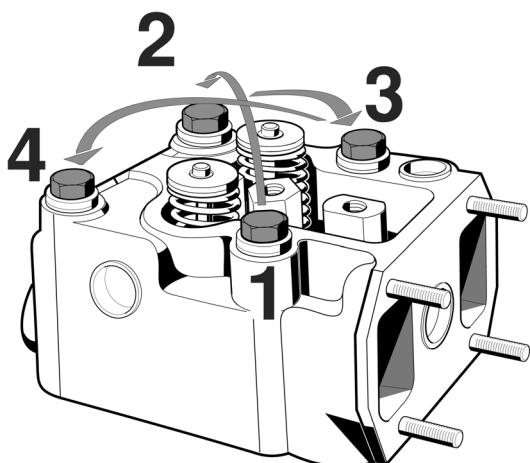


Cylinder Heads

Disassembly Notes	8-2
Valve Seats Specification	8-3
Valves Specification	8-4
Valve Guides Specification	8-5
Specification of Guide Height and Distance to Cylinder Head Surface	8-6
Valves Course	8-7
Rocker Arm, Cold Clearance	8-8
Valves Diagram	8-10
Pre-Assembly Inspections and Measurements	8-11
Bolts Tighten Torques Specifications	8-16
Assembly	8-17
Cylinder Head Gasket	8-20

**Disassembly Notes**

Before loosening the cylinder head fixation bolts, remove valves covers, rocker arms and push rods.



Loosen cylinder head fixation bolts in 3 steps and crosswise.

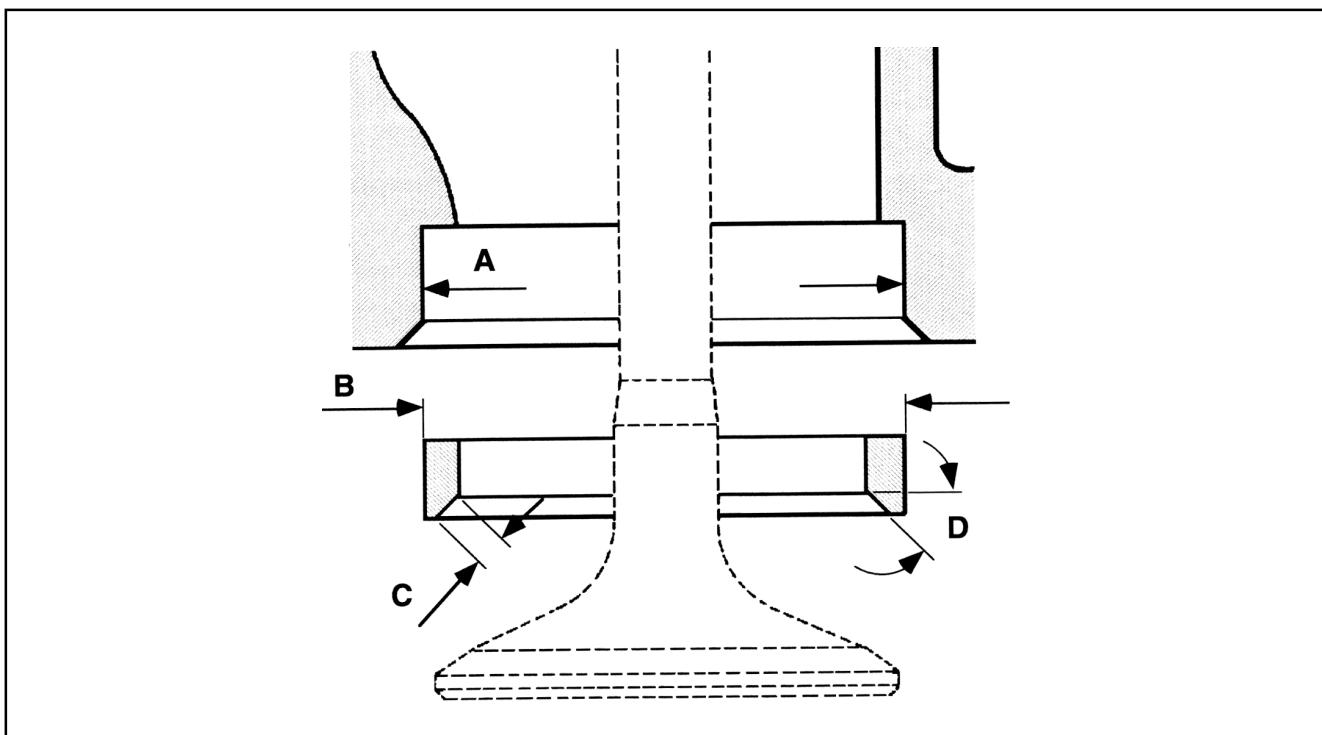
With the aid of the fixation bolts, remove cylinder heads. Remove cylinder head gaskets.



Using the special tool MWM nr. 9.407.0.690.044.6, compress the springs and remove valve locks, removing springs, seal and valves.

To remove valve guides and seats send them to a specialized authorized workshop.

Valve Seats Specification

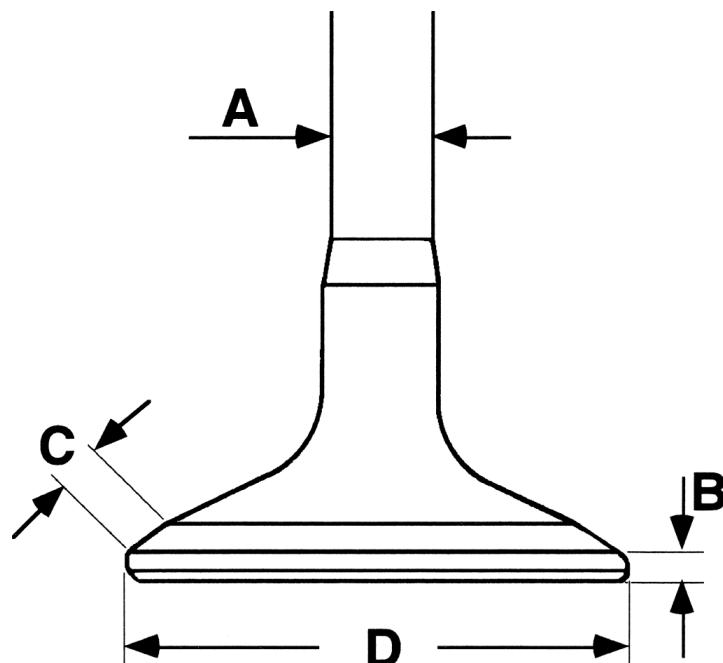


\varnothing (A)	
Housing	(mm)
Standard Intake	46.046 - 46.086
Exhaust	42.976 - 43.016

\varnothing (B)	
Outer	(mm)
Standard Intake	46.152 - 46.168
Exhaust	43.097 - 43.113

\varnothing (C)	
Seat Width	(mm)
Standard	1.90 - 2.00
Intake	2.17 - 2.28
Exhaust	
Maximum	2.80

\varnothing (D)	
Seat Angle	(mm)
Intake	60°
Escape	45°

Valves Specification

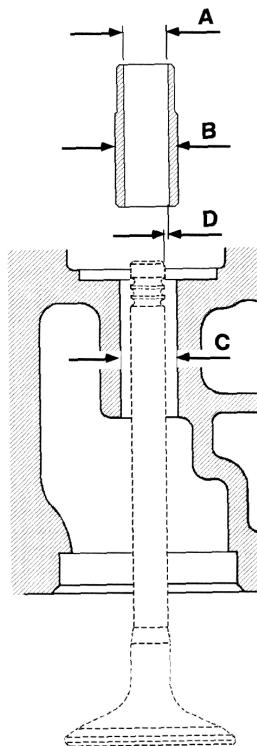
$\varnothing(A)$	
Stem	(mm)
Nominal	8.952 - 8.970
Minimum	8.949

$\varnothing(B)$	
Head height	(mm)
Intake	2.7
Exhaust	2.1

$\varnothing(C)$	
Surface width	(mm)
Intake	3.60
Exhaust	3.11

$\varnothing(D)$	
Head	(mm)
Intake	44.9 - 45.1
Exhaust	40.9 - 41.1

Valve Guides Specification



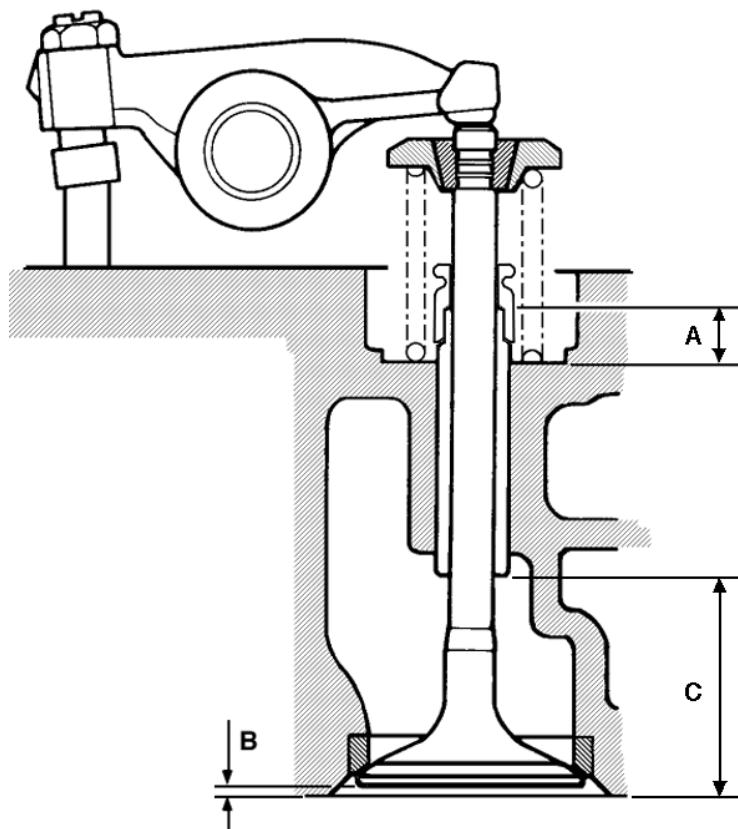
$\varnothing(A)$	
After assembly	(mm)
Nominal	9.000 - 9.022
Repair	9.013 - 9.028
Maximum	9.060

$\varnothing(B)$	
Outer	(mm)
Nominal	15.028 - 15.039

$\varnothing(C)$	
Housing	(mm)
Nominal	14.991 - 15.021

$\varnothing(D)$	
Clearance at the Stem	(mm)
Nominal	0.030 - 0.070
Maximum	0.111

Specification of Guide Height and Distance to Cylinder Head Surface

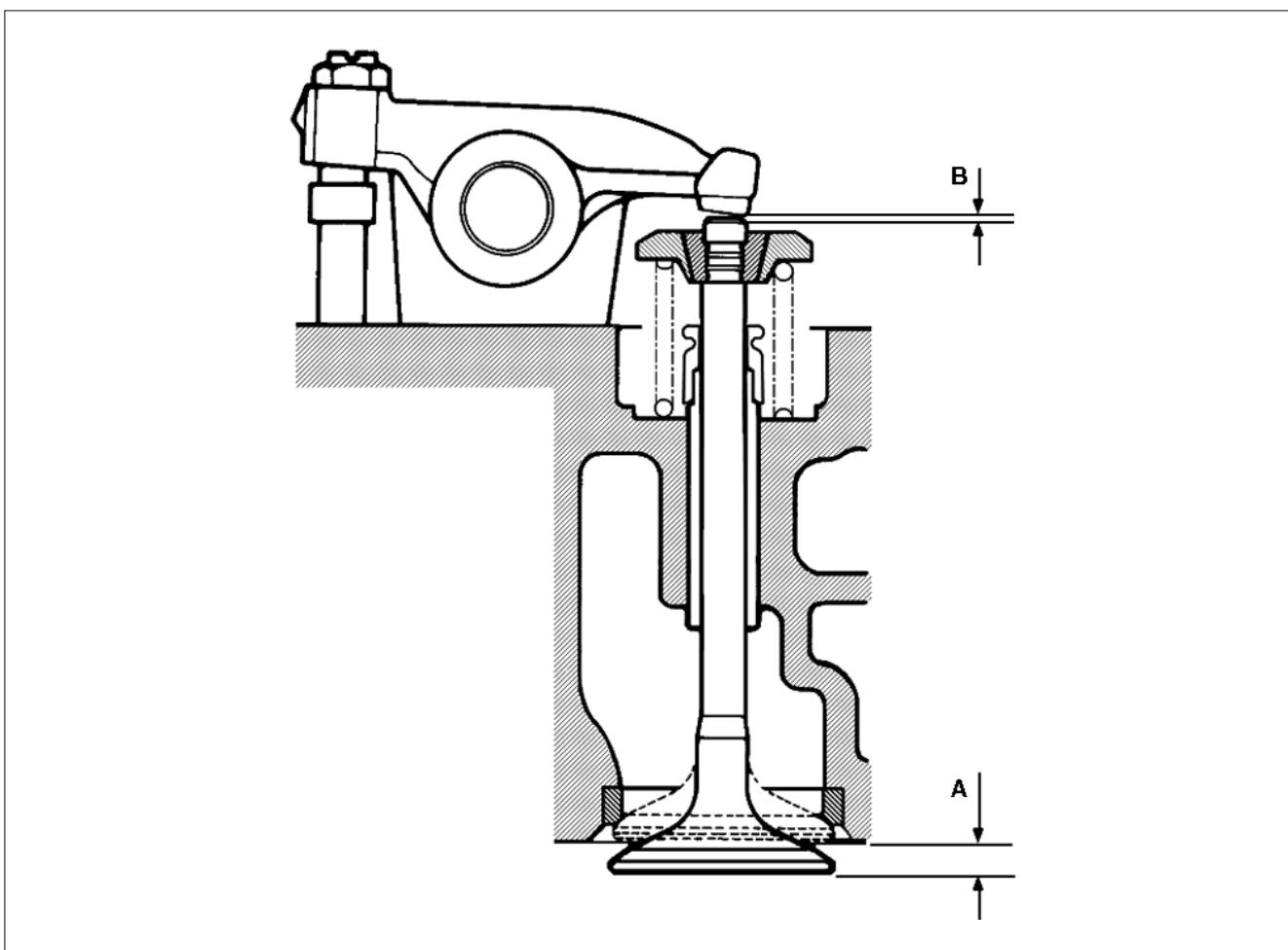


Guide Height (A)	(mm)
Intake and Exhaust	11.3 - 12.6

Distance to cylinder head surface (B)	(mm)
Nominal	
Intake	0.8 - 1.1
Exhaust	1.30 - 1.60
Maximum	
Intake	1.35
Exhaust	1.85

Guide height to cylinder head face (C)	(mm)
Intake and Exhaust	45.0

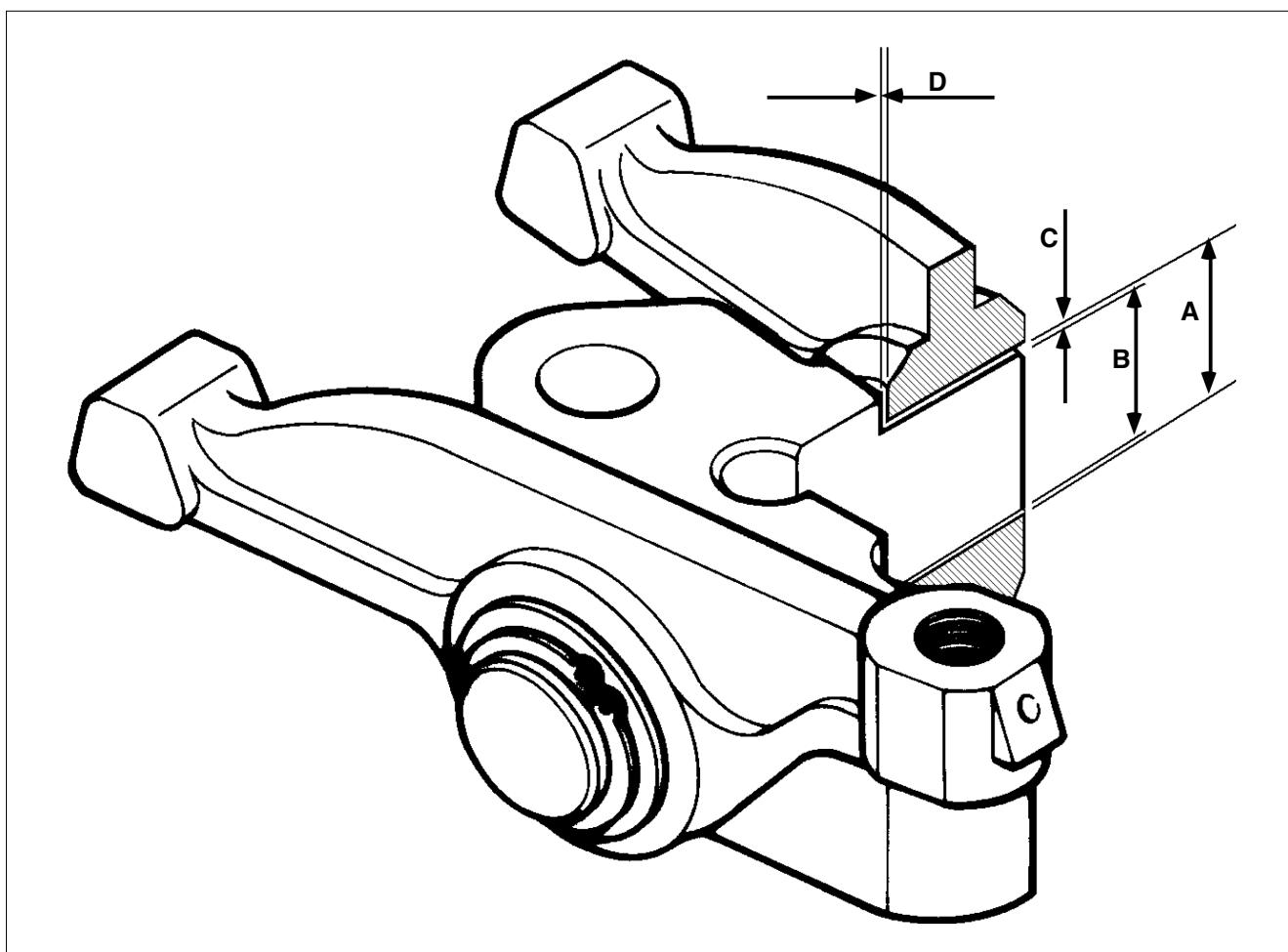
Valves Course and Clearance



\emptyset (A)	
Course	(mm)
Intake	11.10 - 11.34
Exhaust	11.22 - 11.46

\emptyset (B)	
Clearance	(mm)
Intake	0.40
Exhaust	

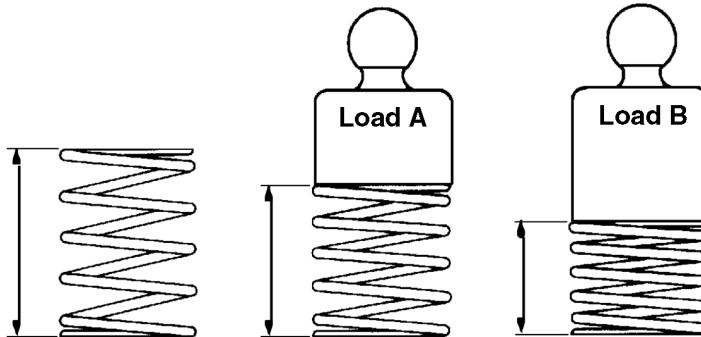
Rocker arm, Cold Clearance



Diameters	mm
Rocker arm (A)	16.000 - 16.018
Shaft (B)	15.966 - 15.984

Clearance	mm
Radial (C)	0.016 - 0.052
Axial (D)	0.050 - 0.260

The test is performed placing the springs on a special device and reading the closing force for two different deflections according to the following table. The intake valves springs are single (only one spring) and exhaust valves springs are double.



Intake valve spring and outer exhaust valve spring				Exhaust valve inner spring			
Ø wire		3,50 mm		Ø wire		2,50 mm	
Load	(Kgf)	Length	(mm)	Load	(Kgf)	Length	(mm)
A	0,0 35.78 ± 18	71.50 38.47		A	0,0 9.95 ± 6.6	54.59 36.25	
B	47.53 ± 23	27.65		B	15.24 ± 7.1	26.50	

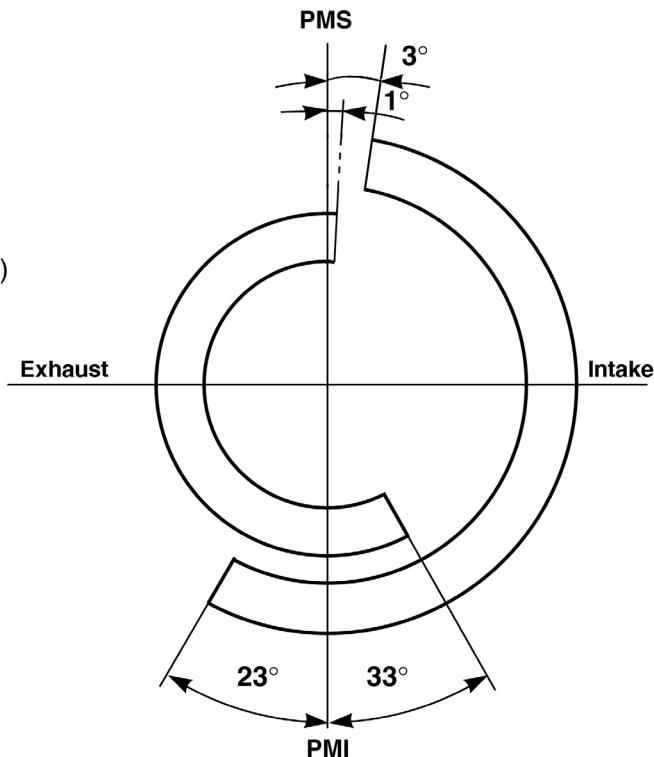


Special device for spring measurement.

Valves Diagram

Valves clearance: 1 mm
(After the check, readjust the clearance to 0.40 mm)

Intake: Open 3° after TDC
Close 23° after PMI
Exhaust: Open 33° before PMI
Close 1° after TDC
Tolerance: ± 3°





Pre-Assembly 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 waste and if the lubrication hole is not obstructed. Check if the push rods are not warped.



Cylinder heads surfaces must never be machined.

Cylinder heads



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.***



Measure valve guide housing bore.



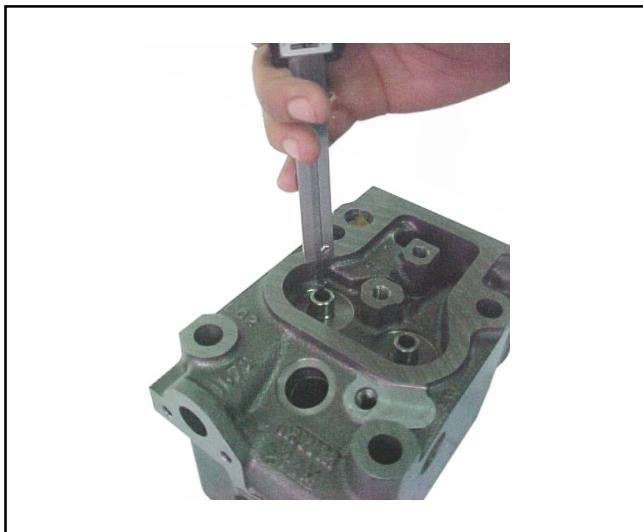
After the measurements, install valve guides with the special tool MWM nr. 9.610.0.690.014.6.



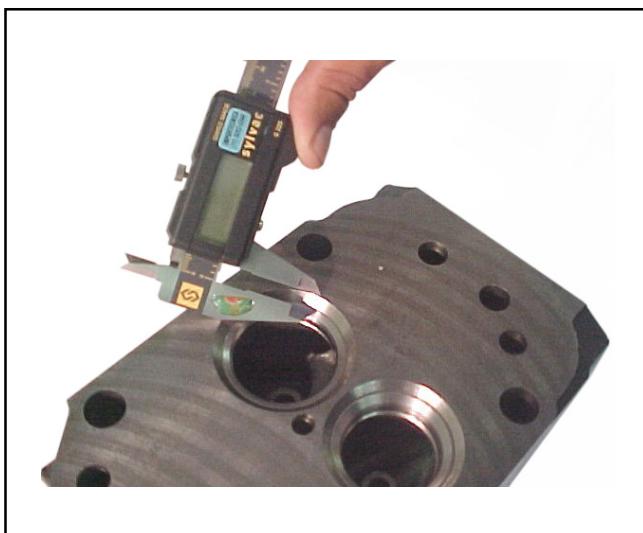
Measure the bore of the assembled valve guide.

Cylinder heads

8 - 14



Measure the width of the valve contact surface.



Measure the valve guide height in relation to the cylinder head.



Measure the width of the valves seat.



Check if the rocker arm ends do not present excessive waste or cracks in the shaft housing or on the contact area with the valve stem. After removing the rocker arms, check for grip signs.



Measure the rocker arm shaft, roundness and taper.

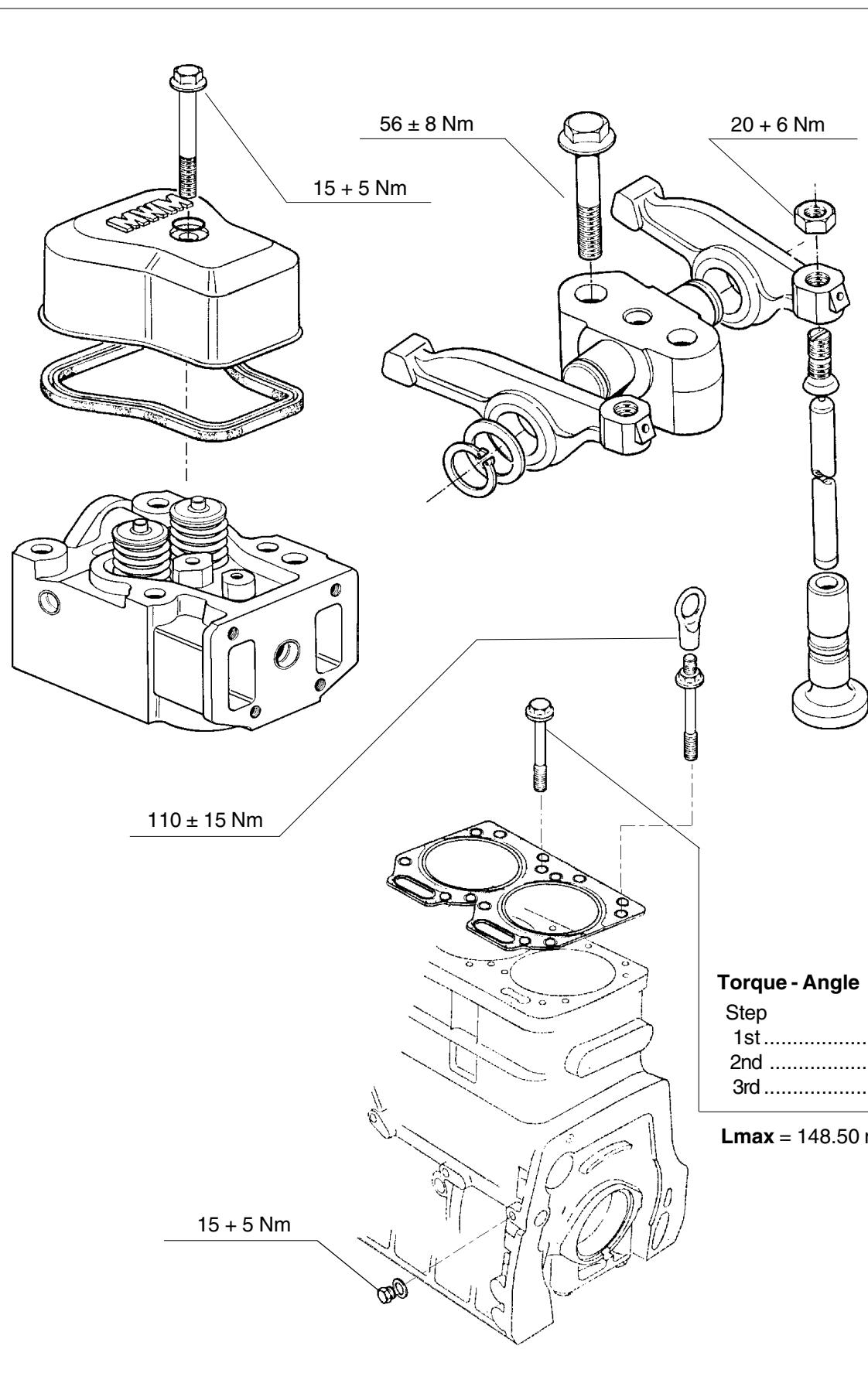


Check using the micrometer.



Measure the shaft housing bore.

Check rocker arms ends axial clearance in the shafts and deformities like roundness and taper.

Bolts Tighten Torques Specifications


Remark

- *Before beginning the assembly of the cylinder head set, all parts must be well clean.*

**Assembly**

Make the seat of the valves on the respective seats (new seats are provided semi finished). Make sure if the seat obtained between the valve and seat is uniform.



Install springs plates.



Install valves seals on the guides with the special tool MWM nr. 9.610.0.690.015.4.



Oil and install valves and springs in cylinder head. With the special device MWM nr. 9.407.0.690.044.6, compress the springs and assembly the valves locks.



Install a dial indicator gauge in the special measurement device MWM nr. 9.407.0.690.031.6 and reset on the flat surface of the cylinder head.

Measure the height difference between valves and cylinder head surfaces.

Cylinder heads

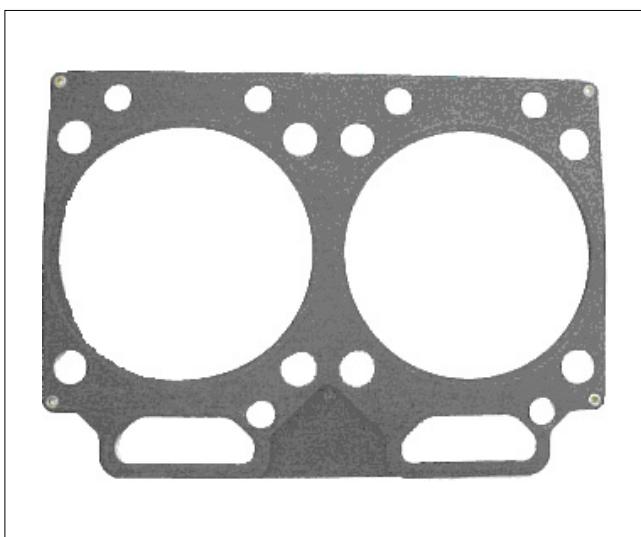


Install the guide-pins for cylinder heads assembly MWM nr. 9.407.0.690.030.4 in the place of two diametrically opposite bolts. Install cylinder head gasket with the "TOP" mark upward.

The cylinder head gasket must be perfectly clean and must never be assembled with grease, oil or glue. Assembly cylinder head on gasket, with the guide-pins installed.



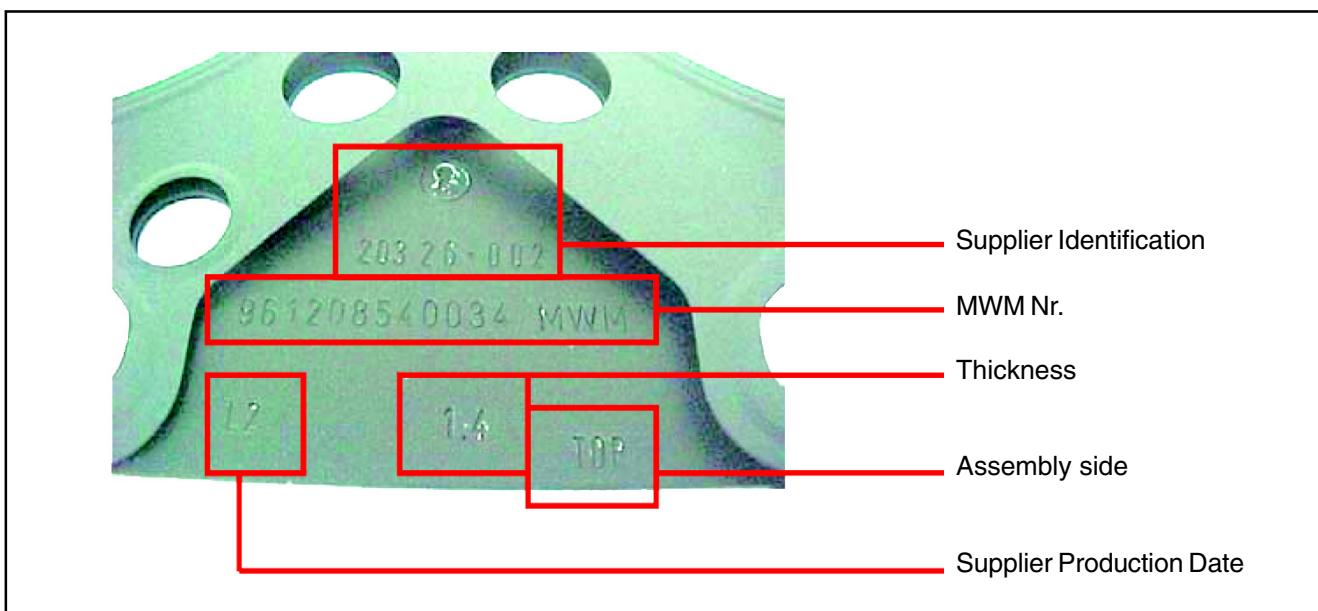
Install cylinder heads.



Cylinder Head Gasket

The cylinder head gasket is made of steel and its main characteristic is its double assembly, that is to say, for two cylinder heads.

Gasket Identification



⚠ Attention

- ***Use only MWM genuine gaskets.***
- ***The thickness of the cylinder head gasket for replacement is only of 1.4 mm.***

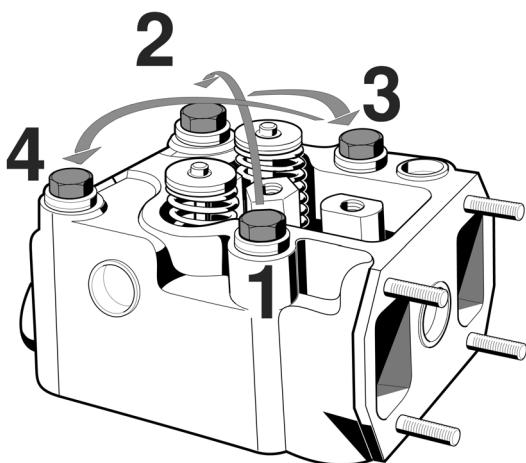
Cylinder heads

Measure cylinder heads fixation bolts length.

Discard bolts longer than 148.50 mm.

Install cylinder head fixation bolts without tighten.
Perform the alignment of the cylinder heads with the help of the intake manifold.

Assembly intake manifold with gaskets and tighten manifold fixation bolts according to the specification.



With the cylinder heads aligned by the intake manifold, tighten the fixation bolts of the cylinder head crosswise according to the sequence indicated and in 3 progressive steps according the specification.

Torque - angle:

1st) 60 + 10 Nm

2nd) 60° ± 3°

3rd) 60° ± 3°





Install rocker arms set assembled, tightening according to the specification.



Install pushrods checking their correct seat on the tappets.

⚠ Attention

- ***Totally unscrew the valve clearance adjustment screw before installing the rocker arms.***

Cylinder heads



Adjust valves clearances. Position the last cylinder in swinging and adjust the valves of the first cylinder. A cylinder is swinging when, turning the crankshaft, the intake and exhaust push rods move simultaneously.

To adjust valves clearance, use a shim with the specified measure between the rocker arm and the valve. The clearance is correct when the shim slightly drags between valve and rocker arm.

Screw the adjustment screw to reach the specified clearance. Tighten the lock nut with the specified torque.

Cold clearance (Intake and Exhaust) = 0.40 mm.

Continue the adjustment following the engine firing order, turning the engine in the rotation sense (anticlockwise seen by the flywheel side or water pump gear) approximately 180° (4 cylinders engine) and 120° (6 cylinders engine), according to the table below.

	4 Cylinders	6 Cylinders
To swing	4 2 1 3	6 2 4 1 5 3
To adjust	1 3 4 2	1 5 3 6 2 4



Oil all the mobile parts of the cylinder head and assembly valves covers, tightening according the specification.

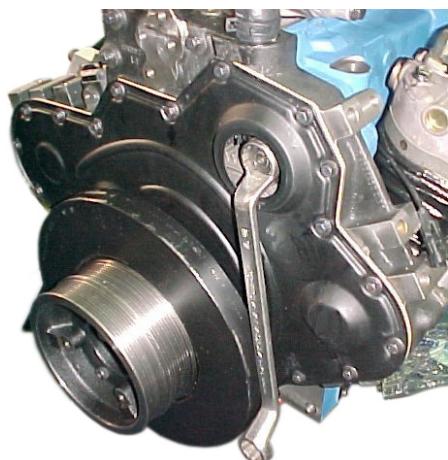
When operating the engine, visually check the cylinder heads and valves covers for leaks.

Gearing Carcass

Disassembly Notes	9-2
Inspections and Measurements	9-3
Specifications	9-3
Gears Backlashes and Clearances Specification	9-6
Bolts Tighten Torques Specification	9-7
Assembly	9-11

Gearing Carcass**Disassembly Notes**

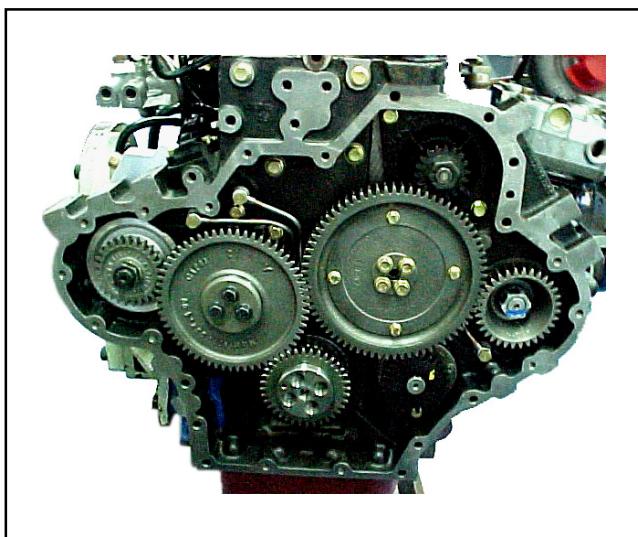
Before disassembling the pulley, lock the flywheel with the special tool MWM nr. 9.610.0.690.026.4.



The engine can be also locked with a lever positioned on the nut of the water pump gear, until that the lever touches the pulley. This way, the crankshaft will stay locked making possible the loosening of the crankshaft pulley bolts.



Loosen the bolts of the crankshaft pulley.
Remove the pulley and damper set.



Inspections and Measurements

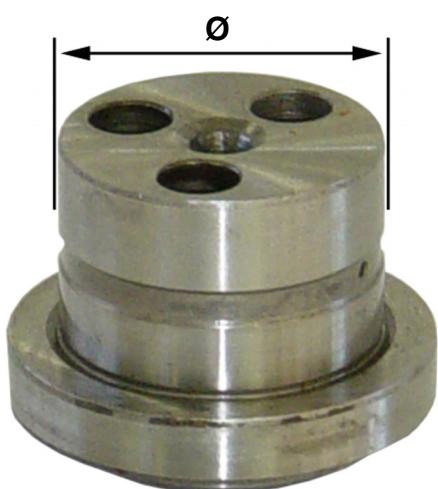
Visually check damper and pulley(s).

Visually check gears. Check for waste signs or cracks on the base of the teeth.

Presenting such as those defects, the gears must be replaced.

Measure the components of the gearing carcass according to the following illustration:

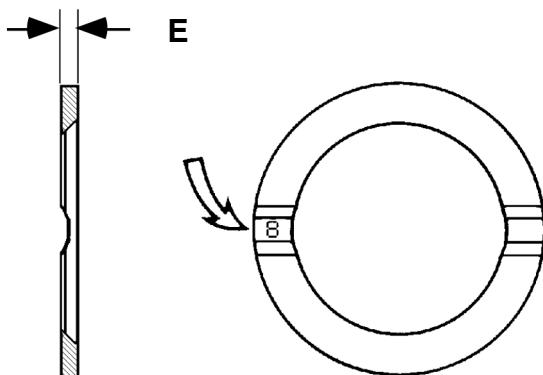
Specifications



Idle gear bearing	
Measurements	mm
Ø nominal	44.995 - 45.011
Gear clearances	mm
Radial	0.013 - 0.075
Axial	0.06 - 0.14

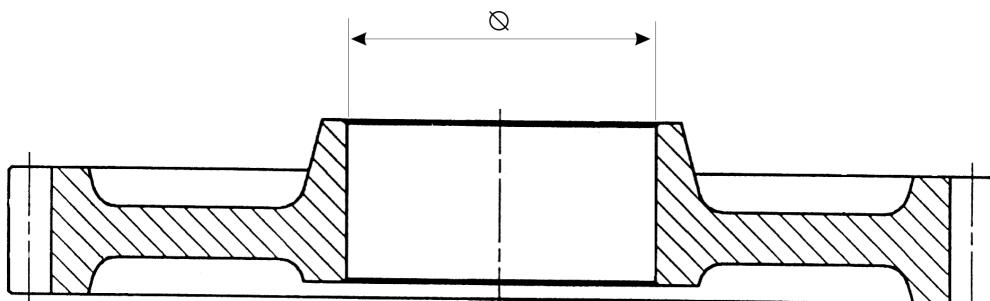
Gearing Carcass

Specifications

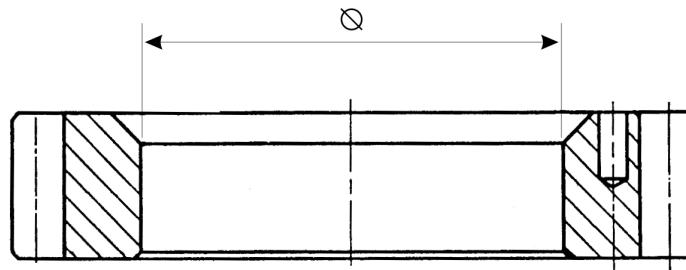


Thrust ring	
E (mm)	MWM nr.
3.46 - 3.48	9.610.0.433.004.4
3.51 - 3.53	9.610.0.433.005.4
3.57 - 3.59	9.610.0.433.006.4

Idle gear	
Ø furo	mm
Without bushing	50.000 - 50.015
With bushing	45.024 - 45.070
Quantity of teeth	61

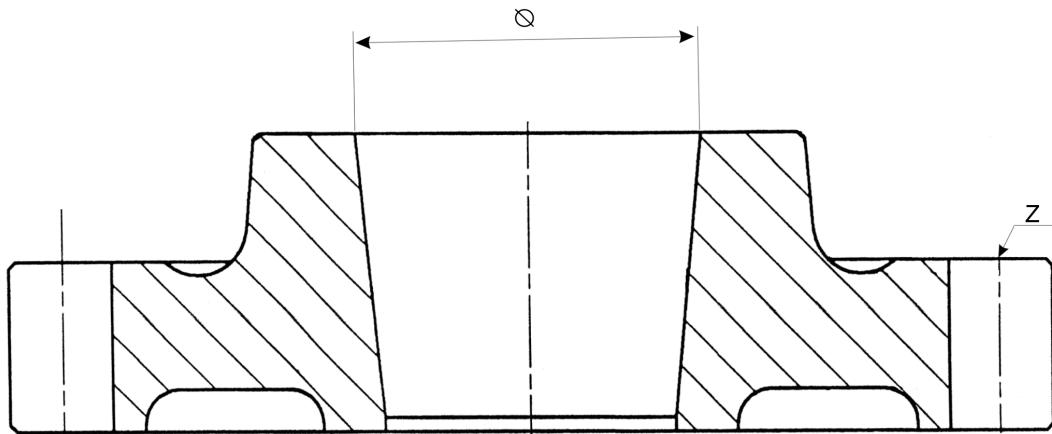


Crankshaft front gear	
Ø hole mm	60.000 - 60.025
quantity of teeth	36

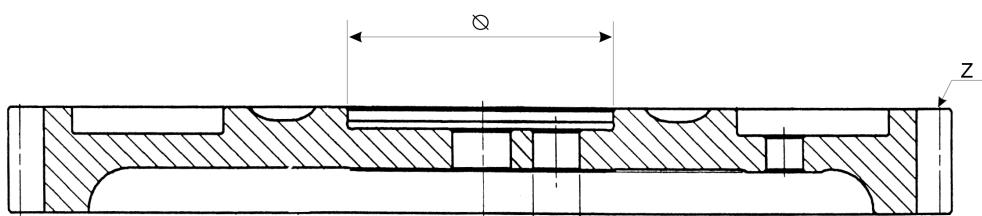


Specifications**High pressure pump gear**

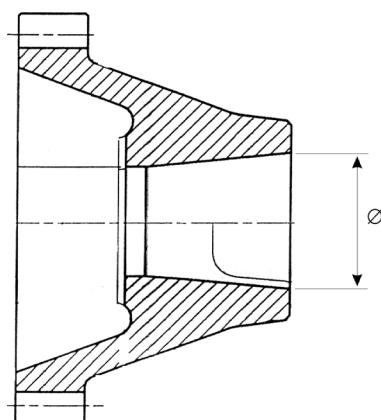
Ø hole mm quantity of teeth	20.000 - 20.033 27
--------------------------------	-----------------------

**Camshaft gear**

Ø hole mm quantity of teeth	52.00 - 52.03 72
--------------------------------	---------------------

**Air compressor gear**

Ø hole mm quantity of teeth	30.00 - 30.033 32
--------------------------------	----------------------

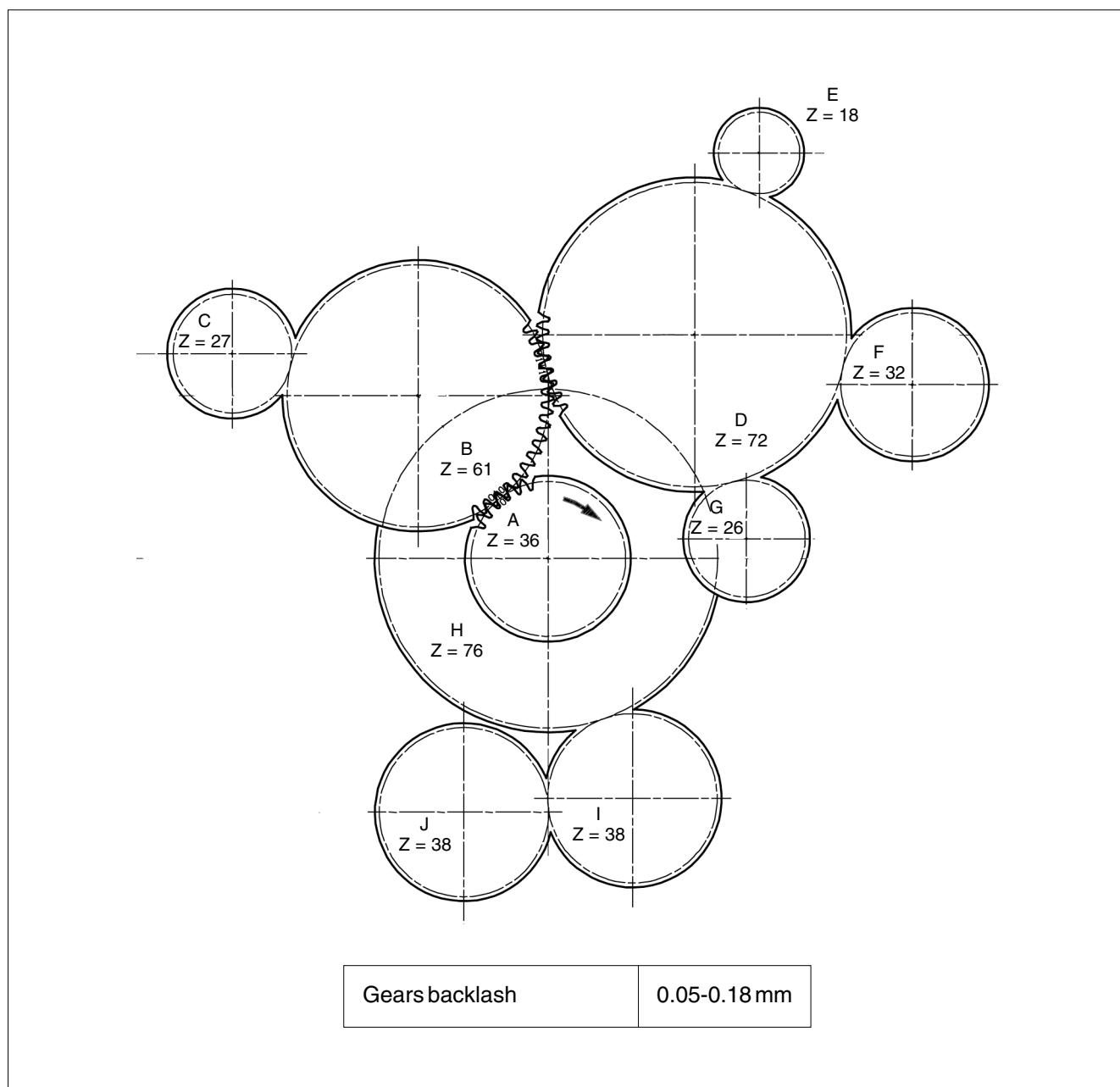


Gearing Carcass

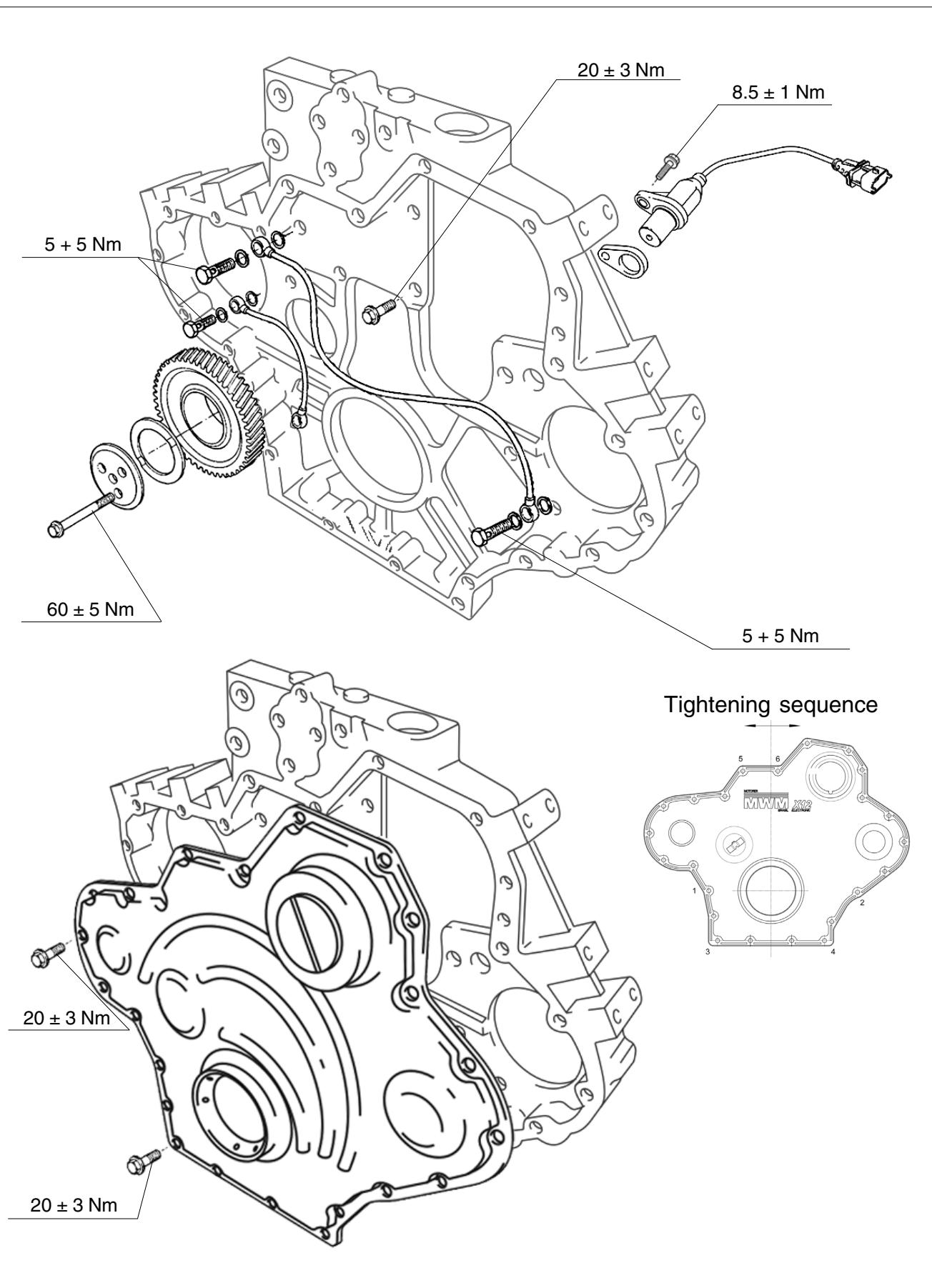
Gears clearances specification

ID	DENOMINATION
A	Crankshaft gear
B	Idle gear
C	High pressure fuel pump gear
D	Camshaft gear
E	Water pump gear
F	Air compressor gear
G	Oil pump gear
H	Balancer unit driving gear (*)
I/J	Balancer unit gears (*)

* For 4.12 engines

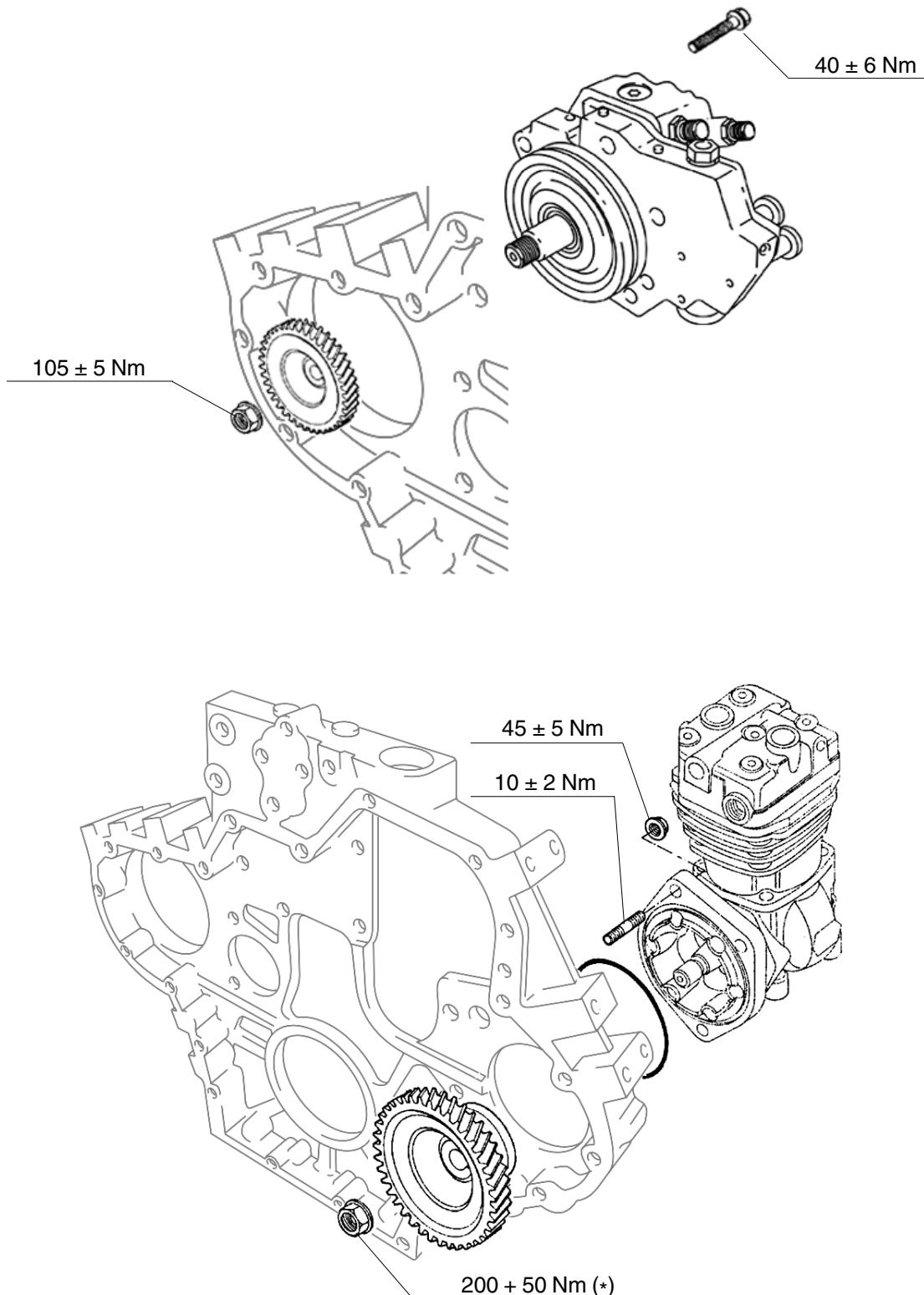


Bolts Tightening Torques Specification

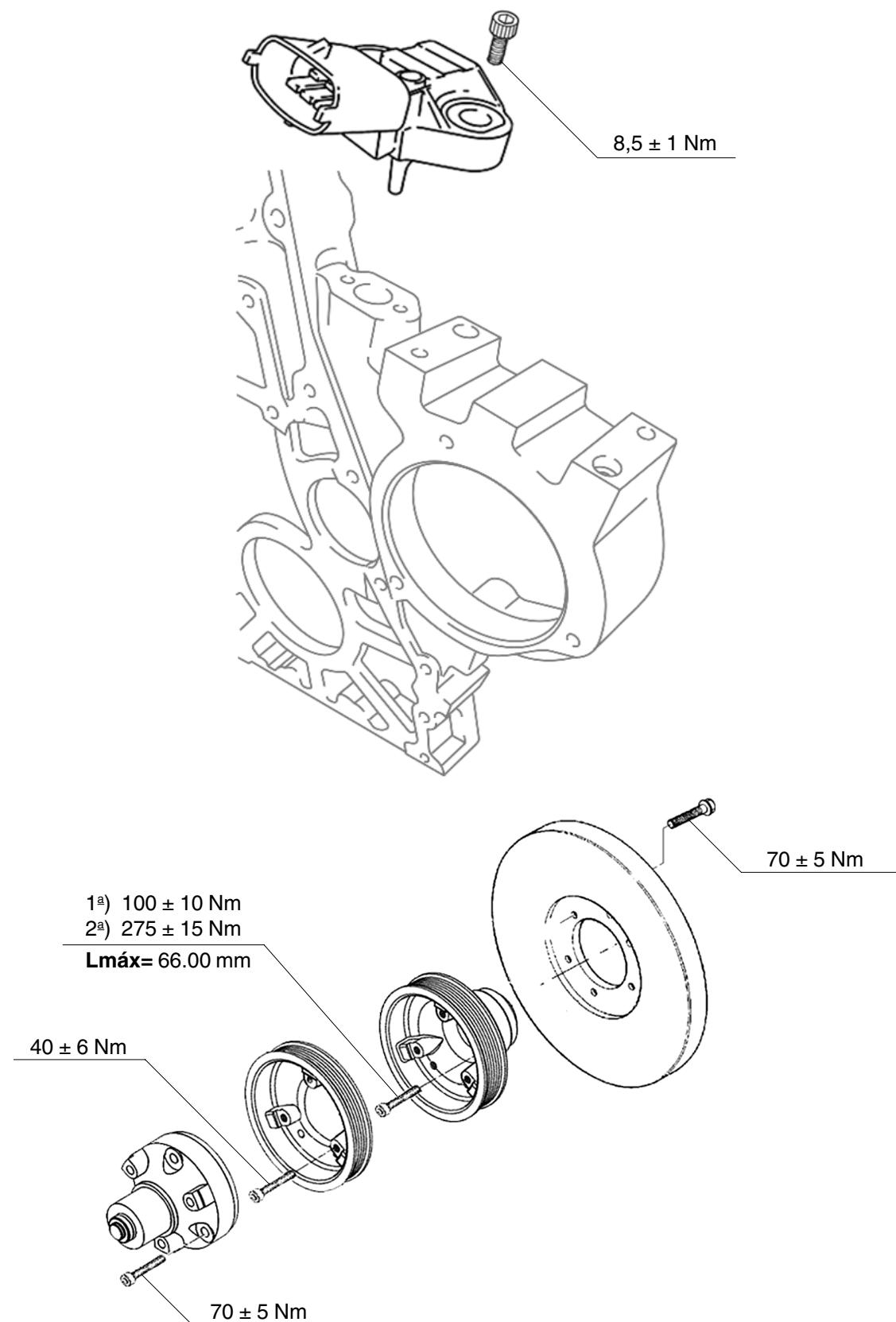


Gearing Carcass

Bolts Tightening Torques Specification

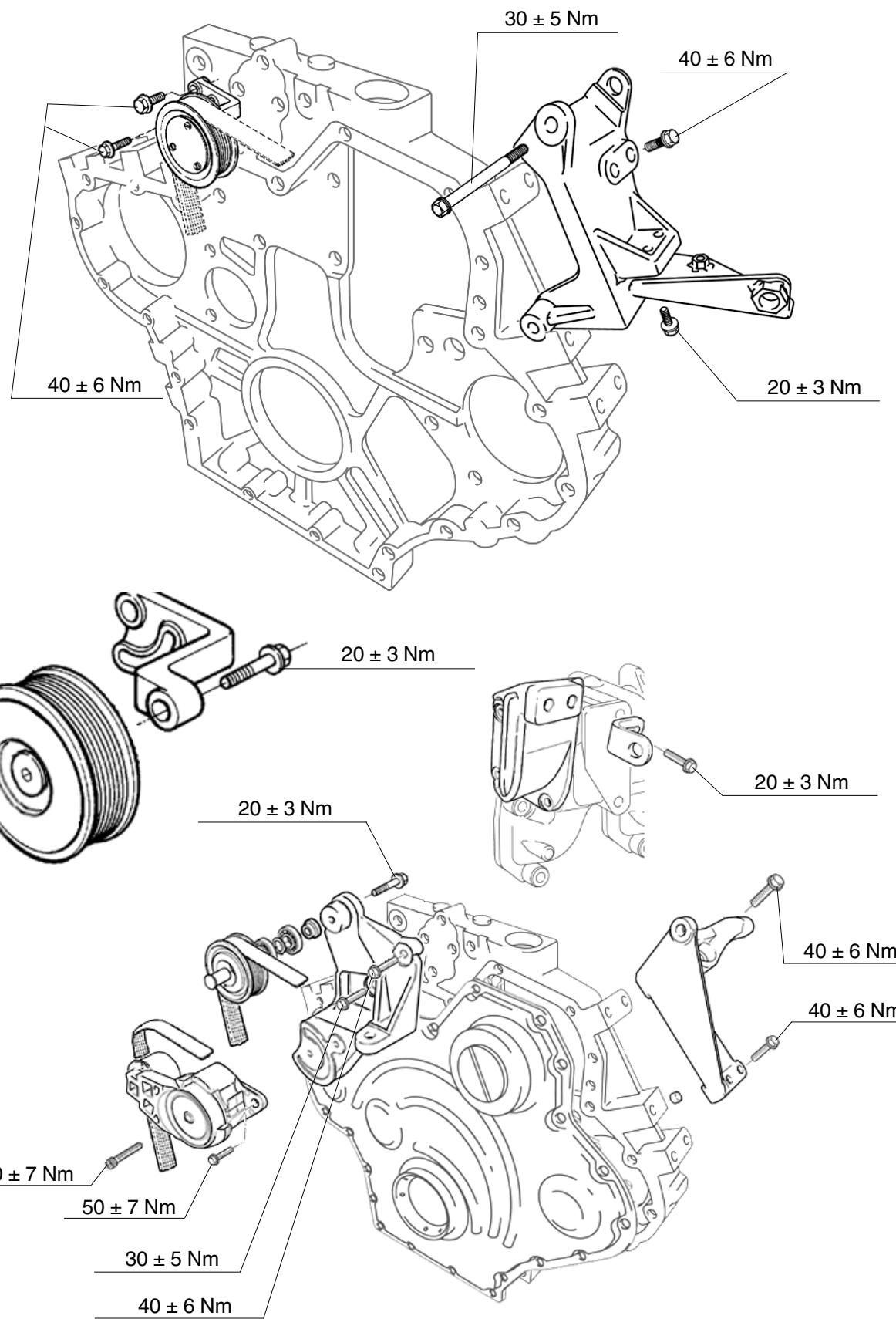


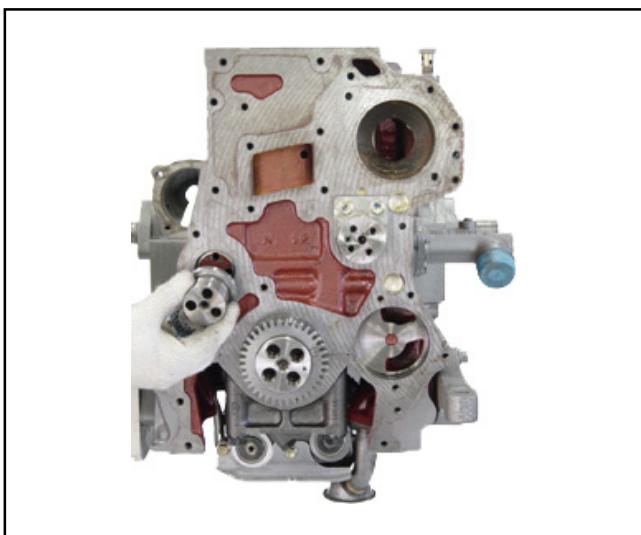
(*) Coincide hole for cotter pin

Bolts Tightening Torques Specification

Gearing Carcass

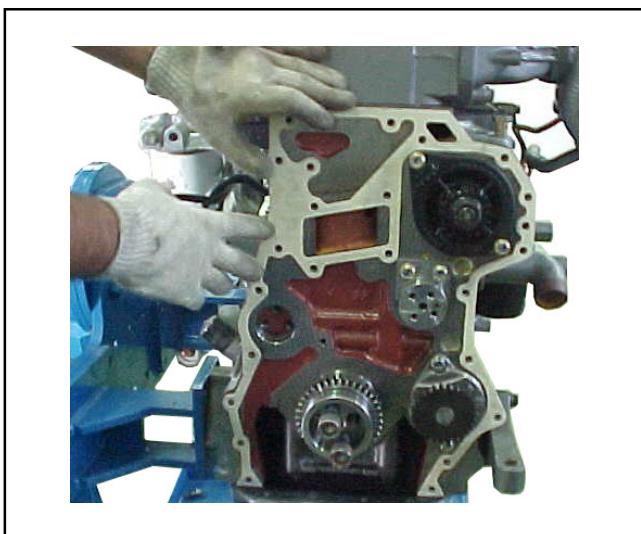
Bolts Tightening Torques Specification



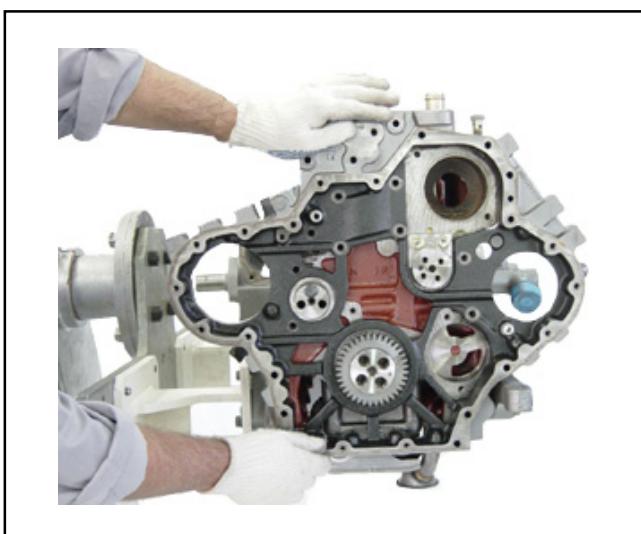


Assembly

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



Assembly the gasket.



Install the intermediary piece tightening the fixation bolts crosswise according to the specification.

⚠ Attention

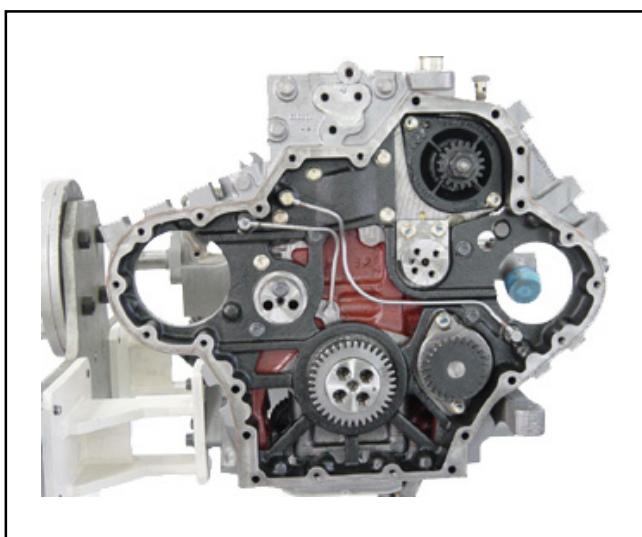
- The centralization of the intermediary piece is important to guarantee the specified clearances of the distribution gears.*



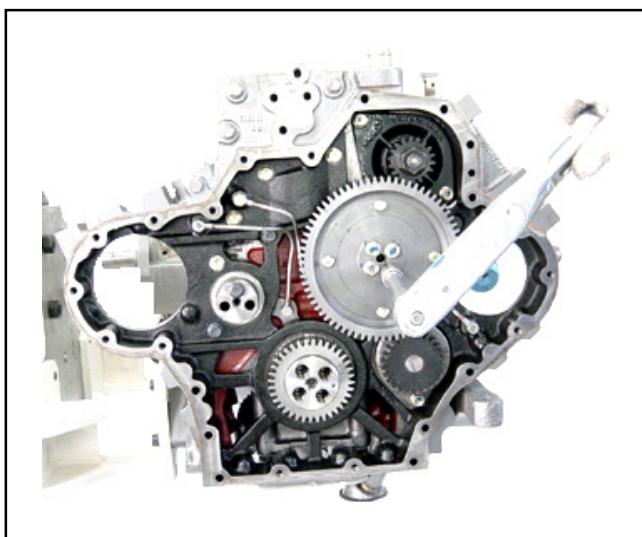
Install water pump, tightening according to the specification. Take care to do not damage the sealing ring.



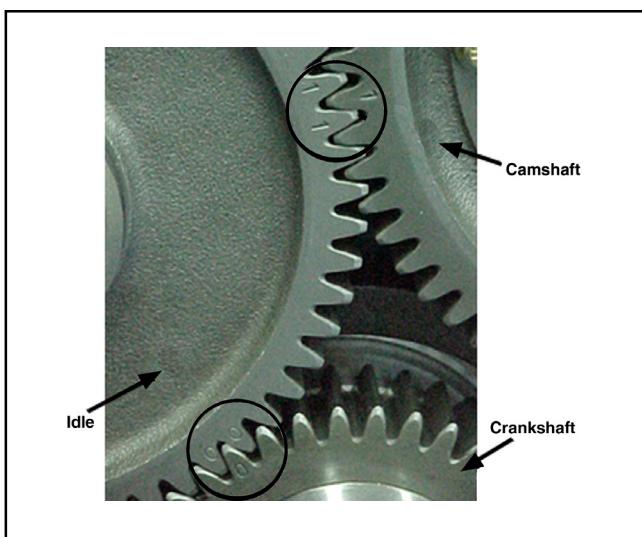
Install lubricant oil pump tightening according to the specification. Take care to do not damage the sealing ring.



Install lubrication pipes tightening according to the specification.

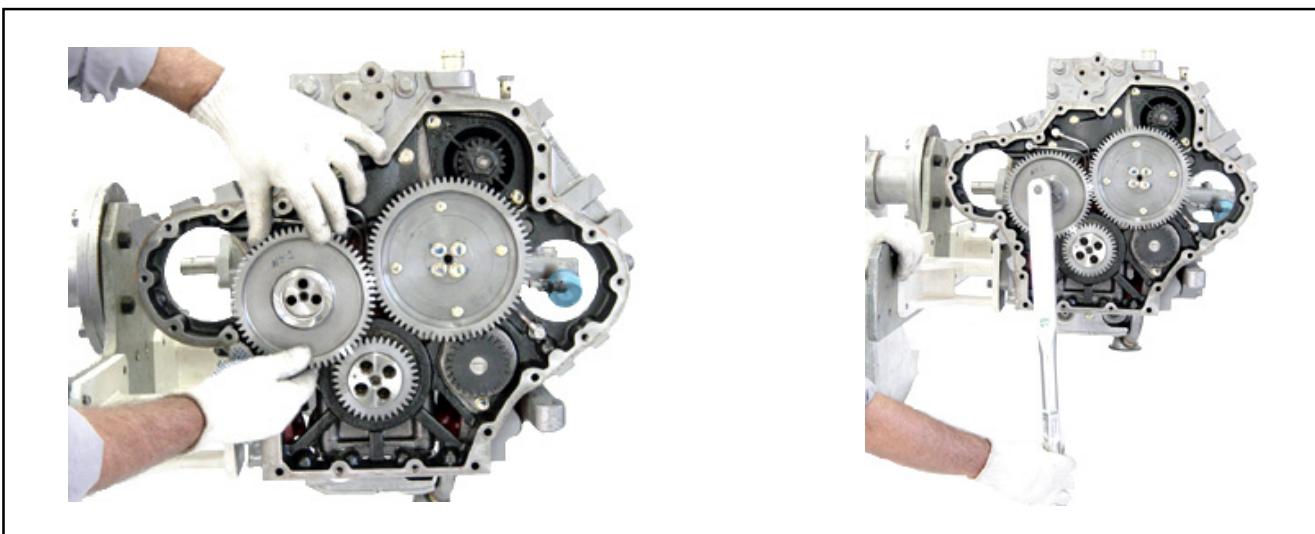


Assembly camshaft gear and tighten the bolts according to the specification.



Detail of the gears timing demarcations.

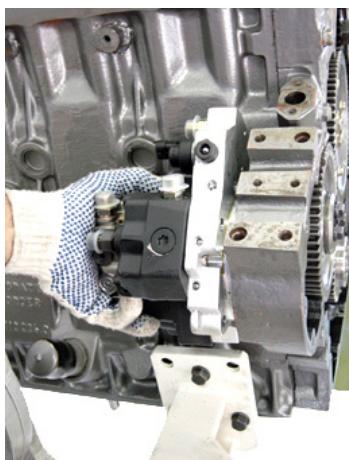
Assembly the idle gear.



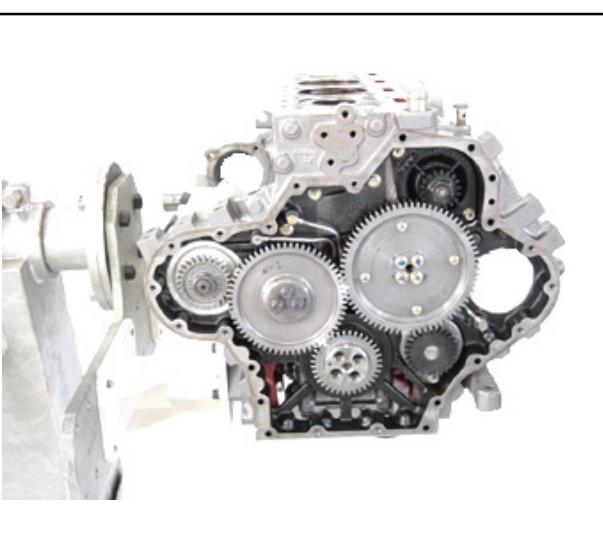
Remove the bolts of the idle bearing and install the thrust ring of the idle gear. The two grooves must stay towards the side of the shaft. There are 3 different thickness of thrust ring in order to guarantee the axial clearance of the idle gear.



Tighten all fixation bolts of the gears with the specified torques.



Install high pressure pump.



View of the assembled gears set.

⚠ Attention

- *During the engine operation there must not be gearing noise.*
- *A noisy operation indicates too much clearance between gears or teeth excessive waste.*



Assembly the front cover of the carcass with a new sealing gasket.

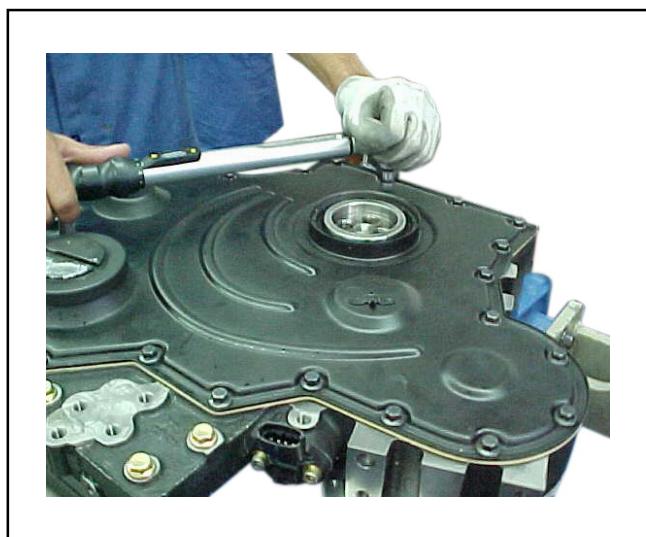


Centre the front cover with the special tool MWM nr. 9.610.0.690.019.6.

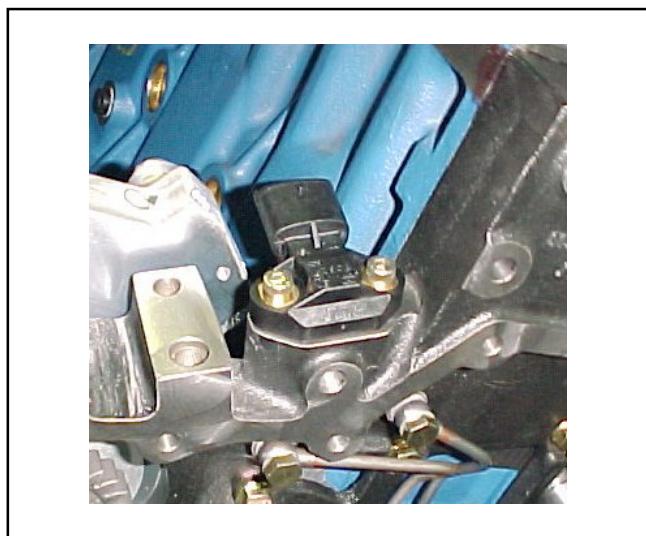
Place the bolts without tightening to allow the movement of the cover.



Install the crankshaft seal with the special tool MWM nr. 9.610.0.690.019.6.



Tighten the fixation bolts of the front cover.



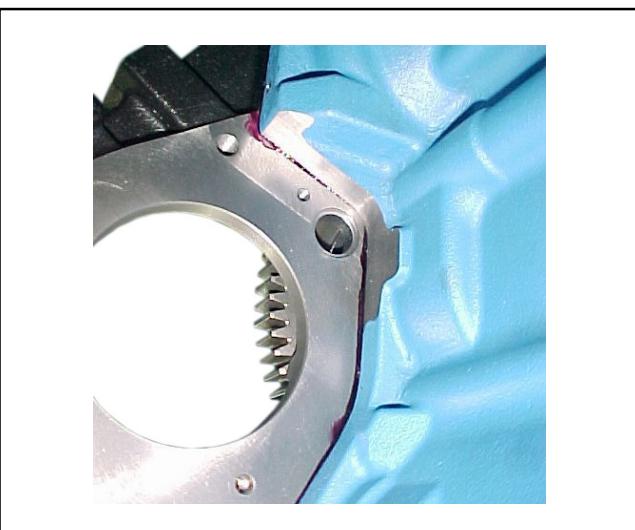
Assembly the temperature and oil pressure sensor.
Apply the specified torque.

Gearing Carcass

Lock the engine with the special tool on the flywheel.



Assembly the front pulley with the damper. Tighten the bolts crosswise with the specified torque.



Check the housing of the camshaft phase sensor. Clean it if necessary.



Assembly the adapter, then the sensor of phase and apply the specified torque.



Before assembling the air compressor, put on a layer of Vaseline on the o-ring area in order to facilitate the assembly.



Assembly the compressor and apply the specified torque.

NOTES