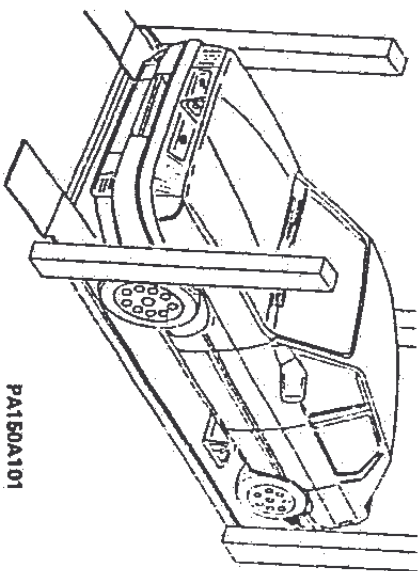




01 - A

ENGINE ASSEMBLY COMPLETE



PAT50A101

**ELECTRONIC-INJECTION
ENGINE (16 VALVES)**

**- ENGINE-TRANSMISSION UNIT,
REMOVAL AND
REPLACEMENT**

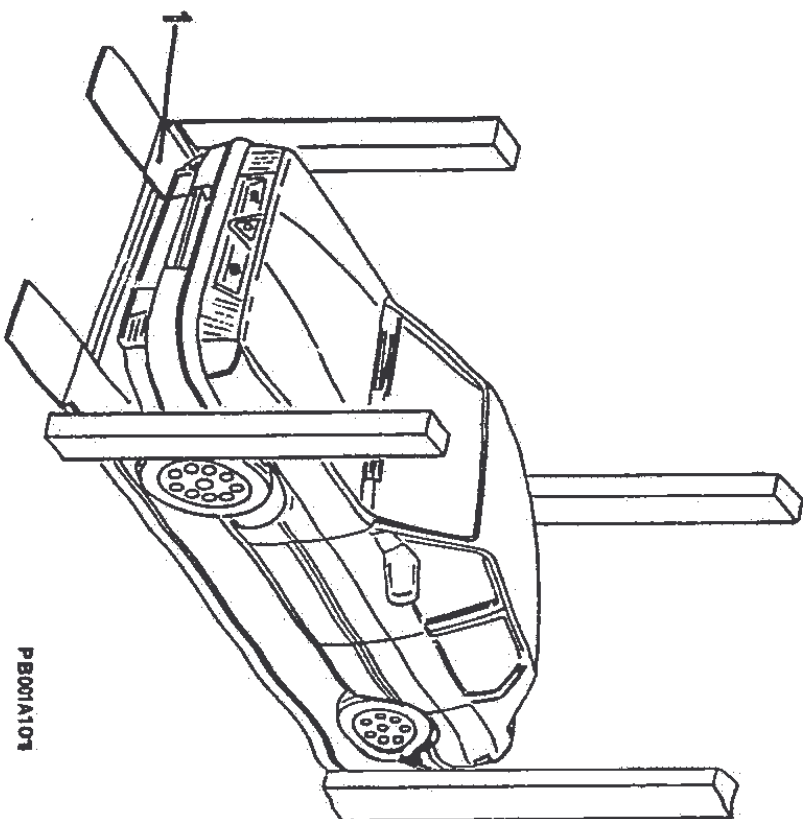
**ENGINE-TRANSMISSION UNIT,
REMOVAL AND REPLACEMENT 01 - 1**



01 - 1

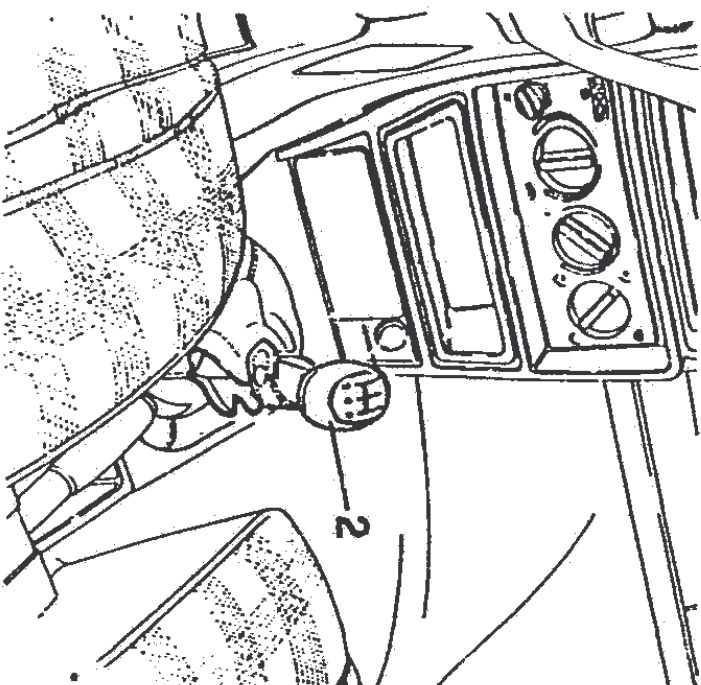
COMPLETE ENGINE UNIT

ENGINE-TRANSMISSION UNIT REMOVAL AND REPLACEMENT



PB001A107

1. Set vehicle on lift.



2. Slide off gear lever knob.

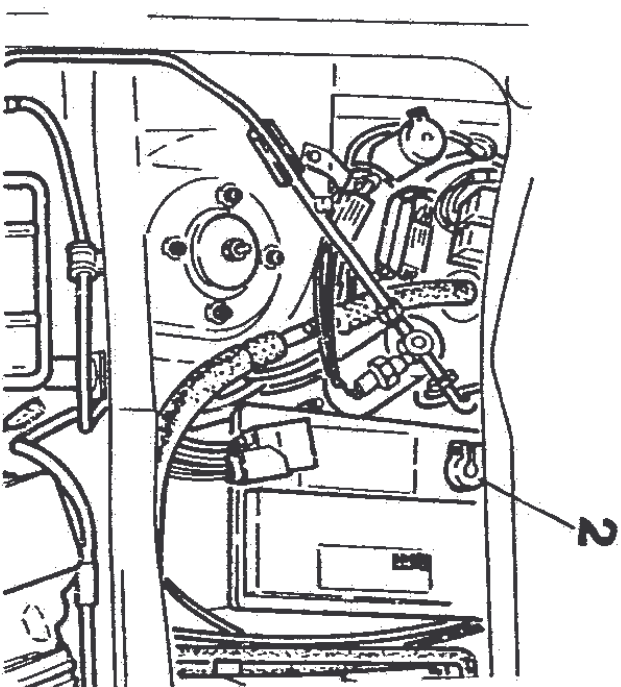
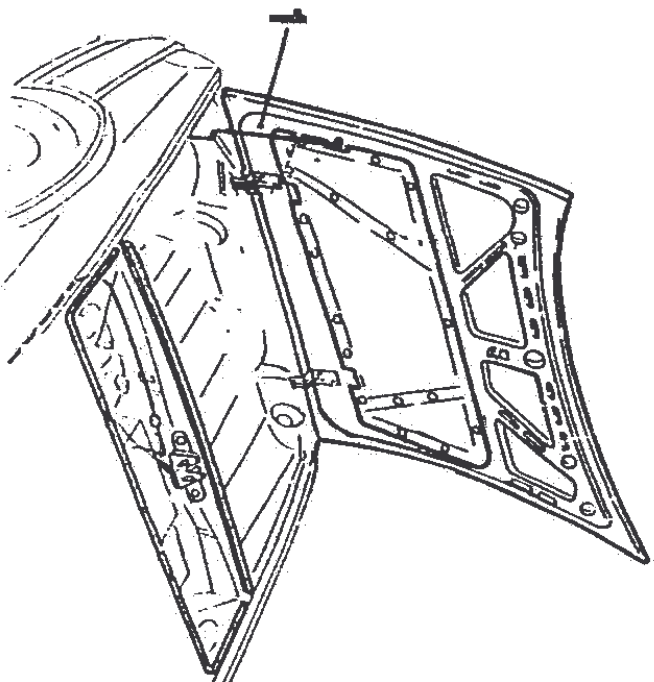




01 - 2

ENGINE ASSEMBLY COMPLETE

ENGINE-TRANSMISSION UNIT REMOVAL AND REPLACEMENT (Continued)



PA162A101

1. Remove the hood (see GR. **56**).

2. Disconnect the battery negative lead.

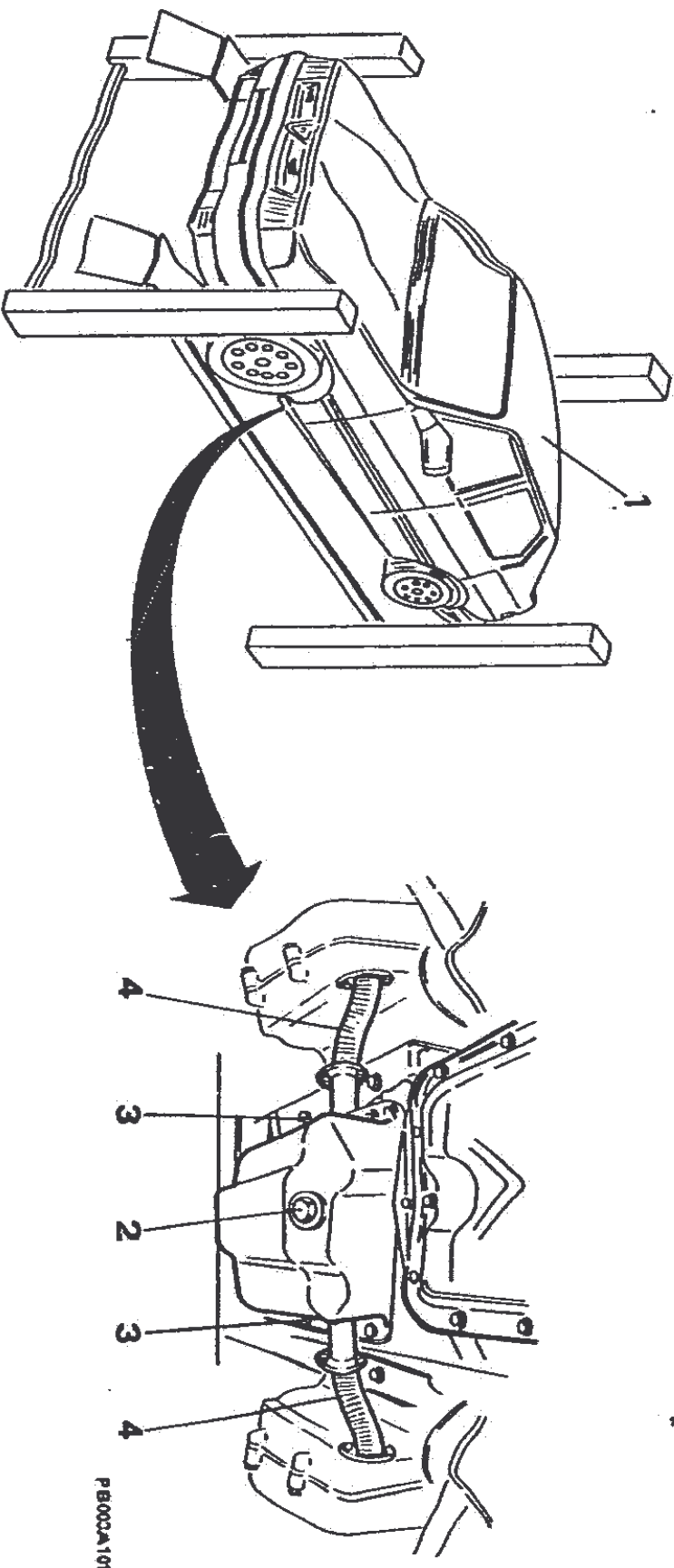




01 - 3

ENGINE ASSEMBLY COMPLETE

ENGINE-TRANSMISSION UNIT REMOVAL AND REPLACEMENT (Continued)



1. Raise the vehicle.
2. Drain the engine oil (see UN. 00).
3. Drain the engine cooling system (see UN. 07).

4. Remove the two oil pipes from the heads.

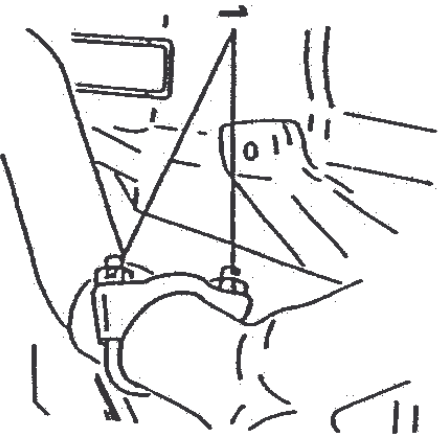




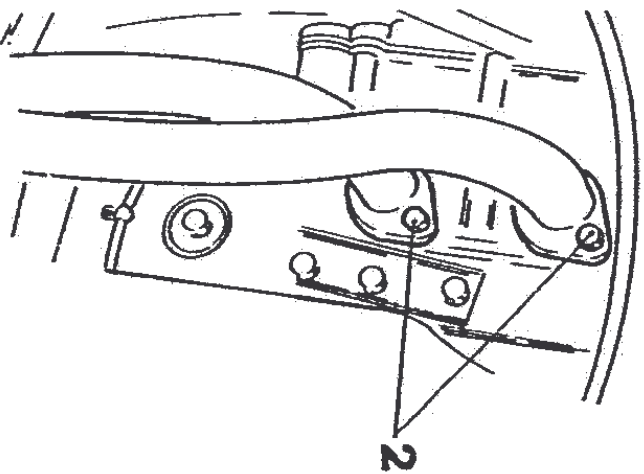
01 - 4

ENGINE ASSEMBLY COMPLETE

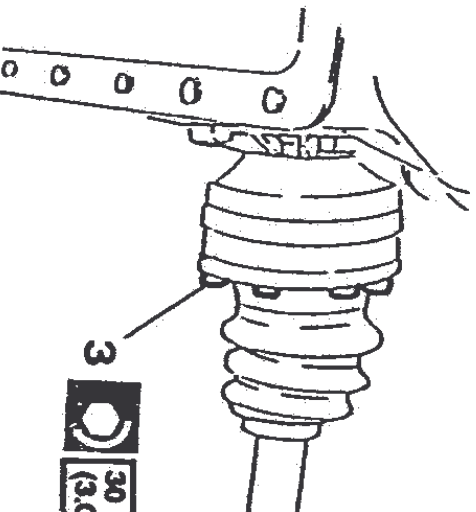
ENGINE-TRANSMISSION UNIT REMOVAL AND REPLACEMENT (Continued)



P8004A101



P8184A102



30 + 35 Nm
(3.0 + 3.5 Kgm)

P8004A103

1. Slacken the exhaust clamp at the joint between the first and second exhaust system sections.
2. Disconnect the manifolds from the heads and remove the first exhaust section.
3. Disconnect the drive shafts from the gearbox stubs.

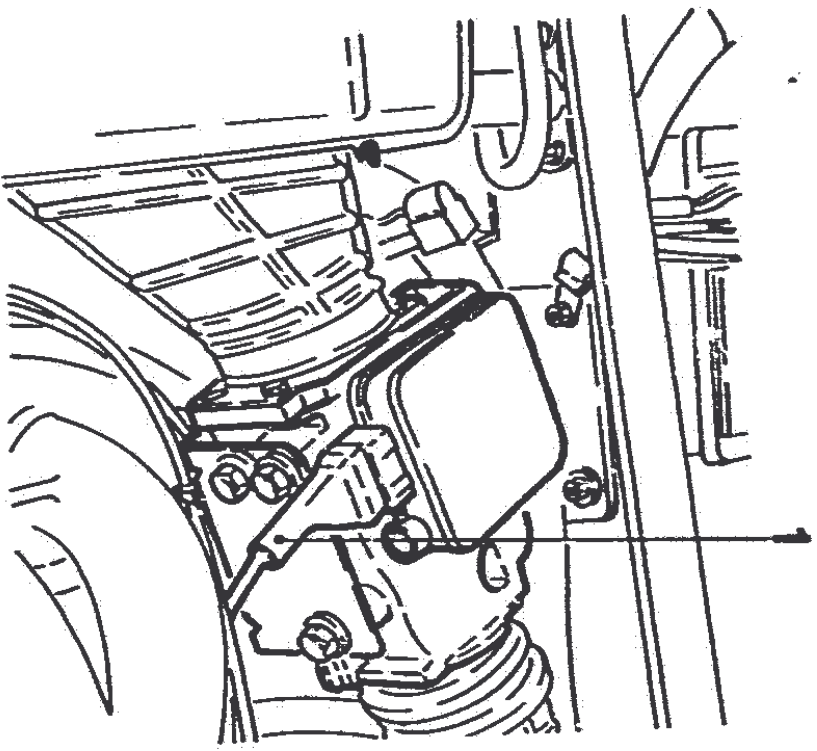




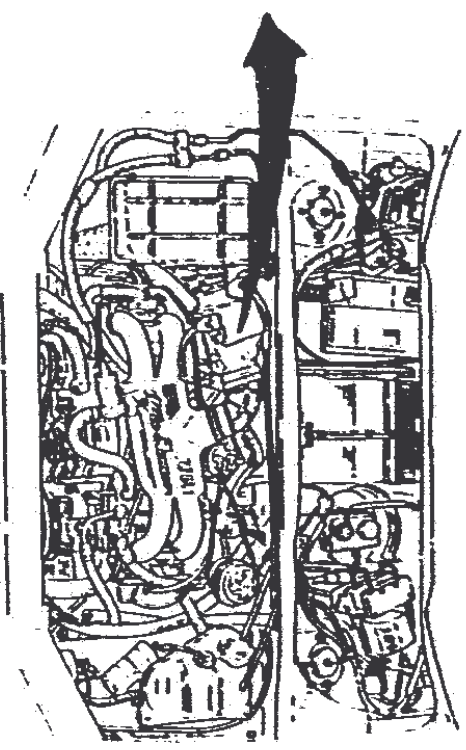
01 - 5

ENGINE ASSEMBLY COMPLETE

ENGINE-TRANSMISSION UNIT REMOVAL AND REPLACEMENT (Continued)



- Lower the vehicle.



P8008A101

1. Disconnect the air flow meter connector.

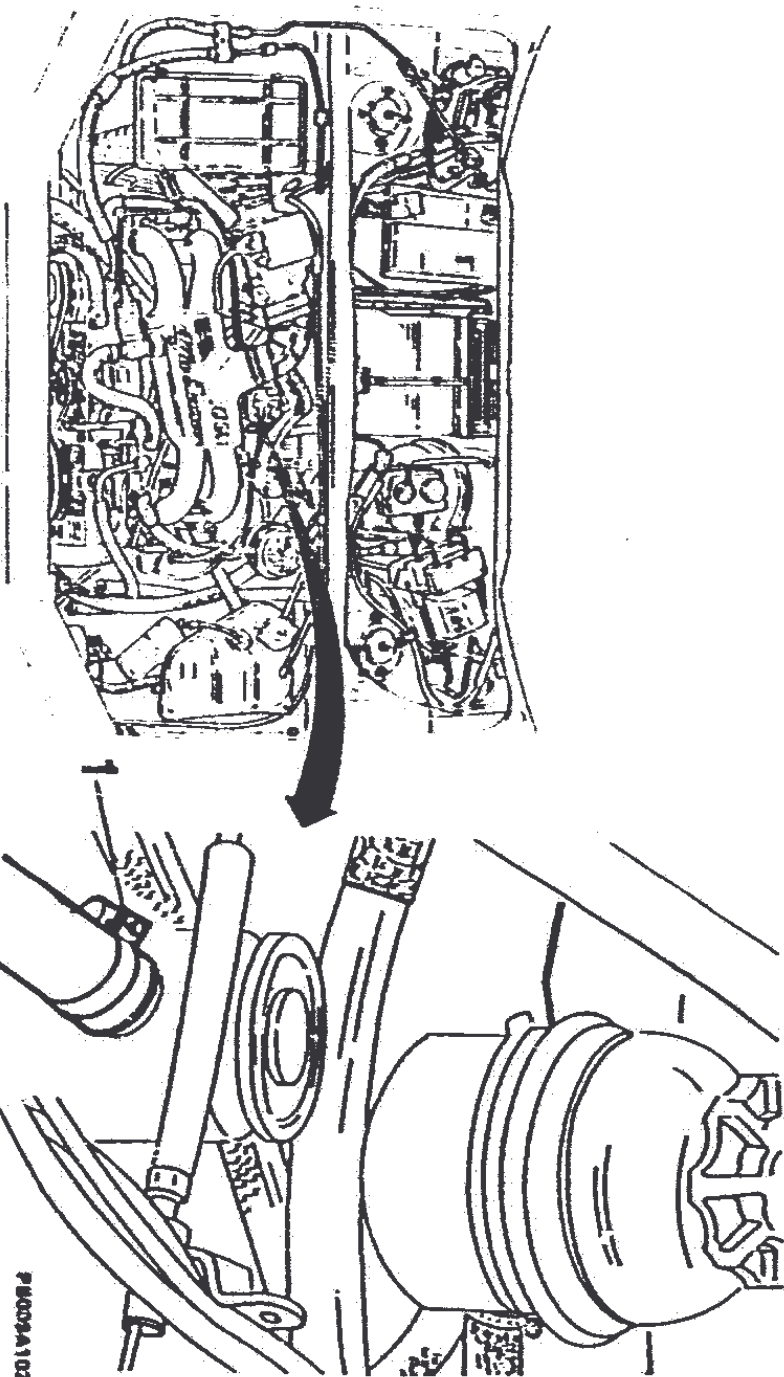




01 - 6

ENGINE ASSEMBLY COMPLETE

ENGINE-TRANSMISSION UNIT REMOVAL AND REPLACEMENT (Continued)



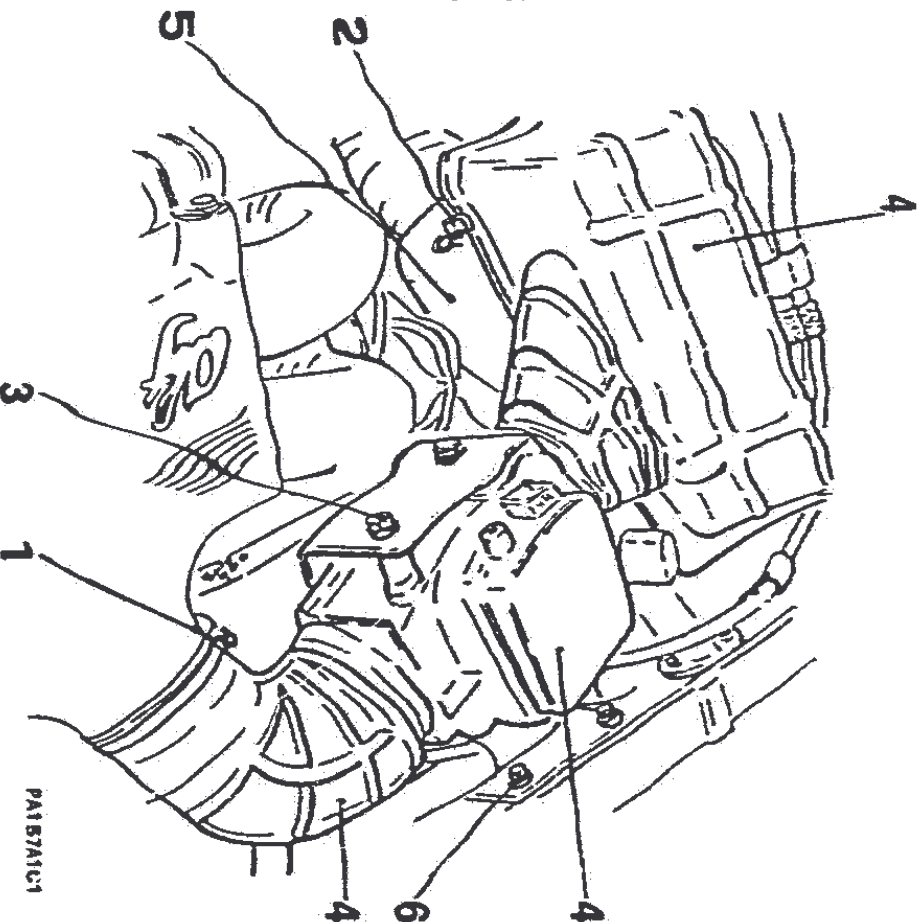
1. Slacken the clip on the blow-by pipe (separator end).





ENGINE-TRANSMISSION UNIT REMOVAL AND REPLACEMENT (Continued)

1. Slacken the corrugated pipe clip.
2. Unclip the air filter cover.
3. Undo the 3 air-flow meter screws.
4. Remove the air-flow meter, air filter and corrugated pipe.
5. Extract the cartridge and remove the air filter bracket by undoing the two retaining screws.
6. Remove the air-flow meter bracket and relative rubber spacers.



PA157A1C1

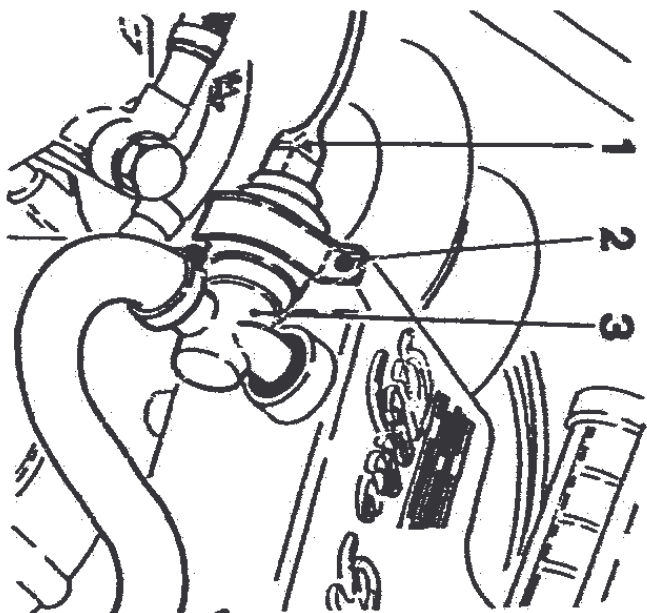




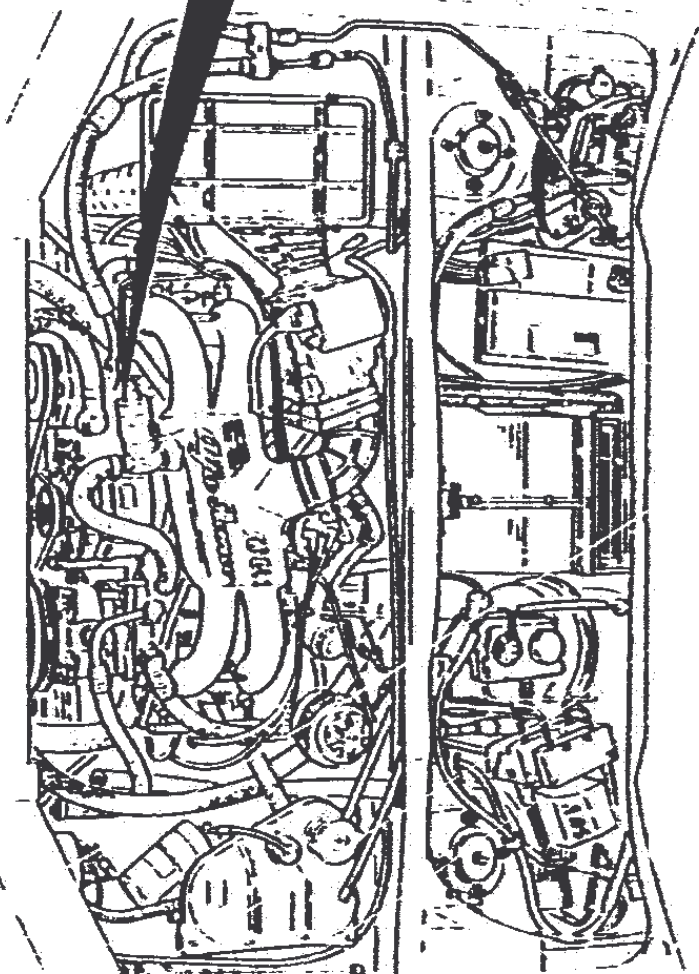
01 - 8

ENGINE ASSEMBLY COMPLETE

ENGINE-TRANSMISSION UNIT REMOVAL AND REPLACEMENT (Continued)



PE006A101



PE006A102

1. Disconnect the electric lead from the constant idling rate actuator.
2. Unscrew the retaining screw.
3. Remove the constant idle r.p.m. actuator.

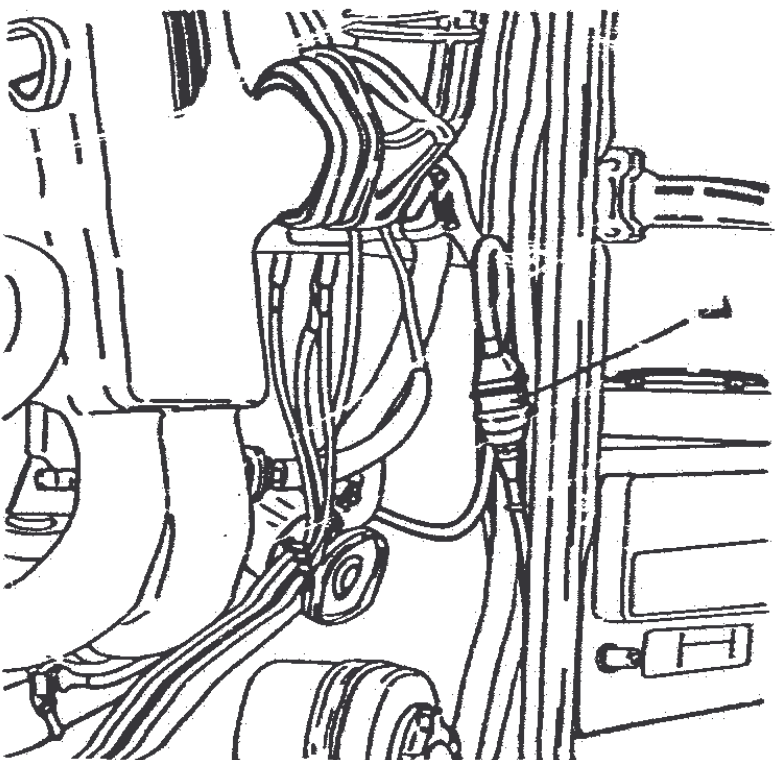




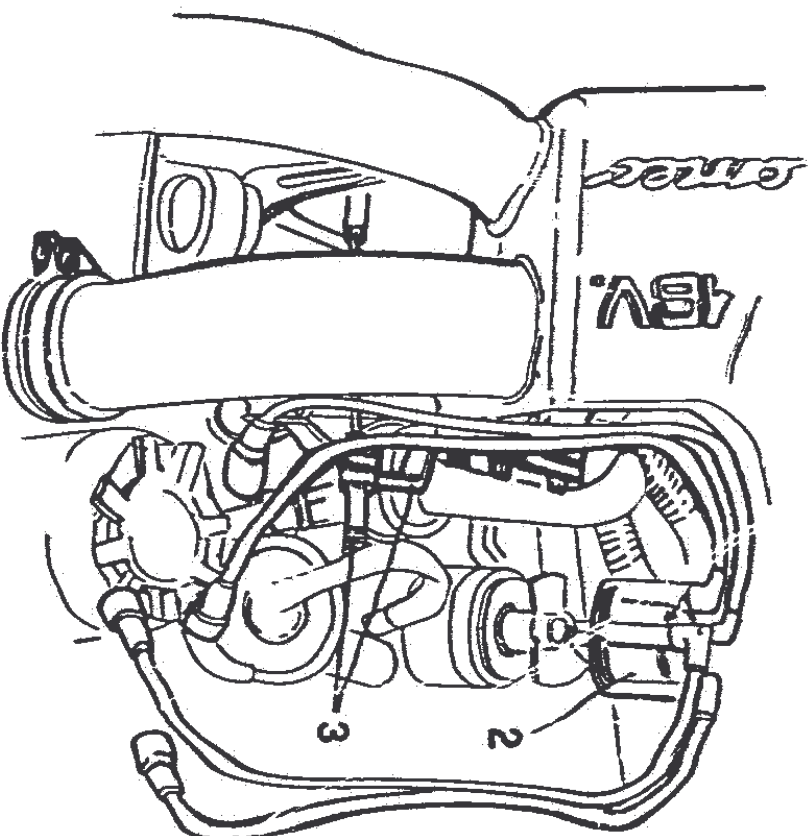
01-9

ENGINE ASSEMBLY COMPLETE

ENGINE - TRANSMISSION UNIT REMOVAL AND REPLACEMENT (continued)



1. Disconnect the electrical connection from the f.p.m. and timing sensor and free the wiring from the clamps.
2. Remove the distributor cap and relative electrical wiring.



3. Remove the accelerator cable and relative support.

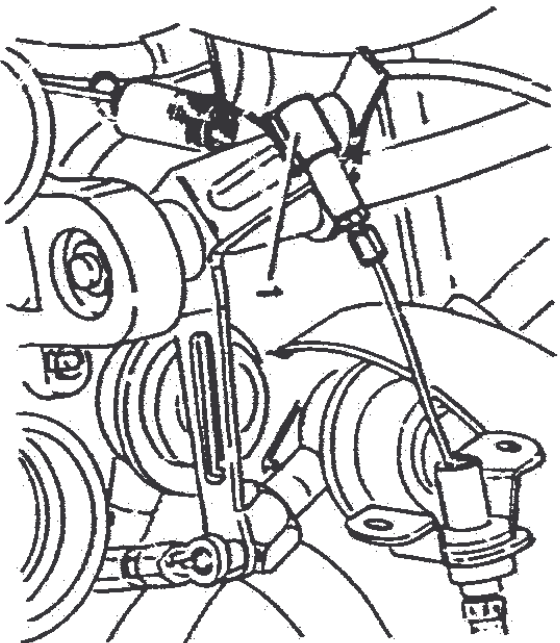




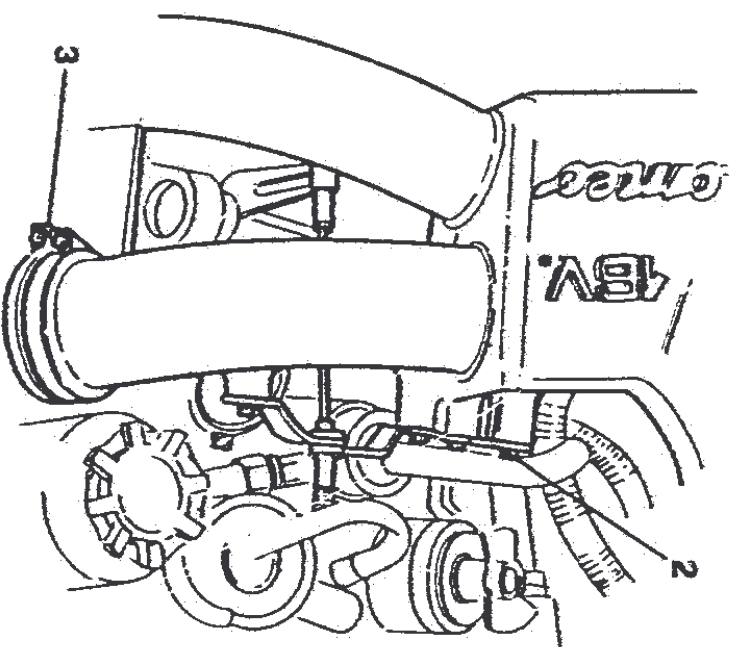
01 - 10

ENGINE ASSEMBLY COMPLETE

ENGINE-TRANSMISSION UNIT REMOVAL AND REPLACEMENT (Continued)



1. Withdraw the return spring for the accelerator adjusting pawl.
2. Remove the pressure regulator and impulse damper bracket.



3. Slacken the four lower clips and remove the air reservoir box.

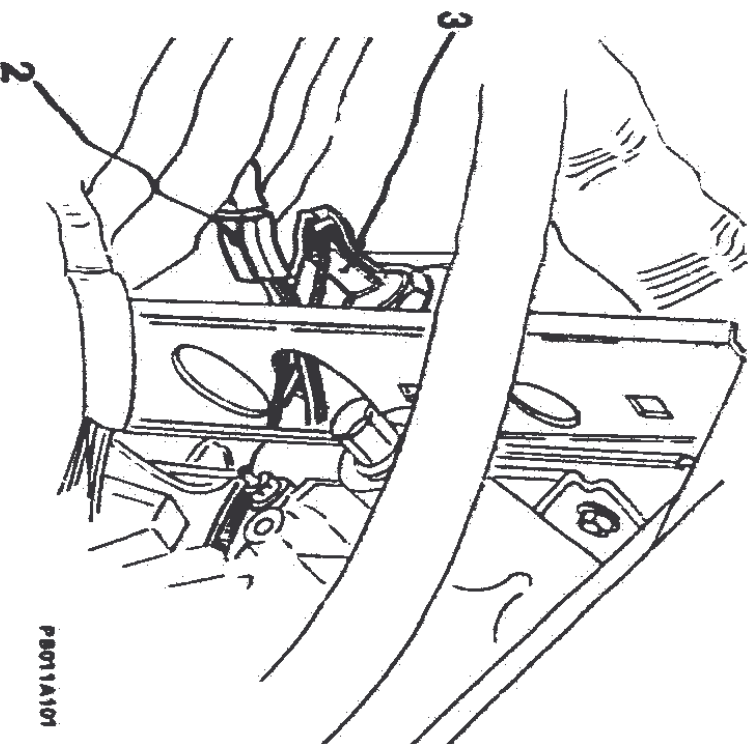
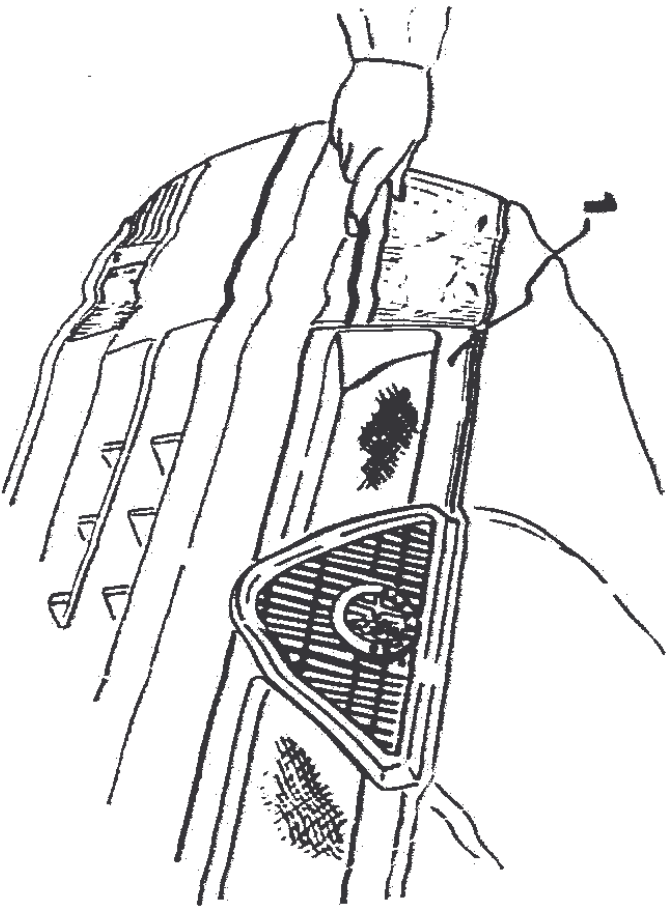




01 .11

ENGINE ASSEMBLY COMPLETE

ENGINE - TRANSMISSION UNIT REMOVAL AND REPLACEMENT (continued)



P8071A101

1. Remove the front facing (See GR. 75).
2. Disconnect the radiator electric fan electrical connection.

3. Disconnect the electric fan thermal contact connection.



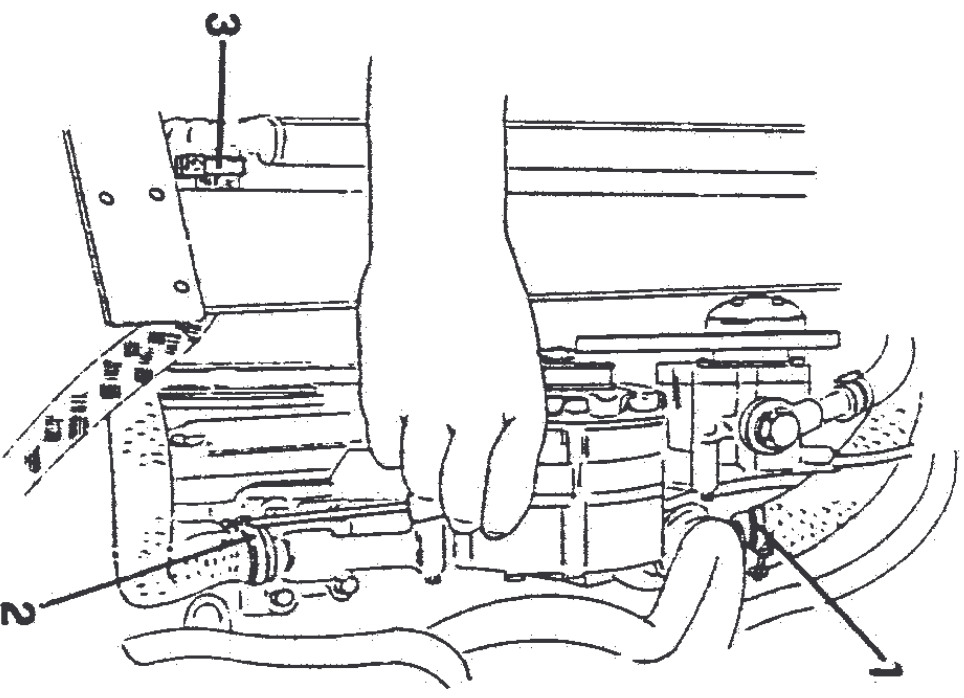


01 - 12

ENGINE ASSEMBLY COMPLETE

ENGINE-TRANSMISSION UNIT REMOVAL AND REPLACEMENT (Continued)

1. Slacken the clip holding the cooling hose to the thermostat valve.
2. Slacken the clip holding the cooling hose to the water pump.
3. Slacken the clip holding the cooling hose to the header tank.



PA102A103

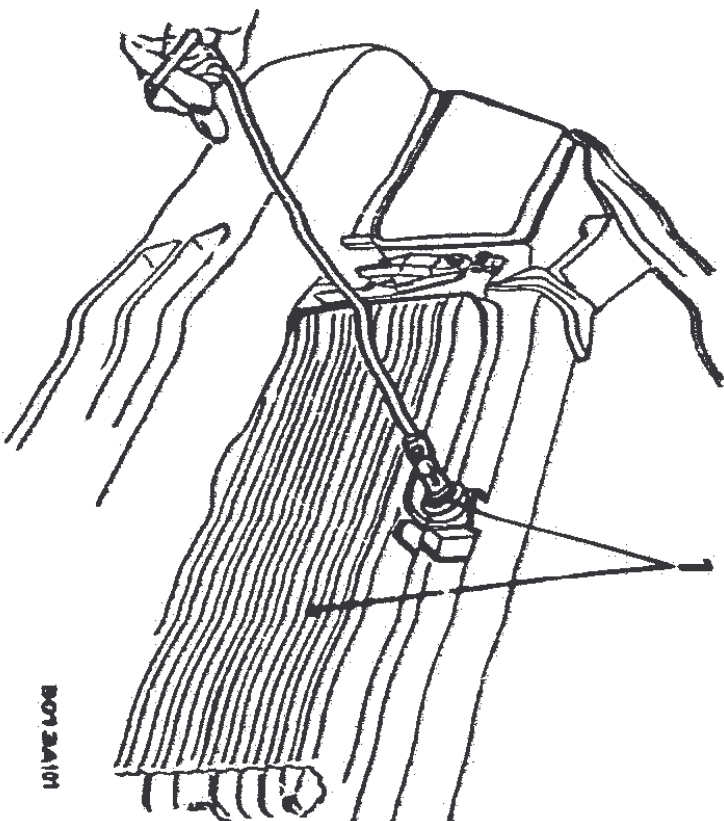




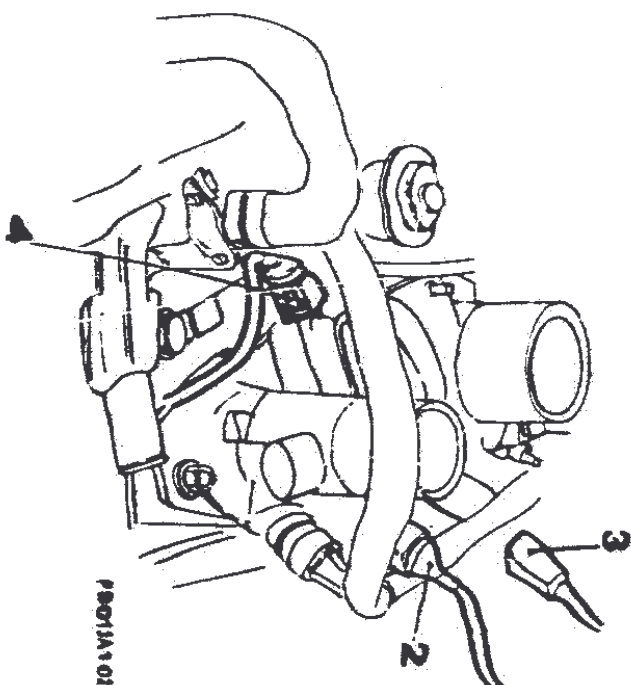
01.13

ENGINE ASSEMBLY COMPLETE

ENGINE - TRANSMISSION UNIT REMOVAL AND REPLACEMENT (continued)



1. Unscrew the screw fastening the radiator and remove it.
2. Disconnect the electric injector electrical leads.
3. Disconnect the electric cable from the throttle valve MIN and MAX opening switch.



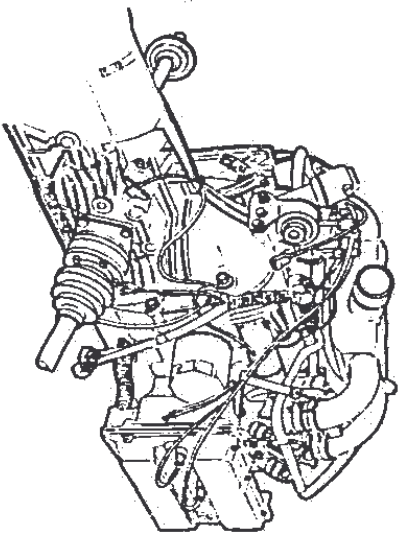
4. Disconnect the engine coolant temperature sensor lead





01 - B

ENGINE ASSEMBLY COMPLETE



ELECTRONIC-INJECTION ENGINE (16 VALVES)

- ENGINE-TRANSMISSION UNIT,
REMOVAL AND
REPLACEMENT (continued)
- ENGINE/GEARBOX-
DIFFERENTIAL SEPARATION
AND UNION

ENGINE-TRANSMISSION UNIT,
REMOVAL AND REPLACEMENT 01 - 14
CYLINDER COMPRESSION TEST 01 - 28

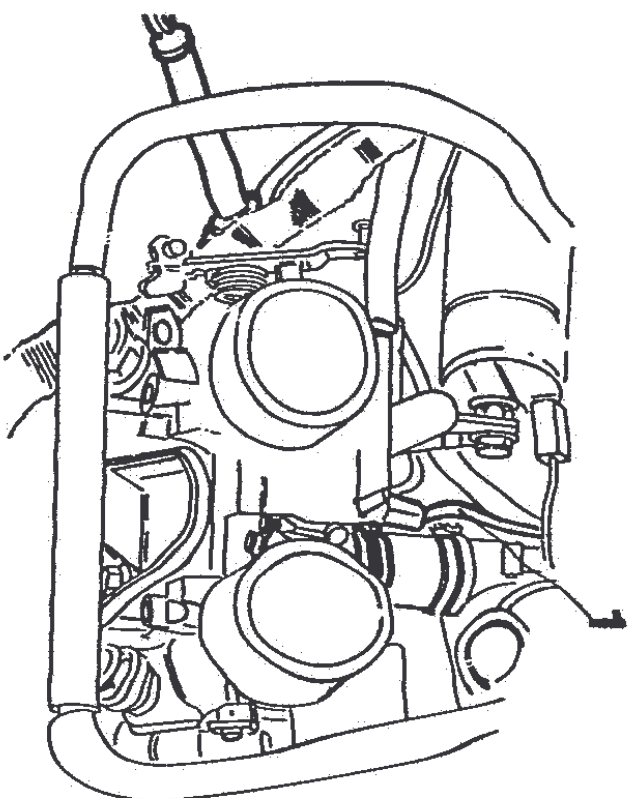
ENGINE/GEARBOX-DIFFERENTIAL
SEPARATION AND UNION 01 - 29



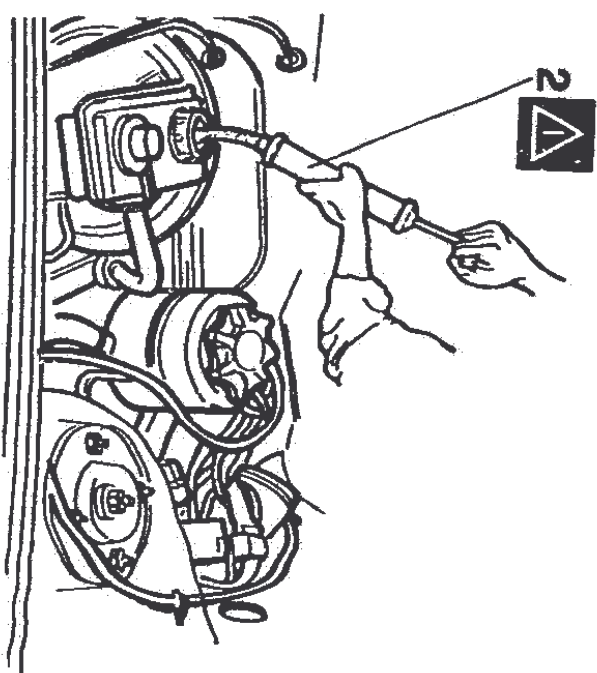
01 - 14

ENGINE ASSEMBLY COMPLETE

ENGINE - TRANSMISSION UNIT REMOVAL AND REPLACEMENT (continued)



1. Disconnect the coolant temperature sender lead.



2. Draw off the clutch/brake fluid up to the level below the clutch pump suction height.

P B01A101

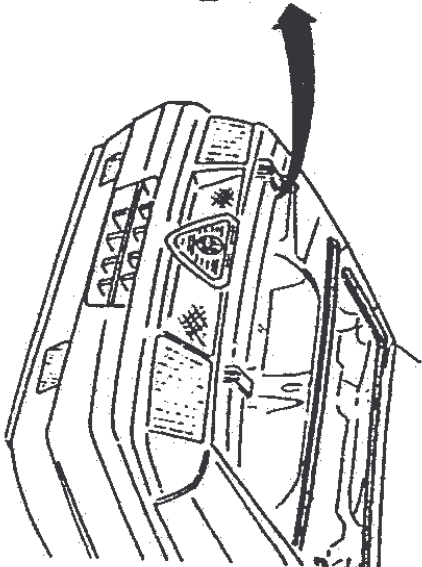
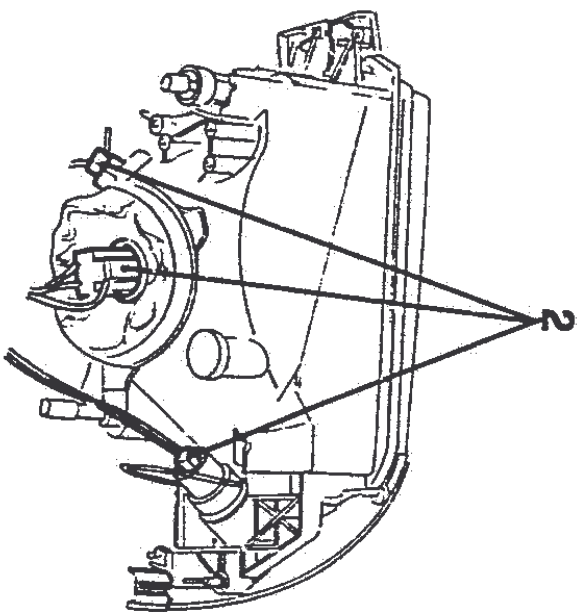
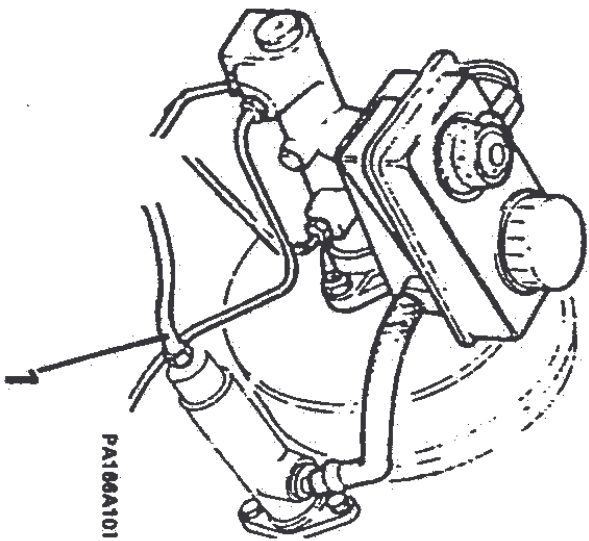




01 - 15

ENGINE ASSEMBLY COMPLETE

ENGINE-TRANSMISSION UNIT REMOVAL AND REPLACEMENT (Continued)



1. Unscrew the union from the clutch master cylinder and remove the pipe from the auxiliary bay.

2. Disconnect the electric leads from the front light as-

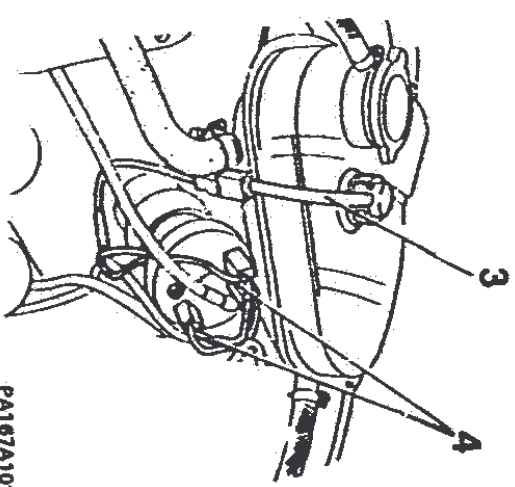
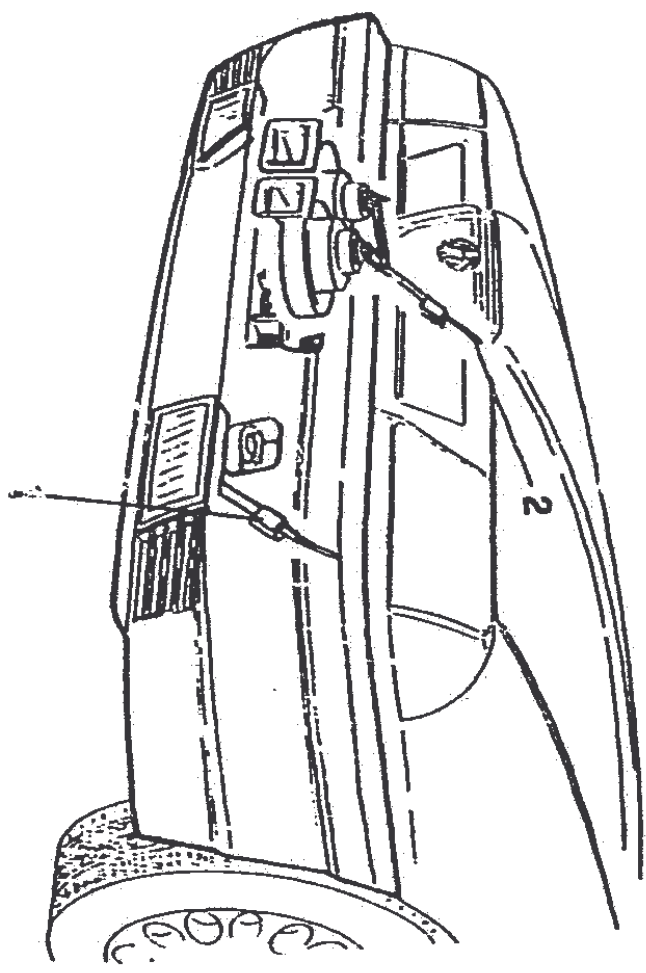




01 - 16

ENGINE ASSEMBLY COMPLETE

ENGINE-TRANSMISSION UNIT REMOVAL AND REPLACEMENT (Continued)



PA167A101

1. Disconnect the leads from the fog-lamps.
2. Disconnect the leads from the horns.
 - Disconnect the electric cooling fan sensor switch.
3. Disconnect the lead from the flexible joint of the cooling liquid level sensor.
4. Disconnect the LT leads from the coil.

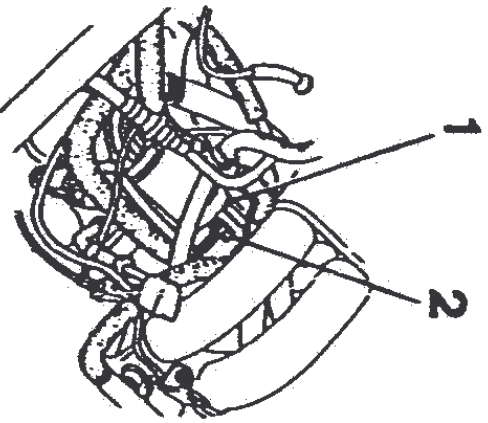




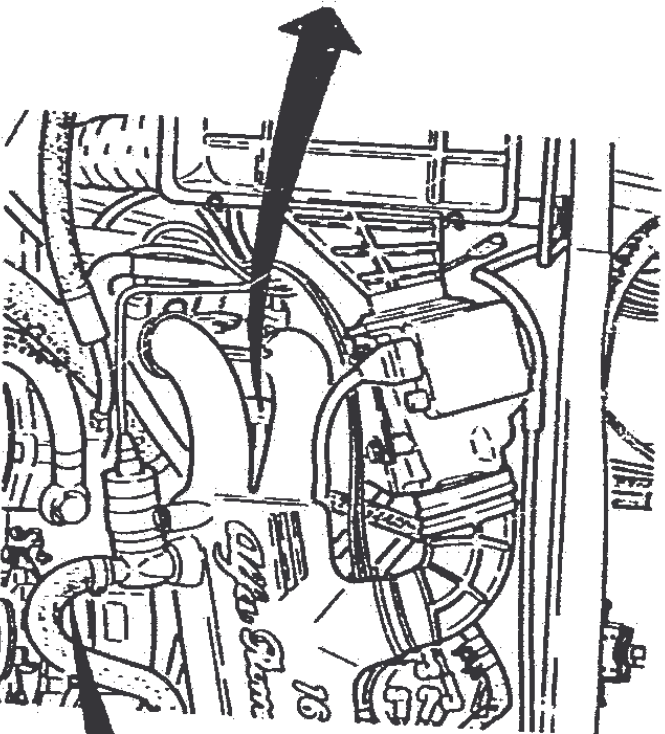
01 - 17

ENGINE ASSEMBLY COMPLETE

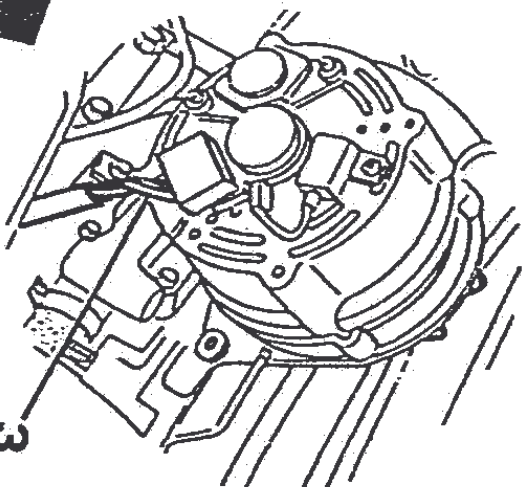
ENGINE-TRANSMISSION UNIT REMOVAL AND REPLACEMENT (Continued)



PB017A101



PB017A102



PB017A103

1. Disconnect the starter motor excitor cable from the mobile connector.
2. Disconnect the starter motor power cable from the terminal on the motor.

- Disconnect the oil pressure sensor lead.
- 3. Sconnettere il cavo del connettore alternatore.

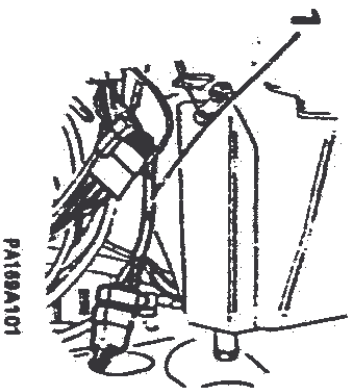




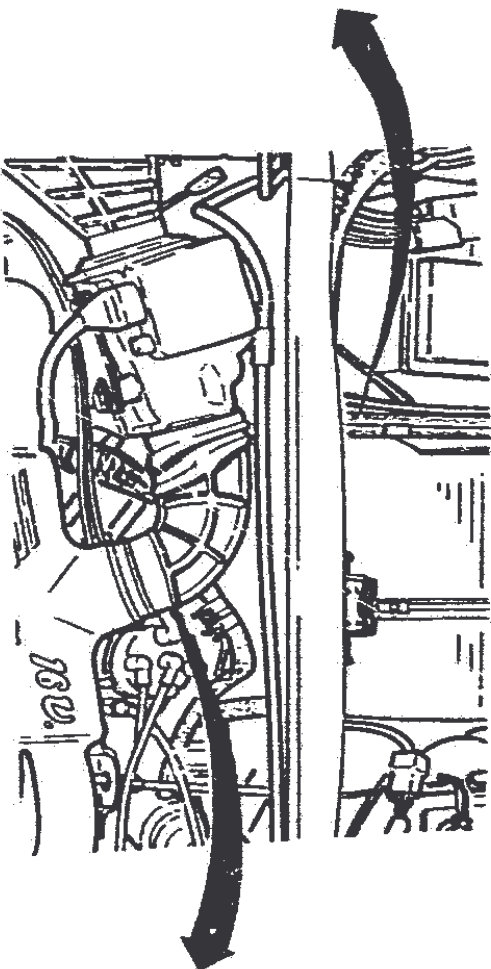
01 - 18

ENGINE ASSEMBLY COMPLETE

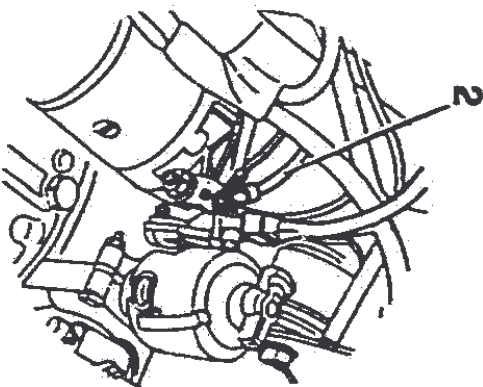
ENGINE-TRANSMISSION UNIT REMOVAL AND REPLACEMENT (Continued)



PA189A101



PA189A102



PA189A103

1. Disconnect the speedometer cable drive.
2. Disconnect the earthing cables, unscrewing the nuts on the engine block.

- Free all cabling from the cable ties and keep them away from the engine so as not to hamper its removal.

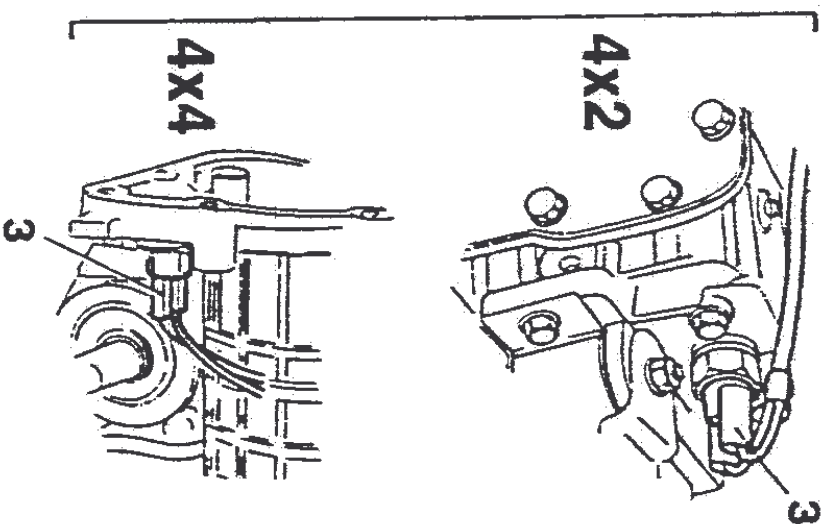
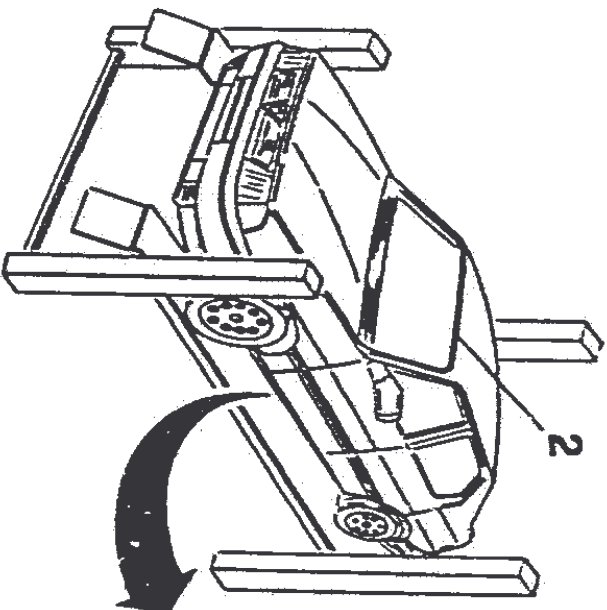
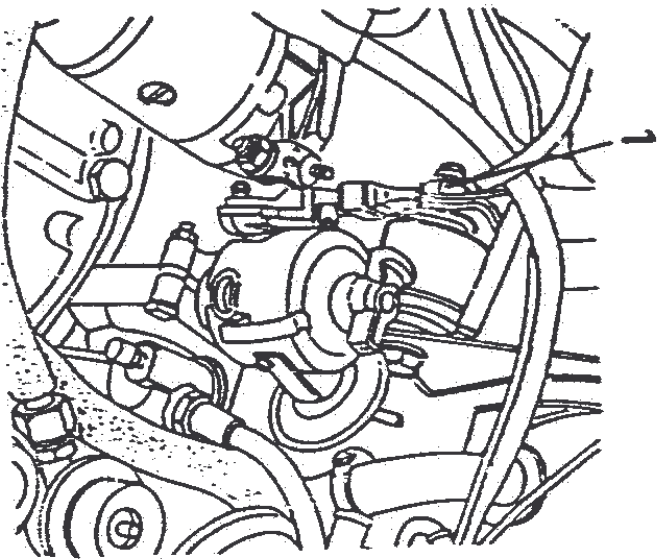




01 - 19

ENGINE ASSEMBLY COMPLETE

ENGINE-TRANSMISSION UNIT REMOVAL AND REPLACEMENT (Continued)



1. Slacken the bolt holding the central engine mounting to the body, without removing it.
2. Raise the vehicle.

3. Disconnect the reverse-gear light lead from the switch on the gearbox.

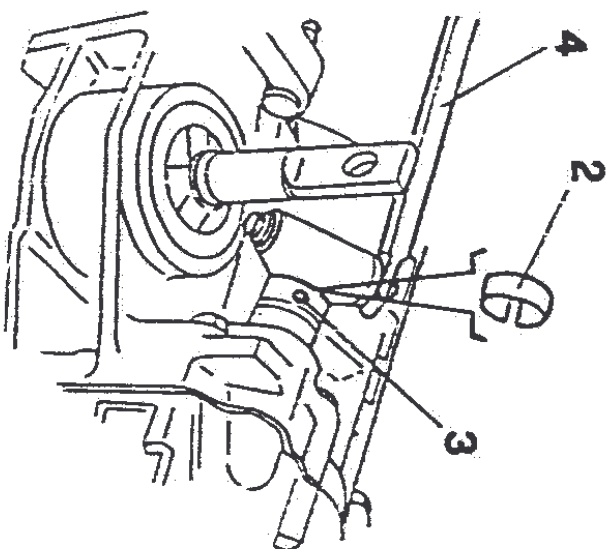
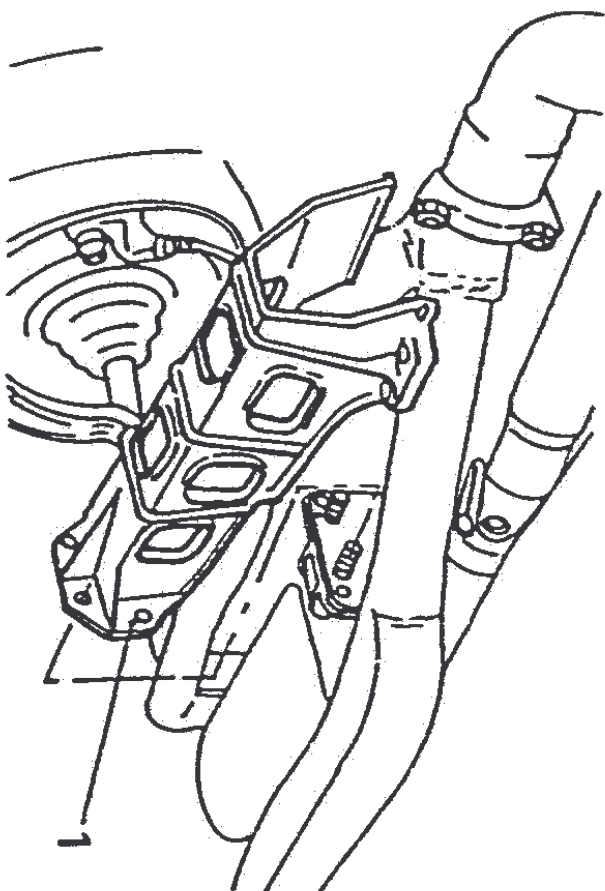




01 - 20

ENGINE ASSEMBLY COMPLETE

ENGINE - TRANSMISSION UNIT REMOVAL AND REPLACEMENT (continued) DRIVE SHAFT (For 4x4 model)

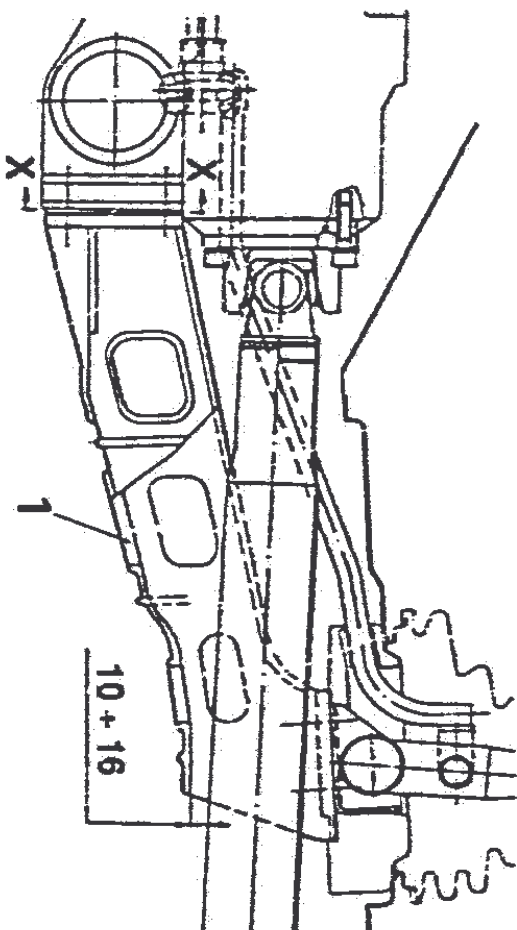
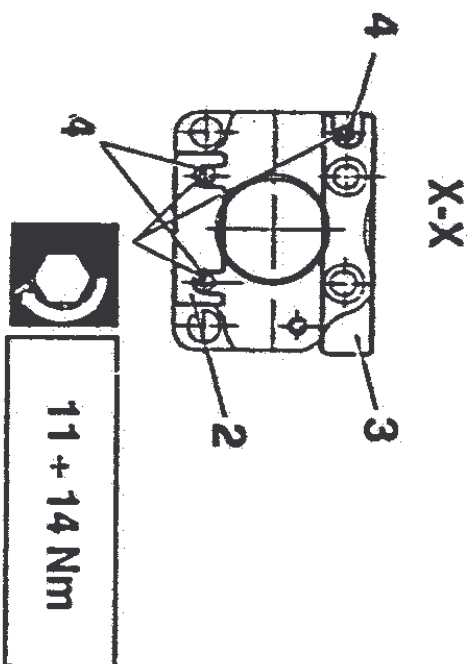


1. Remove the gear control lever support (refer to the following pages for the refitting operations).
2. Remove the flexible safety strap.
3. Remove retaining pin.
4. Remove the gear control lever.



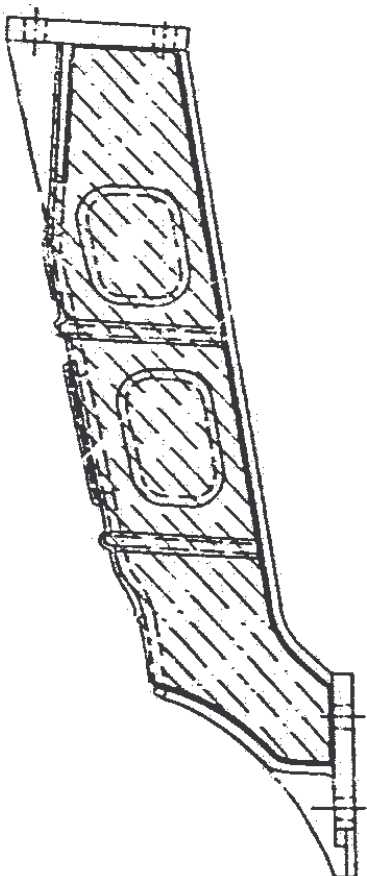


ENGINE - TRANSMISSION UNIT REMOVAL AND REPLACEMENT (continued) DRIVE SHAFT (For 4x4 model)



1. Remove the gear lever support (for 4x4 versions).
 - When refitting the gear control lever it is necessary to check that it is the correct distance away from the drive shaft. If it is not it is possible to operate as follows:
 - Raise the vehicle.
 - Check the distance between the support and the drive shaft.
 - If the values is above 16 mm it will be necessary to insert one or more shims (3) under the lower nuts.
 - If the value is below 10 mm it will be necessary to insert one or more shims (3) under the upper nut.
 - Tighten the nuts (4) to the correct torque.

N.B. Each 0.5 mm shim will vary the value by ~ 3.5 mm.



NOTE: Starting from chassis number 5822286, an off-loaded gear lever support has been fitted and the distance from the drive shaft need not be checked.



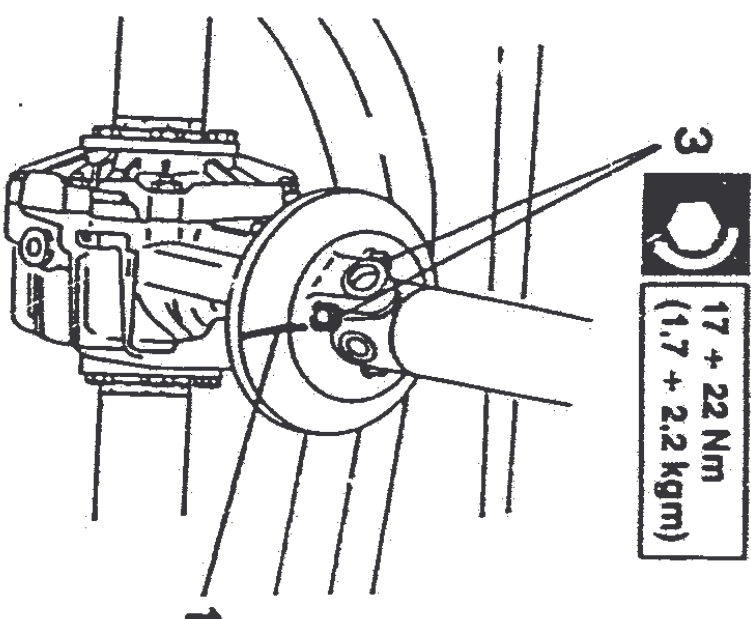
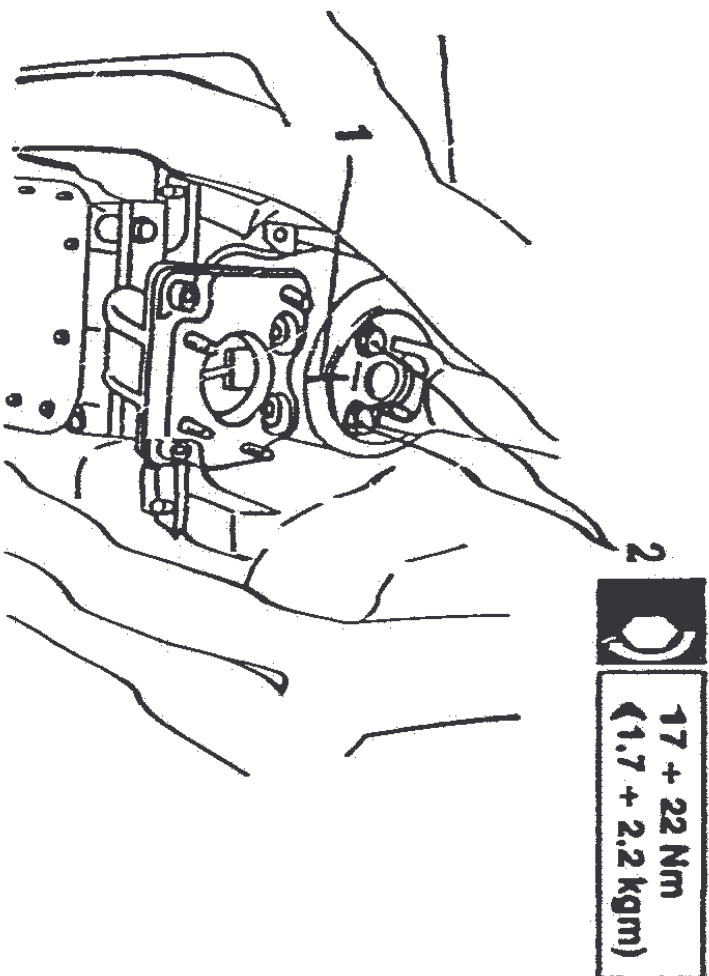


01 - 22

ENGINE ASSEMBLY COMPLETE

ENGINE - TRANSMISSION UNIT REMOVAL AND REPLACEMENT (continued)

DRIVE SHAFT (For 4x4 model)



1. Mark the front and rear flanges of the drive shaft attachment to ensure that they are refitted correctly.
2. Loosen the four screws securing the front flange.
3. Loosen the four screws securing the rear flange to the flywheel.





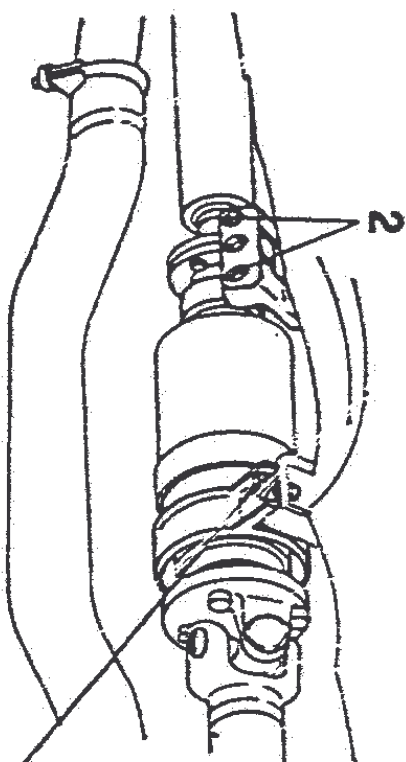
01 - 23

ENGINE ASSEMBLY COMPLETE

ENGINE - TRANSMISSION UNIT REMOVAL AND REPLACEMENT (continued) DRIVE SHAFT (For 4x4 model)



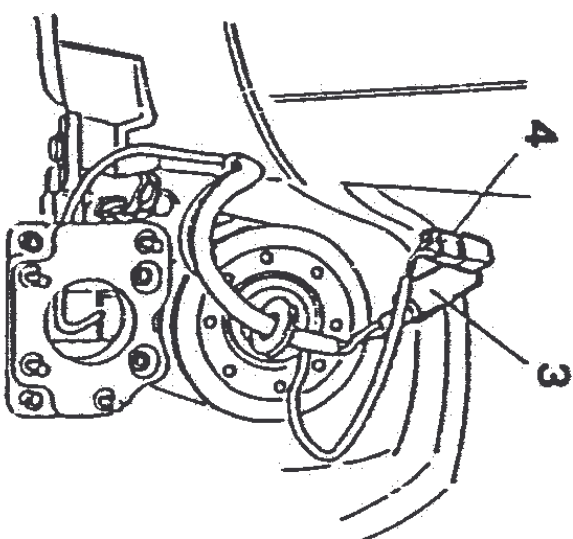
12 + 15 Nm
(1.2 + 1.5 kgm)



12 + 15 Nm
(1.2 + 1.5 kgm)



1. Loosen the two screws securing the rear flexible support of the viscous coupling.
2. Loosen the four screws securing the front support of the viscous coupling and remove the entire drive shaft.



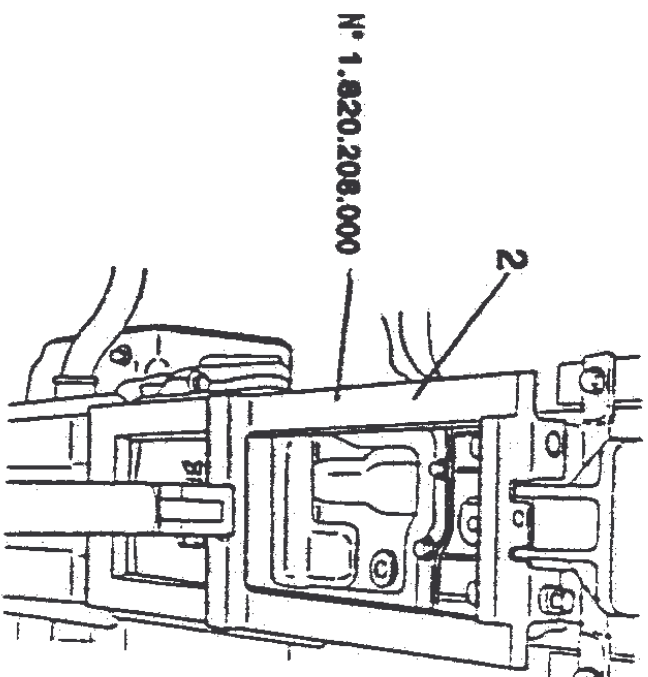
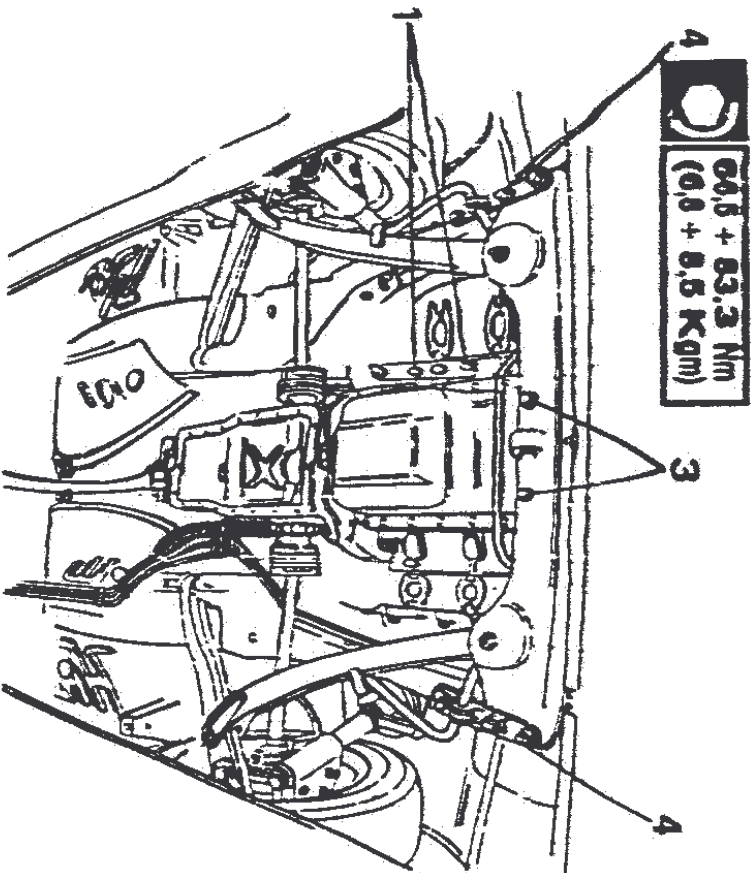
3. Disconnect the electrical connection from the electromagnetic coupling.
4. Disconnect the electrical connection from the anti-disengaging sensor.



01 - 24

ENGINE ASSEMBLY COMPLETE

ENGINE-TRANSMISSION UNIT REMOVAL AND REPLACEMENT (Continued)



1. Undo the two engine torsion bar mounting brackets.
2. Position a column-type hydraulic jack fitted with support No. 1.820.208.000 under the engine-transmission unit to take part of the weight.
3. Release and remove the two bolts holding the front engine mounting to the cross-member.
4. Release and remove the bolts holding the cross-member to the body.

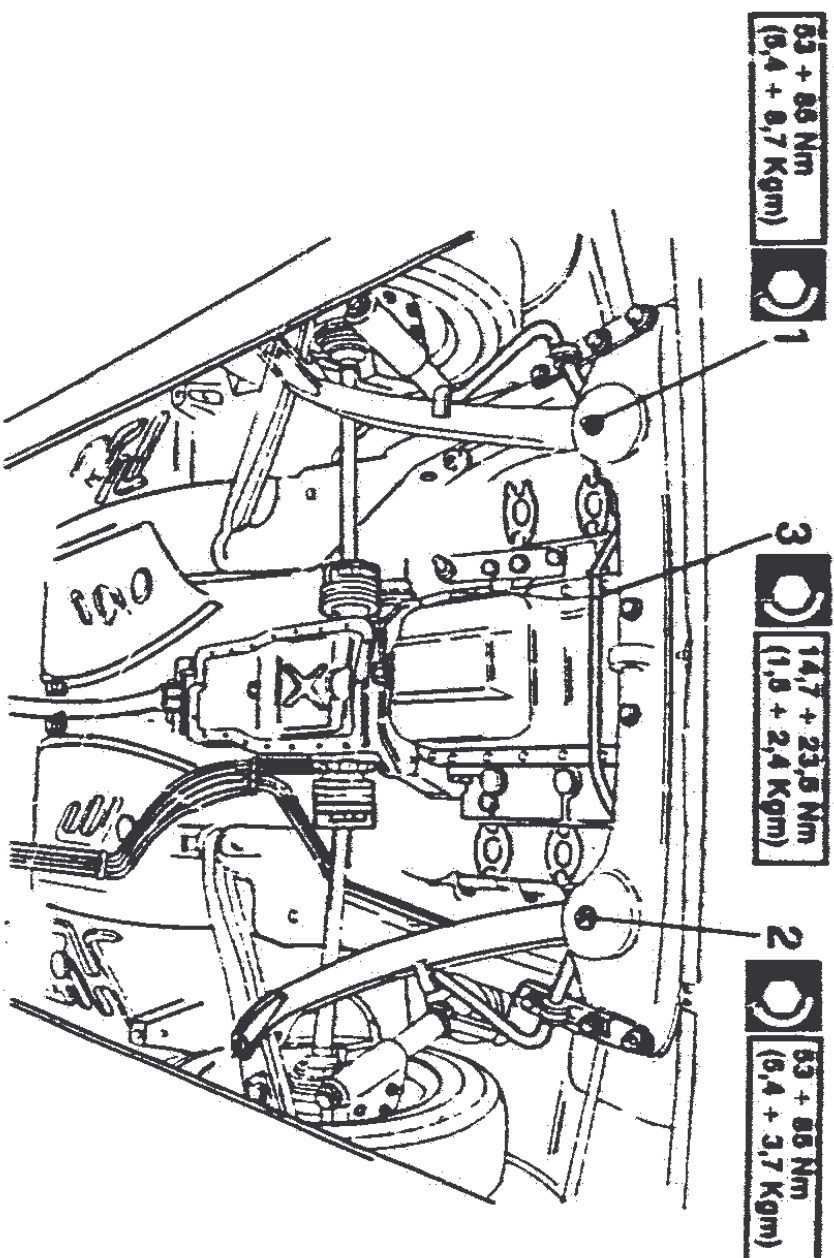




01 - 25

ENGINE ASSEMBLY COMPLETE

ENGINE-TRANSMISSION UNIT REMOVAL AND REPLACEMENT (Continued)



1. Slacken the front cross-member - RH strut union bolt.
2. Unscrew and remove the front cross-member LH strut union bolt and then free the strut from the cross-member.

3. Unscrew the stabilizer-bar mounting bolts from the LH suspension strut.

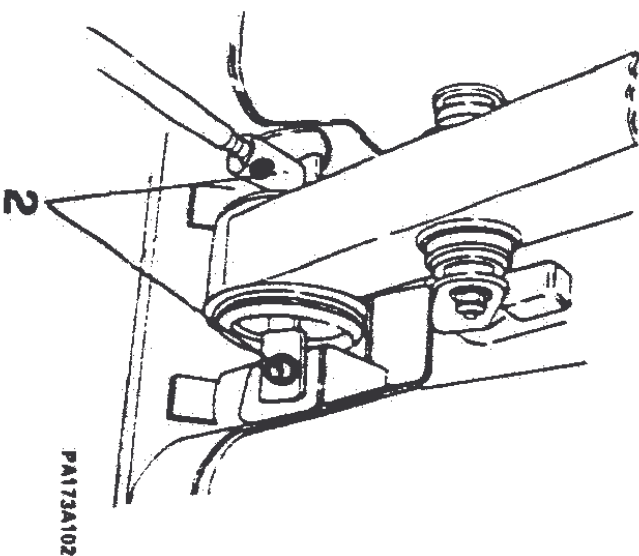
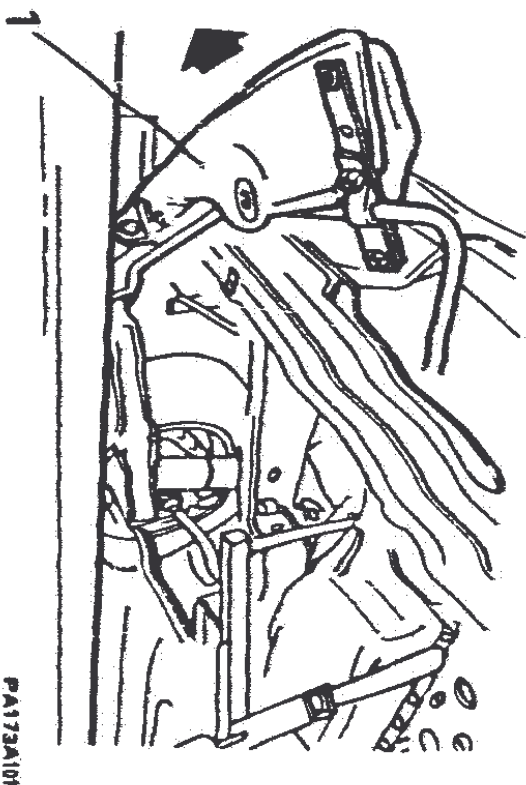




01 - 26

ENGINE ASSEMBLY COMPLETE

ENGINE-TRANSMISSION UNIT REMOVAL AND REPLACEMENT (Continued)



1. Pull away the front cross-member complete with stabilizer bar so that the engine-transmission unit may be extracted from underneath.

2. Release and remove the two engine rear mounting bolts from the body.

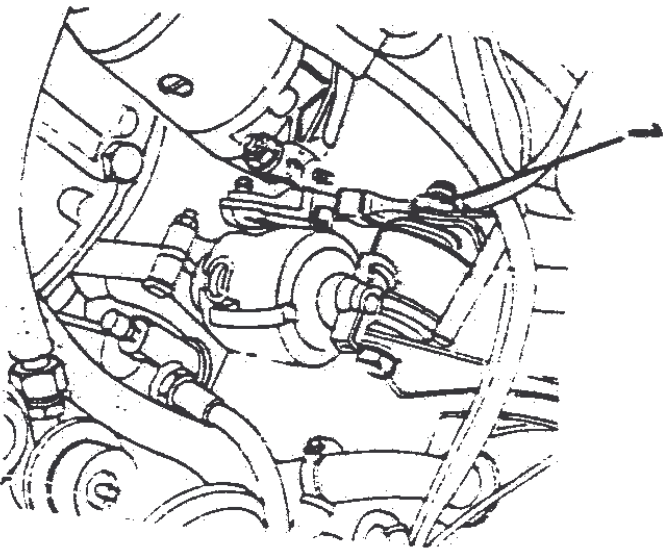




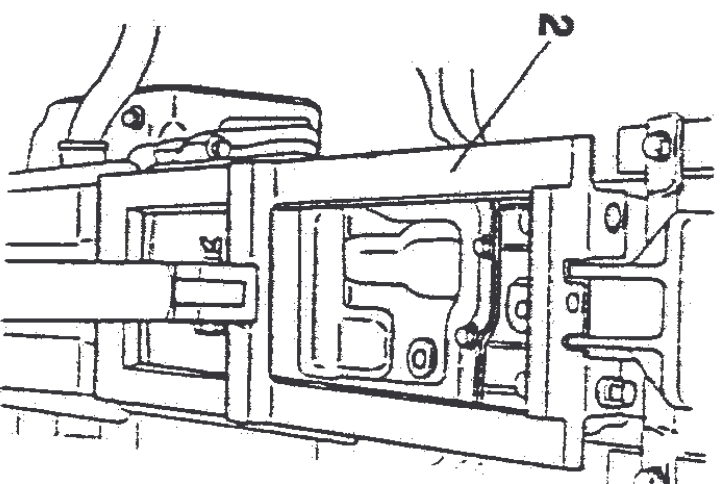
01 - 27

ENGINE ASSEMBLY COMPLETE

ENGINE-TRANSMISSION UNIT REMOVAL AND REPLACEMENT (Continued)



1. Slacken and remove the central engine mounting bolt from the body.



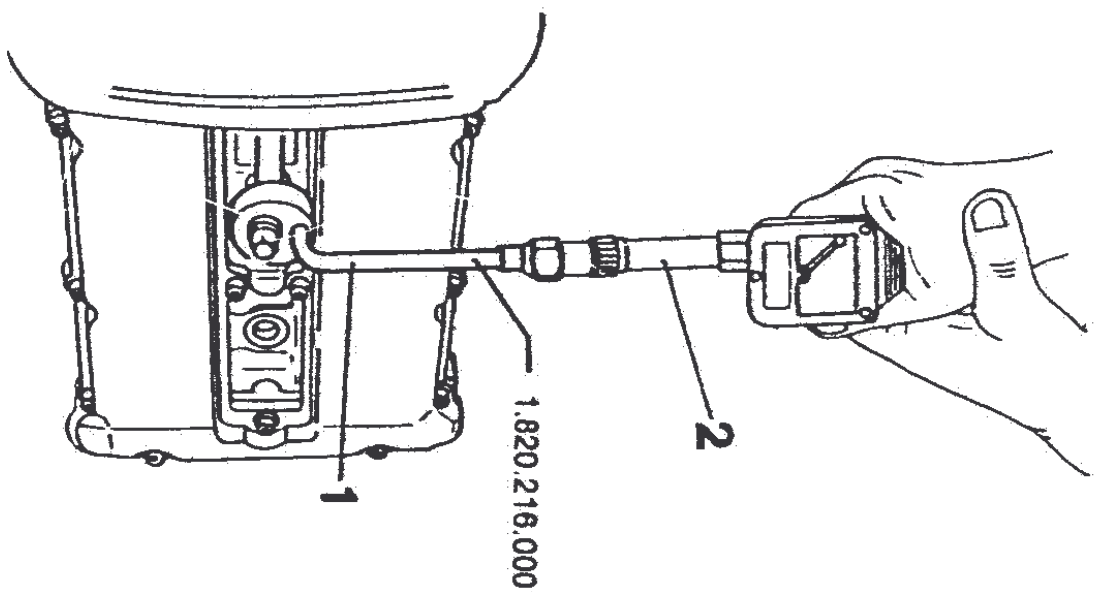
2. Lower the column jack and withdraw the engine - transmission unit from under the engine bay.

PA172AA101



ENGINE - TRANSMISSION UNIT REMOVAL AND REPLACEMENT (continued) CYLINDER COMPRESSION TEST

- After retightening the cylinder pressure as follows:
- Run the engine to normal operating temperature.
- Disconnect the comb from the Ignition-Injection control unit (see GROUP 40).
- Remove the complete air cleaner (see GROUP 04).
- Remove the spark plugs.
- 1. Screw tool N° 1.820.216.000 into the spark plug sealing of cylinder number 1.
- 2. Insert the test apparatus into the tool.
- Keeping the accelerator fully depressed, turn the starter until the maximum cylinder pressure is reached.
- Repeat the procedure for the remaining cylinders.

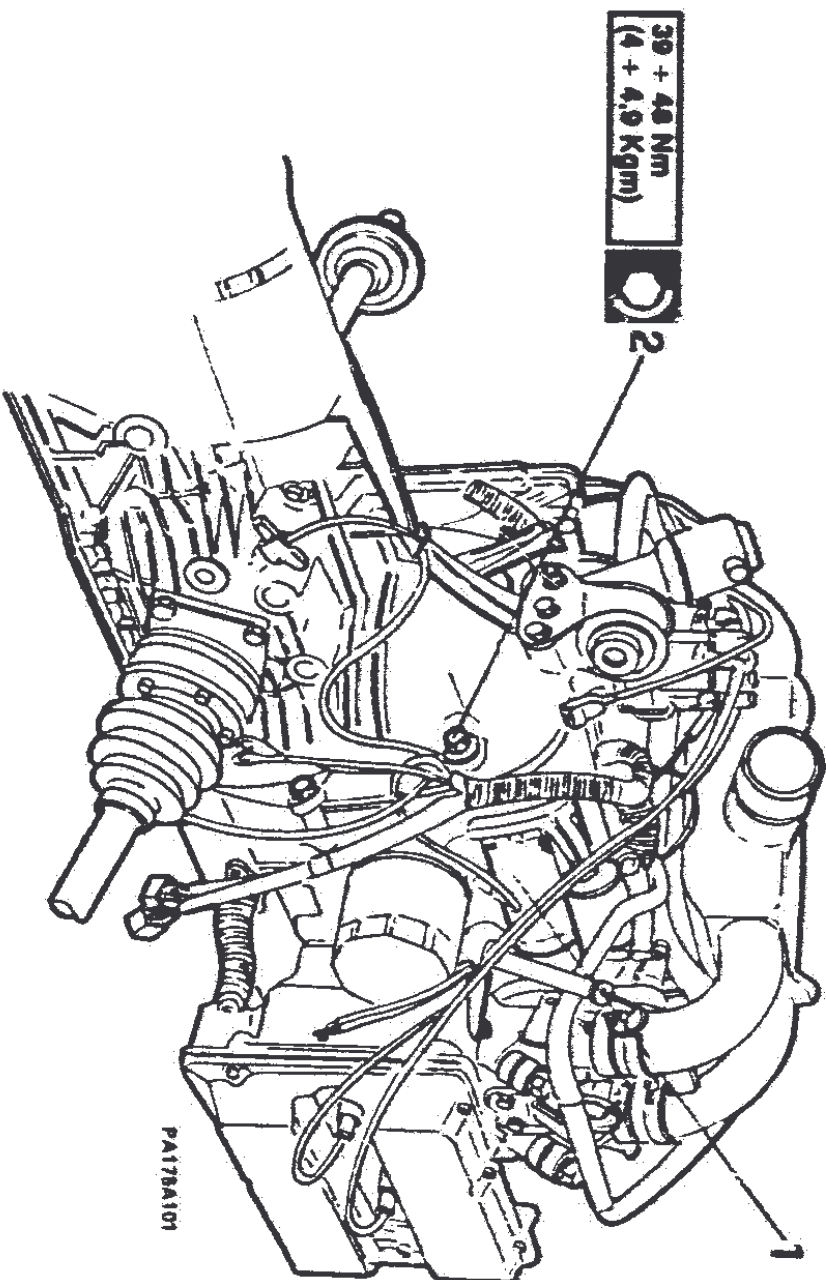




01 - 29

ENGINE ASSEMBLY COMPLETE

ENGINE/GEARBOX-DIFFERENTIAL SEPARATION AND UNION



- Position the engine - transmission unit on rotary stand fitted with support tool No. 1.820.151.000.
- 1. Unscrew the nuts and remove the starter motor.
- Undo the screws and remove the flywheel cover plate.
- 2. Unscrew the nuts securing the gearbox-differential and separate the two groups.



- Lubricate the power take off shaft with the specified grease.



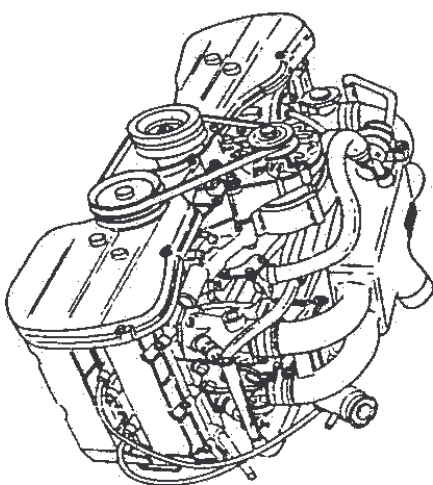
Withdraw the thrust bearing from its housing in the gearbox, so as not to damage it.

Grasso Molykote Paste G



01 - C

ENGINE ASSEMBLY COMPLETE



ELECTRONIC-INJECTION ENGINE (16 VALVES)

- PRELIMINARY DISMANTLING
OPERATIONS
- ENGINE DISMANTLING AND
REASSEMBLY

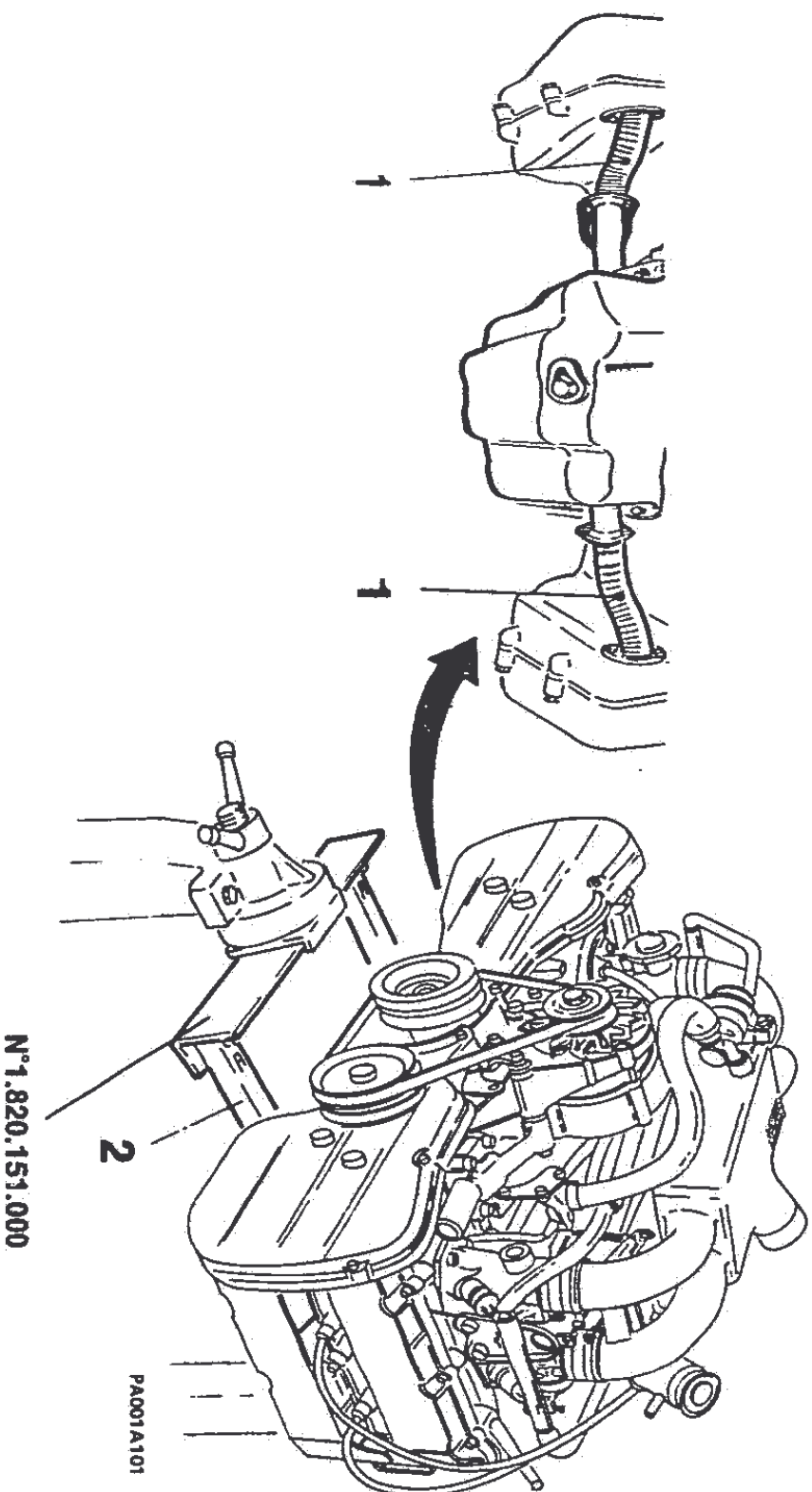
PRELIMINARY DISMANTLING OPERATIONS.....	01 - 30
ENGINE DISMANTLING AND REASSEMBLY.....	01 - 31
CYLINDER HEADS	01 - 40
WATER PUMP	01 - 41
CRANKSHAFT PULLEY AND SPROCKETS	01 - 42
OIL PUMP AND SUMP.....	01 - 43
FRONT BLOCK PLATE.....	01 - 44
PISTONS AND CONNECTING RODS.....	01 - 45



01 - 30

ENGINE ASSEMBLY COMPLETE

PRELIMINARY DISMANTLING OPERATIONS



1. Remove the two oil pipes.

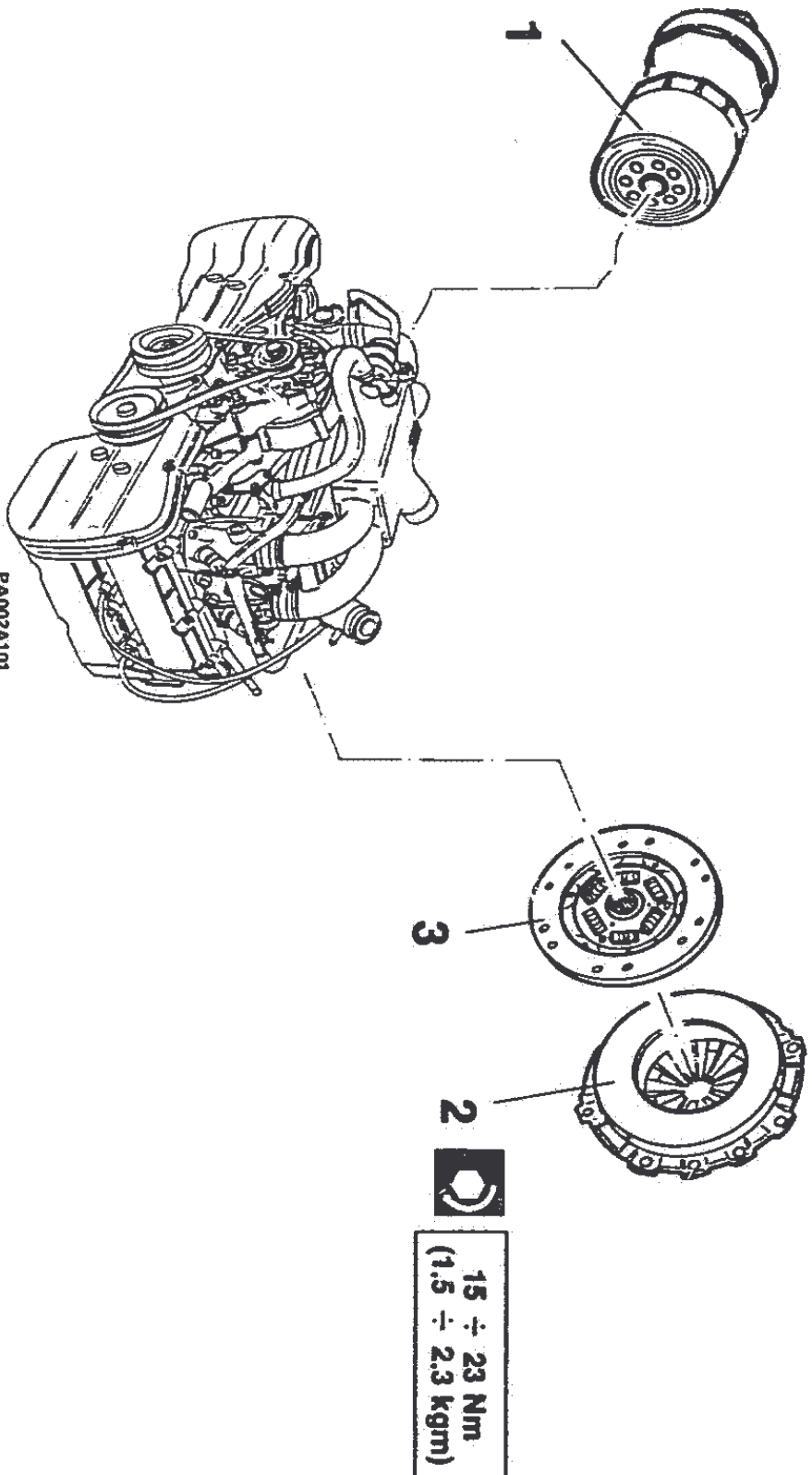
2. Support the engine on special engine stand No. 1.820.151.000.



01 - 31

ENGINE ASSEMBLY COMPLETE

ENGINE DISMANTLING AND REASSEMBLY



1. Remove the oil filter using the special tool.
2. Undo the six retaining bolts and remove the clutch cover.

3. Remove the clutch driven plate
– Fit the crankshaft rotating tool.



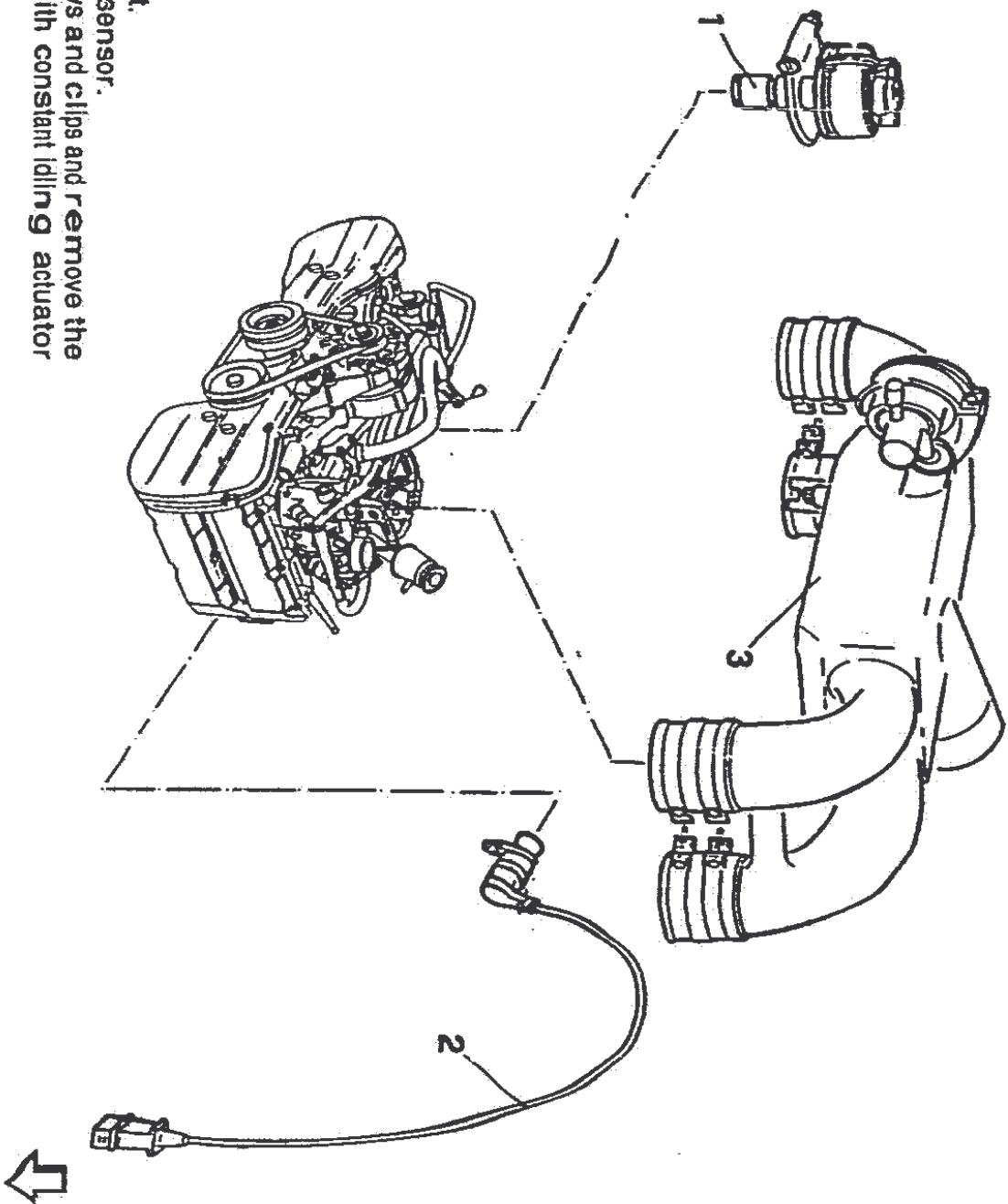


01 - 32

ENGINE ASSEMBLY COMPLETE

ENGINE DISMANTLING AND REASSEMBLY (Continued)

1. Remove the distributor unit.
2. Remove the R.P.M. phase sensor.
3. Slacken the retaining screws and clips and remove the air duct casing complete with constant idling actuator

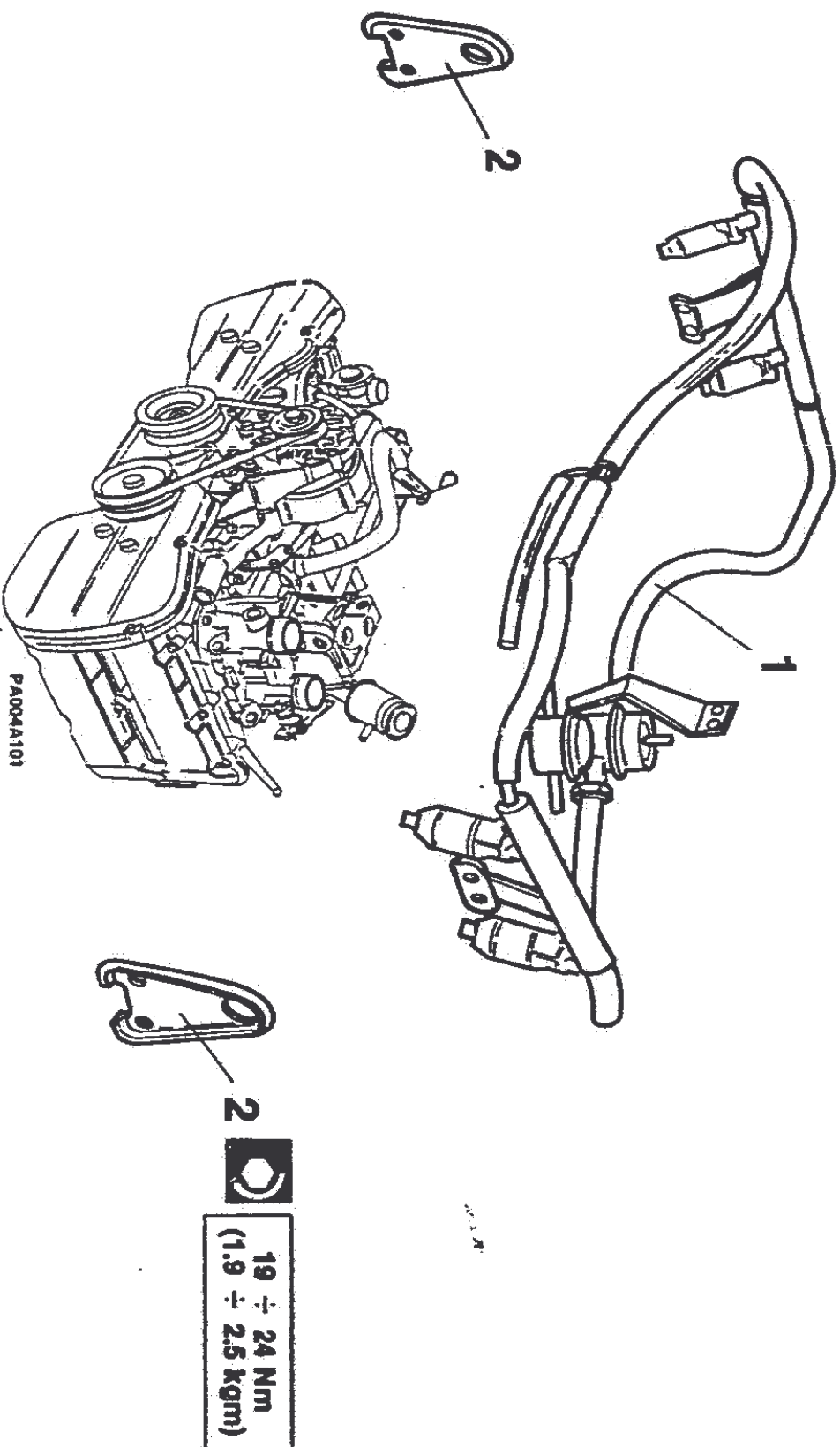




01 - 33

ENGINE ASSEMBLY COMPLETE

ENGINE DISMANTLING AND REASSEMBLY (Continued)



1. Remove the fuel-injection manifold assembly complete with injectors, pressure regulator and impulse damper.
2. Recover the engine lifting brackets.

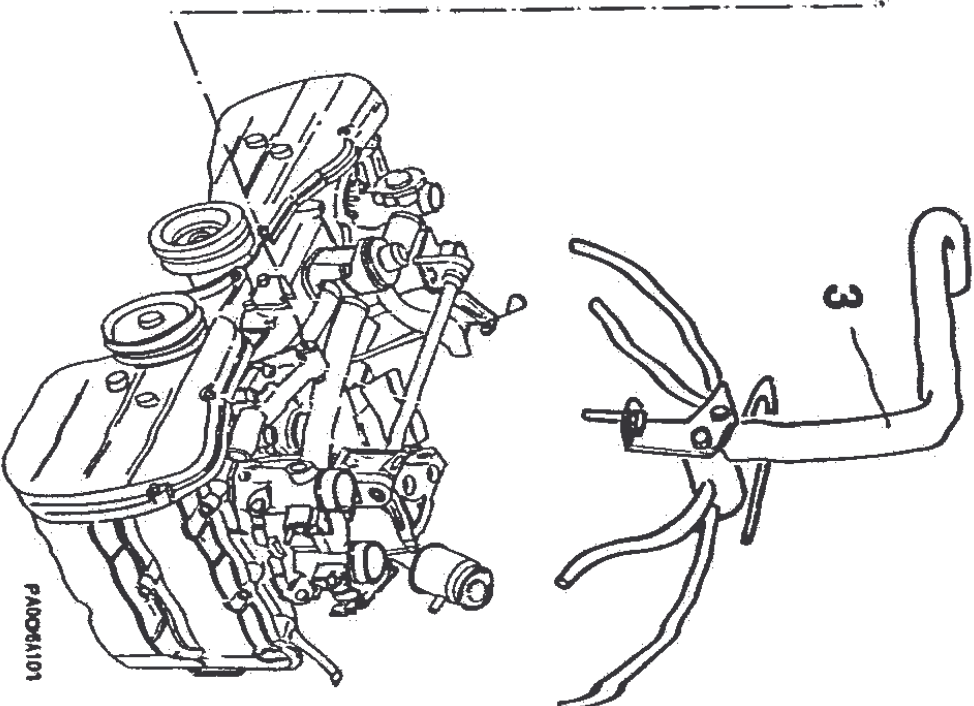
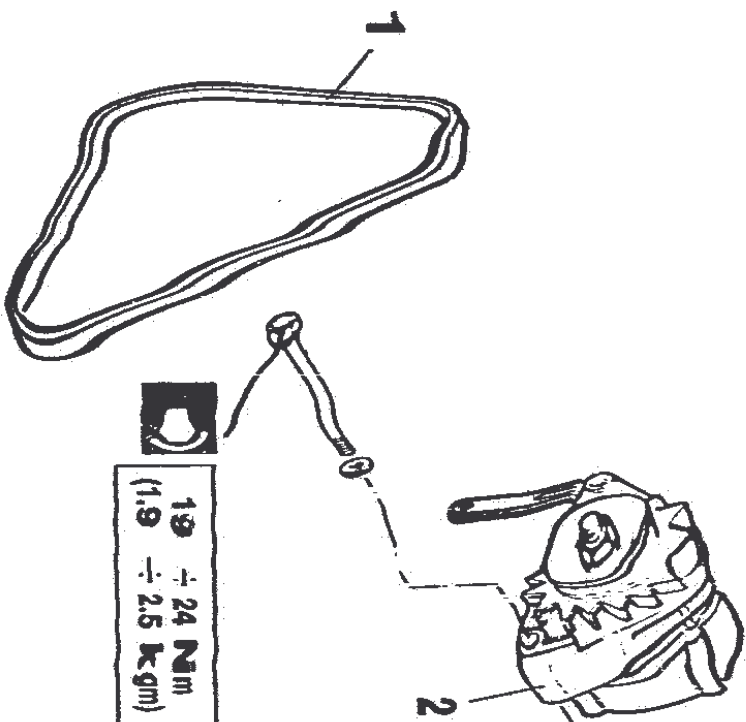




01 - 34

ENGINE ASSEMBLY COMPLETE

ENGINE DISMANTLING AND REASSEMBLY (Continued)



1. Slacken the two alternator fixing bolts and remove the drive belt.
2. Unscrew the two bolts and remove the alternator complete with bracket.

3. Remove the idle air-bleed hose assembly.

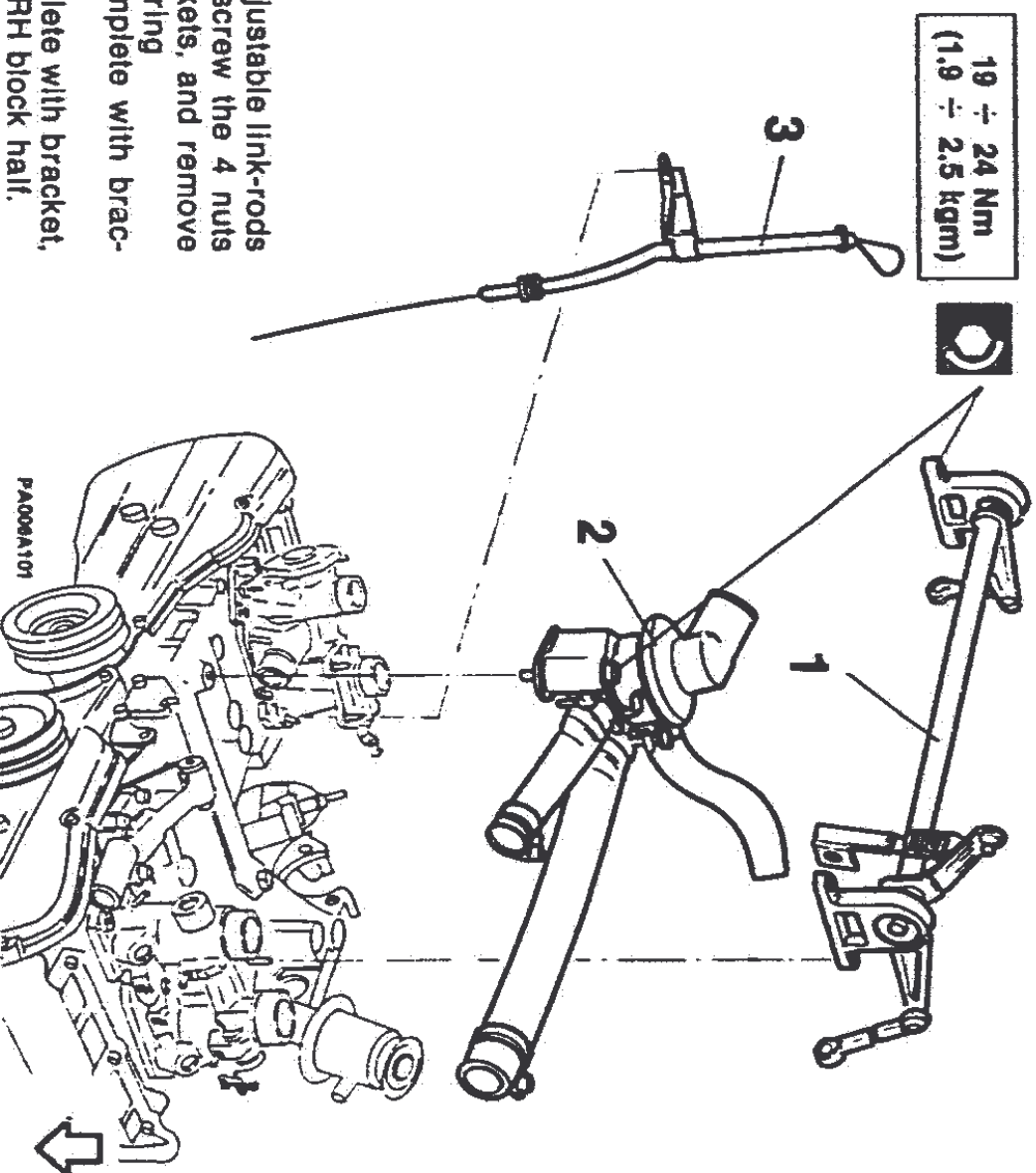




01 - 35

ENGINE ASSEMBLY COMPLETE

ENGINE DISMANTLING AND REASSEMBLY (Continued)

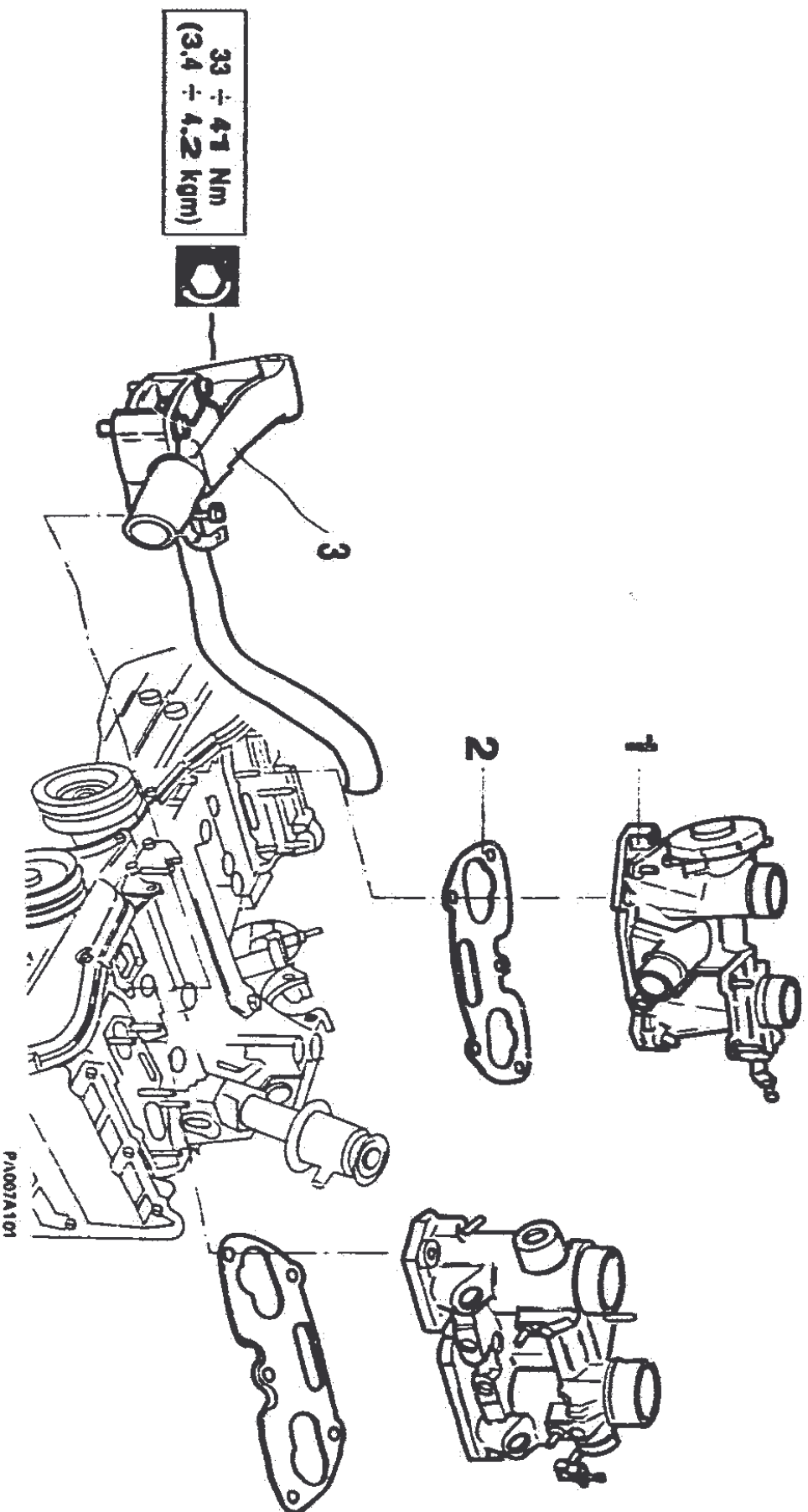




01 - 36

ENGINE ASSEMBLY COMPLETE

ENGINE DISMANTLING AND REASSEMBLY (Continued)



1. Undo the fixing nuts and remove the injector housings.
2. Recover the gaskets.
3. Remove the cooling liquid pipe union.

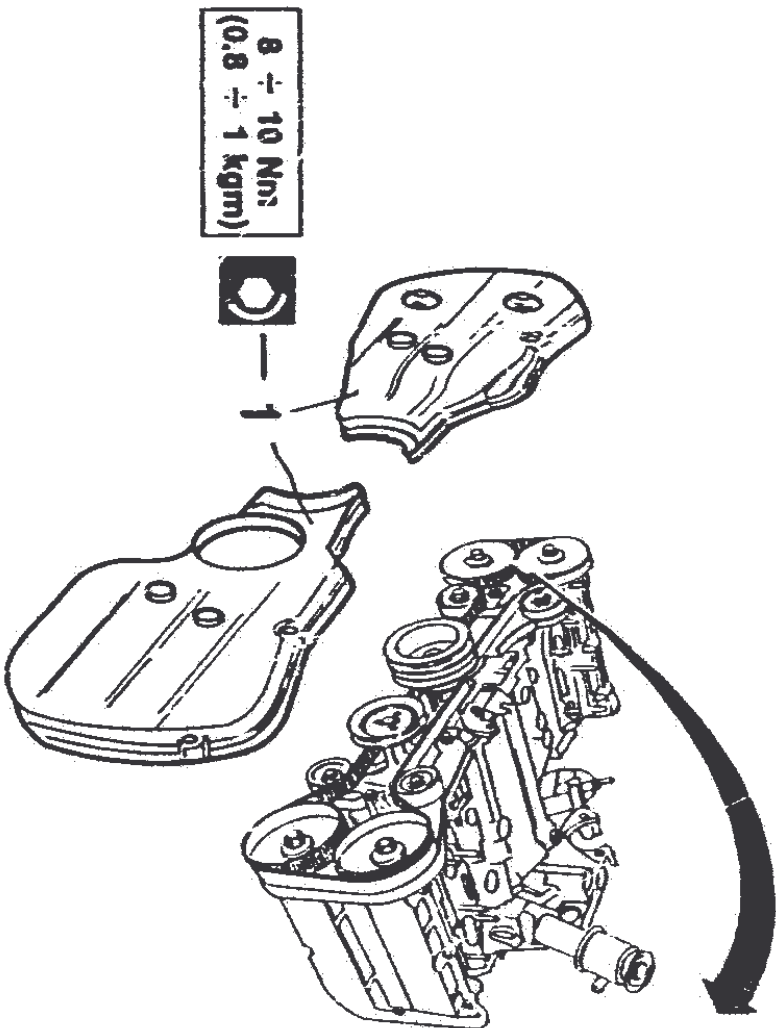




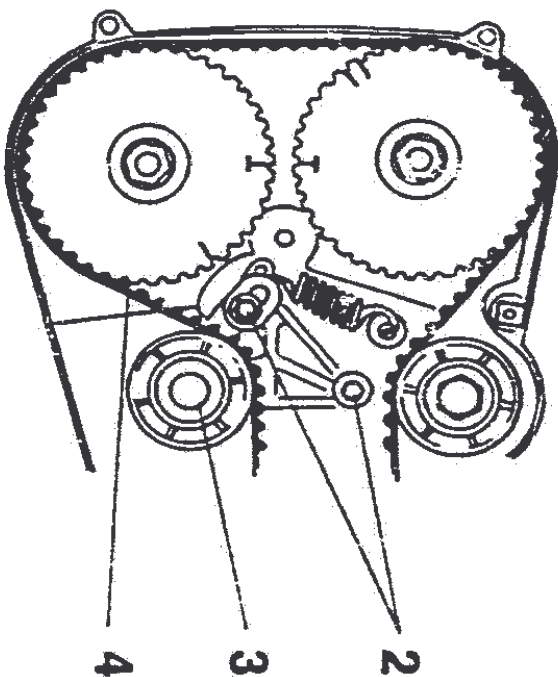
01 - 37

ENGINE ASSEMBLY COMPLETE

ENGINE DISMANTLING AND REASSEMBLY (Continued)



1. Undo the fixing screws and remove the front timing belt covers
2. Slacken the RH belt-tensioner retaining nuts.



3. Push the roller back against its spring and tighten the retaining nuts in this position, leaving the timing belt slack.
4. Withdraw the RH timing belt, and repeat the entire procedure for the LH belt.

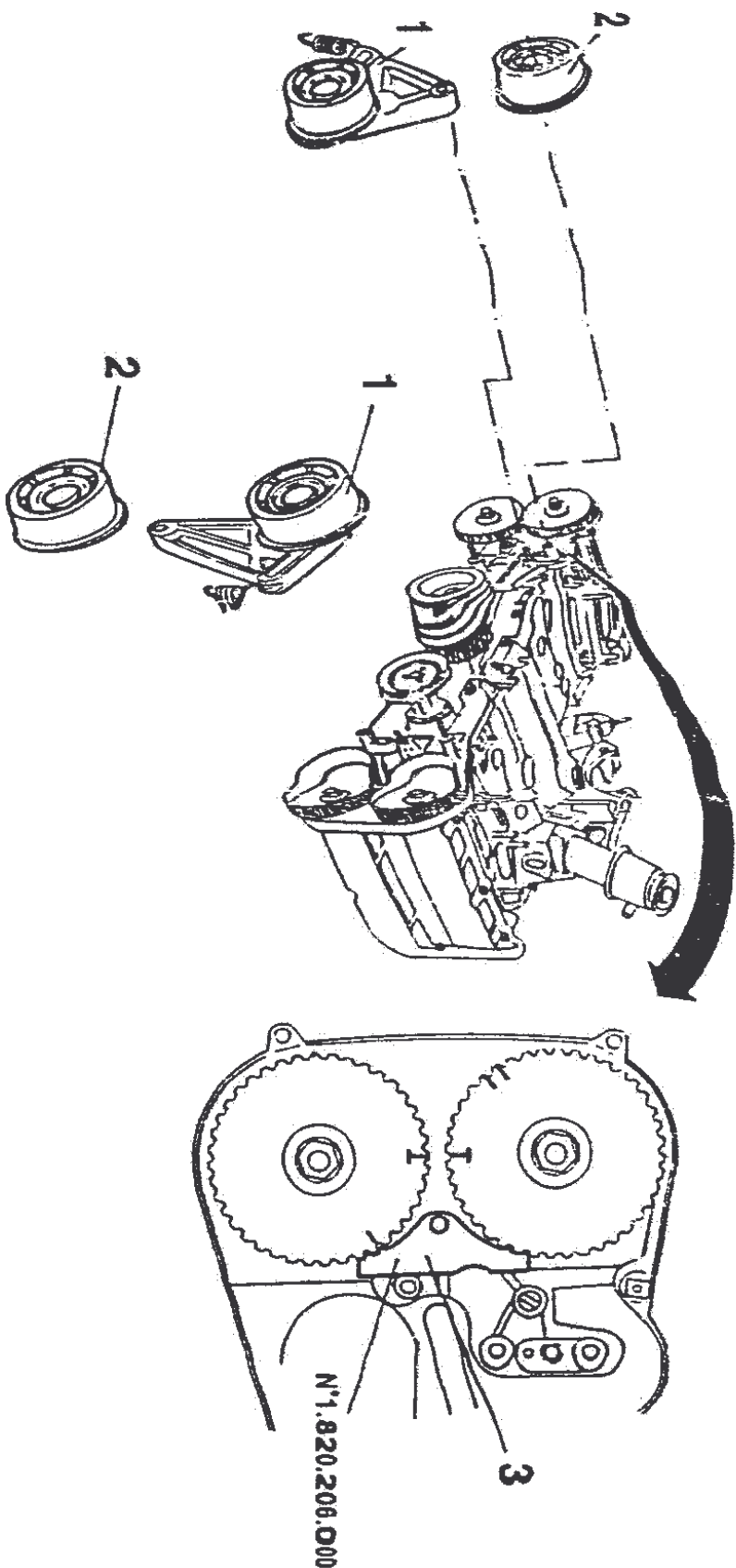




01 - 38

ENGINE ASSEMBLY COMPLETE

ENGINE DISMANTLING AND REASSEMBLY (Continued)



1. Unscrew the fixing nuts and remove the belt-tensioners with their springs.

2. Undo the retaining screws and remove the tension rollers.
3. Insert the special sprocket lock tool No. 1.820.206.000.



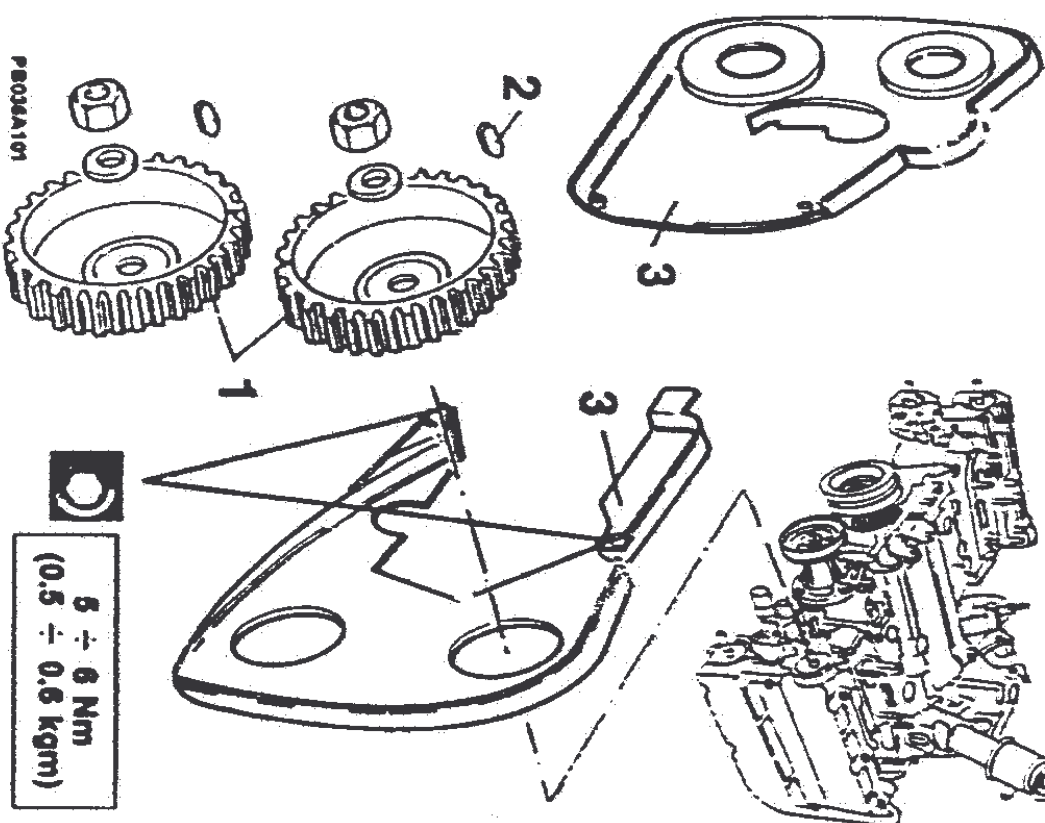
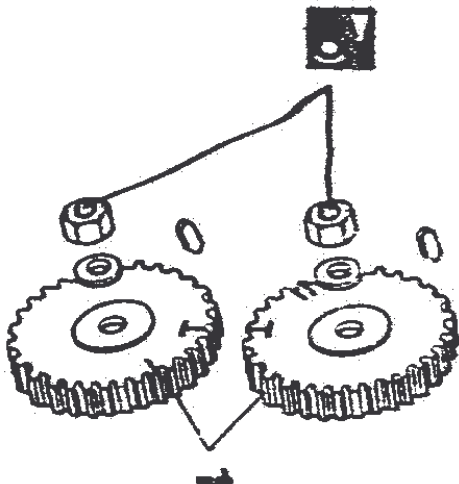


01 - 39

ENGINE ASSEMBLY COMPLETE

ENGINE DISMANTLING AND REASSEMBLY (Continued)

63 ÷ 70 Nm
(6.4 ÷ 7.1 kgm)



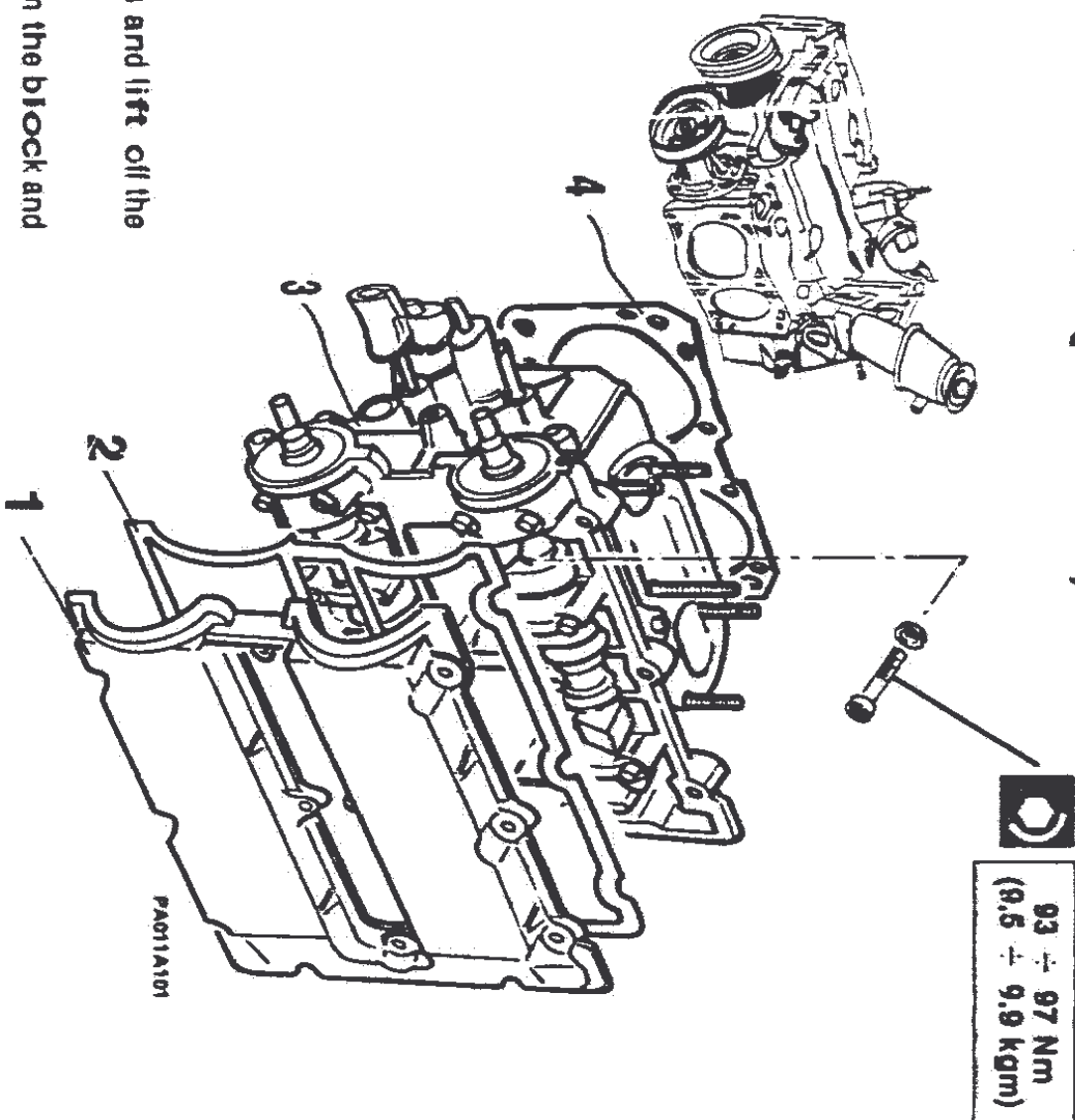
1. Unscrew the retaining nuts from the camshafts and withdraw the LH and RH timing belt sprockets.

2. Recover the 4 keys.

3. Remove the rear timing belt covers.

ENGINE DISMANTLING AND REASSEMBLY (Continued)

CYLINDER HEADS



1. Remove the 12 camshaft cover screws and lift off the camshaft cover.
 2. Remove the camshaft cover gasket.
 3. Unscrew the 8 cylinder head bolts from the block and remove the cylinder head.
 4. Remove the cylinder head gasket.
- Repeat the operation for the other head.



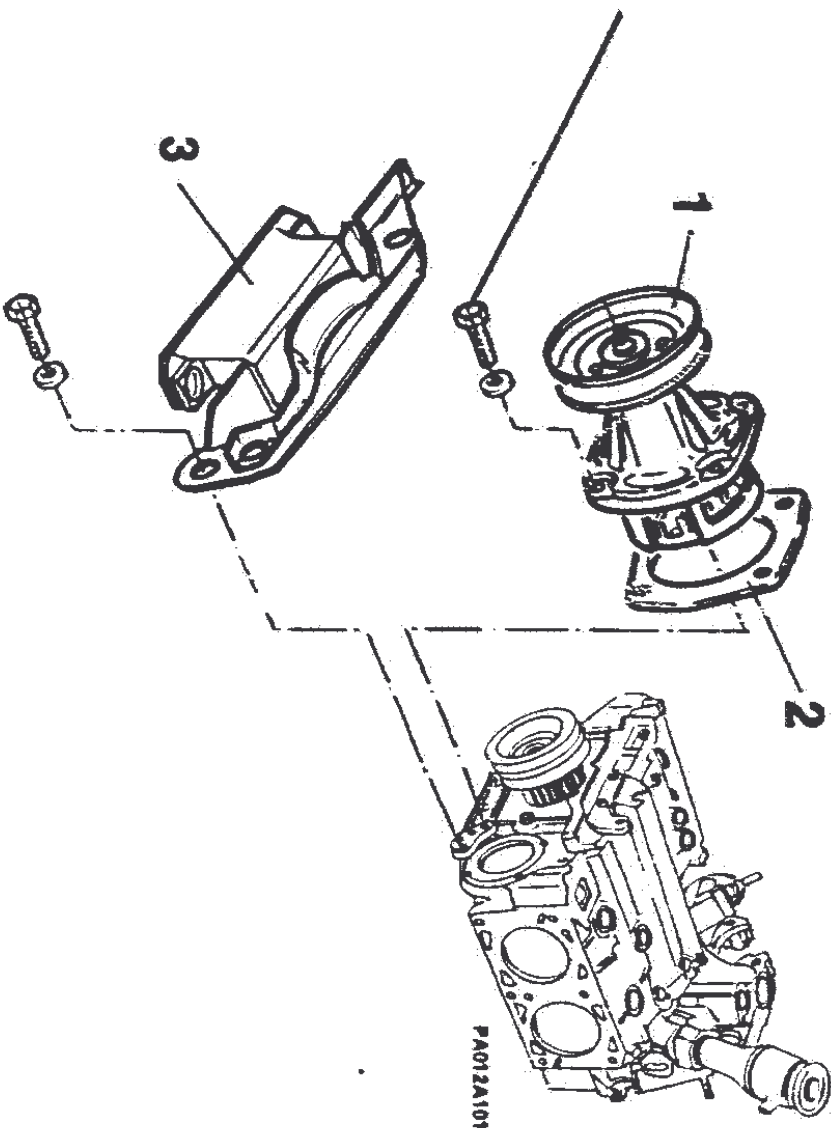
01 - 41

ENGINE ASSEMBLY COMPLETE

ENGINE DISMANTLING AND REASSEMBLY (Continued)

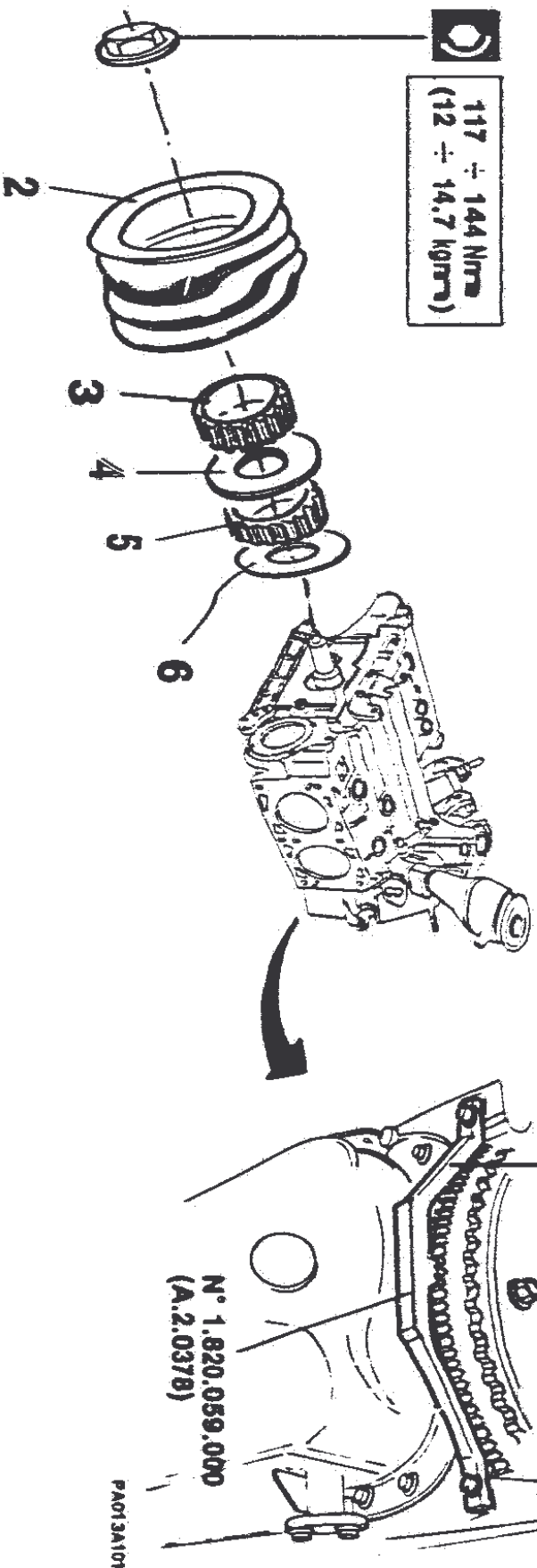
WATER PUMP

19 ÷ 24 Nm
(1.9 ÷ 2.5 kgm)



1. Undo the 4 bolts holding the water pump to the block, and extract the pump.
2. Remove the gasket.
3. Undo the 4 retaining screws and remove the guard with the front flexible engine mounting.

ENGINE DISMANTLING AND REASSEMBLY (Continued)



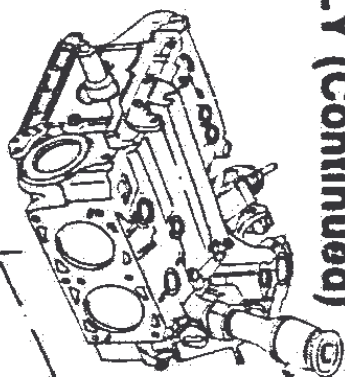
1. Lock the flywheel using special tool No. 1.820.059. (A.2.0378).
2. Withdraw the pulley from the crankshaft
3. Pull off the RH timing belt sprocket.
4. Slide off the spacer.
5. Pull off the LH timing belt sprocket.
6. Slide off the belt guide disk.
7. Remove the special tool No. 1.820.059.000 (A.2.0378).



01 - 43

ENGINE ASSEMBLY COMPLETE

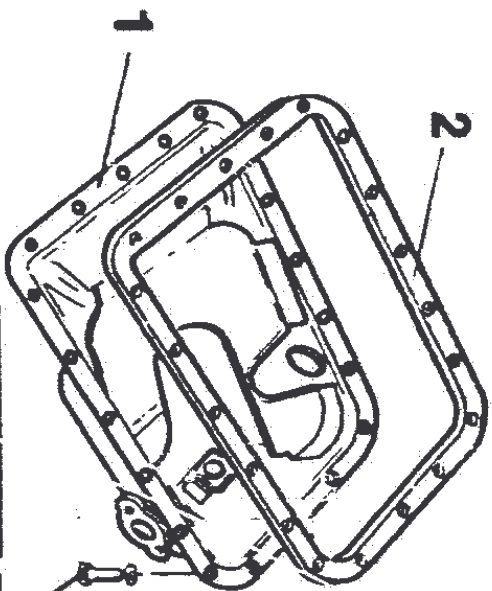
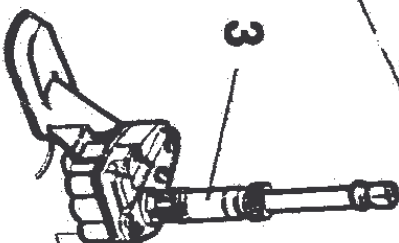
ENGINE DISMANTLING AND REASSEMBLY (Continued) OIL PUMP AND SUMP



19 ÷ 24 Nm
(1.9 ÷ 2.5 kgm)



3



PA01AA101

8 ÷ 10 Nm
(0.8 ÷ 1 kgm)



1. Unscrew the sump bolts and remove the sump.
2. Remove the gasket.
3. Unscrew the retaining bolts in the block end plate and extract the oil pump.



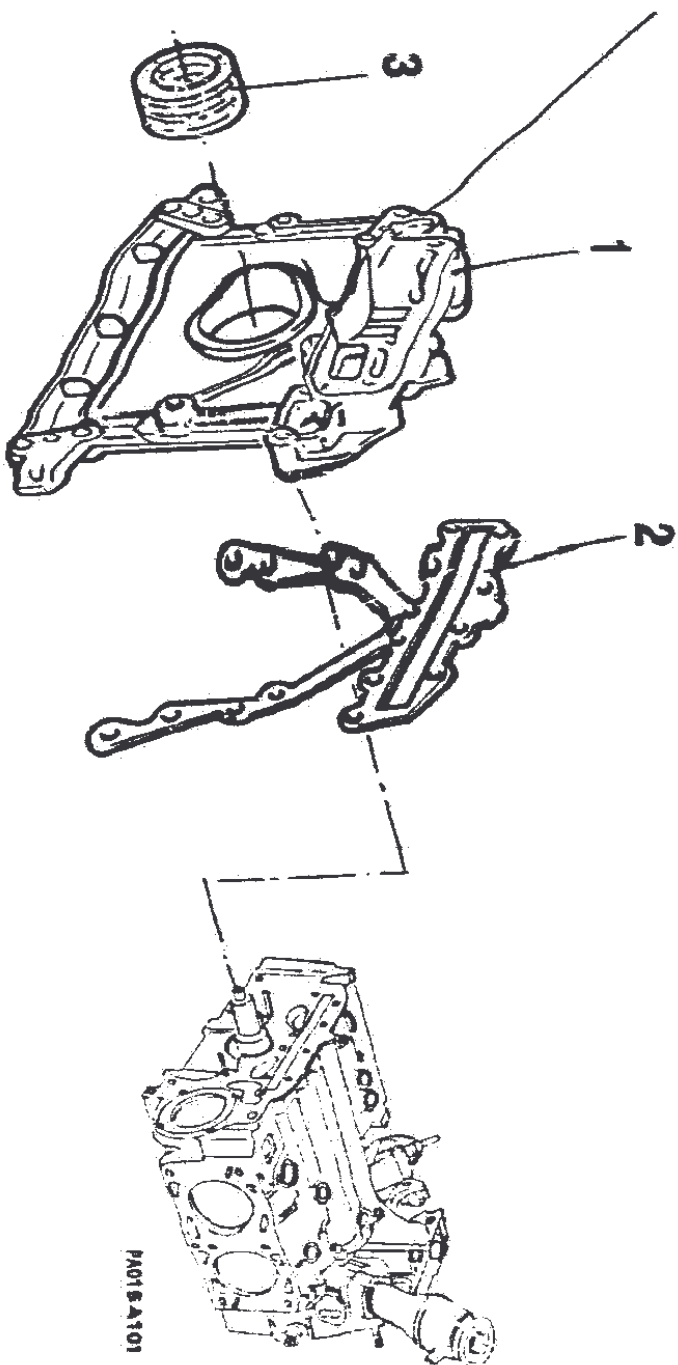
01 - 44

ENGINE ASSEMBLY COMPLETE

ENGINE DISMANTLING AND REASSEMBLY (Continued)

FRONT BLOCK PLATE

10 ÷ 24 Nm
(1.0 ÷ 2.5 kgm)

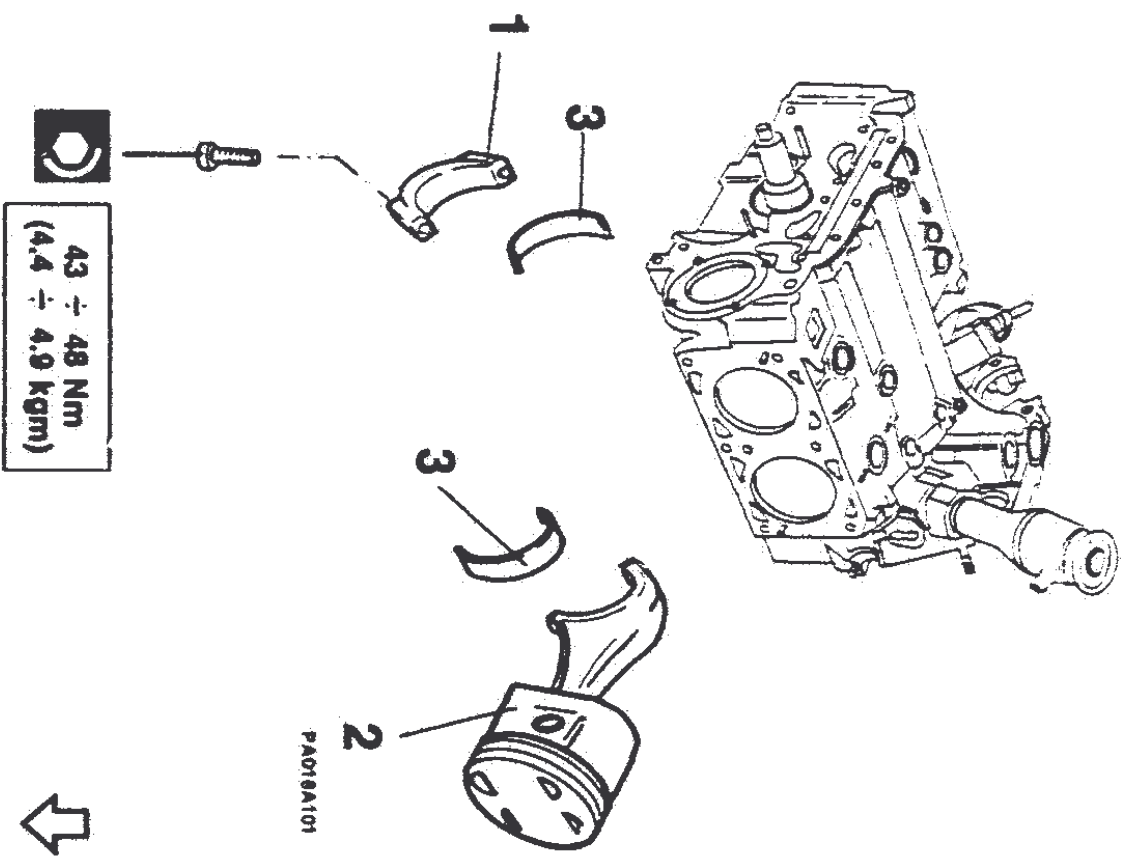


1. Remove the retaining screws and washers, and lift off the front block plate.
2. Remove the gasket.
3. Remove the oil seal from the plate (fit a new seal when reassembling).

ENGINE DISMANTLING AND REASSEMBLY (Continued)

PISTONS AND CONNECTING RODS

- Rotate the crankshaft until the big-end caps are accessible.
1. Remove the big-end bearing caps
 2. Extract the pistons from the head side of the block with connecting rods.
 3. Remove the big-end bearing shells from the connecting rod and cap.

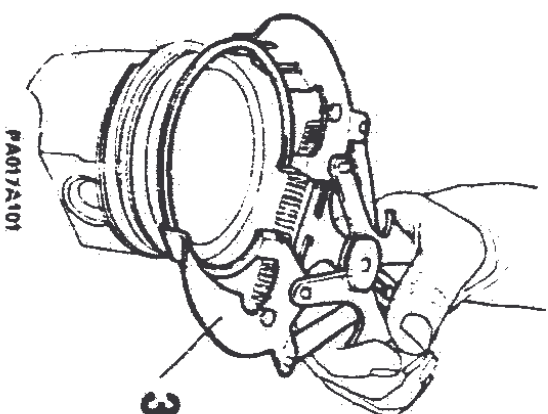
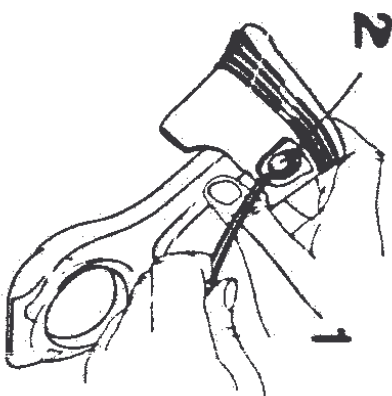




01 - 46

ENGINE ASSEMBLY COMPLETE

ENGINE DISMANTLING AND REASSEMBLY PISTONS AND CONNECTING RODS (Continued)

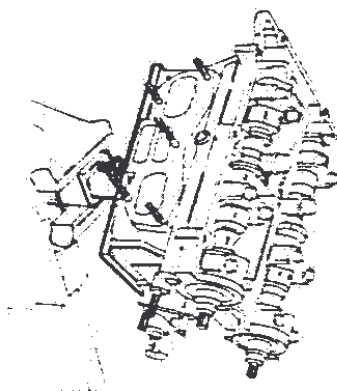


- 1 - Using a screwdriver extract the two gudgeon pin clips.
- 2 - Extract the gudgeon pin.
3. Remove the compression and oil scraper rings from the piston.



01 - D

ENGINE ASSEMBLY COMPLETE



ELECTRONIC INJECTION ENGINE (16 VALVES)

- ENGINE DISMANTLING AND REASSEMBLY (Continued)
- CYLINDER HEAD OVERHAUL

ENGINE DISMANTLING AND REASSEMBLY

FLYWHEEL.....	01 - 47
BLOCK END PLATE.....	01 - 48
CRANKSHAFT.....	01 - 49
CYLINDER HEAD OVERHAUL	
CYLINDER HEAD DISMANTLING.....	01 - 50
CYLINDER HEAD CHECKS.....	01 - 53
- Cylinder head joint face	01 - 53
- Valve guide clearance	01 - 54

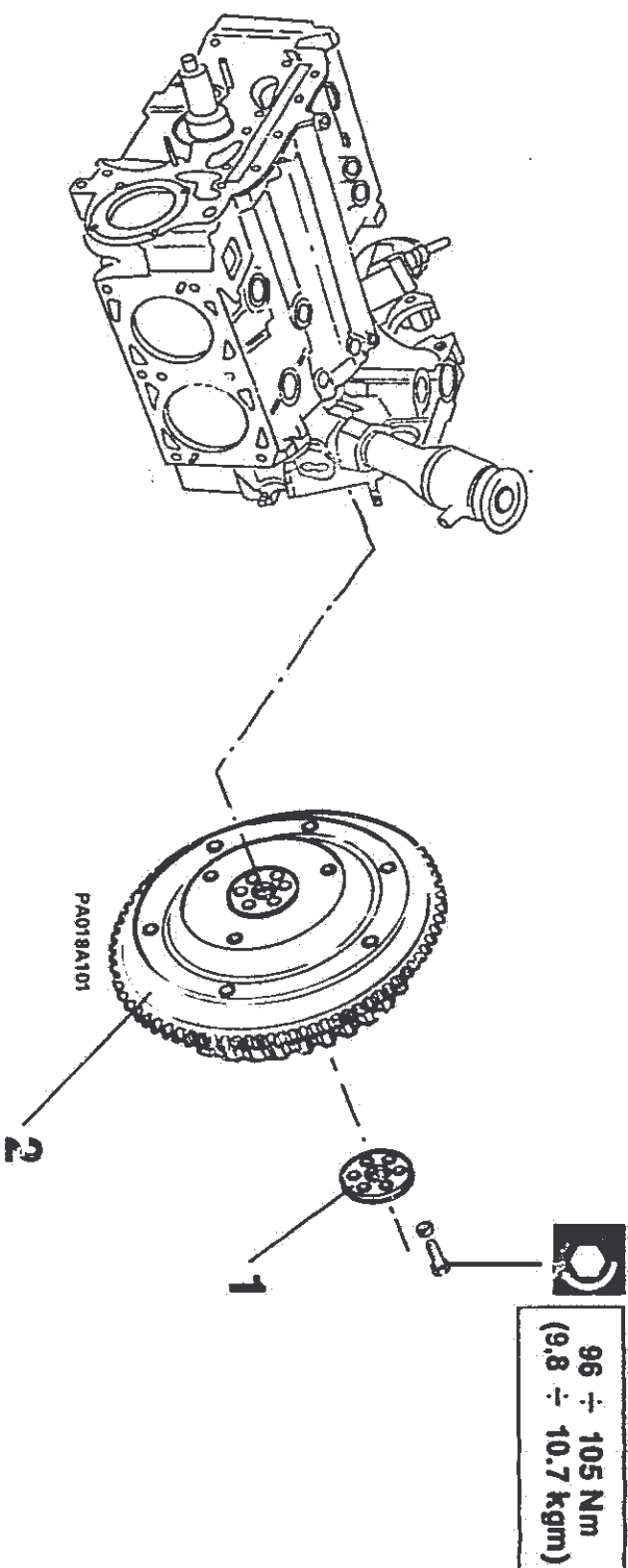
- Valve guide substitution.....	01 - 55
- Valve seats	01 - 56
- Valve seat substitution and valve seal testing.....	01 - 58
- Valve springs	01 - 59
- Tappets and seatings	01 - 60
- Camshafts and bearings.....	01 - 61
- Valves	01 - 62



01 - 47

ENGINE ASSEMBLY COMPLETE

ENGINE DISMANTLING AND REASSEMBLY (Continued) FLYWHEEL



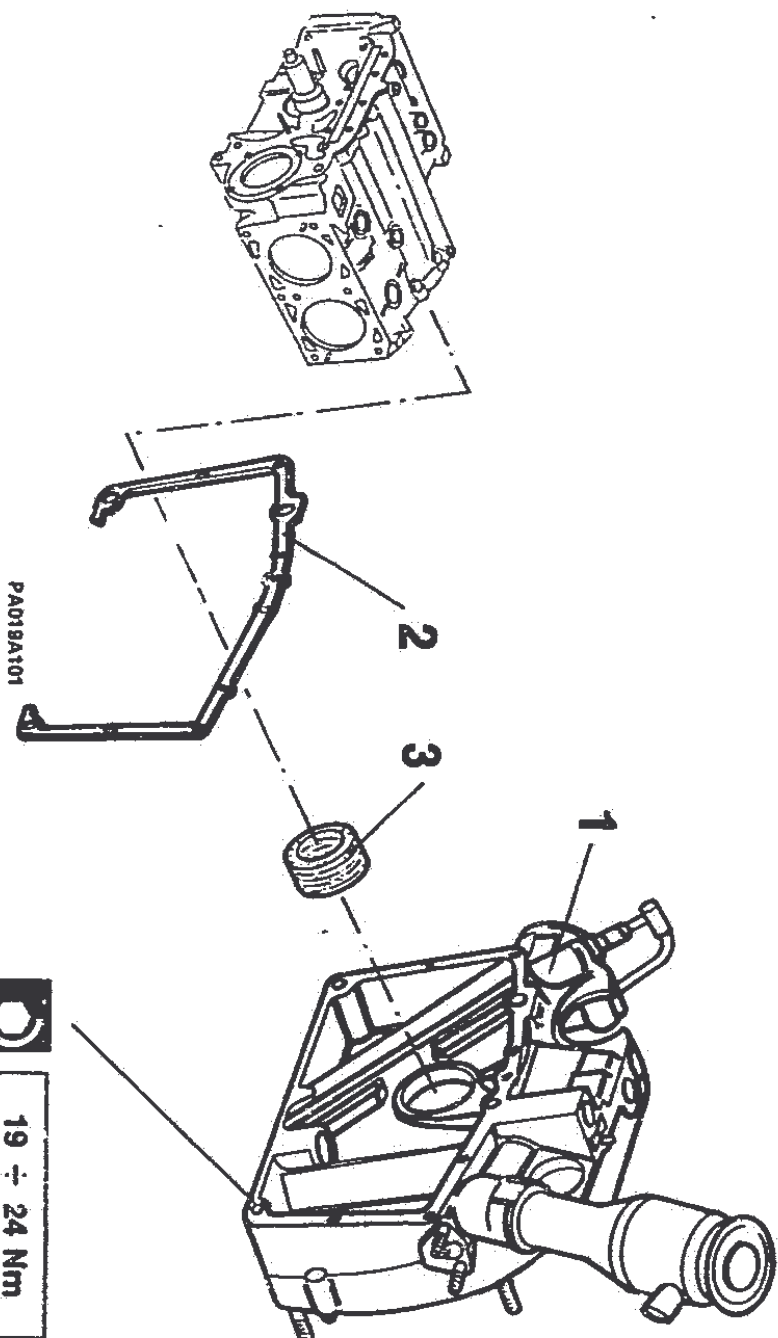
- After having first removed the crankshaft rotating tool used previously, lock the flywheel using special tool No. 1.820.059.000 (A.2.0378)
- Unscrew the bolts attaching the flywheel to the crankshaft.
 1. Remove the bolt retaining washer.
 2. Remove the flywheel.



01 - 48

ENGINE ASSEMBLY COMPLETE

ENGINE DISMANTLING AND REASSEMBLY (Continued) BLOCK END PLATE

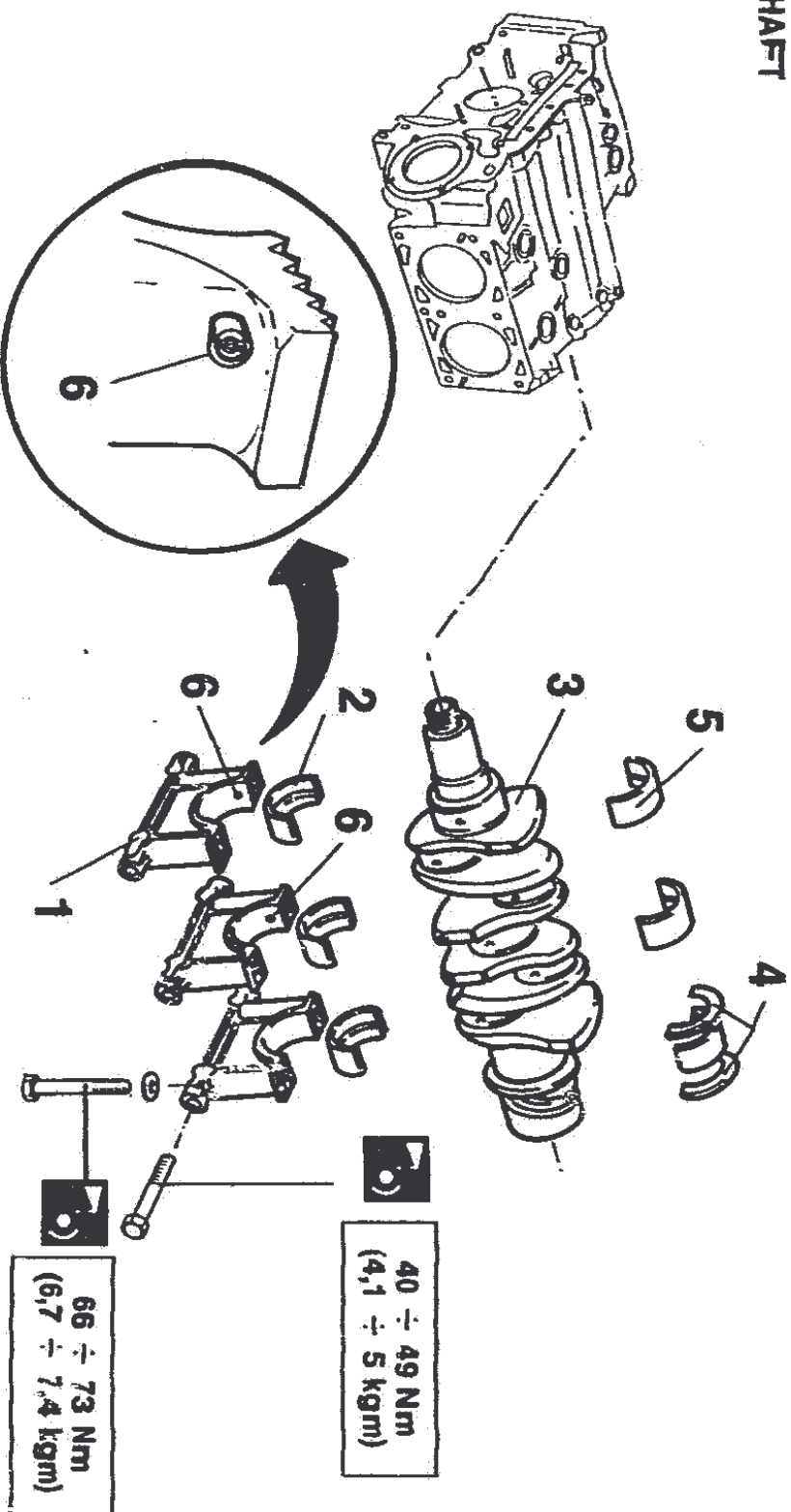


1. Undo the end plate screws and remove it.
2. Remove the gasket.

3. Extract the rear crankshaft oil seal (when reassembling, fit a new seal).

ENGINE DISMANTLING AND REASSEMBLY (Continued)

CRANKSHAFT



1. Unscrew the main bearing-cap retaining bolts and remove the caps.
2. Remove the lower main-bearing shells from the caps.
3. Remove the crankshaft from the block.
4. Remove the thrust half-washers.

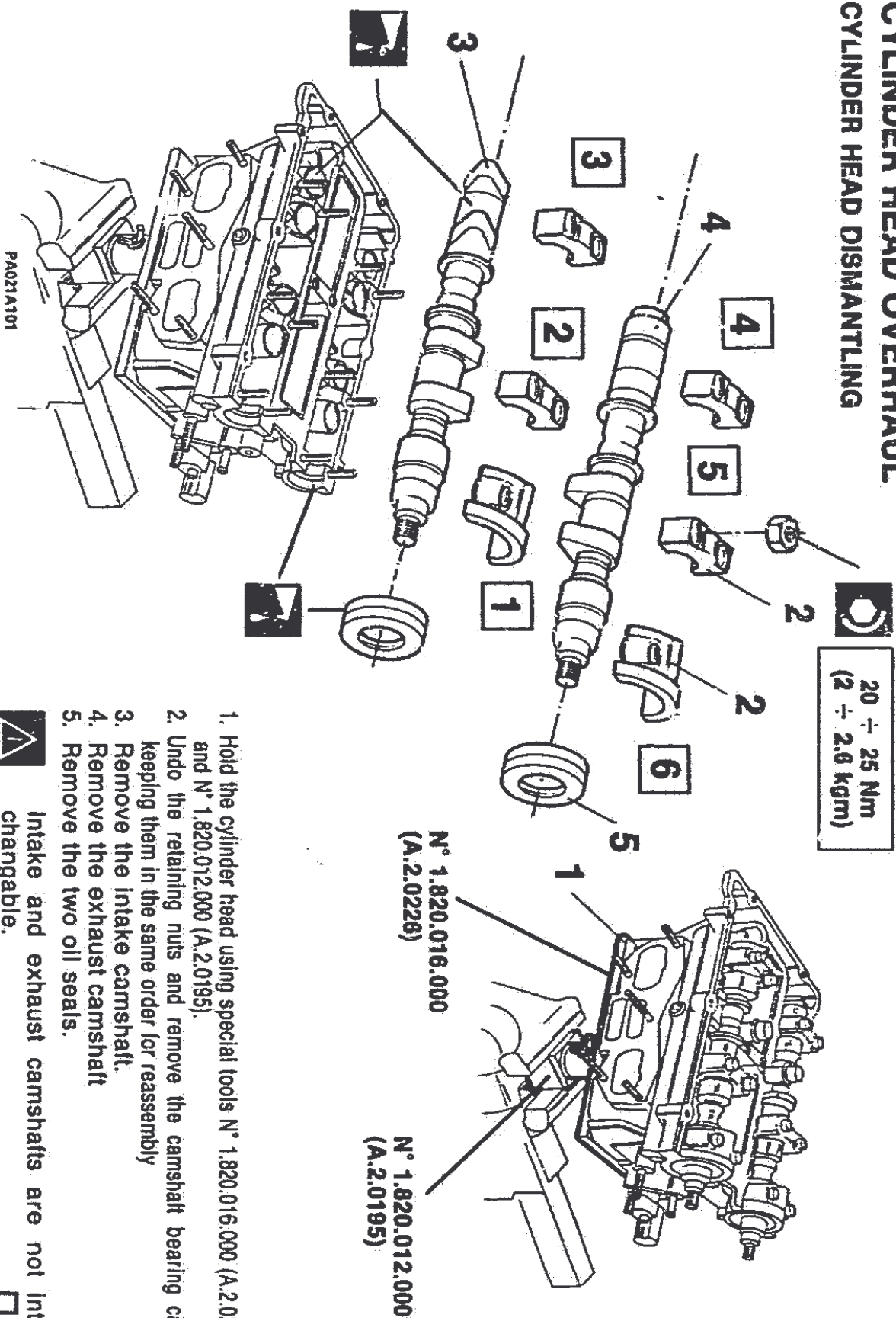
5. Remove the upper main-bearing shells.
 6. When reassembling make sure to replace the caps fitted with oil spray nozzles in their correct positions.
- NOTE** As the crankshaft is nitrided it cannot be ground.



01 - 50

ENGINE ASSEMBLY COMPLETE

CYLINDER HEAD OVERHAUL CYLINDER HEAD DISMANTLING



Intake and exhaust camshafts are not interchangeable.

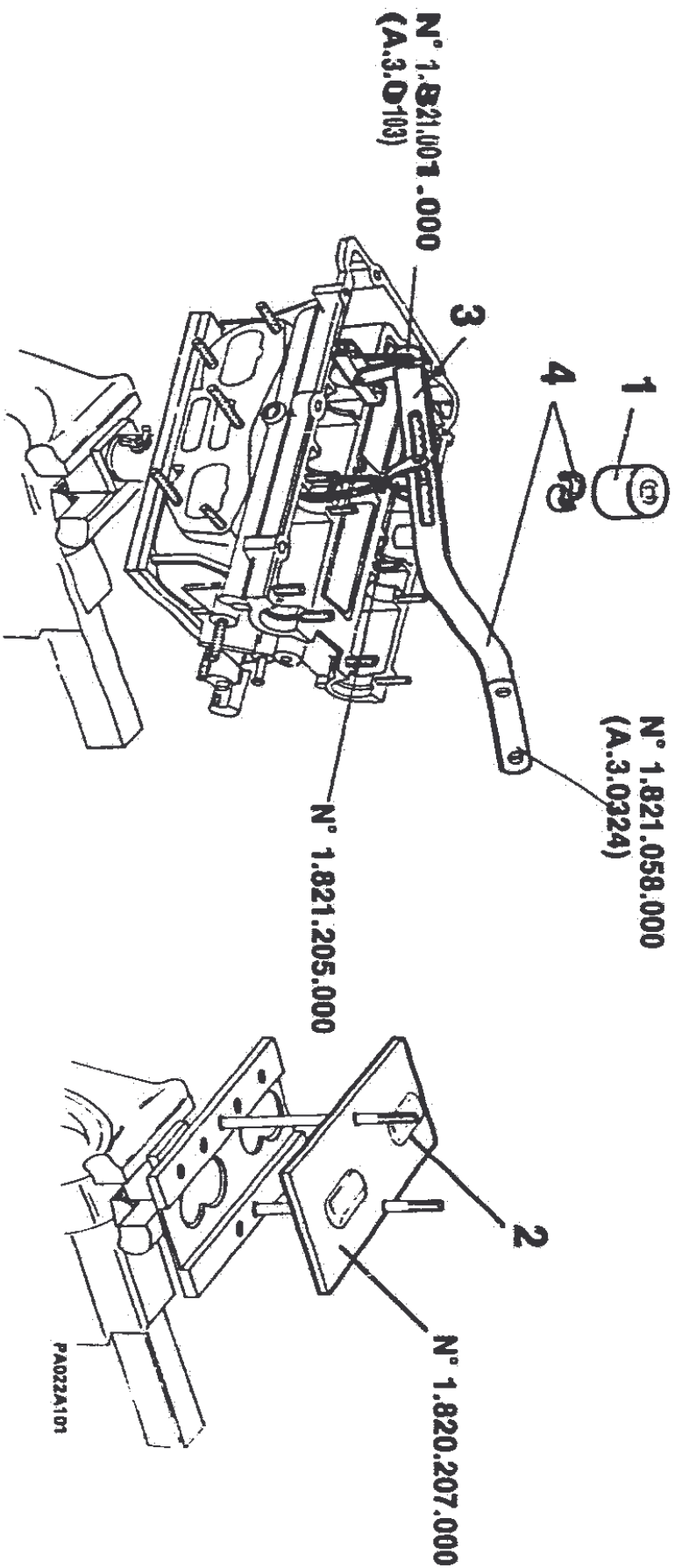




01 - 51

ENGINE ASSEMBLY COMPLETE

CYLINDER HEAD DISMANTLING (Continued)



1. Lift off the tappets and keep them in the same order for reassembly
2. Position special tool No. 1.820.207.000 between the cylinder head and the support.
3. Fit special tools No. 1.821.001.000 (A.3.0103), No. 1.821.058.000 (A.3.0324) and No. 1.821.205.000 to cylinder head.

4. Extract the half cotters from the valve stem while compressing the valve spring.
- Repeat this procedure for each valve.

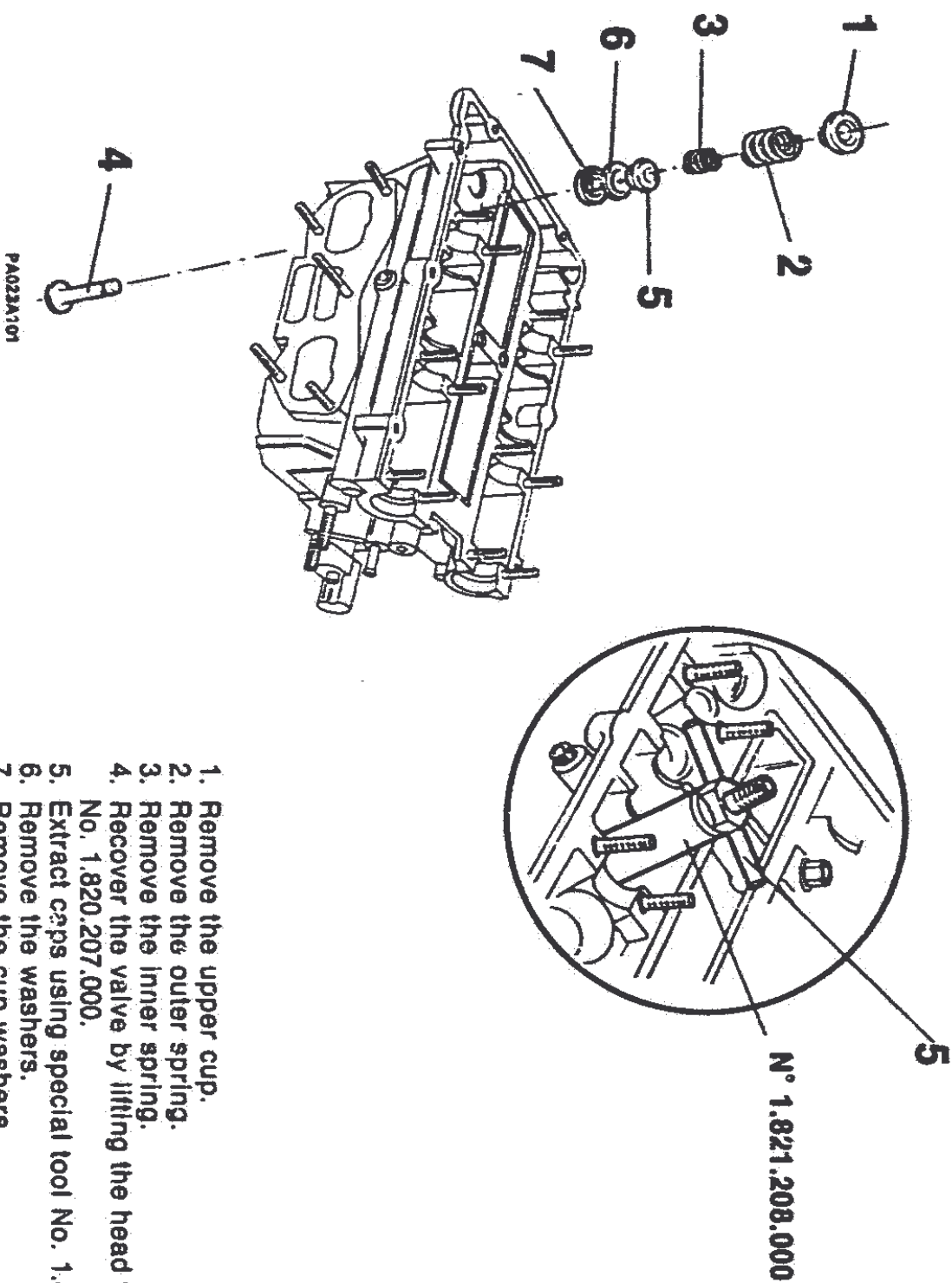




01 - 52

ENGINE ASSEMBLY COMPLETE

CYLINDER HEAD DISMANTLING (Continued)

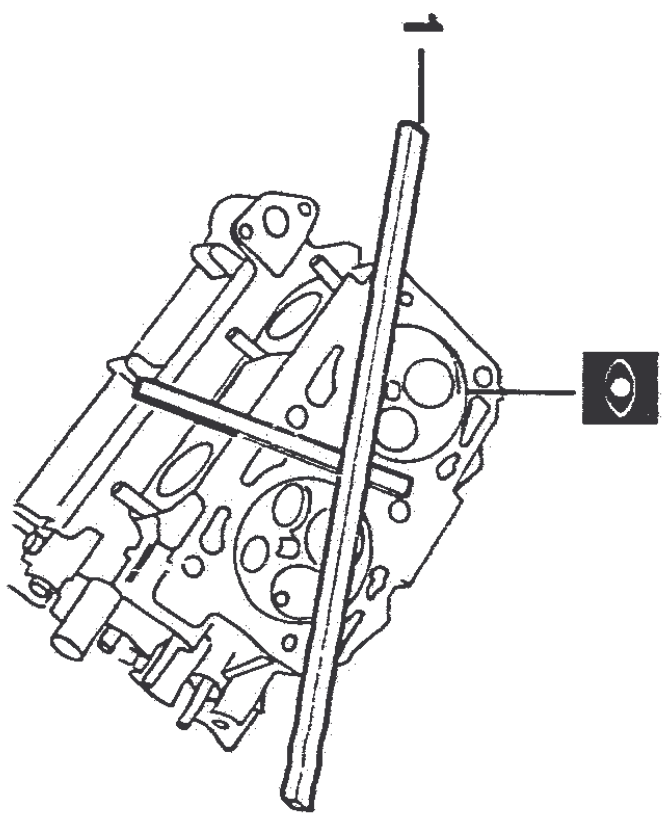
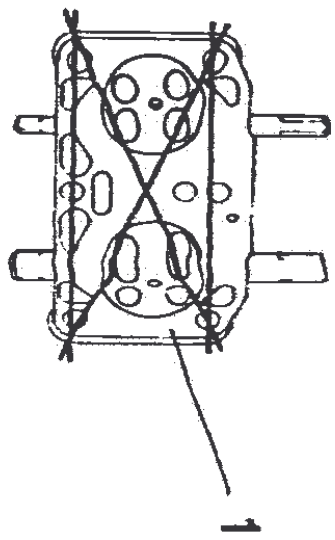




01 - 53

ENGINE ASSEMBLY COMPLETE

CYLINDER HEAD CHECKS Cylinder head joint face



- Examine the cylinder head for cracks and defects.
- 1. Check the cylinder head joint face for flatness, positioning the tool as shown in the picture.
- If the joint face is excessively distorted both heads must be skimmed.



Maximum flatness tolerance for cylinder head joint face	0,03 mm
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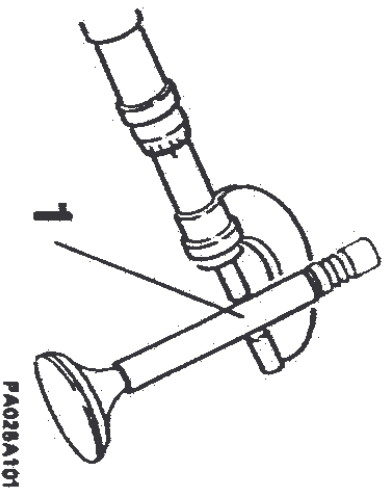
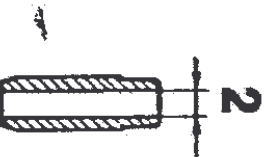
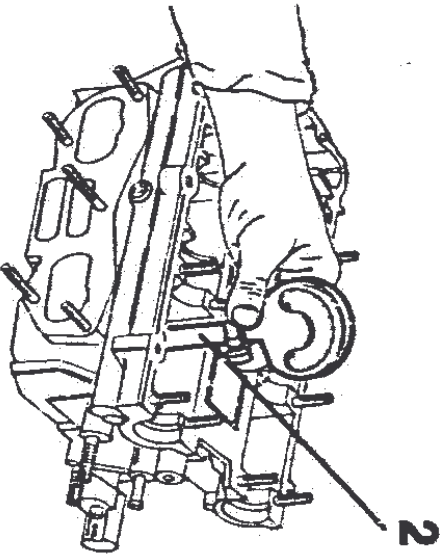
Maximum parallelism tolerance	0,05 mm
Surface finish allowed	1,6 x 10 ⁻³ mm



01 - 54

ENGINE ASSEMBLY COMPLETE

CYLINDER HEAD CHECKS (Continued) Valve guide clearance

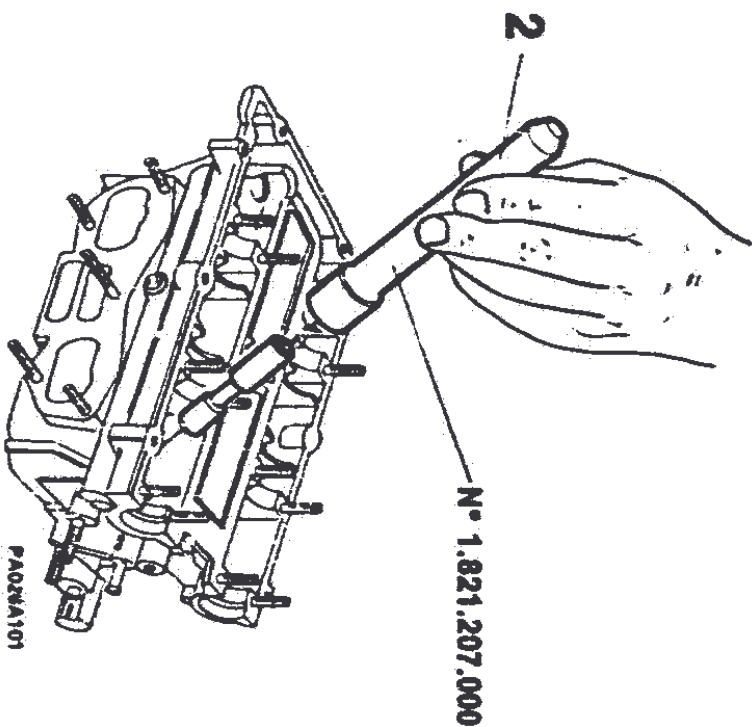
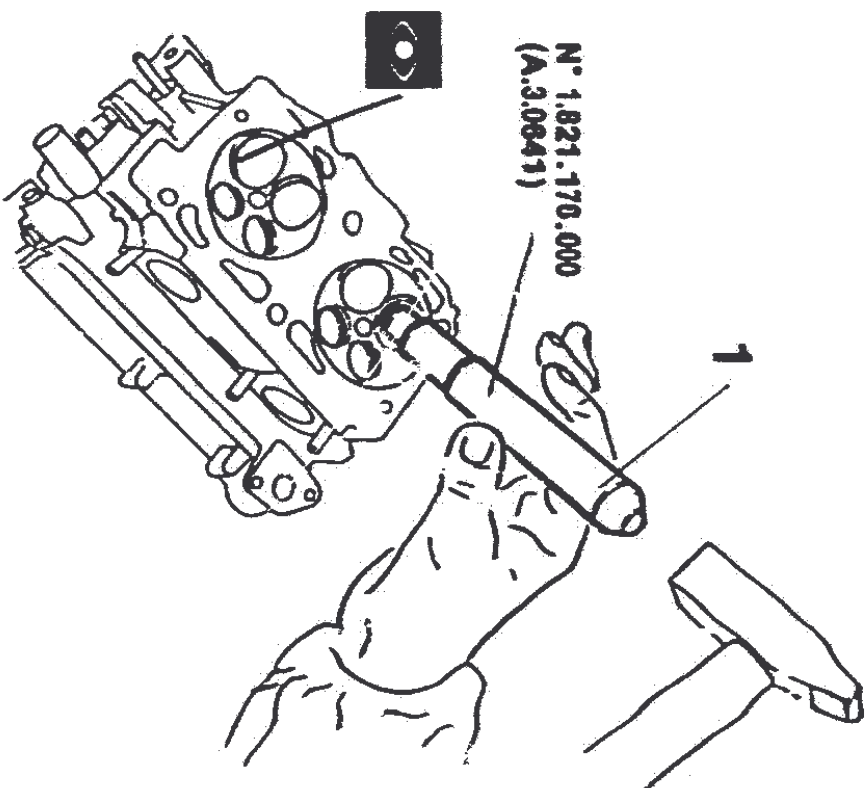


1. Take valve stem diameter measurements using a micrometer in three places and at right-angles to each other.
2. Measure valve guide inside diameter using a dial gauge.
3. Calculate the clearance by subtracting the maximum valve stem diameter from the valve guide inside diameter.



Radial clearance between guide and valve		
Intake	0,020 ÷ 0,185 mm	
Exhaust		

CYLINDER HEAD CHECKS (Continued) Valve guide substitution



1. Examine the valve guides for signs of scratches, grainy patches, distortion or movement in their housings.
1. If necessary extract the valve guides using the special tool No. 1.821.176.000 (A.3.0641).

2. Insert new valve guides using special tool No. 1.821.207.000. This tool ensures that the guides protrude above the lower cup washer seating face.



CYLINDER HEAD CHECKS (Continued)

Valve seats

- Make sure that the valve seats are free from scrapes, cracks or burn marks, and that they are correctly fitted in their housings in the cylinder head.
 - If necessary, mount the cylinder head in the special clamp and re-grind the valve seat faces using the appropriate tool.
- This operation can only be carried out if there is sufficient metal on the seat to allow the defects to be removed while maintaining the seat angles shown; if this is not the case the valve seats will have to be renewed.

- Regrind the valve seat contact face until wear marks are just eliminated, to seat angle:

	β	$90^\circ \pm 20'$
--	---------	--------------------

The regrinding limit is reached at point "a" on reference diameter \varnothing_a .



Reference diameter \varnothing_a	
Intake	31,0 mm
Exhaust	24,5 mm

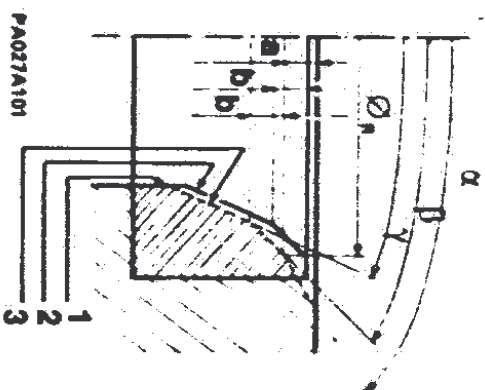


Level "a" regrind limit	
0,4 mm Intake	
1,1 mm exhaust	

- Grind the upper section of the valve seat up to reference diameter \varnothing_a reached in the previous operation, maintaining seat cone angle of α



α	150° Intake
	120° exhaust



1. Valve seat
2. Original profile
3. Profile after the max. number of regrinds





01 - 57

ENGINE ASSEMBLY COMPLETE

CYLINDER HEAD CHECKS Valve seats (Continued)

- Grind the inner band of the valve seat until height "b" of the valve contact face is reached, at seal angle γ

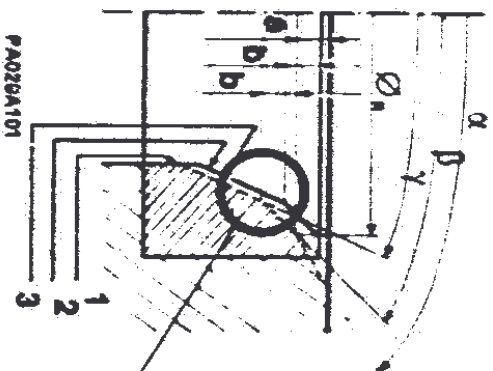


Inner band height	
Intake	0,9° mm
Exhaust	1,1 mm

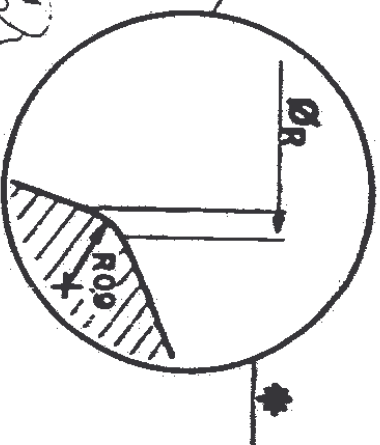


Lower valve seat grinding angle	
Intake	-
Exhaust	14°

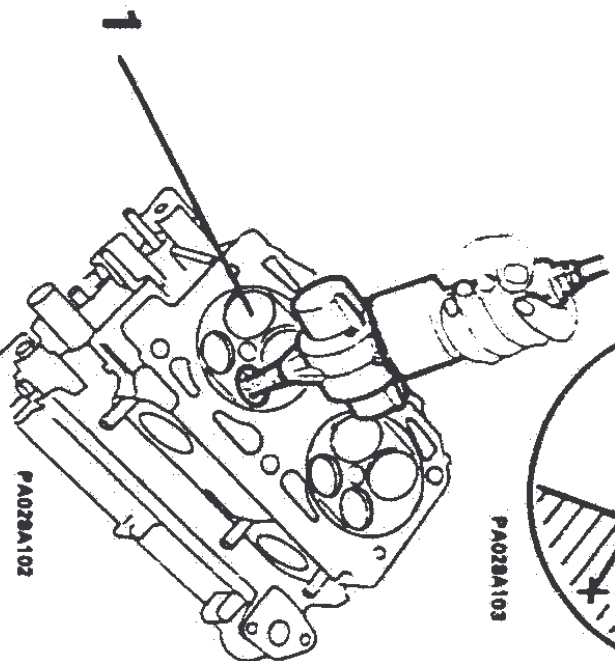
1. When the operation is finished, lap the valve seats.
For valve seat lapping, use the recommended grinding paste (SIPAL AREXONS CarboSilicium for Valves).



1. Valve seats
2. Original profile
3. Profile after the max. re-grind depth



PA02BA103



PA02BA102



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ENGINE ASSEMBLY COMPLETE

CYLINDER HEAD CHECKS (Continued)

Valve seat substitution and valve seat testing

- Remove the worn valve seats using the correct tool.
- Using a set of new valve seats make sure that the dimensions shown in the table are respected.

Valve	Engine
Valve seat out-side diameter mm	a. 34 $+0,118$ $+0,100$ mm b. 28 $+0,118$ $+0,098$ mm
Valve seat housing diameter mm	a. 34 $+0,028$ $+0$ mm b. 28 $+0,021$ $+0$ mm

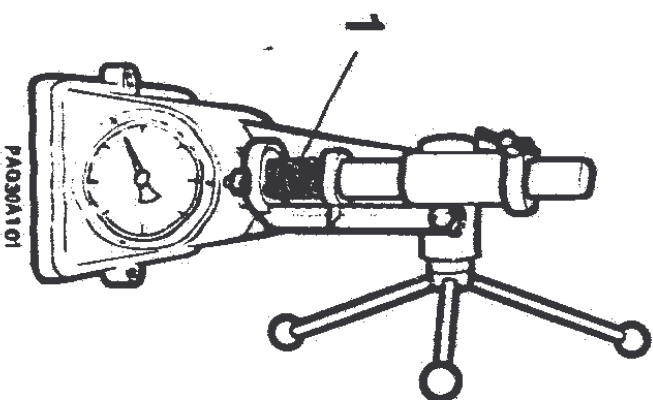
- a. = Intake valve
- b. = Exhaust valve

- Heat up the cylinder head in an oven to 140°C.
- Insert the new valve seats using the correct tool.

- When replacing the guides and after finishing and sanding the seats, the sealing of the valves should be checked with the spark plugs fitted and operating as follows:
- Mount the cylinder head on tool No. 1.820.012.000 (A.2.0195) with relative base No. 1.820.016.000 (A.2.0226) previously clamped in a vice.
- Fill the combustion chamber with petrol.
- Connect a low-pressure air supply to the intake passages and check for air bubbles in the petrol.
- Check the exhaust valves for sealing in the same way.
- If any air passage is noted, make sure that the valves fit perfectly in their seats and repeat the sealing test; if this is still negative, it will be necessary to carry out the lapping operation again

CYLINDER HEAD CHECKS (Continued)

Valve springs



Free spring length		
Outer spring	L _a	~ 51,8 mm
Inner spring	L _b	38 mm

Outside spring		
Spring length	mm	Test load N
Valve closed	32,5	215,740 ± 5,8
Valve open	22,9	349,312 ± 9,8

Inner spring		
Spring length	mm	Test load N
Valve closed	30,5	137,293 ± 3,922
Valve open	20,9	321,560 ± 8,82

Check the free length of the valve springs against the values shown.

The springs must be tested between parallel surfaces perpendicular to their axes with a maximum of 2° error.



1. Using a dynamometer, check the valve specifications against the values shown.



01 - 60

ENGINE ASSEMBLY COMPLETE

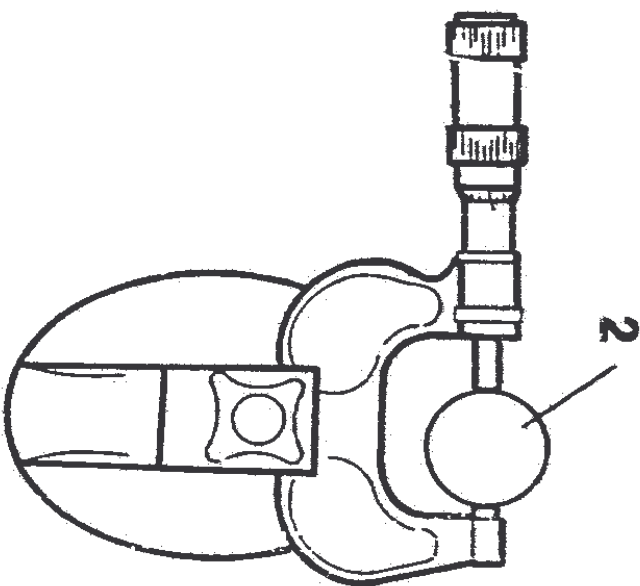
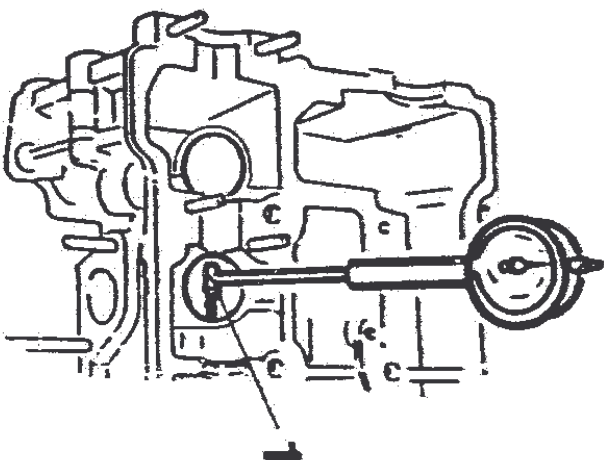
CYLINDER HEAD CHECKS (Continued) Tappets and seatings

Ø

Valve tappet seating diameter (Intake and exhaust)
33,000 + 33,625 mm

Ø

Valve tappet diameter (Intake and exhaust)
32,975 + 32,959 mm



1. Check tappet seating diameters against the values shown.

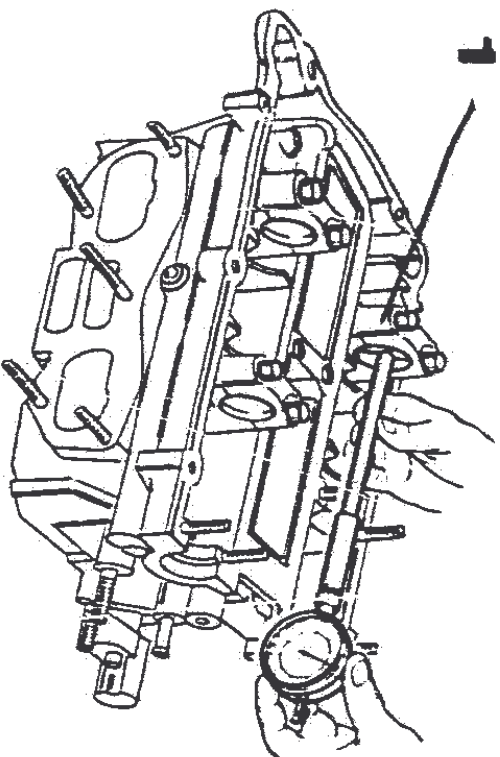
2. Check tappet outside diameters against the values shown.




01 - 61

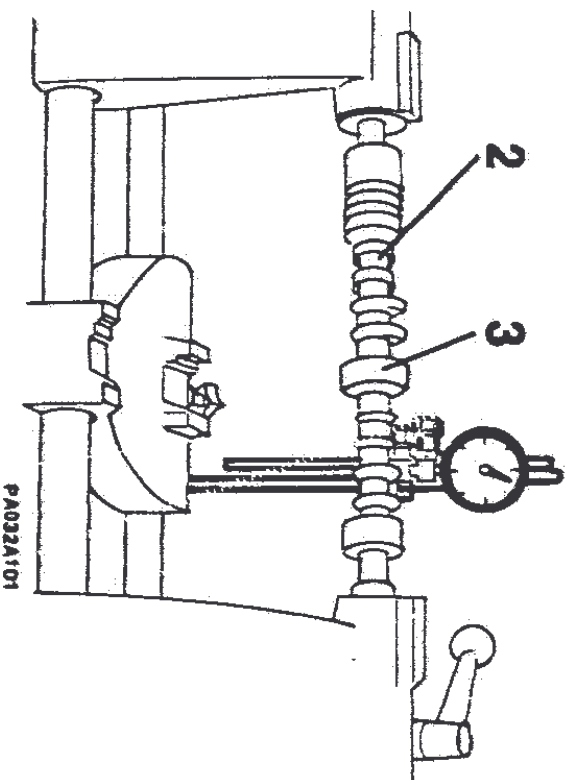
ENGINE ASSEMBLY COMPLETE

CYLINDER HEAD CHECKS (Continued) Cams,shafts and bearings



 Diameter of camshaft pins	26.959 - 26.980 mm
Outer camshaft pin	27.000 - 27.033 mm

1. Mount the camshaft bearing caps and tighten the oiled nuts to the correct torques, and check the bearing diameters against the values shown.



Minimum cam lift		
Intake	8,0 mm sealings	9,5 mm inner
Exhaust		9,2 mm

2. Check the camshaft journal diameters against the values shown.
3. Make sure that the cam lifts exceed the minimum values shown.

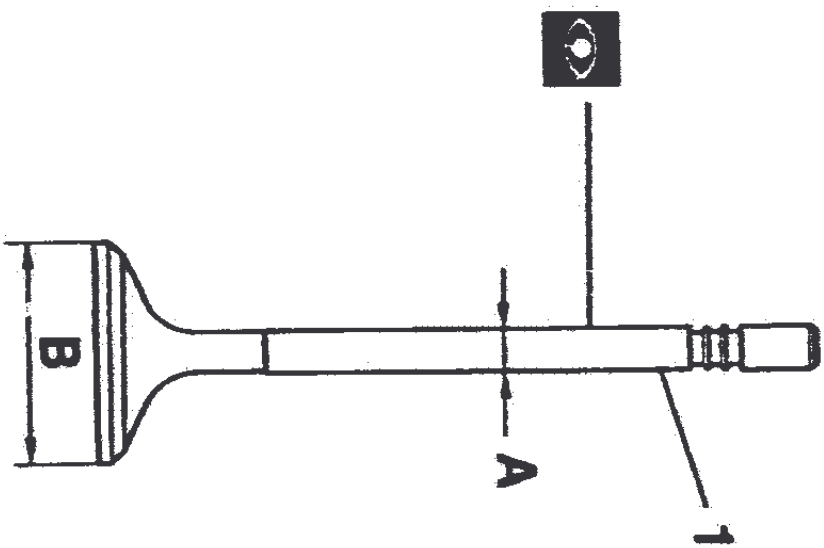


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ENGINE ASSEMBLY COMPLETE

CYLINDER HEAD CHECKS (Continued)

Valves



Ø

Valve stem diameter "A"	
Intake	6,965 + 0,08 mm
Exhaust	

Ø

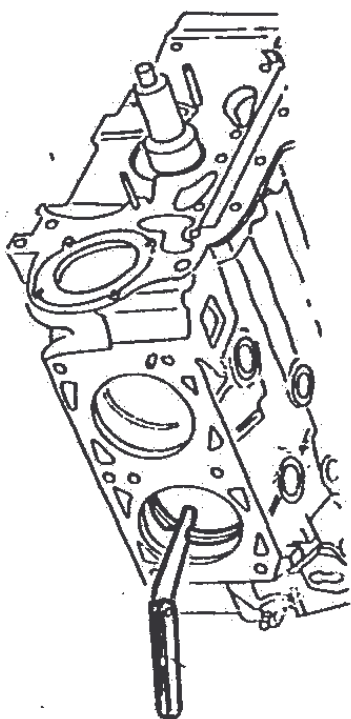
Valve head diameter "B"	
Intake	31,8 ÷ 32,0 mm
Exhaust	25,8 ÷ 26,0 mm

1. Check the valve stem and head diameters against the values shown.



01 - E

ENGINE ASSEMBLY COMPLETE



ELECTRONIC-INJECTION ENGINE (16 VALVES)

- BLOCK CHECKS

BLOCK CHECKS

CRANKSHAFT	01 - 63
- Main and big-end journals	01 - 63
MAIN AND CONNECTING HALF BEARING -	
THRUST RINGS	01 - 66
PISTONS AND GUDGEON PINS	01 - 67
COMPRESSION AND OIL	
SCRAPER RINGS	01 - 69
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PISTON AND CONNECTING ROD	
WEIGHT BALANCE	01 - 71
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CYLINDER LINER - PISTON MATCHING	01 - 75

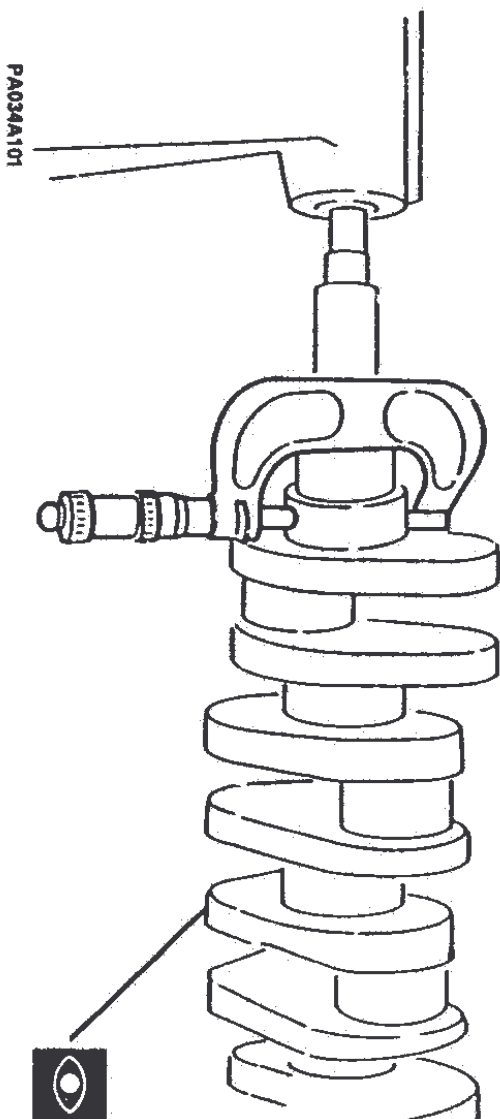
FLYWHEEL	01 - 76
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ENGINE ASSEMBLY COMPLETE

BLOCK CHECKS CRANKSHAFT Main and big-end journals



Main-bearing journal	blue	$59,944 \div 59,954 \text{ mm}$
	red	$59,954 \div 59,964 \text{ mm}$
Big-end journal	blue	$49,984 \div 49,992 \text{ mm}$
	red	$49,992 \div 50,000 \text{ mm}$

NOTE The crankshafts for this engine are nitrided and therefore cannot be reground; in the case of excessive wear, the crankshaft must be substituted.

- The crankshaft journals are divided into two classes, identified with blue or red marks according to the machining tolerances.
- Check main-bearing and big-end bearing crankshaft journal diameters against the values shown



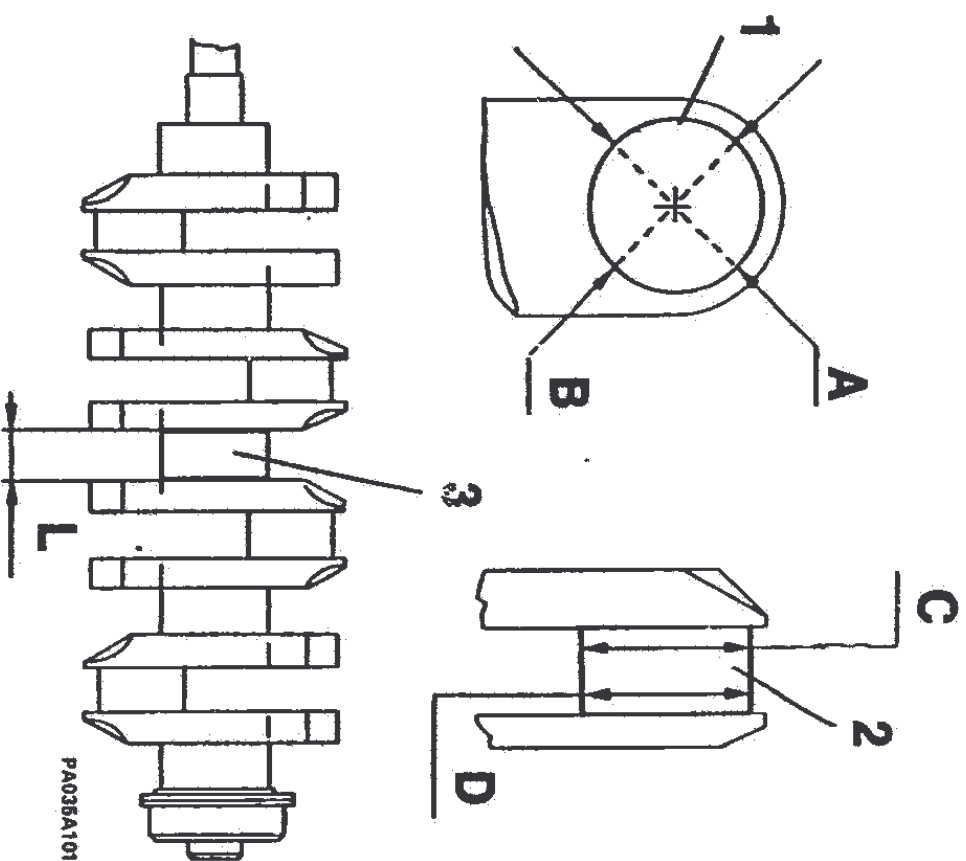


01 - 64

ENGINE ASSEMBLY COMPLETE

CRANKSHAFT

Main and big-end journals (continued)



Maximum journal ovality tolerance

A-B = 0,02 mm



Maximum journal taper tolerance

C-D = 0,02 mm



Centre main-bearing journal length

$L = 26,16 \div 26,96$ mm

1. Check journal ovality measurements against values shown.
2. Check journal taper against tolerances shown.

3. Check centre journal length against dimensions shown.





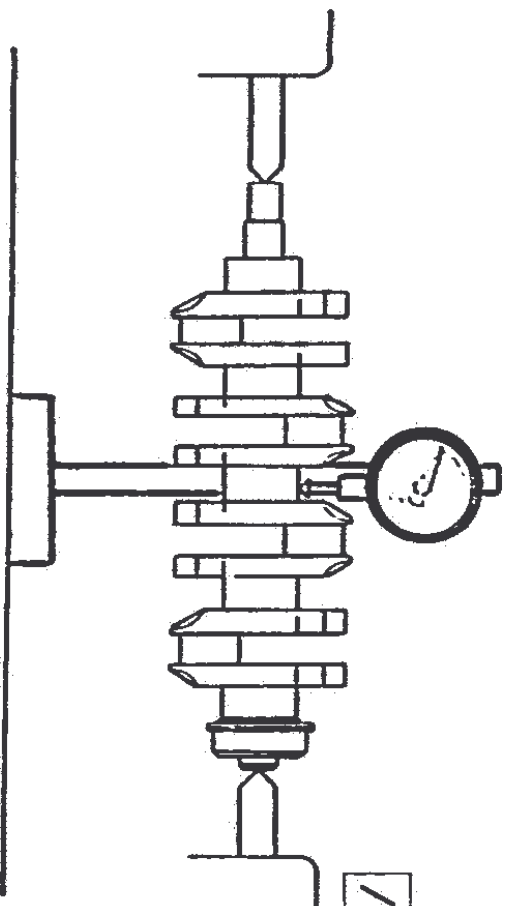


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ENGINE ASSEMBLY COMPLETE

CRANKSHAFT

Main and Big-end Journals (continued)

	Maximum eccentricity between main journals	0,02 mm
	Maximum deviation from parallel between big-end and main journals	0,015 mm
	Maximum deviation in axes between the two pairs of big-end journals and the main journals	0,25 mm

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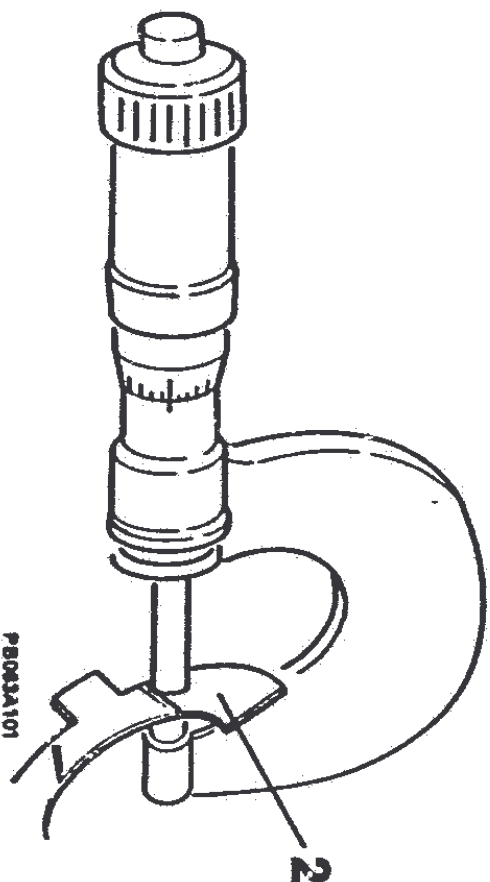
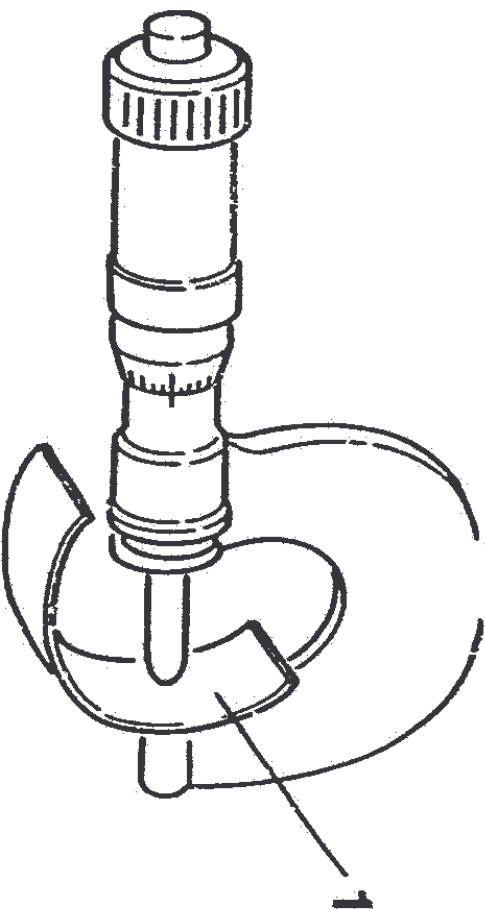
- Make sure that:
- the eccentricity between main-bearing journals;
- the parallelism between main and big-end bearing journals;
- the shift in axes between the two pairs of big-end journals and the main journals fall within the limits shown.



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ENGINE ASSEMBLY COMPLETE

MAIN AND CONNECTING HALF BEARINGS - THRUST RINGS



Class		Half bearing thickness
Red	Main	1.832 to 1.838 mm
	Big end	1.828 to 1.832 mm
Blue	Main	1.838 to 1.842 mm
	Big end	1.830 to 1.836 mm

Half thrust ring thickness	2.311 to 2.362 mm
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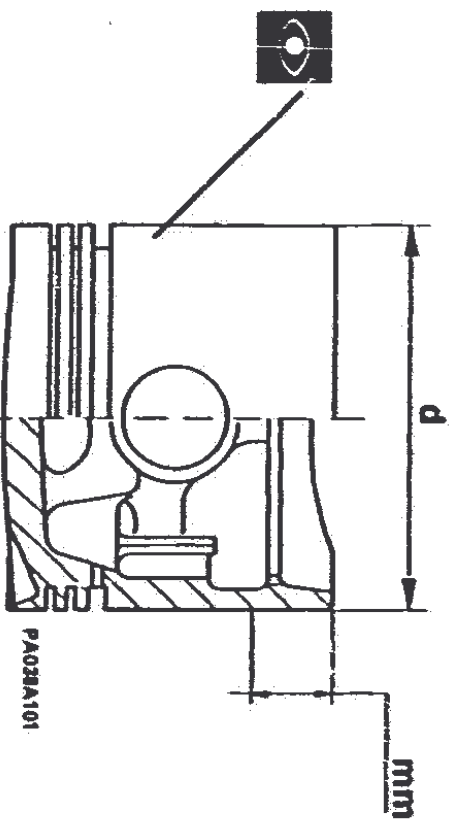
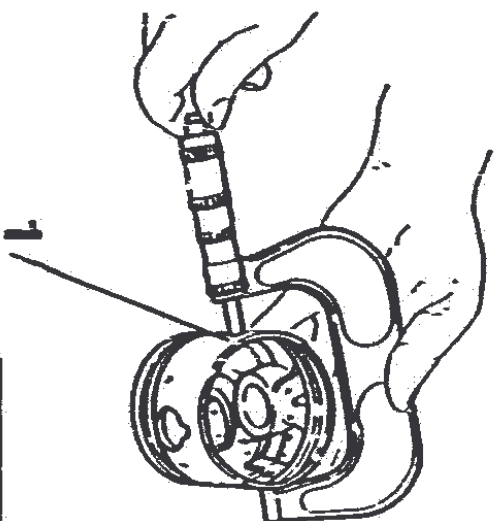
1. The coupling between main and big end half bearings and crankshaft must be carried out by matching parts of the same class which are tagged on the half bearing side end on the corresponding journal with the same RED or BLUE coloured mark.
2. Check that the half bearing thickness ranges within the specified values.
3. Check that the half thrust ring thickness ranges within the specified values.



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ENGINE ASSEMBLY COMPLETE

PISTONS AND GUDGEON PINS



Units: mm

Outside diameter (d)	PISTON MONDIAL		PISTON BORG	
	Class A (Blue)	86,950 ÷ 86,960	86,960 ÷ 86,970	
	Class B (Pink)	86,960 ÷ 86,970	86,970 ÷ 86,980	
	Class C (Green)	86,970 ÷ 86,980	86,980 ÷ 86,990	
	Class D (Yellow)	86,980 ÷ 86,990	86,990 ÷ 87,000	
	Class E (White)	86,990 ÷ 87,000	87,000 ÷ 87,010	

The pistons like the cylinder liners have been divided in to five classes depending of the manufacturing tollerances. These classes, identified by the letters A, B, C, D and E, are marked by blobs of BLUE, PINK, GREEN, YELLOW or WHITE paint on the piston ceiling.

1. Check that the piston outside diameter falls into the dimensions shown.

NOTE This diameter must be measured at right angles to the gudgeon pin axis, and at 11,5 mm and 13,9 mm from the piston skirt for the Borgo and Mondial versions respectively.

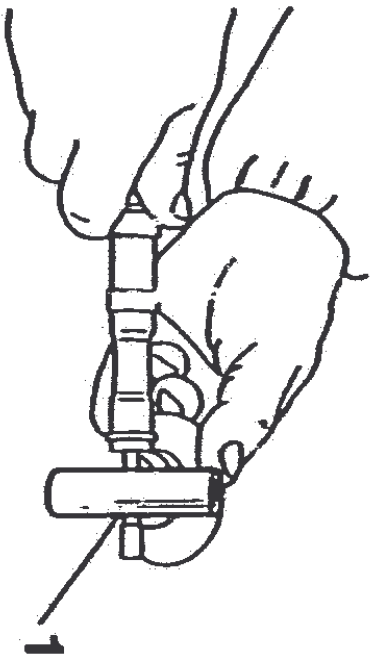




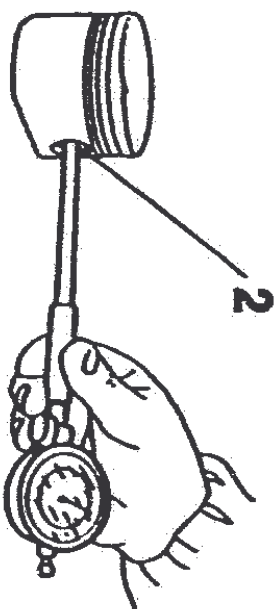
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ENGINE ASSEMBLY COMPLETE

PISTONS AND GUDGEON PINS (Continued)



\varnothing	Gudgeon pin outside diameter	20,998 ÷ 21,000 mm
---------------	------------------------------	--------------------



\varnothing	Gudgeon pin hole diameter	21,004 ÷ 21,008 mm
---------------	---------------------------	--------------------

1. Check the gudgeon pin outside diameter against the dimensions shown.

2. Check the diameter of the gudgeon pin hole in the piston against the dimensions shown.

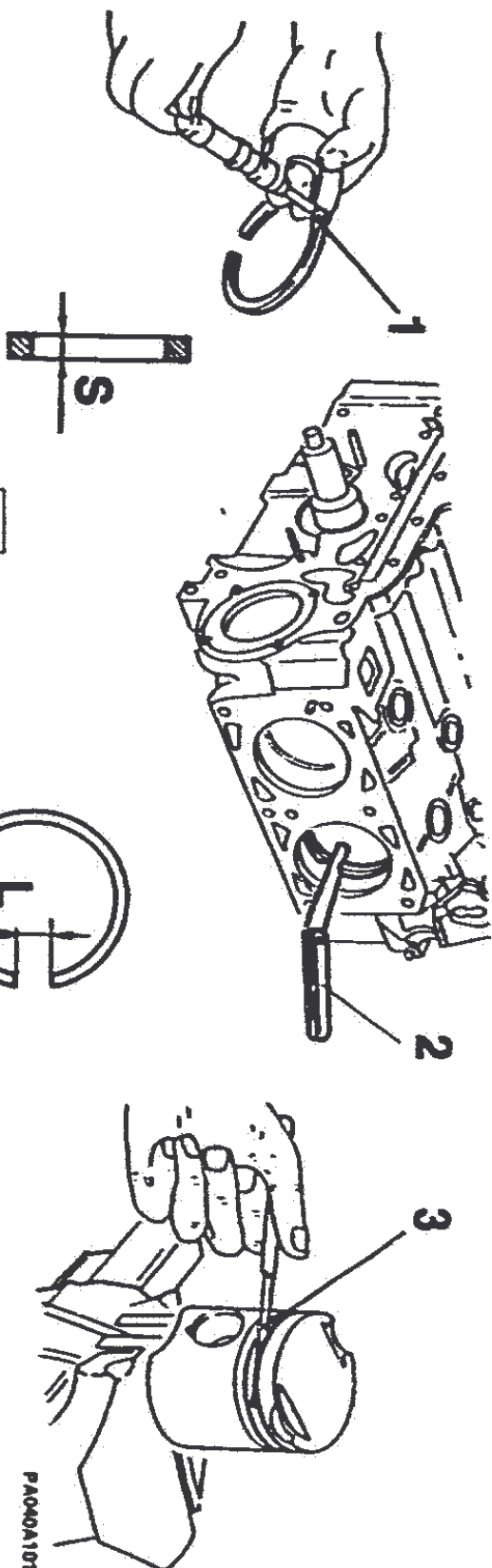
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ENGINE ASSEMBLY COMPLETE

COMPRESSION AND OIL SCRAPER RINGS



Units: mm

	Thickness "S"	Gap "L"	Ring end float
Compression ring	1,478 + 1,480	0,30 + 0,50	0,045 + 0,077
Oil control ring	1,728 + 1,740	0,30 + 0,50	0,035 + 0,067
Oil scraper ring	2,978 + 2,990	0,25 + 0,50	0,025 + 0,057

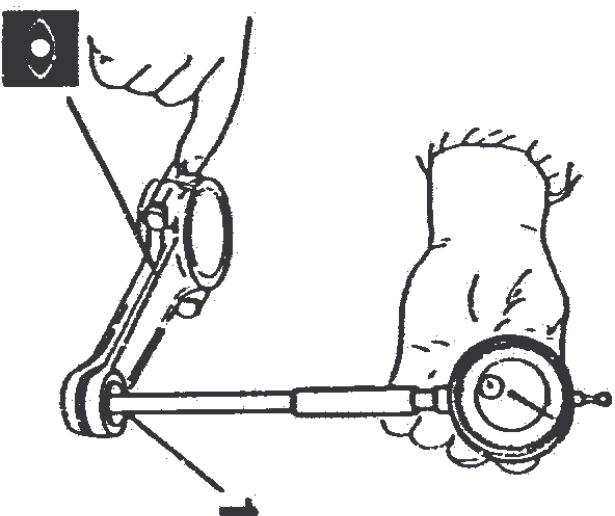
1. Check the thickness S of the compression and oil-scraper rings against the dimensions shown.
2. Fit the rings inside the appropriate test tool or in the engine cylinders, and check gap L against the values shown.
3. Check that the end float values for the rings in their slots fall within the figures shown.



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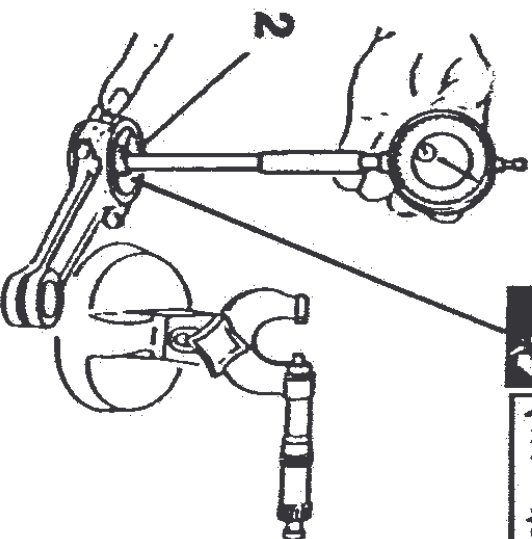
ENGINE ASSEMBLY COMPLETE

CONNECTING RODS



Small-end bush bore

21,007 ÷ 21,015 mm

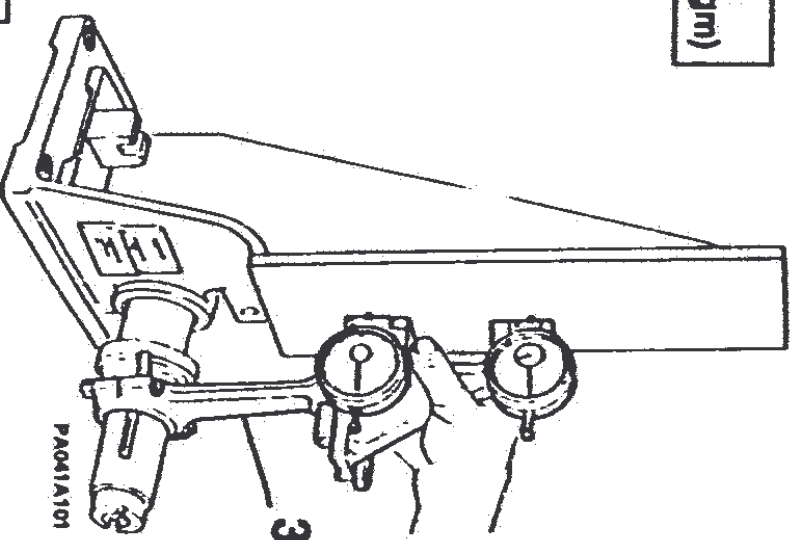


**Big-end bearing
inside diameter**

53,696 ÷ 53,708 mm



**43 + 48 Nm
(4,4 + 4,9 kgm)**



1. Check that the small-end bore is within the limits shown.

2. Mount the big-end bearing caps on the connecting rod and tighten the well-oiled nuts to the correct torque value shown. Check that the big-end bearing diameter falls within the limits shown.

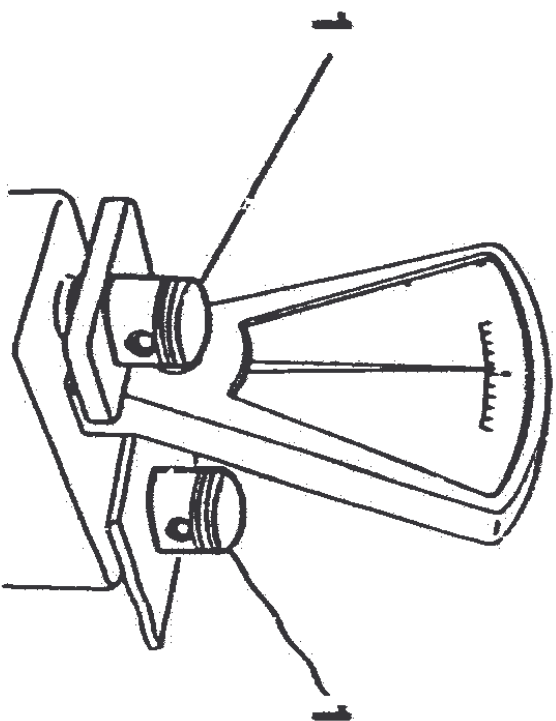
3. Check the connecting rods for trueness.



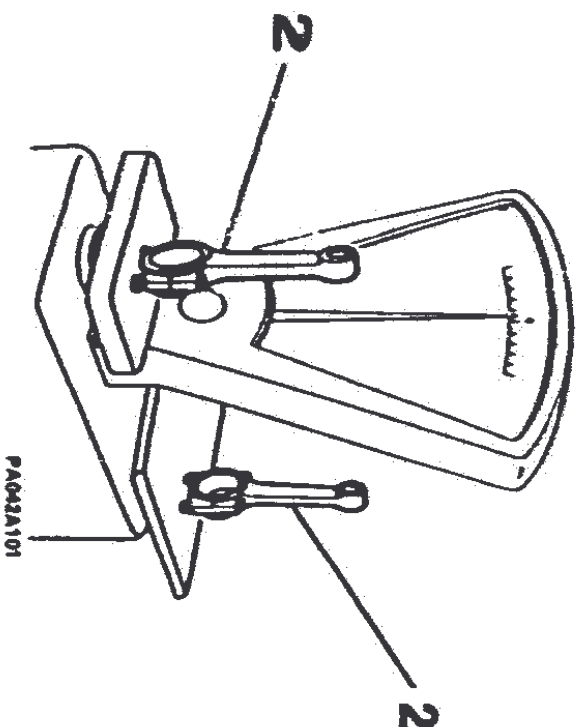
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ENGINE ASSEMBLY COMPLETE

PISTON AND CONNECTING ROD WEIGHT BALANCE



Differenza di peso tra i pistoni ≤ 2 grammi



Connecting rod weight difference ≤ 2 grammi

- Mate the gudgeon pins to the pistons according to their size class code (BLACK or WHITE). Insert the gudgeon pins in the pistons and retain them with the circlips; fit the compression and oil rings.
- 1. Ensure that the difference in weight between pistons falls within the limits shown.

- 2. In the same way, check that the difference in weight between the connecting rods complete with big-end caps and nuts falls inside the limits shown.



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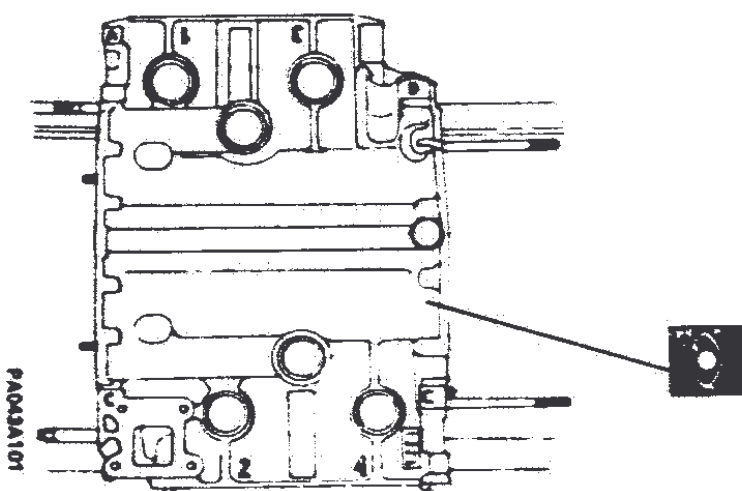
ENGINE ASSEMBLY COMPLETE

BLOCK

- Examine the engine block for cracks or signs of wear on the bearing surfaces.
- Check the surface finish of the cylinder bores.

Cylinder bore maximum surface roughness	$(0,5 \div 1) \times 10^{-4}$ mm
---	----------------------------------

- Identify the cylinder bore class and proceed with dimensional checks.
The cylinder liners are divided into five bore classes, A, B, C, D and E, which is stamped on the top of the block next to each cylinder.



- For the dimensions relative to each class, see "Technical Specifications and Notes".





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ENGINE ASSEMBLY COMPLETE

BLOCK (Continued)

1. Reset the cylinder gauge using a micrometer.
2. At the depth indicated, measure the diameter value and check that the taper and ovalization of the cams is within the specified limits.



Maximum cylinder taper

A-B = 0,02 mm



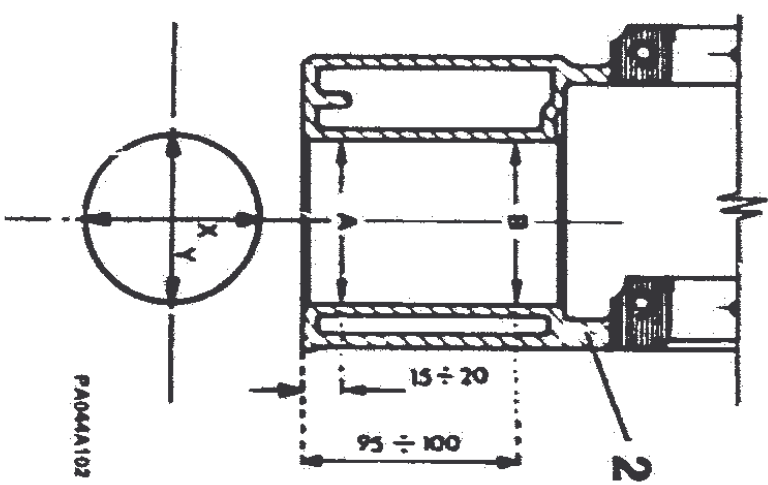
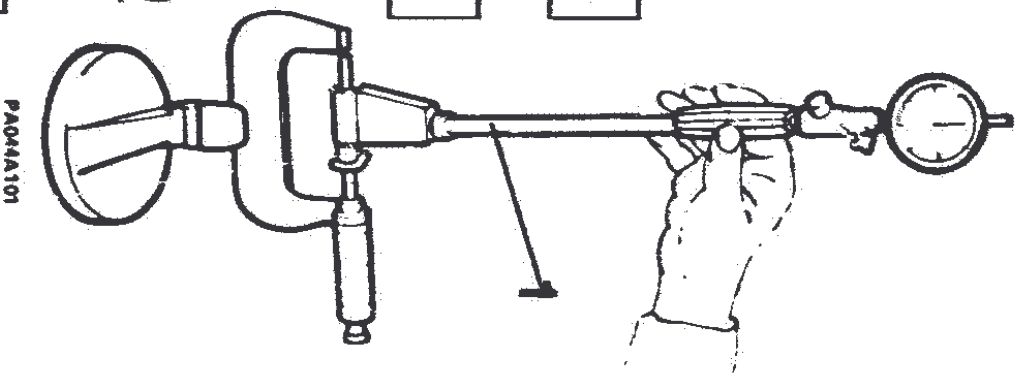
Maximum cylinder ovality

X-Y = 0,02 mm

- Compare the values measured D with the normal values C corresponding to each cylinder class, and calculate the value of maximum cylinder wear.

Maximum cylinder wear

D-C = 0,04 mm





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ENGINE ASSEMBLY COMPLETE

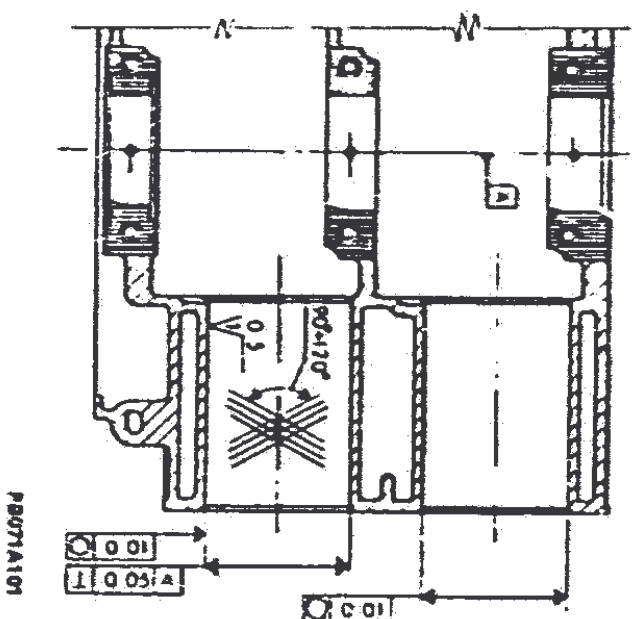
BLOCK (Continued)

- If dimensions are found to be out of tolerance, the cylinders will have to be re-bored, bearing in mind that three piston oversizes are available; re-bore diameters are listed in "Technical Specifications and Notes".
- Install the main caps on the engine block and tighten the screws to the correct torque.
- Re-bore the cylinders to the sizes shown in "Technical Specifications and Notes".



Honing marks on the bores after the operation must form a diamond pattern with intersection angles of $90^\circ \div 120^\circ$.

- If bore wear is found to be within limits but the pistons and rings have to be changed for other reasons, bore honing must however be carried out; in this event bore diameter must be measured and the new bore class defined (independent from the class code stamped on the block) for piston mating purposes.
If cylinder bore is no longer identified by the letter stamped on the block following honing operations, the code letter must be cancelled in order to avoid any errors in subsequent selections.





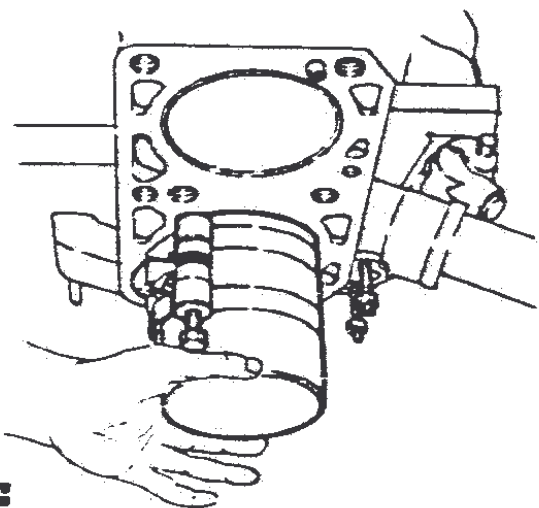
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ENGINE ASSEMBLY COMPLETE

CYLINDER LINER - PISTON MATCHING

- Cylinder - piston set selection is carried out by matching each cylinder liner code letter (stamped on the top of the block) with pistons having the same letter stamped on the crown, or the corresponding color code (shown in the table).

Code letter Ø liner	Piston code letter and color
A	A - blue
B	B - pink
C	C - green
D	D - yellow
E	E - white



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If the code letter on the block has been cancelled, selection is made on the basis of the letter on the piston to be substituted; in such a case it is however advisable to measure the bore diameter.

- For re-bored cylinders, matching pistons complete with rings are available in oversizes of 0,2 - 0,4 and 0,6 mm, corresponding to the oversize liner.



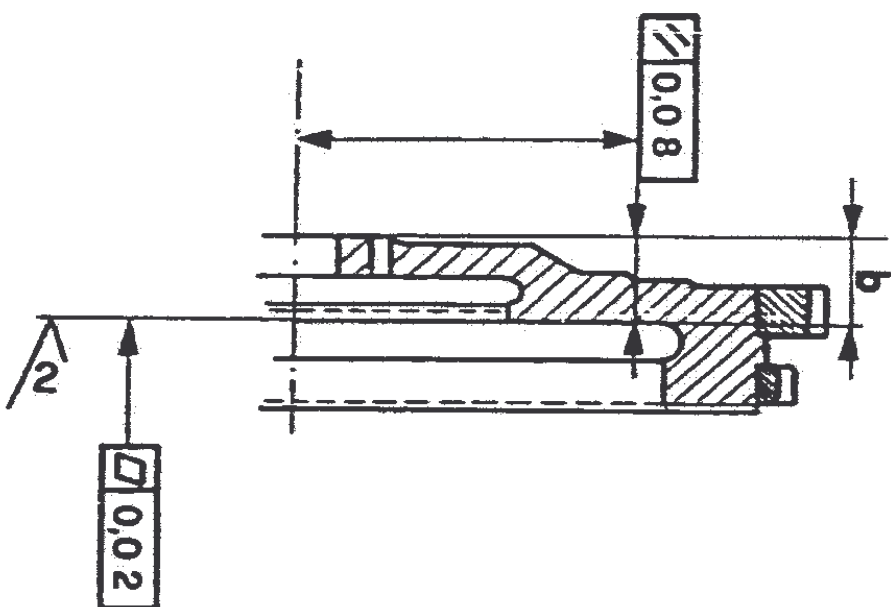
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ENGINE ASSEMBLY COMPLETE

FLYWHEEL

- Check the gear-ring teeth for chips and signs of wear from poor meshing. If present, the flywheel must be substituted.
 - Check the surface on which the clutch driven-plate operates for cuts, pitting or signs of overheating. It is first advisable to ensure that the clutch face has not already been skimmed, and that there is sufficient material to eliminate any defects.
- To this end, make sure that the thickness "B" shown in the drawing exceeds the limit in the table, and that the excess metal is sufficient to allow correction.

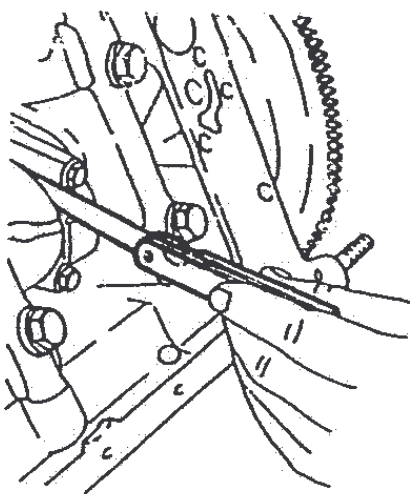
REFERENCE THICKNESS
$B \geq 21,15$





01 - F

ENGINE ASSEMBLY COMPLETE



ELECTRONIC-INJECTION ENGINE (16 VALVES)

- ENGINE REASSEMBLY

ENGINE REASSEMBLY

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ENGINE ASSEMBLY COMPLETE

ENGINE REASSEMBLY

NOTES ON REASSEMBLY

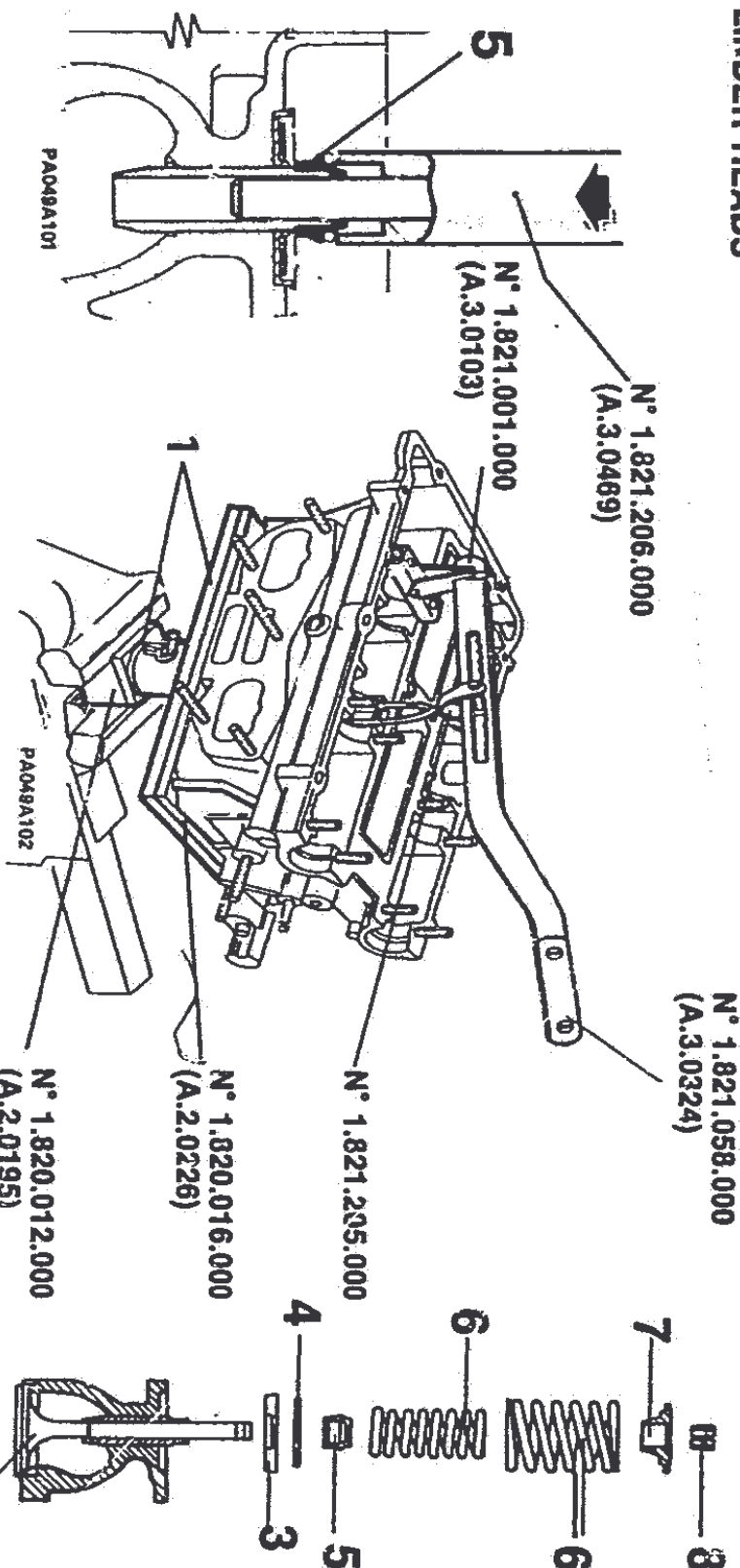
- Lubricate all bearings and running surfaces with engine oil before reassembling.
- Use only new gaskets, oil seals and circlips.
- Tighten bolts and nuts to the correct torque values specified.
- Apply the sealing compounds specified to the following components:
 - Oil sump gasket, block side.
Mastic category 3522-00040 DOW CORNING Silastick 732 RTV
 - Cylinder head and block waterway plugs.
Mastic category 3524 - 00011 LOCTITE 601 (green)
Before applying sealing compounds, remove all traces of the old compound and degrease the surfaces.



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ENGINE ASSEMBLY COMPLETE

CYLINDER HEADS

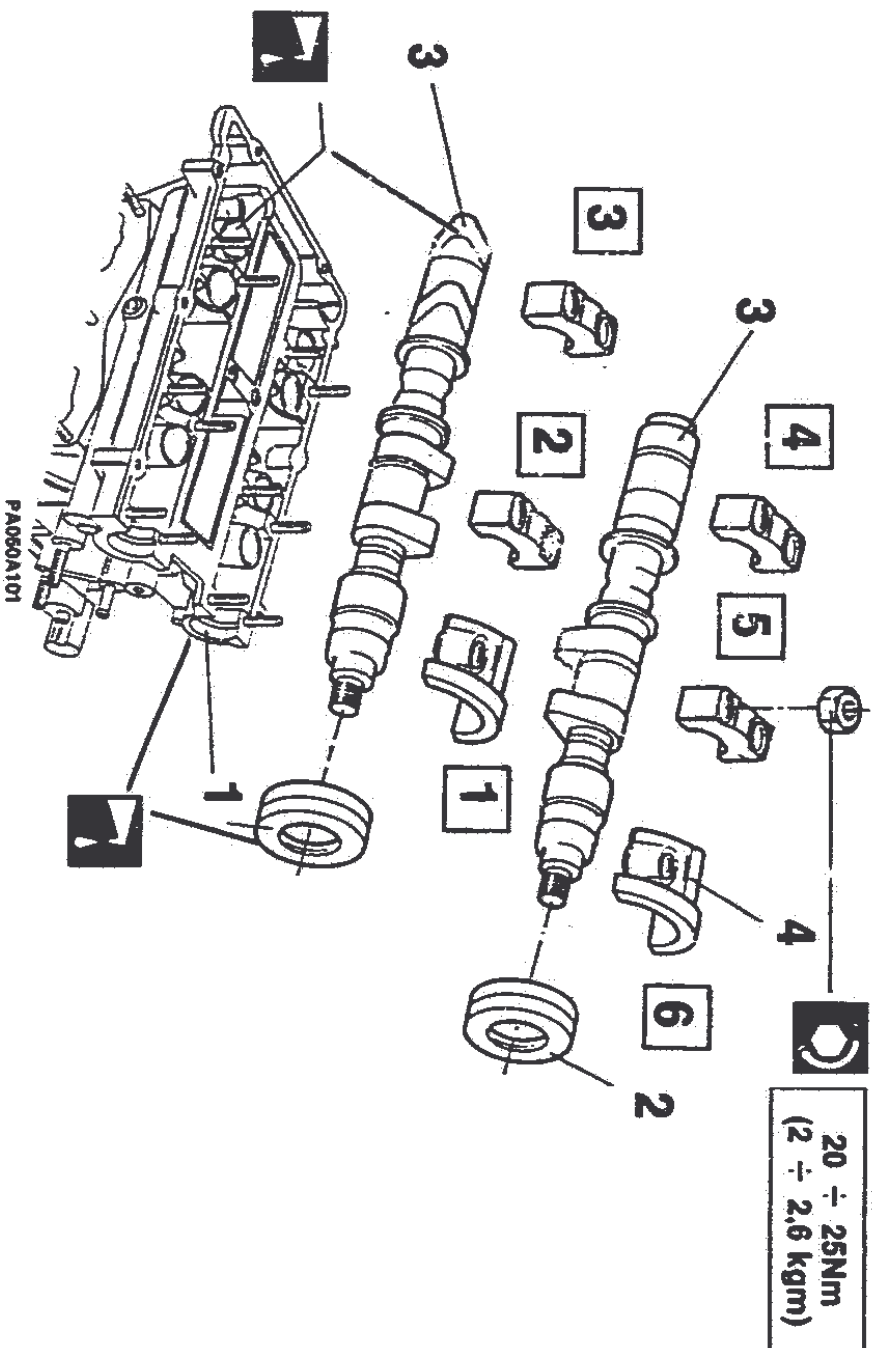




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ENGINE ASSEMBLY COMPLETE

CYLINDER HEADS (Continued)



1. Fit the tappets in their housings.
2. Fit the camshaft oil seals.
3. Place the intake and exhaust camshafts in their correct positions.

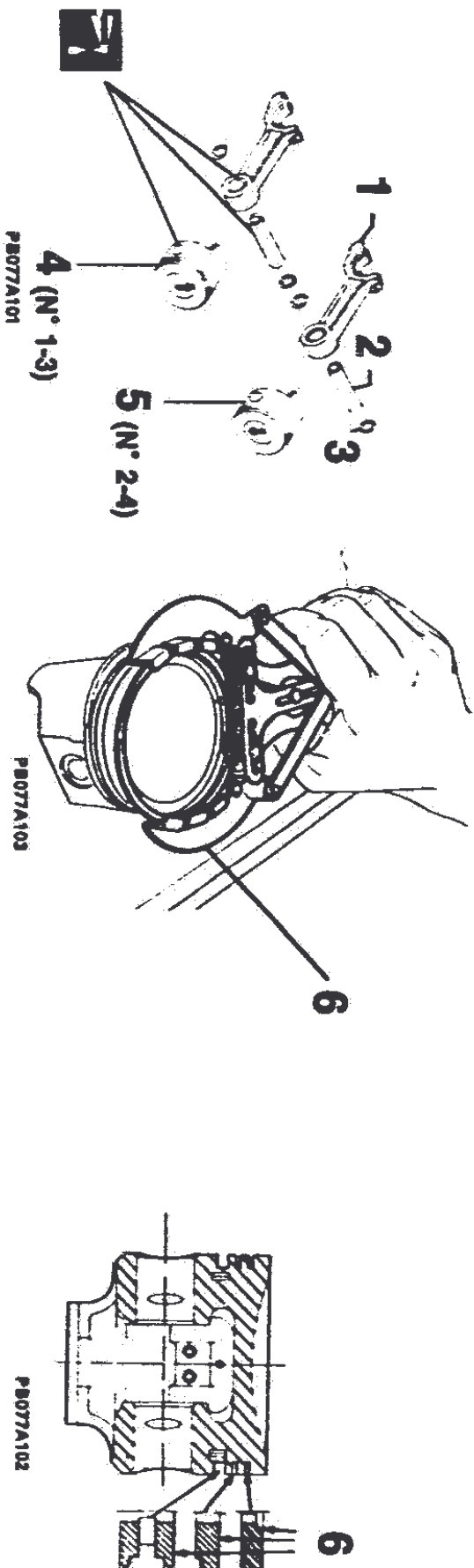
4. Attach the camshaft bearing caps and tighten the nuts.
The intake and exhaust camshafts are not interchangeable.



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ENGINE ASSEMBLY COMPLETE

PISTONS AND CONNECTING RODS



Clearance between liner and piston		
Normal	0.04 to 0.06 (*)	0.03 to 0.05 (**)
Overize	0.04 to 0.06 (*)	0.03 to 0.05 (**)

(*) Pistone Mondial (**) Pistone Borgo

- Choose the pistons as specified in "Coupling cylinder liners and pistons".

1. Place the connecting rod inside the piston.
2. Insert the pin.
3. Insert the two circlips.

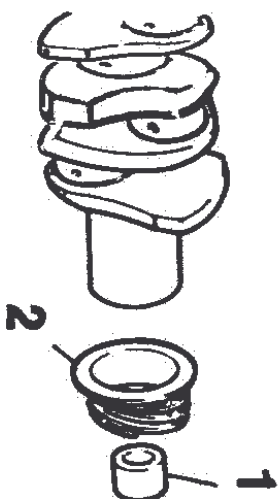
4. Position the pistons of the right-hand head with the arrow facing upwards.
5. Position the pistons of the LH cylinder head with the arrow pointing downwards.
6. Using the special gripping tool, insert the flexible clamps into the seat on the piston, taking care to make sure that the reference indication on the flat surface is facing upwards.



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ENGINE ASSEMBLY COMPLETE

CRANKSHAFT



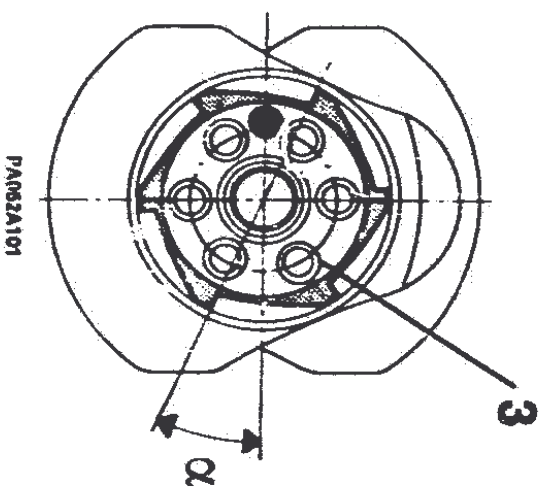
1. Fit the rear crankshaft bush using special tool No. 1.821.104.000 (A.3.0450).
2. Heat up the oil pump - distributor drive gear to 150°.



Rear crankshaft gear orientation

$$\alpha = 24^\circ \pm 2^\circ$$

3. Fit the gear to the crankshaft so that the flywheel centering dowel axis makes the angle shown with the front face of a gear tooth.

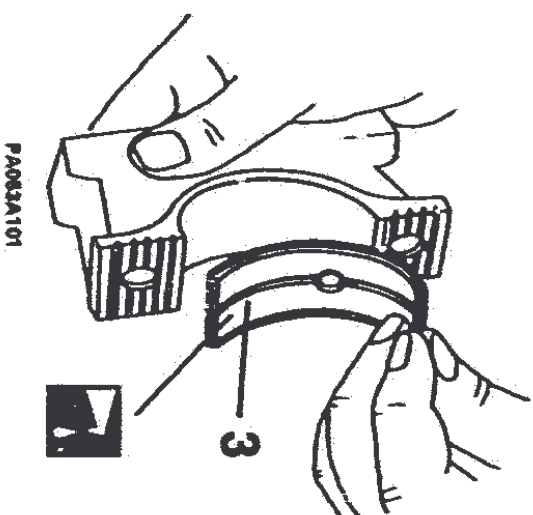
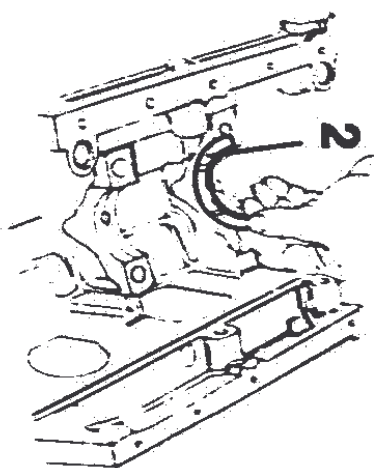
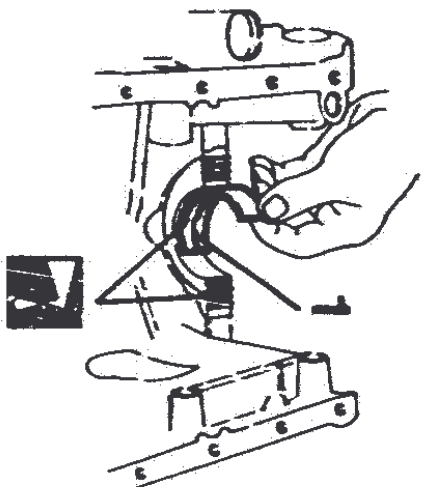




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ENGINE ASSEMBLY COMPLETE

ENGINE ASSEMBLY COMPLETE



PA063A101

1. Place the upper main bearing shells.
2. Insert the split thrust washers in the housing machined in the third main bearing. The thrust washers must be mounted making sure that the oil duct's face the crankshaft shoulder.

- Fit crankshaft in position in the main bearings.
3. Fit the lower main bearing shells in their caps.

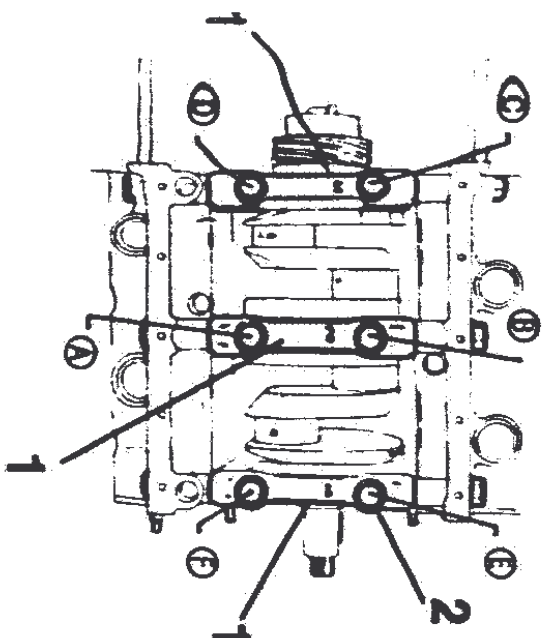




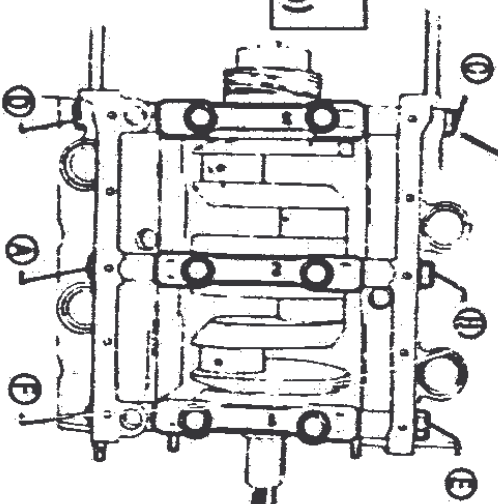
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ENGINE ASSEMBLY COMPLETE

ENGINE ASSEMBLY COMPLETE (Continued)



66 ÷ 73 Nm
(6.7 ÷ 7.4 kgm)



40 ÷ 49 Nm
(4.1 ÷ 5 kgm)

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1. Fit the main bearing caps to their matching block halves in the correct positions (see marking) and screw on the well-oiled bolts without tightening them.
2. Tighten the bolts holding the main bearing caps to the main bearing supports in two or three operations, working in the sequence shown (A to F).

3. Then tighten the bolts holding the main bearing caps to the block, in two or three operations and working in the sequence shown (A to F).
- Turn the crankshaft by hand to make sure that there is no drag.

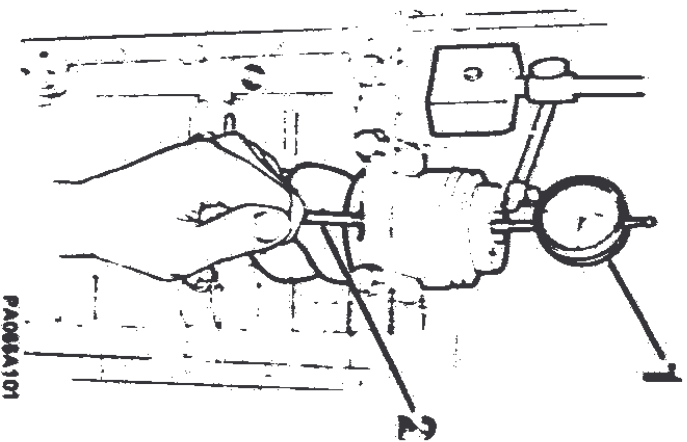




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ENGINE ASSEMBLY COMPLETE

ENGINE ASSEMBLY COMPLETE (Continued)

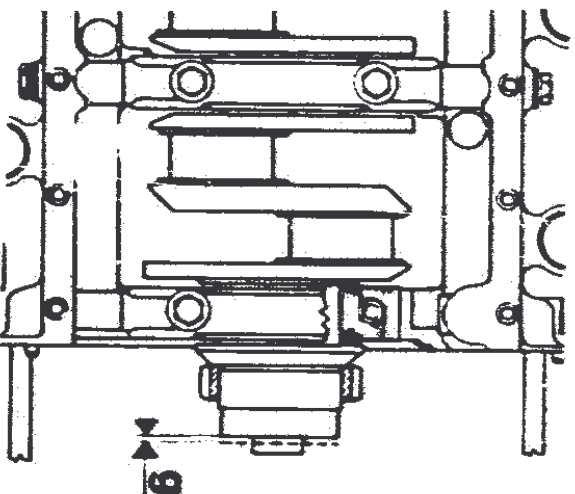


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Crankshaft end float

$g = 0,35$

- Check crankshaft end float as follows:
 1. Set up a dial gauge reading to hundredths of millimeters, placing the feeler in contact with the crankshaft, parallel to its axis.



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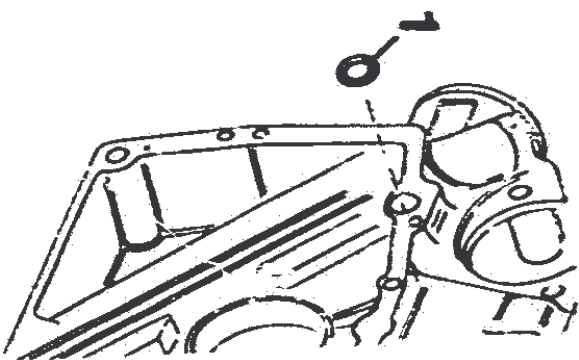
2. Using a screwdriver, lever the crankshaft axially and check that the end-float "g" lies within the limits shown.



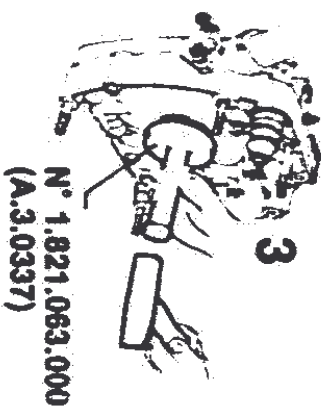
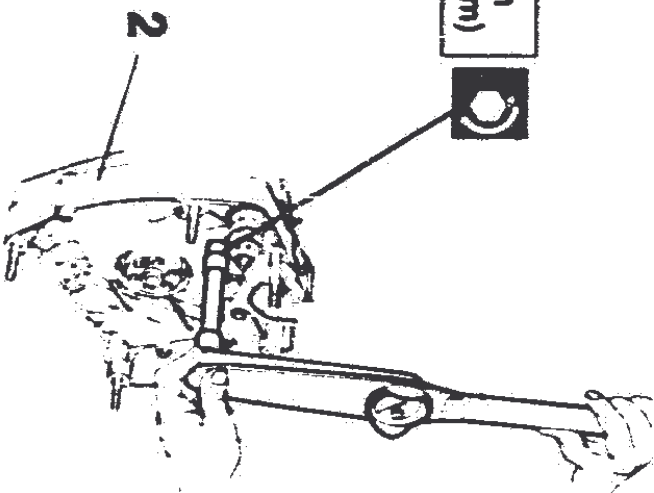
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ENGINE ASSEMBLY COMPLETE

BLOCK END PLATE



19 ÷ 24 Nm
(1.9 ÷ 2.5 kgm)



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1. Insert the sealing ring in the main oil duct of the block end plate.
2. Mount the end plate fitted with its gasket to the block. Tighten the end plate bolts.

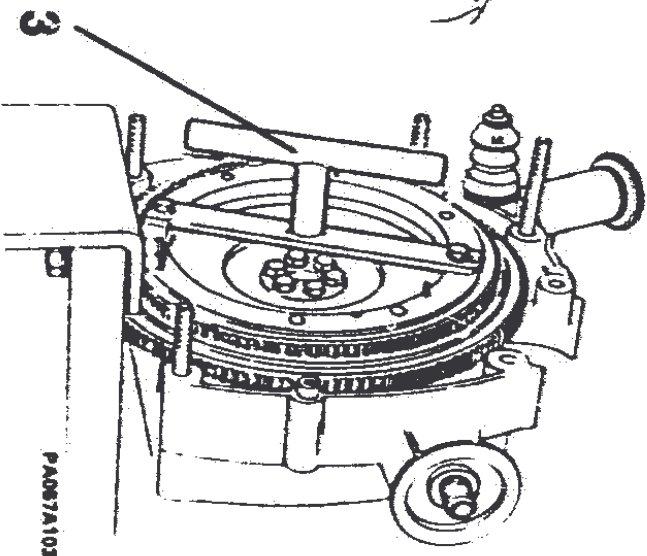
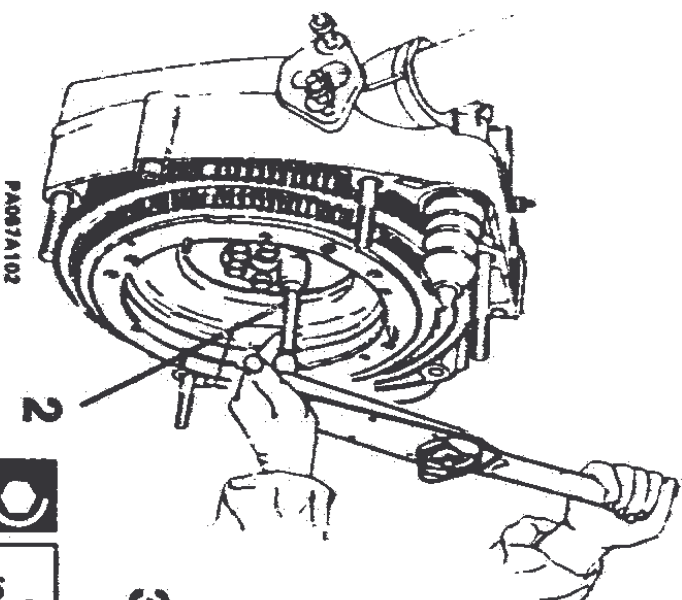
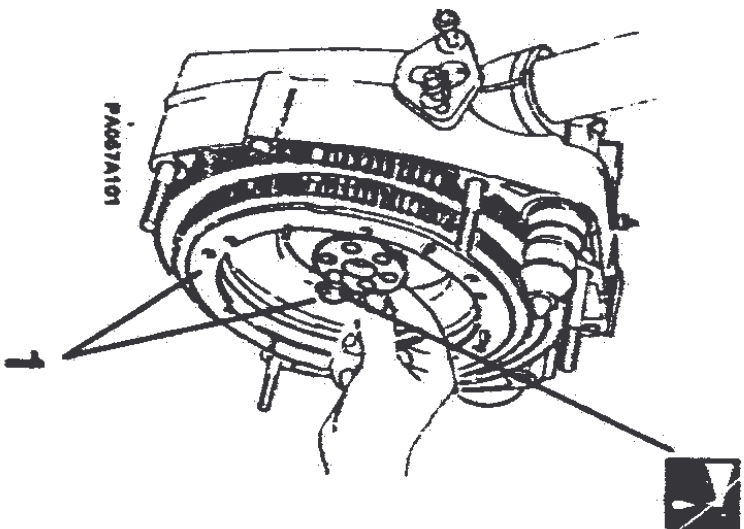
3. Carefully fit the rear crankshaft oil seal in the correct position using special tool No. 1.821.063.000 (A.3.0337).



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ENGINE ASSEMBLY COMPLETE

FLYWHEEL



53 ÷ 105 Nm
(9,8 ÷ 10,7 kgm)

- Lubricate the mounting bolts with engine oil.
- 1. Position the flywheel on the crankshaft and screw in the mounting bolts complete with locking washers, without tightening them.
- Use special tool No. 1.820.059.000 (A.2.0378) to prevent the shaft from rotating.

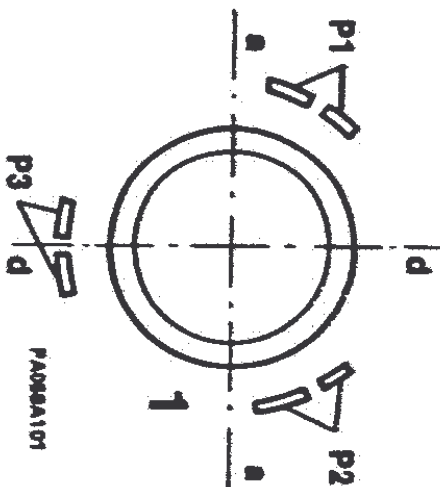
- 2. Tighten the screws to the correct torque.
- 3. Fit a tool to the flywheel to allow its rotation, and remove the previously fitted tool No. 1.820.059.000 (A.2.0378).



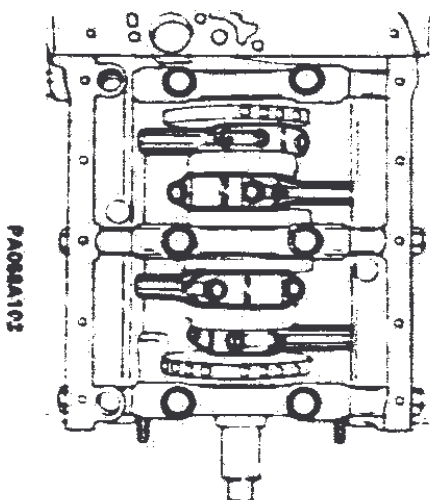
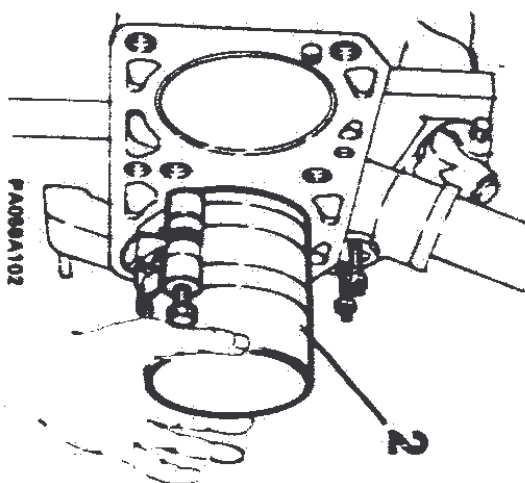
01 - 87

ENGINE ASSEMBLY COMPLETE

PISTONS AND CONNECTING RODS



- P1 position the upper piston ring
- P2 position the lower piston ring
- P3 position the oil-scraper ring
- aa gudgeon pin axis
- dd thrust axis



1. Arrange the rings in their grooves so that the gaps are equally spaced around the piston circumference.
 - Fit the previously-selected shells to the big-end bearings and caps.
2. Insert pistons with their respective connecting rods into the corresponding cylinders using the universal tool.



Pistons must be inserted with the arrows on their crowns pointing in the direction of rotation, upwards for the RH bank pistons and downwards for the LH bank pistons. Big-end caps should be positioned so that their identification numbers can be read.

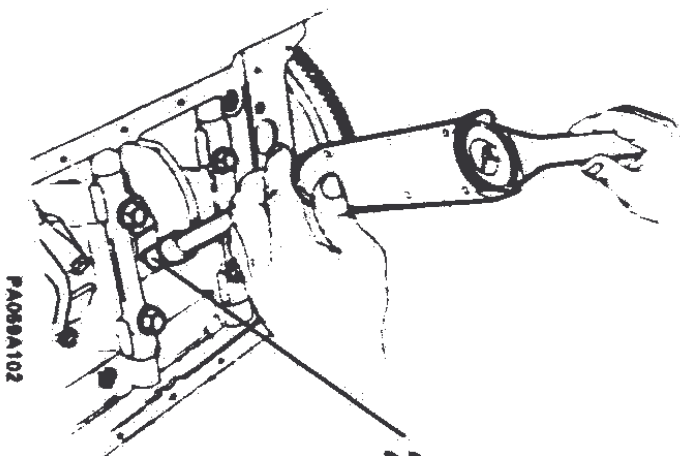
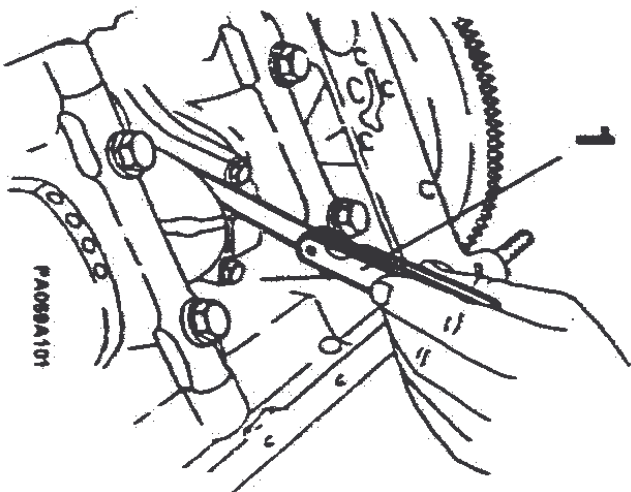




01 - 88

ENGINE ASSEMBLY COMPLETE

PISTONS AND CONNECTING RODS (Continued)



43 ÷ 48 Nm
(4.4 ÷ 4.9 kgm)



Big-end float

—

- Position the main caps and bearing halves.
- 1. Check float between crankweb shoulder and big-end using feeler gauges.

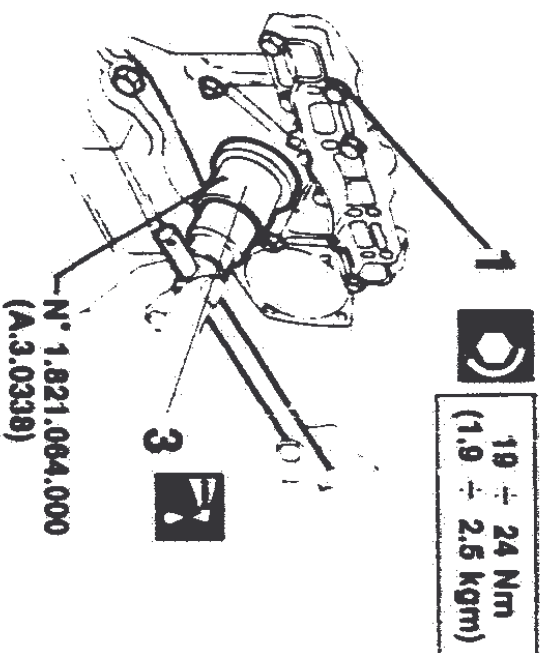
- 2. Turn the crankshaft to gain access to the big-end cap bolts and tighten them to the correct torque.



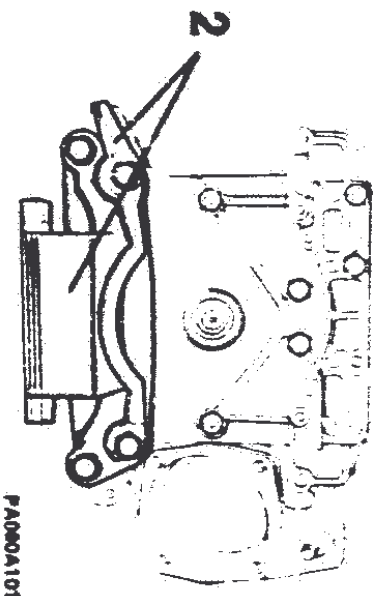
01 - 89

ENGINE ASSEMBLY COMPLETE

FRONT BLOCK PLATE AND FRONT ENGINE MOUNTING



1. Fit the front engine plate complete with gasket to the block and tighten the nuts and bolts to the correct torque.
2. Fit the front engine mounting and pulley guard to the front plate.



3. Force the crankshaft oil seal into position using special tool No. 1.821.064.000 (A.3.0338). Lubricate the sealing lip and the working surface of the ring with engine oil before mounting.



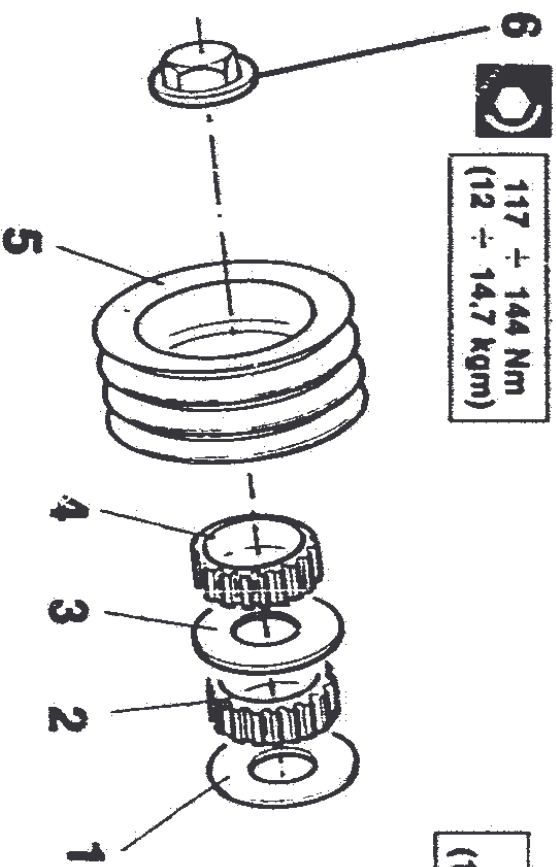
01 - 90

ENGINE ASSEMBLY COMPLETE

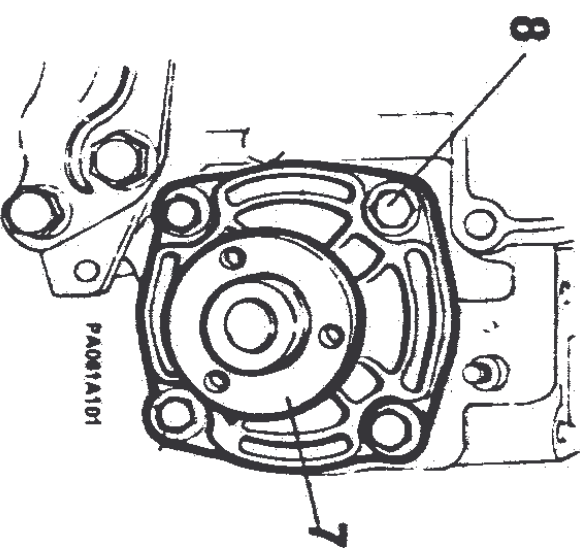
CRANKSHAFT SPROCKETS AND PULLEYS, AND WATER PUMP



117 ÷ 144 Nm
(12 ÷ 14,7 kgm)



19 ÷ 24 Nm
(1,9 ÷ 2,5 kgm)



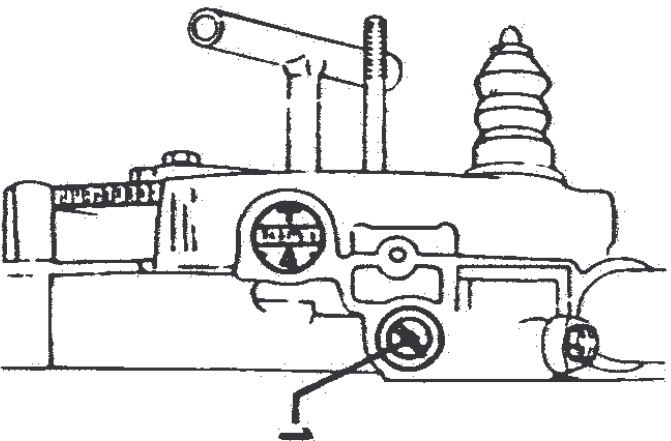
1. Slide the belt guide disk onto the shaft.
2. Fit the drive sprocket for the LH cylinder head timing belt.
3. Fit on the spacer.
4. Fit the drive sprocket for the RH cylinder head timing belt.
5. Fit on the auxiliary drive pulley.
6. Lock the flywheel and tighten the retaining nut to the specified torque.
 - Place a new gasket on the water pump.
7. Mount the pump on the block without its pulley.
8. Screw in and tighten the bolts with their washers to the specified torque.



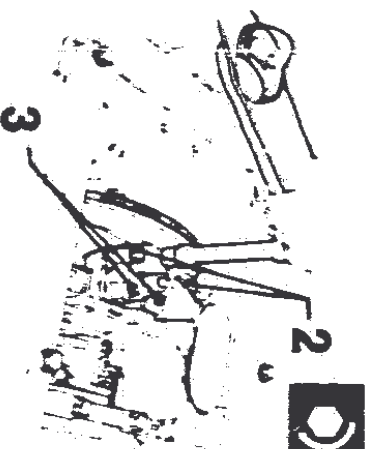
01 - 91

ENGINE ASSEMBLY COMPLETE

OIL PUMP

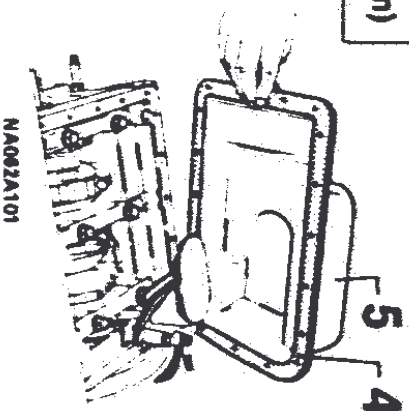


PA062A102



19 ÷ 24 Nm
(1,9 ÷ 2,5 kgm)

8 ÷ 10 Nm
(0,8 ÷ 1 kgm)



NA062A101

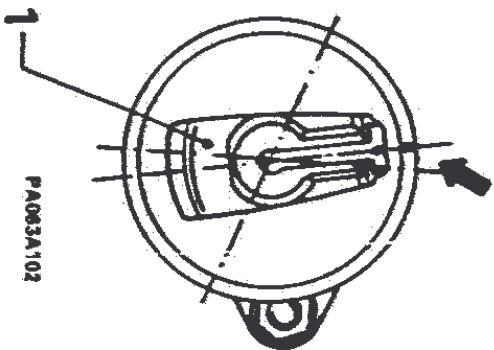
1. Turn the crankshaft to bring piston no. 1 to top dead centre in ignition phase.
2. Fit the oil pump to the engine end plate and tighten the bolts to the specified torque.
3. Tighten the bolts holding the pump body to the support to the specified torque.
4. Replace the gasket, applying the specified joint compound evenly.
Remove all traces of the old sealer before applying the new.
- 5 Replace the oil sump.



01 - 92

ENGINE ASSEMBLY COMPLETE

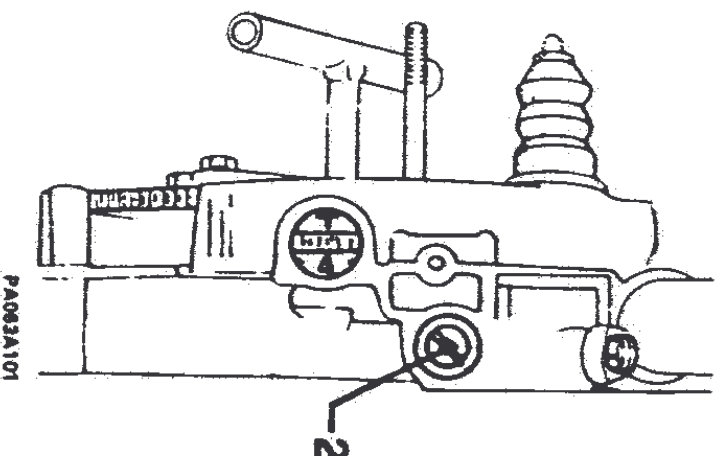
DISTRIBUTOR



- Mount the distributor on the engine end plate.

1. Rotate the distributor shaft so that the wiper arm corresponds to the reference mark on the distributor body.

The wiper arm must point towards cylinder No. 1. This is the ignition position for cylinder No. 1 and corresponds to the correct alignment of oil pump and distributor drive shafts.

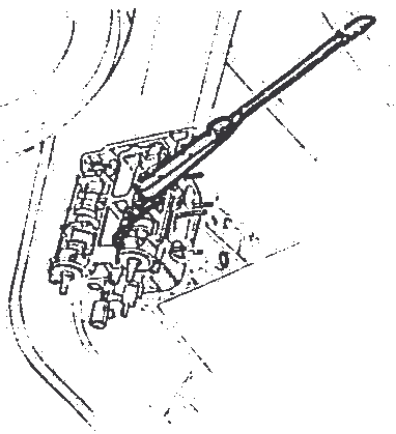


2. If necessary correct any misalignment between wiper arm and distributor body reference mark by rotating the body itself then tighten down the distributor lock nut on the end plate.



01 - G

ENGINE ASSEMBLY COMPLETE



ELECTRONIC-INJECTION ENGINE (16 VALVES)

- ENGINE REASSEMBLY (Continued)

- REMOVING AND REFITTING CYLINDER HEAD WITH ENGINE ON VEHICLE

ENGINE REASSEMBLY	
REFITTING CYLINDER HEADS	01 - 93
ADJUSTING TIMING	01 - 95
REPLACING TIMING BELTS	01 - 98

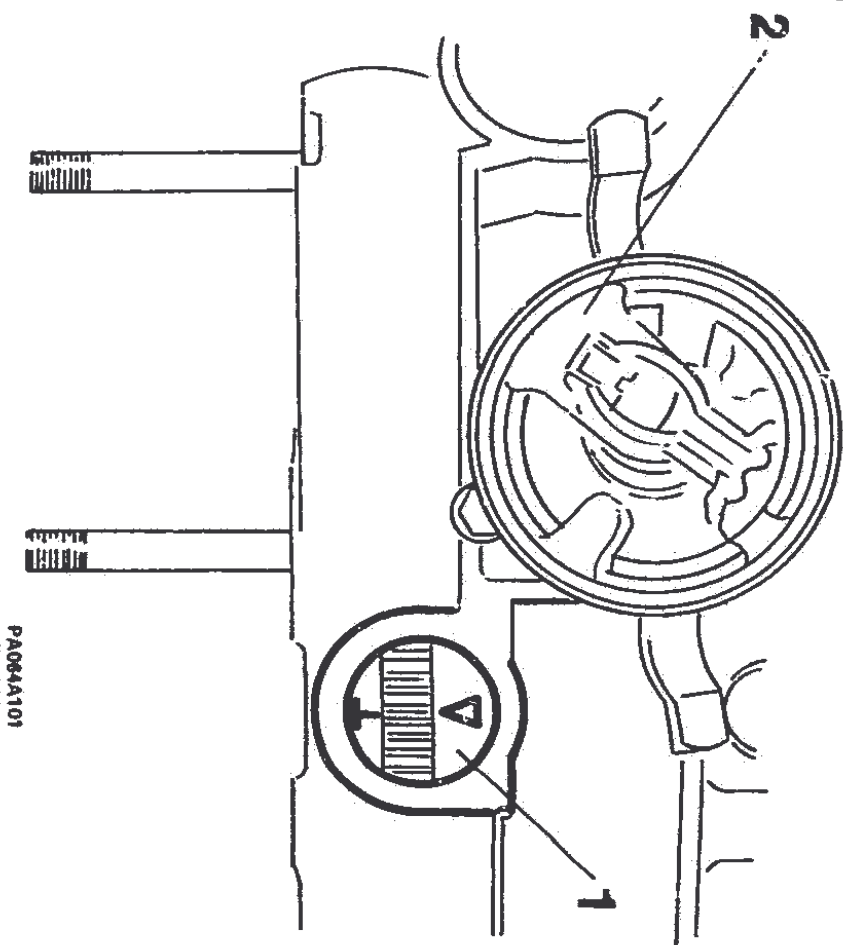
REMOVING AND REFITTING CYLINDER HEAD WITH ENGINE ON VEHICLE	
PRELIMINARY OPERATIONS	01 - 100
REMOVAL OF UNDERBODY COMPONENTS	01 - 101
REMOVAL OF ENGINE COMPARTMENT COMPONENTS	01 - 102



01 - 93

ENGINE ASSEMBLY COMPLETE

ENGINE REASSEMBLY (Continued) REFITTING CYLINDER HEADS



- Refit the cylinder heads to the block as follows:
 1. Turn the crankshaft until the piston reaches top dead centre in cylinder No. 1 in ignition phase; this position is reached when the "T" mark on the flywheel rim is seen to coincide with the index on the engine end plate.
 2. Make sure that the distributor wiper arm corresponds with the first cylinder ignition point.

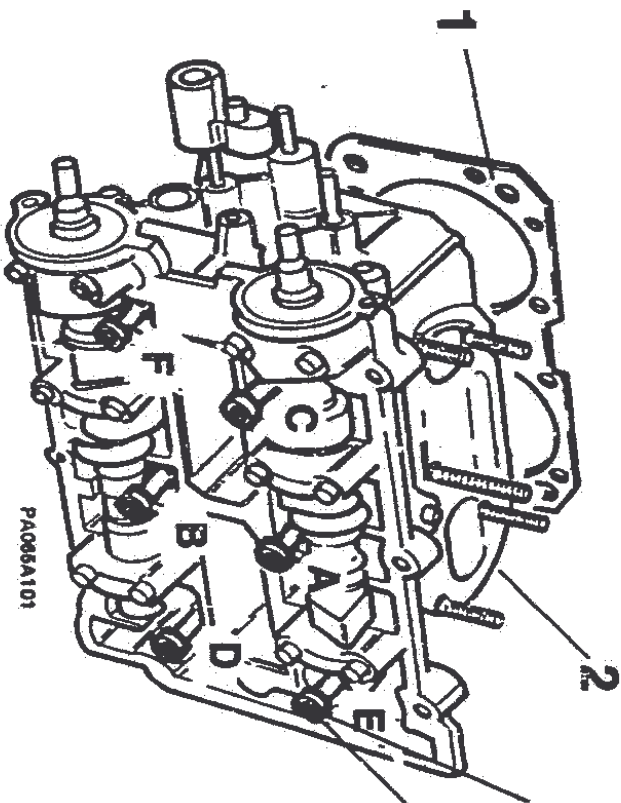




01 - 94

ENGINE ASSEMBLY COMPLETE

REFITTING CYLINDER HEADS (Continued)



93 ÷ 97 Nm
(9.5 ÷ 9.9 kgm)



ATTENTION:
Make sure the camshafts are positioned neutrally.

1. Place the gasket in position.
 2. Fit the cylinder heads to the block.
- Oil the six cylinder head bolts and screw them down to the specified torque in two or three operations, to the sequence shown (A to F).



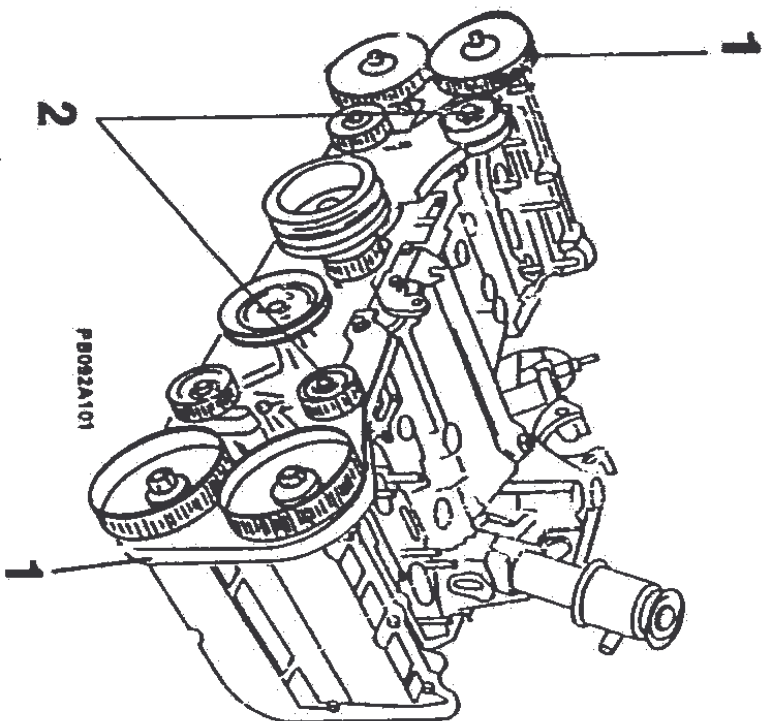
If working on the vehicle when the engine is in place the tightening torques will vary when using the spanner extension N° 1.822.101.000 (see TECHNICAL CHARACTERISTICS AND SPECIFICATIONS)



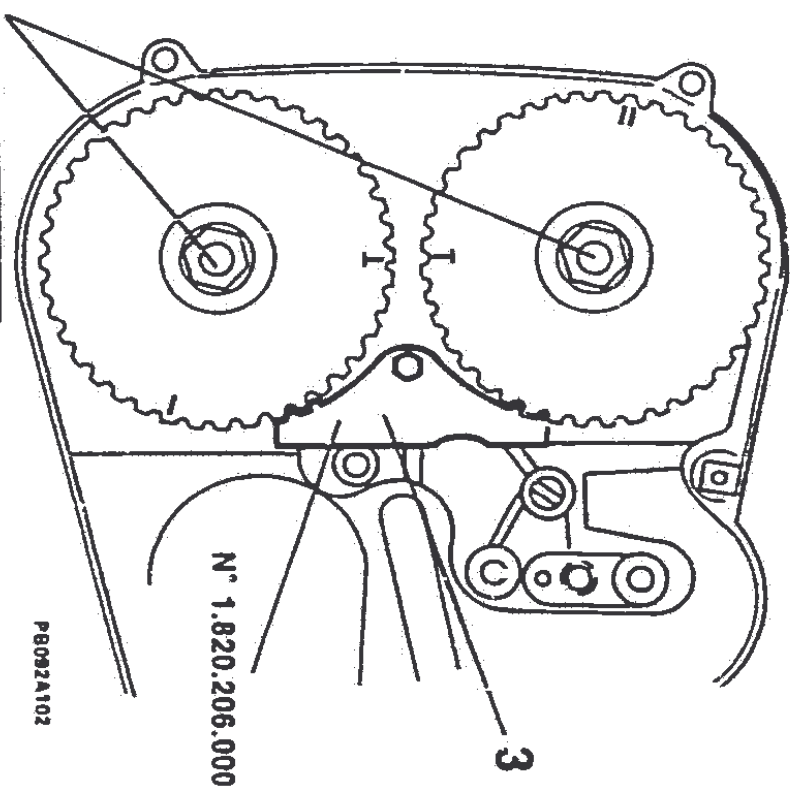
01 - 95

ENGINE ASSEMBLY COMPLETE

ADJUSTING TIMING



1. Install the timing belt rear guards.
2. Mount the belt-tensioner units on the dowels in the block.



83 ÷ 70 Nm
(6,4 ÷ 7,1 kgm)

3. Fit the timing belt drive sprockets and tighten the retaining nuts to the specified torque, locking sprocket movement with special tool No. 1.820.206.000.



ADJUSTING TIMING (Continued)



- Rotate the engine shaft clockwise (seen from the rear end) by about 45° to lower the pistons in cylinders 1 and 2 in order to prevent the valves from striking the pistons when the camshafts are rotated.



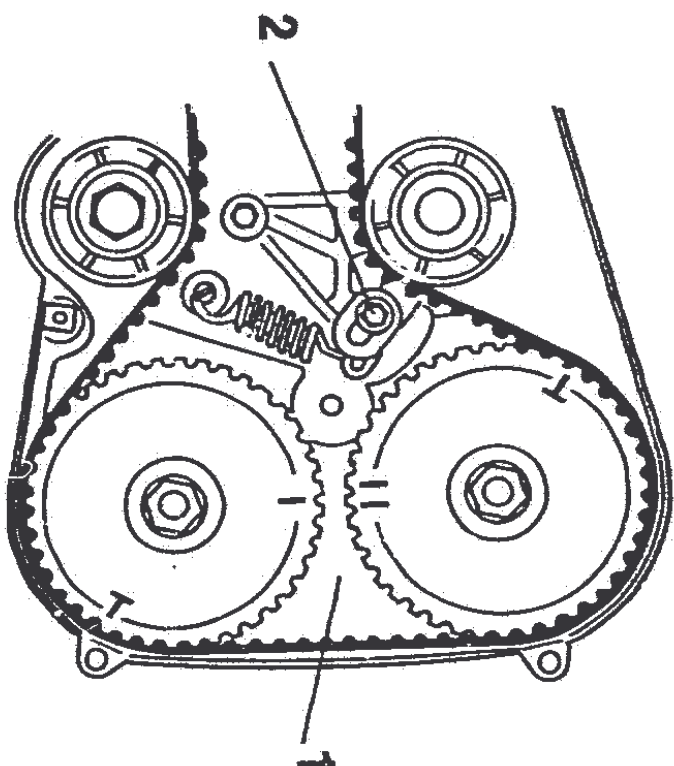


01 - 97

ENGINE ASSEMBLY COMPLETE

ADJUSTING TIMING (Continued)

1. Position the LH cylinder head camshafts so that the space between the two marks on the intake camshaft sprocket coincides with the mark on the exhaust camshaft sprocket.
- Realign the "T" mark on the flywheel rim with the index (piston No. 1 at T.D.C. in ignition phase), and fit the LH timing belt to the sprockets while maintaining the shafts in that position.



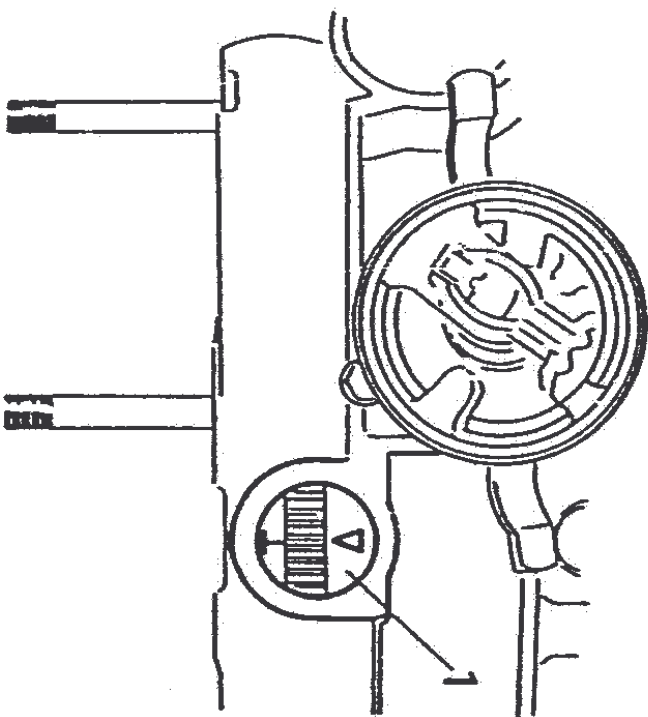
2. Slacken the belt-tensioner lock nut so that the spring may exert full pressure on the belt.
- Repeat the preceding operations to adjust the timing of the right-hand head.
- Turn the crankshaft a few times in its working rotation direction to allow the belts to settle into their final positions.



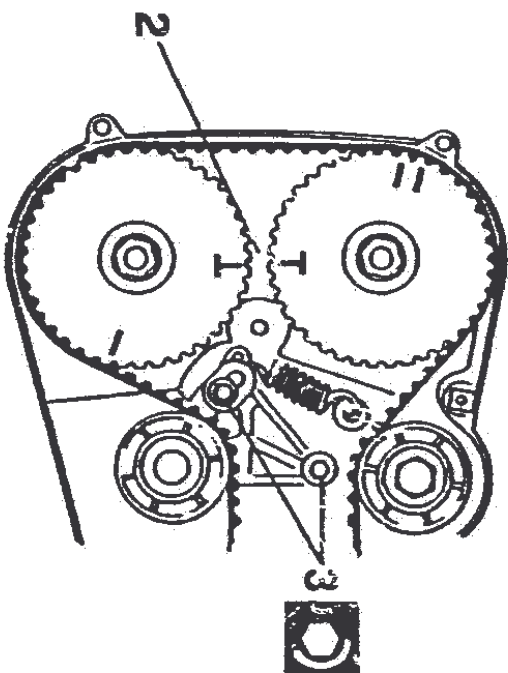
01 - 98

ENGINE ASSEMBLY COMPLETE

REPLACING TIMING BELTS



1. Rotate the crankshaft until the piston of cylinder number 1 is at TDC in the firing phase (notch T on the flywheel). Further rotate the crankshaft in its normal direction of rotation until the reference notch ▼ on the flywheel is aligned with the reference mark.
2. Check that the two pulleys are in line with the "T" marks (camshafts of the right-hand head in the reeling position: no cam engaged).



37 ÷ 46 Nm
(3,8 ÷ 4,7 kgm)

3. Loosen the nuts of the right-hand belt tensioner and tighten them to the specified torque.
- During the operation avoid pressing on the belt which may alter its loading.



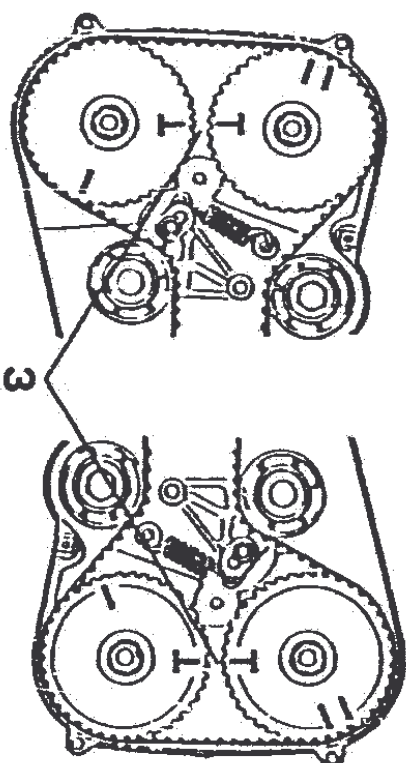
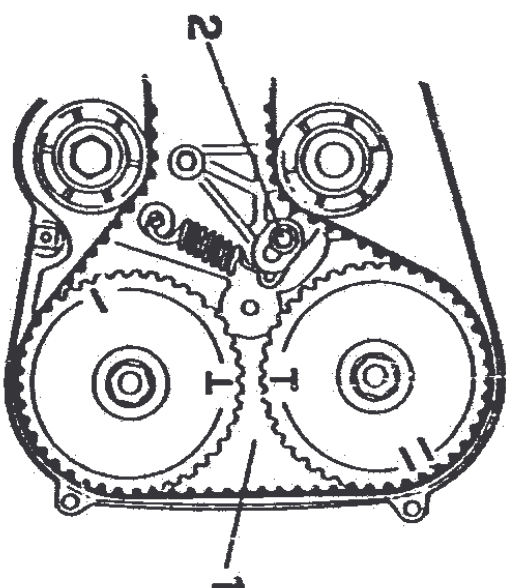


01 - 99

ENGINE ASSEMBLY COMPLETE

REPLACING TIMING BELTS (Continued)

37 ÷ 46 Nm
(3.8 ÷ 4.7 kgm)



- Starting from the position corresponding to the notch "▼" on the flywheel, rotate the crankshaft one complete revolution until the notch ▼ is once again in line with the reference mark (camshafts of the left-hand head in the resting position; no cam engaged).
- 1. Check that the two pulleys are aligned with the "T" marks.
- 2. Loosen the two nuts of the belt tensioner and tighten them to the specified torque.



During the operation avoid pressing on the belt tensioner which may alter the loading.

- After completing the operations on the right and left-hand heads, rotate the crankshaft until the piston in cylinder number 1 is at TDC in the firing phase (T mark on the flywheel).
- 3. Check that the timing marks on the pulleys are in line.



01 - 100

ENGINE ASSEMBLY COMPLETE

**REMOVING AND REFITTING CYLINDER HEAD WITH ENGINE ON VEHICLE
PRELIMINARY OPERATIONS**

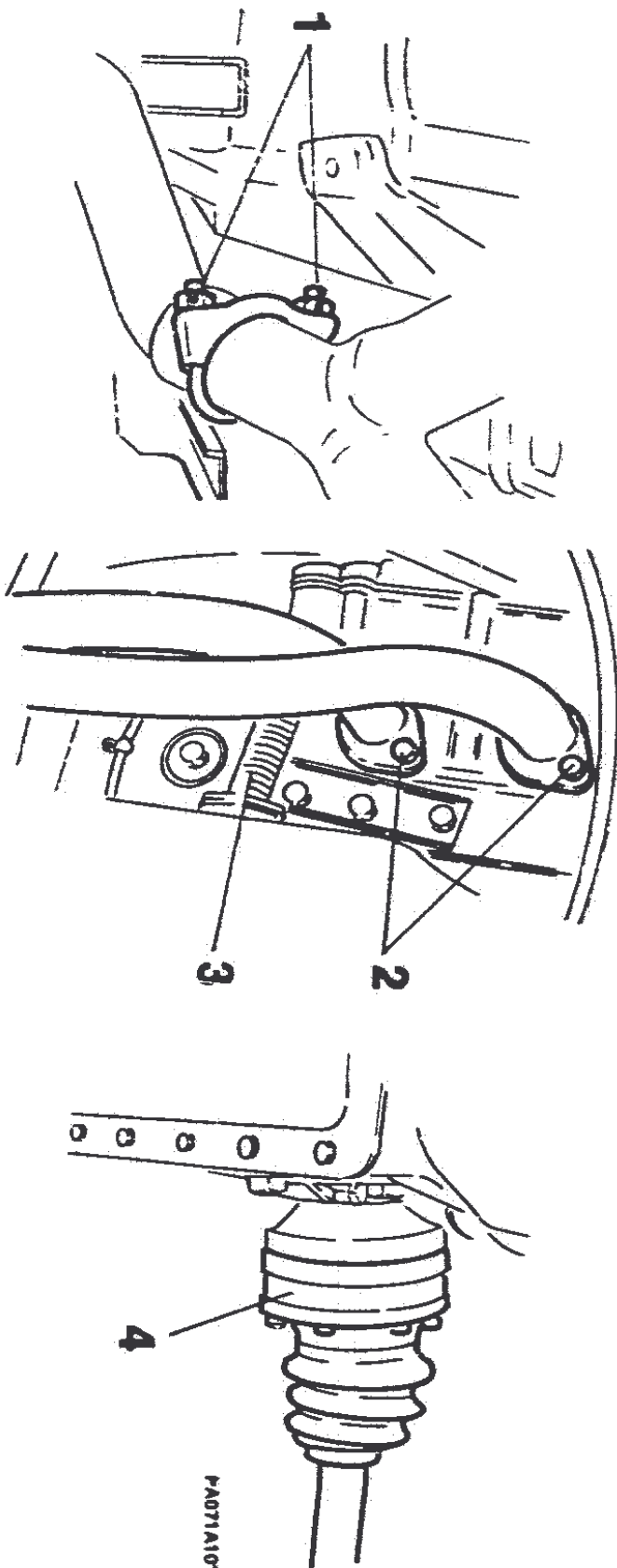
- position the vehicle on the inspection ramp
- remove the hood (see unit [50])
- disconnect the battery negative lead
- raise the vehicle
- drain the engine cooling system (see unit [60])
- drain the engine oil (see unit [60])



01 - 101

ENGINE ASSEMBLY COMPLETE

REMOVAL OF UNDERBODY COMPONENTS



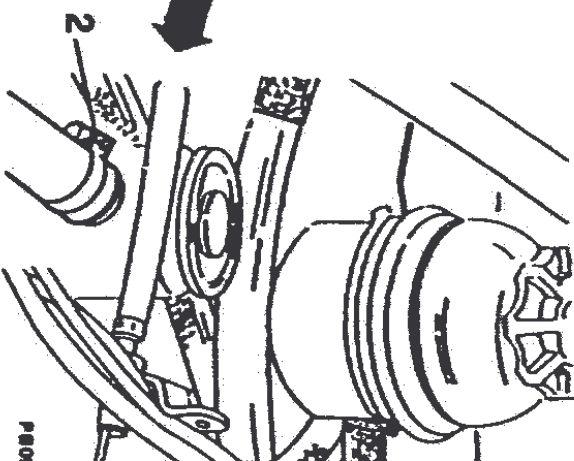
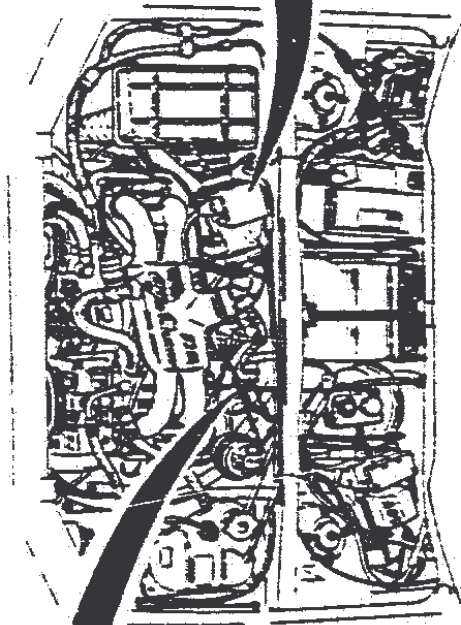
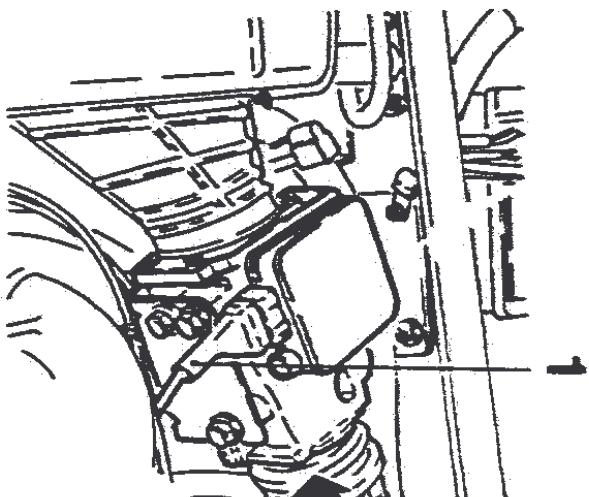
1. Slacken the exhaust clamp nuts at the joint between first and second exhaust system sections.
2. Disconnect the manifolds from the cylinder heads and remove the first exhaust section.
3. Remove the two flexible oil pipes from the heads.
4. Disconnect the LH drive shaft from the gearbox stub.



01 - 102

ENGINE ASSEMBLY COMPLETE

REMOVAL OF ENGINE COMPARTMENT COMPONENTS



PI0092A101

- Lower the vehicle.
- 1. Disconnect the electric cable from the air flow meter.

- 2. Slacken the retaining clip on the breather return pipe (separator end).



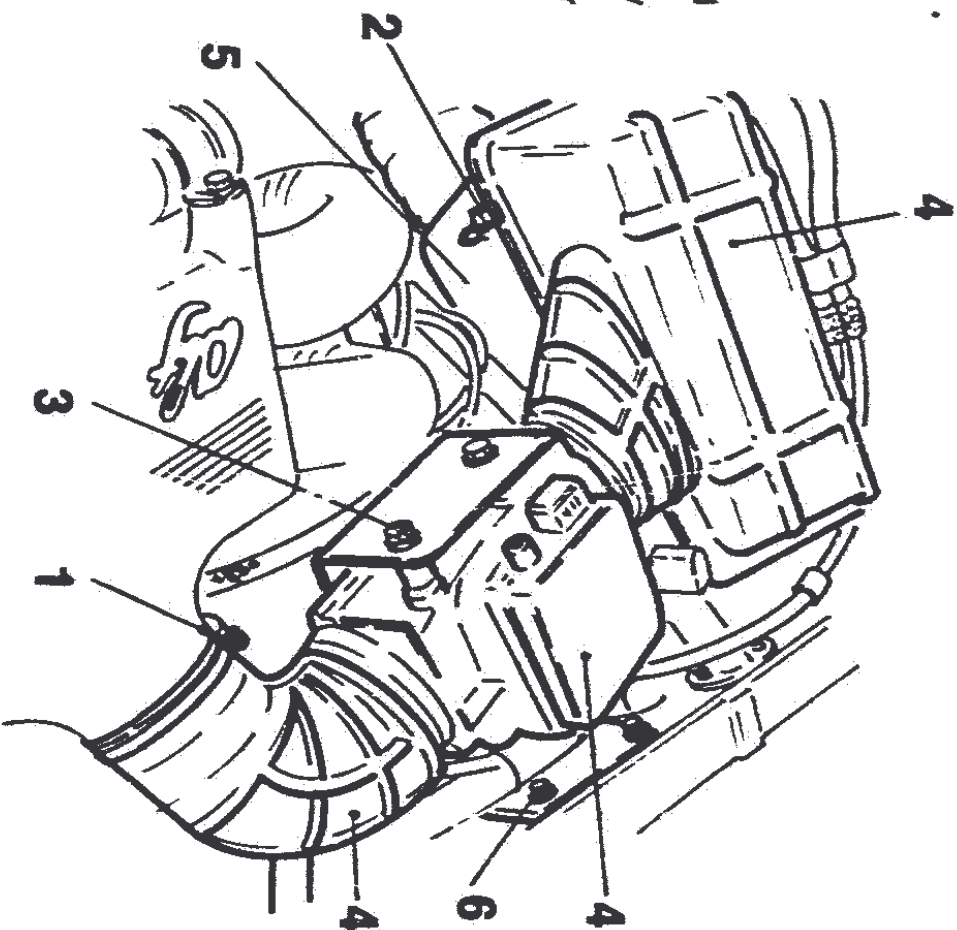


01 - 103

ENGINE ASSEMBLY COMPLETE

REMOVAL OF ENGINE COMPARTMENT COMPONENTS (Continued)

1. Slacken the corrugated pipe clip.
2. Unclip the air filter cover.
3. Undo the three screws holding the air-flow meter.
4. Remove the air-flow meter, air filter and corrugated pipe.
5. Extract the filter and remove the air filter support by unscrewing the two retaining screws.
6. Remove the air-flow meter bracket and relative rubber support.



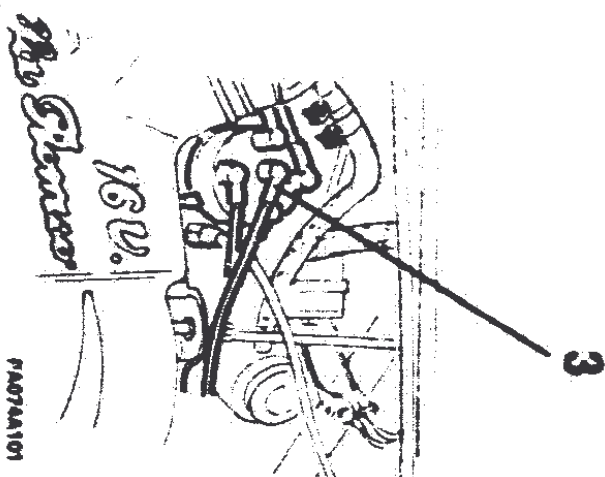
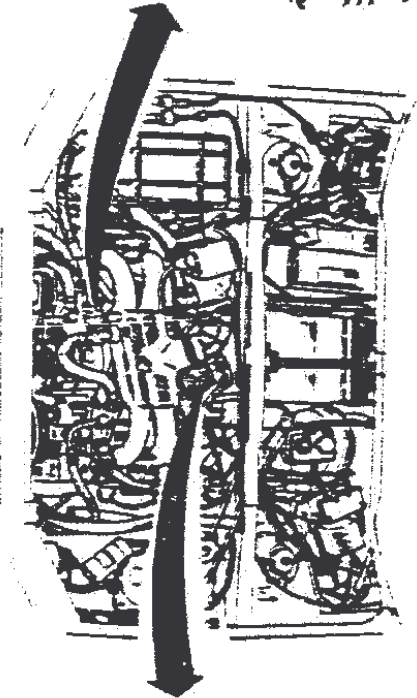
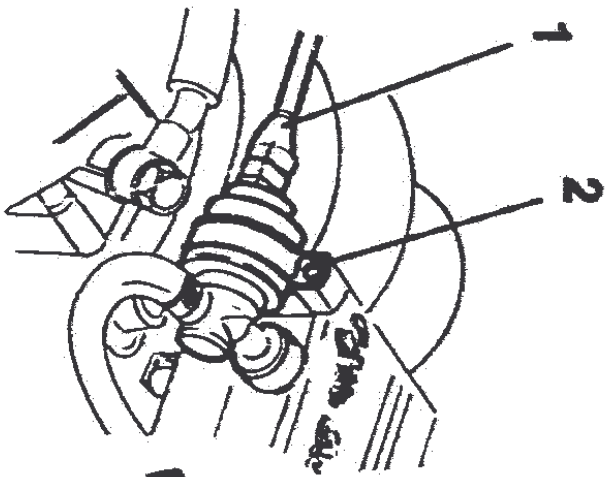
PA072A1G1





01 - 104

ENGINE ASSEMBLY COMPLETE



1. Disconnect the electric cable from the constant idle speed actuator.
2. Undo the mounting screw and remove the actuator.

3. Remove the distributor cap and relative HT leads.



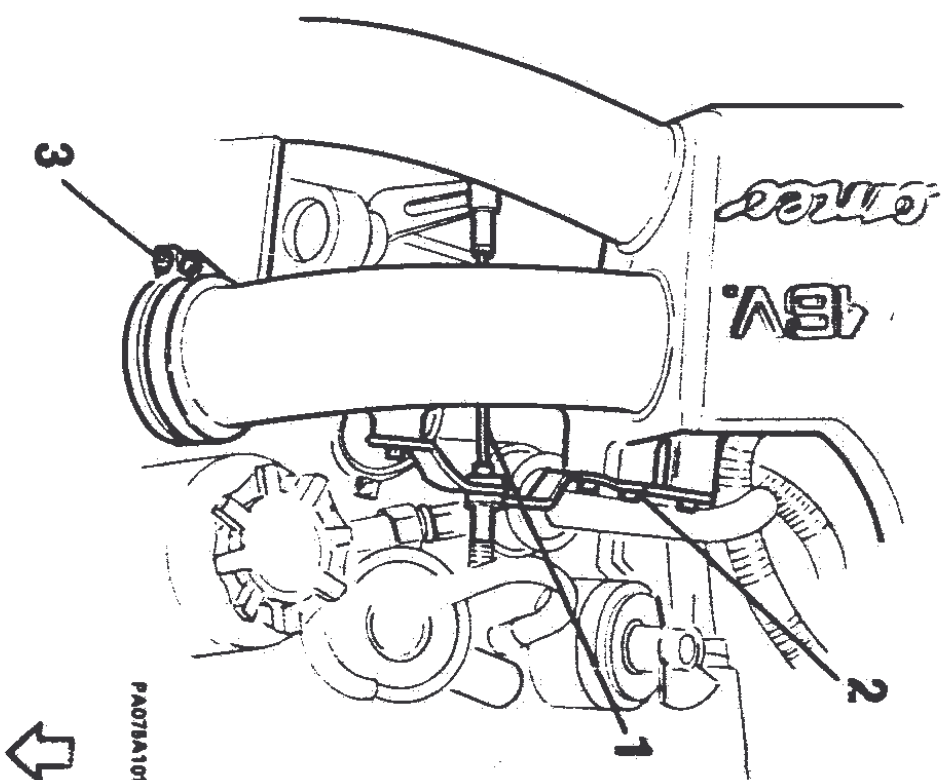


01 - 105

ENGINE ASSEMBLY COMPLETE

REMOVAL OF ENGINE COMPARTMENT COMPONENTS (Continued)

1. Remove the accelerator cable and relative bracket.
2. Remove the pressure regulator and impulse damper bracket.
3. Slacken the 4 lower manifold clips and remove the air reservoir box.

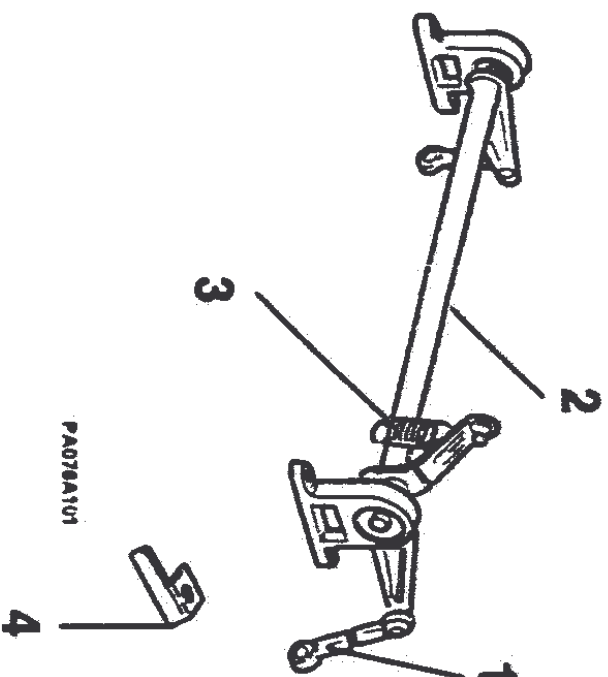
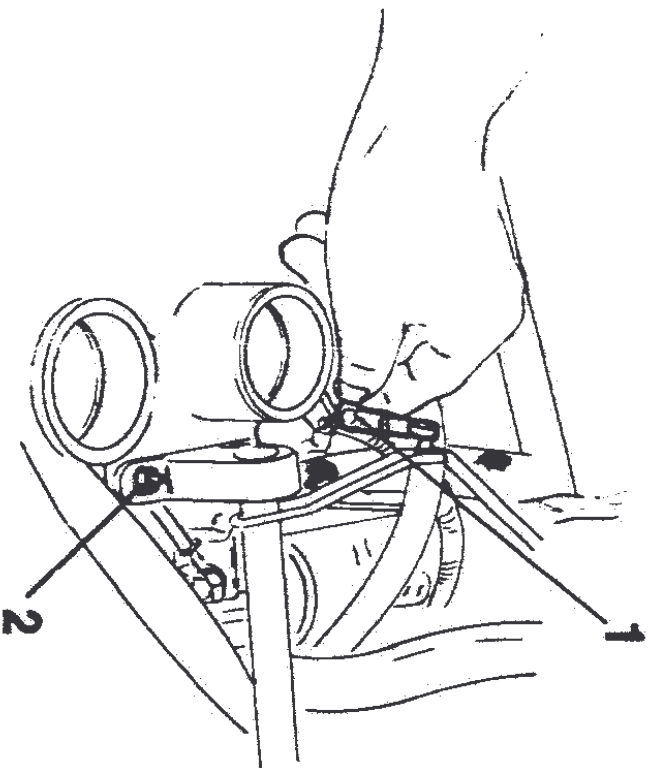




01 - 106

ENGINE ASSEMBLY COMPLETE

REMOVAL OF ENGINE COMPARTMENT COMPONENTS (Continued)



1. Disconnect the two link rods from the accelerator shaft.
2. Unscrew the 4 nuts and remove the accelerator shaft.
3. Recover the spring.
4. Recover the shaft.



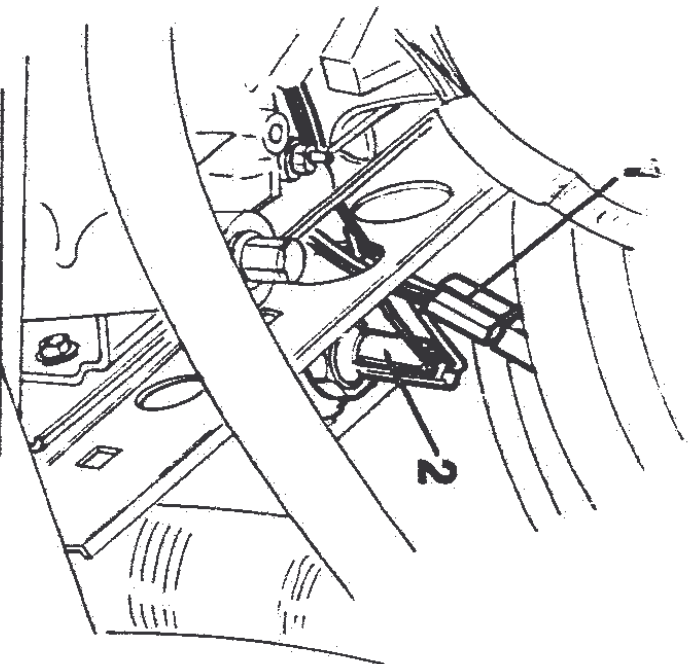


01 - 107

ENGINE ASSEMBLY COMPLETE

REMOVAL OF ENGINE COMPARTMENT COMPONENTS (Continued)

- Remove the front grille (see unit [76]).
- 1. Disconnect the power leads to the electric cooling fan.
- 2. Disconnect the electric lead from the cooling system temperature sensor.



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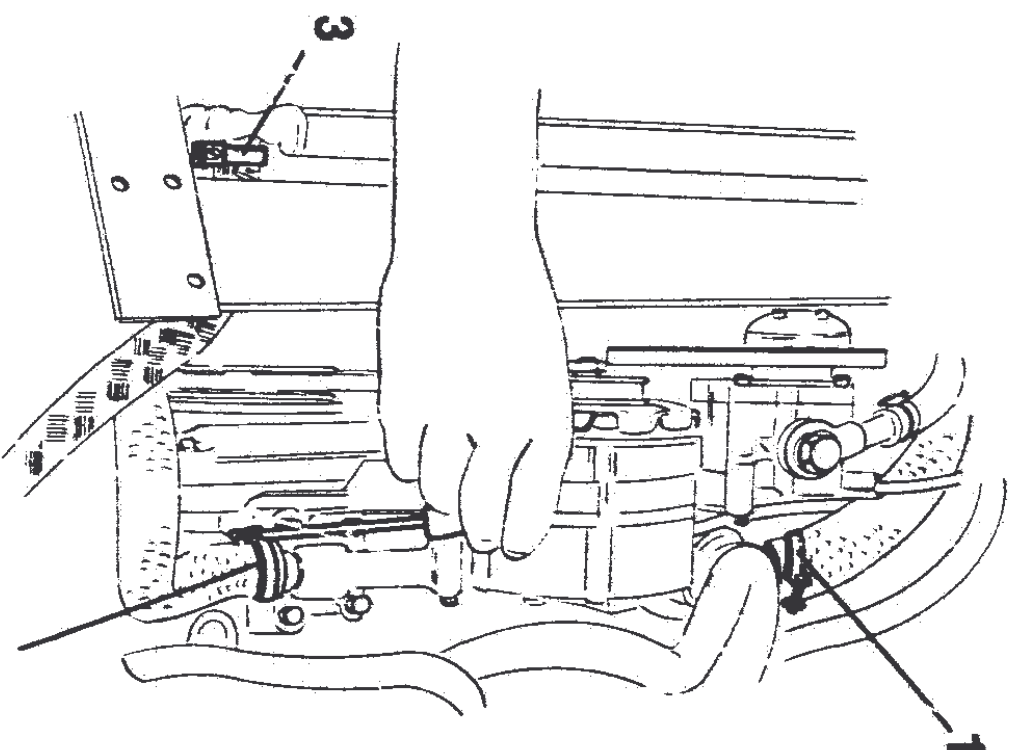


01 - 108

ENGINE ASSEMBLY COMPLETE

REMOVAL OF ENGINE COMPARTMENT COMPONENTS (Continued)

1. Slacken the clip holding the cooling hose to the thermostat valve.
 2. Slacken the clip holding the cooling hose to the water pump.
 3. Slacken the clip holding the cooling hose to the header tank.
- Slacken the bolt holding the radiator to the body, and remove the radiator.



PA078A101



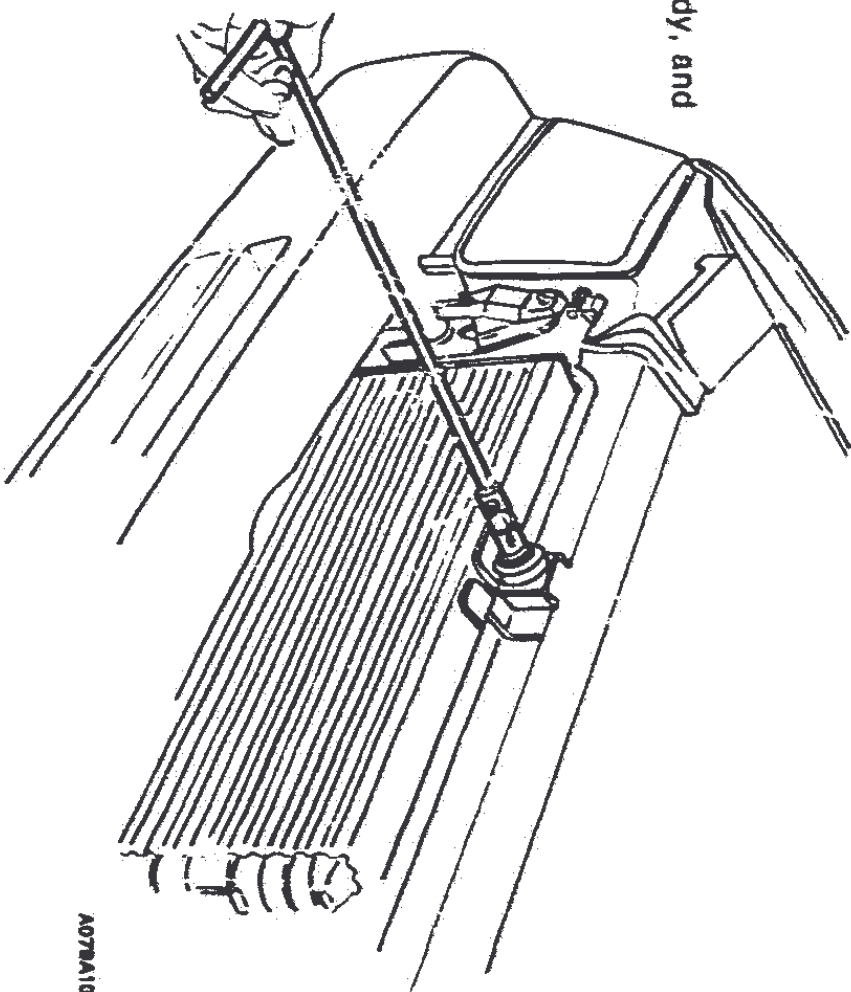


01 - 109

ENGINE ASSEMBLY COMPLETE

REMOVAL OF ENGINE COMPARTMENT COMPONENTS (Continued)

- Slacken the bolt holding the radiator to the body, and remove the radiator.



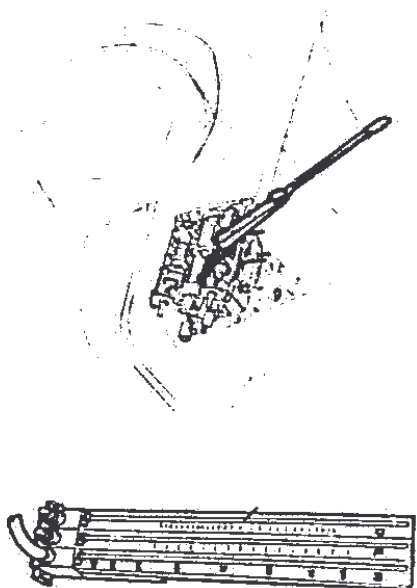
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01 - H

ENGINE ASSEMBLY COMPLETE



ELECTRONIC-INJECTION ENGINE (16 VALVES)

- REMOVING AND REFITTING
CYLINDER HEADS WITH
ENGINE ON VEHICLE

(Continued)

- FLOWTESTING

REMOVING AND REFITTING CYLINDER HEADS WITH ENGINE ON VEHICLE

REMOVAL OF ENGINE COMPARTMENT

COMPONENTS 01 - 110

FLOWTESTING

ON THE BENCH 01 - 117

IN VEHICLE 01 - 118

INJECTOR TUBE ALIGNMENT AND

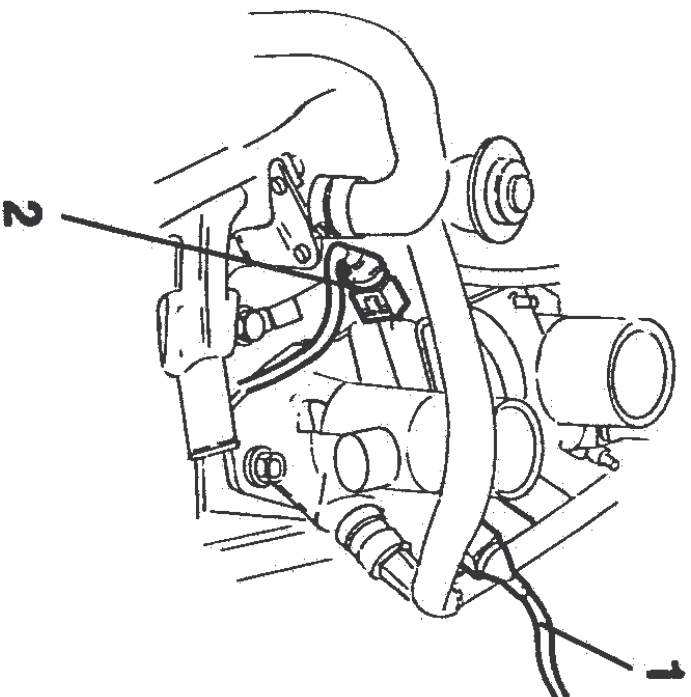
SYNCHRONISING..... 01 - 120



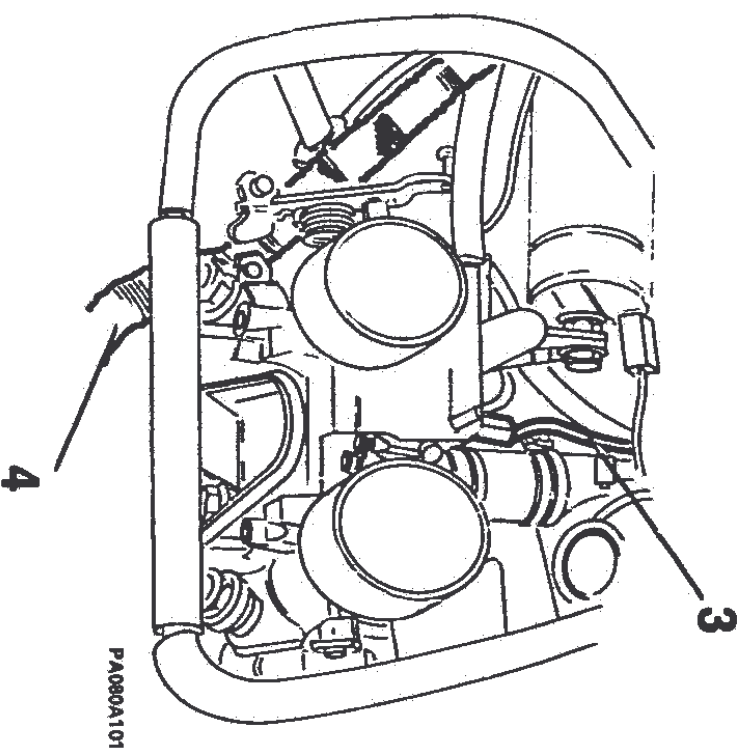
01 - 110

ENGINE ASSEMBLY COMPLETE

REMOVING AND REFITTING CYLINDER HEADS WITH ENGINE ON VEHICLE REMOVAL OF ENGINE COMPARTMENT COMPONENTS (Continued)



1. Disconnect the electrical cables from the electroinjectors.
2. Disconnect the electric cable from the engine coolant NTC sensor.



3. Disconnect the temperature light lead.
4. Remove the corrugated pipe from the cabling.

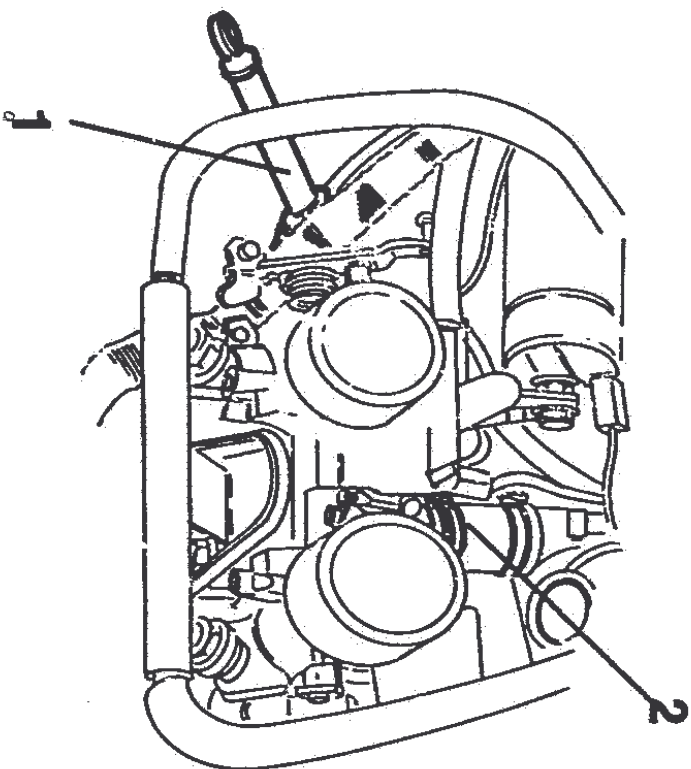




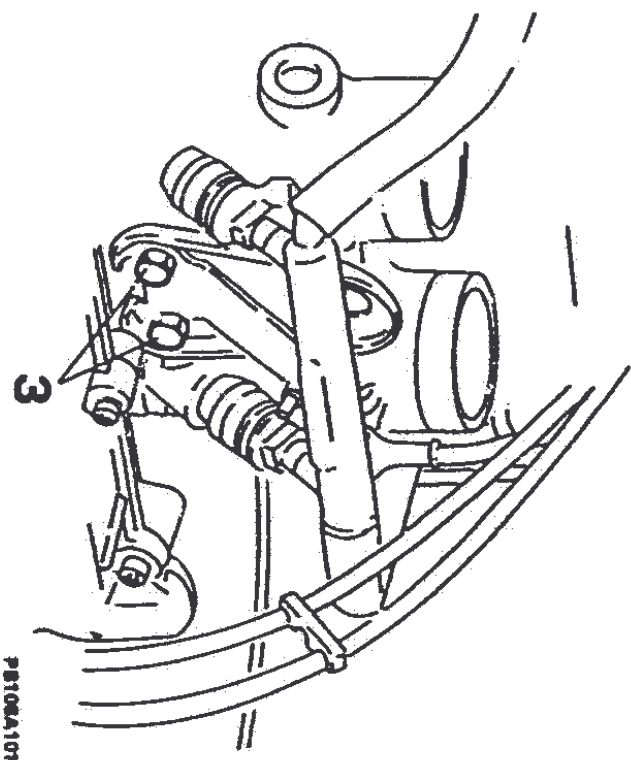
01 - 111

ENGINE ASSEMBLY COMPLETE

REMOVAL OF ENGINE COMPARTMENT COMPONENTS (Continued)



1. Unscrew the nut securing the dipstick support bracket to the engine block and remove the dipstick.
2. Slacken the cooling hose clips.



3. Loosen the screws securing the fuel supply hose.

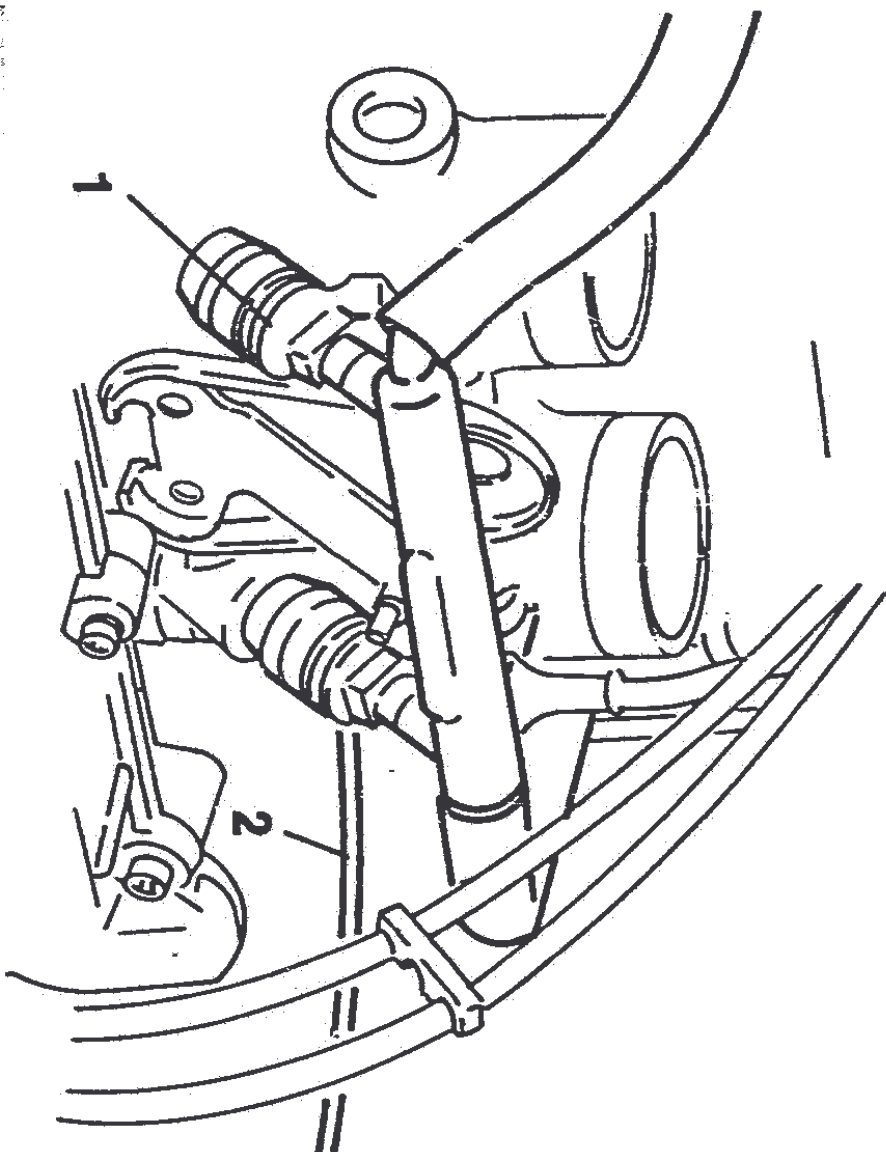




01 - 112

ENGINE ASSEMBLY COMPLETE

REMOVAL OF ENGINE COMPARTMENT COMPONENTS (Continued)



1. Withdraw the electroinjectors together with the fuel supply hose.

2. Disconnect the brake servo vacuum line.

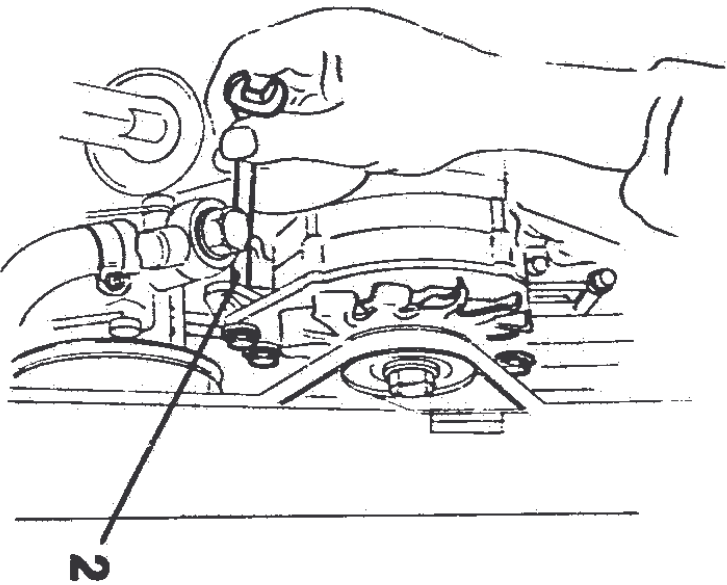
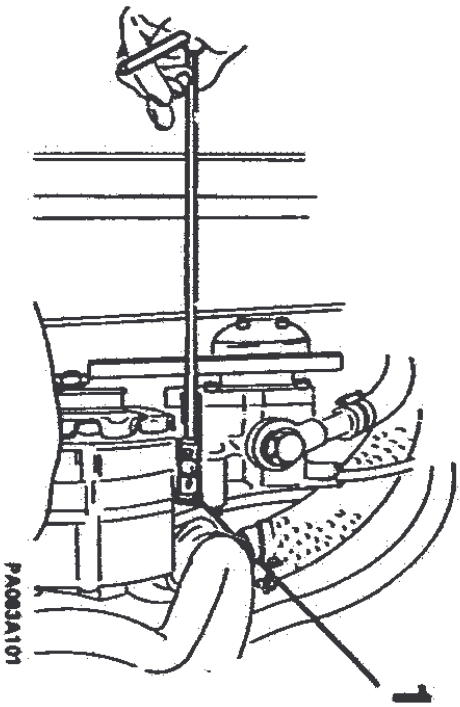




01 - 113

ENGINE ASSEMBLY COMPLETE

REMOVAL OF ENGINE COMPARTMENT COMPONENTS (Continued)



1. Slacken the 3 screws retaining the power steering pump and disconnect the belt.

2. Slacken the 3 alternator mounting bolts and disconnect the belt.



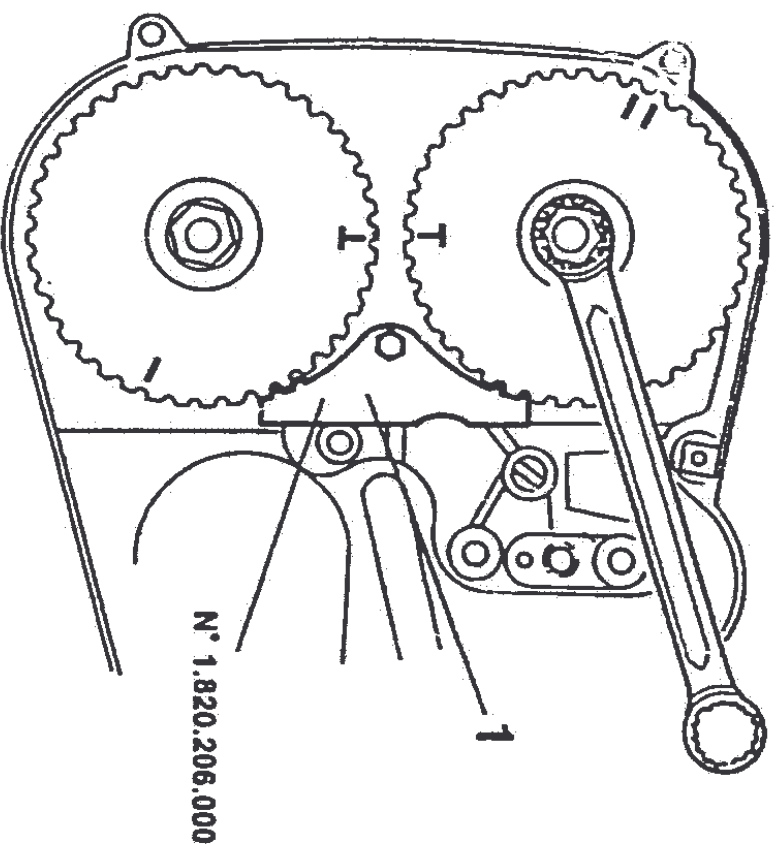


01 - 114

ENGINE ASSEMBLY COMPLETE

REMOVAL OF ENGINE COMPARTMENT COMPONENTS (Continued)

- Remove the two front timing belt protection covers
- Bring piston No.1 up to ignition phase by turning until the "T" on the flywheel coincides with the relative arrow and the camshaft sprocket marks coincide.
- Slacken the belt-tensioners and remove the belt.
- Disconnect the spring from the belt-tensioners and remove them.
- Remove the rollers.
- Insert the sprocket lock tool No. 1.820.206.000.
- Remove the camshaft sprocket.
- Remove the two inside guards.

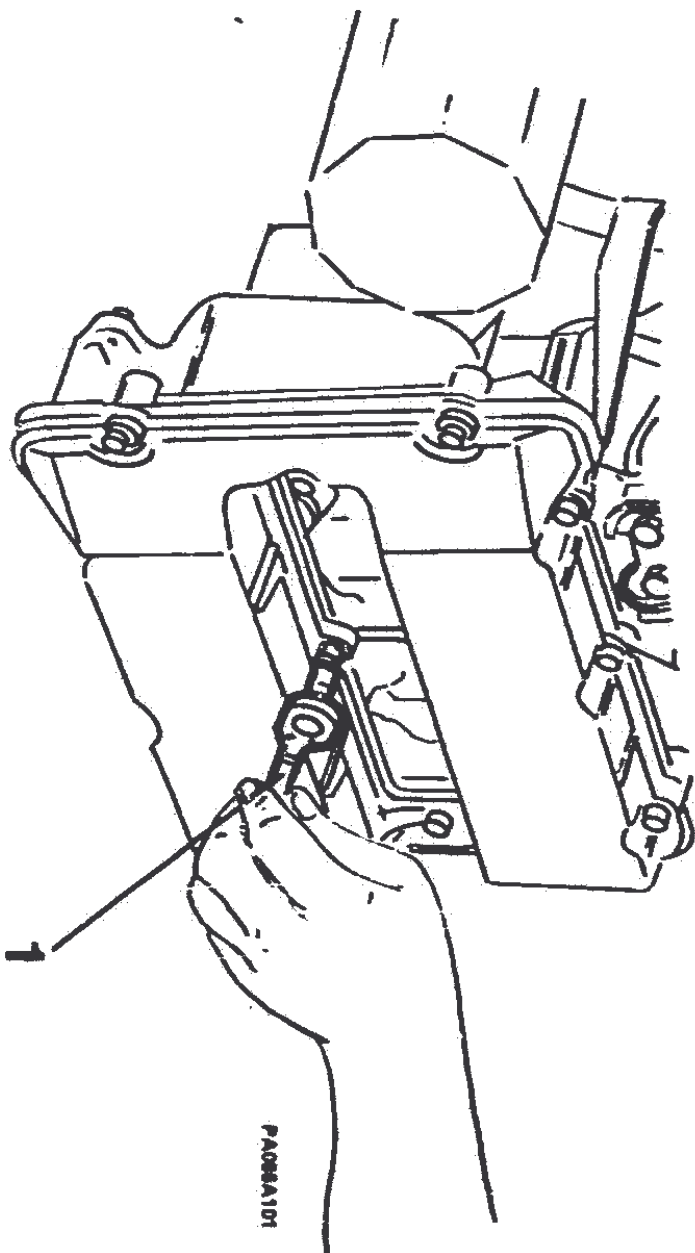




01 - 115

ENGINE ASSEMBLY COMPLETE

REMOVAL OF ENGINE COMPARTMENT COMPONENTS (Continued)



- Remove the two engine bay reinforcing struts.

1. Remove the camshaft covers using a specially shortened socket wrench.

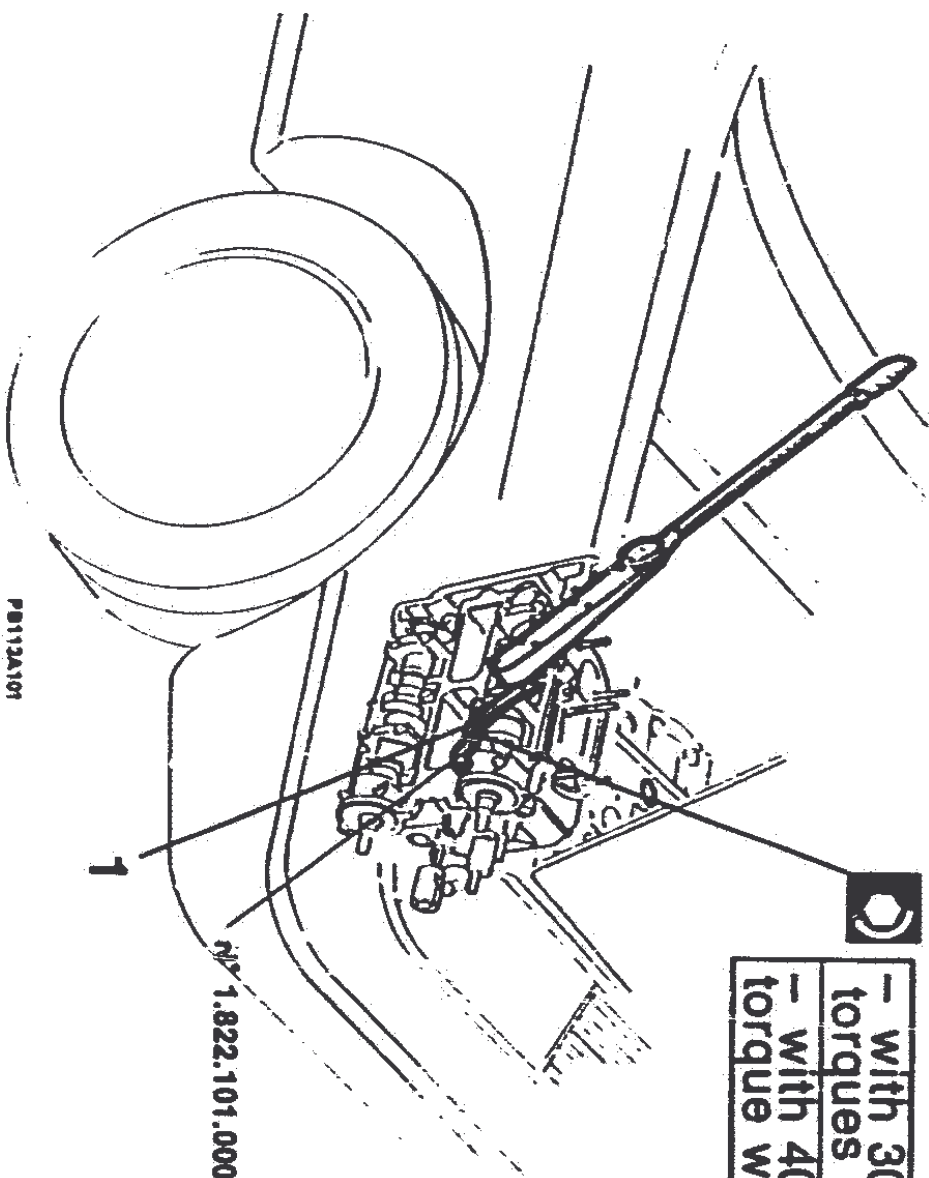




01 - 116

ENGINE ASSEMBLY COMPLETE

REMOVAL OF ENGINE COMPARTMENT COMPONENTS (Continued)



- with 300 mm torques wrench	65 ÷ 67 Nm (6,6 ÷ 6,9 Kgm)
- with 400 mm torque wrench	70 ÷ 73 Nm (7,1 ÷ 7,4 Kgm)

- Remove the cylinder head bolts using spanner No. 1.822.101.000 and appropriate leverage.
- Remove the cylinder heads from the engine bay with due care.
- 1. When reassembling, tighten the bolts to the torque values specified.



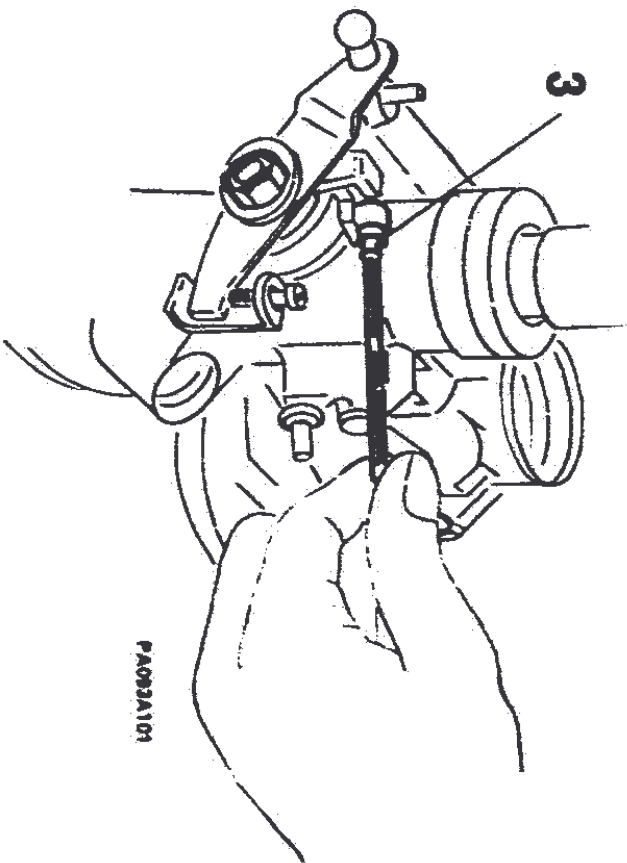
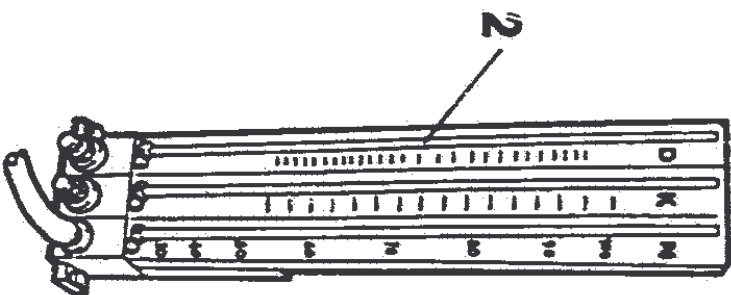
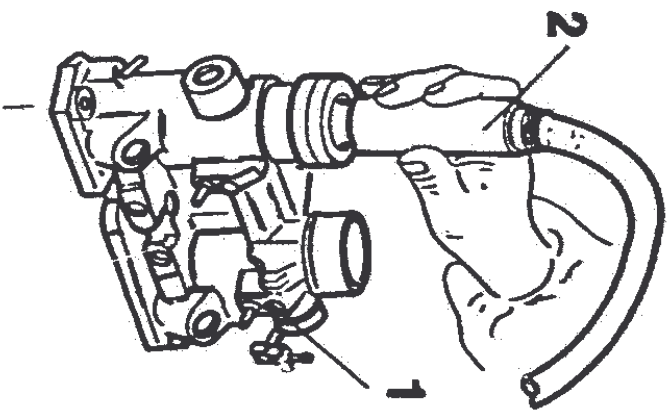
If working with the engine on a bench the tightening torques will vary (see TSN).



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ENGINE ASSEMBLY COMPLETE

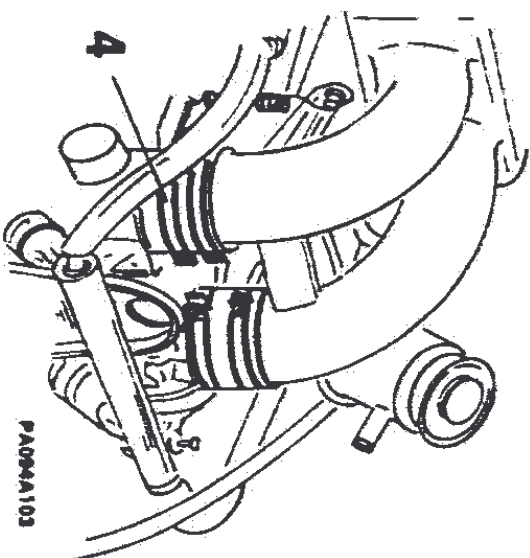
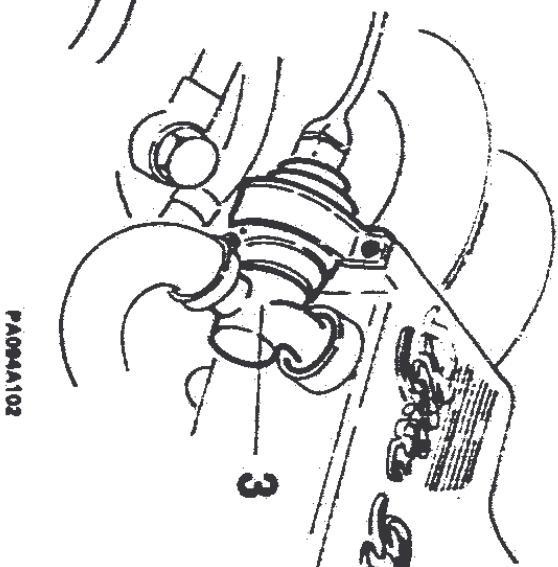
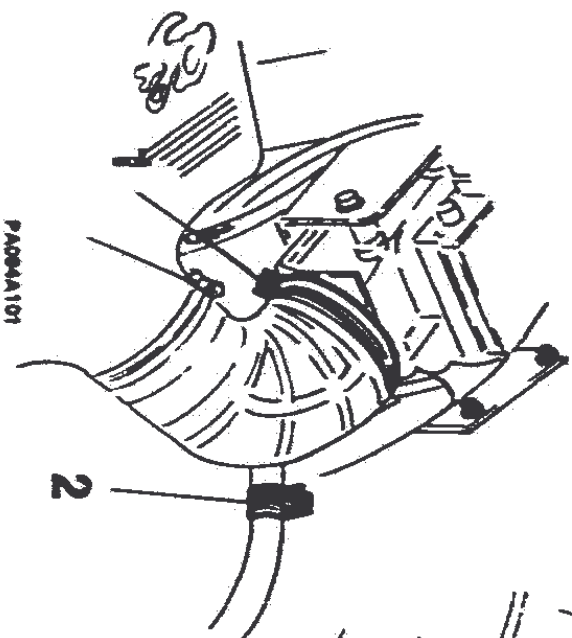
FLOWTESTING ON THE BENCH



1. Remove the seals on the by-pass screws and screw them fully home.
2. Set the flowmeter to read on scale "K".
3. Adjust the throttle regulating screw to obtain a reading of $120 \div 130$.
 - Once the throttles have been adjusted, open (unscrew) the by-pass screws and check for flow readings of $185 \div 190$ on scale "N".



FLOWTESTING (Continued) IN THE VEHICLE

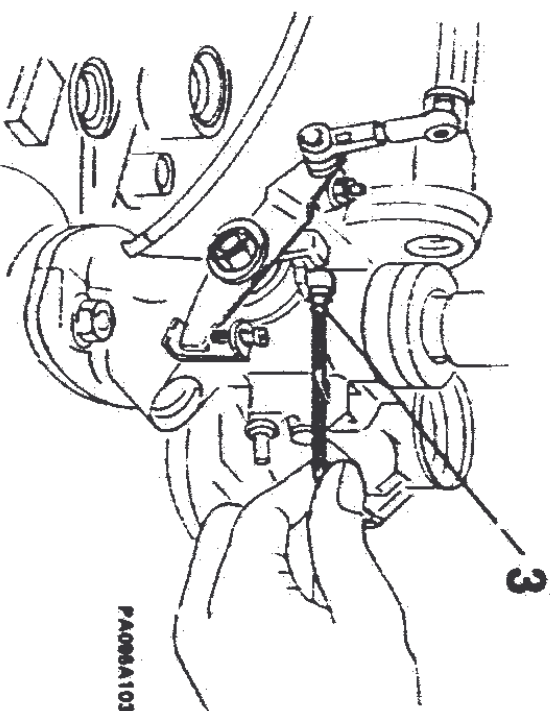
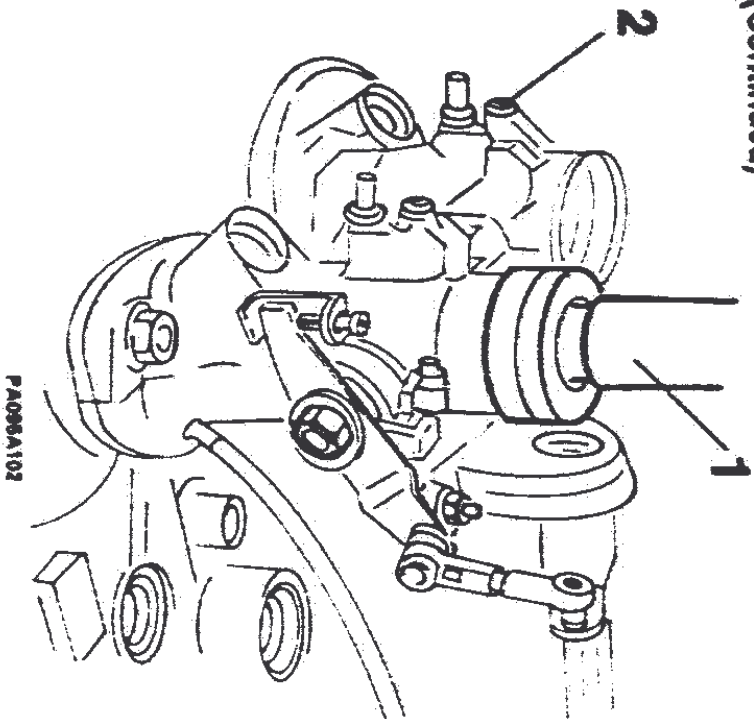
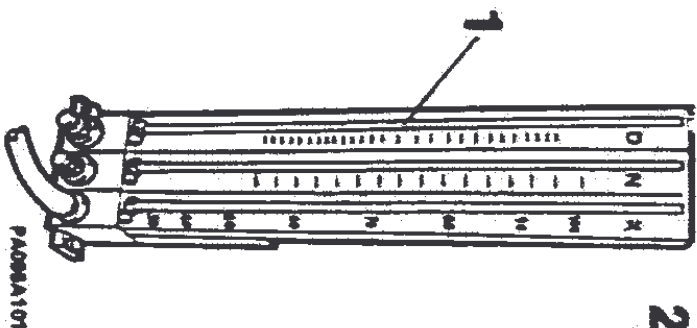


- Disconnect the battery negative lead.
- 1. Slacken the hose clip holding the corrugated pipe to the air-flow meter.
- 2. Slacken the breather return pipe clip.
- 3. Remove the constant idling actuator from the air box.
- 4. Loosen the four lower clamps securing the intake box to the throttle bodies and remove the intake box.



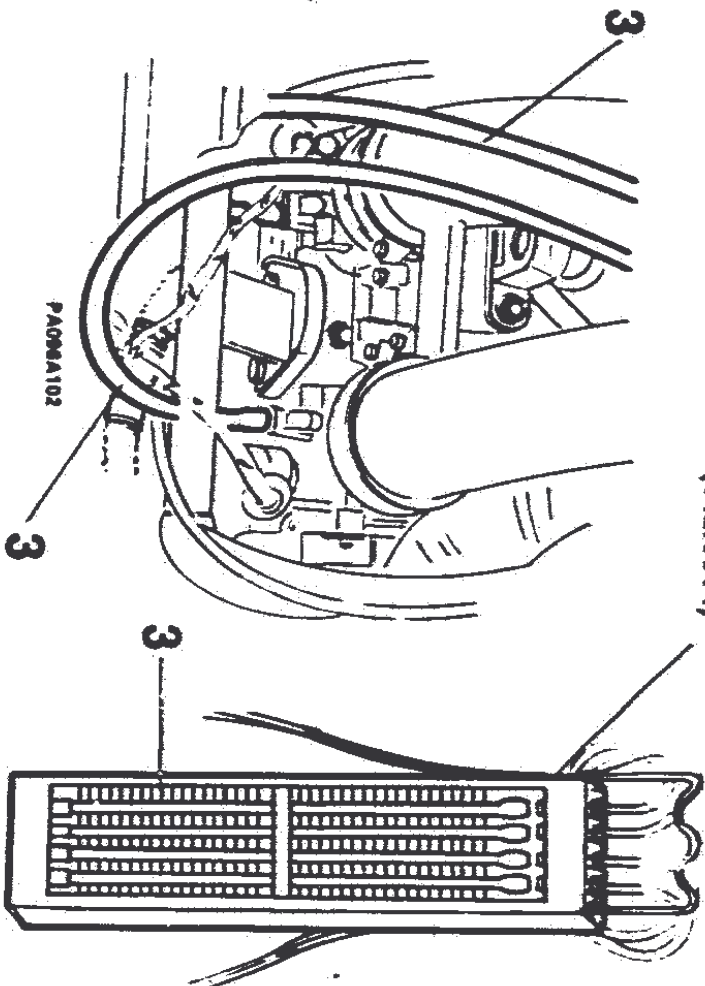
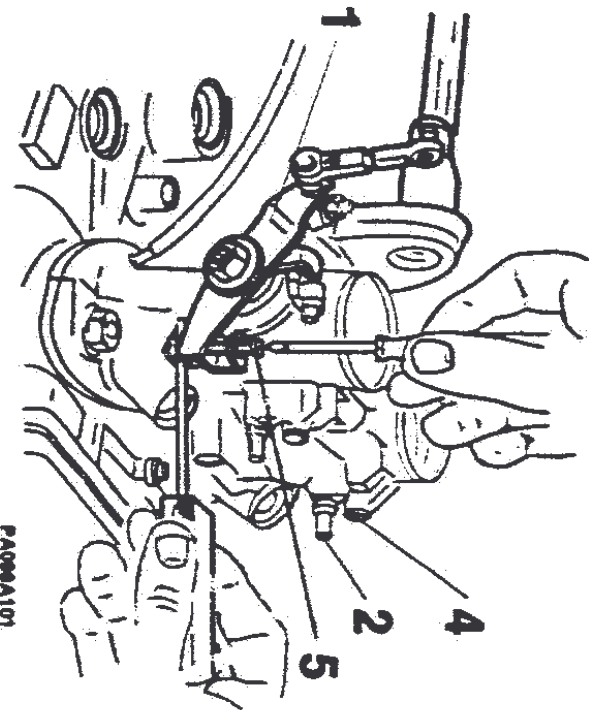


FLOWTESTING IN THE VEHICLE (Continued)



1. Using a flowmeter take measurements for each injector tube. Make sure that flows fall between $185 \div 190$ on the N scale.
 - If the specified values are not read, proceed as follows:
2. Remove the seals from the by-pass screws.
 - With the flowmeter set to scale K, make sure that flow values lie between $120 \div 130$.
3. If these values are not read, adjust the throttle screw.
 - With the throttles adjusted, open the by-pass passages until flow values of $185 \div 190$ are reached on the N scale.

FLOWTESTING (Continued) INJECTOR TUBE ALIGNMENT AND SYN- CHRONISING



N° 1.824.002.003
(C.2.0014)

1. Check the play in the two slackened levers. Recommended value: 1mm.
2. Slacken the vacuum outlets.
3. Connect the outlets to vacuum gauge No. 1.824.002.000 (C.2.0014).
4. With the engine at idle speed check that the difference between cylinders does not exceed 25 mmHg and if necessary adjust the by-pass screws.

5. If there is a pressure difference between cylinders on the same bank of over 25 mmHg, despite the adjustment, substitute that injector tube.
6. Accelerate gently a few times and check that the manometer columns shift simultaneously; in the event of lack of synchronism, adjust the regulating screws on the slackened levers.

PA096A103



01 - I

ENGINE ASSEMBLY COMPLETE

ELECTRONIC-INJECTION ENGINE (16 VALVES)

TSN - TECHNICAL SPECIFICATIONS AND NOTES

TECHNICAL SPECIFICATIONS AND NOTES

ENGINE DATA.....	01 - 121
BLOCK.....	01 - 122
CRANKSHAFT.....	01 - 123
MAIN BEARING SHELLS.....	01 - 125
THRUST HALF-WASHERS.....	01 - 125
FLYWHEEL.....	01 - 126
PISTONS.....	01 - 127
GUDGEON PINS.....	01 - 128
PISTON RINGS.....	01 - 128
CONNECTING RODS.....	01 - 129

BIG-END BEARING SHELLS.....	01 - 129
CYLINDER HEADS.....	01 - 130
VALVES.....	01 - 131
VALVE SEAT REGRINDING ALLOWANCES.....	01 - 131
SPRINGS.....	01 - 132
CAMSHAFT BEARINGS AND TAPPETS.....	01 - 132
CAMSHAFT.....	01 - 133
ASSEMBLY CLEARANCES AND INTERFERENCES.....	01 - 134
HEATING TEMPERATURES.....	01 - 135



01 - 121

ENGINE ASSEMBLY COMPLETE

TECHNICAL SPECIFICATIONS AND NOTES

ENGINE DATA

DATA	30746 - 30747
Type	Otto cycle, 4/stroke
Cylinders	4 horizontally opposed
Fuel system	electronic ignition
Bore - stroke	87 x 72
Cubic capacity	1712
Combustion chamber volume	47,5
Compression ratio	10:1
Maximum power DIN	98 (137) 95 (132) Δ at 6500 RPM.
Maximum torque DIN	157 (16,4) 151 (15,8) Δ at 4600 RPM.

(Δ) With catalytic converter.



ENGINE ASSEMBLY COMPLETE

REFERENCE DIMENSIONS

ENGINES

30746 - 30747

Cylinder bore diameter "a" mm	Standard	cl. A	87,000 ÷ 87,010
		cl. B	87,010 ÷ 87,020
	cl. C	87,020 ÷ 87,030	
	cl. D	87,030 ÷ 87,040	
	cl. E	87,040 ÷ 87,050	
Oversize	1 ^a	87,200 ÷ 87,210	
	2 ^a	87,400 ÷ 87,410	
	3 ^a	87,600 ÷ 87,610	

Maximum alignment error between cylinder and crankshaft axes. mm

0.05

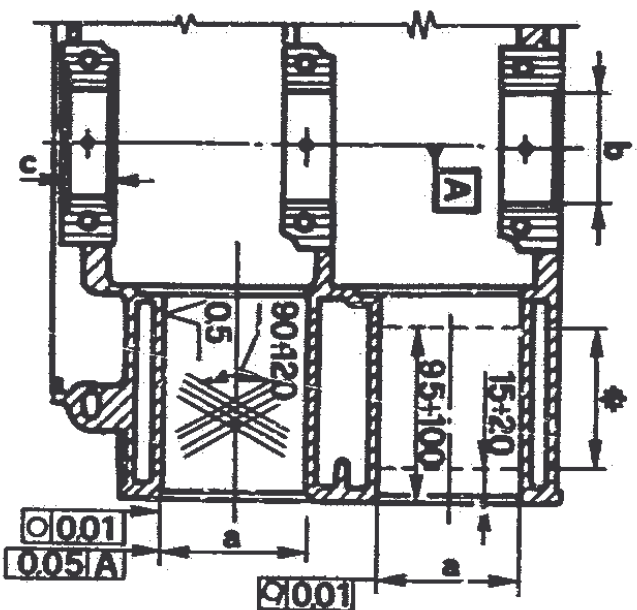
Max. cylinder ovality and taper mm	As in drawing	0,01
	Max	0,02

Cylinder surface finish μm

11

 $(0.5 \div 1)$

Cylinder lapping pattern

 $90^\circ \div 120^\circ$ 

PA117A101

7) Main bearing diameter "b" mm

$$63,663 \div 63,673$$

Rear main bearing thickness "c"

mm

$$23,68 \div 23,73$$

- Area for dimensional checks



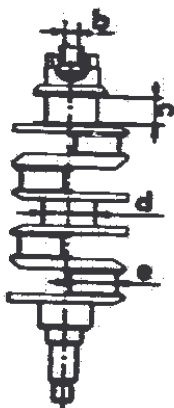
OVALITY X-Y
TAPER A A B



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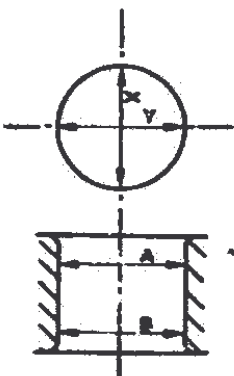
ENGINE ASSEMBLY COMPLETE

CRANKSHAFT (CONTINUED)



GEAR TOOTH

FLYWHEEL CENTERING DOWEL



OVALITY X-Y
TAPER A A B

PAT118A101

REFERENCE DIMENSIONS			Unit: mm
			ENGINES
			30746 - 30747
Crankshaft and crankpin journals surface finish	μm		0.16
Crankshaft and crankpin journals, ovality X-Y and taper A-B	As drawing Maximum		0,006 0,02
Maximum parallelism error between crankshaft and crankpin journals			0,015
Maximum eccentricity between crankshaft journals			0.02
Maximum deviation between crankpin and main bearing axes			0.25
Maximum perpendicular alignment error between crankwebs and crankshaft axis			0.03
Rear crankshaft bush diameter "b"			16,065 ÷ 16,080
Rear crankshaft gear orientation "α" (Oil pump/distributor drive)			24° ± 2°



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ENGINE ASSEMBLY COMPLETE

MAIN BEARING SHELLS



PA120A101

THRUST HALF-WASHERS



PA120A102

REFERENCE DIMENSIONS		Unit: mm
ENGINE		
30746 - 30747		
Thickness "a"	Red	1,832 ÷ 1,838
	Blue	1,836 ÷ 1,842

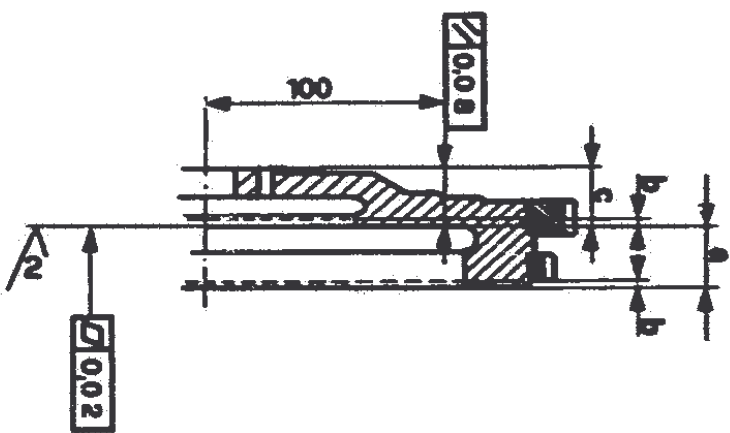
REFERENCE DIMENSIONS		Unit: mm
ENGINE		
30746 - 30747		
Thickness "a"		2,311 ÷ 2,362



01 - 126

ENGINE ASSEMBLY COMPLETE

FLYWHEEL



PA127A101

REFERENCE DIMENSIONS		Unit: mm
		ENGINES
		30746 - 30747
Machining allowances	a	24,0 ÷ 24,2
	b	≤ 0,2
	c	≥ 21,15
Maximum parallelism error between clutch driven-plate bearing surface and flywheel engine mating surface (measured on a 100 mm radius)		0,08
Maximum flatness error for clutch driven-plate bearing surface		0,02
Surface finish for clutch driven-plate bearing surface		μm 2

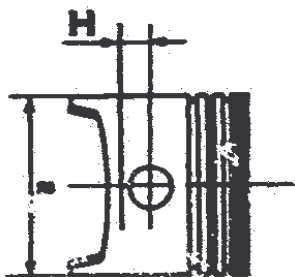
Note: Metal removed in machining, dimension "b", must be the same for both the clutch driven-plate bearing surface and the clutch pressure plate cover mounting surface, so that dimension "a" remains constant. Dimension "c" must not fall below the value shown.



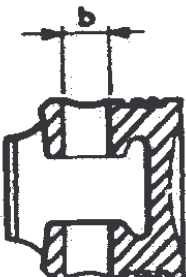
01 - 127

ENGINE ASSEMBLY COMPLETE

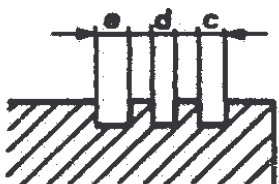
PISTONS



PA122A101



PA122A102



PA122A103

REFERENCE DIMENSIONS

REFERENCE DIMENSIONS		ENGINES		
		30746 - 30747		
		Mondial (1)	Borgo (2)	
Piston diameter "a" (to be measured at right angles to the gudgeon-pin axis at distance "H" from it)	Standard	Class A (Blue)	86,950 - 86,960	86,960 - 86,970
		Class B (Pink)	86,960 - 86,970	86,970 - 86,980
		Class C (Green)	86,970 - 86,980	86,980 - 86,990
		Class D (Yellow)	86,980 - 86,990	86,990 - 87,000
		Class E (White)	86,990 - 87,000	87,000 - 87,010
	Oversize	1"	87,144 - 87,160	87,150 - 87,170
		2"	87,344 - 87,360	87,350 - 87,370
		3"	87,544 - 87,560	87,550 - 87,570
First compression ring groove height "c"	1,535 - 1,555	1,515 - 1,535		
Second compression ring groove height "d"	1,775 - 1,795			
Oil scraper-ring groove height "e"	3,015 - 3,035			
Gudgeon-pin bore in piston "b"	21,004 - 21,008			

Units: mm

(1) H = 13,9 mm

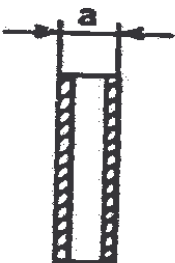
(2) H = 11,5 mm



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ENGINE ASSEMBLY COMPLETE

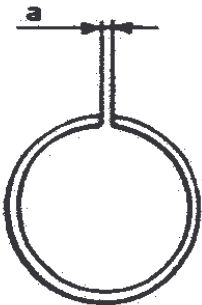
GUDDGEON PINS



PA123A101

REFERENCE DIMENSIONS	Engines	
	Engines	
	30746 - 30747	
Gudgeon pin diameter "a"	20,966 ÷ 21,000	
Gudgeon pin end float	0,004 ÷ 0,012	

PISTON RINGS



PA123A102

REFERENCE DIMENSIONS	Engines	
	Engines	
	30746 - 30747	
Ring thickness "b"	First ring	1,478 ÷ 1,490
	Second ring	1,728 ÷ 1,740
	Oil scraper ring	2,978 ÷ 2,990
	First ring	0,30 ÷ 0,50
Ring gap (1) "a"	Second ring	0,30 ÷ 0,50
	Oilscraper ring	0,25 ÷ 0,50
	Maximum gap for each ring	1

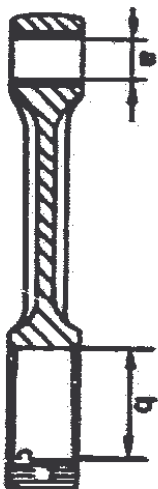
(1) As measured inside measurement ring or cylinder bore



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CONNECTING RODS

ENGINE ASSEMBLY COMPLETE



PA124A101

REFERENCE DIMENSIONS	ENGINES
	30746 - 30747
Small end bush bore "a"	21,007 ÷ 21,015
Big end bore "b"	53,696 ÷ 53,708

Units: mm

BIG-END BEARING SHELLS



PA124A102

REFERENCE DIMENSIONS	ENGINES	
	30746 - 30747	
Big-end shell thickness "a"	Blue	1,830 ÷ 1,836
	Red	1,826 ÷ 1,832

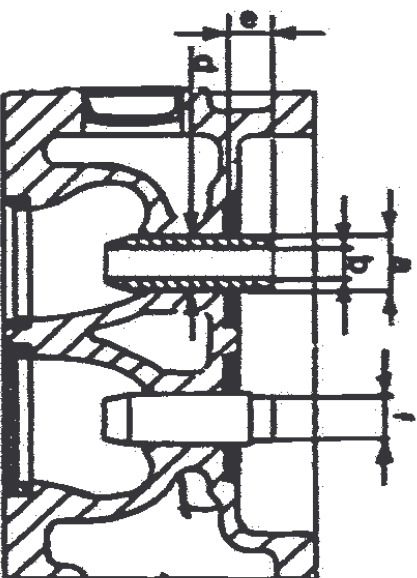
Units: mm



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ENGINE ASSEMBLY COMPLETE

CYLINDER HEADS



REFERENCE DIMENSIONS

ENGINES

30746 - 30747

Unit: mm

Valve guide seat bore "d"

12,000 + 12,018

Valve guide outside diameter "a"

Intake

Standard

12,040 + 12,051

Overize

12,240 + 12,251

Exhaust

Standard

12,050 + 12,068

Overize

12,250 + 12,268

Valve guide bore "b"

7,000 + 7,015

Valve oil seal seating diameter "f"

9,75 + 9,85

Valve guide projection "e"

10,35 + 10,65

Maximum parallelism error between cylinder head machined surfaces

0,05

Maximum flatness error, cylinder head joint face

0,03

Surface finish, cylinder head joint face

μm

1,6

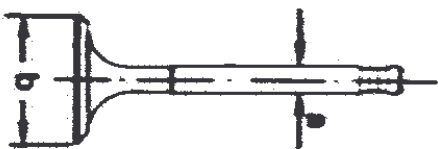
(1) When skimming heads with hemispherical combustion chambers, the operation must be performed to both heads on the same engine.



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ENGINE ASSEMBLY COMPLETE

VALVES



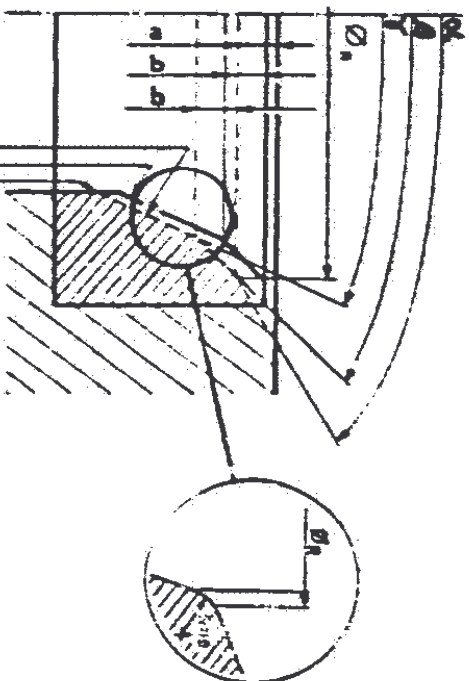
PA12GA101

REFERENCE DIMENSIONS

		Engines
		30746 - 30747
Valve stem diameter "a"	Intake	8,985 + 0,98
	Exhaust	
Valve head diameter "b"	Intake	31,8 ÷ 32,0
	Exhaust	25,8 ÷ 26,0

Units: mm

VALVE SEAT REGRINDING ALLOWANCES



PA12GA102

1 VALVE SEAT
2 ORIGINAL PROFILE
3 PROFILE AFTER WALT NO. OF REGRINDS

REFERENCE DIMENSIONS

		Engines
		30746 - 30747
Reference diameter "Ø R"	Intake	31,0
	Exhaust	24,5
Maximum regrind allowance for upper valve seat band "a"	Intake	0,4
	Exhaust	1,1
Maximum regrind allowance for valve seat contact band	Intake	R = 0,9 b = 1,1
	Exhaust	
Maximum upper valve seating angle "α"	Intake	150°
	Exhaust	120°
Maximum valve seat contact band angle "β"	90° ± 20°	
Inner valve seat angle "γ"	Intake	75°
	Exhaust	60°

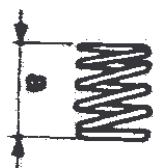
Units: mm



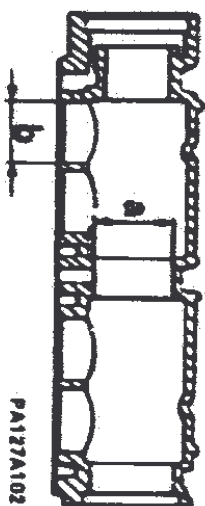
01 - 132

ENGINE ASSEMBLY COMPLETE

SPRINGS



PA127A101



PA127A102



PA127A103

CAMSHAFT BEARINGS AND TAPPETS

REFERENCE DIMENSIONS			Unit: mm
			ENGINES
			30746 - 30747
Spring length with valve open "a"	Outer spring	mm	22,9
	Inner spring	mm	20,9
Spring load at length "a"	Outer spring N	(kg)	349,312 ± 9,8 (35,62 ± 1)
	Inner spring N	(kg)	321,530 ± 8,82 (32,79 ± 0,9)

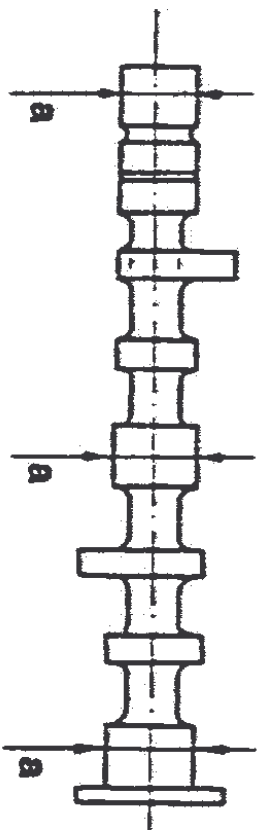
REFERENCE DIMENSIONS		Unit: mm
		ENGINES
		30746 - 30747
Camshaft bearing seat diameter "a"		27,000 ÷ 27,033
Tappet housing diameter "b"		33,000 ÷ 33,025
Tappet diameter "c"		32,975 ÷ 32,959



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ENGINE ASSEMBLY COMPLETE

CAMSHAFT



PA127A101

Unit: mm

REFERENCE DIMENSIONS		ENGINES
		30746 - 30747
Cam lift	Intake	9,00 *
	Exhaust	9,50 **
Camshaft journal diameter (a)		26,959 ÷ 26,980

* Outer cams

** Inner cams



01 - 134

ENGINE ASSEMBLY COMPLETE

ASSEMBLY CLEARANCES AND INTERFERENCES

Units: Nm (Kgm)

REFERENCE DIMENSIONS		ENGINES	
		30746 - 30747	
Piston float	Standard	0,04 ÷ 0,06 (*)	0,03 ÷ 0,05 (**)
	Oversize	0,04 ÷ 0,06 (*)	0,03 ÷ 0,05 (**)
	First ring	0,045 ÷ 0,077	
Piston ring float	Second ring	0,035 ÷ 0,067	
	Oil scraper ring	0,025 ÷ 0,057	
Gudgeon pin radial float		0,004 ÷ 0,012	
Gudgeon pin play in small-end bush		0,007 ÷ 0,049	
Crankshaft main bearing radial float		0,024 ÷ 0,056	
Crankpin radial float		0,032 ÷ 0,064	
Crankshaft end float		0,056 ÷ 0,248	

(*) Mondial piston (**) Borgo piston

(CONTINUED)



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ENGINE ASSEMBLY COMPLETE

ASSEMBLY CLEARANCES AND INTERFERENCES (CONTINUED)

Unit: mm

REFERENCE DIMENSIONS

	ENGINES	
	30746 - 30747	
Camshaft bearing radial float	Front	0,02 + 0,074
	Centre - Rear	0,02 + 0,074
Radial clearance between tappet bucket and seat in camshaft support	0,041 + 0,05	
Valve radial float in guide	Intake	0,02 + 0,05
	Exhaust	0,02 + 0,05
Valve guide/seat interference	Intake	0,022 + 0,051
	Exhaust	0,032 + 0,068

HEATING TEMPERATURES

COMPONENT	ENGINES	
	30746 - 30747	
Cylinder head heating temperature for valve seat insertion	100° ÷ 120 °C	
Gear ring heating temperature for fitting to flywheel	120° ÷ 140 °C	



01 - L

ENGINE ASSEMBLY COMPLETE

**ELECTRONIC-INJECTION
ENGINE (16 VALVES)**

TSN

- TECHNICAL SPECIFICATIONS
- AND NOTES (Continued)
- SPECIAL TOOLS

**TECHNICAL SPECIFICATIONS
AND NOTES**

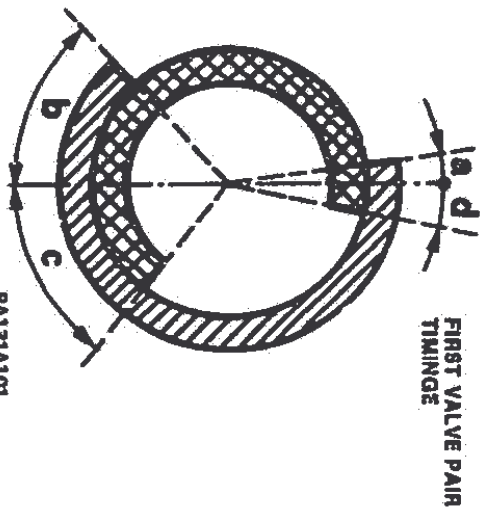
CHECKS AND ADJUSTMENTS	01 - 136
FLUIDS AND LUBRICANTS.....	01 - 137
SEALANTS AND FIXING AGENTS	01 - 137
ABRASIVES.....	01 - 137
TIGHTENING TORQUES.....	01 - 138
SPECIAL TOOLS	01 - 140



01 - 136

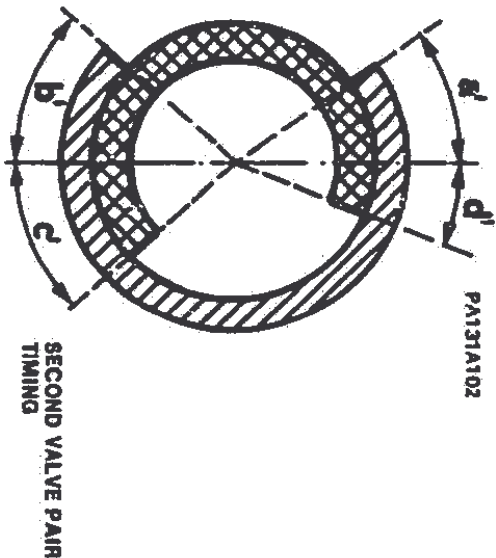
ENGINE ASSEMBLY COMPLETE

CHECKS AND ADJUSTMENTS



INTAKE
EXHAUST

PA131A102



VALVE TIMING ANGLES		ENGINES	
		30745 - 30747	
Intake	Opening (before T.D.C.)	a a'	8° 35°
	Closing (after T.D.C.)	b b'	48° 48°
Exhaust	Opening (before T.D.C.)	c c'	52° 42°
	Closing (after T.D.C.)	d d'	12° 22°



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ENGINE ASSEMBLY COMPLETE

FLUIDS AND LUBRICANTS

APPLICATION	TYPE	PRODUCT	Q.TY
Engine (sump and filter) for periodical replacement	OIL	AGIP NUOVO SINT 2000 10W/40	3,6 kg (4,0 l)
Engine (sump, filter, manifolds and distribution tanks)		IP SINTIAX Motor Oil 10W/40	4,1 kg (4,6 l)
		SELENIA SPECIAL FORMULA ALFA ROMEO 10W/40	

SEALANTS AND FIXING AGENTS

APPLICATION	TYPE	PRODUCT	Q.TY
Oil sump gasket, block side (1)	MASTIC	DOW CORNING Silastik 732 RTV	-
Cylinder head and block waterway core plugs (1)	MASTIC	LOCTITE 601 (green)	-

(1) Before application remove all traces of old compound and degrease surfaces with trichloroethylene or chloroethane.

ABRASIVES

APPLICATION	TYPE	PRODUCT	Q.TY
Valve and seat lapping	ABRASIVE	SIPAL AREXONS Carbosilicium for valves	-



01 - 138

ENGINE ASSEMBLY COMPLETE

TIGHTENING TORQUES

Units: Nm (Kgm)

COMPONENT	ENGINES	
	30746 - 30747	
Block front and rear cover mounting bolts	19 ÷ 24 (1,9 ÷ 2,4)	
Camshaft sprocket retaining nut (in oil)	63 ÷ 70 (6,4 ÷ 7,1)	
Main bearing retaining bolts (in oil)	66 ÷ 73 (6,7 ÷ 7,4)	
Main bearing cap bolts (in oil)	40 ÷ 49 (4,1 ÷ 5)	
Flywheel mounting bolts (in oil)	94 ÷ 105 (9,6 ÷ 10,7)	
Big-end bearing cap bolts	43 ÷ 48 (4,4 ÷ 4,9)	
Front crankshaft pulley retaining nut	118 ÷ 144 (12 ÷ 14,7)	
Drive shaft/differential shaft union bolts (in oil)	30 ÷ 35 (3,0 ÷ 3,5)	
Belt-tensioner retaining nut	With engine cold	37 ÷ 46 (3,8 ÷ 4,7)
	With engine hot	29 ÷ 35 (3 ÷ 3,6)
Oil-pressure switch unit	33 ÷ 41 (3,4 ÷ 4,2)	
Bolts holding front engine cross-member and stabilizer bar to body	66,5 ÷ 83,3 (6,8 ÷ 8,5)	
Bolts holding stabilizer bar to struts	14,7 ÷ 23,5 (1,5 ÷ 2,4)	
Cylinder head bolts	93 ÷ 97 (9,5 ÷ 9,9)	

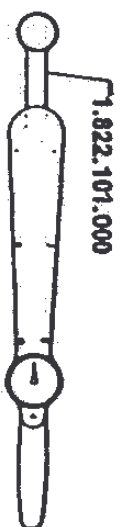
(1) If a torque wrench is used with extension No. 1.822.101.000 as shown in the drawing, torque values become:

to be positioned

(CONTINUED)

- with 300 mm torque wrench
- with 400 mm torque wrench

65 ÷ 67 Nm (6,6 ÷ 6,8 Kgm)
70 ÷ 73 Nm (7,1 ÷ 7,4 Kgm)



PA136A101



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ENGINE ASSEMBLY COMPLETE

TIGHTENING TORQUES (Cont.)

Units: Nm (Kgm)


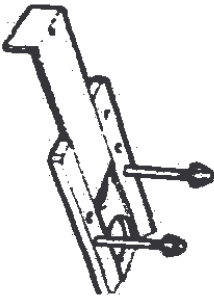
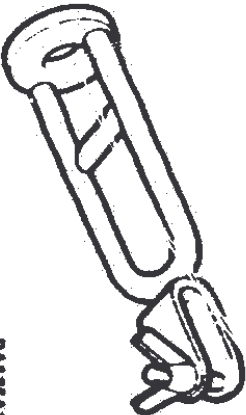
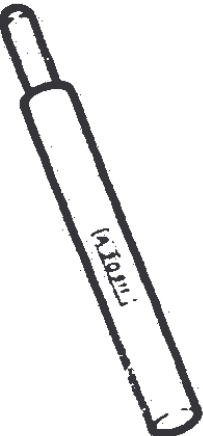
COMPONENT	ENGINES	
	30746 - 30747	
Camschaft bearing block bolts	19 ÷ 24 (1,9 ÷ 2,4)	
Water filler pipe screws	19 ÷ 24 (1,9 ÷ 2,4)	
Oil pump mounting nuts	19 ÷ 24 (1,9 ÷ 2,4)	
Cooling system temperature sensor	15 (1,5)	
Oil pump body/support union bolts	8 ÷ 10 (0,8 ÷ 1)	
Water pump retaining bolts	19 ÷ 24 (1,9 ÷ 2,4)	
Intake manifold nuts	19 ÷ 24 (1,9 ÷ 2,4)	
RH head temperature switch	33 ÷ 41 (3,4 ÷ 4,2)	
Spark plugs	25 ÷ 34 (2,5 ÷ 3,5)	
Gearbox-differential/engine union bolts	39 ÷ 48 (4 ÷ 4,9)	
Front cross-member/strut union bolts	53 ÷ 85 (5,4 ÷ 8,7)	
Clutch circuit hose to pipe union	15 ÷ 19 (1,5 ÷ 1,9)	



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ENGINE ASSEMBLY COMPLETE

SPECIAL TOOLS

1.820.012.000 (A.2.0195)	Cylinder head support clamp	 PA138A101
1.820.016.000 (A.2.0226)	Cylinder head support fork	 PA138A102
1.821.205.000	Valve assembly tool	 PA138A104
1.821.176.000 (A.3.0641)	Valve guide extractor	 PA138A103



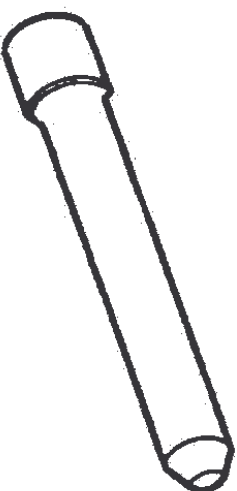


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ENGINE ASSEMBLY COMPLETE

1.821.207.000

Intake valve-guide insertion tool



PA136A101

1.821.204.000

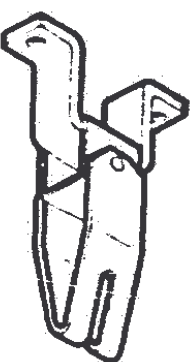
Camshaft seal insertion tool



PA136A102

1.821.001.000
(A.3.0103)

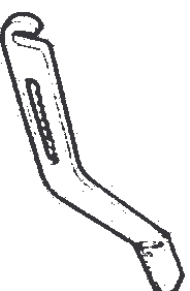
Valve assembly bracket



PA136A104

1.821.058.000
(A.3.0324)

Valve assembly lever



PA136A103



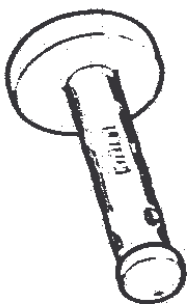


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ENGINE ASSEMBLY COMPLETE

1.821.063.000
(A.3.0337)

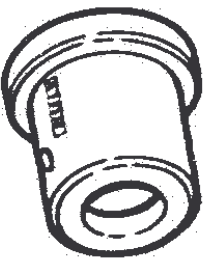
Rear crankshaft oil seal insertion tool



PA137A101

1.821.064.000
(A.3.0338)

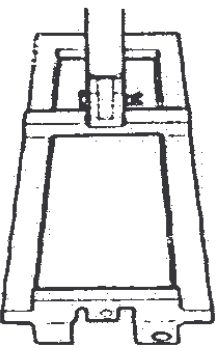
Front crankshaft oil seal insertion tool



PA137A102

1.820.208.000

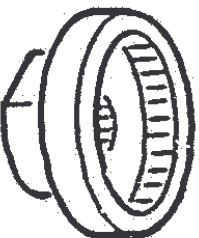
Engine-transmission unit removal tool



PA137A104

1.820.209.000

Anti-torque flange for electromagnetic coupling



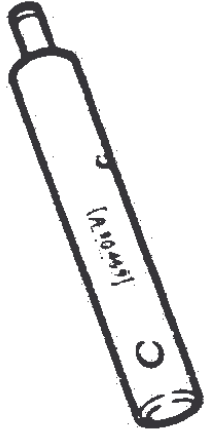
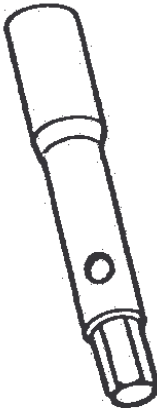
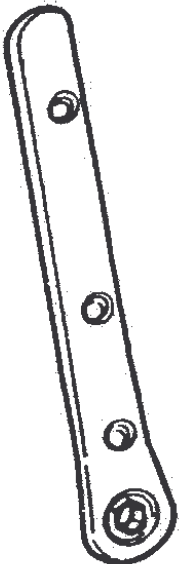

PA137A103





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ENGINE ASSEMBLY COMPLETE

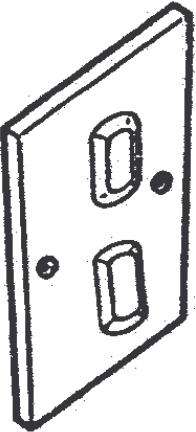

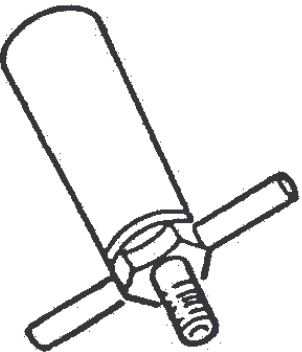
1.821.110.000 (A.3.0469)	Intake valve oil seal insertion tool	 PA128A101
1.822.102.000	Spark plug wrench	 PB140A102
1.822.103.000	Ratchet wrench for spark plugs	 PA128A103
1.820.206.000	Camshaft sprocket locking tool	 PA128A104





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ENGINE ASSEMBLY COMPLETE

1.820.207.000	Valve removal plate	 PA139A101
1.822.101.000	Cylinder head bolt key	 PA139A102
1.821.208.000	Valve-guide oil seal extractor	 PA139A103