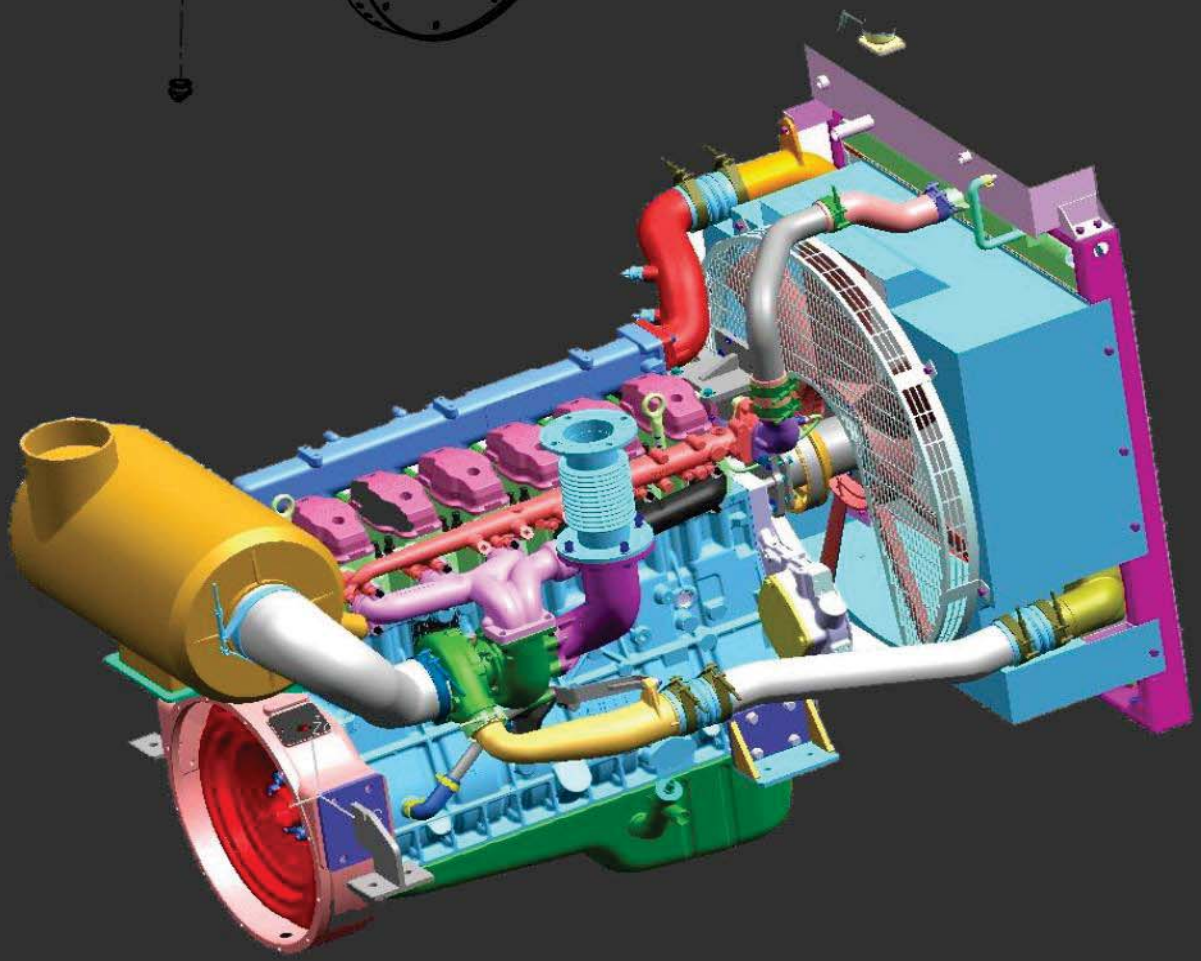
Mahindra NAVISTAR
Engines (P) Limited



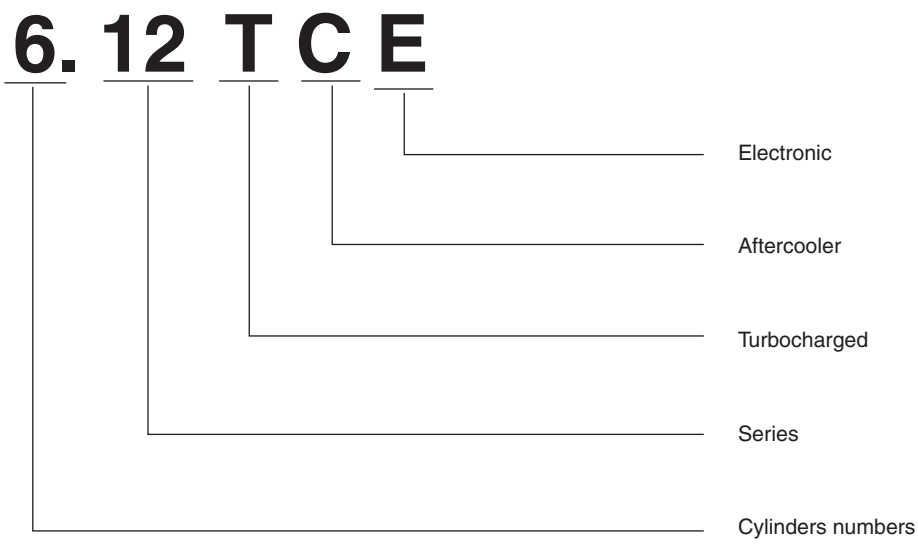
ACTEON 6.12 MECHANICAL

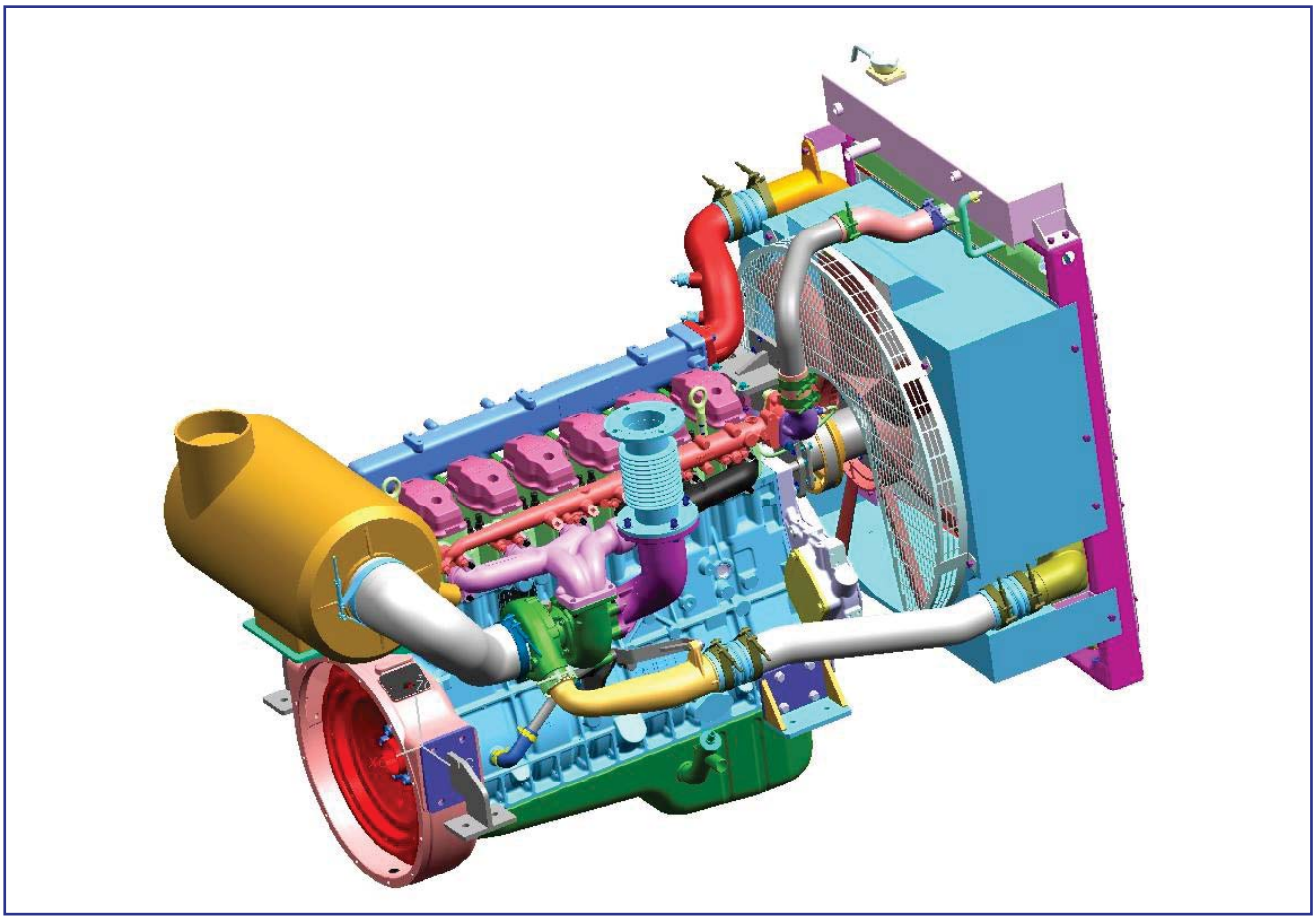
WORKSHOP MANUAL

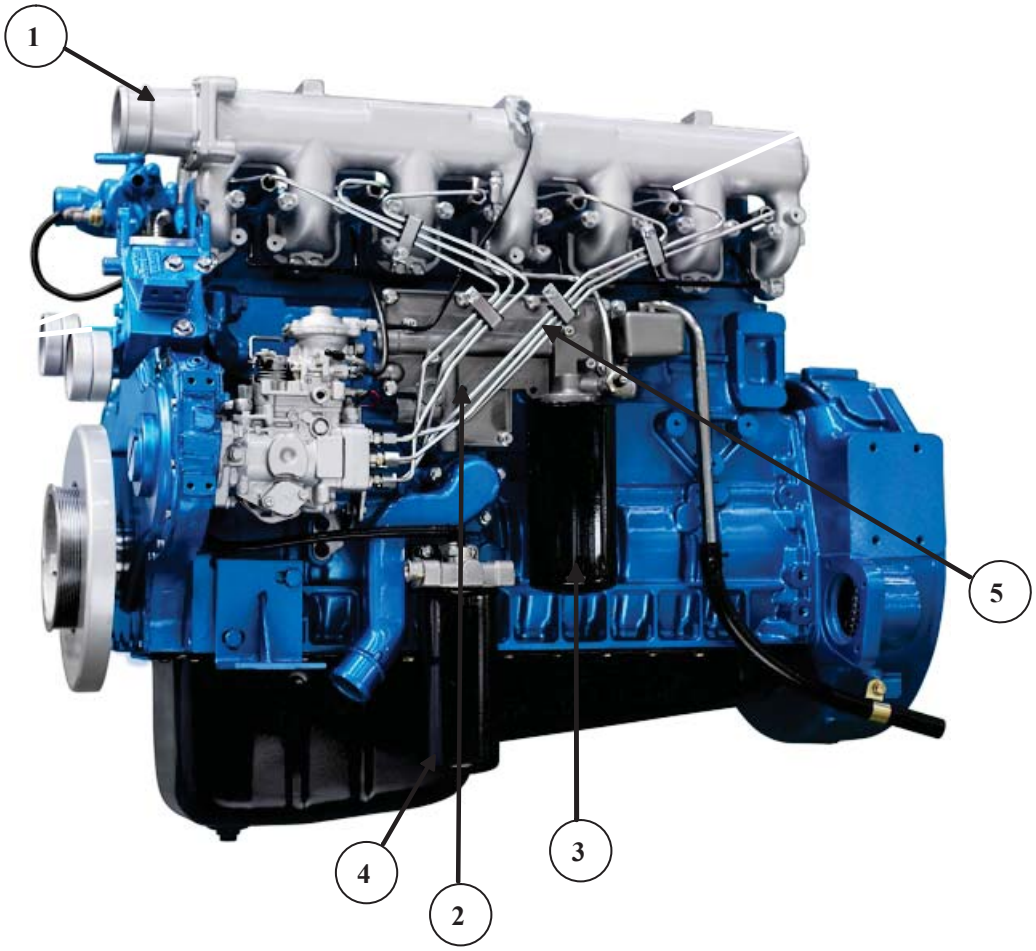
Engine Serial Number Identification and Location

The engine identification and serial number can be found in the following places:

1. Identification plate on the water pipe.
2. Engraving on the right side of the engine block, close to the cylinder head of the cylinder #3.







LEFT VIEW (COLD SIDE)

Mechanical Components

1. Manifold, Intake
2. Oil cooler assembly
3. Oil filter
4. Fuel filter
5. High pressure pipes

Running-in

All MIM engines are assembled and tested in the factory, making sure its immediate operation.

However, it needs to be correctly ran-in, regarding that its performance and durability depends on the cares taken during first operation phase.

As general rule, it is considered as running-in, a period of first 2,000 km for vehicular engines or the first 50 service hours for stationary, industrial and agriculture engines. The vehicle or equipment under moderate operation has decisive importance to its durability, service safety and economy.

During this period it is very important to follow these recommendations:

- Carefully check if engine oil level is correct;
- Carefully check if water level of the engine cooling system is correct;
- Avoid operate the engine at high speeds, that means do not apply extreme conditions of load or, considering vehicle application, to “stretch out” the speeds;
- Avoid forcing the engine at low speeds;
- Avoid forcing the engine while it has not reached the normal operation temperature yet;
- Avoid operating over the limit of 3/4 (75%) of the maximum load of the vehicle or equipment;
- Avoid operating the engine at constant speeds for long periods of time;
- Avoid leaving the engine running at idling speed for a long period of time;
- Strictly follow the maintenance instructions.

Following these recommendations the useful life of the engine will be prolonged.

FUEL SPECIFICATIONS

INDIAN DIESEL SPECIFICATION

S. No	Characteristic	BSII	BSIII	BSIV
1	Density Kg/m^3 15 ^{0} C	820-800	820-845	820-845
2	Sulphur Content mg/kg max	500	350	50
3(a)	Cetane Number minimum and / or	48	51	51
3(b)	Cetane Index	or 46	and 46	and 46
4	Polycyclic Aromatic Hydrocarbon	-	11	11
5	Distillation			
(a)	Reco. Min. At 350 ^{0} C	85	-	-
(b)	Reco. Min. At 370 ^{0}C	95	-	-
(c)	95%Vol Reco at 0° C max	-	360	360

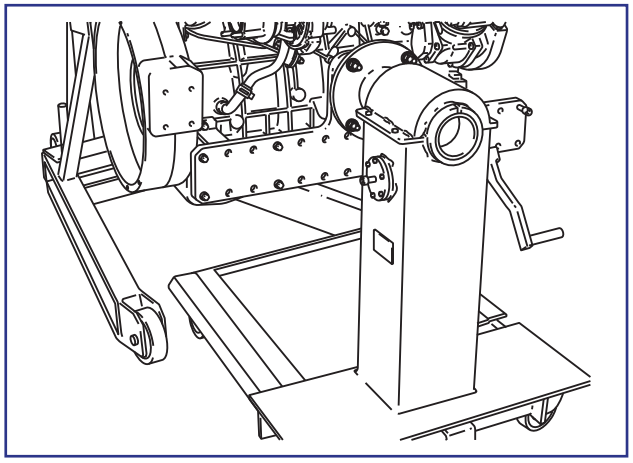
LUBRICANT OIL

Oil Level Check

- Stop the engine and wait 30 minutes so that the oil can flow back to the carter.
- Make sure that the vehicle is levelled.
- Before pulling oil dipstick, clean the surroundings.

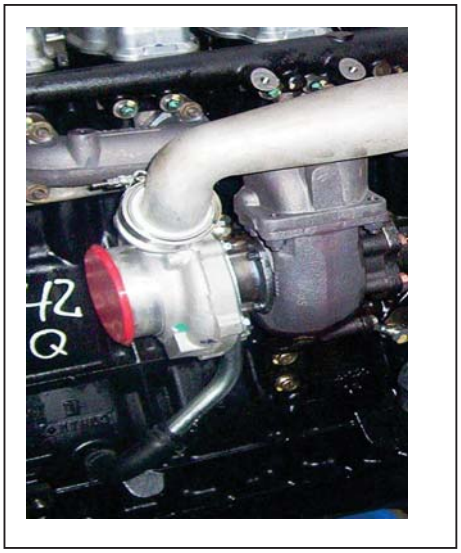
Tighten bolts to the standard torque value (General Torque Guidelines).

Remove safety chain hooks from engine lifting eyes.



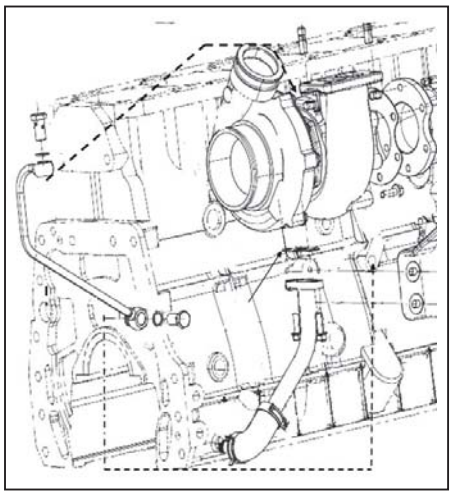
Turbocharger Oil Drain Tube – Removal

10 Mm
Remove the turbo oil drain tube.



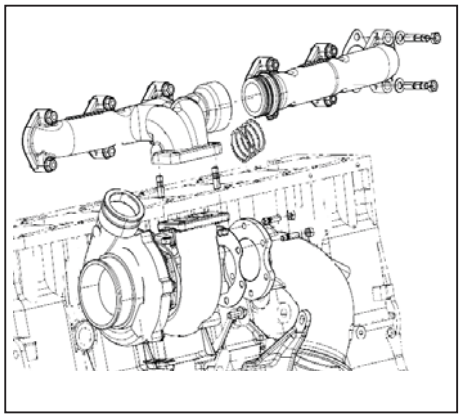
Turbocharger - Removal

15 mm
Remove the 4 nuts.
Discard the nuts.



Exhaust Manifold – Removal

15 mm
Remove the exhaust manifold nuts.
Discard the nuts.



Remove the camshaft and thrust plate from the cylinder block. Take care not to drop the thrust plate.

NOTE: Refer to procedure for camshaft cleaning and inspection.

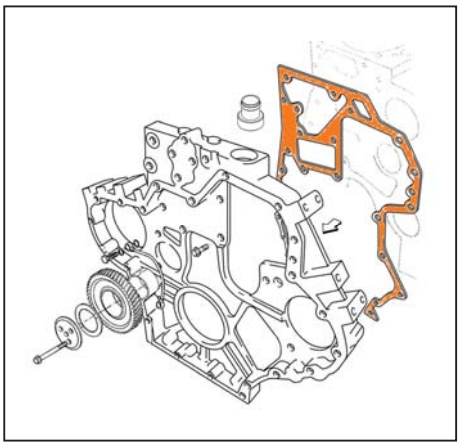
Valve Tappet – Removal

Remove the valve tappets and mark for location as illustrated.

CAUTION: When reusing the camshaft and tappets, the tappets must be matched to their companion lobe on the camshaft to prevent accelerated camshaft wear. Discard tappets that were not marked during removal.

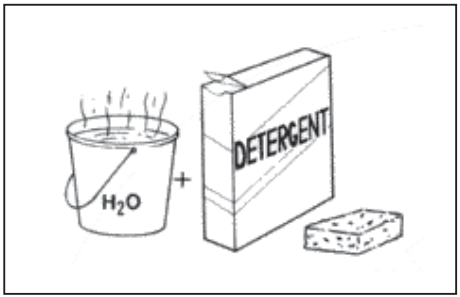
Gear Housing – removal

13 mm
Remove the cap screws, gear housing and gasket.
Discard the gasket.

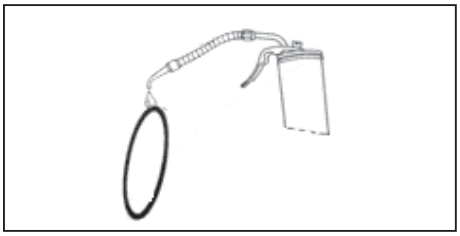


Cylinder Liner Carbon Deposits – Removal

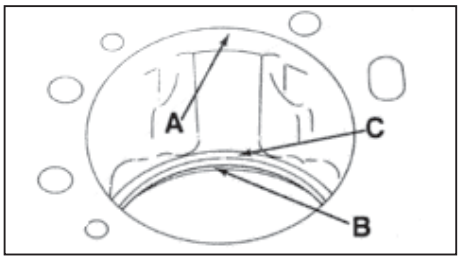
For cleaning the cylinder block a strong solution of hot water and detergent to clean the cylinder bore.



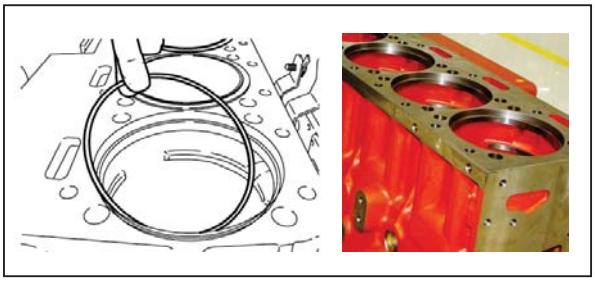
Use clean 15W-40 engine oil to coat the cylinder liner o-ring seals.



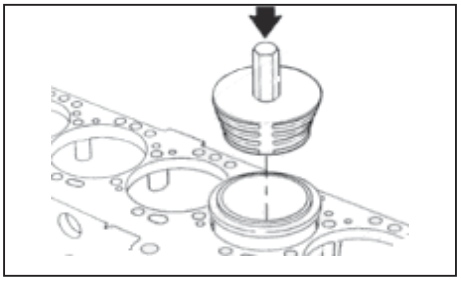
Install the two numbers o-ring seals in cylinder block groove.



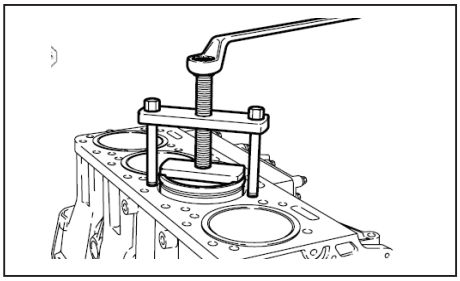
Install the cylinder liner shims.



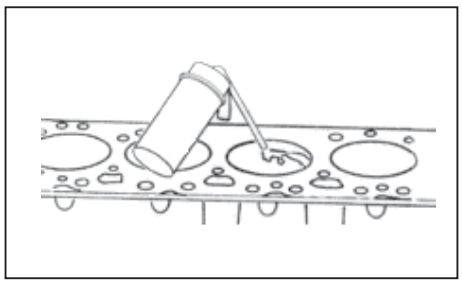
Install the cylinder liner into the block. Use liner installation tool.



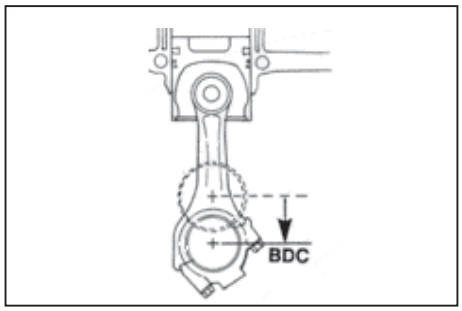
Use cylinder liner driver and leather mallet to drive the cylinder liner into the bore.



Use clean lint – free cloth to clean the crankshaft bearing journals.



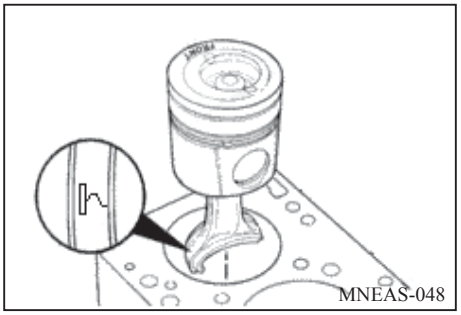
Use a clean lint-free cloth to wipe the cylinder bores. Lubricate the cylinder bore with clean 15W-40 engine oil.



Rotate the crankshaft to position the journal for the connecting rod , which is being installed , at bottom dead centre (BDC)

Caution: Be sure Mark on piston and the numbers on the connecting rod and connecting rod cap are oriented as illustrated.

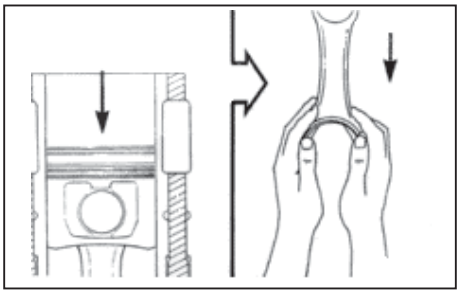
Caution: Use care when installing the piston and connecting rod co the cylinder bore is not damaged.



Position the piston and connecting rod assembly into the cylinder bore with the MARK on the piston towards the front of the cylinder block.

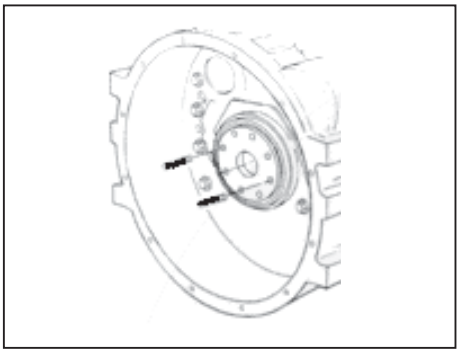
Hold the piston ring compressor against the cylinder liners. Push the piston through the ring compressor and into cylinder liner.

Note: If the piston does not move freely, remove the piston and inspect for broken or damaged rings.



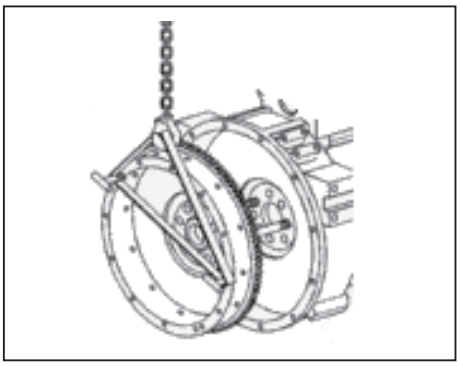
Push the piston into bore until the top of the piston is approximately 50 mm below the top of the bore. Then pull the connecting rod into the crankshaft journal.

Holes can be metric or standard. Be sure to use correct capscrews.
Determine the capscrews thread design and size and install two " T-handles" into the flywheel at points [1] and [2]



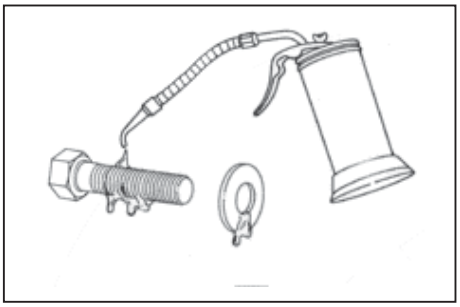
Visually inspect the rear face of the crankshaft and flywheel mounting flange for cleanliness and raised nicks or burrs.

Caution: The weight of the component is more than 25 kg . To avoid personal injury, use a hoist or get assistance to lift the component



Install the flywheel on the guide pins.

Lubricate the threads of the flywheel capscrews and the surface of the washers with clean 15W-40 engine oil.

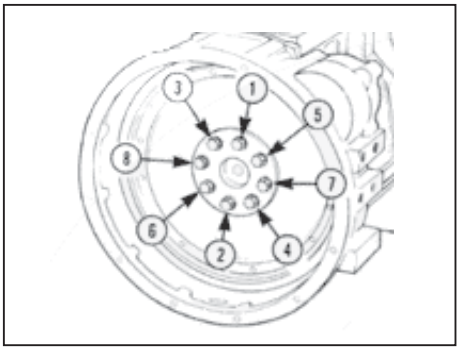


Install the eight flywheel capscrews.

Remove the " T-handle" and guide pins.
Install the remaining flywheel capscrews into the holes from which the guide pins were removed.

15 mm (Alen)

Hold the crankshaft when tightening the flywheel capscrews.
Tighten the flywheel capscrews in the pattern as illustrated.



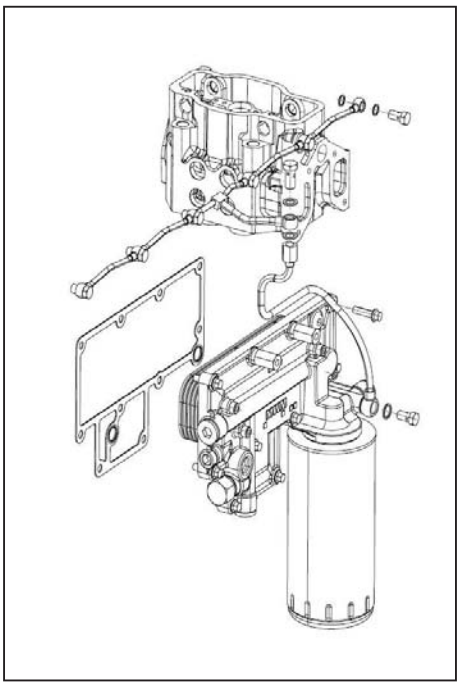
Torque Value:

MIN	**260**	**Nm**
MAX	**290**	**Nm**

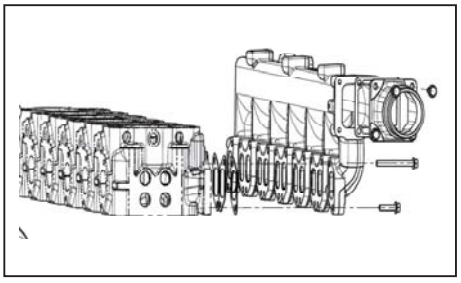
Cylinder Head Lubricating Manifold - Installation

Install the oil manifold and new copper washer as illustrated at cylinder head side.

Torque Value:
MIN 22 NM
MAX 28 NM



Intake Manifold – Installation
13 mm
Use new gasket.
Note: Cylinder head surface must be clean.
Install the intake manifold as illustrated.



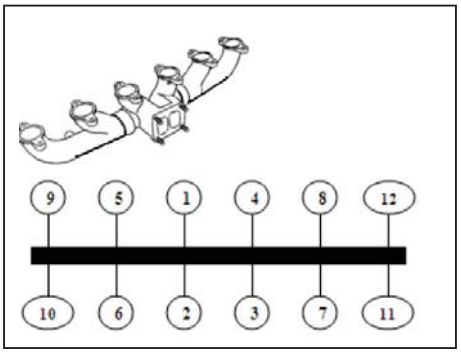
Exhaust Manifold – Installation

Install the exhaust manifold, new gaskets, and nuts.

Follow the tightening sequence shown in the illustration.

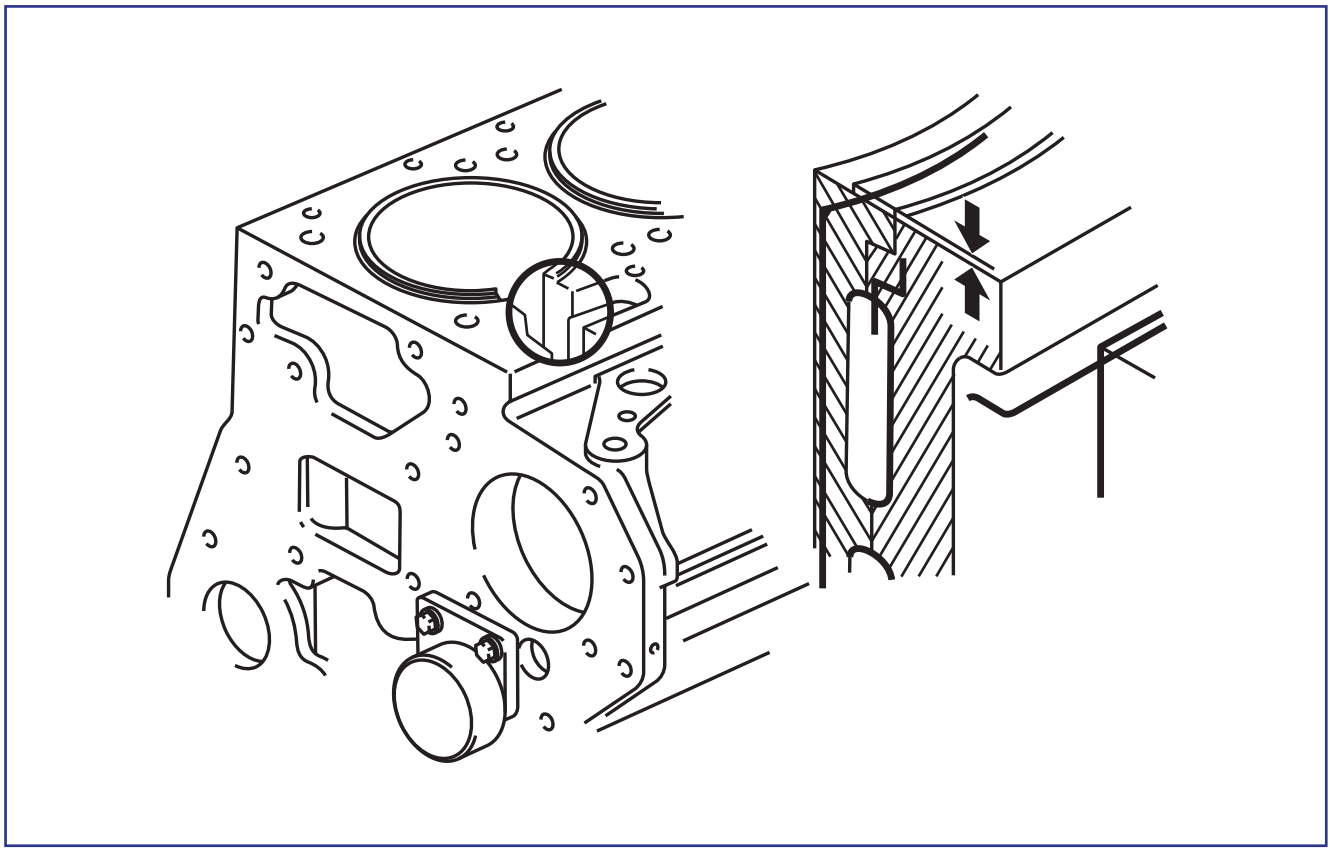
Tighten the exhaust manifold mounting capscrews

15 mm
Torque Value:
MIN 18 Nm
MAX 22 Nm



Inspections and Measurements

LINER PROTRUSION

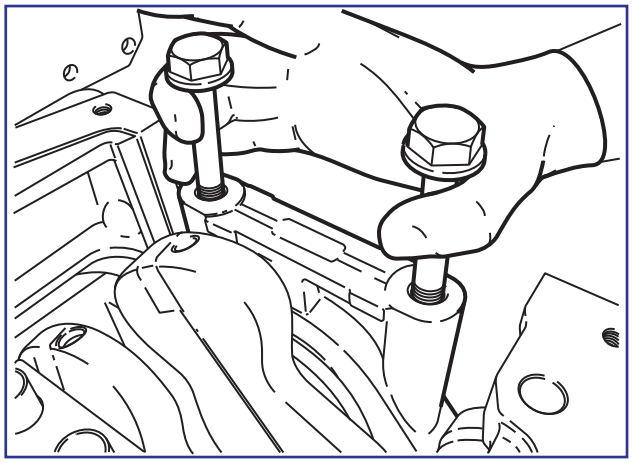


Liner over Engine Block Surface	
Measure	**mm**
Protrusion	*0.03 - 0.10

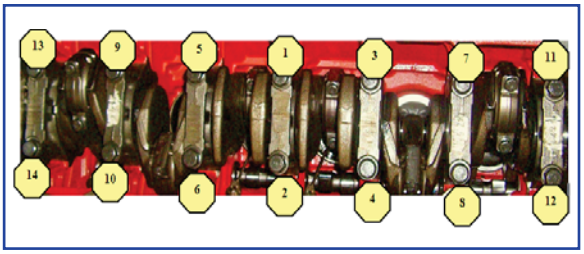
*Affect emissions level

Disassembly Notes

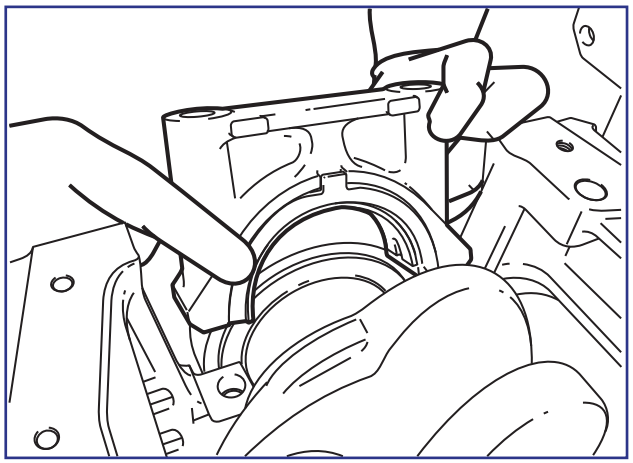
After removing the carter, pistons and connecting rods, flywheel, pulley and gear housing, position the engine on the stand in upright position and loosen the main bearing caps. To remove the bearing caps use the fixation bolts.



Follow the sequence of loosening the main bearing cap screws.

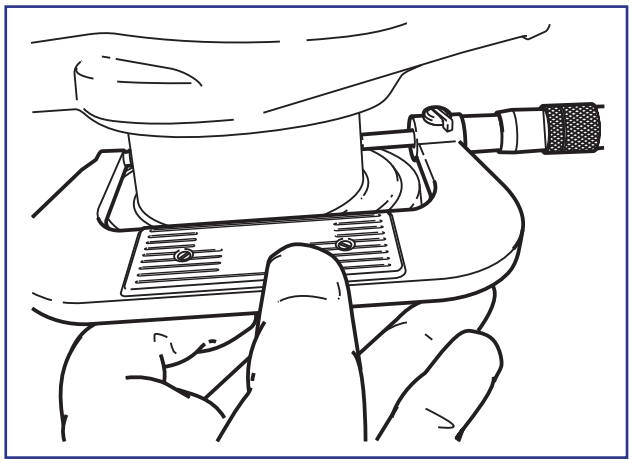


Remove the axial thrust ring from bearing #1 (flywheel side).

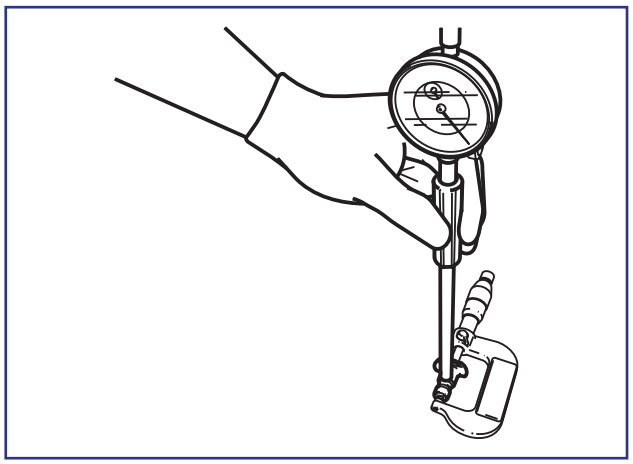


Carefully remove crankshaft in order to do not hit on any part of the engine block, avoiding damaging it. The storage of the crankshaft must always be done in upright position, avoiding any warping possibility.

Measure the crankshaft.The measurements must be taken twice at 90° and in the two edges of the bearing to check crankpins and main journals out-of roundness and taper.

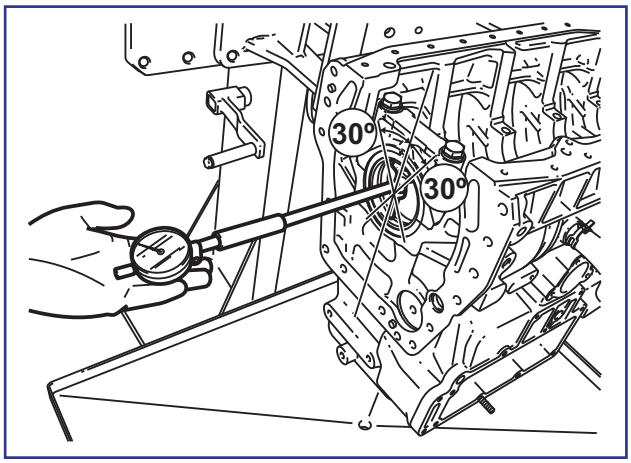


Compare the clearances obtained in the crankshaft through the bore gauge.



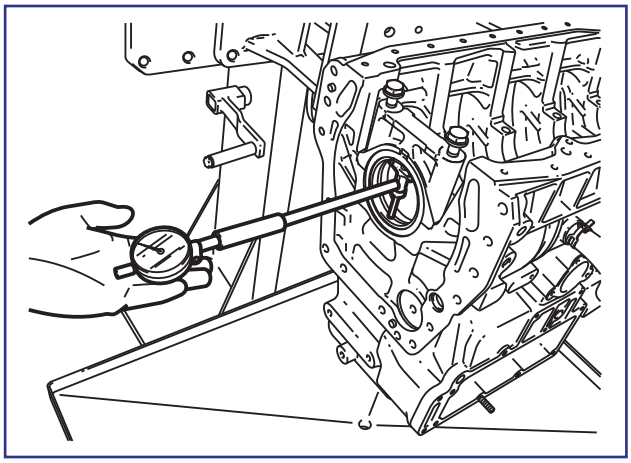
Install bearing caps and tighten according specification. Measure using same procedure from bearings without bearing shells to verify the radial force.

The 1st measurement is made in the centre of the bearing 0.036 – 0.096.



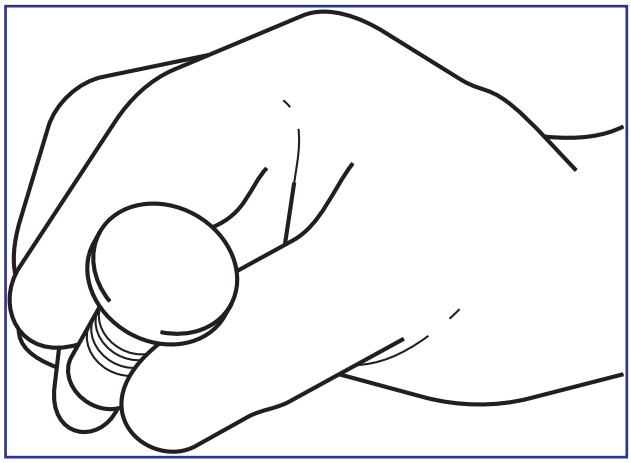
Remove one of the bolts bearing and measure bearing pre-tension.

Pre-tension: 0.05 - 0.15 mm.



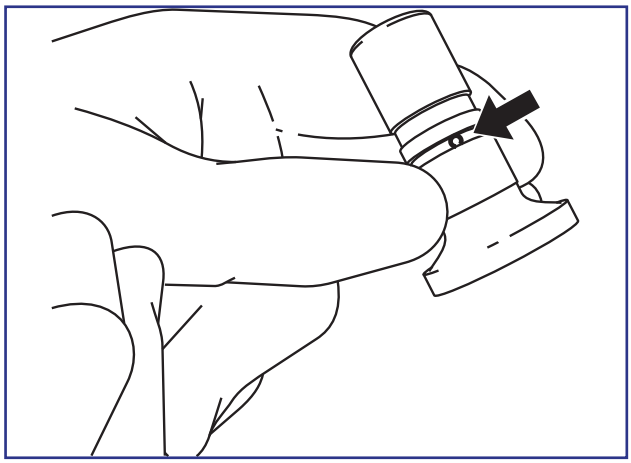
Inspections and Measurements

Visually check the tappets. Check if there are marks of excessive waste on the contact area with the cams of the camshaft.



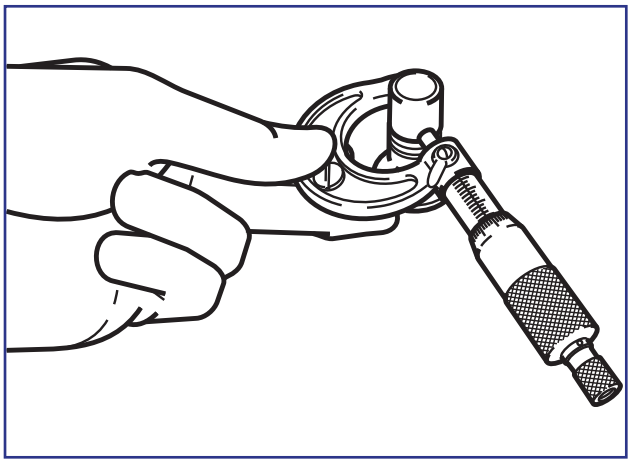
Attention: During its operation the tappets perform a rotating movement, responsible for a uniform distribution of the force, uniforming the waste. It must not have waste on only one area.

Visually check tappet lubrication holes.

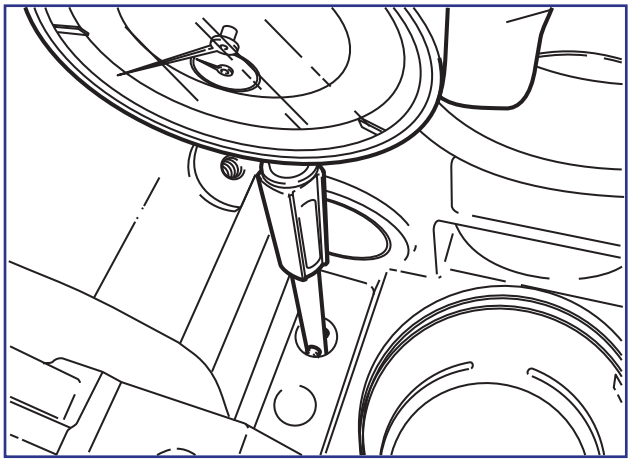


Attention: The lubrication holes of the tappets cannot be obstructed.

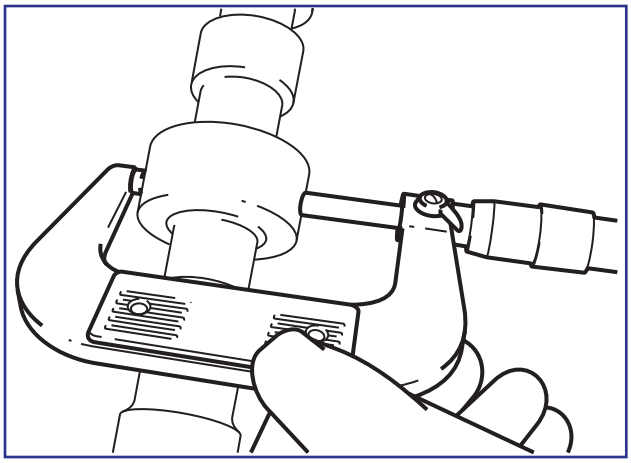
Measure the diameter and out-of-roundness of the tappets housing.



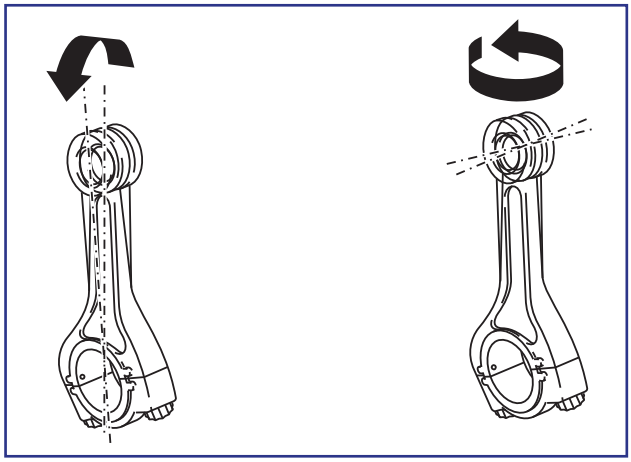
Measure the tappets bore diameter in cylinder block



Measure the camshaft bearing diameters.

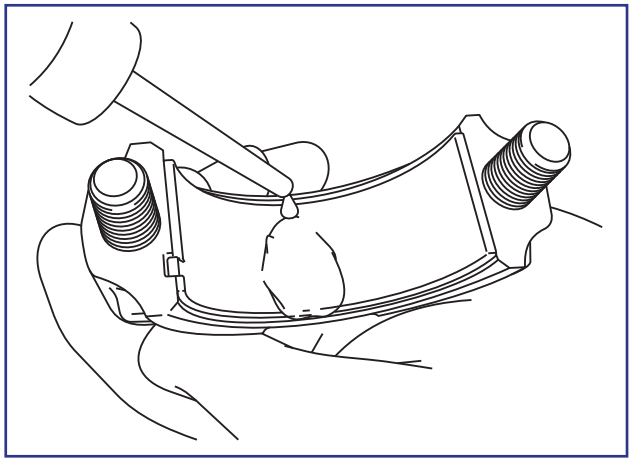


CONNECTING ROD WARPING

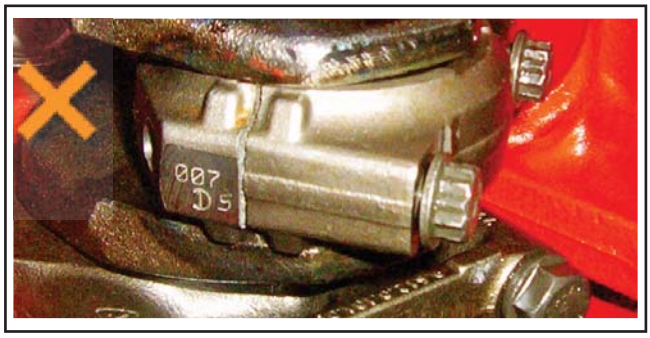


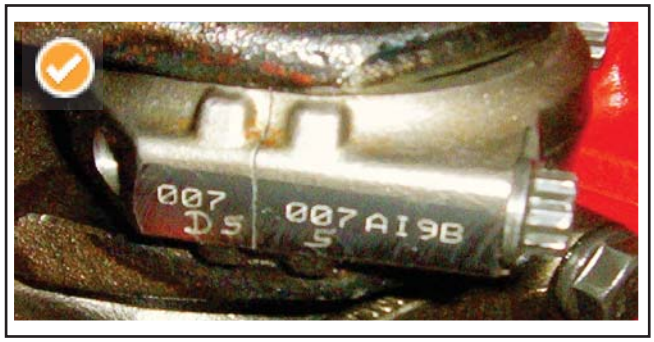
Maximum Torsion	Maximum Warping
0.10	0.03

Lubricate the two inner halves of the bearing shells.



Check the cap position at the time of assembly



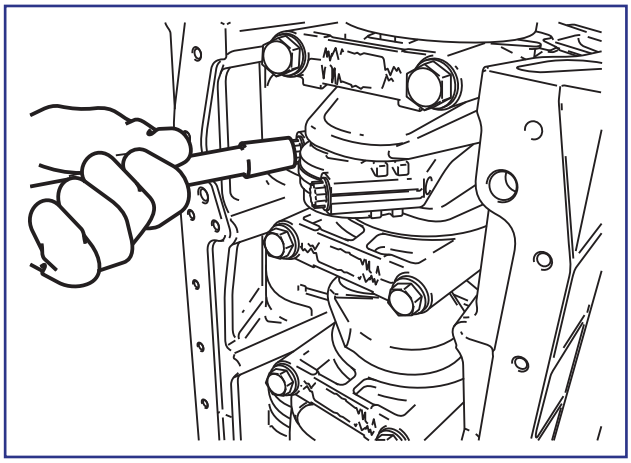


Number punched on con rod and cap must be one side

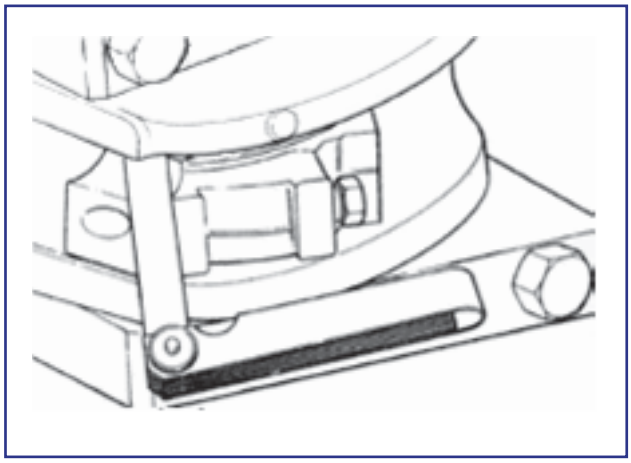
Position the connecting rod stem in the crankshaft crankpin and install the connecting rod cap. Tighten the bolts according to specification.

1st 40 ± 5 N.m

2nd 80° ± 2°



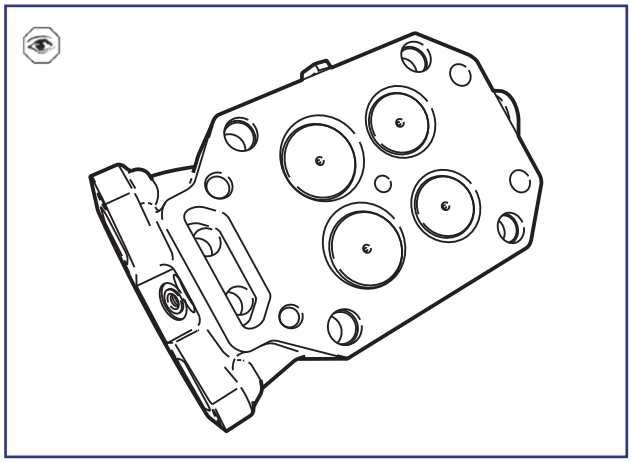
Check if the connecting rod has free side movement. Measure the side clearance.



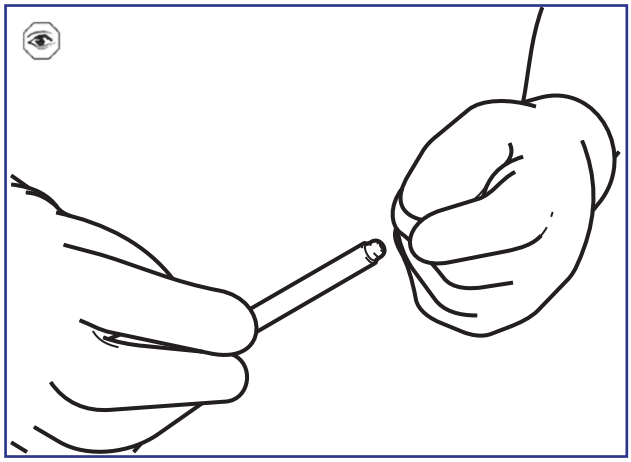
Check if the oil injector is not hittong the piston skirt otherwise injector may brake or bend

Inspections and Measurements

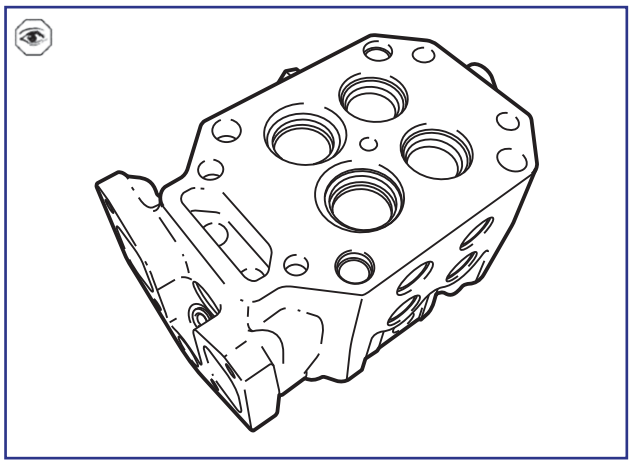
Visually check cylinder heads for leaks.



Check push rods. The push rods ends must not be loosen or cracked. Check for excessive wear. Check if the push rods are not warped.

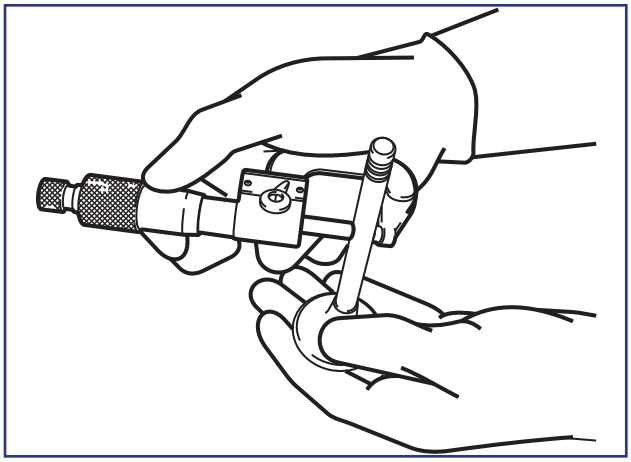


Cylinder heads surfaces must never be machined.

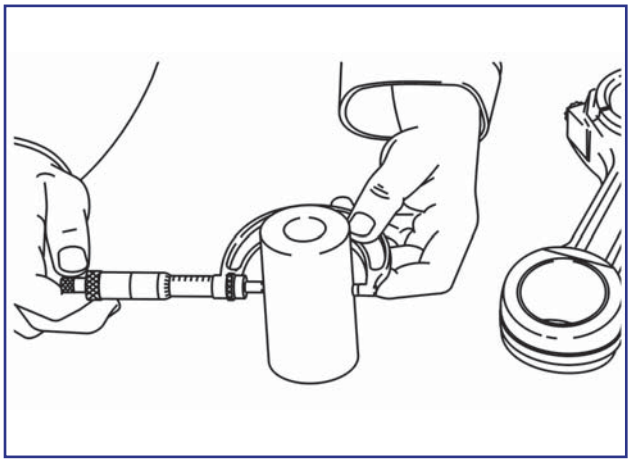


Measure the outer diameter of the valve stem in 3 different points:

- Upper part
- Central part
- Lower part

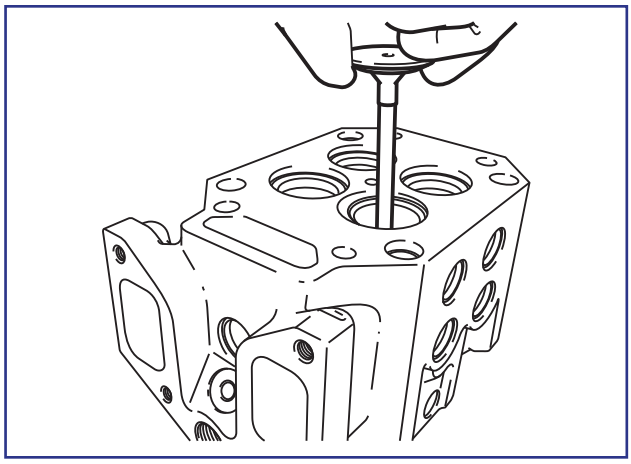


Measure the outer diameter of the valve guide.

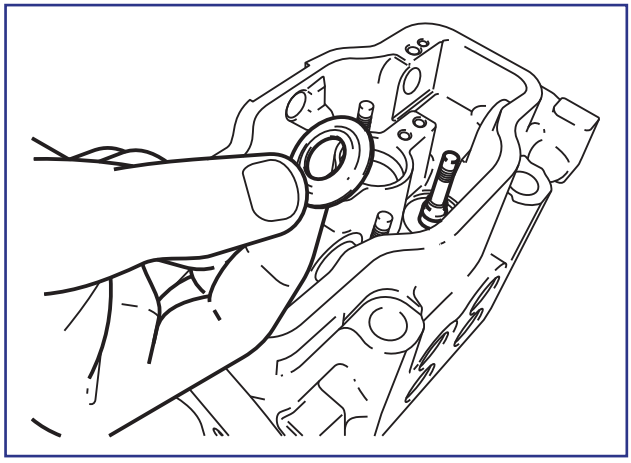


Attention: Do not measure the diameter on the lowered part of the guide.

Install the 4 valves.



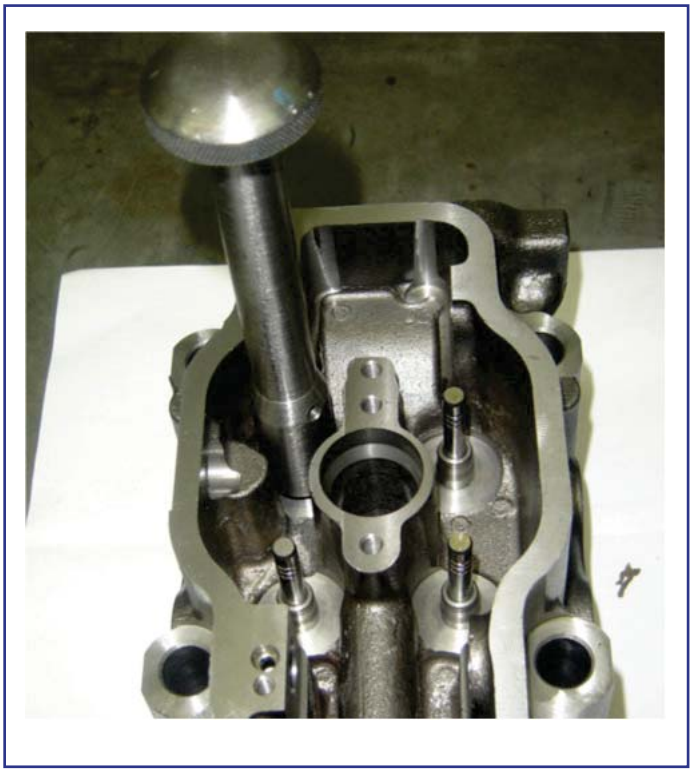
Install the lower spring discs.



Install the special tool No. D7000597C1 to slide the valve retainer.

Put the valve retainers in the shown position.

Using the special tool No. D7000597C1 and its spacer, install the valve retainer in its housing.



2. To adjust the valve cap and rocker arm follow the sequ ence below.
When the engine is cold, turn the crankshaft until cylinder 6 intake and exhaust valves are closed, ensuring that camshaft is not acting the rocker arm that will be adjusted.
In this position check clearance for following valves and respective cylinder.
Cylinder no. 1 is to be counted from flywheel housing side.
Set cylinder no. 6 (damper side) at firing and follow the steps:
Set clearance in valve 3 of cylinder 2
Set clearance in valve 6 of cylinder 3
Set clearance in valve seven of cylinder 4
Set clearance in valve 10 of cylinder 5
Set clearance in valve 11 of cylinder 6
Set valve 12 of cylinder no.6

VALVE ADJUSTMENT	Min.	Max.
Exhaust valve (mm)	0.20	0.40
Intake valve (mm)	0.20	0.40

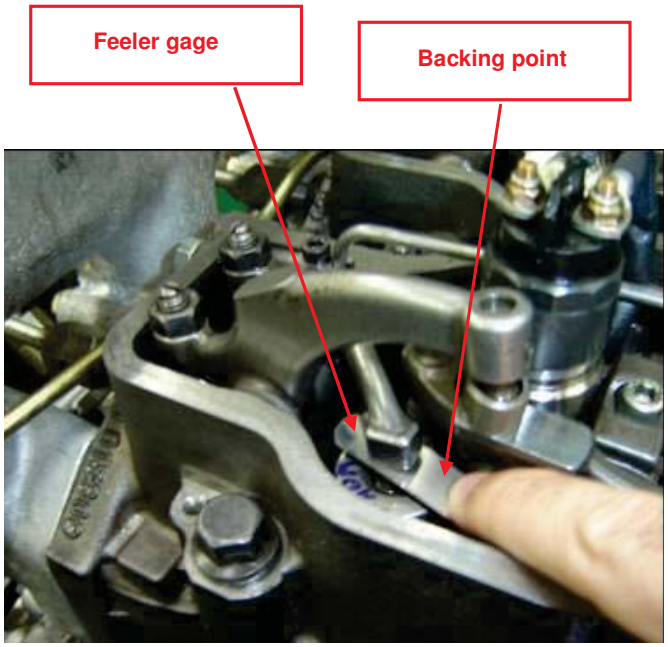


FIGURE 1

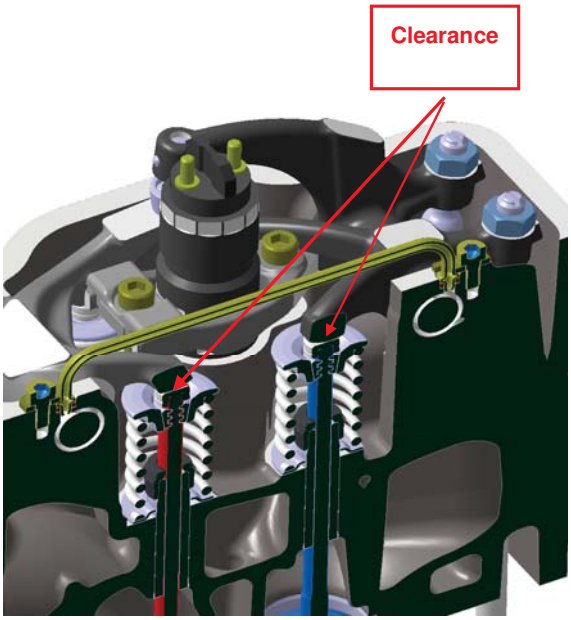


FIGURE 2

FIRING : - CYLINDER No. 6
Set clerance of valves which are circled.

DAMPER SIDE

CYL. 6		CYL. 5		CYL. 4		CYL. 3		CYL. 2		CYL. 1	
IN.	EX.	IN.	EX.	IN.	EX.	IN.	EX.	IN.	EX.	IN.	EX.
(12)	(11)	(10)	9	8	(7)	(6)	5	4	(3)	2	1

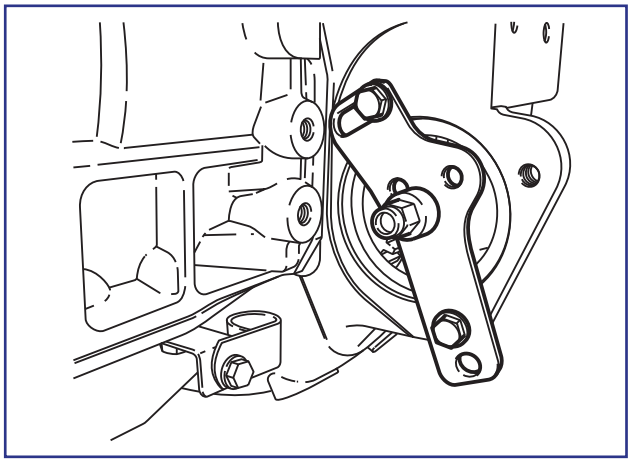
FLYWHEEL HOUSING SIDE

3. With a turnscrew, tighten the adjustment until remove clearances between feeler gauge and both of contact front. (rocker arm and valve cap) Certifying that still can be removed.

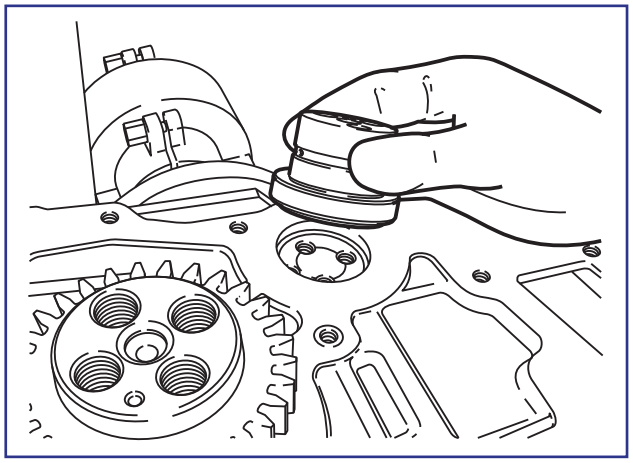
After this operation, tighten with 20 + 6 Nm the adjustment nut.
Note that it is necessary to insert the feeler with fingers for removing any scrub, compressing the analysis just in contact zone between the rocker arm and valve cap .

Assembly

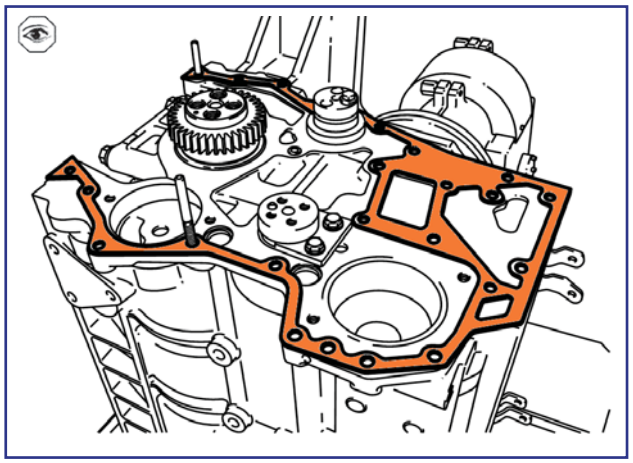
Lock the engine with the special tool No. D7000600C1. With the starter removed install the tool as indicated.



Install the idle bearing without the disk and the thrust ring for a perfect centralization of the intermediary piece.

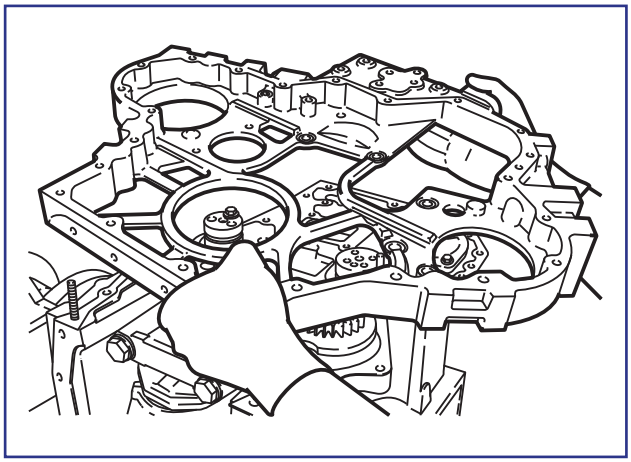


Place the gear housing to block gasket.



Install the gear housing tightening the fixation bolts crosswise according to the specification.

Torque: 25 ± 5 Nm

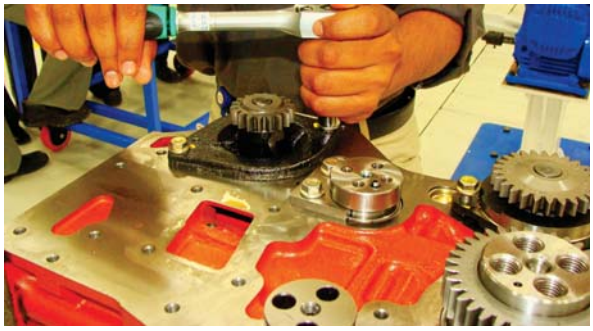


Attention: The centralization of the gear housing is important to guarantee the specified clearances of the distribution gears.

Attention: When removing/installing only water pump, flock the crankshaft and timing gears.

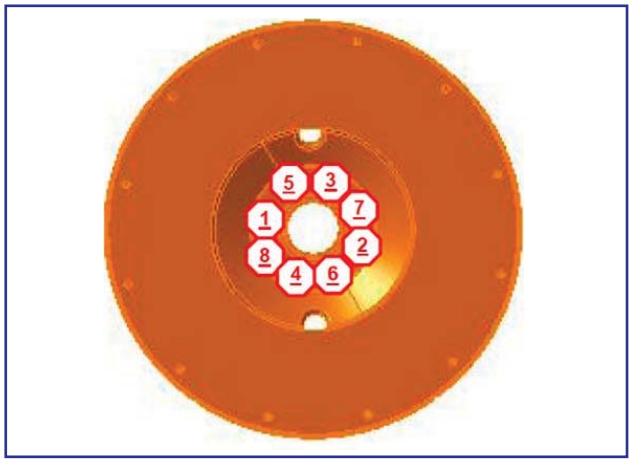
Install the water pump, tightening according to the specification.Take care to do not damage the sealing ring.

Torque: 20 ± 5 Nm



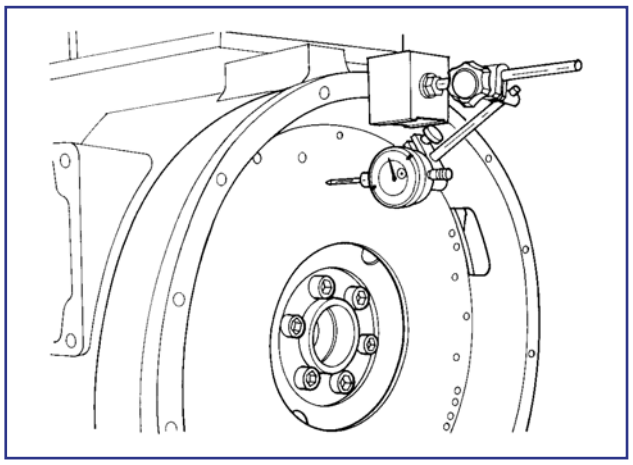
With the engine locked, assembly the flywheel. Tighten the crankshaft fixation bolts according to the specification.

Apply torque: 1st: 90 to 110 Nm
2nd:260 to 290 Nm



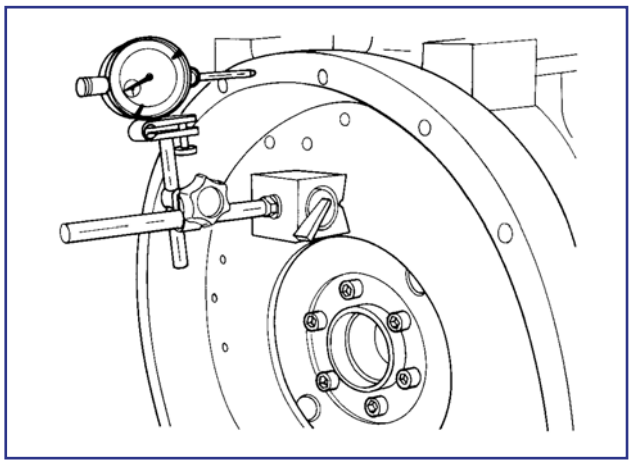
Check the side oscillation of the flywheel.

Maximum side oscillation = 0.30 mm



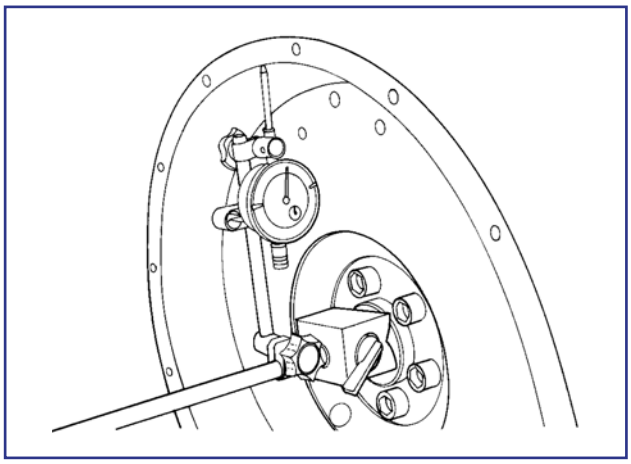
Check the parallelism from flywheel to the housing.

Maximum parallelism = 0.20 mm



Check the concentricity of flywheel to the housing.

Maximum concentricity = 0.20 mm



NOTES

Attention:

- Never perform service on any component of the system while the engine is running.
- Do not smoke while is servicing on the fuel system or any other system of the engine.
- Avoid contact with electric components that may produce sparks.
- Always check tanks, piping, hoses and other components of the fuel system for leakages.

.

- Do not bleed the fuel injection system with the engine in operation. The high pressure in the system can cause serious injuries if disassembled.

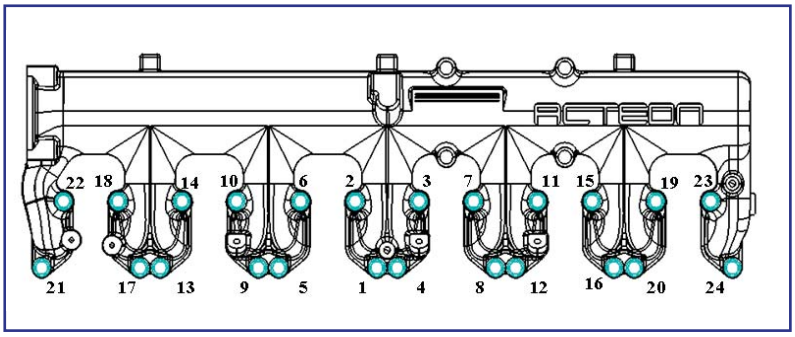
Installation

Caution: To avoid engine damage, do not attempt to grind or machine the intake manifold to compensate for a warped condition.

1. Clean inlet manifold thoroughly with a suitable non-caustic solvent.
2. After cleaning, blow dry using filtered compressed air.
3. Check manifold for cracks and damage. Replace intake manifold as necessary.

ALIGNING INTAKE GASKETS TO MANIFOLD

- Insert an intake manifold bolt into each end of the intake manifold (both top holes).
- Place intake manifold gasket over these two bolts to ensure proper alignment between the manifold and gasket.
- Place all manifold bolts into bolt hole mounting finger tight, in their correct positions.



- Thread intake manifold bolts to the torque value and according to the sequence.

  Torque through 20 ± 3 Nm.

- Assembly the remaining components using the reversal order of removal procedure.

Warning: To avoid serious personal injury, possible death, or damage to the engine or vehicle, read all safety instructions in the “Safety Information” section of this manual.

Warning: To avoid serious personal injury, possible death, or damage to the engine or vehicle, make sure the transmission is in neutral, parking brake is set, and wheels are blocked before doing diagnostic or service procedures on engine or vehicle.

NOTE: For information regarding the removal or installation of adjacent components, refer to the following service procedures located in other sections of this manual:

- Intake Air Elbow
- Water Pipe
- Exhaust Manifold