crank shaft
	Compression pressure decrease	Engine overhaul
	Ring gear damage	Replace ring gear and starter pinion gear
Defective Idling (injector)	Defective injection pressure	Check injection pressure
	Defective injection	Adjustment or replace injector
Idling is defective (nozzle)	Defective injection pressure	Check injection pressure
	Defective atomization	Adjust or replace nozzle
	Carbon adhesion to nozzle point	Remove carbon
	Burning of needle valve	Replace nozzle
Idling is defective (engine)	Valve clearance is defective	Adjust valve clearance
	Valve seat loose connection	Warm up engine
	Low temperature of cooling water	The engine is warmed and it drives.
	Wide variability in compression pressure in-between cylinders	Engine overhaul
	No setting of leaning value after replacing engine ECU	Set learning value
Gas leakage (head gasket)	Reuse	Replace gasket
	Damage	Replace gasket
	Defective assembly	Replace gasket
Gas leakage (head bolt)	Loosening of head bolt	Bolt tightening
	Improper tightening procedure or torque	Tighten confirmation
	Head bolt extension	Replace bolt

Condition	Malfunction description	Main inspection or adjustment areas
Gas leakage (cylinder block)	Crack	Replace cylinder block
	Distortion on the upper cylinder block	Repair or replace cylinder block
	Sinking of cylinder liner insertion part (projection amount shortage of cylinder liner)	Replace cylinder liner or block
Gas leakage (cylinder head)	Crack of cylinder head	Replace cylinder head
	Distortion under cylinder head	Repair or replace cylinder head
Gas leakage (cylinder liner)	Crack of cylinder liner	Replace cylinder liner
	Corrosion of cylinder liner	Replace cylinder liner
	Projection amount shortage of cylinder liner	Replace cylinder liner or block
Gas leakage (other)	Improper timing of injection	Check injection timing

Alternator

Condition	Malfunction description	Main inspection or adjustment areas
The lamp lights → The charging current doesn't flow (alternator)	Defective regulator (PTr open)	Replace regulator
	Defective stator coil (Disconnection and rare short)	Replace stator coil
	Defective field coil (Disconnection and rare short)	Replace field coil
	Defective diode (open and short)	Replace rectifier
	Disconnection and loose connection in lead line part (plate, support and etc.)	Repair or replace lead line
The lamp lights → The charging current doesn't flow (wiring)	Disconnection of wiring (fuse)	Replace wiring (fuse)
The lamp lights → The ammeter shows 14V or more (alternator)	Defective regulator (PTr short)	Replace regulator
	Defective tightening in the voltage detection circuit (support, etc.)	Repair or replace voltage detection circuit and regulator
The lamp lights → The charging current flows normally (alternator)	Defective regulator (Tr open)	Replace regulator
The lamp is off. → The charging current is always low → battery runs out	Defect stator coil (open and short)	Replace stator coil
	Defect diode (open and short)	Replace rectifier
	Disconnection and loose connection of lead line part (plate, support and etc.)	Repair or replace lead line
The lamp is off → The charging current is always low → battery runs out (usage load)	Excess amount of usage load (bad load balance)	Load reduction
The lamp is off → The charging current is always high → The battery liquid disappear is in a short term (alternator)	Defective regulator (PTr short)	Replace regulator
	Defective tightening in the voltage detection circuit (support etc.)	Repair or replace voltage detection circuit
The lamp is off → The charging current is always high → The battery liquid disappears in a short term (battery)	Battery near longevity	Replace battery
Others → Allophone (alternator)	Defective stator coil (rare short and earth)	Replace stator coil
	Hit of internal (defective bearing and wear-out of bracket)	Repair or replace bearing
Others → Allophone (v-belt)	Defective v-belt putting (belt slipping)	Repair

Starter

Condition	Malfunction description	Main inspection or adjustment areas
The starter doesn't turn and its rotation is low	Bad connection of starter key	Repair connected part
	Low battery	Charge or replace
	Coming off, loosening and corrosion of battery terminal	After it cleaning, tighten it
	Coming off the earth	Surely install
	Improper usage of engine oil	Replace proper oil
	Loose connection of start magnet switch assembly	Replace start magnet switch assembly
	Loose connection or breakdown of starter relay	Replace starter relay
	Brush wear-out of starter	Replace brush
	Commutator burning	Repair commutator
	Wear-out of commutator	Under cut
	Short of armature	Replace armature assembly
	Tension shortage in brush spring	Replace brush spring
	Defective clutch operation	Clean or replace

Turbo-charger

Condition	Malfunction description	Main inspection or adjustment areas
Exhaust gas is black (lack of amount of inhalation air)	Blocking of air cleaner element	Clean and replace air cleaner element
	Closing the air intake	Maintain normal
	Leakage from joint of induction system	Check and repair
	Heavy rotation of blower impeller and turbine shaft	Decompose and repair
Exhaust gas is black (the turbo-charger doesn't rotate)	The rotation of blower turbine shaft is heavy	Change engine oil and repair turbo-charger
	Bearing burning	Replace turbo-charger
	Bearing burning	Repair or replace Change engine oil
	Bearing burning (Oil temperature is too high)	Repair or replace Change engine oil
	Bearing burning (The balance of the rotation body is bad)	Replace or wash of rotation part
	Bearing burning	Pay extra attention to the driving precautions of the manual
	Contact or damage of turbine shaft and blower impeller	Check and repair each engine part
	Contact or damage of turbine shaft and blower impeller	Check and repair each engine part
	Contact or damage of turbine shaft and blower impeller	Repair or replace
	Contact or damage of turbine shaft and blower impeller	Replace turbo-charger
	Contact or damage of turbine shaft and blower impeller	Repair or replace

Condition	Malfunction description	Main inspection or adjustment areas
Exhaust gas is black (Influence of exhaust resistance)	Vehicle exhaust emission leakage	Check and repair installation part
	Distortion of muffler	Maintain normal
Exhaust gas is white	Blocking of oil pipe	Replace or repair pipes
	Vacuum pressure increase	Repair or replace air cleaner element
	Damage of bearing and seal ring	Decompose and repair turbo-charger
	Water invasion in cylinder	Replace component and repair water infiltration part
Oil decreases rapidly	Damage of bearing and seal ring	Decompose and repair turbo-charger
	Interfusion of engine oil	Check and maintenance of each engine part
Decrease in engine power	Gas leakage from each exhaust system	Check and repair trouble part
	Air leak of blower	Check and repair trouble part
	Blocking of air cleaner element	Clean or replace air cleaner elements
	Dirt or damage of turbo-charger	Replace turbo-charger
Acceleration (follow of turbo-charger) is bad (slow)	Carbon clinging to turbine	Change engine oil and clean the turbo-charger
	Exhaust air leak	Check and repair trouble part
	Defective fuel	Check fuel
The allophone is generated	Backflow of rejection pressure	Replace turbo-charger
	Contact rotation part	Replace turbo-charger
	Gas leakage from each exhaust system	Check and repair trouble part
It vibrates	Loosening of installation part	Check installation of the turbo-charger and repair
	Damage of turbo-charger	Replace turbo-charger
	Bad balance of the rotation body	Replace rotation bodies

ENGINE OVERHAUL

Page

USED SSTs

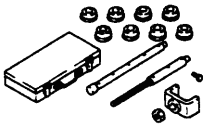
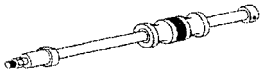
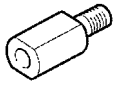
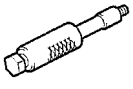
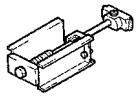
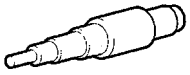
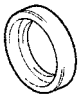
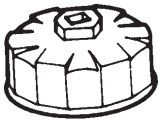
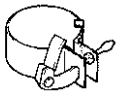
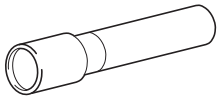
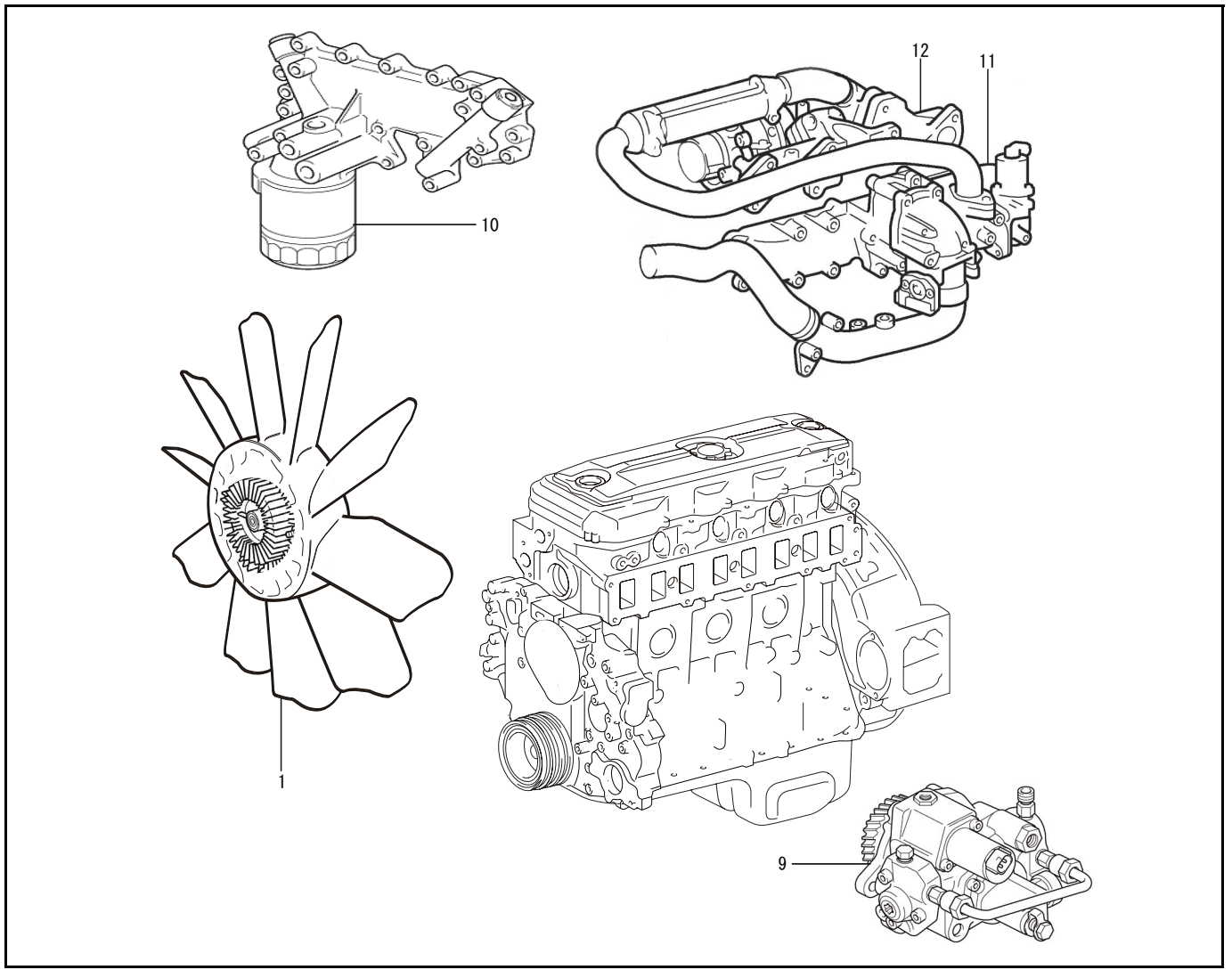
Illustration	Part No.	Part name
	09201-76002-71 (09201-10000)	Remover and replacer, valve guide bush
	09050-32720-71	Compressor, valve spring
	09215-76004-71 (09215-00101)	Remover and replacer, camshaft bearing
	09950-76018-71 (09950-60010)	Replacer set
	09950-76020-71 (09950-70010)	Handle set
	09060-32720-71	Sliding hummer
	09029-88460-71	Puller cramp
	09010-33940-71	Puller slide hummer

Illustration	Part No.	Part name
	09040-33910-71	Puller, cylinder liner
	09020-33940-71	Bar
	09030-33940-71	Ball
	09012-33910-71	Front oil seal press
	09950-76014-71 (09950-40011)	Puller B set
	09040-33940-71	Oil filter Wrench
	09110-33910-71	Piston ring holder
	09050-33940-71	Bar

ENGINE ACCESSORIES

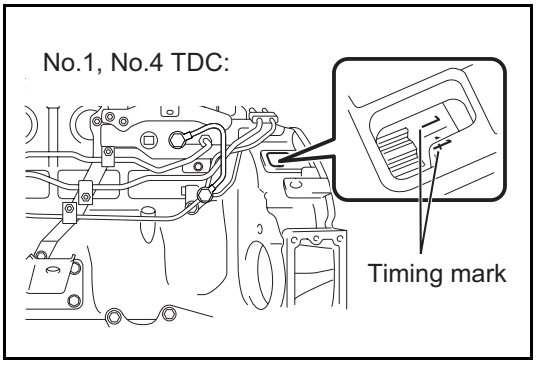
REMOVAL AND INSTALLATION



Removal, inspection and installation procedure

No.	Item	Removal	Inspection	Installation
1	Fan, Pulley, V-belt			**[Point 7]**
2	Alternator			
3	Water pump			
4	Intake pipe			
5	Fuel hose			
6	Injection pipe			
7	Nozzle leakage pipe			
8	Injection nozzle			
9	Injection pump w/drive gear	**[Point 1]**		**[Point 6]**
10	Oil filter	**[Point 2]**		**[Point 5]**
11	Intake manifold			**[Point 3]**
12	Exhaust manifold			**[Point 4]**

The reassembly procedure is the reverse of the disassembly procedure.



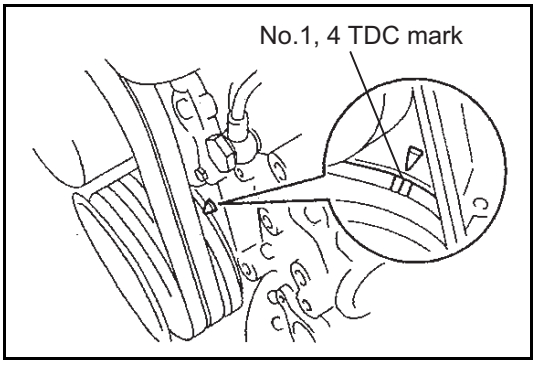
Point operation

[Point 1]

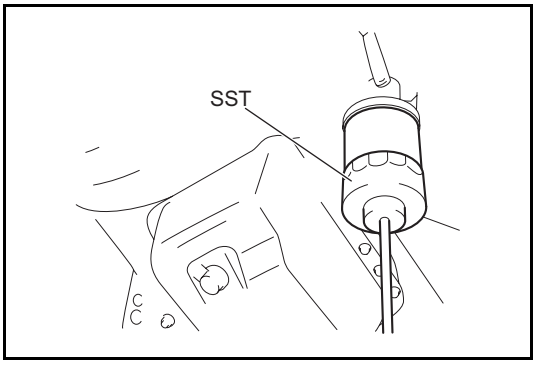
Removal:

1. When setting the compression TDC with the fly wheel, align the timing mark at the position shown in the illustration and set the No.1 cylinder to the TDC.

Note:
The position where the timing marks of the fly wheel and fly wheel housing are aligned will be the TDC.



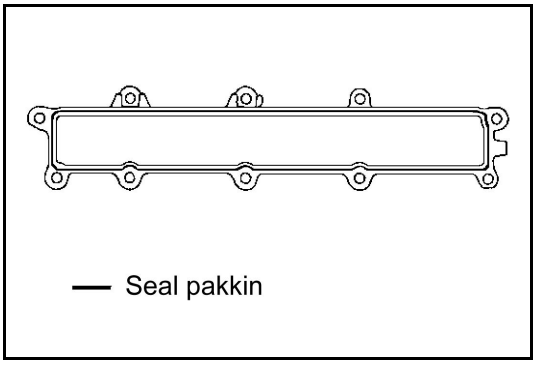
2. When setting the compression TDC with the crank pulley, align the timing mark at the position shown in the illustration and set the No.1 cylinder to the TDC.



[Point 2]

Removal:
Use a SST, remove the oil filter.

SST S0950-31120-71



[Point 3]

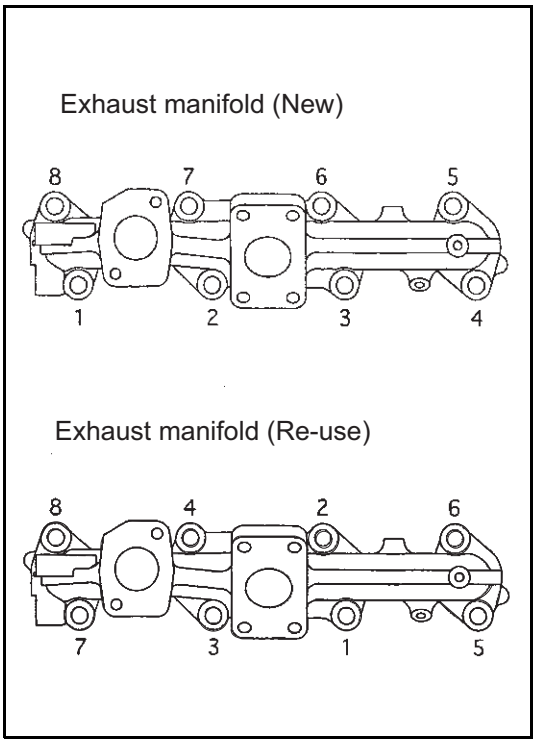
Installation:

1. Apply the black seal packing on the position shown in the illustration in bead shape with the width of 1.5 to 2.5 mm (0.059 to 0.098 in.).

Caution:
- **Degrease the installation surface.**
- **After applying the seal packing, carry out the installation within 3 minutes.**
- **The engine is not started within 2 hours after the installation.**

2. The intake manifold is installed by 8 bolts and 2 nuts.

Standard:
T = 28.5 N·m (290 kgf·cm) [21 ft·lbf]



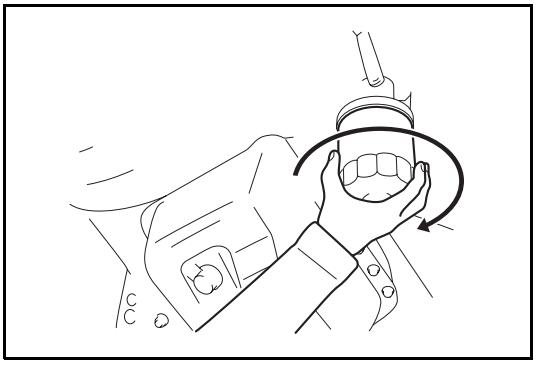
[Point 4]

Installation:

1. The exhaust manifold is installed in the order of illustration by 8 nuts.

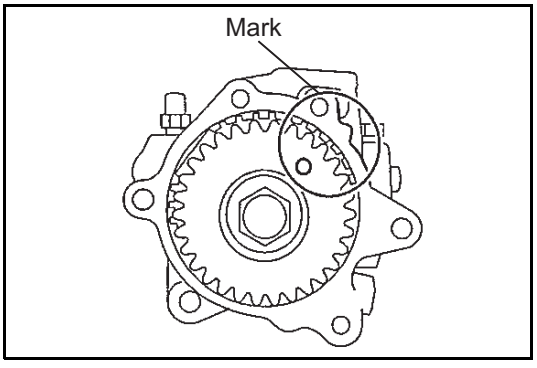
   Standard:
   T = 59 N·m (602 kgf·cm) [44 ft·lbf]

2. It tightens again in the order of illustration.



[Point 5]

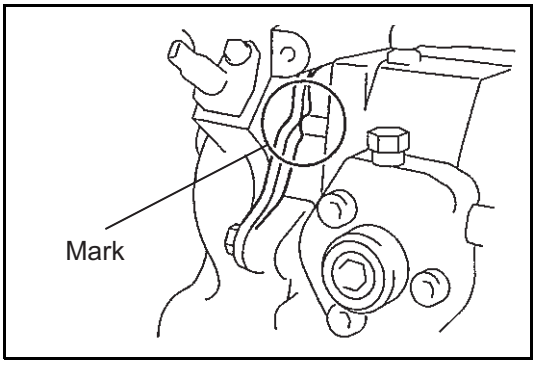
Installation:
After cleaning the attachment surface of the oil filter, fit an O-ring to the oil filter and tighten the filter to the bracket by hand first, and further tighten by 3/4 turn.



[Point 6]

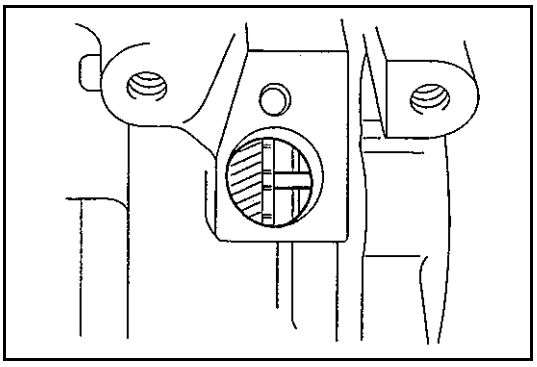
Installation:

1. Align the hole in 6 mm (0.24 in.) diameter in the injection pump drive gear side and the match mark at the timer cover side.



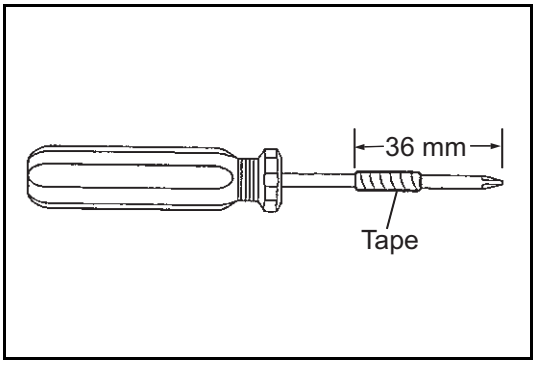
2. While aligning the match mark on the timer cover side and the match mark on the front end plate side, install the injection (supply) pump ASSY using six bolts through O-rings.

   Standard:
   T = 28.5 N·m (290 kgf·cm) [21 ft·lbf]

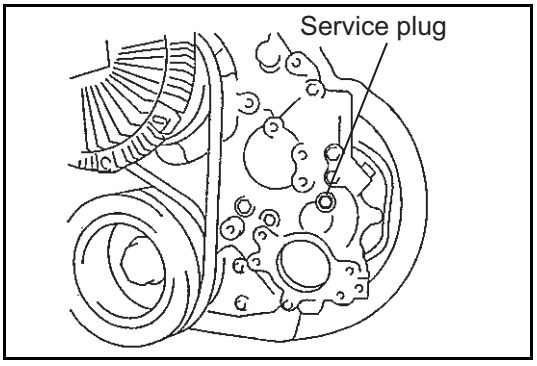


3. Check that the knock pin of the injection pump drive gear can be seen at the center from the installation hole of the dust cover for the timing gear case.

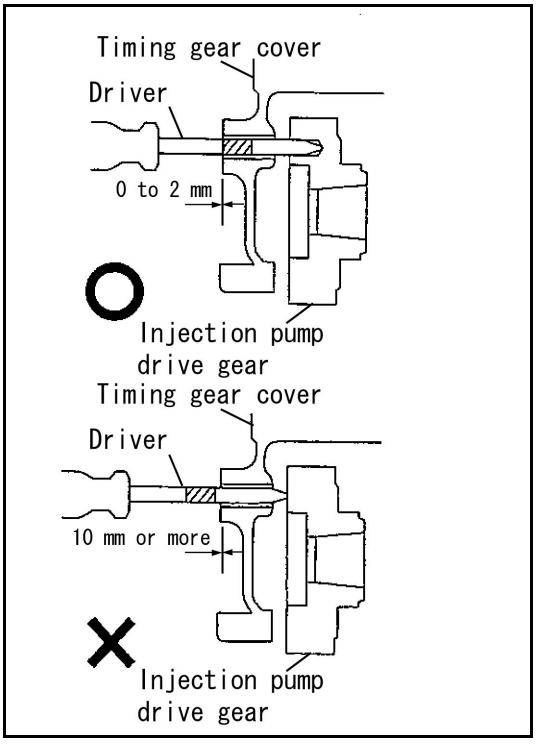
Caution:
Look directly against the installation surface of the crank position sensor No.2.



4. If you cannot see the installation hole of the crank position sensor No.2 directly, use the screwdriver with less than 6 mm (0.24 in.) in diameter, and wrap the vinyl tape around at the position 36 mm (1.4 in.) from the tip of the screwdriver for marking.

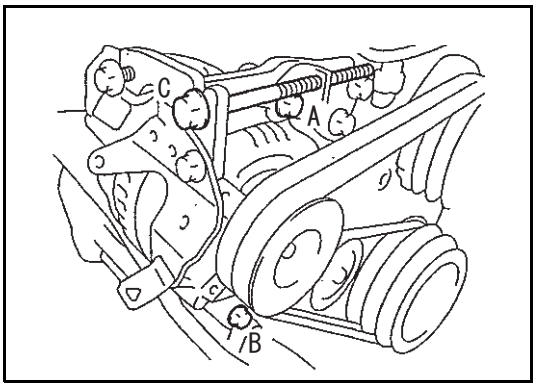


5. The service plug in front of the timing gear case is detached.



6. Insert the screwdriver with the marking to the timing gear case, and check that the mark and the edge of the timing gear case are aligned.

Caution:
After assembling the injection (supply) pump ASSY, make sure to check the timing position of the injection pump timing gear.



[Point 7]

Installation:

1. Bolt C for the adjustment is turned, and the belt is adjusted.
2. Bolt A and B are tightened.

   Standard:
   T = 28.5 N·m (290 kgf·cm) [21 ft·lbf] (Bolt A)
   T = 55 N·m (561 kgf·cm) [41 ft·lbf] (Bolt B)

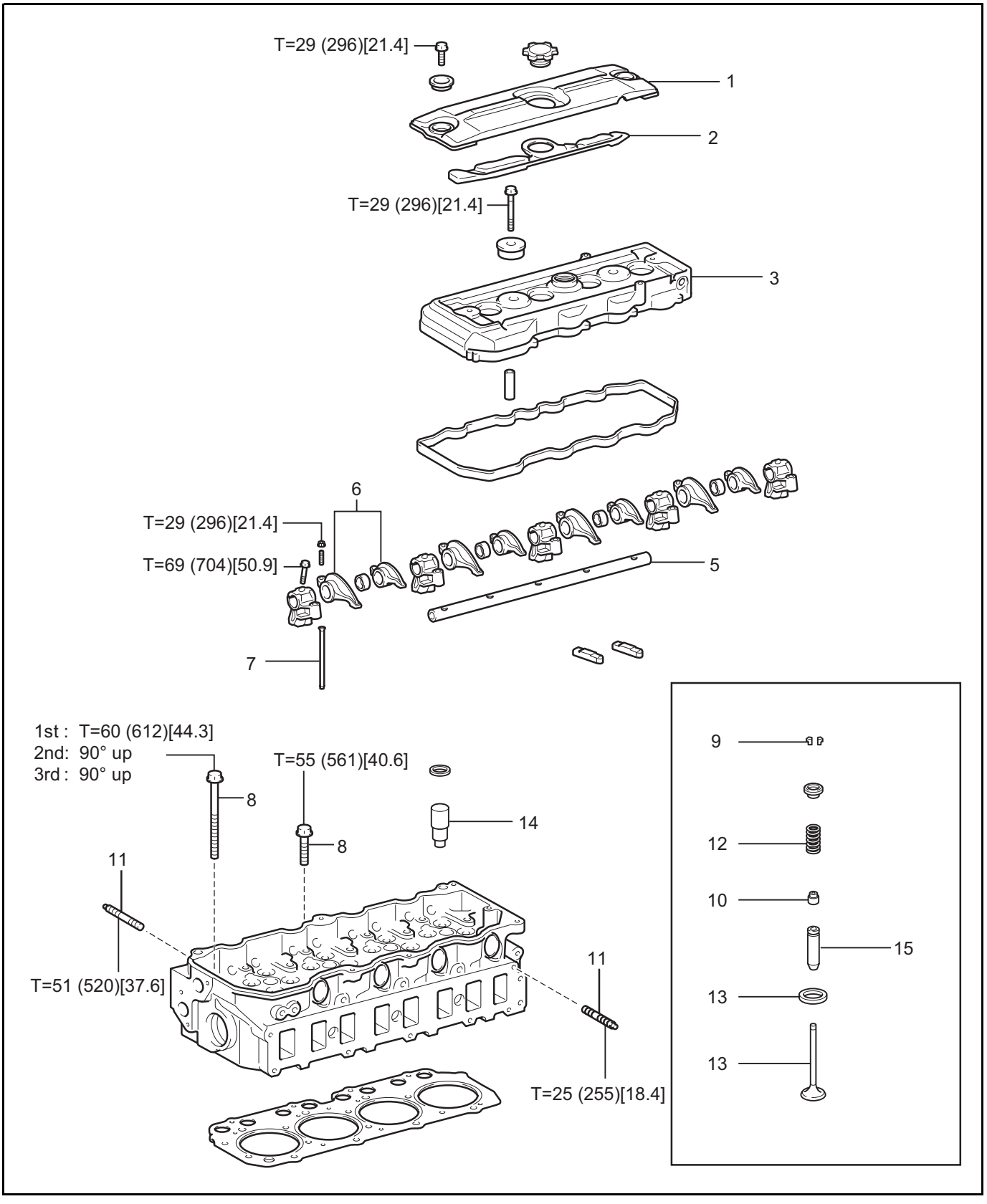
3. Bolt C is tightened.

   Standard:
   T = 5.9 N·m (60 kgf·cm) [4 ft·lbf]

CYLINDER HEAD

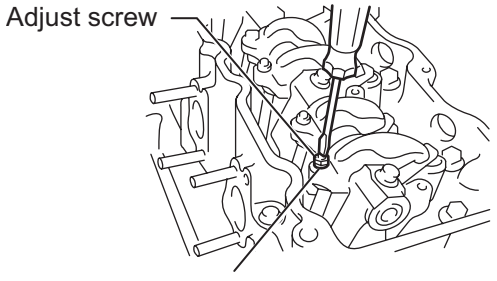
DISASSEMBLY, INSPECTION AND REASSEMBLY

T = N·m (kgf·cm) [ft·lbf]



Disassembly and reassembly procedure

No.	Item	Disassembly	Inspection	Reassembly
1	Cylinder head cover			
2	Cylinder head cushion cove			
3	Cylinder head cover No.1			
4	Valve clearance		**[Point 22]**	
5	Valve rocker shaft No.1	**[Point 1]**	**[Point 2]**	
6	Valve rocker arm No.1, No.2		**[Point 3]**	**[Point 21]**
7	Valve push rod		**[Point 4]**	
8	Cylinder head, Bolt	**[Point 5]**	**[Point 6]**	**[Point 20]**
9	Valve spring retainer lock	**[Point 7]**		**[Point 19]**
10	Valve stem oil seal			**[Point 18]**
11	Stud bolt			**[Point 17]**
12	Valve spring		**[Point 8]**	
13	Valve&Valve seat	**[Point 9]**	**[Point 10]**	**[Point 16]**
14	Injection nozzle seat	**[Point 11]**		**[Point 15]**
15	Valve guide bush	**[Point 12]**	**[Point 13]**	**[Point 14]**



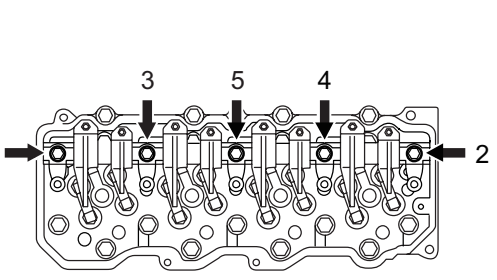
Point Operation

[Point 1]

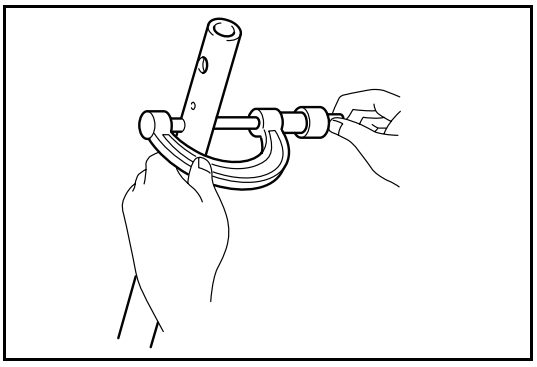
Disassembly:

1. Loosen the lock nut for each valve, and loosen the valve adjusting screw.

Caution:
Always unscrew the adjusting screw before removing the rocker arm.



2. Evenly loosen the support set bolts in the illustrated sequence and remove them.



[Point 2]

Inspection:

1. Use a micrometer and measure the outside diameter of the rocker arm shaft.

   Standard: 21.959 to 21.980 mm (0.8645 to 0.8654 in.)

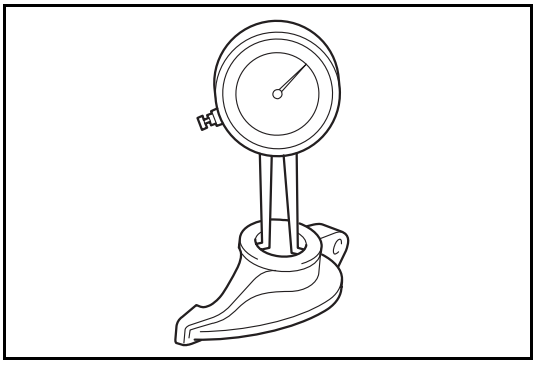
   Limit: 21.92 mm (0.863 in.)

2. Calculate the difference between the rocker arm inside diameter and rocker arm shaft outside diameter.

   Standard: 0.043 to 0.093 mm (0.0017 to 0.0059 in.)

   Limit: 0.15 mm (0.006 in.)

Note:
If it exceeds the limit, replace the valve rocker shaft No.1.



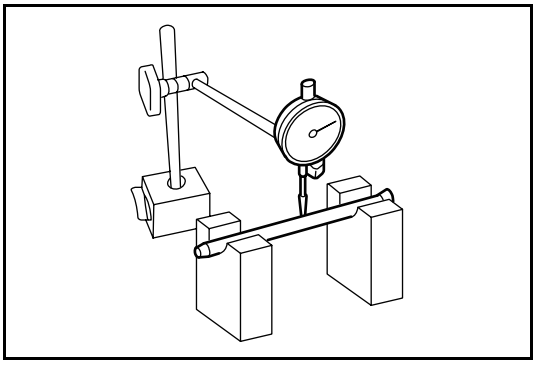
[Point 3]

Inspection:
Use a caliper gauge and measure the inside diameter of the rocker arm.

Standard: 22.023 to 22.052 mm (0.8670 to 0.8682 in.)

Limit: 22.08 mm (0.869 in.)

Note:
If it exceeds the limit, replace the valve rocker arm.

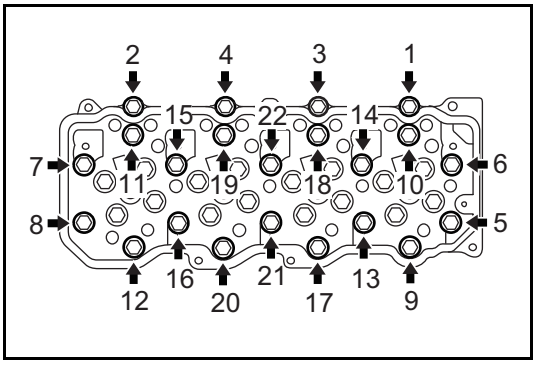


[Point 4]

Inspection:
Use a dial gauge and measure the rod bend while rotating it by 1 turn.

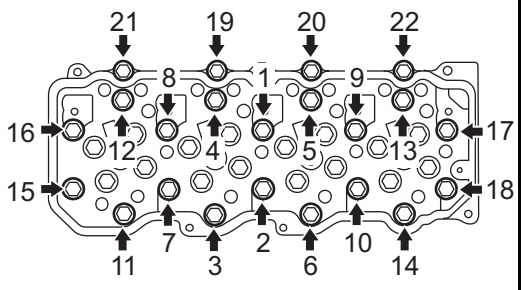
Limit: 0.3 mm (0.118 in.)

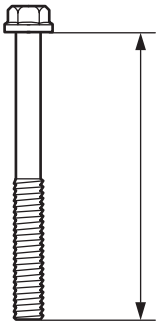
Note:
If it exceeds the limit, replace the push rod.



[Point 5]

Disassembly:
Loosen the cylinder head set bolts (22 pcs.) in 2 to 3 steps in the order shown in the illustration, and remove them.





[Point 6]

Inspection:

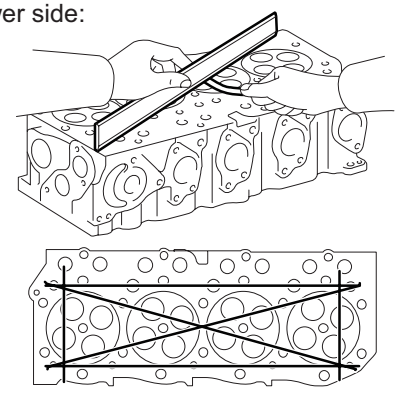
1. Measure the length of the head bolts in 1 to 18 with a vernier caliper.

   Standard: 126 mm (4.96 in.) (New bolt)

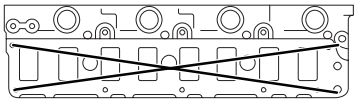
   Limit: 129 mm (5.08 in.)

Note:
Note: If it exceeds the limit, replace the head bolt.

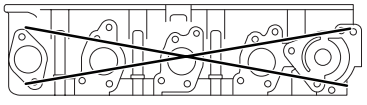
Lower side:



Intake side:



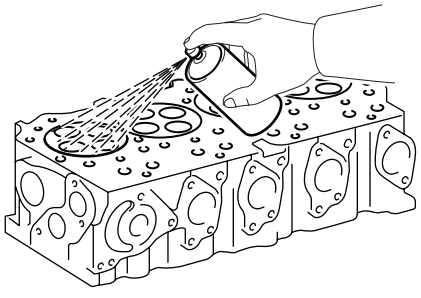
Exhaust side:



2. Inspection of distortions

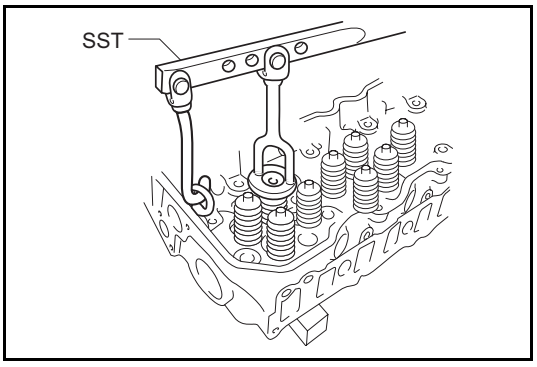
   (1) Use a straightedge and thickness gauge, and measure on 4 sides and measure on 4 sides and diagonal lines of the cylinder head bottom surface.

   Limit: 0.1 mm (0.004 in.)



3. Inspection of cracks

   (1) Inspection the combustion chamber, intake port, exhaust port, head bottom surface and head top surface by color check (color contrast penetrant examination).



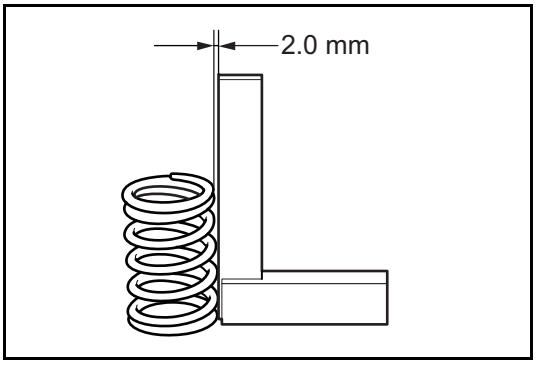
[Point 7]

Disassembly:

1. Use the SST to compress the compression spring, and install the valve spring retainer lock.

   SST 09050-32720-71

Note:
Sort the removed parts according to their positions of installation.



[Point 8]

Inspection:

1. Use a square and thickness gauge to measure the departure from squareness at the top end of the spring.

   Limit: 2.0 mm (0.079 in.)

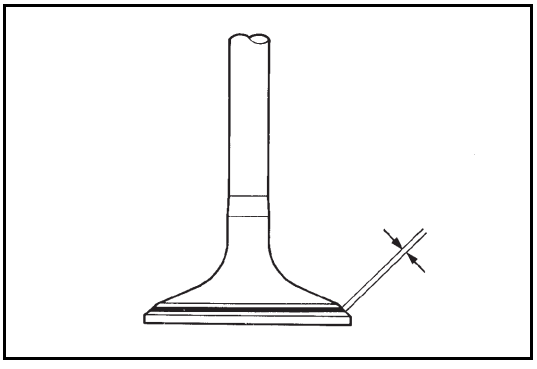
Note:
If it exceeds the limit, replace the valve spring.

   (1) Use vernier calipers and measure the free length.

   Standard: 85.1 mm (3.35 in.)

   Limit: 82.1 mm (3.23 in.)

Note:
If it exceeds the limit, replace the valve spring.



[Point 9]

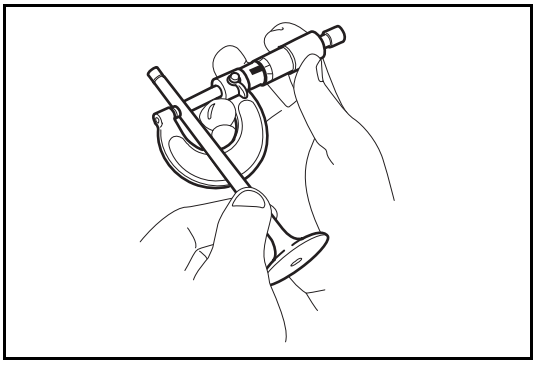
Inspection:

1. Coat red thinly on the valve face.
2. Insert the valve to the valve stem guide, and bring the valve into forced contact with the valve seat.

   Standard:
   Check that the contact width satisfies the standard for the entire circumference.

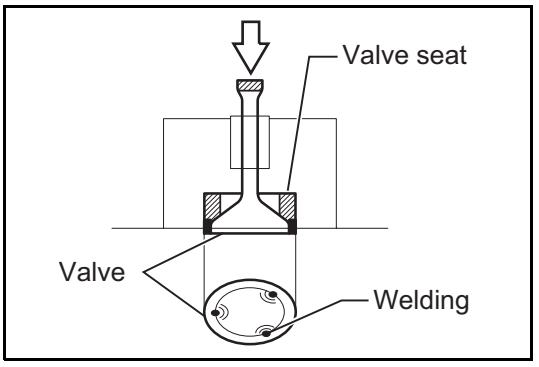
Caution:
Do not rotate the valve while it is in forced contact state.

Note:
If it exceeds the limit, replace the valve seat.



3. Use a micrometer and measure the outside diameter of the valve stem.

   Standard:
   IN: 6.957 to 6.972 mm (0.2739 to 0.2745 in.)
   EX: 6.932 to 6.947 mm (0.2729 to 0.2735 in.)



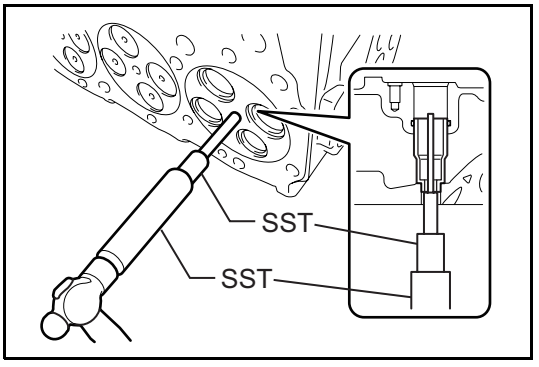
[Point 10]

Disassembly:

1. Using a valve that is no longer required and weld it to the valve seat after cutting out the outer periphery at 3 places.

Caution:
In order to protect the bottom surface of the cylinder head from weld spatter, apply grease before welding.

2. Place the brass bar on the head section of the valve stem and remove the valve seat by using a press.
3. Remove weld spatter or dusts on the base surface of the valve seat.



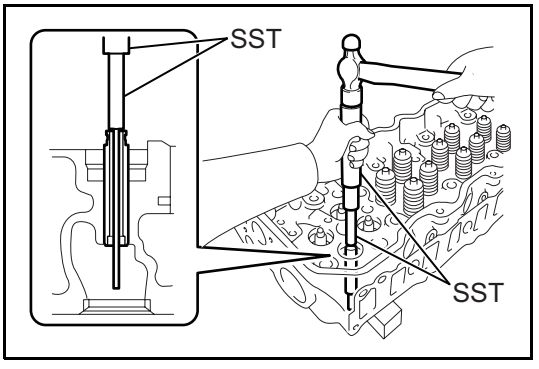
[Point 11]

Disassembly:

1. Use the SST to pull the nozzle seat off towards the upper side of the cylinder head.

   SST 09201-76002-71
   (09201-10000)

2. Remove the O-ring from the cylinder head.

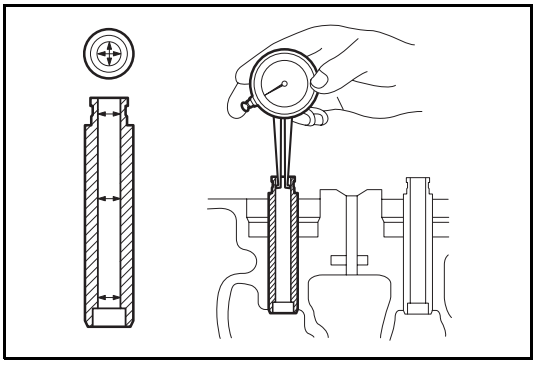


[Point 12]

Disassembly:

1. Warm the cylinder head to about 80 to 100°C (176 to 212°F).
2. Use the SST to drive in the new valve stem guide until the protrusion from the cylinder head top surface satisfies the standard.

   SST 09201-76002-71
   (09201-10000)

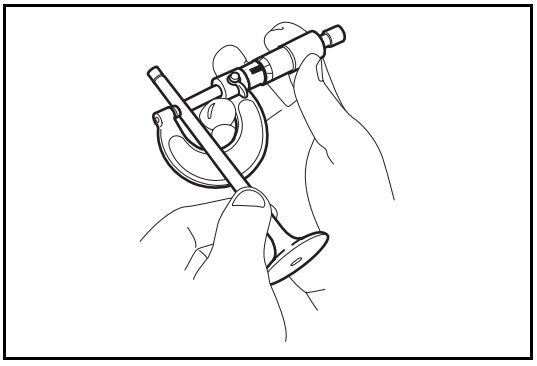


[Point 13]

Inspection:

1. Use a caliper gauge and measure the inside diameter of the valve stem guide.

   Standard:
   IN: 7.000 to 7.015 mm (0.2756 to 0.2762 in.)
   EX: 7.000 to 7.015 mm (0.2756 to 0.2762 in.)



2. Use a micrometer and measure the outside diameter of the valve stem.

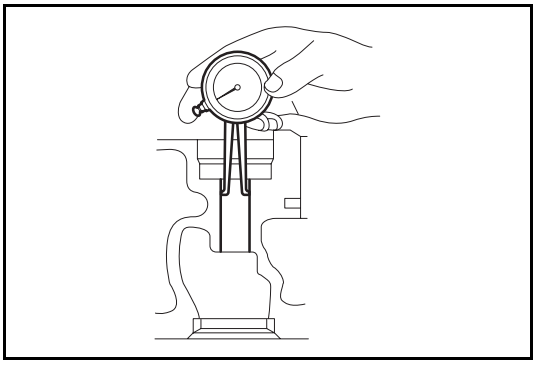
   Standard:
   IN: 6.957 to 6.972 mm (0.2739 to 0.2745 in.)
   EX: 6.932 to 6.947 mm (0.2729 to 0.2735 in.)

3. Calculate the difference between the valve guide inside diameter and valve stem outside diameter.

   Standard:
   IN: 0.023 to 0.058 mm (0.0009 to 0.0023 in.)
   EX: 0.050 to 0.083 mm (0.0020 to 0.0033 in.)

   Limit:
   IN: 0.12 mm (0.005 in.)
   EX: 0.15 mm (0.006 in.)

Note:
If it exceeds the limit, replace the valve guide or valve.

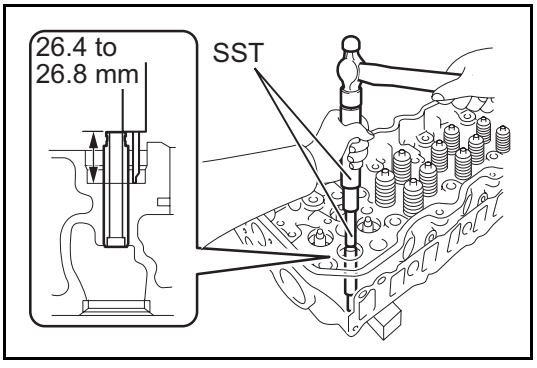


4. Use a caliper gauge and measure the inside diameter of the cylinder bush hole.

   Standard: 13.000 to 13.018 mm (0.5118 to 0.5125 in.)

Note:
If it exceeds the limit, replace the cylinder head.

5. Warm the cylinder head to about 80 to 100°C (176 to 212°F).



[Point 14]

Reassembly:

1. Use the SST to drive in the new valve stem guide until the protrusion from the cylinder head top surface satisfies the standard.

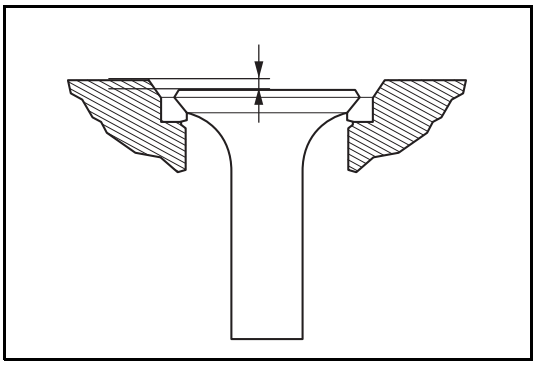
   SST 09201-76002-71
   (09201-10000)

   Standard:
   26.4 to 26.8 mm (1.039 to 1.055 in.) (extrusion amount)

Caution:
Check the protrusion amount as the driving in process is performed, to avoid driving in too far.

2. Polish the bore of the bush using a hand reamer to adjust the oil clearance to the standard.

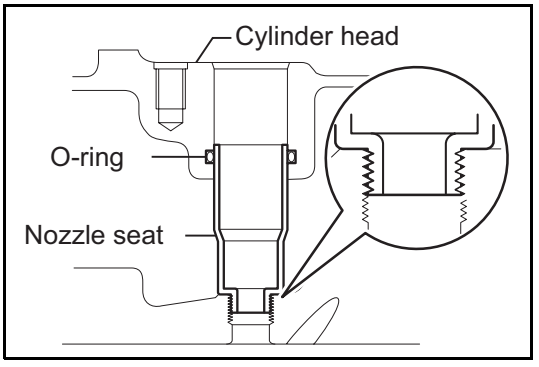
   Standard: 0.014 to 0.029 mm (0.0006 to 0.0011 in.)



3. Using a straight edge ruler and thickness gauge, measure the valve sinking amount.

   Standard: 0.8 to 1.0 mm (0.032 to 0.039 in.)
   Limit: 1.1 mm (0.043 in.)

Note:
If it exceeds the limit, replace the valve or valve seat.

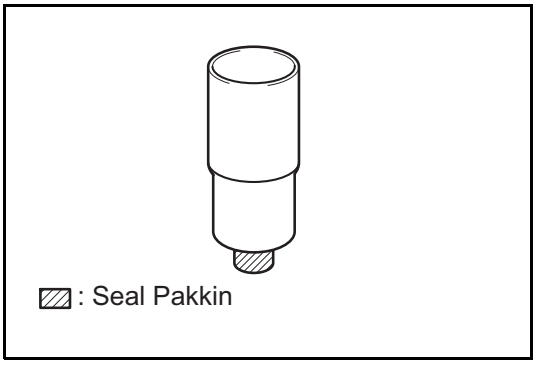


[Point 15]

Reassembly:

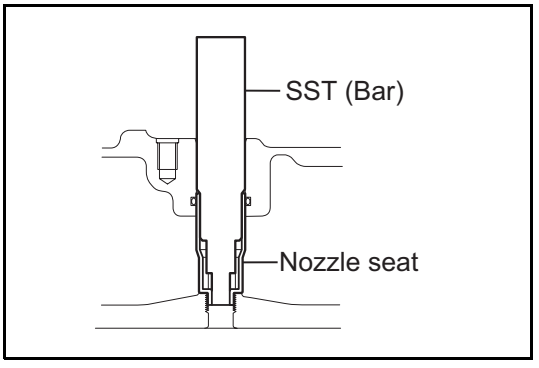
1. Apply engine oil to new O-ring, and attach it to the hole where the nozzle seat of the cylinder head is inserted.

Caution:
- **Make sure to replace the O-ring with new one.**
- **Reusing it may cause water leak and that may lead to overheating or cracks in the cylinder head.**



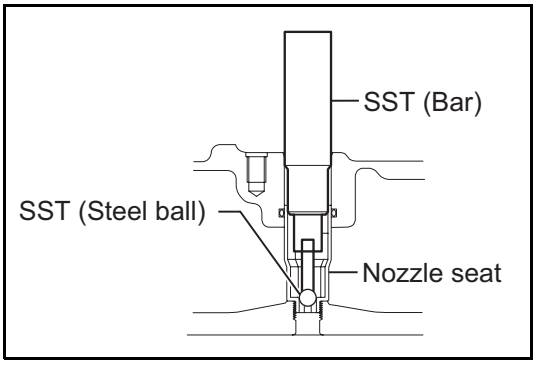
2. Apply black seal packing to the new nozzle seat at the position shown in the illustration.

Caution:
- **Clean and degrease the cylinder head and the installation surface of the nozzle seat.**
- **Make sure to replace the nozzle seat with new one.**
- **Reusing it may cause water leak and that may lead to overheating or cracks in the cylinder head.**



3. Use the SST to install the nozzle seat to the cylinder head.

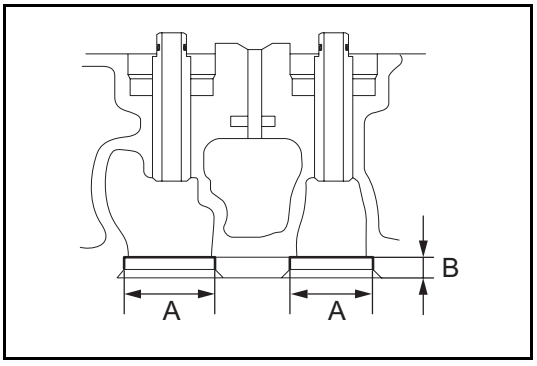
   SST 09020-33940-71



4. Punch out the SST (steel ball) with the SST (bar) and caulk.

   SST 09020-33940-71, 09030-33940-71

Caution:
Since the SST (steel ball) will pop out from the cylinder head, place a plate under the cylinder head to make sure that you will not lose the SST (steel ball).



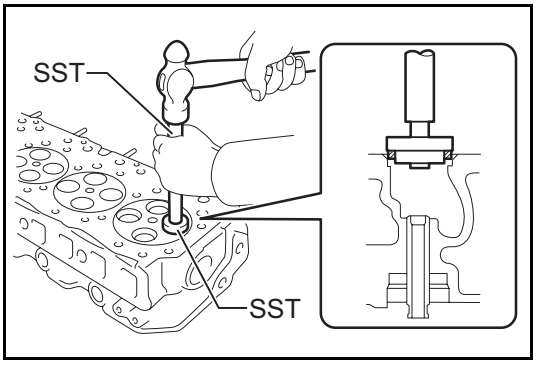
[Point 16]

Reassembly:

1. Use a caliper gauge or vernier caliper to measure the hole where the valve seat of the cylinder head will be installed.

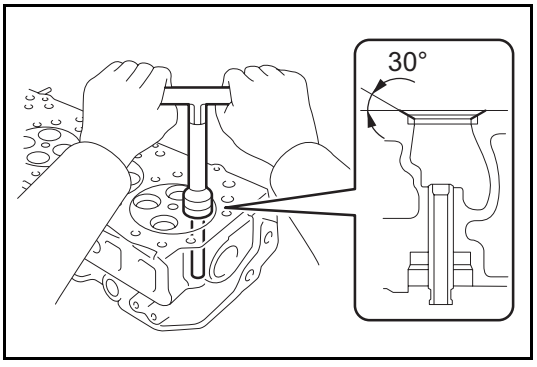
   Standard:
   IN A: 36.000 to 36.015 mm (1.4173 to 1.4179 in.) (Inside diameter)
   IN B: 8.4 to 8.6 mm (0.331 to 0.339 in.) (Depth)
   EX A: 32.000 to 32.016 mm (1.2598 to 1.2605 in.) (Inside diameter)
   EX B: 7.6 to 7.8 mm (0.30 to 0.31 in.) (Depth)

Note:
If it exceeds the limit, replace the cylinder head.



2. Warm the cylinder head to about 80 to 100°C (176 to 212°F).
3. Use the SST 1 - 4 to knock in the cooled new valve seat to the cylinder head for 2 to 3 mm (0.079 to 0.118 in.).

   SST 09950-76018-71
   (09950-60010)



4. Intake valve seat:
   Use a 35° valve seat cutter for refacing.

   Standard: 0.7 to 1.1 mm (0.028 to 0.043 in.)

Caution:
Cutting shall always be done while inspecting the valve contact position and width.

5. Exhaust valve seat:
   Use a 45° valve seat cutter for refacing.

   Standard: 1.7 to 2.1 mm (0.067 to 0.083 in.)

Caution:
Cutting shall always be done while inspecting the valve contact position and width.

6. Cut the face evenly without undulation, and gradually release the force near the end.
7. Coat red thinly on the valve face.
   Check that the contact width satisfies the standard for the entire circumference.

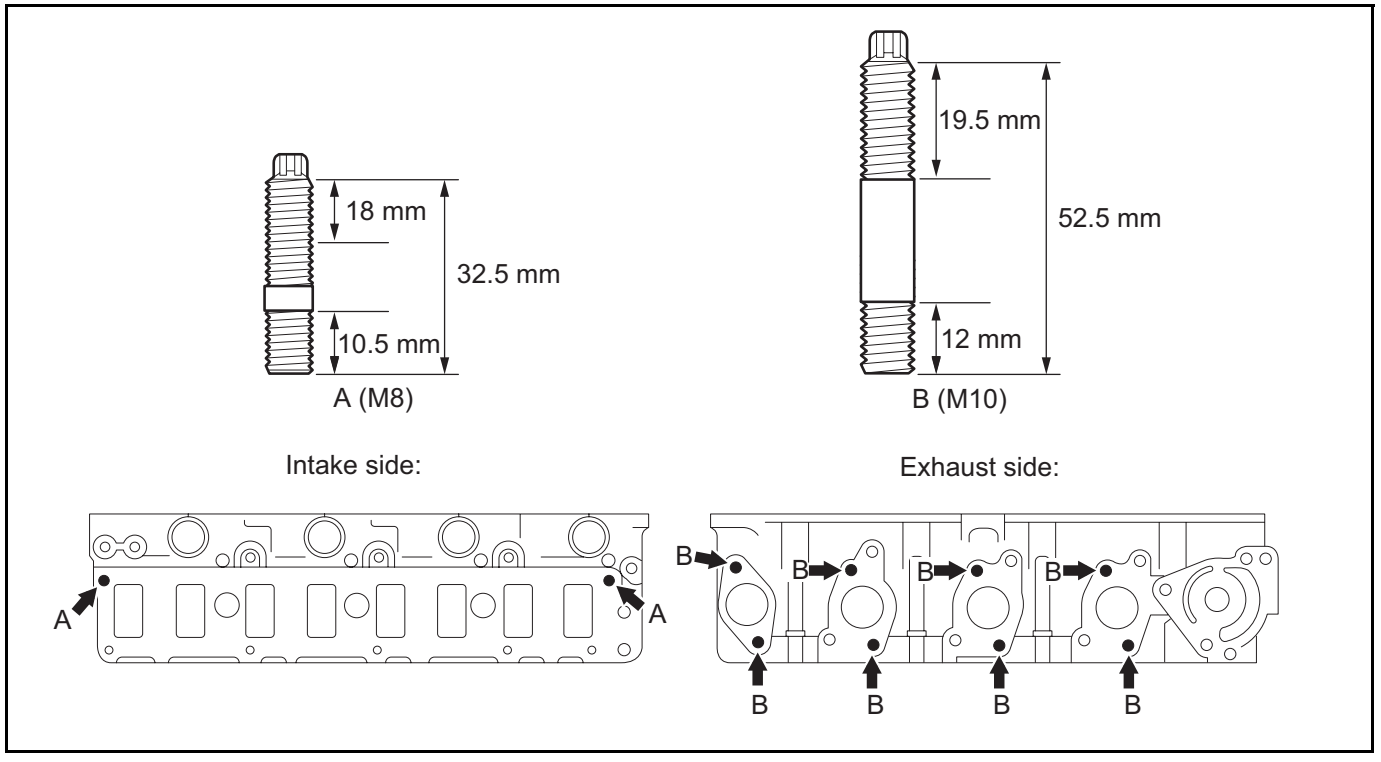
   Standard:
   Contact width should be even along the entire circumference and it should be over 1.24 mm (0.049 in.).

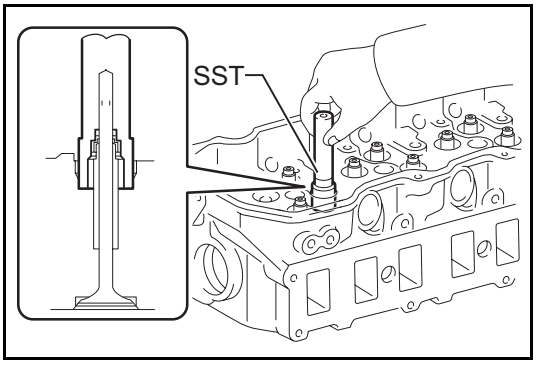
[Point 17]

Reassembly:
Use a torx socket wrench E8 and E10 to install the stud bolts at the positions shown in the illustration.

Standard:
A T = 25 N·m (255 kgf·cm) [18.4 ft·lbf]
B T = 51 N·m (520 kgf·cm) [37.6 ft·lbf]

Caution:
For the stud bolts in the illustration, the bottom side is the cylinder head installation side.





[Point 18]

Reassembly:

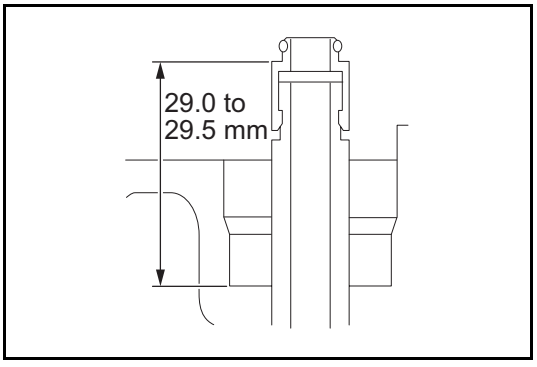
1. Install the valve to the cylinder head.

Note:
This is installed to guide the center of the SST.

2. Apply engine oil to the new valve stem oil shield lip portion and install it to the SST.
3. Use the SST to press the valve stem oil shield in.

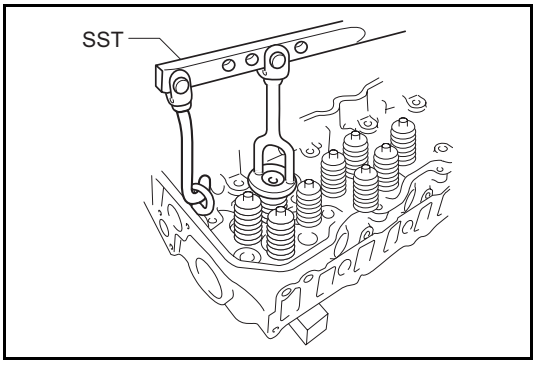
   SST 09050-33940-71

Caution:
After reassembling the valve stem oil shield, check that there will be no deformation, cracks or inclination to the rubber part.



4. After reassembly, check the height.

   Standard: 29.0 to 29.5 mm (1.14 to 1.16 in.)



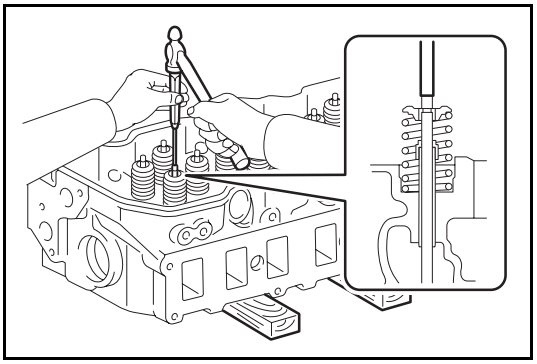
[Point 19]

Reassembly:

1. Use the SST to compress the valve spring and attach the retainer lock.

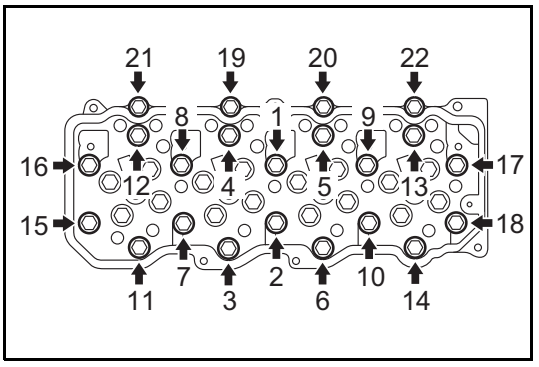
   SST 09050-32720-71

Note:
The valve, inner compression spring and valve spring retainer should be installed at the original positions as when you removed them.



2. Use a 5 mm (0.2 in.) pin punch to hit the valve tip section for settling the spring.

Caution:
- **Do not hit the retainer section.**
- **Do not damage the tip of the valve stem.**



[Point 20]

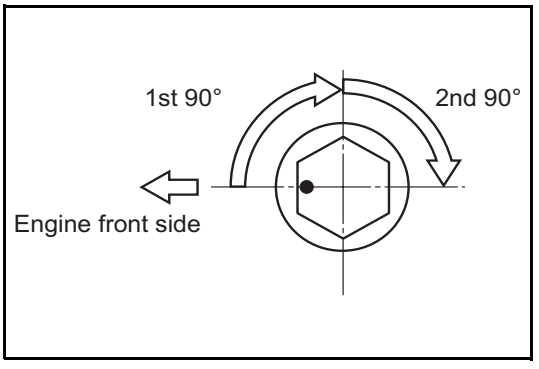
Reassembly:

Caution:

- **Tighten the cylinder head bolts with the plastic region tightening method.**
- **Clean and degrease the installation surface.**

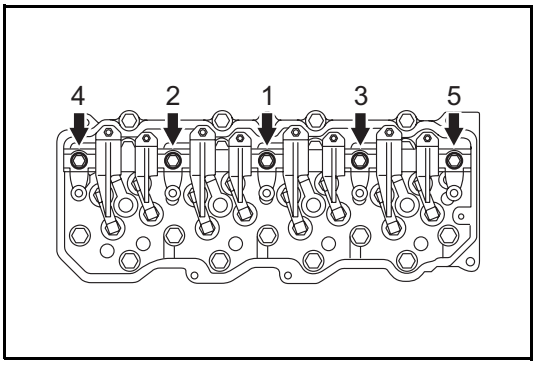
1. Install the cylinder head through new gasket.
2. Apply small amount of engine oil to the threaded part and base surface of the cylinder head bolts.
3. After temporarily tightening 1 to 18 cylinder head bolts several times in the order shown in the illustration, tighten them with the specified torque.

   Standard: T = 60 N·m (612 kgf·cm) [44.3 ft·lbf]



4. Paint the mark on the engine-front side of the cylinder head bolt head section.
5. Using the mark as an indicator, tighten the cylinder head bolts for 90° in the tightening order.
6. In the same order, tighten the cylinder head bolts for another 90°.
7. Check that all the marks painted are at the tightened for 180°.
8. Tighten the cylinder head bolts 19 to 22 in the order shown in the illustration.

   Standard: T = 55 N·m (561 kgf·cm) [40.6 ft·lbf]



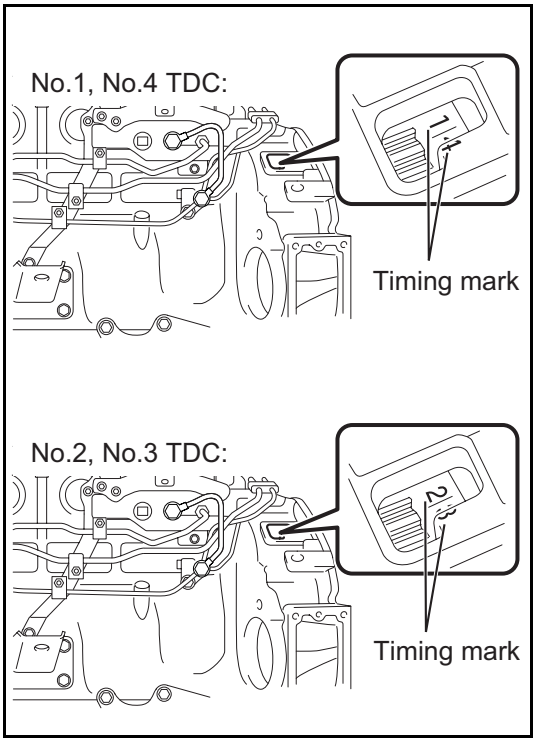
[Point 21]

Reassembly:

Caution:
Tighten in a way that the push rod and valve adjusting screw will not interfere each other.

Install the cylinder head through new gasket.

Standard: T = 69 N·m (704 kgf·cm) [50.9 ft·lbf]

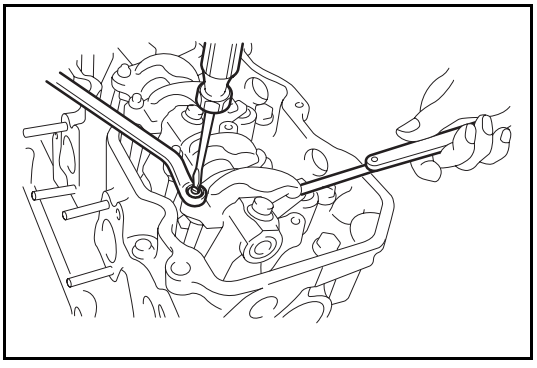


[Point 22]

Reassembly:

1. Set each cylinder to the compression TDC.

Note:
- **Valve clearance adjustment should be performed when each cylinder is at the compression TDC.**
- **Check the TDC from the inspection hole in the fly wheel housing.**
- **The position where the timing marks of the fly wheel and fly wheel housing are aligned will be the TDC.**



2. Insert a thickness gauge between the rocker arm and valve bridge.

   Standard:
   IN: 0.30 mm (0.012 in.)
   EX: 0.45 mm (0.018 in.)

3. Adjust the valve clearance with the adjusting screw of the rocker arm and tighten the lock nut.

   Standard: T = 29 N·m (296 kgf·cm) [21.4 ft·lbf]

4. Check that the feeling of the thickness gauge will not become lighter.

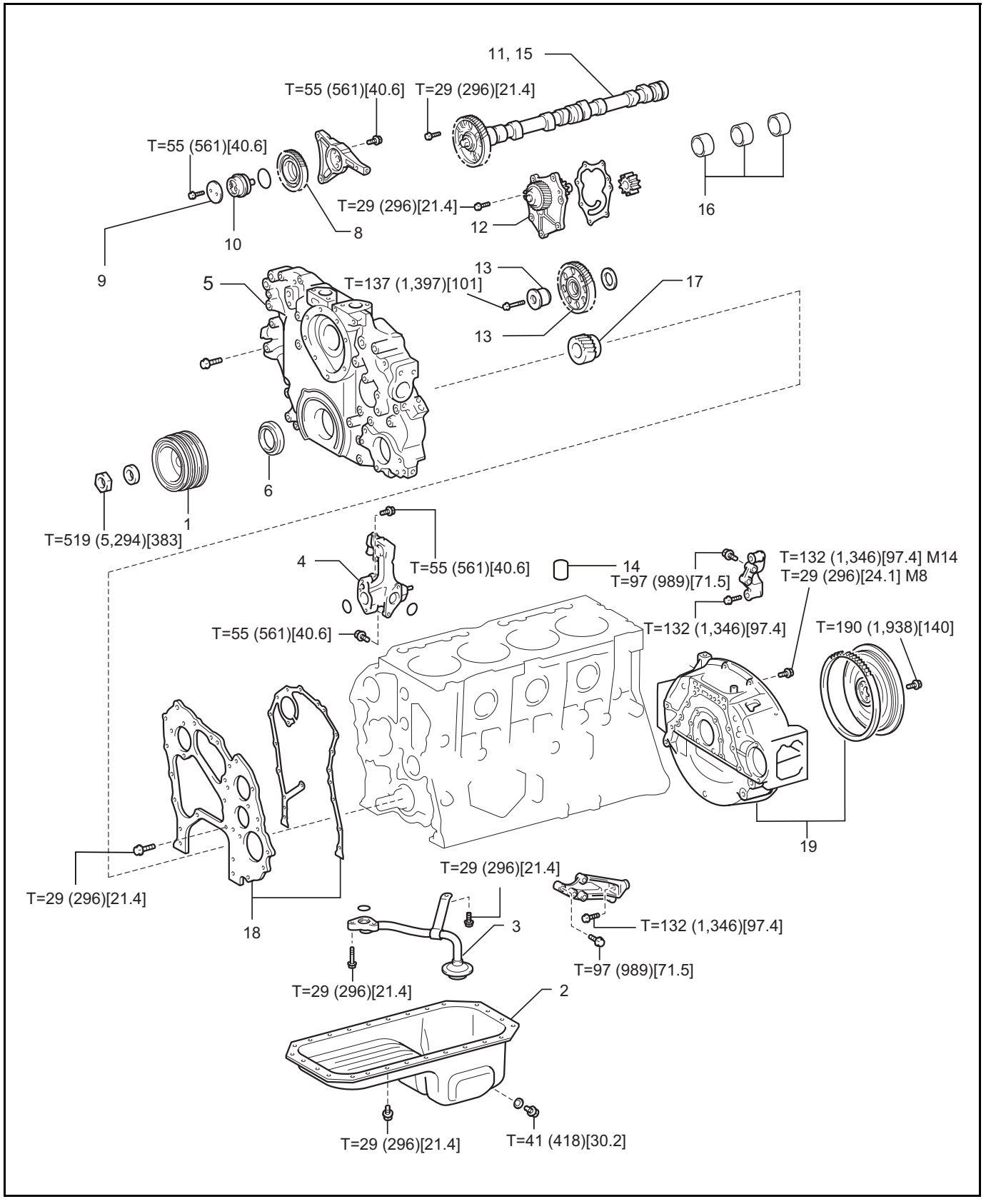
Note:
If it is felt lighter, adjust the valve clearance again.

5. Turn the crankshaft clockwise and adjust the valve clearance of each cylinder.

TIMING GEAR

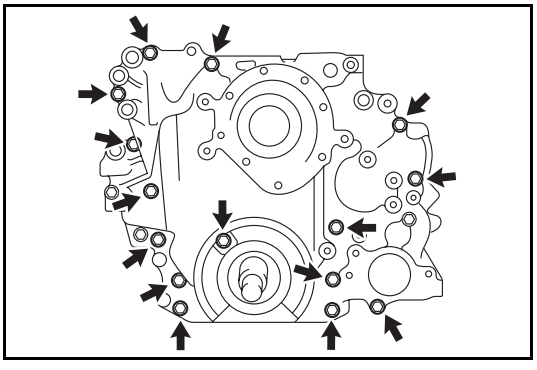
DISASSEMBLY, INSPECTION AND REASSEMBLY

T = N·m (kgf·cm) [ft·lbf]



Disassembly, inspection and reassembly procedure

No.	Item	Reassembly	Inspection	Reassembly
1	Crankshaft pulley			
2	Oil pan			**[Point 24]**
3	Oil strainer			
4	Oil separator			
5	Timing gear case	**[Point 1]**		**[Point 23]**
6	Timing chain cover oil seal			**[Point 22]**
7	Gear's backlash		**[Point 2]**	
8	Idle gear No.2		**[Point 3]**	**[Point 21]**
9	Idle gear thrust plate No.2			
10	Idle gear shaft No.2		**[Point 4]**	**[Point 20]**
11	Camshaft timing gear, camshaft			**[Point 19]**
12	Oil pump assembly			**[Point 16]**
13	Idle gear No.1, idle gear shaft No.1	**[Point 5, 6]**	**[Point 6]**	**[Point 18]**
14	Valve lifter			
15	Camshaft		**[Point 7]**	
16	Camshaft bearing	**[Point 9]**	**[Point 8]**	**[Point 10]**
17	Crankshaft timing gear	**[Point 11]**		**[Point 17]**
18	Front end plate, gasket	**[Point 12]**		**[Point 15]**
19	Flywheel housing, flywheel	**[Point 13]**		**[Point 14]**



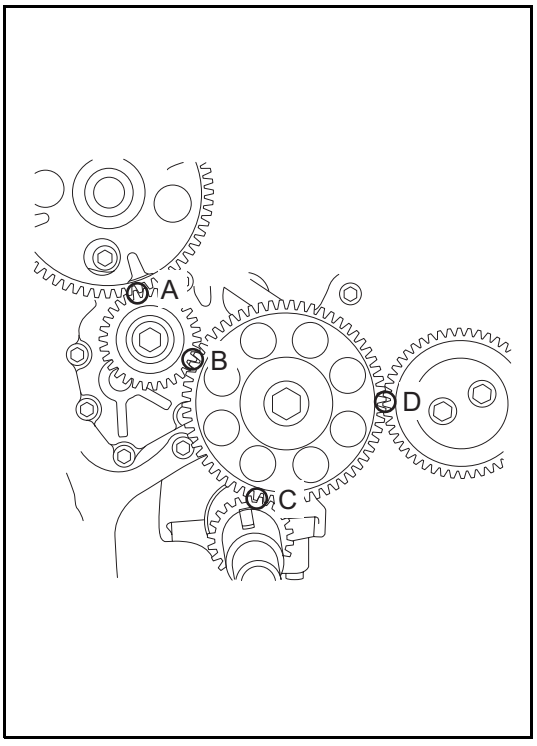
Point Operation

[Point 1]

Disassembly:

1. Remove the 15 bolts.
2. Using a flat head screw driver with the protective tape wrapped around, wrench the timing gear case and remove it.

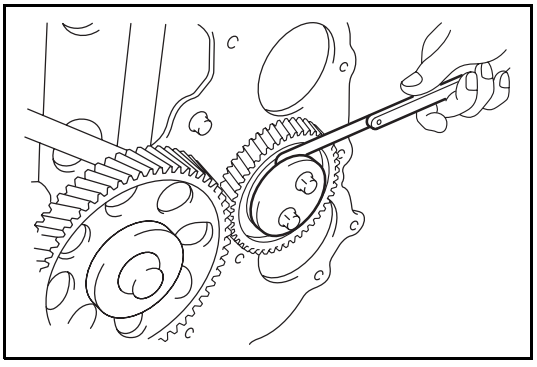
Caution:
So as not to damage installation respect, it removes.



[Point 2]

Inspection:
Use a dial gauge and measure the backlash.

Measurement part	Standard mm (in.)	Limit mm (in.)
A	0.069 to 0.203 (0.0027 to 0.008)	0.3 (0.012)
B	0.065 to 0.215 (0.0026 to 0.0085)	
C	0.035 to 0.193 (0.0014 to 0.0076)	
D	0.036 to 0.227 (0.0014 to 0.0089)	



[Point 3]

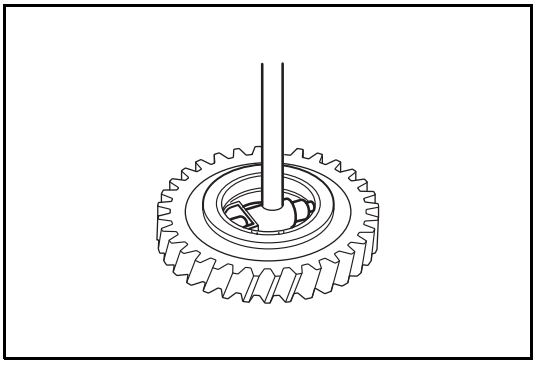
Inspection:

1. Use a thickness gauge, and measure the thrust clearance of idle gear No.2.

   Standard: 0.103 to 0.164 mm (0.0041 to 0.0065 in.)

   Limit: 0.3 mm (0.012 in.)

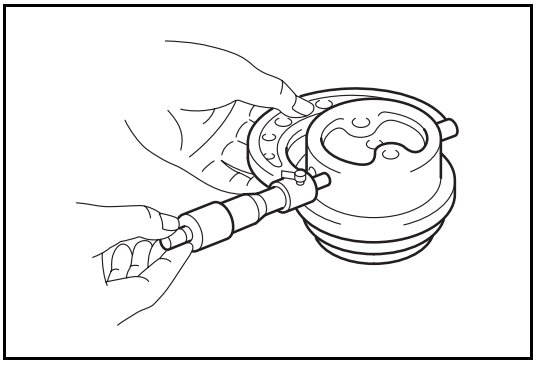
Note:
If it exceeds the limit, replace the idle gear No.2 and idle gear thrust plate.



2. Remove the idle gear No.2.
3. Use a cylinder gauge and measure the inside diameters of idle gear No.2.

   Standard: 50.00 to 50.025 mm (1.9685 to 1.9695 in.)

   Limit: 50.05 mm (1.971 in.)



[Point 4]

Inspection:

1. Use a micrometer and measure the outside diameter of idle gear No.2.

   Standard: 49.950 to 49.975 mm (1.9665 to 1.9675 in.)

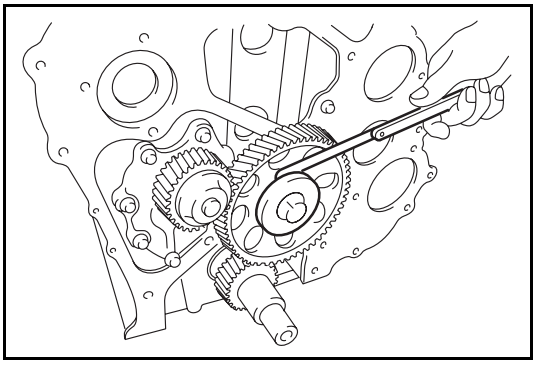
   Limit: 49.95 mm (1.967 in.)

2. Calculate the difference between the idle gear No.2 inside diameter and idle gear shaft No.2 outside diameter.

   Standard: 0.0125 to 0.0375 mm (0.0005 to 0.0015 in.)

   Limit: 0.1 mm (0.004 in.)

Note:
If it exceeds the limit, replace the idle gear No.2 and idle gear shaft No.2.



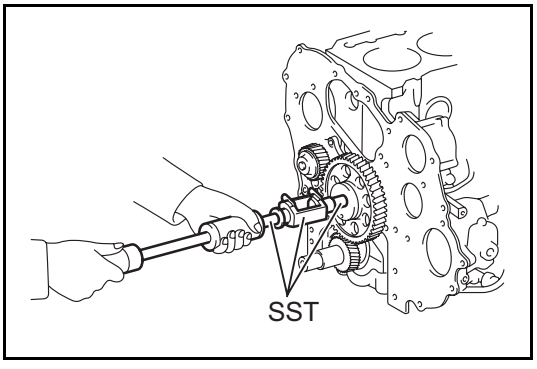
[Point 5]

Inspection:
Use a thickness gauge, and measure the thrust clearance of idle gear No.1.

Standard: 0.103 to 0.164 mm (0.0041 to 0.0065 in.)

Limit: 0.15 mm (0.006 in.)

Note:
If it exceeds the limit, replace the idle gear No.1 and idle gear thrust plate.



[Point 6]

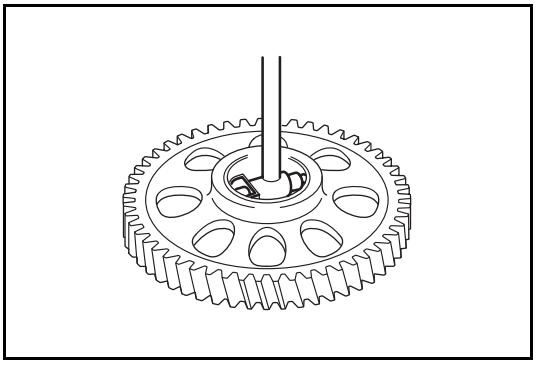
Disassembly•Reassembly:

1. Use a SST to disassembly the idle gear shaft No.1.

   SST 09060-32720-71, 09029-88640-71, 09010-33940-71

Caution:
If the idle gear shaft No.1 is removed, the idle gear No.1 and idle gear thrust plate No.1 will drop, so support the idle gear No.1 with your hand.

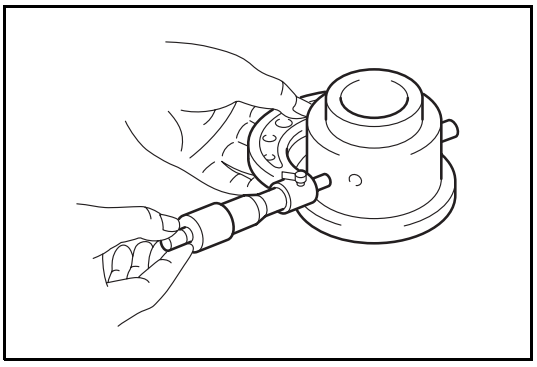
2. Remove the idle gear No.1.



3. Use a cylinder gauge and measure the inside diameters of idle gear No.1.

   Standard: 50.00 to 50.025 mm (1.9685 to 1.9695 in.)

   Limit: 50.05 mm (1.971 in.)



4. Use a micrometer and measure the outside diameter of idle gear shaft No.1.

   Standard: 49.95 to 49.975 mm (1.9665 to 1.9675 in.)

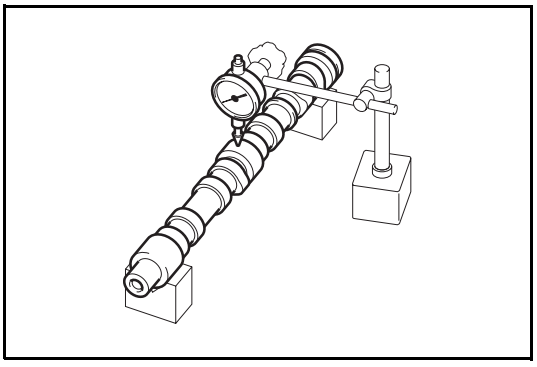
   Limit: 49.95 mm (1.967 in.)

5. Calculate the difference between the idle gear No.1 inside diameter and idle gear shaft No.1 outside diameter.

   Standard: 0.0125 to 0.0370 mm (0.0005 to 0.0015 in.)

   Limit: 0.1 mm (0.004 in.)

Note:
If it exceeds the limit, replace the idle gear No.1 and idle gear shaft No.1.



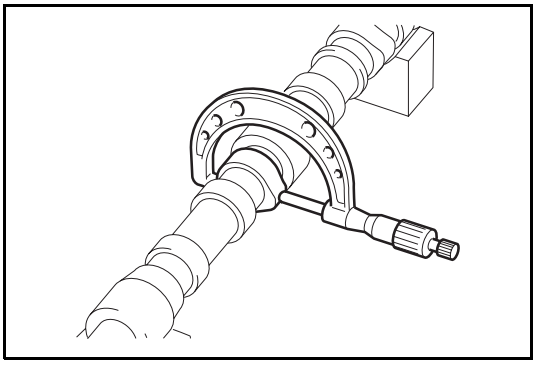
[Point 7]

Inspection:

1. Use a dial gauge, and measure the bend while rotating it by one turn.

   Limit: 0.06 mm (0.0024 in.)

Note:
If it exceeds the limit, replace the camshaft.

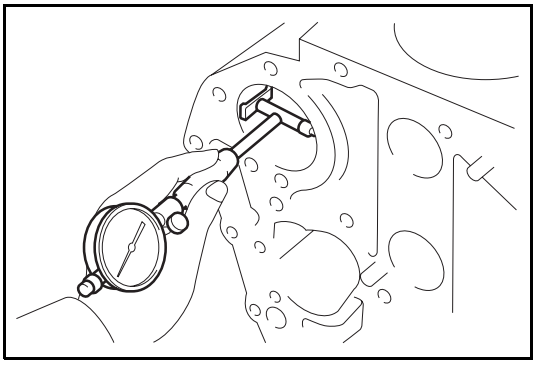


2. Use a micrometer, and measure the cam height outside diameter.

   Standard:
   IN: 50.6576 to 50.8596 mm (1.9944 to 2.0023 in.)
   EX: 49.3561 to 49.5581 mm (1.9431 to 1.9511 in.)

   Limit:
   IN: 50.20 mm (1.98 in.)
   EX: 48.95 mm (1.927 in.)

Note:
If it exceeds the limit, replace the camshaft.

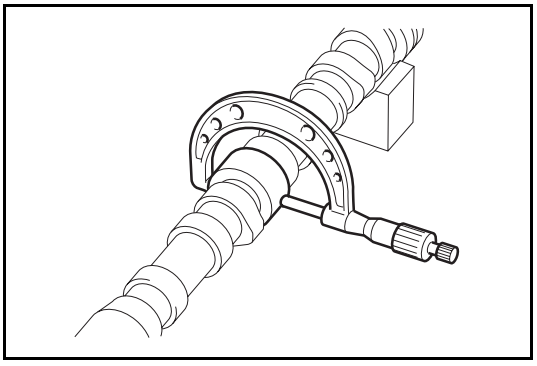


[Point 8]

Inspection:

1. Use a cylinder gauge and measure the inside diameters of camshaft bearings.

   Standard:
   57.035 to 57.135 mm (No.1) (2.2455 to 2.2494 in.)
   56.835 to 56.935 mm (No.2) (2.2376 to 2.2415 in.)
   56.635 to 56.735 mm (No.3) (2.2297 to 2.2337 in.)



2. Use a micrometer, and measure the outside diameter of camshaft journals.

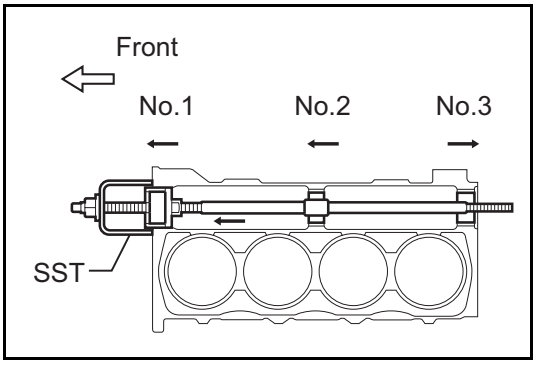
   Standard:
   56.95 to 56.97 mm (No.1) (2.242 to 2.243 in.)
   56.75 to 56.77 mm (No.2) (2.234 to 2.235 in.)
   56.55 to 56.57 mm (No.3) (2.226 to 2.227 in.)

3. Calculate the difference between the camshaft bearing inside diameter and camshaft journal outside diameter.

   Standard: 0.03 to 0.12 mm (0.001 to 0.005 in.)

   Limit: 0.15 mm (0.006 in.)

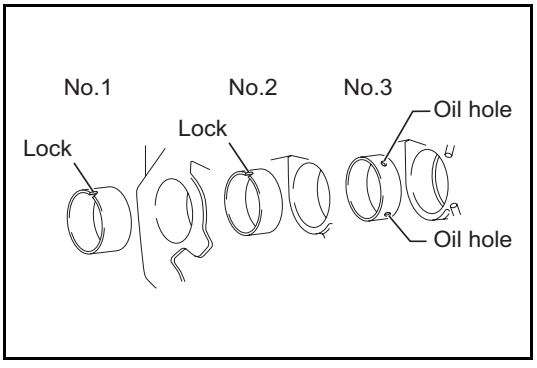
Note:
If it exceeds the limit, replace the camshaft or camshaft bearing.



[Point 9]

Disassembly:
Use a SST, and a new camshaft bearing is removed in the direction of the arrow of the illustration in order of No.1 → No.2 → No.3.

SST 09215-76004-71
(09215-00101)

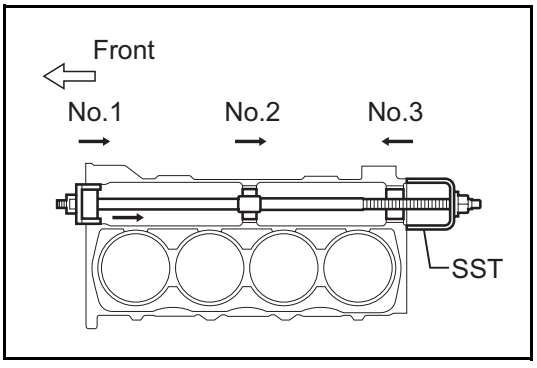


[Point 10]

Disassembly:

1. Confirmation of installation position of new camshaft bearing.

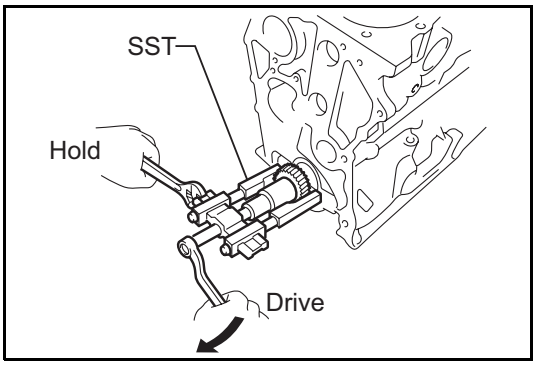
Journal No.	Inside diameter mm (in.)	Outside diameter mm (in.)
1	57.0 (2.244)	60.0 (2.362)
2	56.8 (2.236)	59.8 (2.354)
3	56.6 (2.228)	59.6 (2.247)



2. Use a SST, and a new camshaft bearing is installed in the direction of the arrow of the illustration in order of No.2 → No.1 → No.3.

   SST 09215-76004-71
   (09215-00101)

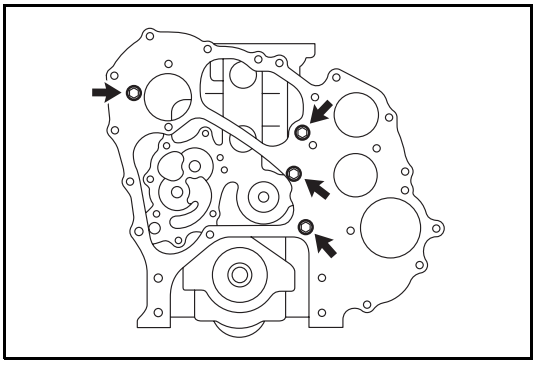
Note:
- **Install No.1 and No.2 bearings with the notches facing directly overhead.**
- **Install No.3 bearing by aligning the oil holes.**



[Point 11]

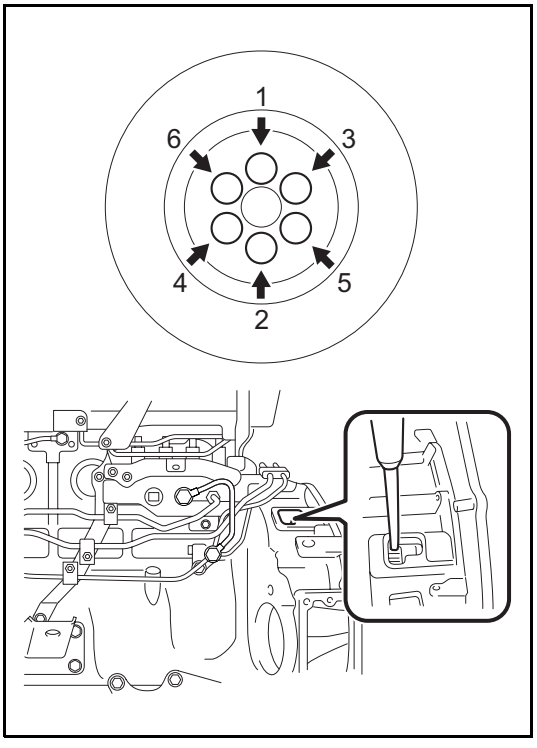
Disassembly:
Use a SST to disassembly the crankshaft timing gear.

SST 09950-76014-71
(09950-40010)



[Point 12]

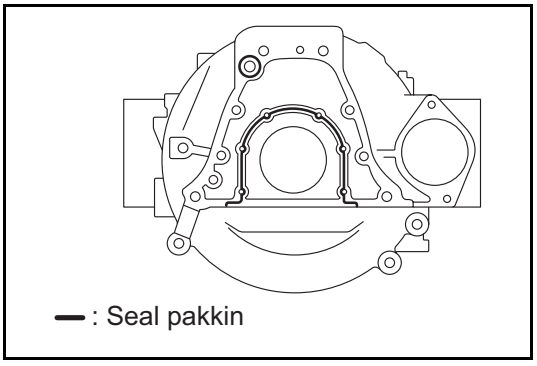
Disassembly:
Remove the 4 bolts and the front end plate.



[Point 13]

Disassembly:
Remove the 6 bolts in the order of the illustration, and remove the flywheel.

Note:
To prevent the crankshaft from turning together, insert a split handle screwdriver into the ring gear of the flywheel from the flywheel inspection hole in the flywheel housing.



[Point 14]

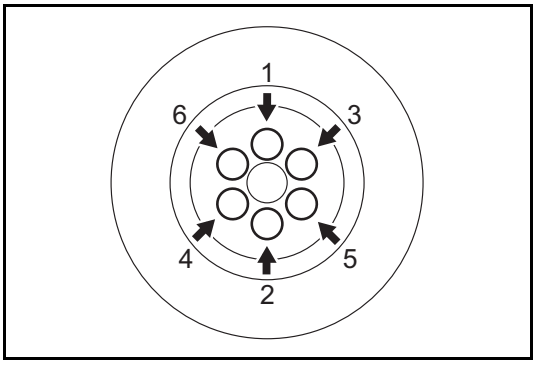
Reassembly:

1. Apply seal packing black in a diameter 1.5 to 2.5mm (0.06 in to 0.09 in) in the position shown in the illustration.

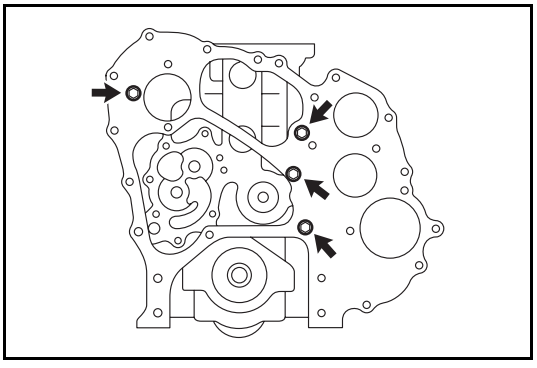
Caution:
- **Clean and degrease the installation surface.**
- **It installs it within 3 minutes after seal packing black is spread.**
- **Wipe away any excess seal packing black after reassembly.**
- **After the installation, leave it for two hours without filling engine oil.**

2. The flywheel housing is installed with 14 bolts.

   Standard:
   T = 132 N·m (1346 kgf·cm) [97.4 ft·lbf] (M14)
   T = 29 N·m (296 kgf·cm) [21.4 ft·lbf] (M8)



3. The color knock part of the crank shaft is set to the knock part of the flywheel.
4. The engine oil is spread on the bolt and the screw.
5. The bolt is installed in the flywheel in the order of illustration.



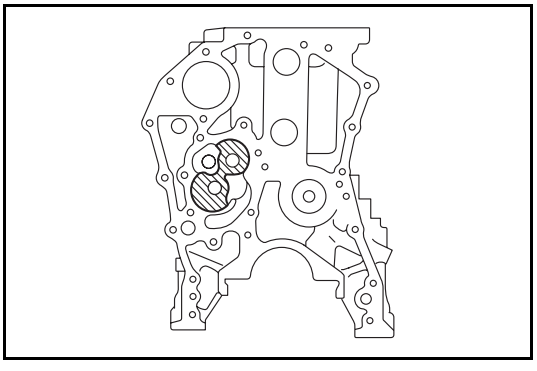
[Point 15]

Reassembly:

1. A new gasket is installed in the front end plate with 4 bolts.

   Standard: T = 29 N·m (296 kgf·cm) [21.4 ft·lbf]

2. Use a cutter to cut the gasket so that it will have flush surface with the bottom surface of the cylinder block.



[Point 16]

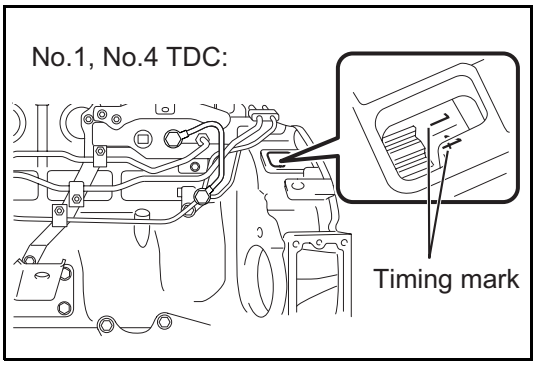
Reassembly:

1. The engine oil is spread on the pump case and the bearing in the cylinder block.

Caution:
Unless applying engine oil, when the engine is started for the first time, oil suction fault may occur and this may cause burn out or abnormal wearing.

2. A new gasket is installed in oil pump ASSY.

   Standard: T = 29 N·m (296 kgf·cm) [21.4 ft·lbf]



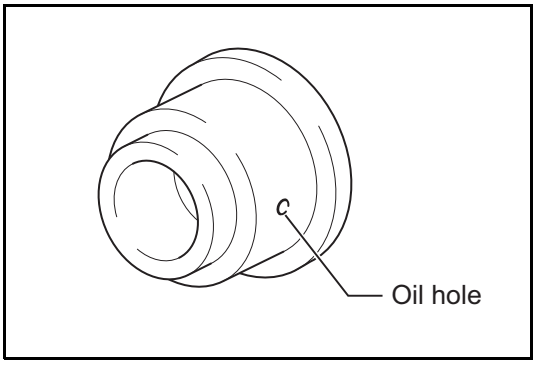
[Point 17]

Reassembly:

1. Rotate the crankshaft clockwise and set the No.1 cylinder to the TDC.

Note:
The position where the timing marks of the flywheel and flywheel housing are aligned will be the TDC.

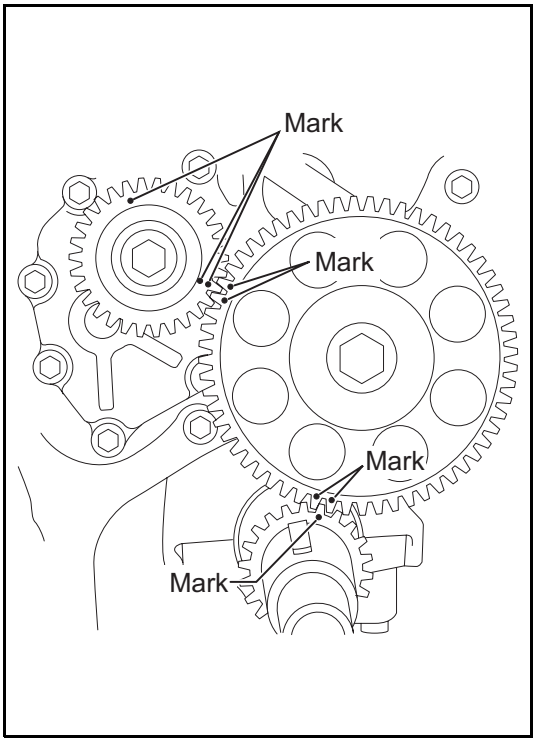
2. Set the match mark to the front side, align it to the key groove and install the crankshaft timing gear to the crankshaft.
3. Use a plastic hammer to knock in the crankshaft timing gear.



[Point 18]

Reassembly:

1. Idle gear No.1 and idol gear thrust plate No.1 are assembled to idle gear shaft No.1.

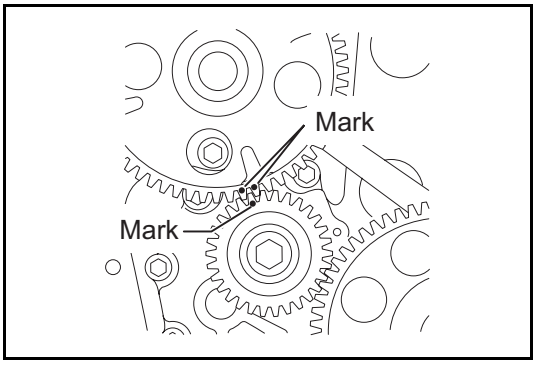


2. Set the oil hole of the idle gear shaft No.1 to the bottom, align the match mark of each gear and insert it firmly to the cylinder block.

Caution:
Unless setting the oil hole to the bottom, it may cause burn out or abnormal wearing.

3. Install the bolts.

   Standard: T = 137 N·m (1397 kgf·cm) [101 ft·lbf]

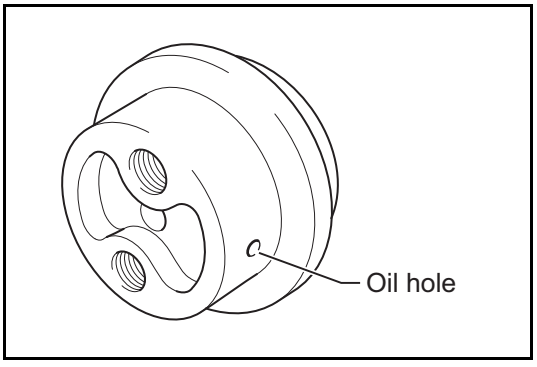


[Point 19]

Reassembly:

1. The engine oil is spread on the camshaft journal and the camshaft bearing.
2. The match mark of the camshaft timing gear and the oil pump gear is matched, and the camshaft is installed.
3. A thrust plate is installed with 2 bolts.

   Standard: T = 29 N·m (296 kgf·cm) [21.4 ft·lbf]



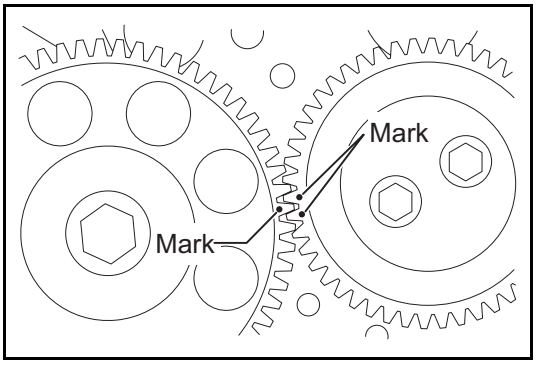
[Point 20]

Reassembly:

1. A new O-ring is installed in idol gear shaft No.2.
2. Set the oil hole of the idle gear shaft No.2 to the bottom and install it to the lock plate through the front end plate with 3 bolts.

   Standard: T = 55 N·m (561 kgf·cm) [40.6 ft·lbfb]

Caution:
Unless setting the oil hole to the bottom, it may cause burn out or abnormal wearing.

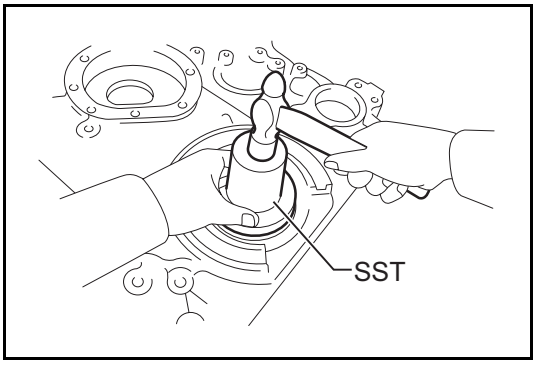


[Point 21]

Reassembly:

1. The match mark of idle gear No.1 and No.2 is matched, and idle gear No.2 is installed.
2. Idle gear thrust plate No.2 is installed with 2 bolts.

   Standard: T = 55 N·m (561 kgf·cm) [40.6 ft·lbf]



[Point 22]

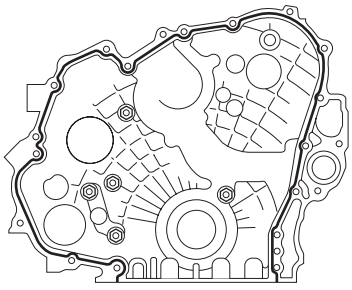
Reassembly:

1. Use the SST to drive in the new oil seal so that its surface is flush with the timing crank case end surface.

Caution:
Check that the oil seal is evenly knocked in.

SST 09012-33910-71

2. The MP grease is spread on the lip of the oil seal.



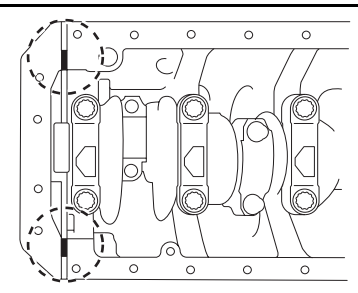
—: Seal pakkin

[Point 23]

Reassembly:

1. Apply seal packing black in a diameter 3 to 4 mm (1.2 to 1.6 in.) in the position shown in the illustration.

Caution:
- **Clean and degrease the installation surface.**
- **It installs it within 3 minutes after seal packing black is spread.**
- **Wipe away any excess seal packing black after reassembly.**
- **After the installation, leave it for 2 hours without filling engine oil.**



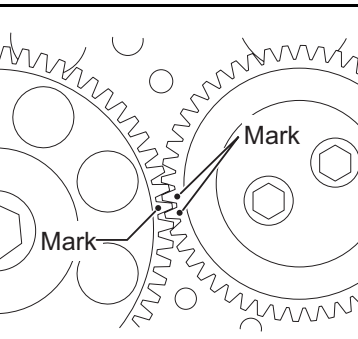
—: Seal pakkin

[Point 24]

Reassembly:

1. Apply seal packing black in a diameter 3 to 4 mm (1.2 to 1.6 in.) in the position shown in the illustration.

Caution:
- **Clean and degrease the installation surface.**
- **It installs it within 3 minutes after seal packing black is spread.**
- **Wipe away any excess seal packing black after reassembly.**
- **After the installation, leave it for 2 hours without filling engine oil.**



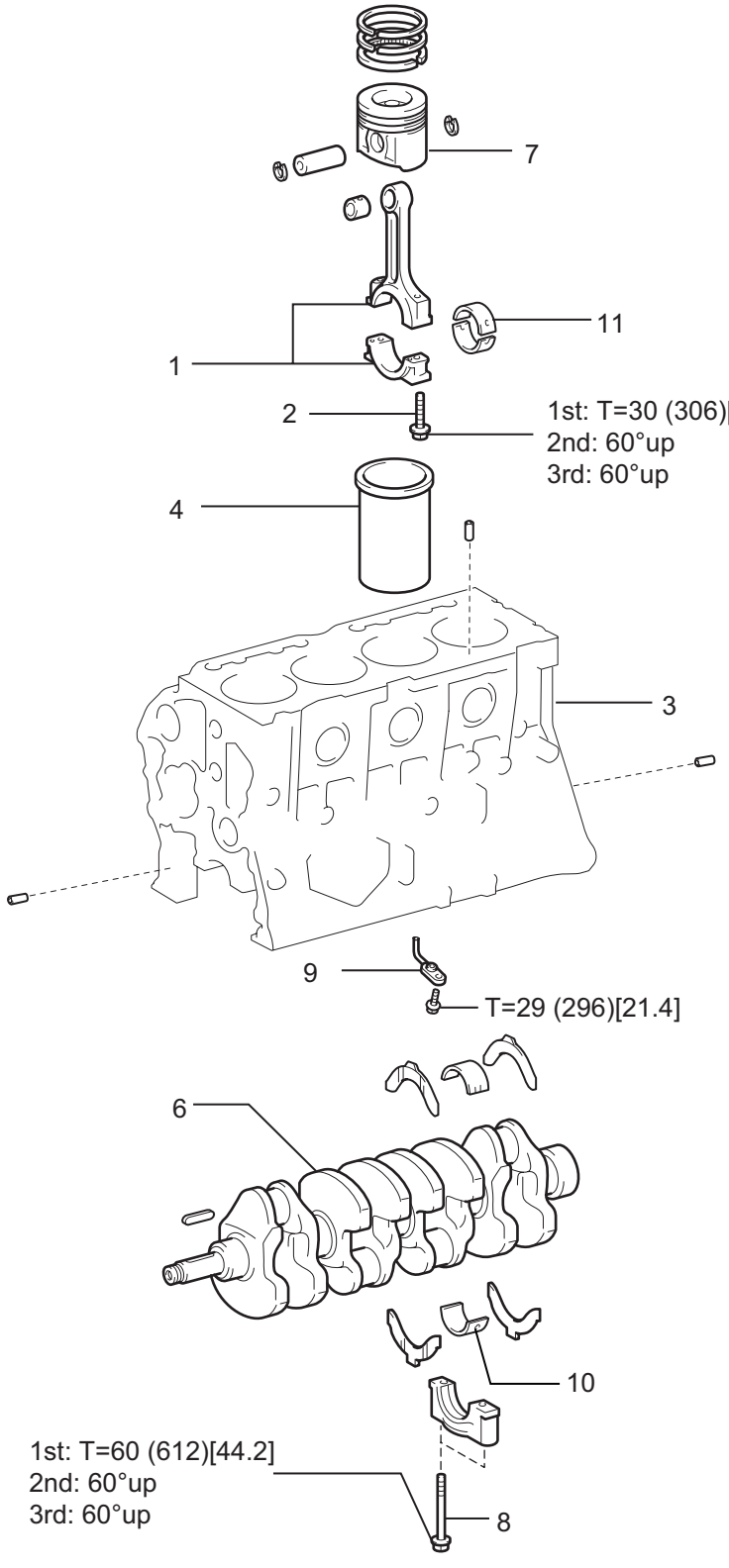
2. The oil pan is installed with 26 bolts.

   Standard: T = 29 N·m (296 kgf·cm) [21.4 ft·lbf]

CYLINDER BLOCK

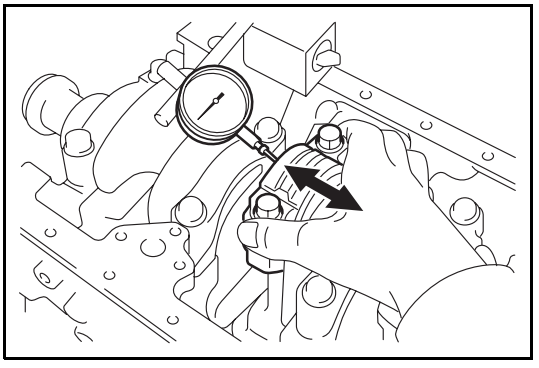
DISASSEMBLY, INSPECTION AND REASSEMBLY

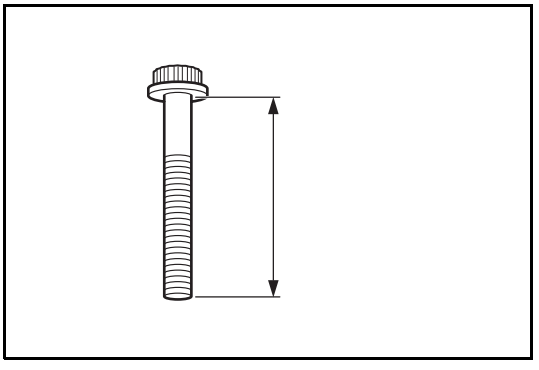
T = N·m (kgf·cm) [ft·lbf]



Disassembly, inspection and reassembly procedure

No.	Item	Reassembly	Inspection	Reassembly
1	Connecting rod, piston		**[Point 1]**	**[Point 17]**
2	Connecting rod, bolt		**[Point 2]**	
3	Cylinder block		**[Point 3]**	
4	Cylinder liner	**[Point 4]**	**[Point 5]**	**[Point 6]**
5	Crankshaft thrust clearance		**[Point 7]**	
6	Crankshaft	**[Point 8]**	**[Point 11]**	**[Point 16]**
7	Piston, piston ring, piston pin	**[Point 9]**	**[Point 10]**	**[Point 15]**
8	Crankshaft bearing cap bolt		**[Point 12]**	
9	Oil nozzle			
10	Crankshaft oil clearance		**[Point 13]**	
11	Connecting rod bearing oil clearance		**[Point 14]**	





Point Operation

[Point 1]

Inspection:
Use a dial gauge, and measure the thrust clearance.

Standard: 0.20 to 0.52 mm (0.001 to 0.0021 in.)

Limit: 0.6 mm (0.024 in.)

Note:
If it exceeds the limit, replace the connecting rod or crankshaft.

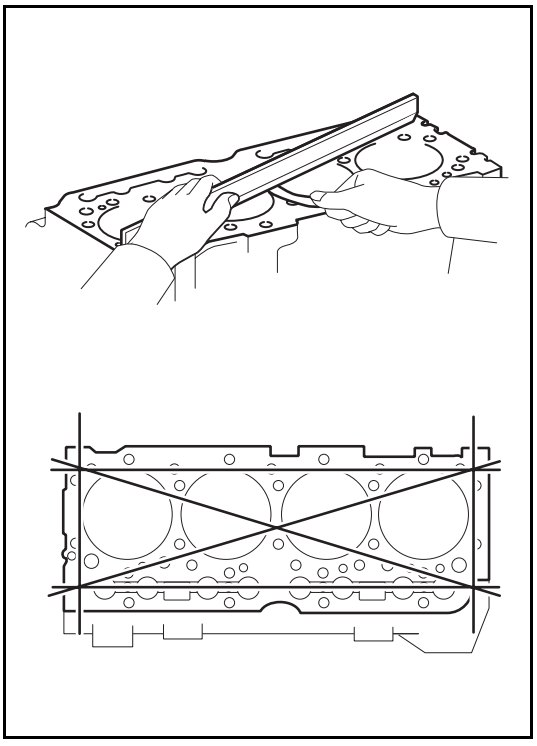
[Point 2]

Inspection:
Measure the length of the head bolt with a vernier caliper.

Standard: 59 mm (2.32 in.) (New bolt)

Limit: 61.5 mm (2.42 in.)

Note:
If it exceeds the limit, replace the connecting bolt.

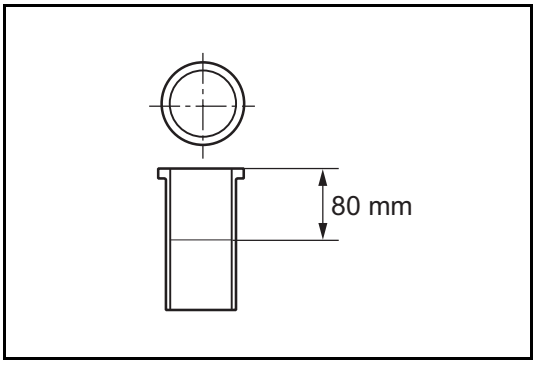


[Point 3]

Inspection:

1. Use a straight and thickness gauge, and measure at 4 illustrated places.

   Limit: 0.1 mm (0.004 in.)

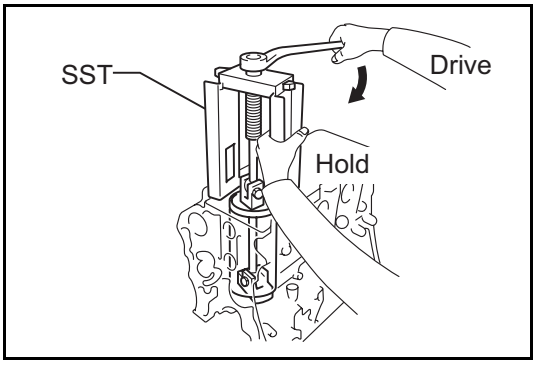


2. Use a cylinder gauge, and measure at illustrated places.

   Standard: 104.012 to 104.036 mm (4.0950 to 4.0959 in.)

   Limit: 104.15 mm (4.1004 in.)

Note:
If it exceeds the limit, replace the cylinder liner.



[Point 4]

Disassembly:
Using SST, remove the cylinder liner.

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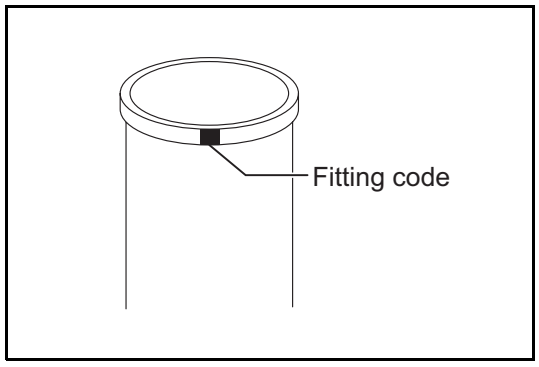
Note:
Sort the removed parts according to their positions of installation.

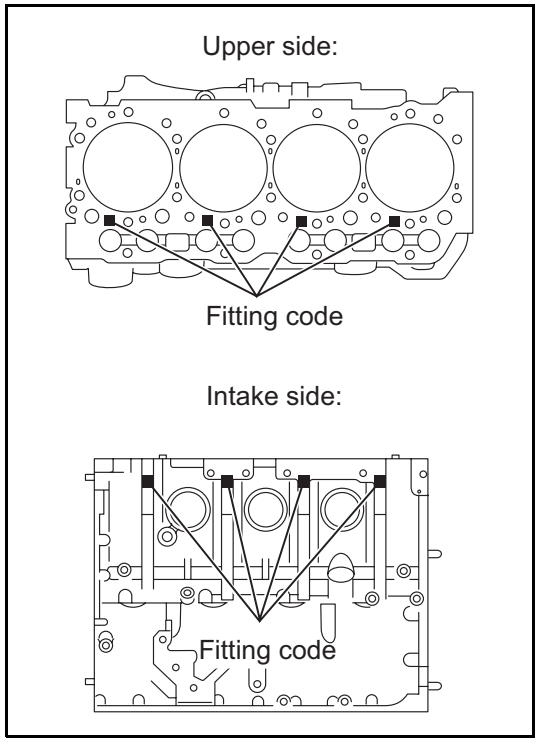


[Point 5]

Inspection:

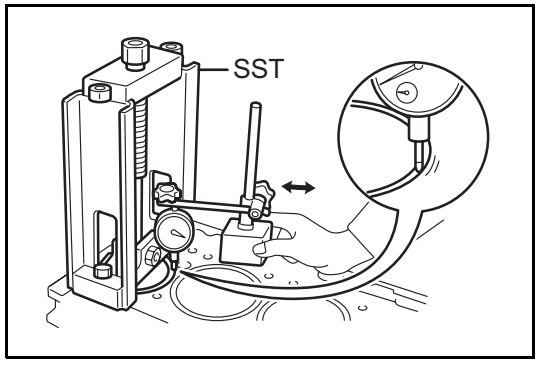
1. Use a micrometer and measure the cylinder liner outside diameter.

Fitting code	Standard mm (in.)
A	106.982 - 106.989 (4.2119 to 4.2122)
B	106.990 - 106.995 (4.2122 to 4.2124)
C	106.996 - 107.004 (4.2124 to 4.2127)



2. Use a cylinder gauge and measure the cylinder block inside diameter.

Fitting code	Standard mm (in.)
A	107.000 - 107.008 (4.2126 to 4.2129)
B	107.008 - 107.014 (4.2129 to 4.2131)
C	107.014 - 107.022 (4.2131 to 4.2135)



[Point 6]

Reassembly:

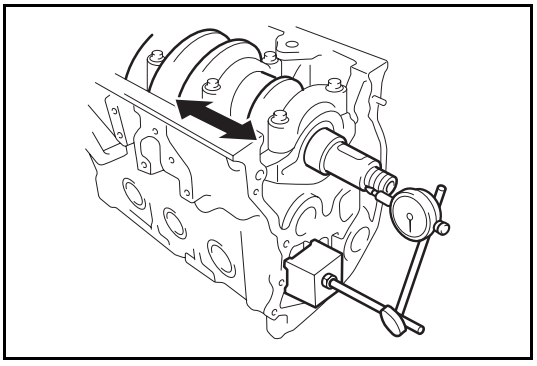
1. Install liner using SST and a press.

   SST 09040-33910-71

   Standard: T = 9.8 N·m (100 kgf·cm) [7.2 ft·lbf]

2. Bore the cylinder after press-fitting, and measure the amount of protrusion.

   Standard: 0.01 to 0.08 mm (0.0004 to 0.0031 in.)



[Point 7]

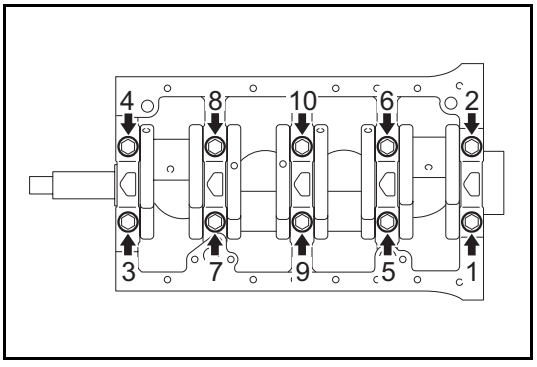
Inspection:

Use a dial gauge, and measure the thrust clearance.

Standard: 0.05 to 0.22 mm (0.002 to 0.0009 in.)

Limit: 0.4 mm (0.02 in.)

Note:
If it exceeds the limit, replace the thrust washer or crankshaft.



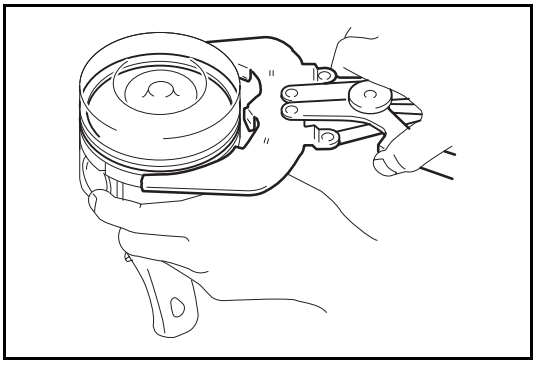
[Point 8]

Disassembly:

1. Remove the 14 bolts in the order shown in the figure at right, and remove crankshaft bearing caps.
2. Use a plastic hammer to lightly tap and remove the bearing cap.

Caution:
Do not tap the thrust washer and bearing hard as they will damage.

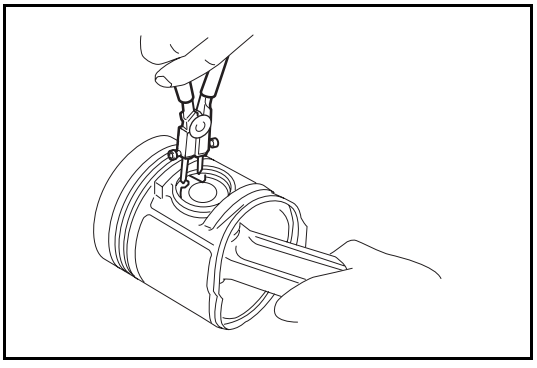
3. Remove the crankshaft.



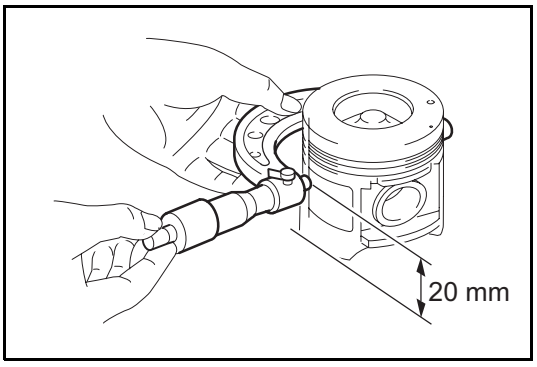
[Point 9]

Disassembly:

1. Use a piston ring tool and remove piston ring.



2. Remove the snap ring.
3. Warn the piston ring to about 50°C (122°F). Use a brass rod extract the piston pin from the piston.

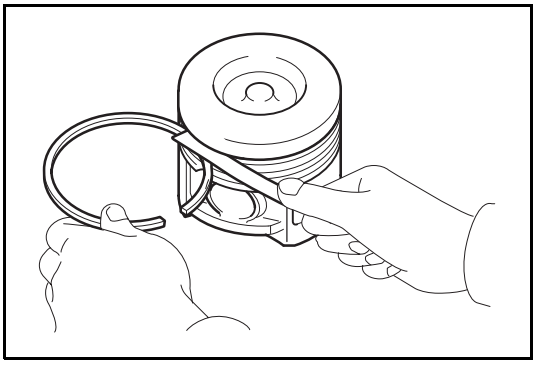


[Point 10]

Inspection:

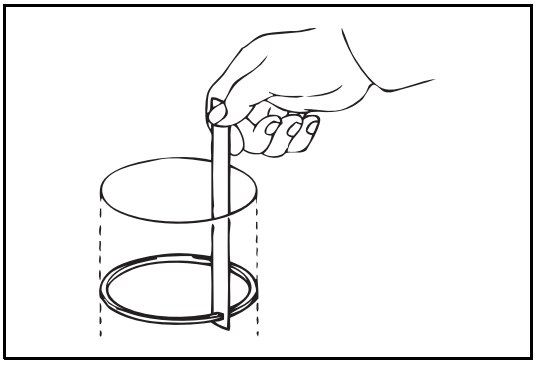
1. Use a micrometer, and measure the piston outside diameter at illustrated places.

   Standard: 103.936 to 103.952 mm (4.0920 to 4.0926 in.)



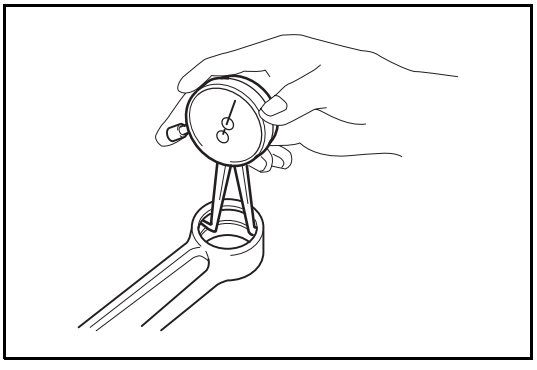
2. Use a thickness gauge to measure the gap between the piston ring and ring groove along the entire circumference and if it exceeds the standard, replace the piston or piston ring.

   Standard:
   0.11 to 0.15 mm (0.004 to 0.006 in.) (No.1)
   0.07 to 0.11 mm (0.003 to 0.004 in.) (No.2)
   0.02 to 0.06 mm (0.001 to 0.0002 in.) (Oil)



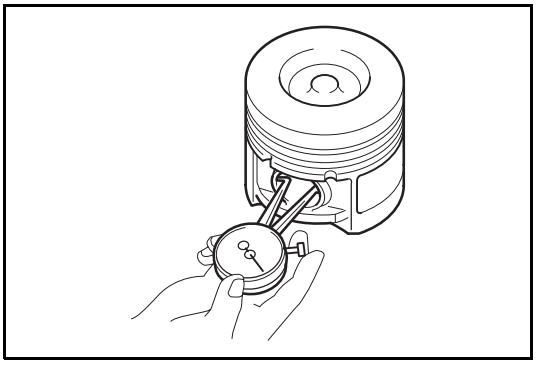
3. Push in the piston ring deeper than the sliding contact surface (approx. 80 mm (3.15 in.)) from the block top surface into the piston, and measure than clearance.

   Standard:
   0.30 to 0.45 mm (0.012 to 0.018 in.) (No.1)
   0.50 to 0.65 mm (0.020 to 0.036 in.) (No.2)
   0.15 to 0.30 mm (0.006 to 0.012 in.) (oil)



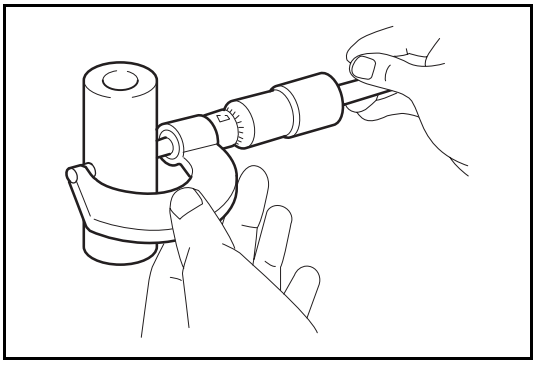
4. Use a caliper gauge and measure the bush inside diameter.

   Standard: 37.035 to 37.045 mm (1.4581 to 1.4585 in.)



5. Use a caliper gauge and measure the piston pin inside diameter.

   Standard: 36.987 to 37.003 mm (1.4562 to 1.4568 in.)



6. Use a micrometer and measure the piston pin outside diameter.

   Standard: 36.989 to 37.000 mm (1.4563 to 1.4567 in.)

7. Calculate the difference between the connecting rod inside diameter and piston pin outside diameter.

   Standard: 0.035 to 0.056 mm (0.0014 to 0.0022 in.)

   Limit: 0.08 mm (0.031 in.)

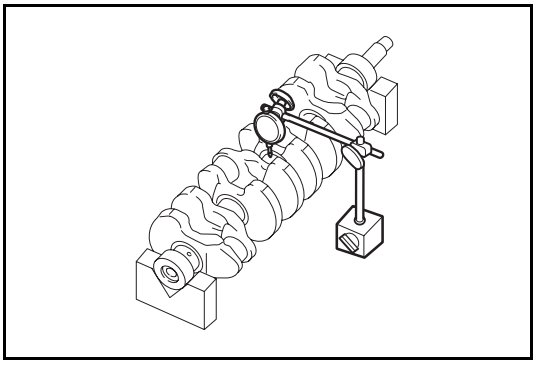
Note:
Note: If it exceeds the limit, replace the bush or piston pin.

8. Calculate the difference between the piston hole inside diameter and piston pin outside diameter.

   Standard: -0.013 to 0.014 mm (-0.0005 to 0.0006 in.)

   Limit: 0.05 mm (0.002 in.)

Note:
If it exceeds the limit, replace the piston or piston pin.

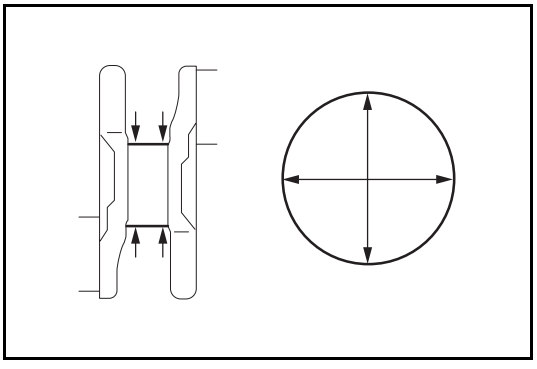


[Point 11]

Inspection:

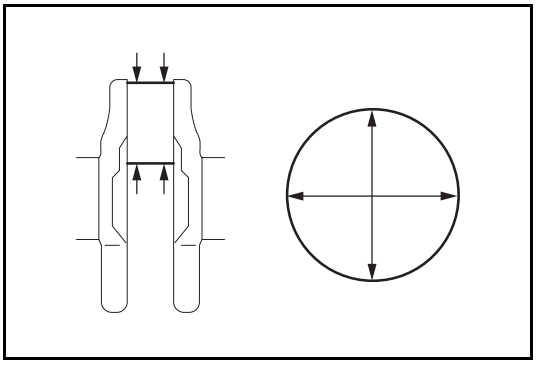
1. Inspect the bending when turning the crankshaft once.
   Bending = runout of the dial gauge/2.

   Limit: 0.04 mm (0.001 in.)



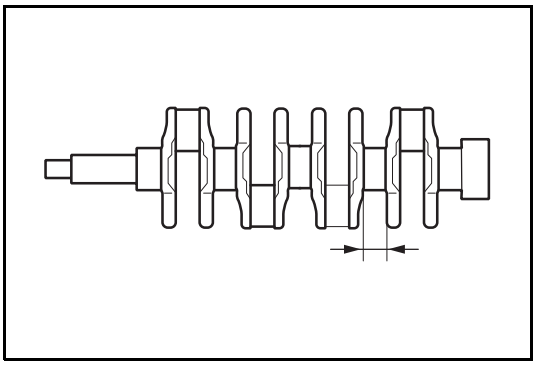
2. Use a micrometer the illustrated places at the crankshaft journal and crank pin.

   Journal outside diameter:
   Standard: 72.940 to 72.960 mm (2.8716 to 2.8724 in.)
   Limit: taper, ellipticity 0.1 mm (0.004 in.)
   Wear: 0.2 mm (0.008 in.)
   Wear limit: 1.2 mm (0.047 in.)



   Crank pin outside diameter:
   Standard: 61.940 to 61.960 mm (2.4386 to 2.4394 in.)
   Limit: taper, ellipticity 0.1 mm (0.004 in.)
   Wear: 0.2 mm (0.008 in.)
   Wear limit: 1.2 mm (0.047 in.)

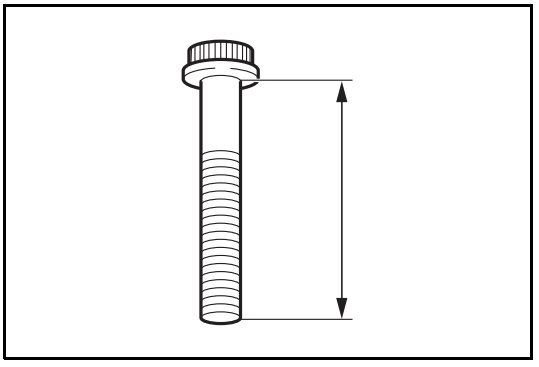
Note:
- **If it exceeds the taper degree, ellipticity or wear, use undersized bearing to correct and re-polish until the oil clearance becomes 0.2 mm or less. (In case of wear, perform this if it exceeds 0.2 mm (0.008 in.) but it is 1.2 mm (0.047 in.) or less.)**
- **If it exceeds the wear limit of 1.2 mm (0.047 in.), replace the crankshaft.**



3. Use a vernier caliper to measure the width of the journal section of the crankshaft No.4, and if it exceeds the application limit, replace the crankshaft.

   Standard: 34.00 to 34.08 mm (1.3386 to 1.3417 in.)

   Limit: 34.48 mm (1.3575 in.)



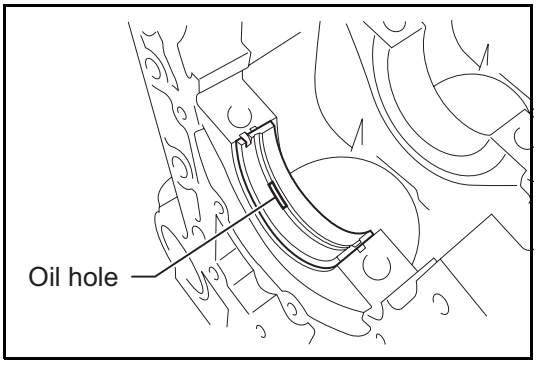
[Point 12]

Inspection:
Measure the length of the head bolt with a vernier caliper.

Standard: 92.8 to 93.8 mm (3.65 to 3.69 in.) (New bolt)

Limit: 95 mm (3.74 in.)

Note:
If it exceeds the limit, replace the bearing cap bolt.

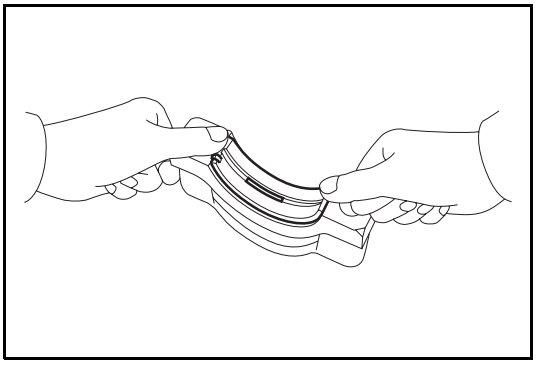


[Point 13]

Inspection:

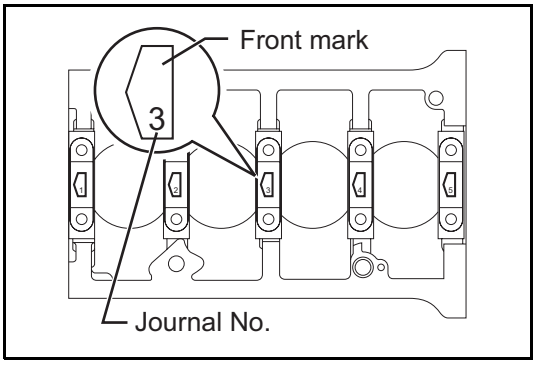
1. Install the upper bearing by matching with the cylinder block oil hole and lock groove.

Note:
Do not smear the bearing outer surface (in contact with the connecting rod oil hole and lock groove.

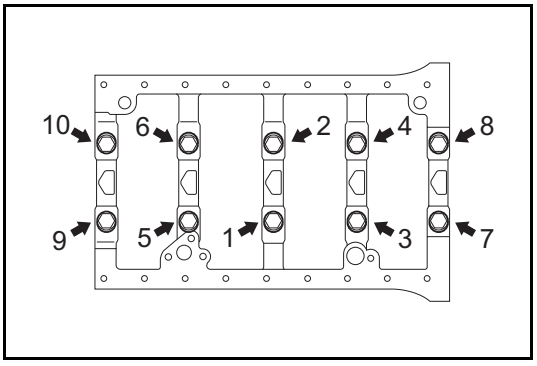


2. Install the lower bearing by matching with the main bearing cap.

Note:
Do not smear the bearing outer surface (in contact with the connecting rod oil hole and lock groove.

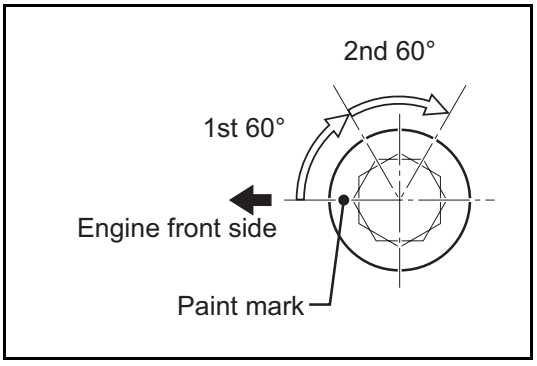


3. The bearing cap is installed in the cylinder block.
4. A small amount of engine oil is spread on volt's.

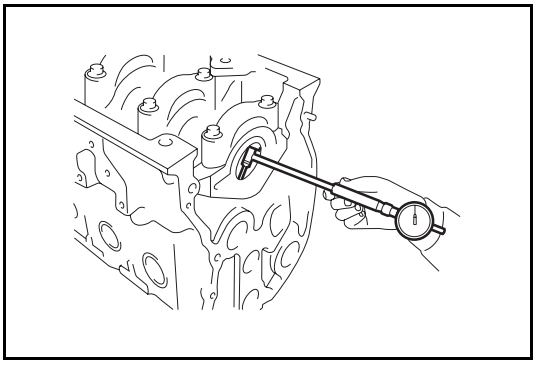


5. The bolt is temporarily tightened, divided into 2 to 3 portions.
6. It tightens with the specified torque.

   Standard: T = 60 N·m (612 kgf·cm) [24.3 ft·lbf]
7. The paint mark is put to the bolt head.



8. It increases from the recorded paint mark by 60° and it tightens.
9. In addition, it increases by 60° and it tightens.



10. Use a cylinder gauge and measure the inside diameter of the crankshaft bearing.
11. Calculate the difference between crankshaft bearing inside diameter and crankshaft journal outside diameter.

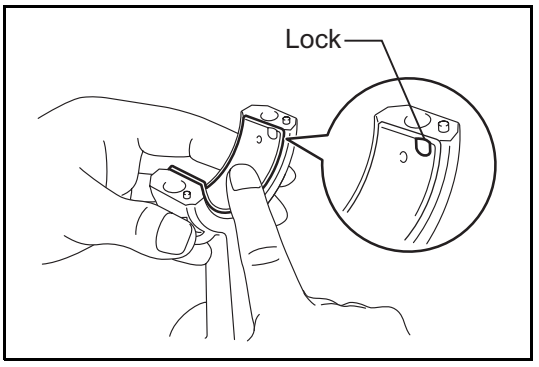
    Standard: 0.051 to 0.102 mm (0.0020 to 0.0040 in.)

    Limit: 0.2 mm (0.008 in.)

Caution:
The crank shaft bearing is not damaged.

Note:
- **If it exceeds the limit, polish the crankshaft and use undersized bearing.**
- **Standard bearing thickness: 2.5 mm (0.098 in.)**
- **Under size bearing value:**

Bearing size	Journal outside diameter mm (in.)
Standard	72.940 to 72.960 (2.8716 to 2.8724)
0.25US	72.690 to 72.710 (2.8724 to 2.8626)
0.50US	72.440 to 72.460 (2.852 to 2.8528)
0.75US	72.190 to 72.210 (2.8421 to 2.8429)
1.00US	71.940 to 71.960 (2.8323 to 2.8331)



[Point 14]

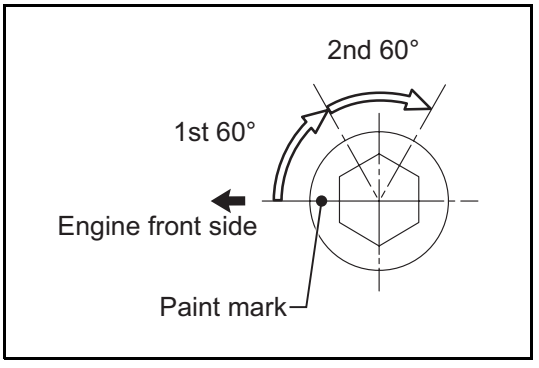
Inspection:

1. Fix the connecting rod to a vise through aluminum caps.
2. Attach the bearings to the connecting rod and bearing cap by aligning to the lock groove.

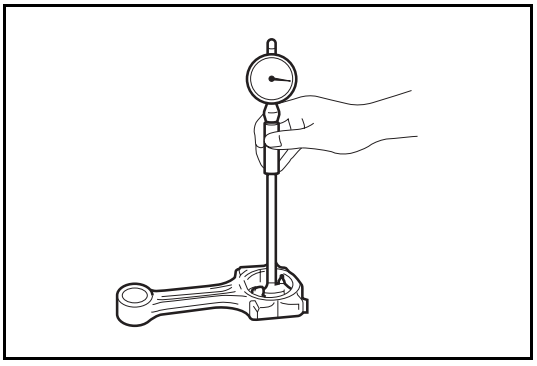
Caution:
Do not apply engine oil to the bearing installation surface and to the back of the bearing.

3. The connecting rod bolt is tightened.
   (1) The mark is confirmed, and the bearing cap is installed.
   (2) The bolt is temporarily tightened, divided into 2 to 3 portions.
   (3) It tightens with the specified torque.

   Standard: T = 30 N·m (306 kgf·cm) [22.1 ft·lbf]



   (4) The paint mark is put to the bolt head.
   (5) It increases from the recorded paint mark by 60° and it tightens.
   (6) In addition, it increases by 60° and it tightens.



4. The inside diameter of the connecting rod bearing is measured with a cylinder gauge.
5. The oil clearance is calculated from the outside diameter of the crank shaft crankpin part and the inside diameter of the connecting rod bearing.

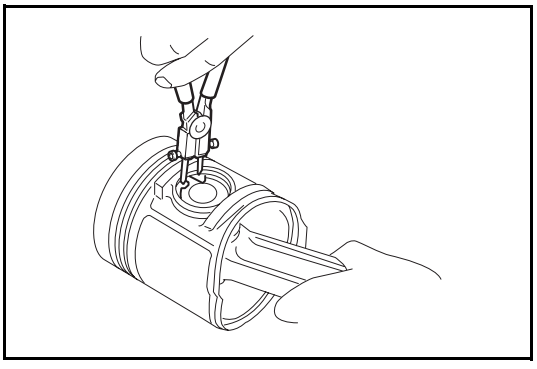
   Standard: 0.031 to 0.082 mm (0.012 to 0.032 in.)

   Limit: 0.2 mm (0.008 in.)

Caution:
The connecting rod bearing is not damaged.

Note:
- **If it exceeds the limit, polish the crankshaft and use undersized bearing.**
- **Standard bearing thickness: 2.5 mm (0.098 in.)**
- **Under size bearing value:**

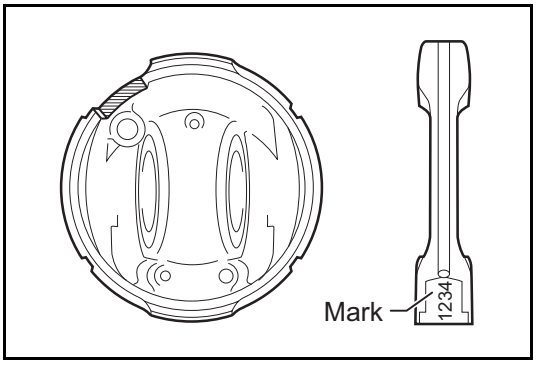
Bearing size	Journal outside diameter mm (in.)
Standard	61.940 to 61.960 (2.4386 to 2.4394)
0.25US	61.690 to 61.710 (2.4394 to 2.4295)
0.50US	61.440 to 61.46 2.4189 to 2.4197)
0.75US	61.190 to 61.210 (2.4091 to 2.4098)
1.00US	60.940 to 60.960 (2.3992 to 2.4000)



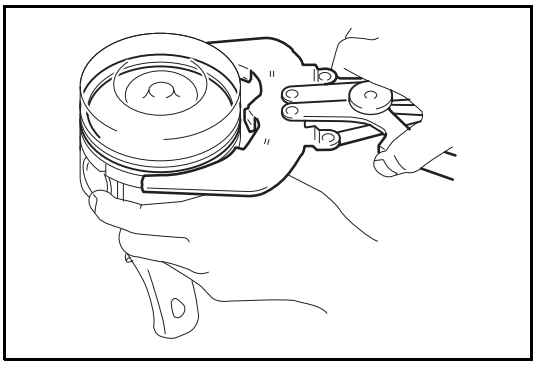
[Point 15]

Reassembly:

1. Install the snap ring to the piston

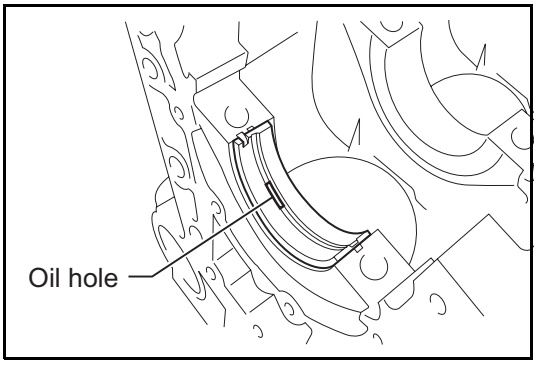


2. Warm the piston to about 50°C (122°F).
3. Adjust the piston and connecting rod until the notch of the piston and the match mark of the connecting rod are aligned and install the piston pin.
4. The snap ring is installed.



5. Use a piston ring tool to install the piston ring in the order of the oil ring, second ring and top ring.

Caution:
- **Install the top ring and second ring in a way that the punch marks come to the top.**
- **For the oil ring, connect the coil joint of the coil expander and insert inside the ring. In addition, the coil expander joint and abutment joint of the ring should be misaligned by 180° when installed.**

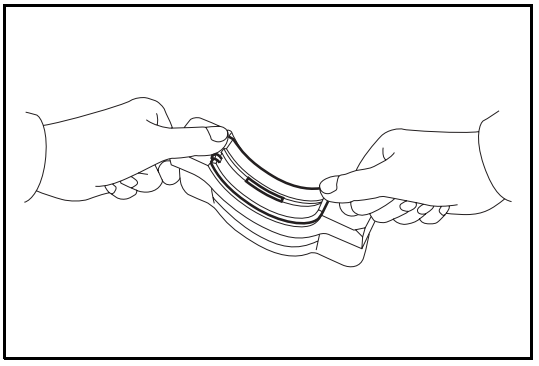


[Point 16]

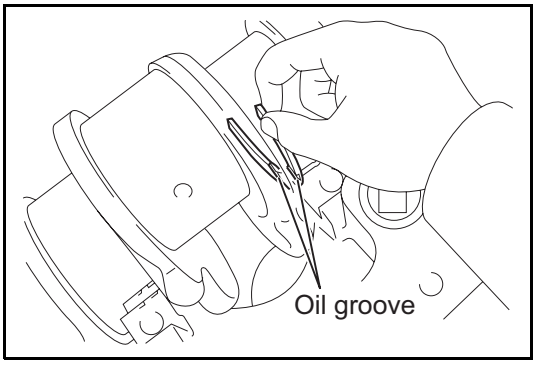
Reassembly:

1. Install the upper bearing by matching with the cylinder block oil hole and lock groove.

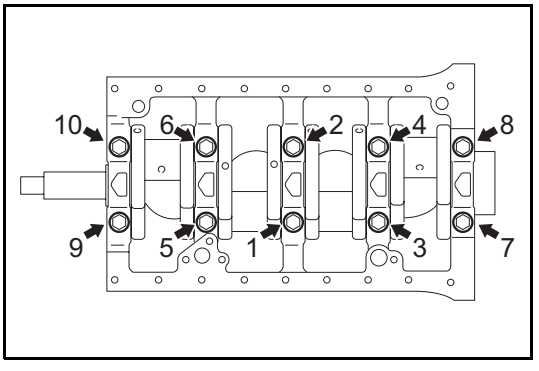
Caution:
Do not smear the bearing outer surface (in contact with the cylinder block oil hole and lock groove.



2. Install the lower bearing by matching with the main bearing cap.
3. Install the crankshaft.



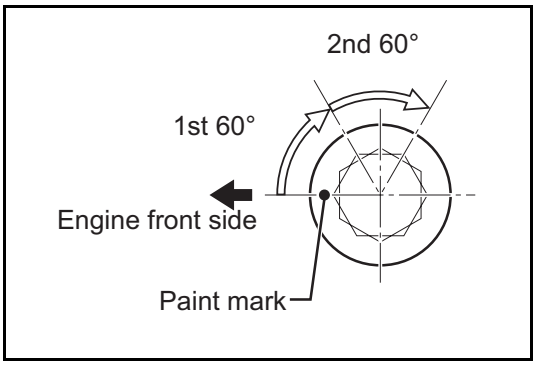
4. Facing the oil groove outside, slip in the thrust bearing between the cylinder block and crankshaft.
5. The main bearing cap is installed in the cylinder block.
6. A small amount of engine oil is spread on volt's.



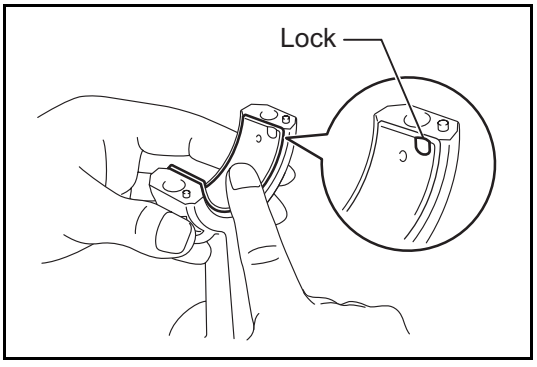
7. The bolt is temporarily tightened in the order of illustration, divided into 2 to 3 portions.
8. It tightens with the specified torque.

   Standard: T = 60 N·m (612 kgf·cm) [44.2 ft·lbf]

9. Paint the mark on the front side of the bolt head section.



10. It increases from the recorded paint mark by 60° and it tightens.
11. In addition, it increases by 60° and it tightens.

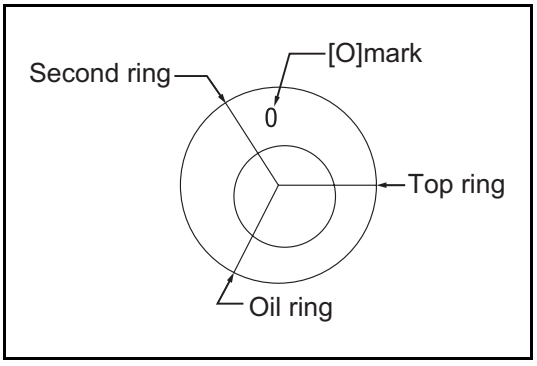


[Point 17]

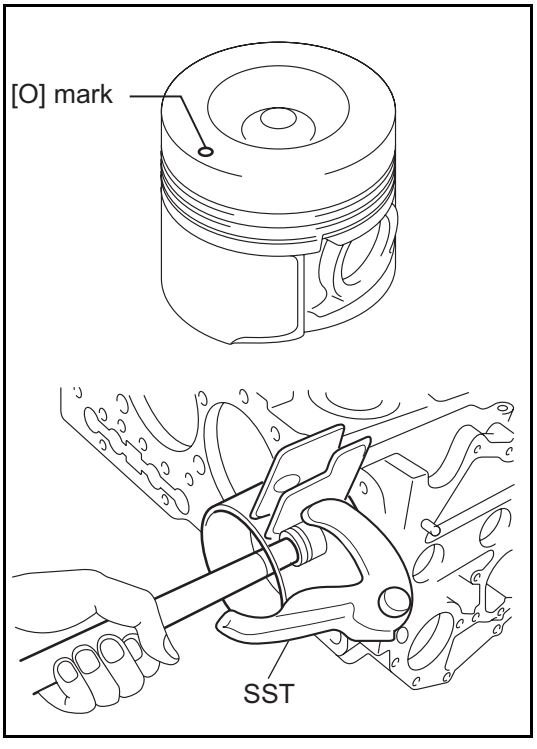
Reassembly:

1. Install the upper bearing by matching with the connecting rod oil hole and lock groove.

Caution:
Do not smear the bearing outer surface (in contact with the connecting rod oil hole and lock groove.



2. Check the position of the abutment joint for the piston ring.



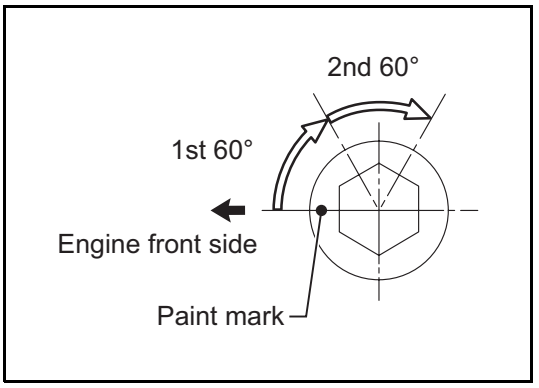
3. Set the "O" mark to the exhaust side, and use a SST to install the piston with connecting rod.

   SST 09110-33910-71

4. The connecting rod bolt is tightened.
   (1) The front mark is confirmed, and the bearing cap is installed.
   (2) The bolt is temporarily tightened, divided into 2 to 3 portions.
   (3) It tightens with the specified torque.

   Standard: T = 30 N·m (306 kgf·cm) [22.1 ft·lbf]

   (4) The paint mark is put to the bolt head.



(5) It increases from the recorded paint mark by 60° and it tightens.

(6) In addition, it increases by 60° and it tightens.

ENGINE TURN-UP

COOLANT INSPECTION

The coolant leveling he radiator reserve tank shall be between the FULL and LOW lines.

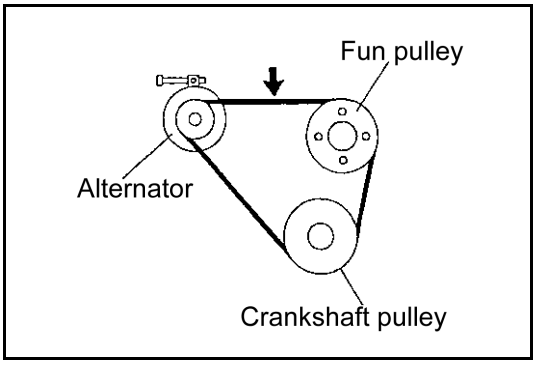
Note:
When the volume of water is few, it replenishes it with the FULL position of radiator reserve tank.

ENGINE OIL INSPECTION

The oil level shall be between F and L on the dipstick. The oil shall not be heavily contaminated, and the viscosity shall be proper. Neither coolant nor light oil shall exist in the engine oil.
Full level 7.1 ℓ (1.88 us gal.)
Oil pan 5.9 ℓ (1.56 us gal.)

BATTERY ELECTROLYTE INSPECTION

Standard:
The specific gravity shall be 1.25 to 1.29 (at 20°C [68°F])



V BELT INSPECTION AND ADJUSTMENT

Fan & alternator V belt tension and bend amount check.

Standard:
Bend amount [98 N (10 kgf)]

New mm (in.)	Check mm (in.)
10.5 to 12.5 (0.413 to 0.492)	12.5 to 16 (0.492 to 0.630)

Tension

New N (kgf)	Check N (kgf)
370 to 490 (38 to 50)	245 to 315 (25 to 32)

Caution:
- **The amount of the bend of the belt is measured at the specified position.**
- **When exchanging it for a new belt, it is adjusted to a central value of the reference value of "New installation".**
- **The check of the belt used for 5 minutes or more is confirmed by the reference value of "Check".**
- **Re-assembly of the belt used for 5 minutes or more is adjusted to a central value of the reference value of "Check".**

IDLE SPEED INSPECTION

1. Check by SST:
   (a) Connect the SST to the fault diagnosis connector.
   (b) Connect a personal computer with installed CD-ROM to the interface box.
   (c) Turn the starter key to "ON".
   (d) Start the personal computer and then start SST.
2. It operates according to the screen instruction, "Engine speed" screen is made to be displayed, and the idol rotational speed is measured.

   Standard:
   800 to 850 r/min (N Range)

Caution:
When interface box is used, the power becomes ON at the time of connection to the machine, and the POWER lamp (red) on the interface box body lights.

NO-LOAD MAXIMUM GOVERNED SPEED INSPECTION

The engine is started, and the engine speed when the accelerator opens completely is measured.

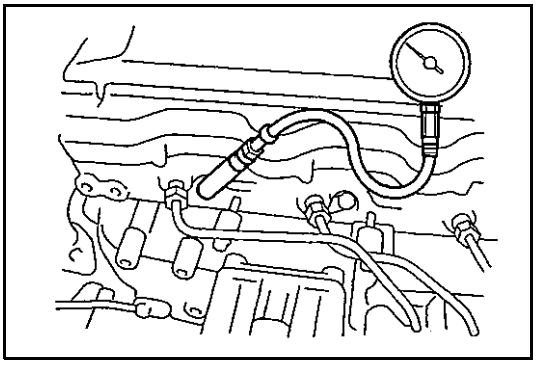
Standard:
2290 to 2390 r/min

COMPRESSION PRESSURE INSPECTION

1. Glow plug ASSY is removed.
2. The connector is disconnected from each injector ASSY.
3. The battery terminal is connected.

Caution:
Because wiring is not short-circuited, the vinyl tape is wrapped around power supply system wiring.

4. It turns the starter, and the foreign body in the cylinder is exhausted.
5. The attachment is installed in the glow plug hall.



6. The compression gauge is installed in the attachment.
7. It turns the starter, and compression is measured.

   Standard:
   3.2 MPa (33 kgf/cm^2) [469 psi] or more (280 r/min)
   Limit:
   2.7 MPa (28 kgf/cm^2) [398 psi] or more (280 r/min)
   Cylinder difference 0.29 MPa (3.0 kgf/cm^2) [43 psi]

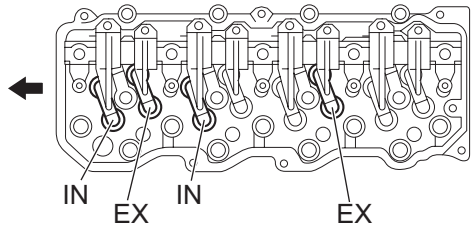
Caution:
The battery completely charged with is used so that 280 r/min or more may keep the engine rotational speed.

8. The battery negative terminal is disconnected.
9. Connector ASSY of the injector is connected.
10. Glow plug ASSY is installed.

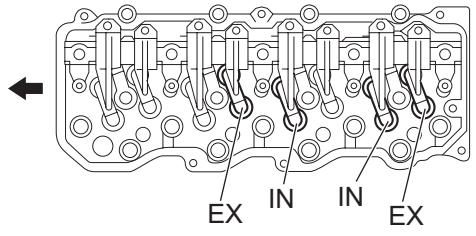
DIESEL SMOKE DENSITY INSPECTION

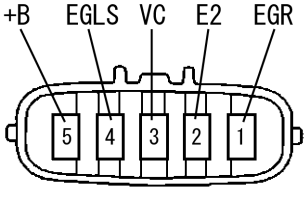
Standard:
10% or less

No.1 TDC:



No.4 TDC:





VALVE CLEARANCE INSPECTION

1. Measure the valve clearance at the position shown in the illustration.

   Standard:
   IN: 0.3 mm (0.01 in.) (Cold engine)
   EX: 0.45 mm (0.018 in.) (Cold engine)

Caution:
- **Inspection of the valve clearance should be performed when cool.**
- **If it is standard, measure the clearance and record it.**

2. Turn the crankshaft clockwise once (360°).
3. Measure the valve clearance at the position shown in the illustration.

   Standard:
   IN: 0.3 mm (0.01 in.) (Cold engine)
   EX: 0.45 mm (0.018 in.) (Cold engine)

Caution:
- **Inspection of the valve clearance should be performed when cool.**
- **If it is standard, measure the clearance and record it.**

EGR VALVE ASSY INSPECTION

Measure the resistance between terminals of EGR valve ASSY with electrical tester.

Standard:

Terminal No. (Symbols)	Resistance
5 (+B) ⇔ 1 (EGR)	6.3 to 7.3 Ω
3 (VC) ⇔ 2 (E2)	2.45 to 4.45 Ω
4 (EGLS) ⇔ 2 (E2)	2.45 to 4.45 Ω

FUEL SYSTEM

FUEL SYSTEM

PRECAUTION

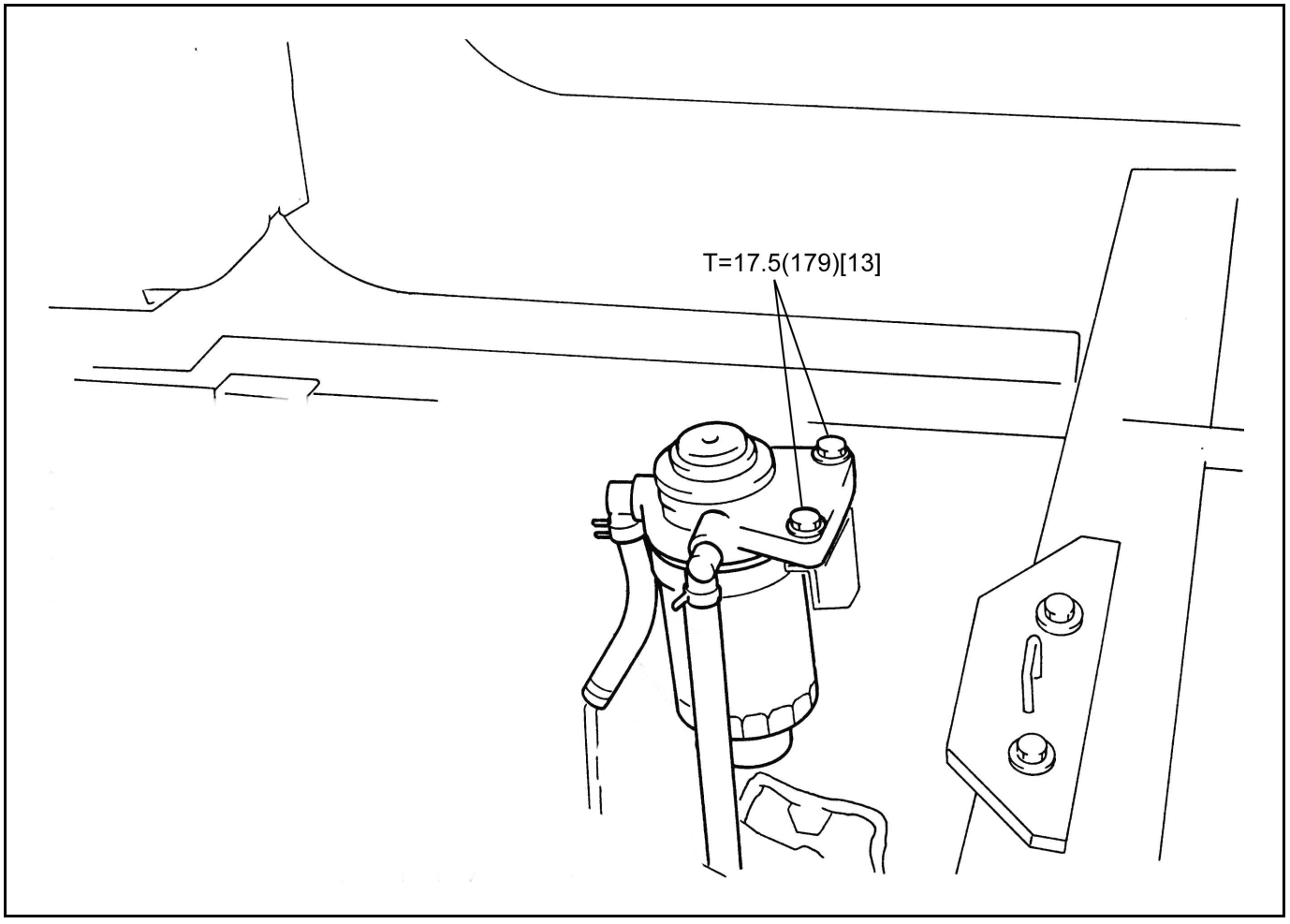
Caution:

- **Before working on the fuel system, remove the negative terminal from the battery.**
- **Never work on the fuel system near open flames. Never smoke during work.**
- **Keep rubber and leather products away from diesel oil.**
- **When the parts of the fuel system are removed, prevent dusts or foreign matters from entering to the system.**
- **Do not change the combinations of the assembled parts such as swapping the injection pipes or injector cylinders.**
- **After performing a repair of the fuel system, make sure that there is no fuel leak.**

FUEL FILTER

REMOVAL, INSPECTION AND INSTALLATION

T = N·m (kgf·cm) [ft·lbf]



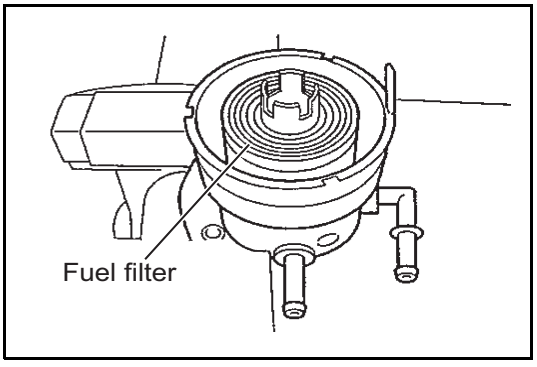
Removal, inspection and installation procedure

No.	Item	Removal	Inspection	Installation
1	Fuel filter ASSY	**[Point 1]**	**[Point 2]**	**[Point 3]**

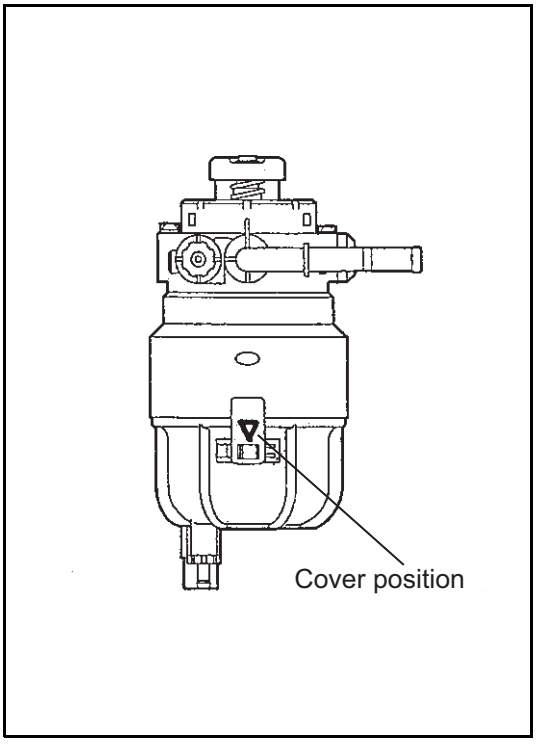
Point Operation

[Point 1]

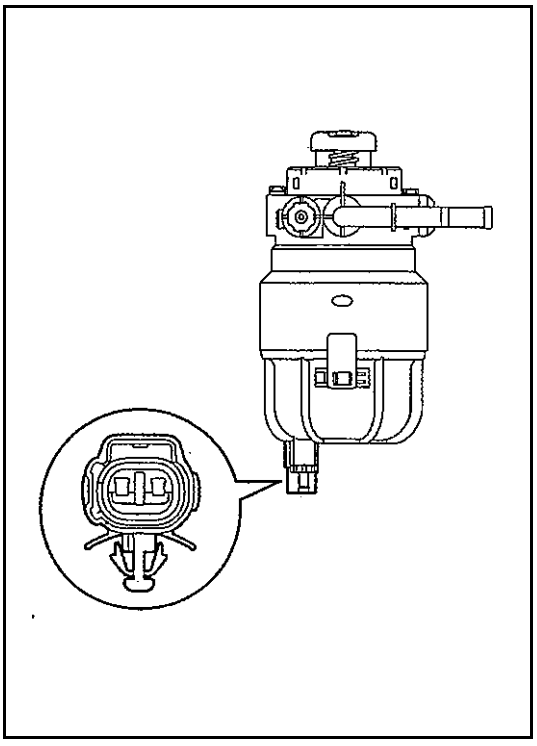
1. Removing the fuel filter ASSY
   (1) Disconnect 2 fuel hoses.
   (2) Disconnect the level warning switch connector.
   (3) Remove 2 bolts, and remove the fuel filter ASSY.
2. Removing the fuel filter element
   (1) Fix the fuel filter ASSY to a vise.
   (2) Turn the fuel filter cover and remove it.
   (3) Remove the fuel filter element.



3. Installing the fuel filter element
   (1) Set the fuel filter element to the fuel filter cover.



   (2) Turn the fuel filter cover to the position shown in the illustration to install.



[Point 2]

Inspection of the level warning switch continuity:
Use an electrical tester to inspect for continuity between the terminals.

Standard:
Top end position of the float → Continuity exists
Bottom end position of the float → No continuity

[Point 3]

1. Installing the fuel filter ASSY

   (1) Install the fuel filter ASSY with 2 bolts.

   Standard:
   T = 17.5 N·m (179 kgf·cm) [13 ft·lbf]

   (2) Connect the level warning switch connector.

   (3) Connect 2 fuel hoses.

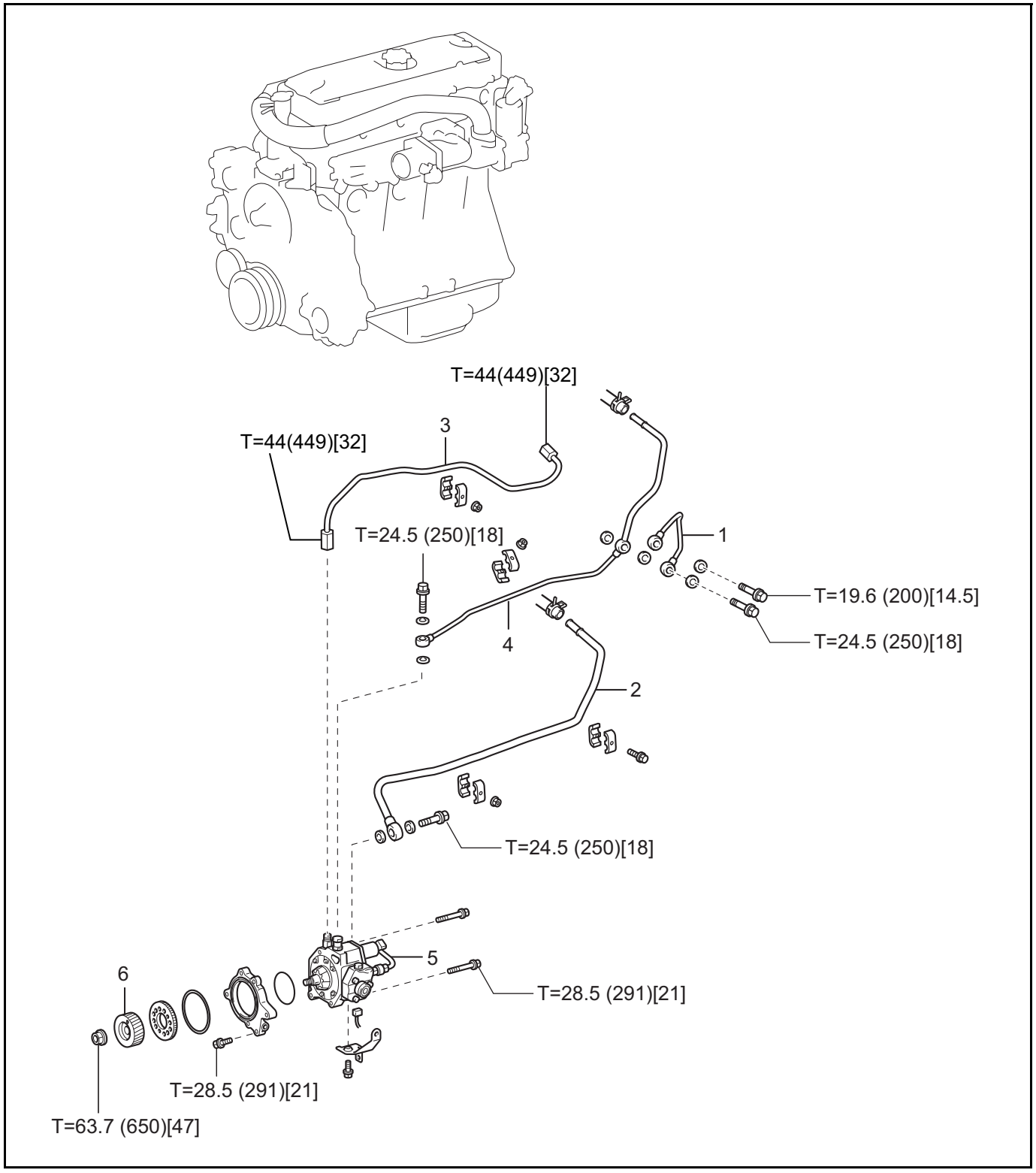
2. Air bleeding of the fuel system
   Operate the priming pump of the fuel filter ASSY and fill the fuel into the fuel system.

3. Inspection of fuel leak.

INJECTION (SUPPLY) PUMP

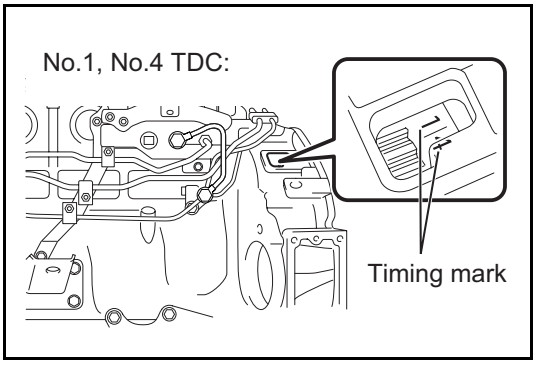
REMOVAL, INSPECTION AND INSTALLATION

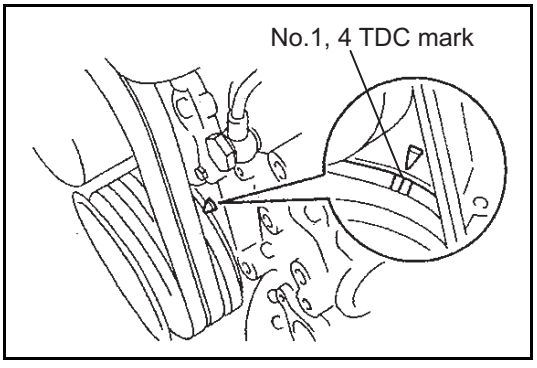
T = N·m (kgf·cm) [ft·lbf]



Removal, inspection and installation procedure

No.	Item	Removal	Inspection	Installation
1	Fuel pipe No.4	**[Point 1]**		**[Point 12]**
2	Fuel pipe	**[Point 2]**		**[Point 11]**
3	Fuel filter to injection pump fuel pipe	**[Point 3]**		**[Point 10]**
4	Fuel return pipe sub-ASSY	**[Point 4]**		**[Point 9]**
5	Injection (supply) pump	**[Point 5]**	**[Point 13]**	**[Point 8]**
6	Injection pump drive gear	**[Point 6]**		**[Point 7]**





Point Operation

1. Setting No.1 compression TDC

   (1) When setting the compression TDC with the flywheel, align the timing mark at the position shown in the illustration and set the No.1 cylinder to the TDC.

Note:
The position where the timing marks of the flywheel and flywheel housing are aligned will be TDC.

   (2) When setting the compression TDC with the crank pulley, align the timing mark at the position shown in the illustration and set the No.1 cylinder to the TDC.

2. Removing the air hose No.1

   (1) Remove 2 bolts.

   (2) Loosen the hose clamp and remove the air hose No.1.

3. Disconnecting the fuel hose

4. Disconnecting the fuel return hose

[Point 1]
Removing the fuel pipe No.4

   (1) Remove 2 union bolts and remove the fuel pipe No.4.

[Point 2]
Removing the fuel pipe

   (1) Remove the nut and remove the fuel pipe clamp.

   (2) Remove the union bolt and remove the fuel pipe.

[Point 3]
Removing the fuel filter to injection pump fuel pipe

   (1) Use a 19 mm (0.75 in.) union nut wrench to remove the fuel filter to injection pump fuel pipe.

[Point 4]

1. Removing the fuel return pipe sub-ASSY

   (1) Remove 2 union bolts and remove the fuel return pipe SUB/ASSY.

2. Removing the dust cover

   (1) Remove the bolt and remove the dust cover.

[Point 5]
Removing the injection (supply) pump ASSY

(1) Remove 6 bolts and remove the injection (supply) pump ASSY.

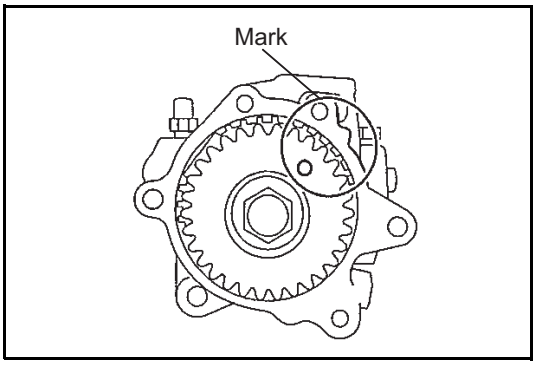
[Point 6]
Removing the injection pump drive gear

(1) Remove the nut and remove the injection pump drive gear and timer cover.

[Point 7]
Installing the injection pump drive gear

(1) Install the injection pump drive gear together with the timer cover with the nut.

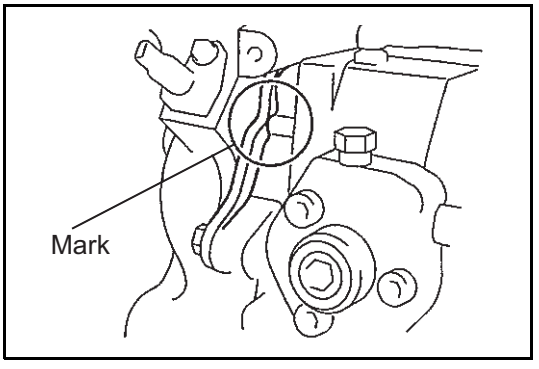
Standard:
T = 63.7 N·m (650 kgf·cm) [47 ft·lbf]



[Point 8]

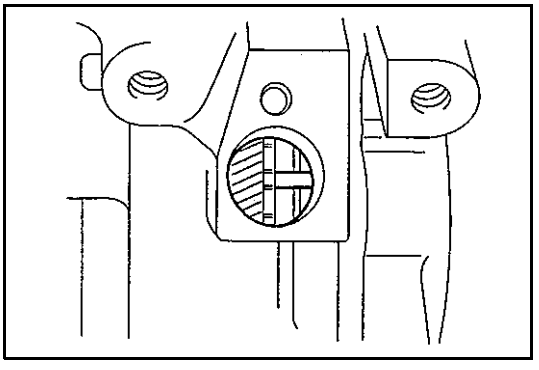
1. Installing the injection (supply) pump ASSY

(1) Align the hole in 6 mm (0.24 in.) diameter at the injection pump drive gear side and the match mark at the timer cover side.



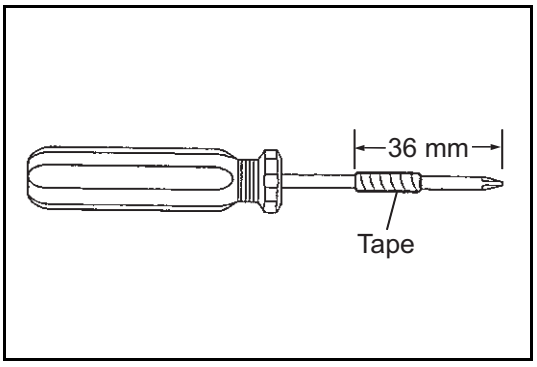
2. While aligning the match mark at the timer cover side and the match mark at the front end plate side, install the injection (supply) pump ASSY using 6 bolts through O-rings.

Standard:
T = 28.5 N·m (291 kgf·cm) [21 ft·lbf]

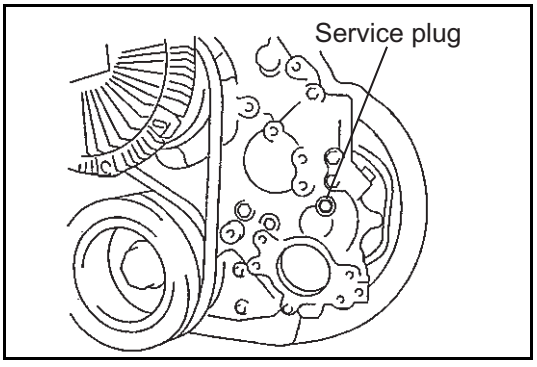


3. Confirm that the knock pin of the injection pump drive gear can be seen at the center from the installation hole of the dust cover for the timing gear case.

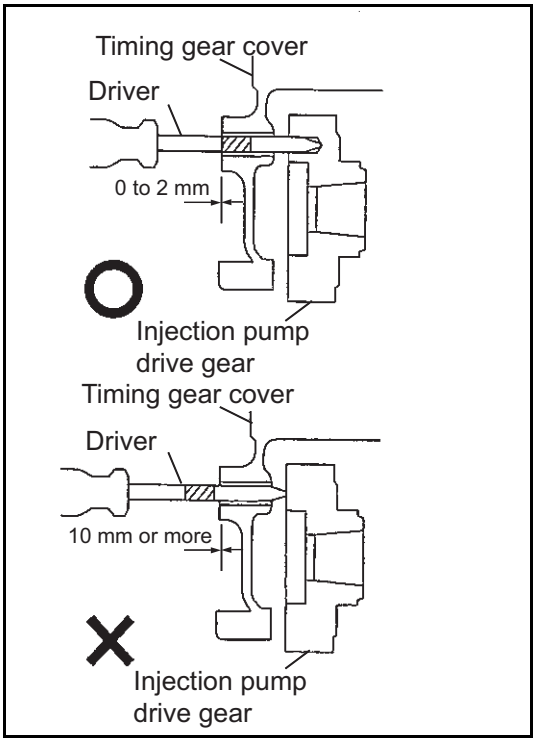
Caution:
Look directly against the installation surface of the crank position sensor No.2.



4. If you cannot see the installation hole of the crank position sensor No.2 directly, use the screwdriver with less than 6 mm (0.24 in.) in diameter, and wrap the vinyl tape around at the position 36 mm (1.4 in.) from the tip of the screwdriver for marking.



5. Remove the service plug at the front face of the timing gear case.



6. Insert the screwdriver with the marking to the timing gear case, and check that the mark and the edge of the timing gear case are aligned.

Caution:
After reassembling the injection (supply) pump ASSY, make sure to check the timing position of the injection pump timing gear.

7. Installing the dust cover
   (1) Install the dust cover with the bolt.
   (2) Connect the connector.

[Point 9]
Installing the fuel return pipe SUB/ASSY

(1) Through the new gasket, install the fuel return pipe sub-ASSY with 2 union bolts.

Standard:
T = 24.5 N·m (250 kgf·cm) [21 ft·lbf]

[Point 10]
Installing the fuel filter to injection pump fuel pipe

(1) Use a union nut wrench (19 mm [0.75 in.]) to install the fuel filter to injection pump fuel pipe.

Standard:
T = 44 N·m (449 kgf·cm) [32 ft·lbf]

[Point 11]
Installing the fuel pipe

(1) Through the new gasket, install the fuel pipe with the union bolt.

Standard:
T = 24.5 N·m (250 kgf·cm) [18 ft·lbf]

[Point 12]
Installing the fuel pipe No.4

1. Through the new gasket, install the fuel pipe No.4 with 2 union bolts.

   Standard:
   T = 19.6 N·m (200 kgf·cm) [14.5 ft·lbf] (M10)
   T = 24.5 N·m (250 kgf·cm) [18 ft·lbf] (M12)

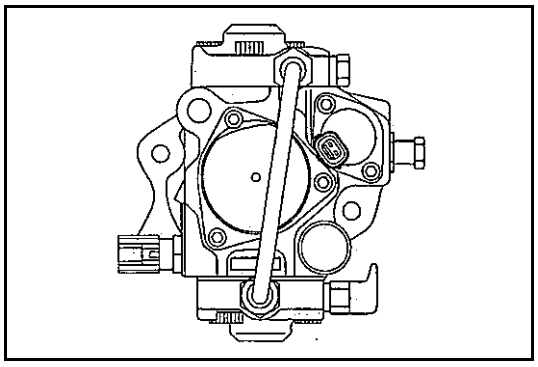
2. Installing the air hose

   (1) Tighten the hose clamp.

3. Updating the supply pump learned value

   (1) When replacing the supply pump, update the learned value stored in the engine ECU by reprogramming.

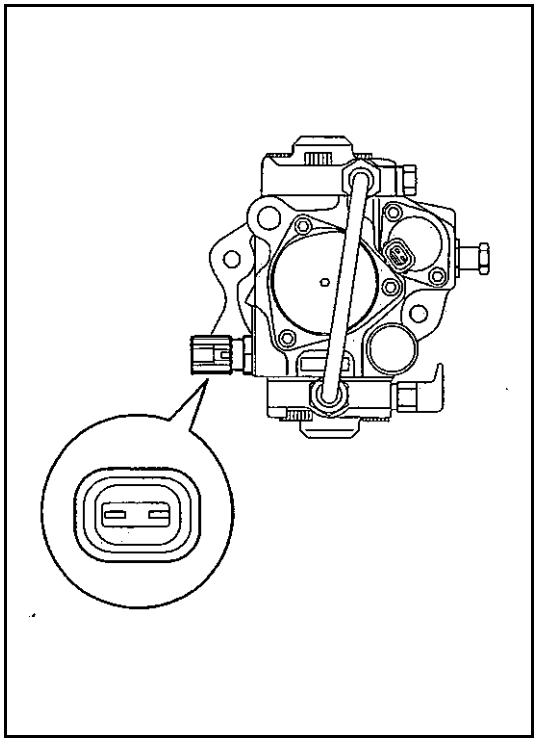
Caution:
Unless the learned value is updated, correct pressure control of the common rail cannot be performed and thus it may cause engine stall and abnormally high pressure of the common rail. Thus, make sure to update the learned value when replacing the supply pump.



[Point 13]
Injection (supply) pump ASSY

(1) Inspection of the suction control valve resistance:
Use an electrical tester to measure the resistance between the terminals.

Standard:
1.6 to 2.6 Ω (20°C [68°F])



(2) Inspection of the fuel temperature sensor resistance:
Use an electrical tester to measure the resistance between the terminals.

Standard:

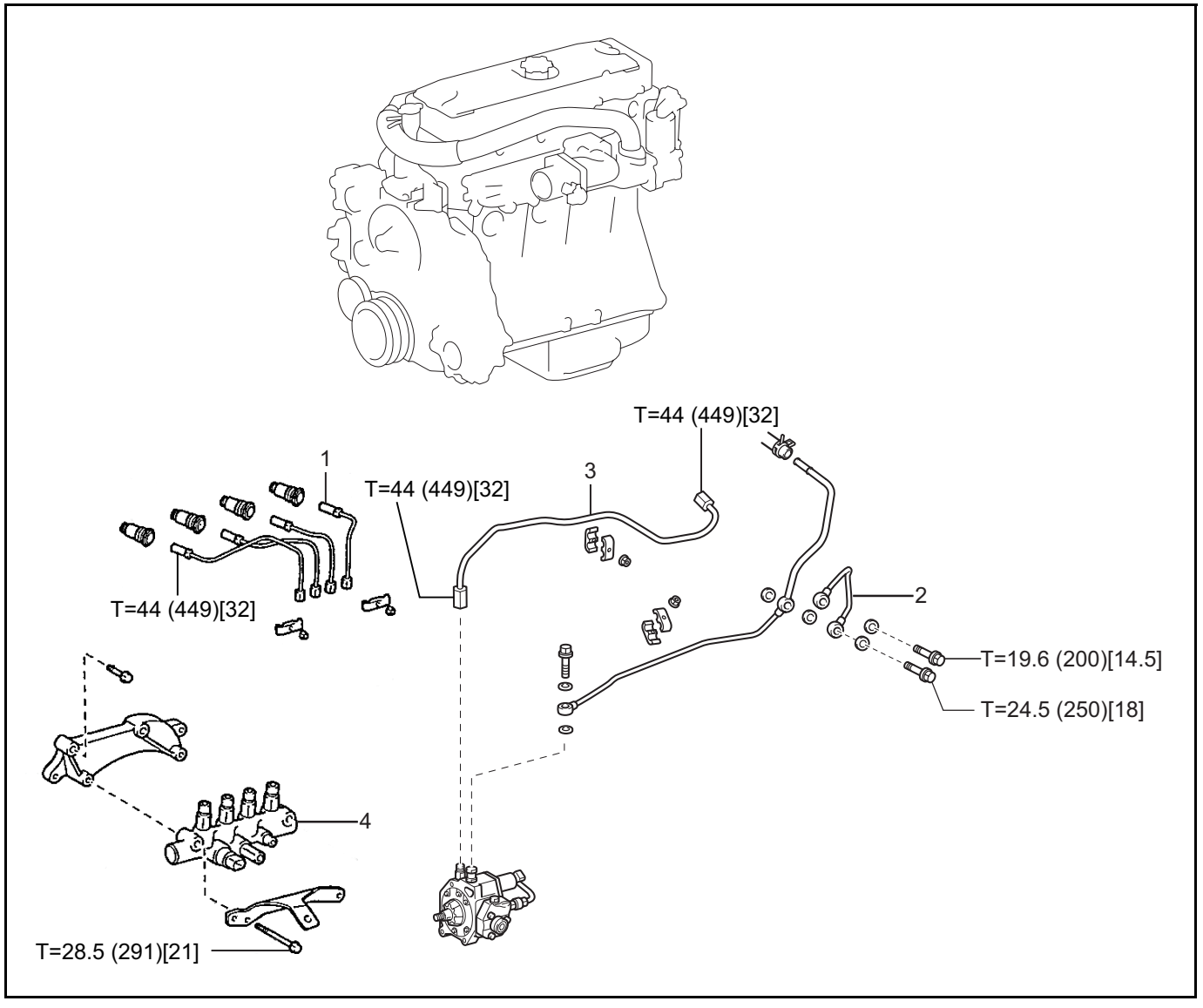
Water temperature	Resistance
When approx. 20°C (68°F)	2.21 to 2.69 kΩ
When approx. 80°C (176°F)	0.287 to 0.349 kΩ

Caution:
When inspecting by soaking the sensor into the water, make sure that water will not enter the terminal section. Wipe off water on the sensor after the inspection.

COMMON RAIL

REMOVAL, INSPECTION AND INSTALLATION

T = N·m (kgf·cm) [ft·lbf]

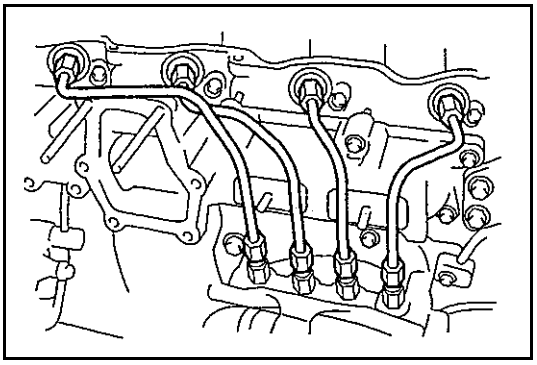


Removal, inspection and installation procedure

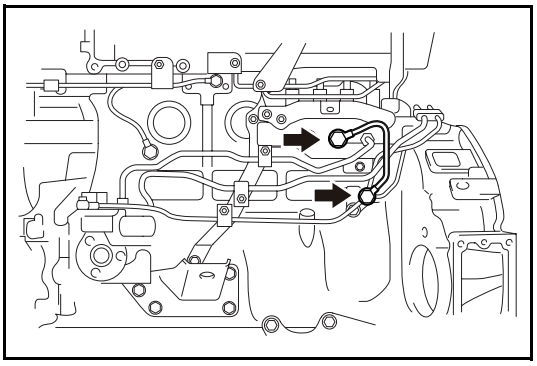
No.	Item	Removal	Inspection	Installation
1	Fuel injection pipe	**[Point 1]**		**[Point 8]**
2	Fuel pipe No.4	**[Point 2]**		**[Point 7]**
3	Fuel filter to injection pump fuel pipe	**[Point 3]**		**[Point 6]**
4	Common rail ASSY	**[Point 4]**	**[Point 9]**	**[Point 5]**

Point operation

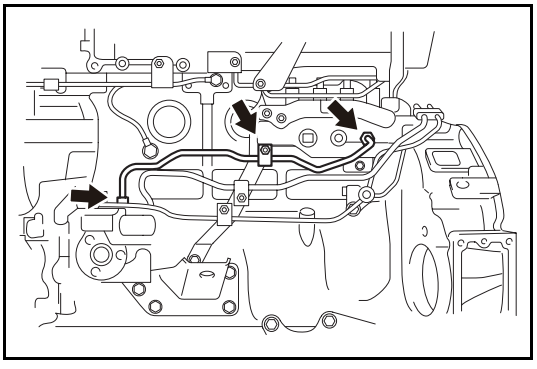
1. Removing the air hose No.1
   (1) Remove 2 bolts.
   (2) Loosen the hose clamp and remove the air hose No.1.



[Point 1]
Removing the fuel injection pipe
   (1) Remove 2 nuts and remove the injection pipe clamp.
   (2) Remove the fuel injection pipe No.1 to No.4.



[Point 2]
Removing the fuel pipe No.4
Use a union nut wrench (19 mm [0.75 in.]) to remove the fuel pipe No.4.



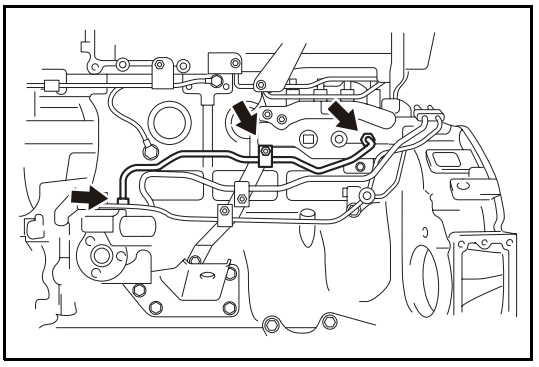
[Point 3]
Removing the fuel filter to injection pump fuel pipe
   (1) Remove the nut and remove the fuel pipe clamp.
   (2) Use a union nut wrench (19 mm [0.75 in.]) to remove the fuel filter to injection pump fuel pipe.

[Point 4]
Removing the common rail ASSY
   (1) Disconnect the connector.
   (2) Remove 2 bolts and remove the common rail ASSY.

[Point 5]
Installing the common rail ASSY
   (1) Through the brackets, install the common rail ASSY with 2 bolts.

   Standard:
   T = 28.5 N·m (291 kgf·cm) [21 ft·lbf]

   (2) Connect the connector.

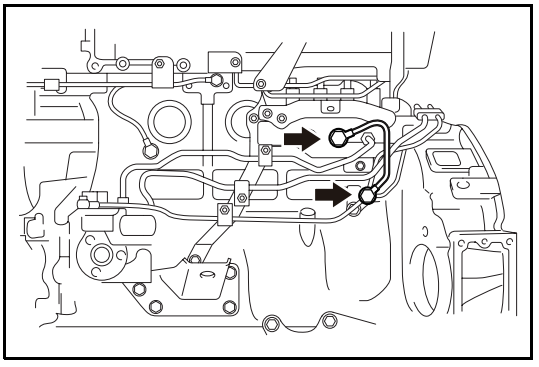


[Point 6]
Installing the fuel filter to injection pump fuel pipe

(1) Use a union nut wrench (19 mm [0.75 in.]) to install the fuel filter to injection pump fuel pipe.

Standard:
T = 44 N·m (449 kgf·cm) [32 ft·lbf]

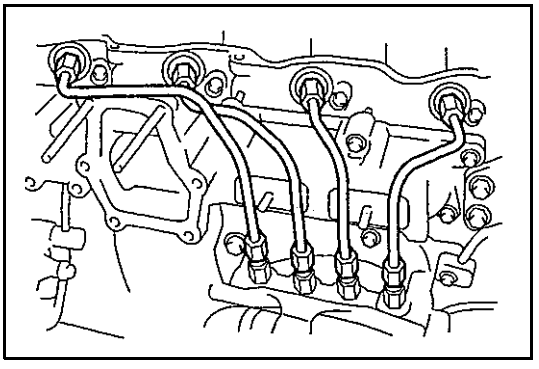
(2) Tighten the fuel pipe clamp until the metal parts on both ends of the clamp are attached firmly.



[Point 7]
Installing the fuel pipe No.4

(1) Use a union nut wrench (19 mm [0.75 in.]) to install the fuel pipe No.4.

Standard:
T = 19.6 N·m (200 kgf·cm) [14.5 ft·lbf] (M10)
T = 24.5 N·m (250 kgf·cm) [18 ft·lbf] (M12)



[Point 8]
1. Installing the fuel injection pipe

   (1) Install the fuel injection pipes No.1 to No.4.

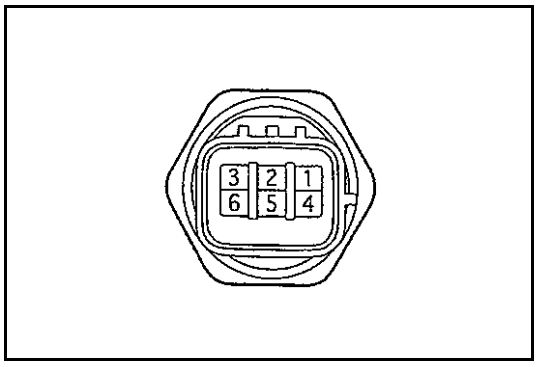
   Standard:
   T = 44 N·m (449 kgf·cm) [32 ft·lbf]

   (2) Install the injection pipe clamp with 2 nuts.

2. Installing the air hose No.1
3. Air bleeding of the fuel system

   (1) Operate the priming pump of the fuel filter ASSY and fill the fuel in the fuel system.

4. Inspection of fuel leak



[Point 9]

Inspection of the fuel pressure sensor resistance:
Use an electrical tester to measure the resistance between each terminal.

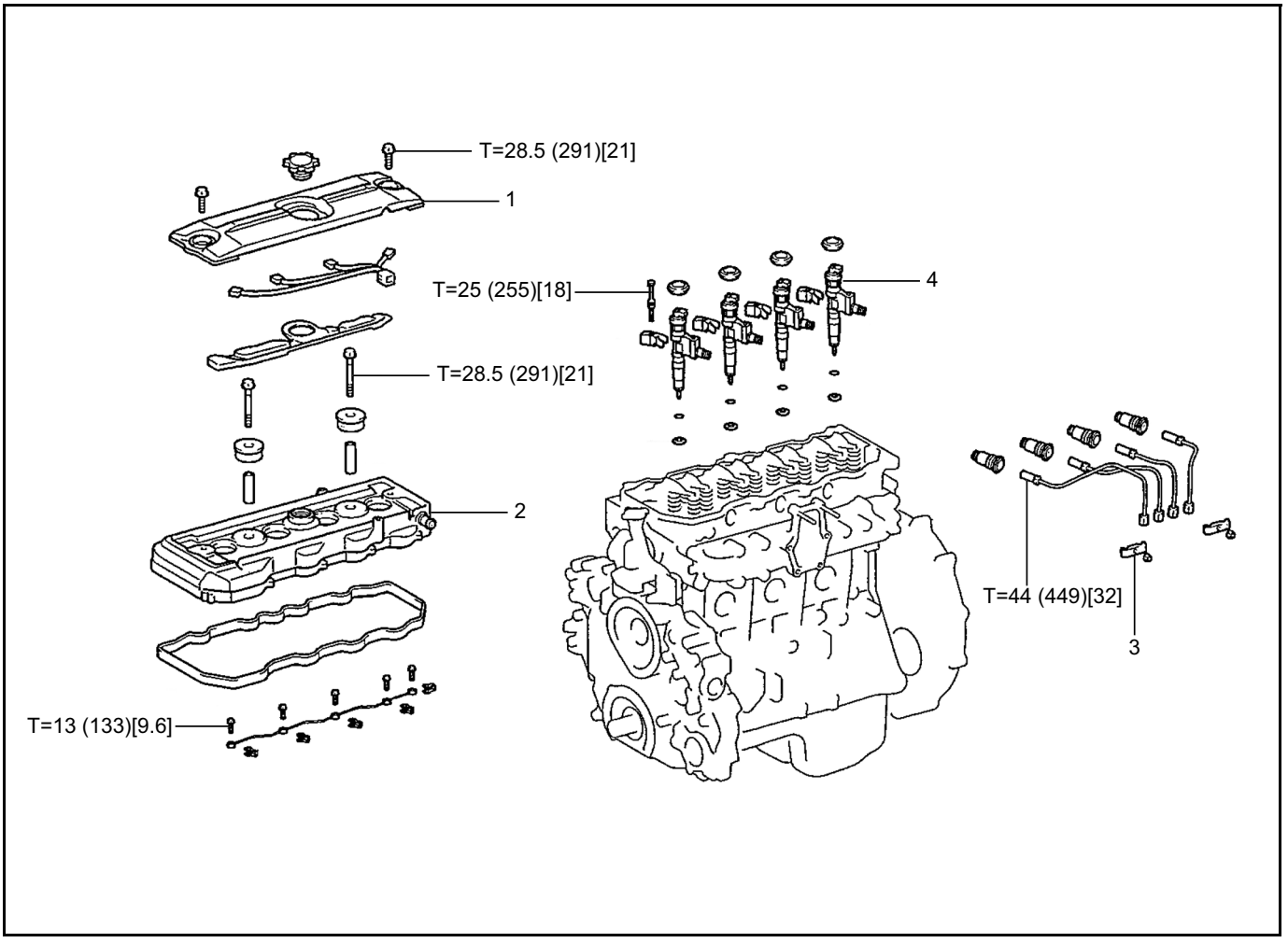
Standard:

Between terminals	Resistance	Temperature
2 (PR2) ⇔ 3 (E2S)	16.4 kΩ or less	20°C (68°F)
1 (VCS) ⇔ 2 (PR2)	3 kΩ or less	20°C (68°F)

FUEL INJECTOR

REMOVAL, INSPECTION AND INSTALLATION

T = N·m (kgf·cm) [ft·lbf]



Removal, inspection and installation procedure

No.	Item	Removal	Inspection	Installation
1	Cylinder head cover No.2	**[Point 1]**		**[Point 9]**
2	Cylinder head cover	**[Point 2]**		**[Point 8]**
3	Fuel pipe clamp	**[Point 3]**		**[Point 7]**
4	Fuel injector	**[Point 4]**	**[Point 5]**	**[Point 6]**

Point Operation

1. ID code check
   "ID code check" checks whether the injector ASSY installed to each cylinder is identical to the ID code that is registered to the engine ECU.

Note:
If they are not identical, correct the registration and check the phenomenon again according to the following procedure.

   (1) Correct the registration contents of ID code in "ID code registration (manual input)".

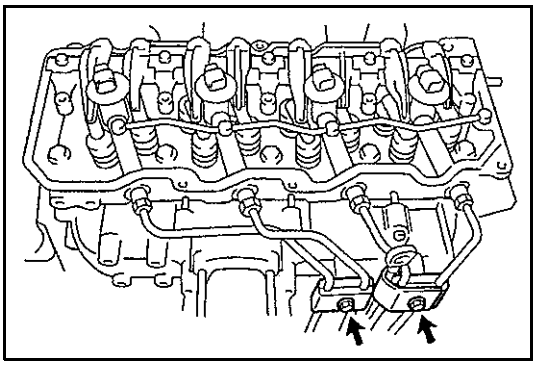
   (2) After correcting the registration contents of ID code, check the existence of the phenomenon at the time of storing.
   If there is no phenomenon at the time of storing, there is a possibility of a phenomenon due to incorrect registration of ID code.

2. Removing the air hose No.1
   (1) Remove 2 bolts.
   (2) Loosen the hose clamp and remove the air hose No.1.
3. Removing the oil filler cap

[Point 1]
Removing the cylinder head cover No.2
Remove 2 bolts and remove the cylinder head cover No.2.

[Point 2]

1. Remove the cylinder head cover
   (1) Disconnect the injector connector.
   (2) Remove 2 bolts and remove the cylinder head cover.
2. Removing the breather pipe
3. Removing the bracket
   Remove 4 bolts and remove the bracket.

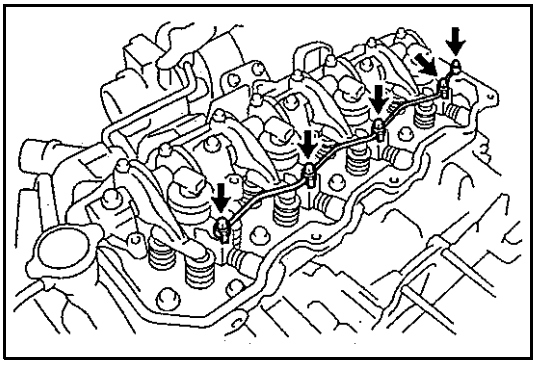


[Point 3]
Removing the fuel pipe clamp

(1) Remove 2 nuts and remove the fuel pipe clamp.

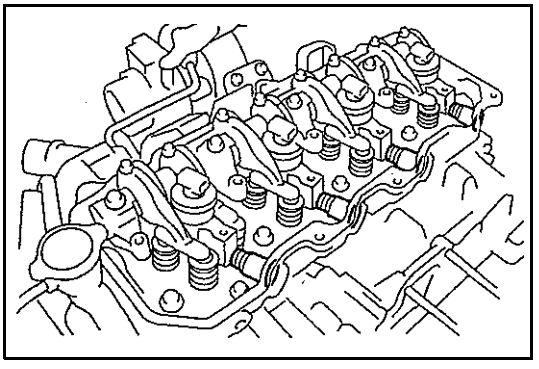
[Point 4]
Removing the fuel injector ASSY

(1) Use a union nut wrench (19 mm [0.75 in.]) and disconnect the injection pipes No.1, No.2, No.3 and No.4.

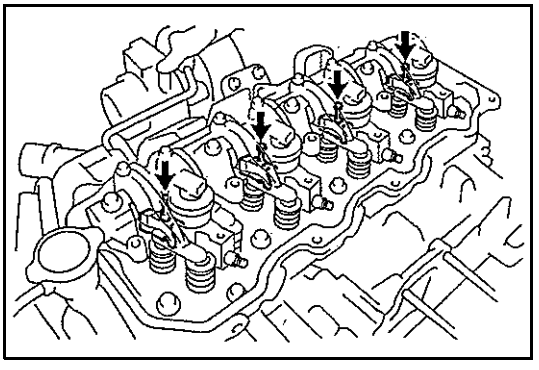


(2) Remove 5 union bolts and remove the nozzle cage pipe.

Caution:
In order to avoid foreign matters to enter, cover it with a vinyl bag.



(3) Use a flat head screwdriver to slide 4 nozzle holder seals.

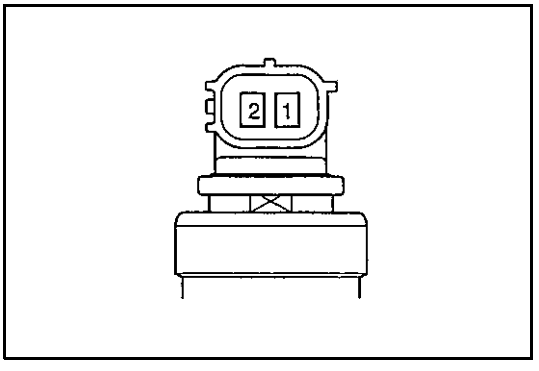


(4) Remove 4 bolts and remove 4 nozzle holder clamps.

Caution:
Separate the bolts and nozzle clamps that are removed according to each cylinder.

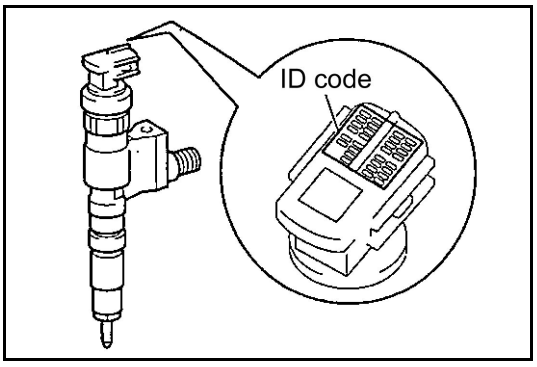
(5) Remove the fuel injector ASSY.

(6) Remove the injection nozzle seat gasket from the cylinder head.



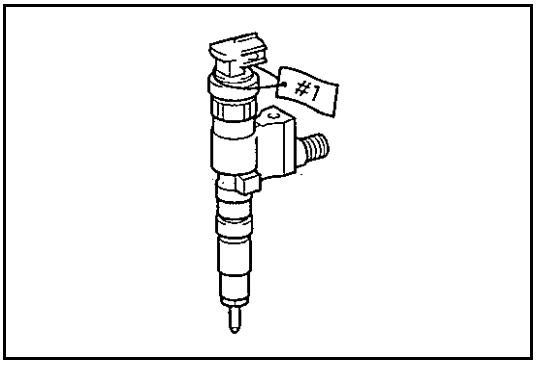
[Point 5]
Inspection of resistance:
Use an electrical tester to measure the resistance between the terminals.

Standard:
0.35 to 0.55 Ω (20°C [68°F])



[Point 6]
Installing the fuel injector ASSY

Caution:
Since the injector ASSY has different injection characteristic for each cylinder, it is necessary to register ID code (manual input) to the engine ECU by using the SST.



(1) In order for new injector ASSY to be able to judge for each cylinder, distinguish them by attaching a tag with cylinder numbers (#1 to #4) written on it.

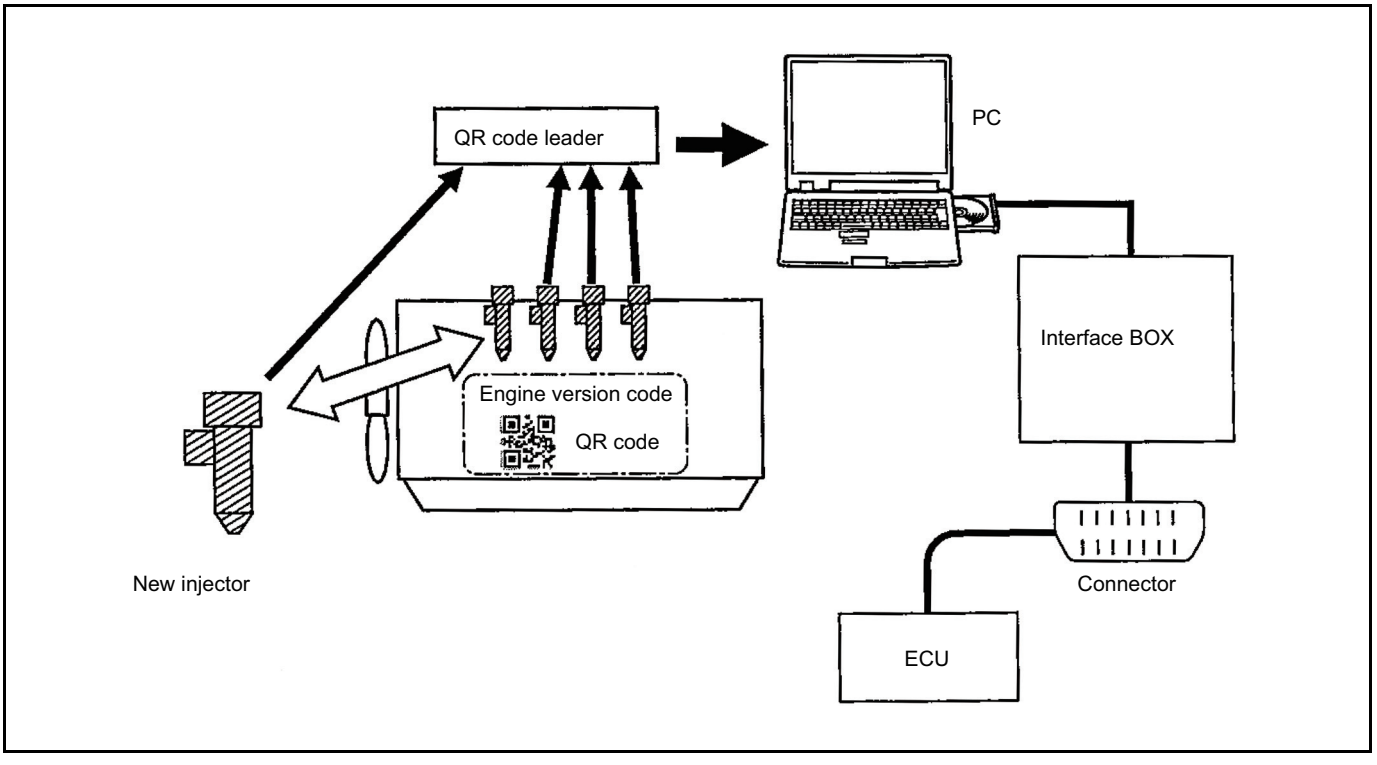
(2) Writing the injector correction value to the engine ECU (writing by the SST)

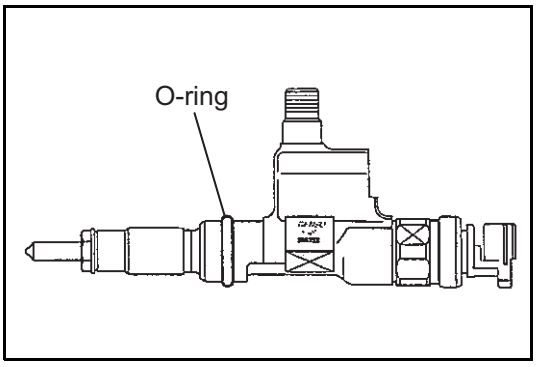
Caution:
When the injector is replaced, it is necessary to write the injector correction value (QR code) that is stated on the new injector to the engine ECU. Unless writing the correction value correctly, it may cause engine failure.

Note:
For the method of writing the injector correction value, there is a method of using PC and QR code reader at the same time.

- **Read the QR code of the injector with the scanner of the QR code reader and create the correction data file.**
- **Write the injector correction value directly to the engine ECU from the SST.**

(3) Install new injection nozzle seat gasket to the cylinder head.





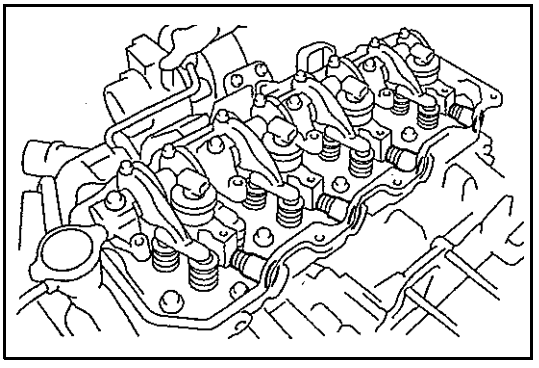
(4) Attach new O-ring to the fuel injector ASSY.

Note:
Apply engine oil to the O-ring.

(5) Install the new cylinder head cover gasket No.2 to the fuel injector ASSY.

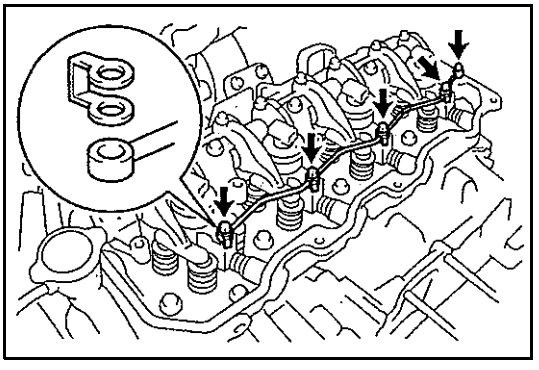
(6) According to the tag (cylinder number #1 to #4) that are attached to the fuel injector ASSY, insert the fuel injector ASSY, nozzle holder clamp and nozzle holder clamp bolt to each cylinder.

Caution:
- **If the injector ASSY is incorrectly installed to a different cylinder, it may cause rough idling and noise.**
- **Make sure that O-ring will not be pinched between the cylinder head and injector.**
- **Check that there is no foreign matters attached on the insert section.**



(7) Install the nozzle holder seal.

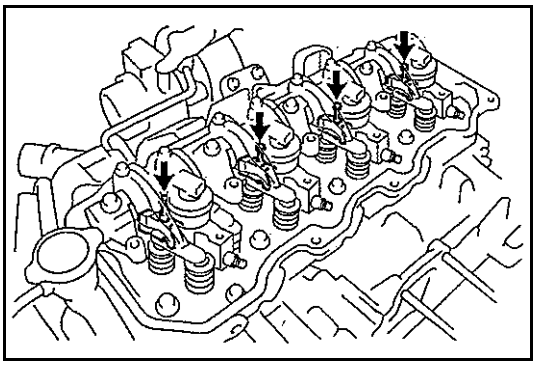
Caution:
Firmly insert the tip of the nozzle holder seal to the fuel injector ASSY.



(8) Through five new nozzle leakage pipe gaskets, tighten the union bolt by hand until it no longer turns to temporarily install the nozzle leakage pipe ASSY.

(9) Temporarily install the injection pipes No.1 to No.4.

Note:
Tighten the nut section of the injection pipe by hand until it no longer turns.



(10) Tighten the nozzle holder clamp bolt.

Standard:
T = 25 N·m (255 kgf·cm) [18 ft·lbf]

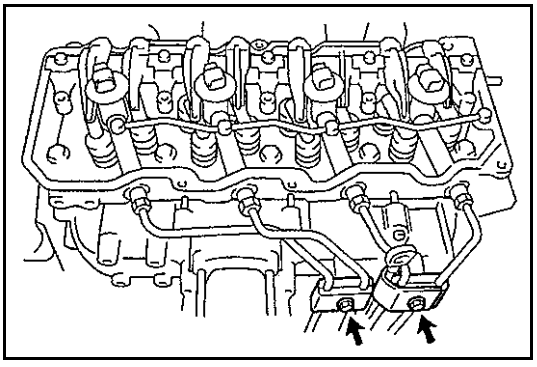
Caution:
After tightening the nozzle holder clamp bolt, check that there is no interference between the valve spring and fuel injector as well as nozzle holder clamp.

(11) Tighten the nozzle leakage pipe ASSY.

Standard:
T = 13 N·m (133 kgf·cm) [9.6 ft·lbf]

(12) Use a union nut wrench (19 mm [0.75 in.]) to install the fuel pipes No.1 to No.4.

Standard:
T = 44 N·m (449 kgf·cm) [32 ft·lbf]



[Point 7]

1. Installing the fuel pipe clamp
   With 2 nuts, simultaneously tighten the fuel pipe clamp with the oil level gauge guide until the metal parts of the clamp are attached firmly.
2. Attaching the bracket
3. Installing the breather pipe

[Point 8]

1. Installing the cylinder head cover
   (1) Install the new cylinder head cover gasket No.2 to the injector.
   (2) Install the cylinder head cover gasket to the cylinder head cover.
   (3) Tighten 2 bolts.

   Standard:
   T = 28.5 N·m (291 kgf·cm) [21 ft·lbf]

   (4) Connect the injection connector.
2. Attaching the cylinder head cover cushion rubber

[Point 9]

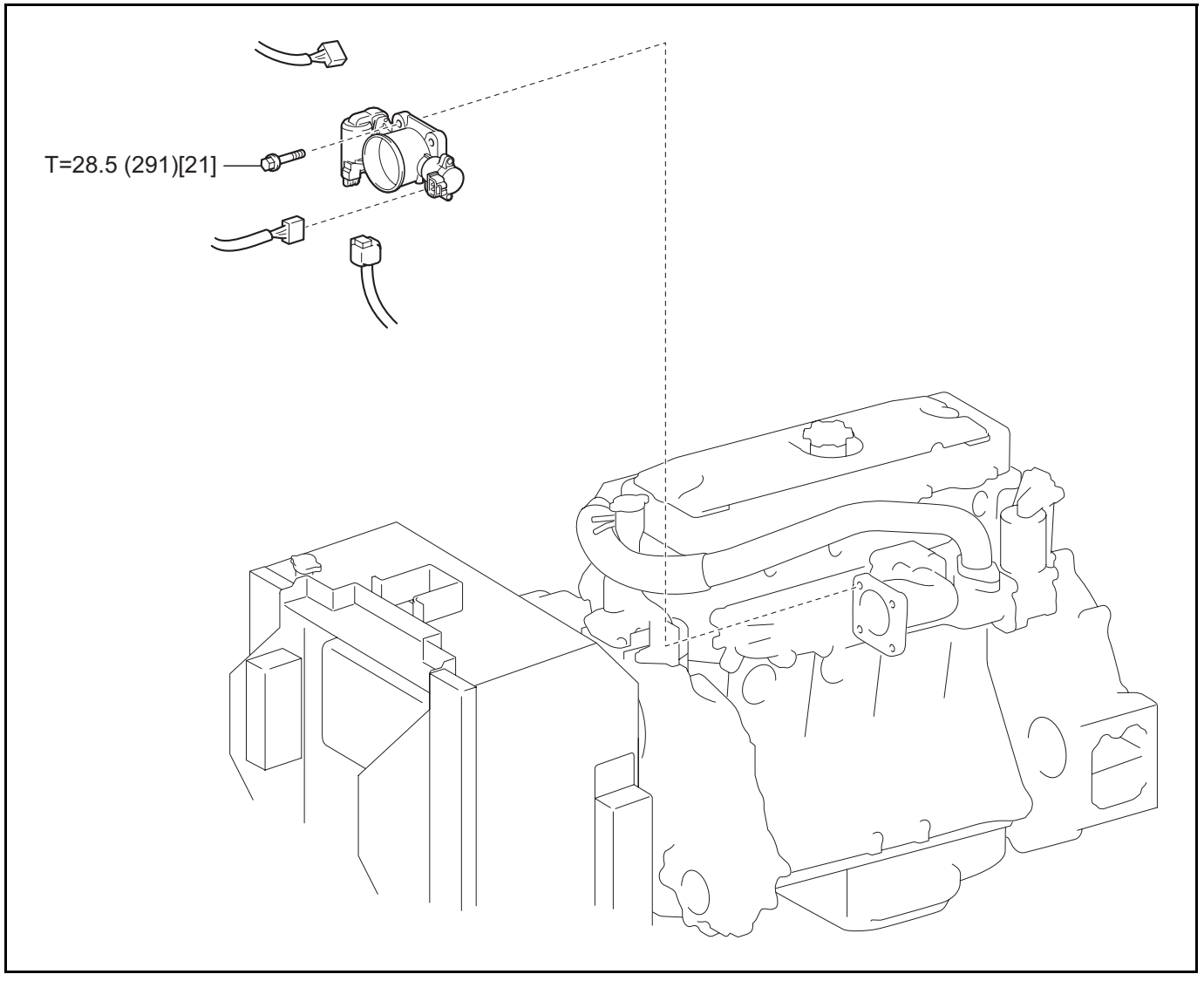
1. Installing the cylinder head cover No.2
   Install the cylinder head cover No.2 with 2 bolts.

   Standard:
   T = 28.5 N·m (290 kgf·cm) [21 ft·lbf]
2. Installing the oil filler cap
3. Installing the air hose No.1
4. Air bleeding of the fuel system
   Operate the priming pump of the fuel filter ASSY and fill the fuel into the fuel system.
5. Inspection of fuel leak

VENTURI ASSY

REMOVAL, INSPECTION AND INSTALLATION

T = N·m (kgf·cm) [ft·lbf]



Removal, inspection and installation procedure

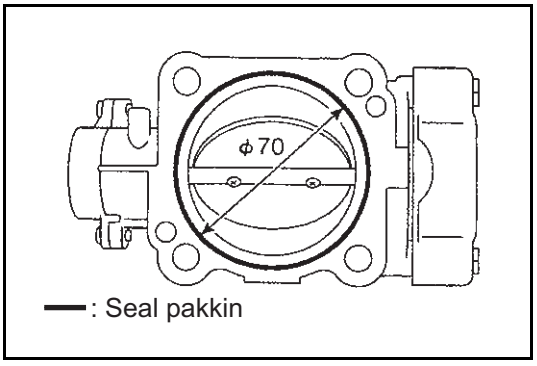
No.	Item	Removal	Inspection	Installation
1	Venturi ASSY	**[Point 1]**	**[Point 3]**	**[Point 2]**

Point Operation

1. Disconnecting the battery negative terminal
2. Removing the air hose No.1
   (1) Loosen the hose clamp.
   (2) Remove 2 bolts and remove the air hose No.1.

[Point 1]
Removing the venturi ASSY

(1) Disconnect the connector.
(2) Remove 2 bolts and 2 nuts, and then remove the venturi ASSY.



[Point 2]

1. Installing the venturi ASSY
   (1) Apply the black seal packing on the position shown in the illustration in bead shape with the width of 1.5 to 2.5 mm (0.06 to 0.1 in.).

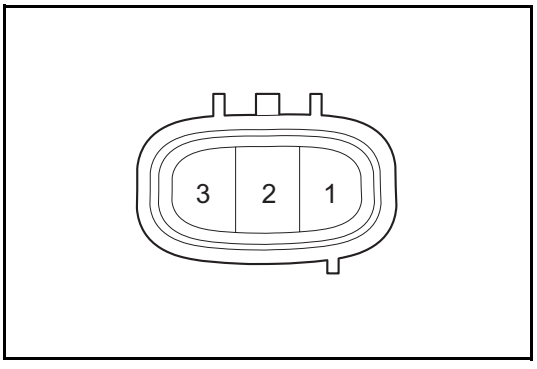
Caution:
- **Clean and degrease the installation surface.**
- **After applying the seal packing, install within three minutes.**
- **Do not start the engine for 2 hours.**

(1) Install the venturi ASSY with 2 bolts and 2 nuts.

Standard
T = 28.5 N·m (291 kgf·cm) [21 ft·lbf]

(2) Install the connector.

2. Install the battery negative terminal.



[Point 3]
Continuity inspection

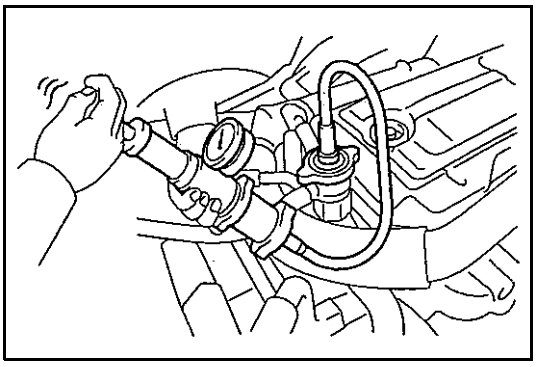
(1) Use an electrical tester to inspect for continuity between each terminal.

Standard:

Terminals	Condition	Resistance
2 (+B) ⇔ 3 (GND)	Constant	2 to 10 kΩ

COOLING SYSTEM

Page



COOLING SYSTEM

INSPECTION OF FUNCTIONS

1. Inspections of coolant leak

Warning:
In order to avoid burns, do not remove the radiator cap when the engine and radiator are still hot. Liquid and steam will burst out because of pressure.

(1) Fill the coolant into the radiator and install the radiator cap tester.

Instruments:

Banzai	• Radiator cap tester [RCT-2A] • Radiator cap tester adapter set [RCT-2A-30S]
Iyasaka	• Radiator cap tester [RCT-2] • Radiator cap tester adapter set [RCT-2-AST]

(2) Warm up the engine.

(3) Pump up to 137 kPa (1.4 kgf/cm^2 [19 psi]) and check that the pressure does not drop.

Note:
If the pressure drops, check whether there are any leaks in the hose, radiator or water pump. If there are no leak to outside, check the heater core, cylinder block or cylinder head.

2. Inspection of the coolant amount

(1) When the engine is cool, check that the water level in the reserve tank lies between FULL and LOW.

Note:
If the water amount is not sufficient, fill the coolant up to FULL.

3. Inspection of the coolant

(1) Remove the radiator cap.

Warning:
In order to avoid burns, do not remove the radiator cap when the engine and radiator are still hot. Liquid and steam will burst out because of pressure.

(2) Inspect whether excessive rust or boiling scale is accumulated around the radiator cap or radiator filler hole.

Note:
If it is excessively dirty, replace the coolant.

(3) Install the radiator cap.

COOLANT

REPLACEMENT

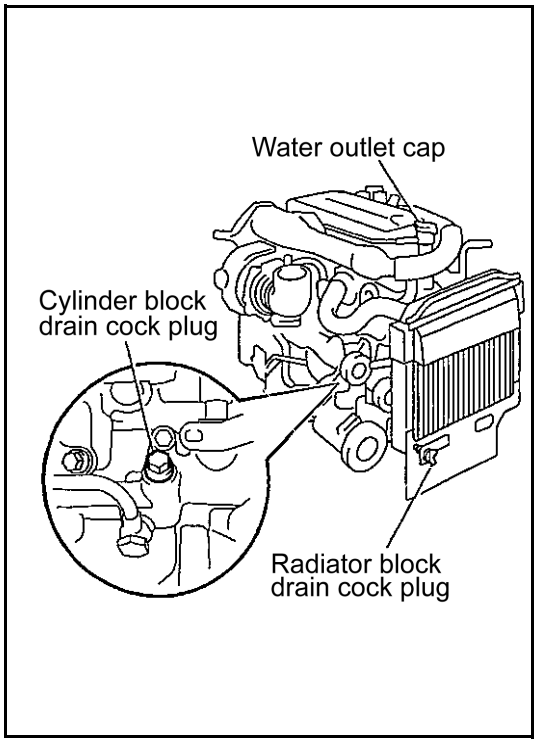
1. Draining the coolant

Warning:
In order to avoid burns, do not remove the radiator cap when the engine and radiator are still hot. (Since the liquid and steam will burst out because of pressure)

(1) Remove the radiator cap.

(2) Loosen the drain cock plug and drain the coolant.

(3) Drain the coolant in the reserve tank.



2. Adding the coolant

(1) Tighten the drain cock plug and fill the coolant from the radiator filling port until it spills over. [★1]

Standard:
T = 27 N·m (275 kgf·cm) [20 ft·lbf]
(cylinder block drain cock plug)

Note:
Press 2 radiator hoses by hand several times, and if the water level at the radiator filling port goes down, add the coolant.

(2) Install the radiator cap.

(3) Fill the coolant to the radiator reserve tank up to the upper limit.

(4) Warm up the engine until the thermostat opens the valve.

Note:
Press 2 radiator hoses several times during warm-up.

(5) Stop the engine and wait until the coolant cools down, then remove the radiator cap and check the water level.

(6) If the water level drops, repeat the operations from [★1].

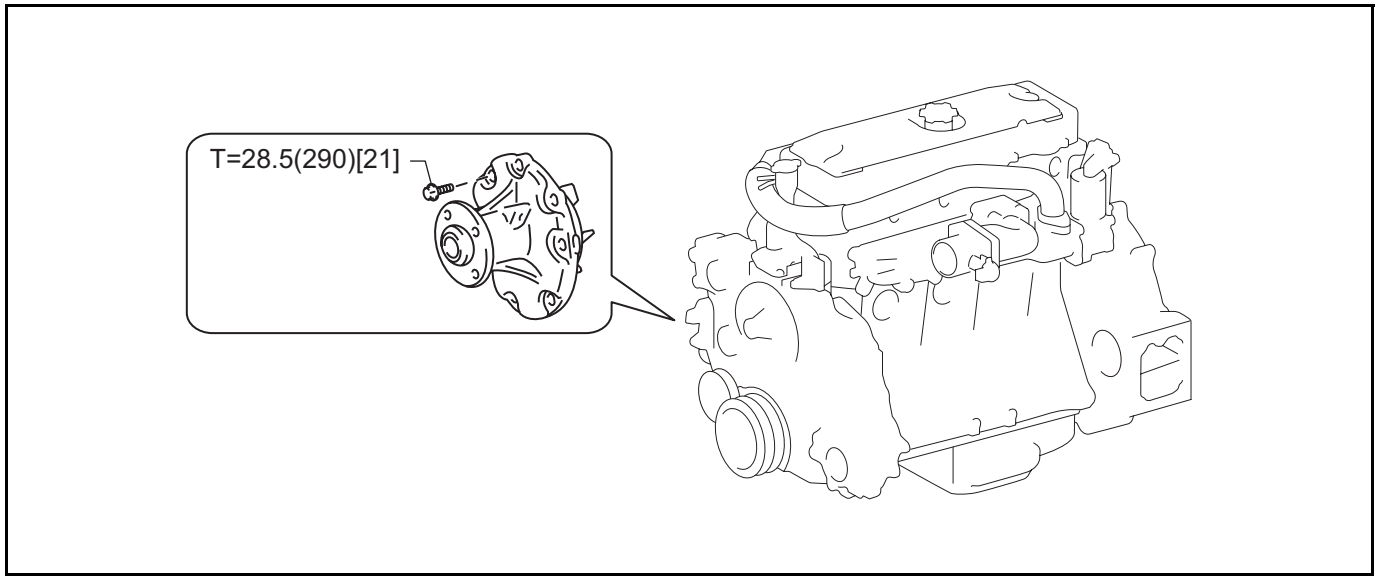
(7) If the water level stops going down, adjust the coolant in the radiator reserve tank.

3. Inspection of coolant leak

WATER PUMP ASSY

REMOVAL AND INSTALLATION

T = N·m (kgf·cm) [ft·lbf]



Removal and installation procedure

No.	Item	Removal	Inspection	Installation
1	Water pump	**[Point 1]**		**[Point 2]**

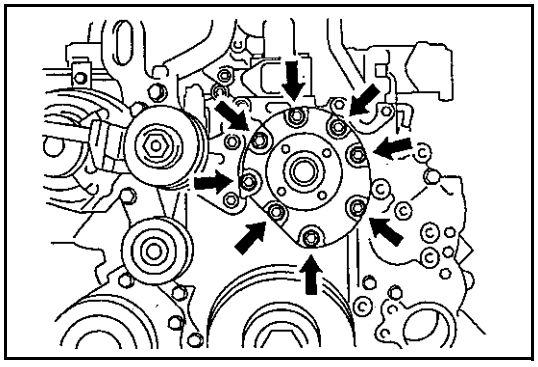
Point Operation

1. Removing the fan

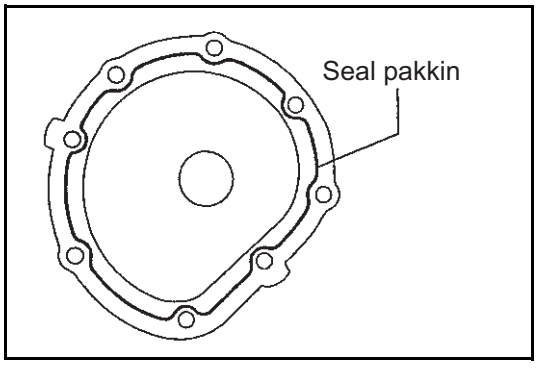
   (1) Remove 4 nuts and remove the fan spacer.

Note:
Loosen 4 nuts for installing the fan spacer.

2. Removing the fan pulley



[Point 1]
Removing the water pump ASSY
Remove 8 bolts and remove the water pump ASSY.



[Point 2]

1. Installing the water pump ASSY

   (1) Apply the black seal packing on the position shown in the illustration in bead shape with the width of 1.5 to 2.5 mm (0.060 to 0.098 in.).

Caution:
- **Clean and degrease the installation surfaces of the water pump and cylinder block.**
- **After applying the seal packing, install within 3 minutes.**
- **After the installation, leave it for 2 hours without starting the engine.**

   (2) Install the water pump ASSY with 8 bolts.

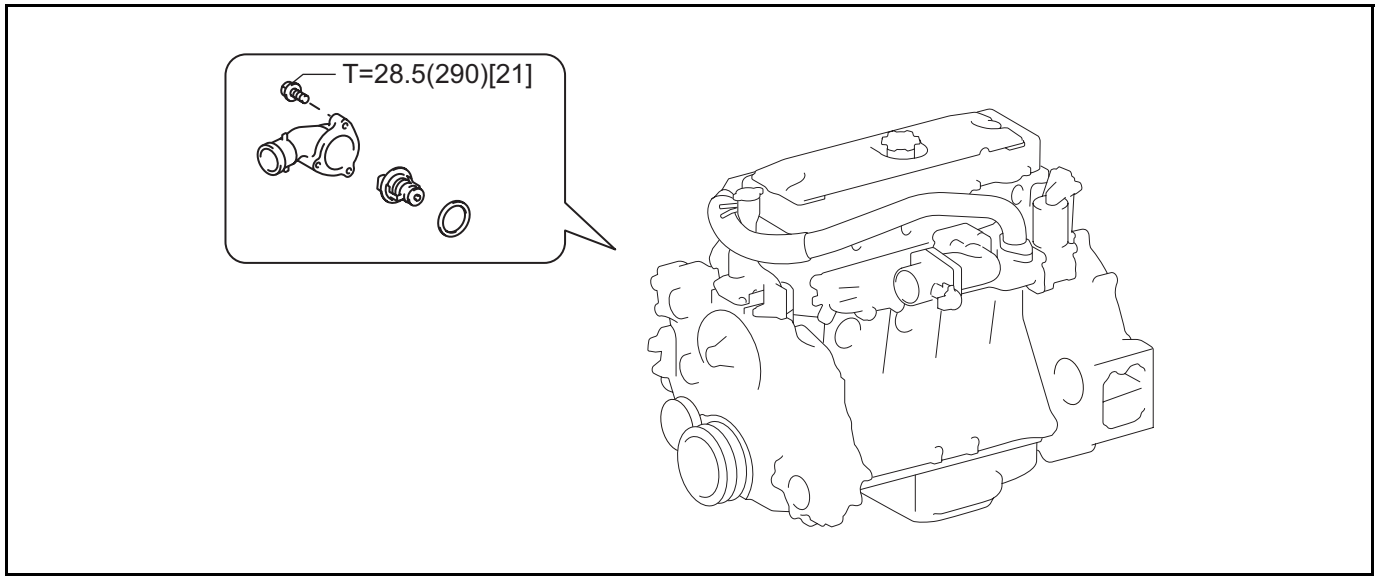
   Standard
   T = 28.5 N·m (290 kgf·cm) [21ft·lbf]

2. Installing the fan pulley
3. Installing the fan
   Install the fan spacer with 4 nuts.
4. Installing the fan & alternator V-belt
5. Inspection and adjustment of the belt tension
6. Adding the coolant
7. Inspection of coolant leak

THERMOSTAT

REMOVAL, INSPECTION AND INSTALLATION

T = N·m (kgf·cm) [ft·lbf]

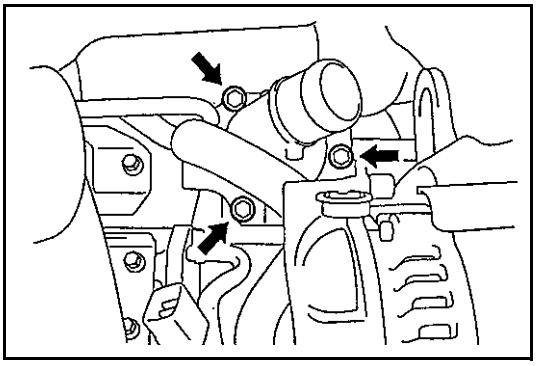


Removal, inspection and installation procedure

No.	Item	Removal	Inspection	Installation
1	Thermostat	**[Point 1]**	**[Point 2]**	**[Point 3]**

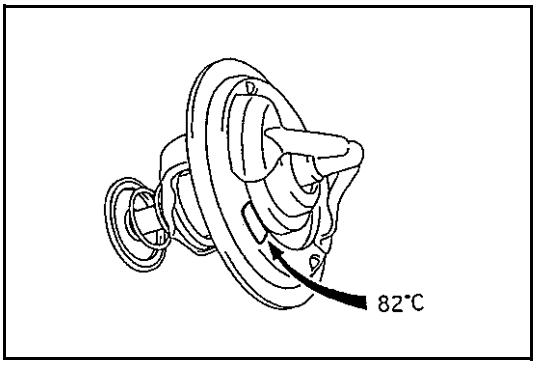
Point Operation

1. Draining the coolant
2. Removing the radiator inlet hose
3. Removing the air hose No.1
   Remove 2 bolts and hose clamp and remove the air hose No.1.



[Point 1]

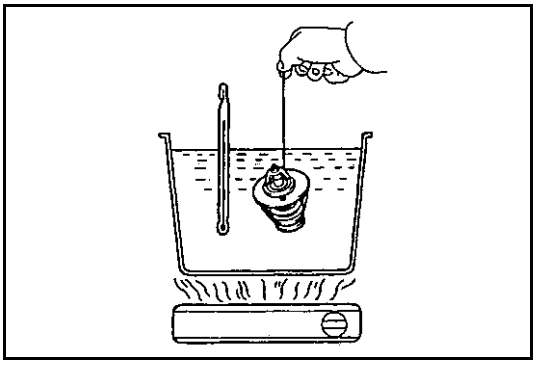
1. Removing the thermostat
   (1) Remove 3 bolts and remove the water inlet.
   (2) Remove the thermostat and gasket.



[Point 2]

1. Thermostat inspection

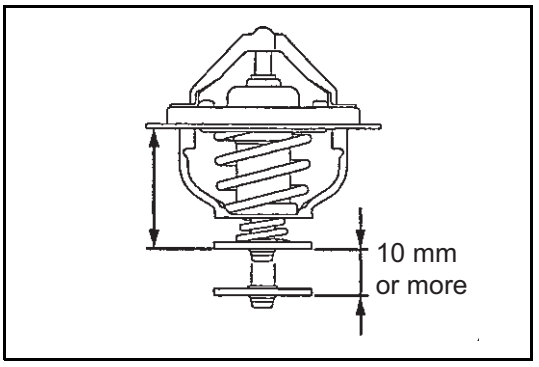
Note:
On the thermostat, the temperature for opening the valve is punched.



(1) Soak the thermostat to water, and gradually heat up.
(2) Inspect the temperature when the valve starts opening.

Standard:
80 to 84°C (176 to 183°F)

Note:
If the temperature for opening the valve is outside the standard, replace the thermostat.



(3) Inspect the valve lift amount.

Standard:
Lift amount 10 mm (0.4 in.) or more
Temperature when fully opened 95°C (203°F)

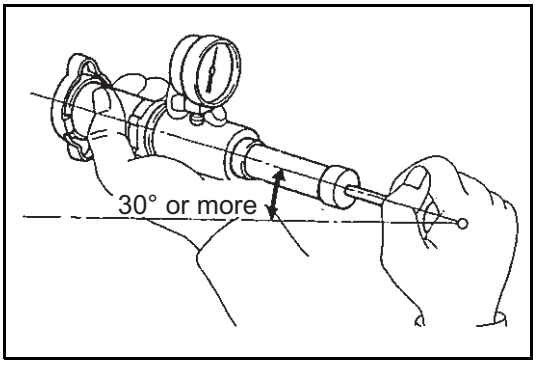
Note:
If the valve lift amount is outside the standard, replace the thermostat.

(4) Inspect that the valve is fully opened when the thermostat is at lower temperature (40°C [104°F] or less).

Note:
If the valve is not fully opened, replace the thermostat.

2. Water outlet cap

Caution:
- **If the radiator cap is dirty, make sure to use water for rinsing the dirt off.**
- **Before using a radiator cap tester, wet the relief valve and pressure valve with the coolant or water.**
- **When using a radiator cap tester, inspect by tilting it by 30° or more.**



(1) Use a radiator cap tester, pump it slowly, and check that the air is released from the vacuum valve.

Standard:
Pumping speed once in 3 seconds or more

Caution:
Pump with constant pace.

Note:
If air is not released from the vacuum valve, replace the water outlet cap.

(2) Pump the tester and measure the opening pressure.

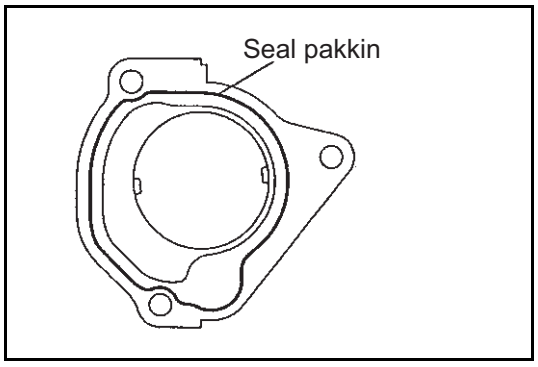
Standard:
Pumping speed once in one seconds or more

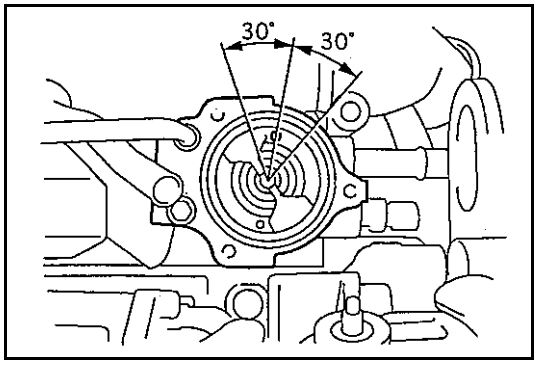
Caution:
This pumping speed is applied to the first pumping only. (for closing the vacuum valve) After this, the pumping speed can be slower.

Standard:
108 kPa (1.1 kgf/cm^2) [15.7 psi]

Limit:
79 kPa (0.8 kgf/cm^2 [11 psi])

Note:
- **Use the maximum measurement value of the tester as the opening pressure.**
- **If the opening pressure is lower than the minimum value, replace the water outlet cap.**





[Point 3]

1. Installing the thermostat

   (1) Apply the black seal packing on the position shown in the illustration in bead shape with the width of 1.5 to 2.5 mm (0.06 to 0.1 in.).

Caution:

- **Clean and degrease the installation surfaces of the water inlet and cylinder head.**
- **After applying the seal packing, install within 3 minutes.**
- **After the installation, leave it for 2 hours without starting the engine.**

   (2) Install the new gasket to the thermostat.

   (3) Adjust the jiggle valve to the position shown in the illustration and install the thermostat.

   (4) Install the water inlet with 3 bolts.

   Standard
   T = 28.5 N·m (290 kgf·cm) [21 ft·lbf]

2. Installing the air hose No.1

   (1) Install the air hose No.1 with 2 bolts.

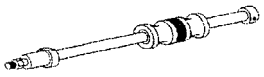
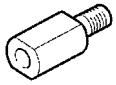
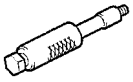
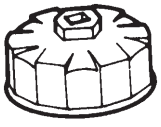
   (2) Tighten the hose clamp.

3. Adding the coolant

4. Inspection of coolant leak

LUBLICATION SYSTEM

USED SSTs

Illustration	Part No.	Part name
	09060-32720-71	Sliding hummer
	09029-88460-71	Puller cramp
	09010-33940-71	Puller slide hummer
	09040-33940-71	Oil filter Wrench

LUBLICATION SYSTEM

INSPECTION OF FUNCTIONS

1. Inspection of the engine oil amount
   Warm up the engine and 5 minutes after stopping the engine, inspect that the oil amount is between Low and Full levels with the oil level gauge.
   If the oil amount is insufficient, inspect any leaks and then fill the oil up to the Full level mark.

Caution:
Do not fill in the oil beyond Full level mark.

2. Inspection of the oil pressure

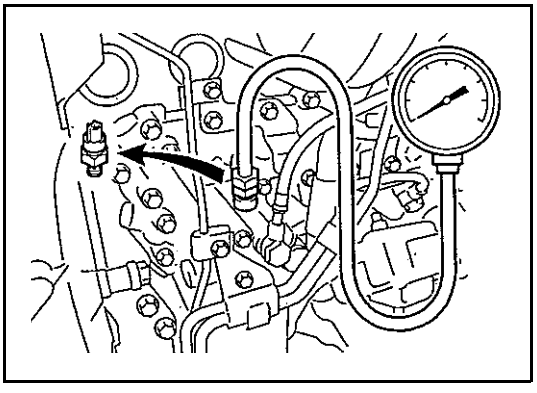
   (1) Prepare for the joint bolt and union.

   (2) Removing the engine oil pressure switch ASSY

Note:
Disconnect the connector for the oil pressure switch and remove the oil pressure switch.

   (3) Install the union you prepared to the oil bracket through the new gasket.

   Standard:
   T = 24.5 N·m (250 kgf·cm) [18 ft·lbf]



   (4) Installing the oil pressure gauge

Note:
Install the pressure gauge through the adapter.

Instruments:

Banzai	• Automatic transmission oil pressure gauge set [OPG-210] • Adapter D (OPG-230)
Iyasaka	• Automatic transmission oil pressure gauge set [ATG-100] • Adapter D (ATG-OP20)

   (5) Warming up the engine

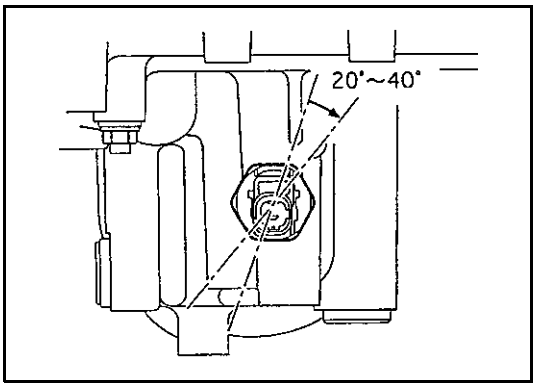
   (6) Inspection of the oil pressure

   Standard:

During idling	190 kPa (2 kgf/cm^2) [28.4 psi]

   (7) Removing the union and joint bolt

   (8) Removing the oil pressure gauge

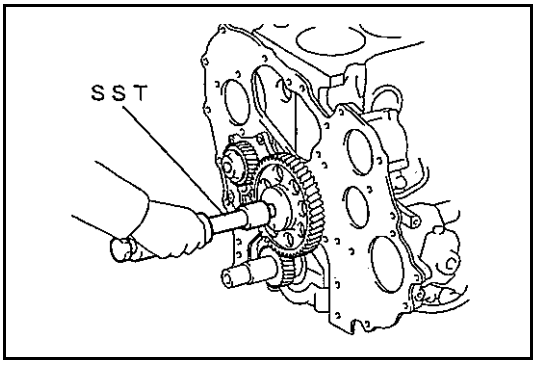


(9) Installing the engine oil pressure switch ASSY

Note:
Insert the oil pressure switch through the new gasket until you can no longer turn by hand, and then use a 23 mm (0.9 in.) deep socket wrench to tighten by turning it by the range of 20° to 40°.

(10) Connect the connector for the oil pressure switch.

(11) Inspection of engine oil leak

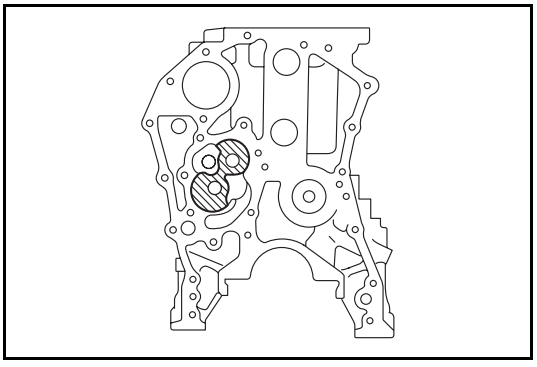


OIL PUMP

REPLACEMENT

1. Removing the camshaft
2. Removing the idle gear shaft No.1
   (1) Remove the bolt.
   (2) Use the SST to remove the idle gear shaft No.1.

   SST 09060-32720-71, 09029-88460-71, 09010-33940-71

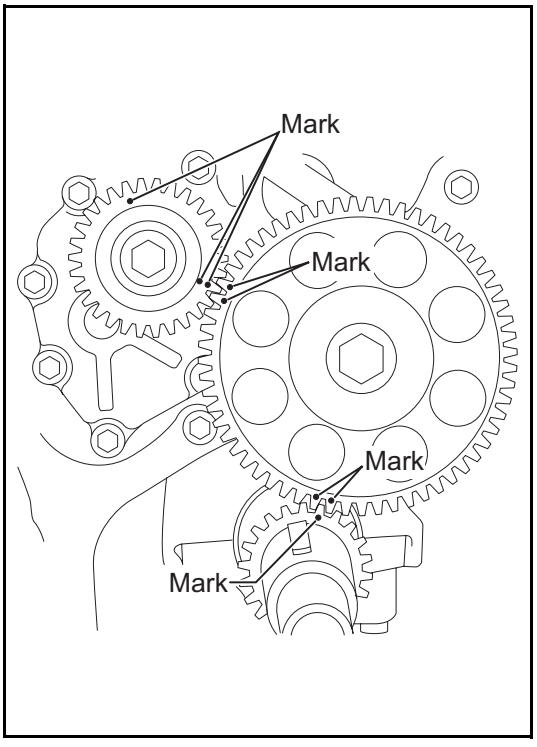


3. Removing the oil pump ASSY
   Remove the 7 bolts and remove the oil pump ASSY.
4. Installing the oil pump ASSY
   (1) Apply engine oil to the pump case and bearing section of the cylinder block.

Note:
Unless applying engine oil, when the engine is started for the first time, oil suction fault may occur and this may cause burn out or abnormal wearing.

   (2) Install the oil pump ASSY through new gasket.

   Standard:
   T = 28.5 N·m (290 kgf·cm) [21 ft·lbf]



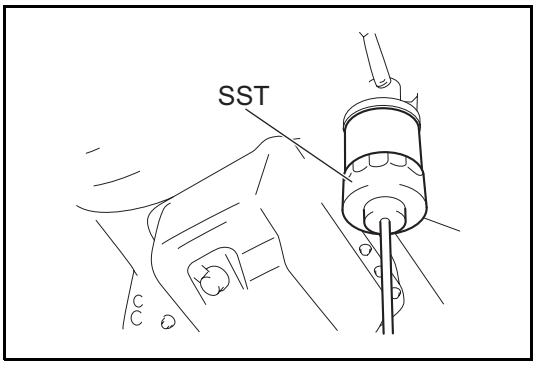
5. Installing the idle gear shaft No.1
   (1) Set the oil hole of the idle gear shaft No.1 to the bottom, align the match mark of each gear and insert the cylinder block firmly.

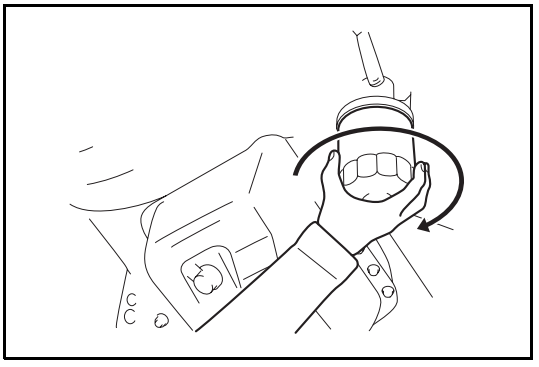
Caution:
Unless setting the oil hole to the bottom, it may cause burn out or abnormal wearing.

   (2) Install the idle gear shaft No.1 with the bolt.

   Standard:
   T = 137 N·m (1397 kgf·cm) [101 ft·lbf]

6. Installing the camshaft





OIL FILTER

REPLACEMENT

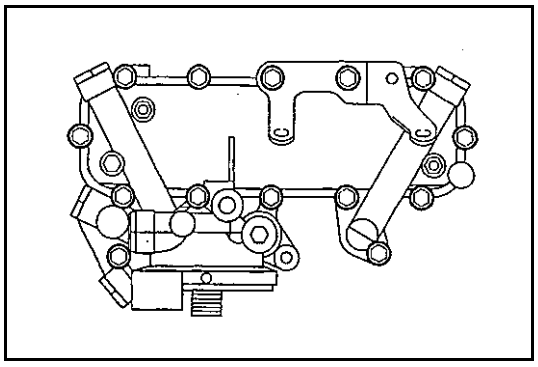
1. Removing the oil filter drain plug
   Remove the oil filter drain plug and drain the engine oil.
2. Removing the oil filter
   Use the SST to remove the oil filter.

   SST 09040-33940-71

3. Installing the oil filter
   (1) Apply small amount of engine oil to the O-ring of the new oil filter.

Caution:
Remove any dirt and foreign matters on the installation surface of the oil filter.

   (2) Install until the O-ring touches the installation surface.
   (3) After the O-ring touches the installation surface, further tighten by 2/3 of a turn.
4. Inspection of engine oil
5. Inspection of engine oil leak

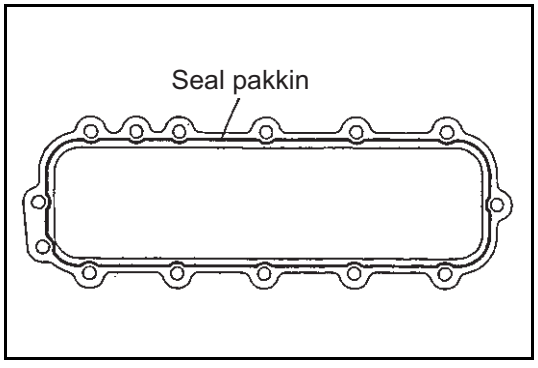


OIL COOLER ASSY

REPLACEMENT

1. Draining the coolant
2. Removing the Front exhaust pipe ASSY
3. Removing the oil filter
4. Removing the oil pressure switch
5. Removing the oil cooler bracket ASSY
   (1) Remove the 14 bolts and remove the oil cooler ASSY.
6. Removing the oil cooler ASSY
   (1) Remove the 4 nuts and remove the oil cooler ASSY.
7. Installing the oil cooler ASSY
   (1) Install the oil cooler ASSY with 4 nuts.

   Standard:
   T = 12 N·m (122 kgf·cm) [9 ft·lbf]



8. Installing the oil cooler bracket
   (1) Apply the black seal packing on the position shown in the illustration in bead shape with the width of 1.5 to 2.5 mm (0.06 to 0.1 in.).

Caution:
- **Clean and degrease the installation surfaces of the oil cooler and cylinder block.**
- **After applying the seal packing, install it within 3 minutes and tighten it within 15 minutes.**
- **After installation, leave it for 2 hours without starting the engine.**

   (2) Install the oil cooler ASSY with the 14 bolts.

   Standard:

   T = 28.5 N·m (290 kgf·cm) [21 ft·lbf]

9. Installing the oil pressure switch
10. Installing the oil filter
11. Installing the exhaust pipe ASSY
12. Adding the engine oil
13. Inspection of engine oil leak
14. Inspection of coolant leak

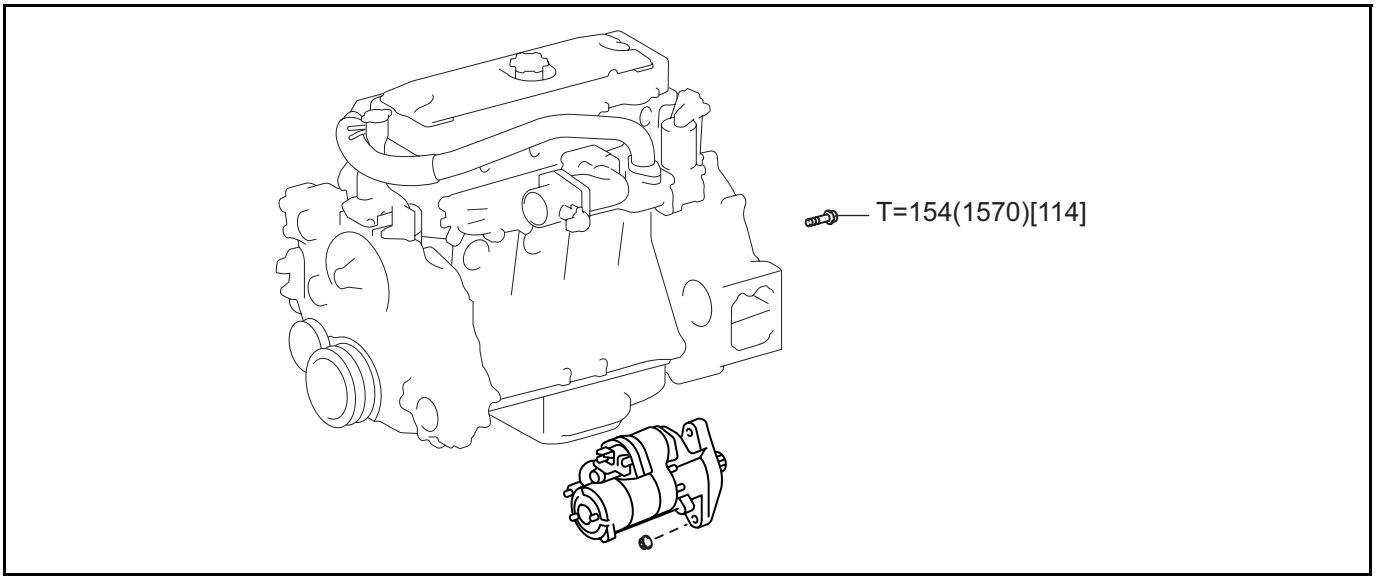
STARTING SYSTEM

Page

STATER MOTOR ASSY

REMOVAL, INSPECTION AND INSTALLATION

T = N·m (kgf·cm) [ft·lbf]



Removal, inspection and installation procedure

No.	Item	Removal	Inspection	Installation
1	Starting motor	**[Point 1]**	**[Point 2]**	**[Point 3]**

Point Operation

Disconnecting the battery negative terminal

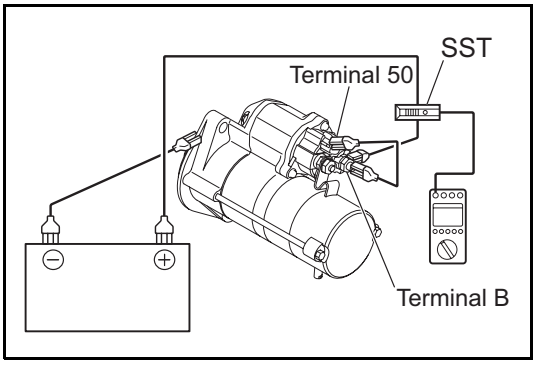
[Point 1]
Removing the starter ASSY

(1) Disconnect the connector.

(2) Remove the terminal cap and then remove the terminal 50 installation bolt and the wire harness.

(3) Remove the terminal cap and then remove the terminal B installation nut and the wire harness.

(4) Remove the bolt, nut and remove the starter ASSY.



[Point 2]

1. Starter ASSY

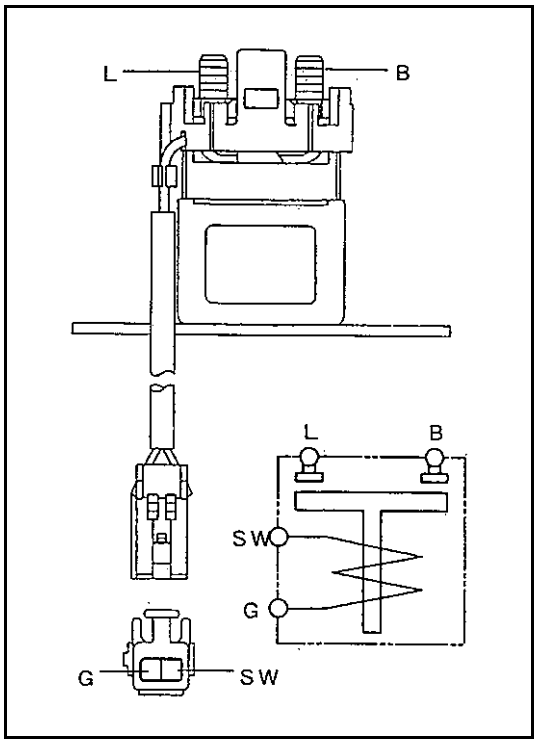
(1) Fix the starter ASSY to a vise.

(2) Connect the wire harness as shown in the illustration.

Caution:
Use a thick cable as large current will flow.

(3) Connect the terminal 50 and once the instruction of the electrical tester is stabilized, measure the current.

Standard: 200 A or less



[Point 3]
Installing the starter ASSY
Install the starter ASSY with 2 bolts and nuts.

Standard:
T = 154 N·m (1570 kgf·cm) [114 ft·lbf]

(1) Install the wire harness to the terminal B with the nut.

(2) Install the wire harness to the terminal 50.

2. Starter relay ASSY

(1) Continuity inspection

(2) Use an electrical tester to inspect for continuity between each terminal.

Standard:
Between the terminals SW ⇔ G Continuity exists
Between the terminals L ⇔ B No continuity

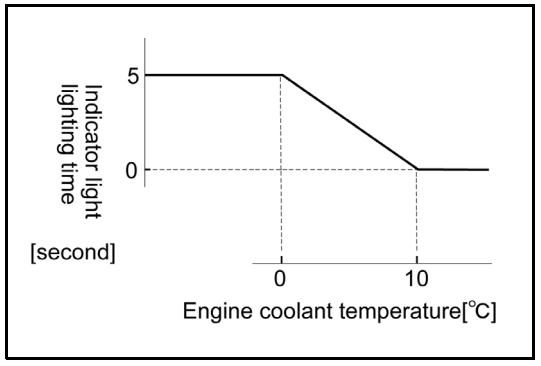
(3) Apply the battery voltage between the terminals SW ⇔ G, and inspect the continuity between the terminals L ⇔ B.

Standard:
Continuity

PREHEATING SYSTEM

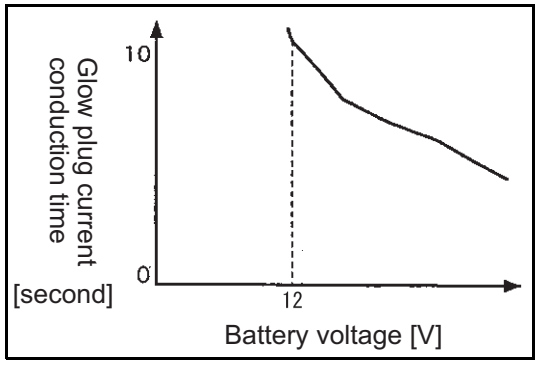
INSPECTION OF PREHEATING TIMER

Caution:
Before performing inspection, turn off the ignition switch for 60 seconds or more.



1. Inspection of the glow indicator light lighting time
   Turn the ignition switch on and measure the indicator light lighting time.

   Standard:
   Depending on the engine coolant temperature, it turns on as shown in the illustration.



2. Inspection of pre-heat function
   (1) Turn the ignition switch on.
   (2) Inspect the passing time to the glow plug ASSY (glow plug relay).

   Standard:

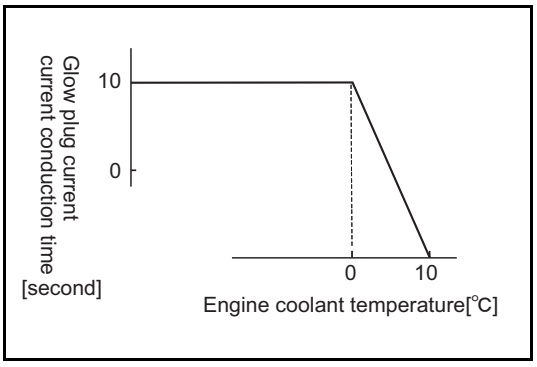
Engine coolant temperature	Pre-heat time
10°C (50°F) or above	0 second
10°C (50°F) or below	It will be as shown in the illustration. (Maximum 5 seconds or more)

   (3) Set the ignition switch to STA position.
   (4) Inspect that the battery voltage is applied to the glow plug.
   (5) Inspect the current conduction time of the glow plug during engine cranking.

Caution:
Do not start the engine.

Standard:

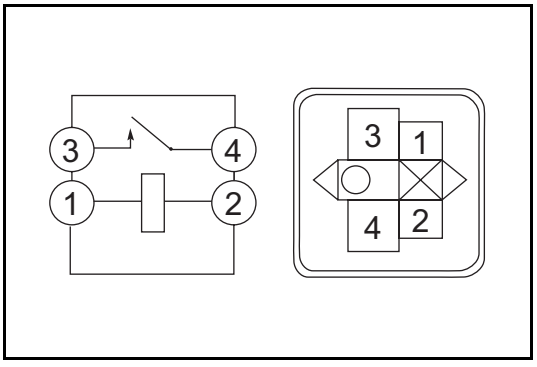
Engine coolant temperature	Pre-heat time
10°C (50°F) or above	0 second
10°C (50°F) or below	It will be as shown in the illustration. (Maximum 5 seconds or more)



3. Inspection of afterglow

   (1) When started the engine by cranking, inspect the current conduction time to the glow plug ASSY.

Standard:
Depending on the engine coolant temperature, it will be as shown in the illustration.



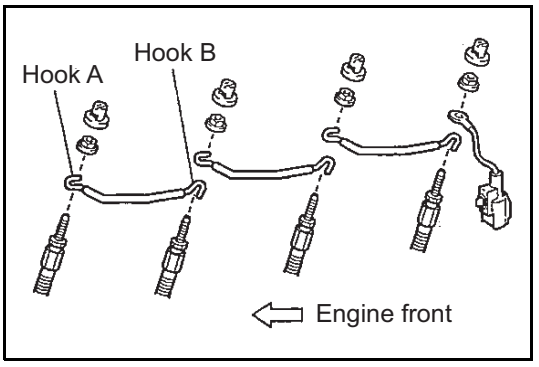
4. Glow plug relay ASSY

   (1) Use an electrical tester to inspect for continuity between each terminal.

Standard
Between the terminals 3 ⇔ 5 Continuity exists
Between the terminals 1 ⇔ 2 No continuity

   (2) When adding the battery voltage between the terminals 3 ⇔ 5, check the continuity between the terminals 1 ⇔ 2.

Standard:
Continuity



REPLACEMENT OF GLOW PLUG

1. Disconnecting the battery negative terminal
2. Draining the coolant
3. Removing EGR pipe No.1
4. Removing the glow plug ground wire
   (1) Remove the glow plug screw grommet.
   (2) Remove the nut and remove the glow plug ground wire.
5. Removing the glow plug ASSY
   Use a 12 mm (0.5 in.) deep socket wrench to remove the glow plug ASSY.
6. Installing the glow plug ASSY
   Use a 12 mm (0.5 in.) deep socket wrench to install the glow plug ASSY.

   Standard:
   T = 25 N·m (255 kgf·cm) [18 ft·lbf]
7. Installing the glow plug ground wire
   (1) Install the glow plug ground wire by lapping it over the engine front side as shown in the illustration.

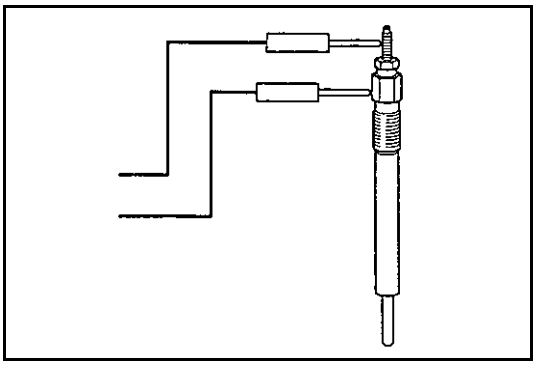
Caution:
Incorrect installation order may cause the wire to deform when tightening.

   (2) Install the engine harness SUB/ASSY to the glow plug of the cylinder No.4.
   (3) Install the glow plug ground wire with the nut.

   Standard:
   T = 1.5 N·m (15 kgf·cm) [1.1 ft·lbf]

Caution:
Check that the glow plug ground wire is not interfering with the cylinder head and intake manifold.

   (4) Install the glow plug screw grommet.
8. Installing EGR pipe No.1
9. Adding the coolant
10. Inspection of coolant leak



INSPECTION OF GLOW PLUG

Glow plug ASSY

(1) Use an electrical tester to measure the resistance between the terminal ⇔ body earth.

Standard:
Approx. 2.7 to 3.5 Ω (20°C [68°F])

CHARGING SYSTEM

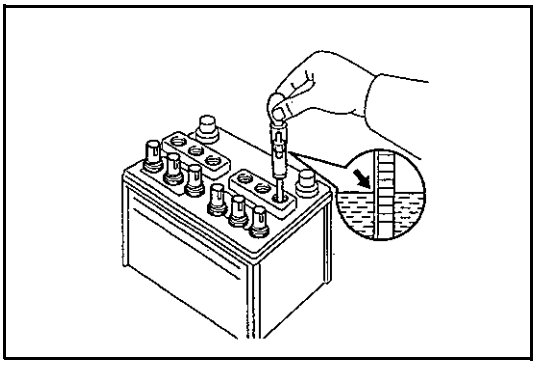
Page

CHARGING SYSTEM

INSPECTION OF FUNCTIONS

Caution:
- **Inspect whether the battery cables are correctly connected to the terminals.**
- **If boost charge is performed, do not connect the battery cables.**
- **Do not disconnect the battery while starting the engine.**

1. Inspection of the battery liquid amount
   If it is less than the lower level, replace the battery. Or, add distilled water.

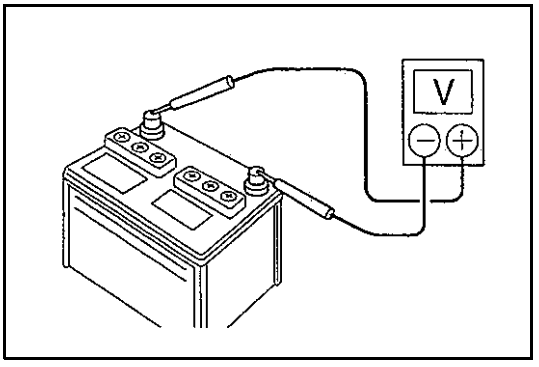


2. Inspection of the specific gravity of the battery (other than maintenance-free batteries)

   (1) Inspect the specific gravity of the battery for each cell.

   Standard:
   1.25 to 1.29 (liquid temperature 20°C [68°F])

Note:
If the standard is not met, recharge the battery.



3. Inspection of the battery voltage

   (1) In order to eliminate the amount of surface charge, stop the engine after driving and then turn the ignition switch on (within 20 seconds) and turn the switches of the electric equipment on.

   (2) Turn the ignition switch off and also turn the switches of the electric equipment off.

   (3) Measure the battery voltage between the terminals.

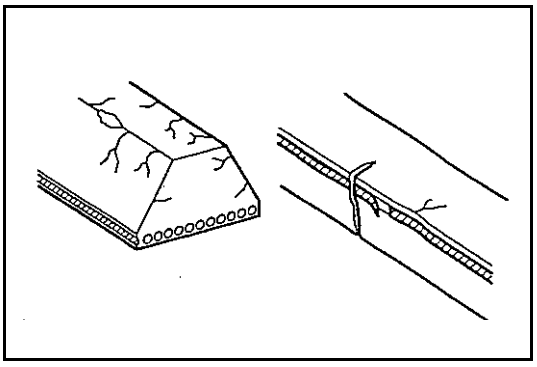
   Standard:
   12 to 12.5 V (liquid temperature 20°C [68°F])

Note:
If the standard is not met, recharge the battery.

4. Inspection of the battery terminal, fusible link and fuse

   (1) Inspect whether the battery terminal is loosened, or corroded.

   (2) Inspect whether there is a continuity on the fusible link and fuse.

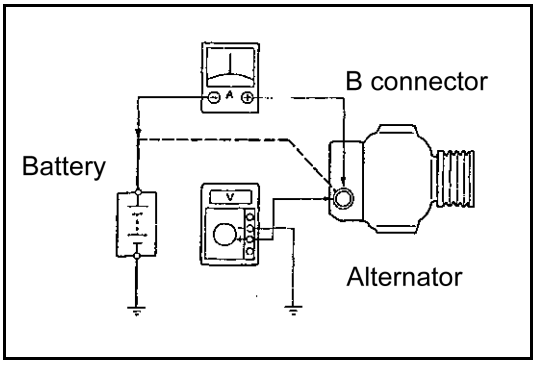


5. Inspection of the belt
   (1) Inspect excessive wear of the belt, or any cracks.

Note:
If there are any defects, replace the belt.

6. Inspection of the alternator wire
   (1) Inspect whether the wire is in good condition.
7. Inspection of the alternator noise
   (1) Inspect whether there are any noises from the alternator during engine start.
8. Inspection of the charge warning lamp
   (1) Warm up the engine and turn the ignition switch OFF.
   (2) Turn all the switches of the electric equipment off.
   (3) Turn the ignition switch on and check whether the charge warning lamp turns on.
   (4) Start the engine and check that the lamp goes off.

Note:
If the lamp does not work as mentioned above, perform troubleshooting for the charge warning lamp circuit.



9. No-load test

Note:
If using a battery/alternator tester, connect it to the charging circuit according to the operation manual of the tester.
If a tester is not used, connect the voltmeter to the charge circuit as follows:

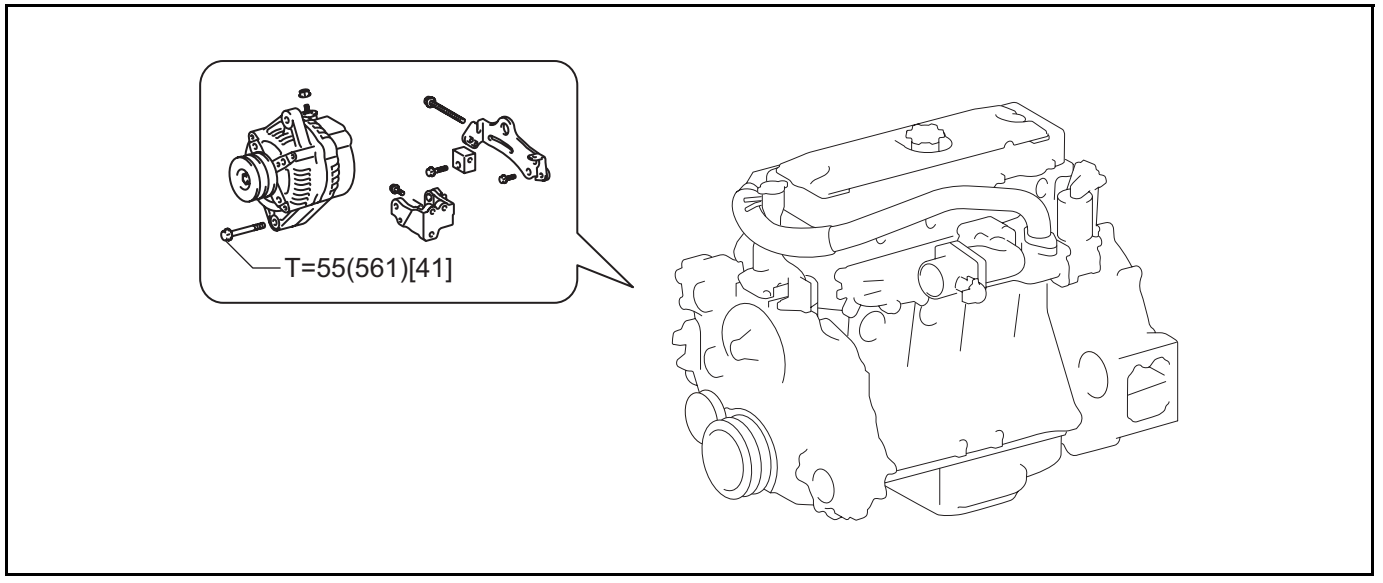
   (1) Remove the terminal B of the alternator and connect it to the negative terminal of the ammeter.
   (2) Connect the positive terminal of the ammeter to the terminal B of the alternator.
   (3) Connect the positive terminal of the voltmeter to the terminal B of the alternator.
   (4) Connect the negative terminal of the voltmeter to the earth.
   (5) Inspection of the charging circuit
   Use an electrical tester to measure the battery voltage when the engine speed is increased up to 2000 r/min.

Standard:
13.2 to 14 V (10 A or less)

ALTERNATOR ASSY

REMOVAL AND INSTALLATION

T = N·m (kgf·cm) [ft·lbf]

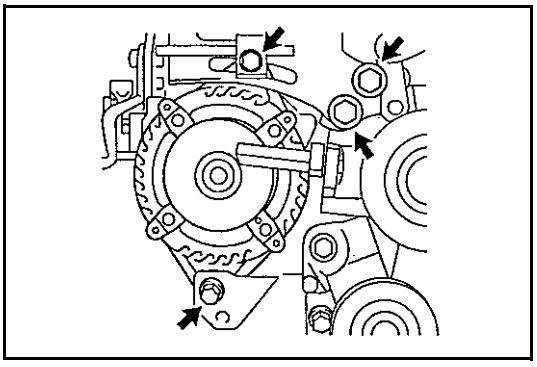


Removal and installation procedure

No.	Item	Removal	Inspection	Installation
1	Alternator	**[Point 1]**		**[Point 2]**

Point Operation

1. Disconnecting the battery negative terminal
2. Draining the coolant
3. Removing the radiator inlet hose
4. Removing the air hose No.1
5. Removing the fan & alternator V-belt
6. Removing the alternator bracket
   (1) Remove 2 bolts and remove the alternator bracket.



[Point 1]

1. Removing the alternator ASSY
   (1) Disconnect the connector.
   (2) Remove the terminal cap and then remove the terminal B installation nut and the wire harness.
   (3) Remove the bolt and remove the alternator ASSY.

[Point 2]

1. Installing the alternator ASSY
   Temporarily install the alternator ASSY with the bolt.
2. Installing the alternator bracket
   (1) Install the alternator bracket with 2 bolts.

   Standard:
   T = 55 N·m (561 kgf·cm) [41 ft·lbf]

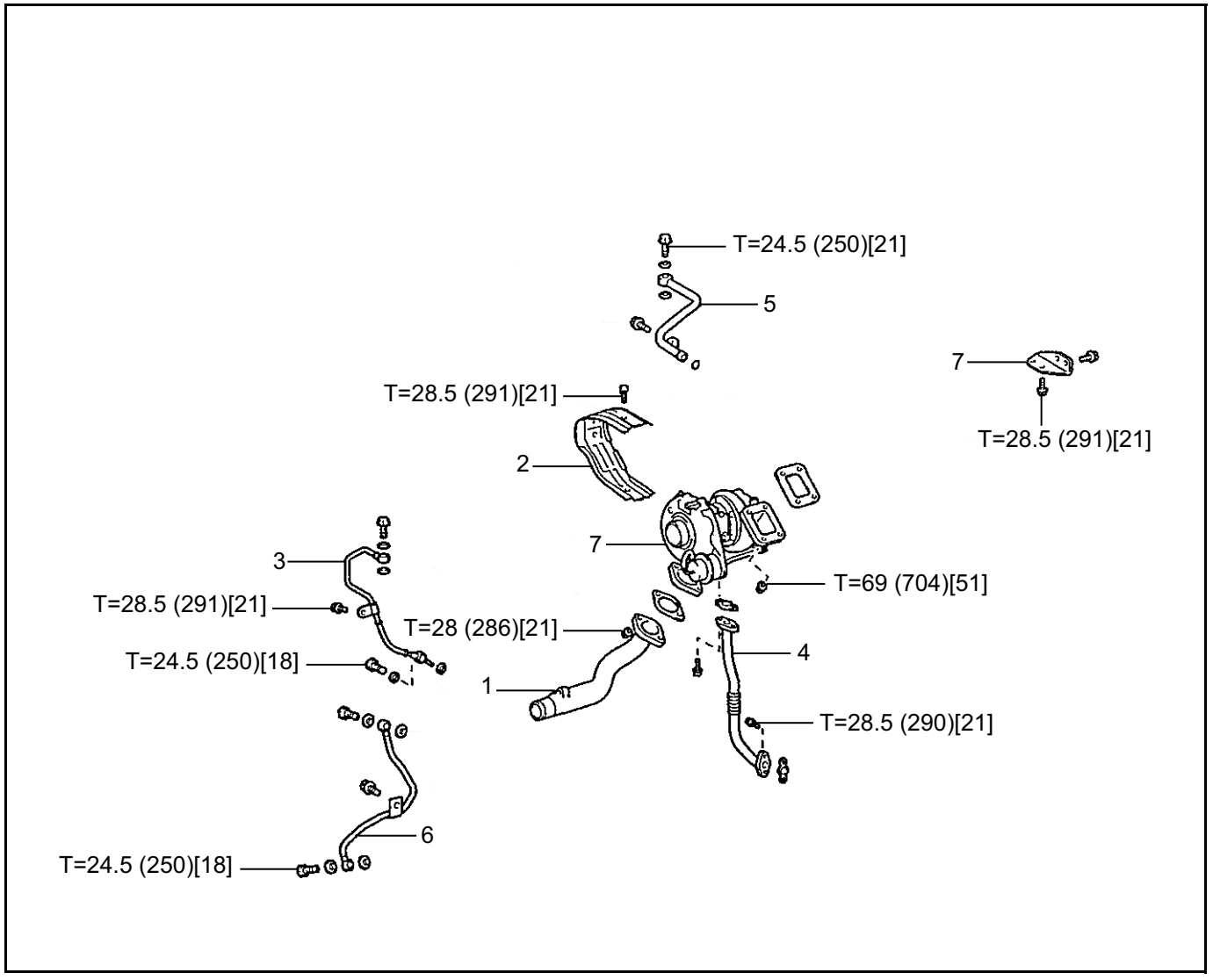
   (2) Install the wire harness to the terminal B with the nut. Connect the connector.
3. Installing the fan & alternator V-belt
4. Inspection of the fan & alternator V-belt
5. Installing the air hose No.1
6. Adding the coolant
7. Inspection of coolant leak

TURBOCHARGER SYSTEM

TURBOCHARGER ASSY

REMOVAL AND INSTALLATION

T = N·m (kgf·cm) [ft·lbf]



Removal and installation procedure

No.	Item	Removal	Inspection	Installation
1	Intake pipe	**[Point 1]**		**[Point 15]**
2	Turbo insulator No.1	**[Point 2]**		**[Point 14]**
3	Inlet oil pipe	**[Point 3]**		**[Point 13]**
4	Outlet oil pipe	**[Point 4]**		**[Point 12]**
5	Turbo water pipe No.1	**[Point 5]**		**[Point 11]**
6	Turbo water pipe No.2	**[Point 6]**		**[Point 10]**
7	Bracket			**[Point 9]**
8	Turbocharger ASSY	**[Point 7]**		**[Point 8]**

Point Operation

1. Draining the coolant
2. Disconnecting the air hose ASSY
   Loosen the hose clamp, remove the bolt and disconnect the air hose ASSY from the turbocharger ASSY.
3. Removing the ventilation pipe No.2
   (1) Disconnect the breather hose.
   (2) Remove 3 bolts and remove the ventilation pipe No.2.
4. Removing the EGR cooler
   (1) Disconnect the water bypass hose.
   (2) Remove 6 bolts and remove the EGR cooler.
5. Removing the exhaust front pipe

[Point 1]

1. Removing the intake pipe
   (1) Loosen the hose clamp and disconnect the air hose No.2.
   (2) Remove 2 nuts and remove the intake pipe.
2. Removing the bracket
   (1) Remove 2 bolts and remove the bracket.

[Point 2]
Removing the turbo insulator No.1
   (1) Remove 2 bolts and remove the turbo insulator No.1

[Point 3]
Removing the inlet oil pipe
   (1) Remove the inlet oil pipe with the bolt and 2 union bolts.

[Point 4]
Removing the outlet oil pipe
   (1) Remove 4 bolts and remove the outlet oil pipe.

[Point 5]
Removing the turbo water pipe No.1

[Point 6]
Removing the turbo water pipe No.2

[Point 7]

1. Removing the bracket
2. Removing the turbine outlet elbow
3. Removing the turbocharger ASSY
   (1) Remove 4 bolts and remove the turbocharger ASSY.

[Point 8]
Installing the turbocharger ASSY
Install the turbocharger ASSY with 4 bolts through the new gaskets.

Standard:
T = 69 N·m (704 kgf·cm) [51 ft·lbf]

[Point 9]
Installing the bracket
Install the bracket with 4 bolts.

Standard:
T = 28.5 N·m (291 kgf·cm) [21 ft·lbf]

[Point 10]
Installing the turbo water pipe No.2
Install the turbo water pipe No.2 with the union bolt through the new gasket.

Standard:
T = 24.5 N·m (250 kgf·cm) [18 ft·lbf]

[Point 11]
Installing the turbo water pipe No.1

(1) Install the turbo water pipe No.1 with the union bolt through the new gasket.

Standard:
T = 24.5 N·m (250 kgf·cm) [18 ft·lbf]

[Point 12]
Installing the outlet oil pipe

(1) Install the outlet oil pipe with 4 bolts trough the new gaskets.

Standard:
T = 28.5 N·m (291 kgf·cm) [21 ft·lbf]

[Point 13]
Installing the inlet oil pipe

(1) Install the inlet oil pipe with 2 union bolts and a bolt through the new gaskets.

Standard:
T = 28.5 N·m (291 kgf·cm) [21 ft·lbf] (bolt)
T = 24.5 N·m (250 kgf·cm) [18 ft·lbf] (union bolt)

[Point 14]

1. Installing the turbo insulator No.1

(1) Install the turbo insulator No.1 with 2 bolts.

Standard:
T = 28.5 N·m (291 kgf·cm) [21 ft·lbf]

[Point 15]

1. Installing the intake pipe

(1) Install the intake pipe with 2 nuts through the new gaskets.

Standard:
T = 28 N·m (286 kgf·cm) [21 ft·lbf]

(2) Connect the air hose No.2 and tighten it with the hose clamp.

2. Installing the exhaust front pipe
3. Installing the EGR cooler
4. Installing the ventilation pipe No.2

(1) Install the ventilation pipe No.2 with 3 bolts.

(2) Connect the breather hose.

5. Installing the air hose ASSY
   (1) Tighten the air hose ASSY to the turbocharger ASSY with the hose clamp.
   (2) Install the air hose ASSY with the bolt.
6. Adding the coolant
7. Inspection of coolant leak
8. Inspection of exhaust leak

APPENDIX

Page

SST LIST

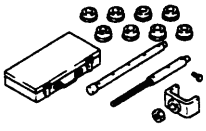
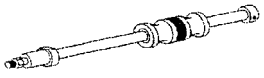
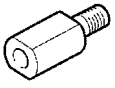
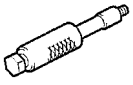
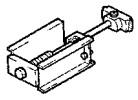
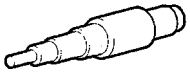
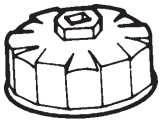
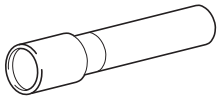
Illustration	Part No.	Part name	Section						
			2	3	4	5	6	7	8
	09201-76002-71 (09201-10000)	Remover and replacer, valve guide bush	○						
	09050-32720-71	Compressor, valve spring	○						
	09215-76004-71 (09215-00101)	Remover and replacer, camshaft bearing	○						
	09950-76018-71 (09950-60010)	Replacer set	○						
	09950-76020-71 (09950-70010)	Handle set	○						
	09060-32720-71	Sliding hummer	○			○			
	090229-88460-71	Puller cramp	○			○			
	09010-33940-71	Puller slide hummer	○			○			

Illustration	Part No.	Part name	Section						
			2	3	4	5	6	7	8
	09040-33910-71	Puller, cylinder liner	○						
	09020-33940-71	Bar	○						
	09030-33940-71	Ball	○						
	09012-33910-71	Front oil seal press	○						
	09950-76014-71 (09950-40011)	Puller B set	○						
	09040-33940-71	Oil filter Wrench	○			○			
	09110-33910-71	Piston ring holder	○						
	09050-33940-71	Bar	○						

9

SERVICE STANDARDS

ENGINE

Cylinder head

Lower surface distortion limit mm (in.)			0.1 (0.004)
Distortion limit for mounting surface of the manifold mm (in.)			0.1 (0.004)
Valve seat	Correction angle	IN	30°
		EX	45°
	Contact width standard mm (in.)		1.24 (0.049)
	Standard	IN (Inside diameter)	36.000 to 36.015 (1.4173 to 1.4179)
		IN (Depth)	8.4 to 8.6 (0.331 to 0.339)
		EX (Inside diameter)	32.000 to 32.016 (1.2598 to 1.2605)
		EX (Depth)	7.6 to 7.8 (0.30 to 0.31)
Bore (Valve guide bushing) mm (in.)	Standard		13.000 to 13.018 (0.5118 to 0.5125)

Valve guide bushing

Bore mm (in.)	Standard	7.000 to 7.015 (0.2756 to 0.2762)
Protrusion from head top surface	Standard	26.4 to 26.8 (1.039 to 1.055)
Protrusion from head top surface (with valve stem seal)	Standard	29.0 to 29.5 (1.14 to 1.16)

Valve

Stem section outside diameter mm (in.)	Standard	IN	6.957 to 6.972 (0.2739 to 0.2745)
		EX	6.932 to 6.947 (0.2729 to 0.2735)
Oil clearance with the valve guide bushing mm (in.)	Standard	IN	0.023 to 0.058 (0.0009 to 0.0023)
		EX	0.050 to 0.083 (0.0020 to 0.0033)
	Limit	IN	0.12 (0.005)
		EX	0.15 (0.006)

Valve spring

Free length mm (in.)	Standard	85.1 (3.35)
	Limit	82.1 (3.23)
Squareness mm (in.)		2.0 (0.079)

Rocker arm & shaft

Rocker arm inside diameter mm (in.)	Standard	22.023 to 22.052 (0.8670 to 0.8682)
	Limit	22.08 (0.869)
Rocker shaft outside diameter mm (in.)	Standard	21.959 to 21.980 (0.8645 to 0.8654)
	Limit	21.92 (0.863)
Oil clearance between the rocker shaft and rocker arm mm (in.)	Standard	0.043 to 0.093 (0.0017 to 0.0059)
	Limit	0.15 (0.006)

Push rod

Face runout limit mm (in.)	0.30 (0.118)

Camshaft

Face runout limit			mm (in.)	0.06 (0.0024)
Cam height	mm (in.)	Standard	IN	50.6576 to 50.8596 (1.9944 to 2.0023)
			EX	49.3561 to 49.5581 (1.9431 to 1.9511)
		Limit	IN	50.20 (1.98)
			EX	48.95 (1.927)
Cam journal outside diameter	mm (in.)	Standard	No.1	57.035 to 57.135 (2.2455 to 2.2494)
			No.2	56.835 to 56.935 (2.2376 to 2.2415)
			No.3	56.635 to 56.735 (2.2297 to 2.2337)
Camshaft bearing inside diameter	mm (in.)	Standard	No.1	56.95 to 56.97 (2.242 to 2.243)
			No.2	56.75 to 56.77 (2.234 to 2.235)
			No.3	56.55 to 56.57 (2.226 to 2.227)
Camshaft journal oil clearance	mm (in.)	Standard		0.03 to 0.12 (0.001 to 0.005)
		Limit		0.15 (0.006)

Timing gear and Idle gear

Idle gear No.1 thrust clearance	mm (in.)	Standard	0.103 to 0.164 (0.0041 to 0.0065)
		Limit	0.15 (0.006)
Idle gear No.1 inside diameter	mm (in.)	Standard	50.00 to 50.025 (1.9685 to 1.9695)
		Limit	50.05 (1.971)
Idle gear shaft No.1 outside diameter	mm (in.)	Standard	49.950 to 49.975 (1.9665 to 1.9675)
		Limit	49.95 (1.967)
Idle gear No.1 oil clearance	mm (in.)	Standard	0.0125 to 0.0375 (0.0005 to 0.0015)
		Limit	0.1 (0.004)
Idle gear No.2 thrust clearance	mm (in.)	Standard	0.103 to 0.164 (0.0041 to 0.0065)
		Limit	0.3 (0.012)
Idle gear No.2 inside diameter	mm (in.)	Standard	50.00 to 50.025 (1.9685 to 1.9695)
		Limit	50.05 (1.971)
Idle gear shaft No.2 outside diameter	mm (in.)	Standard	49.950 to 49.975 (1.9665 to 1.9675)
		Limit	49.95 (1.967)
Idle gear No.2 oil clearance	mm (in.)	Standard	0.0125 to 0.0375 (0.0005 to 0.0015)
		Limit	0.1 (0.004)
Gear backlash (Idle gear No.1 × Idle gear No.2)	mm (in.)	Standard	0.036 to 0.227 (0.0014 to 0.0089)
		Limit	0.3 (0.012)
Gear backlash (Camshaft gear × Idle gear No.1)	mm (in.)	Standard	0.069 to 0.203 (0.0027 to 0.008)
		Limit	0.3 (0.0012)
Gear backlash (Oil pump gear × Idle gear No.1)	mm (in.)	Standard	0.065 to 0.215 (0.0026 to 0.0085)
		Limit	0.3 (0.0012)
Gear backlash (Crankshaft gear × Idle gear No.1)	mm (in.)	Standard	0.035 to 0.193 (0.0014 to 0.0076)
		Limit	0.3 (0.0012)

Cylinder block

Top surface distortion limit mm (in.)		0.1
Cylinder bore mm (in.)	Standard	104.012 to 104.036 (4.095 to 4.0959)
	Limit	104.15 (4.1004)
Cylinder liner outside diameter mm (in.)	A	106.982 to 106.989 (4.2119 to 4.2122)
	B	106.990 to 106.995 (4.2122 to 4.2124)
	C	106.996 to 107.004 (4.2124 to 4.2127)
Cylinder hole bore liner mm (in.)	A	107.000 to 107.008 (4.2126 to 4.2129)
	B	107.008 to 107.014 (4.2129 to 4.2131)
	C	107.014 to 107.022 (4.2131 to 4.2135)

Piston, piston pin, piston ring

Piston outside diameter mm (in.)	Standard		103.936 to 103.952 (4.0920 to 4.0926)
Clearance between the piston ring and ring groove mm (in.)	Standard	No.1	0.11 to 0.15 (0.004 to 0.006)
		No.2	0.07 to 0.11 (0.003 to 0.004)
		No.3	0.02 to 0.06 (0.001 to 0.002)
Piston ring gap mm (in.)	Standard	No.1	0.30 to 0.45 (0.012 to 0.018)
		No.2	0.50 to 0.65 (0.020 to 0.036)
		No.3	0.15 to 0.30 (0.006 to 0.012)
Piston pin outside diameter mm (in.)			36.989 to 37.000 (1.4563 to 1.4567)
Piston pin hole inside diameter mm (in.)			36.987 to 37.003 (1.4562 to 1.4568)
Oil clearance (Piston to Piston pin) mm (in.)	Standard		-0.013 to 0.014 (-0.0005 to 0.0006)
	Limit		0.05 (0.002)

Connecting rod

Thrust clearance mm (in.)	Standard	0.020 to 0.52 (0.001 to 0.021)
	Limit	0.6 (0.024)
Bush inside diameter mm (in.)		37.035 to 37.045 (1.4581 to 1.4585)
Oil clearance (Bush to Piston pin) mm (in.)	Standard	0.35 to 0.056 (0.0014 to 0.0022)
	Limit	0.08 (0.031)
Oil clearance (Bearing cap) mm (in.)	Standard	0.031 to 0.082 mm (0.012 to 0.032)
	Limit	0.2 (0.008)
Bearing inside diameter mm (in.)	Standard	61.940 to 61.960 (2.4386 to 2.4394)
	0.25US	61.690 to 61.710 (2.4394 to 2.4295)
	0.50US	61.440 to 61.46 (2.4189 to 2.4197)
	0.75US	61.190 to 61.210 (2.4091 to 2.4098)
	1.00US	60.940 to 60.960 (2.3992 to 2.4000)

Crankshaft

Thrust clearance	mm (in.)	Standard	0.05 to 0.22 (0.002 to 0.009)
		Limit	0.4 (0.02)
Journal outside diameter	mm (in.)	Standard	72.940 to 72.960 (2.8716 to 2.8724)
		0.25US	72.690 to 72.710 (2.8724 to 2.8626)
		0.50US	72.440 to 72.460 (2.852 to 2.8528)
		0.75US	72.190 to 72.210 (2.8421 to 2.8429)
		1.00US	71.940 to 71.960 (2.8323 to 2.8331)
No.4 Journal outside diameter	mm (in.)	Standard	34.000 to 34.080 (1.3386 to 1.3417)
		Limit	34.48 (1.3575)
Oil clearance	mm (in.)	Standard	0.051 to 0.102 (0.0020 to 0.0040)
		Limit	0.2 (0.008)
Crank pin outside diameter	mm (in.)	Standard	61.940 to 61.960 (2.4386 to 2.4394)
Face runout limit			mm (in.) 0.04 (0.001)

Engine adjustment

Coolant capacity			Refer to repair manual for each vehicle model.
Lubricating oil capacity	ℓ (US gal)	Oil pan capacity	5.9 (1.6)
Idle speed			Refer to repair manual for each vehicle model.
No-load maximum speed			Refer to repair manual for each vehicle model.
Compression		Standard	Refer to repair manual for each vehicle model.
		Limit	
		Cylinder difference	

TIGHTENING TORQUE FOR EACH PART

Tightening place		Tightening torque N·m (kgf·cm) [ft·lbf]
Cylinder block × Cylinder head		60 (612) [44.3]
		55 (560) [40.1]
Cylinder block × Camshaft thrust plate		29 (290) [21.4]
Cylinder block × No.1 idle gear shaft		137 (1400) [101.1]
Cylinder block × No.2 idle gear shaft		55 (560) [40.1]
Cylinder block × No.2 idle gear thrust plate		55 (560) [40.1]
Cylinder block × Oil pan		295 (290) [21.4]
Cylinder block × Crankshaft bearing cap		60 (612) [44.3]
Cylinder block × Flywheel housing	M8	29 (296) [21.4]
	M14	132 (1346) [97.4]
Cylinder block × Front end plate		29 (296) [21.4]
Cylinder block × Oil pump		29 (296) [21.4]
Cylinder head × Cylinder head cover		29 (296) [21.4]
Cylinder head × Rocker shaft		69 (704) [50.9]
Cylinder head × Rocker arm		29 (290) [21.4]
Crankshaft × Crankshaft pulley		519 (5300) [382.8]
Connecting rod × Connecting rod cap		30 (306) [22.1]
Water inlet × Water pump		28.5 (290) [21.0]
Water pump × Fan, Fan pulley		28.5 (290) [21.0]