marine engines

section 3.1

8061 MARINE

TURBOCHARGED INTERCOOLED

8061 SRM 33.10
8061 SRM 33.12
8061 SRM 33.40
8061 SRM 33.42

WORKSHOP MANUAL

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IVECO aifo

The data contained in this publication may not have been updated following modifications carried out by the manufacturer, at any time, for technical or commercial reasons and also to conform to the requirements of the law in the various countries.

This publication supplies features and data together with the suitable methods for repair operations to be carried out on each single component of the engine
Following the supplied instructions and using the inherent specific fixtures, a correct repair procedure will be obtained in due time, protecting the operators from all possible accidents.
Before starting any repair, be be sure that all accident prevention devices are available and efficient.
Therefore check and wear what indicated by the safety provision. protective glasses, helmet, gloves, safety shoes.
Before use, check all work, lifting and transport equipment.

	8061MARINE TURBOCHARGED INTERCOOLED				
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TIMING

Valve Timing	
- Intake	
opens before T D C	4° 30'
closes afters B D C	46 °
- Exhaust	
opens · before B D C	48° 30'
closes afters T D C	6°
Clearance between valves and rockers for timing checks	0,45 mm
Operating clearance between valves and rockers, cold engine	
intake and exhaust	0,30 ± 0,05

FUEL SYSTEM

In line injection pump type Bosch PES	
Fixed injection pump delivery start advance	20° + 1°
Fuel injectors setting	250 + 8 bar
Firing order	1 - 5 - 3 - 6 - 2 - 4

LUBRICATION

Minimun oil pressure	
- at full throttle	2,5 kg/cm²
- when idling	0,7 kg/cm²

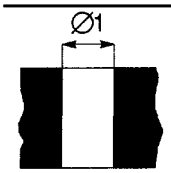
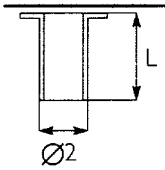
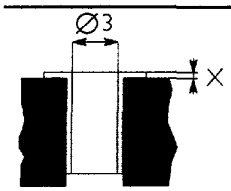
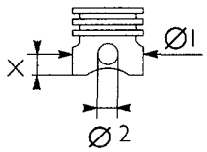
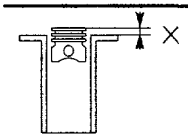
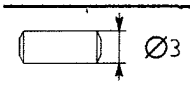
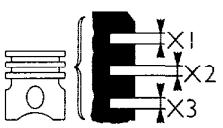
STARTING

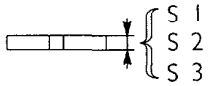
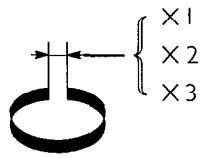
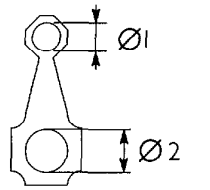
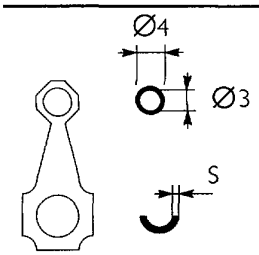
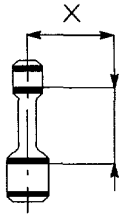
By starter motor

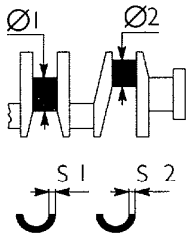
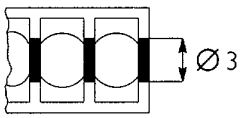
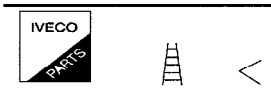
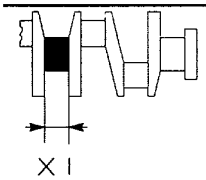
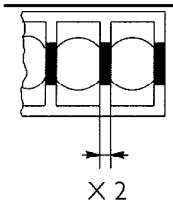
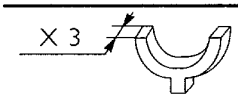
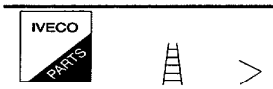
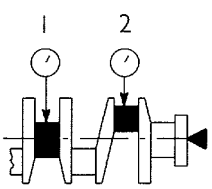
ELECTRIC SYSTEM

- Voltage	12 V
- Self - regulated alternator	14 V, 45 A
- Starting motor power	3 KW
- Battery (optional)	176 Ah

DATA ON ASSEMBLY CLEARANCES

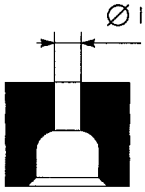
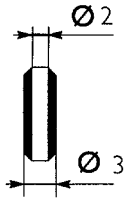
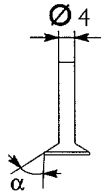
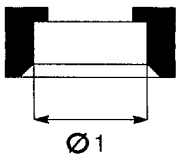
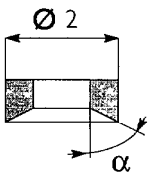
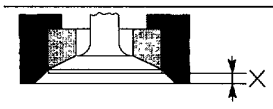
CYLINDER BLOCK AND CRANK MECHANISM COMPONENTS		mm
	Bores for cylinder liners Ø 1	106,85 – 106,90
	Cylinder liners outside diameter Ø 2 length L	 106,94 – 106,97 198,00 ÷ 198,50
	Cylinder liners–crankcase bores	0,04 ÷ 0,12
IVECO PARTS >	Outside diameter Ø 2	0,2
	Cylinder liners inside diameter Ø 3 protrusion X	 104,000 ÷ 104,024
	Pistons measurement height X outside diameter Ø 1 housing for gudgeon pin Ø 2	 12 103,870 ÷ 103,852 38,000 ÷ 38,006
	Piston–cylinder liner	0,130÷0,172
IVECO PARTS <	Piston diameter Ø 1	0,4 – 0,8
	Piston protrusion X	0,64 ÷ 0,97
	Gudgeon pin Ø 3	37,984 ÷ 37,990
	Gudgeon pin – pin housing	0,010 ÷ 0,022
	X 1 * Piston ring grooves X 2 X 3 * measured on 101 mm diameter	3,20 ÷ 3,23 2,55 ÷ 2,57 4,03 ÷4,05

			mm
	Piston rings	S 1 *	3,095 – 3,075
		S 2	2,490 – 20478
		S 3	3,990 ÷ 3,975
	* measured on 101 mm diameter		
	Piston ring – grooves	1	0,105 ÷ 0,155
		2	0,060 ÷ 0,092
		3	0,040 ÷ 0,075
IVECO PARTS >	Piston rings		0,4 – 0,8
	Piston ring end gap in cylinder liner		
		X 1	0,30 ÷ 0,55
		X 2	0,60 ÷ 0,85
		X 3	0,30 ÷ 0,60
	Small end bush housing	Ø 1	41,846 ÷ 41,884
	Big end bearing housing	Ø 2	67,407 – 67,422
	Small end bush diameter		
	outside	Ø 4	41,979 ÷ 42,017
	inside	Ø 3	38,004 ÷ 38,014
	Big end bearing shell (S=thickness)	S	1,805 – 1,815
	Small end bush – housing		0,095 ÷ 0,171
	Gudgeon pin – bush		0,014 ÷ 0,031
IVECO PARTS <	Big end bearing shells		0,254 – 0,508
	Measurement dimension	X	125
	Maximum out-of-parallel error on connecting rod axes	//	0,07

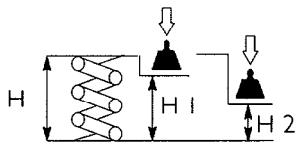
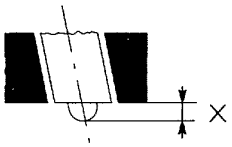
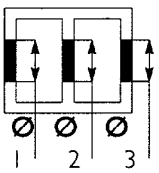
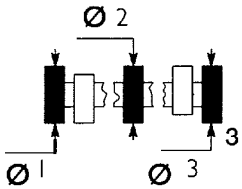
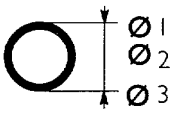
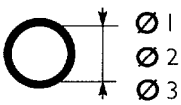
			mm
	Main journals	Ø 1	79,791 – 79,810
	Crankpins	Ø 2	63,725 ÷ 63,744
	Main bearing shells (S=thickness)	S 1	2,169 ÷ 2,178
	Big end bearing shells (S=thickness)	S 2	1,805 ÷ 1,815
	Main bearing housings	Ø 3	84,200 ÷ 84,230
	Bearing shells – main journals		0,034 – 0,101
	Bearing shells – crankpins		0,033 ÷ 0,087
	Main bearing shells Big end bearing shells		0,254 – 0,508
	Main journal, thrust bearing	X 1	32,0 ÷ 32,1
	Main bearing housing, thrust bearing	X 2	25,010 ÷ 25,060
	Thrust washer halves	X 3	3,378 ÷ 3,429
	Crankshaft end float		0,082 ÷ 0,334
	Thrust washer halves		0,254 – 0,508 – 0,762 – 1,016
	Alignment	1	≤ 0,10
		2	± 0,25
	Ovality	1 – 2	0,008
	Taper	1 – 2	0,012

CYLINDER HEAD. VALVE GEAR

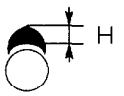
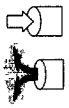
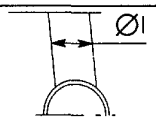
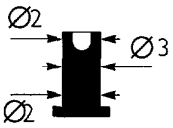
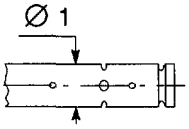
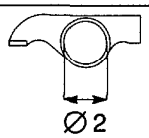
mm

	Valve guide housings in the cylinder head Ø 1	13950 – 13983
	Valve guide Ø 2 Ø 3	8023 – 8043 13993 ÷ 14016
	Valve guides and seatings in the head	0010 ÷ 0066
IVECO PARTS	Valve guides	+ 02
	Valves Ø 4 α Ø 4 α	7985 – 8000 60° 30' ± 7' 7985 ÷ 800 45° 30' ± 7'
	Valve stem and its guide	0023 – 0058
	Housing in head for valve seat Ø 1 Ø 1	– 39000 ÷ 39025
	Outside diameter of valve seat, angle of valve seat in cylinder head Ø 2 α Ø 2 α	– 60° ± 5' 39136 ÷ 39161 45° ± 5'
	Recessing of valves X	07 ÷ 1
	Between valve seat and head	0111 ÷ 0161

mm

	Valve spring height Free height Under a load of 270 ± 14 N 528 ± 26 N	 H H1 H2	 44 6 34 23 8
	Injector protrusion	X	0 7 ÷ 1 5
	Camshaft bearing housing in crankcase	 Ø 1 Ø 2 Ø 3 Ø 4	 55 280 ÷ 55 305 54 780 ÷ 54 805 54.280÷ 54 305 53 780 ÷ 53 805
	Camshaft bearing journals	 Ø 5 Ø 6 Ø 7 Ø 8	 51 470 ÷ 51 500 50 970 ÷ 51 000 50 470 – 50 500 49 970 ÷ 50 000
	Outside diameter of camshaft bushes front front intermediate rear intermediate rear	 Ø 1 Ø 2 Ø 3 Ø 4	 55 375 ÷ 55 430 54 875 – 54 930 54 375 – 54 430 53 875 ÷ 53 930
	Inside diameter of bushes front front intermediate rear intermediate rear	 Ø 1 Ø 2 Ø 3 Ø 4	 51 580 ÷ 51 630 51 080 ÷ 51 130 50 580 ÷ 50 630 50 080 ÷ 50.130
	Bushes and housings in crankcase		0 07 ÷ 0 15
	Bushes and bearing journals		0 08 ÷ 0 16

mm

	Effective cam lift  H H	5 97 6 25
	Tappet cup housing in crank-case Ø 1	15 000 ÷ 15 018
	Outside diameter of tappet cup Ø 2 Ø 3	14 740 ÷ 14 780 14.950 ÷ 14 970
	Between tappets and housings	0 030 ÷ 0 068
	Tappets	0 1 – 0 2 – 0 3
	Rocker shaft Ø 1	17 982 ÷ 18 000
	Rockers Ø 2	18 016 ÷ 18 034
	Between rockers and shaft	0.016 ÷ 0 052

" MOTOMETER " VALUES

	T.D.C. pressure * bar	≥ 26
	Min. permissible T.D.C. pressure * bar	≤ 19
	Engine motoring over speed rpm	≈ 260

(*) Starter–driven engine with oil temperature at 40° – 50° C and injection pump at shut–off.

TIGHTENING TORQUES

PART.	TORQUE	Nm (kgm)
Cylinder head attachment bolt	1 st stage preliminary torque	70 (7.1)
	2 st stage preliminary torque	70 (7.1)
	3 st stage preliminary torque	90°
	4 st stage preliminary torque	90°
Main bearing cap attachment bolts	preliminary torque	80 (8 2)
	angle	90°
Big end cap attachment bolts	preliminary torque	40 (4.1)
	angle	60°
Flywheel attachment bolts	preliminary torque	40 (4.1)
	angle	60°

DESCRIPTION	THREAD	TIGHTENING TORQUE Nm M Max	M Min
Oil sump fixing screw	M10x1 25	32	25
Heater seat plug	M42x1 5	135	115
Fixing screw,right and left rear support	M12x1.75	85	70
Fixing screw, flywheel housing	M8	25	20
Fixing screw, rear seal cover	M8	25	20
Fixing screw, timing housing	M8	25	20
Fixing screw, timing housing and cover	M8	25	20
Nut for stud of fixing timing housing and cover	M8	25	20
Oil jet for piston cooling	M12x1.25	50	40
Fixing nut, cylinder head upper cover	M8	15	12
Fixing screw, rockers support	M8	25	20
Nut for screw to adjust valve clearance	M8x1	22	18
Fixing nut, hub damper centering	M30x1.5	460	450

DESCRIPTION	THREAD	TIGHTENING TORQUE Nm	
		M Max	M Min
Fixing screw, drive pulley	M10 x1 25	55	45
Fixing screw,intermediate pin with flange	M10 x1.25	55	50
Fixing screw, camshaft thrust plate	M8	35	30
Fixing screw, gear support	M8	25	20
Fixing screw or nut, flywheel housing to the crankcase	M14x2	135	115
Fixing screw, advance variator	M8	35	30
Fixing screw, oil pump cover	M8	25	20
Fixing screw, oil pump to the front cap	M8	25	20
Fixing screw, oil pipes to the pump	M8	25	20
Fixing screw, oil pressure valve	M8	25	20
Oil pressure valve	M22 x1 5	220	180
Fixing screw, cooler inner element	M8	25	20
Fixing screw, cooler	M10 x1 25	55	45
Fixing screw, cooler	M12 x1 75	85	70
Fixing screw, water pump cover	M8	12	10
Fixing screw, water pump	M10 x1 25	55	45

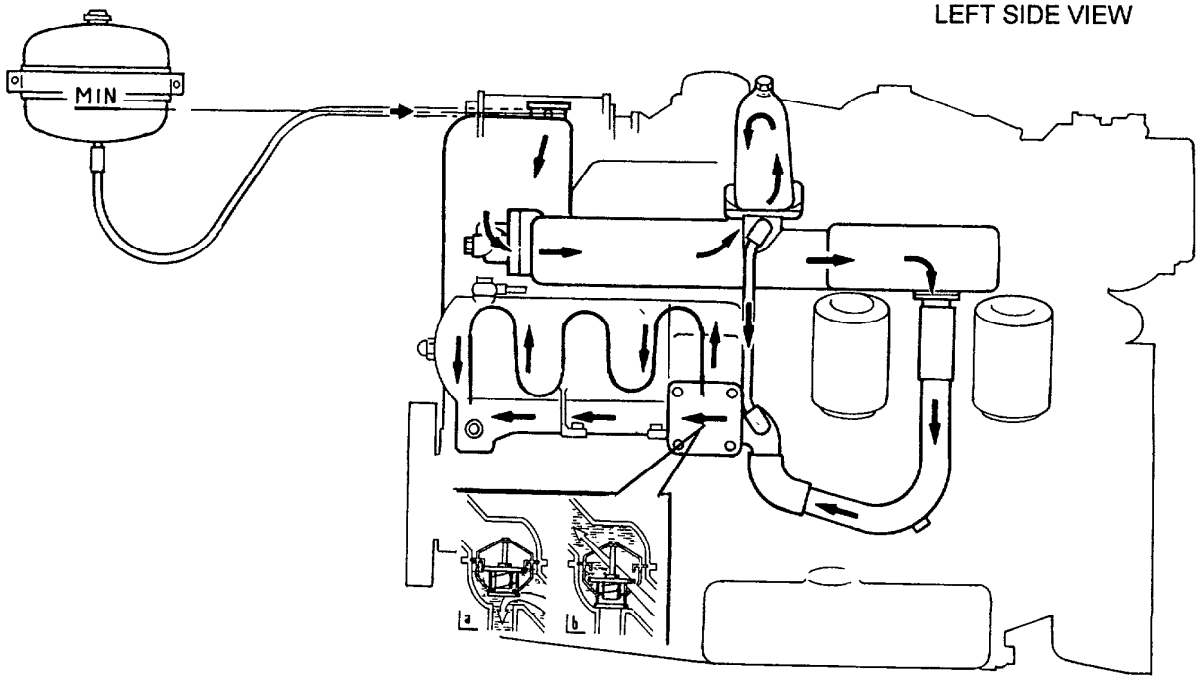
TOOLS

TOOL NUMBER	DESCRIPTION
99305049	Equipment for checking spring loading
99305121	Hot air unit
99322230	Swivelling telescopic stand
99340033	Damper flywheel extractor
99340205	Impact extractor
99341003	Single action bridge
99341016	Pair of brackets with holes
99342135	Pin for extracting injectors (to be used with 99340205)
99342145	Extractor for injector holder case
99346204	Extractor for injectors (to be used with 99340205 and 99342135)
99348001	Extractor with locking device
99348004	Universal extractor, internal, 5 to 70 mm
99350108	Wrench for valve gear clearance adjustment screw
99360183	Tongs for fitting engine piston rings
99360288	Drift for removing valve guides
99360293	Drift for refitting valve guides (use with 9936028)
99360310	Tool for rotating engine flywheel
99360314	Tool for removing cartridge filters
99360352	Tool for locking engine flywheel
99360357	Tool for removing and refitting engine valves
99360365	Installing tool for fitting crankshaft rear seal (use with 99370005)
99360419	Box with set of tools for recutting valve seatings
99360467	Adapter for checking cylinder compression (to be used with 99395682)
99360500	Crankshaft lifting tool
99360508	Ring for lifting cylinder block
99360595	Hoisting beam for removing and refitting engine
99360605	Ring clamp for inserting standard and oversize pistons into the cylinders
99361033	Brackets for securing engine to swivelling stand 99322230
99365063	Tool for refitting injector holder cases
99370005	Handle for interchangeable drifts99370006 Handle for interchangeable drifts
99370349	Installing tool for fitting crankshaft front seal (use with 99370006)
99390310	Reaming tool for valve guide
99390425	Tap for threading injector holder cases to be extracted
99394017	Reamer for reconditioning lower part of injector holder case (use with 99394019)
99394018	Cutter for reconditioning injector seating housing (use with 99394019)
99394019	Pilot bush
99395216	Pair of gauges for angle tightening with 1/2" and 3/4" square attachment
99395363	Tee square assembly for checking connecting rod distortion
99395682	Diesel engine cylinder compression tester
99395687	Bore micrometer (50 – 175 mm)
99395850	Torque wrench for checking belt tension

FUNCTIONAL DIAGRAMS

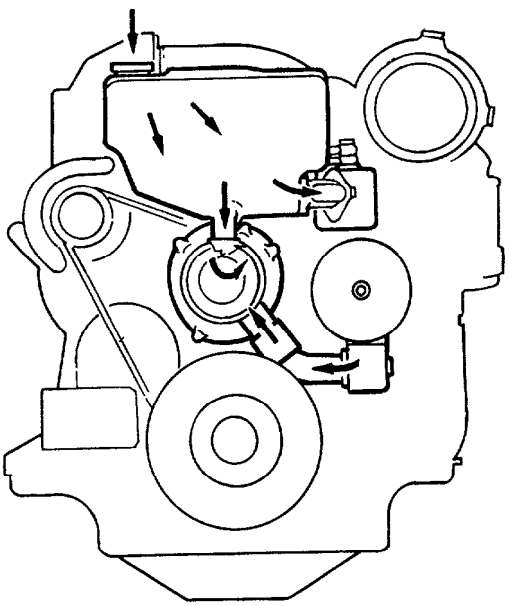
FRESH WATER COOLING CIRCUIT

LEFT SIDE VIEW



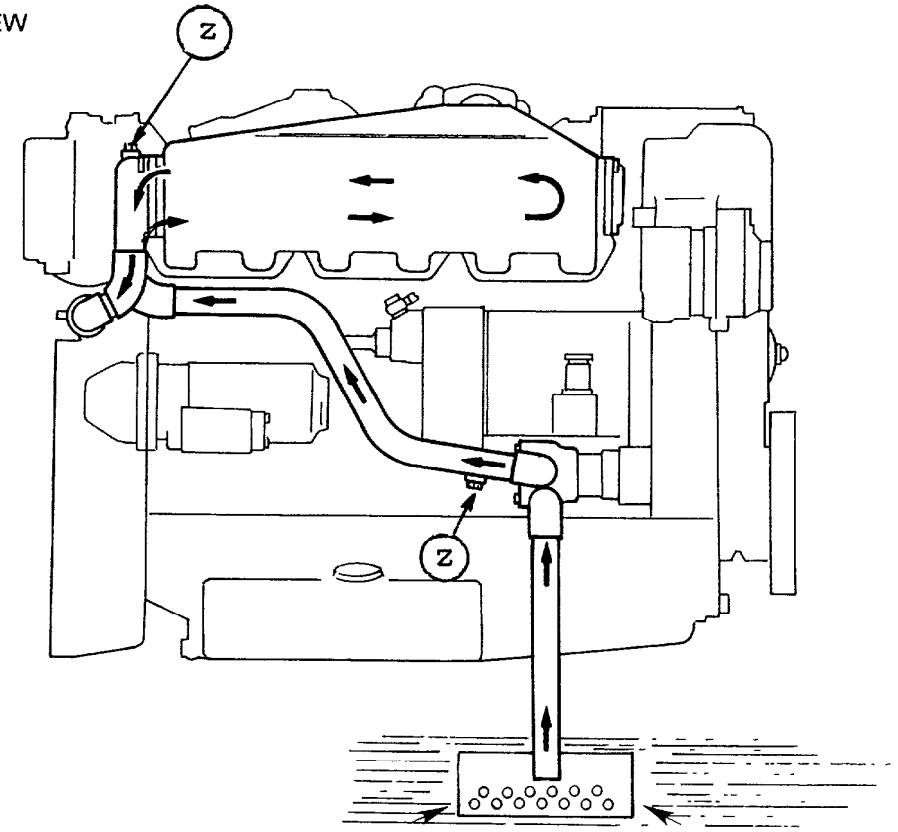
a Water circuit at closed thermostat - b.Water circuit at open thermostat

FRONT SIDE

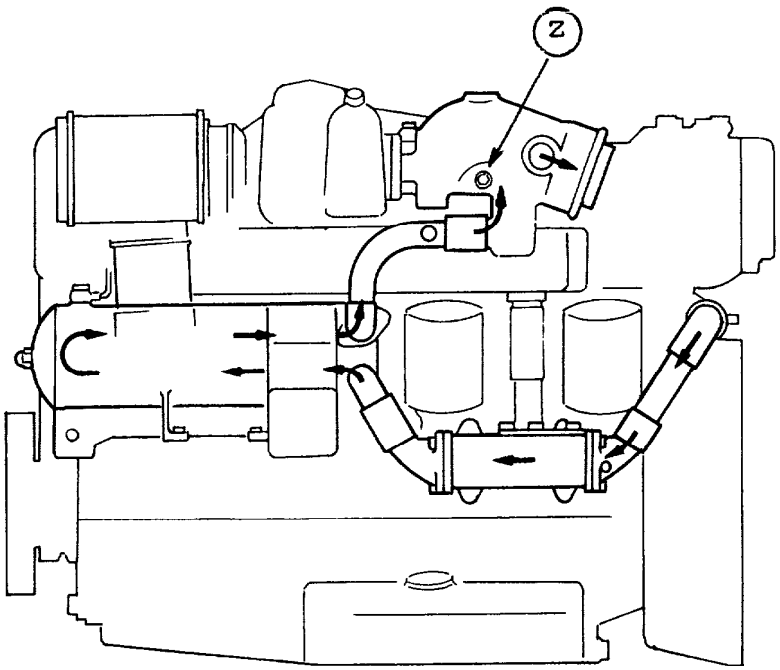


SEA WATER COOLING CIRCUIT

RIGHT SIDE VIEW



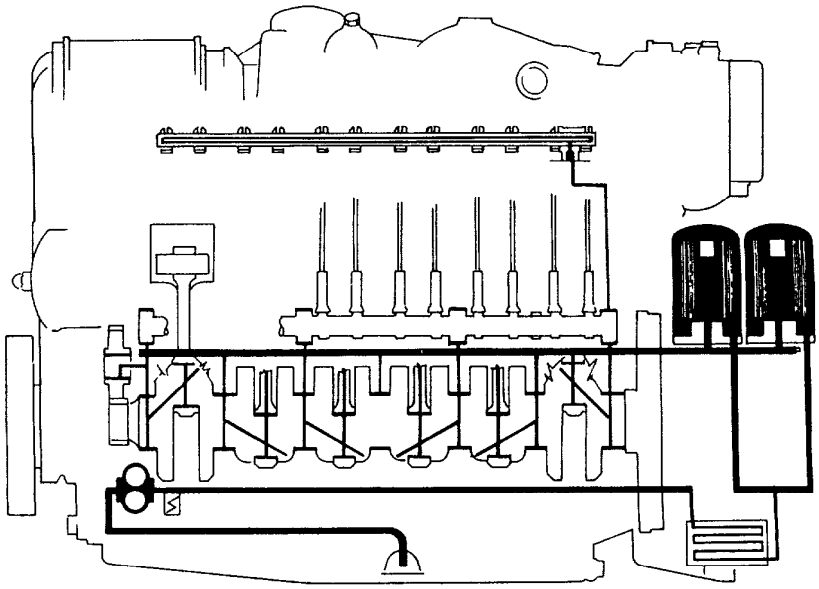
LEFT SIDE VIEW



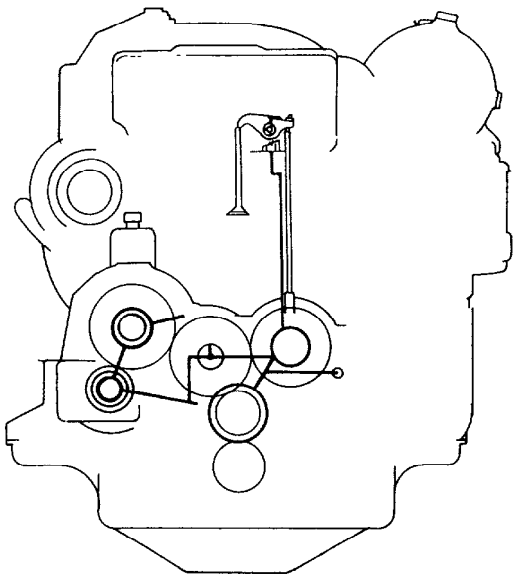
Z = sacrifical anode

LUBRICATION CIRCUIT

LATERAL SECTION



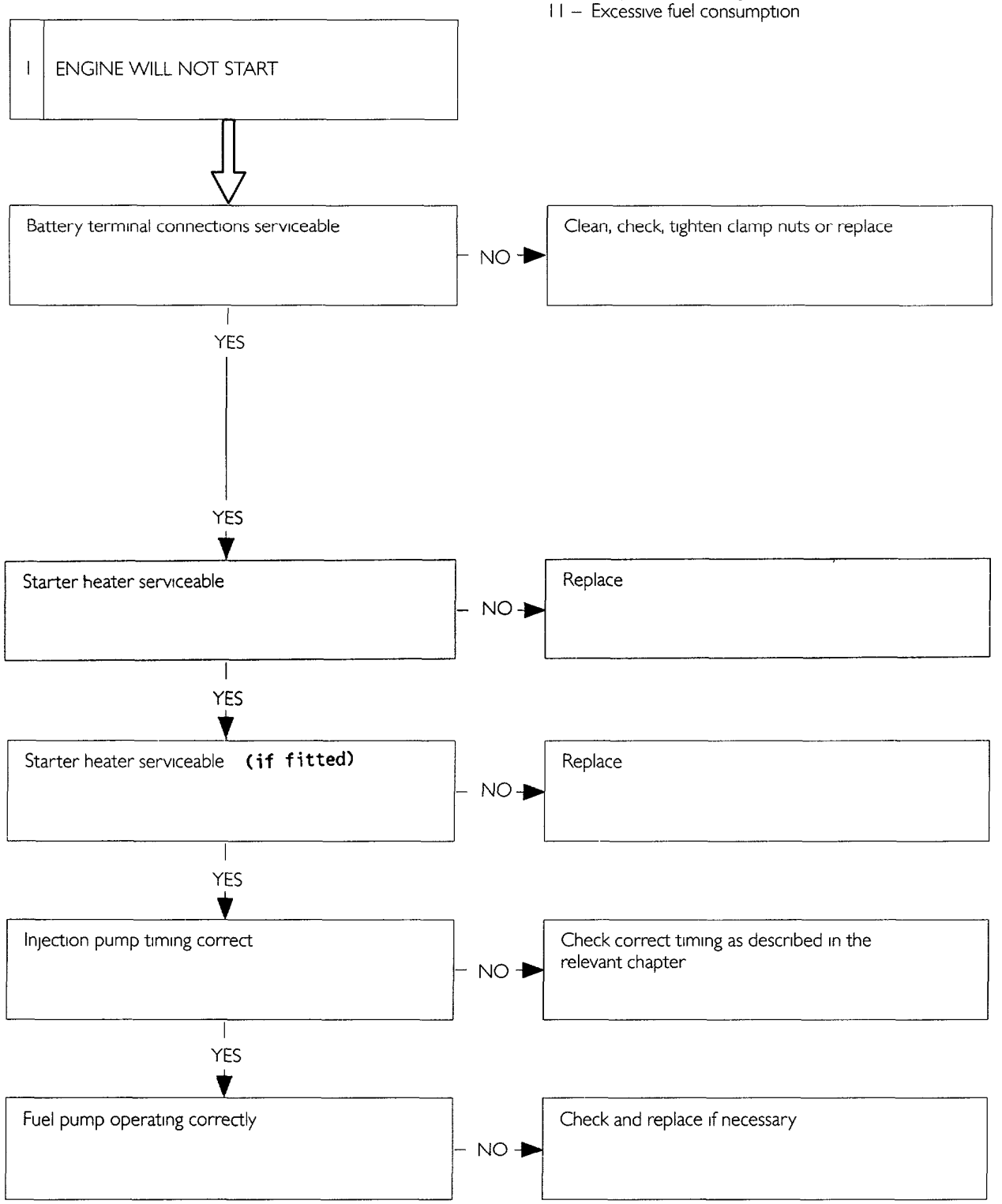
FRONT SECTION

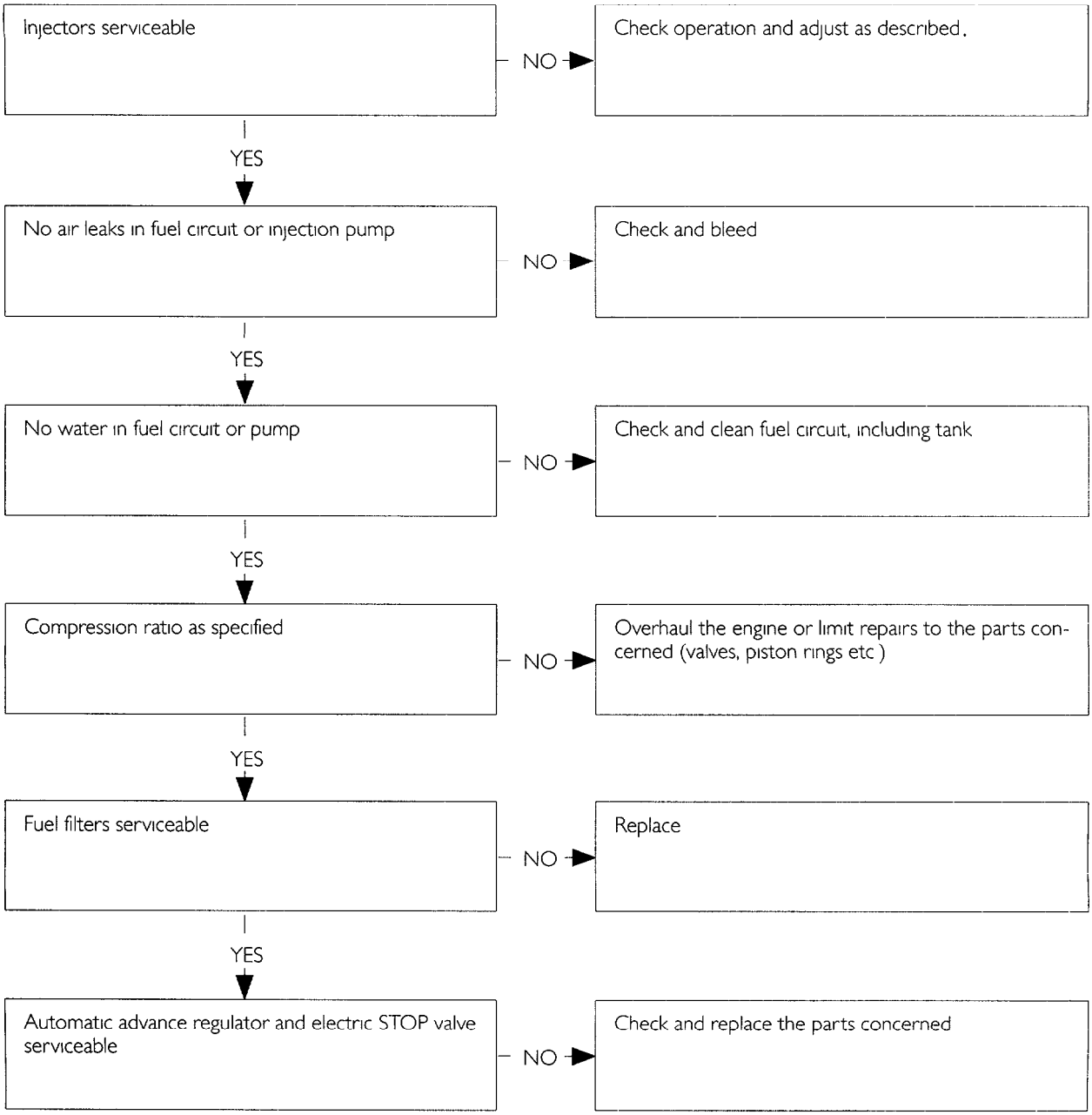


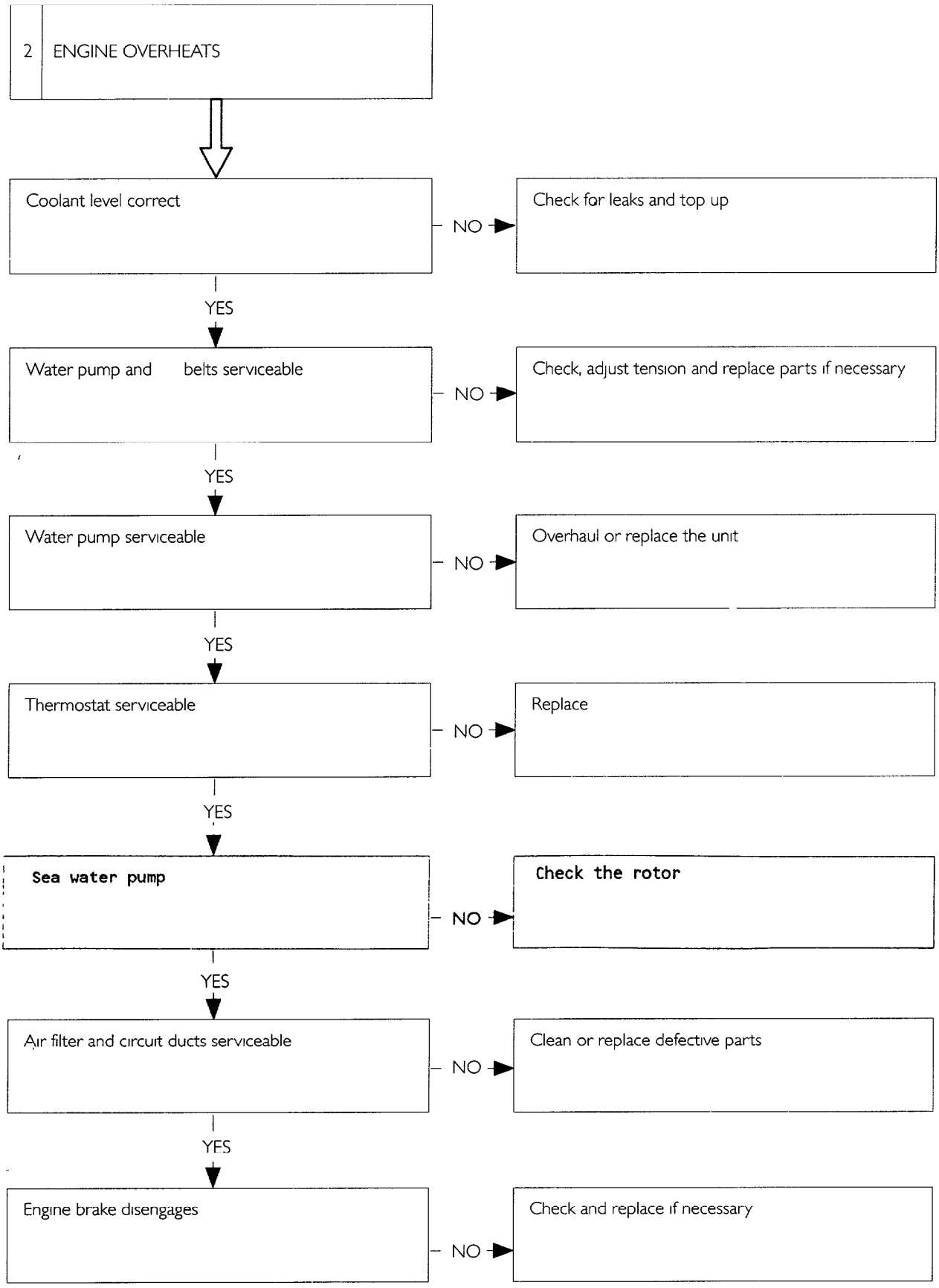
FAULT DIAGNOSIS

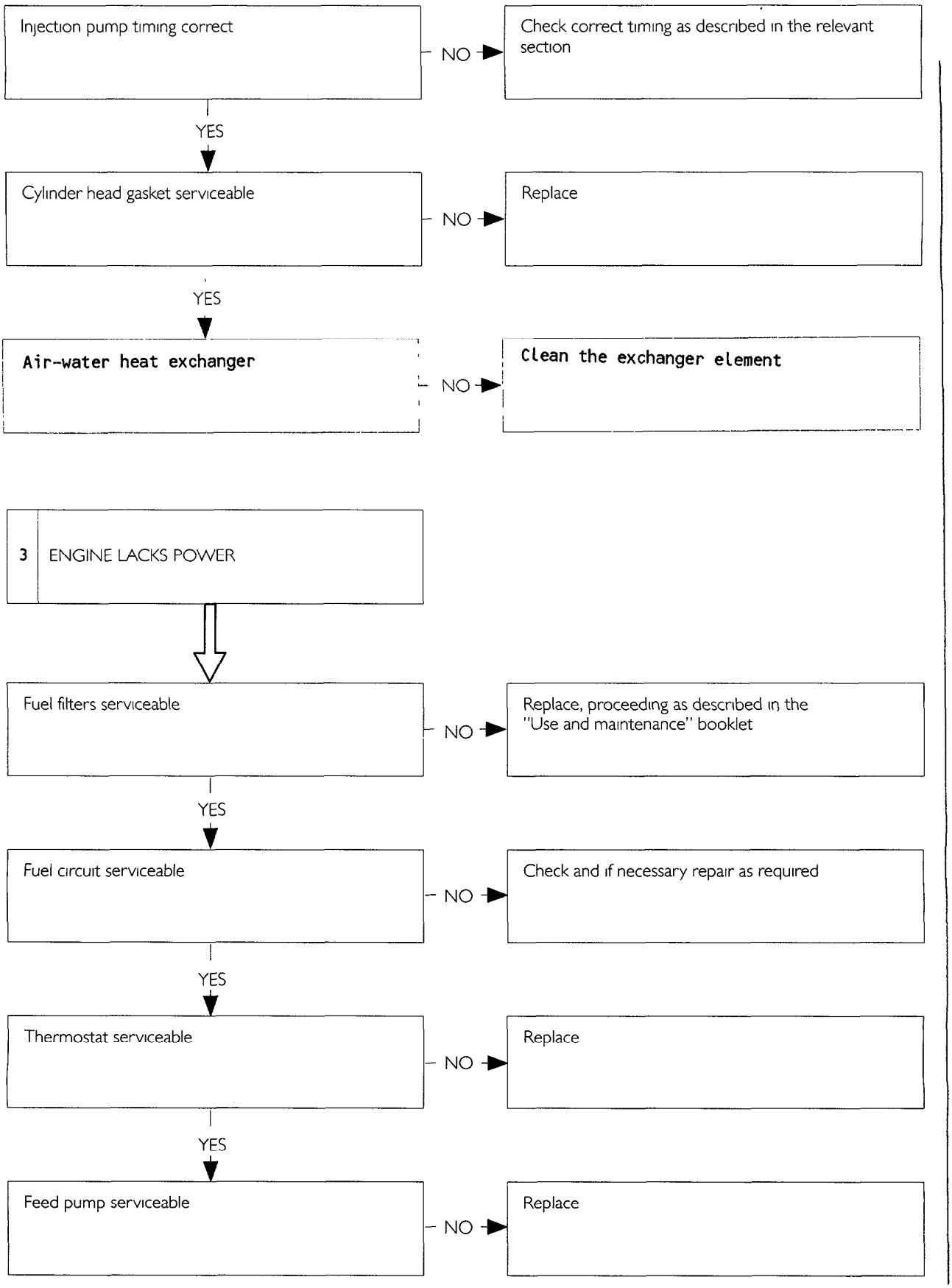
Main engine operating faults

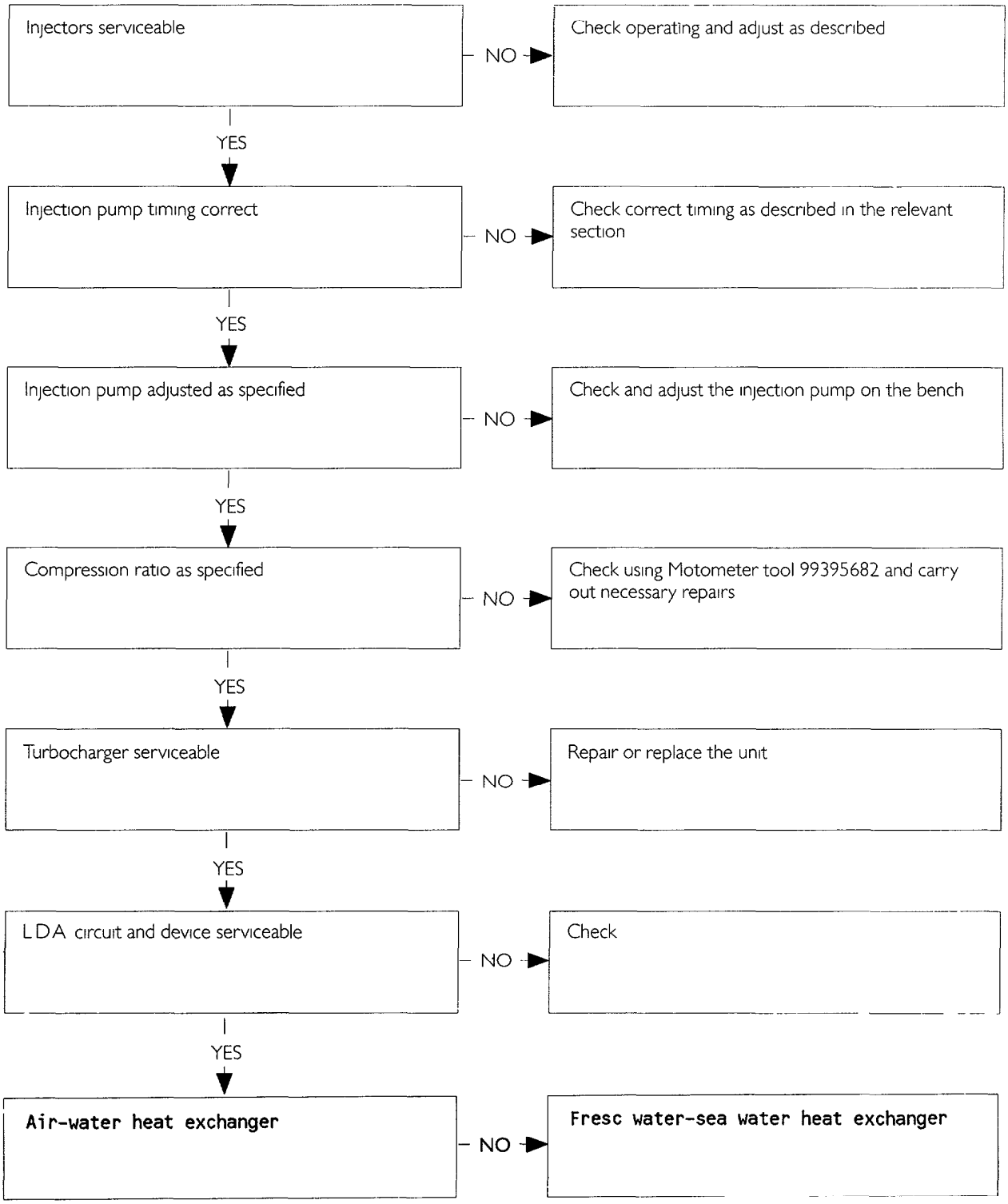
1 – Engine will not start
2 – Engine overheats
3 – Engine lacks power
4 – Engine emits black or dark grey smoke
5 – Engine emits grey (whitish) smoke
6 – Engine emits blue smoke
7 – Abnormal knocking from the engine
8 – Engine stops
9 – Engine exceeds maximum rpm
10 – Oil pressure too high or too low
11 – Excessive fuel consumption

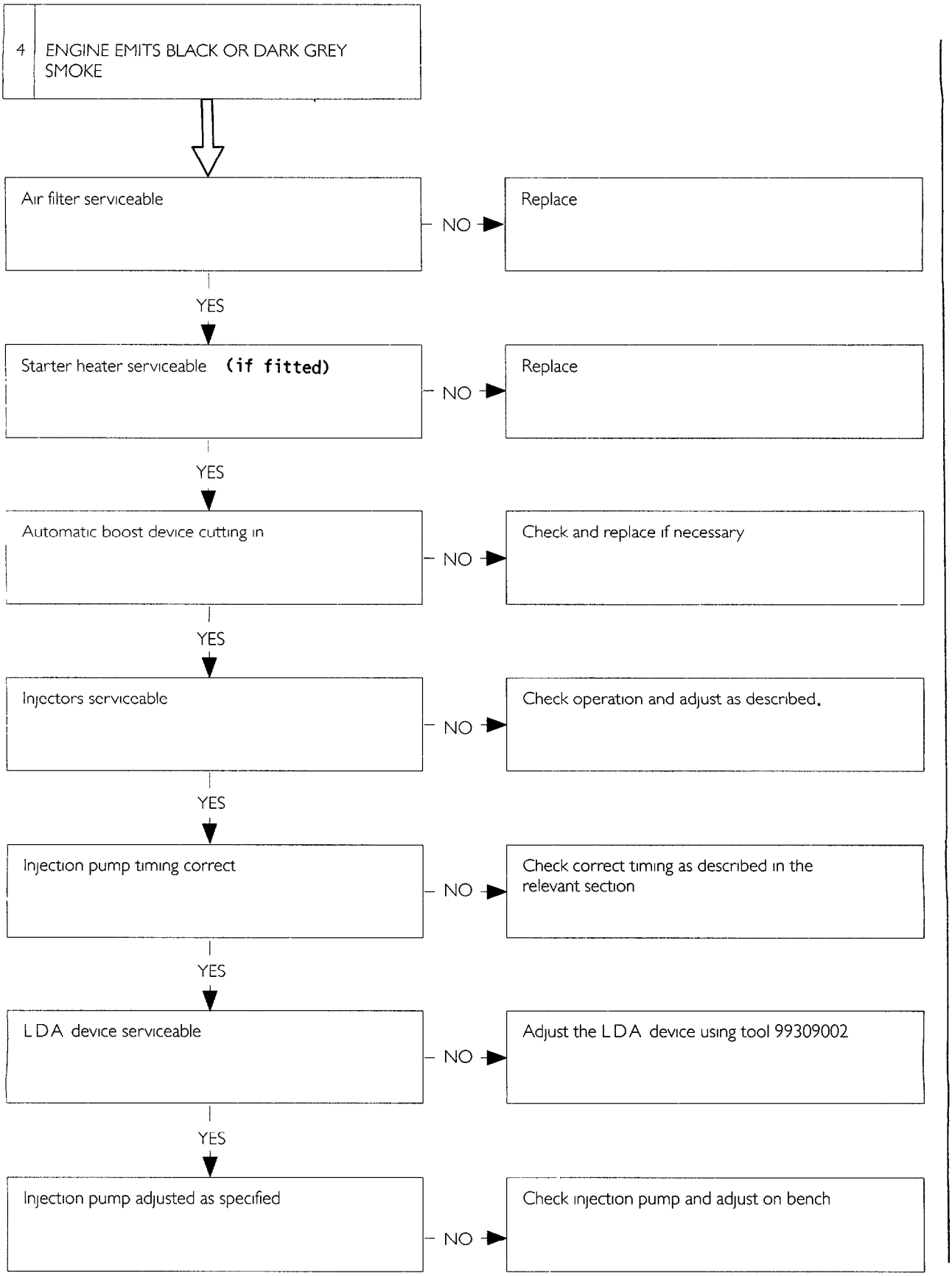


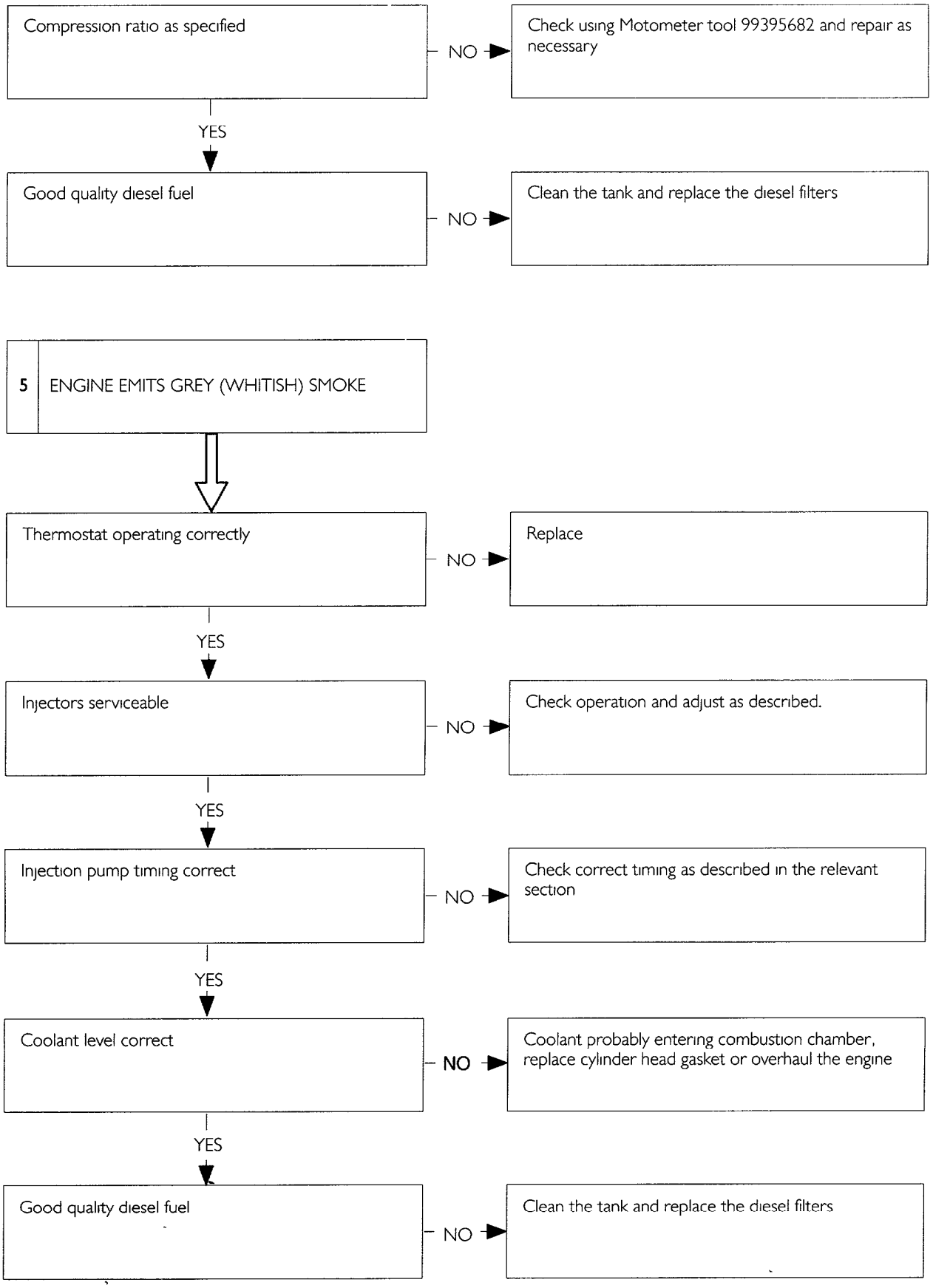

Injectors serviceable
NO
Check operation and adjust as described.
YES
No air leaks in fuel circuit or injection pump
NO
Check and bleed
YES
No water in fuel circuit or pump
NO
Check and clean fuel circuit, including tank
YES
Compression ratio as specified
NO
Overhaul the engine or limit repairs to the parts concerned (valves, piston rings etc)
YES
Fuel filters serviceable
NO
Replace
YES
Automatic advance regulator and electric STOP valve serviceable
NO
Check and replace the parts concerned

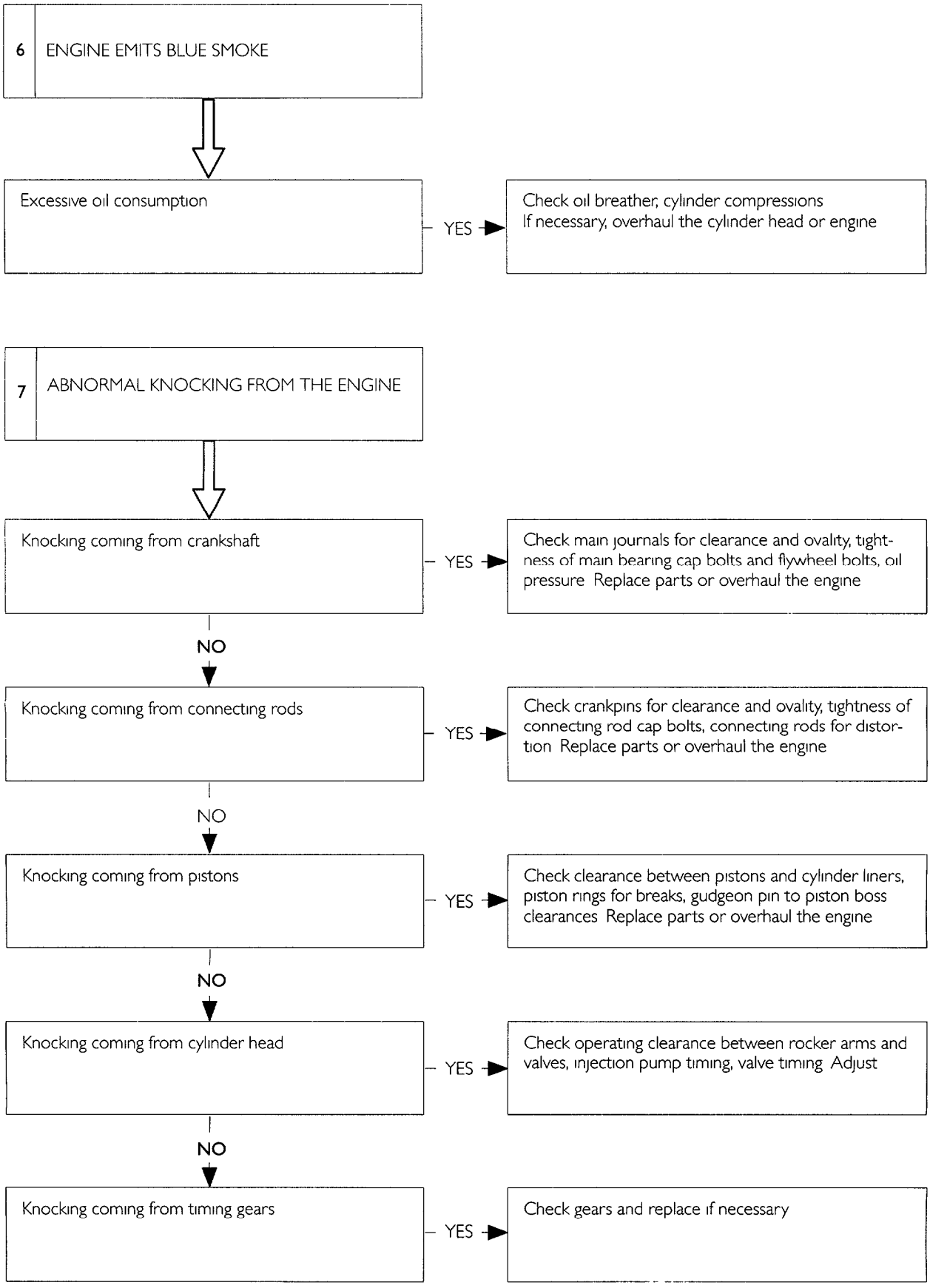

2 ENGINE OVERHEATS
Coolant level correct
NO
Check for leaks and top up
YES
Water pump and belts serviceable
NO
Check, adjust tension and replace parts if necessary
YES
Water pump serviceable
NO
Overhaul or replace the unit
YES
Thermostat serviceable
NO
Replace
YES
Sea water pump
NO
Check the rotor
YES
Air filter and circuit ducts serviceable
NO
Clean or replace defective parts
YES
Engine brake disengages
NO
Check and replace if necessary

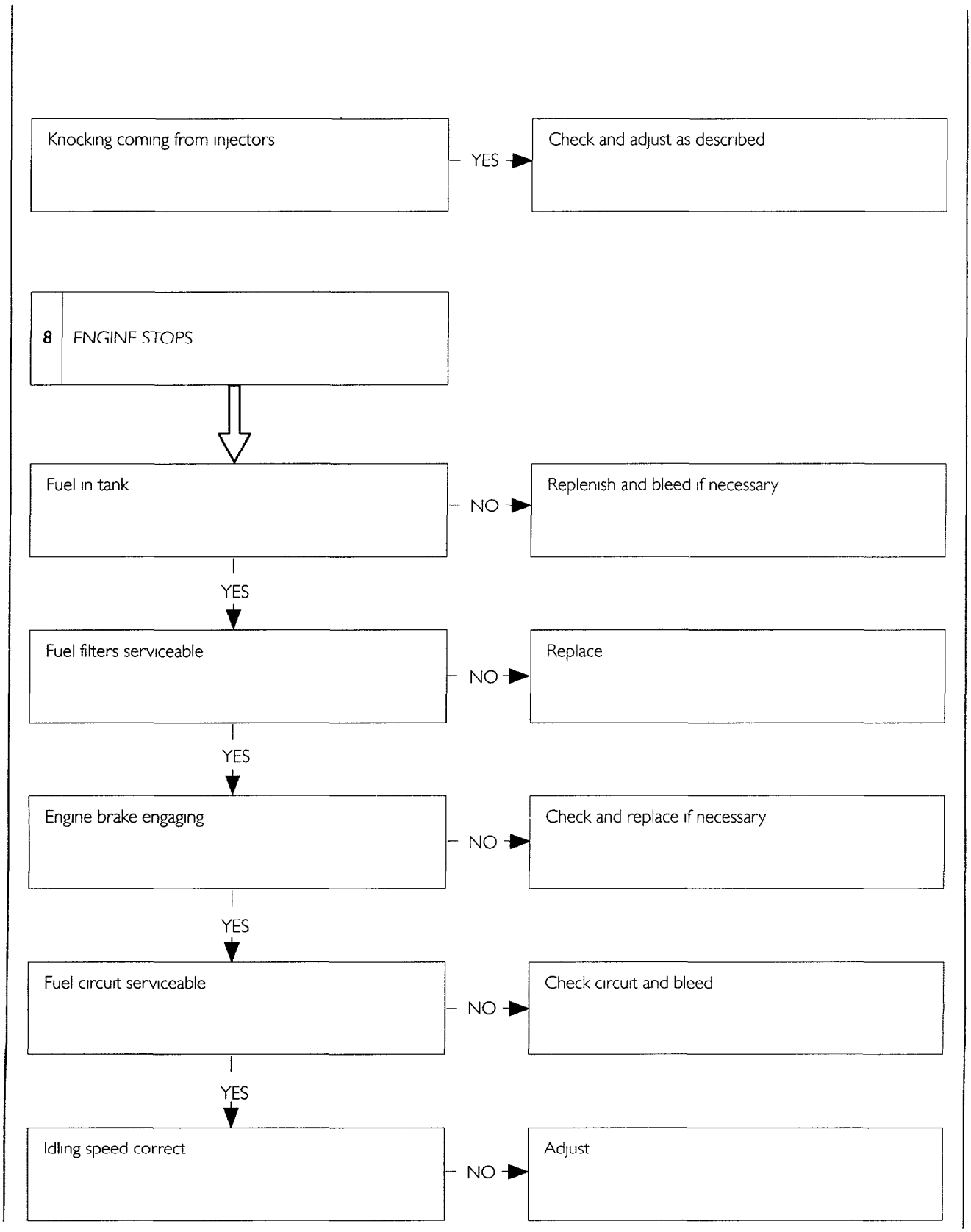

Injection pump timing correct
NO
Check correct timing as described in the relevant section
YES
Cylinder head gasket serviceable
NO
Replace
YES
Air-water heat exchanger
NO
Clean the exchanger element
3 ENGINE LACKS POWER
Fuel filters serviceable
NO
Replace, proceeding as described in the "Use and maintenance" booklet
YES
Fuel circuit serviceable
NO
Check and if necessary repair as required
YES
Thermostat serviceable
NO
Replace
YES
Feed pump serviceable
NO
Replace

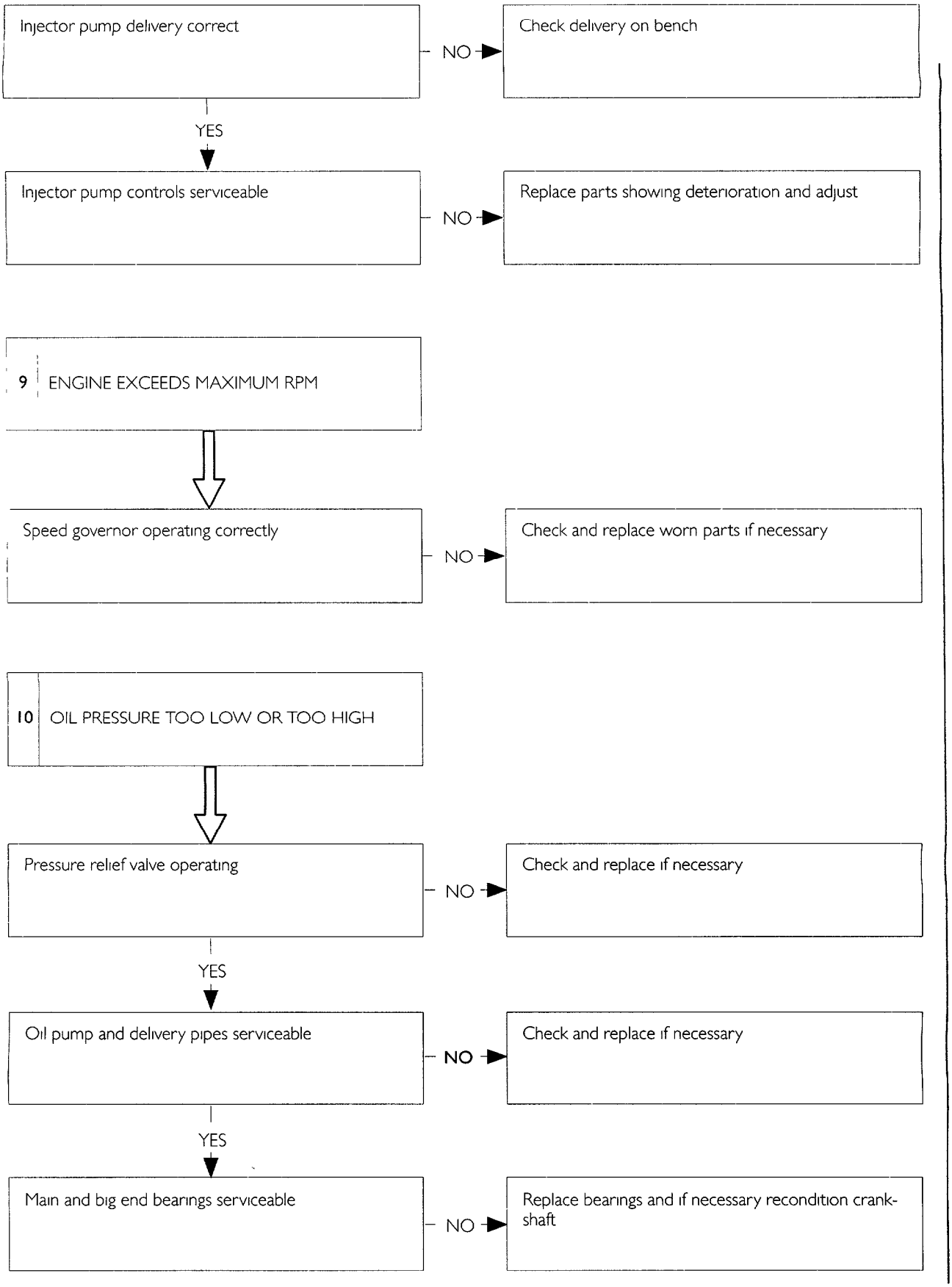

Injectors serviceable
NO
Check operating and adjust as described
YES
Injection pump timing correct
NO
Check correct timing as described in the relevant section
YES
Injection pump adjusted as specified
NO
Check and adjust the injection pump on the bench
YES
Compression ratio as specified
NO
Check using Motometer tool 99395682 and carry out necessary repairs
YES
Turbocharger serviceable
NO
Repair or replace the unit
YES
LDA circuit and device serviceable
NO
Check
YES
Air-water heat exchanger
NO
Fresc water-sea water heat exchanger


4 ENGINE EMITS BLACK OR DARK GREY SMOKE
Air filter serviceable
NO
Replace
YES
Starter heater serviceable (if fitted)
NO
Replace
YES
Automatic boost device cutting in
NO
Check and replace if necessary
YES
Injectors serviceable
NO
Check operation and adjust as described.
YES
Injection pump timing correct
NO
Check correct timing as described in the relevant section
YES
LDA device serviceable
NO
Adjust the LDA device using tool 99309002
YES
Injection pump adjusted as specified
NO
Check injection pump and adjust on bench


Compression ratio as specified
NO
Check using Motometer tool 99395682 and repair as necessary
YES
Good quality diesel fuel
NO
Clean the tank and replace the diesel filters
5 ENGINE EMITS GREY (WHITISH) SMOKE
Thermostat operating correctly
NO
Replace
YES
Injectors serviceable
NO
Check operation and adjust as described.
YES
Injection pump timing correct
NO
Check correct timing as described in the relevant section
YES
Coolant level correct
NO
Coolant probably entering combustion chamber, replace cylinder head gasket or overhaul the engine
YES
Good quality diesel fuel
NO
Clean the tank and replace the diesel filters


6 ENGINE EMITS BLUE SMOKE
Excessive oil consumption
YES
Check oil breather, cylinder compressions
If necessary, overhaul the cylinder head or engine
7 ABNORMAL KNOCKING FROM THE ENGINE
Knocking coming from crankshaft
YES
Check main journals for clearance and ovality, tightness of main bearing cap bolts and flywheel bolts, oil pressure Replace parts or overhaul the engine
NO
Knocking coming from connecting rods
YES
Check crankpins for clearance and ovality, tightness of connecting rod cap bolts, connecting rods for distortion Replace parts or overhaul the engine
NO
Knocking coming from pistons
YES
Check clearance between pistons and cylinder liners, piston rings for breaks, gudgeon pin to piston boss clearances Replace parts or overhaul the engine
NO
Knocking coming from cylinder head
YES
Check operating clearance between rocker arms and valves, injection pump timing, valve timing Adjust
NO
Knocking coming from timing gears
YES
Check gears and replace if necessary


Knocking coming from injectors
YES
Check and adjust as described
8 ENGINE STOPS
Fuel in tank
NO
Replenish and bleed if necessary
YES
Fuel filters serviceable
NO
Replace
YES
Engine brake engaging
NO
Check and replace if necessary
YES
Fuel circuit serviceable
NO
Check circuit and bleed
YES
Idling speed correct
NO
Adjust


Injector pump delivery correct
NO
Check delivery on bench
YES
Injector pump controls serviceable
NO
Replace parts showing deterioration and adjust
9 ENGINE EXCEEDS MAXIMUM RPM
Speed governor operating correctly
NO
Check and replace worn parts if necessary
10 OIL PRESSURE TOO LOW OR TOO HIGH
Pressure relief valve operating
NO
Check and replace if necessary
YES
Oil pump and delivery pipes serviceable
NO
Check and replace if necessary
YES
Main and big end bearings serviceable
NO
Replace bearings and if necessary recondition crankshaft

Engine oil viscosity correct — NO → Replace engine oil with one of suitable viscosity

II EXCESSIVE FUEL CONSUMPTION

Fuel tank and pipes serviceable — NO → Eliminate any leaks and replace parts showing deterioration

YES

Air filter serviceable — NO → Replace

YES

Injector adjustment correct — NO → Check operation and adjust as described.

YES

Injector pump adjustment correct — NO → Check and adjust on test bench

YES

L D A device serviceable — NO → Adjust the L D A, device using tool 99309002

YES

Injection pump timing correct — NO → Check static setting of injection pump

SEA WATER PUMP

GENERALITIES

The sea water circulation for cooling the fresh water and the marine gear oil is ensured by a self-priming pump type neoprene impeller

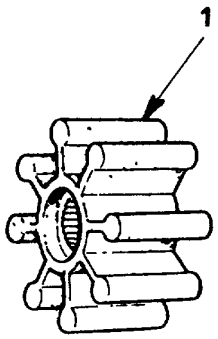
INSTRUCTION FOR USE

Each time the engine is started, check that the sea water intake valve is open. Dry running of the pump would damage the impeller (1) in a very short time.

Under normal operating conditions of the engine check every 800 hours the state of the neoprene impeller, after removing first the cover

Make sure that it is free from cracks or excessive wear of the lobe.

If not replace it.

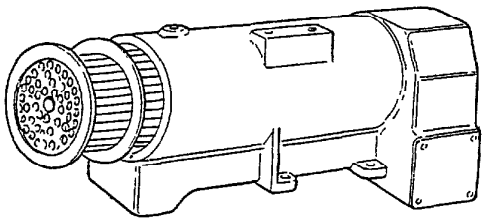


HEAT EXCHANGERS

FRESH WATER-SEA WATER HEAT EXCHANGER

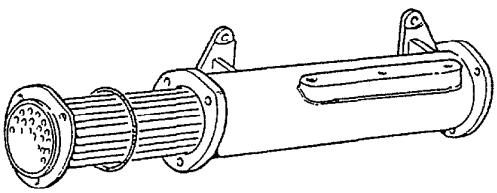
GENERALITIES

When the fresh water circulating in the engine reaches temperature values in excess of 68° (all versions) is convoyed under thermostatic control to the fresh water sea water heat exchanger, where it is cooled and returned to circulation
This heat exchanger consists essentially of a cast iron body with the fresh water circulation therein and a copper tube bundle containing the circulating sea water for cooling the fresh water



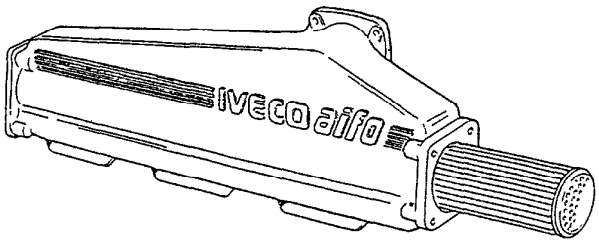
OIL WATER HEAT EXCHANGER

On the engine is fitted an oil-water heat exchanger which is composed by a body with the oil circulation therein and a copper tube bundle containing the circulating sea water for cooling the engine oil



AIR - WATER HEAT EXCHANGER

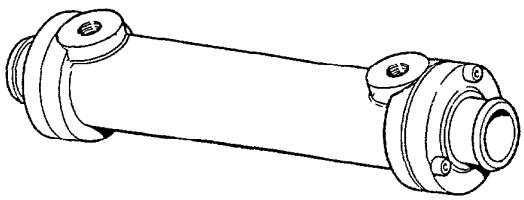
In the intake manifold is fitted the sea water-air heat ex changer
The engine intake air is cooled from the circulating sea water



MARINE GEAR OIL -WATER HEAT EXCHANGER

On the engine is fitted a marine gear oil-sea water heat exchanger which is composed by a copper tube bundle containing sea water for cooling the engine oil

Remove the engine lifting bracket (1), take off the fuel filter support bracket (2)

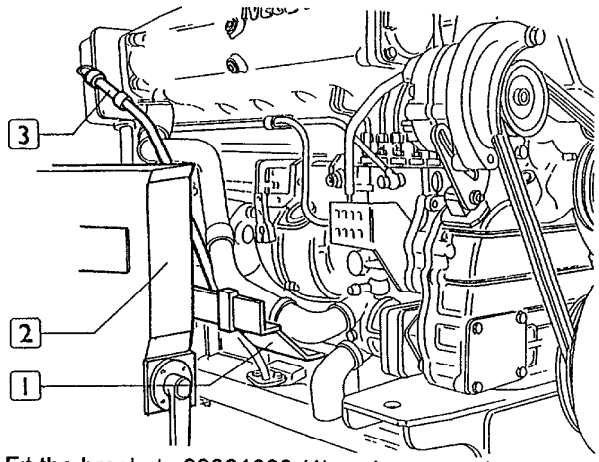


MAINTENANCE

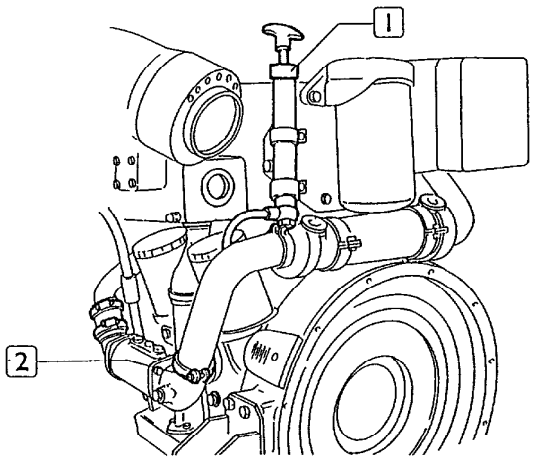
For ensuring the perfect efficiency of the fresh water-sea water heat exchanger it is necessary to clean periodically the tube bundle
Remove the tube bundle from the exchanger body and immerse it into a solution of water and anti-incrustator type "P3" or the like (*) which does not attack copper, brass, aluminium and tin
- After the end of the reaction (indicated by effervescence) after about 15 to 20 minutes, rinse the tube bundle aboundingly with running water for completely eliminating any residue of the solution and re-assemble the bundle into the exchanger body

(*) When using solvents observe the prescriptions of the makers

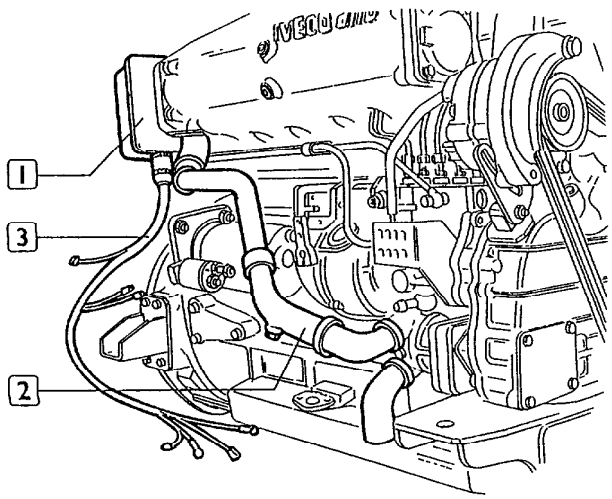
ENGINE BENCH DISASSEMBLY



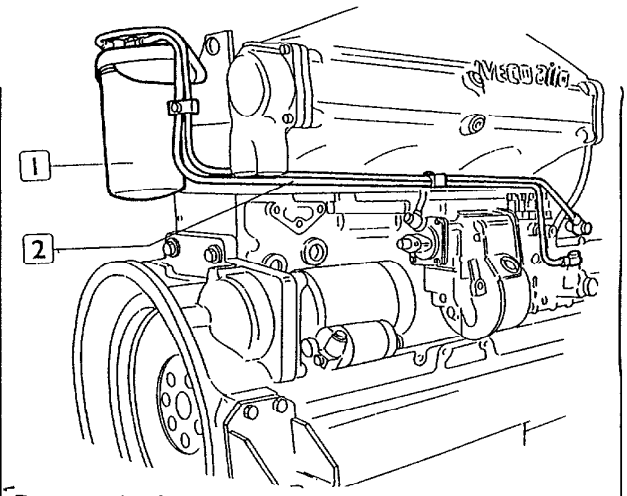
Fit the brackets 99361033 (1) and arrange the engine on the swivelling stand 99322205 (2), remove the oil level dipstick sleeve (3)



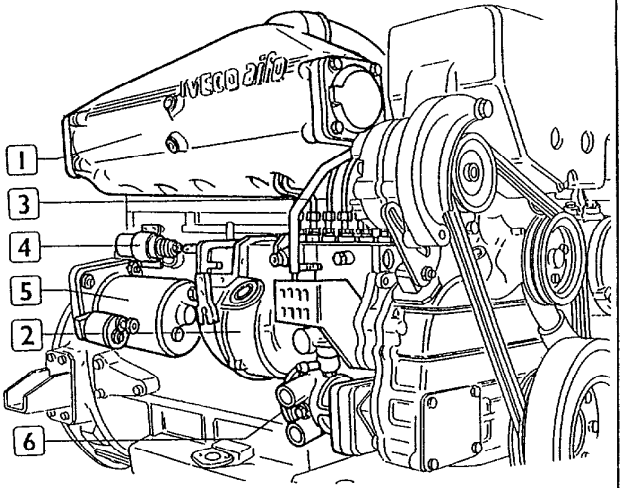
Drain the oil from the sump by means of the hand suction pump (1), drain the engine water cooling circuit unscrewing the bolts (2) and the clamps of the sleeves placed on the bottom of the engine



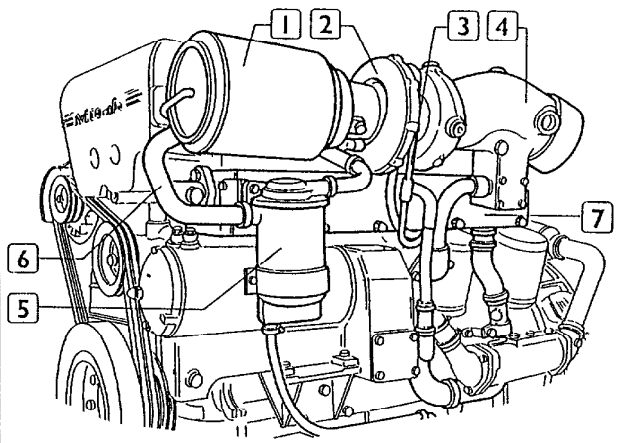
Remove the engine stop and starting box (1), the electric system (3)
Remove the water pipes (2) and the oil lines



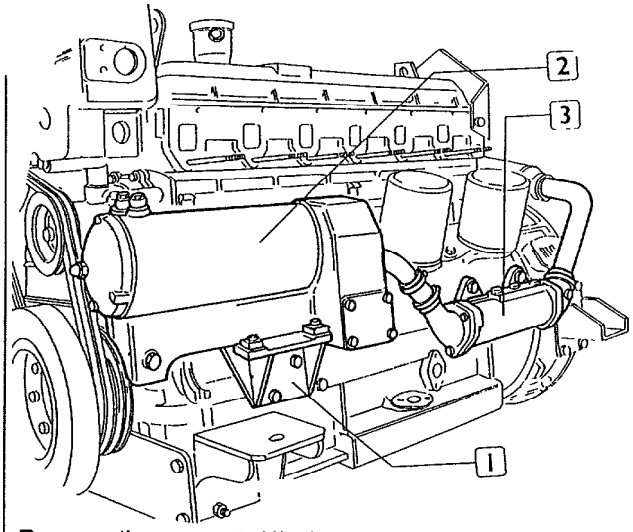
Remove the fuel filter (1) with the relevant lines (2)



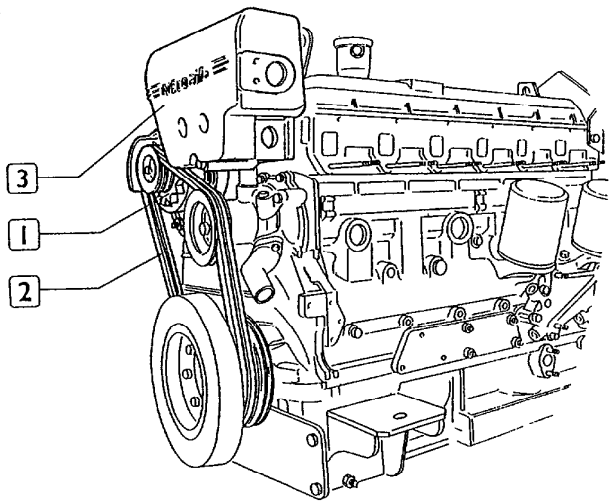
Disassemble the intake manifold (1), remove the injection pump (2), the injectors lines (3), remove the engine stop solenoid (4), the starter motor (5), disassemble at the end the sea water pump (6)



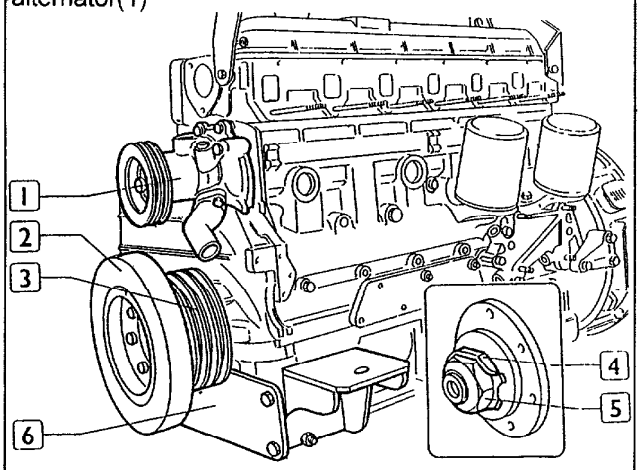
Unscrew the coupling and remove the air cleaner (1), the turbocharger (2) with the relevant oil lines (3), remove the exhaust cooled bend(4), remove the engine breather tank (5) with the connection rubber pipe (6), disassemble the exhaust manifold(7) with the wastegate valve



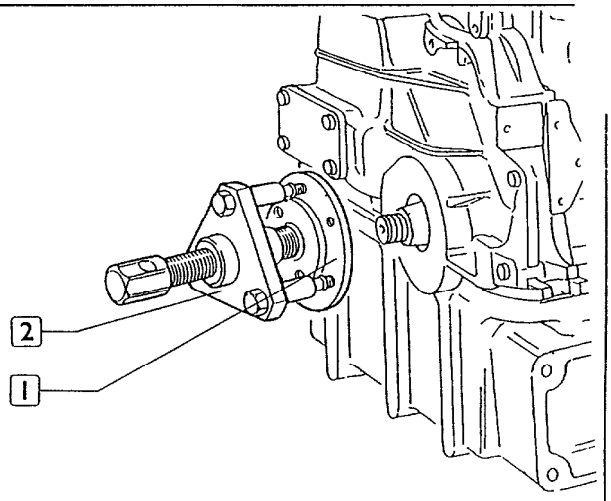
Remove the support (1), the water-water heat exchanger (2), disassemble the oil-water heat exchanger (3)



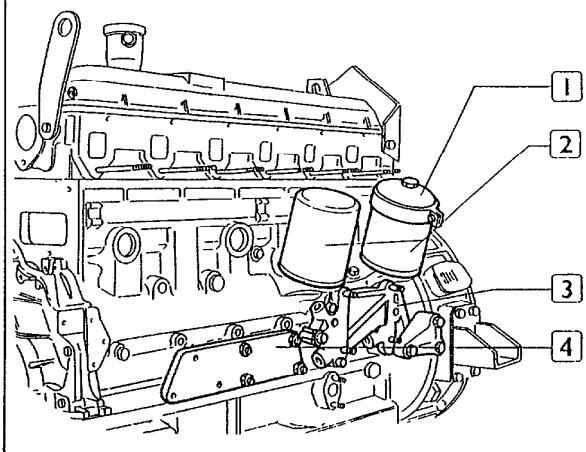
Lock the flywheel using tool 99360352
Move the alternator (1) in the forward direction and take off the relevant belts (2) Take off the water tank (3), the alternator(1)



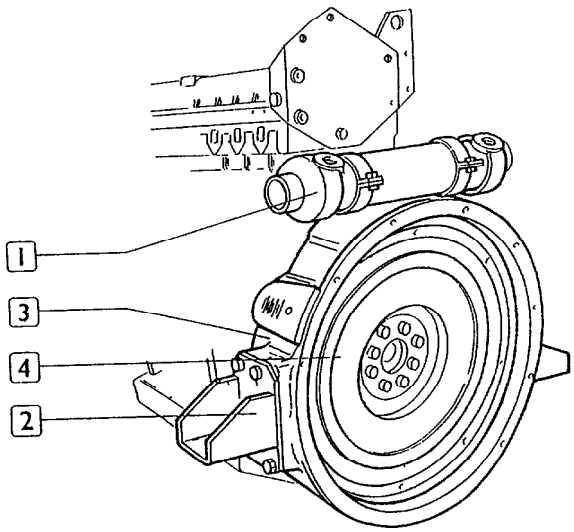
Remove the water pump (1) with the pulley, the flywheel dumper (2), the power take-off pulley (3), strighten the locking plate (4) on the hub and unscrew the nut (5), remove the front brackets (6)



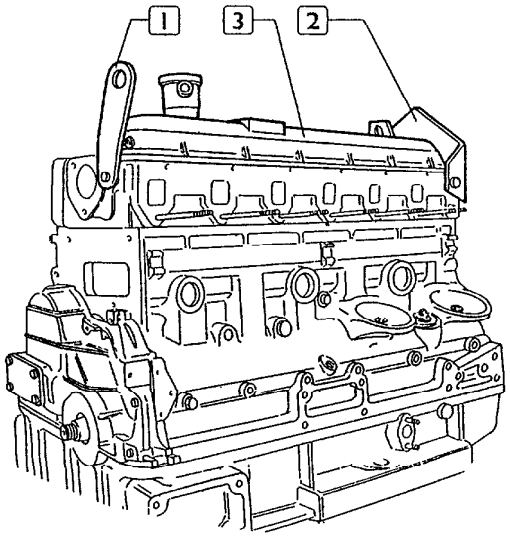
Remove the hub (1) for the damper flywheel using the tool 99340033 (3)



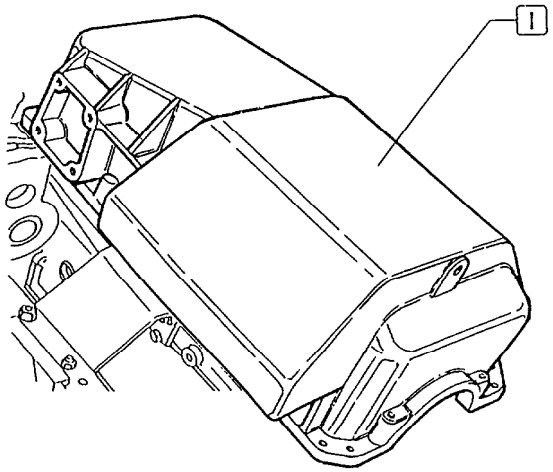
Using tool 99360314 (1), unscrew the oil filters (2)taking off the oil-water heat exchanger support (3) and the water-water heat exchanger support (4)



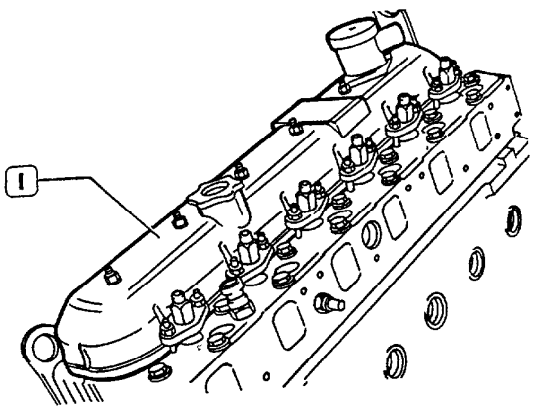
Remove the marine gear heat exchanger (1), take off the engine rear supports (2), the flywheel (4) and the and the carter flywheel (3)



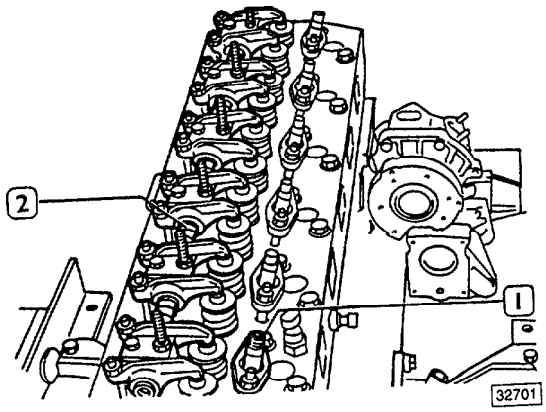
Remove the engine lifting bracket (1), take off the fuel filter support bracket (2)



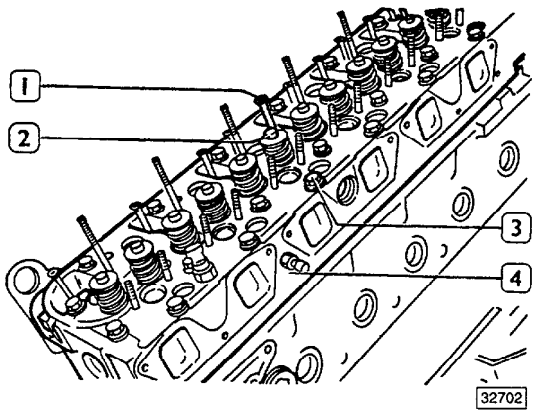
Rotate the engine 180° and remove the oil sump (1)



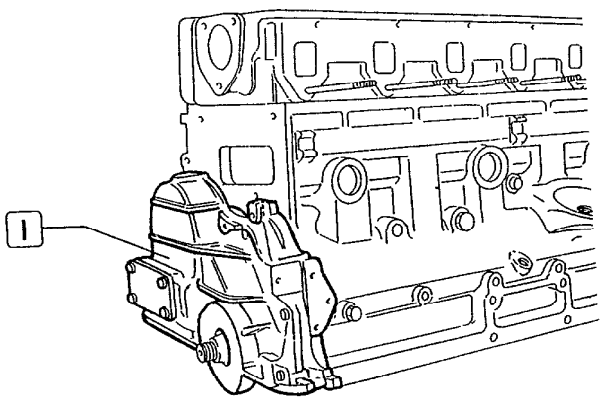
Remove the rocker cover (1)



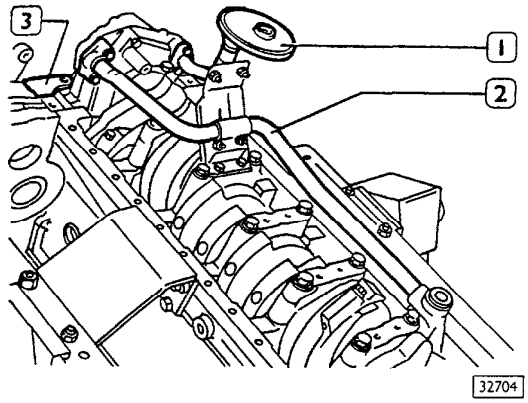
Remove the injectors (1) and the rocker shaft assembly (2)



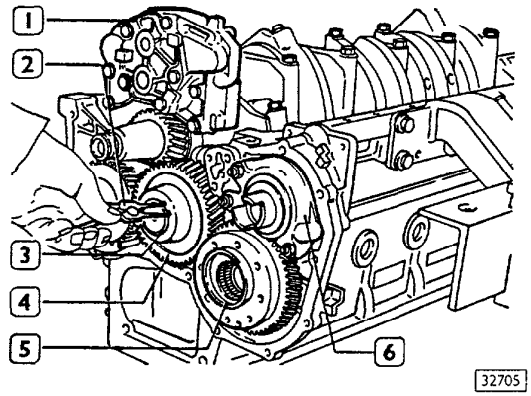
Recover the pushrods (1) and the caps (2) from the valve stems
Unsrew the bolts (3) securing the cylinder head (4) and remove the same, recovering the gasket



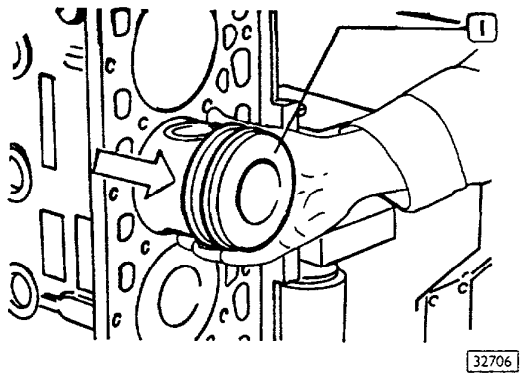
Remove the front cover (1) of the timing gears



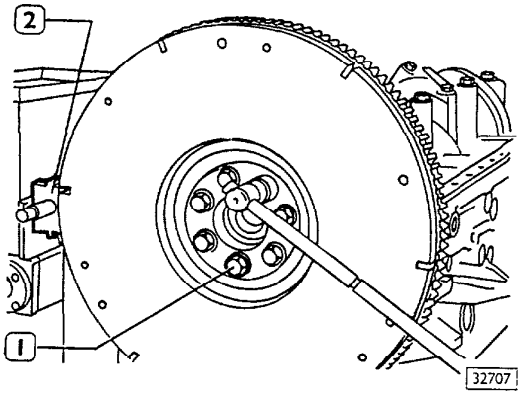
Dismount the oil suction pipe (1), the oil feed pipe (2) and the control toothed wheel cover (3).



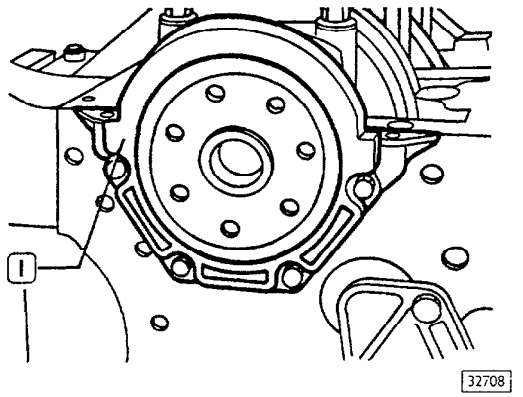
Remove the locking ring (3) by means of round pliers (2) and pull off the transmission gear wheel (4). Replace the oil pump (1) Dismount the driving shaft bearing (6) of the power steering pump Dismount the driving toothed wheel (5) of the injection pump.



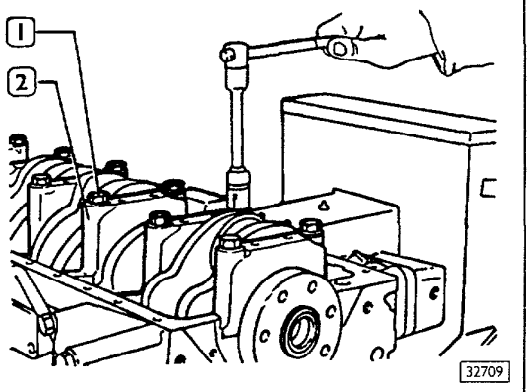
Dismount the connecting rod covers, put aside the bearing shells and pull out the assembly piston/connecting rod (1) out of the upper part of the crankcase



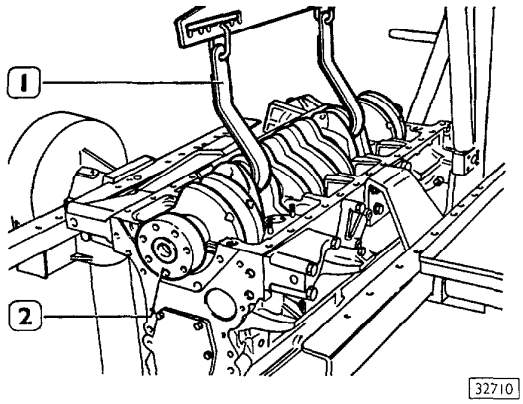
Loosen the engine flywheel fastening screws (1), remove tool 99360352 (2) and dismount the flywheel



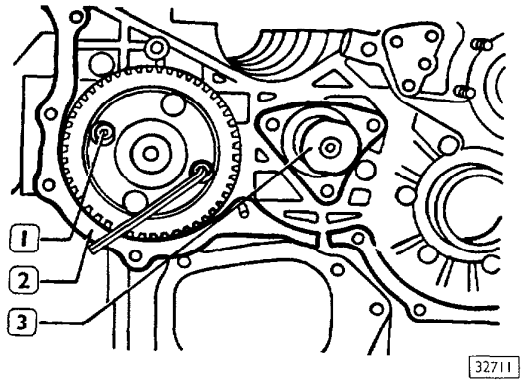
Dismount the rear cover (1) together with the sealing ring



Loosen the screws (1) of the main bearing covers (2) and dismount the covers



Lift and dismount the crankshaft (2) by means of tool 99360500 (1), keep the main bearing shells and the shoulder semi-rings of the crankcase



Loosen the locking screws (1) of the collar plate and pull out the camshaft Pull the valve lifters out of their seats and dismount the oil spring nozzles.
Remove the bracket (3) of the transmission gear wheel and the control housing (2)

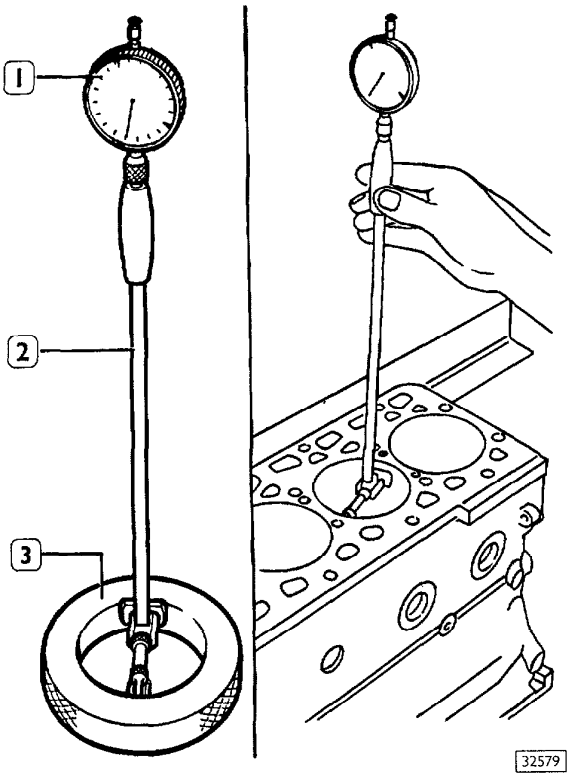
Clean carefully all dismounted parts and check their integrity after dismounting of the engine
On the following pages instructions for the main checks and measurings are given which have to be carried out to determine whether the parts can be used again for mounting

REPAIRS

CYLINDER BLOCK

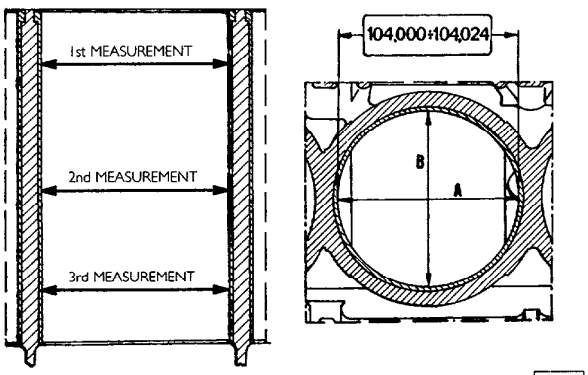
CONTROLS AND MEASUREMENT

Because of its ductility the cylinder liner must never be measured inside when dismounted, the inner diameter must be measured at completely mounted liner



In order to determine the value of the out-of-round, of the conical form and of the wear the inner diameter of the liners is checked by means of gauge 99395687 (2) provided with centi indicating caliper (1) that has been previously calibrated at a ring gauge (3) with a diameter of 104 mm

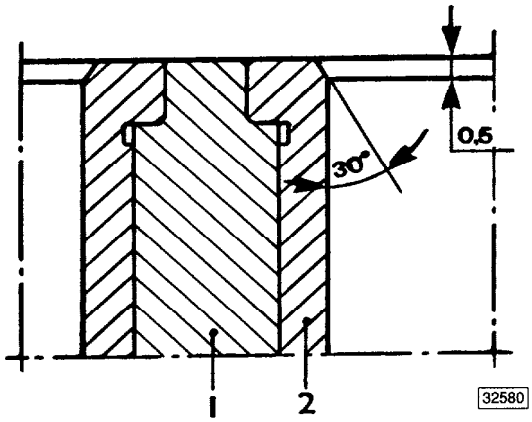
If a ring gauge with a diameter of 104 mm is not available, use a slide gauge



PLAN FOR CHECKING CYLINDER LINER DIAMETER

The measurements must be carried out for each individual cylinder at three different levels in the liner and in two planes at right angles to each other, one parallel to the lengthwise axis (A) and the other at right angles to it (B) Maximum wear is generally found in this plane (B) and in line with the first measurement If ovality or taper or wear of any kind is found, it may be eliminated at overhaul by grinding the liners if the wear or scoring is light, or by reboring and then grinding if there is deep scoring or marked ovality

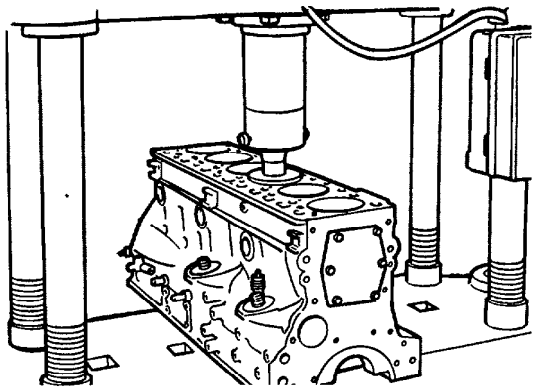
Where reconditioning is carried out, all liners must be finished to the same oversize (0 4 – 0 8 mm)



PLAN OF CHAMFER TO BE APPLIED TO CYLINDER LINERS AFTER RECONDITIONING

1. Crankcase 2 Cylinder liner

REPLACING CYLINDER LINERS



Removal and installation of the cylinder block liners is carried out using a hydraulic press and the appropriate adaptor plate

To install the cylinder liners in the cylinder block by using a press, the following steps have to be carried out

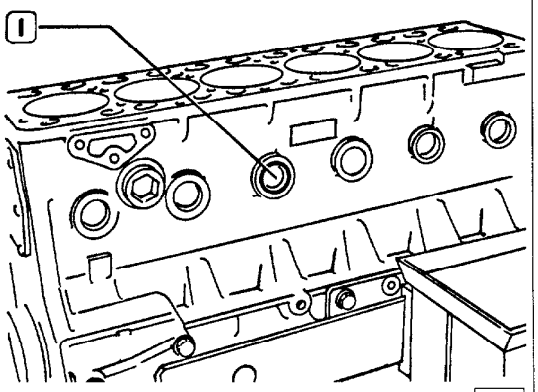
- ☐ Measure to ensure cylinder liner outer diameter is 106 970 – 106 940 mm and the cylinder block bore diameter is 106 850 – 106 900 mm,
- ☐ Lubricate the fitting surfaces with engine oil,
- ☐ Insert cylinder liner into the cylinder block and test, after pressing–in 70 – 90 mm the load must be not less than 5000 N and not more than 23 000 N,
- ☐ Continue pressing in and test, 30 mm before finishing, the load must be between 10 000 and 40 000 N,
- ☐ When pressing in is completed, wait 5" with a load of 50 000 or more to ensure liner is fully home, Strike blow with a hammer to ensure the liner is flush with the cylinder block,

If the fitting load is not within the specific figures, extract the liner and install a new one in its place
After they have been fitted, cylinder liners must be reamed and ground

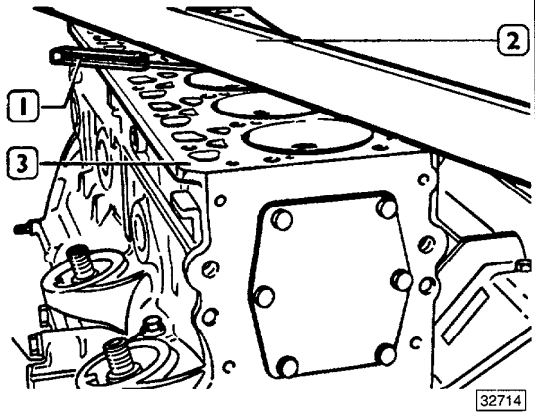
(NOTE 10 000 N = 1 Tonne)

Cylinder liners are supplied with an inner diameter slightly below nominal diameter to allow for any deformation which occurs during fitting to be corrected

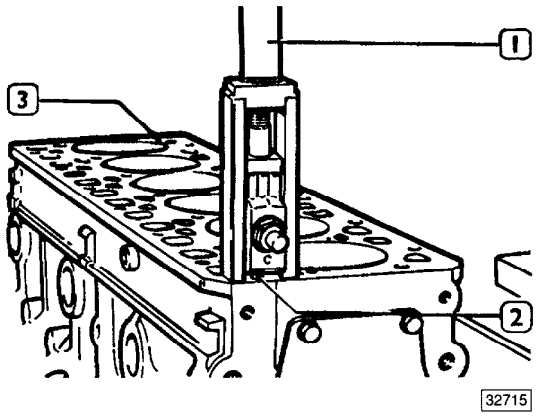
Replacement cylinder liners are also supplied with the outside diameter 0 2 mm oversize



Check the condition of the machining plugs (1) in the cylinder block, if they are rusted or there is the least suspicion of leakage, replace them



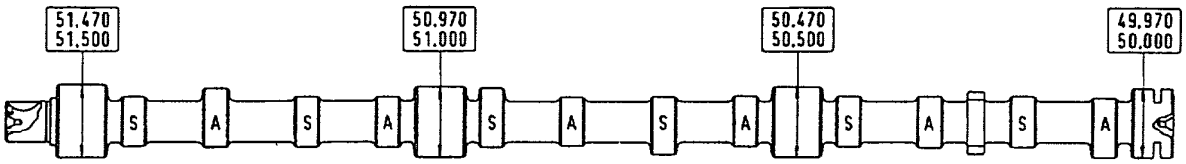
Check that the cylinder head mating surface (3) are flat using a calibrate rule (2) and a feeler gauge (1)
Grind any rough spots removing as little material as possible after removing the locating dowels
After grinding the cylinder head surface, restore the proptrusion of the cylinder liner border support base to 0 64 – 0 97 mm



Using the tool (1), remove the locating dowel (2) from the mating surface (3) of the cylinder

Extract the locating dowel only if the mating surface requires skimming

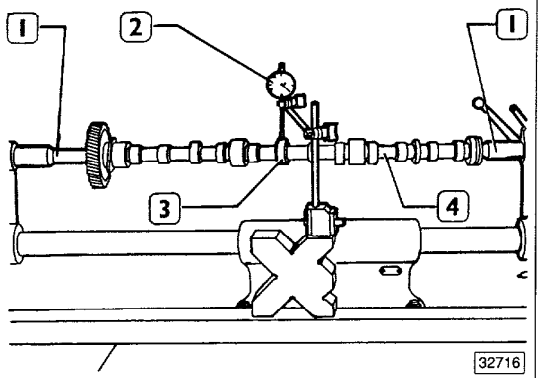
CAMSHAFT



MAIN DATA FOR THE CAMSHAFT

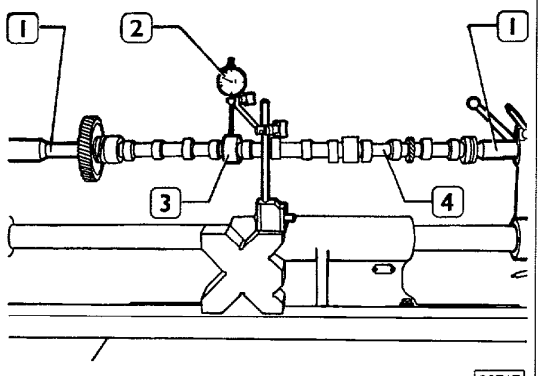
The surfaces of the shaft bearing journals and those of the cams must be absolutely smooth,

CHECKING CAM LIFT AND JOURNAL ALIGNMENT



Arrange the camshaft (4) between the centres (1) and using the hundredths dial gauge (2) check the lift of the cams (3) which should be

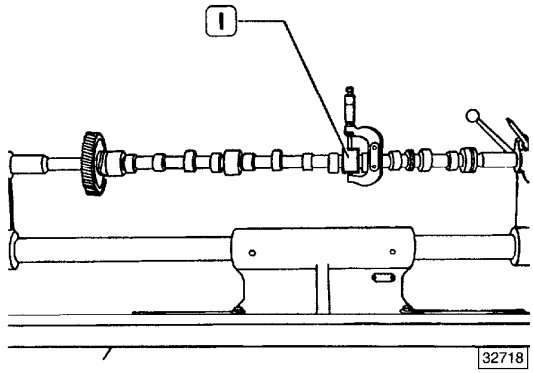
- ☐ 5 9/ mm for the inlet cam
- ☐ 6 25 mm for the exhaust cam



Still with the camshaft (4) arranged between centres (1), check the alignment of the support journals (3) using the hundredths dial gauge, this must not be more than 0 020 mm If a larger misalignment is found, replace the shaft

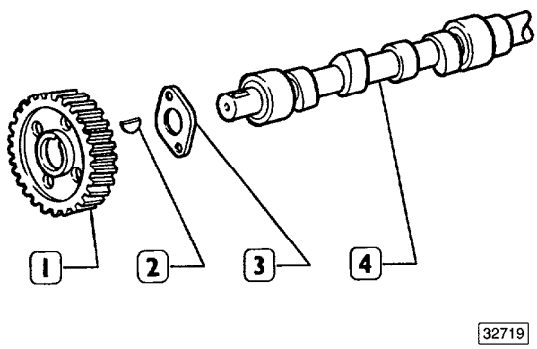
if they show traces of seizing and scoring, the shaft and associated bushes must be replaced

FIGURE 54



To check the assembly clearance, measure the inside diameters of the bushes (fig 57) and the diameter of the journals (1, fig 54) of the camshaft, the difference will give you the actual clearance If clearances of more than 0 1 60 mm are found, replace the bushes and the shaft too, if necessary

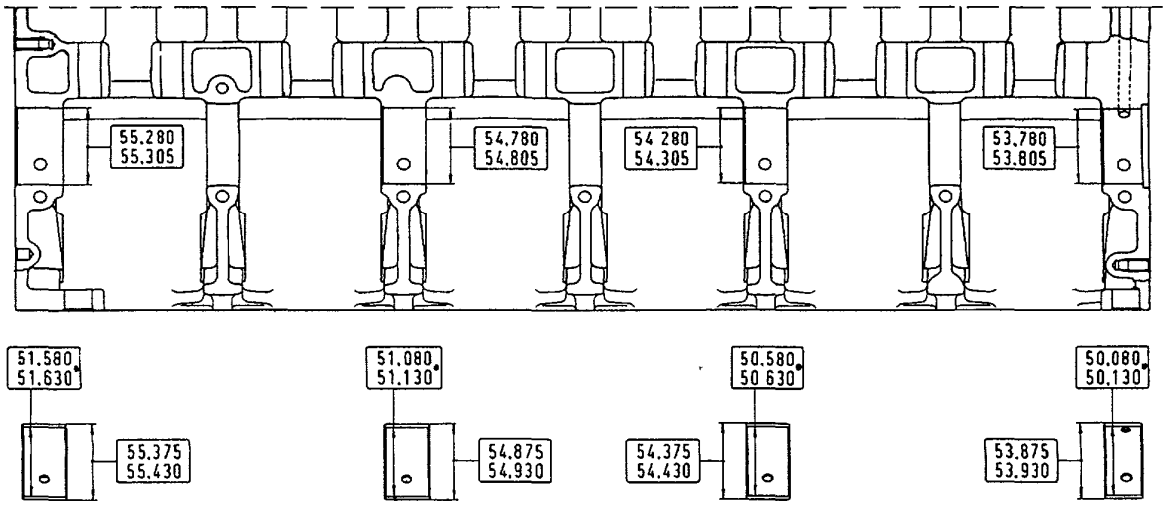
REPLACING THE CAMSHAFT GEAR



Check that the teeth of the camshaft gear (1) are not excessively damaged or worn, if they are, replace it When fitting the new gear, it should be heated in an oven for 10' at a temperature of 180° and then shrunk onto the shaft, having first fitted the plate (3) and key (2) to the shaft

BUSHES

The surfaces of the bushes must not show any signs of seizing or scoring, if they do, replace them



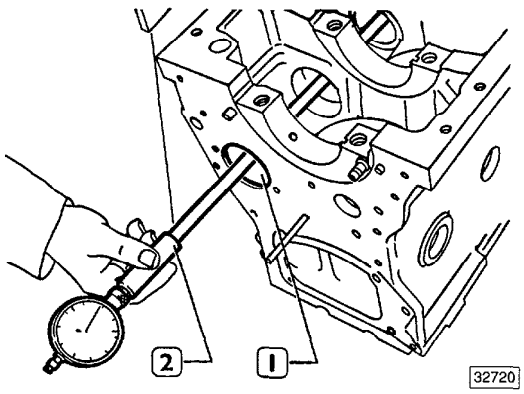
1403

MAIN DATA FOR CAMSHAFT BUSHES AND THEIR HOUSINGS IN THE CRANKCASE

- Dimension to be obtained after the bushes have been installed

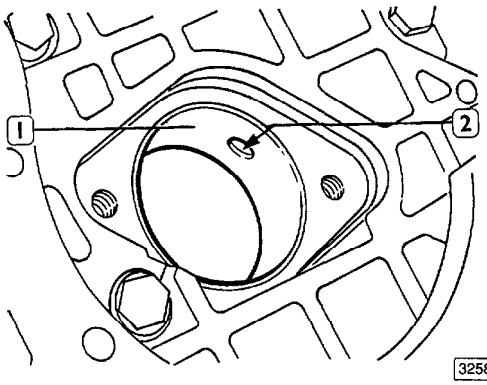
REPLACING THE BUSHES

FIGURE 57



32720

Before replacing the bushes (1), measure the bush diameters using a bore micrometer (2)
To remove and refit the camshaft bushes, use a suitable drift



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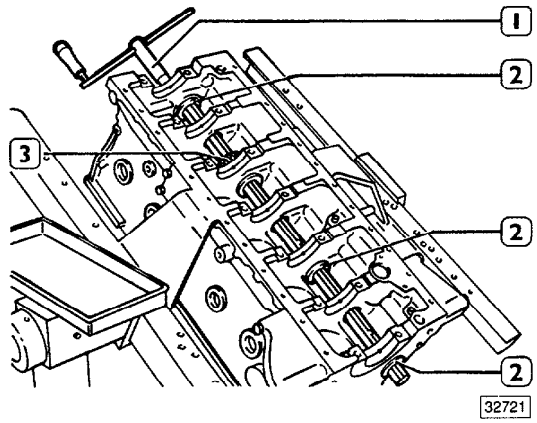
When fitting the bushes (1), make sure that the holes (2) are lined up with the oil feed holes in the crankcase

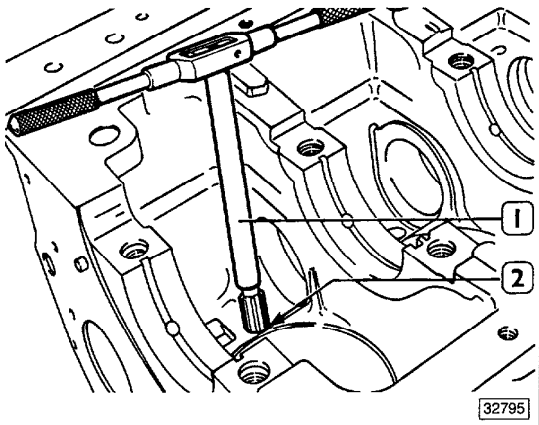


After fitting, ream the camshaft bushes using the arbor (1) fitted with the pilot bushes (2) and cutter (3) so that the specified values are obtained

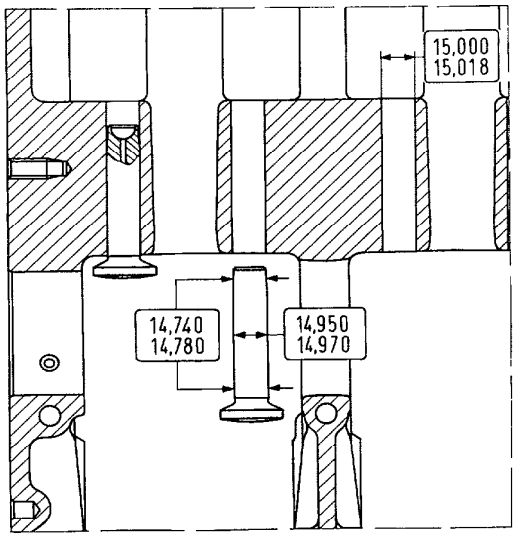
TAPPETS

Replacement tappets are supplied in standard size and 0 10, 0 20 and 0 30 mm oversizes

REPLACING TAPPETS

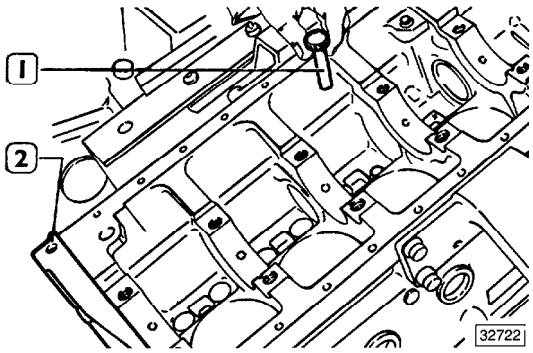


Replacing the tappets because of excessive play in the housings involves fitting oversize tappets and reaming out the seatings using an appropriate reamer (1)

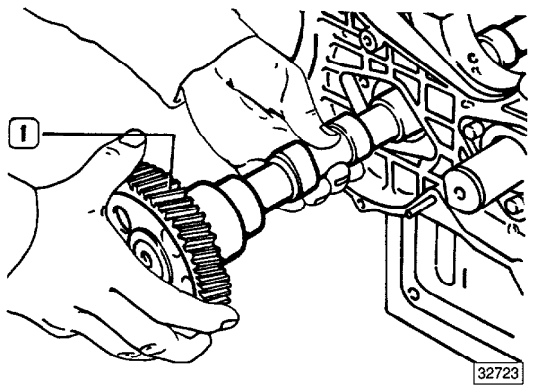


MAIN DATA FOR TAPPETS AND THEIR HOUSINGS IN THE CRANKCASE

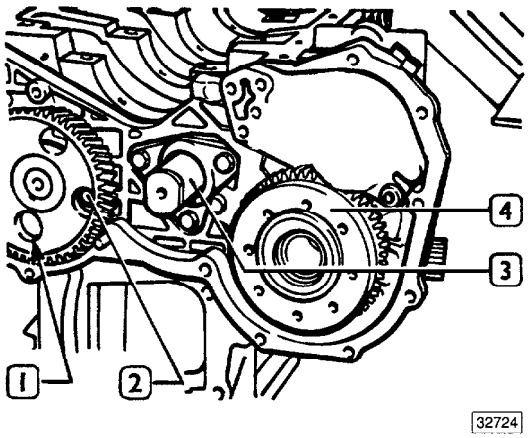
Fitting tappets, camshaft



Secure the timing gear casing (2) to the crankcase, first fitting the gasket, and tighten the screws to a torque of 25 Nm using a torque wrench Lubricate the tappets (1) and fit into their housings in the crankcase

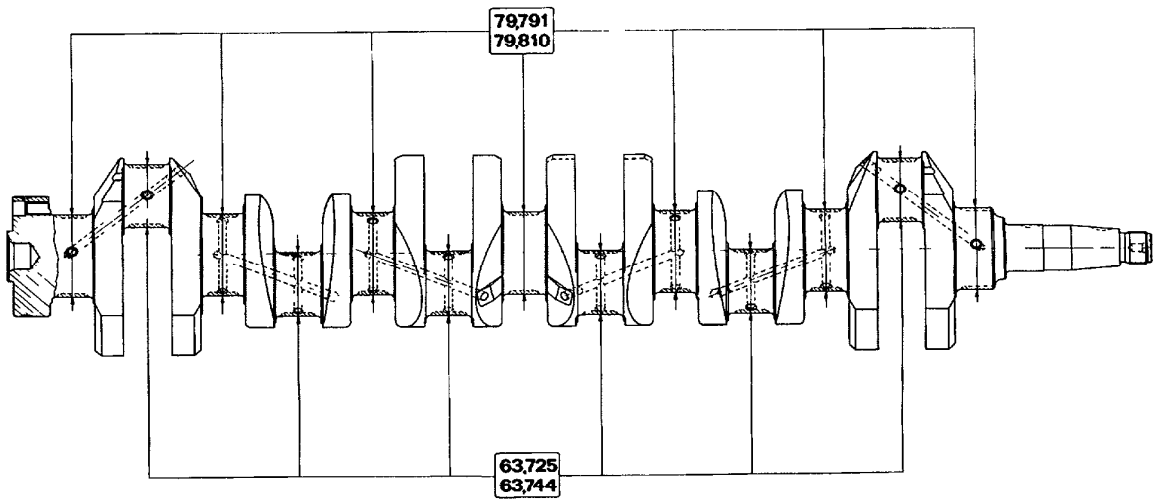


Lubricate the camshaft bearings and insert the shaft (1) into the crankcase



Through the holes (1) in the camshaft gear, tighten the screws (2) securing the camshaft retainer plate to the crankcase
Fit the idler gear pin (3), the injection pump gear (4)

CRANKSHAFT

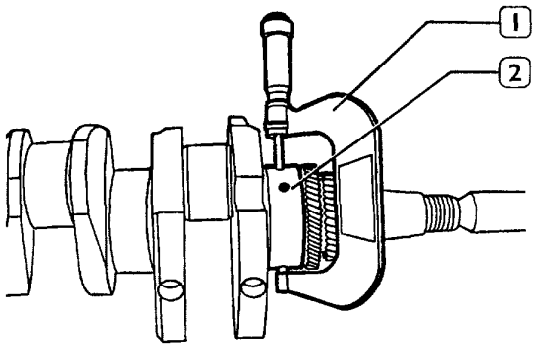


MAIN DATA FOR THE CRANKSHAFT MAIN BEARING JOURNALS AND CRANKPINS

MEASURING THE MAIN BEARINGS JOURNALS AND CRANKPINS

Before regrinding the journals, measure the main journals (2) with a micrometer (1) and establish on the basis of the scale of bearing undersizes (7) the diameter to which the journals must be reground

The classes of undersize are
0 254, 0 508 mm



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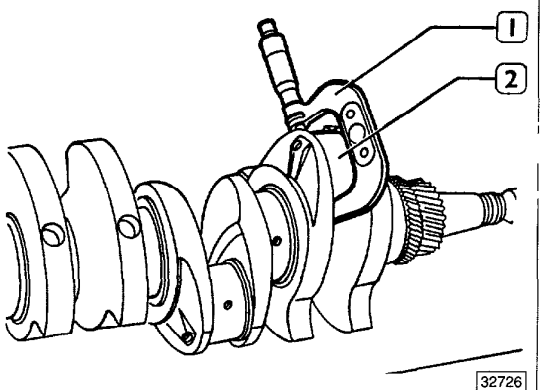
MEASURING THE MAIN BEARING JOURNALS

Main bearing journals and crankpins are always all reground to the same undersize class so as not to impair crankshaft balance

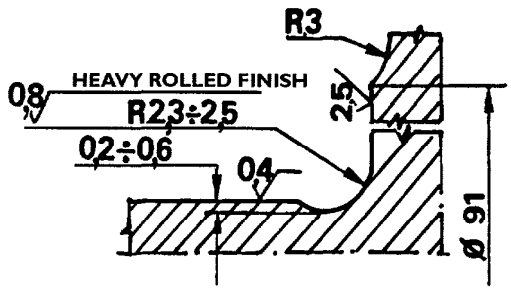


32726

MEASURING THE CRANKPINS

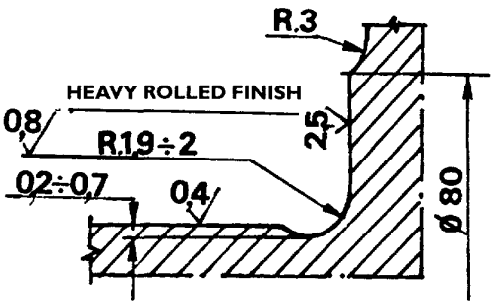
During the grinding operation, take great care to comply with the values for the main journal and crankpin blend radii given in the following figures

Regrinding carried out on main journals or crankpins must be indicated by appropriate markings stamped on the side of crank web no 1
For undersize crankpins the letter M
For undersize main journals the letter B
For undersize crankpins and main journals the letters MB



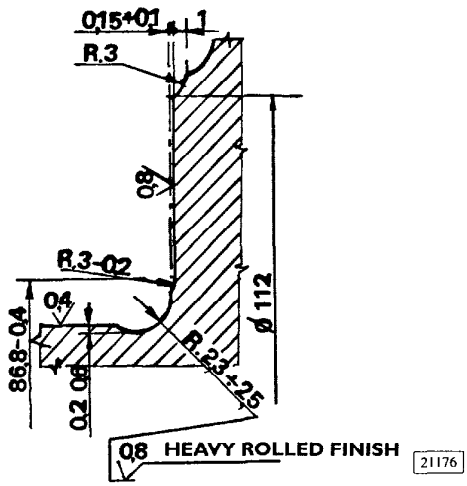
21177

DETAIL OF MAIN JOURNAL BLEND RADII



21178

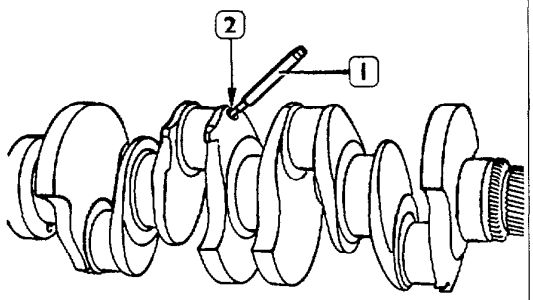
DETAIL OF CRANKPIN BLEND RADII



21176

DETAIL OF THRUST BEARING
MAIN JOURNAL BLEND RADII

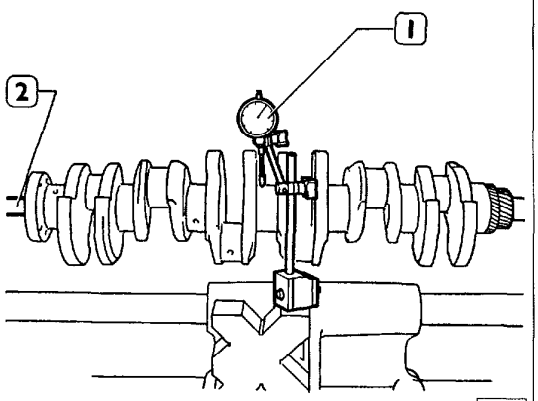
REMOVING/FITTING OILWAY PLUGS



32597

Check that the lubrication circuit plugs (2) do not show any leaks at an internal pressure of 15 bars, if they do, replace using a suitable drift (1)

CHECKING MAIN JOURNAL ALIGNMENT

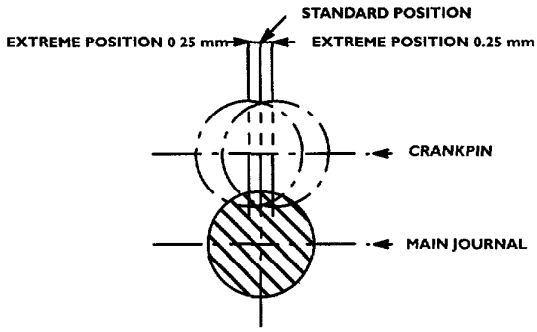


32727

This check must be carried out after regrinding, if any, of the crankshaft journals by positioning the crankshaft between centres (2) and using a hundredths dial gauge (1) for the check

Main journal alignment maximum tolerance

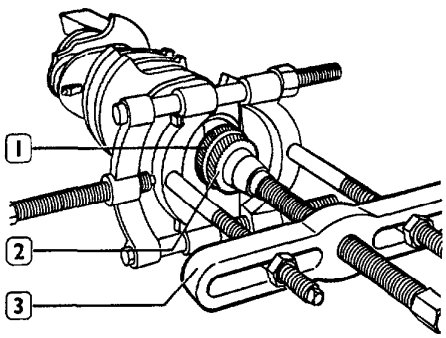
- ☐ > 0 10 mm (total reading on the dial gauge)



2219

- ☐ Alignment of the crankpins with the main journals the centreline of each pair of crankpins and the centreline of the main journals must be in the same plane the maximum tolerance permitted at right angles to this plane is ± 0 25 mm
- ☐ For the distance between the axis of rotation of the shaft and the outer surface of the crankpins, the maximum tolerance permitted is ± 0 10 mm

REPLACING CAMSHAFT AND OIL PUMP DRIVE GEARS



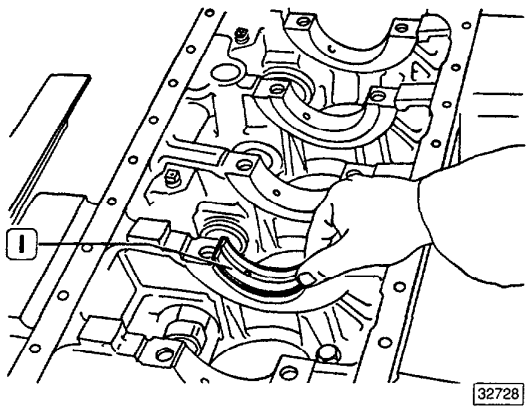
32599

Check that the teeth of the gears (1, 2) are not damaged or worn, if they are, remove them using a suitable extractor (3) When fitting new gears (1, 2), they must be heated in an oven for 10' to a temperature of 180° and shrunk on to the crankshaft, having first fitted the key

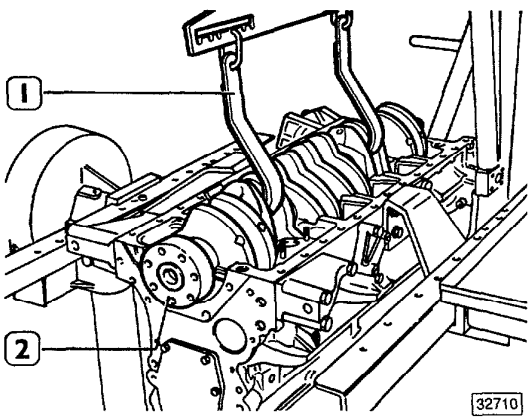
MOUNTING MAIN BEARING

Replacement main bearings are supplied in inside diameter undersizes.

Do not carry out fitting operations on the bearings

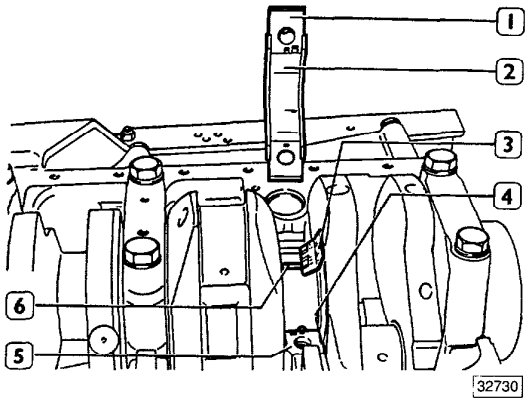


Position the bearing shells (1) in the main bearing housings in the crankcase



Lift the crankshaft (2) using tool 99360500 (1) and carefully place it on the bearing shells in the housings

MEASURING MAIN BEARING ASSEMBLY CLEARANCES

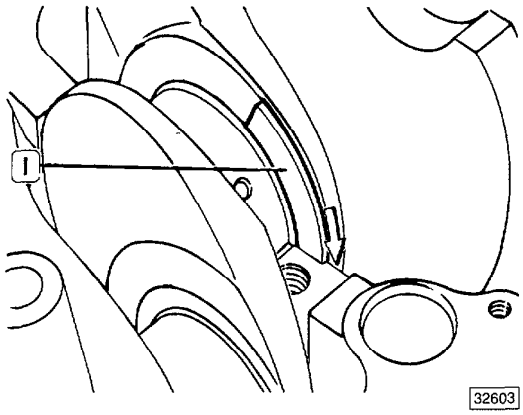


The clearance between the crankshaft journals and the relevant bearings is checked by the plastigage method, proceeding as follows

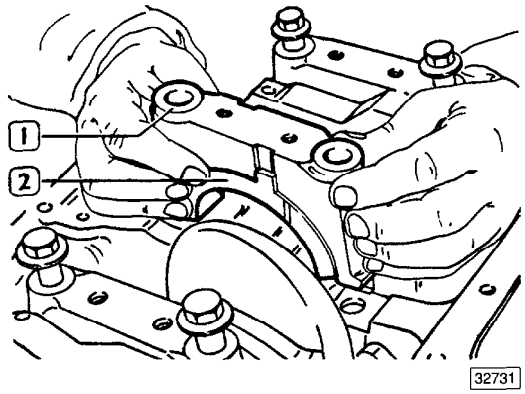
- ☐ thoroughly clean the parts and remove all traces of oil
- ☐ arrange a strip of plastigage (6) on the main journals (4), parallel with the lengthwise axis
- ☐ fit the caps (1) together with the bearing shell to the relevant housings
- ☐ fit the cap securing bolts and tighten them to the prescribed torque using a torque wrench, the bolts must be lubricated with oil beforehand
- ☐ remove the caps from the housings and determine the clearance between the bearing shells and the crankshaft main journals by comparing the width of the plastigage at the point of greatest flattening with the scale divisions given on the package (3) containing the plastigage

Checking crankshaft end float

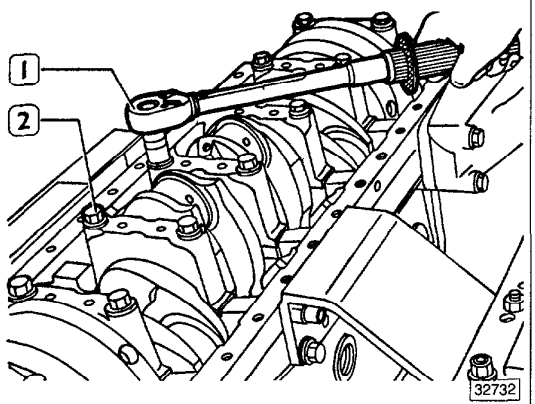
The normal assembly clearance is 0 082 – 0 334 mm If a larger end float is found, replace the thrust washer halves with new ones of standard thickness or if necessary an oversize of 0 127, 0 254, 0 508 mm



Position the thrust washer halves (1) on the 6th housing with the surface covered with anti-friction alloy towards the facing on the crankshaft

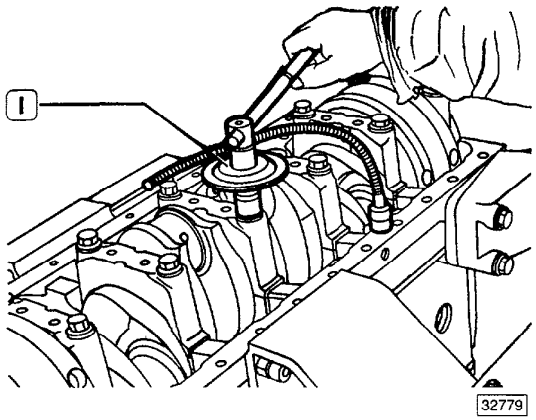


Fit the main bearing caps with bearing shells, before fitting the cap (1), position the halves of the thrust washer (2) with the surface covered with anti-friction alloy towards the facing on the crankshaft

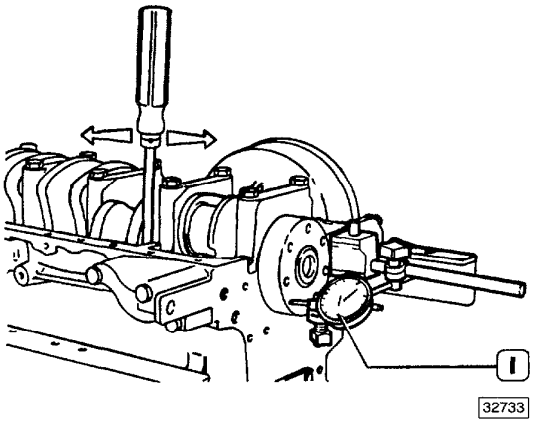


Using a torque wrench (1), tighten the securing bolts (2) to a torque of 80 Nm

The bolts must be lubricated

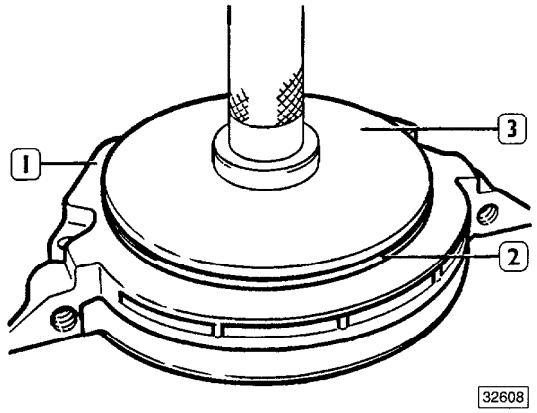


Further tighten the screws by 90°, using tool 99395216 (1)

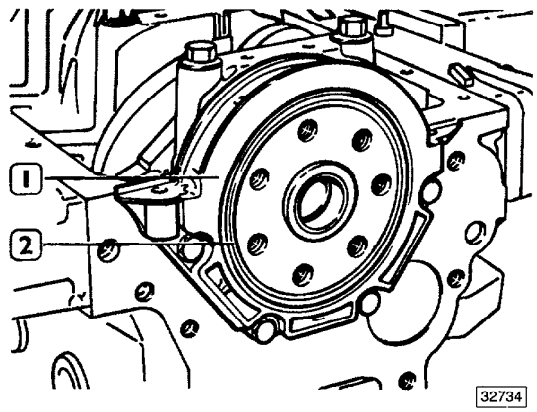


Fit the dial gauge (1) with magnetic base and check end float

CRANKSHAFT REAR COVER



The oil seal (2) is fitted to the cover (1) using the appropriate installing tool (3)



Fit the rear cover (1) to the crankcase, having first fitted the gasket

FLYWHEEL

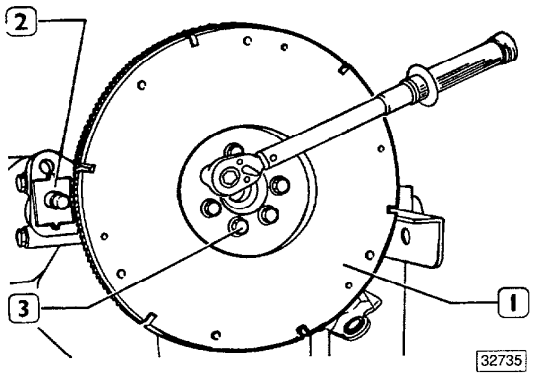
Check the surface on which the clutch plate bears; if it is scored, skimming will be required

REPLACING THE FLYWHEEL RING GEAR

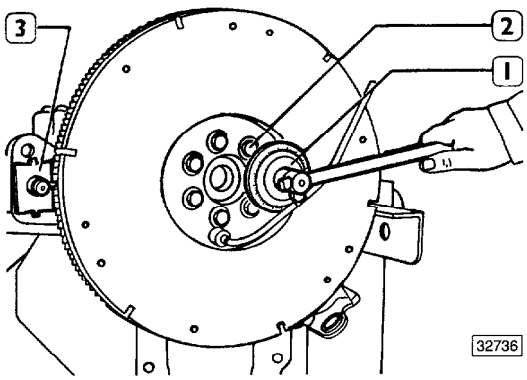
If the teeth of the gear fitted to the flywheel are badly damaged, replace the ring gear Before fitting, the gear must be heated to a temperature of 80°C

Fitting the flywheel

The bolts may be re-used provided that the Ø of the thread is not less than 11 5 mm

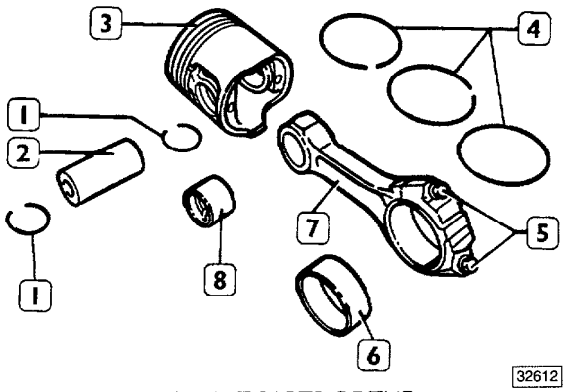


Fit the flywheel (1), fit tool 99360352 (2) and, using a torque wrench, tighten the bolts (3) previously coated with LOCTITE HVX 576 to a torque of 40 Nm



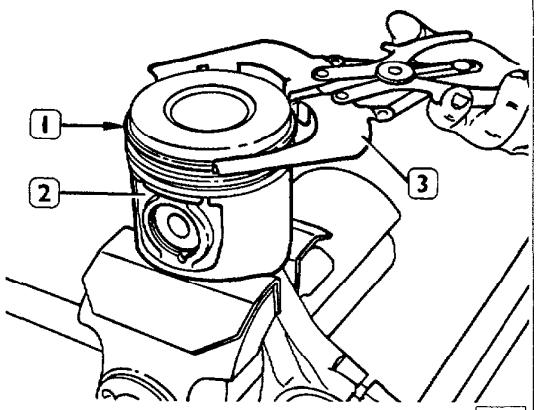
Fit tool 99395216 (1) and further tighten the screws (2) by 60° Remove the flywheel locking tool (3)

CONNECTING ROD/PISTON ASSEMBLY

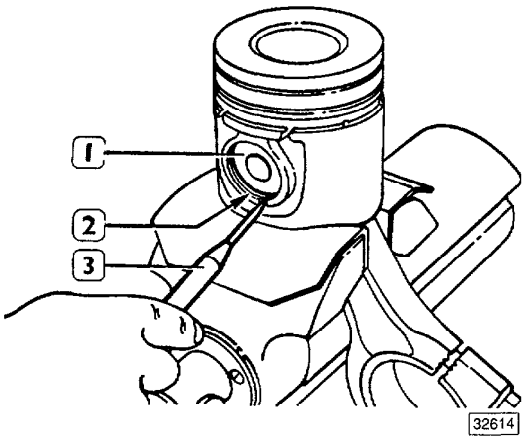


COMPONENT PARTS OF THE CONNECTING ROD/PISTON ASSEMBLY

1 Retaining clips 2 Gudgeon pin 3 Piston 4 Piston rings 5 Bolt 6 Bearing shells 7 Connecting rod 8 Bush



Remove the piston rings (1) from the piston (2) using tongs 99360183 (3)

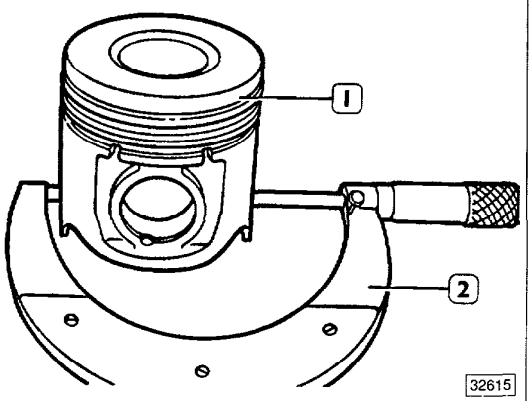


The gudgeon pin (1) retaining clips (2) are removed using a scriber (3) as shown in the figure

PISTON

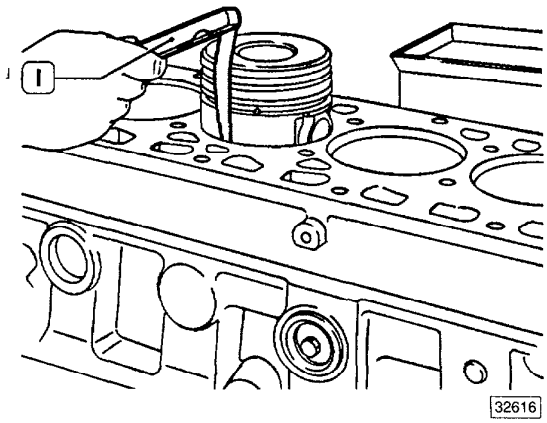
Replacement pistons are supplied in standard size or 0 4, 0 8 mm oversizes

Measuring the piston diameter



The diameter of the piston (1) is measured using a micrometer (2) to determine the assembly clearance

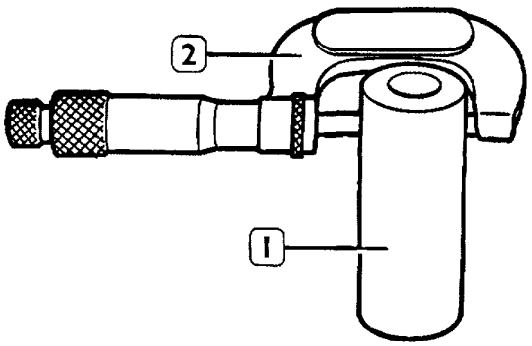
The diameter must be measured 12 mm from the base of the skirt



The clearance between the piston and cylinder liner can also be measured using a feeler gauge (1)

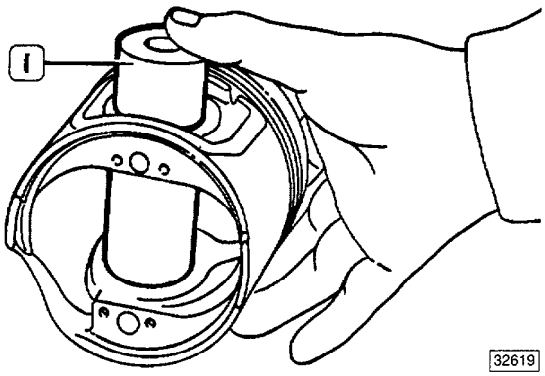
GUDGEON PIN

The pins are fitted with clearance both in the small end and in the piston



The diameter of the pin (1) is measured using a micrometer (2)

Conditions for a correct gudgeon pin to piston fit

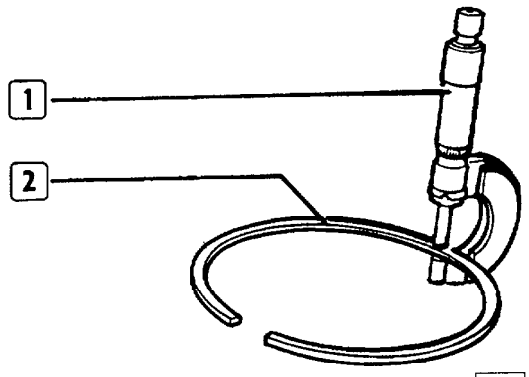


When fitting new pins, check the correct fit with the housing in the piston by carrying out the following check

- ☐ lubricate the pin and its housing in the piston bosses with engine oil
- ☐ holding the pin in a vertical position, insert it into the bosses in the piston
- ☐ it should be possible to insert the pin simply by pressing on it
- ☐ the pin should not drop out of the bosses by itself

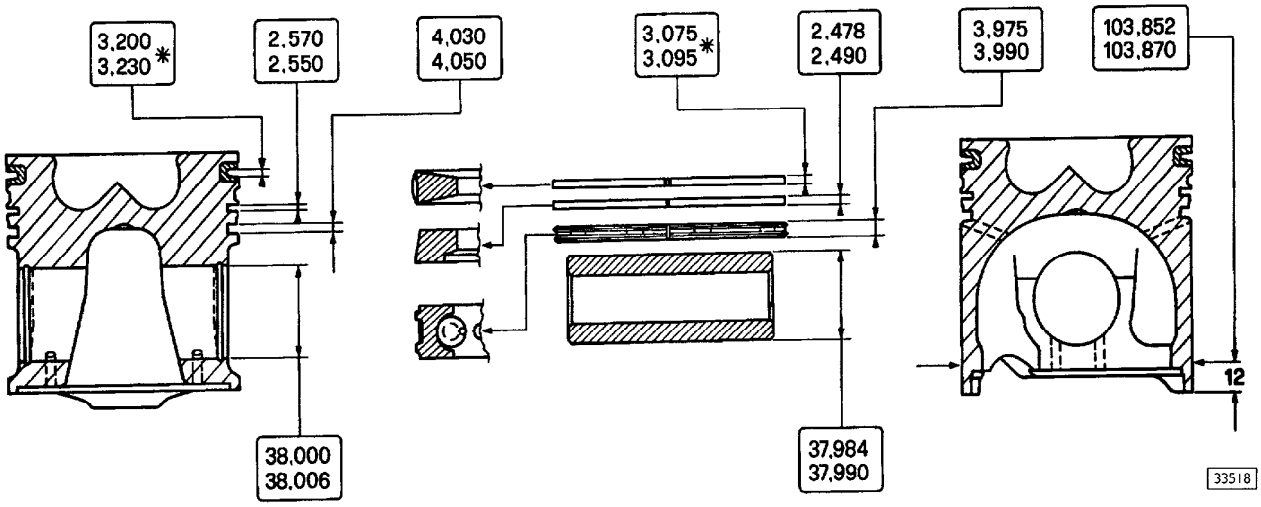
PISTON RINGS

Replacement piston rings are supplied in standard size and 0 4, 0 8 mm oversize



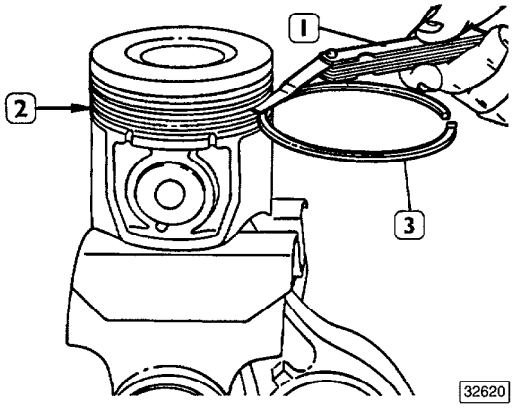
Check the thickness of the piston ring (2) using a micrometer (1)

PISTON



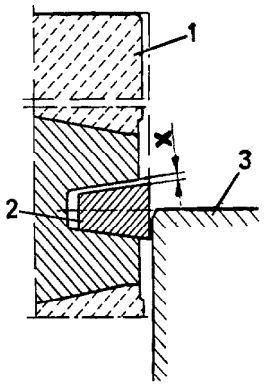
MAIN DATA FOR THE PISTON, PISTON RINGS AND GUDGEON PIN

* The dimension is measured on a Ø 101 mm



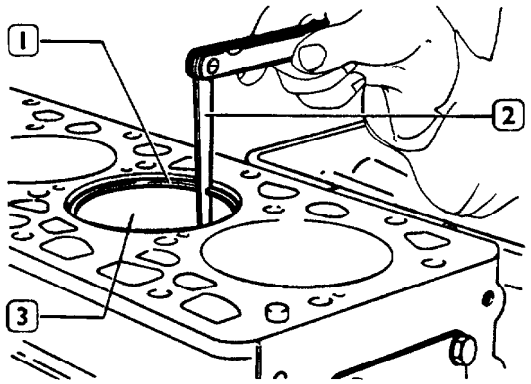
32620

Check the clearance between the piston rings (3) and the grooves on the piston (2) using a feeler gauge (1)



3513

The compression ring (2) in the first slot is wedge shaped The clearance between the compression ring and the groove is measured by positioning the piston (1) with the relevant ring in the cylinder liner (3) in such a way that the compression ring half projects from the cylinder liner

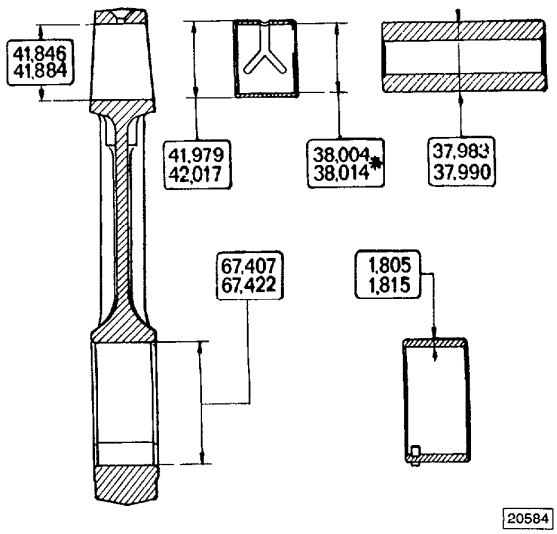


32737

The clearance between the ends of the piston rings (1) inserted into the cylinder liner (3) is measured using a feeler gauge (2)

If the gap between the ends is found to be less or more than the specified value, replace the piston rings

CONNECTING RODS

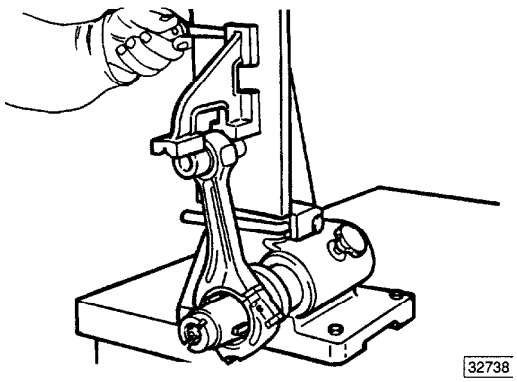


20584

MAIN DATA FOR THE CONNECTING ROD, BUSH, GUDGEON PIN AND BEARING SHELLS

* Dimension to be obtained after installing the bush

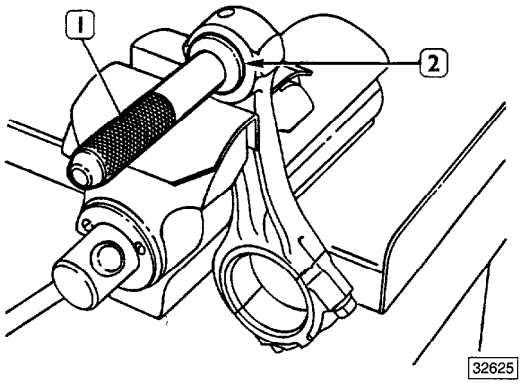
Checking connecting rods for distortion



Check that the connecting rod axes are parallel The tolerance permitted is 0 07 mm measured at 125 mm from the lengthwise axis of the rod

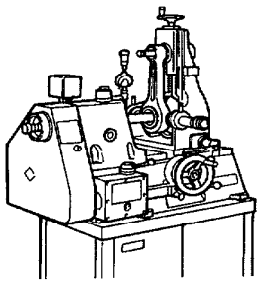
Each connecting rod is marked on the body and cap with a number corresponding to that of the cylinder to which it is fitted In case of replacement, it is therefore necessary to number the new connecting rod with the same number as the one replaced

BUSHES



The bush (2) is removed and refitted using the appropriate drift (1)

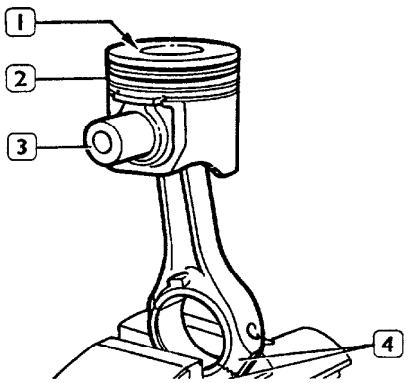
After installing the bush in the connecting rod small end, remove the part which protrudes at the side and then ream the bush to the specified diameter



Reaming the small end bush using reaming machine 99301044

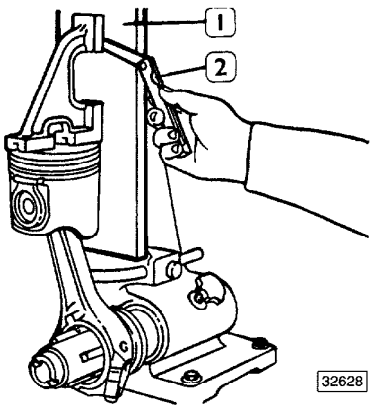
ASSEMBLING THE CONNECTING ROD/PISTON ASSEMBLY

Assembling connecting rod to piston



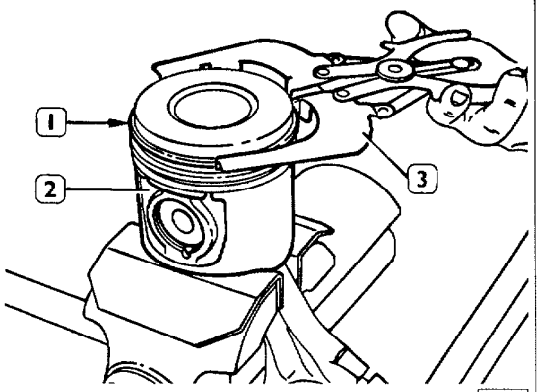
The piston (2) must be fitted so that the words TAPPET SIDE (1) on the crown are on the opposite side to the number (4) engraved on the connecting rod Insert the gudgeon pin (3) and fit the retainer snap rings

Checking connecting rod/piston for distortion



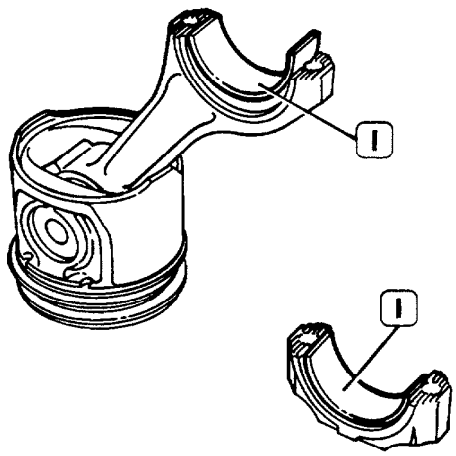
Check the connecting rod–piston assembly for distortion using fixture 99395363 (1) and a feeler gauge (2) The plane of the piston crown must be exactly at right angles to the plane of the fixture 99395363

Fitting piston rings



32613

The piston rings (1) are fitted to the pistons (2) using tongs 99360183 (3) The rings must be fitted with the word TOP facing upwards, and also the ring gaps must be located so that they are 120° apart from each other

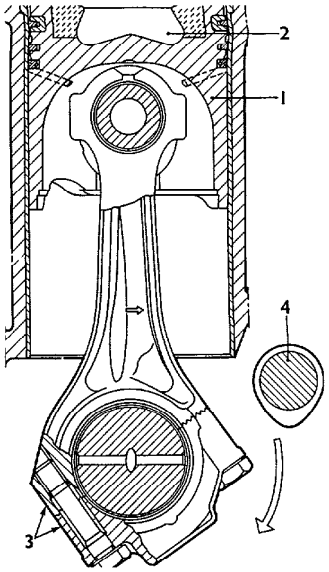


32630

Fit the bearing shells (1) to the connecting rod and to the cap

Do not carry out any fitting operations on the bearing shells

The connecting rod bolts may be reused provided that the Ø of the thread measured between 19 and 35 mm from the beginning of the screw is not less than 105 mm

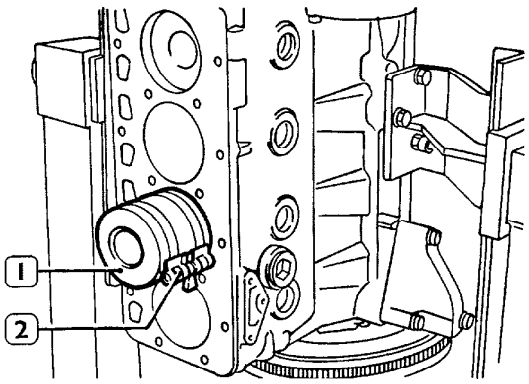


32631

PLAN FOR ASSEMBLING THE CONNECTING ROD TO THE PISTON FOR FITTING THE ASSEMBLY INTO THE CYLINDER

1 Piston 2 Combustion chamber 3 Area stamped with the number of the cylinder to which the connecting rod belongs 4 Camshaft

The arrow indicates the direction of rotation of the engine viewed from the camshaft drive end



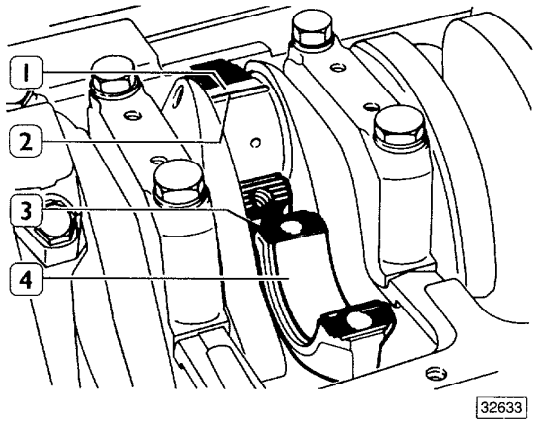
32632

The connecting rod/piston assembly (1) is fitted into the cylinder liner using ring clamp 99360605 (2)
Lubricate the parts concerned before fitting

When fitting the connecting rod/piston assemblies into the liners, check that

- ☐ the connecting rod number corresponds to the number of its cylinder
- ☐ the words TAPPET SIDE stamped on the crown are facing the camshaft
- ☐ the numbers on the connecting rods are facing away from the camshaft side
- ☐ the piston ring gaps are staggered 120° from each other

MEASURING CRANKPIN ASSEMBLY CLEARANCE

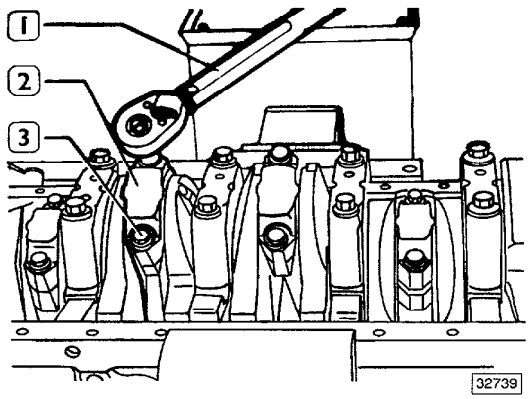


To measure the clearance, carry out the following operations

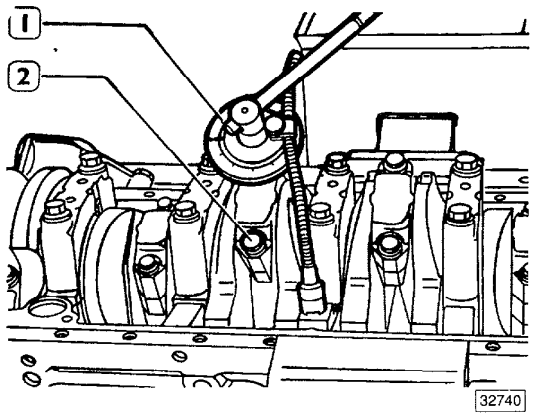
- ☐ thoroughly clean the parts and remove all traces of oil
- position a strip of plastigage (2) on the crankshaft journals
- ☐ (1)
- fit the connecting rod cap (3) and tighten the bolts to the
- ☐ prescribed torque, the bolts must be lubricated
- remove the cap (3) and determine the clearance by
- ☐ comparing the width of the plastigage (2) at the point of greatest flattening with the scale divisions given on the package (3) containing the plastigage

Lubricate the parts concerned before final assembly
Before re–using the connecting rod cap securing bolts, check that the diameter of the thread measured at 19 – 35 mm from the beginning of the screw is not less than 10 5 mm, if it is, replace the bolt

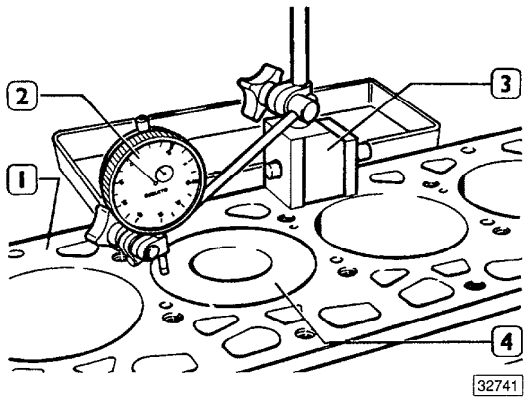
Fitting connecting rod caps



Fit the connecting rod caps (2) and, using a torque wrench (1), tighten the bolts (3) to a torque of 40 Nm, the bolts must be lubricated beforehand



Fit tool 99395216 (1) to the dial wrench and tighten the bolts (2) further by 60°
Check that the connecting rods can be moved axially on the crankpins



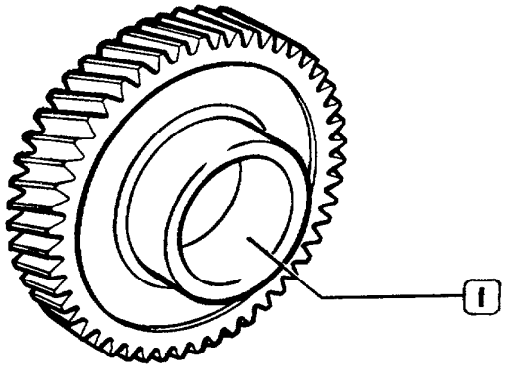
When fitting is complete, check the position of the pistons (4) at TDC with respect to the cylinder block face using a dial gauge (2) with magnetic base (3)
The top lands of the pistons must project 0 64 – 0 97 mm above the face of the cylinder block (1)

TIMING GEARS

CHECKING AND REPLACING THE IDLER GEAR

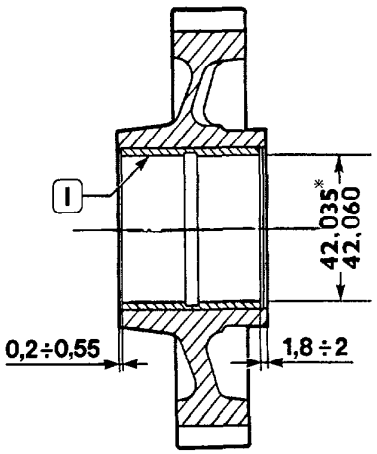
Check the idler gear for damage and excessive tooth wear, replacing it if necessary

REPLACING THE IDLER GEAR BUSH



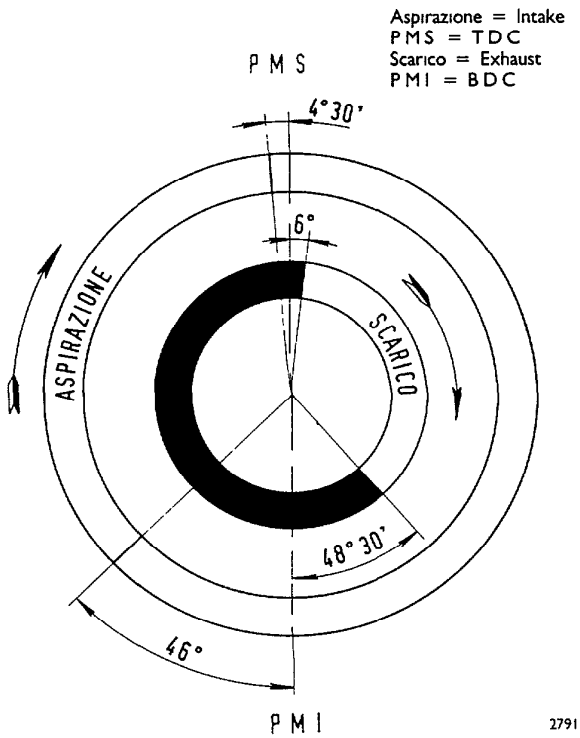
32637

Check the contact surfaces of the bush (1) for scoring or signs of seizing, if these are found, replace the bush using a suitable drift



32638

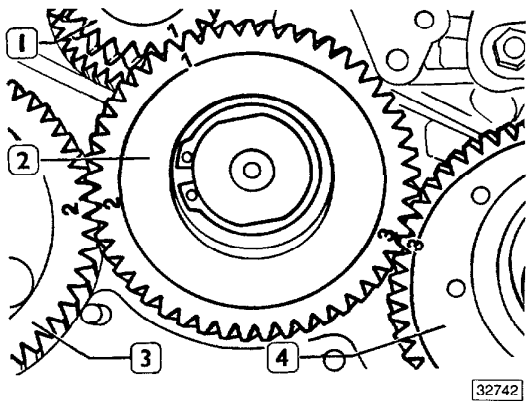
After fitting the bush (1), it must be reamed to the diameter shown in the figure (*)



2791

The timing check is carried out as follows:

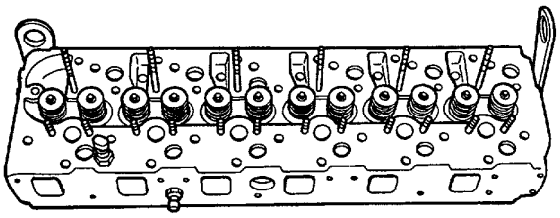
- provisionally set the play between the valves and rockers at 0.45 mm and check with a graduated sector that the advance and retard angles for intake and exhaust correspond to those indicated in the diagram



32742

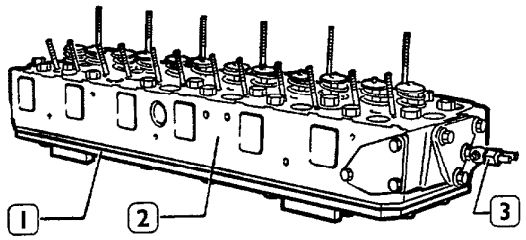
Install the idler gear (2), locating it so that the numbers 1, 2 and 3 marked on it line up with the same numbers engraved on the crankshaft gear (1), the camshaft gear (3) and the injection pump gear (4)

CYLINDER HEAD



32743

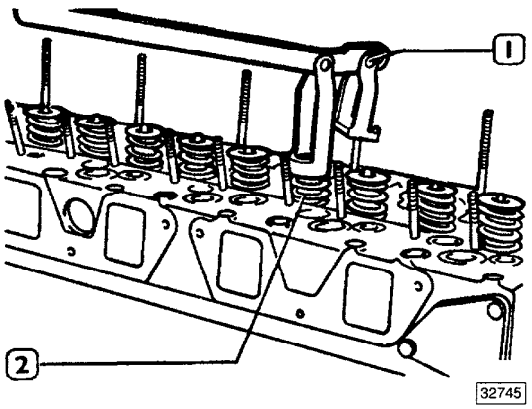
Hydraulic leak test



32744

Before dismantling the cylinder head, carry out the hydraulic leak test using the appropriate equipment (1, 3) By means of the coupling (3), pump in water heated to approx 90°, to a pressure of 4 – 5 bars Under these conditions, no leaks should be found, and if they are, the cylinder head (2) should be replaced

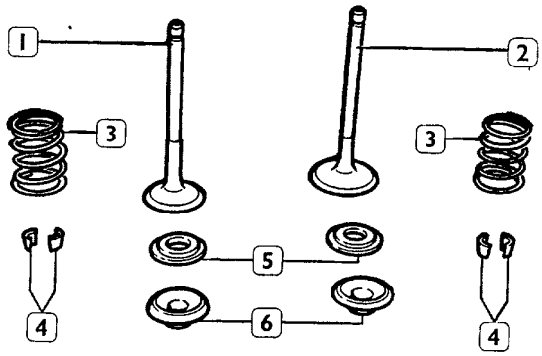
DISMANTLING THE VALVES



32745

Rest the cylinder head on the workbench and, using tool 99360357 (1), apply pressure to the upper spring cup (6, fig 121) so that the valve collets (4) can be extracted and the valve released, take off the upper cup (6), the spring (3) and the lower cup (5) Repeat the operation on all the valves Turn the cylinder head upside down and withdraw the valves

FIGURE 121

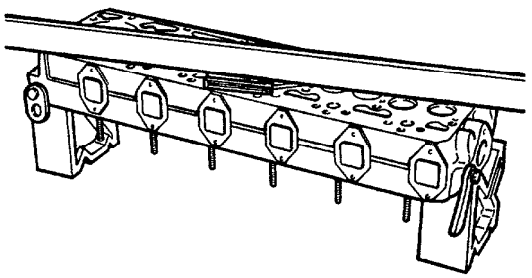


32643

COMPONENT PARTS OF THE VALVE ASSEMBLY

1 Exhaust valve 2 Inlet valve 3 Spring 4 Collets 5 Lower cups 6 Upper cups

Checking the mating surface of the head with the cylinder block



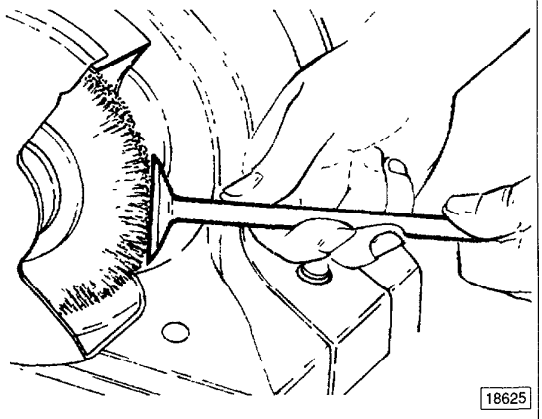
32746

The mating surface of the head with the cylinder block is checked using a straight edge and a feeler gauge If values of more than 0 15 mm are found over the whole length of the surface, true up the head on a suitable surface grinder, removing as little material as possible

After this operation, the recessing of the valves and protrusion of the injectors should be checked

VALVES

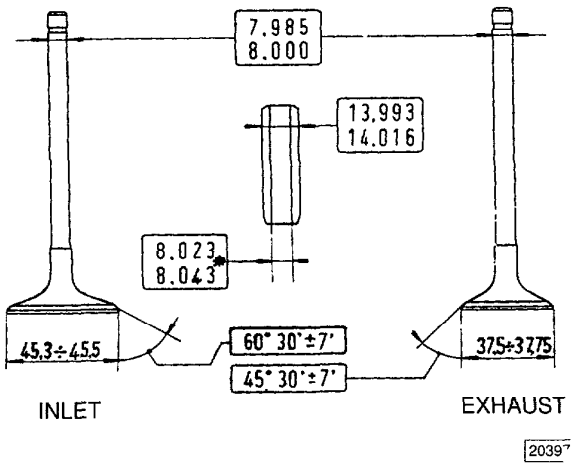
Removal of deposits and inspection of valves



Remove carbon deposits from the valves using a suitable wire brush

Check the valves for signs of seizing or cracking and also, using a micrometer, check that the diameter of the valve stem is within the specified limits (see fig 124) If not, replace the valves

FIGURE 124



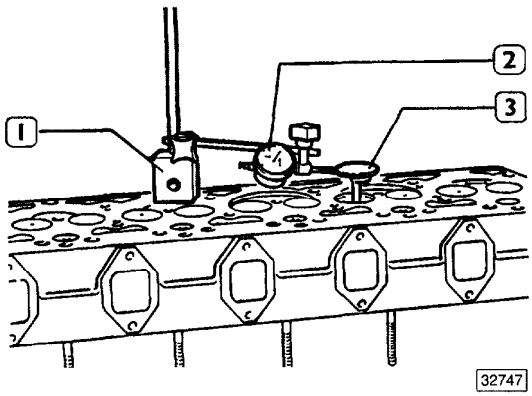
MAIN DATA FOR VALVES AND VALVE GUIDES

* Dimension to be obtained after installing the valve guides

Refacing the valves

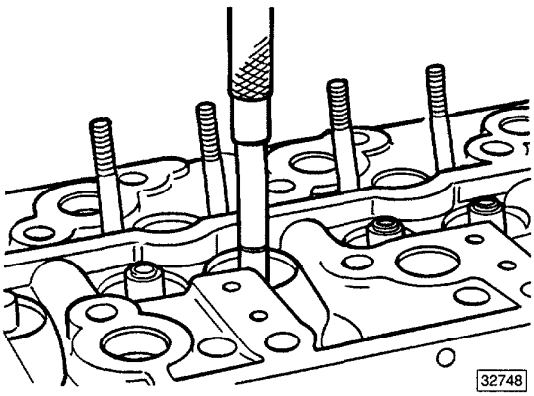
If necessary, reface the seatings on the valves using grinding machine 99301014, setting an angle of 455 30' " 7' for exhaust valves and 605 30' " 7' for inlet valves, removing as little material as possible

Checking the play between a valve stem and its valve guide



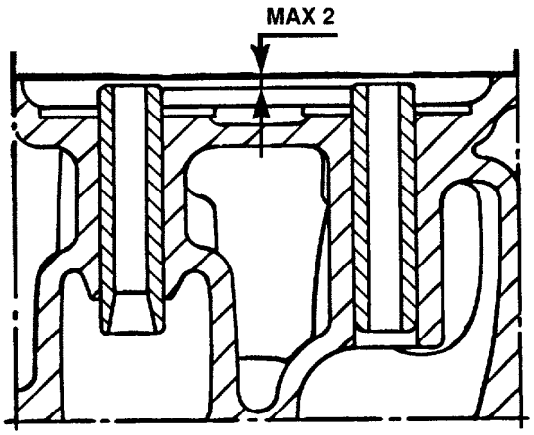
Using a dial gauge (2) with magnetic base (1), check the play between the valve stem (3) and its guide If excessive play is found, replace the valve and, if necessary, the valve guide

VALVE GUIDES



The valve guides are removed and fitted using drifts 99360288 and 99360293

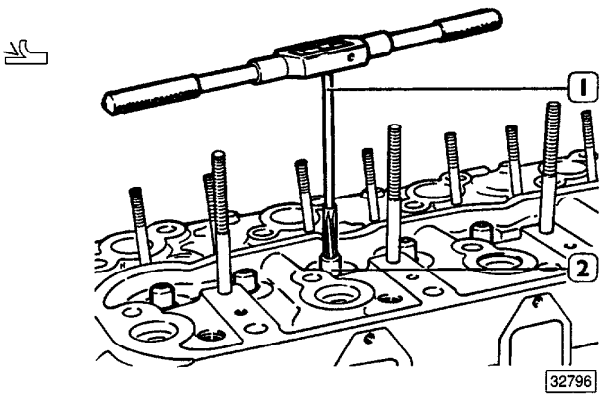
Replacement valve guides are also supplied with the outside diameter 0 2 mm oversize



32647

VALUES FOR INSTALLING VALVE GUIDES

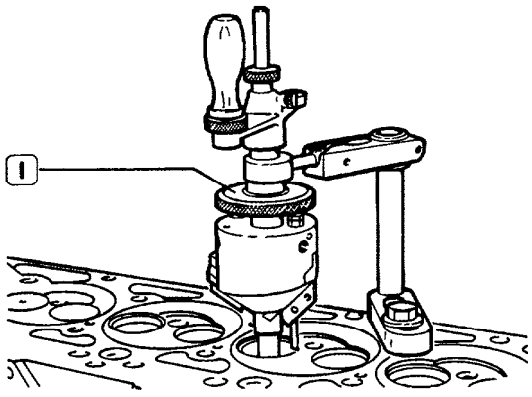
Reaming the internal surfaces of valve guides



32796

After installing the valve guides, ream the hole in the valve guide (2) using reaming tool 99390310 (1)

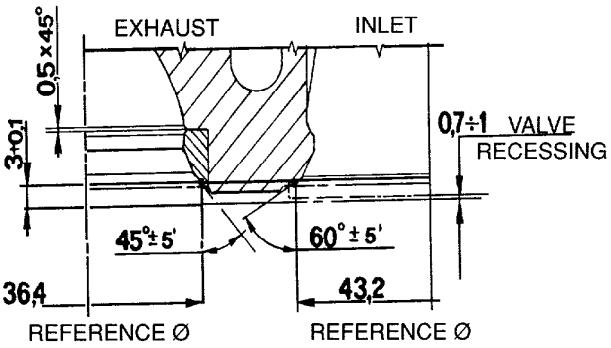
Recutting the valve seats



32749

Using the Hunger tool 99360419 (1), recut the valve seats in the cylinder head so as to obtain perfect sealing

The valve seats in the cylinder head are recut whenever the valves or valve guides are reconditioned or replaced

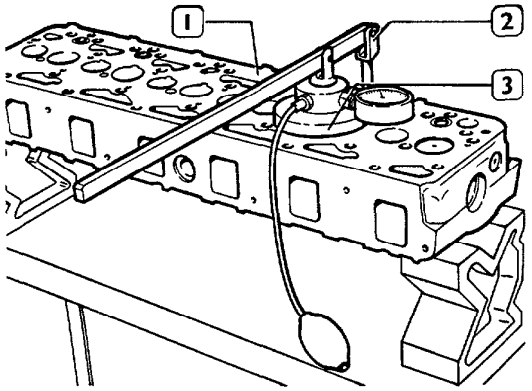


20585

MAIN DATA ON THE INLET AND EXHAUST VALVE SEATINGS

When assembling after the recutting operations, check that the recessing of the inlet and exhaust valves with respect to the cylinder head face is 0 7 – 1 mm

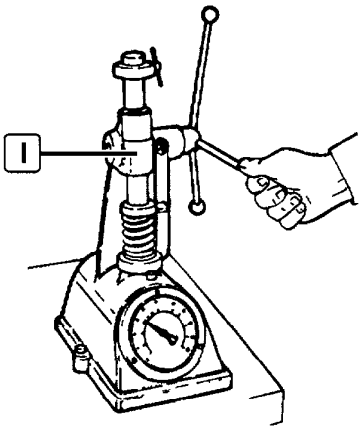
Valve leakage test



32750

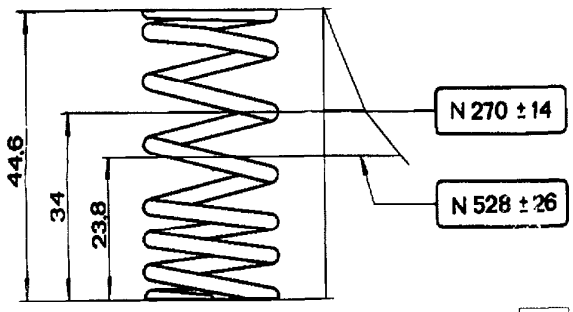
The leakage test on the valves in the cylinder head (1) is carried out using the appropriate equipment (2 and 3)

VALVE SPRINGS



16587

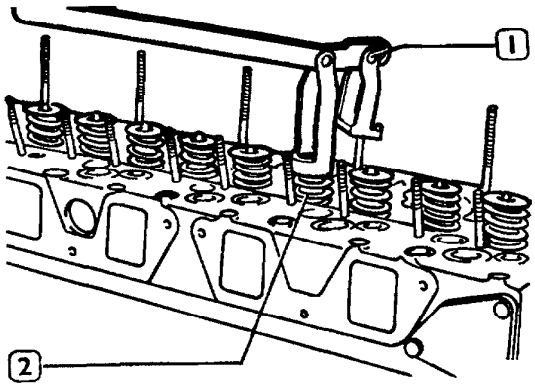
Before fitting, the characteristics of the valve springs must be checked using tool 99305049, and the data on load and elastic deformation compared with those given for new springs in the following figure



20398

MAIN DATA FOR CHECKING THE VALVE SPRINGS

Refitting the valves

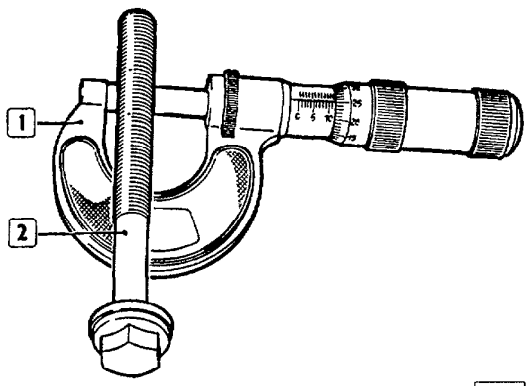


32745

To fit, reverse the order of the operations carried out for removal as described.

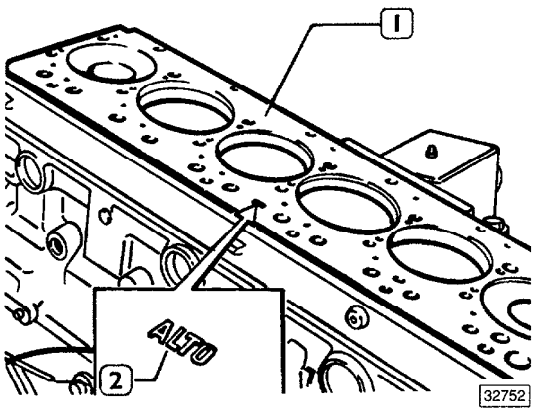
Lubricate the valve stems with engine oil

Fitting the cylinder head



18929

Before re-using the cylinder head bolts (2), with a micrometer (1) measure that the thread diameter of the bolts is not less than 11.5 mm at any point, if it is, replace them

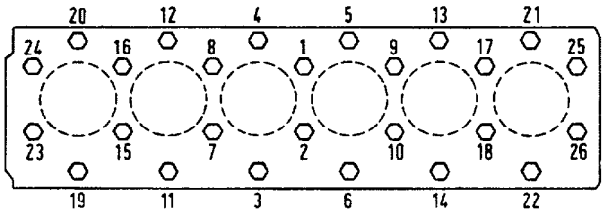


32752

To fit and tighten down the cylinder head, follow the instructions given below

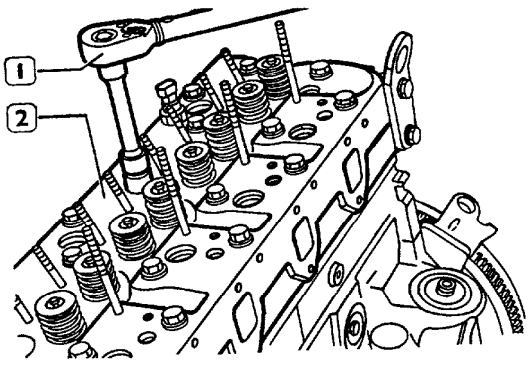
- ☐ arrange the gasket (1) on the crankcase with the word ALTO [TOP] (2) facing the operator

FIGURE 137



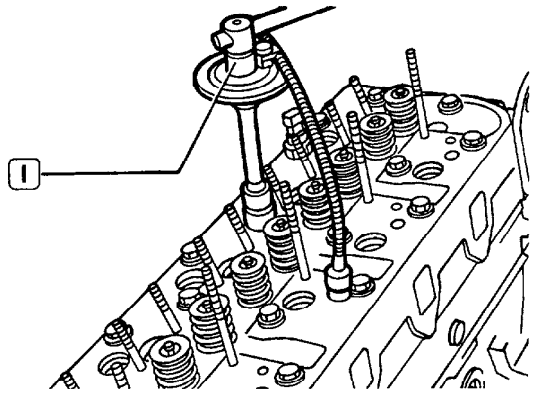
6935

PLAN SHOWING CYLINDER HEAD BOLT TIGHTENING SEQUENCE



32753

- ☐ fit the cylinder head (2), insert the bolts (3) after lubricating them and tighten them as follows in the sequence shown in figure 137
- ☐ stage 1 · using a torque wrench (1), tighten to the preliminary torque of 70 Nm
- ☐ stage 2 retighten to the torque of 70 Nm

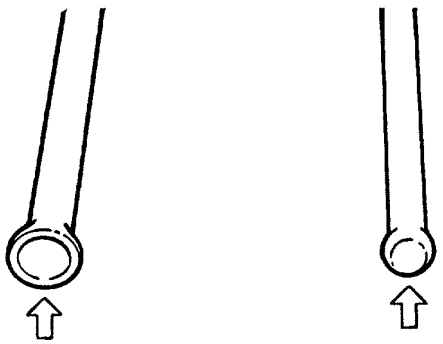


32754

- ☐ stage 3 fit tool 99395216 (1) to the angle gauge wrench and tighten by an angle of 90°

4:st stage preliminary torque 90°

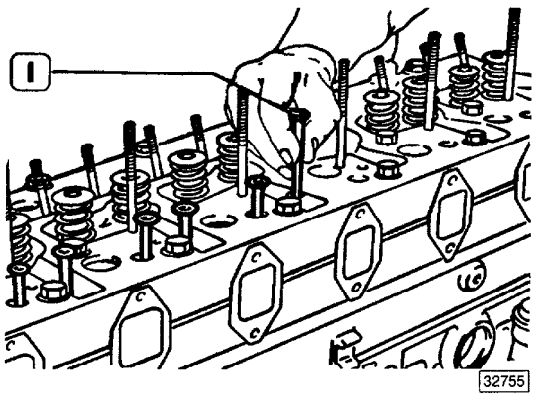
PUSH RODS



32655

The valve pushrods must be free from distortion, the cup seatings for the adjustment screws and the ball ends locating in the tappets must not show any signs of seizing or wear, if they do, replace the rods

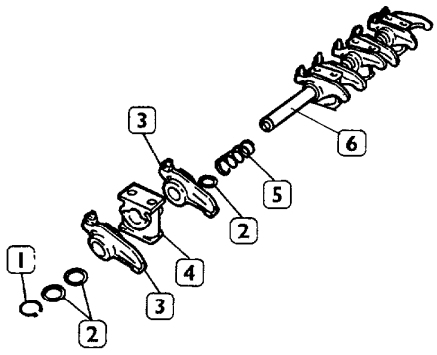
Pushrods for inlet and exhaust valves are identical and therefore interchangeable



32755

Fit the pushrods (1) into their seatings

PUSH RODS



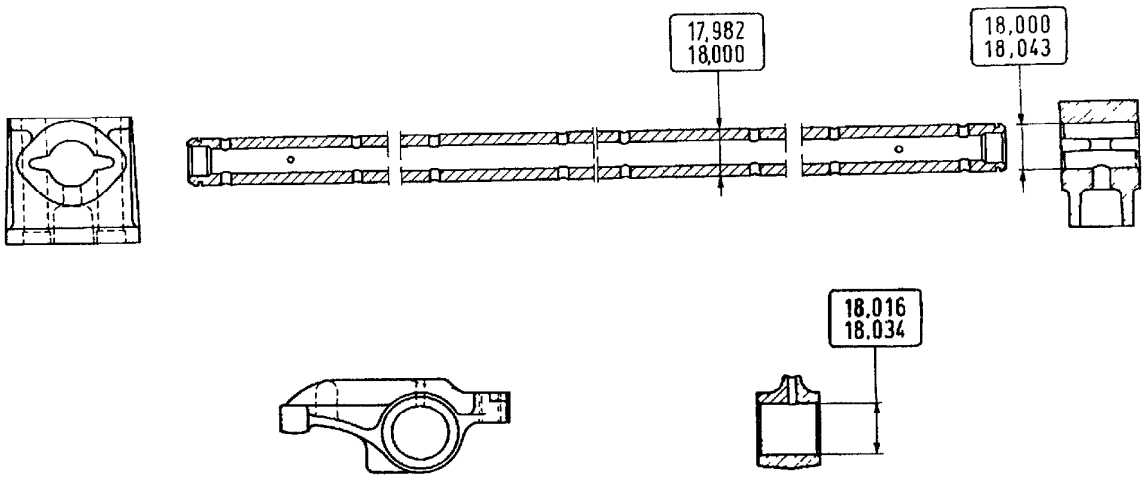
COMPONENT PARTS OF THE ROCKER SHAFT
1 Circlip 2 Adjustment shims 3 Rockers
4 Pedestal for shaft 5 Spring 6 Shaft

Check that the contact surfaces are free from scoring or signs of seizing, if not, replace the parts showing deterioration

Check the clearance between the valve gear rockers and the rocker shaft and between the pedestals and rocker shaft, which should be 0 016 – 0 052 and 0 – 0 061 mm respectively, replace any parts giving rise to clearances larger than those specified

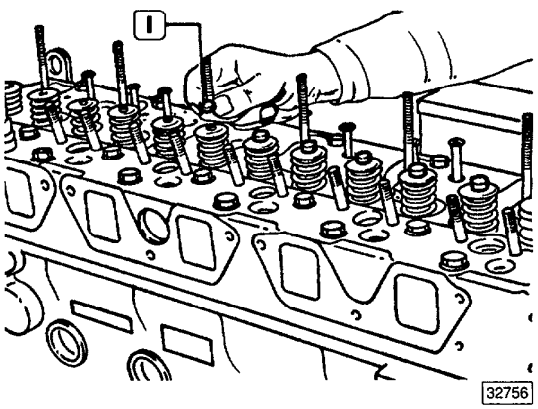
Check that the plugs fitted to the ends of the shaft provide a perfect seal

ROCKER SHAFT

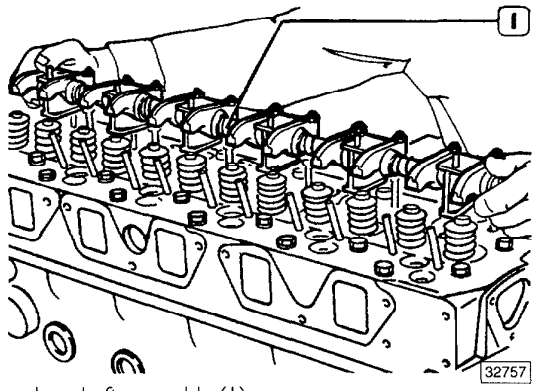


MAIN DATA FOR ROCKER SHAFT PEDESTALS, ROCKER SHAFT AND ROCKERS

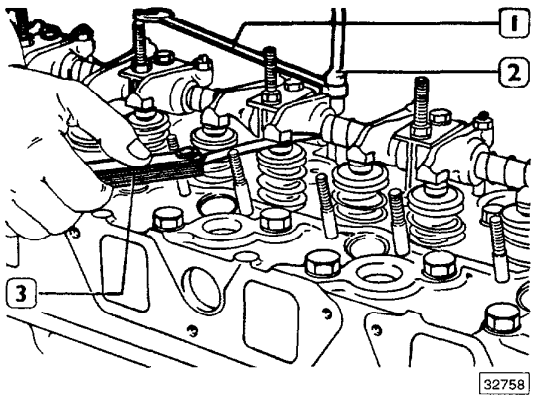
Fitting the rocker shaft and adjusting the operating clearance between the valves and rockers



Fit the caps (1) onto the valve stems



Fit the rocker shaft assembly (1)
Adjust the operating clearance between the valves and rockers as described below



The clearance between the rockers and valves is adjusted using wrench 99350108 (2), a bi-hexagon wrench (1) and a feeler gauge (3) The operating clearance is **0,30 ± 0,05** mm for both inlet and exhaust, subsequent adjustments are carried out when a value outside the range 0 15 – 0 45 mm is found Move the cylinder on which the clearance is to be adjusted to the firing position, the valves of this cylinder are closed while those of the symmetrical cylinder are rocking Symmetrical cylinders are 1 and 6, 2 and 5 and 3 and 4

To speed up adjustment of the rocker to valve operating clearances, proceed as follows
rotate the crankshaft until the valves of no 1 cylinder are rocking and adjust the valves marked with an asterisk as shown in the table

cylinder no	1	2	3	4	5	6
inlet	–	–	*	–	*	*
exhaust	–	*	–	*	–	*

rotate the crankshaft until the valves of no 6 cylinder are rocking and adjust the valves marked with an asterisk as shown in the table

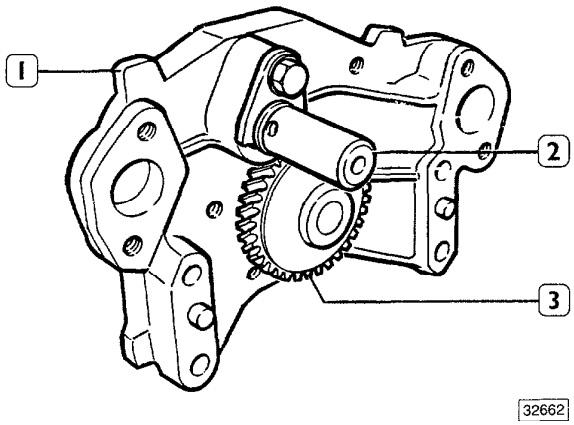
cylinder no	1	2	3	4	5	6
inlet	*	*	–	*	–	–
exhaust	*	–	*	–	*	–

LUBRICATION

Engine lubrication is obtained by means of a gear type pump (fig 147) fitted to the lower part of the crankcase in line with the front main bearing, it is driven by the crankshaft gear

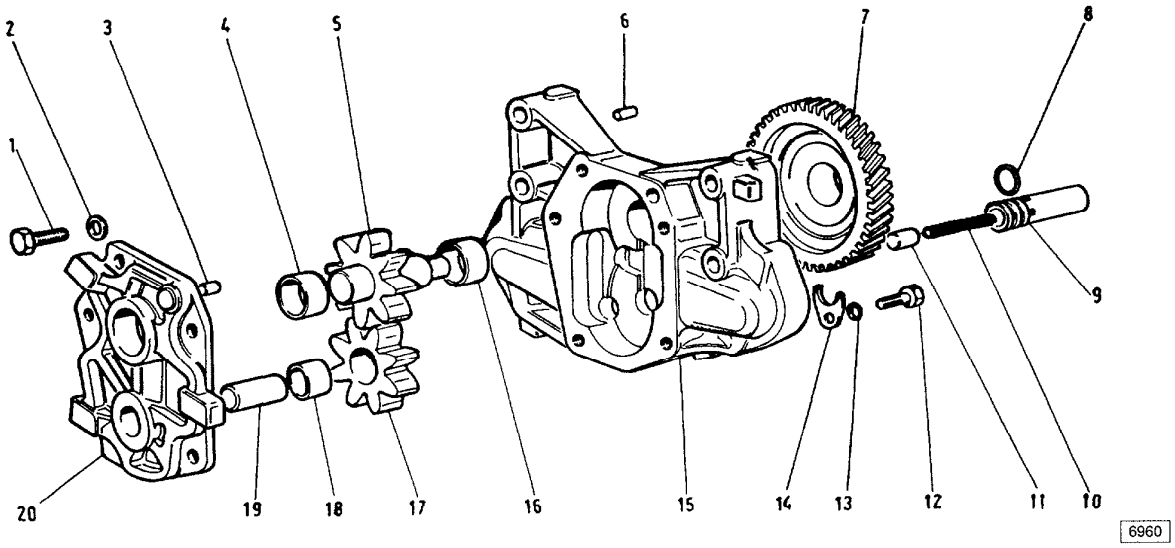
OIL PUMP

FIGURE 147



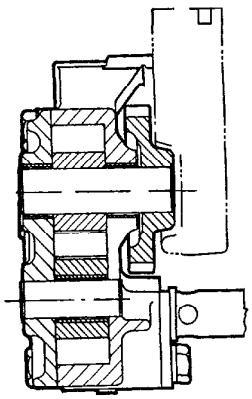
OIL PUMP ASSEMBLY
1 Pump body 2 Relief valve 3 Driven gear

FIGURE 148

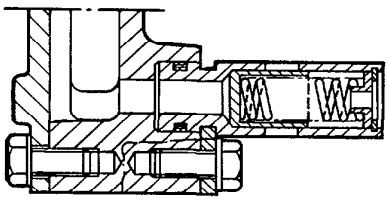


COMPONENT PARTS OF THE OIL PUMP ASSEMBLY

1 Screw 2 Washer 3 Locating dowel 4 Bush 5 Oil pump gear 6 Locating dowel 7 Driven gear operating the oil pump 8 Seal 9 Valve body 10 Spring 11 Valve 12 Screw 13 Washer 14 Attachment plate 15 Oil pump body 16 Bush 17 Oil pump gear 18 Bush 19 Spindle 20 Oil pump cover



SECTIONAL VIEW OF OIL PUMP



SECTIONAL VIEW OF OIL PRESSURE RELIEF VALVE

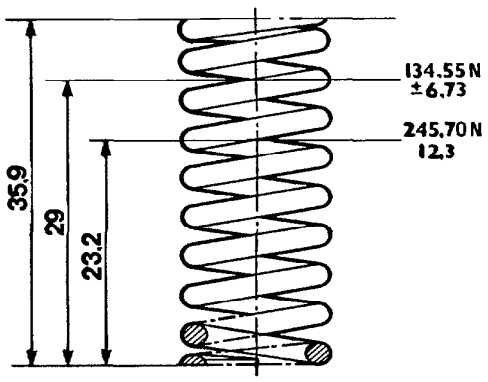
Checks

Check that the gears (5, 17 fig 148) and gear wheel (7) show no signs of wear or seizing, if they do, replace the complete pump

Check that the valve (11, fig 148) slides freely in its housing and shows no signs of seizing or scoring, also check the setting data for the relief spring (10) compared with those given in figure 151

Valve starts to open 6 bars, valve finishes opening 11 bars

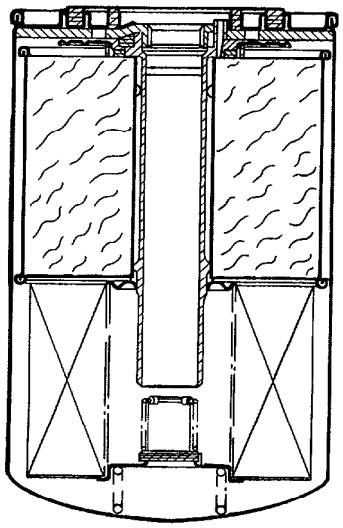
FIGURE 151



MAIN DATA FOR CHECKING THE RELIEF VALVE SPRING

OIL FILTER

Two double filtration filters are fitted to the engine Opening pressure for the filter valve 2 5 ± 0 2 bars

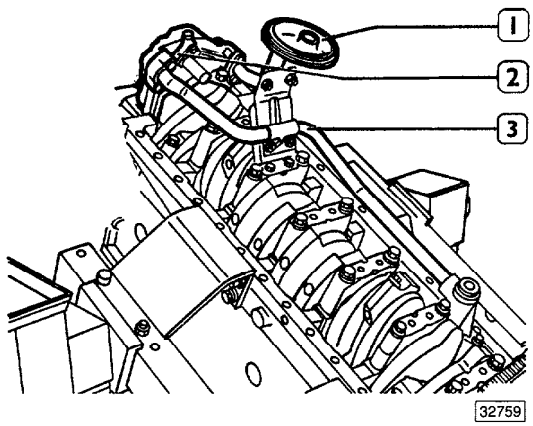


32666

SECTIONAL VIEW OF THE OIL FILTER

When fitting the filters, observe the following instructions
- oil the seals
- screw the filters up until the seals contact the seating bases
- tighten further for another 3/4 of a turn

Fitting the oil pump



32759

Fit the oil pump (2), the suction (1) and delivery (3) pipes

COOLING

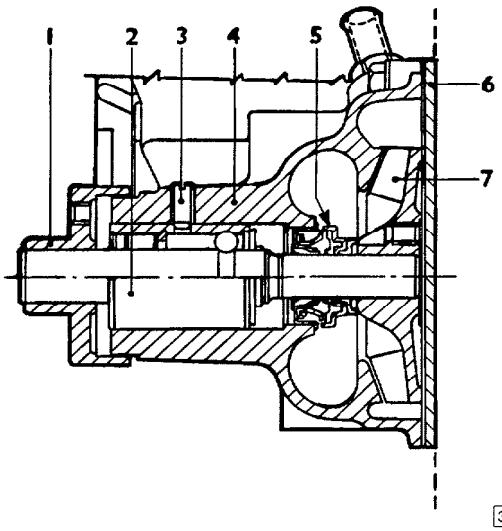
WATER PUMP

The water pump is of the centrifugal impeller type The pump bearing is integral with the rotor spindle

Water sealing between the pump body (4, fig 154) and the spindle (2) is obtained by means of a seal (5)

The screw (3, fig 154) retaining the bearing must be locked in its housing using LOCTITE 242 sealant

FIGURE 154



32668

SECTIONAL VIEW OF WATER PUMP
1 Hub 2 Spindle with bearing 3 Screw 4 Pump body
5 Seal 6 Cover 7 Rotor

Check that the pump body has no cracks or water leaks, if it has, replace the water pump complete

MOUNTING OF THE INJECTION PUMP AND TIMING

Mount the injection pump as following

Check the exact timing of the timing gears,

Turn flywheel in order to have the mark 20° ± 1 (2) alligned with the reference pointer (1)

Check that the plunger N° 1 of the pump is in delivery start position

Fit the injection pump the double tooth of the joint must correspond with the double space of the bush

When the injection pump is fitted, align the mark (3), punched on the support flange, with the mark (2) punched on the pump body,fix it temporaryly with the four screws (1) fig 208

Install tool 99365186 (4) with dial gauge on the injection pump and position the tool rod on the tappet top

Turn the flywheel in the opposite sens to the normal rotation by about ½ turn

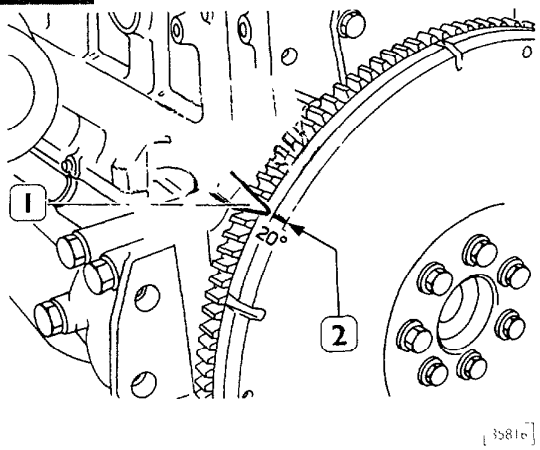
When the tappet is at B.D C ,reset the dial gauge at 0 position having 1 mm of pre-load

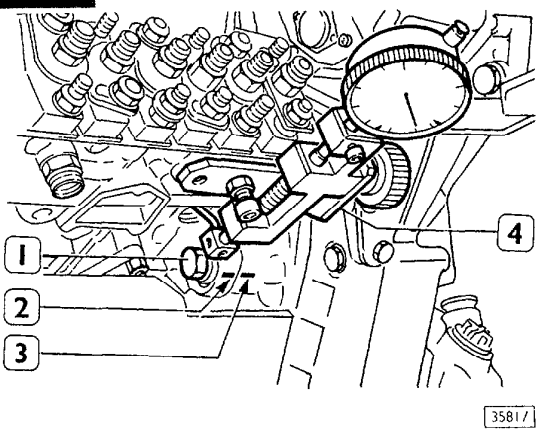
Turn the flywheel in the opposite sens and check that, when the 20° ± 1 (2) fig 207, is alligned with reference pointer (1), the plunger pre-stroke must be 3,0 – 3,10 mm, see dial gauge

Block the four screws (1) fig 208 without moving the injection pump

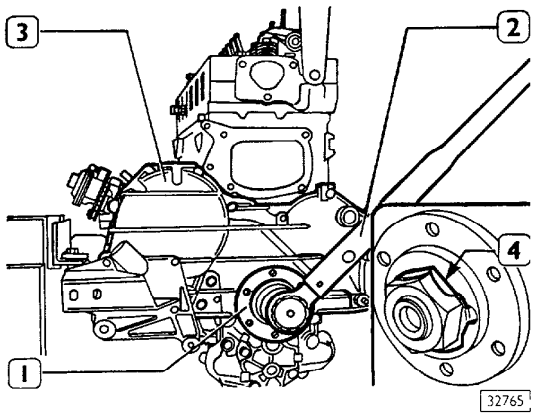
So the pump is timed with the engine.

If in doubt on the exactness of the pump timing check again the timing using the spill point method.



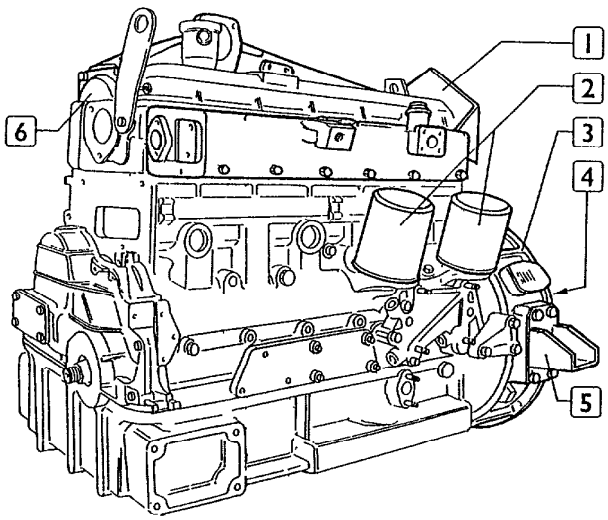


ENGINE BENCH DRESSING

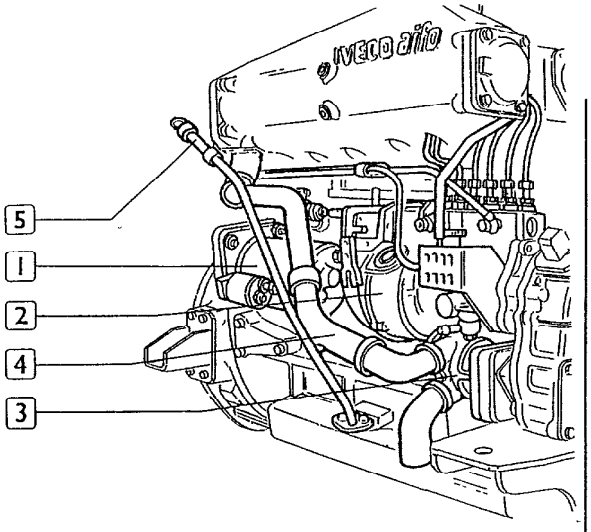


Fit the timing cover (3)
Fit tool 99360352 to the flywheel to prevent it from rotating
Fit the hub (1) with loking plate, tighten the nut with a torque wrench (2) and bend over the locking plate (4)

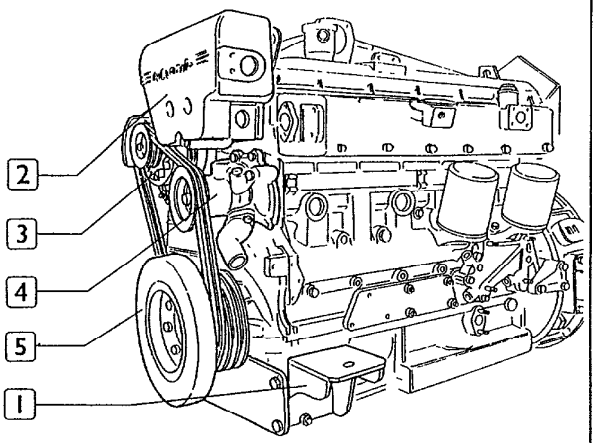
Rotate 180° the engine and fit the oil sump



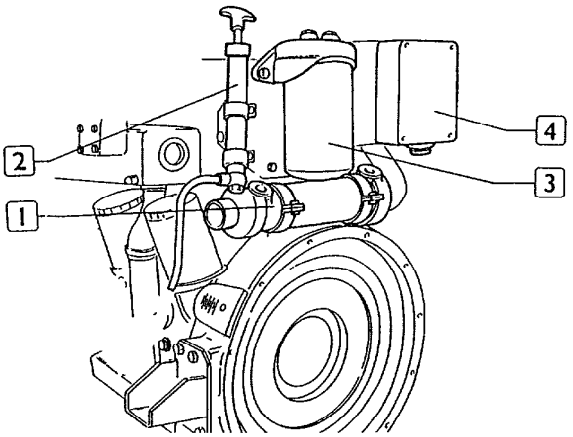
Fit the fuel filter support (1), the oil filter (2),the flywheel cover(3), the flywheel (4), the rear engine support (5) and the intake manifold (6)
Fit the exhaust manifold, the wastegate valve with the relevant connection pipes



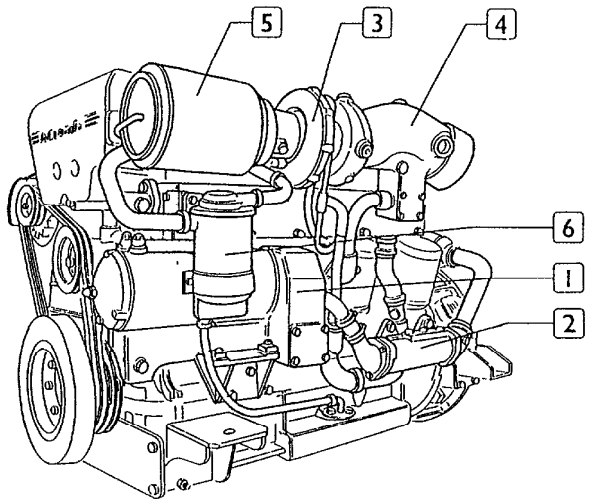
Fit the starter motor (1) the injection pump (2) with the fuel filter and injectors lines, Fit the sea water pump (3) with the relevant pipes (4) and the oil dipstick (5)



Fit the front engine supports (1), the water tank (2), the alternator (3), the water pump with its pulley (4) and the flywheel dumper with the power take-off pulley (5)



Fit the marine gear heat exchanger (1) the hand oil suction pump (2) with the connection pipe to the oil pump the fuel filter (3) and the engine stop and starting box(4) (4)



Fit the support and the water-water heat exchanger (1) the oil-water heat exchanger (2), the turbocharger (3) with the oil pipes and the gas cooling exhaust bend (4)

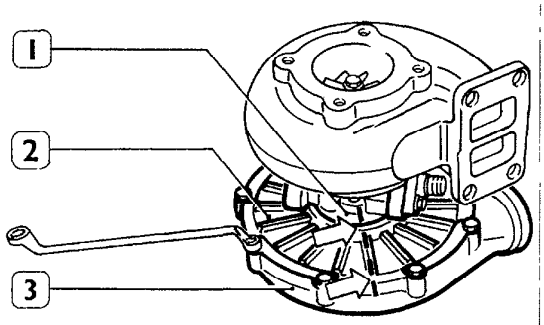
Fit the air cleaner (5) and the engine breather tank (6) Complete all these operation assembling the relevant lines

Using a lift and specific hooks, remove the engine from the swivelling stand 99322230 and remove the brackets 99361033

Refill the engine with oil in the sump according to the indicated quatities

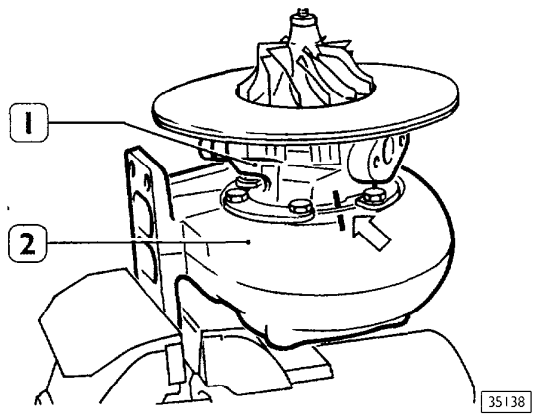
OVERHAULING THE TURBO-CHARGER : KKK

Preliminary checks



35137

Thoroughly clean the outside of the turbocharger using anti-corrosion and anti-oxidising liquids
Mark the assembly position of the compressor body (3) to the flange (2) and of the flange to the centre body (1) Separate the compressor body (3) from the flange (2) by removing the retaining screws (4)

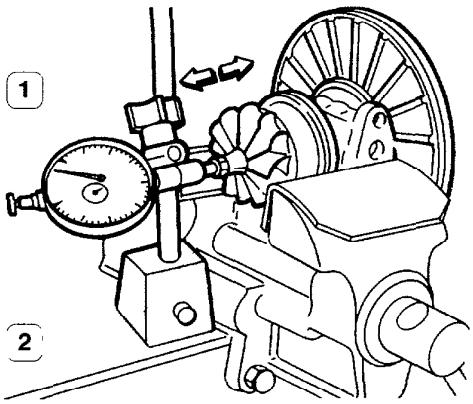


35138

Mark the assembly position of the turbine body (2) on the centre body (1)
Remove the securing screws and separate the centre body (1) from the turbine body (2)

After detaching the turbine and compressor bodies and before proceeding to check the play in the bearings, check that the above components and the centre body are free from wear or erosion or foreign object impacts, also, there should be no carbonised oil present in the oil outlet port
If even one of these points is found, replace the turbocharger complete

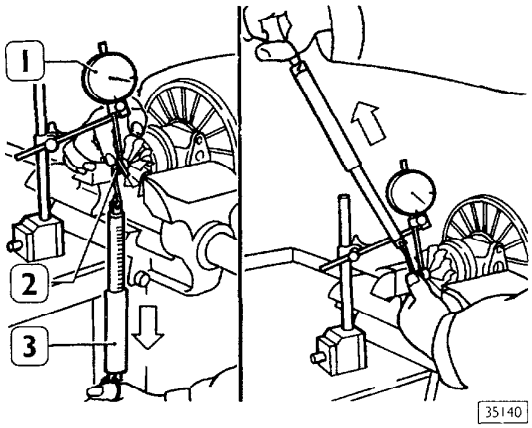
Checking bearing play



35 39

The end and radial play in the bearings should be measured on the shaft at the turbine rotor (2) end

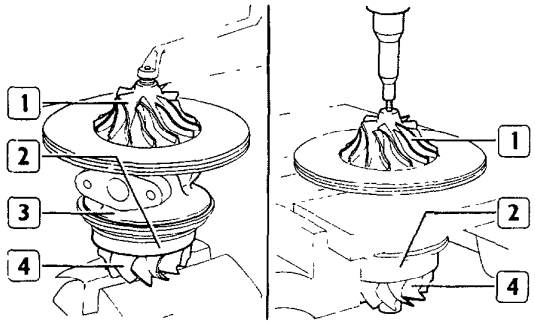
Position the stylus of the dial gauge (1) with magnetic base on the spindle (2) and zero the dial gauge
Press the spindle (2) in the directions shown by the arrows and check that the end play in the bearings is no more than 0 16 mm



35140

Position the stylus of the dial gauge (1) on the spindle (2) at the point shown in the figure Using a spring balance (3), pull down on the spindle with a force of 50 N and zero the dial gauge in these conditions Still with a force of 50 N, pull up on the spindle and measure the spindle deflection on the dial gauge
This should be not more than 0 42 mm
Repeat the check at one other point at least on the spindle

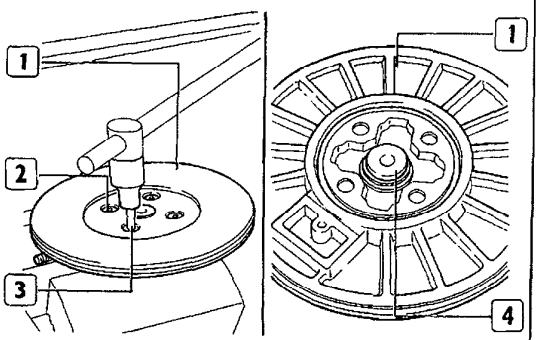
Dismantling



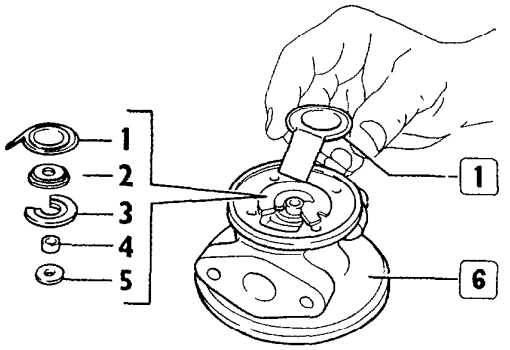
32800

Remove the compressor rotor retaining nut (1), using a press, extract the turbine shaft (4) complete with heat shield (2) from the compressor rotor (1) and the centre body (3)

On assembly, the threads of the compressor rotor retaining nut was coated with LOCTITE 640, if excessive tightness is found when dismantling, heat the nut with a hot air generator to a temperature of not more than 130° C, taking care to protect the spindle threads from possible overheating

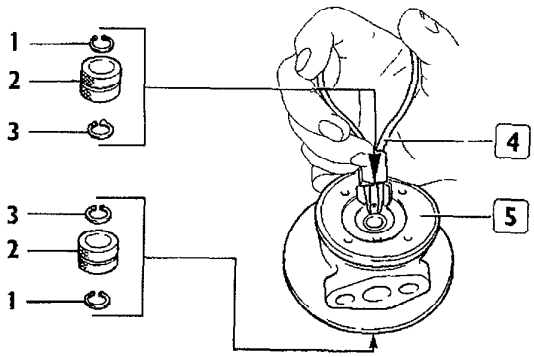


Separate the flange (1) from the centre body by removing the securing screws (2) using a socket wrench (3)
From the flange (1), remove the seal bush (4) complete with circlip



35 41

From the centre body (6), remove the oil thrower, thrust washer (2), axial bearing (3), spacer (4) and washer (5)

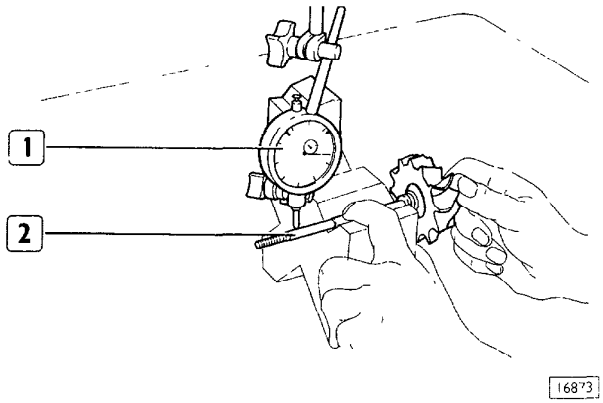


32802

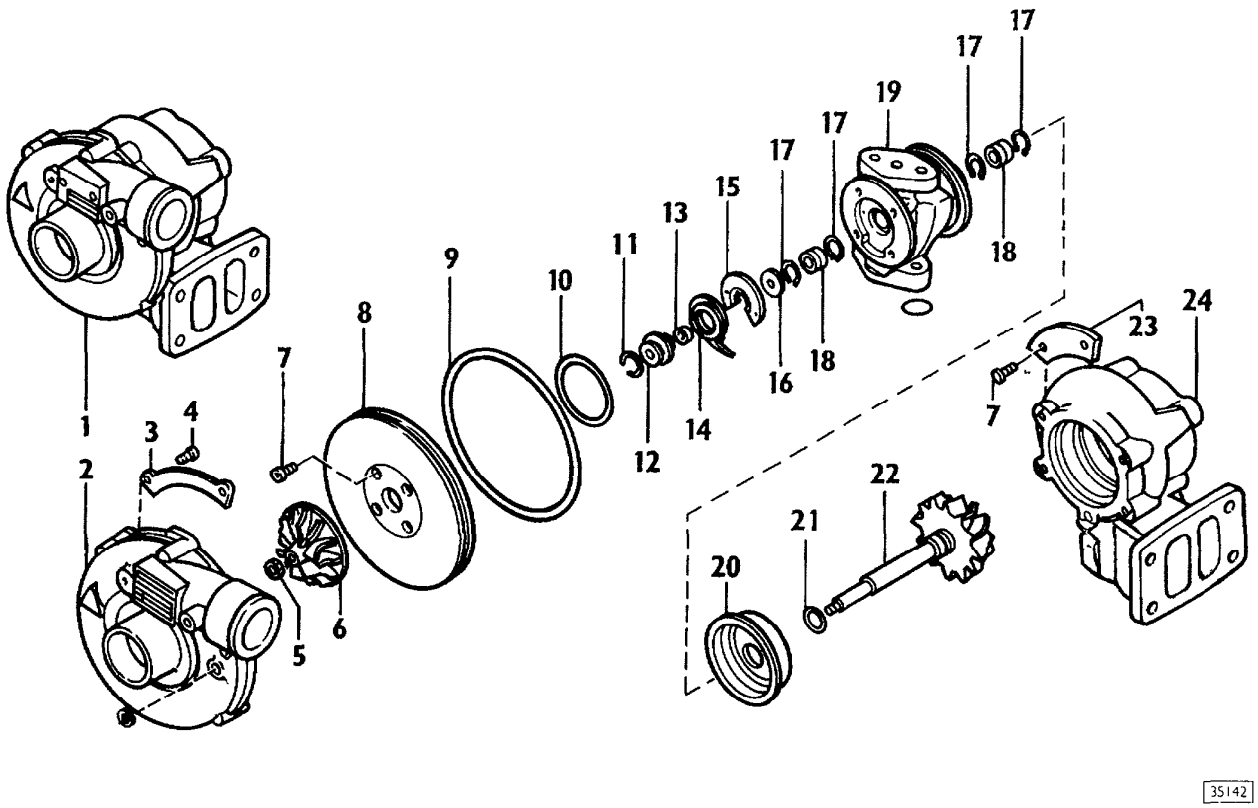
Using pliers (4), remove the circlips (1) and remove the bushes (2) from the centre body (5)
Remove the circlips (3), replacing them if necessary

Checks

Carefully clean the component parts of the turbocharger with kerosene and a stiff bristled brush, drying with compressed air To clean the turbine scrolls, where carbon deposits are difficult to remove, use appropriate means (e g. sand-blaster) If on first checking the rotating assembly excessive axial or radial play is found, check which component is responsible for the wear.
It is advisable to replace all components which are supplied as a kit of spares.
Check the vanes of the compressor and turbine rotors for breaks, deterioration or distortion
If any fault is found, the unit must be replaced Check that the gas inlet and outlet flanges are flat



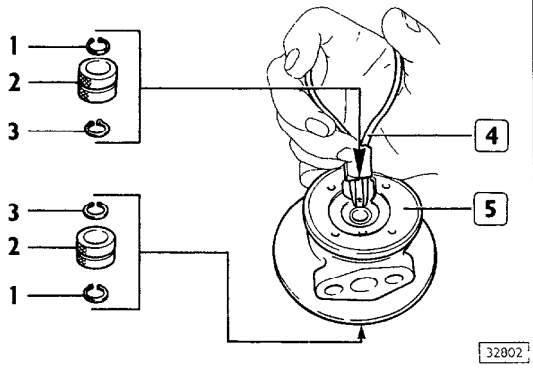
Using a dial gauge (1) with magnetic base, check the run-out of the turbine rotor shaft (2), run-out measured 5 mm from the end of the spindle must be not more than 0.008 mm



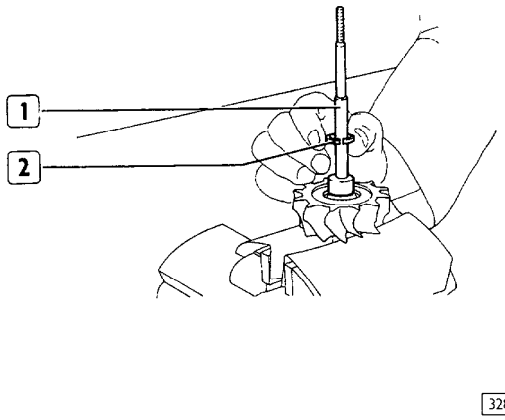
COMPONENT PARTS OF THE TURBOCHARGER

1 Turbocharger assembly – 2 Compressor body – 3 Plate – 4 Screw – 5 Nut – 6 Compressor rotor– 7 Screw – 8 Flange – 9 Seal – 10 Seal – 11 Circlip – 12 Bush – 13 Spacer – 14 Oil thrower – 15 Axial bearing – 16 Thrust washer – 17 Circlip – 18 Bearing – 19 Centre body – 20 Heat shield – 21 Circlip – 22 Turbine rotor – 23 Plate – 24 Turbine body

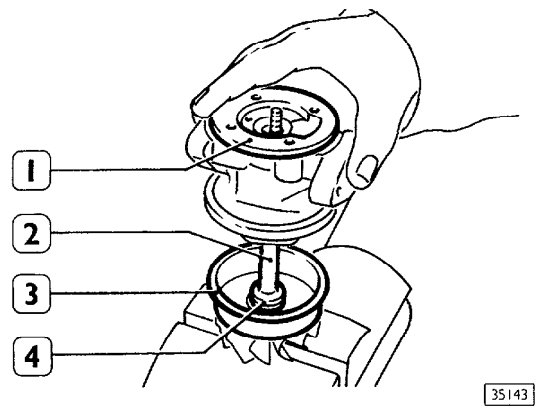
Assembling



Using pliers (4), fit the inner circlips (3) to the centre body (5), insert the bushes (2) lubricated with engine oil and secure them with the outer circlips (1)

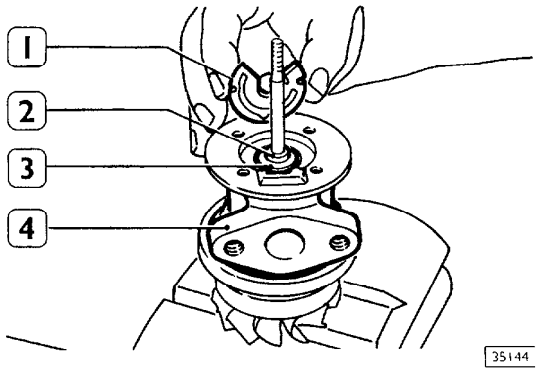


Position the circlip (2) in its housing on the turbine rotor shaft (1)

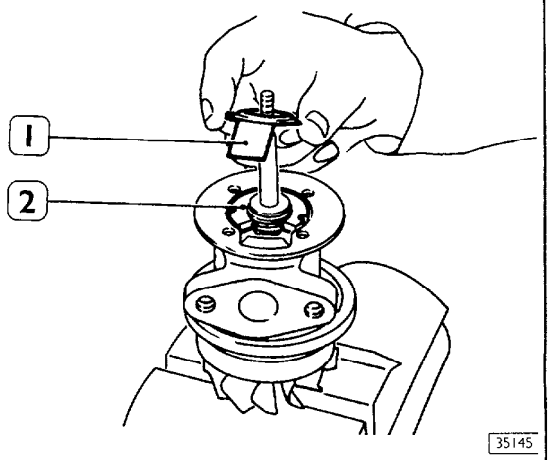


Lubricate the turbine rotor shaft (2), fit the heat shield (3), fit the centre body (1)
When compressing the circlip (4), make sure that the opening is 90^0 away from the oil feed hole

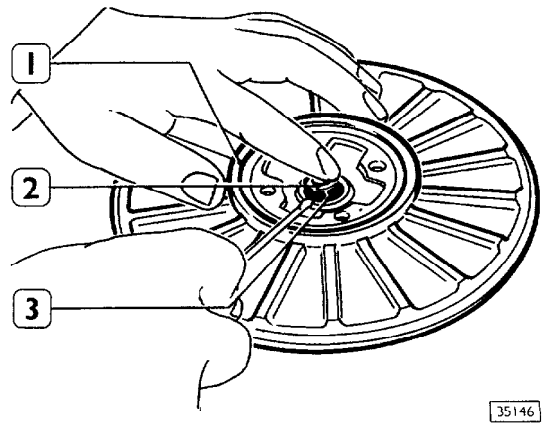
The circlip (4) is correctly positioned in its housing if the heat shield (3) and centre body (1) rotate freely



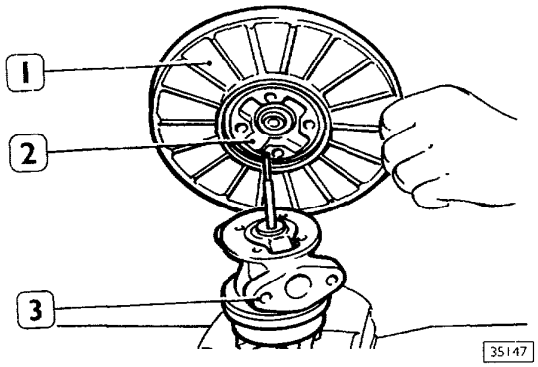
Position the washer (3), spacer (2) and axial bearing (1) in the centre body (4)



Fit the thrust washer (2) and the oil thrower (1)

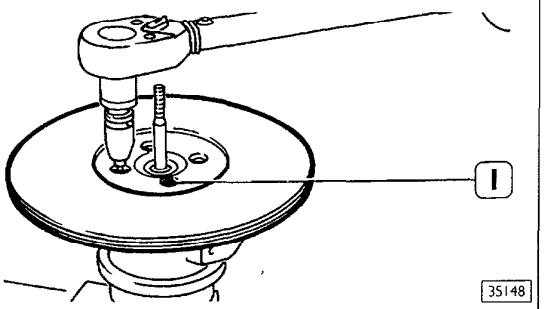


Fit the bush (2) complete with circlip (3) to the flange (1)

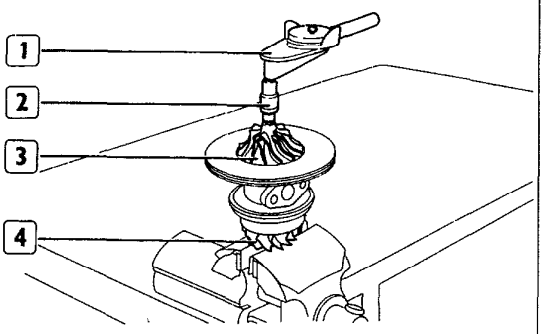


Fit the inner seal (2) to the flange (1) and fit this to the centre body (3), lining up the marks made when dismantling

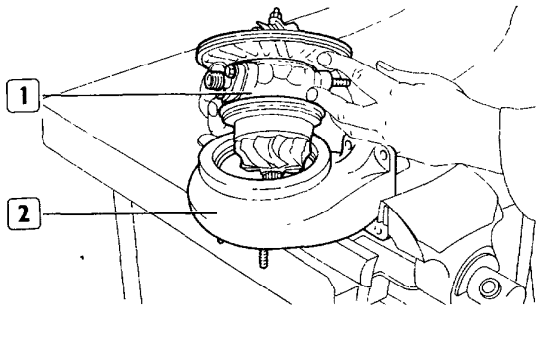
The seal (2) must be coated with NEVER–SEEZ compound



Apply LOCTITE 640 to the threads of the screws (1) and tighten them to a torque of 6 Nm (0 6 kgm)

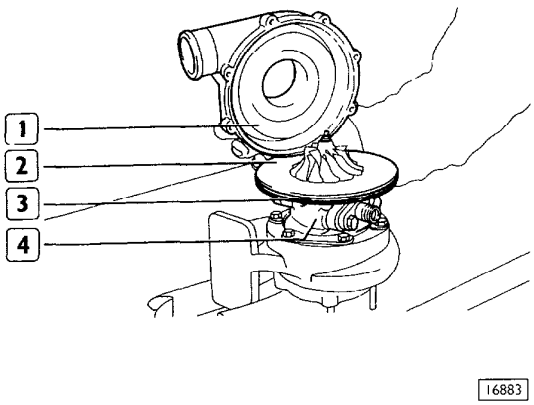


Heat the compressor rotor (1) to 130^0 C Lubricate the rotor shaft (3) and fit the compressor rotor (1) to this Screw on a new securing nut and tighten it to a torque of 7 + 2 Nm, (0 5 + 0 2 kgm) After about 10' apply LOCTITE 640 to the threads of the shaft, unscrew the nut by 1 – 2 turns and retighten it to a torque of $5^{+60°}_{-5°}$ Nm
(0 5 $^{+60°}_{-5°}$ kgm)
To conclude, seal the shaft nut and thread with locking varnish and check the end and radial play in the bearings as described on page 153



Fit the centre body (1) complete into the turbine body (2), taking care to line up the marks made when dismantling Tighten the screws securing the centre body to the turbine body to a torque of 20 Nm (2 kgm)

The threads of the turbine body securing screws must be coated with NEVER–SEEZ compound beforehand



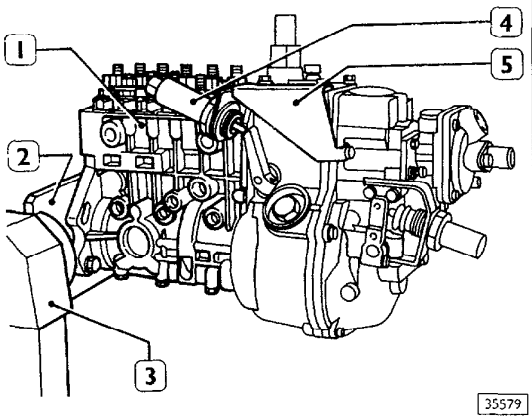
Position a new seal (3) in the housing on the intermediate disc (2) and fit the compressor body (1) to the centre body (4), taking care to line up the marks made when dismantling Tighten the screws securing the compressor body to the centre body to a torque of 7 Nm (0 7 kgm)

Before fitting the turbocharger to the engine, the centre body should be filled with engine lubricating oil

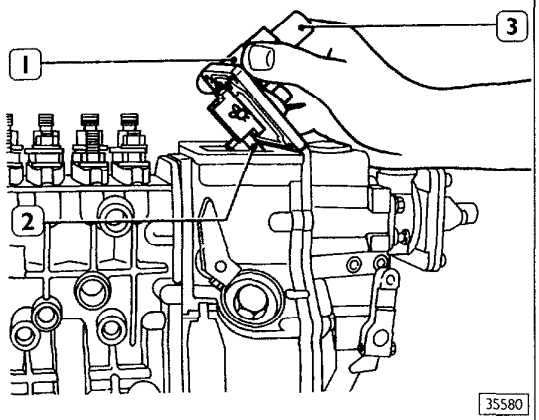
INJECTION PUMP PES 6MW100

GOVERNOR RQV 325-1350

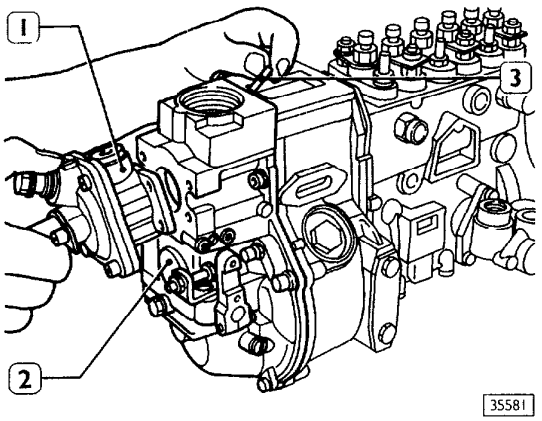
DISMANTLING



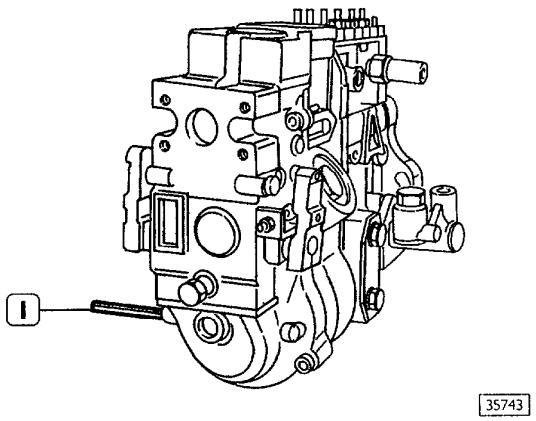
Position the injection pump (1) on the swivelling mounting 99365014 (3) complete with plate 99365163 (2)
Remove all the lead seals fitted to the injection pump Take off the delivery zeroing cylinder support bracket (5)



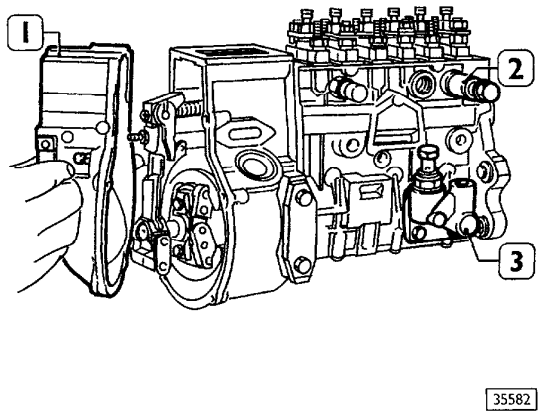
Remove the screws securing the cover (1) of the mounting for the TAS device (3) and raise the cover (1) at an angle so that the connection of the TAS device (3) is withdrawn from the pin (2)



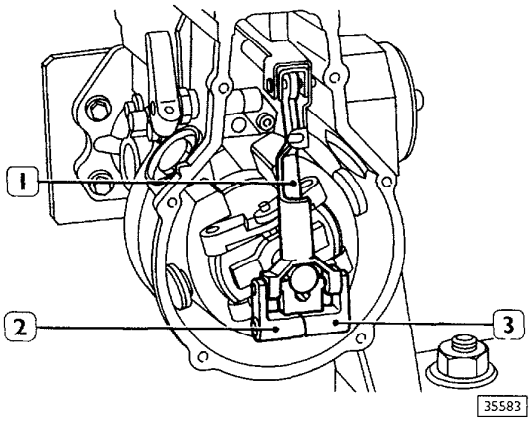
Remove the screws securing the LDA device (1) and, moving it to an appropriate angle, detach it so that the pin (3) with its connecting linkage comes out of the governor cover (2)



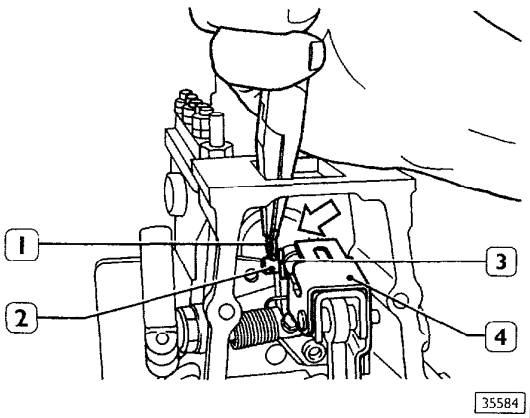
Unscrew the two threaded side plugs from the cover of the speed governor and, using a suitable punch, take out the guide pin (1)



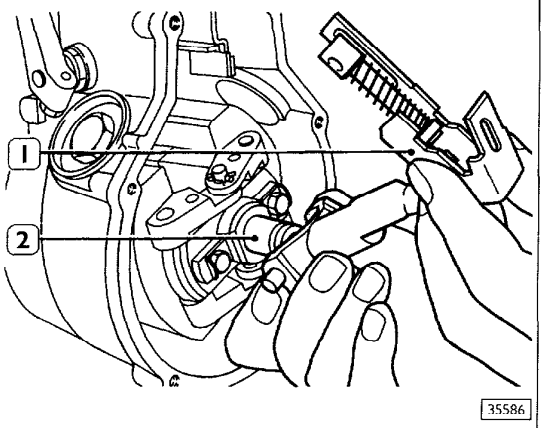
Remove the screws securing the cover (1) and moving it upwards, withdraw it from its seating, remove the pressure relief valve (2) and the feed pump (3)



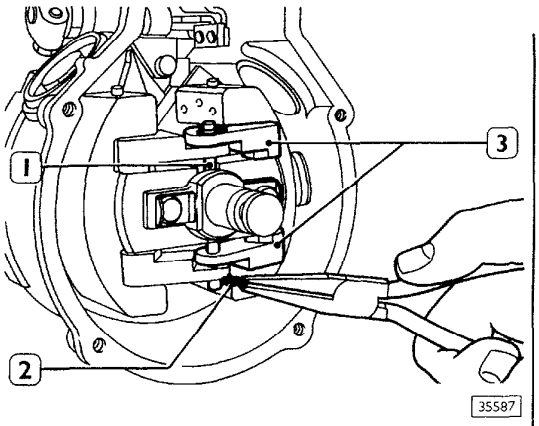
Take off the two swivel levers (2 and 3) from the lever hinge pins (1)



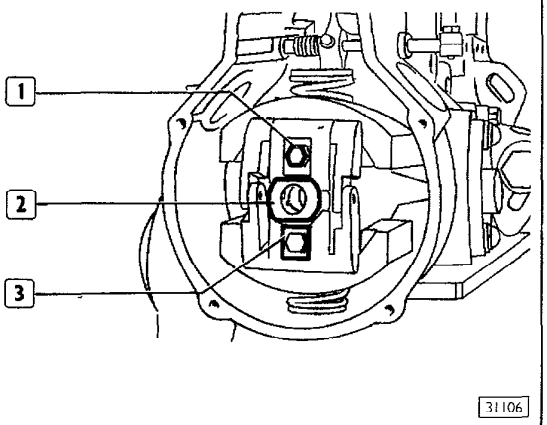
Remove the cotter pin (1) and washers (3) from the pin (2), move the link (4) sideways so as to withdraw it from the pin (2)



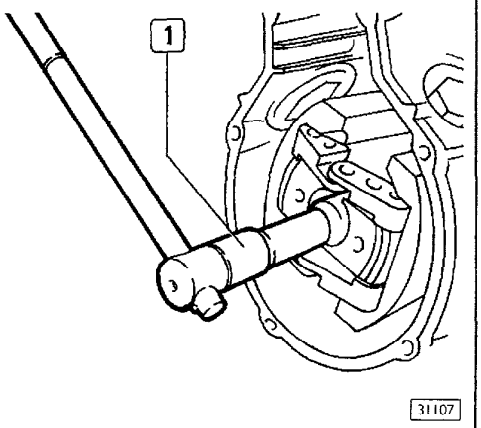
Rotate the linkage (1) and by moving it downwards, withdraw it from its seating on the pin (2)



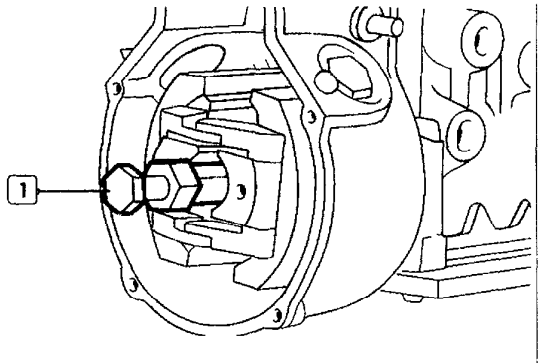
Remove the spring clip (2) from the pin (1) and withdraw the pin from the lever (3)



Straighten the tabs of the locking plate (3), remove the securing screws (3) and withdraw the guide bush (2)

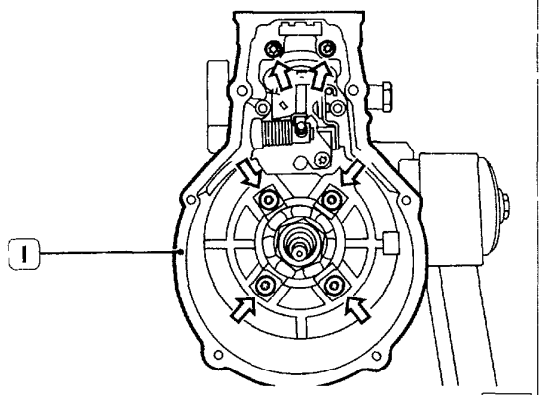


Using tool 99365033, prevent the camshaft from rotating and take off the ring nut securing the centrifugal weights using wrench 99350034 (1)



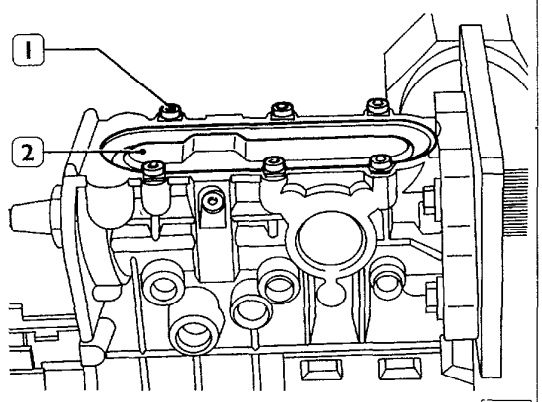
31108

Using tool 99365033, prevent the camshaft from rotating and remove from it the governing device, using extractor 99342111 (1)



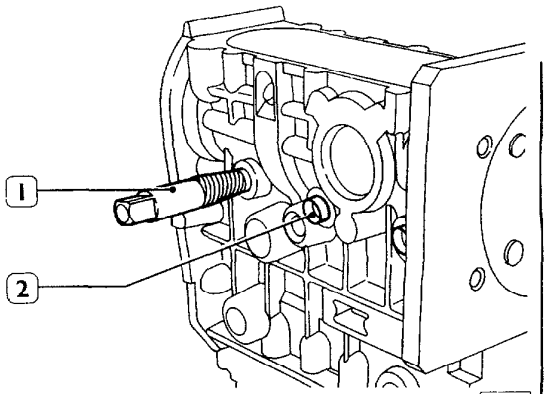
35588

Remove the securing screws (arrowed) and detach the governor casing (1) from the pump body



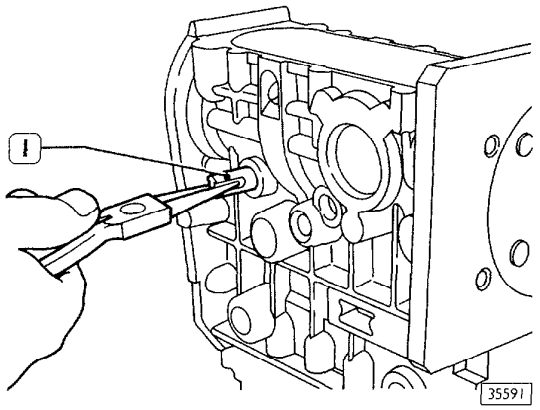
35589

Rotate the pump body 180°
Remove the screws (1) and the plates below
Retain the cover (2), and remove the cover and gasket



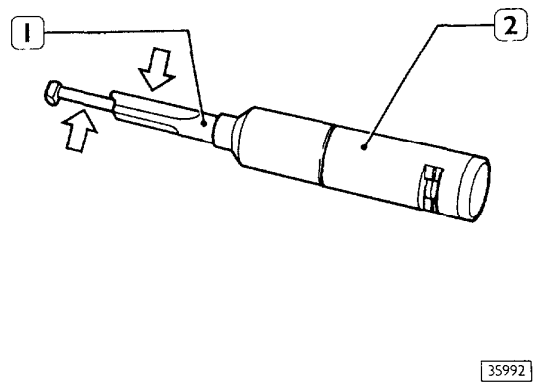
35590

Using an extractor (1), remove the plugs (2) from the pump body



35591

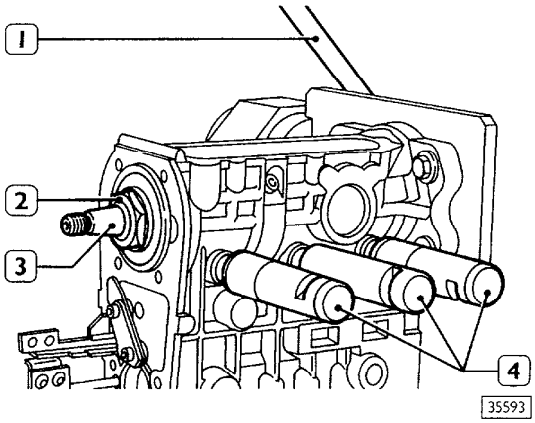
Withdraw the tappet guide pins (1)



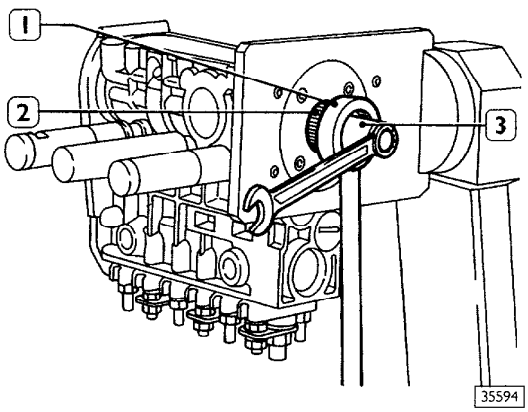
35992

To remove the camshaft, proceed as follows

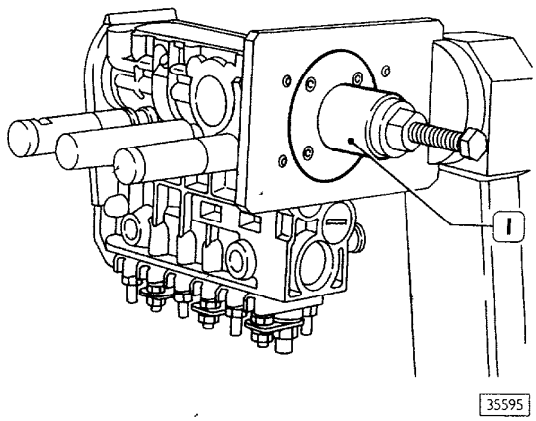
- turn the rotating part (2) of tappet lifting tool 99365185 (1) anti-clockwise as far as it will go, and lubricate it with grease at the points shown by the arrows



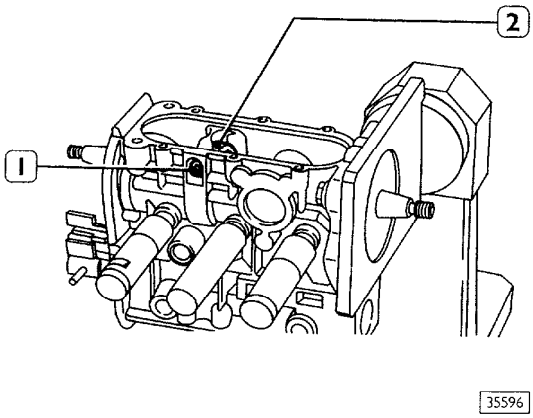
- ☐ turn the camshaft using wrench 99365033 (1) to compress the tappets of the first cylinder
- ☐ insert tool 99365185 (4) into the tappet guide pin housing of the first cylinder with the edge facing upwards and press it by hand until it is felt to stop
- ☐ turn the camshaft again and compress the roller tappet of the second cylinder, again press in the tappet lifter as far as it will go
- ☐ in this way the roller tappets of the first and second cylinders of the camshaft are lifted and locked, proceed in the same way for the other tappets
- ☐ remove the bearing retaining nut (2) from the camshaft (2)



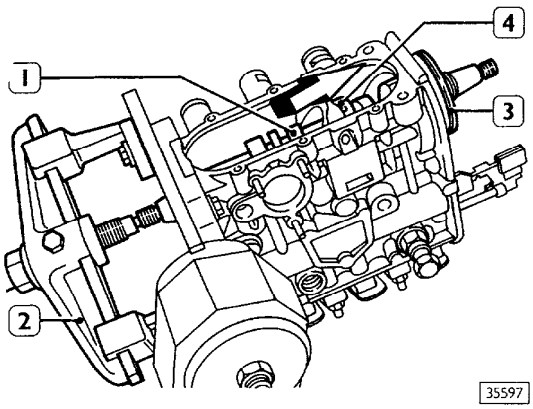
Using tool 99365033 (1), prevent the camshaft from rotating and remove the ring nut (3) retaining the splined bush (2)



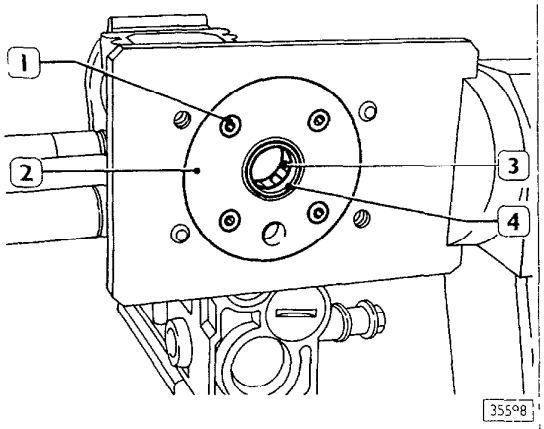
Using extractor 99342139 (1), extract the splined bush (2, figure 19) from the camshaft



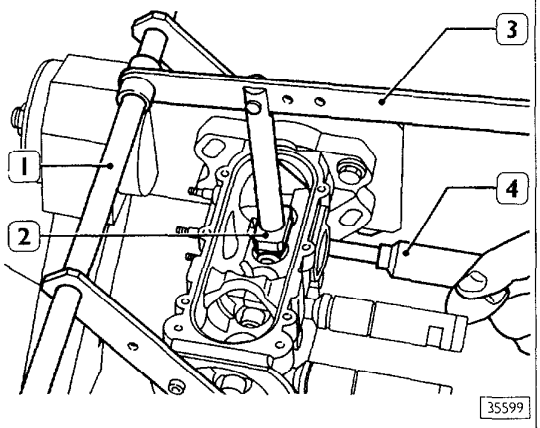
Remove the screws (1) securing the intermediate half bearing (2)



Using the universal extractor (2) fitted to the pump body as shown in the figure, remove from the pump body the camshaft (1) complete with ball bearing (3) and intermediate half bearing (4)

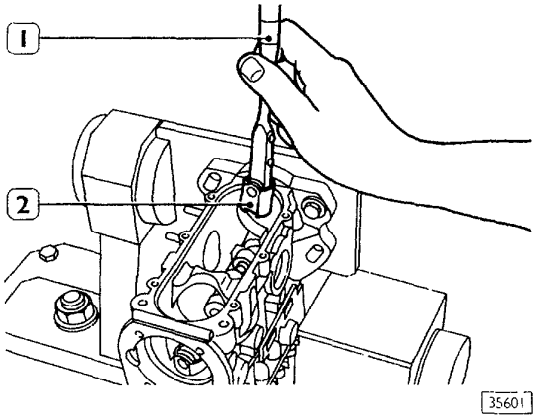


Remove the screws (1) and take off the cover (2) complete with bearing (3) and O-ring (4)

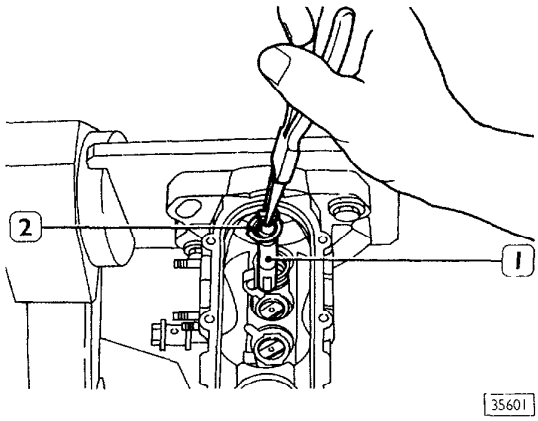


Fit tool 99342128 (1) equipped with rectangular base adapter (2) to the body, rest the adapter on two tappets, compress them by pressing down on the lever (3) and then extract tool 99365185 (4) from the pump body
Proceed in the same way to extract the remaining tools from the pump body

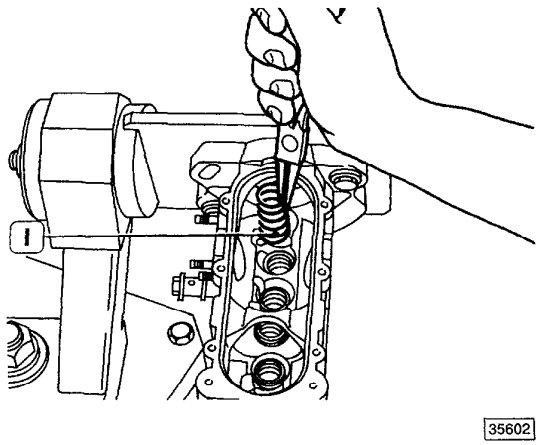
The component parts of the plunger assemblies which are removed one after the other from the pump body must be carefully placed in a suitable container in the order of dismantling, moreover, the components of one plunger assembly must not be mixed up with the components of the other units since they are not interchangeable



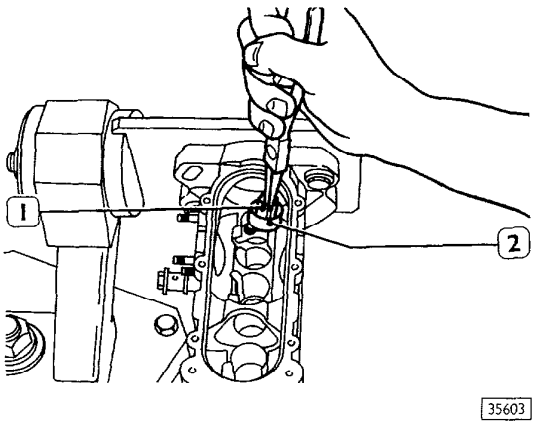
Using tool 99365022 (1), extract the roller tappet (2)



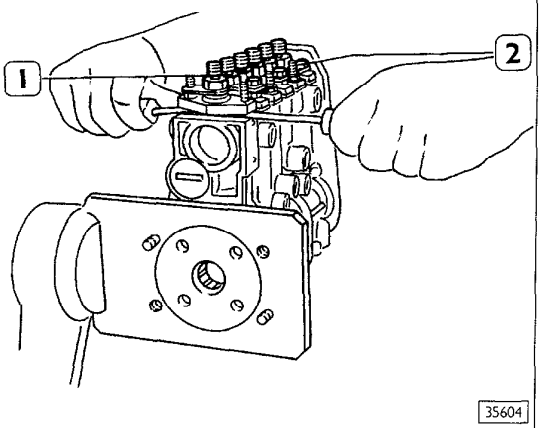
Using pliers, withdraw the piston (1) and cup (2)



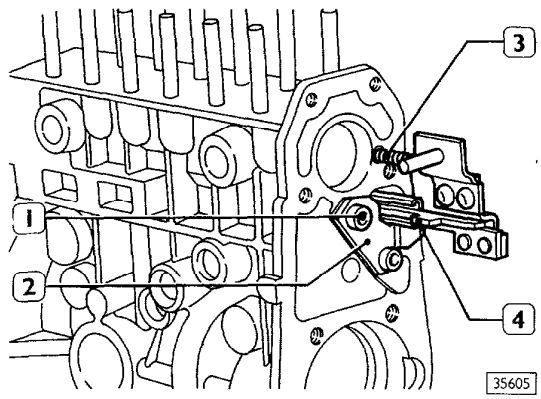
Extract the spring (1)



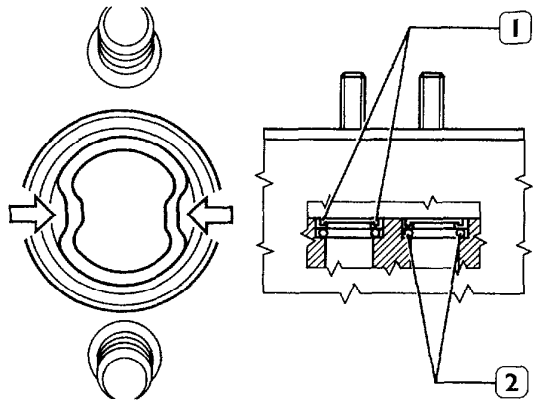
Extract the regulating sleeve (1) and the spring seating cup (2)



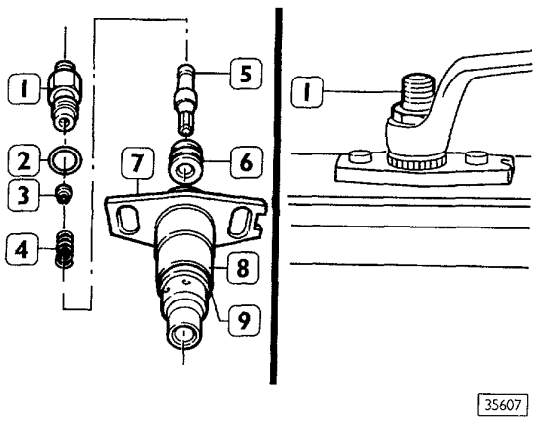
Rotate the pump 180°, take off the nuts and spring washers, using two screwdrivers, lever off the barrel unit (1) complete with O-ring and adjustment shims



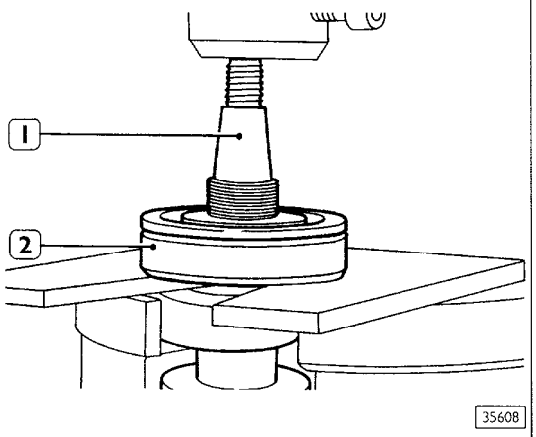
Remove the screws (1) securing the control rod retaining bracket (2) to the pump body and withdraw the control rod (4) from the body with the reaction spring (3)



Using a screwdriver and taking care not to damage the pump body, distort the cup (1) as shown by the arrows and extract it, the remove the O-ring



Remove the snap ring (9) and withdraw the jet-breaker ring (8) from the barrel (7)
Secure the cylinder (7) by suitable means in a vice, taking the union (2) apart releases the O-ring (2), the cup (3), the spring (4), delivery valve (5) and the delivery valve body (6)



Using a press or suitable extractor, remove the bearing (2) from the camshaft (1)

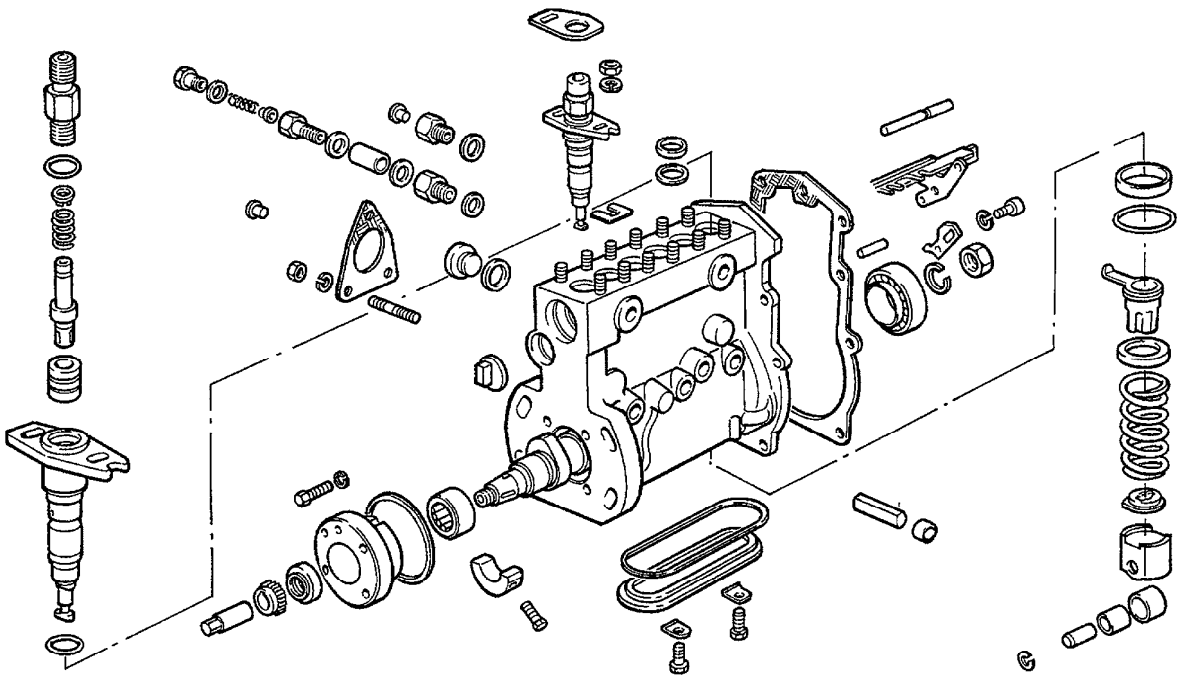
CHECKS

Carefully wash all component parts of the injection pump with a suitable detergent such as Chlorothene, gasoline, dry with compressed air and carry out the various checks Check that the pump body and its covers are free from cracks or damage, that the tappet housings in the pump body are free from wear and damage

Check that the threads of the studs and of the holes for screws are not damaged

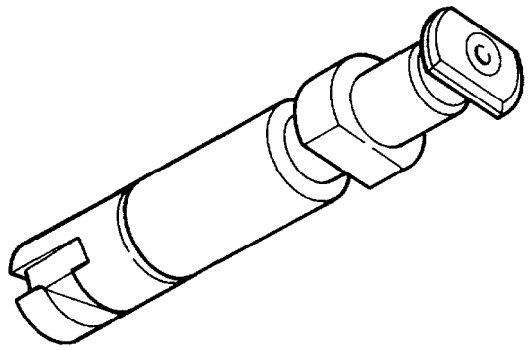
Check that there are no leaks from the plug protecting the suction compartment, if there are, replace the pump body

Check that the housings for the bearing and half bearing are not damaged



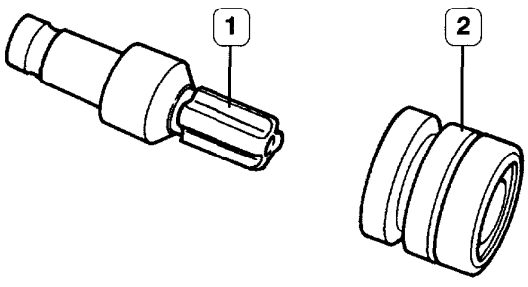
COMPONENT PARTS OF THE INJECTION PUMP

35609



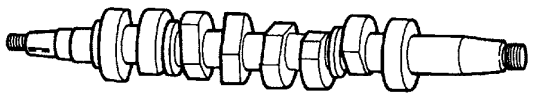
35610

Check the plunger assemblies, the piston helixes must be free from damage, the mating surfaces of the pistons and their barrels must not show any signs of wear
Lubricate the piston and its barrel with test oil then insert the piston into the barrel, when the pistons are held in a more or less vertical position, they should slide out under their own weight



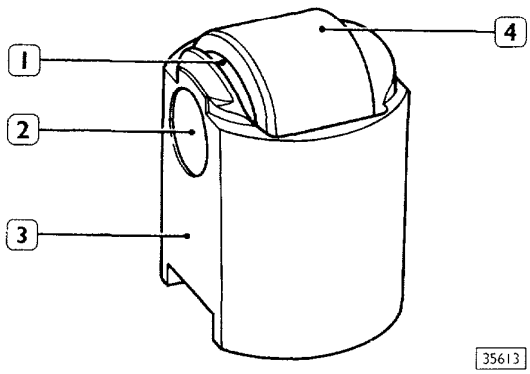
35611

Check that the delivery valve (1) slides freely and without play in the valve body (2)
Also, the tapered parts of the seat and valve must be free from damage and any wear must be uniform, if not, replace the parts



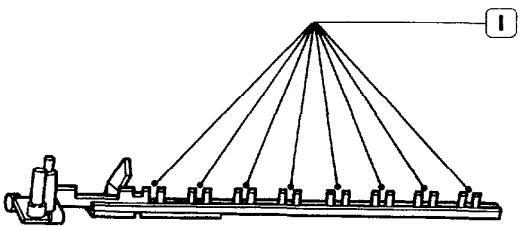
35612

Check that the cams, bearing journals and threads on the shaft are free from wear and damage, if not, replace the shaft



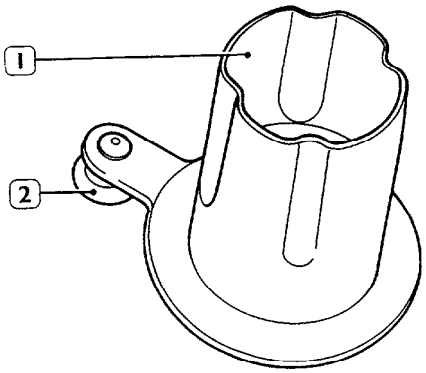
35613

Check that the roller tappets (3) are free from wear on the surfaces of the sliding roller (4), the bush (1) and the bearing pin (2)



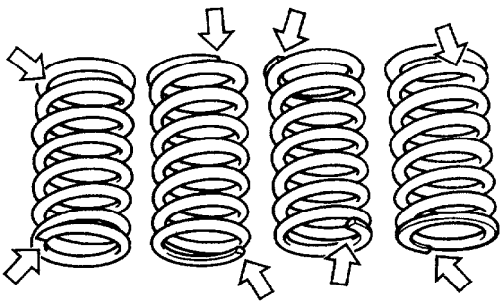
35614

Check that the control rod is free from distortion and slides freely in its housing in the pump body, also, the transverse notches must be free from breaks or damage



35615

Check that the ball (2) is not loose on the regulating sleeve, that the support of the ball is not distorted and that the guide (1) is not distorted

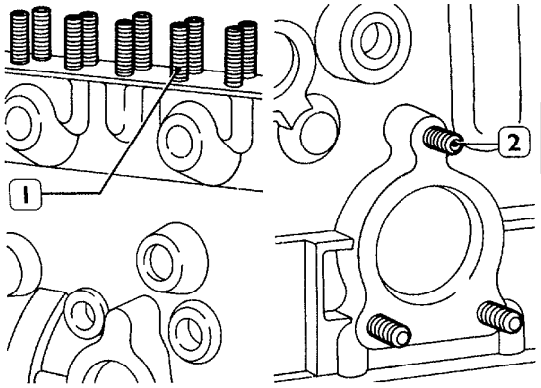


35616

Check that the springs are not weakened or damaged, the arrows indicate the points of greatest wear

ASSEMBLY

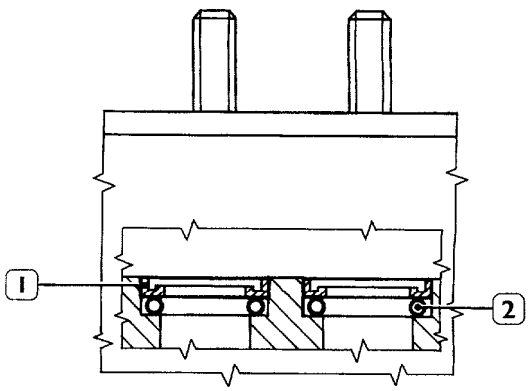
When assembling, paper gaskets, O-rings, plugs and internal washers should be replaced with new parts



35167

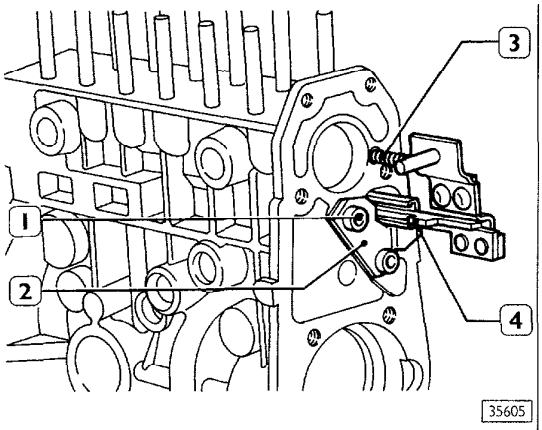
If studs are replaced, the threads should be coated before fitting with

- LOCTITE CVX for the plunger assembly securing studs (1) (setting time at a temperature of 20° 30 minutes)
- LOCTITE 601 for the feed pump securing studs (2) (setting time at a temperature of 20° 30 minutes)

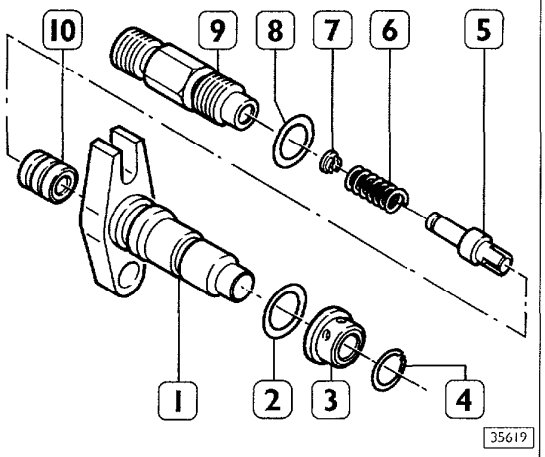


35618

Position a new O-ring (2) in the pump body, and fit the cup (1) using a suitable drift

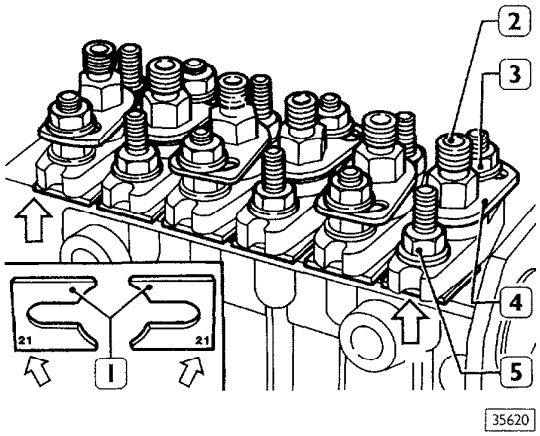


Fit the control rod (4) with the spring (3)
Check that it slides freely and secure it to the pump body by means of the bracket (2) with the screws (1)



COMPONENT PARTS OF THE PLUNGER ASSEMBLY
1 Barrel – 2 O–ring – 2 Jet breaker ring – 4 Snap ring – 5 Delivery valve – 6 Spring – 7 Cup – 8 O–ring – 9 Union – 10 Delivery valve body

Reassemble the plunger unit proceeding as follows
Secure the barrel (1) in the vice by appropriate means and insert into it the valve body (1), the delivery valve (5), fitting onto this the spring (6) and cup (7)
Position a new O–ring (8) to the union (9) and screw this onto the barrel, tightening it to a torque of 50 – 60 Nm
Take the barrel (1) out of the vice, fit to it a new O–ring (2), the jet breaker ring and the snap ring (4)



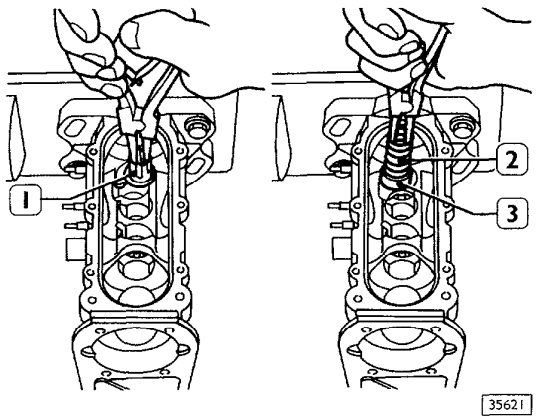
If it has not proved necessary to replace the components of the plunger assemblies, these must be refitted to the pump body, taking account of the position noted when dismantling

Position the start of delivery adjustment shims on the pump body

The adjustment shims (1) must be paired with the same thickness and the same markings

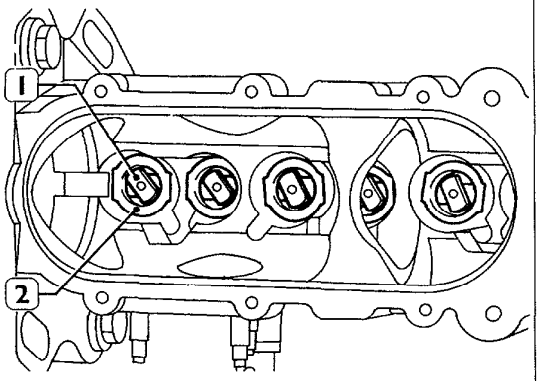
Fit the barrel (2) with the notch (arrowed) facing away from the identification plate and with the slot in the component positioned centrally with respect to the stud
Tighten the nuts (5) to a torque of 20 – 25 Nm
Fit the plate (4) with the slot positioned centrally with respect to the stud and tighten the securing nut (3)

FIGURE 47



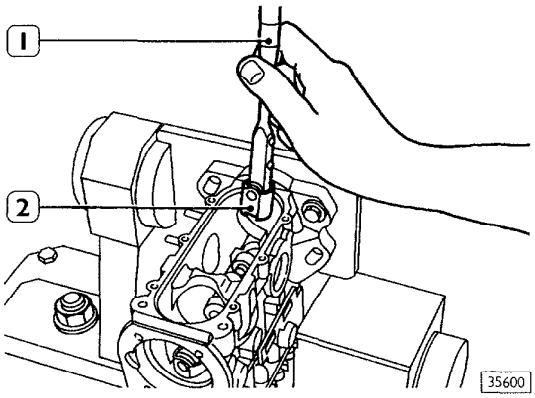
Fit the regulating sleeve (1) Coat the end of the spring (2) with grease, insert it into the spring seating cup (3) and insert it into the pump body
Check that the regulating sleeve is correctly engaged with the rod by manoeuvring the rod

FIGURE 48



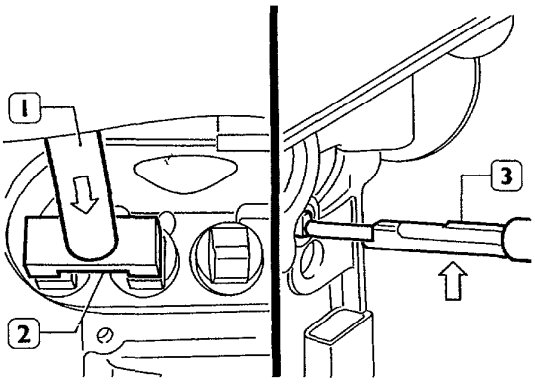
35622

Fit the cups (2)
Fit the pistons (1) with the markings stamped on the feet of the pistons facing away from the identification plate fitted to the pump body and positioned in the direction of the regulating sleeve housing



35600

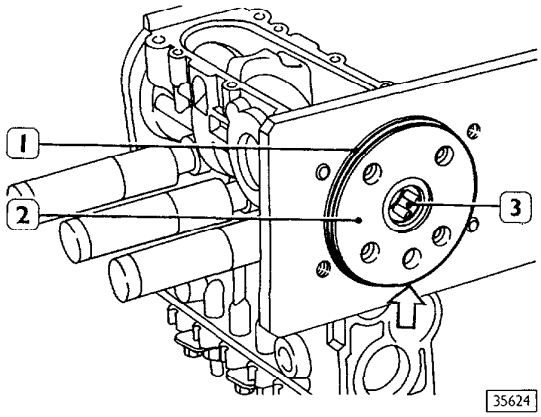
Using tool 99365022 (1), fit the roller tappet (2) into the pump body, positioning it correctly on the cup (2, fig 48)



35623

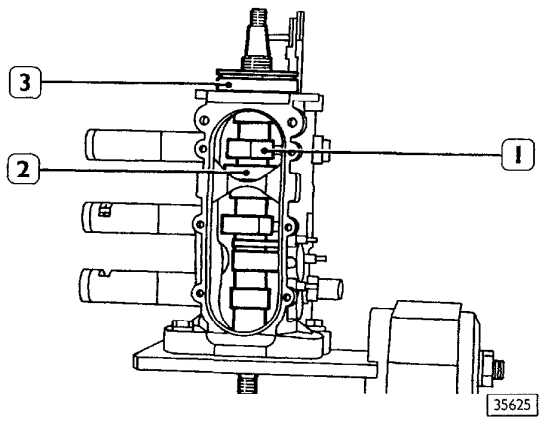
Fit tool 99342128 (1) equipped with the circular base adapter (2) to the pump body and rest the adapter on a tappet

By means of the tool mentioned above, compress the tappet and at the same time move the control rod so that the foot of the plunger is inserted in the seating on the sleeve (1, fig 47)
Pull the control rod outwards for the whole of its travel and release it, then repeat the operations on the other tappets
Replace the circular base adapter (2) with the rectangular base adapter and rest this on two tappets, compress the tappets so as to position them at TDC and insert tool 99365185 (3), having first lubricated it, and with the support edge (arrowed) facing upwards, as far as it will go Repeat the operations to insert the other two tools



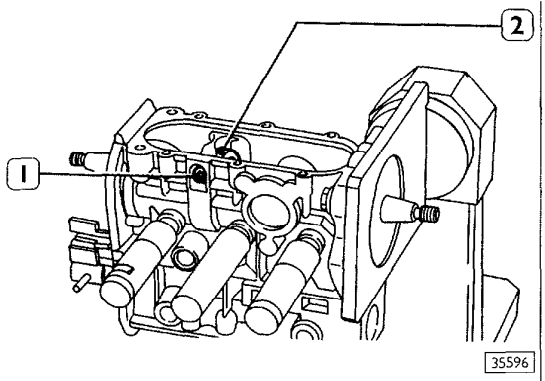
35624

Using suitable tools, replace the roller bearing (3) in the cover (2), fit a new O-ring (1) to the cover and fit it to the pump body with the oil feed holes (arrowed) lined up



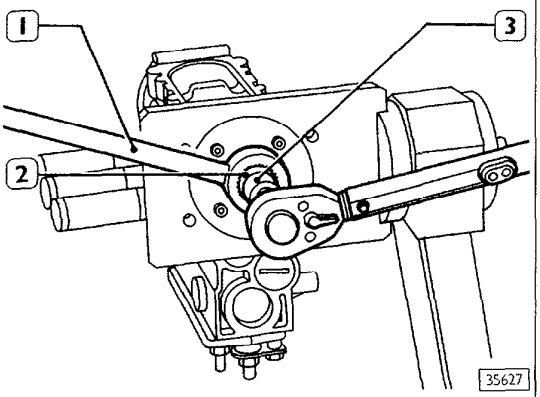
35625

Coat the intermediate half bearing (2) with grease so that it sticks to the camshaft (1) and fit the shaft, complete with bearings (3), into the pump body

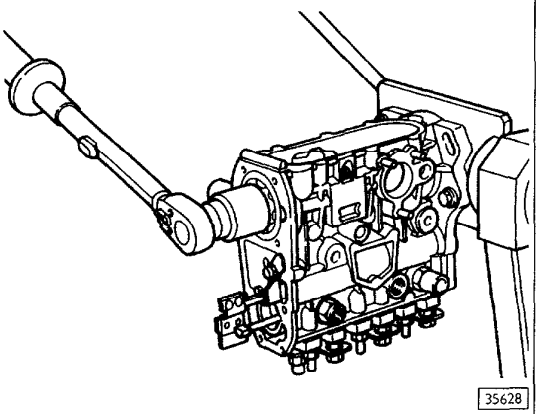


Tighten the screws (1) securing the intermediate half bearing (2) to the pump body to a torque of 8 – 10 Nm

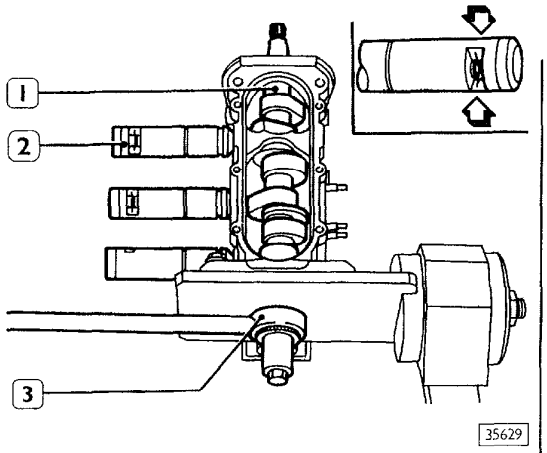
The screw threads must be coated beforehand with LOCTITE 638



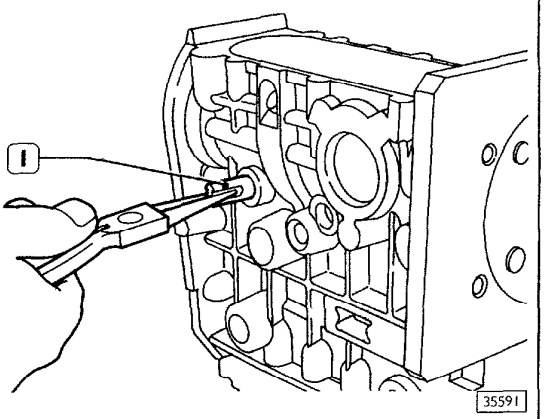
Fit the splined bush (2) to the camshaft, fit tool 99365033 (1) to the bush to prevent the shaft from rotating and tighten the ring nut (3) retaining the bush to a torque of 100 – 120 Nm



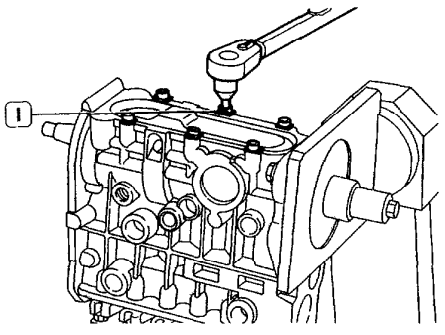
Preventing the camshaft from rotating by means of tool 99365033 (1), tighten the bearing retaining nut (2) to a torque of 100 – 120 Nm



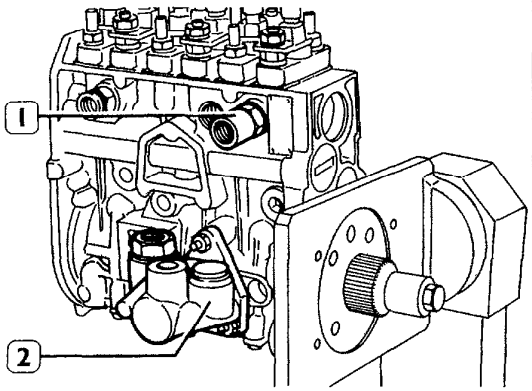
Using tool 99365033 (3) rotate the camshaft (1) until the roller tappet of the first plunger is compressed at TDC
Rotate the handle of tool 99365185 (2) until the threaded end lines up with the slots shown by the arrows
In this way the roller tappet is freed and is positioned on the camshaft
Again rotate the camshaft (1) until the tappet of the second plunger is compressed at TDC
Completely withdraw tool 99365185 (2) from the pump body so as to free the tappet of the second plunger
Repeat the same operations in succession the other tappets in order to withdraw the other tools from the pump body



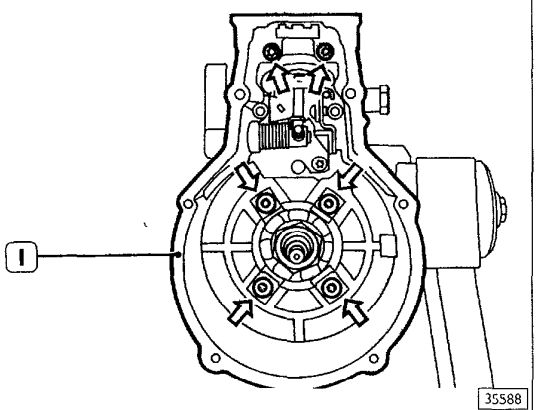
Insert the roller tappet guide pins (1) into the pump body. Fit the plugs, coated beforehand with LOCTITE 601 (setting time of LOCTITE 601 at 20° C, approx 3 hours)



Fit the lower cover with a new gasket and tighten the securing screws (1) to a torque of 4 – 7 Nm (0 4 – 0 7 kgm)



Fit the pressure relief valve (1) and feed pump (2), tightening the nuts (3) to a torque of 7 – 9 Nm (0 7 – 0 9 kgm)

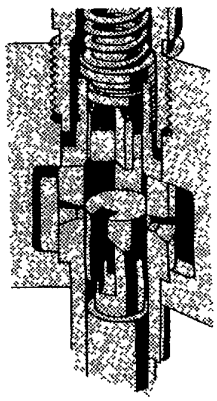


Fit the speed governor casing (1) with the rubber gasket under it, tightening the eight screws to a torque of 8 – 10 Nm (0 8 – 1 0 kgm)
Remove the injection pump from plate 99365163 and position it on the test bench, where assembly will be completed during the calibration phase

TESTING AND ADJUSTING THE INJECTION PUMP

1 - DELIVERY START

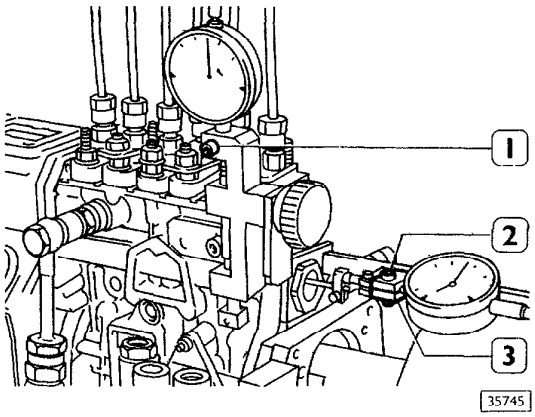
1 Test pressure bar : 30 - 32
.2 Prestroke (from B D C.) m· 3 0 - 3.10 (2 95 - 3.15)
.3 Rod stroke mm·
4 Rotation direction . C.W.
5 Pump injection order . 1 - 5 - 3 - 6 - 2 - 4
6 Cams order
.7 Tolerance ·
8 Delivery start cylinder n° 1



Adjust the position of each plunger so that start of delivery to the injectors occurs after each plunger has travelled the same distance in mm given in paragraph 1 2 from BDC to the point at which the feed holes in the barrel are closed

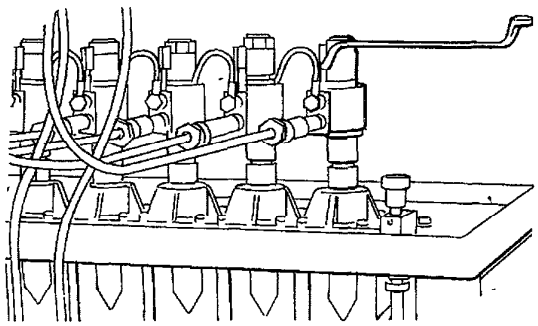
ADJUSTING START OF DELIVERY WITH THE HIGH PRESSURE SYSTEM

FIGURE 62



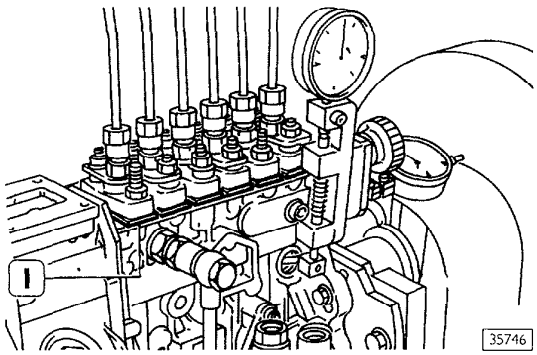
Make a connection between the injection pump and the drive joint of the test bench, connect the test fluid delivery pipe from the bench to the injection pump and close off the pump outlet manifold with a plug

Using the test bench pipes, make the connection between the pump and the injectors
Take off the tappet cover plug and fit the checking tool 99365183 (1, fig 62), bring the stylus of the tool into contact with the tappets, position the dial gauge and zero it with the tappet moved to BDC
Remove the rod cover plug and fit tool 99365138 (3, fig 62) to check the travel of the control rod, position the dial gauge and after moving the rod to the STOP position, zero it
Move the control rod to a travel of 9 – 12 mm, locking it in position with the screw (2, fig 62) provided on the tool



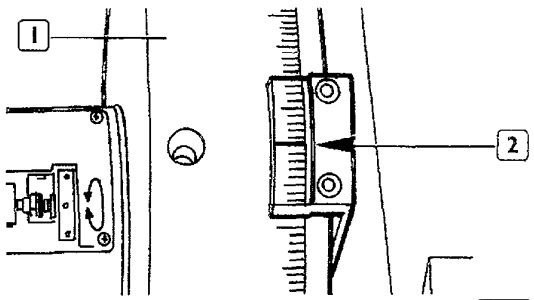
31143

Loosen the bleed screw corresponding to plunger 1, apply a pressure of 30 – 32 bars to the inside of the flooding chamber such as to lift the delivery valve by compressing the spring acting against it
The test fluid will then be discharged from the pipe placed at the side of the injector
By turning the bench flywheel in the specified direction of rotation, upward movement of the plunger is caused until the feed holes are closed, discharge of the test fluid from the pipe placed beside the injector then ceases, determining the start of delivery



35746

If closing of the supply ports by the plunger is too early or too late, correct by varying the shims (1) under the plunger column unit

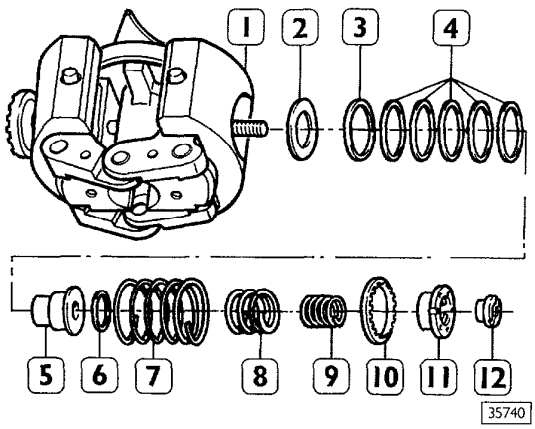


31145

When the adjustment is complete, zero the graduated flywheel (1) of the test bench with the reference pointer (2)

Before adjusting subsequent elements, fit the governing device and record the position of the reference pointer

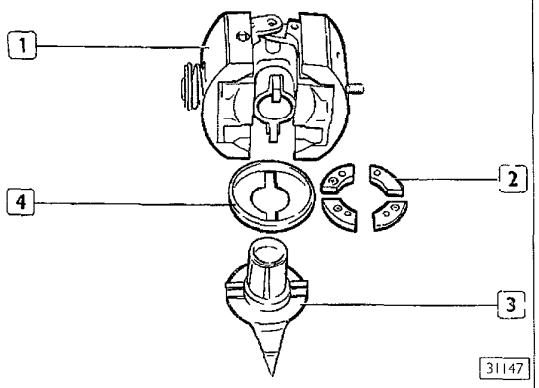
FIGURE 66



35740

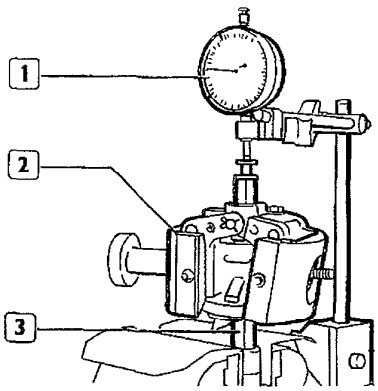
COMPONENT PARTS OF THE SPEED GOVERNOR
1 Centrifugal weights – 2 Washer – 3–4 Adjustment shims – 5 Collar – 6 Adjustment shim – 7 Idling spring – 8 Intermediate spring – 9 Internal spring – 10 Ring nut – 11 Collar – 12 Ring nut

FIGURE 67



COMPONENT PARTS OF THE SPEED GOVERNOR
1 Body – 2 Spring wedges – 3 Joint – 4 Cup

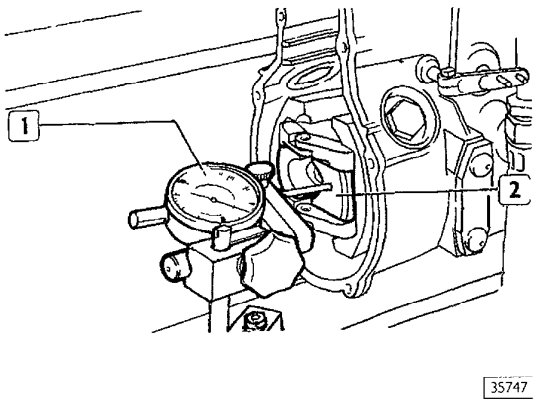
ADJUSTING THE IDLING CUT-IN RANGE OF THE SPEED GOVERNOR



Fit a dummy cone (3) in the vice and position the governing device (2) on it
Inside one centrifugal weight, insert the washer (2, fig 67), the adjuster collar (5, fig 66) and lock it in its housing by means of a retainer, fit a dial gauge (1) with magnetic base (4) to the pin
Preload the dial gauge and zero it
Check the movement of the centrifugal weight from the closing position until it comes to bear against the adjustment collar, the movement obtained, read off from the dial gauge, should be 2 0 ± 0 1 mm
If the value is found to differ from this, replace the adjustment collar
Carry out the same operation on the other governor weight
Assemble in the order shown in figure 66 and screw in the ring nut (12) flush with its stud
Then screw it in four notches
Carry out the same operations on the opposite weight
Final checking of the components will be determined on the test bench

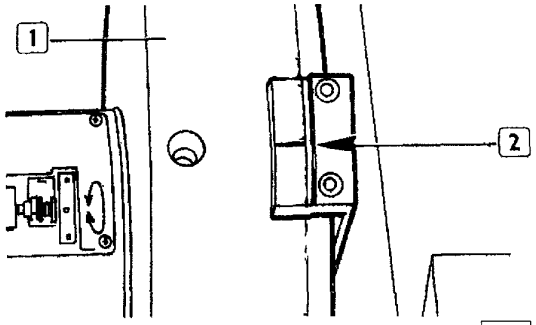
For removing and fitting the ring nuts (12, fig 66), use wrench 99352107

ADJUSTING SPRING WEDGE PRELOAD



Remove the joint from the governing device and take the spring wedges from their housing
Refit the cup and joint without the spring wedges
Position the governing device (2) on the crankshaft, fit the adjustment shim and, using wrench 99350034, tighten the securing ring nut
Position a dial gauge (1) in contact with the governing device (2), apply preload and zero the gauge
Move the device axially, checking that the value obtained is within the range 0 05 – 0 10 mm
To adjust, if necessary, replace the adjustment washer
Take the governing device out of its housing, insert the cup, the spring wedges and the joint
Tighten the securing ring nut to a torque of 65 – 75 Nm (6 6 – 7 6 kgm) using wrench 99350034

ADJUSTING START OF DELIVERY



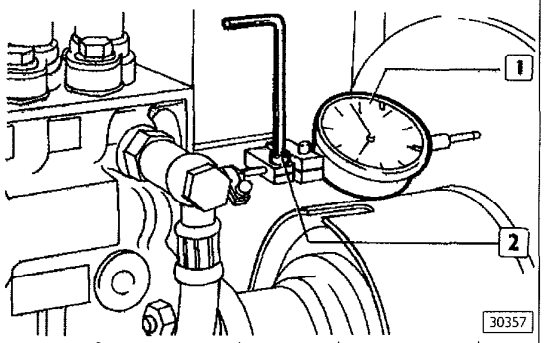
31145

Remove the tool with dial gauge
Adjust the following elements, observing the injection order and associated tolerance and check whether the start of delivery mark on the flywheel (1) of the test bench lines up with the zeroing mark (2)
If the marks do not line up, correct the position of the plunger column by varying the shims

2 BASIC ADJUSTMENT AND CONTROL

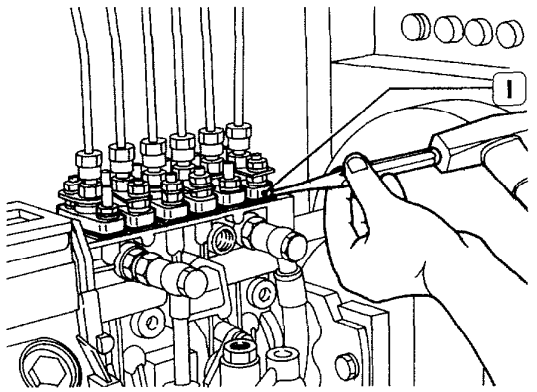
.1 Speed RPM : 1350
Pressure on LDA hPA : 1000
Rod stroke mm 12 7 - 12.8
Average delivery
for 100 flows cm^3 13,7 - 13,9
Max. gap cm^3 . 0,2
2 Speed RPM .
Rod stroke mm . 6,0 - 6,2
Average delivery
for 100 flows cm^3 : 0,9 - 1,1
Max. gap cm^3 :0,2

Carrying out the BASIC ADJUSTMENT makes it possible to determine the serviceability of the delivery valves and plunger elements
The tests are carried out so that the connection positions of the inlet and exhaust manifolds as on the engine are complied with
The original pressure relief valve is used on the exhaust manifold



30357

In the absence of a connection between the governing device and the associated rod, the position in mm,
both at maximum and at minimum, is set by tightening
the locking screw (2) provided on the dial gauge mounting (1)



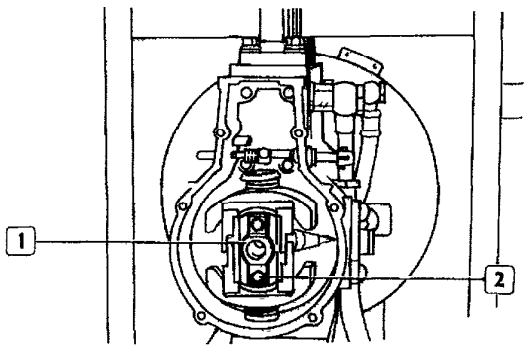
35776

2.1 ADJUSTING AND CHECKING MAXIMUM DELIVERY

At a corresponding speed of rotation and control rod travel, adjust uniformity of the maximum delivery of each element, complying with the maximum difference per element requirement Correct delivery by altering the position of the adjustment flanges (1) on the slots

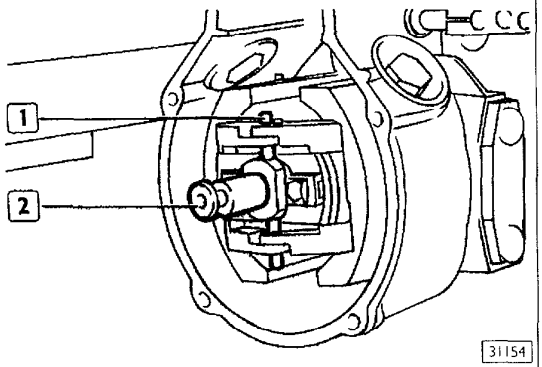
2.2 ADJUSTING AND CHECKING MINIMUM DELIVERY

At a corresponding speed of rotation and control rod travel, adjust uniformity of the minimum delivery of each unit, complying with the maximum difference requirement If in order to obtain uniform deliveries of the various elements it is necessary to adjust the slots of the flanged bushes or replace the delivery valves, repeat the maximum delivery test



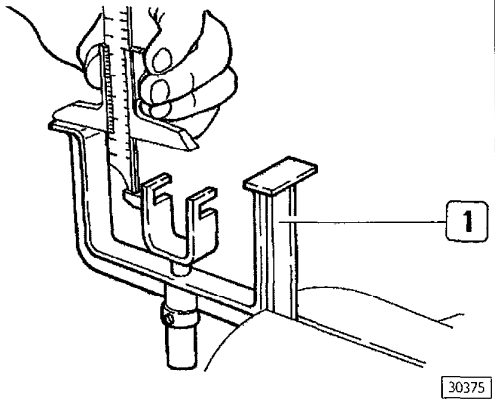
31143

Fit the guide bush (1) and tighten the screws (2) as appropriate after first fitting the locking plates underneath them
Bend over the locking plates for the screws (2)

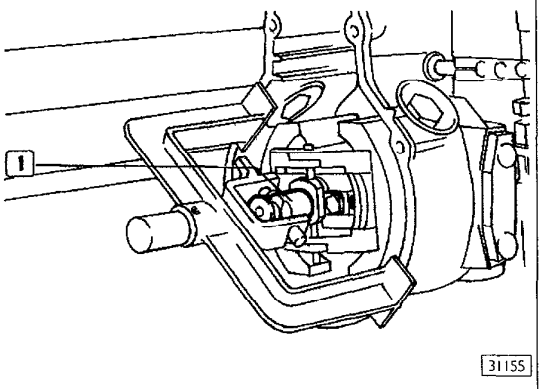


Fit the pin (2) and the transverse pin (1), securing them with their spring clips

PRESETTING SPRING PIN PROTRUSION



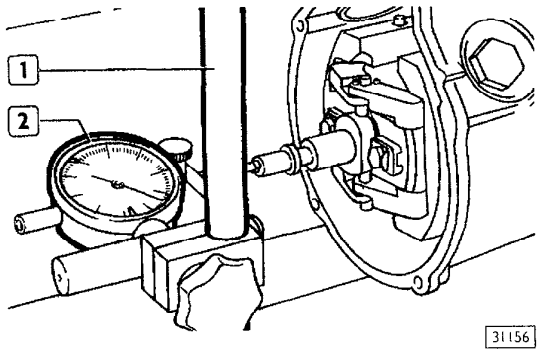
Using gauge 99365162 (1), check the distance between the centre of the joint and the face of the governor casing, with no gasket, this should be 37 1 ± 0.2 mm.



To correct the protrusion, turn the adjusting screw inside the spring pin (1)

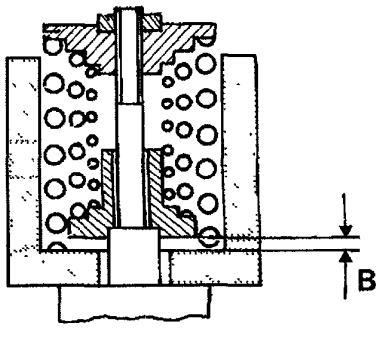
3 - AXIAL STROKE OF ELASTIC AXLE

1	Speed	RPM .
	Stroke	mm ·
2	Speed	RPM :
	Stroke	mm .
3	Speed	RPM
	Stroke	mm :
4	Speed	RPM :
	Stroke	mm .
5	Speed	RPM ·
	Stroke	mm :



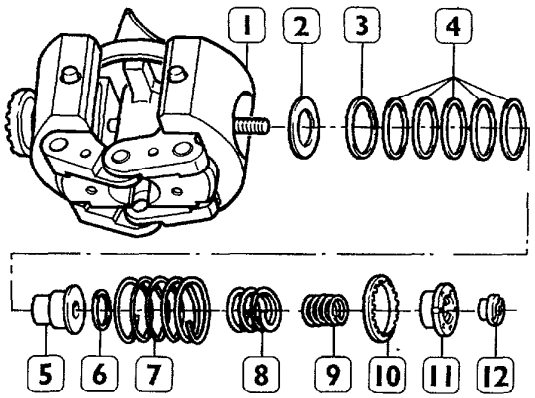
Secure a support (1) to take the *dial gauge* (2) to the test bench and position the gauge so as to contact the spring pin, zeroing it with a preload of at least 20 mm
Lock the control rod to a travel of about 9 mm

For safety, it is advisable to use a cover for the internal mechanism



B Idling speed amplitude

Raise the speed of rotation of the bench to the rpm values given in sections 31, 32, 33, 34, 35 and, by plotting a graph, check the corresponding axial travel of the spring pin in mm
This travel is determined by the opening of the governor weights due to the action of centrifugal force
It is advisable to achieve the higher tolerance

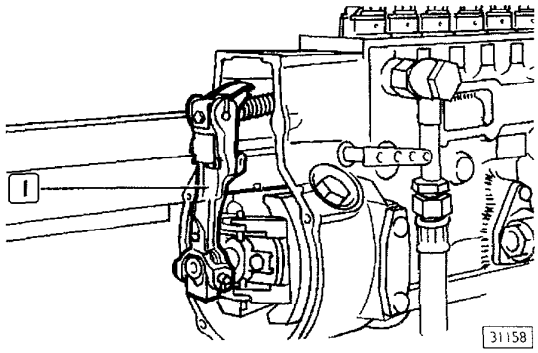


35740

If necessary, correction may be carried out
on the ring nut (12) for applying loading to springs (7, 8 and 9) using wrench 99352107, by varying the shims (3, 4 and 6) fitted under the springs, by replacing the springs themselves
Finally check that the total spring pin travel is not less than 13 mm, if it is not possible to obtain this, replace the weights unit complete (1)

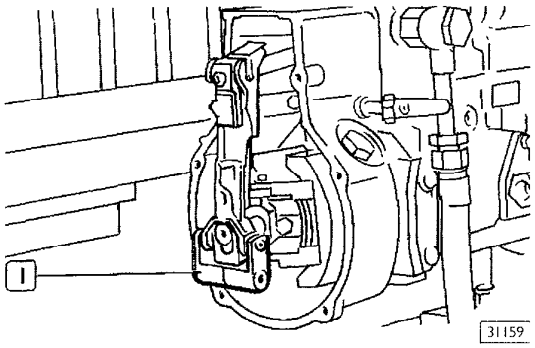
4 CHECKING THE SPRING PIN POSITION

The spring pin position must be checked with the governor cover fitted



31158

Fit the rod connecting linkage, securing it with the spring clip

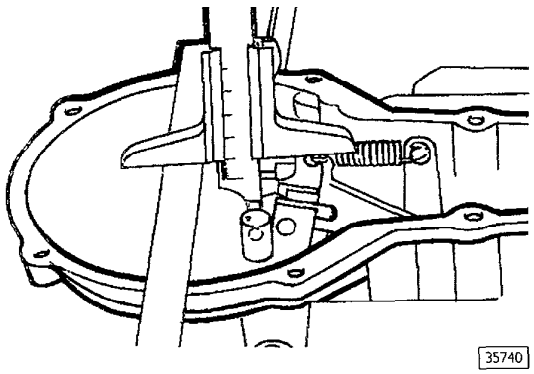


31159

Fit the two swivel levers (1)

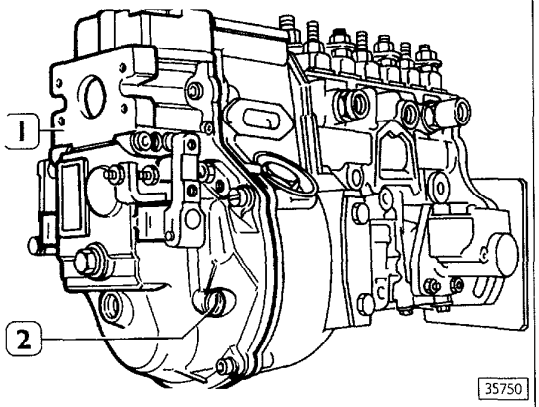
CHECKING THE LINK SETTING ON THE GOVERNOR COVER

To carry out the measurement, it is necessary to remove the outer lever stop screw to allow the guide pin to move to its full extent inside the housing present in the link.


35740

Measure the distance between the face of the cover with gasket and the centre of the guide pin, which should be 24.5 ± 0.1 mm

FITTING THE GOVERNOR COVER

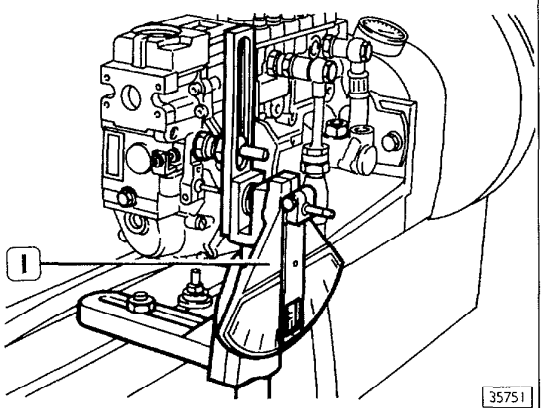


Secure the cover (1) complete with gasket to the governor casing so that the control piston is inserted into its housing in the inner lever and with the oil recovery recess facing upwards
Tightening torque for the cover securing screws (1) 8 – 10 Nm (0 8 – 1 0 kgm)

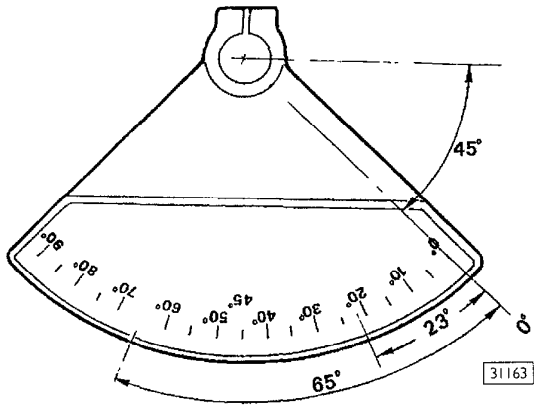
When fitting the guide pin, it is advisable to insert it into the cover, centring the associated swivel levers before the cover itself is secured to the governor casing

Fit the side screws (2)
It is advisable not to fit the outer lever stop screw, this screw will be fitted when it is necessary to adjust it

FITTING THE GRADUATED QUADRANT



Fit the graduated quadrant (1) for the following checks of the angular travel of the outer lever



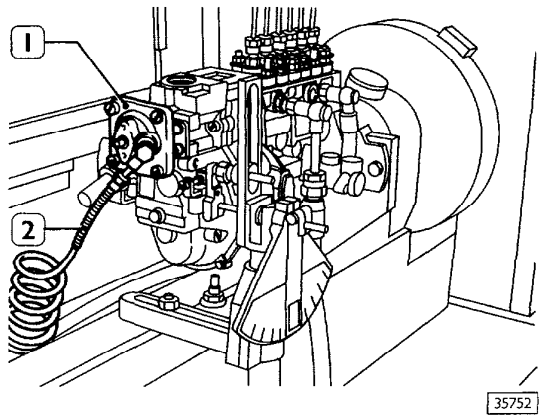
Position the graduated quadrant so that the subdivision corresponding to 45^0 is perpendicular to the plane of the bench, then position the reference pointer and the lever in line with 45^0, 0^0 will then be at 45^0 from the plane of the bench and thus from the horizontal plane
From the value indicated in the specification, see example, it is then necessary to subtract 45^0 and the resulting angle will have to be set on the quadrant
For example
110° – 45° = 65°
68° – 45° = 23°

4 - CHECK OF EL. AXLE PISITION

1 Control lever position
degres . max.
(excluding the inner and outer stops for the control lever)
2 Speed RPM:
Rod stroke mm :

5 - DELIVERY AT FULL LOAD

Speed	RPM	1350
Pressure on LDA	hPa	1000
Rod stroke	mm	12,7 - 12,8
Arage delivery for 1000 flows	cm^3	137 - 139 (135 - 141)
Max gap	cm^3	2



Fit the LDA device (1) and connect the test bench air line (2) to it

6 - GOVERNOR GAP CURVE AT MAX

1 Control lever position from horizontal axle for RQV degrees ·
with pressure on LDA hPa
2 Adjustment point of control lever for RQV
Speed RPM 1510
Rod stroke mm 5,4 - 5,9
Check
3 Rod stroke mm
Speed RPM
4 Rod stroke mm
Speed RPM
.5 Rod stroke mm
Speed RPM

In the air pressure conditions specified in paragraph 6 1 and with the external lever at maximum, increase the speed of rotation until the rod travel prescribed in paragraph 6 3 is read off from the dial gauge, check that the speed of rotation is within the limits prescribed in the same paragraph
If necessary, correct the position of the external lever so that the values correspond, the angular travel of the lever should be within the values in degrees given in paragraph 6 1
Keeping the position of the external lever unchanged, increase the speed of rotation to obtain the rod travel given in paragraph 6 4, check that the speed of rotation is within the limits in the same paragraph
Further increase the speed up to the values in paragraph 6 5, and at that point check the corresponding rod travel If the values given in paragraphs 6 4 and 6 5 are found not to correspond, taking paragraph 6 3 as the adjustment point, check that there are no tight spots in the governor mechanism or the movement of the rod

7 - GOVERNOR GAP CURVE AT MIN.

1 *Control lever position from horizontal axle degres*

Adjustment

.2 Speed RPM 350
Rod stroke mm . 6,0 - 6,2
Check .
3 Rod stroke mm
Speed RPM ·
4 Rod stroke mm
Speed RPM
5 Rod stroke mm
Speed RPM ·
.6 Rod stroke mm
Speed RPM
7 Rod stroke lineary
Speed RPM

Paragraph 7 2
At a speed of **350** rpm, adjust the stop screw (1) to obtain a control rod travel of **6,0÷6,2** the external lever should travel an angular distance corresponding to the values given in paragraph 7 1
When the speed of rotation is reduced, due to the effect of a reduction in centrifugal force, the expansion of the governor weights is reduced, allowing the control rod to increase its travel; then check that the values given in paragraph 7 3 and following are complied with

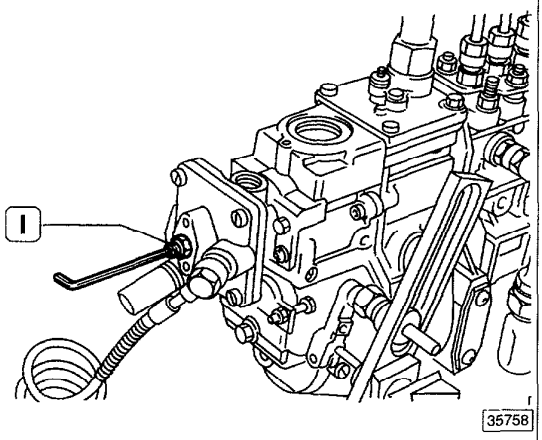
8 - ADJUSTMENT OF TORQUE INCREASE DEVICE

.1 Mechanical stroke of the device mm ·
.2 Control lever position at max
.3 Pressure on LDA hPa .
.4 Speed RPM
Rod stroke mm
5 Speed RPM .
Rod stroke mm
6 Speed RPM .
Rod stroke mm·
7 Speed RPM
Rod stroke mm
.8 Speed RPM .
Rod stroke mm.

Matching determined by the cam track
The adjustment was carried out in paragraph 5

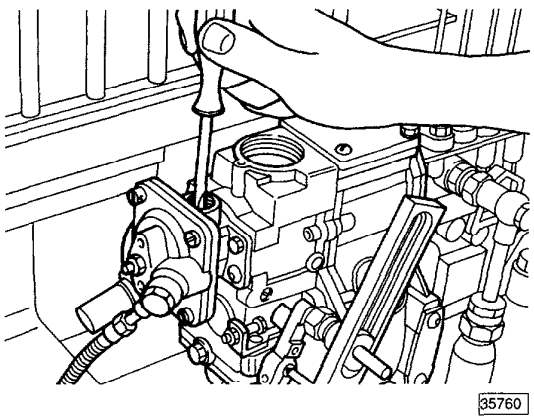
9 - ADJUSTMENT AND CONTROL OF THE TURBOCHARGING

Adjustment			
Speed		RPM	600
1	Pressure on LDA	hPa	1000
	Rod stroke	mm	12,7 - 12,8
2	Pressure on LDA	hPa	300
	Rod stroke	mm	11,2 - 11,4
3	Pressure on LDA	hPa	0,0
	Rod stroke	mm	9,3 - 9,5
	Check		
	Speed	RPM	
4	Pressure on LDA	hPa	
	Rod stroke	mm	



Paragraph 9 1
Check the control rod travel already adjusted in paragraph 5

Paragraph 9 2
With no air pressure to the LDA, adjust the position of the screw (1) to obtain maximum rod travel for aspirated engine conditions



Paragraph 9 3
Send the required air pressure to the LDA and adjust the relevant ring nut to vary the load of the spring acting against the movement of the diaphragm

CHECK

Paragraph 9 4
Under the conditions in the previous paragraph, reduce the air pressure on the LDA to the value required and check that the rod travel corresponds
If this check value is not obtained, the spring of the LDA device should be replaced and the adjustment operations repeated

10 - REVERSE POINT

1 Operating the control lever from min to max with energized solenoid
Speed RPM
Rod stroke mm MIN
2 Operating the control lever from min to max with pressure on LDA hPa .
Speed RPM
Rod stroke mm . MIN

No provision is made for this adjustment on this type of pump

11 - DELIVERIES MOVEMENT

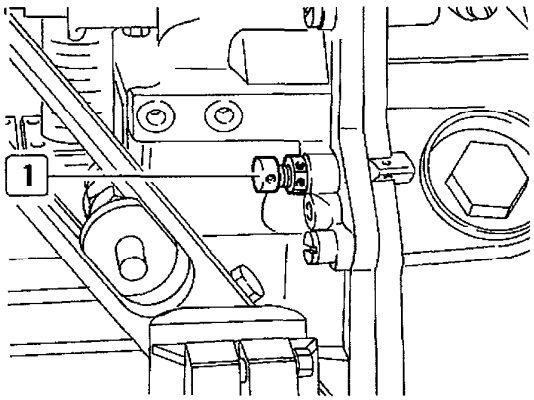
.1 Pressure on LDA hPa 1000
Speed RPM 1350
Average delivery for 1000 flows cm³ 137 - 139 (135 - 141)
Max gap cm³ 2
2 Pressure on LDA hPa 1000
Speed RPM 700 -
Average delivery for 1000 flows cm³ 135 - 137 (133 - 139)
Max gap cm³ 2
3 Pressure on LDA hPa 1000
Speed RPM 500
Average delivery for 1000 flows cm³ 122 - 124 (120 - 126)
Max gap cm³ 2
4 Pressure on LDA hPa .0,0
Speed RPM 1350
Average delivery for 1000 flows cm³ 75 - 77 (73 - 78)
Max gap cm³ 2

Paragraph 1 1 1/2/3
With **1000** hPa pressure and at the speed required, check the average delivery in matching conditions

Paragraph 1 1 4
With no air pressure and at the speed required, check the average delivery in aspirated engine conditions

12 - ADJUSTMENT OF GOVERNOR OPERATION SPEED

Pressure on LDA hPa 1000
Control lever position at max
Rod stroke mm 9,4
Speed RPM 1420 - 1440



In the conditions required in the specification, insert and adjust the position of the external lever stop screw (1), bringing it into contact with this lever

13 - DELIVERY CONTROL AT MIM. SPEED

.1 Speed RPM 350
Rod stroke mm 6,0 - 6,2
Average delivery for 1000 flows cm³ 8,4 - 9,0 (8 - 10)
Max gap cm³ 2
2 Speed RPM 300
Rod stroke mm 14,8 - 15,0

Final check of the conditions of the pump operating at idling speed

14 - DELIVERY AT STARTING SPEED
(with covers-rod plug fitted on the pump body and with the solenoid energized if fitted)

Control lever position at max
Speed RPM
Average delivery
for 1000 flows cm^3

ADJUSTING STARTING DELIVERY

Take off the dial gauge holder tool for checking and adjusting control rod travel and refit the control rod cover plug with its sealing washer
Bring the speed of rotation to 100 rpm, position the external lever at maximum
Check that the additional delivery corresponds

SETTING DATA FOR IN - LINE INJECTION PUMP

INJECTION PUMP PES 6 MW 100
GOVERNOR RQV 300 - 1350
FEEDING PUMP FP/KG24MW304-1

A S 7.00
ENGINE 8061SRM33.ALL VERSIONS

PRESSURE PIPES (ENGINE) DIAM 6X2 mm
CYLINDERS N.. 1 - 2 - 3 - 4 - 5 - 6 L = 650 mm.
ENGINE INJECTORS CALIBRATION 250 + 8 bar
FITTING 20° ± 1° BEFORE T D C WITH PLUNGER N 1 OF THE INJECTION PUMP IN THE DELIVERY START POSITION AND CYLINDER N 1 OF THE ENGINE IN COMPRESSION STROKE

TEST BENCH WITH STATIC AND DYNAMIC SPECIFICATIONS
ACCORDING TO RULES ISO 4008/1 AND 4008/2
PIPES : RULE ISO 4093 (6 x 2 x 600 mm.)
INJECTORS RULE ISO 7440 (PASTILLE WITH CALIBRATED HOLE- -)
CALIBRATION· 172 + 3 bar
TEST FLUID. TEMPERATURE 40° C ± 2
TEST FLUID: ISO 4113
FEEDING PRESSURE 1,5 + 0,3 bar
BURETTES EMPTYING TIME 30'

SETTING DATA OF THE INJECTION PUMP
THE VALUES INDICATED IN BRACKETS MUST BE USED ON USED ONLY AS CONTROL VALUES

1 - DELIVERY START

1 Test pressure bar 30 - 32
2 Prestroke (from B D C.) m 3 0 - 3 10 (2 95 - 3 15)
.3 Rod stroke mm:
.4 Rotation direction : C W
.5 Pump injection order · 1 - 5 - 3 - 6 - 2 - 4
.6 Cams order
.7 Tolerance .
.8 Delivery start cylinder n° 1

2 BASIC ADJUSTMENT AND CONTROL

1 Speed RPM 1350
Pressure on LDA hPA : 1000
Rod stroke mm · 12 7 - 12.8
Average delivery
for 100 flows cm^3 13,7 - 13,9
Max gap cm^3 0,2
2 Speed RPM
Rod stroke mm : 6,0 - 6,2
Average delivery
for 100 flows cm^3 0,9 - 1,1
Max gap cm^3 0,2

3 - AXIAL STROKE OF ELASTIC AXLE

1 Speed RPM .
Stroke mm
.2 Speed RPM ·
Stroke mm
.3 Speed RPM
Stroke mm .
4 Speed RPM
Stroke mm
5 Speed RPM
Stroke mm

4 - CHECK OF EL. AXLE PISITION

.1 Control lever position
degres max
(excluding the inner and outer stops for the control lever)
2 Speed RPM
Rod stroke mm

5 - DELIVERY AT FULL LOAD

Speed	RPM	1350
Pressure on LDA	hPa	1000
Rod stroke	mm	12,7 - 12,8
Arage delivery for 1000 flows	cm^3	137 - 139 (135 - 141)
Max gap	cm^3	2

6 - GOVERNOR GAP CURVE AT MAX

1 Control lever position from horizontal axle for RQV degrees with pressure on LDA hPa
2 Adjustment point of control lever for RQV
Speed RPM 1510
Rod stroke mm 5,4 - 5,9
Check
3 Rod stroke mm
Speed RPM
4 Rod stroke mm
Speed RPM
5 Rod stroke mm
Speed RPM

7 - GOVERNOR GAP CURVE AT MIN.

1 Control lever position from horizontal axle degres

Adjustment
2 Speed RPM 350
Rod stroke mm 6,0 - 6,2
Check
3 Rod stroke mm
Speed RPM
4 Rod stroke mm
Speed RPM
5 Rod stroke mm
Speed RPM
6 Rod stroke mm
Speed RPM
7 Rod stroke lineary
Speed RPM

8 - ADJUSTMENT OF TORQUE INCREASE DEVICE

1 Mechanical stroke of the device mm
2 Control lever position at max
3 Pressure on LDA hPa
4 Speed RPM
Rod stroke mm
5 Speed RPM
Rod stroke mm
6 Speed RPM
Rod stroke mm
7 Speed RPM
Rod stroke mm
8 Speed RPM
Rod stroke mm

9 - ADJUSTMENT AND CONTROL OF THE TURBOCHARGING

Adjustment
Speed RPM 600
1 Pressure on LDA hPa 1000
Rod stroke mm 12,7 - 12,8
2 Pressure on LDA hPa 300
Rod stroke mm 11,2 - 11,4
3 Pressure on LDA hPa 0,0
Rod stroke mm 9,3 - 9,5
Check
Speed RPM
4 Pressure on LDA hPa
Rod stroke mm

10 - REVERSE POINT

1 Operating the control lever from min to max with energized solenoid
Speed RPM
Rod stroke mm MIN
2 Operating the control lever from min to max with pressure on LDA hPa
Speed RPM
Rod stroke mm MIN

11 - DELIVERIES MOVEMENT

1	Pressure on LDA	hPa	1000
	Speed	RPM	1350
	Average delivery for 1000 flows	cm^3	137 - 139 (135 - 141)
	Max gap	cm^3	2
2	Pressure on LDA	hPa	1000
	Speed	RPM	700
	Average delivery for 1000 flows	cm^3	135 - 137 (133 - 139)
	Max gap	cm^3	2
3	Pressure on LDA	hPa	1000
	Speed	RPM	500
	Average delivery for 1000 flows	cm^3	122 - 124 (120 - 126)
	Max gap	cm^3	2
4	Pressure on LDA	hPa	0,0
	Speed	RPM	1350
	Average delivery for 1000 flows	cm^3	75 - 77 (73 - 78)
	Max gap	cm^3	2

12 - ADJUSTMENT OF GOVERNOR OPERATION SPEED

Pressure on LDA	hPa	1000
Control lever position at max		
Rod stroke	mm	9,4
Speed	RPM	1420 - 1440

13 - DELIVERY CONTROL AT MIM. SPEED

1	Speed	RPM	350
	Rod stroke	mm	6,0 - 6,2
	Average delivery for 1000 flows	cm^3	8,4 - 9,0 (8 - 10)
	Max gap	cm^3	2
2	Speed	RPM	300
	Rod stroke	mm	14,8 - 15,0

14 - DELIVERY AT STARTING SPEED

(with covers-rod plug fitted on the pump body and with the solenoid energized if fitted)

Control lever position at max		
Speed	RPM	
Average delivery for 1000 flows	cm^3	

TIGHTENING TORQUES

PART	TORQUE	
	Nm	(kgm)
Plunger assembly securing nuts	20 ÷ 25	(2.1 ÷ 2.6)
Mounting cover securing screws	18 ÷ 20	(1.8 ÷ 2.0)
Camshaft intermediate bearing hexagonal socket head securing screws	8 ÷ 10	(0.8 ÷ 1.0)
Feed pump securing nuts	7 ÷ 9	(0.7 ÷ 0.9)
Screws securing the governor casing to the injection pump body	8 ÷ 10	(0.8 ÷ 1.0)
Ring nut securing the governing device to the camshaft	65 ÷ 75	(6.6 ÷ 7.6)
Governor cover attachment screws	8 ÷ 10	(0.8 ÷ 1.0)
Camshaft splined bush attachment ring nut	100 ÷ 120	(10 ÷ 12)
Nut securing bearing to camshaft	100 ÷ 120	(10 ÷ 12)

TOOLS

TOOL NO.	DESCRIPTION
99341001	Double action bridge
99431016	Pair of puller arms with holes
99342111	Extractor for injection pump governor weight spider
99342128	Tool for compressing injection pump tappet springs during removal and refitting
99342139	Extractor for injection pump/engine coupling sleeve
99350034	Wrench for ring nut securing spider to injection pump shaft
99365014	Swivelling stand for overhauling injection pump
99365022	Tool for fitting injection pump tappets
99365033	Wrench for holding injection pump drive joint while unscrewing camshaft nut
99365138	Tool for checking injection pump control rod travel (use with 99395606)
00365160	Wrench for removing injector pipes
99365162	Gauge for checking distance from spider to governor cover stop
99365163	Plate to support injection pump during overhaul (use with 99365014)
99365183	Tool for setting the injection pump on the engine for checking start of delivery on test bench (use with 99395604)
99365185	Set of tools (3) for compressing tappets while removing and fitting camshaft
99365186	Tool for setting the injection pump on the engine and for checking start of delivery on test bench (use with 99365183, 99395604)
99395187	Tool for adjusting cold start delivery
99395606	Hundredths dial gauge

11 - DELIVERIES MOVEMENT

1	Pressure on LDA	hPa	1000
	Speed	RPM	1350
	Average delivery for 1000 flows	cm^3	137 - 139 (135 - 141)
	Max gap	cm^3	2
2	Pressure on LDA	hPa	1000
	Speed	RPM	700
	Average delivery for 1000 flows	cm^3	135 - 137 (133 - 139)
	Max gap	cm^3	2
3	Pressure on LDA	hPa	1000
	Speed	RPM	500
	Average delivery for 1000 flows	cm^3	122 - 124 (120 - 126)
	Max gap	cm^3	2
4	Pressure on LDA	hPa	0,0
	Speed	RPM	1350
	Average delivery for 1000 flows	cm^3	75 - 77 (73 - 78)
	Max gap	cm^3	2

12 - ADJUSTMENT OF GOVERNOR OPERATION SPEED

Pressure on LDA	hPa	1000
Control lever position at max		
Rod stroke	mm	9,4
Speed	RPM	1420 - 1440

13 - DELIVERY CONTROL AT MIM. SPEED

1	Speed	RPM	350
	Rod stroke	mm	6,0 - 6,2
	Average delivery for 1000 flows	cm^3	8,4 - 9,0 (8 - 10)
	Max gap	cm^3	2
2	Speed	RPM	300
	Rod stroke	mm	14,8 - 15,0

14 - DELIVERY AT STARTING SPEED

(with covers-rod plug fitted on the pump body and with the solenoid energized if fitted)

Control lever position at max

Speed	RPM	
Average delivery for 1000 flows	cm^3	

TIGHTENING TORQUES

PART	TORQUE	
	Nm	(kgm)
Plunger assembly securing nuts	20 ÷ 25	(2.1 ÷ 2.6)
Mounting cover securing screws	18 ÷ 20	(1.8 ÷ 2.0)
Camshaft intermediate bearing hexagonal socket head securing screws	8 ÷ 10	(0.8 ÷ 1.0)
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Screws securing the governor casing to the injection pump body	8 ÷ 10	(0.8 – 1.0)
Ring nut securing the governing device to the camshaft	65 ÷ 75	(6.6 ÷ 7.6)
Governor cover attachment screws	8 ÷ 10	(0.8 ÷ 1.0)
Camshaft splined bush attachment ring nut	100 ÷ 120	(10 ÷ 12)
Nut securing bearing to camshaft	100 ÷ 120	(10 ÷ 12)

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99365185	Set of tools (3) for compressing tappets while removing and fitting camshaft
99365186	Tool for setting the injection pump on the engine and for checking start of delivery on test bench (use with 99365183, 99395604)
99395187	Tool for adjusting cold start delivery
99395606	Hundredths dial gauge