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REPAIR MANUAL

• ENGINES

- Engine 2492 cm^3 (code AR 67301)


GROUP 01 - ENGINE MAIN MECHANICAL UNIT


GROUP 04 - FUEL SYSTEM


GROUP 05 - ENGINE IGNITION, STARTING AND CHARGING


GROUP 07 - ENGINE COOLING SYSTEM

GROUP 01

ENGINE

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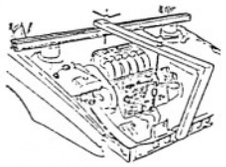

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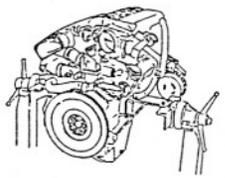

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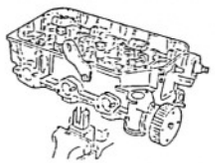

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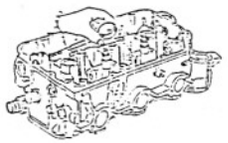

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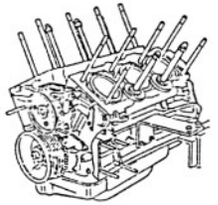

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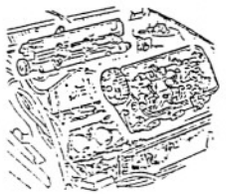


ENGINE

GENERALITIES

The engine is of the six 60° V mounted cylinder type in light alloy and has a total cubic capacity of **2492 cm^3** with static ignition and injection controlled by a single BOSCH MOTRONIC M 1.7 control unit.
From a dynamic point of view the "V" arrangement and the 60° angle make the engine extremely compact and well balanced.
With a piston stroke of **68,3 mm** and a bore of **88 mm**, the engine is of the super square type (stroke and bore ratio lower than 1), which permits a better arrangement of the valves and an optimal filling of the cylinders (high volumetric ratio).
The clutch-gearbox-transmission assembly is connected towards the rear of the engine and forms and integral part of the engine.
The engine is installed in the front of the vehicle and is arranged transversally with a 14° inclination forwards. It is supported by "suspended" type attachments and fixed to the body by two supports with flexible damping and to the suspension cross member by a third.
To reduce the shaking of the engine to a minimum, a retaining rod is mounted on the body.
The engine described below conforms to the "USA 83" exhaust emissions limits.

STRUCTURE

Engine block:

a single block in light aluminium and silicon alloy with high mechanical resistance and thermal conductivity.
The crankshaft is supported by five main supports.
Grooves in the wall of the engine block permit the passage of the cooling liquid and oil.
Jets which spray oil to cool the pistons are located at the base of the cylinders.

Cylinder liners:

these, in cast iron, are of the low-slung type and are directly reached fromthe outside by the cooling liquid for a more rational heat dissipation (humid).
The dimensions of the cylinder liners permits the gas to be contained and avoids deformation.
The cylinder liners are already coupled with their relative pistons when supplied and are divided into three dimensional classes.

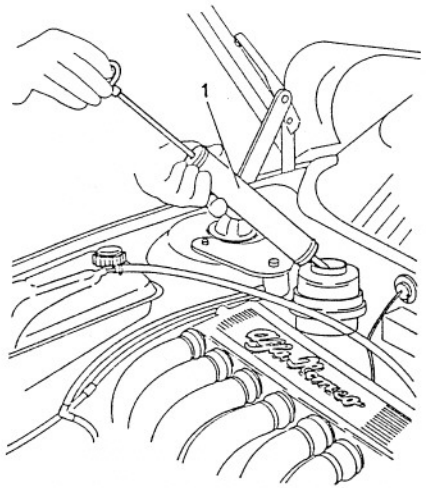
Cylinder heads:

these are of the monilithic type, compact fused in shell of aluminium and silicon alloy.
The 47° "V" position of the valves gives the combustion chamber and optimal configuration.
Each cylinder head is supported by a camshaft for the intake valves and a system of rods and rocker arms for the control of the exhaust valves.

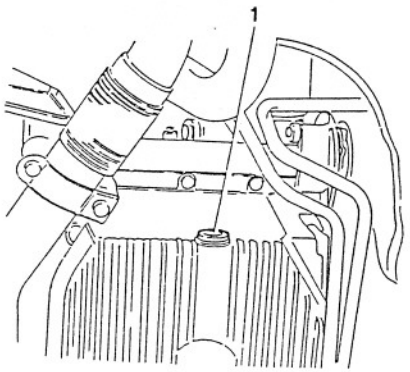
Oil sump:

this is of light aluminium formed by die-casting and is completely surrounded by anti-lapping panels.
A gasket with a silicon rubber insert is fitted between the sump and the engine block.

1. Empty the power steering oil tank using a suitable syringe.

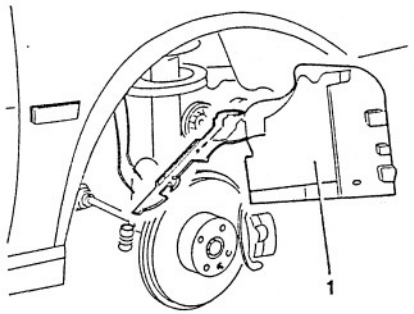


1. Drain off the engine oil by unscrewing the reltive cap on the oil sump (see **GROUP 00**).

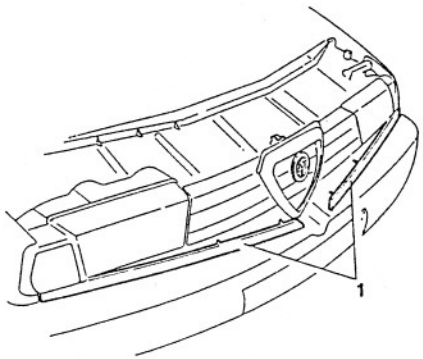


– Remove the front wheels.

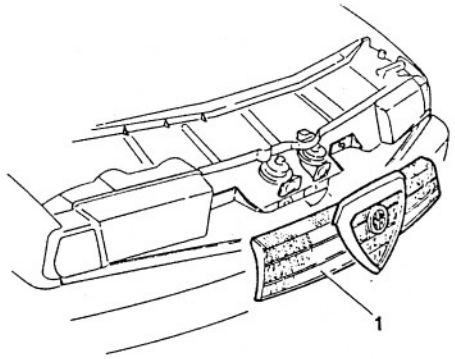
1. Remove the central engine protection covers through the right and left wheel arches.



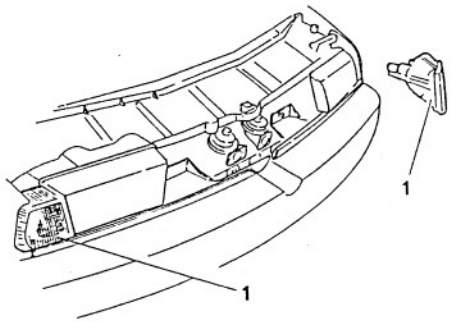
1. From the centre, detatch the two strips of grill trim.



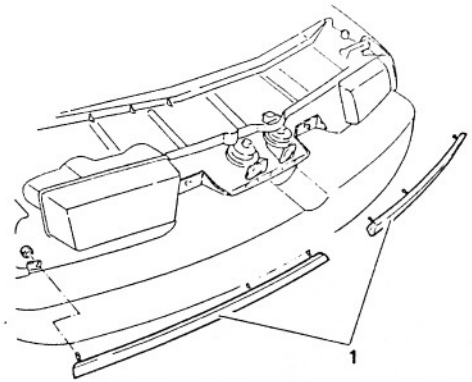
1. Remove the grill (see **GROUP 75**).



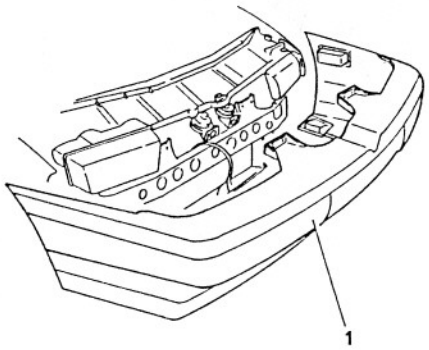
1. Remove the front direction indicators (see **GROUP 40**).



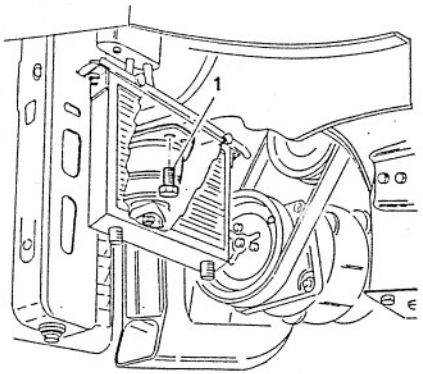
1. Unscrew the side nut securing the two strips of trim to the body and remove them.



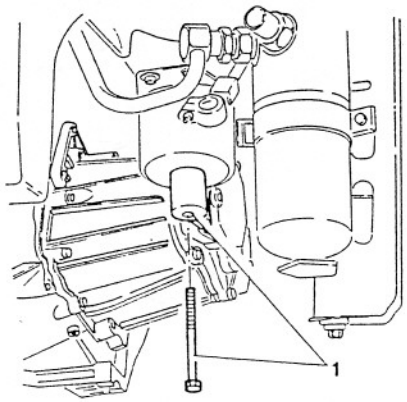
1. Remove the front bumper (see **GROUP 75**)



1. Disconnect the timing side engine mounting from the body.



1. Disconnect the engine support bracket on the gearbox side from the hydraulic support.

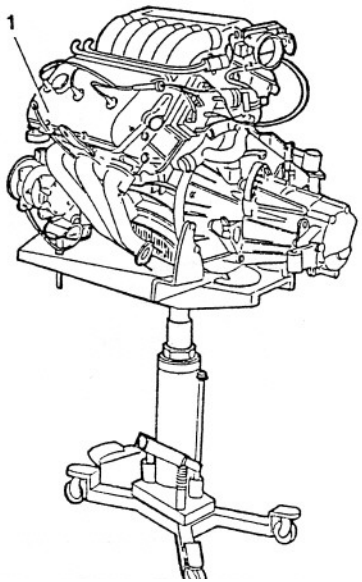


CAUTION:
To prevent the electric cables from getting in the way during engine removal, disconnect them from the cable clamps and move them away from the engine.

1. Lower the hydraulic jack and remove the engine group from the engine compartment.

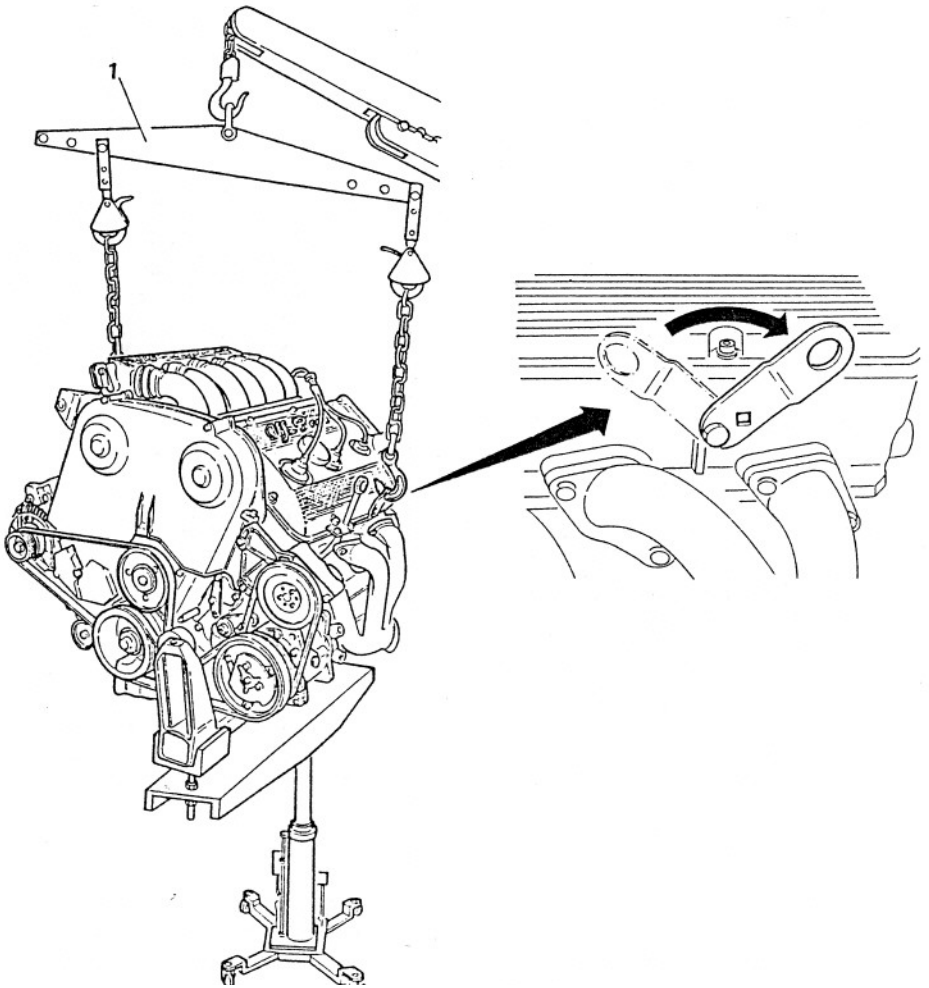
CAUTION:
Before lowering, check that all cables and hoses have been disconnected.

CAUTION:
Take all necessary precautions to avoid damaging components.



1. Support the engine group with a hydraulic lift in addition to the hydraulic jack used for engine removal. The following indications should be heeded:
   - Rotate the left side engine support bracket and balance the weight of the engine by adjusting the chain hooks attached to the swing bar as shown in the diagram.

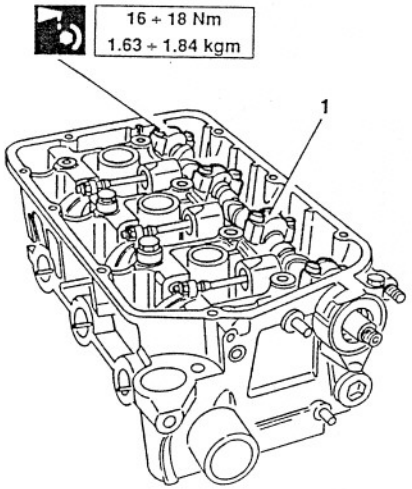
CAUTION:
To move the engine use a hydraulic crane after disenganging the supporting hydraulic jack.

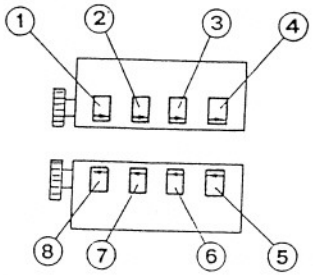


REMOVAL OF CAMSHAFT AND ROCKER ARMS SUPPORT SHAFT

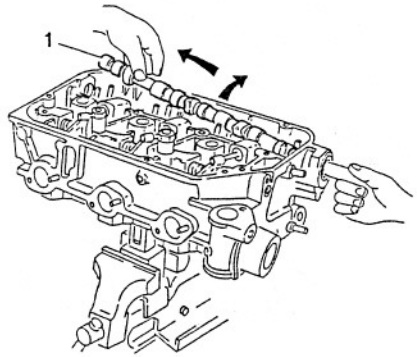
1. Remove the camshaft caps.

The caps are numbered in sequence (1, 2, 3 and 4 on the right-hand cylinder head; 5, 6, 7 and 8 for the left-hand cylinder head). On installation, replace the caps in the same order.





1. Remove the camshaft by first lifting the rear end, and then withdrawing it as indicated by the arrows in the diagram.

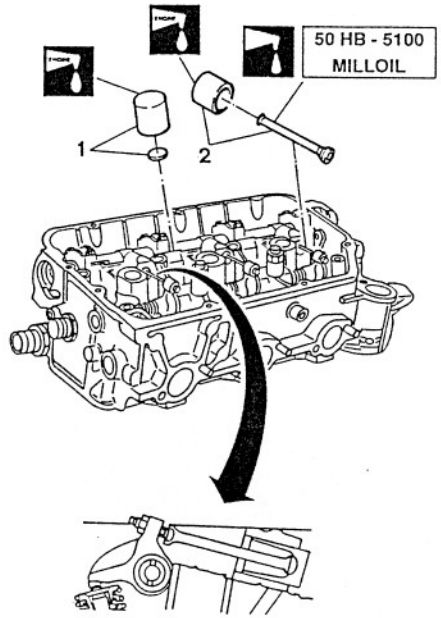


CAUTION:
Proceed with care; the cams and support mating surfaces are easily damaged.

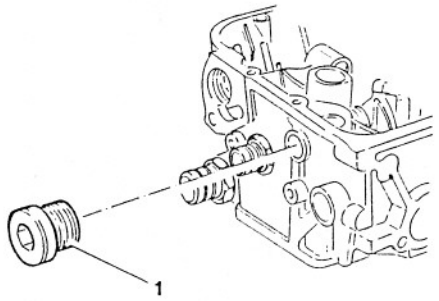
1. Withdraw the intake side valve cups and relative valve clearance adjustment shims.
2. Withdraw the exhaust side valve cups and relative rocker arm rods.

NOTE: Arrange the components in sequence order if they are to be re-used.

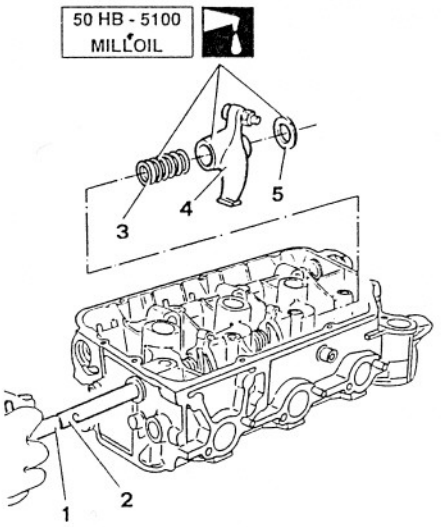
NOTE: For checking and adjustment of valve clearance follow the indications given in the relevant paragraph.



1. Remove the rocker arm shaft plug.



1. Screw a suitable tool onto the threaded tug of the rocker arm shaft.
2. Gradually withdraw the rocker arm shaft.
3. Remove the springs.
4. Remove the rocker arms.
5. Remove the washers.

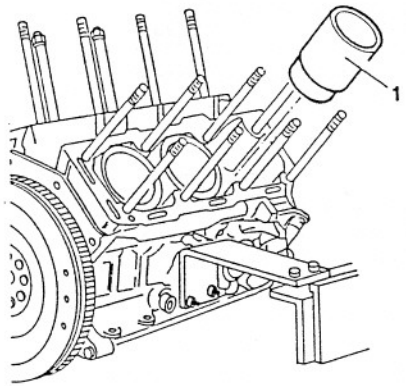


CYLINDER LINER PROTRUSION CHECK

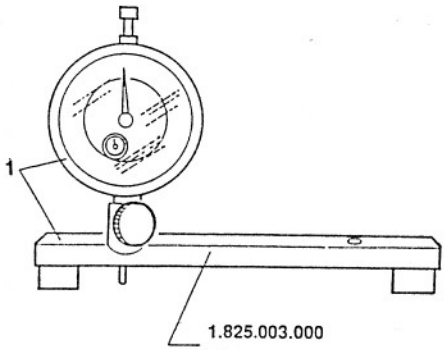
Without seal rings

NOTE: **This procedure, a preliminary check to verify the correct mating of the cylinder liners with the engine block, should be carried out without seal rings and the cylinder liner retainer, which tightened to the correct torque would eliminate the thickness, is not therfore required.**

1. Insert the cylinder liners into the engine block ensuring that they reach the stop limit.

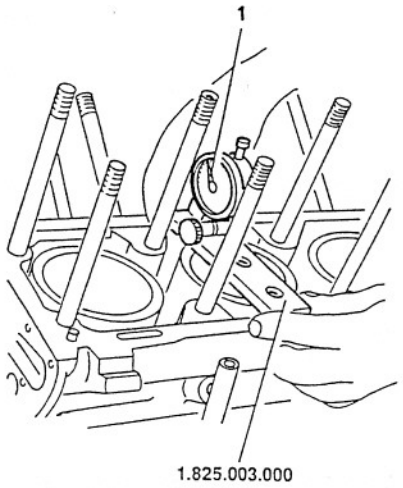


1. Apply a centesimal dial gauge to tool N° 1.825.003.000 (C.6.0148) and reset them on a datum plane.



1. Place tool N° 1.825.003.000 (C.6.0148) on the engine block, first on one side and then on the other, so that the dial gauge probe rests on the edge of the liner; then check that the protrusion is within the prescribed limits.

Protrusion of cylinder liners from the engine block
0.01 to 0.06 mm



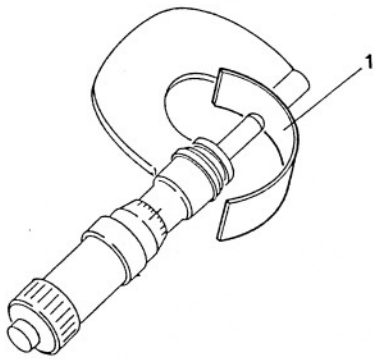
MAIN AND ROD BEARING HALVES THRUST HALF RINGS

- Clean the main and rod bearing halves and visually check for scoring or traces of binding. Replace all bearing halves if traces of wear are detected.

NOTE: **Coupling between the main and rod bearing halves and the crankshaft must be carried out by matching the parts of the same dimensional class identified by dots of the same colour on the side of the bearing half and on the relevant crankshaft journal.**

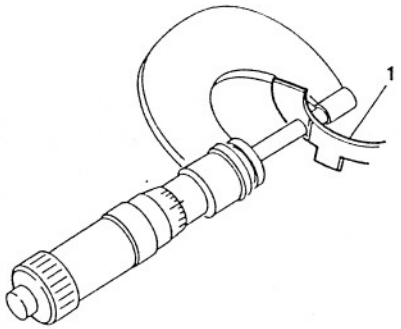
1. Using a micrometer, measure the thickness of the bearing halves and check that they are within the prescribed limits.

Thickness of bearing halves		
RED (A)	MAIN	1.833 to 1.839 mm
	ROD	1.737 to 1.745 mm
BLUE (B)	MAIN	1.839 to 1.845 mm
	ROD	1.741 to 1.749 mm
GREEN (C)	MAIN	1.845 to 1.851 mm
	ROD	-



1. Check that the thickness of the thrust half rings is within the prescribed limits.

Thickness of thrust ring halves
2.310 to 2.360 mm



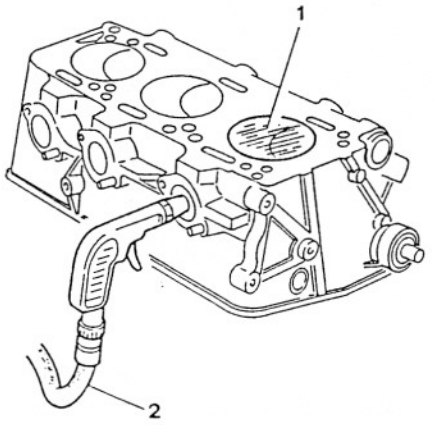
INDICATIONS FOR REASSEMBLY

For reassembly, reverse the procedure followed for disassembly except where otherwise stated.

VALVE LEAKAGE TEST

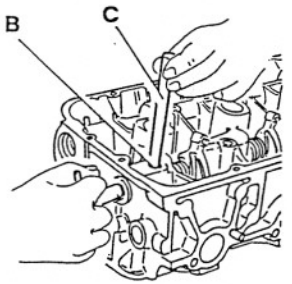
– Insert the spark plugs in their seats.

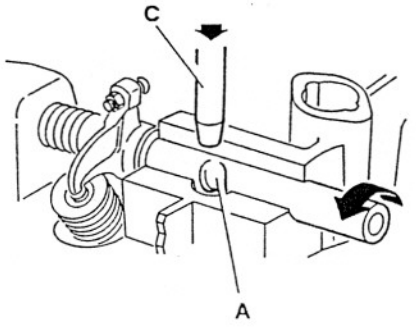
1. Pour some petrol into one of the combustion chambers so that it just covers the valve heads.
2. Blow low-pressure air into the intake and exhaust ports and check that no bubbles form in the petrol; if there are bubbles, check for correct assembly and grind the valve seats again if necessary.



CORRECT POSITIONING OF THE ROCKER ARM SHAFT

– After reassembling the washers, rocker arms and springs, rotate the shaft to alin notches "A" with the holes "B" in order to permit ther passage of the cylinder head support studs. Use pin "C" (diam. 12mm) to ensure correct alignment.





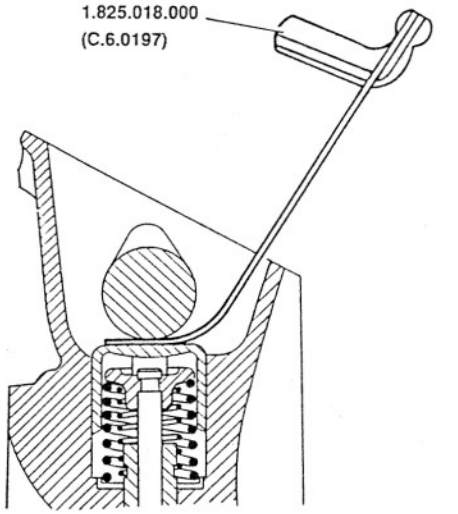
CHECKING AND ADJUSTMENT OF VALVE CLEARANCE

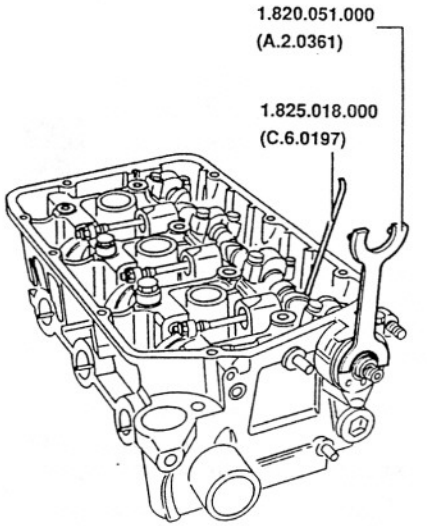
Intake valve clearance check

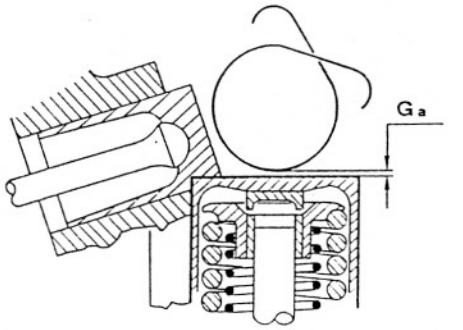
After installation of the camshaft, check the clearance of the intake valves as follows:

- temporarily install the timing system drive toothed pulley hub.
- using tool N° 1.820.051.000 (A.2.0361) for the rotation of the camshaft and feeler gauge N° 1.825.018.000 (C.6.0197), checkthat the clearance "G_a" between the cam heel radius and valve cups is within the prescribed limits.
  If not, replace the intake valve caps with others of a suitable thickness.

Valve clearance intake side
G_a = 0.475 to 0.500 mm

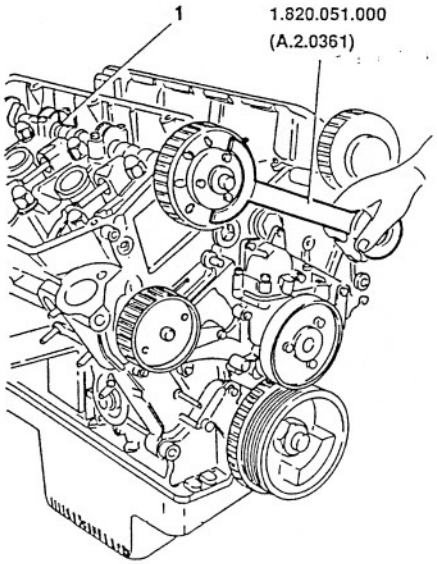




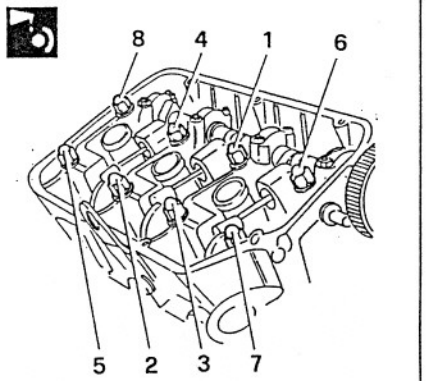


1. Using lever tool N° 1.820.051.000 (A.2.0361) rotate the camshaft of each cylinder head to align the timing marks on the camshaft to those on the camshaft caps.

NOTE: **On the right-hand cylinder head, the timing mark is located on cap N° 3, while on the left cylinder head that mark is located on cap N° 7.**



- Install the cylinder heads on the engine block.
- Lubricate the nuts and washers with engine oil and tighten, in two or three stages, the eight nuts securing each cylinder head following the indications given in the table.

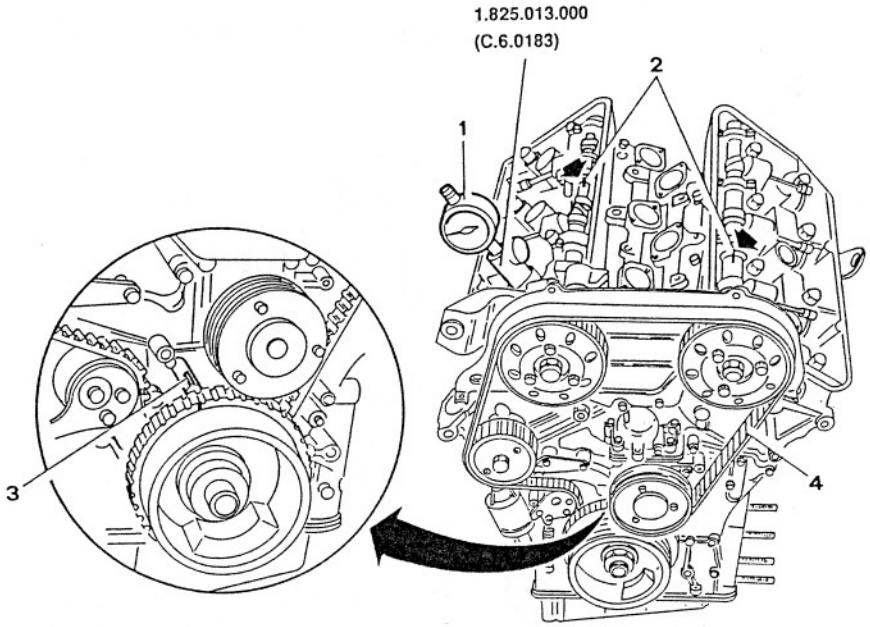


On installation Lubricate the nuts, washers and threads of the studs with oil and tighten to the prescribed torque in the order shown.	88.5 to 97.8 Nm 9 to 10 kgm
After bench testing when the engine is cold, one at a time loosen the nuts by one revolution following the sequence indicated; wipe the surfaces betweem washers and nuts with oil and tighten to the prescribed torque once again.	97.8 to 108.2 Nm 10 to 11 kgm

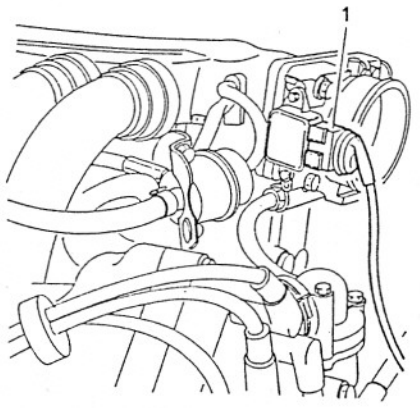
INSTALLATION OF TIMING BELT AND CHECKING OF ENGINE TIMING

1. Install tool N° 1.825.013.000 (C.6.0183) complete with dial gauge, into the the seat of the first cylinder spark plug.
- Rotate the crankshaft in the direction of normal rotation and bring the piston of the first cylinder to the exact T.D.C. in the firing phase.
2. Check that the marks engraved on the camshafts are aligned to those on the relative caps.
3. Check that the reference marks on the phonic wheel are aligned with the reference pin on the front cover of the engine block.
4. Fit the timing belt keeping the arms under tension and following the order indicated below:

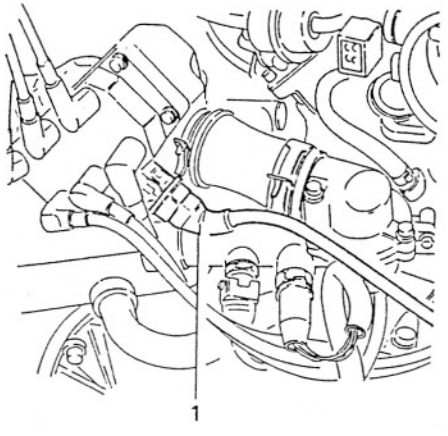
   1°- Crankshaft toothed pulley
   2°- Left cylinder head toothed pulley
   3°- Right cylinder head toothed pulley
   4°- Oil pump drive toothed pulley
   5°- Hydraulic belt tensioner pulley



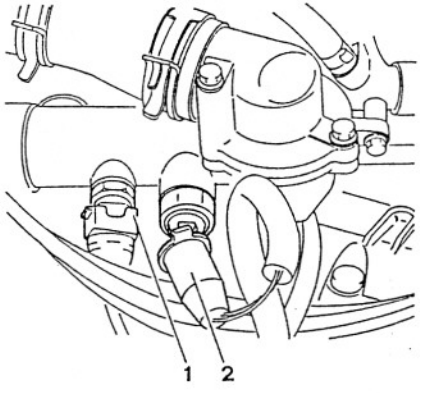
1. Disconnect the throttle valve potentiometer connection.



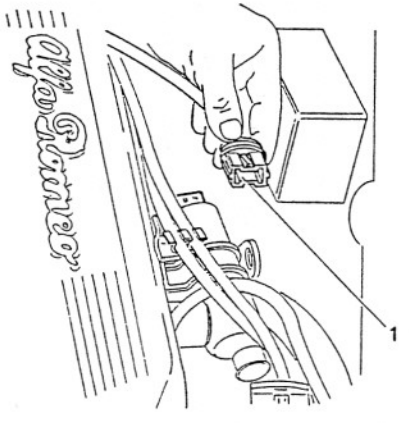
1. Disconnect the ignition coil connection.



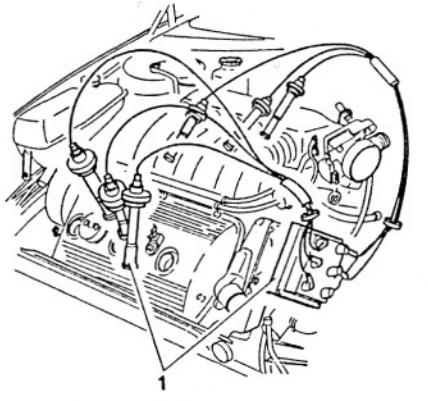
1. Disconnect electrical connection from the engine coolant temperature sensor (NTC).
2. Disconnect the electrical connection from the engine coolant temperature indicator sender and the maximum temperature warning light contact connections.



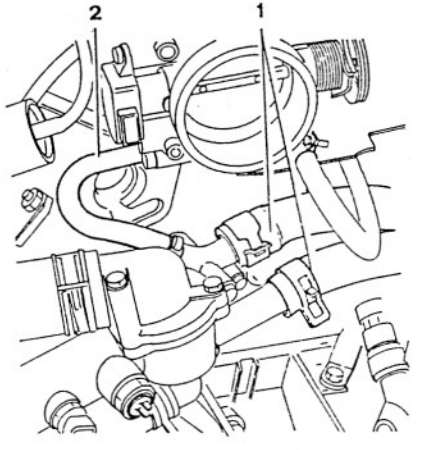
1. Disconnect electrical connection of the constant idle speed actuator.



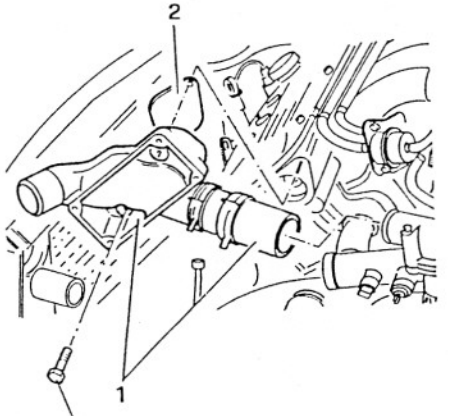
. Remove the ignition coils together with the spark plug leads.



1. Disconnect the two engine coolant sleeves (delivery and return to heater) from the thermostatic cup
2. Disconnect the engine coolant outlet hose from the throttle valve.

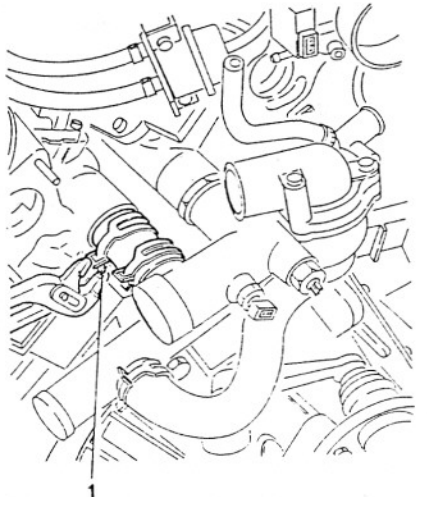


1. Remove the ignition coils support together with sleeve connected to the thermostatic cup.
2. Remove the gasket.

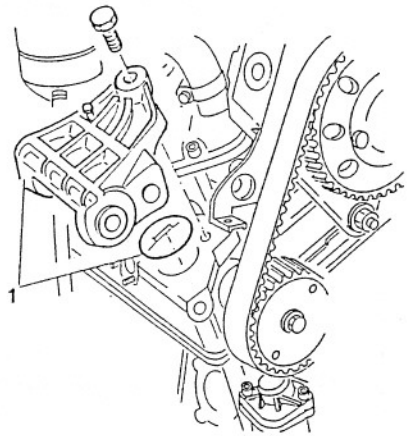


13.6 ÷ 16.8 Nm
1.4 ÷ 1.7 kg

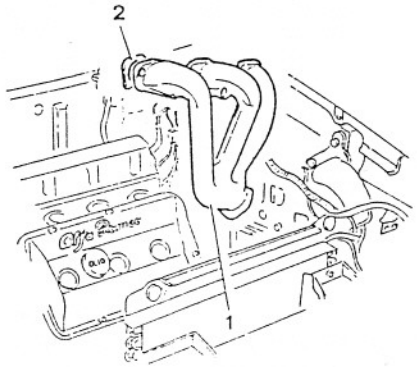
1. Disconnect the sleeve connecting the thermostatic cup to the left cylinder head.



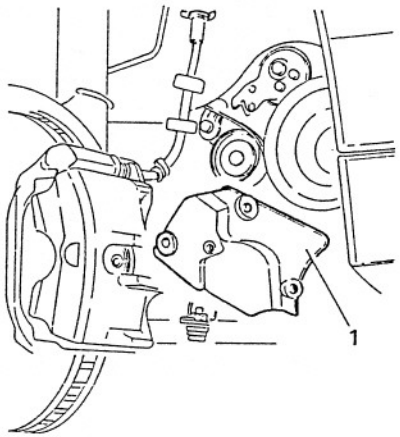
1. Remove the previously loosened upper alternator support bulb and remove the alternator support together with the O-ring.



1. Remove the exhaust manifolds
2. Remove the gaskets.



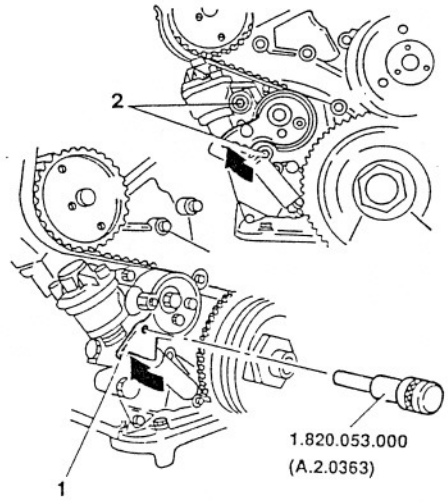
– Raise the vehicle on a lift.
1. Remove the hydraulic belt tensioner protection plate.



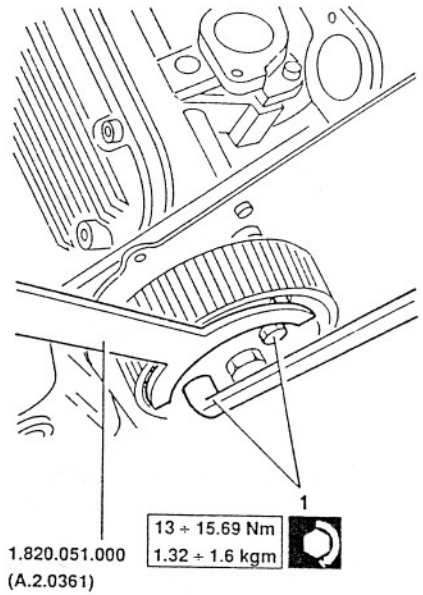
1. Raise the arm of the hydraulic belt tensioner and lock the belt tensioner with tool N° 1.820.053.000 (A.2.0363).

NOTE: To introducce tool N° 1.820.053.000 (A.2.0363) it is necessary to align the housing hole with that in the belt tensioner body.

2. Loosen the two nuts securing the body of the belt tensioner to the engine block.
– Rotate the hydraulic belt tensioner upwards and lock it in position by tightening the previously loosened nuts.



– Lower the vehicle.
– Slide the timing belt off the pulleys.
1. Using tool N° 1.820.051.000 (A.2.0361) as a reactor, unscrew the three screws securing the right-hand timing pulley to the support hub.



TECHNICAL CHARACTERISTICS AND SPECIFICATIONS

All technical, dimensional checks and inspections relevant to the AR 67301 engine are presented below.

The same information has been included in the description of the repair procedure presented earlier, where reference can also be made to the figures.
The information below has been synthetically enlarged with other data useful for the complete inspection of the engine and its parts.
The order in which the components are presented is the same as that for the reassembly of overhaulled engines.

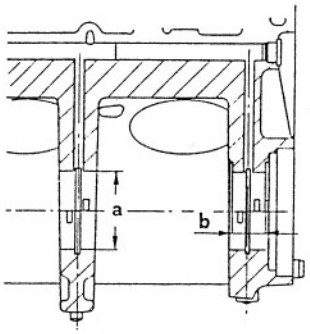
TECHNICAL CHARACTERISTICS OF THE ENGINE

Engine		AR 67301
Cycle		eight cycles, four stroke
Fuel supply		electronic injection
Displacement	cm^3	2492
Number of cylinders		6 a V di 60°
Bore	mm	88
Stroke	mm	68.3
Maximum Power	CV DIN (kW CEE) giri/min	166 (121) 5800
Maximum torque	kg DIN (Nm CEE) r.p.m.	21,7 (216) 4500
Compression ratio		10
Engine oil pressure (1) - at idle speed - at 4000 r.p.m.	kPa (bars; kg/cm^2)	 147 (1.5; 1.53) 500 (5; 5.1)

(1) With engine at operating temperature (oil at 100° C)

COMPLETE ENGINE BLOCK

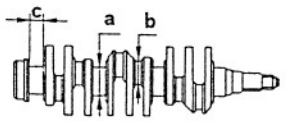
Engine block

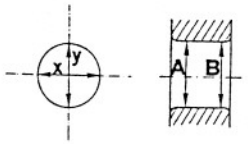


Unit: mm

Diameter of main supports (a)	A - Red	63.657 ÷ 63.663
	B - Blue	63.663 ÷ 63.669
	C - Green	63.669 ÷ 63.675
Length of rear main support shoulder (b)		26.450 ÷ 26.500

Crankshaft



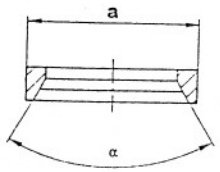


(1) Ovalization X:Y
(2) Taper A:B

Unit: mm

Diamter of main journal (a)	A - Red	59.973 ÷ 59.979
	B - Blue	59.967 ÷ 59.973
	C - Green	59.961 ÷ 59.967
Diameter of rod journal (b)	A - Red	51.990 ÷ 52.000
	B - Blue	51.980 ÷ 51.990
Length of rear main journal (c)		31.300 ÷ 31.335
Maximum ovalization of main and rod journal (1)		0.004
Maximum taper of main and rod journals (2)		0.010
Maximum error of parallelism between main and rod journals		0.015
Maximum eccentricity between main journals		0.040
Maximum deviation between centre lines of handle and main journal		0.300

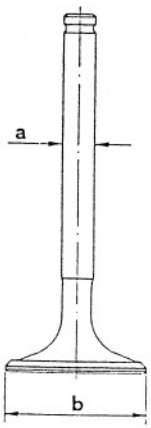
Valve seatings



Unit: mm

Outer diameter of valve seat (a)	Intake	42.065 ÷ 42.100
	Exhaust	37.095 ÷ 37.111
Valve seat taper (α)		90° ± 20'
Interference between valve seat and housing	Intake	0.040 ÷ 0.100
	Exhaust	0.070 ÷ 0.111
Cylinder head shrink-fit temperature for installation of valve seatings		100°C

Valve

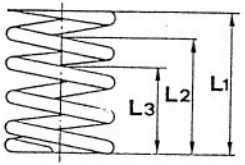


Unit: mm

Diameter of valve stem (a)	Intake	8.957 ÷ 8.977 (1) 8.950 ÷ 8.980 (2)
	Exhaust	8.925 ÷ 8.945
Diameter of valve head (b)	Intake	40.850 ÷ 41.000 (1) 40.800 ÷ 41.000 (2)
	Exhaust	36.450 ÷ 36.600
Radial play between valve stem and guide	Intake	0.023 ÷ 0.058 (1) 0.020 ÷ 0.065 (2)
	Exhaust	0.055 ÷ 0.090

(1) Livia (2) Ate

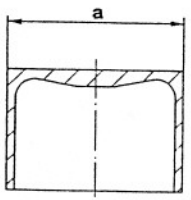
Valve springs



Unit: mm

Length of valve spring at rest (L_1)	Outer spring	44.6
	Inner spring	44.1
Length of valve spring with closed valve (L_2)	Outer spring	32.5
	Inner spring	30.5
Length of valve spring with open valve (L_3)	Outer spring	23.5
	Inner spring	21.5
Load corresponding to spring length with valve closed	Outer spring	243 ÷ 252 N (24.8 ÷ 25.7 kg)
	Inner spring	126 ÷ 130 N (12.8 ÷ 13.3 kg)
Load corresponding to spring length with valve open	Outer spring	470 ÷ 488 N (47.9 ÷ 49.7 kg)
	Inner spring	222 ÷ 231 N (22.7 ÷ 23.5 kg)

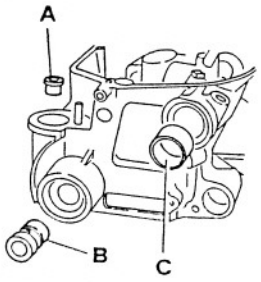
Valve cups



Unit: mm

Diameter of valve cups (a)	Intake	34.973 ÷ 34.989
	Exhaust	21.971 ÷ 21.989
Radial play between valve cups and seating	Intake	0.011 ÷ 0.052
	Exhaust	0.011 ÷ 0.050

Cylinder head bushings



Unit: mm

Inner diameter of bushing "A"	19.000 ÷ 19.021
Inner diameter of bushing "B"	19.000 ÷ 19.021
Inner diameter of bushing "C"	32.000 ÷ 32.025

TIGHTENING TORQUES

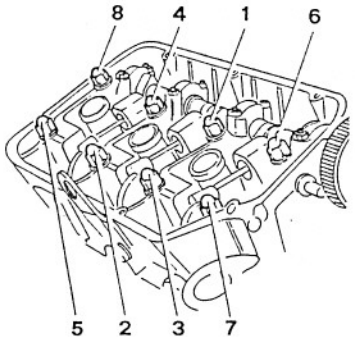
Engine block

Part	Nm	kgm
Nuts securing main caps to supports on engine block (in oil)	84 ÷ 92.7	8.56 ÷ 9.45
Screws securing flywheel to crankshaft (with fixative)	112.8	11.5
Nut securing crankshaft front pulley (in oil)	235.4	24
Screws securing rod caps (in oil)	53.4 ÷ 59	5.45 ÷ 6.0
Screws securing water pump body to engine block	8.1 ÷ 9.3	0.83 ÷ 0.95
Screw securing belt tensioner pulley	17 ÷ 20	1.7 ÷ 2.0
Screws securing exhaust manifold	25.5	2.6
Screws securing front cover	8.1 ÷ 9.3	0.83 ÷ 0.95
Tightening starter motor	38.25 ÷ 45	3.9 ÷ 4.6
Oil sump drainage plug	64 ÷ 79	6.5 ÷ 8
Oil filter	14.7 ÷ 19.6	1.5 ÷ 2
Screws securing hydraulic belt tensioner cover	8.1 ÷ 10	0.83 ÷ 1.02
Oil sump retaining screws	9 ÷ 11	0.9 ÷ 1.1
Water pump pulley retaining screws	8.5 ÷ 10.5	0.87 ÷ 1.07
Water pump cover retaining screws	6.5 ÷ 10.5	0.66 ÷ 1.07
Thermostat unit retaining screws	32.3 ÷ 39.9	3.3 ÷ 4.1

Cylinder head

Part	Nm	kgm
Nut securing camshaft (in oil)	16 ÷ 18	1.63 ÷ 1.84
Nut securing camshaft front hub	97 ÷ 117.12	10 ÷ 12
Spark plug tightening (in ISECO Molykote A oil)	24.5 ÷ 34.3	2.5 ÷ 3.5
Engine oil pressure meter (on oil filter support)	10.6 ÷ 13.1	1.1 ÷ 1.3
Minimum engine oil level sensor (on engine block)	25	2.5
Minimum engine oil pressure warning lamp sensor (on oil filter support)	34 ÷ 42	3.5 ÷ 4.3
Engine oil temperature sensor (on engine block)	34 ÷ 42	3.5 ÷ 4.3
Nut-screw regulating rocker arm clearance	14.8 ÷ 17.7	1.5 ÷ 1.8
Screws securing return pulley	17.8 ÷ 22.1	1.82 ÷ 2.25
Screws securing timing cover	8.9 ÷ 11	0.91 ÷ 1.1
Screws securing pulley to front and rear hubs	13 ÷ 15.69	1.32 ÷ 1.6

Tightening nuts securing cylinder head to engine block

Tightening sequence	Phase	Nm	kgm
	**When refitting:** Gradually tighten following the indicated sequence	88.5 ÷ 97.8	9 ÷ 10
	After trials and bench testing: With engine cold, loosen the nuts by one turn following the sequence indicated, smear with engine oil and tighten in the sequence shown		10 ÷ 11

PROCEDURE FOR FAULT RECTIFICATION

ENGINE - NOISY OPERATION

FAULTS AND SYMPTOMS	FAULT ISOLATION	TEST REFERENCE
BACKGROUND BEATING (DUE TO INBALANCE)	A background beat that can be heard when the engine is under load or noise coming from the rod-crankshaft and piston-cylinder liner couplings	D

NOTE: **Before performing the tests indicated below, check the oil level, grade of oil and oil filter. If necessary change engine oil and filter using the prescribed quantities and grades.**

BEATING WHEN ENGINE IS AT IDLE	TEST A

TEST STEPS	RESULTS	REMEDY
A1 CHECK VALVE CLEARANCE – Check that the clearance between the cam heel radius and the top of the valve cup is within the specified limits.	OK ▶ ~~OK~~ ▶	Carry out step A2 Adjust clearance
A2 VISUALY CHECK CAMS AND CUPS – Visually check the cuspid of the cams and the top of the cups for wear, scoring, binding etc.	OK ▶ ~~OK~~ ▶	Carry out step A3 Replace defective items
A3 CHECK AXIAL PLAY – Check that camshaft axial play is within the specified limits.	OK ▶ ~~OK~~ ▶	Carry out step A4 Replace defective camshaft
A4 CHECK CUPS AND SEATINGS – Check the outer diameter of the cups and the diameter of the relevant seatings; also check for scroing, binding etc.	~~OK~~ ▶	Replace affected cups and/or relevant cylinder head

End of test A