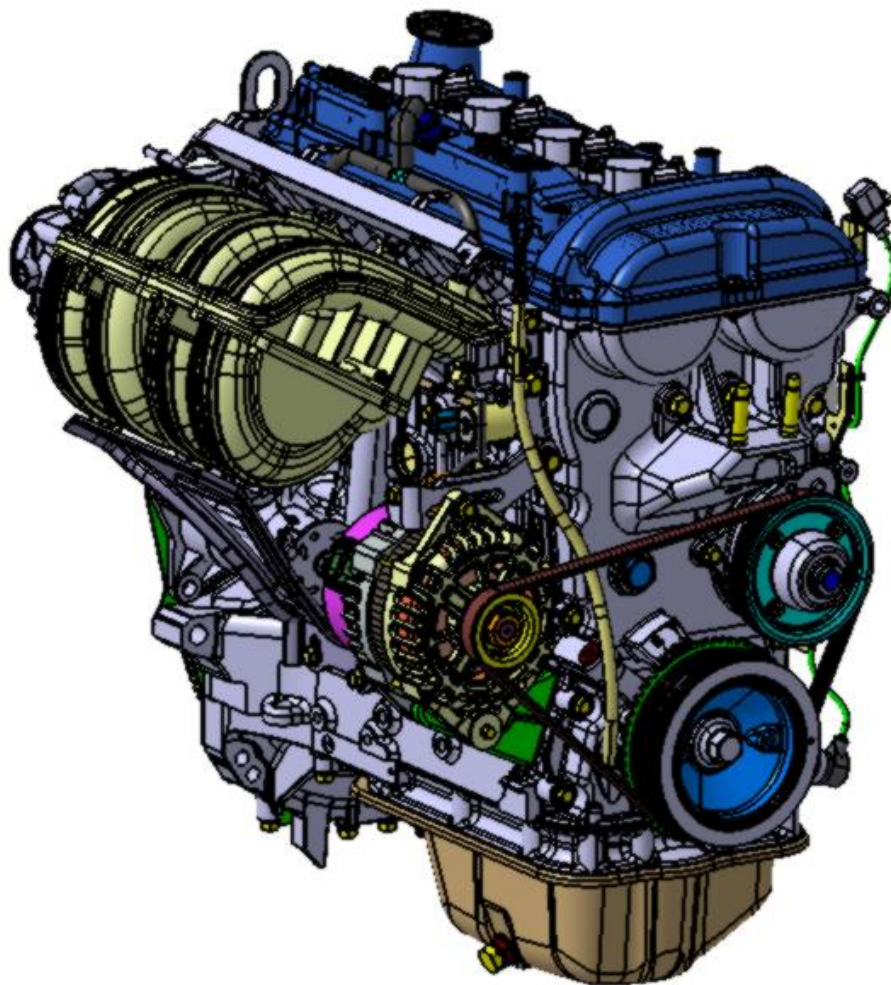




HM484Q Engine

Service Manual



Preface

The maintenance and repair of engine is a highly professional work. If not received the maintenance-related technical training, it is likely to cause property damage or personal injury during maintenance operations. Therefore, it is very necessary to receive the appropriate training or learn by yourself the related technical information prior to the engine maintenance and repair work

This manual mainly describes the maintenance and repair operations of HM484Q series engine, and related technical parameters of process standards. In the course of use, it is proposed to apply in combination with the maintenance manual, circuit diagrams and other relevant information of corresponding vehicle, and strictly comply with the operation practice presented in these materials.

The contents of manual are categorized according to the component assemblies and systems of engine (Such as: generator, starter, lubrication system, etc.); the order of each part of content in this manual is arranged according to the order broken down of engine from outside to inside (the engine can be completely decomposed as per the order of operations set out in this manual that). It is proposed to read through this manual before the operations of repair and maintenance.

All contents of this manual are the latest information at the time of publication, and the applied data are in line with the technical standards of HM484Q series. FAW HAIMA Power Co., Ltd. reserves the right to change the engine technique features and contents relevant in this manual. The technical personnel using this manual shall pay attention to the updated information at any time.

FAW HAIMA Power Co., Ltd

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How to Use This Manual

Subject scope

- I This manual includes procedures for maintenance operations, specifically divided into the following five basic operations.
 - I Removal/installation
 - II Break down/installation
 - III Reset
 - IV Check
 - V Adjustment
- I Simple operations may be completed by observing the engine outlook, e.g. Removal/installation of peripheral parts, parts cleaning and visual observation etc.,

Repair steps

1. Prior to the most of the maintenance work, the illustrations shall be observed, as it can identify the parts, explaining how they were fixed together, how to check the appearance of parts. Figure descriptions are available for the removal and installation to be demonstrated by the system.
2. The vulnerable parts, tightening torque and lubricants, as well as the sealants symbols are illustrated in the figures, of the tags and instructions were also made for the special tools or equipment required by the removal or installation.
3. The operation sequences and the main operation procedures of parts have the corresponding number in the chart descriptions. This information is often the key or core elementary content of diagnostic procedures, please refer to this information at the time of the maintenance of spare-parts.

Cue signal

In the manual, you will read the warnings, cautions, attentions, statements and the upper/lower limits.

Warning

- I Alert that it will cause personal injury if neglected.

Caution

- I Note that it may cause engine damage if neglected.

Attention

- I Attention to additional information provided to complete some programs.

Statement

- I Prompt the tolerant range when checking or adjusting.

Upper/Lower Limits

- I Prompt the upper and lower limit not to exceed when checking or adjusting.

Technique parameters

Technique parameters

Technique parameters of complete apparatus

Items		Parameters		Remark
Model		HM484Q	HM484Q-B	
Number of cylinders and arrangement		Inline 4-cylinder		
Combustion chamber		Pentroof		
Ignition order		1—3—4—2		As per cylinder number
Direction of rotation		Counterclockwise		Looking forward from behind (the flywheel side is the back end)
Valve timing mechanism		Double overhead camshaft, timing sprocket drive, double VVT		
Number of valves		16		
Displacement (cc)		1995	1840	
Cylinder bore × stroke (mm)		84×90	84×83	
Compression ratio		10		
Valve timing (°)	Intake	On	-4~36(BTDC)	
		Off	64~24(ABDC)	
	Exhaust	On	56~32(BBDC)	
		Off	0~24(ATDC)	
Maximum power (kW/rpm)		102/6000	94/6000	
Maximum torque (N·m/rpm)		180/4500	166/4500	
Idling speed (rpm)		A/C Idle: 800±50		
		Target idle speed: 750±50		
Spark advance angle (°)		6±3		In the idle state
Starting method		Electric start		
Cooling method		Water cooling forced circulation		
Lubrication method		Pressure and splashing complex		
Overall dimension (mm)		584.1×638.1×641.9		
Net mass (kg)		130	128.25	

Technique parameters

Technical specification of service

Items		Parameters	
Cylinder cover			
Height (mm{in})	Standard	124.45 ~ 124.55{4.8996 ~ 4.9035}	
	Maximum grinding allowance	0.2{0.0078}	
Deformation at joint face of cylinder gasket (mm{in})	Max.	0.03{0.0011}	
Deformation at joint face of manifold (mm{in})	Max.	0.05{0.0019}	
	Maximum grinding allowance	0.20{0.0078}	
Valve gap (cold status of engine) (mm{in})	Intake	0.18~0.26{0.007~0.0102}	
	Exhaust	0.26~0.34{0.0102~0.0133}	
Valve and valve guide pipe			
Edge thickness (mm{in})	Intake	Standard	0.85{0.0334}
		Min.	0.35{0.014}
	Exhaust	Standard	1.50{0.0590}
		Min.	0.9{0.035}
Valve length (mm{in})	Intake	Standard	101.15 ~ 101.65{3.9822 ~ 4.0019}
		Min.	100.95{3.9744}
	Exhaust	Standard	101.07 ~ 101.57{3.9791 ~ 3.9988}
		Min.	100.87{3.9712}
Valve stem diameter (mm{in})	Intake	Standard	4.965~4.980{0.1954~0.1960}
		Min.	4.915{0.1935}
	Exhaust	Standard	4.955~4.970{0.195~0.1956}
		Min.	4.905{0.1931}
I.D. of valve duct (mm{in})	Standard	5-5.012{0.1968-0.1973}	
	Enlarged size	5.012-5.022{0.1973-0.1977}	
Protrusion height of valve guide pipe (mm{in})	Intake	19.8-20.4{0.7795-0.8031}	
	Exhaust	14.6-15.2{0.5748-0.5984}	
Valve seat			
Contact width of valve seat (mm{in})		0.9~1.3{0.0354~0.0511}	
Valve seat angle (°)	Intake	43.5~44	
	Exhaust	43.5~44	
Sink of valve seat (protrusion height of valve) (mm{in})	Intake	44.37{1.7468}	
	Exhaust	44.37{1.7468}	

Technique parameters

Technical specification of service

Items		Parameters	
Valve spring			
Height H pressure of valve spring (N{kgf, lbf})	Intake	H: 38.8mm {1.528in}	203 ~ 225 {20.71 ~ 22.95, 45.62 ~ 50.56}
	Exhaust	H: 38.8mm {1.528in}	203 ~ 225 {20.71 ~ 22.95, 45.62 ~ 50.56}
Perpendicularity (mm{in})	Intake	Max.	1.86{0.073}
	Exhaust	Max.	1.86{0.073}
Valve oil seal			
Depth L (mm{in})	Intake		22.1{0.87}
	Exhaust		16.9{0.665}
Camshaft			
Axial run-out of camshaft (mm{in})		Max.	0.03{0.0012}
Protrusion height of cam (mm{in})	Intake	Standard	43.81{1.7248}
		Min.	43.61{1.7169}
	Exhaust	Standard	43.78{1.7236}
		Min.	43.58{1.7157}
Journal diameter (mm{in})		Standard	25.936 ~ 25.965{1.0211 ~ 1.0222}
		Min.	25.906{1.0199}
Journal gap (mm{in})		Standard	0.035 ~ 0.085{0.0014 ~ 0.0033}
End gap (mm{in})		Standard	0.08 ~ 0.20{0.0031 ~ 0.0078}
		Max.	0.21{0.0082}
Tappet			
Tappet hole diameter (mm{in})		Standard	31.000 ~ 31.025{1.2205 ~ 1.2215}
Tappet diameter (mm{in})		Standard	30.964 ~ 30.980{1.2191 ~ 1.2197}
Gap between tappet and tappet hole (mm{in})		Standard	0.020 ~ 0.061{0.00079 ~ 0.00240}
		Max.	0.180{0.0071}
Cylinder block			
Height (from top surface to main cover boundary line) (mm{in})		Standard	273.5{10.7677}
		Maximum grinding allowance	0.20{0.008}
Deformation at top surface (mm{in})		Standard	0.05{0.002}

Technique parameters

Technical specification of service

Items		Parameters	
Cylinder bore diameter [measured at 37mm (1.45in) below top surface] (mm{in})	Standard	84.00~84.03{3.3071~3.3083}	
	Oversize: 0.25{0.01}	84.25~84.28{3.3169~3.3181}	
	Oversize: 0.50{0.02}	84.50~84.53{3.3268~3.3279}	
Wearing limit (mm{in})		0.15{0.006}	
Piston diameter (mm{in}) [Measured at 28mm {1.1in} below lower edge of oil ring groove, perpendicular to the piston pin hole axis]	Standard	83.97~84{3.305~3.3071}	
	Oversize: 0.25{0.01}	84.22~84.25{3.3157~3.3169}	
	Oversize: 0.50{0.02}	84.47~84.50{3.3256~3.3268}	
Gap between piston and cylinder bore (mm{in})	Standard	0.02~0.04{0.0008~0.0016}	
	Max.	0.10{0.004}	
Piston ring			
Gap between piston ring and ring groove (mm{in})	Top ring	Standard	0.030~0.070{0.0012~0.0027}
	Second ring	Standard	0.020~0.060{0.0008~0.0024}
	Oil ring	Standard	0.040~0.120{0.0016~0.0047}
	Top ring/second ring	Max.	0.15{0.006}
	Oil ring	Max.	0.15{0.006}
Opening gap[measured within cylinder] (mm{in})	Top ring	0.20~0.35{0.008~0.014}	
	Second ring	0.30~0.45{0.012~0.018}	
	Oil ring	0.20~0.50{0.008~0.020}	
	Max.	1.0{0.039}	
Piston pin			
Piston pin diameter (mm{in})	Standard	19.002~19.005{0.7481~0.7482}	
Piston pin hole diameter (mm{in})	Standard	19.010~19.015{0.7484~0.7486}	
Gap between small end hole of connecting rod and piston pin (mm{in})	Standard	-0.031~-0.017{-0.0013~ -0.0007}	
Gap between piston pin hole and piston pin (mm{in})	Standard	0.005~0.013{0.000~0.0005}	
Connecting rod and connecting rod bearing			
Length [from center to center] (mm{in})	Standard	139.9~140{5.5118~5.5079}	
Small end bore diameter of connecting rod (mm{in})	Standard	18.974~18.985{0.7476~ 0.7474}	
Connecting rod end gap	Standard	0.100~0.250{0.004~0.010}	

Technique parameters

Technical specification of service

Items		Parameters
(mm{in})	Max.	0.30{0.012}
Connecting rod bush size (mm{in})	Standard	1.487~1.499{0.05854~0.05902}
	0.25{0.01} reduced size	1.612~1.624{0.06346~0.06394}
	0.50{0.02} reduced size	1.737~1.749{0.06839~0.06886}

Technical specification of service

Items		Parameters
Connecting rod bearing gap (mm{in})	Standard	0.015~0.048{0.0006~0.0019}
	Max.	0.10{0.0039}
Crankshaft		
Axial run-out of crankshaft (mm{in})		0.03{0.0012}
Main journal diameter (mm{in})	Standard	49.982~50.000{1.9678~1.9685}
	0.25{0.01} reduced size	49.732~9.75{1.9580~1.9586}
Main journal gap (mm{in})	Standard	0.018~0.036{0.00071~0.00142}
	Max.	0.1{0.0039}
Main shaft bush size (mm{in})	Standard	1.988~2.003{0.0783~0.0789}
	0.25{0.01} reduced size	2.113~2.128{0.0831~0.0837}
Crank pin diameter (mm{in})	Standard	44.980~45.000{1.7709~1.7717}
	0.25{0.01} reduced size	44.730~44.750{1.7610~1.7618}
	0.50{0.02} reduced size	44.480~44.500{1.7512~1.7520}
Crankshaft		
Thrust bearing size (mm{in})	Standard	1.925~1.975{0.0758~0.0778}
	0.25{0.01} reduced size	2.050~2.100{0.0807~0.0827}
	0.50{0.02} reduced size	2.175~2.225{0.0856~0.0876}
	0.75{0.03} reduced size	2.300~2.350{0.0906~0.0925}
Crankshaft end gap (mm{in})	Standard	0.05~0.25{0.002~0.010}
	Max.	0.30{0.012}
Onboard checking		

Technique parameters

Technical specification of service

Items		Parameters
Compression pressure kpa{kgf/cm ² ,psi}[rpm]}	Standard value	1370{14.0, 199}[300]
	Minimum limit	1080{11.0, 156}[300]
	Maximum limit of pressure difference among cylinders	200{2.0, 28}
Engine oil pressure (kpa{kgf/cm ² , psi}[rpm])		446~588{4.6~6.1, 64~84}[2500]
Engine oil filling amount L{US qt, Imp qt}	Replacement of engine oil	3.1{3.2, 2.7}
	Replacement of engine oil and engine oil filter	3.3{3.5, 2.9}
Engine oil grade		API engine oil grade SJ or above
Engine oil viscosity grade	Above -25 °C{13°F}	SAE 10W-30
	-30 °C-37 °C{-22 °F-98 °F}	SAE 5W-30
Alternator belt		
Deflection (mm{in}) [With a 98N {10kgf,22lbf} force applied in the middle]	New	6.5~7.5{0.26~0.29}
	Old	7.0~9.0{0.28~0.35}
	Limit	10{0.39}
Tension force N{kgf,lbf}	New	686~834{70~85, 160~180}
	Old	490~686{50~70, 120~150}
	Limit	392{40, 88}
Starter		
Unloaded test	Voltage (V)	14
	Current (A)	110
Assembly/disassembly part of timing chain		
Extension length of automatic tensioner push rod (mm{in})		3{0.1181}
Crankshaft speed sensor		
Gap between signal wheel and sensor (mm{in})		0.5~1.1{0.020~0.043}
Thermostat		
Open temperature (°C{°F})		80~84{176~183}
Full open temperature (°C{°F})		95{203}
Full open travel (mm{in})		≥8.5{0.33}
Clutch pressure plate		
Diaphragm spring	Depth (mm{in})	≤0.6{0.024}
	Radial run-out (mm{in})	≤0.6{0.024}
Flatness of pressure plate (mm{in})		0.05{0.0019}
Clutch friction plate		

Technique parameters

Technical specification of service

Items		Parameters
Thickness of prominent rivet(mm{in})		≥0.3{0.012}
radical cycle run-out(mm{in})		≤0.7{0.028}
Flywheel		
Radial run-out (mm{in})		≤0.13{0.0051}
Engine oil pump		
Gap between inner rotor tooth tip to outer rotor (mm{in})	Standard	0.06~0.18{0.0024~0.0070}
	Max.	0.22{0.009}
Gap between outer rotor and pump body (mm{in})	Standard	0.100~0.181{0.0040~0.0071}
	Max.	0.22{0.009}
Backlash (mm{in})	Standard	0.040~0.095{0.0016~0.0038}
	Max.	0.14{0.006}
Pressure spring length (mm{in}) Pressure: 82.6-90.4N {8.43-9.22kgf, 18.56-20.31lbf}		35.15{1.3839}
Knock-in distance of front end oil seal (mm{in}) [from engine oil pump body edge]		0~1.0{0~0.039}
Rear oil seal		
Knock-in distance of rear oil seal (mm{in}) [from the edge of crankshaft rear cap]		0~0.5{0~0.019}
Plastic tightening bolt length		
Cylinder cover bolt (mm{in})	Standard	104.2~104.8{4.103~4.125}
	Max.	105.5{4.154}
Main bearing cap bolt (mm{in})	Standard	67.7~68.3{2.665~2.689}
	Max.	68.7{2.705}
Connecting rod cover bolt (mm{in})	Standard	46.7~47.3{1.838~1.862}
	Max.	47.6{1.874}

Tightening torque

Installation location	Torque rating			Remark
	N•m	kgf•m	ft•lbf	
Generator				

Technique parameters


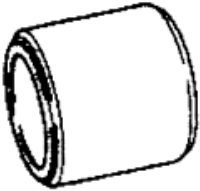
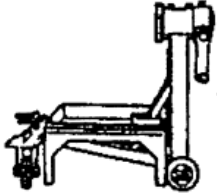


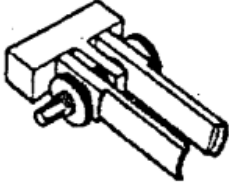
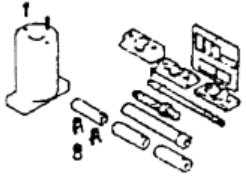
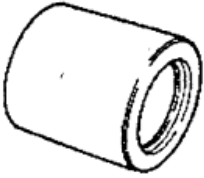
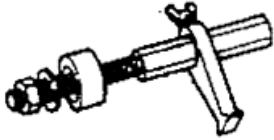
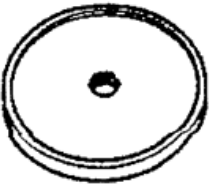


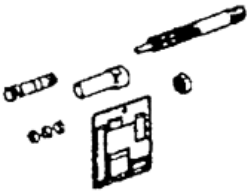
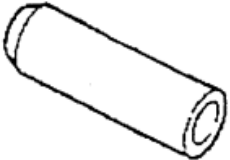

Installation location	Torque rating			Remark
	N•m	kgf•m	ft•lbf	
Bearing	45.1	4.6	33.0	
Adjustable arm	45.1	4.6	33.0	
Adjustment slider	21.6	2.2	15.8	
Ignition and control systems				
Ignition coil	8.8	0.9	6.4	
Spark plug	25	2.6	18.3	
Fuel rail	21.6	2.2	15.8	
Camshaft position sensor	8.8	0.9	6.4	
Water temperature sensor	15	1.53	10.9	
Knock sensor	21.6	2.2	15.8	
Knock sensor bracket	8.8	0.9	6.4	
Crankshaft speed sensor clamp and bracket	8.8	0.9	6.4	
Crankshaft speed sensor	8.8	0.9	6.4	
OCV valve	8.8	0.9	6.4	
Intake and Exhaust System				
Throttle body	8.8	0.9	6.4	
Intake manifold	21.6	2.2	15.8	
Intake manifold bracket(Manifold side)	21.6	2.2	15.8	
Intake manifold bracket (Cylinder block side)	45.1	4.6	33.0	
Exhaust manifold	21.6	2.2	15.8	
Thermal shield of exhaust manifold	21.6	2.2	15.8	
Lubrication system				
Oil switch	14.7	1.5	10.7	
Oil filter	15	1.53	10.9	
Oil filter connector	34.3	3.5	25.1	
Oil filter	8.8	0.9	6.4	
Oil pan body	21.6	2.2	15.8	
Oil pan	21.6	2.2	15.8	
Cold system				
Water pump	21.6	2.2	15.8	
Water pump pulley	8.8	0.9	6.4	

Technique parameters

Installation location	Torque rating			Remark
	N•m	kgf•m	ft•lbf	
Outlet pipe seat	21.6	2.2	15.8	
Thermostat switching section	21.6	2.2	15.8	
thermostat seat	21.6	2.2	15.8	
Bypass hose	21.6	2.2	15.8	
Bypass tube	21.6	2.2	15.8	
Cylinder block and crank connecting rod mechanisms				
Crankshaft pulley	162	16.7	118.4	
Flywheel	100	10.3	73.1	
Clutch partition	8.8	0.9	6.4	
Clutch compressing disc	21.6	2.2	15.8	
Crankshaft rear cover	8.8	0.9	6.4	
Main bearing cap	19.6	2.0	14.3	First determine the pre-tightening torque, and then tightening angle.
	Tightening 85°~ 95°			
Connecting rod cap	24.5	2.5	17.9	Please note the use limit of bolt length (See the corresponding section)
	Tightening 85°~ 95°			
Cylinder head, valve and others				
Cylinder head	19.6	2.0	14.3	First determine the pre-tightening torque, and then tightening angle. Please note the use limit of bolt length (See the corresponding section)
	Tightening 85°~ 95° Retightening 85°~ 95°			
Camshaft cover	12.7	1.3	9.3	
Cylinder head cover	8.8	0.9	6.4	
Oil pump and timing sprocket casing assemblies	21.6	2.2	15.8	Refer to the corresponding part of figure
	45.1	4.6	33.3	Refer to the corresponding part of figure
Upper guide of timing sprocket	8.8	0.9	6.4	
Timing sprocket guide rail	8.8	0.9	6.4	
Tensioner arm	19.1	1.9	14.1	
Timing sprocket tensioner	8.8	0.9	6.4	
VVT fixing bolt	60	6.12	43.6	
Front/rear hooks	45.1	4.6	33.0	



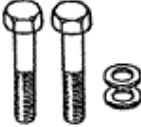

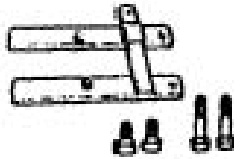



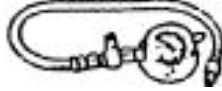

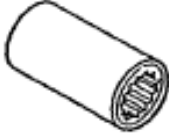




Special tool

Special tools

<p>49 T012 0A0A Tappet retainer component</p> 	<p>49 B014 001 Seal installer</p> 	<p>49 0107 680A Engine service platform</p> 
<p>49 L010 1A0 Engine hook components</p> 	<p>49 0636 100B Valve spring puller</p> 	<p>49 B012 0A2 Pivot</p> 
<p>49 L011 0A0B Piston pin assembly kit</p> 	<p>49 T028 302 Dust cover installer</p> 	<p>49 E011 1A0 Gear rim stop device</p> 
<p>49 W033 105 Seal installer</p> 	<p>49 G030 797 Handle (Part of 49G030 795)</p> 	<p>49 B012 005 Puller/installer of valve guide</p> 
<p>49 L012 0A0A Installer component of valve oil seal and guide</p> 	<p>49 E011 001 Guide apparatus</p> 	<p>49 S120 170 Puller of valve oil seal</p> 

Special tool

Special tools

<p>49 B010 001 Seal installer</p> 	<p>49 E011 002 Screw</p> 	<p>49 G011 103 Bolt component</p> 
<p>49 S12 710 Studded connection fixture</p> 	<p>49 E011 1A1 Fixture component</p> 	<p>49 H010 401 Seal installer</p> 
<p>49 G033 107A Dust cover installer</p> 	<p>49 9200 020A Belt pressure gauge</p> 	<p>49 0187 280A Oil pressure gauge</p> 
<p>49 G014 001 Oil filter sleeve</p> 	<p>49 D015 001 Extension sleeve</p> 	<p>49 1285 071 Needle bearing puller</p> 
<p>49 E011 1A0 Gear rim assembly fixtures</p> 	<p>49 SE01 310A Clutch disc positioning tool</p> 	<p>49 F028 202 Sleeve mounting unit</p> 

Inspection and maintenance on CBU

Check of compression pressure

Warning

I The oil temperature is very hot when the engine remains in warm-up state. In case of disassembly and assembly, be cautious of scald.

1. Warm up the engine to the normal operating temperature;
2. Flame out and let the engine cool down for 10mins;
3. Remove the fuel pump relay (See the appropriate CBU Service Manual);
4. Remove the spark plug of cylinder 1(See the Ignition and Control Systems);
5. Disconnect the harness joint of ignition coil (See the appropriate CBU Service Manual);
6. Connect a pressure gauge in the spark plug hole of cylinder 1;
7. Step to the end the throttle pedal and start the engine;
8. Record the max.reading of barometer;
9. Check each cylinder pressure as per the above-said method.

I If the pressure of one or more cylinders are too low, or the pressure difference between the cylinders too much exceeded the specified range, drop some dots of engine oil inside and recheck the pressure;

- If the pressure increased, the piston, piston ring and cylinder wall may be worn and the overhaul is necessary;
- If the pressure of adjacent cylinder is too low, it means that the cylinder pad may have been damaged or the cylinder head deformed, the overhaul is necessary;
- If the compression pressure is still low, it indicates that the valve may be clamped or the seal surface is not in tight contact and the overhaul is necessary;
- Compression pressure

kPa {kgf/cm², psi}[rpm]

Items	Compression pressure
Standard value	1370{14.0, 199}[300]
Minimum limit	1080{11.0, 156}[300]
Maximum limit of pressure difference among cylinders	200kPa {2.0kgf/cm ² , 28psi}

10. Take out the pressure gauge.
11. Connect the ignition coil harness.
12. Fit the fuel pump relay.
13. Fit the spark plug.

Tightening torque: 22~25N·m{2.3~2.6kgf·m, 16~18ft·lbf}.

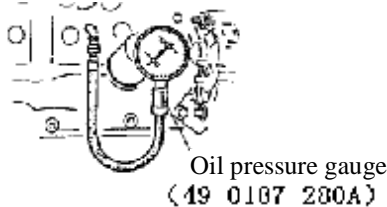
Check of oil pressure

Warning

- I **As waste oil is carcinogenic, wash your skin with soap and clean water after the work.**

The oil temperature of warm-up engine is very hot and easily scalding, operate after the engine shut down and cooled down.

1. Remove the oil pressure switch.
2. Fit the special tools on the mounting hole of oil pressure switch.



3. Warm up the engine to the normal operating temperature.
4. Bring the engine up to the specified speed and pay attention to the reading of oil gauge.

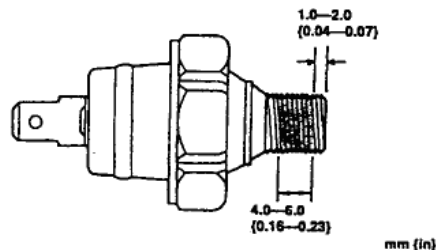
- I **If the pressure gauge is not within the specified range, check the reason and repair and replace as needed.**

Attention

- I **The oil of different viscosity and temperature may varies in pressure.**

Oil pressure: 446~588kPa{4.6~6.1kgf/cm², 64~841psi}[2500rpm]

5. Flame out the engine and let it cool down.
6. Remove the special tool.
7. As shown in the following Fig., evenly smear the sealant on the threads of oil pressure switch.

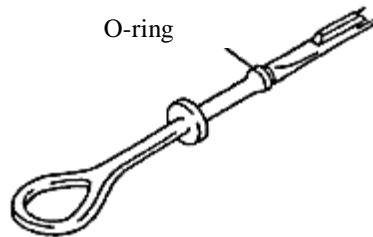


The bolt needs to smear the sealant when in reuse

8. Fit the oil pressure switch with the tightening torque: 12~14.7N·m{1.2~1.5kgf·m, 9~10.7ft·lbf}.
9. Start the engine and check whether there is any oil leakage.

Check of engine oil pressure

1. Park the vehicle on a flat ground;
2. Warm up the engine to the normal temperature and then shut down;
3. Wait for 5mins.
4. Pull out the dipstick and observe the oil level and state, check whether it remains between the scales F and L.
5. Fill up or replace oil as needed.
6. Confirm the assembly of dipstick O-ring as shown in the following Fig.



7. Reinsert the dipstick.

Replacement of engine oil pressure

Warning

- I **As the oil temperature of warm-up engine is very hot, be cautious of scalding.**
 - I **As waste oil is carcinogenic, wash your skin with soap and clean water after the work.**
1. Remove the oil filler cap and drain plug.
 2. Put the oil into a suitable vessel.
 3. Replace by a new gasket and fit the oil drain plug.
 4. Tightening torque: 30~41N·m{3.1~4.2kgf·m, 22~30ft·lbf}
 5. Fill into the engine the specified type and dosage of oil.
 6. Refit the oil filler cap.
 7. Start the engine and check for any leakage.
 8. Check the engine oil level and add as needed (See——Check of Engine Oil)

Attention

- I **In some cases, the real volume of oil added according to the scale may be different from the specified.**

Use of Engine Service Platform

Oil volume L{US qt, Imp qt}

Items	Volume
Oil replacement	3.1{3.2, 2.7}
Oil and filter replacement	3.3{3.5, 2.9}

Engine oil grading: more than API/SL.

Oil viscosity option standard	Oil viscosity grade
Higher than $-25^{\circ}\text{C}\{13^{\circ}\text{F}\}$	SAE 10W-30
$-30^{\circ}\text{C}\sim 37^{\circ}\text{C}\{-22^{\circ}\text{F}\sim 98^{\circ}\text{F}\}$	SAE 5W-30

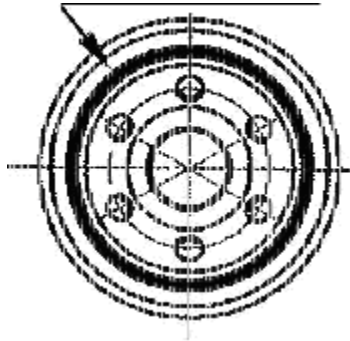
Replacement of oil filter

1. Use a special tool to remove the oil filter.



2. Use a piece of clean fabric to clean up the surface of new oil filter.
3. Smear clean oil around the O-ring of new oil filter.

Smear clean oil around the O-ring



4. Use a special tool to fit the oil filter.

Tightening torque: $14\sim 16\text{N}\cdot\text{m}\{142.3\sim 162.6\text{kgf}\cdot\text{cm}, 127.5\sim 145.7\text{in}\cdot\text{lbf}\}$

5. Start the engine and check for any leakage.

Check whether the oil level needs to add (See——Engine Oil and Check of Engine Oil).

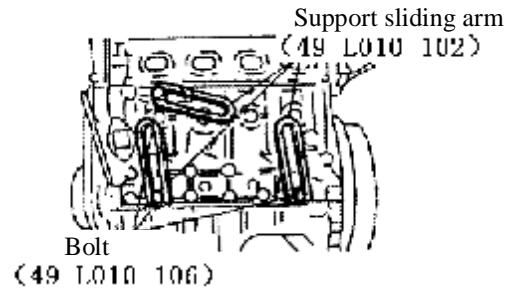
Others

Other checks and maintenances, e.g. generator and starter etc., can be also carried out on the CBU, please refer to this manual and the CBU-relevant Service Manual.

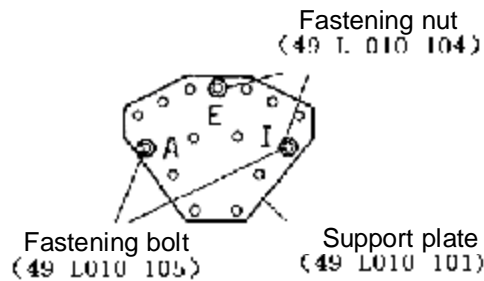
Use of Engine Service Platform

Upper Service Platform of Engine

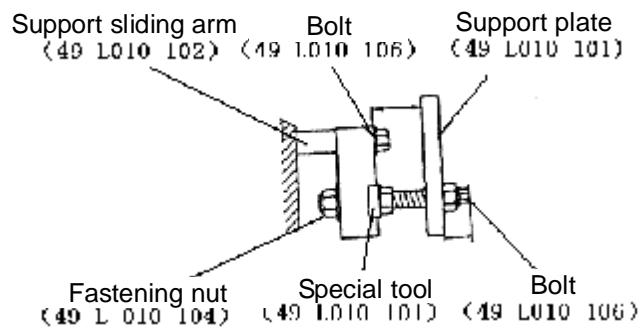
1. Fit the support sliding arm of special tools at the exhaust side of cylinder block and tighten the fastening bolt (as shown in Fig.).



2. Install special tools as per the position shown in Fig.



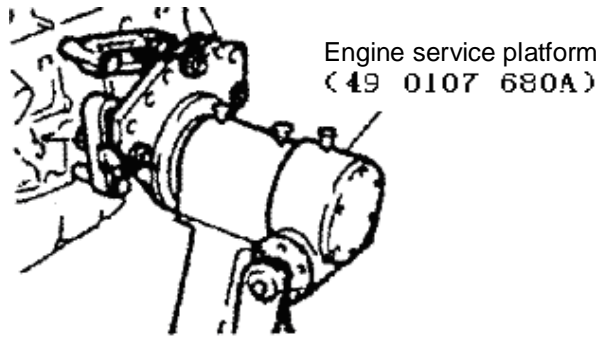
3. Adjust the fastening bolt and assure that a part of thread in about 20mm (0.79in) is exposed.
4. Adjust the bolt and nut and enable the support plate and support sliding arm of special tool to locate on the same level.
5. Tighten the bolt and nut of special tool.



Attention

- I The self-lock braking system of engine service platform may become suddenly ineffective under unbalanced state, e.g. sudden and rapid action during the upper/lower the engine gets on and off the platform may cause the unbalance of engine service platform and result in hazard. Thus, during the operation, ensure the equitability of engine and whole service platform. When operating the turnover of engine, firmly grip the rotating handle of service platform.

6. Install the engine on the service platform.



7. Place the engine into a designated container.
8. Replace by new drain plug spacer and tighten the drain plug.
Tightening torque: 30~41N·m{3.1~4.2kgf·m, 22~30ft·lbf}

Lower Service Platform of Engine

Unload the engine from the service platform in the reversing order with that of the upper service platform of engine.

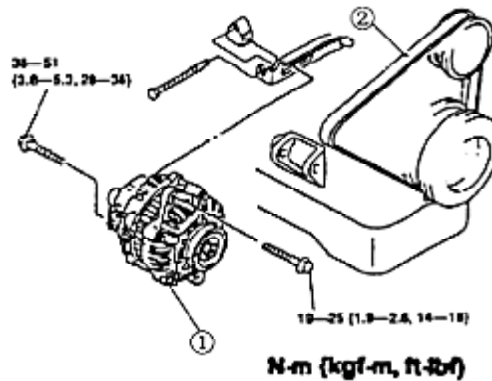
Generator and starter

Lubrication system of Engine

Warning

I When disassembling/assembling a generator on the CBU, you should remove first the battery cable, otherwise the terminal B of generator will get in touch with the bodywork , cause sparks and result in personnel injury and electrical component damage.

1. Disassemble as per the order shown in Fig.
2. Assemble in the reversing order of disassembly.
3. Check the deflection /tension of belt (See—Engine belt, Check of Engine Belt).



1	Generator
2	Alternator belt

Check of engine belt

1. When necessary, check the deflection and tension of engine belt.

Deflection check of engine belt

Attention

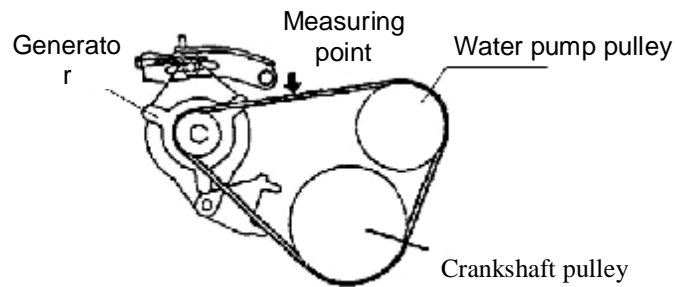
I The belt deflection shall be checked in 30mins after the engine cooled down or shut down.

1. Appropriate pressure of 98N{10kgf, 22lbf} is to be added between two pulleys.

I If the deflection is out of the specified scope, adjust the engine belt (See—Adjustment of Engine Belt).

Limit value: 10mm {0.39in}

Generator and Starter



Tension check of engine belt

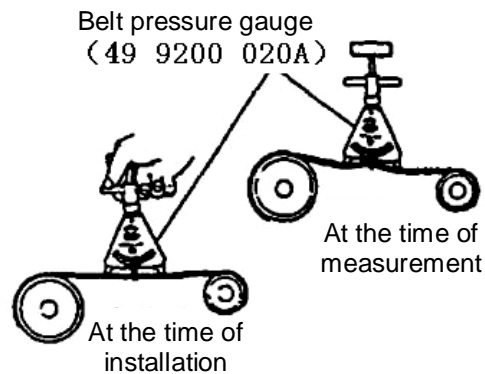
Attention

I The tension check may replace the deflection check. The tension pulley shall be checked in 30mins after the engine cooled down or shut down.

1. Use a special tool to check the belt tension between two driving wheels.

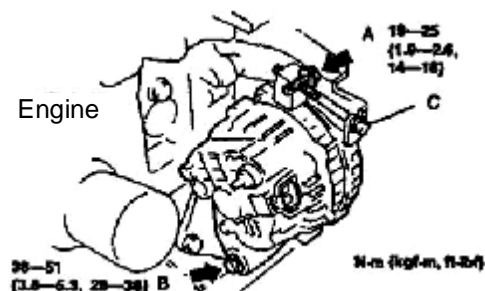
I If the tension is beyond the specified range, the adjustment is necessary (See— Adjustment of Engine Belt).

Limit value: 392N {40kgf, 88lbf}



Adjustment of engine belt

1. Loosen the pillar bolt A and bolt B.



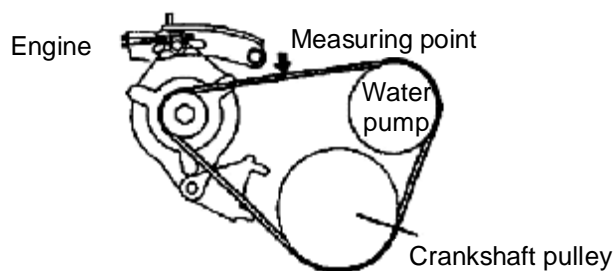
2. Adjust the deflection or tension of belt by regulating the stud C.

Attention

I If replacing by a new engine belt or an engine belt run not more than 5mins, adjust as per the standard measure of a new part.

I If an engine belt operated more than 5mins, adjust as per the standard measure of an old part.

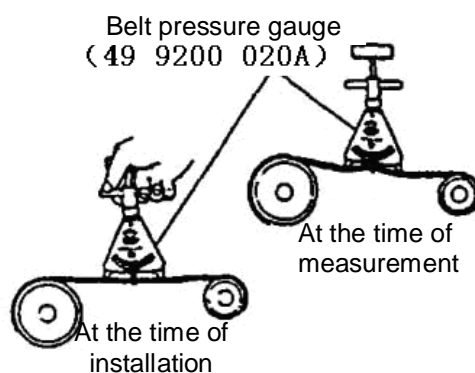
Generator and Starter



Deflection mm{in}

[The force of 98N{10kgf, 22lbf} shall be applied in-between]

	New	Old
Alternator belt	6.5~7.5 {0.26~0.29}	7.0~9.0 {0.28~0.35}



Tension N{kgf, lbf}

	New	Old
Alternator belt	686~834 {70~85, 160~180}	490~686 {50~70, 120~150}

3. Tighten the bolts A and B as per the torque shown in Table.
4. Check the deflection or tension of belt (See——Check of Engine Belt).

I If not within the standard value, readjust by starting from the 1st step and.

Check of engine

1. Confirm that the battery has been charged.
2. Confirm that the deflection/tension of belt is within the defined range (See——Generator, Check of Engine Belt).
3. Set the ignition switch in the “ON” position, now the charge warning light is lit.
4. Confirm that the charge warning light goes off when the engine started operating.

I If not in such case, refer to CBU Faults Diagnostic and Disposal.

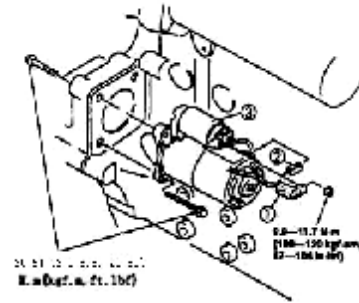
Lubrication system of starter

Warning

- I** When removing and installing the starter on the CBU, if the negative cable of battery is not loosened, the starter terminal B will produce sparks by the access into connection or the contact with the body, this will cause personnel injury and result in the electrical component damage, thus you should firstly remove the negative cable of battery when doing the following operations.

1. Remove the negative cable of battery.
2. Disassemble as per the order shown in Fig.
3. Assemble in the reversing order of disassembly.

1	Cable terminal B
2	Cable terminal S
3	Starter



Check of starter

On-board check

1. Confirm that the battery has been charged.
2. Start up the starter to confirm it is running in stable operation and without noise.

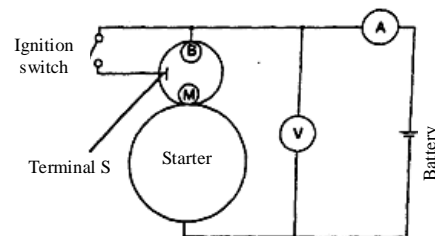
- I** If incorrect, set the ignition switch onto the “START” position and measure the voltage at the terminals S and B.

- If the voltage is out of the specified range, check and repair the harness and ignition switch.
- If the voltage is in the specified range, remove the starter and check the solenoid switch and starter.

Standard value: >8V

No-load test

1. Confirm that the battery has been charged.
2. As shown in Fig., connect the starter, battery, voltmeter and ammeter.
3. Have the starter run and confirm it runs in the stable operation.
4. While the starter is running, measure the voltage and current.



- I** If incorrect, repair or replace.

Standard

Voltage (V)	11.5
Current (A)	<80

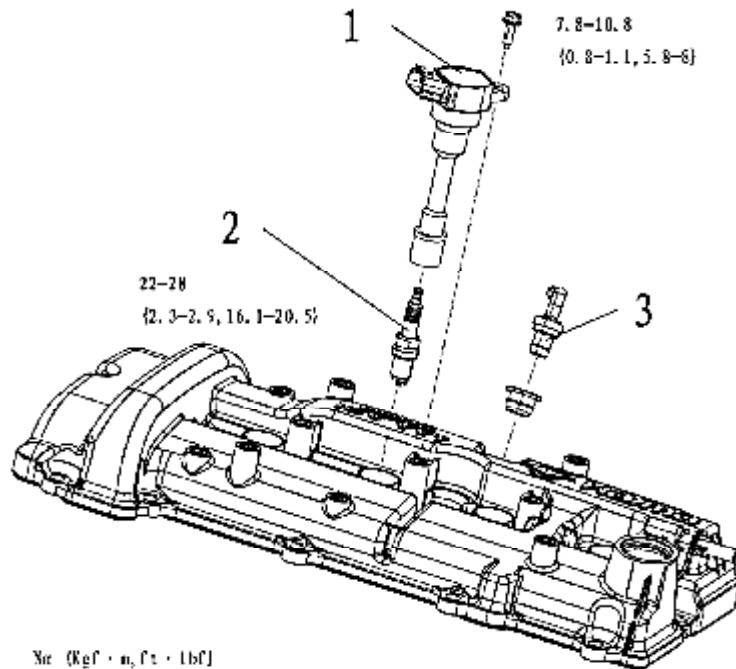
Ignition and control systems

Lubrication system of ignition and PVC valve

Caution

- I **When removing the ignition coil and spark plug, it is very easy to tear up the extension bar sheath, therefore, disassemble it when the replacement is necessary. At the disassembly time, be cautious to avoid tearing or damage.**

1. Disassemble in the order as shown in Fig.
2. Assemble in the reversing order of disassembly.



№ (kgf · m, lbf · in)

1	Ignition coil
2	Spark plug (See—Removal/Installation of Spark Plug)
3	Positive Crankcase Ventilation(PCV)valve (See—Check of PVC valve)

Instructions of plug removal/installation

Caution

- I **The spark plugs have to be carefully fitted, as the powerful strike will result in spark plug damage.**

Check of PVC valve

1. Dismantle the PCV valve.
2. Confirm the ventilation of PCV valve behaves as shown in the Table.

I Replace if abnormal.

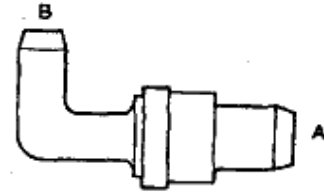
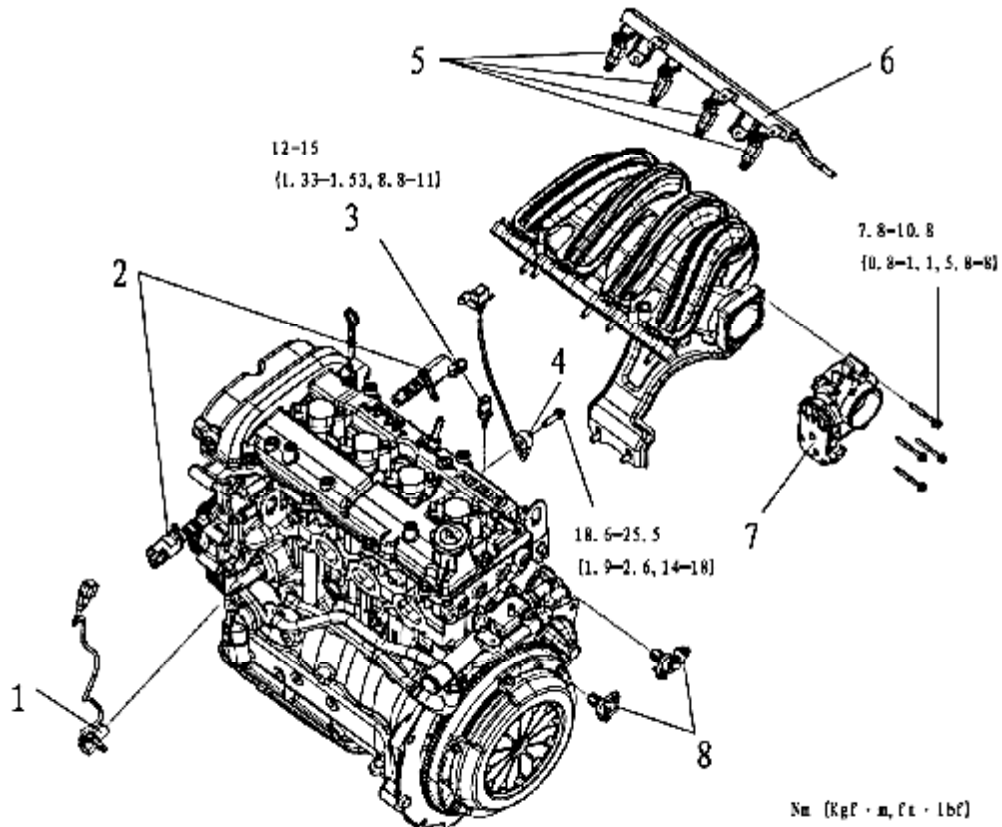


Table of ventilation

Testing condition	Result of testing
Blow into the joint A	Air outlets from the joint B
Blow into the joint B	No air outlets from the joint A

Disassembly/assembly of control system parts

1. Disassemble as per the order shown in Fig.
2. Assemble in the reversing order of disassembly.

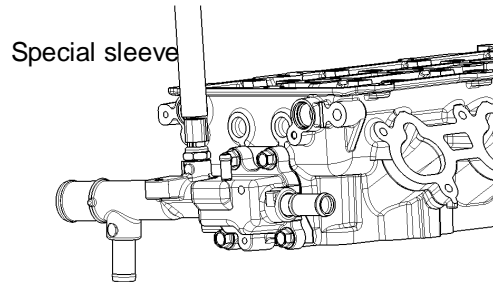


1	Crankshaft position sensor (See—Check of Crankshaft Position Sensor)
2	Oil control valve
3	Water temperature sensor (See—Instructions of Removal and Installation)
4	Knock sensor
5	Injector
6	Fuel rail
7	Electronic throttle body
8	Cam position sensor

*Note 1: This part has only listed the installations all parts of control system on the engine. The relevant diagnostics and checks are referred to the corresponding part of CBU.

Removal/installation instructions of water temperature sensor

Use a special tool to disassemble/assemble the water temperature sensor.



Check of crankshaft position sensor

Check of clearance

Attention

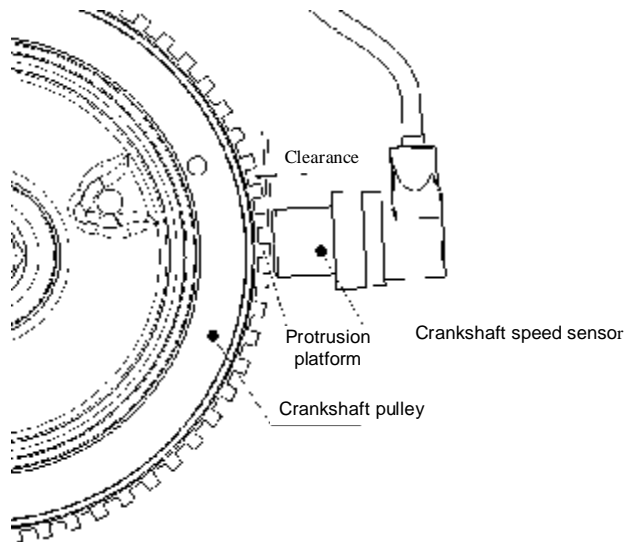
I Do the following checks only when necessary.

1. Confirm that the crankshaft speed sensor has been correctly installed.
2. Use a feeler to measure the clearance between the platform of signal wheel protrusion and crankshaft speed sensor.

I If in wrong clearance, you may adjust the crankshaft speed sensor or check for any distortion and notch in the signal wheel protrusion (If yes, you should replace the crankshaft pulley. See Timing Sprocket—Disassembly Instructions of Crankshaft Pulley).

Standard value

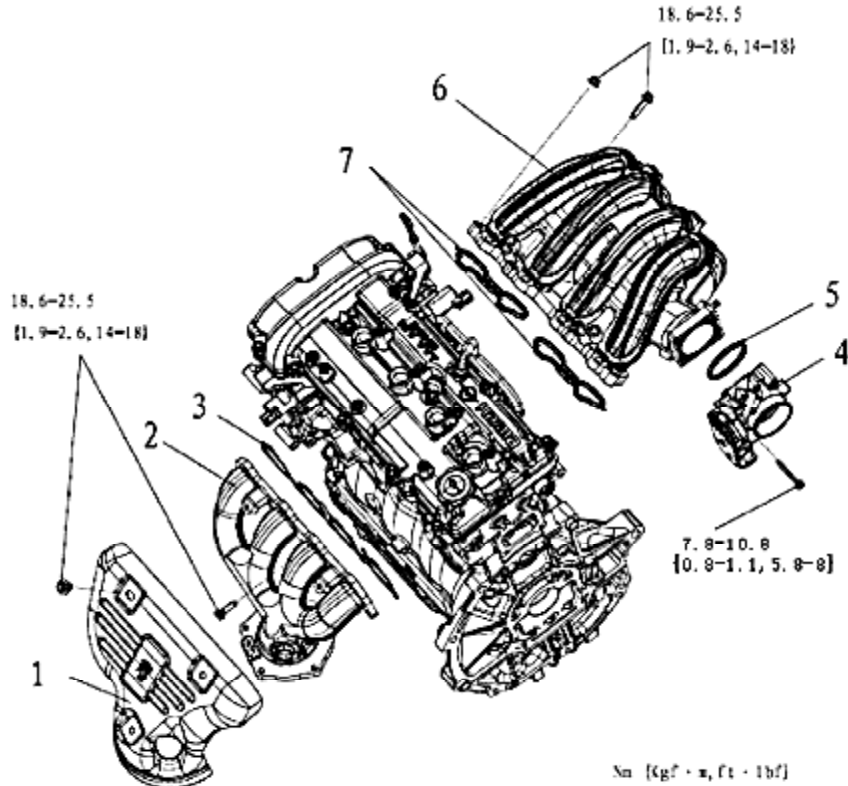
0.5~1.1mm(0.020~0.043in)



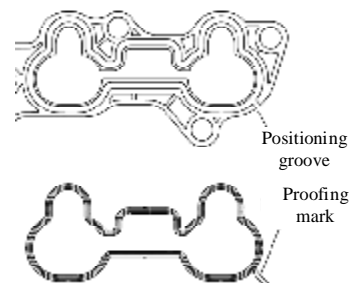
Intake and exhaust systems

Removal/installation of intake and exhaust systems

1. Disassemble as per the order shown in Fig.
2. Assemble in the reversing order of disassembly.



1	Thermal shield of exhaust manifold
2	Exhaust manifold
3	Exhaust manifold gasket
4	Throttle body
5	Sealant ring of throttle body (See Assembly Instructions)
6	Intake manifold
7	Sealant ring of intake manifold (See Assembly instructions)



Assembly instructions of intake manifold sealant ring

At the installation time, you shall properly put the sealant ring into the groove of intake manifold and enable the error proofing mark to clamp into the positioning groove of intake manifold.

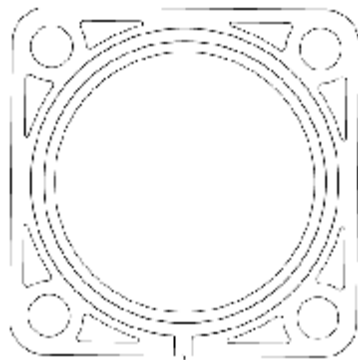
Caution

- I Prior to the installation, the sealant ring shall be checked for any damaged, if

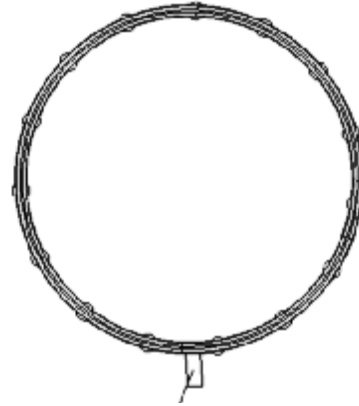
yes, it shall be replaced.

Installation instructions of throttle body sealant ring

At the installation time, you shall properly put the sealant ring into the groove of throttle body and enable the error proofing mark to clamp into the positioning groove of throttle body.



Positioning groove



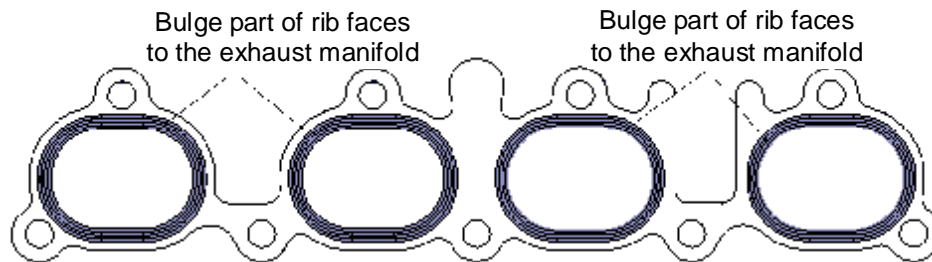
Error proofing mark

Caution;

- I Prior to the installation, the seal strip shall be checked for any damaged, if yes, it shall be replaced**

Installation instructions of exhaust manifold gasket

At the installation time, raised part of spacer shall face to the exhaust manifold.

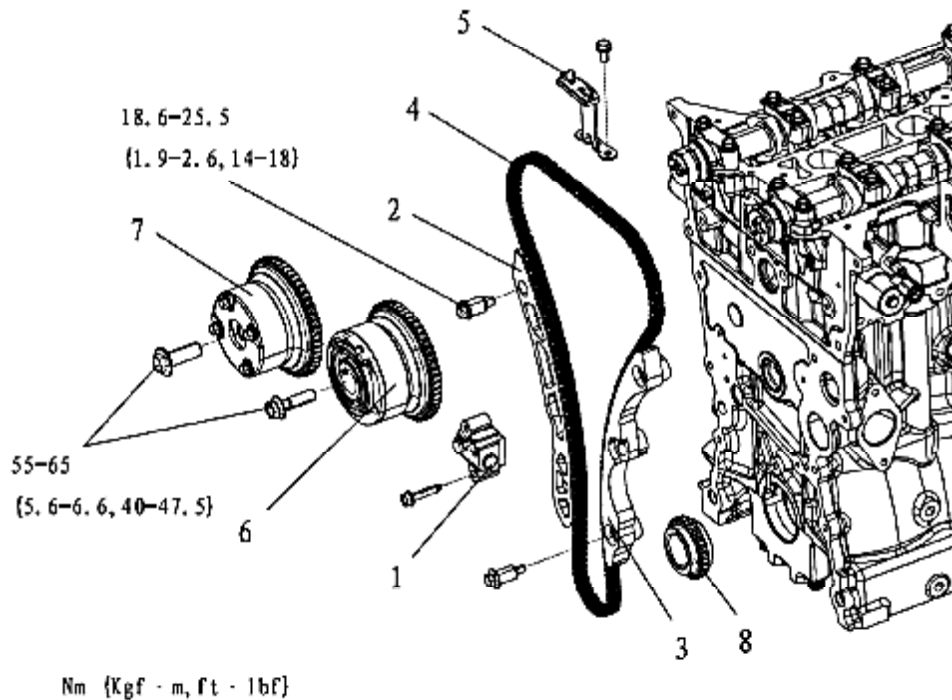


Timing sprocket

Lubrication system of timing sprocket

1. Remove the engine belt (See—Generator).
2. Remove the camshaft position sensor and crankshaft position sensor (See—Ignition and Control Systems).
3. Remove the ignition coil (See—Ignition).
4. Remove the cylinder head cover (See—Cylinder Head Cover).
5. Remove the timing sprocket casing (See—Timing Sprocket Casing).
6. Remove the oil pan.
7. Remove the oil pan body.
8. Disassemble as per the order shown in Fig.
9. Assemble in the reversing order of disassembly.
10. Adjust the deflection/tension of engine belt (See—Generator).
11. Check the clearance of crankshaft position sensor (See—Ignition and Control Systems).

Other thread torque not indicated: 7. 8-10. 8 {0. 8-1. 1, 5. 8-8}



1	Tensioner
2	Tensioner arm
3	Timing sprocket guide
4	Timing sprocket

5	Upper guide of timing sprocket
6	Exhaust VVT
7	Intake VVT
8	Timing sprocket

Lubrication system of tensioner

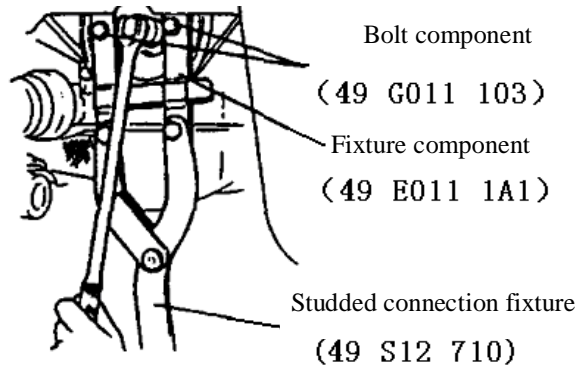
1. Disassembly as per the order shown in Fig.
2. Assemble in the reversing order of disassembly.

Instructions to the removal of tensioner

1. Unscrew the tensioner bolt.
2. Slowly take out the tensioner (prevent a sudden pop-up of plunger).

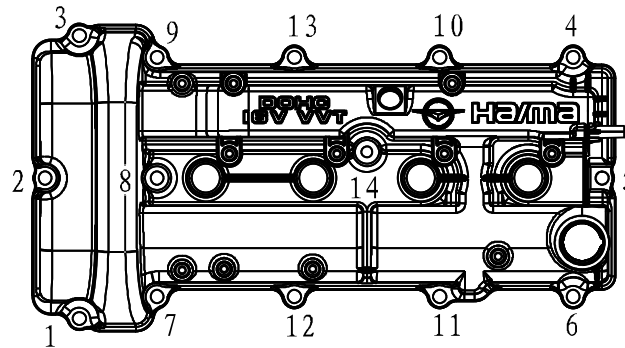
Disassembly instructions of crankshaft pulley

Use a special tool to fix the crankshaft for disassembly.



Disassembly instructions of cylinder head cover

Unscrew the bolts in 2-3 steps as per the order shown in Fig.t.



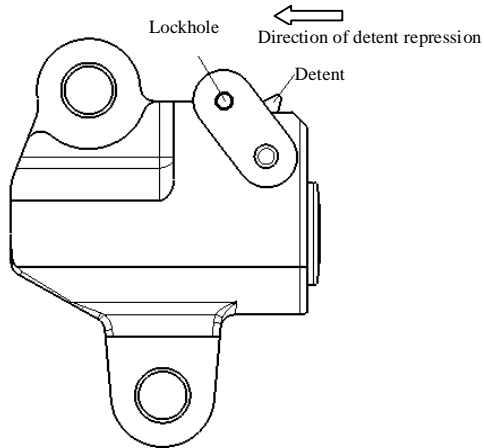
Disassembly instructions of timing sprocket

1. Fit the lock bolt of crankshaft pulley.
2. Turn clockwise the crankshaft and align with the valve check sign.
 - I **Key slot of timing sprocket faced upward.**
 - I **Align with the valve check sign on the intake and exhaust of VVT timing sprocket.**
3. Disassemble the tensioner (See——Disassembly of Tensioner).
4. Remove the tensioner arm.
5. Remove the timing sprocket rail.
6. Remove the timing sprocket.

7. Remove the upper timing sprocket rail.

Assembly instructions of tensioner

1. Repress the detent by use of a bench vice (direction shown in Fig.) and insert a hard wire into the lockhole to lock up the tensioner.



2. Fit the tensioner on the cylinder block and tighten the bolt.

Assembly instructions of tensioner arm

After the installation, the tensioner arm cannot be tightened too much, swing the tensioner arm to see if it can freely drop down.

Assembly instructions of timing sprocket

1. Rotate the intake/exhaust camshafts so as to bring 2 timing marks on the intake and exhaust VVTs to a specified angel.
2. Install the timing sprocket rail.
3. Install the timing sprocket.

I The timing marks on the intake/exhaust VVT and timing sprocket should be aligned with that on the timing sprocket.

4. Fit the tensioner arm (See—Assembly Instructions of Tensioner Arm).

I Be sure that the timing sprocket stays in the timing sprocket rail and tensioner arm groove.

5. Pull out the lock pin of tensioner, now the tappet will pop up and push the tensioner arm to compress the timing sprocket.

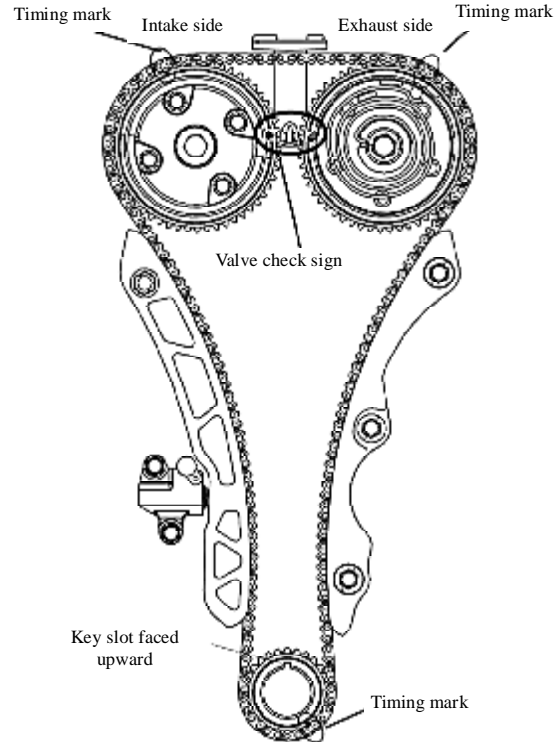
I Confirm that the timing sprocket chain is in the guide groove of tensioner arm and timing sprocket rail.

6. Confirm that all timing marks (4) are completely aligned.

I If not aligned, disassemble the timing sprocket, and restart the operation from the 1st step.

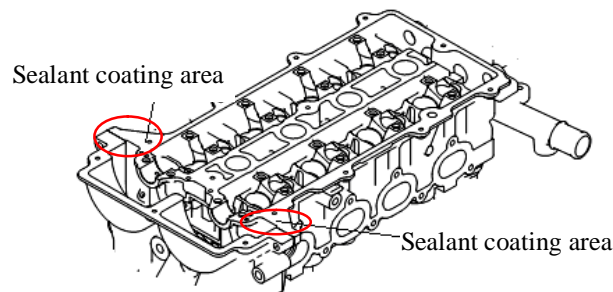
7. Turn clockwise two crankshaft ring and confirm that two valve check signs on the intake/exhaust VVT sprockets have been aligned.

I If not aligned, restart from the 1st step.



Assembly instructions of cylinder head cover

1. Confirm that there are no oil, water and other foreign substances in the cylinder head cover groove.
2. Confirm that the cylinder head cover gasket has fully attached in the groove of cylinder head cover.
3. Smear sealant on the joint part between the cylinder head and timing sprocket casing.

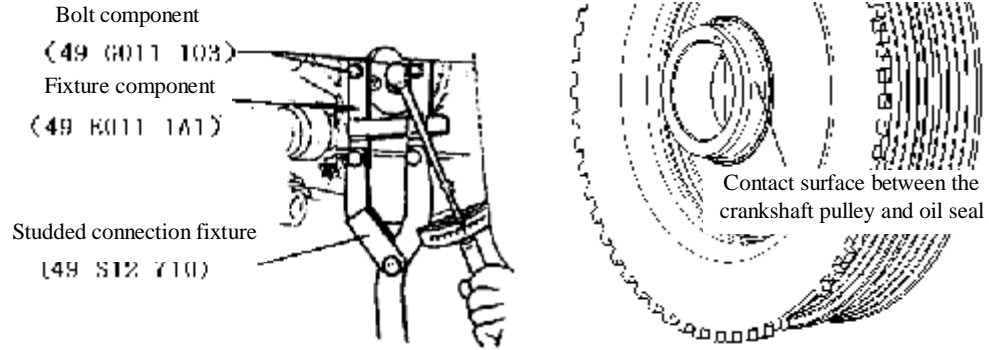


4. Assemble the cylinder head cover bolt in the reversing order of the disassembly instructions of cylinder head cover (See—Disassembly of Cylinder Head Cover)

Assembly instructions of crankshaft pulley

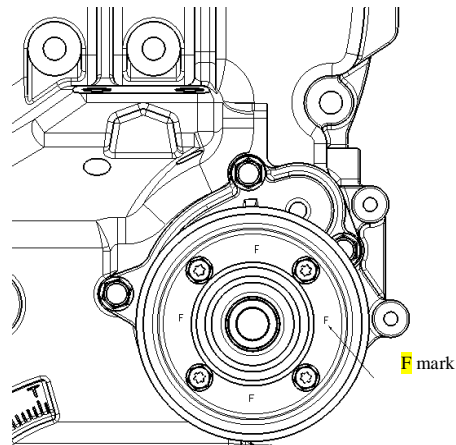
Use a special tool to fix crankshaft for further assembly.

I Smear oil on the contact surface between the crankshaft pulley and oil seal.



Assembly instructions of water pump pulley

1. Fit the water pump pulley, orienting the sign “F” outward.



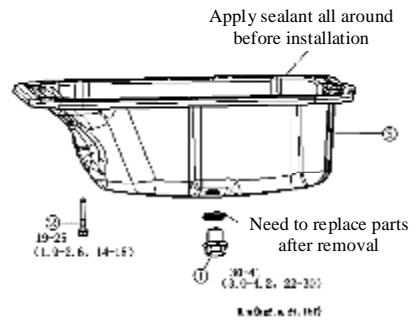
2. After the engine belt assembled, apply force on the water pump pulley bolt.

Lubrication system

Removal/installation of oil pan

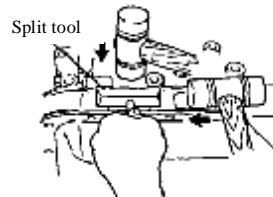
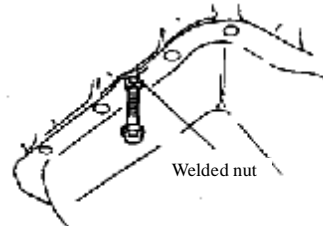
1. Drain out the engine oil (See——Check on the CBU, Replacement of Engine Oil).
2. Disassemble as per the order show in Fig. below
3. Assemble in the reversing order of disassembly.

1	Drain plug
2	Bolt
3	Oil pan See——Removal/installation instructions



Disassembly instructions of oil pan

1. Remove the oil pan bolt.
2. Remove sealant from the bolt threads.
3. Screw in a bolt on the welded nut so to save a small clearance between the oil pan and oil pan body.
4. Use a split tool to dismantle the oil pan.



Assembly instructions of oil pan

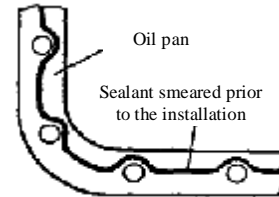
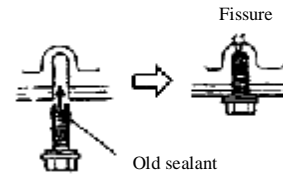
Caution

I If the bolt is reused, the sealant on the old thread has to be removed. The screw with old thread sealant may damage the screw hole.

1. Add continuously sealant around the inside of oil pan bolt hole and make the end overlapped.

Sealant diameter: $\Phi 2.0 \sim \Phi 3.0\text{mm}\{0.079 \sim 0.118\text{in}\}$

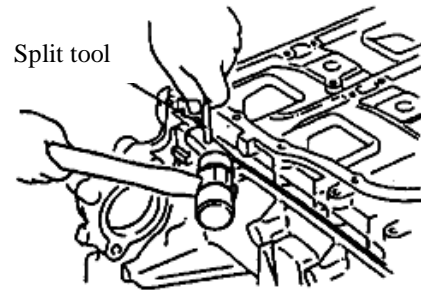
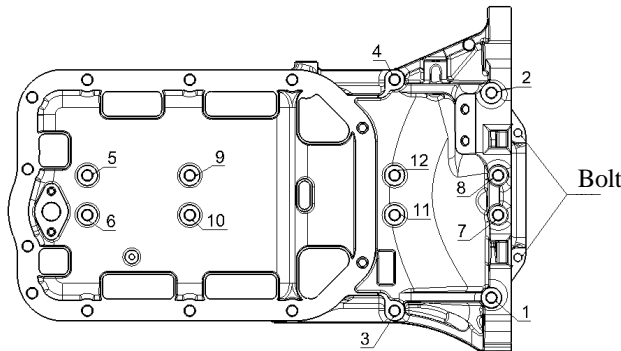
2. Install the oil pan.



Removal/installation of oil pan body

Disassembly instructions of oil pan body

1. Remove two bolts behind the oil pan body.
2. Unscrew, in 2—3 steps, the oil pan body bolts as per the order shown in Fig., below.
3. Use the split tool to remove the oil pan body.



Assembly instructions of oil pan body

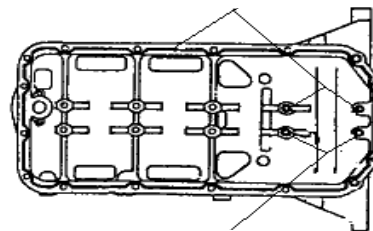
1. Smear evenly the sealant on the oil pan body as shown in the following Fig.

Sealant diameter: $\Phi 2.0 \sim \Phi 3.0\text{mm}\{0.08 \sim 0.11\text{in}\}$

2. Tightening bolt A.

Tighten the oil pan body bolts in 2-3 steps as per the reversing order of the disassembly (See—— Disassembly Oil Pan Body)

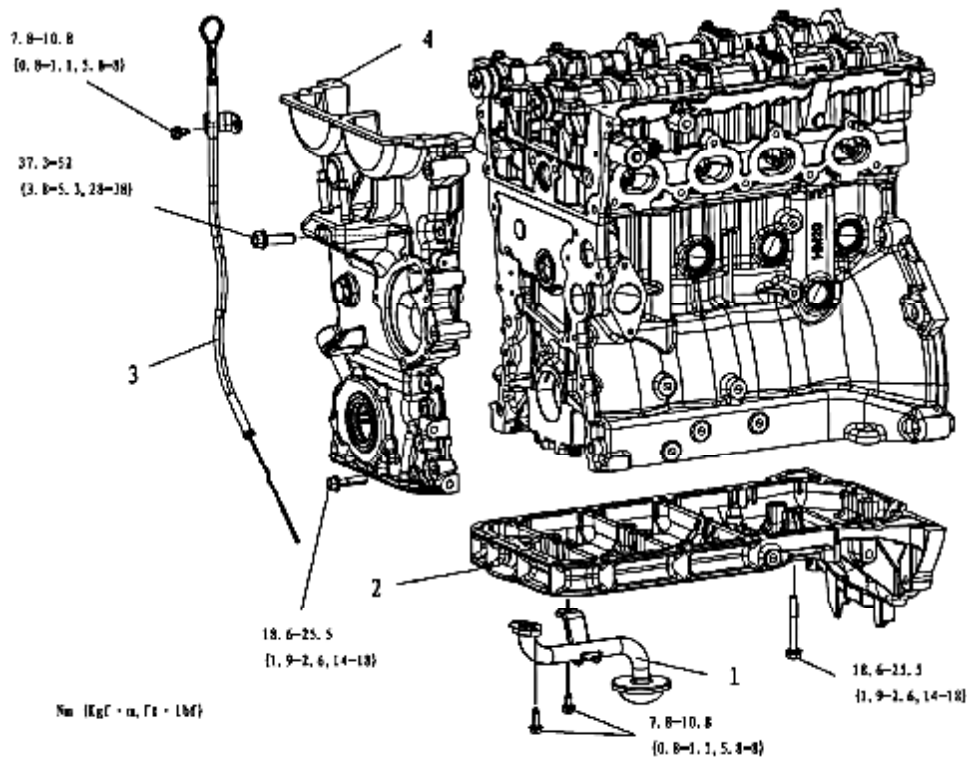
Sealant smeared prior to the installation



Sealant smeared prior to the installation

Removal/installation of timing sprocket casing

1. Remove the crankshaft pulley (See—Crankshaft Pulley).
2. Remove the cylinder head cover (See—Disassembly instructions of Cylinder Head Cover).
3. Remove the oil pan (See—Oil Pan, Removal/Installation of Oil Pan).
4. Remove the oil pan body (See—Removal/Installation of Oil Pan Body).
5. Remove the water pump (See—Removal/Installation of Water Pump).
6. Disassemble as per the order shown in Fig., below.
7. Assemble in the reversing order of disassembly.



1	Oil filter (See—Assembly instructions)
2	Oil pan body (See—Disassembly and Assembly Instructions)
3	Dipstick guide
4	oil pump and Timing sprocket casing assemblies (See—Disassembly and Assembly Instructions)

Disassembly instructions of oil pump seal

Remove the oil seal by use of a screwdriver wrapped with a piece of clean fabric.

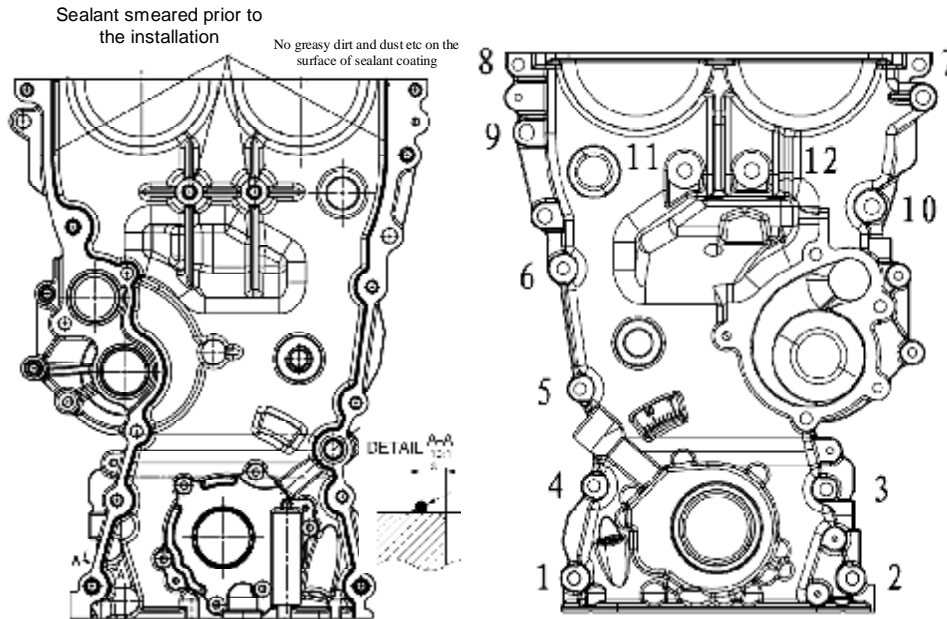
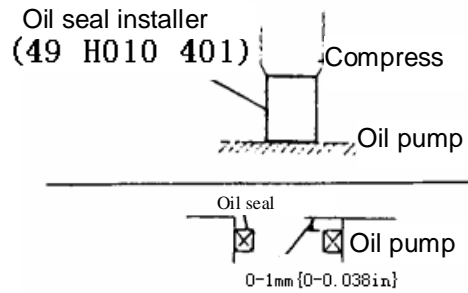
Assembly instructions of oil pump and timing sprocket casing assemblies

1. Add clean oil outside the oil sea;
2. Fit the oil seal with hands;
3. Use a special tool to evenly press in the Seal;

Press depth: 0~1mm{0~0.038in}

4. As shown in Fig., smear evenly the sealant around the sprocket casing edge.

Sealant diameter: $\Phi 1 \sim \Phi 2\text{mm}\{0.04 \sim 0.07\text{in}\}$



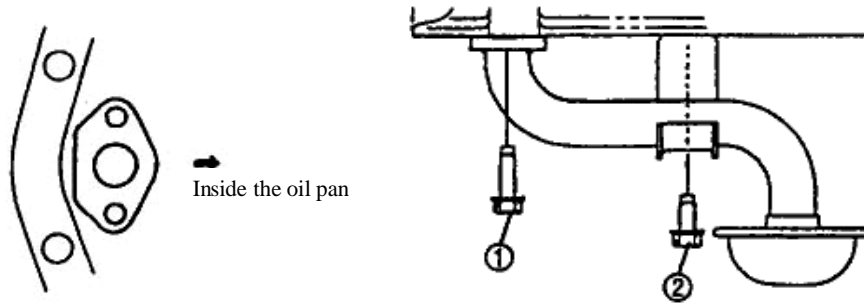
5. Fit the sprocket casing and tighten the bolts as per the order shown in Fig.

I Specification and torque of mounting bolt

S/C	Specification	Length of bolt stem (mm)	Mouting torque (N·m)
1、 2、 5、 6、 7、 8	M8	35	18.6~25.5
3、 4	M8	30	18.6~25.5
9、 10	M10	35	37.3~52
11、 12	M10	55	37.3~52

Assembly instructions of oil filter

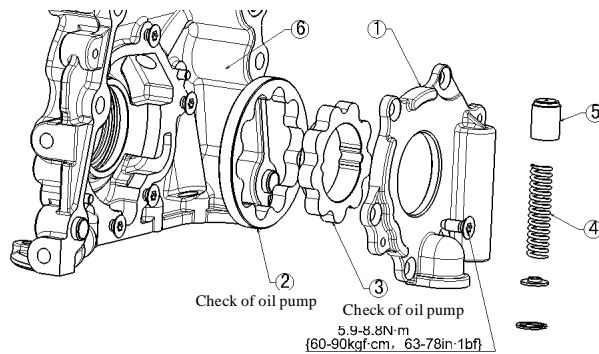
1. Install the oil filter spacer as shown in the left diagram.
2. Tighten the bolts as per the order shown in the right Fig.



Break down/installation of oil pump and timing sprocket casing

1. Remove the timing sprocket casing (See——Removal/installation of Timing Sprocket Casing).
2. Break down as shown in the following Fig.
3. Assemble as per the reversing order of the disassembly.

1	Oil pump cover
2	External rotor
3	Internal rotor
4	Pressure spring
5	Control piston
6	Timing sprocket casing

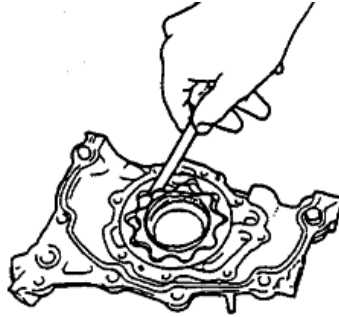


Rotor clearance inspection

1. Measure the following clearance, and replace rotor and/or pump body if necessary.

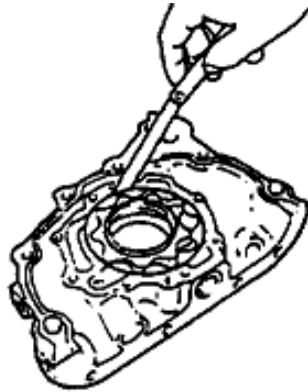
Standard tip clearance: 0.06~0.18 mm{0.0024~0.0070in}

Max.tip clearance: 0.22mm {0.009in}



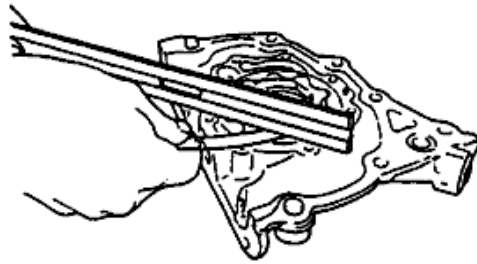
Standard clearance of pump body: 0.100~0.181{0.0040~0.0071}

Max.clearance of pump body: 0.22mm {0.009in}



Standard lateral clearance: 0.040~0.095mm{0.0016~0.0037in}

Max. lateral clearance: 0.14mm {0.055in}



Check of pressure spring

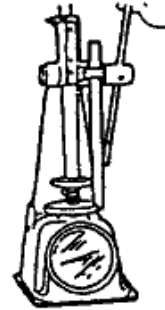
Apply pressure on the spring and check the spring height. Replace the pressure spring if necessary.

Pressure:

82.6~90.4N{8.43~9.22kgf, 18.56~20.31lbf}

Standard height:

35.15mm [1.3839in]

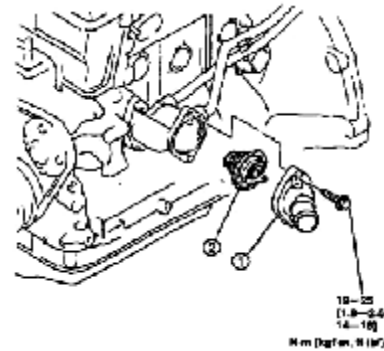


Cold system

Removal/installation of thermostat

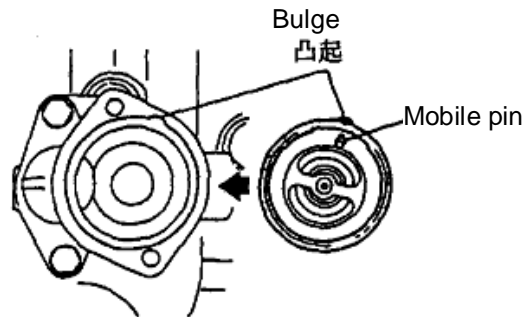
1. Disassemble as per the order shown in Fig.
2. Assemble in the reversing order of disassembly.

1	Thermostat cover
2	Thermostat See——Precautions to Installation



Assembly instructions of thermostat

1. As shown in Fig., confirm whether the notches on the thermostat switching section and thermostat washer have been aligned.
2. Align with the notch on the washer, and fit the thermostat on the thermostat switching section.



Check of thermostat

Put the thermostat into a vessel containing hot water and then heat it up by inserting the

thermostat in water. Check the thermostat.

I If non-conform to the provisions, replace the thermostat.

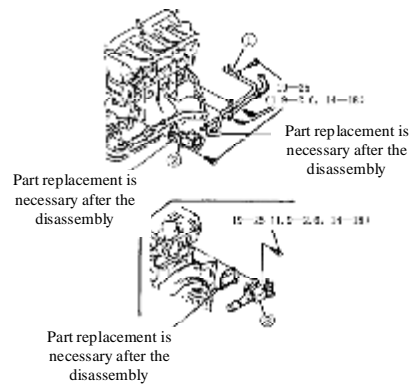
- Close the valve at room temperature.
- Warm up and open the valve.

Items	Engine
Initial temperature(°C{°F})	80~84{176~183}
Fully opened temperature(°C{°F})	95{203}
Fully opened stroke(mm{in})	≥8.5{0.33}

Removal/installation of cooling water pipe

1. Remove the thermostat (See——this section, Disassembly/assembly of Thermostat).
2. Disassemble as per the order shown in Fig.
3. Assemble in the reversing order of disassembly.

1	Bypass pipeline. See——Assembly instructions
2	Thermostat switching section
3	Outlet pipe seat



Assembly instructions of cooling water pipe

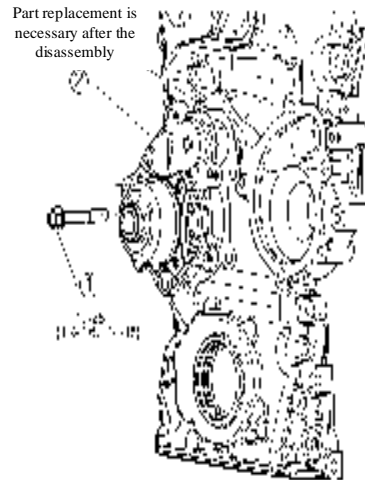
Replace the O-ring and then smear water on the O-ring to ease its loading.

- I Attention:** Do not smear the engine oil or other oily substances on the O-ring.

Removal/installation of water pump

1. Remove the engine belt. (See—Engine Belt)
2. Disassemble as per the order shown in Fig.
3. Assemble in the reversing order of disassembly.

1	Bolt
2	Water pump

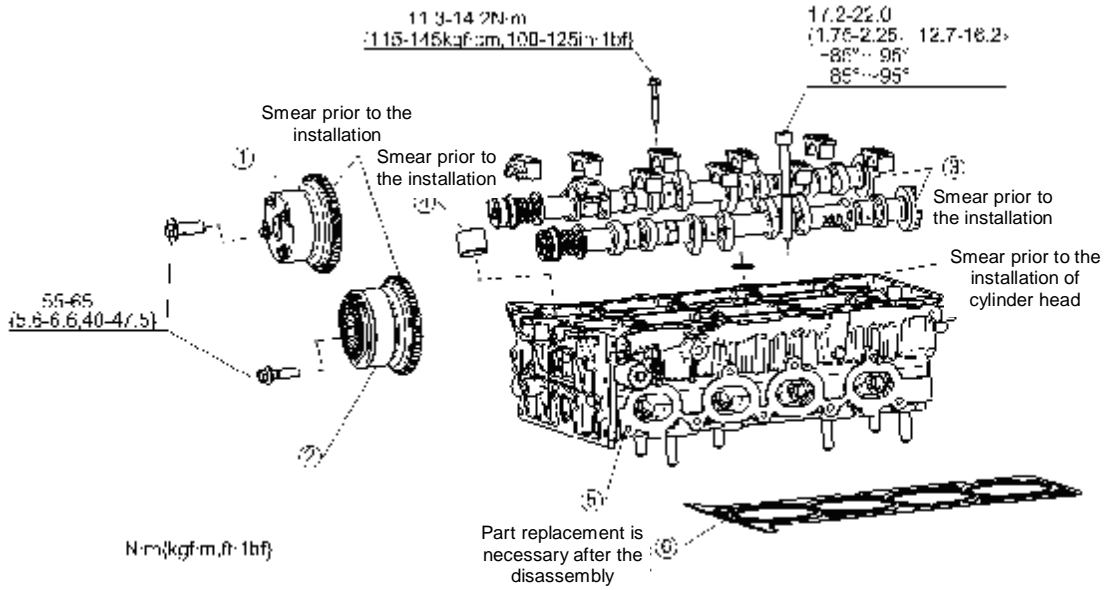


Cylinder head and valves

Removal / installation of cylinder head

1. Remove the intake/exhaust manifold (See—Intake/Exhaust System).
2. Remove the timing sprocket (See—Timing Sprocket).
3. Disassembly as shown in Fig.
4. Assemble in the reversing order of disassembly.

Cylinder head and valve mechanisms

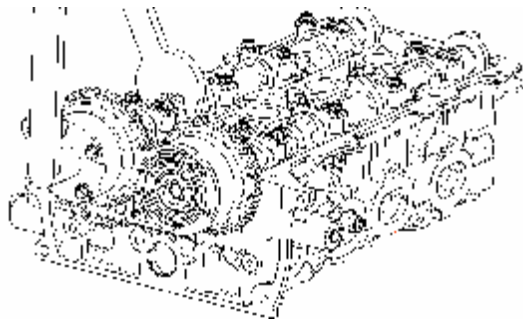


1	Intake VVT (please refer to Removal/Installation Instructions)
2	Exhaust VVT (please refer to Removal/Installation Instructions)
3	Camshaft (please refer to Removal/Installation Instructions)
4	Tappet
5	Cylinder head (Removal/Installation Instructions)
6	Cylinder head pad

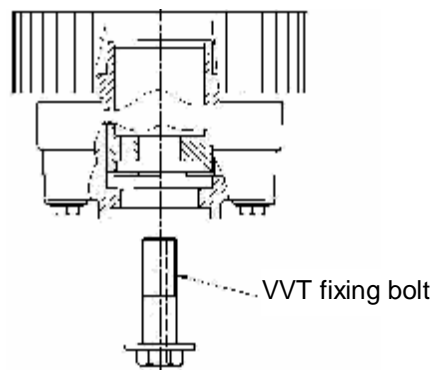
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VVT Disassembly instructions of intake and exhaust

1. As shown in Fig. Disassemble by jamming the hexagonal casting on the camshaft with a wrench



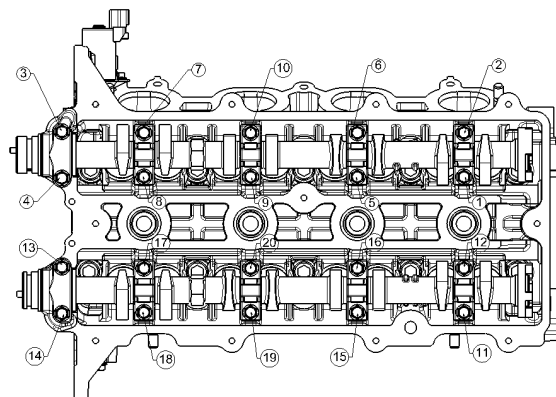
2. Remove the VVT fixing bolt.



3. Slight swing the VVT and carefully take it out from the camshaft.

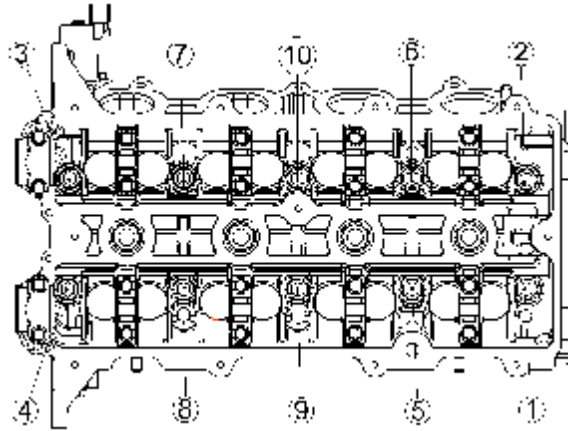
Disassembly instructions of camshaft

1. Check and adjust the valve clearance when necessary (See this section, Valve Clearance).
2. Check the end gap of camshaft (See this section, Check of spring).
3. Check the journal gap of camshaft (See this section, Check of spring).
4. Unscrew the camshaft bearing bolt, in 2–3 steps, as per the order shown in Fig.



Disassembly instructions of cylinder head

Unscrew the cylinder head bolt, in 2-3 steps, as per the order shown in Fig.



Assembly instructions of cylinder head

1. Measure the length of every cylinder head bolt and replace once it surpasses the standard value.

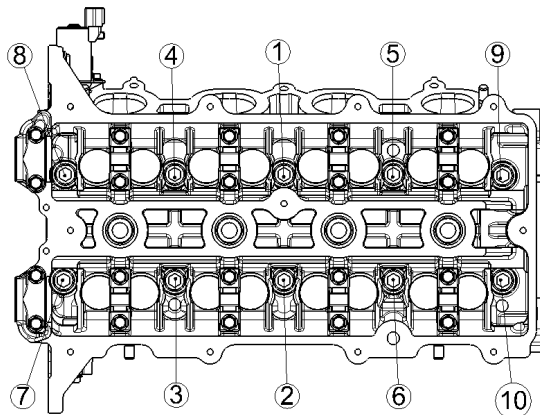
Standard length: 104.2~104.8mm{4.103~4.125in}

Max.length: 105.5mm {4.154in}



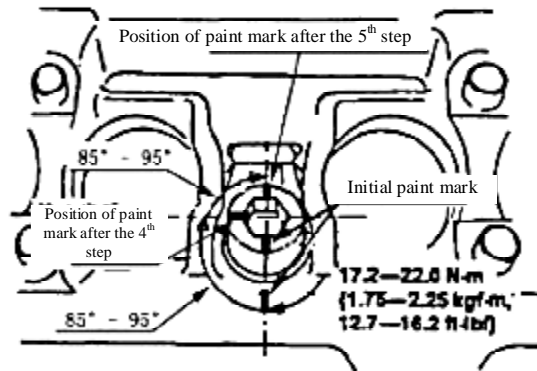
2. Tighten the cylinder head bolt, in 2-3 steps as per the order shown in the Fig,

Tightening torque: 17.2~22.0N·m{1.75~2.25kgf·m, 12.7~16.2ft·lbf}



3. Mark each bolt head.
4. Tighten the bolt as per the order shown in the Fig.2, and turn each bolt for 85°~95° based on the mark as shown in the following Fig.

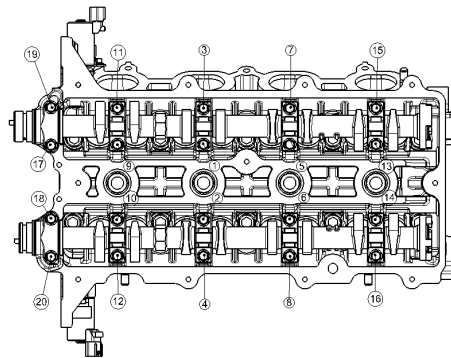
- Turn all bolts again for further $85^{\circ} \sim 95^{\circ}$ as per the provision in the 4th step and tighten the bolt.



Assembly instructions of camshaft

Caution

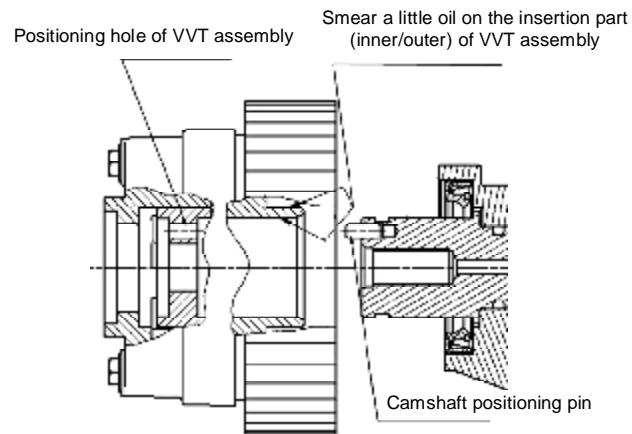
- I **As the mounting clearance of camshaft is very small, it must be assured that the journal of camshaft is tightly stuck in the bearing seat during installation; otherwise it will be damaged due to the excessive pressure on the contact surface between the shaft and bearing. To avoid such case, the following practice shall be observed.**
 - Contain the camshaft into the cylinder head, by sticking the camshaft journal tightly in the bearing seat.
 - Smear a little oil on the camshaft journal and bearing seat.
 - Fit all camshaft bearing caps on the journals to which they correspond respectively
 - Tighten with hand, the camshaft bolts marked in the Figure with the numbers 5, 7, 2 and 4.
 - Tighten the camshaft cap bolt in 2-3 steps in the order shown in the Fig.



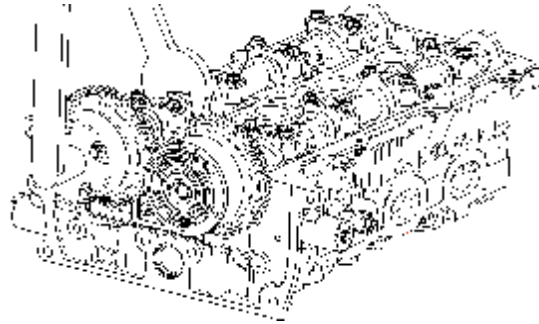
- Smear clean oil on the insertion part of camshaft assembly.

Assembly instructions of VVT

- Turn the camshaft, keeping the positioning pin facing upward
- Smear a little oil all around the insertion part of VVT assembly and align the VVT assembly positioning hole with the camshaft positioning pin. Then set in slowly the VVT assembly.

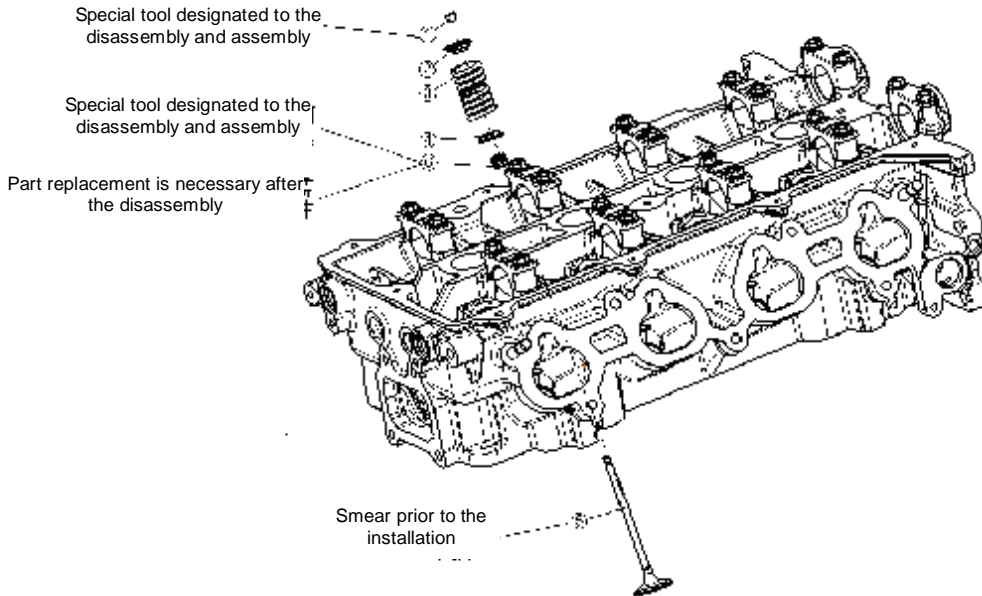


3. As shown in Fig., tighten the VVT fixing bolts by jamming the hexagonal casting on the camshaft with a wrench.



Removal / installation of valve gear

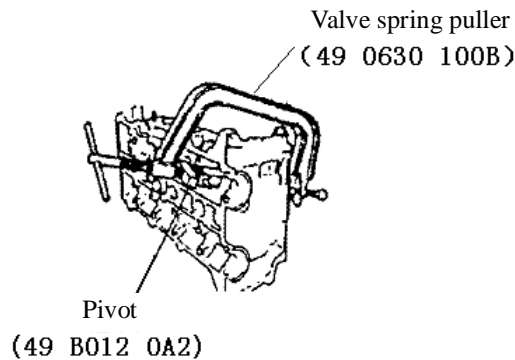
1. Remove the cylinder head (See——Disassembly of Cylinder Head).
2. Disassemble as per the order shown in the Fig.
3. Assemble in the reversing order of disassembly.



1	Valve split collet (please refer to the Removal/Installation Instruction)
2	Upper seat of valve spring
3	Lower seat of valve spring (refer to the Assembly Instructions)
4	Lower seat of valve spring
5	Valve
6	Valve oil seal(refer to Removal/installation Instruction)

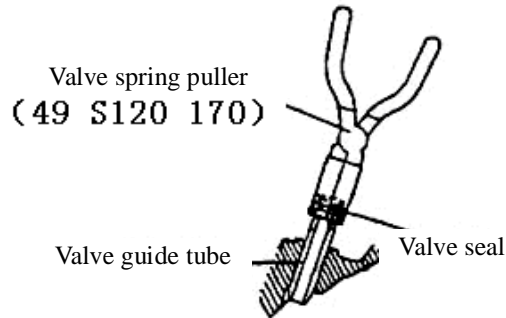
Disassembly of valve split collets

Use a special tool to press the lower seat of valve spring and remove the valve split collet.



Disassembly of valve oil seal

- I Use a special tool to remove the valve oil seal.

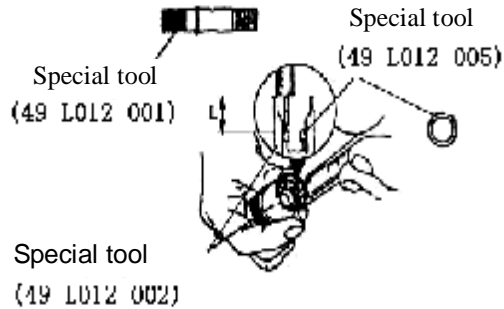


Assembly of valve oil seal

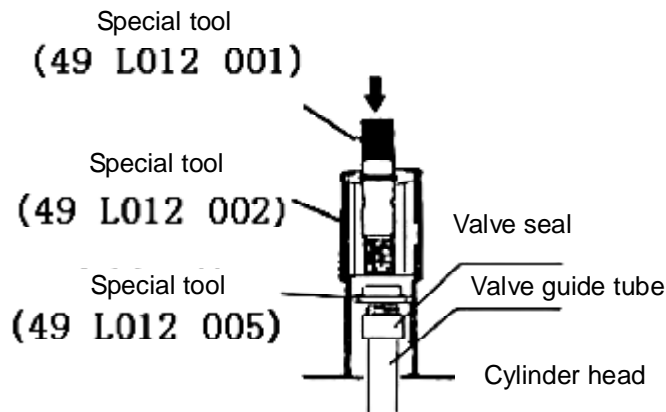
1. Adjust the special tool and enable the encasing depth L to meet the requirements.

Depth L

Intake: 22.1mm (0.87in); Exhaust: 16.9mm (0.665in).

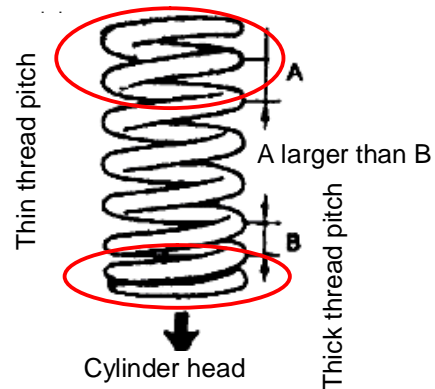


2. Press with hands the valve oil seal into the valve guide.
3. Keep tapping the special tool by use of a plastic hammer until its bottom gets in touch with the cylinder head.



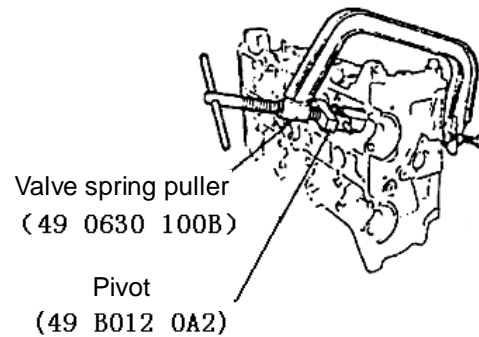
Valve spring

Fit the valve spring and face the end with dense thread pitch toward the cylinder head.



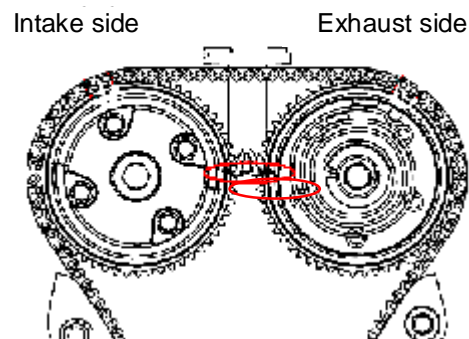
Installation of valve split collets

Use a special tool to press the valve spring seat and fit the valve split collet.



Inspection of valve clearance

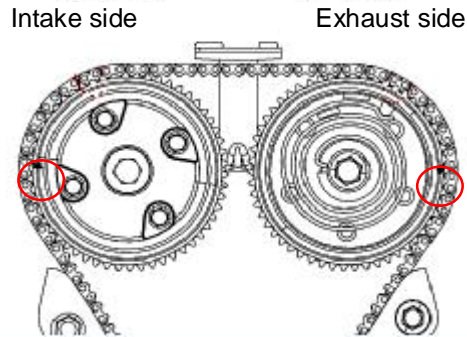
1. Remove the cylinder head cover (See the timing belt, Disassembly of Cylinder Head Cover).
 2. Confirm that the engine has been cooled down.
 3. Measure the valve clearance.
- (1) Turn clockwise the crankshaft, enabling the piston to locate on the TDC of the cylinder no.1, i.e.: the valve sign shall be located as shown in the following figure.



- (2) Measure with a feeler the valve clearances of all cylinders as marked in Fig. A.

I If the valve clearance exceeded the standard value, replace the tappet (See—Adjustment of Valve Clearance).

- (3) Turn clockwise the crankshaft for 360°, enabling the piston to locate on the TDC of cylinder no.4, i.e.: allow the valve check signs on the intake and exhaust VVTs to locate as shown in Fig. below.



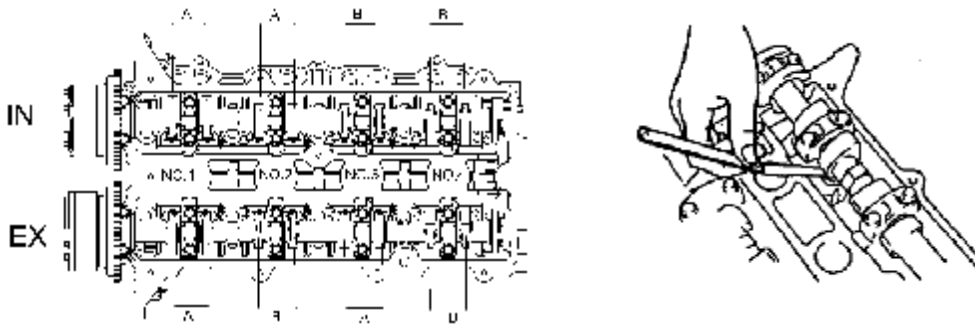
- (4) Measure with a feeler the valve clearances of all cylinders as marked in Fig. B.

I If the valve clearance exceeded the standard value, replace the tappet (See—Adjustment of Valve Clearance).

Standard value of valve clearance (the engine under cooling state)

Intake: 0.18~0.26mm{0.0071~0.0102in}(0.22±0.04mm{0.0087±0.0016in})

Exhaust 0.26~0.34mm{0.0102~0.0134in}(0.30±0.04mm{0.0118±0.0016in})



4. Fit the cylinder head cover (See—Installation of Timing Sprocket and Cylinder Head Cover).

Adjustment of valve clearance

All valves which require the adjustment of clearance shall be operated as per the following procedure:

1. Turn clockwise the camshaft with the key slot of crankshaft facing upward.
2. Disassemble the camshaft (See this section, Disassembly of Camshaft).
3. Take out the tappet whose valve clearance needs to be adjusted.
4. Select a suitable tappet.

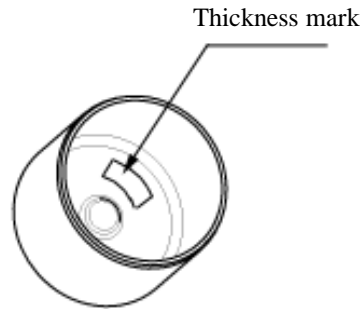
Thickness of new tappet = thickness of old tappet + measured valve clearance—standard valve clearance

(Intake: 0.22mm{0.0087in}; exhaust: 0.30mm{0.0118in})

5. Contain the selected tappet into the tappet hole.
6. Reconfirm the valve clearance (See the Valve Clearance, Inspection of Valve Clearance).

Attention

- I The thickness of tappet will be marked in 3 digitals at the side of tappet as shown in Fig., below.



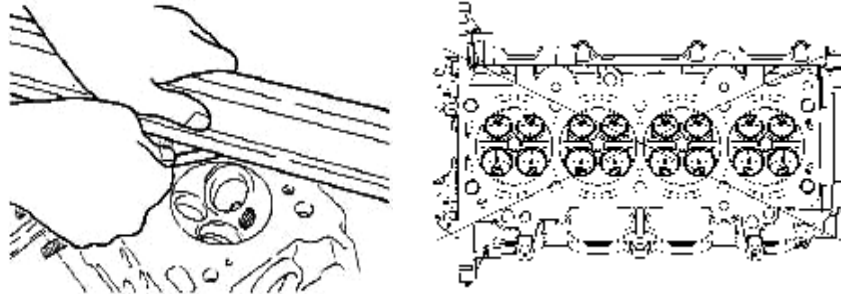
Relationship between the tappet mark and thickness is shown in the following table:

Mark	Thickness (mm)	Mark	Thickness (mm)	Mark	Thickness (mm)
270	2.70	292	2.92	314	3.14
272	2.72	294	2.94	316	3.16
274	2.74	296	2.96	318	3.18
276	2.76	298	2.98	320	3.20
278	2.78	300	3.00	322	3.22
280	2.80	302	3.02	324	3.24
282	2.82	304	3.04	326	3.26
284	2.84	306	3.06	328	3.28
286	2.86	308	3.08	330	3.30
288	2.88	310	3.10		
290	2.90	312	3.12		

Check/repair of cylinder head

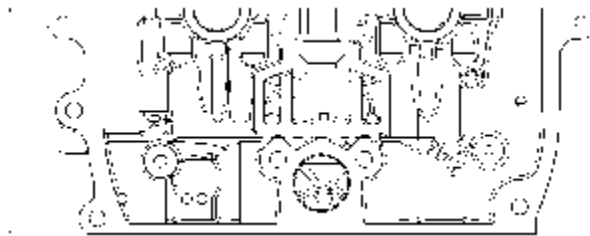
1. Make a defect test on the cylinder head. Replace the cylinder head when necessary.
2. Check the following items and repair or replace as necessary.
 - (1) Whether the valve seat is sunken.
 - (2) Whether the journal and end clearances of camshaft are too large.
3. Use a straight edge ruler and feeler as shown in Fig. to check in 6 directions whether the cylinder head is distorted.

Max Distortion: 0.06mm (0.002in)



4. If the distortion of cylinder head surpassed the max.value, check the height of cylinder head. If the height is also out of the standard value, replace the cylinder head.

Standard height: 124.45~124.55mm{4.8996~4.9035in}

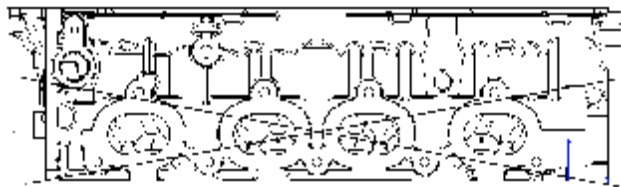


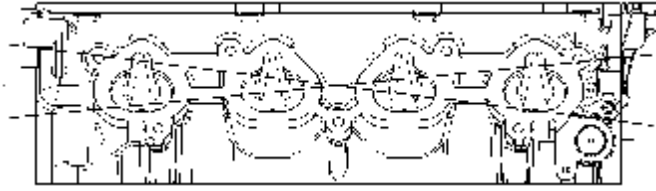
5. If the distortion of cylinder head exceeded the max. value, but the height within the standard value, you can grind the height or replace the cylinder head.

Max.grinding tolerance: 0.20mm (0.0078in)

6. Use a straight edge ruler and feeler as shown in Fig. to measure the distortions in all directions of manifold flanges of cylinder head intake and exhaust.

Max. distortion: 0.05mm (0.0019in)





- If the distortion measured by the 6 step exceeded the max.value, grind the surface or replace the cylinder head.

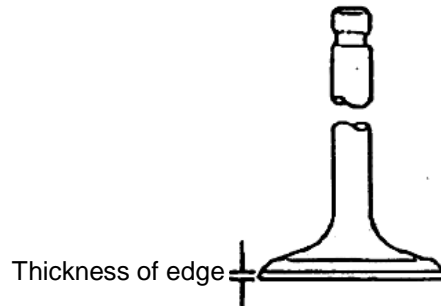
Max.grinding tolerance: 0.20mm (0.0078in)

Check of valve and valve guide

- Measure the edge thickness of each valve head and replace the valve when necessary.

Standard thickness: intake valve: 0.85mm{0.034in}; exhaust valve: 1.50mm {0.059in}

Min.thickness: exhaust valve: 0.35mm{0.014in}; exhaust valve: 0.90mm {0.035in}



- Measure the length of each valve and replace the valve as necessary.

Standard length:

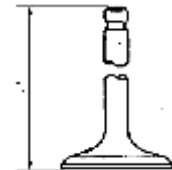
Intake valve: 101.15~101.65{3.9823~4.0020}

Exhaust valve: 101.07~101.57{3.9791~3.9988}

Min. length:

Intake valve: 100.95mm {3.9744in}

Exhaust valve: 100.87mm {3.9712in}



- Measure the diameter of each valve rod, at three points of A, B and C shown in Fig, respectively in the directions X and Y, replace the valve when necessary.

Standard diameter:

Intake valve: 4.965~4.980mm{0.1954~0.1961in}

Exhaust valve: 4.955~4.970mm{0.1951~0.1957in}

Min.diameter

Intake valve: 4.915mm {0.1935in}

Exhaust valve: 4.905mm {0.1931in}

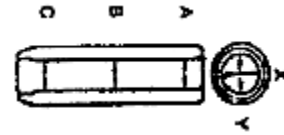


4. Measure the inner diameter of each valve guide, at three points of A, B and C shown in Fig, respectively in the directions X and Y, replace the valve guide when necessary.

Standard I/D

Standard: 5~5.012mm{0.1968~0.1973in}

Extra size: 5.012~5.022mm{0.1973~0.1977in}

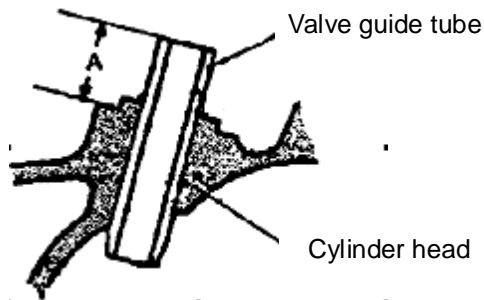


5. In absence of lower seat of valve spring, measure the size A, the protrusion height of each valve guide. Replace the valve guide when necessary.

Standard height

At the intake side: 19.8~20.4mm{0.7795~0.8031in}

At the exhaust side: 14.6~15.2mm{0.5748~0.5984in}

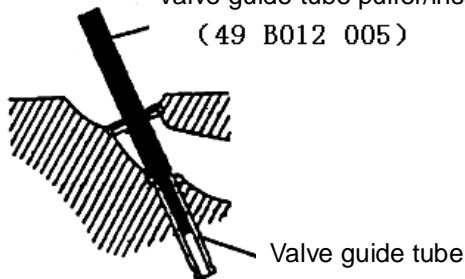


Replacement of valve guide

Disassembly of valve guide

Use a special tool to press out the valve guide from the side of combustion chamber.

Valve guide tube puller/installer
(49 B012 005)



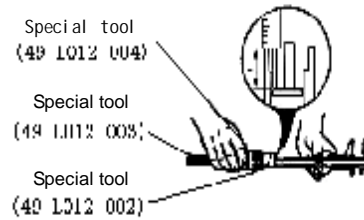
Assembly of valve guide

1. Adjust the special tool, enabling the pressed depth L to meet the requirements.

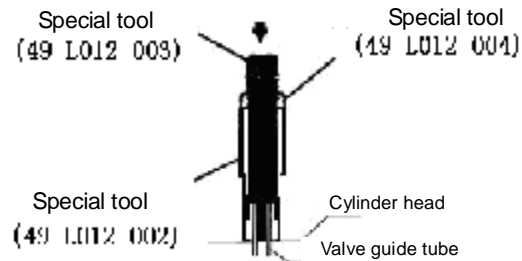
Depth L

Intake side: 19.8~20.4mm{0.7795~0.8031in}

Exhaust side: 14.6~15.2mm{0.5748~0.5984in}



- Press in the valve guide from the back of combustion chamber until the special tool gets in touch with the cylinder head.



- Check whether the height of valve guide meets the technique index(See——Check of Valve Guide).

Standard height:

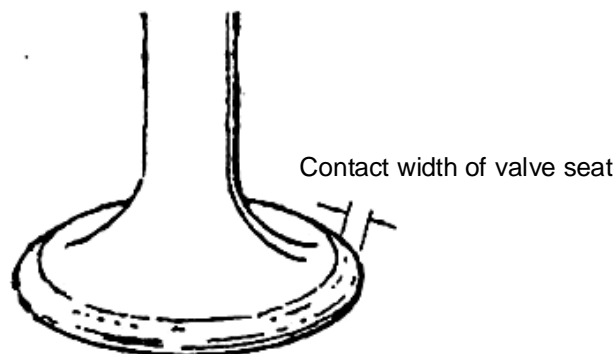
Intake side: 19.8~20.4mm{0.7795~0.8031in}

Exhaust side: 14.6~15.2mm{0.5748~0.5984in}

Check/repair of valve seat

- By use of surface painting method, measure the contact width of valve seat. If necessary, use a valve seat cutter 44° to reprocess the surface of valve or valve seat.

Standard width: 0.9~1.3mm{0.035~0.051in}

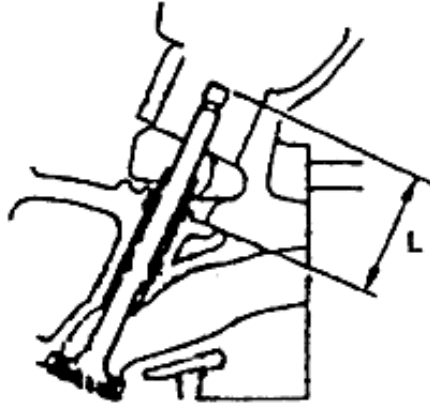


- Check the indentation of valve seat. Measure the extension length of valve rod (size: L). Replace the cylinder head when necessary.

Standard size L

Intake:44.07~44.67mm{1.7350~1.7587in}

Exhaust:44.07~44.67mm{1.7350~1.7587in}

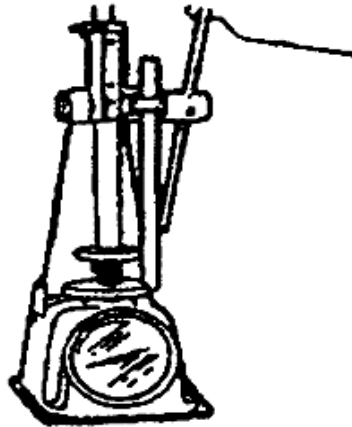


Check of valve spring

1. Apply the pressure on the valve spring. Check the spring height. Replace the valve spring when necessary

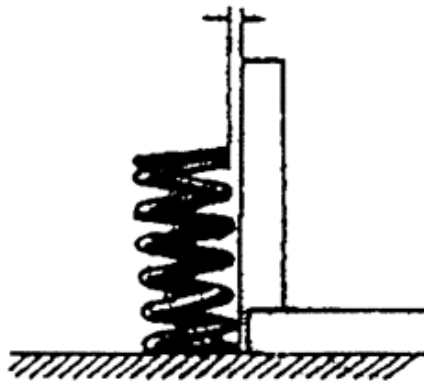
Pressure: 203~225N{20.71~22.95kgf, 45.68~50.63lbf}

Standard height: 38.8mm {1.528in}



2. Measure the perpendicularity of valve spring. If the perpendicularity exceeded the standard, replace the valve spring.

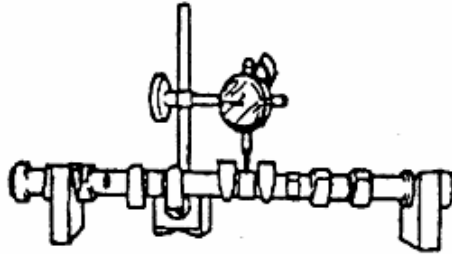
Max. perpendicularity of valve spring: 1.86mm {0.073in}



Check of spring

1. Place the journals of camshafts No. 1 and 5 on the V-block, measure the radius run-out of camshaft. Replace the camshaft when necessary.

Radius run-out: 0.03mm {0.0012in}



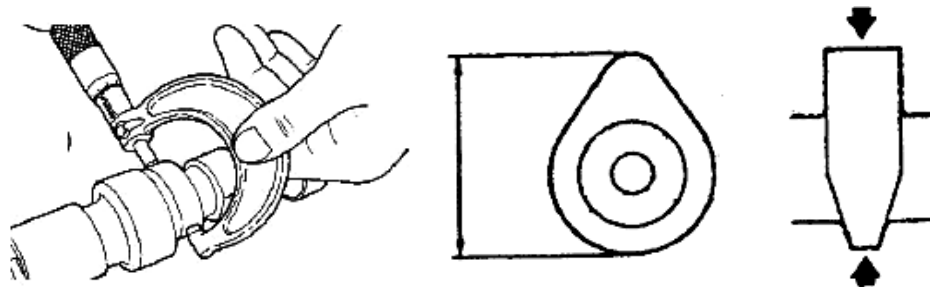
2. Measure the height of two convexes as shown in Fig. Replace the camshaft when necessary.

Standard height

Intake side: 43.81mm{1.7248in}; Exhaust side: 43.78mm {1.7236in}

Min.height

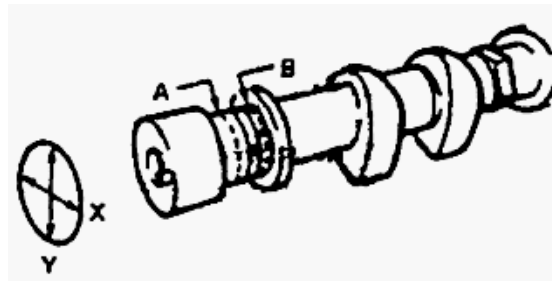
Intake side: 43.61mm{1.7169in}; Exhaust side: 43.58mm {1.7157in}



3. Measure the journal diameters at two points of A and B shown in Fig, respectively in the directions X and Y, replace the camshaft when necessary.

Standard diameter: 25.940~25.965mm{1.0213~1.0222in}

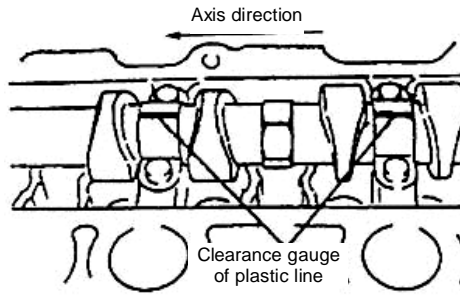
Min.diameter: 25.910mm{1.0201in}



4. Remove the tappet and measure the journal clearance of camshaft according to the method shown as below:

- (1) Wipe out all oil on/in the journal and bearing seat.
- (2) Contain the camshaft into the bearing seat.
- (3) As shown in the following figure, cut the clearance gauge of plastic line into the size

matching with the bearing width, and then place it on the journal in the axis direction.

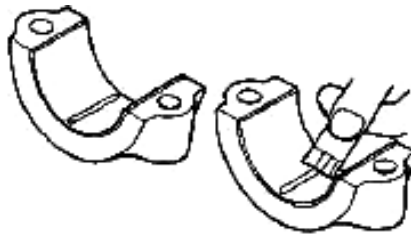


- (4) Fit the camshaft cover (See—Removal/Installation of Cylinder Head, Precautions to the Installation of Camshaft).

Attention: Do not turn the camshaft while measuring the clearance.

- (5) Disassemble the camshaft cover (See—Removal/Installation of Cylinder Head, Precautions to the Disassembly of Camshaft).
- (6) Measure the widest point of extruded part of clearance gauge of plastic line by use of the scale on the clearance gauge of plastic line, resulting therefore in the journal clearance. Replace the cylinder head and camshaft cover when necessary.

Standard journal clearance: 0.035~0.081mm{0.0014~0.0031in}



5. Fit the camshaft cover (See—Removal/Installation of Cylinder Head, Precautions to the Disassembly of Camshaft).
6. As shown in the following Fig., fit the dial gauge, push forward/rearward the camshaft from its back, measure the end gap of camshaft. Replace the cylinder head or camshaft when necessary.

Caution

I Do not push the camshaft with the cam so to prevent damage of cam.

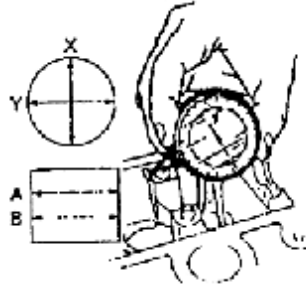
Standard end gap: 0.08~0.20mm{0.0031~0.0078in}

Max. end gap: 0.21mm {0.0082in}

Check of tappet

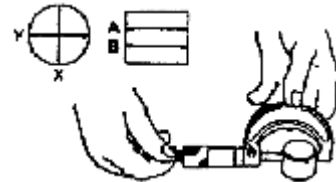
1. Measure the diameter of each tappet hole at two points of A and B shown in Fig, respectively in the directions X and Y, replace the camshaft when necessary.

Standard diameter: 31.000~31.025mm{1.2205~1.2215in}



2. Measure the diameter of each tappet hole at two points of A and B shown in Fig, respectively in the directions X and Y.

Standard diameter: 30.964~30.980mm{1.2191~1.2197in}



3. Calculate the clearance between the tappet and appropriate tappet hole. Replace the tappet or cylinder head if necessary

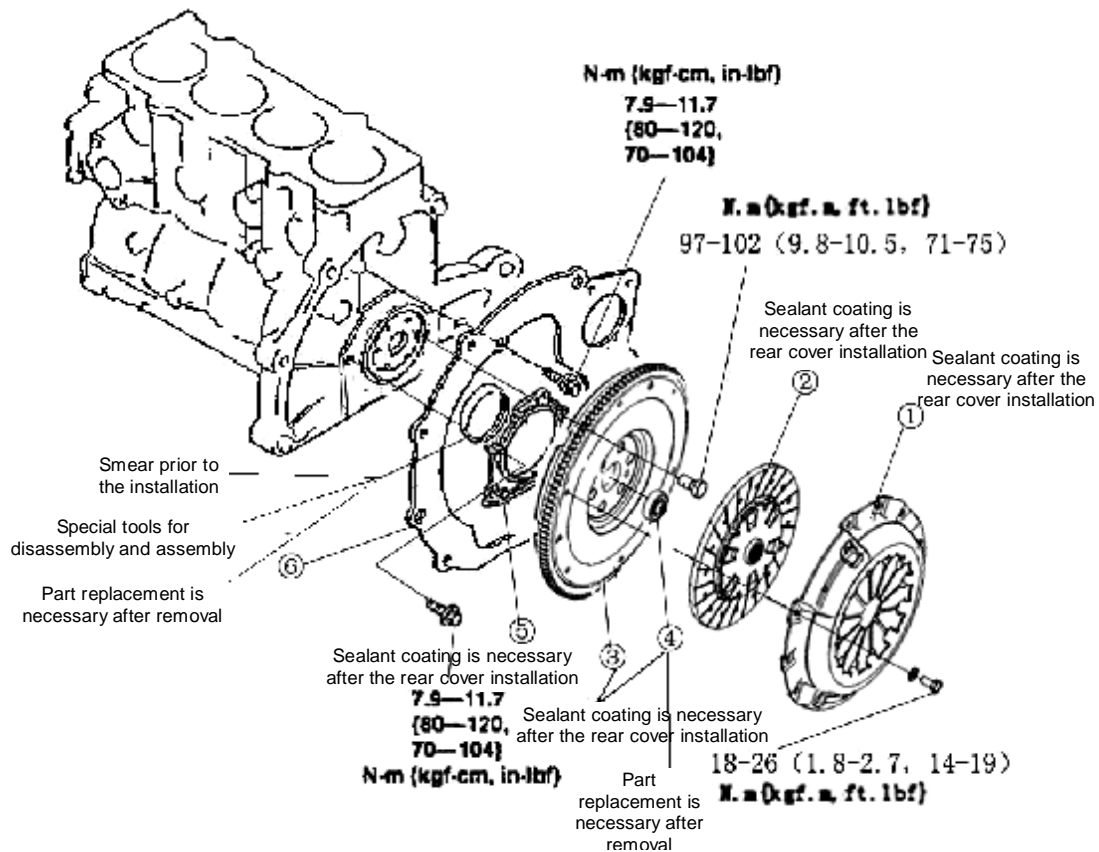
Standard clearance: 0.020~0.061mm{0.00079~0.00240in}

Max. clearance: 0.180mm {0.0071in}

Flywheel and clutch

Removal/installation of flywheel and clutch

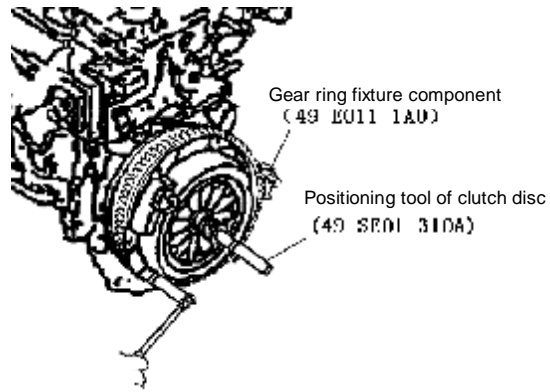
1. If necessary to disassemble the crankshaft rear cover, the oil pan body shall be removed at first (See—Lubrication System, Disassembly/Assembly of Oil Pan Body).
2. Disassemble as per the order shown in Fig.
3. Assemble in the reversing order of disassembly.



1	Clutch compressing disc (See—Disassembly Instructions /See—Assembly instructions)
2	Clutch disc plate(See—Disassembly Instructions /See—Assembly instructions)
3	Flywheel (See—Disassembly Instructions /See—Assembly instructions)
4	Pilot bearing(See—Disassembly Instructions /See—Assembly instructions)
5	Crankshaft rear cover(See—Disassembly Instructions of Rear Oil Seal /See—Assembly instructions of Rear Oil Seal /See—Assembly instructions)
6	Gearbox partition

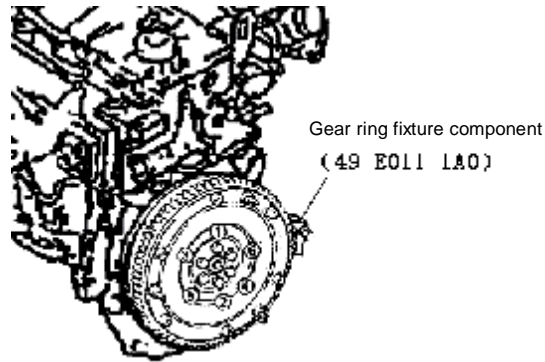
Disassembly instructions of clutch compressing disc and disc plate

1. Use a special tool to lock the flywheel and localize the clutch (as shown in Fig.).
2. Unscrew the bolts by one time, as per the criss cross method, until the pressure of diaphragm spring has been released.
3. Remove the clutch compressing disc and disc plate.



Disassembly instructions of flywheel

1. Use a special tool (as shown in Fig.) to clamp the flywheel.
2. Dismantle evenly the mounting bolts in several times according to the criss cross order (as shown in Fig.)
3. Remove the flywheel.

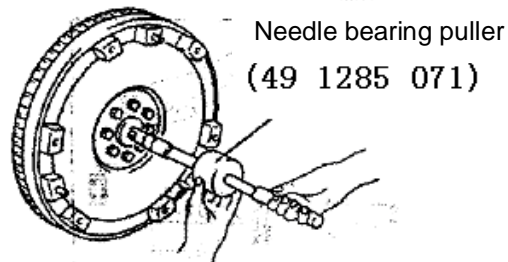


Disassembly instructions of pilot bearing

Attention

- I In general, it is unnecessary to disassemble the pilot bearing other than replacement.

Use a special tools (as shown in Fig.) to disassemble the pilot bearing.



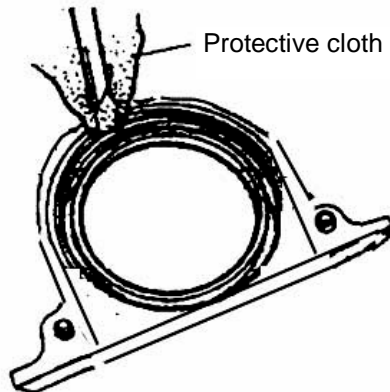
Disassembly instructions of rear oil seal

Attention

- I In general, it is unnecessary to disassemble the rear oil seal other than

replacement.

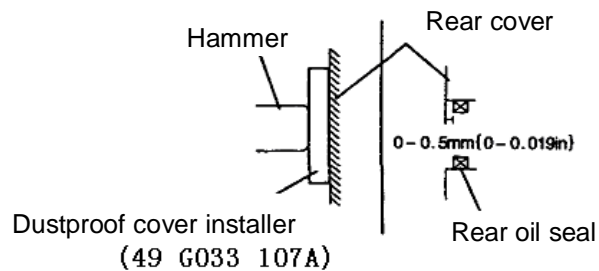
Remove the oil seal by use of a screwdriver wrapped with protective cloth.



Assembly instructions of rear oil seal

1. Add clean oil on the oil seal.
2. Fit the oil seal with hands.
3. Use a special tool and hammer to press in the seal.

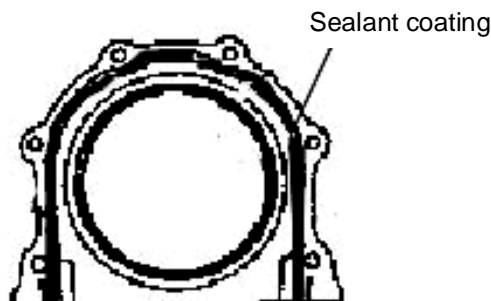
Press depth: 0~0.5mm{0~0.019in}



Assembly instructions of crankshaft rear cover

1. As shown in Fig., smear evenly the sealant in the groove of crankshaft rear cover.

Sealant diameter: $\Phi 1.5 \sim 2.5\text{mm}$ {0.06~0.10in}



2. Fit the crankshaft rear cover.

Assembly instructions of flywheel

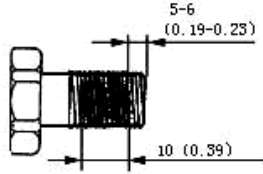
1. Fit the flywheel on the crankshaft.

Flywheel and clutch

- Prior to the installation, clean the bolt threads and hole. As shown in the following Fig., smear evenly the sealant on the threads.

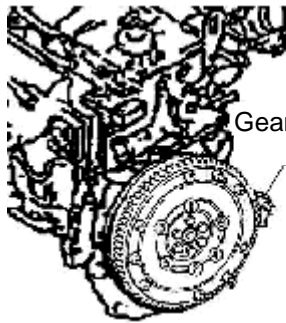
Attention

I It is unnecessary to smear sealant when a new bolt is used



It is necessary to smear sealant when the bolt is reused.

- Pre-tighten manually the flywheel bolt.
- Fit the special tools on the flywheel (as shown in Fig.).
- Gradually tighten the flywheel bolt according to criss cross order (as shown in Fig.).



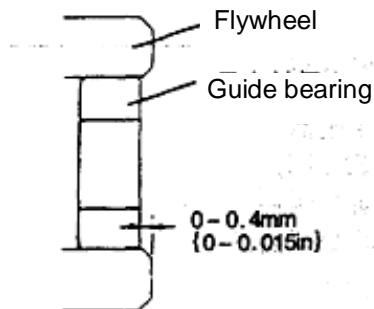
Gear ring fixture component

Assembly instructions of pilot bearing

Attention

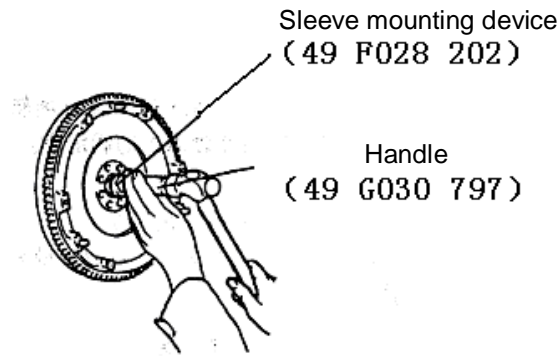
I Fit the pilot bearing as per the following instructions.

Mounting depth of pilot bearing: 0~0.4mm{0~0.015in}



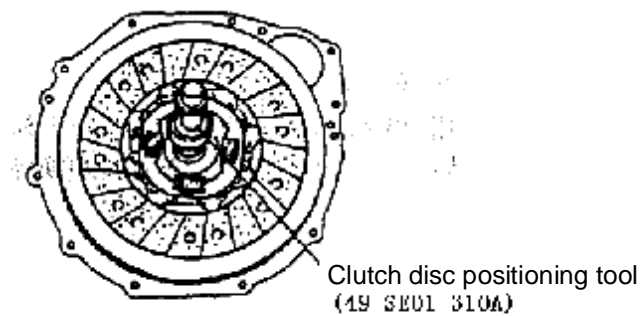
Use as special tool (as shown in Fig.) to install a new pilot bearing.

Flywheel and clutch



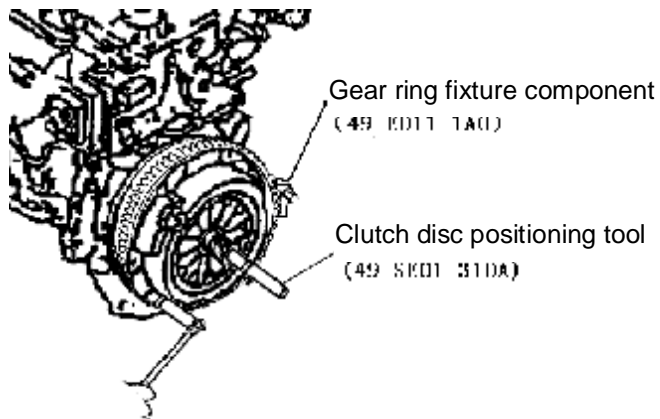
Assembly instructions of clutch disc plate

Use as special tool (as shown in Fig.) to hold the position of clutch disc plate.



Assembly instructions of clutch compressing disc

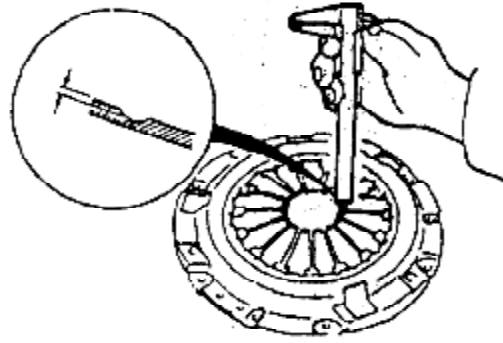
1. Use a special tool to jam the flywheel and localize the clutch (as shown in Fig.).
2. Evenly tighten the bolts according to criss cross order (as shown in Fig.)



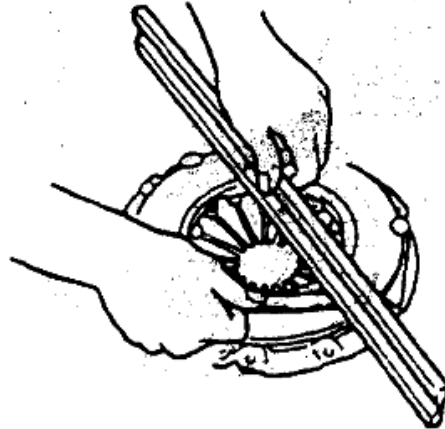
Check of clutch compressing disc

1. Measure the wear of diaphragm spring.
I If the standard exceeded, the clutch compressing disc shall be replaced.

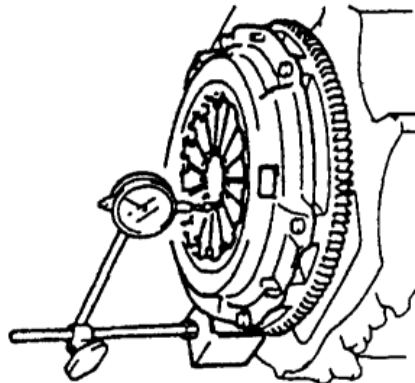
Depth: $\leq 0.6\text{mm}$ {0.024in}



2. Use as knife straight edge and feeler to measure the flatness of press disc.
I If the standard exceeded, the clutch assembly shall be replaced.
Max. clearance: 0.05mm {0.0019in}



3. Fit the dial gauge on the cylinder block, turn the flywheel to check the radius run-out of diaphragm spring.
I If the standard exceeded, the clutch compressing disc shall be replaced.
Radical run-out: $\leq 0.6\text{mm}$ {0.024in}

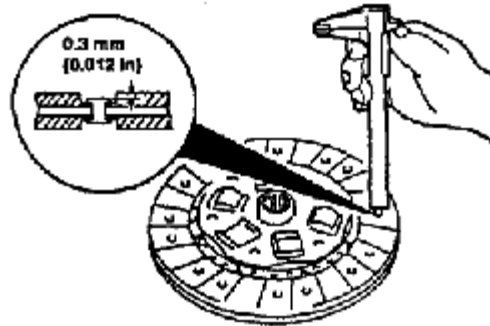


Check of clutch plate

1. Use a vernier caliper to measure the rivets at both sides and the depth of disc plate between the surfaces.

I If the standard exceeded, the clutch disc plate shall be replaced.

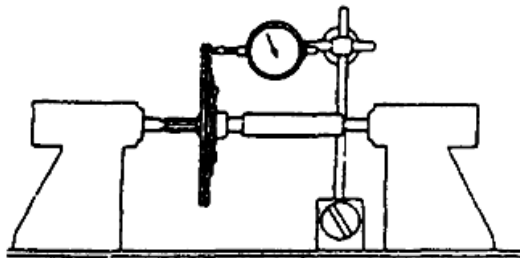
Depth: $\geq 0.3\text{mm}$ {0.012in}



2. Use a dial gauge to measure the radical run-out of clutch disc plate

I If the standard exceeded, the clutch disc plate shall be replaced.

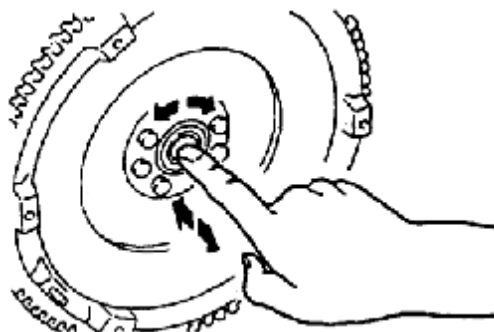
Radical run-out: $\leq 0.7\text{mm}$ {0.028in}



Check of pilot bearing

Forcibly turn the bearing in axis direction instead of removing the pilot bearing.

I If unable to rotate or there is strong resistance or abnormal noise, the pilot bearing shall be replaced.

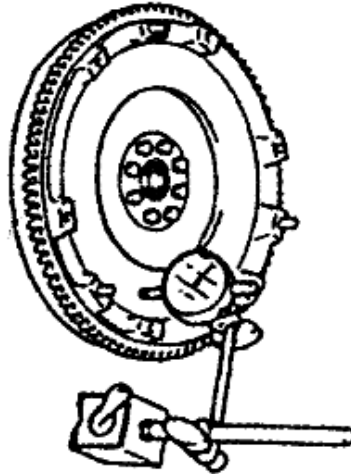


Check of flywheel

1. Fit the dial gauge on the cylinder block.
2. Turn the flywheel and measure the radical run-out of flywheel.

I If the standard exceeded, the flywheel shall be replaced.

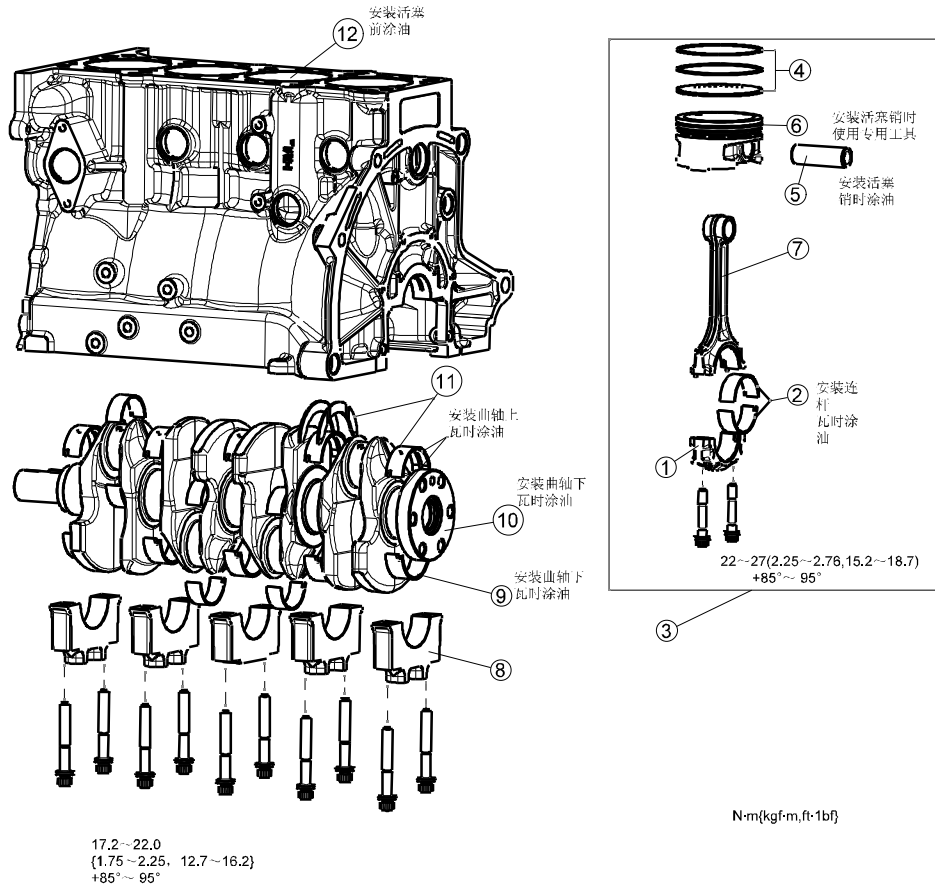
Radical run-out: $\leq 0.13\text{mm}\{0.0051\text{in}\}$



Cylinder block and crank connecting rod mechanisms

Break down/installation of cylinder block and crank connecting rod mechanisms

1. Remove the cylinder head (See—Cylinder Head), Oil Pan Body, Oil Pump (See—Lubrication System), Crankshaft Rear Cover (See—Flywheel and Clutch).
2. Disassemble as per the order shown in Fig.
3. Assemble as per the reversing order of disassembly.



1	Connecting rod cap (See—Removal/Installation Instructions)
2	Connecting rod bearing
3	piston connecting rod assembly(See—Removal/Installation Instructions)
4	Piston ring (See—Installation Instructions)
5	Piston pin (See—Removal/Installation Instructions)
6	Piston
7	Connecting rod

8	Main bearing cap(See—Removal/Installation Instructions)
9	Lower bearing of crankshaft
10	Crankshaft (See—Disassembly instructions)
11	Upper bearing of crankshaft and thrust bearing
12	Cylinder block

Cylinder block and crank connecting rod mechanisms

Disassembly of connecting rod cap

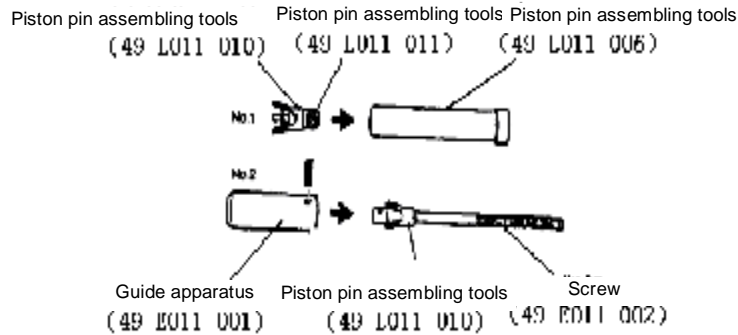
Check the end gap of connecting rod (See——this section, Check of Connecting Rod).

Disassembly of piston and connecting rod

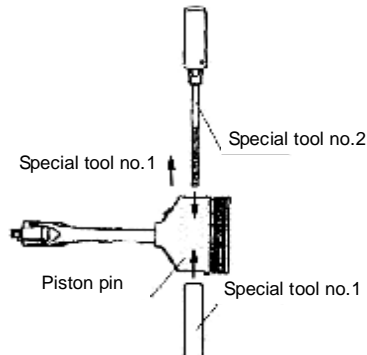
Check the crankshaft pin clearance (See——this section, Check of connecting rod).

Disassembly of piston pin

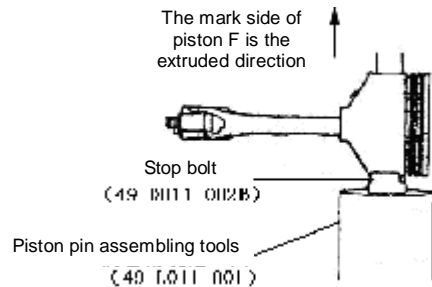
1. As shown in Fig. fit the special tools no. 1 and 2.



2. As shown in Fig., insert the special tool no.2 into the piston pin and tighten on the special tool no.1.



3. As shown in the following figure, fit the special tool fitted as per the 2nd step and the piston connecting rod assembly on the special tool.

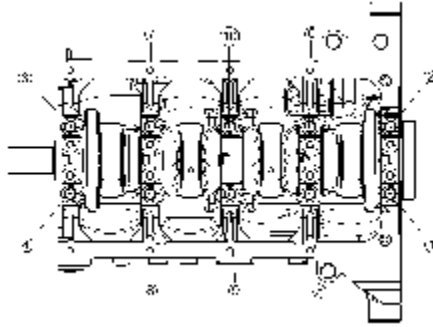


4. Use a press to press out the piston pin.

Disassembly of main bearing cap

1. Check the end gap of crankshaft (See——this section, Check/Repair of Crankshaft).

2. As shown in Fig., unscrew the main bearing cap bolt in several steps.

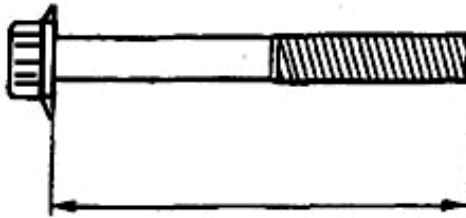


Disassembly of crankshaft

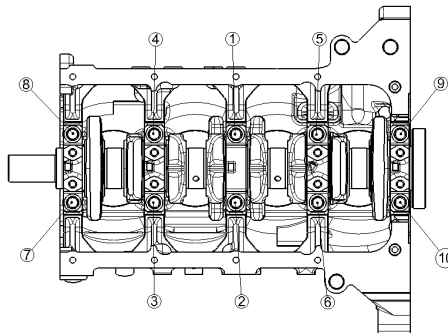
Check the main journal clearance (See——this section, Check/Repair of Crankshaft).

Installation of main bearing cap

1. Measure the length of each bolt. Replace when the standard value is exceeded.
Standard length: 67.7~68.3mm {2.665~2.689in}
Max.length: 68.7mm {2.705in}

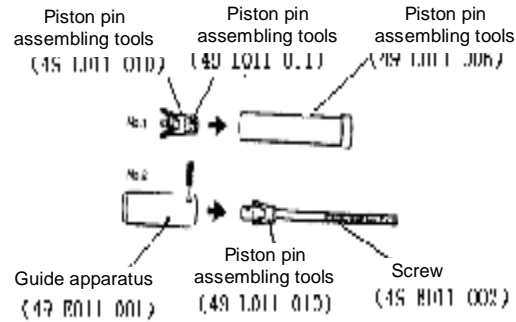


2. Tighten the bolts in several steps as per the order shown in Fig.

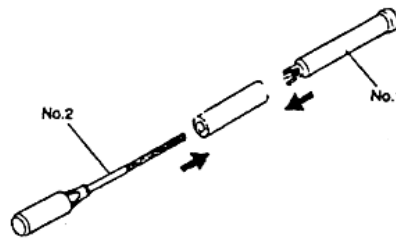


Installation of piston pin

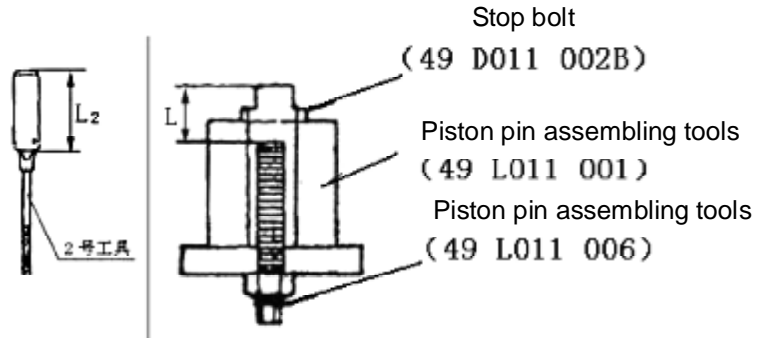
1. Fit the special tool as shown in Fig.



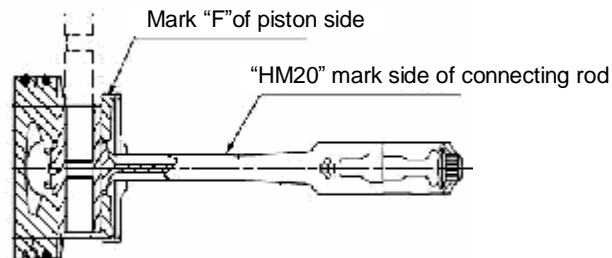
2. Insert the special tool no.2 into the piston pin and tighten it on the special tool no.1



3. Measure the guide portion length L_2 of the tool no.2, and calculate as per the following formula: $L=L_2-1.75\text{mm}$; fit the special tools(stop bolt) to make the size L suitable.

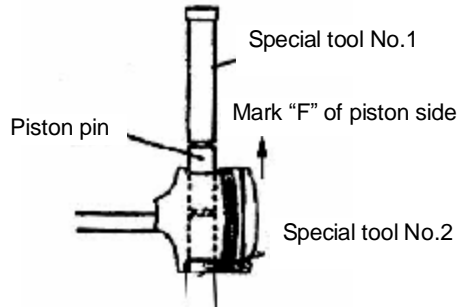


4. Smear clean engine oil on the piston pin.
5. Place the piston and connecting rod on the press table, facing upward the "F" mark of piston side and the "HM20" mark side of connecting rod, just as shown in the following figure.



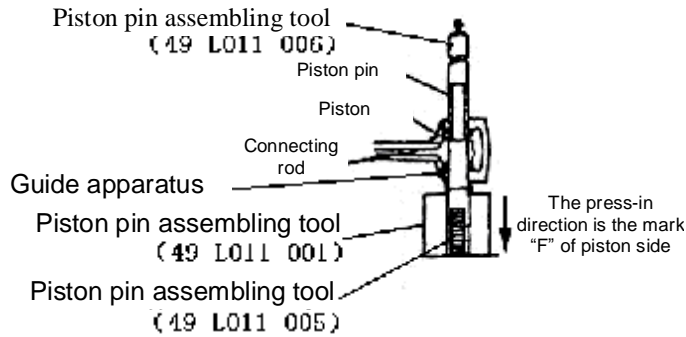
Cylinder block and crank connecting rod mechanisms

6. Insert the piston pin and the special tool fitted as per the 2nd step into the piston and connecting rod as shown in Fig.,below;



7. Use a press to press in the piston pin into the piston and connecting rod until the special tool no.2 (guide tube) gets in contact with the special tool (stop bolt).
8. While pressing in the piston pin, check the press-in pressure. If lower than the index, replace the piston pin or connecting rod.

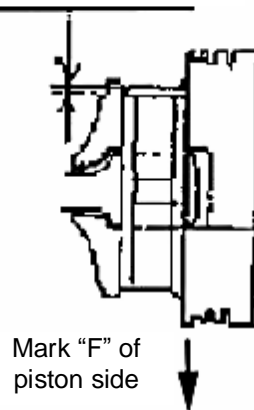
Pressure: 4.90~14.70kN(500~1500kgf, 1100~3300lbf)



9. Check the pressed depth of piston pin. If it is out of the standard value, restart from the 1st step.

Press-in depth of piston pin: 1.65~2.05mm{0.0650~0.0807in}

Press-in depth of piston pin



Installation of piston ring

1. As shown in Fig., below, contain the corrugated ring into the groove of piston ring, and then contain one end of the oil control ring into the groove, and then press in other parts in place. Afterward, check whether all rings can slide smoothly in both directions.

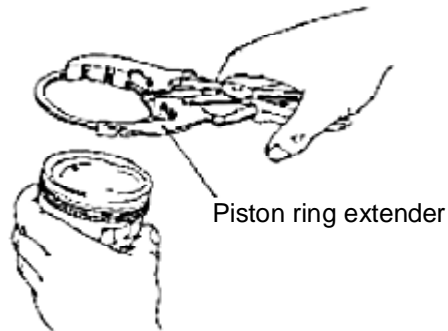
Caution

- I Do not use the piston ring expander to fit the oil control ring, otherwise it will result in breakage.**

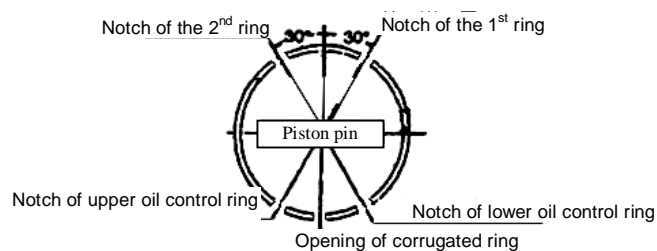
Head face of oil control ring



2. Use a piston ring extender to fit the 2nd and 1st piston control rings. Face the mark upward at the time of installation

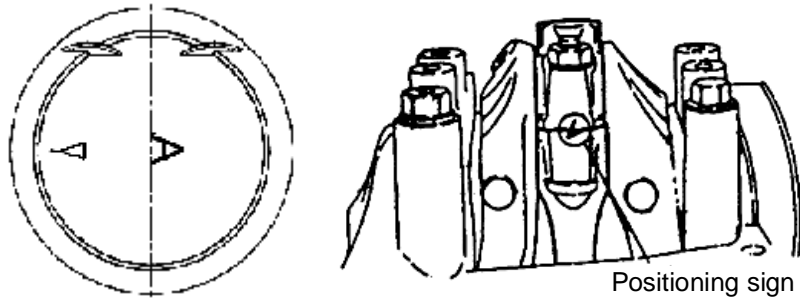


3. Align with the notch of each ring as per the figure below.



Installation of piston connecting rod assembly

1. The arrow on the top of piston aims to the front of engine.
2. When the connecting rod cap is fitted, the positioning sign of connecting rod cap shall be aligned.

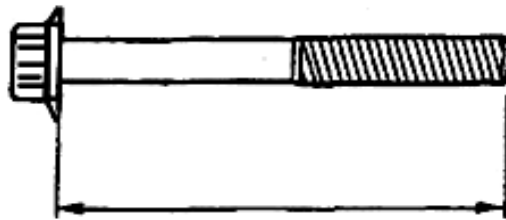


Installation of connecting rod cap

Measure the length of each bolt. Replace when the standard value exceeded.

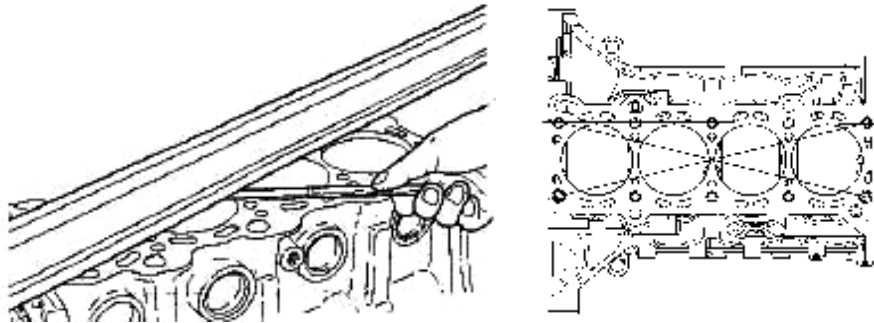
Standard length: 46.7~47.3mm {1.838~1.862in}

Max.length: 47.6mm {1.874in}



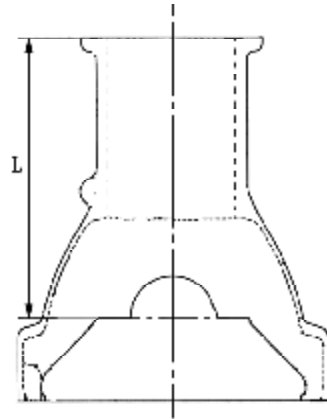
Check/repair of cylinder block

1. Use a straight edge ruler and feeler to measure the distortion on the surface of cylinder block as per 6 directions shown in Fig.
2. The max.distortion: 0.05mm{0.002in}



3. If the distortion on the surface of cylinder block surpassed the max.value, check the height of cylinder block. If the height is also out of the standard value, replace the cylinder block.

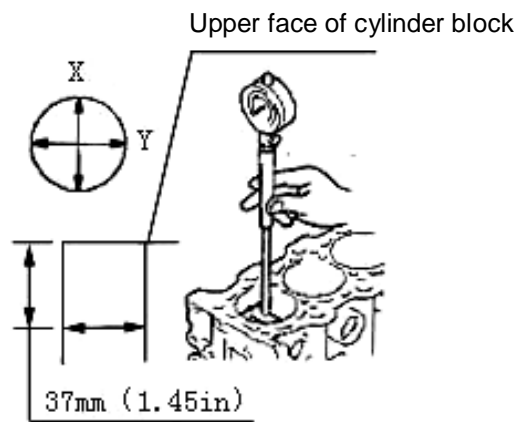
Standard height: 213.45~213.55mm{8.4035~8.4066in}



4. If the distortion of cylinder block exceeded the max.value with the height within the range of standard value, grind the height or replace the cylinder block.

Max. grinding size: 0.20mm {0.008in}

5. As shown in the following figure, measure the I/D of cylinder with an I/D dial gauge at 37mm{1.45in} away from the surface, in the directions of X and Y, .



6. If the I/D of cylinder exceeded the wear limit, replace the cylinder block or rebore the cylinder and fit the oversized piston to have it conform to the standard clearance of between the piston and cylinder.

Wear limit: 0.15mm {0.006in}

Attention

- I The diameter of cylinder boring shall be determined according to the oversized diameter of piston. All cylinders shall be in the same diameter.
- I In order to prevent the heat generation at the time of boring, resulting in distortion of cylinder block, the cylinders shall be bored in the following order: 2→4→1→3.
- I A honing margin of 0.02mm {0.000787in} shall be reserved by boring. After the boring, hone the cylinder bore until the last process size.

Cylinder block and crank connecting rod mechanisms

I/D of cylinder mm{in}

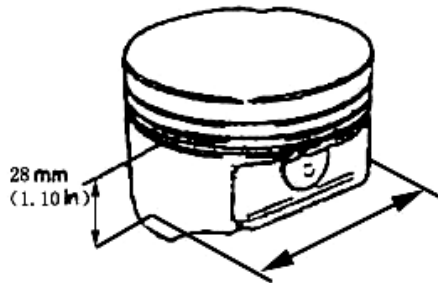
Size	Diameter
Standard	84~84.03{3.3071~3.3083}
Oversize: 0.25{0.01}	84.25~84.28{3.3169~3.3181}
Oversize: 0.50{0.02}	84.50~84.53{3.3268 3.3280}

Check of piston, piston ring and piston pin

1. Measure the piston diameter in the direction perpendicular to the axis of the piston pin hole and 28mm {1.10in} below the lower edge of oil ring groove.

Piston diameter mm {in}

Size	Diameter
standard	83.97~84{3.3059~3.3071}
Oversize: 0.25{0.01}	84.22~84.25{3.3157~3.3169}
Oversize: 0.50{0.02}	84.47~84.50{3.3256~3.3268}



2. Calculate the clearance between the piston and cylinder. Replace the piston or rebores the cylinder when necessary to be applicable to the oversized piston.
Standard clearance: 0.02~0.04mm{0.000~0.0016in}
Max.clearance: 0.10mm {0.004in}
3. If the piston replaced, the replacement of piston ring shall be also done.
4. Measure, with a feeler, the clearance on the entire perimeter between the piston ring and ring groove (as shown in Fig.) Replace the piston and piston ring when necessary.

Standard clearance:

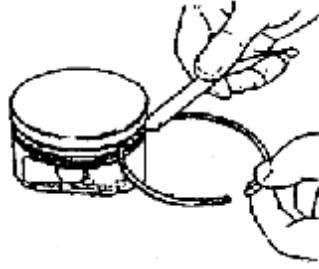
1st ring: 0.030~0.070mm{0.0012~0.0028in}

2nd ring: 0.020~0.060mm{0.0008~0.0024in}

Oil ring: 0.040~0.12mm{0.0016~0.047in}

Max.clearance

1st and 2nd rings: 0.15mm{0.006in}; Oil ring: 0.15mm {0.006in}



5. Place manually the piston ring into the cylinder, use the piston to push the piston ring to the stroke end of cylinder bore.
6. Measure, with a feeler, the gap of each piston ring. Replace the piston ring when necessary.

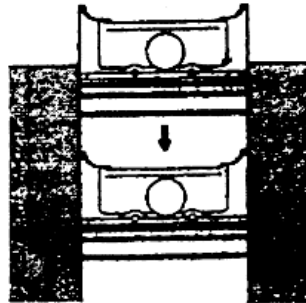
Standard notch clearance

1st ring: 0.20~0.35mm{0.008~0.014in}

2nd ring: 0.30~0.45mm{0.012~0.018in}

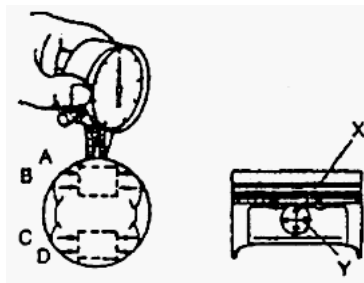
Oil ring: 0.20~0.50mm{0.008~0.020in}

Max.gap: 1.0mm{0.039in}



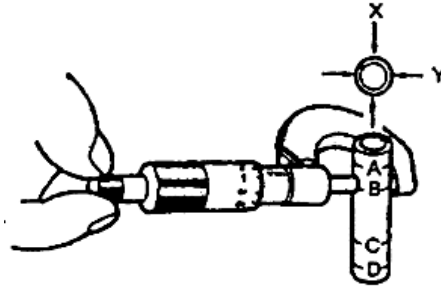
7. As shown in Fig., measure the diameter of each piston pin hole at 4 points as A, B, C and D in the directions of X and Y.

Standard diameter: 19.010~19.015mm{0.7484~0.7486in}



8. As shown in Fig., measure the diameter of each piston pin at 4 points as A, B, C and D in the directions of X and Y.

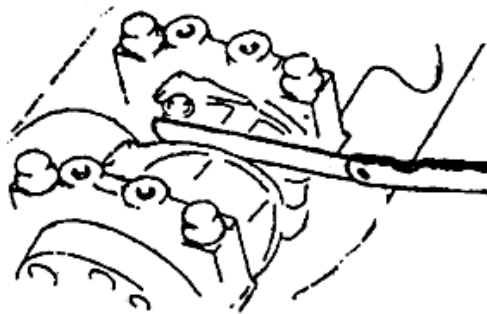
Standard diameter: 19.002~19.005mm{0.7481~0.7482in}



9. Calculate the clearance between the piston pin and piston pin hole. Replace the piston and / or piston pin when necessary.
Standard clearance: 0.005~0.013mm{0.0002~0.0005in}
10. Measure the diameter of connecting rod small end (See——Check of Connecting Rod), calculate the clearance between the connecting rod small end and piston pin. Replace the connecting rod or piston pin when necessary.
Standard clearance: -0.031~-0.017mm{-0.0013~-0.0007in}

Check of connecting rod

1. Measure, with a feeler, the end gap of connecting rod. Replace the connecting rod and connecting rod cap when necessary.
Standard clearance
0.100~0.250mm {0.004~0.010in}
Max.clearance
0.30mm {0.012in}



2. Measure the clearance of crankshaft pin journal by the following way:
 - (1) Wipe out all oil on/in the journal and bearing seat;
 - (2) Cut the clearance gauge of plastic line so that it can match with the width of bearing, and then place it on the top of journal and perpendicular to its axis.
 - (3) Fit the connecting rod cap (See——this section, Assembly of Piston and Connecting Rod).
 - (4) Remove the connecting rod cap bolt and slowly take out the connecting rod cap.
 - (5) Measure, with a clearance gauge of plastic line, the widest point of extruded part of

Cylinder block and crank connecting rod mechanisms

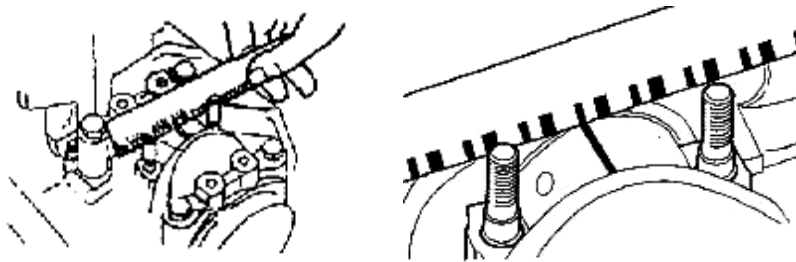
clearance gauge of plastic line, whereby the journal clearance will be achieved. If the clearance exceeded the max. value, replace the connecting rod bearing or grind the crankshaft pin, and use the bearing applicable to the reduced size of crankshaft pin to meet the standard clearance.

Standard clearance: 0.015~0.048mm{0.0006~0.00191in}

Max.clearance: 0.10mm {0.0039in}

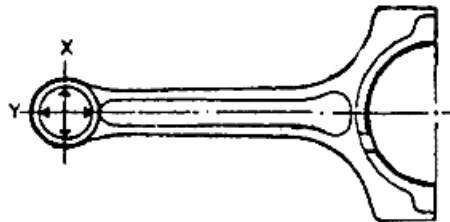
mm{in}

Size of connecting rod bearing	Thickness of connecting rod bearing
Standard	1.487~1.499{0.05854~0.05902}
0.25{0.01}Oversize:	1.612~1.624{0.06346~0.06394}
0.50{0.02}Oversize:	1.737~1.749{0.06839~0.06886}



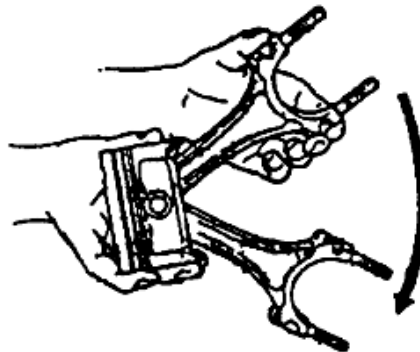
3. As shown in Fig., measure the I/D of each connecting rod small end in the directions X and Y.

Standard diameter: 18.974~18.985mm{0.7476~0.7474in}



Check of piston and connecting rod

As shown in Fig., check the swing torque. If the large end cannot drop in reliance on the weight of its own, replace the piston or piston pin.



Check/repair of crankshaft

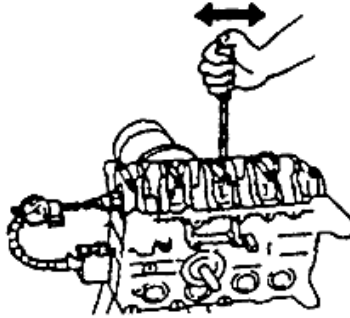
- As shown in the following Fig., fit the dial gauge, push forward/rearward the crankshaft from its back, measure the end gap of crankshaft. If the end gap exceeded the max. value, replace the stop bearing or grind the crankshaft, and fit the bearing applicable to the reduced size of crankshaft to meet the standard end gap.

Standard end gap: 0.05~0.25mm{0.002~0.011in}

Max. end gap: 0.30mm{0.012in}

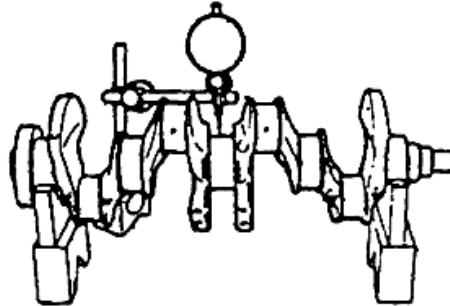
mm{in}

Size of stop bearing	Thickness of stop bearing
Standard	1.925~1.975{0.0758~0.0778}
Reduced size of 0.25{0.01}	2.05~2.100{0.0807~0.0827}
Reduced size of 0.50{0.02}	2.175~2.225{0.0856~0.0876}
Reduced size of 0.75{0.03}	2.300~2.350{0.0906~0.0925}



- Measure the radius run-out of crankshaft. Replace the crankshaft when necessary.

Max. radical run-out: 0.03mm{0.0012in}



- At two points of A and B shown in Fig., measure the journal diameter in the directions X and Y. replace the crankshaft or grind the journal when necessary and fit the bearing applicable to the reduced size of crankshaft.

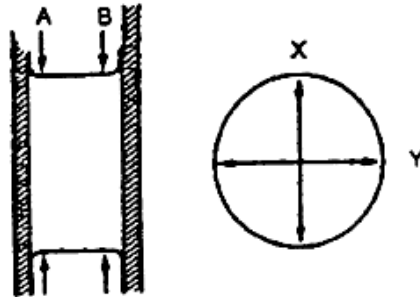
mm{in}

Main journal	Diameter
Standard	49.982~50{1.9678~1.9685}
Reduce size: 0.25{0.01}	49.732~49.75{1.9580~1.9586}

Cylinder block and crank connecting rod mechanisms

mm{in}

Crank pin	Diameter
Standard	44.980~45.000{1.7709~1.7717}
Reduce size: 0.25{0.01}	44.730~44.750{1.7610~1.7618}
Reduce size: 0.50{0.02}	44.480~44.500{1.7512~1.7520}



4. Measure the main journal clearance in the following way.
 - (1) Wipe out the oil on/in the crankshaft journal and bearing seat.
 - (2) Cut the clearance gauge of plastic line so that it can match with the bearing width and then place it on the top of journal and perpendicular to its axis.
 - (3) Fit the main bearing cap (See——this section, Installation of Main Bearing Cap).
 - (4) Remove the main bearing cap bolt and slowly take out the main bearing cap (See——this section, Installation of Main Bearing Cap).
 - (5) Measure, with a clearance gauge of plastic line, the widest point of extruded part of clearance gauge of plastic line, whereby the journal clearance can be achieved. If the clearance exceeded the max. value, grind the main bearing hole and fit the bearing suitable for the reduced size of crankshaft to meet the current clearance.

Standard clearance: 0.018~0.036mm{0.00071~0.00142in}

Max.clearance: 0.1mm {0.0039in}

mm{in}

Size of bearing	Thickness of bearing
Standard	1.988~2.003{0.0783~0.0789}
Reduced size: 0.25{0.01}	2.113~2.128{0.0831~0.0837}

