Engine

EM Engine Structure

Precautions

Precaution for Draining Engine Coolant:

■ Drain engine coolant after the engine is in cooling condition.

Precautions for Disconnecting Fuel Pipe:

■ Before starting to work, make sure there is no article which may cause combustion or spark in working area.

■ Before disconnecting and dismantling, first release fuel pressure. For methods to release fuel pressure, please refer to "the release of fuel pressure in fuel pipe".

■ After disconnecting pipe, plug the opening to avoid fuel leakage.

Precaution of Dismantling and Disassembly:

■ If it is required to use special repair tools, please use special repair tools. Always keep safe operation, and do not force to do or conduct improper operation.

■ Be careful not to damage the matching surface or sliding surface.

■ If necessary, use adhesive tape or equivalent to seal the opening of engine system, to avoid foreign matters from entering.

■ Methodically mark and arrange the dismantled parts, to facilitate troubleshooting and re-assembly.

■ The basic principles for loosening bolts and nuts are to loosen the exterior first, and then loosen the diagonal position, and so on. If the loosening sequence is specified, please follow the specified sequence.

Precaution of Inspection, Repair and Replacement:

■ Before repairing or replacing, completely inspect parts. Use the same methods to inspect the replaced parts. If necessary, please replace.

Precaution of Assembly and Installation:

■ The basic principles for tightening bolts and nuts are to first tighten middle with the same tightening torque, and then tighten exterior diagonal position. If the tightening sequence is specified, please follow the specified sequence.

■ Cushion, oil seal or rubber sealing ring are easy to be damaged during dismantling. If necessary, replace them.

■ Completely flush, clean and blow each part to dry condition. Carefully inspect whether engine oil or engine coolant pipe is blocked.

■ When refilling engine coolant after drain it out, it is necessary to release air from pipe.

■ After repairing, start the engine and increase engine rotation speed to inspect whether the engine coolant, fuel, engine oil and tail gas have leakage.

Parts to be tightened according to the Specified Angle:

■ Use angle wrench to finally tighten the following engine parts:

—— Cylinder head bolt

—— Main bearing cover bolts

—— Connecting rod cap nut

—— Crankshaft belt pulley bolts (it is unnecessary to use angle wrench, because bolt flange is used for fixing groove tightened according to fix angle).

■ Do not finally tighten them according to torque value.

■ Torque value of these parts is applied to pre-tightening steps.

■ Keep surface of thread and base seat clean and apply oil on it.

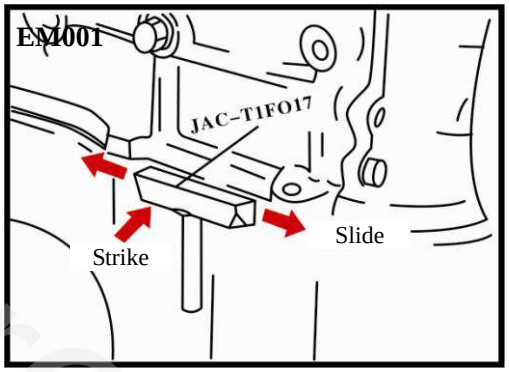
Dismantling Sealant:

■ After dismantling fixing nuts and bolts, use a scraper to separate matching surface and dismantle oil sealant.

■ Pay attention not to damage matching surface.

■ Insert the scraper, and then, as shown in figure, knock it and slide it from the side.

■ In some places where it is difficult to use scraper, please use plastic hammer to slightly knock the parts and dismantle them.



■ If it is inevitable to use screwdriver and other tools, please pay attention not to damage the matching surface.

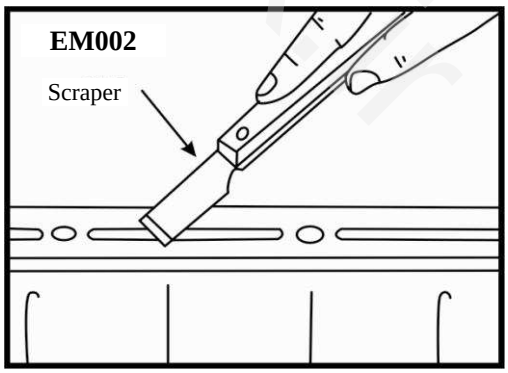
Steps for Application of Sealant:

■ Use a scraper to remove oil sealant on the surface of cushion and matching surface.

■ Completely remove oil sealant from the groove, fixing bolts and bolt holes.

■ Use lead-free gasoline to clean sealant application surface and matching surface, and remove the attached water, grease and foreign matters.

■ Put the sealant with the specified size completely onto the specified position.



■ If there is a groove to place sealant, please put the sealant into this groove.

■ For bolt holes, generally apply sealant into the holes. Sometimes, apply sealant outside of the hole.

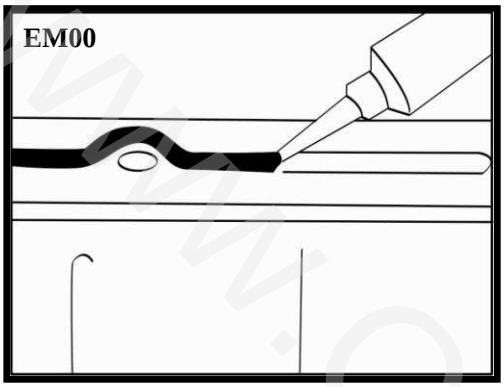
■ Install binding parts within 5mins after applying sealant.

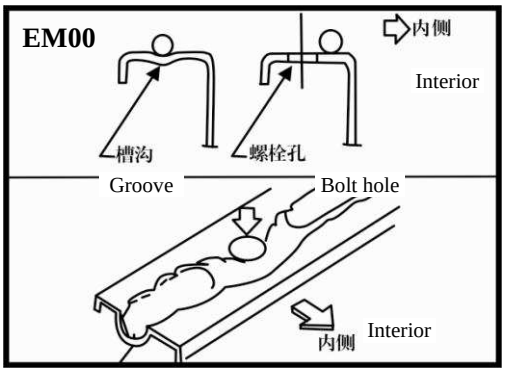
■ If there is dirt on the sealant, immediately clean it.

■ Do not re-tighten locking bolts or nuts after installation.

■ After 30 mins of installation, refill engine oil and engine coolant.

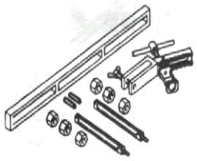
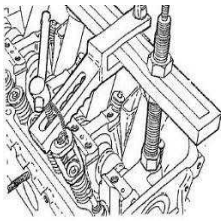
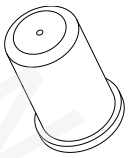
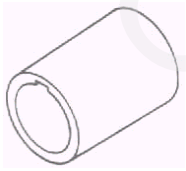
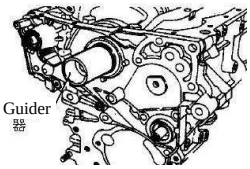
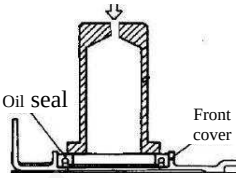
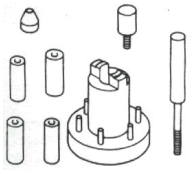
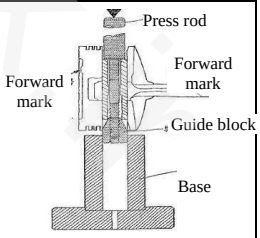
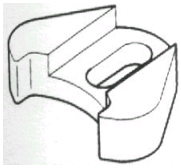
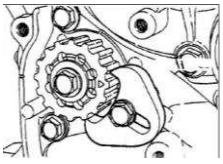
■ If there is special instruction in this manual.

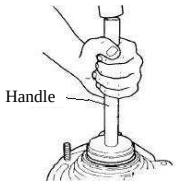
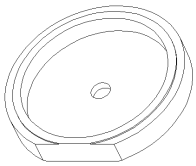
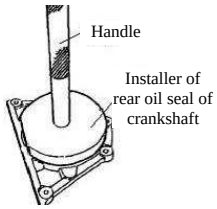
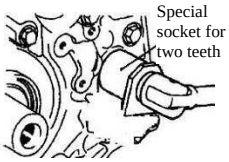
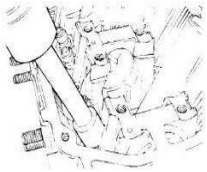
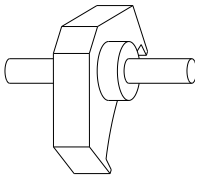
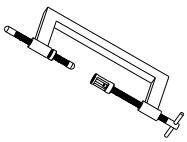
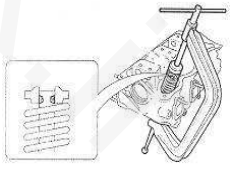
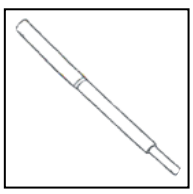
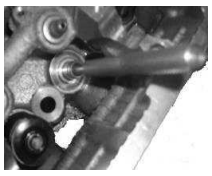


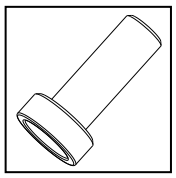
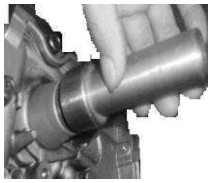
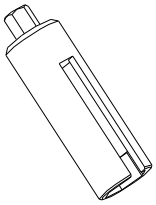
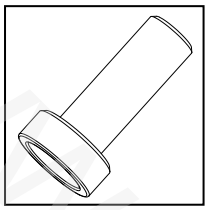
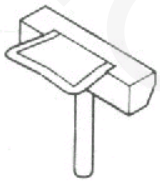
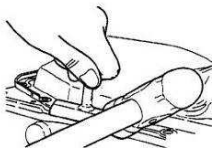


Preparation Work

Special Tool Table

No.	Tools Name	Overall diagram	Code	Purpose	
1	Valve spring compressor		JAC-T1F001	It is used for dismantling engine valve and relevant parts when it is unnecessary to dismantle.	
2	Camshaft oil seal installer		JAC-T1F002	Install engine camshaft oil seal	
3	Crankshaft front oil seal guider		JAC-T1F003	It can guide to install crankshaft front oil seal.	
4	Crankshaft front oil seal installer		JAC-T1F004	Install crankshaft front oil seal	
5	Dismantle tool of piston pin		JAC-T1F005	It is used for dismantling of engine piston pin.	
6	Timing gear pulley stopper		JAC-T1F006	It is used for supporting fixing balance axle chain wheel.	

7	Handle		JAC-T1F007	Mounting bearing used with relevant installer.	
8	Crankshaft rear oil seal installer		JAC-T1F008	Install crankshaft rear oil seal	
9	Double-teeth special sleeve		JAC-T1F009	It is used for dismantling front cover plug cock of the engine.	
10	Valve oil seal installer		JAC-T1F010	Install valve oil seal	
11	Flywheel stop dog		JAC-T1F011	Fixed flywheel, easily dismantle	
12	Valve spring compressor		JAC-T1F012	Dismantling engine valve and relevant parts when disassembly	
13	Valve guide pipe dismantle tool		JAC-T1F013	Dismantle valve duct	

14	Balance shaft oil seal installing tool		JAC-T1F014	It is used for installing oil seal on engine balance shaft.	
15	Oxygen sensor wrench		JAC-T1F015	It is used for dismantling and installing oxygen sensor.	
16	Mounting tools for pulley oil seal		JAC-T1F016	It is used for installing oil seal on engine timing belt pulley.	
17	Oil pan unloaded		JAC-T1F017	It is used for dismantling of oil pan.	
18	Fuel pressure gauge		JAC-T1F018	Measure fuel pressure	

Auxiliary Material Table of Engine Assembly

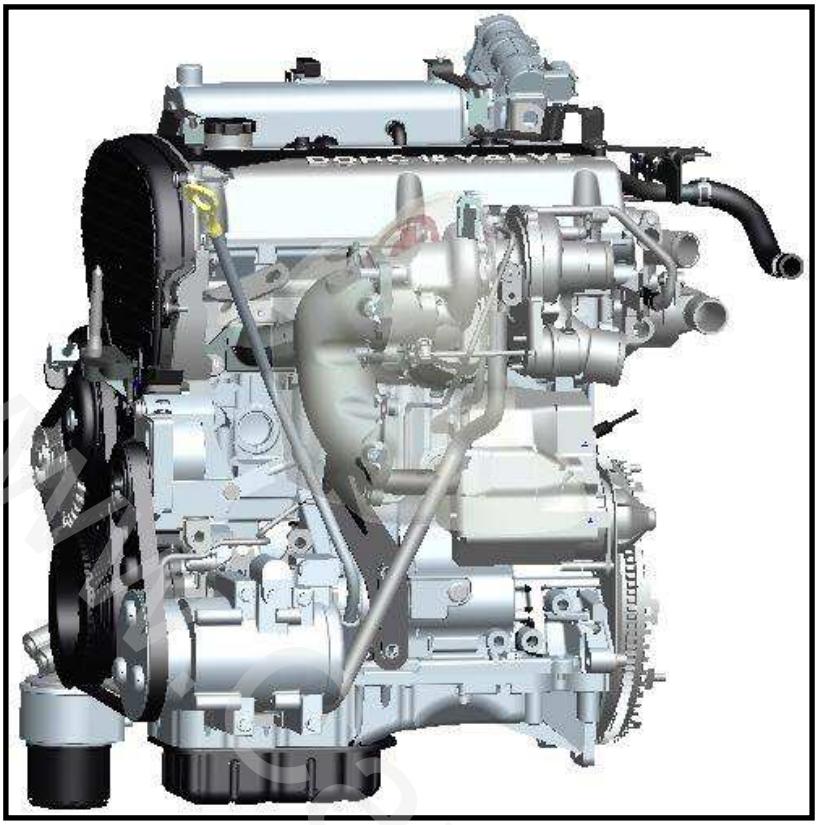
No.	Name	Application	Specification Brand
1	oil	Oil filling, oil for assembly	5W-30 (in winter of northern areas) 15W-40 (in summer of northern areas and full year in southern areas) quality grade is SJ or above.
2	Silica gel	Oil pump, water pump, oil pan, crankshaft rear oil seal housing	LT5699 or equivalent
3	Sealant	Oil pressure switch, drain plug, flywheel bolt	LT243 or equivalent
4	Sealant	Coolant temperature sensor, water temperature warning switch	LT648 or equivalent
5	Gasoline		RON93# and above grade of lead-free gasoline
6	Sealant	Double-end bolt	LT271 or equivalent

Auxiliary Material Table for Cylinder Head Assembly

No.	Name	Present material and model	Assembly position
1	Oil	5W-30 (in winter of northern areas) 15W-40 (in summer of northern areas and full year in southern areas) quality grade is SJ or above.	Valve head, camshaft, rocker arm, rocker arm shaft, camshaft oil seal
2	Sealant	LT271 or equivalent	Double-end bolt
3	Sealant	LT962T or equivalent	Spark plug guide sleeve, cylinder body/cylinder cover dash-shaped plug, filler neck

Structure Overview of Engine

Engine appearance as show in figure:



External View of Engine Assembly

This engine assembly is mainly used for M2 vehicle model manufactured by JAC, as shown in figure:

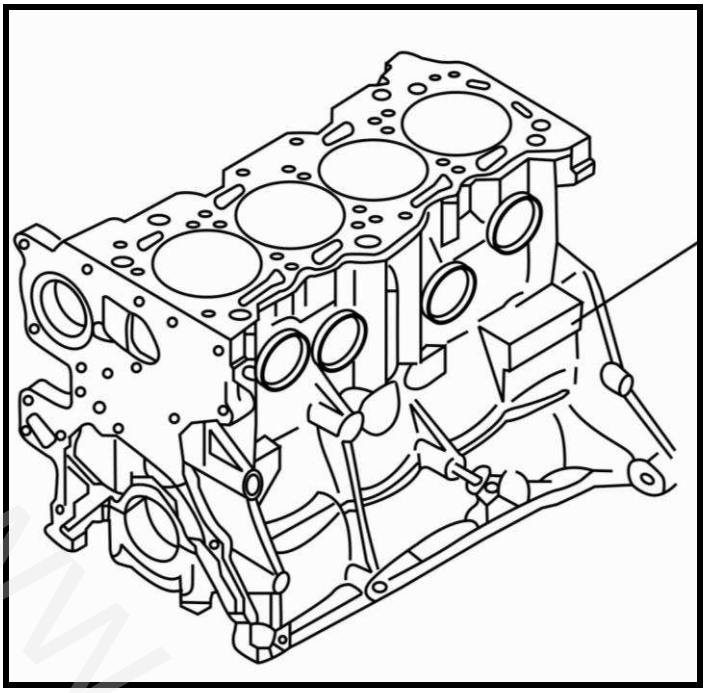
SII models

Structure Parameter of Engine:

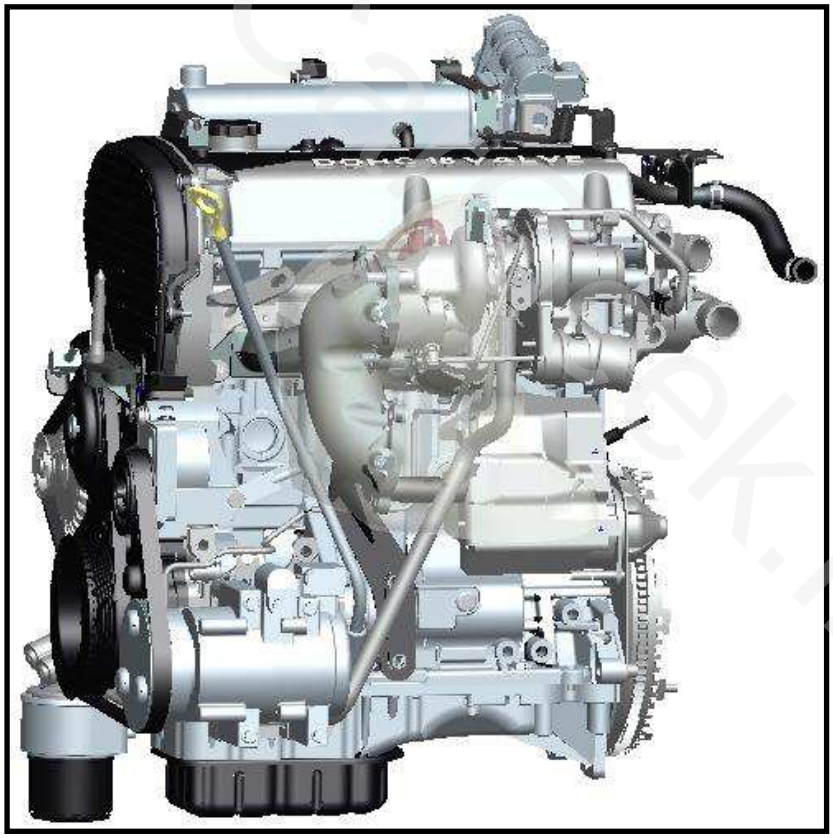
Structure Parameter Table of Engine

Model		HFC4GA3.1D
Type		L4/16.DOHC.MPI
Cylinder number		4
Fuel chamber		Pentroof type
Total displacement (CC)		1997
Cylinder bore mm		85.0
Stroke mm		88.0
Compression ratio		8.5
Valves and drive mechanism		DOHC-4
Cylinder distance mm		93
Cylinder body height mm		235
Big and small center distance of connecting rod		150
Valve Number	Air intake valve	8
	Air exhaust valve	8
Output	Max. power	130 kW / 5200 rpm
	Max.torque	235 N•m / 2000-4000 rpm
Fuel octane value		RON93# and above 93# grade of lead-free gasoline
It meets emission laws and rules.		State V
Overall dimensions		Length 692 mm× width 675 mm× height 704 mm
Engine weight (Kg)		(Dry condition)
Lubrication system		Pressure oil supply
Fuel supply way		Electric fuel pump, without oil return system
Oil pump type		Cycloid gear pump
Cooling system		Forced circular water cooling
Water pump type		Centrifugal, impeller type

Engine No. Position



Drive Belt



Engine Drive Belt Schematic Diagram

Inspection before Dismantling:

1. Inspect whether the pulley has crack, abrasion and oil stain. If yes, please replace it.

2. Inspect whether the pulley is correctly installed in the groove of belt pulley.

3. Inspect the deflection of belt in the middle point of the pulley.

Notes:

■ The inspection should be conducted when the engine is in cooling condition, or turned off for 30 mins.

■ Use a pulley tensometer for inspection.

■ If the deflection value exceeds limit value, adjust it.

Dismantling:

1. Unscrew locking bolt of power steering pump belt, select the tension of adjusting bolt, and then loosen power steering pump and air conditioning compressor drive belt.

2. Remove power steering pump and air conditioning compressor drive belt.

3. Unscrew adjusting locking bolts of electric generator, and then loosen engine drive belt.

4. Remove electric generator drive belt from electric generator pulley.

Installation:

1. Install belt onto the pulley according to the reverse order of dismantling.

Notes:

■ After replacing belt, adjust its "new belt" value to make it suitable for pulley groove.

■ When installing belt, make sure that the belt and pulley groove are aligned and arranged correctly.

■ Do not splash engine oil, power steering fluid and engine coolant onto belt and each pulley groove.

■ Do not excessively wind or bend the belt.

2. Adjust the tension of belt. First adjust it to the specified value, and then rotate crankshaft for two circles. Re-inspect whether it reaches the specified value, to avoid the deflection change between pulleys.

3. Tighten bolts and nuts to the specified torque.

4. Make sure that the tension of all belts is within standard range.

Air Filter and Air Pipe

Component Position Schematic Diagram

1-PCV hose 2-Air intake hose 3-Air filter assembly

Dismantling:

1. Loosen intake hose locking clamp and PCV hose clamp.
2. Dismantle upper cover buckle of air filter.
3. Dismantle intake hose and remove upper cover of filter and intake hose.
4. Dismantle 3 fixing bolts of air filter seat, and remove the seat.

■ Tightening torque: 8 ~ 12 N•m

Inspection after Dismantling:

Inspect whether air pipe has crack or abrasion. If yes, please replace it.

Installation:

Install it according to the reverse order of dismantling.

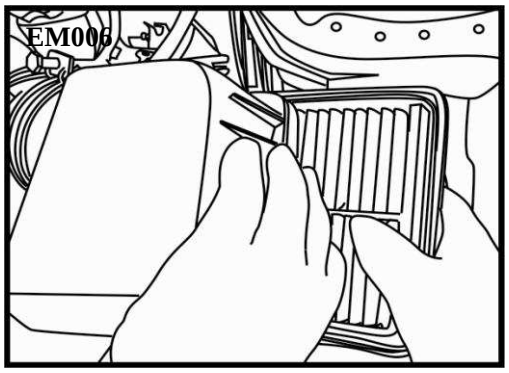
Notes:

■ Install each joint in good condition and place and tighten clamp.

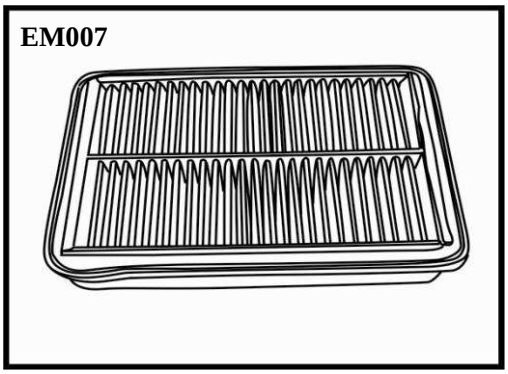
Inspection and Replacement of Air Filter Element:

Dismantling:

1. Loosen upper cover locking buckle of air filter, and rise up upper cover.



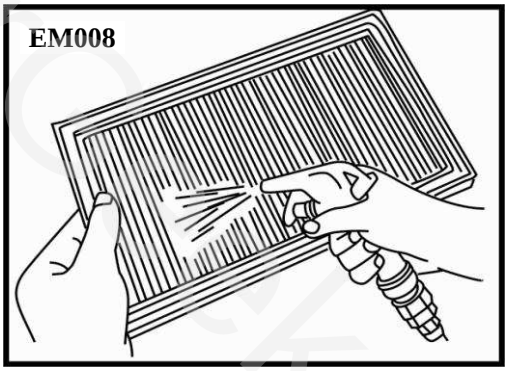
2. Dismantling air filter element.



Inspection after Dismantling:

■ Regularly clean and replace air filter element according to the recommended time.

■ Use compressed air to blow from the back of air filter element until it is clean.

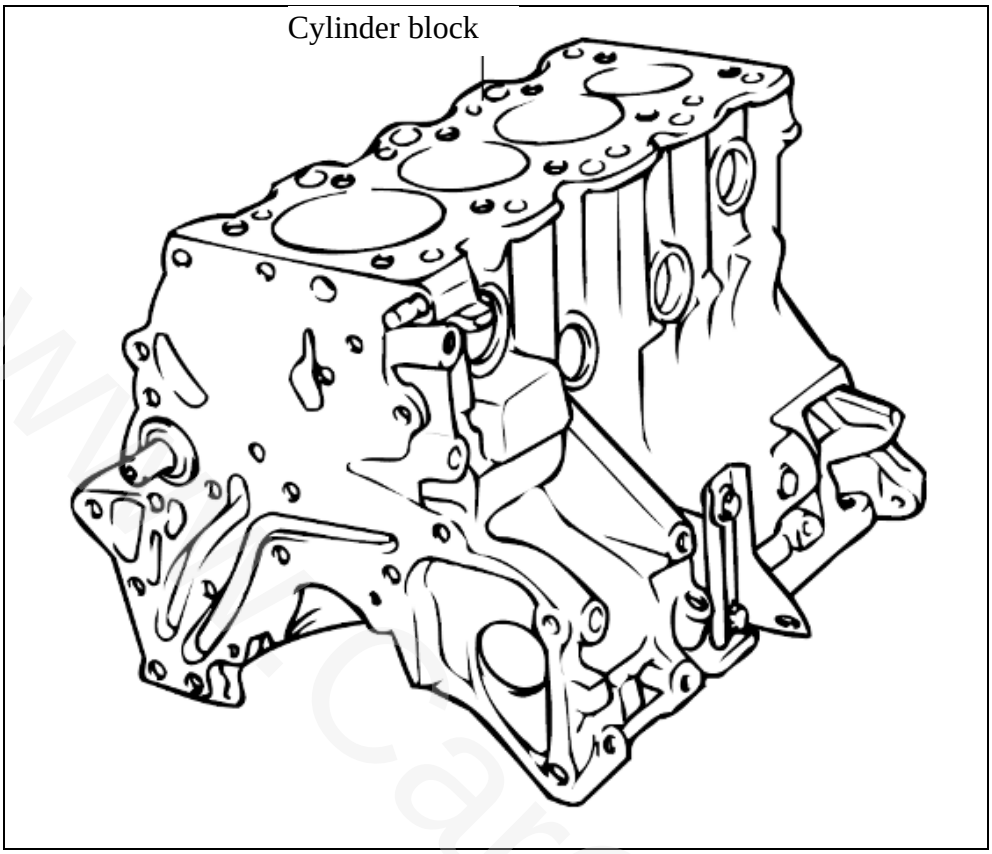


Installation:

Install it according to the reverse order of dismantling.

Engine Cylinder Block

1. Component



2. Dismantling

Dismantle cylinder head, oil pump housing, timing belt, flywheel, piston and crankshaft. For detailed information, please refer to relevant section.

3. Inspection:

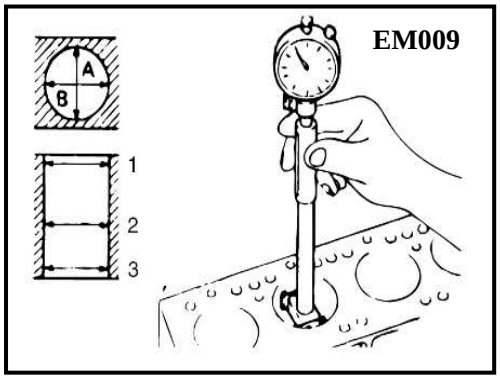
1) Inspect whether cylinder body has scratch, rusting and corrosion. Meanwhile, inspect whether there is crack or other defect. If there is any defect, replace cylinder body.

2) Measure the bore on three shown height in A and B directions by using a cylinder gauge.

① Height 1: Position of the first piston ring at TDC (upper stop point).

② Height 2: Intermediate of cylinder.

③ Height 3: Bottom of cylinder.



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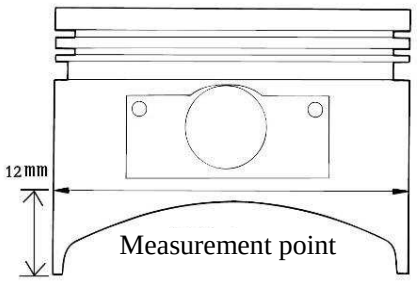
3) If the cylinder exceeds the specified cylindricity or roundness after inspection, or cylinder wall has serious abrasion or scratch, re-bore the cylinder and grind cylinder body. And install new piston and piston ring.
Standard Value:
Cylinder Bore:85 + 0.03 mm
Cylindricity or roundness of the bore: maximum 0.01 mm
4) If the top of cylinder has projected mark or deposited carbon, use a reamer or No.600 sand paper to remove them.
5) If the re-bored cylinder hole is excessive, keep the specified clearance between piston and cylinder, and make sure that all used pistons have the same size. Outer diameter of piston is measured on 12 mm above the bottom of piston skirt of the piston and measured along the thrust force.

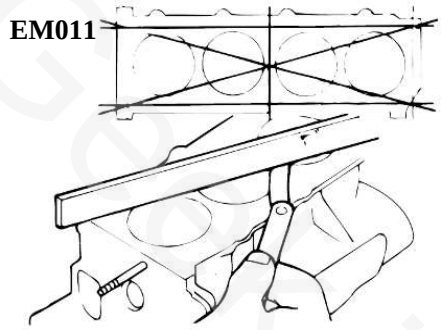
Clearance between piston and cylinder:
0.02 - 0.04 mm

EM010



6) Inspect whether there is damage or crack.
7) Inspect the flatness of upper surface of cylinder body. If it exceeds limit value, grind it to minimum limit value or replace it.

EM011



① Standard value:

Cylinder body flatness:

Max. 0.05 mm

②Maintenance limited value:

Cylinder body flatness 0.1 mm

Notes:

■ When assembly cylinder head, the grinding size of less than 0.2 mm is allowed.
4. Repair Cylinder
1) For cylinder repair, it is necessary to re-bore the cylinder hole, and then install a new cylinder sleeve.

Notes:

■ To avoid deformation due to high temperature during grinding, cylinder hole should be bored according to ignition sequence.
2) Grind cylinder and modify it to suitable size (outer diameter of piston + clearance between cylinders).

3) Inspect clearance between piston and cylinder.

Notes:

When repairing cylinder, repair four cylinders to make them have the same size. Do not only bore one cylinder.

5. Installation

Install the following parts by referring to relevant sections:

1) Crankshaft

2) Flywheel

3) Piston

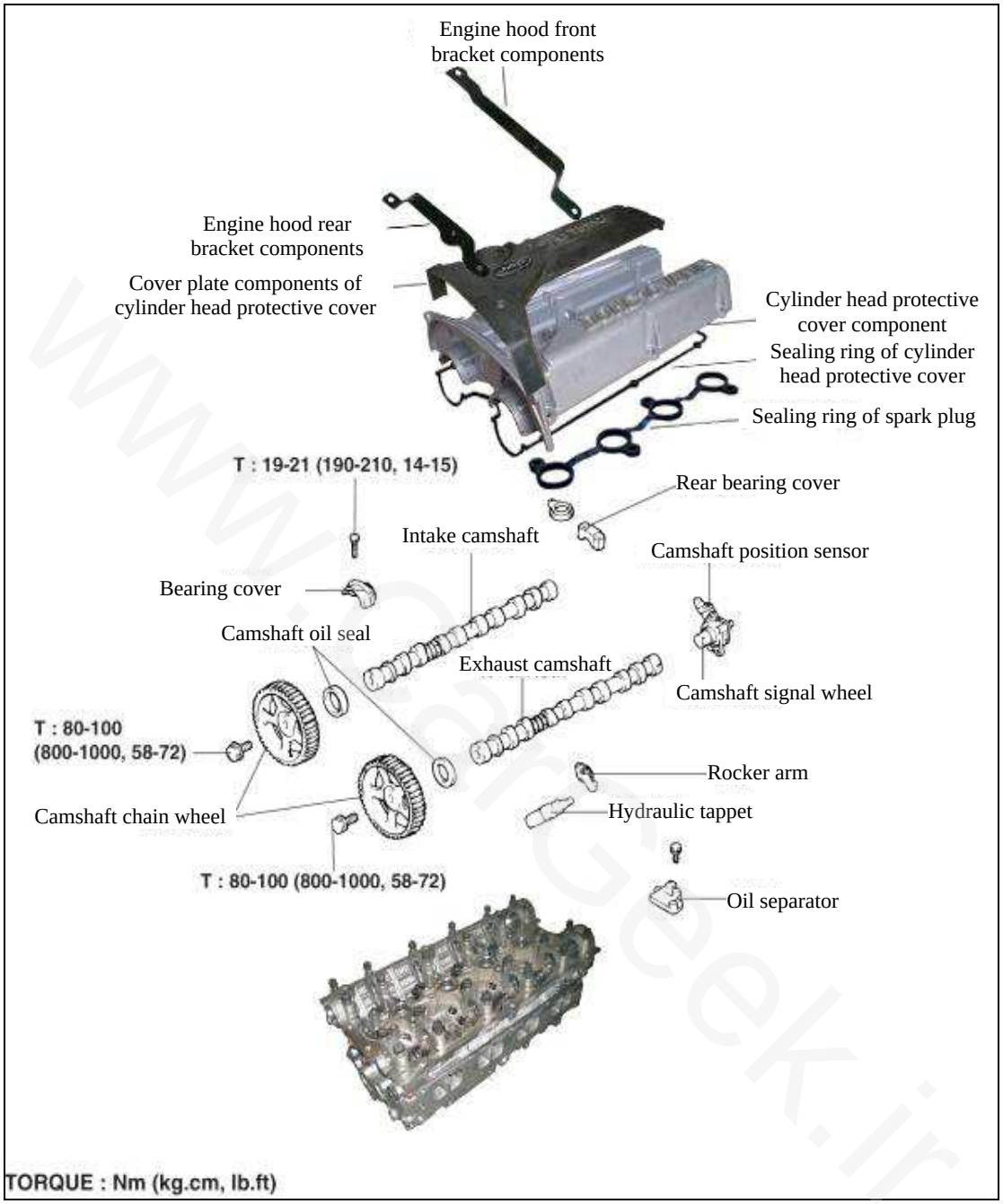
4) Cylinder Hood

5) Timing belt chain

6) Oil pump housing

Camshaft

1. Component



2. Dismantling

1) Disconnect negative pole from battery.

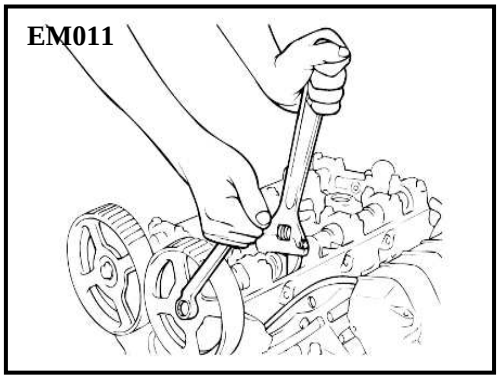
2) Discharge coolant of engine.

3) Dismantle breathing hole between air filter and rocker arm housing.

4) Dismantling air filter.
5) Dismantling timing belt shield.
6) Dismantle rocker arm and crankshaft position sensor.
7) Loosen fixing bolt of camshaft chain wheel, and then dismantle camshaft chain wheel.
8) Loosen camshaft bearing cover bolts, and remove bearing cover, camshaft, rocker arm and hydraulic tappet.

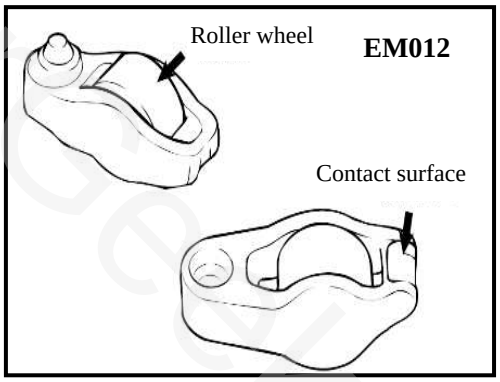
Notes:

■ Gradually loosen cover bolts to avoid bending camshaft.



3. Inspection
1) Rocker arm

① Inspect the rotation of roller wheel. If it can't rotate smoothly or there is any loosening, replace it.
② Inspect the surface of roller wheel. If there is any depression or obvious scratch, replace it.
③ Inspect whether valve contact surface has damage or obvious scratch. If necessary, replace it.

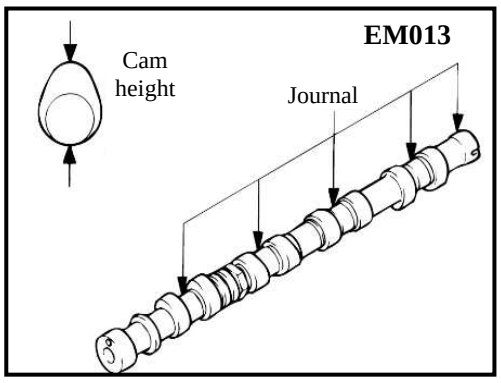


2) Camshaft

① Inspect whether camshaft journal has abrasion. If the journal has serious abrasion, replace camshaft.
② Inspect whether the tip point of cam has damage. If the tip point has damage, or excessive abrasion, replace camshaft.

③ Cam Height

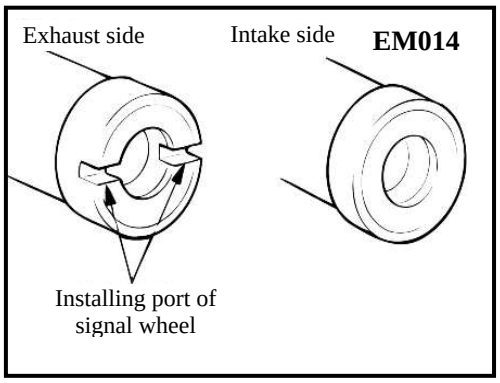
Standard Value
Air intake : 35.493 mm
Air exhaust : 35.204 mm



Limiting Value
Air intake : 34.993 mm
Air exhaust : 34.704 mm
3. Installation
1) Install camshaft onto cylinder head, but do not install rocker arm.
Notes:

■ Apply oil onto the journal and cam of camshaft.

■ There is a cutting groove at the back of exhaust camshaft to install camshaft position sensor signal wheel.

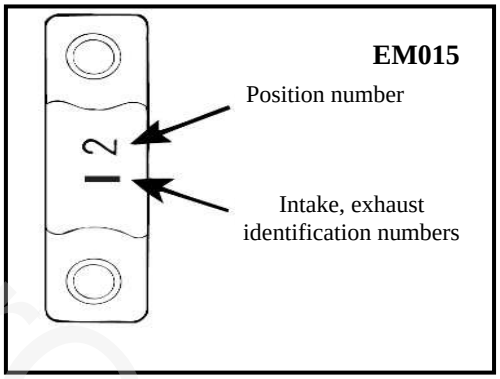


2) Install bearing cover.

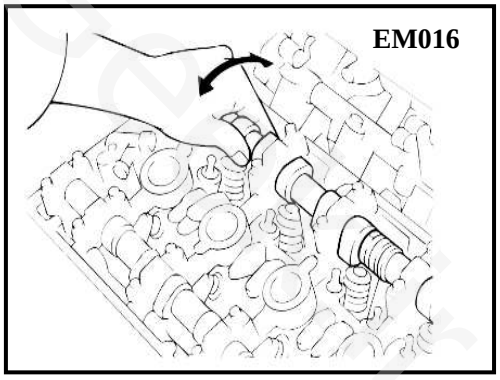
Marks on the cover are to identify air intake / air exhaust.

I: Air intake camshaft

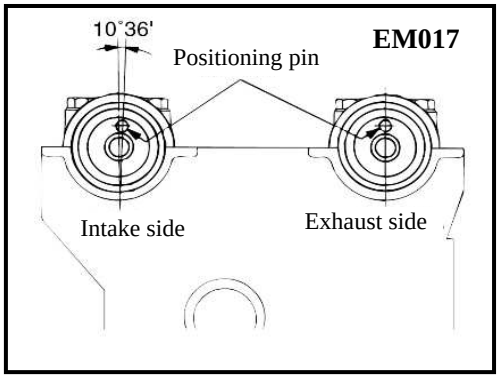
E: Air exhaust camshaft



3) Inspect camshaft to make sure it can be rotated easily with hands. After inspection, dismantle bearing cover and camshaft, and then install rocker arm.



4) Make sure that the positioning pins at the end of camshaft chain wheel are located on the top.



5) Tighten bearing cover to the specified torque in two or three times according to the figure.

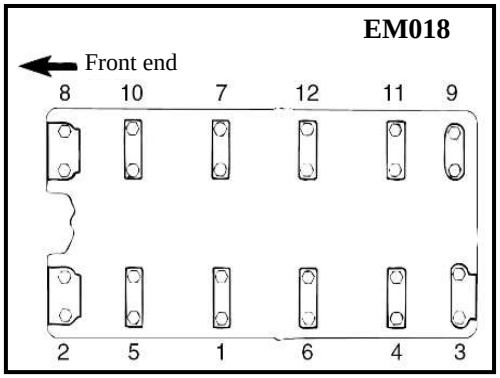
Notes:

■ Uniformly tighten rocker arm

Tightening Torque

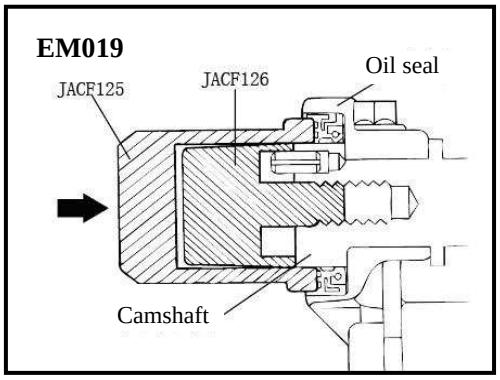
Main bearing cover bolt:

19 ～ 21 N•m



6) Use special tool, camshaft oil seal installer and guide rod (JACF125, JACF126).

Make sure to apply oil on the surface of oil seal, and then insert oil seal along the front of camshaft. Use a hammer to push the installer until the oil seal is in its proper position.

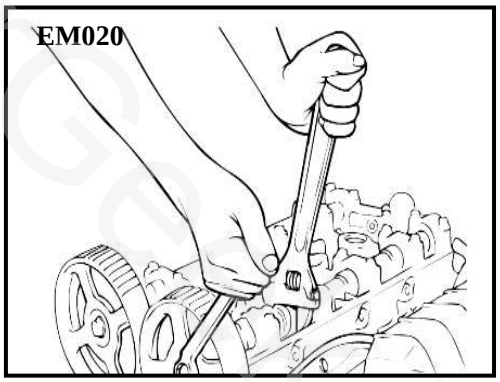


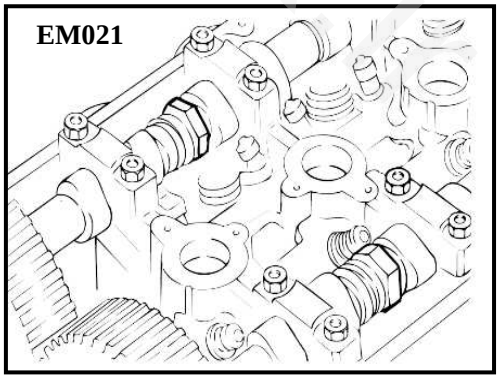
7) Install and tighten camshaft chain wheel bolts to the specified torque.

Tightening torque

Camshaft sprocket bolt:

80 ～ 100 N•m





8) Install cylinder protective cover, and apply oil onto the shown position.

①Tightening torque

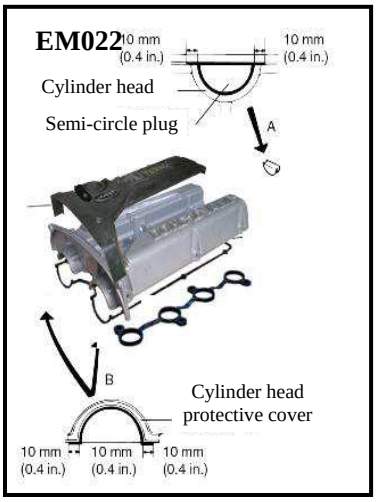
Rocker arm cover bolt: 8 ～ 10 N•m

Center cover bolt: 4 ～ 5 N•m

② Sealant

A position: Threebond No.10 or equivalent

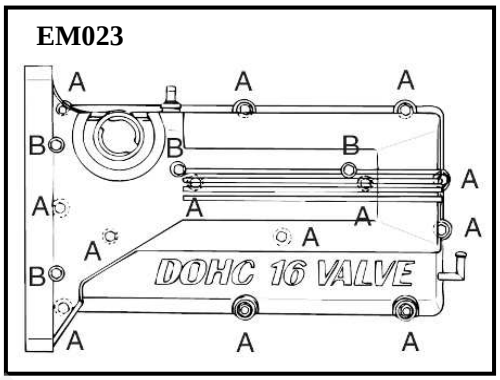
B position: Threebond No.1212D or equivalent



③ Bolt

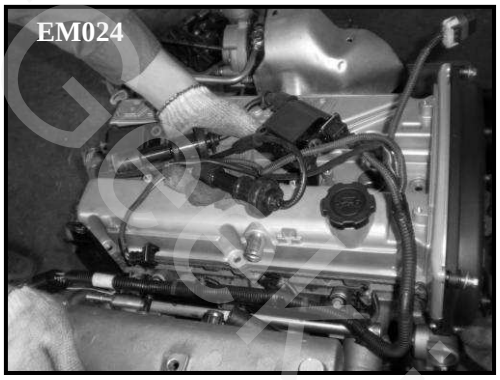
A: 13EA

B: 4EA

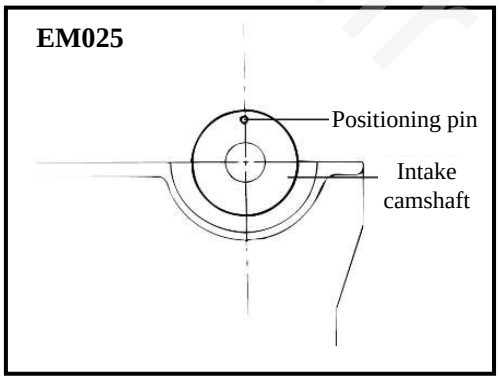


9) Install spark plug and ignition coil.

Connect secondary guide wire, and then install protective cover plate.

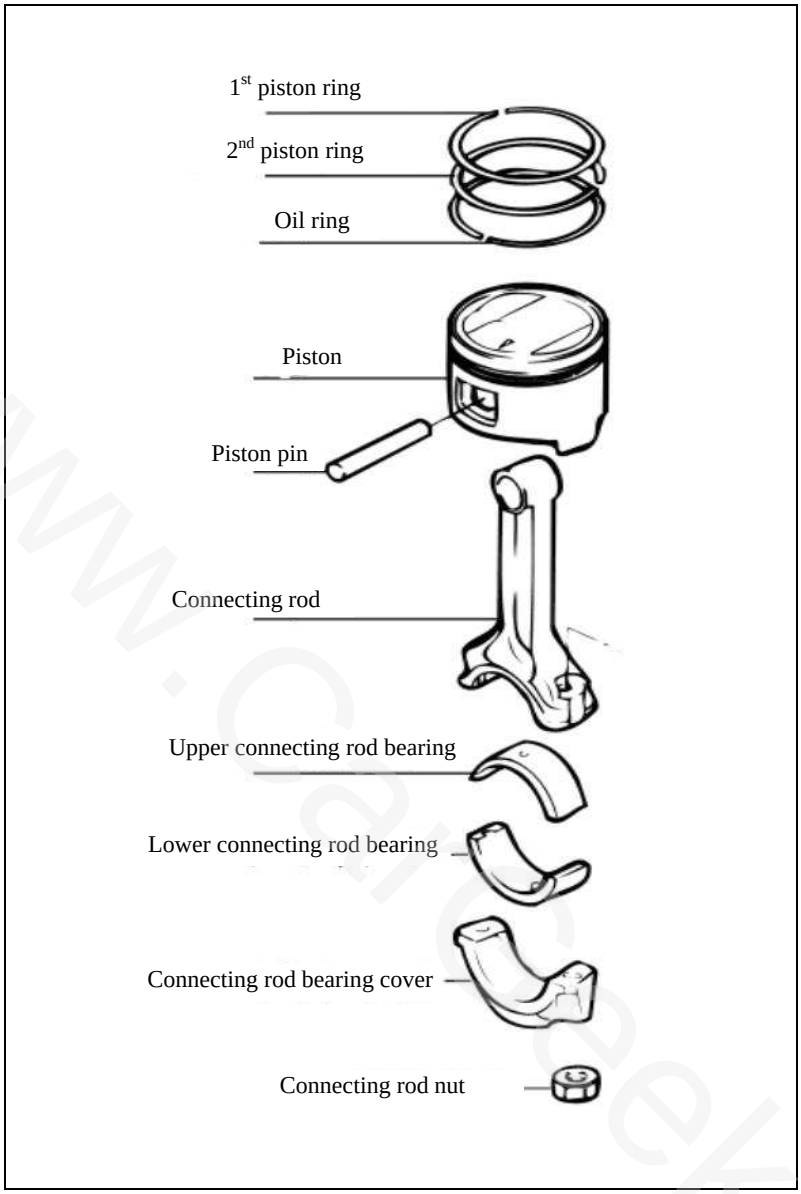


10). After installing camshaft position sensor signal wheel on the rear of exhaust camshaft, install rear cover and sensor of camshaft.



Connecting Rod

1. Component



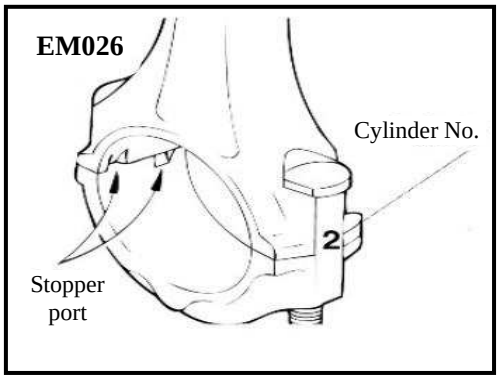
2. Dismantling

Notes:

Press relevant tie rods (according to cylinder number), and place bushings in sequence to facilitate correct re-installation.

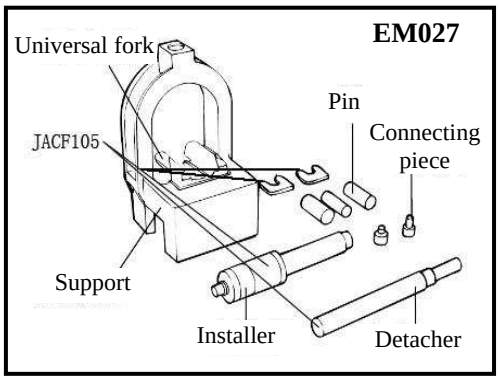
1) Dismantle connecting rod cover nuts, and then dismantle lower cover and bushing under the big end. Make marks for re-installation.

2) Push each piston connecting rod assembly to the top of cylinder.



3. Dismantle and reinstalling of piston

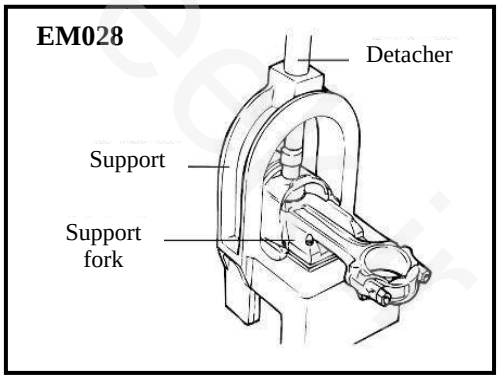
1) Use special tool JACF105 to dismantle and re-install piston and connecting rod.



2) Piston pin is pressed into the small end of connecting rod, and piston is floating on the pin.

3) The tool consists of a fork type piece, guider, and support of connecting piece, installer and detacher. When installing or dismantling pin, piston is clamped in the support. When installing or dismantling, guider helps to fix piston pin. At this moment, connecting rod is clamped by the fork piece.

4) Dismantle piston pin from piston. When the connecting rod is fixed on the fork piece, put piston into the support. Detaching tool goes through the top of the support. This can be used to press piston pin out.

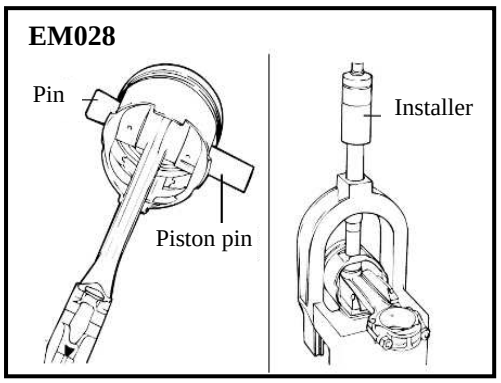


5) To install new piston pin, it is necessary to install a proper fork piece to support connecting rod.

6) Fix connecting rod inside piston. Insert proper pin column from the side of piston and connecting rod. Slightly clap guide column by using hands to make it clamped by piston. Insert a new pin into the piston from another side, to make the pin guide column face downwards, and put the assembly into the support.

Notes:

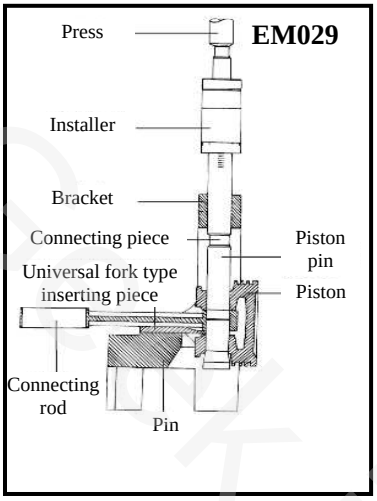
■Pin guide column should be aligned with the centre of connecting rod through piston. If it is installed properly, piston guide column is just located under the centre of the hole in tool arch arm and evenly placed on the fork piece. If wrong size of pin guide column is used, piston and pin can't be aligned with the support.



7) Insert installer tool into support arch arm hole, and use a hydraulic press to exert pressure to piston pin, to let it go through the small end of connecting rod. Continue to exert pressure until the pin guide column can fall freely and installer tool is just aligned with the top of arch arm.

Notes:

■ When installing centre shaft lining, the pressure exerted on the arch arm should not exceed 1250 ± 500 kg/cm^2.



3. Inspection

1) Piston and piston pin

① Inspect whether each piston has damage, scratch, abrasion and other defect. Replace the defected piston.

② Inspect whether each piston ring is broken, has damage and abnormal abrasion. Replace the defected piston. When it is required to replace piston, all its rings should also be replaced.

③ Inspect the matching condition of piston pin in piston hole. Replace the defected piston and pin assembly. Piston pin must be pressed into pin hole stably with hands (at indoor temperature).

2) Piston Ring

① Measure the side clearance of piston ring. If the measured value exceeds repair limit value, insert a new ring into the ring groove. Measure the side clearance. If the clearance still exceeds repair limit value, replace piston together with ring. If the clearance is smaller than repair limit value, only replace piston ring.

Standard Value

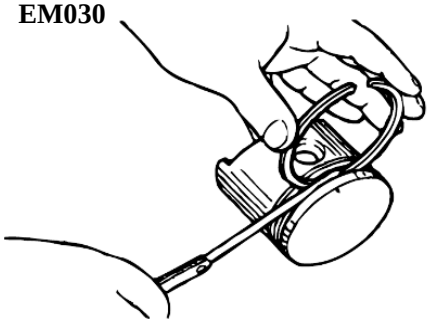
Piston ring side clearance

No.l: 0.04 ～ 0.75 mm

No.2: 0.02 ～0.06 mm

Oil ring: 0.06 ～ 0.15 mm

EM030



② Measure the end play of piston ring. Put a piston ring into the cylinder hole. Press piston slight to push the ring downwards until the ring perpendicular to the cylinder wall. Use a clearance gauge to measure the clearance. If the clearance exceeds service limit value, replace piston ring.

Piston ring end clearance

Standard dimension

No.l: 0.25 ～ 0.35 mm

No.2: 0.40 ～ 0.55 mm

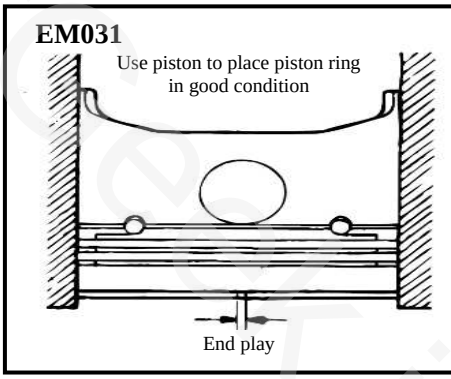
Oil ring blade: 0.10 ～ 0.6 mm

Limiting value

No.l , No.2: 0.8 mm

Oil ring blade 1.0 mm

EM031



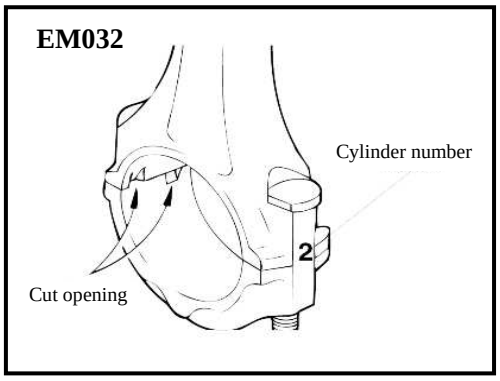
4. Installation

Notes:

■ When install connecting rod cover, make sure the cylinder number matches with the mark made on connecting rod cover when dismantling it. When installing a new connecting rod, make sure the cut openings clamped the bushing are on the same side.

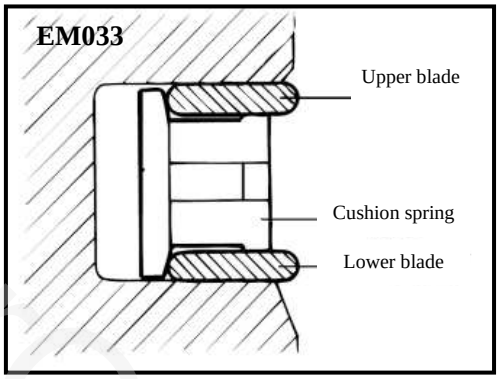
■ If the thrust surface is damaged, replace connecting rod. If connecting rod thrush surface has abrasion in layer, or the surface of small end, inner bore are very rough, replace connecting rod.

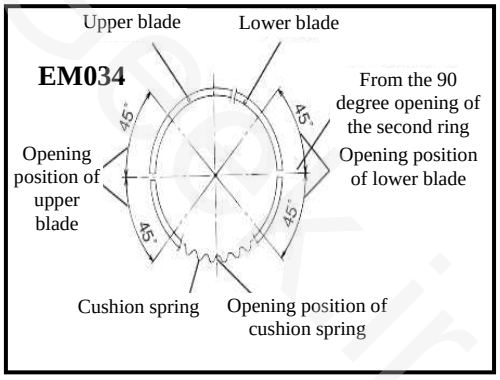
1) Install cushion spring.



2) Install upper blade To install blade, first place one end of blade between piston ring groove and cushion spring, and make them tightly clamp, and then use finger to press it down to insert it into the groove, as shown in figure. When installing blade, do not

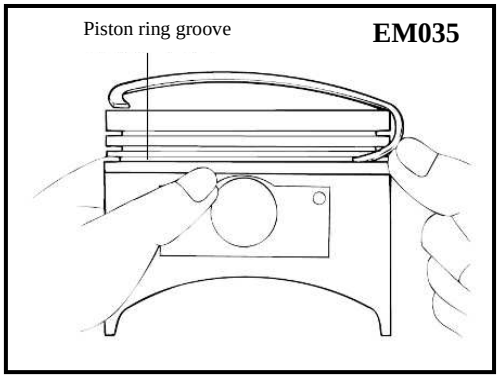
Use piston ring expander.





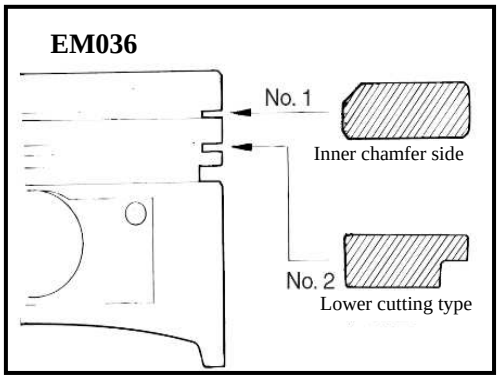
3) Install lower blade according to the same sequence shown in step 2.

4) Apply oil around piston and on piston ring groove.



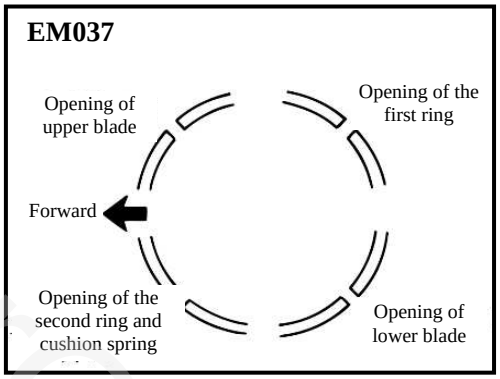
5) Use piston ring expander to install the second circle of piston ring.

6) Install top piston ring.



7) Place each piston ring to make its opening away from the opening of its adjacent ring. Make sure the opening position is not in thrust direction and pin direction.

8) When installing into cylinder, use piston ring compander to tightly clamp the piston ring.



9) Make sure that the front mark of piston and front mark of connecting rod toward the front of engine.

10) When installing connecting rod cover, make sure the cylinder number is aligned with mark made on the connecting rod cover when dismantling it.

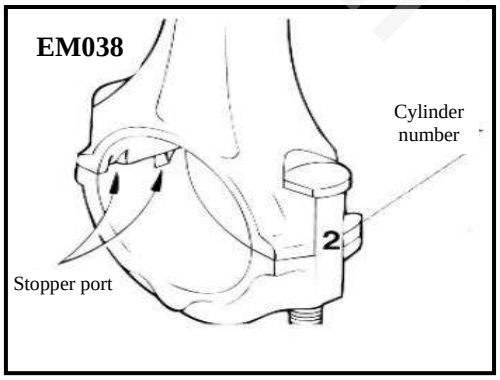
11) When installing a new connecting rod, make sure the cut openings clamping bushing are on the same side.

12) Tighten connecting rod cover nuts.

Tightening Torque

Connecting rod cap nut:

20 N•m (200) kg/cm^2 + 90°

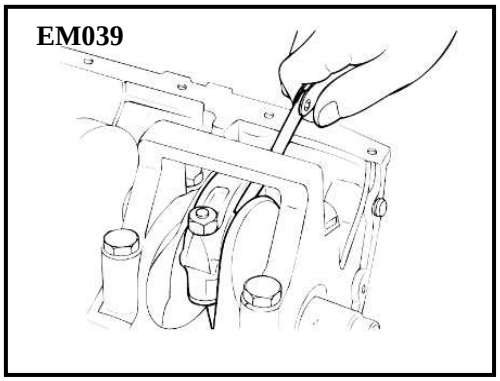


13) Inspect connecting rod side clearance.

Connecting Rod Side Clearance:

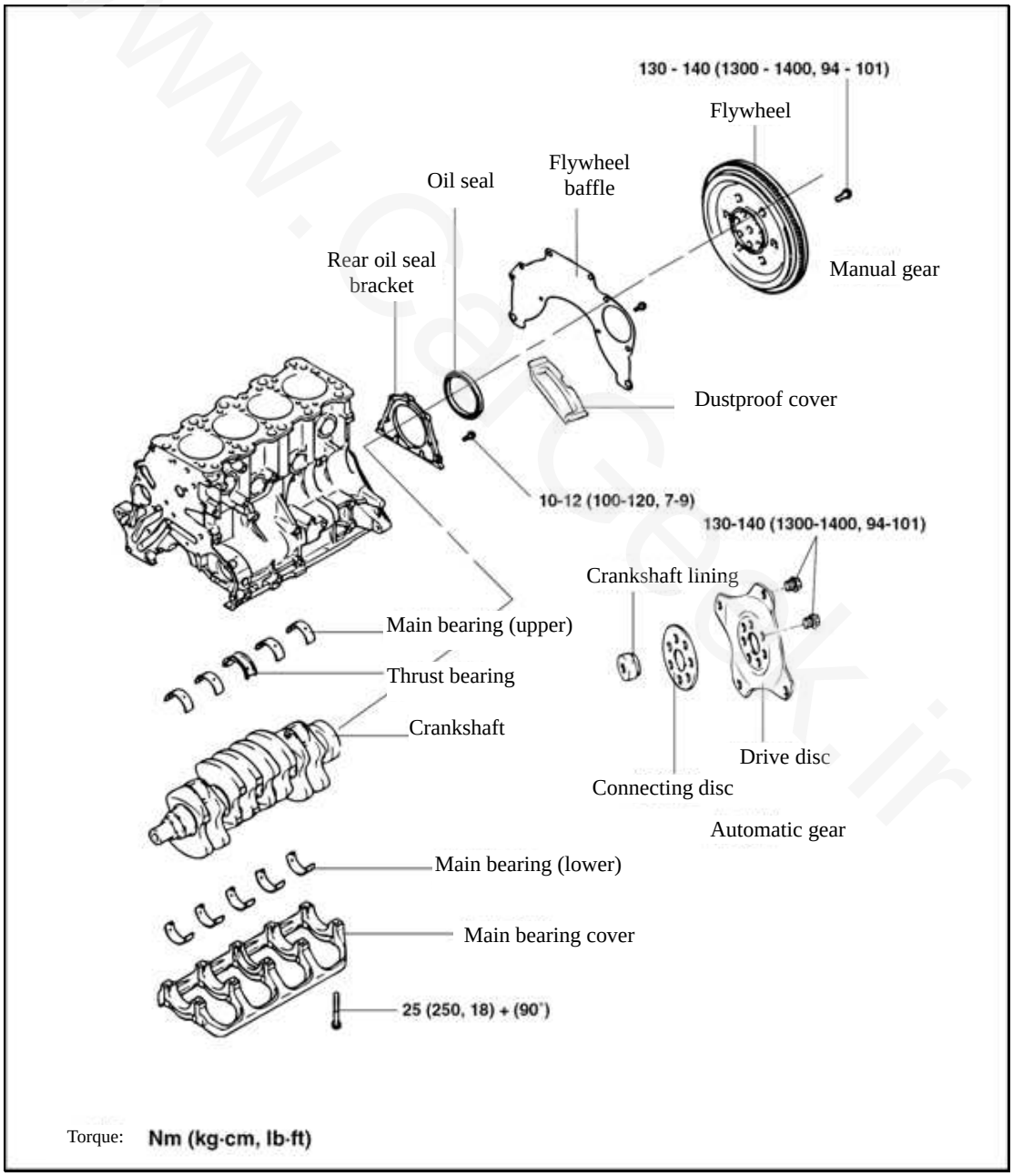
Standard value: 0.10 ～ 0.25 mm

Limiting value: 0.4mm



Crankshaft

1. Component



2. Dismantling

1) Dismantle timing belt, oil pump housing, flywheel, cylinder head assembly and oil pan.

2) Dismantle rear oil seal support and rear oil seal.

3) Dismantle connecting rod cap.

Notes:

■ Make marks on bearing cover so that it is facilitate re-installation according to original position and direction.

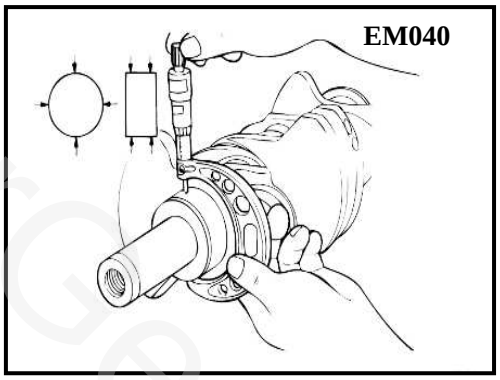
4) Dismantle main bearing and crankshaft Place bearing in sequence according to cover number.

3. Inspection

1) Crankshaft

① Inspect whether crankshaft journal and connecting rod journal have damage, nonuniform abrasion and crack. Meanwhile, inspect whether oil hole is blocked. Repair or replace any defected part.

② Inspect the roundness and cylindricity of crankshaft journal.


EM040

Standard value

Outer diameter of crankshaft journal:

56.982 ～ 57.000 mm

Outer diameter of crankshaft pin:

44.980 ～ 45.000 mm

2). Main bearing and connecting rod bearing

① Visually inspect whether each bearing has peeling off, melting, scratch or improper contact surface. Replace any defected bearing.

② Inspect bearing clearance through the measurement of outer diameter of crankshaft journal and inner diameter of bearing. Obtain the clearance value through the calculation of measured diameter difference.

Standard value clearance

Main bearing of crankshaft:

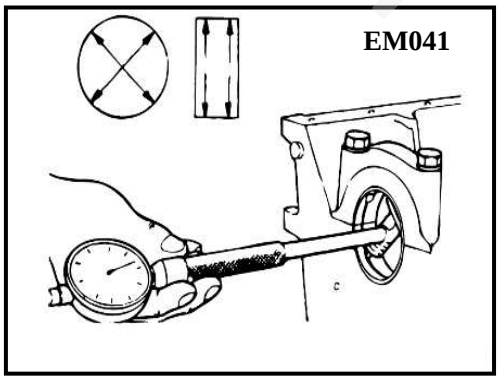
No.l,2,4,5: 0.018 ～ 0.036 mm

No.3: 0.024 ～ 0.042 mm

Connecting rod bearing:

0.015 ～ 0.048 mm

Limiting value:

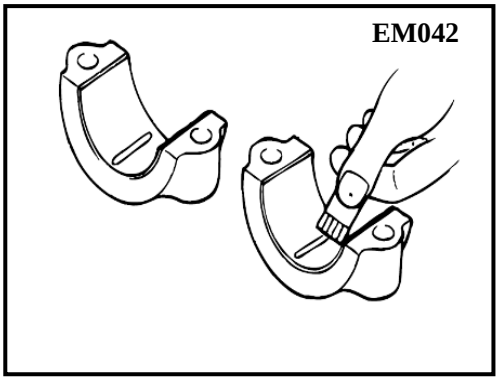

EM041

3) How to use plastic gauge

① Plastic gauge is normally used for measuring clearance.

② Remove oil, grease and any other dirt from bearing and journal.

③ Cut the plastic gauge to make its length equal to the width of bearing. Keep away from oil hole, and place it on the position parallel to the journal.



④ Install crankshaft, bearing and cover and tighten them to the specified torque. During this operation, do not rotate crankshaft. Dismantle lower cover, and use the scale marked on the package of plastic gauge to measure the width of plastic gauge on maximum width position. If the clearance exceeds service limit value, it is necessary to replace bearing or use small size of bearing. When installing new crankshaft, make sure to use standard size of bearing. If the standard clearance still can't be achieved after replacing bearing, it is necessary to grind journal to reduce size, and install proper size of bearing.

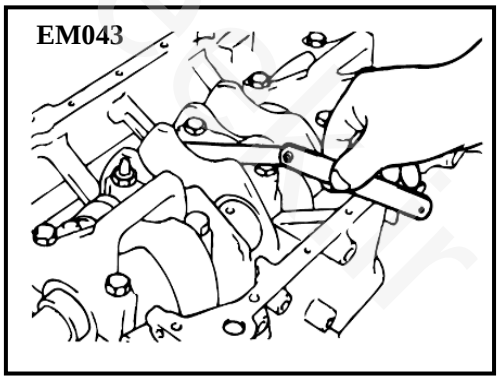
3) Oil Seal

Inspect whether front and rear oil seals have damage or surface abrasion. Replace any defected oil seal.

4) Bearing Cover

After installation of bearing cover, make sure that crankshaft can rotate smoothly and axial clearance is correct. If axial clearance exceeds limit value, replace thrust bearing.

Standard value: 0.05 ～ 0.25 mm



5) Drive disc (A/T)

Replace transformative, damaged or cracking drive disc.

6) Flywheel (M/T)

① Inspect whether clutch disc contact surface of flywheel has damage or abrasion. If there is any serious damage or abrasion, replace flywheel.

② Inspect the radial runout of clutch disc contact surface of flywheel.

Limiting Value

Flywheel radial run-out: 0.13 mm

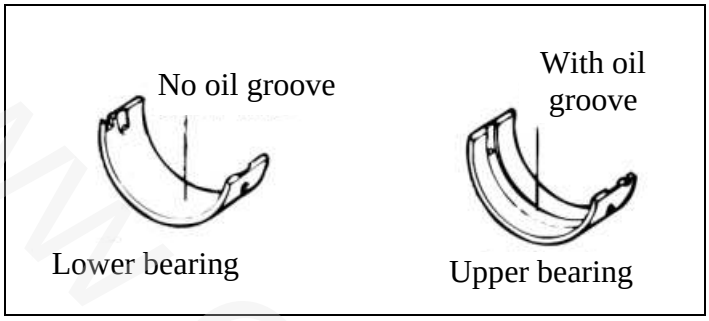
③ Inspect whether ring gear has damage, crack and abrasion. If necessary, replace it.

4. Installation

1) Install main bushing with groove on body side (upper bushing).

2) Install main bushing without groove on main bearing cover side (lower bushing).

3) Install thrust bearing on body side.



4) Apply oil onto main journal and connecting rod journal, and install crankshaft.

5) Install bearing cover by making the arrow direction towards the front of the engine. Cover number must be correct.

6) Tighten cover bolt to the specified torque.

Tightening Torque

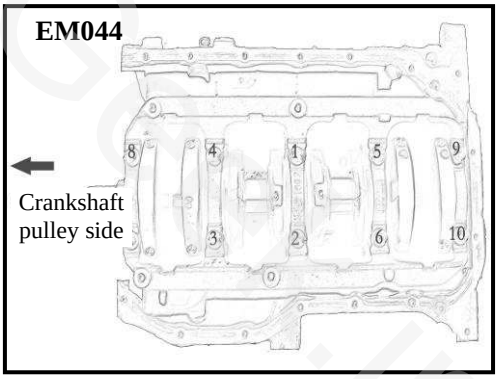
Main bearing cover bolts:

25 ± 2 N•m + (90° ~ 94°)

7) Uniformly tighten cover bolts to the specified torque in four or five times.

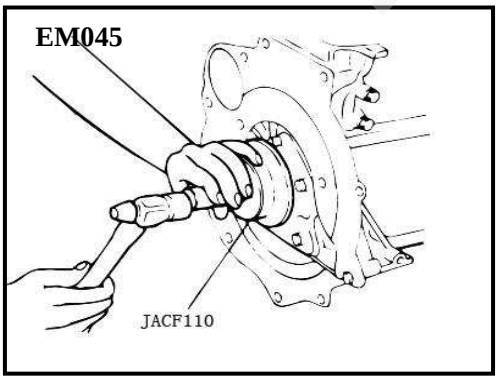
8) Make sure that crankshaft rotates freely and inspect axial clearance of crankshaft.

EM044

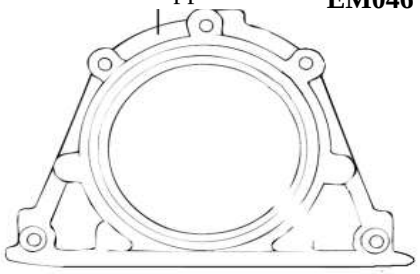


9) Use special tool (JAC-F110) to install oil seal onto the oil seal bracket. It is necessary to use new oil seal.

EM045



10) Install rear oil seal bracket onto the body.



Tightening Torque

Oil seal bracket: 10 ～ 12 N•m (100 ～ 120 kg/cm^2)

11) Install flywheel baffle onto the body.

12) Install flywheel assembly and tighten bolts to the specified torque.

Tightening Torque

Flywheel bolt:

130 ～ 140 N•m (1300 ～ 1400 kg/cm^2)

13) Install connecting disc onto the body.

14) Install drive disc and tighten bolts to the specified torque.

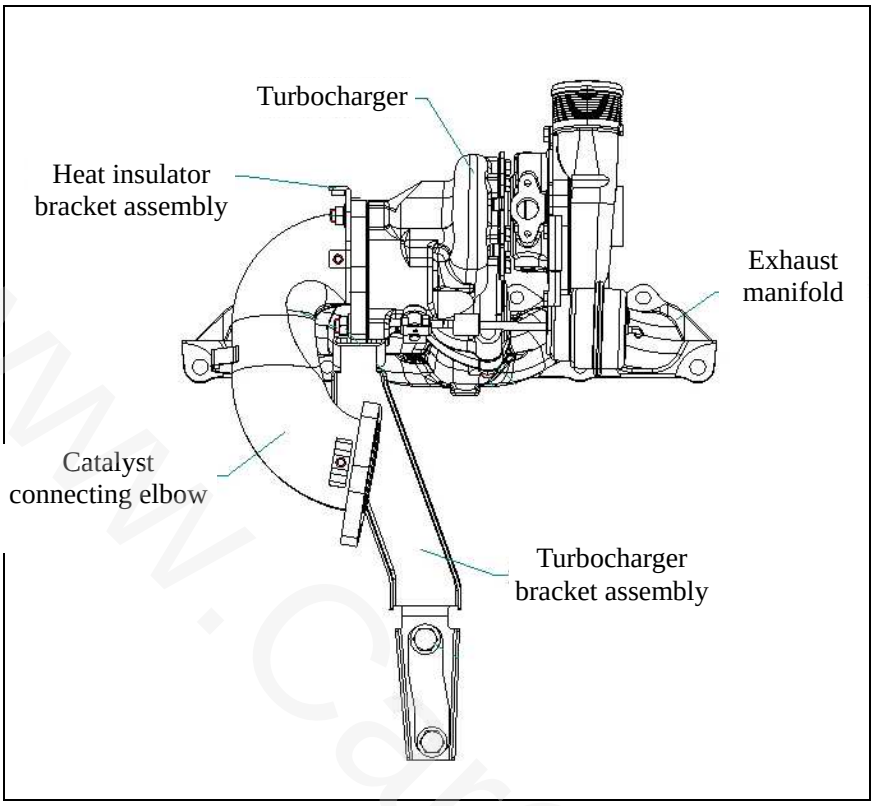
Tightening Torque

Drive disc: 130 ～ 140 N•m (1300 ～ 1400 kg/cm^2)

Inspection of Air Exhaust System

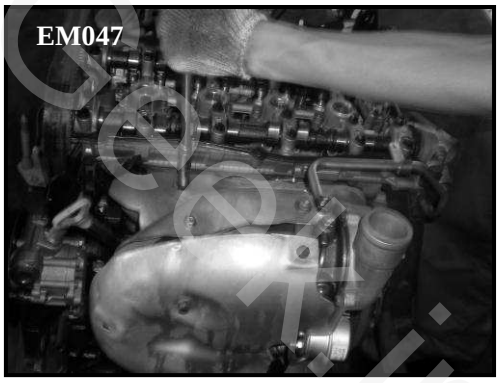
1. Exhaust Pipe

1. Component



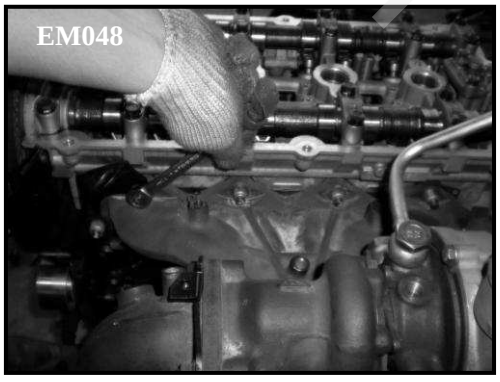
2. Dismantling

1) Dismantle heater insulator.



2) Dismantle air exhaust manifold.

3) Dismantle air exhaust manifold gasket.



3. Inspection

1) Inspect whether it has damage or crack.

2) Use a ruler and plug gauge to inspect the deformation of cylinder head matching surface.

Standard value: 0.15 mm

Maintenance limit: 0.3 mm

3) Inspect whether exhaust manifold has damage or crack.

4. Installation

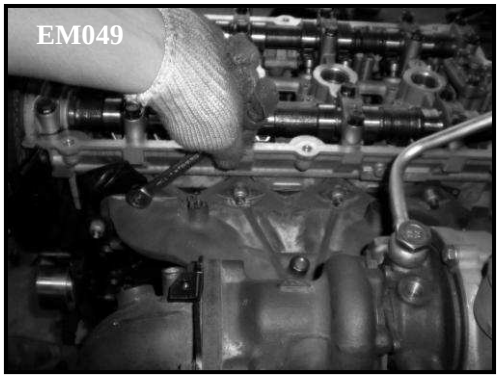
1) Install exhaust manifold with washer.

Tightening torque.

Air exhaust manifold

M8: 25 ～ 30 N•m

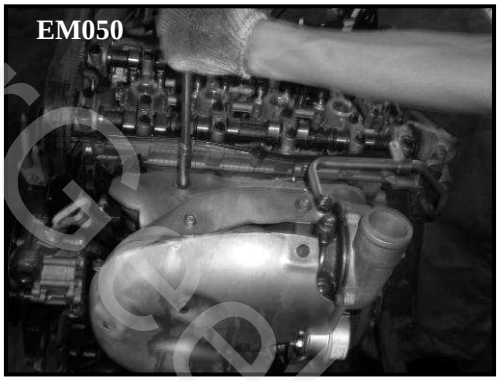
M10: 30 ～ 40 N•m



Notes:

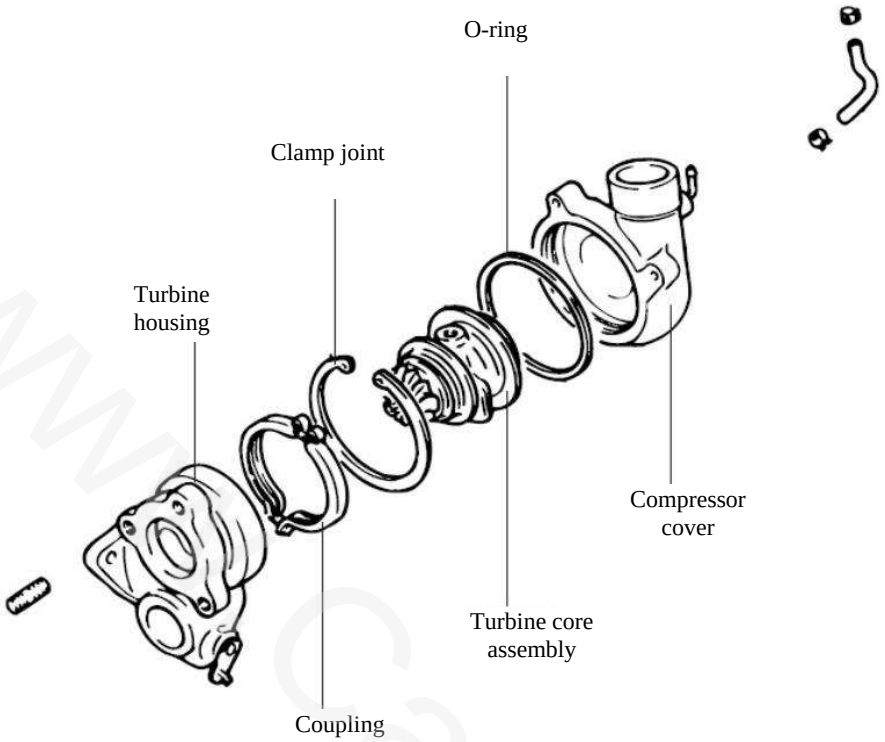
■ Do not use the used exhaust manifold washer.

2) Install heat shield.



II. Turbocharger

1. Component

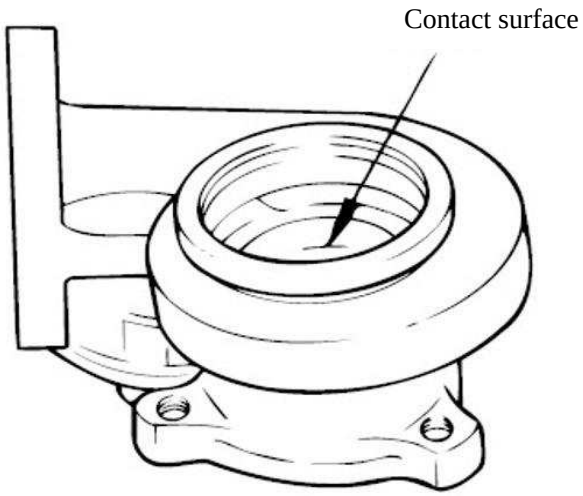


2. Inspection

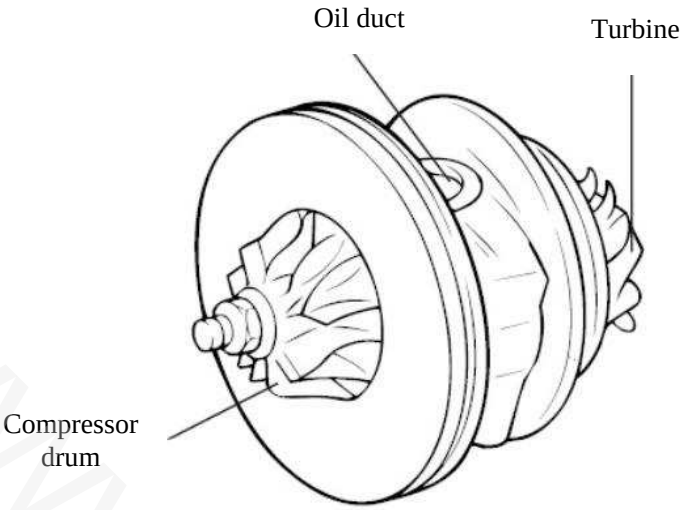
1) Inspect whether the inner housing contacted with turbine has crack, tilting and other damage due to overdue.

2) Make sure that exhaust gas valve rod can be pushed freely with hands.

3) Make sure that the inner housing surface contacted with compressor has no damage.



4) If there is crack or breaking on turbine blade, the turbine and shaft assembly can't be used. If the blade only has slight bending, it can be used. But if there is serious bending, it can't be used.



5) Inspect whether there is foreign matter blocked oil pipe in turbine core assembly.

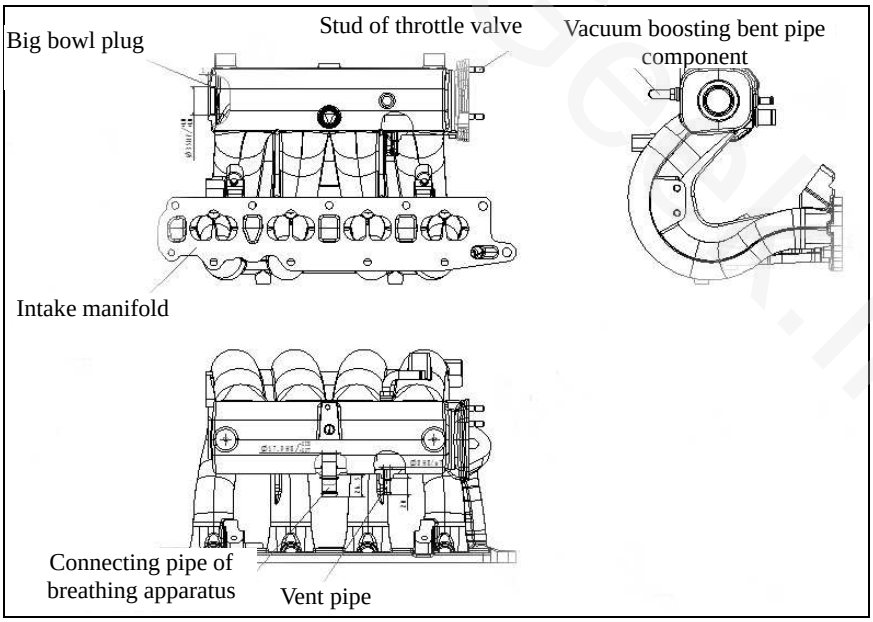
6) Exhaust gas valve Inspection

① Under the following pressure, inspect the operation of waste gas valve rod.

Normal value: 77.5 KPa (0.79 kgf/cm^2)

3. Air Intake Manifold

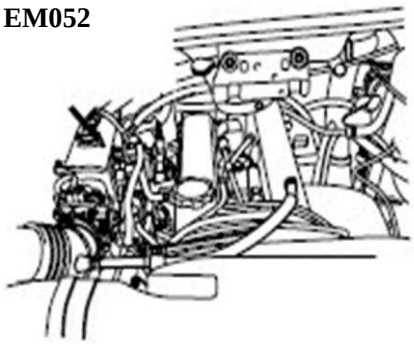
1. Component



2. **Dismantling**

1) Dismantle breathing hose connecting to rocker arm.

EM052

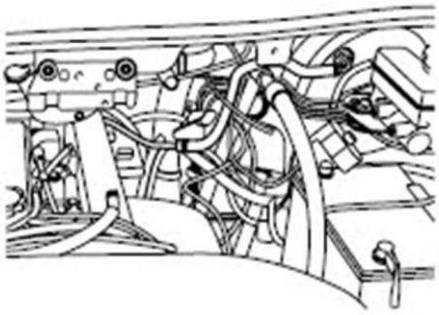


2) Dismantle engine coolant hose and throttle valve body.

3) Dismantle crankcase forced vent valve (pcv) and brake boosting vacuum hose.

4) Disconnect vacuum hose connector.

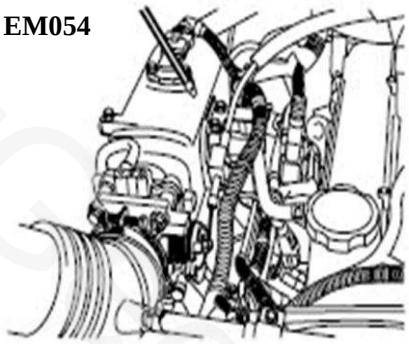
EM053



5) Release pressure from fuel pipe to avoid fuel splashing, and then disconnect high-pressure hose.

6) Disconnect fuel injector wire harness connector.

EM054

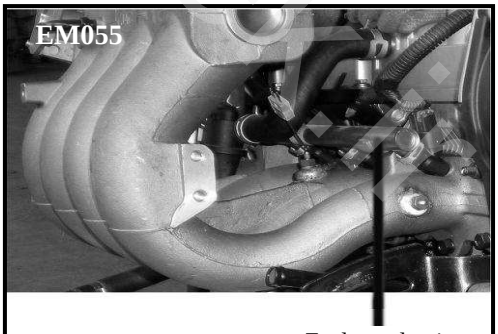


7) Dismantle fuel supply pipe and pressure regulator together with fuel injector.

Notes:

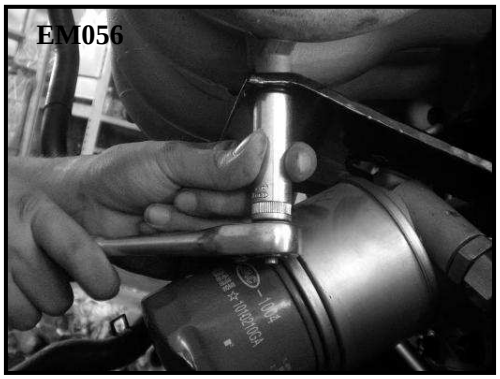
With dismantle oil supply pipe. Don't drop Injector.

EM055

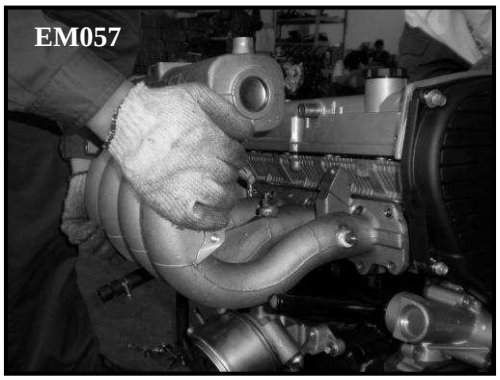


Fuel supply pipe

8) Dismantle air intake manifold fixing bracket.



9) Dismantle air intake manifold.



3. Inspection

Air intake manifold and stable pressure box

1) Inspect whether part has damage or crack.

2) Inspect the connection of vacuum outlet or air pipe.

3) Use a ruler and plug gauge to inspect flatness.

Standard value: 0.15 mm or below

Maintenance limit: 0.2 mm

4. Installation

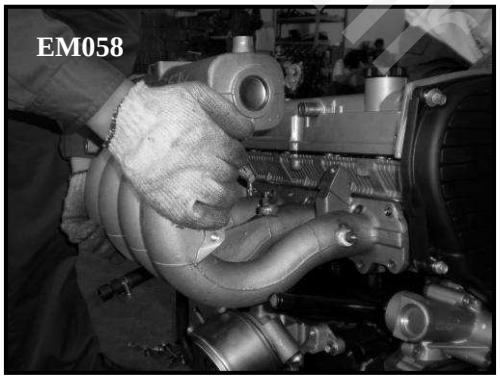
1) Install intake manifold and new washer, and tighten them to the specified torque.

Tightening Torque:

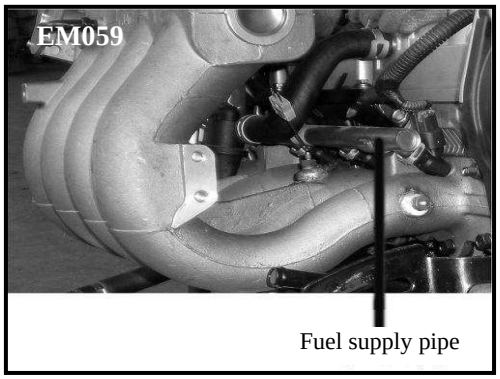
Air Intake manifold:

Bolt: 15 ～ 20 N•m

Nut: 30 ～ 42 N•m



2) Install fuel supply pipe and injector assembly onto the intake manifold.



Notes:

■ Make sure that there is no clash between fuel injectors on the intake manifold.

3) Install pressure stabilizing box support.

4) Connect fuel injector connector and wire harness, and then install the cover.

5) Connect with vacuum hose.

Tightening Torque

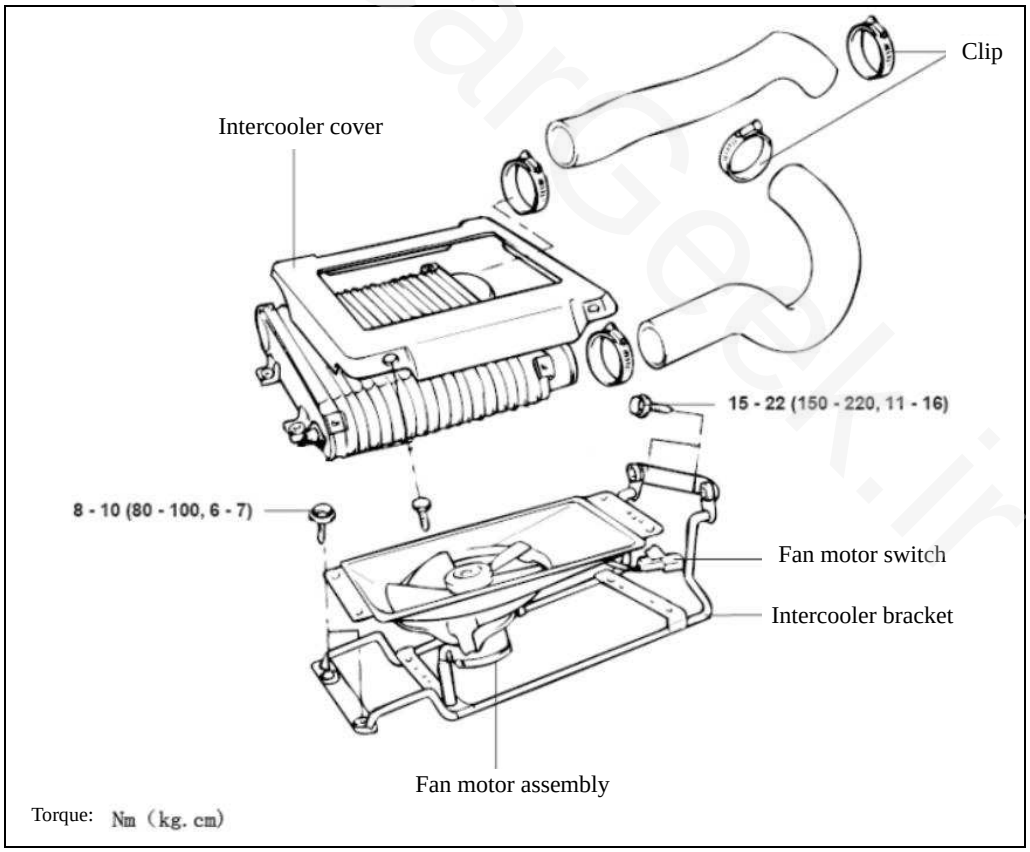
Intake manifold fixing seat and cylinder body: 18 ～ 25 N•m

6) Connect PCV valve and brake boosting hose.

7) Install respirator hose

4. Intercooler

1. Component



2. Dismantling

1) Dismantle condenser housing.

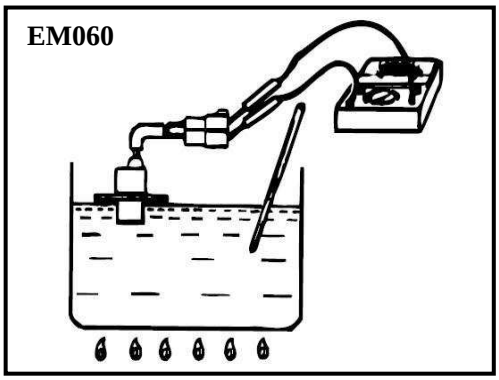
2) Dismantle fan motor and temperature switch connector.

3) Dismantle air hose.

4) Dismantle condenser assembly.

5) Dismantle fan motor assembly.

6) Dismantle condenser support.



3. Inspection

1) Air temperature switch

① Put the sensor into the water.

② Heat the water and inspect whether it is conducted.

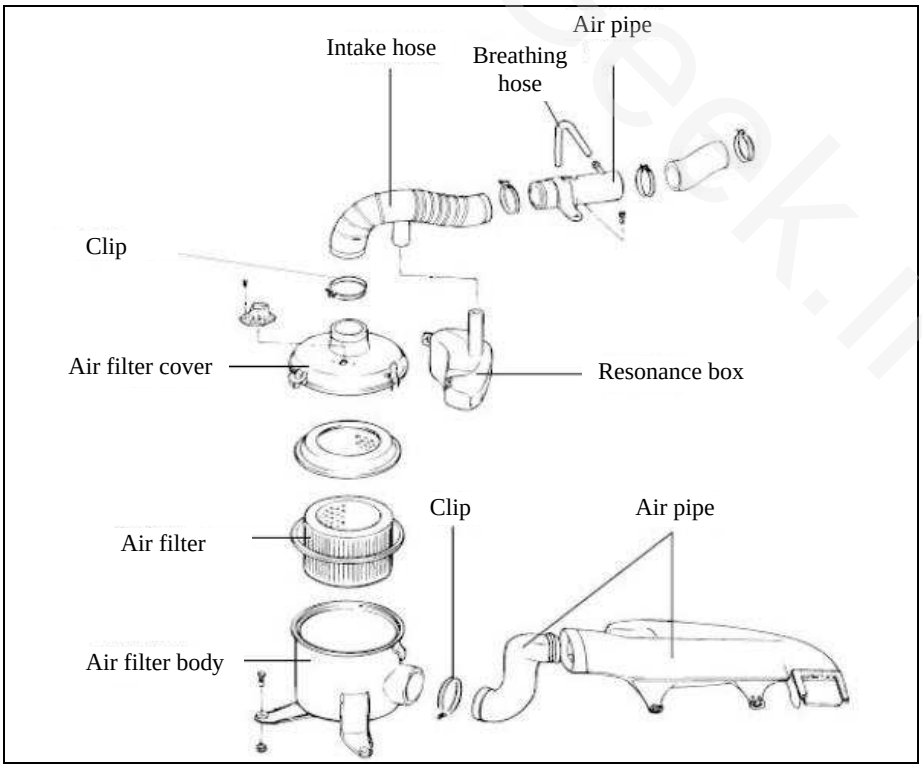
Temperature	Normal Condition
50 °C or below	Disconnect
60 °C or below	Connectivity

③ Condenser fan motor

At speed of ≤ 60 Km/h and intake temperature of ≥ 50 °C, inspect working condition of the fan.

5. Air Filter

1. Component



2. Dismantling

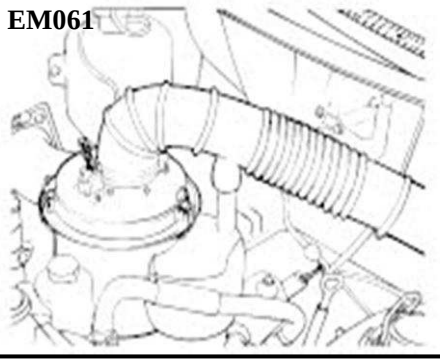
1) Disconnect air flow sensor connector.

2) Dismantle air intake hose on the air filter and resonance box.

3) Dismantle three bolts connecting air filter mounting bracket.

4) Dismantle air filter

EM061

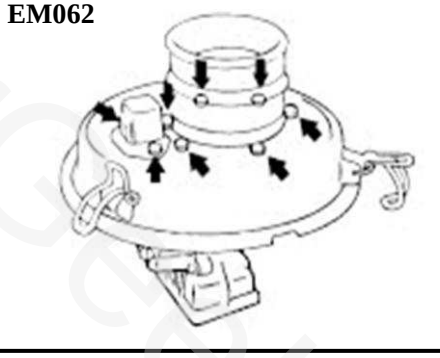


5) Dismantle air flow sensor from air filter cover.

Notes:

■ Do not drag air flow sensor wire, and connect the connector to air filter cover.

EM062

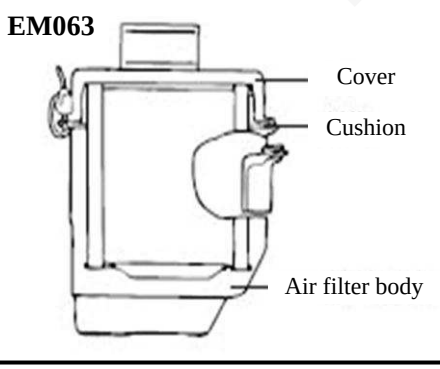


3. Inspection

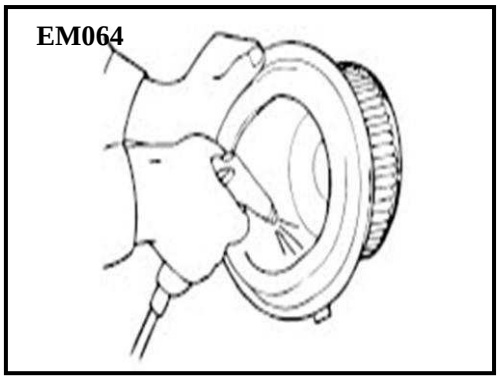
1) Inspect whether air filter body, cover or filter element have deformation, corrosion or damage.

2) Inspect whether air pipe has damage.

EM063



3) Inspect whether filter element is blocked, expanded or damaged. If the filter element has slight block, remove dust and scrap by using compressed air blowing into filter element.



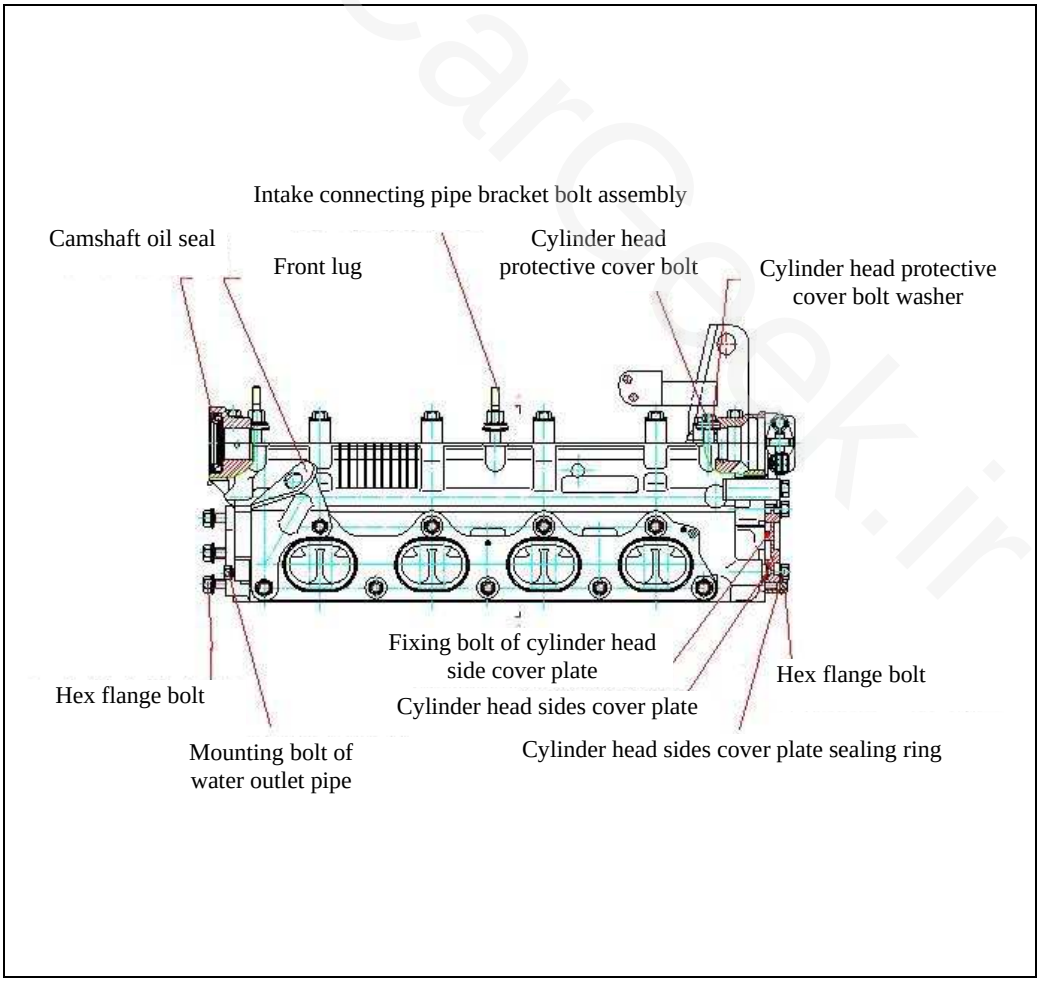
4. Installation

Install air filter assembly according to the reverse order of dismantling.

Cylinder Head Cover Assembly

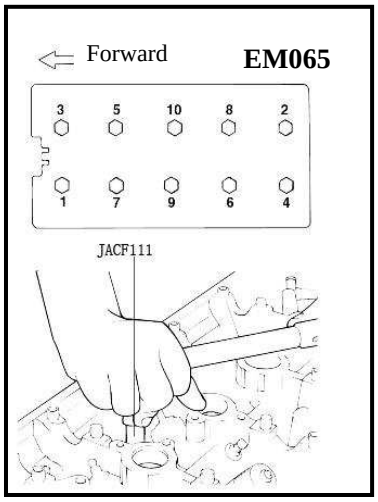
1. Cylinder Head

1. Component



2. Dismantling

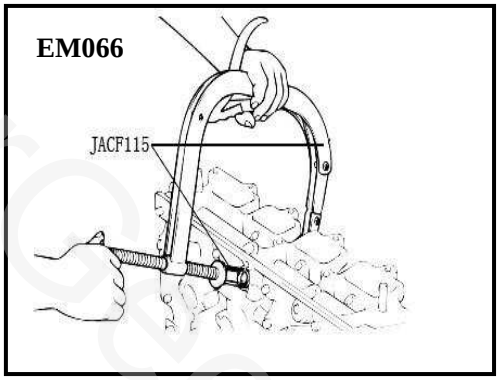
1) Use special tool (JACF111) to dismantle cylinder head bolts according to the sequence shown in figure.



2) Use special tool (JACF115) to dismantle valve spring lock plate, and then dismantle upper spring seat, valve spring, and lower spring seat and valve.

Notes:

■ Place these parts in good arrangement to facilitate re-installation according to their original position.



3) Use a pair of pliers to dismantle valve lifter sealing piece.

Notes:

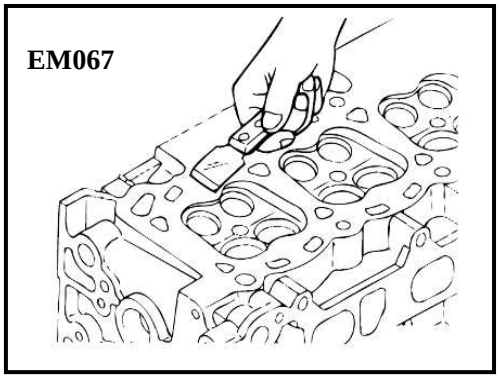
■ Do not use the used valve lifter sealing piece.

3. Inspection

1) Cylinder Hood

① Inspect whether cylinder head has crack, damage and whether there is coolant leakage. If it has crack, replace cylinder head.

② Completely remove scraps, sealant mixture and deposited carbon. After cleaning oil path, blow compressed air to verify whether oil path is blocked.



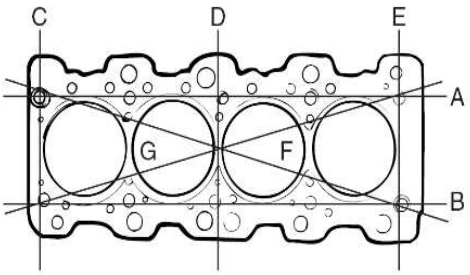
③ Inspect the flatness of cylinder head surface according to the direction shown in figure. If flatness in any direction exceeds repair limit value, replace cylinder head or slightly process cylinder head matching surface.

Flatness of cylinder head washer surface.

Standard value: Below 0.03 mm

Limiting value: 0.2 mm

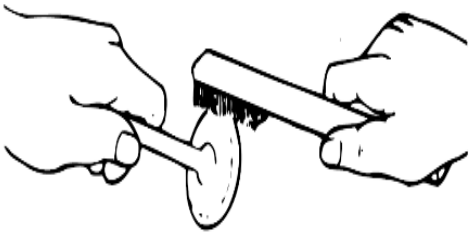
EM068



2) Valve

① Use a steel wire brush to completely clean valve.

EM069



② Inspect whether each valve has abrasion, damage, and head and rod B have deformation. If necessary, replace it. If rod end surface A has depression or abrasion, repair the surface according to actual condition. This repair must be limited to the minimum valve range. Meanwhile, re-process valve surface.

If the allowance amount reduces to below repair limit valve, replace valve.

Allowance amount

Standard value

Air intake: 1.0mm

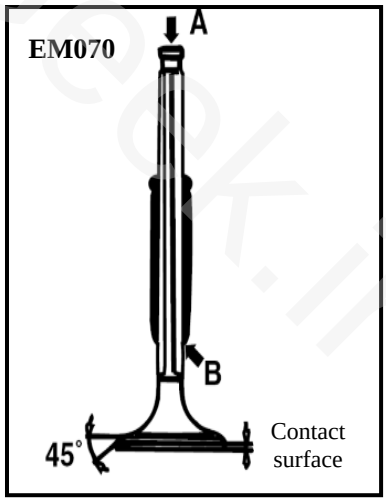
Air exhaust: 1.5mm

Limiting value

Air intake: 0.7mm

Air exhaust: 1.0mm

EM070



3) Valve Spring

① Inspect the free height of each valve spring. If it exceeds repair limit value, replace spring.

② Use a ruler to inspect the verticality of each spring. If the spring is not vertical seriously, replace it.

Valve Spring

Standard value

Free height: 45.8 mm

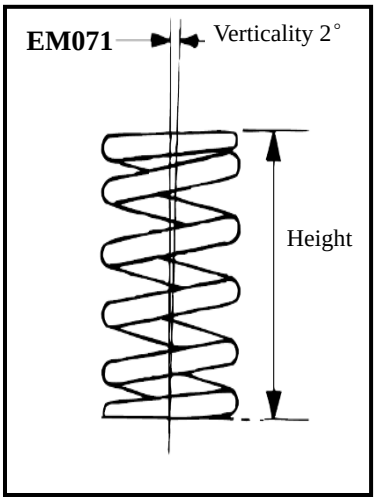
Load: 25.3 kg / 40 mm

Verticality: 1.5° or below

Limiting value

Free height: 44.82 mm

Verticality: 4°



Valve Guide Pipe

Inspect the clearance between valve rod and guide pipe. If the clearance exceeds repair limit value, replace it with a No.1 bigger valve guide pipe.

4) Clearance between Valve Rod and Guide Pipe

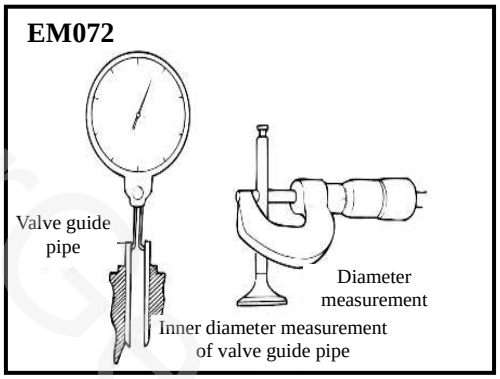
Standard Value

Air intake: 0.020 ～ 0.047 mm

Air exhaust: 0.050 ～ 0.085 mm

Limiting value Air intake: 0.l mm

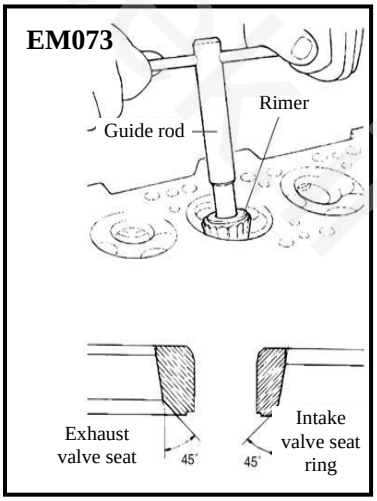
Air exhaust: 0.15 mm



5) Repair Valve Seat

Inspect whether valve seat overheats and whether valve surface has nonuniform contact. If necessary, repair or replace valve seat. Before repairing valve seat, inspect whether valve guide pipe has abrasion. If valve guide pipe has abrasion, replace valve guide pipe and repair valve seat. Use a valve seat grinder or milling cutter to repair valve seat. Valve seat contacting width should be within the specified range, and located at the centre of valve surface.

After repairing, use grinding cream to grind valve and valve seat.



6) Replacement of Valve Race

① Clean the inner surface of valve seat ring hole.

② Heat the cylinder head to about 250℃ (480°F), and press and install a seat ring into the hole of cylinder head.

③ Use grinding cream to grind valve and new seat.

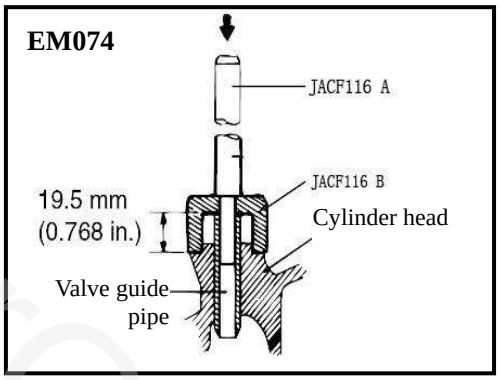
Valve seat contacting width:

0.9 ～ 1.3 mm

7) Replace Valve Guide Pipe.

① Use special tool (JACF116A) to remove old valve guide pipe along the bottom direction of cylinder head.

② Repair valve guide pipe hole, to make it match with new big size of valve guide pipe.

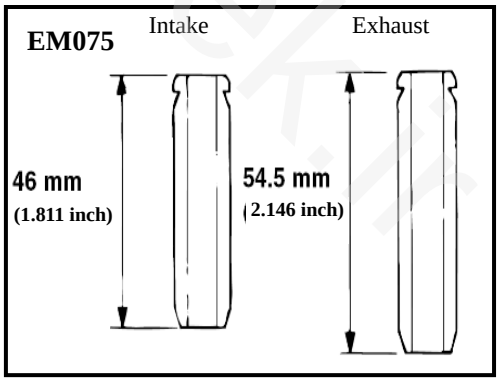


③ Press valve guide pipe by special tool (JACF116B). It is necessary to press valve guide pipe from the top of cylinder head. Attention should be paid that the length of intake valve pipe and exhaust valve pipe is not the same.

Notes:

■ Do not install valve guide pipe with original size.

Unless the size is enlarged.



④ After pressing and installing valve guide pipe, insert a new valve and inspect whether the clearance between valve rod and guide pipe is suitable.

⑤ After replacing valve guide pipe, inspect whether the valve position is suitable. If necessary, repair the valve seat.

Valve Guide Pipe Enlarged Dimensions

Enlarged dimension mm (inch)	Dimension mark	Enlarged dimension valve duct hole dimension (inch.)
0.05 (0.002)	5	12.050 - 12.068 (0.4744 ～ 0.4751)
0.25 (0.010)	25	12.250 - 12.268 (0.4823 ～ 0.4830)
0.50 (0.020)	50	12.500 - 12.518 (0.4921 ～ 0.4928)

Notes:

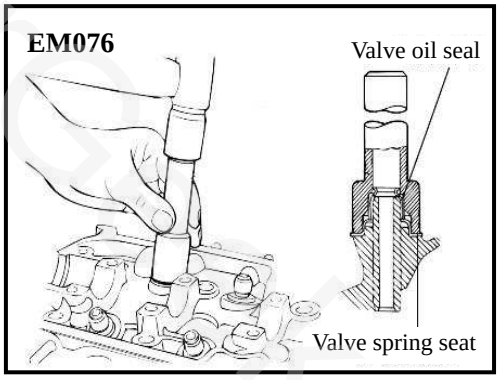
1. Before installing, clean each part.
2. Apply oil onto the sliding and rotating parts.
3. Install spring seat.
4. Lightly knock valve oil seal by special tool in the correct position.

Notes:

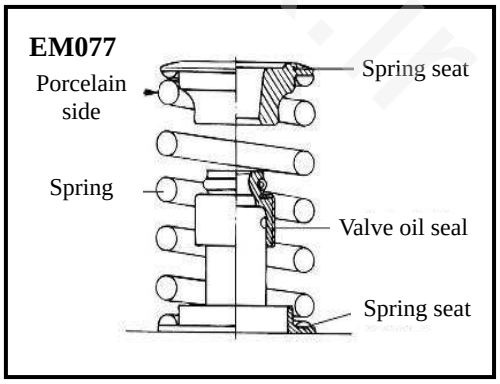
■ Do not use old valve oil seal.

■ Improper installation of valve oil seal may cause oil leakage of valve guide pipe.

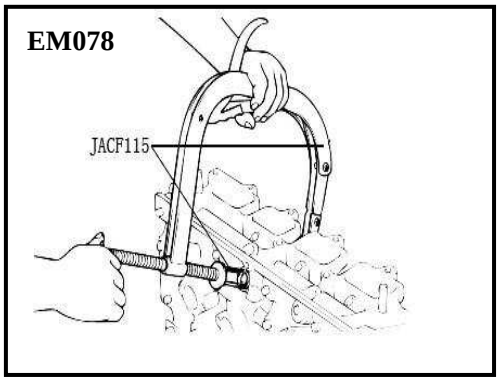
⑥ Apply oil onto each valve. Valve was inserted in the valve guide pipe Avoid to use hard force to push valve into sealing piece. After inserting valve, inspect whether it can slide smoothly.



⑦ Place valve spring and make porcelain surface towards upper seat of valve spring, and then install spring seat.



⑧ Use special tool (JACF115) to compress spring and install lock latch. After installing valve, before loosening valve spring compressor, make sure that the locking latch is located at its proper position.



Notes:

■ When the spring is compressed, inspect whether the sealing piece of valve rod isn't compressed onto the bottom of spring seat.

⑨ Clean the gasket surface of engine body and cylinder cover.

⑩ Confirm identification mark on the cylinder cover gasket.

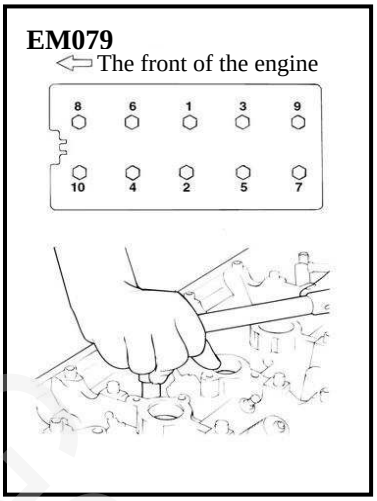
⑪ When installing washer, make the marked surface upwards cylinder head.

Notes:

■ Inspect and measure the length of each cylinder head bolt.

Max. length: 99.4 mm

⑫ Tighten bolts to the specified torque.



Tightening torque

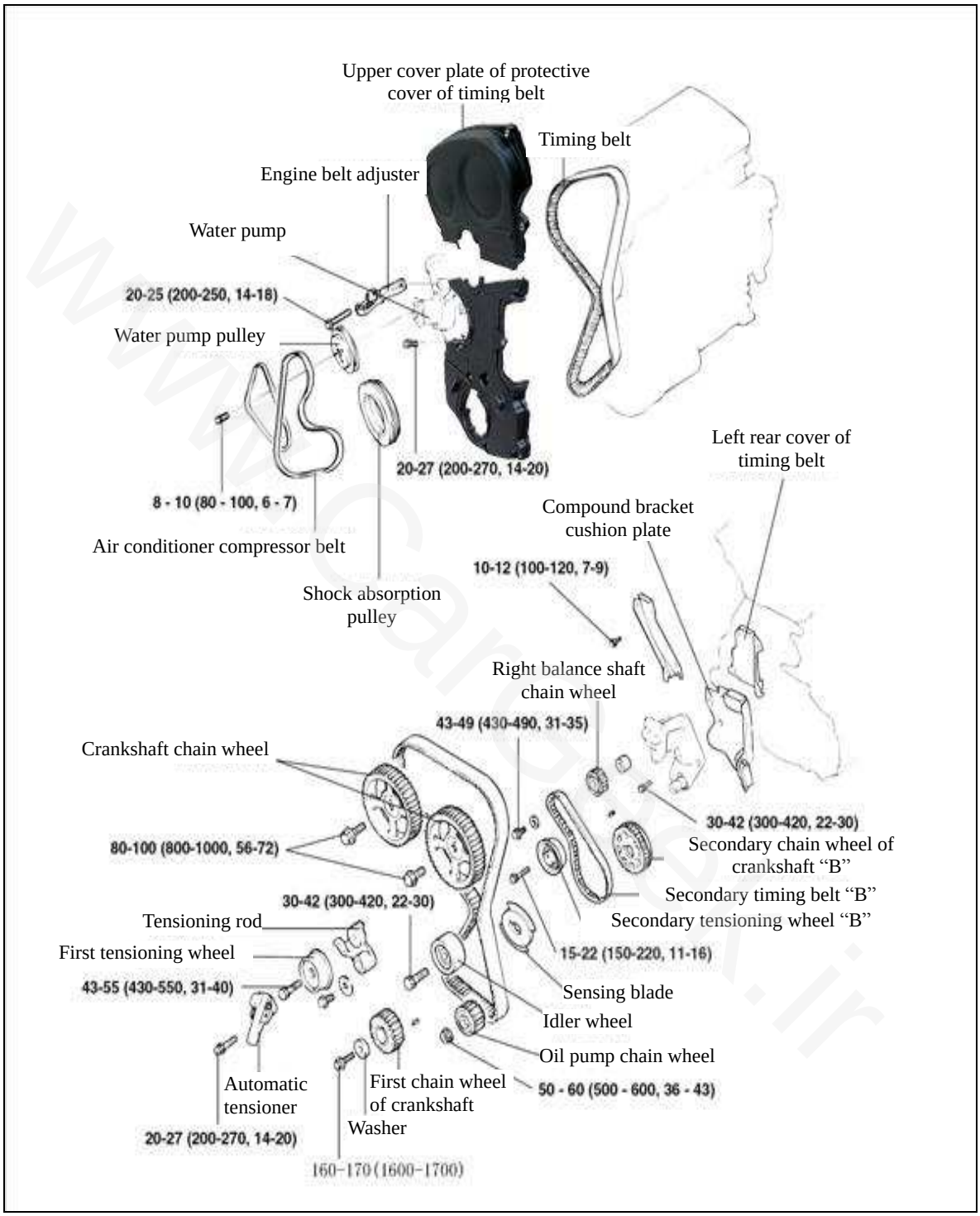
The used parts (cylinder head bolts, cylinder head, cylinder body): 20 N•m + 90°+ 90°

New parts (even if only one part is replaced): 64 N•m＋loosening＋20 N•m + 90° + 90°

Timing Belt

1. Timing Belt

1. Component



2. Dismantling

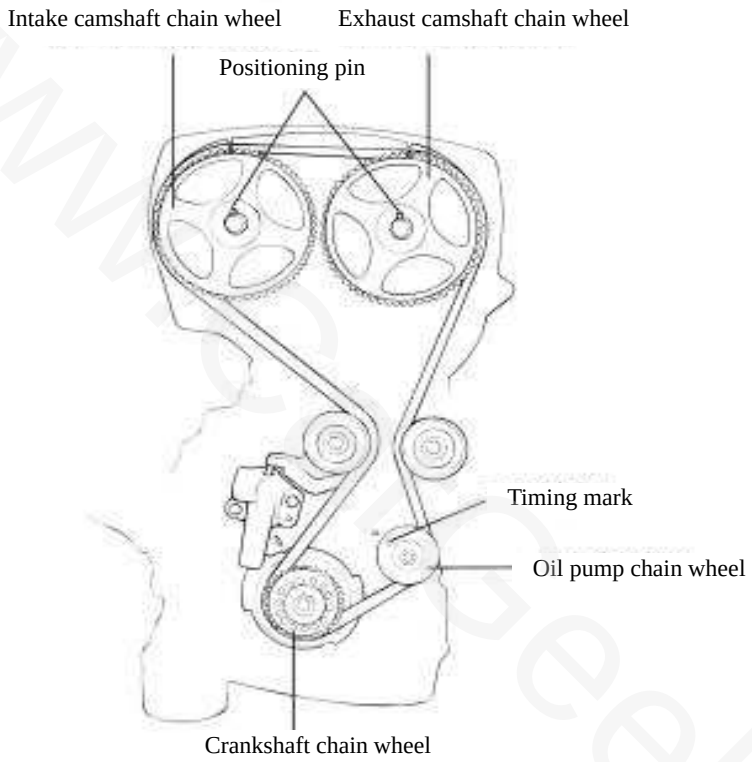
Notes:

■ Rotate crankshaft in clockwise and align timing mark, to set No.1 cylinder piston onto T.D.C. At this moment, the timing marks of camshaft chain wheel and cylinder head cover are just aligned. Positioning pin of camshaft chain wheel is located upper side.

1) Dismantle crankshaft pulley, engine water pump pulley and drive belt pulley.

2) Dismantle timing belt with shield.

3).Dismantle auto-tensioner.



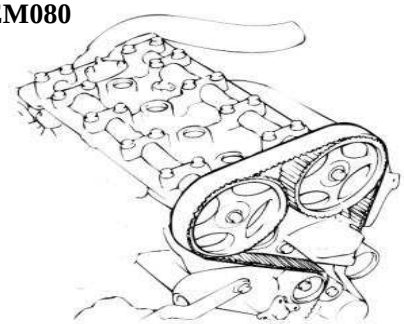
Notes:

■ If timing belt is to be used again, make an arrow mark showing rotation direction (or front side of engine) to ensure that it has the same direction when re-installing.

■ At this moment, the timing marks of camshaft chain wheel and locking housing are just aligned. Positioning pin of camshaft chain wheel is located upper side.

4) Dismantle timing belt.

EM080

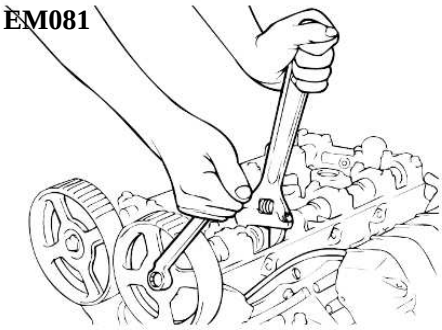


5) Dismantle camshaft sprocket.

Notes:

■ When using wrench, do not damage valve cylinder head and camshaft sprocket.

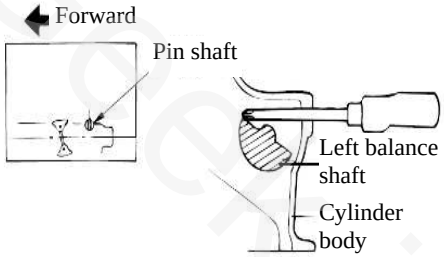
EM081



6) When dismantling oil pump chain wheel nuts, first dismantle inspection bolt of left balance shaft on the left of cylinder body, and insert a pair of screwdrivers to keep the position of left balance shaft. Screwdriver with shaft diameter of 8 mm can be inserted into more than 60 mm (2.36 inch).

7) Dismantle oil pump placket.

EM082



8) Unscrew mounting bolt of left balance shaft chain wheel until it can be loosened with hands.

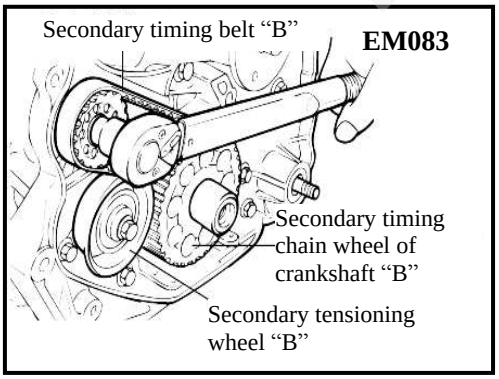
9) Next, dismantle secondary tensioning wheel "B" and secondary timing belt "B".

Notes:

■ After dismantling secondary timing belt "B", use a pair of pliers or other tool to clamp chain wheel, meanwhile do not loosen bolt.

10) Dismantle secondary crankshaft chain wheel "B" from crankshaft.

EM083



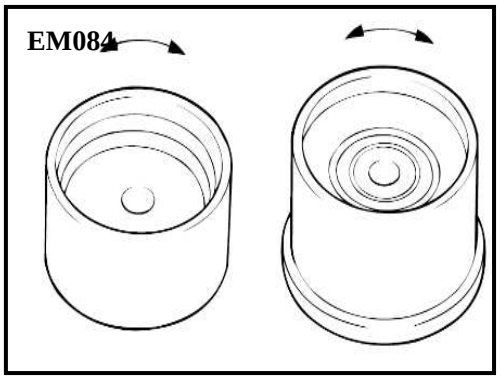
3. Inspection

1) Chain wheel, tensioner belt pulley and idler wheel.

① Inspect whether camshaft chain wheel, crankshaft chain wheel, tensioner pulley and idler wheel have abnormal abrasion, crack or damage. If necessary, replace them.

② Inspect whether tensioning wheel and idler wheel rotate freely and smoothly, and inspect their free play and noise. If necessary, replace it.

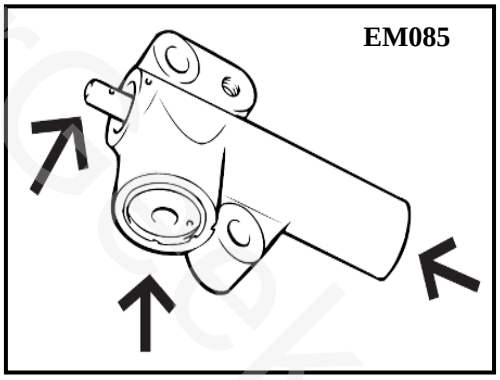
③ If there is grease flowing out of bearing, replace tensioning wheel.



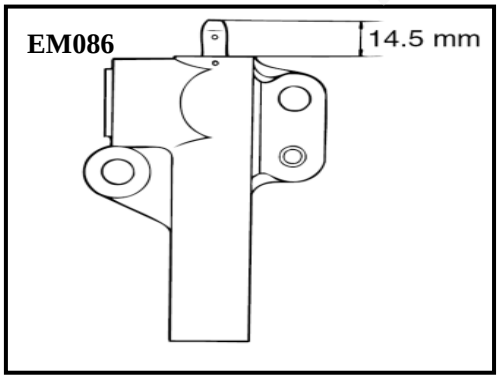
2).Auto-tensioner

① Inspect whether automatic tensioning wheel has leakage. If necessary, replace it.

② Inspect whether rod end has abrasion or damage. If necessary, replace it.



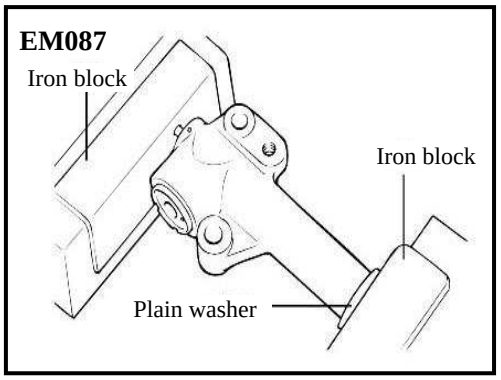
③ Measure the projection length of the rod. If it exceeds the specified value, replace tensioning wheel.
Standard value: 14.5 mm



④ Use a pair of soft pliers to slowly press automatic tensioner rod. If it is easy to be compressed, replace automatic tensioner. When pushing the rod, you should feel that there is too much resistance. It is necessary to press into for several times.

Notes:

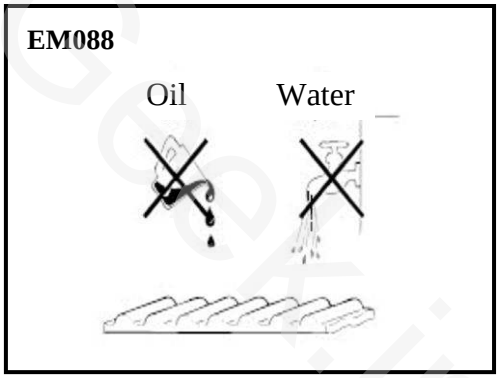
■ When using a pair of pliers to clamp automatic tensioner, make it in horizontal position. A pair of soft pliers should be used to avoid damage automatic tensioner.



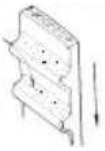
3) Timing belt

① Inspect whether there is deposited oil or dust on the belt. If necessary, replace it. For a little amount of oil stain, use dry cloth or paper to wipe it. Do not clean it with cleaning agent.

② When dismantling, overhauling engine or tensioning of belt, carefully inspect belt. If one of the following defects occurs, replace it with a new belt.



Descriptions	Defect Condition
1. Hardening of the rubber back	The back side is smooth without elasticity, so hard that it leaves no mark even pressing it with fingers. 
2. Crack of the rubber back	
3. Crack or separation of canvas	 Crack  Crack Separation  Separation

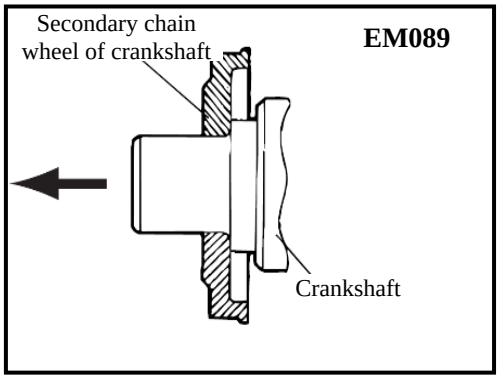
Descriptions	Defect Condition
4. The teeth is worn seriously (preliminary)	Canvas exposed in force borne surface (canvas has burrs, rubber grinds into white, and texture of canvas is unclear.
5. Belt tooth is worn seriously (late period).	Side abrasion of the tooth (on force borne surface) 
6. Tooth root cracks.	Side abrasion of the tooth, and rubber exposes on force borne surface (tooth width reduces) Rubber exposes 
7. Flex cracking	 Crack
8. Belt side has serious abrasion.	Lack of teeth and canvas fiber exposes 
9. Belt side cracks.	Side of arch belt  Abnormal abrasion (Canvas has burrs) 

4. Installation

1) Install crankshaft chain wheel "B" onto the crankshaft.

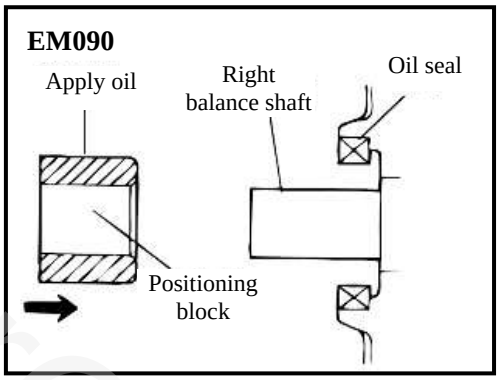
Notes:

■ For flange direction, if this direction is wrong, it may cause belt damage.

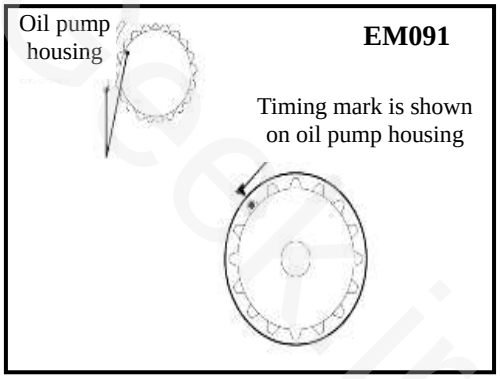


2) Apply a little amount of oil onto the surface of lining, and then install it onto the right balance shaft.

3) Install balance shaft chain wheel onto the right balance shaft, and then slightly tighten flange bolt with hands.

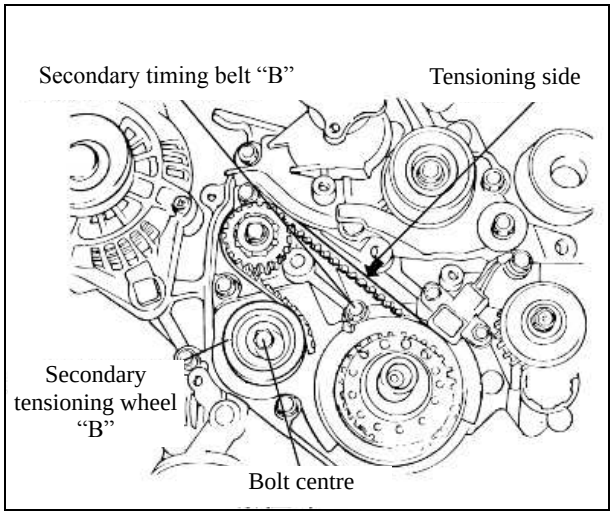


4) Align timing mark on oil pump housing with that of chain wheel.



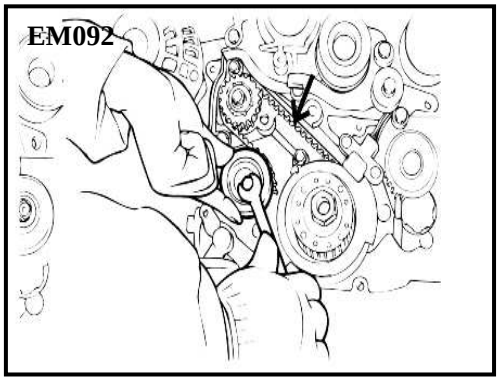
5) When installing timing belt "B", make sure that its tensioning side has no loosening condition.

Install tensioning wheel "B" to make the centre of belt pulley on the left of mounting bolt, and flange of belt pulley towards the front of the engine. Align timing mark of right balance shaft chain wheel with that of oil pump housing.



6) Rise up tensioning wheel "B" to tension timing belt "B" and tension its tensioning side. Under this condition, tighten bolt to fix tensioning wheel "B". When tightening bolt, pay attention to avoid shaft rotation.

If the shaft rotates, belt tensioning force will change, and noise may be produced when engine rotates.

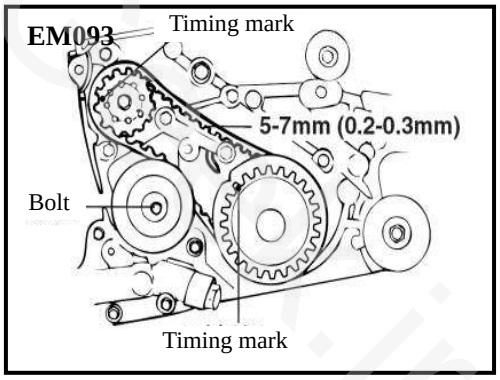


7) Inspect and verify that timing marks are aligned.

8) Verify tensioning force of timing belt.

Method 1: Use fingers to press the span centre on tensioning side according to the arrow direction. This is to verify whether belt deflection is within the specified value range.

Belt deflection: 5 ～ 7 mm (0.20 ～ 0.28 inch)



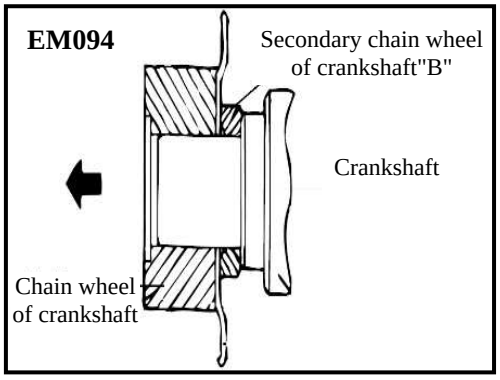
Method 2: Use a tension meter to measure the tensioning force of timing belt.

Span length	Pressure	Torque
139 mm (5.47 inch)	0.42 kg/cm^2 (42 KPa)	50 ～ 100 N•m (500 ～ 1000 kg/cm^2)

9) Flange and crank chain was installed on the crankshaft Make sure that the installation is conducted according to the instruction in figure.

Notes:

■ Pay attention to flange direction. If it is installed in wrong direction, it may cause belt damage.



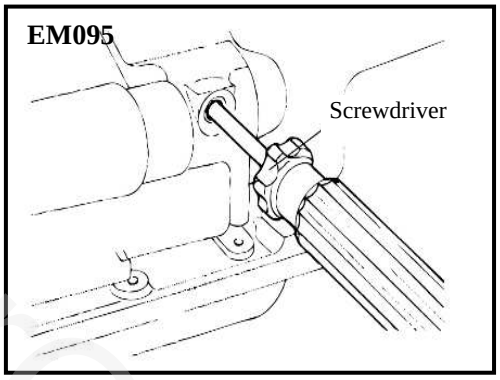
10) Install special washer and chain wheel bolt onto the crankshaft, and tighten chain wheel bolt.

Tightening Torque:

Crankshaft chain bolt:

160 ～ 170 N•m

11) Insert screwdriver into the inspection hole of left balance shaft on the left of cylinder body to keep the shaft stationary.

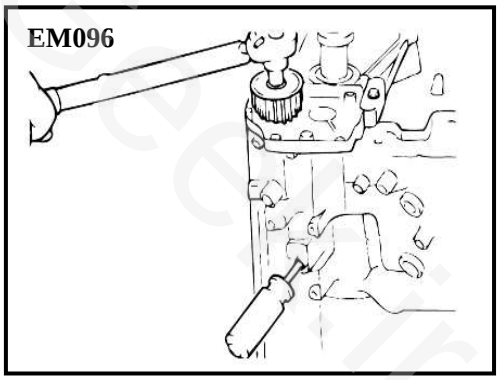


12) Install oil pump chain wheel and tighten nut to the specified torque.

Tightening Torque

A. Oil pump sprocket:

50 ～ 60 N•m

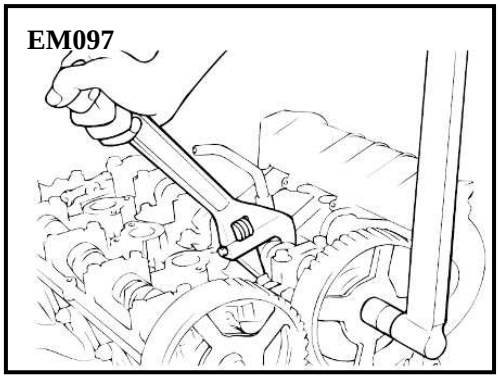


13) Install camshaft chain wheel and tighten bolt to the specified torque.

Tightening Torque

B. Camshaft sprocket bolt

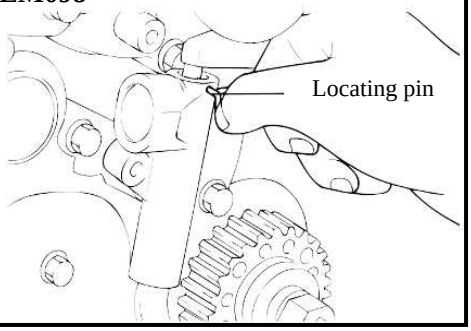
80 ～ 100 N•m



14) Install automatic tensioner.

Keep installed locating pin in the auto-tensioner

EM098



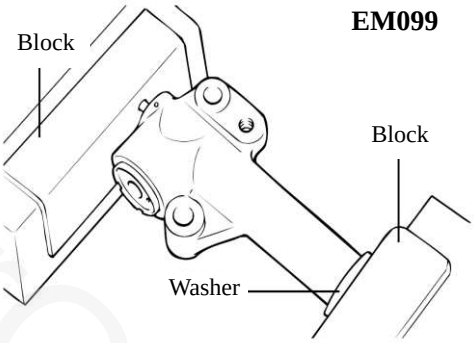
Notes:

■ If the automatic tensioner rod on its full extension position, reset it according to the following:

① Clamp it into the bench clamp on horizontal position by using the soft pliers.

② Use a pair of pliers to slowly press rod into the locating hole and align it with the locating hole of cylinder.

EM099

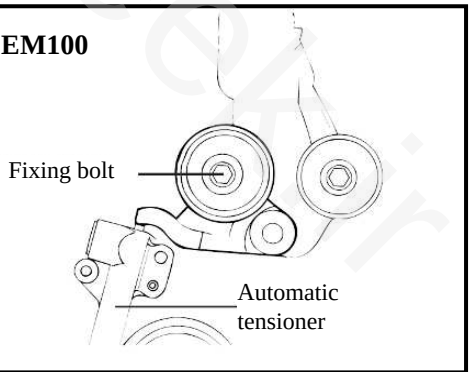


③ Insert positioning pin into automatic tensioner and rod.

15) Install tensioning wheel onto tensioning rod.

Tightening Torque
Tensioner:
43 ～ 55 N•m

EM100

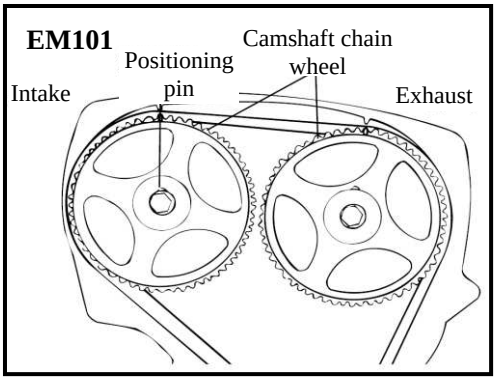


16) Rotate camshaft chain wheel, to make the positioning pin of camshaft chain wheel onto the top. Correctly set timing mark of chain wheel.

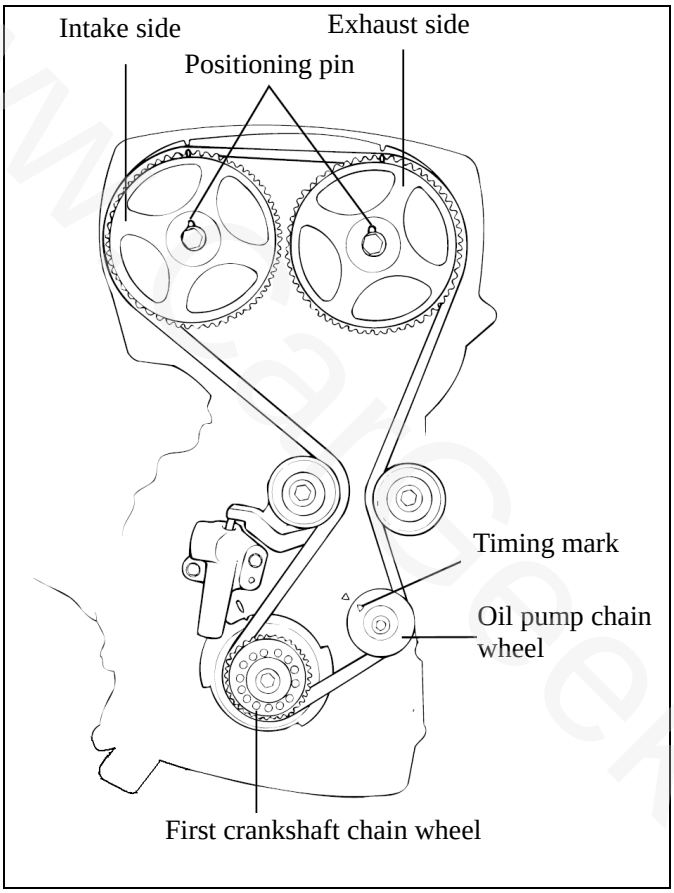
Notes:

1) Before installing timing belt, if the timing mark of camshaft chain wheel is not aligned with timing mark of rocker arm sleeve, do not rotate camshaft chain wheel in any direction. Rotating chain wheel may cause contact of valve with piston.

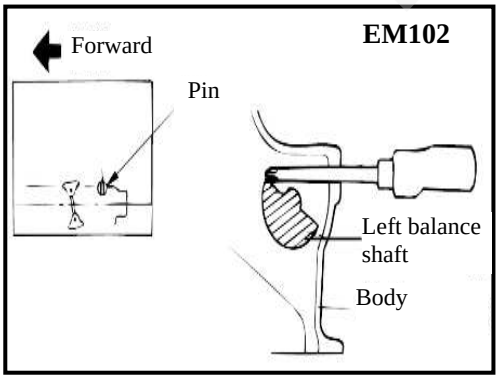
2) If it is necessary to rotate camshaft chain wheel, first rotate crankshaft chain wheel counterclockwise based on timing mark. After the camshaft chain wheel is correctly timed, return crankshaft to the upper stop point.



17) Align timing mark of each chain wheel, and install belt according to the following sequence.
Crankshaft chain wheel - oil pump chain wheel - idler wheel - exhaust camshaft chain wheel - intake camshaft chain wheel - tensioning wheel.



Notes:
① Make sure that No.1 cylinder position is located on the upper stop position (compression stroke).
② When aligning timing mark of oil pump chain wheel, dismantle inspection bolt of left balance shaft on the left of cylinder body, and then insert a screwdriver (diameter: 8 mm; inserting length: 60 mm or more).



③ After inspecting timing mark, install inspection bolt of left balance shaft.

Tightening torque: 2.7 ～ 3.4 kg/cm^2

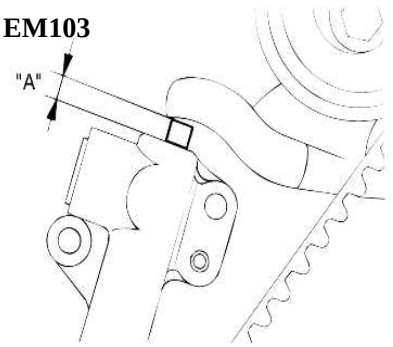
(Apply liquid sealant: Threebond NO.1212B or equivalent)

18) Pull out locating pin

19) Rotate crankshaft for 6 circles in clockwise and keep for 5mins. And then measure the projection section "A" of automatic tensioner (clearance between tensioning lever and automatic tensioner) to ensure that it is within the specified range.

Standard value: 5.5 ～ 9 mm

EM103



20. Install Upper/lower shield of timing pulley.

EM104

Fault Diagnosis

Engine is Difficult to Start:

Fault Phenomenon and Reason		Troubleshooting
The starter doesn't rotate	1. Battery doesn't rotate.	Tightening or charging
	2. Electric circuit is broken.	Inspection and repair
	3. Starter has damage.	Repair or replace
Spark plug misfire	1. Ignition timing is incorrect.	Adjust
	2. Ignition coil damaged	Replace
	3. Bad ground wire connection	Repair
	4. Spark plug has improper clearance or burned out.	Adjust or replace
	5. Electric ignition system has fault.	Repair or replace
Oil supply system fault	1. Gasoline pump supplies insufficient oil.	Repair or replace
	2. Gasoline hose and gasoline filter are blocked.	Clean
Cylinder compression pressure reduce	1. Cylinder cushion has crack.	Replace
	2. Valve clearance is improperly adjusted or damaged.	Adjust, repair or replace
	3. Intake manifold is loose, or there is air flowing into it.	Tightening
	4. Piston, piston ring, cylinder worn	Repair or replace

Power is Insufficient during Running:

Fault Phenomenon and Reason		Troubleshooting
Power is insufficient during running	Accelerator pedal and throttle body are improperly adjusted.	Adjust
	Cylinder compression pressure reduce	1. Inspect whether valve, spark plug, cylinder cushion have leakage; 2 cylinder grinding
	Ignition timing is not correct	Adjust
	Gas supply insufficient	Adjust or replace
	Air intake insufficient	Inspect intake system
	Air exhaust block	Check air exhaust system and clear carbon deposition
	Spark plug clearance is improper or damage	Adjust or replace

Knock Cylinder Sound in the Engine:

Fault Phenomenon and Reason	Troubleshooting

There is cylinder striking sound inside the engine.	Bushing has abrasion, and cam of camshaft and rocker arm have abrasion.	Replace
	Crankshaft , connecting rod journal diameter and piston pin worn seriously	Replace or repair
	Piston ring damaged	Replace
	Valve clearance is improper.	Adjust
	Thrust clearance of crankshaft is too big.	Adjust

Engine Too Hot:

Fault Phenomenon and Reason		Troubleshooting
Engine too hot	Ignition timing is not correct	Adjust
	Spark plug clearance is improper or carbon deposit	Clean or adjust
	Air intake manifold loosed, air intake manifold blocked	Tightening or clean
	Fan belt tensile force is insufficient	Adjust
	Coolant is insufficient or water pipe is blocked.	Supplement or clean
	Clearance of water pump is improper or damage	Repair or replace
	Oil pump is insufficient	Supplement
	Oil path is blocked or oil pump is damaged.	Clean or replace
Fault Phenomenon and Reason		Troubleshooting
Engine too hot	Cylinder gasket damage	Replace
	Clutch sliding	Repair or replace
	Radiator is blocked by Water scales.	Clean or replace

Oil Consumption is Too Much:

Fault Phenomenon and Reason		Troubleshooting
Oil consumption too much	Valve guide pipe oil seal is worn or damaged.	Replace
	Oil cup is worn or damaged.	Replace
	Piston ring isn't staggered according to the regulation.	Adjust
	Cylinder gasket damage	Replace
	Valve or valve guide pipe is worn.	Replace
	Engine overheats, interior pressure increases, and some lubricating oil is drained out of outlet.	Inspect relevant parts and eliminate faults.

Maintenance Data and Specification

Engine Overhaul Data List

Item	Specification Parameter	Limiting Value
Type	In-line, dual overhead cam, 16-valve, turbocharging	
Cylinder numbers	4	
Cylinder bore	83 mm	
Stroke	83 mm	
Discharged	1.795 L	
Compression ratio	8.5:1	
Ignition orders	1-3-4-2	
Air intake valve		
Open (BTDC)	12º	
OFF(ABDC)	56º	
Air exhaust valve		
Open (BBDC)	54º	
OFF (ATDC)	14º	
Cylinder gasket surface flatness	Max. 0.03 mm	
Manifold installing flatness	0.15 mm	
The size of repaired valve seat hole is enlarged.		
Air intake		
0.3 mm O.S.	35.3 ～ 35.325 mm	
0.6 mm O.S.	35.6 ～ 35.625 mm	
Air exhaust		
0.3 mm O.S.	33.3 ～ 33.326 mm	
0.6 mm O.S.	33.6 ～ 33.625 mm	
The size of repaired valve guide pipe hole is enlarged (intake and exhaust)		
0.05 mm O.S.		
0.05 mm O.S.	12.05 ～ 12.068 mm	
0.05 mm O.S.	12.25 ～ 12.268 mm	
	12.50 ～ 12.518 mm	
Cam height		
Air intake	35.493 mm	34.993 mm
Air exhaust		
Manual transmission	35.204 mm	34.704 mm
Automatic transmission	35.204 mm	34.704 mm
Outer diameter of journal	$\varphi 26^{-0.020}_{-0.035}$	
Bearing clearance	0.040 ～ 0.076 mm	
End play	0.1 ～ 0.2 mm	

Valve		
Valve length		
Air intake	109.5 mm	
Air exhaust	109.7 mm	
Outer diameter of valve rod		
Air intake	6.565 ～ 6.580 mm	
Air exhaust	6.530 ～ 6.550 mm	
Taper angle	45º ± 10’	
Width (edge) of valve head		
Air intake	1.0 mm	0.7 mm
Air exhaust	1.5 mm	1.0 mm
Clearance between valve rod and guide pipe		
Air intake	0.020 ～ 0.050 mm	0.1 mm
Air exhaust	0.050 ～ 0.085 mm	0.15 mm
Valve guide pipe		
Length		
Air intake	45.5 ± 0.1 mm	
Air exhaust	50.5 ± 0.1 mm	
Maintenance over dimension	0.05, 0.25, 0.50 mm	
Valve seat		
Seat contacting width	0.9 ～ 1.3 mm	
Seat tapering angle	44º ～ 44º5’	
Maintenance dimension	0.2 mm	
	0.6 mm more than tolerance	
Valve spring	46 mm	
Free length	25.3 kg / 40 mm	44.82 mm
Bearing capacity	When assembling height	
Tilting	Less than 1.5º	4º
Cylinder body		
Cylinder bore	$\varphi 85_{0}^{+0.04}$ mm	
Bore out of roundness and taper	Less than 0.01 mm	0.1 mm
Cylinder gasket surface flatness	Less than 0.05 mm	
Piston		
Outer diameter	84.97 ～ 85 mm	
Clearance between piston and cylinder	0.02 ～ 0.04 mm	
Ring slot width		
No.1	1.21 ～ 1.23 mm	
No.2	1.51 ～ 1.53 mm	
Oil ring	2.81 ～ 2.83 mm	

Item	Specification Parameter	Limiting Value
Piston ring Side clearance No.1 No.2 Oil ring End play No.1 No.2 Oil ring side blade	 0.04 ～ 0.075 mm 0.02 ～ 0.06 mm 0.06 ～ 0.15 mm 0.25 ～ 0.35 mm 0.40 ～ 0.55 mm 0.10 ～ 0.60 mm	 0.1 mm 0.8 mm 0.8 mm 1.0 mm
Connecting rod Degree of curvature Torsion resistance Connecting rod big end and side gap of crankshaft Installing torque of piston pin Connecting rod journal out diameter Connecting rod bearing clearance Clearance between main bearings of crankshaft No.1,2,4,5 journal No.3 journal	 0.05 mm 0.1 mm 0.10 ～ 0.25 mm 125 ± 50 N•m 44.98 ～ 45 mm 0.015 ～ 0.048 mm 0.018 ～ 0.036 mm 0.024 ～ 0.042 mm	 0.2 mm 0.1 mm 0.1 mm
Crankshaft Outer diameter of journal Journal concentricity Journal cylindrical Axial clearance	 56.982 ～ 57.000 mm 0.03 mm 0.01 mm 0.05 ～ 0.25 mm	 0.25 mm
Flywheel Runout		 0.13 mm
Oil pressure with idling [Oil temperature 120 ℃]	≥ 80 KPa	
Oil pump Top clearance Drive gear Driven gear: Side clearance Drive gear Driven gear:	 0.16 ～ 0.21 mm 0.18 ～ 0.21 mm 0.08 ～ 0.14 mm 0.06 ～ 0.12 mm	 0.25 mm 0.25 mm 0.25 mm 0.25 mm

Safety spring Free length When loading [61 N],	 46.6 mm 40.1 mm	

Item	Specification parameter	Limiting value
Left balance shaft Rear journal diameter Rear journal diameter Clearance Front Rear Balance shaft Rear journal diameter Rear journal diameter Clearance Front Rear	 18.467 ～ 18.480 /41.959 - 41.975 mm 40.951 ～ 40.967 mm 0.020 ～ 0.061 mm 0.050 ～ 0.091 mm 18.467 ～ 18.480 mm 40.951 ～ 40.967 mm 0.020 ～ 0.054 mm 0.042 ～ 0.083 mm	
Cooling type	Water cooling	
Cooling system capacity	4.0 L	
Thermostat Type Normal opening temperature Opening temperature range Full open temperature	 Paraffin type 82 ℃ 80 ℃～84 ℃ 95 ℃	
Radiator cover Main valve open pressure Main valve close pressure Opening pressure of vacuum valve	 107.9 ± 14.7 KPa (1.1 ± 0.15 kg/cm²,15.64 ± 2.13 psi) 83.4 KPa (0.85 kg/cm², 12.1 psi) -6.86 KPa (-0.07 kg/cm², -1.00psi)	
Air exhaust pipe Muffler Suspension system	 Expansion series resonant Rubber suspension device	
Coolant temperature sensor Type Resistance 20℃ 80℃	 Thermistance type 2.45 ± 0.14 KΩ 0.3222 KΩ	

Fastening Torque Specification Table

Name	Specification	Fastening Torque (N•m)
Forced bolt		
Cylinder head bolt subassembly	M11	63 **N•m** + loosening + (20 ± 2 **N•m**) + 90º+ 90º
Main bearing cover bolts	M10	25 ± 2 **N•m** + (90º~94º)
Fixing bolt components of crankshaft shock absorbing belt pulley	M8×25	20~30 **N•m**
Connecting rod nut	M8	20 ± 2 N•m + (90º~94º)
Fastening bolt components of camshaft bearing cover	M8×40	19 ~ 21 N•m
Crankshaft flywheel bolt	M12×21	130 ~ 140 N•m
Crankshaft gear wheel fastening bolt	M14×40	160 ~ 170 N•m
Camshaft gear shape wheel lock bolt	M12×30	80 ~ 100 N•m
Primary tensioning wheel bolt components	M10×30	43 ~ 55 N•m
Bolt(left balance shaft)	M8×16	34 ~ 40 N•m
Fastening bolt subassembly (right balance shaft)	M8×16	43 ~ 49 N•m
Common bolt		
Hexagon flange bolt (flywheel battle)	M6×10	10 ~ 12 N•m
Sound insulator plate bolt of main bearing cover	M8×16	17 ~ 26 N•m
Left balance shaft check bolt	M10×12	27 ~ 34 N•m
Hexagon flange bolt (crankshaft rear oil seal support)	M6×14	10 ~ 12 N•m
Hex plug of right balance shaft sleeve	1/16″	8 ~ 12 N•m
Water sleeve inner hexagonal screw plug	3/8″	40 ~ 50 N•m
Hex plug of main oil path	3/8″	55 ~ 75 N•m
Air exhaust nut	M8	25 ~ 30 N•m
	M10	35 ~ 55 N•m
Oil duct bolt plug	1/8″	8 ~ 12 N•m
Air exhaust plug	1/4″	20 ~ 30 N•m
Hexagon flange with teeth nut(air intake manifold nut)	M10	30~42 N•m
Outlet pipe installing bolt	M8×20	19 ~ 28 N•m
Cylinder head side cover plate fixing bolt	M8×20	19 ~ 28 N•m
Mounting bolt of camshaft phase sensor	M6×18	9 ~ 11 N•m
Camshaft rear end cover installing bolt	M8×25	8 ~ 12 N•m
Starter thermal baffle bolt	M6×14	9 ~ 11 N•m
Starter thermal baffle nut		9 ~ 11 N•m
ECM support installing bolt	M6×10	12 ~ 15 N•m
ECM bolt	M6×20	12 ~ 15 N•m
Mounting bolt of oil separator	M6×25	10 ~ 12 N•m
Hanging ring installing bolt	M8×16	15 ~ 20 N•m

assembly		
Air intake pipe bolt subassembly	M8	15 ~ 20 N•m
	M10	18 ~ 25 N•m
Water pipe fixing bolt	M6×12	8 ~ 12 N•m
Camshaft signal wheel bolt	M85×0	15 ~ 22 N•m
Fastening bolts(air intake pipe support)	M10×18	18 ~ 25 N•m
3.Carbon tank solenoid valve bolt	M8×10	8 ~ 10 N•m
Fastening bolts(air intake manifold pipe assembly)	M6×12	8 ~ 10 N•m
Throttle fastening bolt components	M8×32	5 ~ 10 N•m
Throttle mounting nuts	M8	15 ~ 22 N•m
Fastening bolt components of oil pressure guide rail	M8×26	10 ~ 13 N•m
Oil pan drain bolt	M14×17	35 ~ 45 N•m
Oil pan bolt Ⅰ	M6×60	10 ~ 12 N•m
Oil pan bolt Ⅱ	M6×32	10 ~ 12 N•m
Oil pan bolt Ⅲ	M6×20	10 ~ 12 N•m
Oil pan side cover bolt	M6×22	10 ~ 12 N•m
Hexagon flange bolt (oil pump housing)	M8×22	20 ~ 27 N•m
Oil pump housing bolt	M8×32	20 ~ 27 N•m
Air filter support bolt I	M8×45	20 ~ 27 N•m
Air filter support bolt Ⅱ	M8×38	20 ~ 27 N•m
Air filter support bolt Ⅲ	M6×20	8 ~ 10 N•m
Oil pump cover bolt	M8×20	15 ~ 18 N•m
Oil pump housing screw plug	M20×1.5	20 ~ 27 N•m
Shaft-end nut	M10	50 ~ 60 N•m
Oil strainer bolt subassembly	M8×20	15 ~ 22 N•m
Screw plug (air filter support)	M18×20	39 ~ 49 N•m
Installing bolt of ignition coil	M6×20	8 ~ 12 N•m
Thermal baffle fastening bolt	M8×12	12 ~ 15 N•m
Catalytic converter fastening bolt	M8×25	30 ~ 40 N•m
Air exhaust nut	M8	25~30 N•m
	M10	30~40 N•m
Timing gear chamber cover bolt Ⅰcomponents	M6×25	8 ~ 10 N•m
Timing gear chamber cover bolt Ⅱcomponents	M6×28	10 ~ 12 N•m
Composite support nut	M10×20	55 ~ 65 N•m
Composite support nut	M10×1.25-6 H	55 ~ 65 N•m
Idle bolt subassembly	M10×22	30 ~ 42 N•m
Second class tensioner bolt subassembly	M8×45	15 ~ 22 N•m
Tensioning wheel lever bolt components	M8×16	23 ~ 27 N•m
Auto-tensioner bolt	M8×51	20 ~ 27 N•m
Coolant temperature sensor	M17	20 ~ 40 N•m
Oil Pressure Switch	R1/8	15 ~ 22 N•m
Crankshaft position sensor bolt	M6	6 ~ 10 N•m
Knock sensor bolt	M8×28	16 ~ 24 N•m

Oxygen sensor	M18	40 ~ 50 N•m
Spark plug	M14×1.25	20 ~ 30 N•m
Thermostat valve seat long bolt	M8×20	19 ~ 28 N•m
Thermostat valve seat short bolt	M8×20	19 ~ 28 N•m
Hexagon flange with teeth nut(thermostat valve seat)	M8	19 ~ 28 N•m
Hexagon flange bolt (water pump)	M8	23 ~ 27 N•m
Water pump bolt II	M8	23 ~ 27 N•m
Water pump bolt III	M8	23 ~ 27 N•m
Water pump bolt IV	M8	23 ~ 27 N•m
Generator support bolt	M8×90	8 ~ 12 N•m
	M8×40	20 ~ 25 N•m
Fan bolt	M6	8 ~ 10 N•m
Long bolt of power steering pump	M8×88	22 ~ 25 N•m
Short bolt of power steering pump	M8×30	17 ~ 26 N•m
Generator support bolt	M8	20 ~ 25 N•m
Outlet pipe installing bolt	M8×20	10 ~ 15 N•m
Inlet pipe installing bolt	M8×20	10 ~ 15 N•m
Start motor bolt	M10	27 ~ 35 N•m
Water pump pulley bolt	M6×11.5	8 ~ 10 N•m
Low torque bolt		
Hexagon flange bolt (cylinder cover shield cover plate)	M6×22	4 ~ 5 N•m
Air filter		12 ~ 16 N•m
Supercharger connecting studs	M12×1.5	40 ~ 50 N•m
Supercharger connecting nut	M12×1.5	40 ~ 50 N•m
Supercharger oil return steel pipe steel pipe bolt	M6	10 ~ 12 N•m
Supercharger support bolt	M10	25 ~ 30 N•m