

# GROUP 01

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**6 cylinders** Alfa 75 2.5 6V iniezione

**6 cylinders** Alfa 90 2.0 6V iniezione

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**ENGINE REMOVAL  
ALFETTA AND  
ALFA 90 MOTRONIC  
(017.13) VEHICLES**

**PRELIMINARY OPERATIONS**

a. Place the vehicle over a garage lift and chock front wheels.

**CAUTION:**

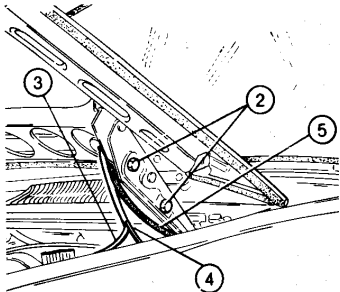
**When the engine is hot, proceed with caution to avoid burns.**

b. Lift covers from covers from windshield wiper arm retaining nuts.

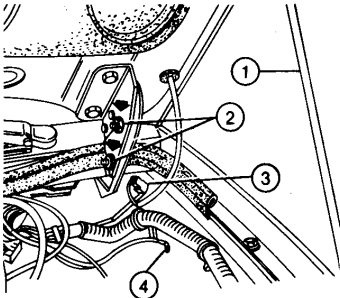
Slacken nuts and remove wipers. Open hood and secure in open position with associated strut (1). Remove hinge bolts (2) and lay hood back in fully open position, **protecting contact areas with suitable soft materials.**

If necessary, disconnect engine compartment light supply (3) and ground (4) cables and windshield washer hose (5).

**ALFETTA VEHICLE**



**ALFA 90 VEHICLE**



- 1. Strut
- 2. Bolts
- 3. Engine compartment light supply (in-line connection)
- 4. Engine compartment light ground cable
- 5. Windshield washer hose

**CAUTION:**

**For maximum safety, the hood should be secured in the open position to prevent it from falling suddenly.**

**ENGINE COMPARTMENT  
COMPONENT DISCONNECTION**

**For location of parts identified by reference numbers below, see the view of the engine compartment for the vehicle in question.**

a. Disconnect positive and negative cables from battery (1). Disconnect the battery tie rods and lift out battery complete with tray.

**b. Cooling circuit disconnection**

— Place a suitable container under the vehicle to collect drained coolant.

— Disconnect lines as follows:

- disconnect suction hose (2) from water pump;
- disconnect delivery hose (3) from thermostat unit;
- disconnect heater return line (4) from water pump;
- disconnect expansion tank/radiator line (5) from radiator;
- disconnect expansion tank/cooling circuit line (6) from pipe tee;
- disconnect heater delivery (7);
- disconnect vent line (8).

**c. Radiator removal**

— Disconnect fan control cable (9) from temperature switch on radiator.

— Disconnect fan supply cable (10) from in-line connection.

— Remove screw (11) retaining radiator to body shell, retrieving spacer and the two cushion pads.

— Remove radiator (12) together with fan (13).

**d. Air intake circuit removal**

— Disconnect cable (14) from air flow sensor.

— Slacken screws on clips (15) and remove corrugated intake duct (16).

— Release clips (17), remove cover (18) together with air flow sensor, and take out the filter element.

— **Alfa 90 - post-modification version**  
Remove the air weighing extension (49) disconnecting it from the fitting on the body shell and from the air filter container.

**e. Fuel supply circuit disconnection**

**CAUTION:**

**Fuel supply circuit is pressurized. Consequently, fuel tank should be drained before disconnecting delivery line. After disconnection, line ends should be held up.**

**Moreover, make sure that the workshop is provided with proper equipment, so as to work safely.**

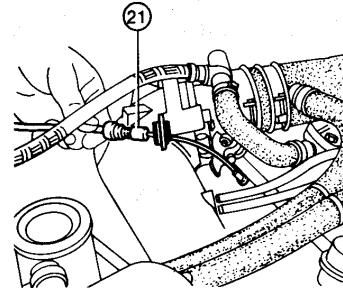
— Disconnect lines as follows:

- disconnect fuel delivery line (19) and remove from fuel inlet manifold side;
- disconnect fuel leak-back line (20) and remove from pressure regulator side.

**f. Accelerator cable disconnection**

— Turn accelerator lever so as to relieve tension on cable and free detent at cable end.

— Release lever and withdraw accelerator cable (21) with associated sheath from bracket.



g. Detach corrugated alternator cooling hose (22) from air intake and from seat on alternator. Remove hose.

h. Disconnect vacuum servo line (23) from intake manifold.

**i. PVC circuit disconnection:**

— Disconnect crankcase vapour line (24) from valve cover.

— Disconnect oil vapour recirculation line (25) from throttle body.

— Disconnect separator return line (26) from dipstick base.

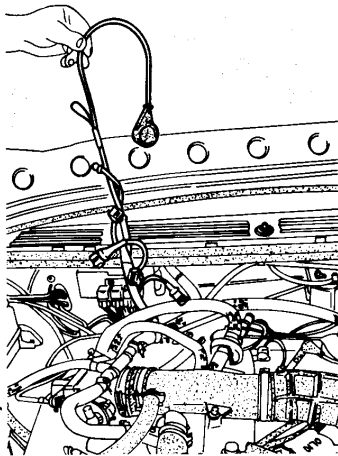
**j. Disconnect the following electrical cables and remove, preferably as indicated.**

- HT cable (27) from ignition coil.
- Alternator supply cable (28) and battery charge indicator cable (29) from terminal board (30) on L.H. side of vehicle (first remove cover).
- Supply cable (31) and field cable (32) from starter.
- Engine oil pressure indicator cable (33) from sending unit on engine block.
- Valve timing variator cable (34) from variator.
- Control cables (35) from electroinjectors.
- Coolant temperature sensor cable (36) from sensor on cylinder head.
- Coolant temperature gauge cable (37) from sending unit on cylinder head.

- High coolant temperature indicator cable (38) from sending unit on cylinder head.
- Throttle position sending unit cable (39) from idle or WOT contact.
- Auxiliary air cable (40) from auxiliary air valve.
- Ground cable (41) from intake manifold and from auxiliary air valve.
- Rev. and timing transducer cables (42) from associated connections.

**NOTE:**

Withdraw electroinjector cables together with all other cables contained in the same sheath.



- Engine oil level indicator cable (43) from in-line connection adjacent to sensor on engine block (see alternator position).
- Low engine oil pressure indicator cable (44) from sending unit on engine block (see distributor position).

Release cables from any clips and arrange so they will not interfere with engine removal.

- k. Remove two screws (45) retaining heat guard on L.H. engine mount.
- l. Remove upper retaining screws (46) from both side engine mounts.
- m. **Power steering circuit disconnection**
  - Disconnect supply line (47) from power steering unit.
  - Disconnect exhaust line (48) from power steering unit.

**UNDERBODY COMPONENT DISCONNECTION**

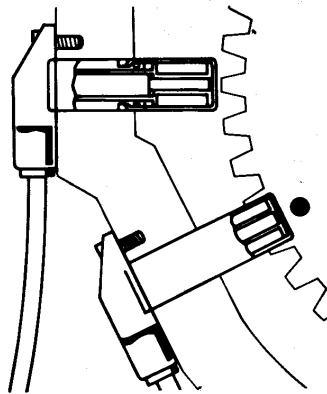
**Alfetta Motronic vehicles:** follow procedure described in paragraphs a. through h. for standard Alfetta and Giulietta vehicles. Before starting the procedure outlined in para. h. carry out operation outlined in para. 1. below.

For location of parts, see view of underbody, Alfetta and Giulietta vehicles.

**Alfa 90 Motronic vehicles:** follow procedure described in paragraphs a. through h. for standard Alfa 90 vehicles. Before starting the procedure outlined in para. h. carry out operation outlined in para. 1. below.

For location of parts, see view of underbody, Alfa 90 vehicles.

1. Back off socket screws and remove engine rev. and timing transducers from bell housing.



**ENGINE INSTALLATION ALFETTA AND ALFA 90 MOTRONIC (017.13) VEHICLES**

**UNDERBODY COMPONENT INSTALLATION**

**Alfetta Motronic vehicles:** follow procedure described in paragraph a. through j. for standard Alfetta and Giulietta vehicles. For location of parts, see view of underbody, Alfetta and Giulietta vehicles.

**Alfa 90 Motronic vehicles:** follow procedure described in paragraphs a. through k. for standard Alfa 90 vehicles.

For location of parts, see view of underbody, Alfa 90 vehicles.

**ENGINE COMPARTMENT CONNECTIONS**

For location of parts identified by reference numbers below, see view of engine compartment for the vehicle in question.

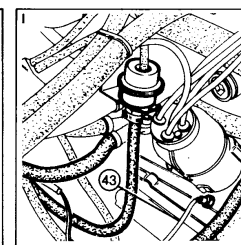
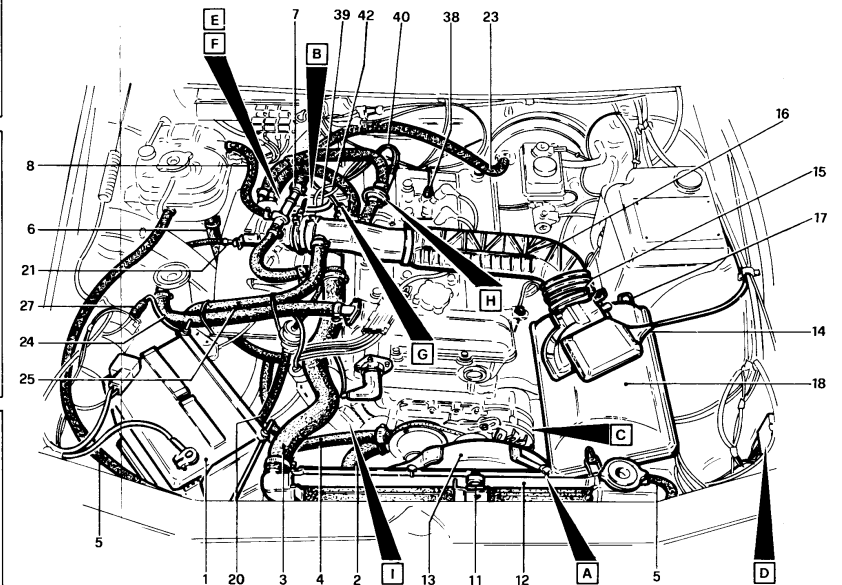
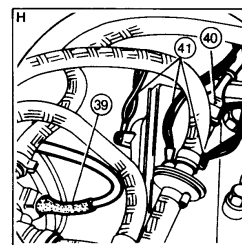
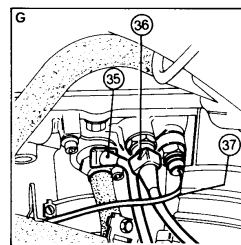
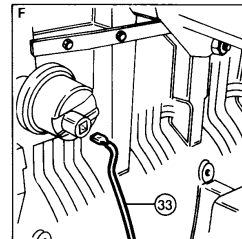
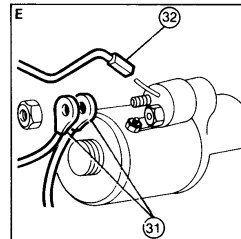
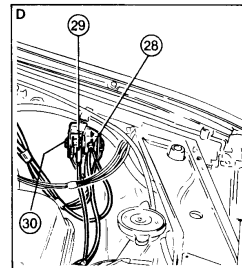
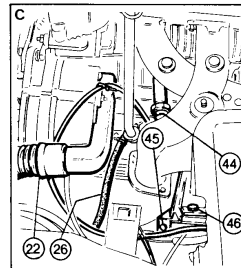
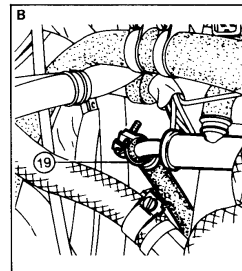
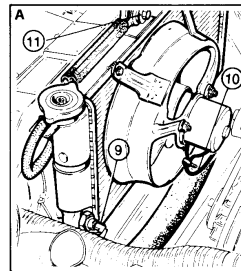
- a. Lower vehicle and secure top of heat guard through screws (45).
- b. Secure top of engine mounts to crossmember through screws (46).
- c. Connect power steering supply line (47) and exhaust line (48). Restore all electrical connections; to do so, follow the procedure described in paragraph j., «Engine compartment component disconnection», in reverse order.
- d. Connect PVC circuit lines following the procedure described in paragraph i., «Engine compartment component disconnection», in reverse order.
- e. Connect accelerator cable following the procedure described in paragraph f., «Engine compartment component disconnection», in reverse order.
- f. Connect alternator cooling hose (22) and vacuum servo line (23) to intake manifold.
- g. Connect fuel and air intake circuits following the procedures described in paragraphs e. and d., «Engine compartment component disconnection», in reverse order.
- h. Install radiator and fan following the procedure described in paragraph c., «Engine compartment component disconnection», in reverse order.
- i. Connect cooling circuit lines following the procedure described in paragraph b., «Engine compartment component disconnection» in reverse order.
- j. Position battery (1) and associated tray in engine compartment. Secure battery with retainer and connect terminals.
- k. Top up fluids and lubricants and carry out adjustments as described in the «Specifications» paragraph of each Group. For Alfa 90 vehicles, see also «GROUP 00».
- l. Hold up hood and install hinge bolts on both sides of vehicle.
- m. Install windshield wiper arms and blades.

## ENGINE MAIN MECHANICAL UNIT

### VIEW OF ENGINE COMPARTMENT ALFETTA 2.0 MOTRONIC (017.13) VEHICLE

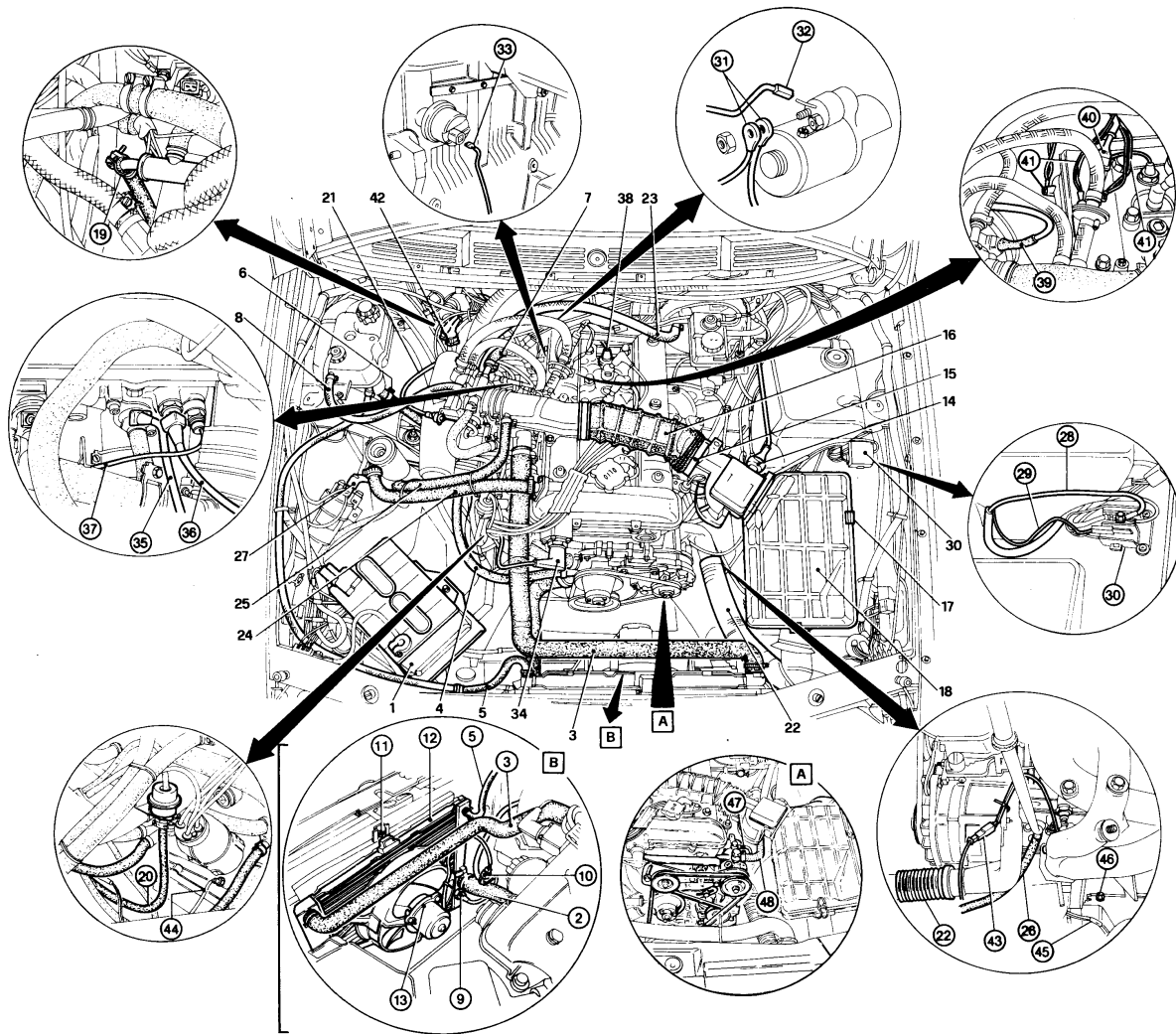
Engine compartment components to be removed or disconnected are listed below in numerical order. For further details, see «ENGINE REMOVAL AND INSTALLATION PROCEDURES».

1. Battery
2. Coolant suction hose (radiator/pump)
3. Coolant delivery hose (engine/radiator)
4. Heater return hose
5. Expansion tank/radiator line
6. Expansion tank/cooling circuit line
7. Heater delivery line
8. Vent line
9. Fan control cable
10. Fan supply cable
11. Radiator retaining screw
12. Radiator
13. Fan
14. Air flow sensor cable
15. Clip
16. Intake duct
17. Clips
18. Cover with air flow sensor
19. Fuel delivery line
20. Fuel return line
21. Accelerator cable
22. Alternator cooling hose
23. Vacuum servo line
24. Crankcase vapour line to oil separator
25. Oil vapour recirculation line
26. Separator return line to oil pan
27. HT cable
28. Alternator supply cable
29. Battery charge indicator cable
30. Terminal board
31. Starter supply cable
32. Starter field cable
33. Engine oil pressure indicator cable
34. Valve timing variator cable
35. Electroinjector control cables
36. Coolant temperature sensor cable
37. Coolant temperature gauge cable
38. Coolant temperature indicator light cable
39. Throttle position sending unit cable
40. Auxiliary air cable
41. Ground cable
42. Rev. and timing transducer cables
43. Engine oil level indicator cable
44. Low engine oil pressure indicator cable
45. Heat guard upper retaining screws
46. Engine mount upper retaining screws



## ENGINE MAIN MECHANICAL UNIT

VIEW OF ENGINE COMPARTMENT Alfa 90 2.0 (017.13) (PRE-MODIFICATION VERSION)

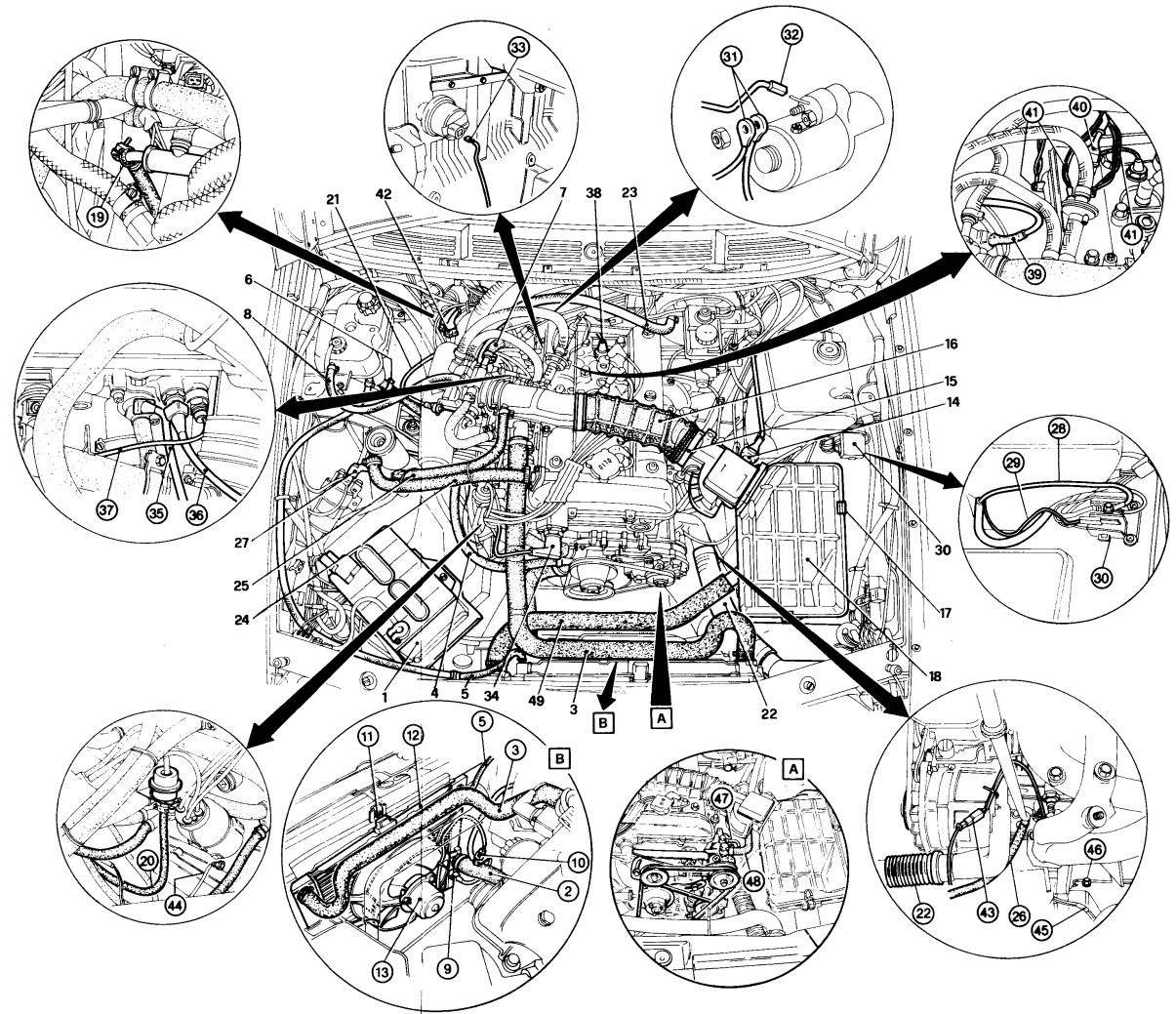


1. Battery
2. Coolant suction hose (radiator/pump)
3. Coolant delivery hose (engine/radiator)
4. Heater return hose
5. Expansion tank/radiator line
6. Expansion tank/cooling circuit line
7. Heat delivery line
8. Vent line
9. Fan control cable
10. Fan supply cable
11. Radiator retaining screw
12. Radiator
13. Fan
14. Air flow sensor cable
15. Clip
16. Intake duct
17. Clips
18. Cover with air flow sensor
19. Fuel delivery line
20. Fuel return line
21. Accelerator cable
22. Alternator cooling hose
23. Vacuum servo line
24. Crankcase vapour line to oil separator
25. Oil vapour recirculation line
26. Separator return line to oil pan
27. HT cable
28. Alternator supply cable
29. Battery charge indicator cable
30. Terminal board
31. Starter supply cable
32. Starter field cable
33. Engine oil pressure indicator cable
34. Valve timing variator cable
35. Electroinjector control cables
36. Coolant temperature sensor cable
37. Coolant temperature gauge cable
38. Coolant temperature indicator light cable
39. Throttle position sending unit cable
40. Auxiliary air cable
41. Ground cable
42. Rev. and timing transducer cables
43. Engine oil level indicator cable
44. Low engine oil pressure indicator cable
45. Heat guard upper retaining screws
46. Engine mount upper retaining screws
47. Steering supply line
48. Steering exhaust line

ENGINE MAIN MECHANICAL UNIT

VIEW OF ENGINE COMPARTMENT Alfa 90 2.0 (017.13) (POST-MODIFICATION VERSION)

1. Battery
2. Coolant suction hose (radiator/pump)
3. Coolant delivery hose (engine/radiator)
4. Heater return hose
5. Expansion tank/radiator line
6. Expansion tank/cooling circuit line
7. Heat delivery line
8. Vent line
9. Fan control cable
10. Fan supply cable
11. Radiator retaining screw
12. Radiator
13. Fan
14. Air flow sensor cable
15. Clip
16. Intake duct
17. Clips
18. Cover with air flow sensor
19. Fuel delivery line
20. Fuel return line
21. Accelerator cable
22. Alternator cooling hose
23. Vacuum servo line
24. Crankcase vapour line to oil separator
25. Oil vapour recirculation line
26. Separator return line to oil pan
27. HT cable
28. Alternator supply cable
29. Battery charge indicator cable
30. Terminal board
31. Starter supply cable
32. Starter field cable
33. Engine oil pressure indicator cable
34. Valve timing variator cable
35. Electroinjector control cables
36. Coolant temperature sensor cable
37. Coolant temperature gauge cable
38. Coolant temperature indicator light cable
39. Throttle position sending unit cable
40. Auxiliary air cable
41. Ground cable
42. Rev. and timing transducer cables
43. Engine oil level indicator cable
44. Low engine oil pressure indicator cable
45. Heat guard upper retaining screws
46. Engine mount upper retaining screws
47. Steering supply line
48. Steering exhaust line
49. Air weighing extension





# ENGINE REMOVAL AND INSTALLATION

Alfa 75 1.8 turbo

## FOREWORD

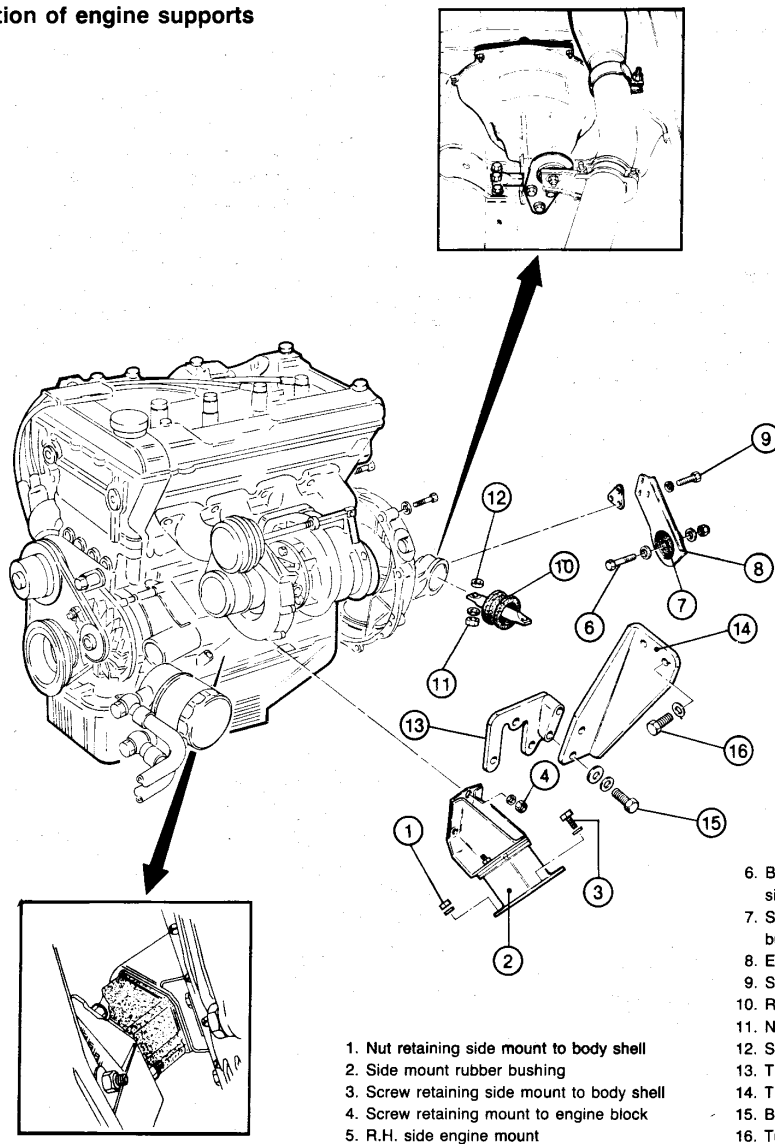
This section contains all the data and procedures relating to the removal and installation of the engine fitted on the following Alfa Romeo vehicle:

Alfa 75 1.8 turbo

Given that the operations involved in removing and installing the engine are somewhat numerous, the operator is urged to read the intervention procedures carefully and to examine with care the illustration of the assembly that give an indispensable but of course incomplete overall view of the engine.

Following the above advice permits the correct operational techniques to be acquired and familiarizes the technician with the technical data, and caution and warning captions.

## Location of engine supports



**REMOVAL**

**1. Preliminary operations**

- a. Place vehicle on lift platform and chock wheels.

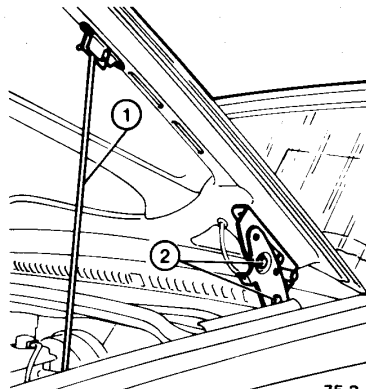
**CAUTION:**

When the engine is hot, proceed with caution to avoid burns.

- b. Open hood and secure in open position with associated strut (1). Remove hinge bolts (2) and lay hood back in fully open position.

**CAUTION:**

Protect contact points with suitable soft materials.



1. Strut  
2. Bolts

**CAUTION:**

For maximum safety, the hood should be secured in the open position to prevent it from falling suddenly.

For location of parts identified by reference numbers below, see the view of the engine compartment for the vehicle in question.

- c. Disconnect positive «+» and negative «-» terminals from battery (1).
  - d. Slacken screw (2) retaining intercooler air intake (3) and battery bracket (4) (see detail A).
  - e. Disconnect power brake vacuum servo line (5) from the intercooler union, loosening the relative clamp (see detail E).
  - f. Unscrew the four screws (7) retaining air intake duct to the front panel of the body shell.
- Remove air intake duct (3), complete with sleeve (8), withdrawing it from intercooler (9) (see detail A).

**2. Air supply system removal**

- a. Disconnect from the supercharging pressure control solenoid valve (10) the following components (see detail B):
  - connector (11) for solenoid valve supply cable;
  - hose (12) to oil vapor sedimenter;
  - pressure line (13) from the turbocharger compressor;
  - hose (14) to overpressure valve (Waste-Gate).
- b. If necessary remove solenoid valve (10) from the air filter cover, unscrewing two nuts with washers (15).
- c. Disconnect union (16) from air flow meter (17).
- d. Unscrew upper screw (18) retaining air intake duct bracket to air flow meter.
- e. Slacken the two clamps (19) retaining air intake duct to air flow meter.
- f. Release clips (20) securing air filter cover (21) and remove it together with air flow meter (17), withdrawing it from the air intake duct.
- g. Remove filtering element and, if necessary, unscrew the two nuts and the screw securing the air filter casing to the body and remove it.
- h. Slacken clamp (22) securing air intake duct (23) to turbocharger compressor inlet (see detail C).
- i. Slacken clamp (24) securing oil vapour exhaust hose to the oil vapour sedimenter and remove air intake duct (23), withdraw-

ing it from the turbocharger compressor inlet.

**WARNING:**

Plug the turbocharger compressor inlet so as to prevent any foreign matter from entering.

**3. Coolant lines and radiator**

- a. Disconnect the following pipes and hoses, removing them preferably from the end indicated:
  - slacken clamp (25) and remove coolant return sleeve (26) from the thermostat;
  - slacken the clamp and remove coolant delivery sleeve (27) from the water pump (see detail D);

**NOTE:**

Place a suitable container under the vehicle to collect drained coolant.

- slacken the clamp and remove heater coolant return hose (28) from the water pump (see detail D);
- slacken the clamp and remove radiator delivery line (29) from tee (see detail D);
- slacken the clamp and remove breather line (30) from the radiator (see detail D);
- slacken the clamp and remove cooling system breather line (31) from union on cylinder head (see detail E);
- slacken the clamp and remove heater coolant delivery line (32) from union on cylinder head (see detail E).
- b. Disconnect fan control cable (33) from the temperature switch on the lower right part of the radiator (see detail F).
- c. Disconnect fan supply cable (34) from in-line connection (see detail F).
- d. Remove screw (35) retaining radiator (36) to front of body steel and remove it together with the fan.

**4. Removal of fuel system**

**WARNING:**

- **Proceed with caution: the supply system may be under pressure.**
- **Keep tubing pointing upwards to prevent fuel escaping.**  
Ensure also, that the workshop is correctly equipped to enable operations to be performed safely.

- a. Disconnect fuel return hose from lower part of pressure regulator (37).
- b. Slacken the nut and disconnect fuel delivery line (38) from the lower part of hammering damper (39) (see detail G).

**CAUTION:**

There may be residual pressure between fuel pump and hammering damper which could cause petrol to spray out; plug disconnected hose (38).

**5. Accelerator cable disconnection**

- a. Slacken the three retaining screws and remove accelerator control protection plate (40).
- b. Rotate fully, anticlockwise, accelerator control cam (41) and withdraw the pawl of control cable (42) from the end of the cam (see detail H).
- c. Withdraw accelerator control cable (42) from support bracket (43), withdrawing it from the bottom (see detail H).

**6. Oil cooling system removal**

- a. Unscrew union (44) and disconnect oil delivery hose (45) to cooling radiator (see detail I).
- b. Unscrew union (46) and disconnect oil return hose (47) from cooling radiator (see detail I).

**NOTE:**

Place a suitable container under the vehicle to collect any oil leakage.

**7. Electrical cable disconnection**

- a. Disconnect the following electrical cables and remove as indicated:
  - supercharging pressure sender cable (6) from manifold on intercooler;
  - HT cable (48) from ignition coil;
  - throttle position sending unit cable (49) from mobile connection (see detail H);
  - minimum cut-out switch (50) cables from relative switch (see detail H);
  - supply cables (51) and ground cables (52) from auxiliary air solenoid (see detail E);
  - air intake manifold ground cables (52A) from the right side of cylinder head (see detail E);
  - maximum coolant temperature cable (53) from thermal switch on the cylinder block (see detail E);
  - Hall effect cable (54) from distributor (see detail D);
  - alternator supply (56) and warning light (57) cables from terminal board (58) on engine compartment left valance panel (see detail L);
  - engine oil pressure indicator cable (59) from bulb on right side of engine block (see detail M);
  - engine oil minimum pressure indicator light cable (60) from transmitter on oil filter support (see detail N), or from mobile connection (61) near alternator (see detail C);
  - engine oil minimum pressure indicator light cable (55) from transmitter on R.H. side of engine block, under the distributor (see detail D);
  - coolant temperature indicator cable (62), from bulb on cylinder head, under intake manifold (see detail O);
  - coolant temperature sensor cable (63) from transmitter on cylinder head, under intake manifold (see detail O);
  - pulse sensor cable (64) from relative connector on cylinder head, under intake manifold (see detail M);
  - electro-injector feed cables (65) from respective connectors (see detail O);
  - feed (66) and energizing cables (67) from starting motor on R.H. side of rear cover (see detail O).

**NOTE:**

Release the electrical cables from ar clips and arrange so that they will not interfere with engine removal.

**8. Final operations**

- a. Remove the three screws (68) securing heat guard (69) to brake/clutch system pump and remove heat guard.
- b. Slacken and remove bolt (70) securing collar (71); this collar joins turbocharger exhaust gas union to the exhaust pipe (see detail P).
- c. Slacken (but do not remove), on both sides, screws (72) fixing the upper part of the engine side mounts to the body step (see detail P).
- d. Remove heat guard (73) from L.H. side mount (see detail P).

For the following steps see the figure «View of underbody».

**9. Oil discharge**

(if required by the operations to be performed)

- a. Raise the vehicle on the garage lift
- b. Unscrew plug (1) and drain engine oil.  
Screw plug on again after the job has been completed.

**10. Exhaust pipe removal**

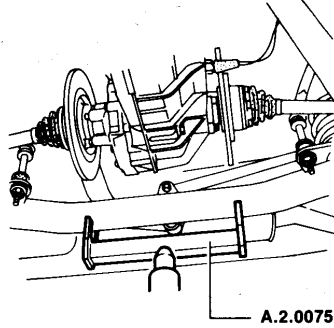
- a. Slacken nut (2) securing clamp connecting exhaust pipe front and cent sections (see detail A).
- b. Separate front section (4) from cent section and from turbocharger exhaust gas union.
- c. Remove the three screws (5) securing bracket (6) to end of flywheel cover (see detail A).
- d. Slacken nut (7) securing clamp

connecting centre section (9) of exhaust pipe and tail pipe (10) (see detail B).  
 e. Free centre section (9) from rubber support rings (11), and withdraw from tail pipe to remove.

**11. Propeller shaft removal**

a. Remove centre cross member (12) after removing screws (13) securing it to the body shell.  
 b. Slide off boot (14), unscrew and remove bolt (15) and disconnect gear selector rod (16) (see detail C).  
 If necessary, remove screws (17) securing gear lever support (18) and move it to permit the removal of the propeller shaft (see detail C).  
 c. Slacken bolts (19) and remove flywheel guard (20).  
 d. With gearbox in neutral, rotate propeller shaft (21), alternately slackening nuts (22) and bolts (23) securing it, respectively, to the flywheel and to the clutch yoke (see details D and E).  
 e. Remove the two screws (24) and disconnect pin (25) of engine rear mount from the body shell (see detail A).  
 f. Slacken the two nuts (26) and disconnect propeller shaft centre support (27) from the body shell (see detail C).

g. Remove the six screws (28) securing rear cross member (29) to body shell and remove it.  
 h. Raise the rear axle using a column lift provided with cradle A.2.0075 and then extract propeller shaft from the clutch yoke.



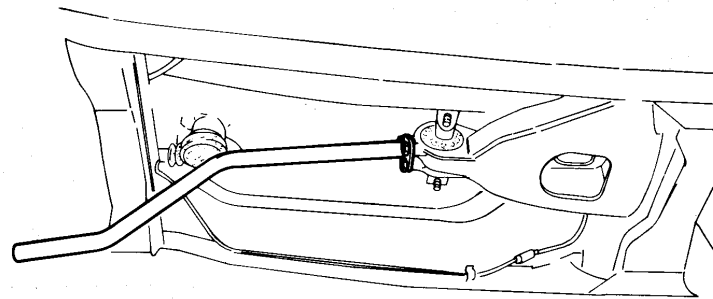
i. Lower the column lift and remove the propeller shaft.

**12. Final operations**

a. Remove the screw from the body steel and disconnect the ground cable (30).  
 b. Fit a suitable operating lever on the engine rear support to aid engine removal operations.  
 c. Slacken and remove lower nuts (31) retaining side engine mounts (32) (see detail F).  
 d. Lower garage lift and then unscrew and remove upper screws (33) retaining side mounts (32) (see detail F). Raise the garage lift.  
 e. Hook a suitable hydraulic lift to engine lift bracket.  
 Activate lift and raise engine while tilting with a suitable lever.

**NOTE:**

**If necessary, disconnect center spark plug cables and remove spark plug.**



**INSTALLATION**

For the following operations refer to bottom view of vehicle in question.

**1. Preliminary operations**

- a. Install service handle on rear engine mount.
- b. Fasten engine to lifting bracket and, using a suitable hoist, lower powerplant slowly in engine compartment guiding it with the service handle.
- c. Centralize engine in engine compartment over the two side mounts and ensure that holes for screws and studs are correctly aligned on both mounts.
- d. Start and tighten screws (33) retaining cushion mounts to body on both sides.
- e. Raise vehicle, start and tighten nuts (31) retaining mounts to body at bottom on both sides.
- f. Remove service handle from rear engine mount.
- g. Connect ground cable (30) to body steel and tighten the relative screws.

**2. Install the propeller shaft group**

- a. Install the propeller shaft group by following the removal procedures in reverse order («Removal» step 11.) and noting the points below:
  - Lubricate shaft front bushing and rear joint spherical seat using 5 cm<sup>3</sup> (0.2 fl-oz) of ISECO MOLYKOTE BR2 grease.  
If necessary lubricate the flywheel bushings with the same grease.
  - Restrain shaft by suitable means and tighten nuts (22) and bolts (23) of flex. couplings each in turn to the specified torque.

**T** : Tightening torque  
Nuts and bolts retaining shaft flex. couplings to flywheel and clutch fork  
55 to 57 N·m  
(5.6 to 5.8 kg·m  
40.6 to 42.0 ft·lb)

**CAUTION:**  
When assembling use new self-locking nuts.

- Tighten nuts (26) retaining center bearing (27) to underbody.

**T** : Tightening torque  
Center bearing nuts  
93 to 103 N·m  
(9.5 to 10.5 kg·m  
6.6 to 76.0 ft·lb)

- b. Fix pin (25) or engine rear support using the two screws (24).
- c. Assemble flywheel guard (20) and tighten bolts (19).
- d. Re-connect rod (16) to the gearlever with bolt (15) and slide on boot (14).

**T** : Tightening torque  
Nut retaining gear control rod to rear lever  
13 to 16 N·m  
(1.3 to 1.6 kg·m  
9.4 to 11.6 ft·lb)

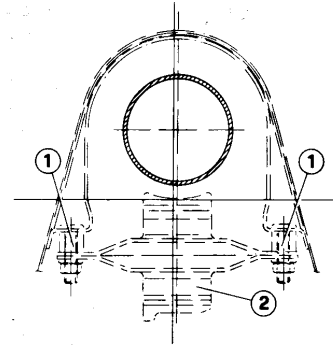
- e. Secure crossmember (12) to body shell using screws (13).
- f. Tighten transmission unit crossmember (29) to body capscrews (28) to the specified torque.

**T** : Tightening torque  
Transmission unit crossmember to body capscrews  
39 to 44 N·m  
(4.0 to 4.5 kg·m  
28.8 to 32.5 ft·lb)

- g. Check the specified distance «A» between the propeller shaft and rear engine support.

Distance «A» between the propeller shaft and rear engine support  
A = 7 mm (0.28 in)

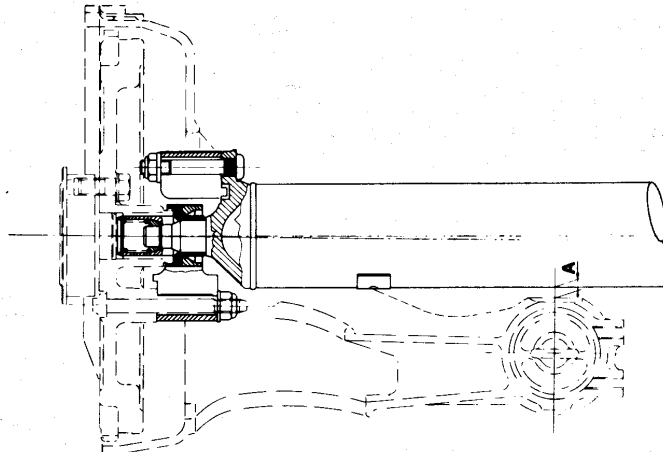
- h. If this distance differs from the specified one, vary the length of the spacers (1) placed between the rear engine support (2) and the body accordingly.



1. Spacer  
2. Rear engine support

**3. Exhaust pipe installation**

- a. Place centre section (9) of the exhaust pipe on rubber support rings (11).
- b. Connect centre section (9) of the exhaust pipe to tail pipe (10) without tightening the nut (7) on clamp (8).
- c. Connect centre section (9) of the exhaust pipe to the front section (4) without tightening the nut (2) on clamp (3).



## ENGINE MAIN MECHANICAL UNIT

- d. Tighten screws (5) securing bracket (6) to the end of the flywheel cover.
- e. Rock exhaust pipe to obtain proper alignment.
- f. Tighten fully nuts (2) and (7) securing clamps (3) and (8) respectively.

In order to follow the following steps of the procedure consult the figure «View of the Engine Compartment» of the vehicle in question.

### 4. Installation of radiator

Refit radiator together with electric fan, then reconnect cooling system tubing by reversing the order of the procedure described in «Removal» step 3.

### 5. Air filter installation

Assemble the air filter and then re-connect the air supply hoses by following the procedures described in «Removal» step 2. in reverse order.

### 6. Fuel supply system

Assemble the fuel supply system by following the procedures described in «Removal» step 4. in reverse order.

### 7. Accelerator cable

Connect accelerator cable adopting a reversal of the «Removal» sequence, step 5.

### 8. Oil cooling system

Restore the oil cooling circuit by following the procedures described in «Removal» step 6. in reverse order.

### 9. Electrical connections

Restore electrical connection, reversing the order of the procedure described in «Removal» step 7.

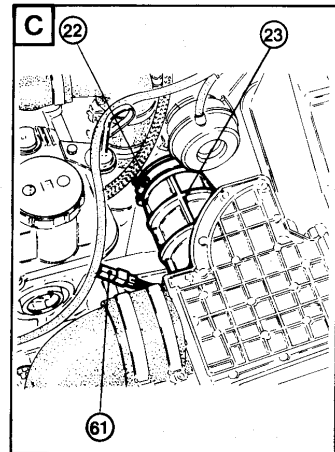
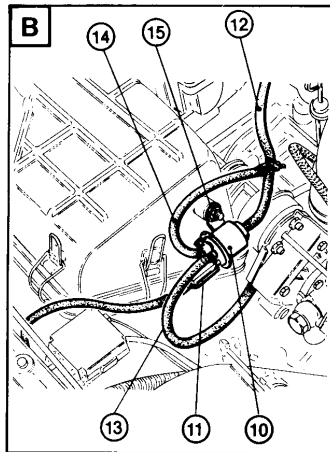
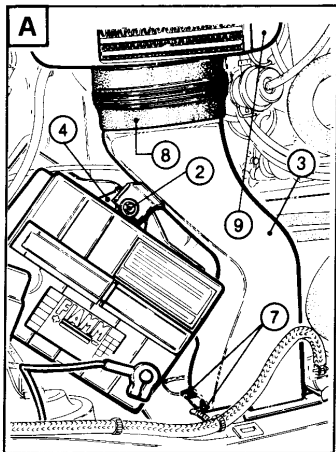
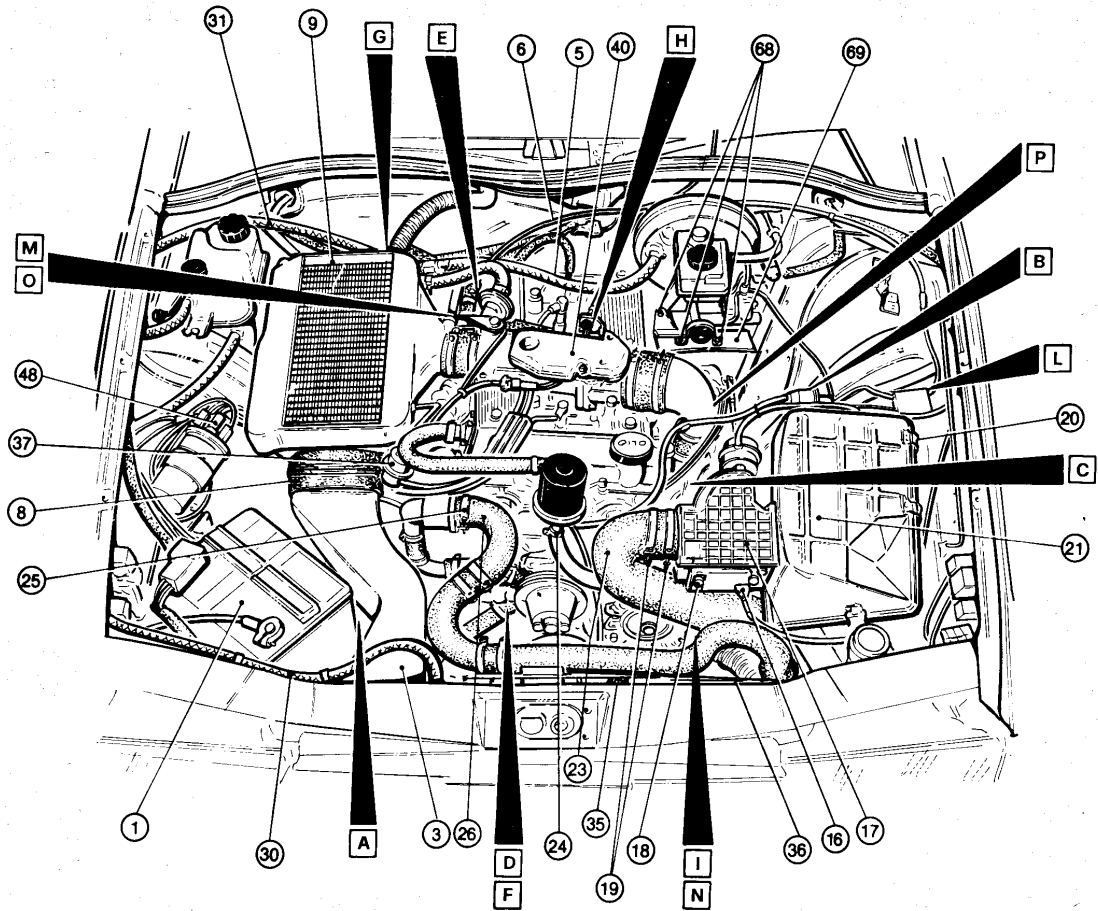
### 10. Final operations

a. Assemble heat guard (69) on the brake/clutch system pump by tightening the three screws (68).

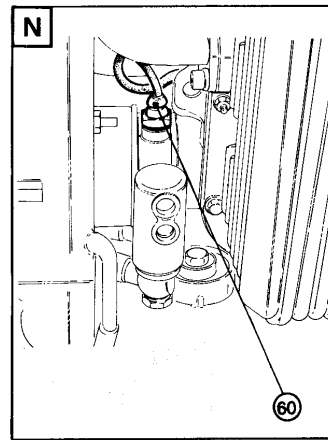
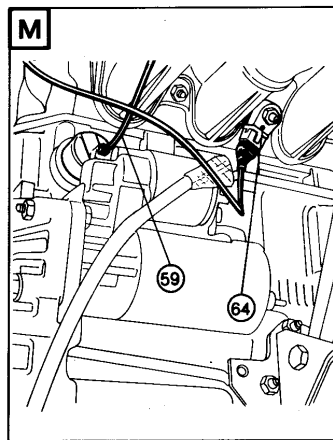
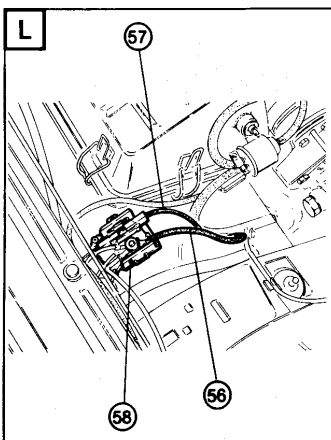
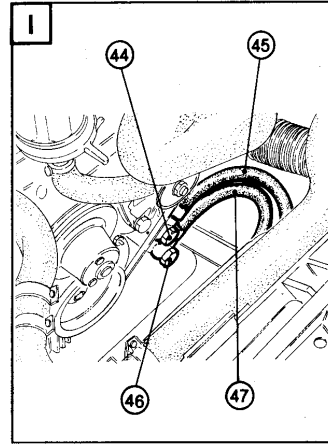
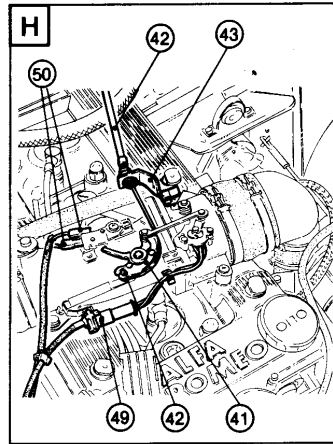
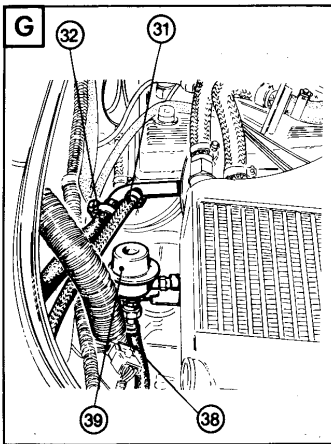
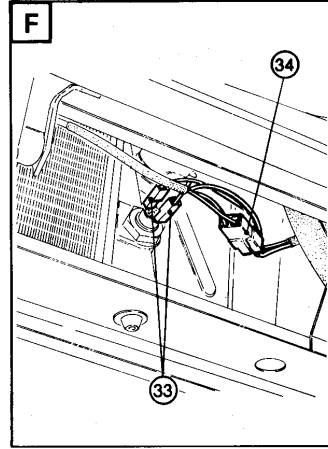
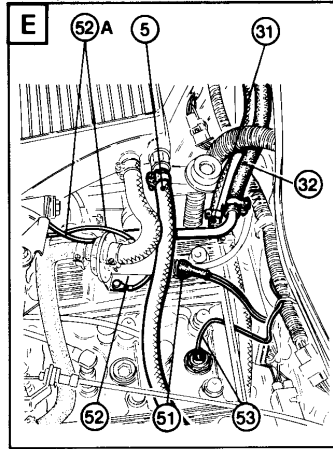
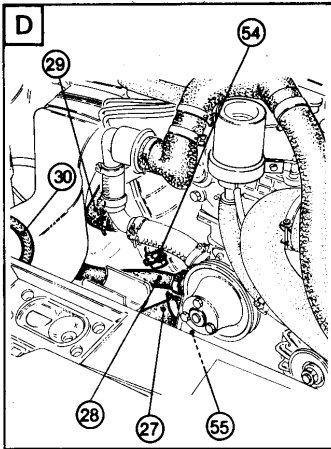
- b. Tighten bolt (70) securing collar (71) joining turbocharger exhaust gas union to the front section of the exhaust pipe.
- c. Re-connect servobrake vacuum intake hose (5) to the union on intercooler.
- d. Re-connect hose (6) from turbocharger pressure gauge to the union on the intercooler.
- e. Assemble air intake duct (3), complete with sleeve (8), to intercooler (9) and fix it to the front body shell panel using the four screws (7).
- f. Place battery (1) in engine compartment and secure with bracket (4); secure bracket and air intake duct support using screws (2) and then re-connect battery terminals.
- g. For references and adjustments see specifications of appropriate groups.
- h. Release hood, prop up and install hinge bolts on both sides of vehicle.

# ENGINE MAIN MECHANICAL UNIT

## VIEW OF ENGINE COMPARTMENT Alfa 75 1.8 turbo

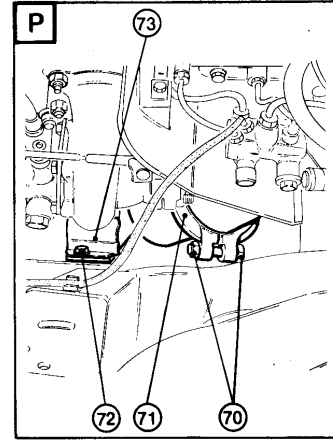
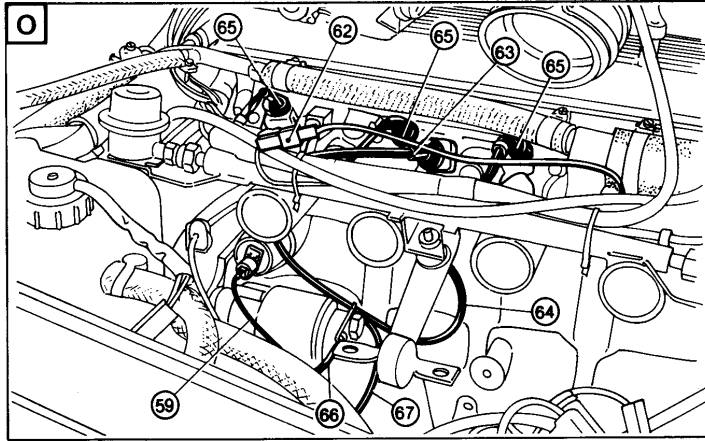


ENGINE MAIN MECHANICAL UNIT





## ENGINE MAIN MECHANICAL UNIT

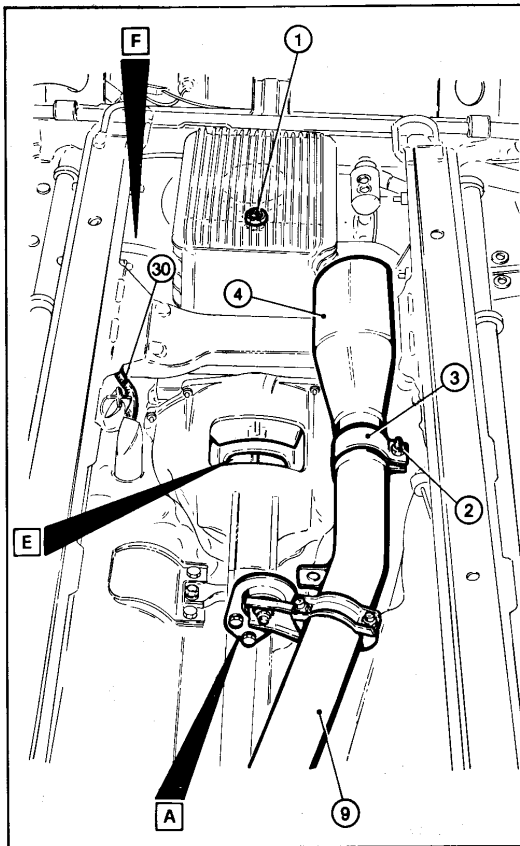


- |  |   |   |
|--|---|---|
| <ol style="list-style-type: none"> <li>1. Battery</li> <li>2. Air intake and battery bracket retaining screws</li> <li>3. Intercooler air intake</li> <li>4. Battery retaining bracket</li> <li>5. Servo brake vacuum intake hose</li> <li>6. Supercharging pressure sender cable</li> <li>7. Intercooler air intake retaining screws</li> <li>8. Sleeve</li> <li>9. Intercooler</li> <li>10. Supercharging pressure control solenoid valve (Pierburg)</li> <li>11. «Pierburg» solenoid valve supply cable</li> <li>12. Hose connecting oil sedimenter</li> <li>13. Pressure intake hose (from compressor)</li> <li>14. Hose connecting overpressure valve</li> <li>15. Nuts and washers retaining «Pierburg» valve</li> <li>16. Air flow meter cable</li> <li>17. Air flow meter</li> <li>18. Air intake upper retaining screw</li> <li>19. Air intake retaining clamps</li> <li>20. Air filter cover retaining clips</li> <li>21. Air filter cover</li> <li>22. Clamp securing air intake duct to compressor</li> <li>23. Air intake duct</li> <li>24. Oil vapour exhaust hose</li> <li>25. Sleeve clamp</li> <li>26. Coolant return sleeve</li> </ol> | <ol style="list-style-type: none"> <li>27. Coolant delivery sleeve</li> <li>28. Coolant return hose (from heater)</li> <li>29. Radiator coolant supply hose</li> <li>30. Radiator breather hose</li> <li>31. Cooling system breather hose</li> <li>32. Coolant delivery hose (to heater)</li> <li>33. Fan control cable</li> <li>34. Fan supply cable</li> <li>35. Radiator retaining screw</li> <li>36. Radiator</li> <li>37. Pressure regulator</li> <li>38. Fuel delivery hose</li> <li>39. Hammering damper</li> <li>40. Accelerator control guard</li> <li>41. Accelerator control cam (throttle control)</li> <li>42. Accelerator control cable</li> <li>43. Accelerator control cable support bracket</li> <li>44. Union</li> <li>45. Oil delivery hose (to radiator)</li> <li>46. Union</li> <li>47. Oil return hose (from radiator)</li> <li>48. Ignition coil cable</li> <li>49. Throttle position sending unit cable</li> <li>50. Minimum cut-out switch</li> <li>51. Auxiliary air solenoid valve supply cable</li> <li>52. Auxiliary air solenoid valve ground cables</li> <li>52A Air intake manifold ground cables</li> <li>53. Coolant maximum temperature indicator light cable</li> <li>54. Hall effect sensor cable</li> </ol> | <ol style="list-style-type: none"> <li>55. Engine oil level indicator light cable</li> <li>56. Alternator supply cable</li> <li>57. Alternator indicator light cable</li> <li>58. Terminal board</li> <li>59. Engine oil pressure indicator cable</li> <li>60. Low engine oil pressure indicator light cable</li> <li>61. Connector for low engine oil pressure cable</li> <li>62. Coolant temperature indicator cable</li> <li>63. Coolant temperature sensor cable</li> <li>64. Knock sensor cable</li> <li>65. Electro-injector supply cables</li> <li>66. Starting motor supply cables</li> <li>67. Starting motor electromagnet energizing cable</li> <li>68. Heat guard retaining screws</li> <li>69. Heat guard</li> <li>70. Collar retaining bolt</li> <li>71. Collar</li> <li>72. Engine mount upper retaining screws</li> <li>73. Heat guard (on LH mount)</li> </ol> |
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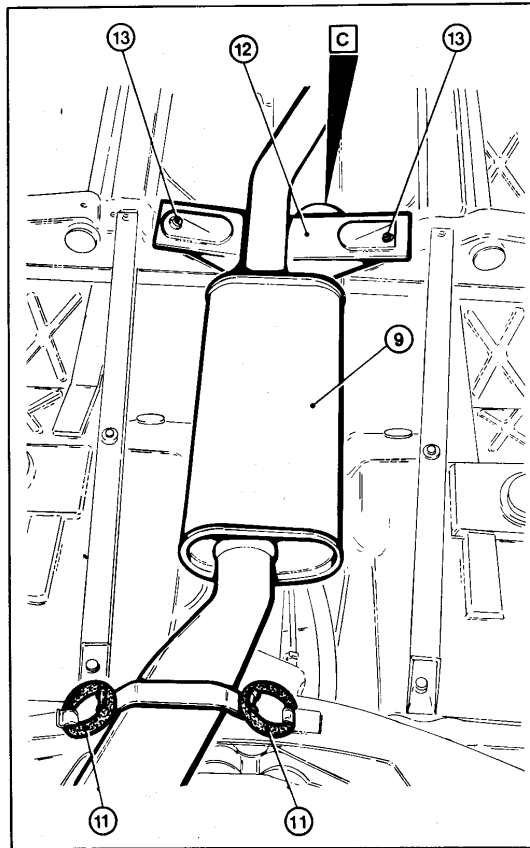
ENGINE MAIN MECHANICAL UNIT

VIEW OF UNDERBODY Alfa 75 1.8 turbo

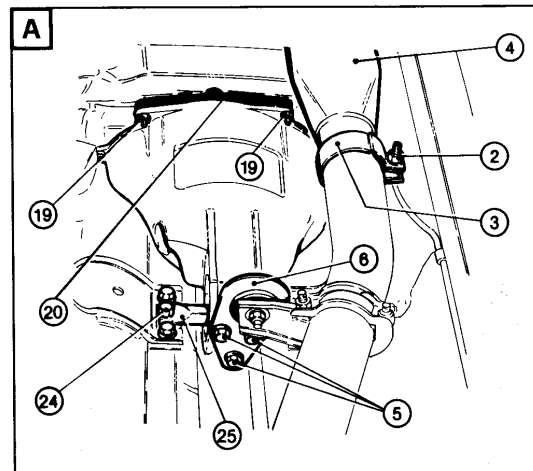
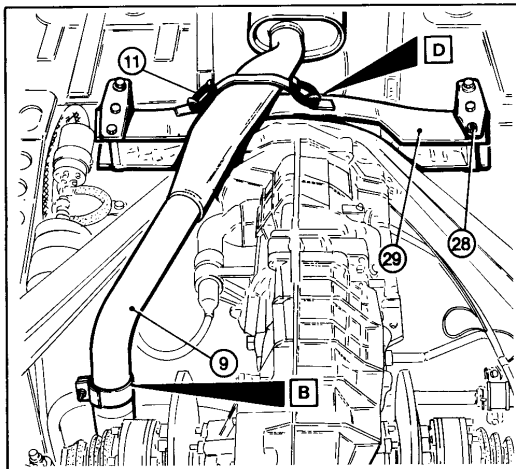
FRONT SECTION



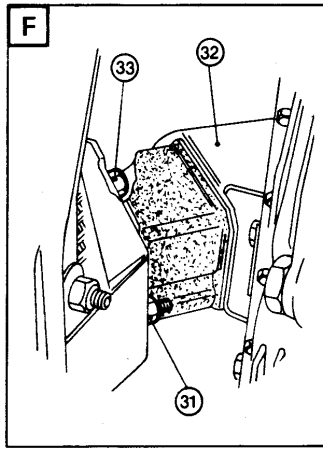
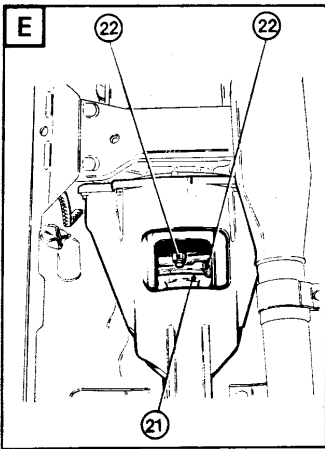
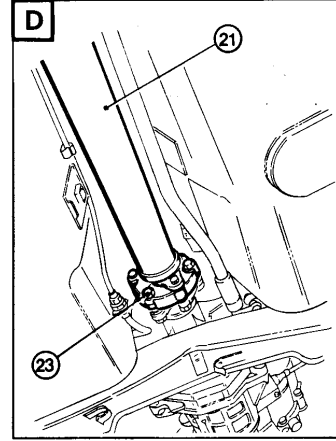
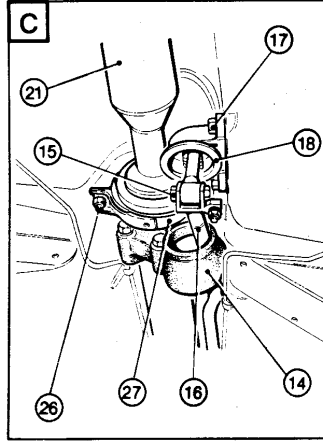
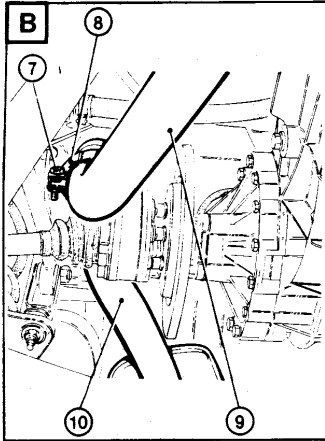
CENTRE SECTION



REAR SECTION



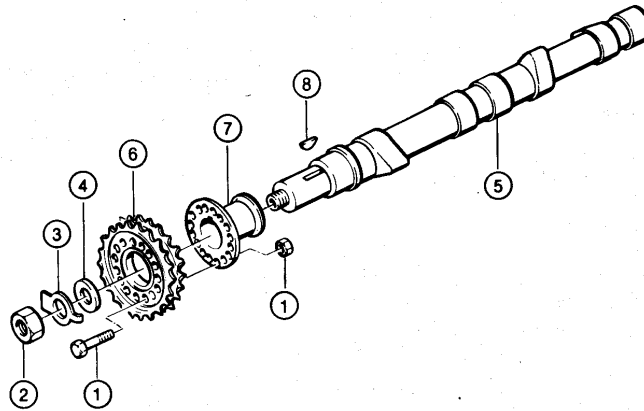
## ENGINE MAIN MECHANICAL UNIT



1. Oil drain plug
2. Clamp nut
3. Clamp
4. Exhaust pipe front section
5. Bracket retaining screws
6. Exhaust pipe centre section support bracket
7. Clamp nut
8. Clamp
9. Exhaust pipe centre section
10. Tail pipe
11. Exhaust pipe centre section rubber support rings
12. Cross member
13. Cross member retaining screws
14. Boot
15. Retaining bolt
16. Gear rod

17. Support retaining screws
18. Gear lever support
19. Guard retaining bolts
20. Flywheel guard
21. Transmission shaft
22. Front flexible coupling retaining nuts
23. Rear flexible coupling retaining bolts
24. Pin retaining bolts
25. Engine rear support pin
26. Propeller shaft centre support retaining nuts
27. Propeller shaft centre support
28. Rear crossmember retaining screws
29. Rear crossmember
30. Ground cable
31. Engine side mount lower retaining nuts
32. Engine side mounts
33. Engine side mount upper retaining screws

- g. Remove the following parts from camshafts (5):
- Bolt (1)
  - Nut (2), lockwasher (3) and washer (4) on drive gear.
  - Gear (6), flange (7) and woodruff key (8)



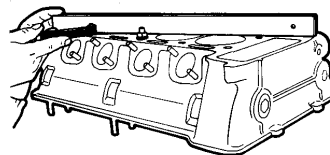
1. Bolt
2. Nut
3. Lockwasher
4. Washer
5. Camshaft
6. Drive gear
7. Flange
8. Woodruff key

## CHECKS AND INSPECTION

### CYLINDER HEADS AND VALVES

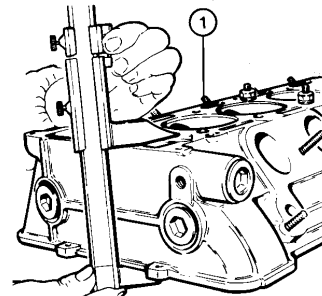
#### CYLINDER HEAD SEALING SURFACE INSPECTION

- a. Thoroughly clean head surfaces using butyl acetate or methylethylketone to remove any gasket fragments.
- b. Visually inspect head for cracks or other defects.
- c. Check head sealing surface for warpage using a straightedge and feeler gauge positioned as shown.



Maximum flatness error of cylinder head sealing surface: 0.05 mm (0.002 in)

- d. In the event of excessive warpage, head must be refaced. Before refacing, remove the four exhaust manifold studs (1).



1. Studs

Minimum cylinder head height after refacing: 111.5 mm (4.390 in)

Do not machine head below the minimum allowable thickness, otherwise severe engine damage might result.

e. Check finish of machined surface.

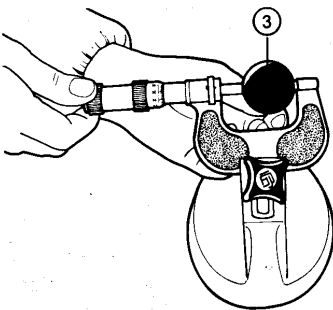
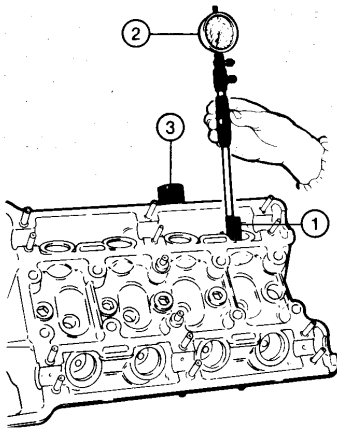
**Maximum allowable surface roughness:**  
1.6  $\mu\text{m}$  (63 microinch)

**Head top and bottom faces must be parallel to within:**  
0.087 mm (0.0034 in)

**TAPPETS AND TAPPET HOUSING BORES**

a. Check tappet housing bores using a bore gauge (1) and a dial indicator (2). Compare readings with dimensions and tolerances given in Inspection Specifications Tables.

b. Check tappet skirt and head for signs of scuffing, score marks or excessive wear. Check diameter of tappet (3) using an outside micrometer, referring to Inspection Specifications Tables for dimensions and tolerances.



1. Bore gauge  
2. Dial indicator  
3. Tappet

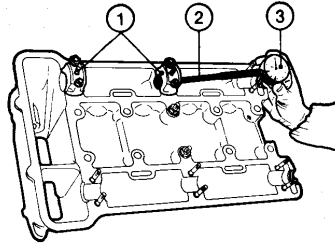
**CAMSHAFTS AND CAMSHAFT JOURNAL HOUSING BORES**

a. Install caps (1), lubricate nuts, and tighten to the specified torque.

b. Using a bore gauge (2) with dial indicator (3), measure camshaft journal housing bore diameter.

**T** : Tightening torque  
Camshaft cap nuts  
20 to 22 Nm  
(2 to 2.25 kgm  
14.7 to 16.2 ft.lb)

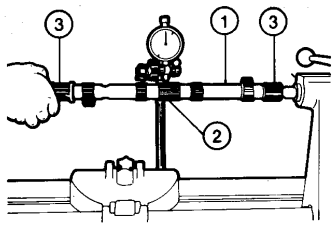
**Camshaft journal housing bore diameter:**  
27.000 to 27.033 mm  
(1.0630 to 1.0643 in)



1. Caps  
2. Bore gauge  
3. Dial gauge

c. Check cam lobes and camshaft journals for score marks, scuffing, signs of overheating or excessive wear.

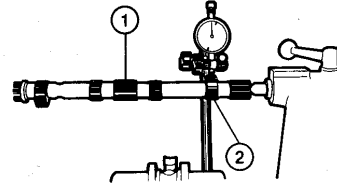
d. Measure camshaft journal diameter using an outside micrometer. Check for out-of-round condition using a dial gauge.



1. Camshaft  
2. Center journal  
3. End journals

**Camshaft journal diameter:**  
26.959 to 26.980 mm  
(1.0614 to 1.0622 in)

e. Check height of cam lobes using a dial indicator. Scrap and replace camshaft if height falls below requirements.



1. Camshaft  
2. Cam

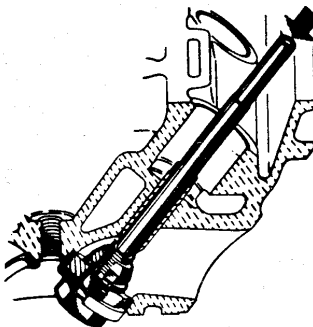
Minimum cam lobes height mm (in)				
Engine				
Cam	016.00	016.78 016.55	017.13 061.00 062.02 062.12	061.34
i.	9 (0.35)	9.5 (0.37)	11 (0.43)	8 (0.31)
e.	9 (0.35)	9.5 (0.37)	9 (0.35)	9 (0.35)

i. = intake valve cam  
e. = exhaust valve cam

**VALVE SEAT INSERT REPLACEMENT**

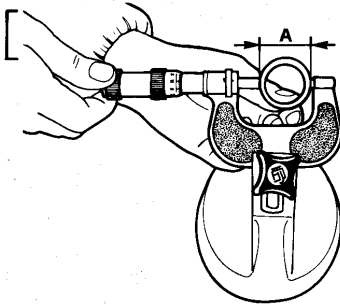
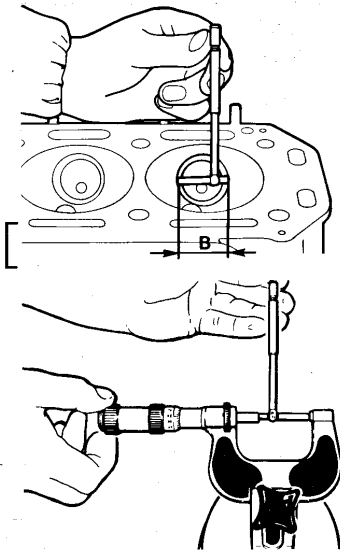
a. Check seat inserts for nicks, cracks or burn marks, and ensure that they are firm in housing bores. Replace if necessary.

b. To remove seat inserts, use a suitable tool as shown below.



c. Prior to installing new seat inserts, check insert and housing bore dimensions against specifications shown in table.

# ENGINE MAIN MECHANICAL UNIT

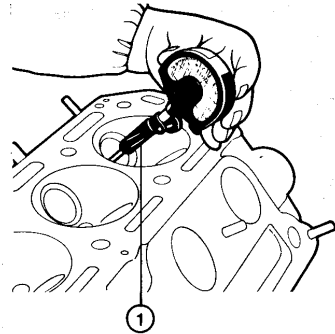


Valve	Engine 016.00 - 016.78 061.00 - 062.02 - 061.34	
<b>Insert housing bore O.D. [B = mm (in)]</b>		
Standard	i.	42.532 to 42.557 (1.6745 to 1.6755)
	e.	38.532 to 38.557 (1.5170 to 1.5180)
Oversize	i.	42.832 to 42.857 (1.6863 to 1.6873)
	e.	38.832 to 38.857 (1.5288 to 1.5298)

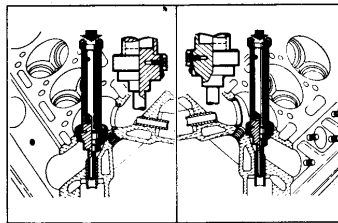
Valve	Engine 016.55 - 017.13 062.12	
<b>Insert housing bore O.D. [B = mm (in)]</b>		
Standard	i.	45.000 to 45.025 (1.7717 to 1.7726)
	e.	41.000 to 41.025 (1.6142 to 1.6152)
Oversize	i.	45.300 to 45.325 (1.7835 to 1.7844)
	e.	41.300 to 41.325 (1.6260 to 1.6270)

i. = Intake valve    e. = Exhaust valve



1. Bore gauge

- d. Heat cylinder head in oven to 100°C (212°F).  
 e. Install valve seat inserts using a suitable driver as shown.



c. Calculate clearance by subtracting maximum stem diameter from guide I.D.

### Valve stem/guide clearance:

**Intake:** 0.013 to 0.043 mm  
(0.0005 to 0.0017 in)

**Exhaust:** 0.040 to 0.080 mm  
(0.0016 to 0.0031 in)

**Exhaust:** 0.040 to 0.075 mm (1)  
(0.0016 to 0.0030 in) (1)

**Exhaust:** 0.040 to 0.070 mm (2)  
(0.0016 to 0.0028 in) (2)

- (1) For 061.34 engine only  
 (2) For Eaton-Livia valve, 061.34 engine

Valve	Engine 016.00 - 016.78 061.00 - 062.02	
<b>Seat insert O.D. [A = mm (in)]</b>		
Standard	i.	42.597 to 42.632 (1.6770 to 1.6784)
	e.	38.597 to 38.632 (1.5196 to 1.5209)
Oversize	i.	42.897 to 42.932 (1.6889 to 1.6902)
	e.	38.897 to 38.932 (1.5314 to 1.5328)

Valve	Engine 016.55 - 017.13 062.12 - 061.34	
<b>Seat insert O.D. [A = mm (in)]</b>		
Standard	i.	45.065 to 45.100 (1.7742 to 1.7756)
	i.	42.597 to 42.632 (1.6770 to 1.6784)(1)
	e.	41.065 to 41.100 (1.6167 to 1.6181)
	e.	38.642 to 38.658 (1.5213 to 1.5220)(1)
Oversize	i.	45.365 to 45.400 (1.7860 to 1.7874)
	i.	42.897 to 42.932 (1.6888 to 1.6902)(1)
	e.	41.365 to 41.400 (1.6285 to 1.6299)
	e.	38.492 to 38.958 (1.5154 to 1.5338)(1)

i. = Intake valve    e. = Exhaust valve

(1) For 061.34 engine only

## VALVE GUIDES

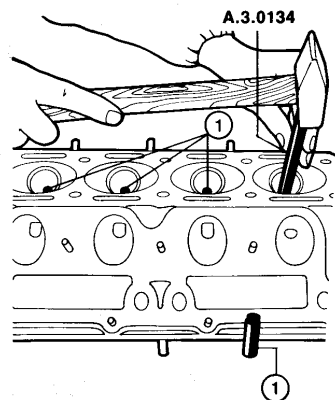
Check valve stem clearance in guide, if clearance exceeds tolerance scrap and replace worn parts.

## Clearance measurement

- a. Using an outside micrometer, measure valve stem at three different points, each offset by 90 degrees.  
 b. Measure guide I.D. using a bore gauge



**Valve guide I.D.:**  
 9.000 to 9.015 mm  
 (0.3543 to 0.3549 in)



1. Valve guides

## Valve guide replacement

- a. Check valve guides for score marks, scuffing, distortion or signs of movement in seats.  
 b. If replacement is necessary, remove worn guides using driver A.3.0134 as shown.

## ENGINE MAIN MECHANICAL UNIT

c. Check guide seat diameter and O.D. of new guides; interference fit must be within specified tolerances.

**Valve guide seat diameter:**  
13.990 to 14.018 mm  
(0.5508 to 0.5519 in)

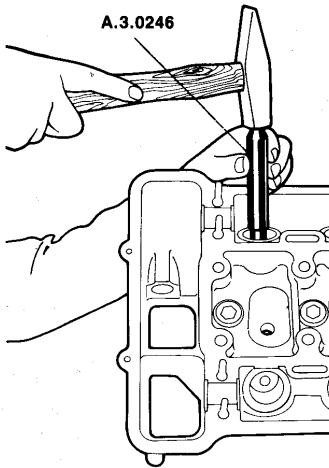
**Valve guide O.D.:**  
14.033 to 14.044 mm  
(0.5525 to 0.5529 in)  
(intake and exhaust)

14.048 to 14.059 mm  
(0.5531 to 0.5535 in)  
(exhaust) (1)

**Valve guide/seat interference fit:**  
0.015 to 0.054 mm  
(0.0006 to 0.0021 in)  
(intake and exhaust)  
0.030 to 0.069 mm  
(0.0012 to 0.0027 in)  
(exhaust) (1)

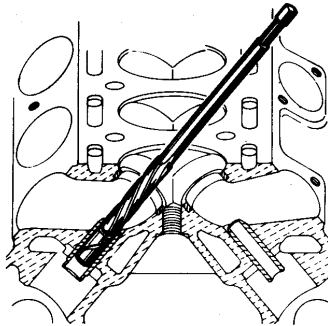
(1) For 061.34 engine only

d. Install new guides using tool **A.3.0246** for intake valve guides and a suitable tool for exhaust valve guides. These tools ensure that the correct guide stand-out from the bottom spring cup abutment surface on cylinder head is maintained.



Valve guide stand-out mm (in)	
Valve	Engine
	016.00 - 016.78 - 016.55 062.02 - 062.12 - 061.34
Intake	13.300 to 13.500 (0.5236 to 0.5315)
Exhaust	16.300 to 16.500 (0.6417 to 0.6496)
Valve	Engine
	017.13 - 061.00
Intake	11.800 to 12.000 (0.4646 to 0.4724)
Exhaust	16.300 to 16.500 (0.6417 to 0.6496)

e. Ream valve guides to the specified diameter. Check I.D. after reaming.

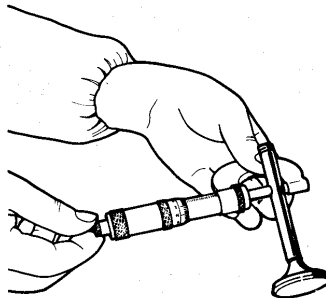


**Valve guide fitted I.D. after reaming:**  
9.000 to 9.015 mm  
(0.3543 to 0.3549 in)

### VALVES AND VALVE SEATS

Check valves for nicks, burns or excessive deposits due to poor sealing between valve face and seat. If necessary, scrap and replace valves.

a. If valves are in good condition, check dimensions against specifications.



**Valve stem diameter:**

**Intake:** 8.972 to 8.987 mm  
(0.3532 to 0.3538 in)

**Exhaust:** 8.935 to 8.960 mm  
(0.3518 to 0.3528 in)

**Exhaust:** 8.940 to 8.960 mm (1)  
(0.3520 to 0.3528 in) (1)

**Exhaust:** 8.945 to 8.960 mm (2)  
(0.3522 to 0.3528 in) (2)

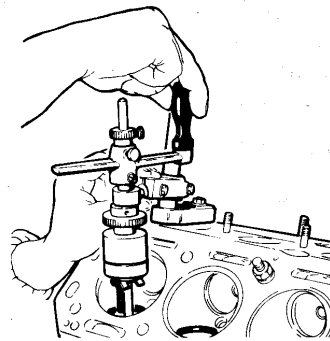
(1) ATE valve stem diameter for 062.12 and 061.34 engine  
(2) Eaton-Livia valve stem diameter for 061.34 engine

Valve head diameter mm (in)		
Type	Engine	
	016.00 - 016.78 - 061.00 062.02 - 061.34	
Ate	i.	41.000 to 41.200 (1.6142 to 1.6220)
	e.	37.000 to 37.200 (1.4567 to 1.4646)
Eaton Livia	i.	41.000 to 41.150 (1)(2) (1.6142 to 1.6201) (1)(2)
	e.	37.000 to 37.150 (1.4567 to 1.4626)
Type	Engine	
	017.13 - 016.55 - 062.12	
Ate	i.	44.010 to 44.150 (1.7327 to 1.7382)
	e.	40.010 to 40.150 (1.5752 to 1.5807)
Eaton Livia	i.	44.000 to 44.150 (1.7323 to 1.7382)
	e.	40.000 to 40.150 (1.5748 to 1.5807)

i. = intake valve    e. = exhaust valve

(1) For 062.02 and 061.00 engines:  
41.850 to 42.000 (1.6476 to 1.6535)  
(2) For 061.34 engine:  
41.800 to 42.000 (1.6457 to 1.6535)

b. Grind valve seats using suitable equipment as shown below.

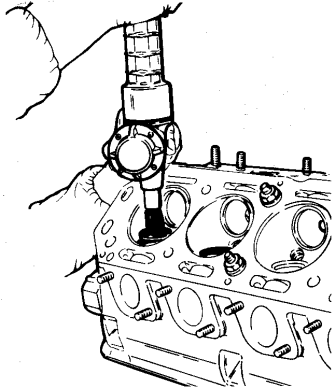


**Seat angle is the same for both intake and exhaust valve seats, and should be: 120°**

c. To produce correct seat angle, position grinder at 30°.

d. After machining, grind each valve in to the associated seat using a suitable tool.

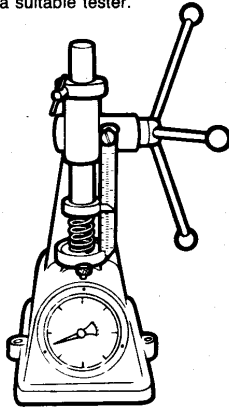
## ENGINE MAIN MECHANICAL UNIT



- When grinding valves and seats, use SIPAL AREXONS Carbo-silicium abrasive paste, Part No. 4100-31502.
- Lubricate valve stems with engine oil.
- Thoroughly clean valves and seats using kerosene or solvent.

### VALVE SPRINGS

Inspect valve springs for cracks or lack of tension. If poor spring performance is suspected, check inner and outer spring compressed length against specifications using a suitable tester.



Inspection load N (kg) (lb)		
Spring	Engine	
	016.00 - 016.78	016.55
Outer	348.8 to 366.1 (35.67 to 37.33) (78.4 to 82.3)	379.5 to 395.2 (38.7 to 40.3) (85.3 to 88.9)
Inner	218.1 to 227.1 (22.24 to 23.16) (49.1 to 51.1)	218.1 to 227.1 (22.24 to 23.16) (49.1 to 51.1)
Spring	Engine	
	061.00 - 062.02 - 062.12 017.13 - 061.34	
Outer	452.1 to 469.8 (46.10 to 47.90) (101.7 to 105.7)	
Inner	243.9 to 252.3 (24.87 to 25.73) (54.9 to 56.7)	

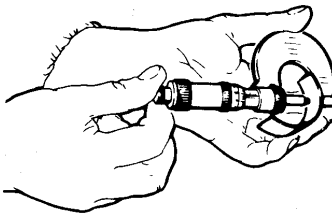
Spring compressed length mm (in)		
Spring	Engine	
	016.00 - 016.78 016.55	017.13 - 061.00 062.02 - 062.12 061.34
Outer	27.5 (1.08)	25.5 (1.00)
Inner	26 (1.02)	23.5 (0.93)

### ENGINE BLOCK

- Inspect engine block for cracks or excessive wear in cylinder bores.
- Thoroughly clean engine block faces with butyl acetate or methylethylketone to remove any gasket fragments.

### MAIN AND CONNECTING ROD BEARINGS

- Clean main and connecting rod bearings and check for scoring or scuffing.
- In the event of excessive wear, scrap and replace all bearings.
- Connecting rod and main bearing assembly to crankshaft must be carried out matching parts of the same grade, identified by paint marks of the same colour (RED or BLUE) applied on the side of each bearing and the associated crankshaft journal or crankpin.
- Measure wall thickness of bearing halves using an outside micrometer and compare results with specifications. Replace any excessively worn bearings.



Grade	Bearing	
Red	Main	1.829 to 1.835 mm (0.0720 to 0.0722 in)
	Conn. rod	1.829 to 1.835 mm (0.0720 to 0.0722 in)
Blue	Main	1.835 to 1.841 mm (0.0722 to 0.0725 in)
	Conn. rod	1.835 to 1.841 mm (0.0722 to 0.0725 in)

### MAIN BEARING CAPS

- Install main bearing caps in engine block. Caps are numbered to ensure proper positioning.
- Lubricate cap nuts and associated washers in engine oil and tighten to the specified torque.

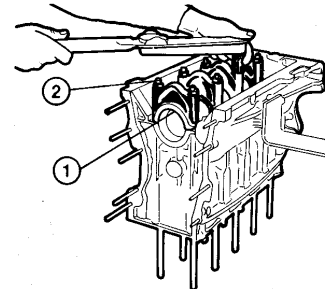
**T** : Tightening torque

Main bearing cap nuts

46 to 49 Nm

(4.7 to 5 kgm

33.9 to 36.1 ft.lb)



- Main bearing caps
- Nuts and washers

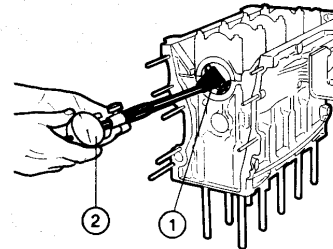
- Using a bore gauge with dial indicator, measure installed diameter of main bearings and compare with specifications.

Main bearing diameter:

63.647 to 63.666 mm

(2.5058 to 2.5065 in)

For  
061.00 - 061.34 - 062.02 - 062.12  
engines:  
63.652 to 63.671 mm  
(2.5060 to 2.5067 in)



- Bore gauge
- Dial indicator



d. Check centre main bearing housing width.

Centre main bearing housing width:  
25.15 to 25.20 mm (0.990 to 0.992 in)

**THRUST RINGS**

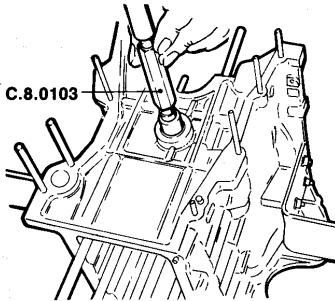
a. Measure thrust ring thickness and compare with specifications.

Thrust ring thickness:  
2.310 to 2.360 mm (0.091 to 0.093 in)

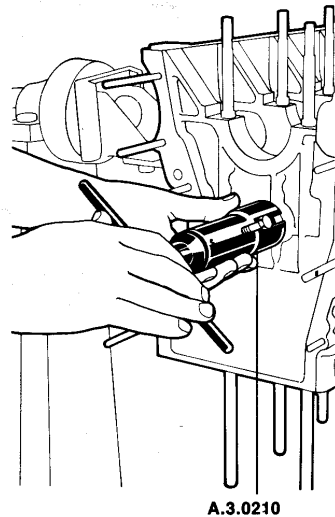
For 061.34 engine:  
2.311 to 2.362 mm (0.0910 to 0.930 in)

**CAMSHAFT IDLER GEAR BUSHING**

a. Using plug gauge C.8.0103, check the camshaft idler gear bushing for wear.

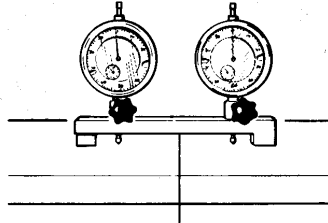


b. If replacement is necessary, remove bushing using puller A.3.0210. Also scrap and replace bushing on front cover at this time.



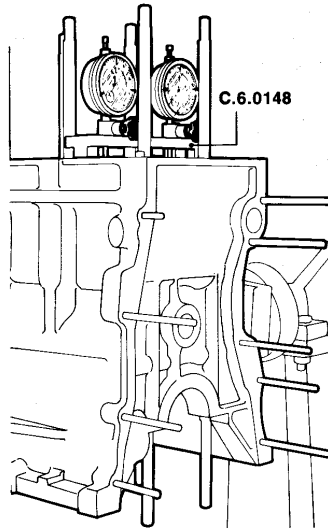
**CYLINDER LINER STAND-OUT**

a. Thoroughly clean liners and insert in block.  
b. Apply dial indicators to gauge C.6.0148. Place gauge on a surface plate and zero the dial indicators.



C.6.0148

c. Place gauge on cylinder block so that dial indicator styluses rest on edges of liner.  
Read liner stand-out off dial indicator.  
d. Compare stand-out reading with specifications.



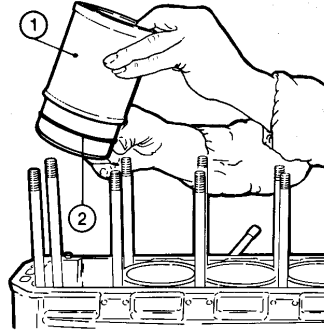
Cylinder liner stand-out:

016.00 engine =  
0.00 to 0.06 mm (0.0000 to 0.0024 in)

016.78 - 062.02 - 016.55 - 062.12  
061.00 - 017.13 - 061.34 engines =  
0.01 to 0.06 mm (0.0004 to 0.0024 in)

e. If liner ① stand-out must be checked with seals ② installed, proceed as follows:  
— Secure liners in block using retainers A.2.0117.

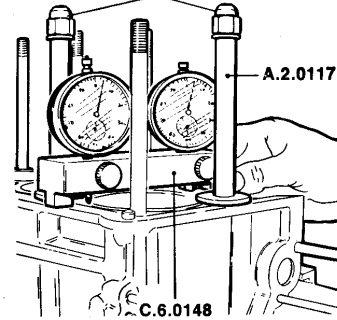
— Tighten retainer nuts to the specified torque.



1. Cylinder liners  
2. Seals

— Position gauge on block and check stand-out as directed in paragraph d.

T : 10 to 15 Nm  
(1 to 1.5 kgm  
7.4 to 11.0 ft.lb)



**CRANKSHAFT**

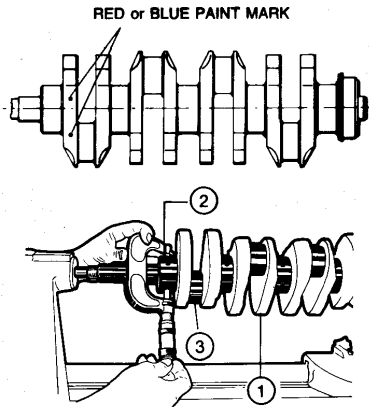
a. Examine crankshaft main journals and crankpins for uneven wear, scoring, scuffing or overheating.

**NOTE:**

Crankshaft has been carbonitrided, and thus cannot be reconditioned. Consequently, if measurements reveal excessive wear, crankshaft must be scrapped and replaced.

b. Measure crankshaft main journal and crankpin diameters and compare with data given in Inspection Specifications under Crankshaft.

Crankshaft main journals and crankpins are graded according to machining tolerances. Grades are identified by RED or BLUE paint marks.



1. Crankshaft
2. Main journal
3. Crankpin

c. Measure main journal and crankpin diameter at several points to check for ovality.



**Maximum permissible main journal and crankpin ovality:**  
**A-B = 0.007 mm (0.0003 in)**

d. Measure main journal and crankpin diameter at points A and B shown below to check for taper.



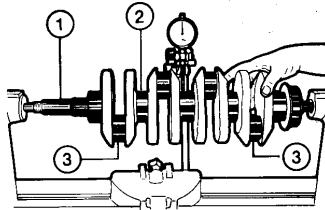
**Maximum permissible main journal and crankpin taper:**  
**A-B = 0.01 mm (0.0004 in)**

e. Support crankshaft on V-blocks or a lathe. Place dial indicator stylus in contact with main journals and crankpins and compare dimensions with the following specifications:

**Maximum main journal eccentricity:**  
**0.04 mm (0.0016 in)**

**Maximum crankpin misalignment relative to main journals:**  
**0.015 mm (0.0006 in)**

**Maximum crankpin centerline misalignment relative to main journal centerline:**  
**0.3 mm (0.012 in)**

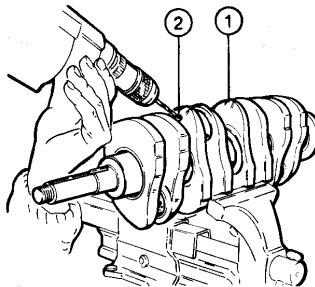


1. Crankshaft
2. Main journal
3. Crankpin

f. Check width of center main journal, which should be 30.000 to 30.035 mm (1.1811 to 1.1825 in).

g. If the foregoing inspection shows crankshaft to be in good condition, clean oil passages as follows:

- Drill out the aluminum plugs blocking the oil passages.



1. Crankshaft
2. Oil passages

- Clean oil passage using a wire brush.
- Clean the crankshaft and oil passages with hot fuel oil and dry with compressed air.
- Block passages with new aluminum plugs.
- Stake plugs in place using a suitable tool.

**CYLINDER LINERS**

a. Note liner grade and check dimensions.

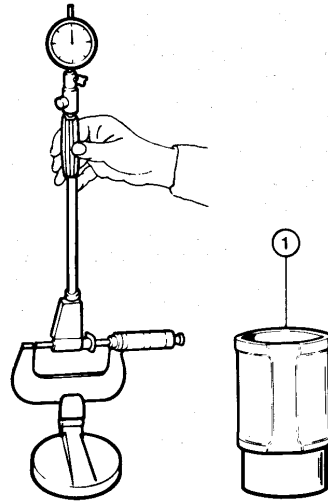
Liners are graded A, B, or C according to bore diameter. Grades are identified by paint marks on the outside of liners. Colour for each grade is as follows:

BLUE = A PINK = B GREEN = C

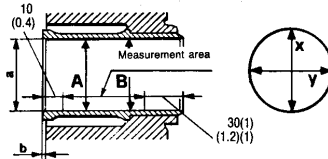
b. Refer to the Liner and Piston Inspection Specifications Table for the correct dimensions for each grade.

To check dimensions, proceed as follows:

- Zero the bore gauge on a suitable outside micrometer.
- Measure bore at the points indicated. Compare measurements to establish liner ① taper and ovality.



1. Cylinder liners



(1) 26 mm (1 in) for 062.12 engines

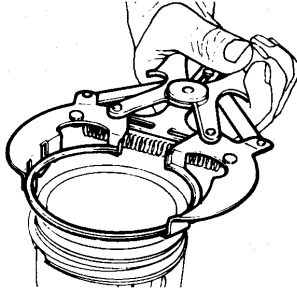
**Maximum liner taper:**  
**A-B = 0.01 mm (0.0004 in)**

**Maximum liner out-of-round:**  
**X-Y = 0.01 mm (0.0004 in)**

- Compare results of measurements with nominal dimensions for each liner grade and determine maximum wear.

**PISTONS AND CONNECTING RODS**

a. Remove compression rings and oil control ring together with expander spring as shown.

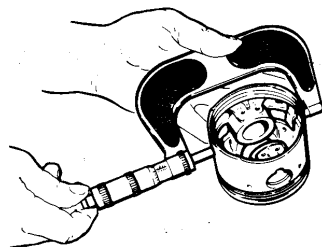


b. Using a screw driver, remove piston pin retaining ring.  
 c. Withdraw piston pin and separate connecting rod from piston.  
 d. Thoroughly inspect pistons for score marks on skirt or damaged ring grooves. Damaged or scored pistons must be scrapped and replaced.

Like the cylinder liners, pistons are graded according to machining tolerances. Grades are identified by paint marks on the piston head.

Colour for each grade is as follows:  
 BLUE = A PINK = B GREEN = C

e. Using an outside micrometer, measure the diameter of the piston skirt at right angles to the piston pin bore and at the following distance from the bottom edge of the skirt:



**016.00 - 061.00 engines:**  
 Borgo piston: 17 mm (0.67 in)  
 Mondial piston: 20 mm (0.79 in)

**016.78 - 061.34 - 062.02 engines:**  
 15 mm (0.59 in)

**016.55 - 062.12 - 017.13 engines:**  
 17 mm (0.67 in)

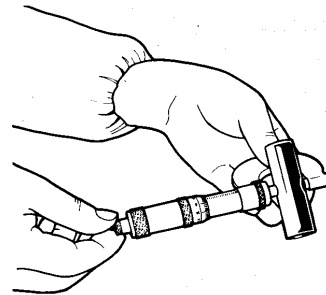
Compare results of measurement with tolerances given on Piston Specifications Table.

f. Check pin bores in piston and connecting rod for excessive wear.

g. Measure pin diameter with an outside micrometer.

Measure piston bore diameter using a bore gauge.

Compare measurements with specifications for the grade concerned.



**Piston pin bore diameter:**

**Black** 22.000 to 22.002 mm  
 (0.86614 to 0.86622 in)  
 22.001 to 22.003 mm (1)  
 (8.8662 to 8.8663 in) (1)

**White** 22.003 to 22.005 mm  
 (0.86626 to 0.86634 in)

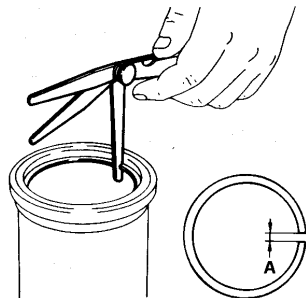
(1) For 061.34 engine only

**Pin diameter:**

**Black** 21.994 to 21.997 mm  
 (0.8659 to 0.8660 in)

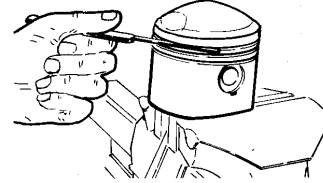
**White** 21.997 to 22.000 mm  
 (0.8660 to 0.8661 in)

h. Measure thickness of compression and oil control rings. Install rings in a suitable checking fixture or in cylinder liner and check ring gap «A» with a feeler gauge.



Measure ring clearance in groove using a feeler gauge.

Compare results of measurement with dimensions and tolerances given in «Piston and Piston Ring Inspection Specifications Table».

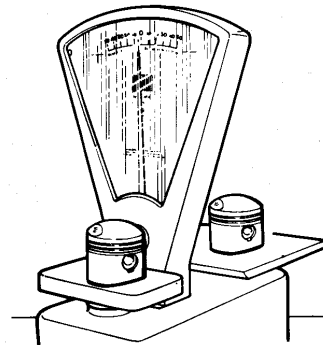


i. Match piston pins with pistons of the same grade.

Grade is identified by WHITE or BLACK paint marks on the inside of the pin and on the pin boss in the piston.

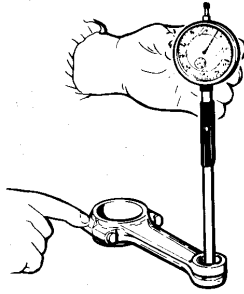
j. Pistons and pins may be reused if contact surfaces, particularly those in the piston bosses, are completely free from scratches or scoring of any kind.

k. Install pins in pistons of the same grade and fit retaining rings. Using a balance scale similar to that shown, check that the weight difference between pistons does not exceed 4 grams.



l. Examine connecting rods for cracks, scoring or signs of excessive wear. If connecting rods and caps are undamaged, carry out the measurements described below to determine whether they may be reused.

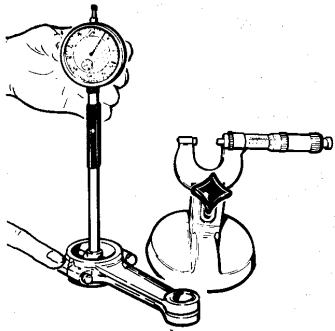
m. Measure fitted diameter of small end bushing using a bore gauge and dial indicator.



**Small end bushing fitted diameter:**  
22.005 to 22.015 mm  
(0.8663 to 0.8667 in)

n. Install connecting rod caps, lubricate nuts and washers in oil and tighten to the specified torque. Measure big end bore as described in paragraph m. above.

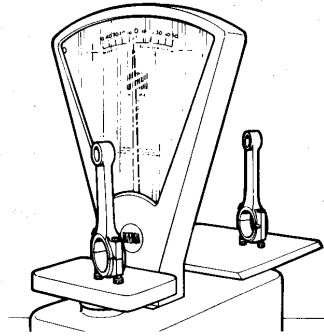
**T** : Tightening torque  
Connecting rod cap nuts (wet)  
49 to 52 Nm  
(5 to 5.3 kgm  
36.1 to 38.4 ft.lb)



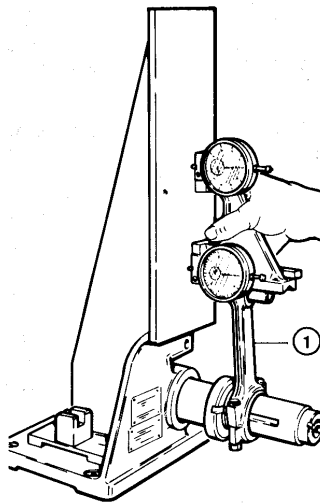
**Big end bore diameter:**  
53.695 to 57.708 mm  
(2.1140 to 2.1145 in)

o. Using a balance scale similar to that shown, check that the weight difference between connecting rods complete with caps and fasteners **does not exceed 2 grams**.

PA3469B0000003



p. Check alignment of connecting rods ① using a fixture as shown.



1. Connecting rod

**NOTE:**

Misaligned connecting rods must be scrapped and replaced, as they impose excessive loads on bearings, pistons and cylinder walls, which leads to irregular piston and rod wear.

**CYLINDER LINER, PISTON AND CONNECTING ROD MATCHING**

a. **Cylinder liners and pistons.** Cylinder liners and pistons must be paired using parts of the same grade, identified by paint marks of the same colour on the piston

head and on the outside of the cylinder liner as described in the foregoing paragraphs.

**Liner/piston clearance:**

**016.00 - 061.00 - 062.02 - 016.78 engines:**  
0.030 to 0.049 mm  
(0.0012 to 0.0019 in)

**016.55 - 061.34 - 062.12 - 017.13 engines:**  
0.040 to 0.059 mm  
(0.0016 to 0.0023 in)

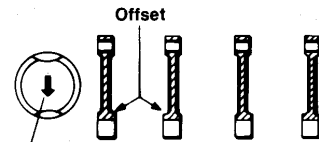
b. **Pistons and pins.** Pistons and pins must be paired using parts of the same grade, identified by paint marks of the same colour on the inside of the pin and on the piston boss.

**Pin/piston bore clearance:**  
(black and white)  
0.003 to 0.008 mm  
(0.00012 to 0.00031 in)

**061.34 engine:**  
0.004 to 0.009 mm (black)  
(0.00016 to 0.00035 in) (black)  
0.003 to 0.008 mm (white)  
(0.00012 to 0.00031 in) (white)

c. **Pistons and connecting rods.** Connecting rods must be installed with the offset facing towards the intermediate main journals.

For 1800 and 2000 engines, pistons must be positioned with the arrow stamped on the head toward the exhaust side.



**Arrow**  
(1800 and 2000 cc engines only)

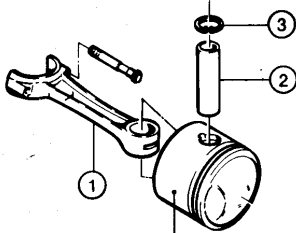
**Pin/small end clearance:**

**Black** 0.008 to 0.021 mm  
(0.0003 to 0.0008 in)  
**White** 0.005 to 0.018 mm  
(0.0002 to 0.0007 in)

d. Insert small end of connecting rod between piston bosses and align bores for piston pin installation.

## ENGINE MAIN MECHANICAL UNIT

- e. Insert piston pin (2) through piston (4) and connecting rod (1). Secure pin with two retaining rings (3).



1. Connecting rod
2. Piston pin
3. Retaining rings
4. Piston

### FLYWHEEL

- a. Check inside diameter of center bushing.  
If necessary, install a new bushing and ream to the specified size.

**Flywheel center bushing I.D.**  
(after reaming): 26.010 to 26.023 mm  
(1.0240 to 1.0245 in)

- b. Check ring gear teeth for chipping or signs of pick-up.  
If damaged, remove ring gear using a hydraulic press and replace.

- c. Thoroughly clean mating surfaces of flywheel and new ring gear.

d. Heat the new ring gear evenly to 120 to 140°C (248 to 284°F).

Fit ring gear over flywheel and check that it is correctly seated.

- e. Allow ring gear to cool slowly at room temperature.

**Do not attempt to accelerate cooling.**

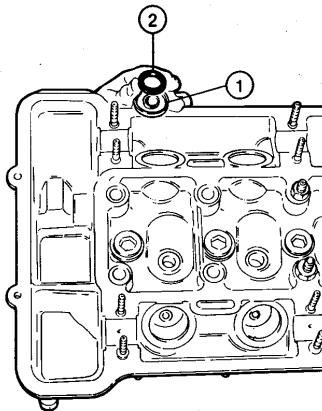
## ENGINE ASSEMBLY

### CYLINDER HEAD ASSEMBLY

After inspecting as described above and replacing defective parts, assemble engine using the special purpose tools described during engine disassembly and the assembly tools indicated below.

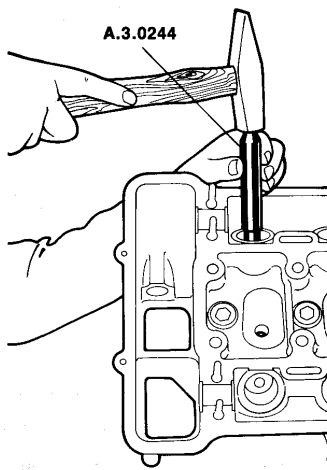
- a. Clamp support A.2.0195 and fork A.2.0196 in vice and install cylinder head on fork.

- b. Fit bottom spring cups (1) and abutment washers (2) over intake and exhaust valve guides.



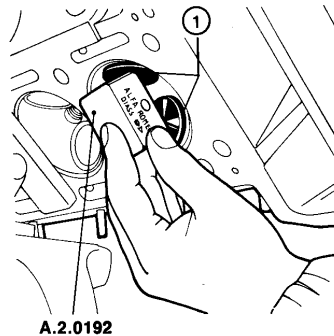
1. Bottom spring cup
2. Abutment washer

- c. Install oil seals on intake valve guides using tool A.3.0244.



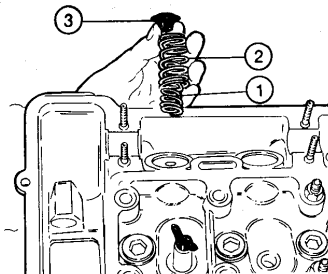
- d. Lubricate valve stems with clean engine oil and install in the associated guides.

Retain valves using support tool A.2.0192. Support should be secured to spark plug hole through the associated wing nut.



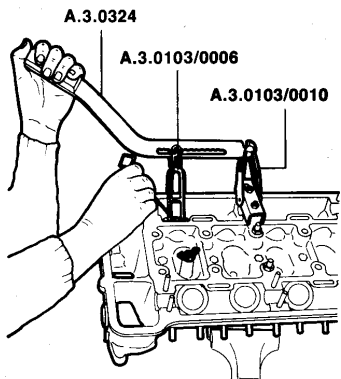
1. Valves

- e. Insert inner springs (1), outer springs (2) and top spring cup (3) over valve stems. Damping coils of springs must face downward.



1. Inner springs
2. Outer springs
3. Top spring cups

f. Install support **A.3.0103/0010** on head center studs and, using spring compressor **A.3.0103/0006** and lever **A.3.0324**, compress springs and install spring retainer locks in grooves on valve stem.

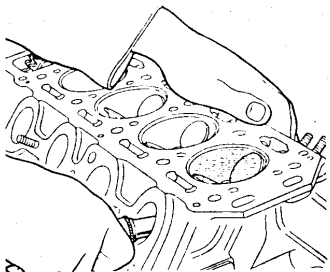


**Valve leakage test.**

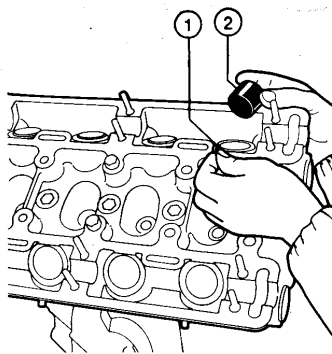
Install spark plugs in seats. Pour enough fuel in a combustion chamber to barely cover the head of the valve under test.

Introduce air at low pressure into the intake and exhaust passages and check for air bubbles in the fuel.

If leakage is detected, check that valves are properly seated and repeat leakage test. If leakage persists, regrind the valve seats as described under «Inspection - Valves and valve seats».



g. Install valve tip caps (1) ensuring that they are returned to their original positions. Lubricate tappets (2) with clean engine oil and install in associated seats.



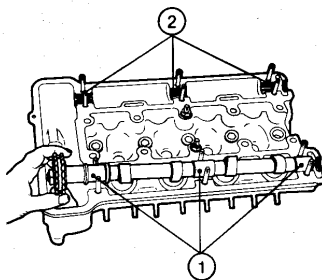
1. Valve tip caps  
2. Tappets

h. Install flanges and woodruff keys on camshafts.

Position gears with washers, lockwashers and nuts.

Tighten nuts.

i. Using clean engine oil, lubricate camshaft journals (1) and housings (2) on cylinder head.



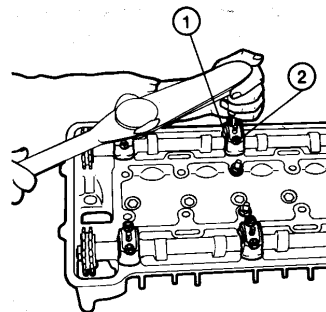
1. Camshaft journals  
2. Housings

j. Position caps (1) in numerical order (numbers are marked on caps).

Lubricate nuts and washers (2) with engine oil and tighten to specified torque.

Check camshaft journal running clearance and camshaft end float against specifications.

**T** : Tightening torque  
Camshaft cap nuts (wet)  
20 to 22 Nm  
(2 to 2.25 kgm  
14.8 to 16.2 ft.lb)



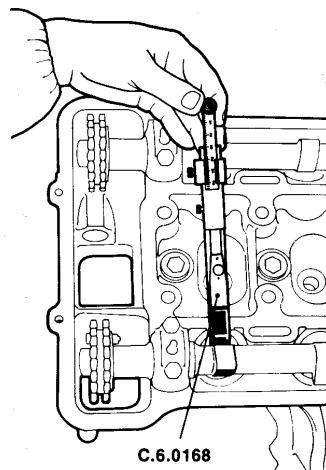
1. Camshaft caps  
2. Nuts and washers

**Camshaft journal running clearance:**  
0.020 to 0.074 mm (0.0008 to 0.0029 in)

**Camshaft end float:**  
0.065 to 0.182 mm (0.0026 to 0.0072 in)

k. Using gauge **C.6.0168**, check clearance between cam heel radius and tappet head against specifications.

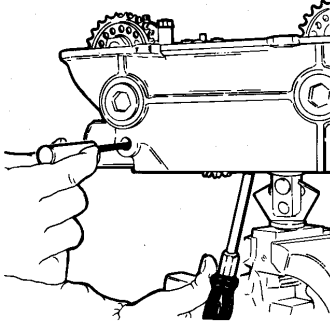
To adjust clearance, remove valve tip cap and install another of the correct thickness. Use a suitable tool to check tip cap thickness.



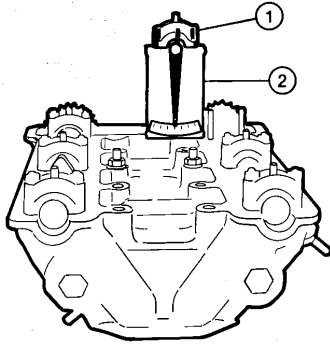
**C.6.0168**

**Valve clearance:**  
Intake: 0.400 to 0.450 mm  
(0.0157 to 0.0177 in)  
Exhaust: 0.450 to 0.500 mm  
(0.0177 to 0.0197 in)  
Exhaust: 0.500 to 0.600 mm (1)  
(0.0197 to 0.0236 in) (1)  
(1) For 061.34 engine only

I. Grease chain tensioner spring and insert in tensioner. Insert spring retainer plate in slot on tensioner and install tensioner assembly in seat on cylinder head. Install screw as shown below, ensuring that it is aligned with hole on spring retainer plate.



m. If a new cylinder head is used, restore timing marks on front camshaft caps (1) using a suitable tool (2).



1. Front caps  
2. Timing tool

**Angular position of timing mark on front bearing cap**

	Engine		
	016.00	016.78 016.55	061.34
Intake (β)	+1°	-0°15'	-1°20'30"
Exhaust (α)	-4°	+0°15'	-7°

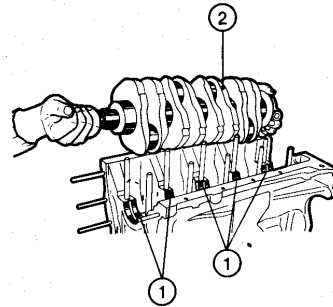
  

	Engine	
	017.13	062.02 - 061.00 - 062.12
Intake (β)	+12°45'	-2°04'
Exhaust (α)	-1°	-1°06'

**ENGINE BLOCK ASSEMBLY**

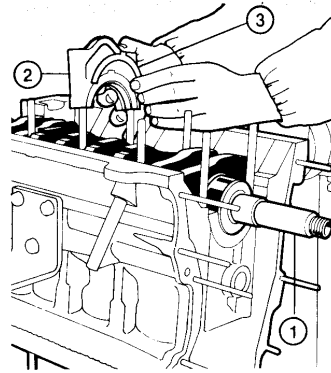
**CRANKSHAFT**

a. Install crankshaft in block as follows:  
 - Install the main bearing halves in the block and lubricate with oil. Crankshaft (2) must be matched with main bearings of same grade, identified by paint marks of the same colour (RED or BLUE) applied on the side of each bearing (1) and associated crankshaft journal.



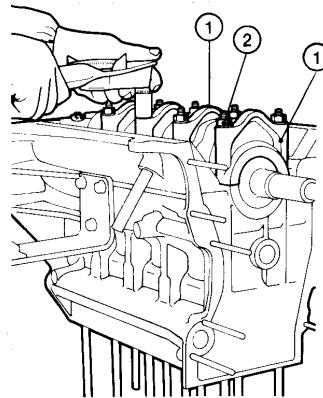
1. Top main bearing halves  
2. Crankshaft

- Lubricate crankshaft journals and position crankshaft (1) over main bearings.  
 - Insert thrust ring halves in seat on center main bearing. Rotate crankshaft to settle thrust rings. When installing thrust rings, make sure that oil grooves face crankshaft throws.  
 b. **Main bearing cap installation.**  
 - Install bearing halves in caps and lubricate with oil.  
 - Install center bearing cap (2) together with bearing half and thrust ring halves (3). Parts should be positioned as indicated by number on bearing cap.



1. Crankshaft  
2. Center main bearing cap  
3. Thrust ring half

- Install front and rear bearing caps (1) together with associated bearing halves. Parts should be positioned as indicated by numbers on bearing cap.  
 - Lubricate nuts and washers (2) with engine oil. Start nuts until they are finger tight.



1. Main bearing caps  
2. Nuts and washers

- Tighten the bearing cap nuts to the specified torque in two or three stages.


**T** : Tightening torque  
**Main bearing cap nuts (wet)**  
 46 to 49 Nm  
 (4.7 to 5 kgm  
 33.9 to 36.1 ft.lb)

c. **Crankshaft end play check.**  
 - Apply a dial indicator (1) with magnetic base on engine block so that indicator stylus contacts crankshaft parallel to crankshaft centerline.

## ENGINE MAIN MECHANICAL UNIT

### SPECIFICATIONS

#### ENGINE SPECIFICATIONS

		Engine			
		1600	1800	2000	2000
		(061.00)	(062.02)	(062.12)	(017.13)
Type		Otto cycle, 4-stroke			
No. and arrangement of cylinders		4, in-line			
Cylinder numbering					
Bore - Stroke	mm (in)	78 × 82 (3.07 × 3.23)	80 × 88.5 (3.15 × 3.48)	84 × 88.5 (3.31 × 3.48)	84 × 88.5 (3.31 × 3.48)
Displacement	cm <sup>3</sup> (cu.in)	1570 (95.80)	1779 (108.55)	1962 (119.72)	1962 (119.72)
Combustion chamber volume	cm <sup>3</sup> (cu.in)	51 (3.11)	52 (3.17)	61.3 (3.74)	61.3 (3.74)
Compression ratio		9	9.5	9	10
Power output DIN Maximum	kW (HP)	81 (110) at 5800	88 (120) at 5300 rpm	94 (128) at 5400 rpm	94 (128) at 5400 rpm
Max. torque DIN	Nm (kgm) (ft.lb)	146 (14.9) (107.7) at 4000 rpm	168.8 (17) (124.4) at 4000 rpm	179.5 (18.2) (132.4) at 4000 rpm	176.5 (17.9) (130.2) at 4000 rpm
Mean effective piston speed (1)	m/sec (ft/s)	15.3 (50.2)	15.6 (51.2)	15.93 (52.3)	15.93 (52.3)
Octane rating	N.O. - R.M. Sensitivity (2)	≥ 98 ≤ 11			
Engine oil pressure (3) at 800 - 900 rpm at 5000 rpm	kPa (bar; kg/cm <sup>2</sup> ; psi)	49.03 to 98.06 (0.49 to 0.98; 0.5 to 1; 7.1 to 14.2) 343.21 to 490.3 (3.43 to 4.90; 3.5 to 5; 49.8 to 71.1)			

(1) At maximum output rpm

(2) Difference between Research Method and Motor Method Octane Rating

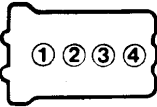
(3) Check with oil at operating temperature (90°C; 194°F)



## ENGINE MAIN MECHANICAL UNIT

### SPECIFICATIONS

#### ENGINE SPECIFICATIONS

		Engine	
		1800	
		(061.34)	
Type		Otto cycle, 4-stroke	
No. and arrangement of cylinders		4 in-line	
Cylinder numbering			
Bore - Stroke	mm (in)	80 x 88,5 (3.15 x 3.48)	
Displacement	cm <sup>3</sup> (cu.in)	1779 (108.55)	
Combustion chamber volume	cm <sup>3</sup> (cu.in)	68.4 (4.17)	
Compression ratio		7.5	
Power output DIN Maximum	kW (HP)	114 (153) at 5800 rpm	
Max. torque DIN	Nm (kgm) (ft-lb)	225.4 (23) (166) at 2600 rpm	
Mean effective piston speed (1)	m/sec (ft/s)	15.34 (50.3)	
Octane rating	N.O. - R.M. Sensitivity (2)	≥ 98 ≤ 11	
Engine oil pressure (3)		49.03	
Minimum at idle		(0.49; 0.5; 7.1)	
Minimum at peak rpm	kPa (bar; kg/cm <sup>2</sup> ; psi)	343.19 (3.43; 3.5; 49.7)	
Maximum at peak rpm		441.24 to 490.27 (4.41 to 4.90; 4.5 to 5.0; 63.9 to 71)	

(1) At maximum output rpm

(2) Difference between Research Method and Motor Method Octane Rating

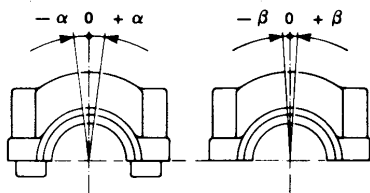
(3) Check with oil at operating temperature (90°C; 194°F)

# ENGINE MAIN MECHANICAL UNIT

## CHECKS AND ADJUSTMENTS

### VALVE TIMING DATA (1)

REFERENCE MARKS ON FRONT CAMSHAFT BEARING CAP (viewed from flywheel side)

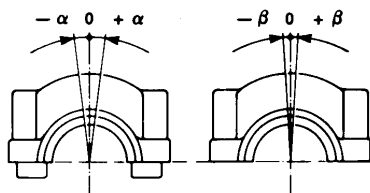


		Engine					
		1600		1800		2000	
		(016.00)		(016.78)		(016.55) (017.13)	
Camshafts	Intake	105.20.03.200.00		105.48.03.200.01		116.85.03.200.01	
	Exhaust	105.20.03.200.00		105.48.03.200.01		105.20.03.200.00	
Clearance between cam heel radius and tappet head	Intake	mm	0.400 to 0.450		0.400 to 0.450		
		(in)	(0.016 to 0.018)		(0.016 to 0.018)		
	Exhaust	mm	0.450 to 0.500		0.450 to 0.500		
		(in)	(0.018 to 0.020)		(0.018 to 0.020)		
Angular position of timing mark on front bearing cap	Intake	(β)	+1°		-0°15'		+12°45'
	Exhaust	(α)	-4°		+0°15'		-1°
Nominal lift	Intake	mm	9		9.5		11
		(in)	(0.35)		(0.37)		(0.43)
	Exhaust	mm	9		9.5		9
		(in)	(0.35)		(0.37)		(0.37)

(1) Engine cold

### VALVE TIMING DATA (1)

REFERENCE MARKS ON FRONT CAMSHAFT BEARING CAP (viewed from flywheel side)



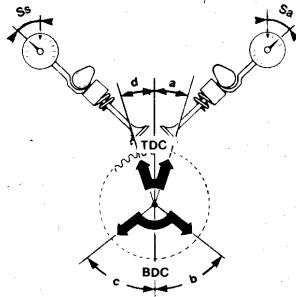
		Engine							
		1600		1800		2000		1800	
		(061.00)		(062.02)		(062.12)		(061.34)	
Camshafts	Intake	116.55.03.200.08				116.99.03.200.00			
	Exhaust	105.20.03.200.00				105.20.03.200.00			
Clearance between cam heel radius and tappet head	Intake	mm	0.400 to 0.450		0.400 to 0.450				
		(in)	(0.016 to 0.018)		(0.016 to 0.018)				
	Exhaust	mm	0.450 to 0.500		0.550 to 0.600				
		(in)	(0.018 to 0.020)		(0.022 to 0.024)				
Angular position of timing mark on front bearing cap	Intake	(β)	-2°04'		-1°20'30"				
	Exhaust	(α)	-1°06'		-7°				
Nominal lift	Intake	mm	11		8				
		(in)	(0.43)		(0.31)				
	Exhaust	mm	9		9				
		(in)	(0.35)		(0.35)				

(1) Engine cold

# ENGINE MAIN MECHANICAL UNIT

## VALVE TIMING DATA (1)

**VALVE OPENING AND CLOSING ANGLE CHECK**  
(crankshaft rotation counterclockwise when viewed from flywheel side)



mm (in)

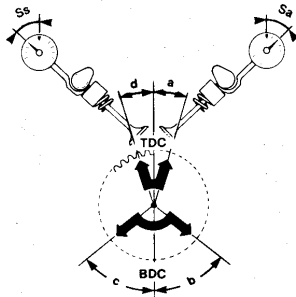
		Engine			
		1600	1800	2000	
		(016.00)	(016.78)	(016.55)	(017.13)
<b>Intake</b>	Opening	Linear displacement of tappet (Sa)	0.25 (0.010)		
		Corresponding angular movement (BTDC) (2) (a)	14°46' to 17°46'	21°30' to 24°30'	4° to -3°
<b>Exhaust</b>	Closing	Linear displacement of tappet (Ss)	0.25 (0.010)		
		Corresponding angular movement (ABDC) (b)	38°46' to 41°46'	40°30' to 43°30'	65° to 72°
<b>Exhaust</b>	Opening	Linear displacement of tappet (Ss)	0.20 (0.008)		
		Corresponding angular movement (BBDC) (c)	44°46' to 47°46'	40°30' to 43°30'	38°30' to 41°30'
<b>Exhaust</b>	Closing	Linear displacement of tappet (Ss)	0.20 (0.008)		
		Corresponding angular movement (ATDC) (d)	8°46' to 11°46'	21°30' to 24°30'	14°30' to 17°30'

(1) Engine cold

(2) ATDC for 017.13 engines

## VALVE TIMING DATA (1)

**VALVE OPENING AND CLOSING ANGLE CHECK**  
(crankshaft rotation counterclockwise when viewed from flywheel side)



mm (in)

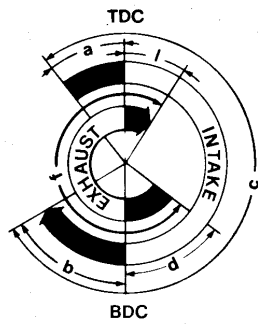
		Engine			
		1600	1800	2000	1800
		(061.00)	(062.02)	(062.12)	(061.34)
<b>Intake</b>	Opening	Linear displacement of tappet (Sa)	0.25 (0.010)		
		Corresponding angular movement (BTDC) (a)	27°30' to 30°30'	14°49' to 17°49'	
<b>Exhaust</b>	Closing	Linear displacement of tappet (Ss)	0.25 (0.010)		
		Corresponding angular movement (ABDC) (b)	38°30' to 41°30'	28°49' to 31°49'	
<b>Exhaust</b>	Opening	Linear displacement of tappet (Ss)	0.20 (0.008)		
		Corresponding angular movement (BBDC) (c)	38°30' to 41°30'	50°45'30" to 53°45'30"	
<b>Exhaust</b>	Closing	Linear displacement of tappet (Ss)	0.20 (0.008)		
		Corresponding angular movement (ATDC) (d)	14°30' to 17°30'	2°45'30" to 5°45'30"	

(1) Engine cold

**ENGINE MAIN MECHANICAL UNIT**

**VALVE TIMING DATA (1)**

**VALVE TIMING DIAGRAM**  
(crankshaft rotation clockwise when viewed from front)

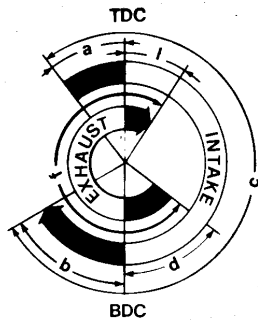


		Engine			
		1600	1800	2000	
		(016.00)	(016.78)	(016.55)	(017.13)
<b>Intake</b>	Opens (BTDC) (a)	40°30'	48°		28°44' to 21°44'
	Closes (ABDC) (b)	64°30'	67°		90°28' to 97°28'
	Angle (c)	285°8'	295°		299°12'
<b>Exhaust</b>	Opens (BBDC) (d)	63°54'	60°20'		58°12'
	Closes (ATDC) (e)	27°54'	41°20'		33°48'
	Angles (f)	271°48'	281°40'		272°

(1) Engine cold

**VALVE TIMING DATA (1)**

**VALVE TIMING DIAGRAM**  
(crankshaft rotation clockwise when viewed from front)



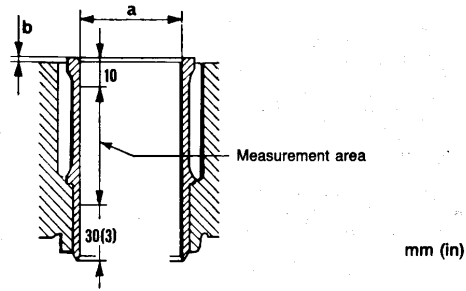
		Engine			
		1600	1800	2000	1800
		(061.00)	(062.02)	(062.12)	(061.34)
<b>Intake</b>	Opens (BTDC) (a)	53°44'	53°44'		40°36'
	Closes (ABDC) (b)	65°28'	65°28'		54°36'
	Angle (c)	299°12'			275°12'
<b>Exhaust</b>	Opens (BBDC) (d)	58°12'		60°	
	Closes (ATDC) (e)	33°48'		12°	
	Angle (f)	272°		252°	

(1) Engine cold

# ENGINE MAIN MECHANICAL UNIT

## CYLINDER LINERS, PISTONS, RINGS AND PINS

### Cylinder liners



Description		Engine			
		1600	1800	2000	
		(016.00 - 061.00)	(016.78 - 062.02) (061.34)	(016.55 - 062.12)	(017.13)
Liner bore dia.	(a) Class A (Blue)	77.985 to 77.994 (3.0703 to 3.0706)	79.985 to 79.994 (3.0703 to 3.0706)	83.985 to 83.994 (3.3065 to 3.3068)	
	Class B (Pink)	77.995 to 78.004 (3.0707 to 3.0710)	79.995 to 80.004 (3.1494 to 3.1497)	83.995 to 84.004 (3.3069 to 3.3072)	
	Class C (Green)	78.005 to 78.014 (3.0711 to 3.0714)	80.005 to 80.014 (3.1498 to 3.1502)	84.005 to 84.014 (3.3073 to 3.3076)	
Liner stand-out (1)	(b)	0.00 to 0.06 (0.00 to 0.0024)	0.01 to 0.06 (0.0004 to 0.0024)		
Max. ovality and taper (2)		0.01 (0.0004)			
Max. out-of-roundness		0.01 (0.0004)			

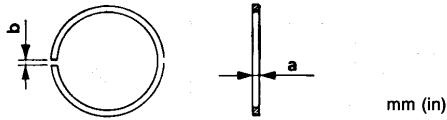
(1) Check after fitting liner retainers and tightening nuts to 10 - 15 Nm (1 to 1.5 kgm; 7.4 to 11.1 ft.lb)

(2) Max. limit along entire liner length (a)

(3) 26 mm (1 in) for 2000 engines (062.12)

## ENGINE MAIN MECHANICAL UNIT

### Piston rings



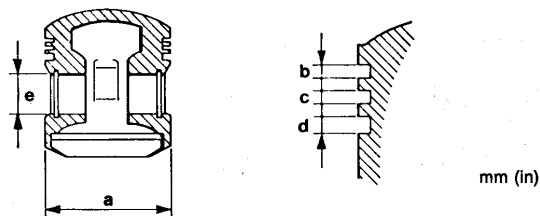
Description		Engine			
		1600	1800	2000	
		(016.00 - 061.00)	(016.78 - 062.02) (061.34)	(016.55 - 062.12)	(017.13)
Ring thickness	(a) Top compression ring	1.478 to 1.490 (0.0582 to 0.0587)		1.478 to 1.490 (0.0582 to 0.0587)	1.728 to 1.740 (0.0680 to 0.0685)
	2nd compression ring	1.728 to 1.740 (0.0680 to 0.0685) 1.478 to 1.490 (0.0582 to 0.0587) (2)		1.728 to 1.740 (0.0680 to 0.0685)	1.478 to 1.490 (0.0582 to 0.0587)
	Oil control ring	3.978 to 3.990 (0.1566 to 0.1571) 3.478 to 3.490 (0.1369 to 0.1374) (2)		4.478 to 4.490 (0.1763 to 0.1768)	3.478 to 3.490 (0.1369 to 0.1374)
Ring gap (1)	(b) Top compression ring	0.30 to 0.45 (0.012 to 0.018) 0.30 to 0.50 (0.0118 to 0.0197) (2)		0.25 to 0.40 (0.010 to 0.016)	0.30 to 0.45 (0.012 to 0.018)
	2nd compression ring	0.30 to 0.45 (0.012 to 0.018) 0.30 to 0.50 (0.0118 to 0.0197) (2)		0.30 to 0.45 (0.012 to 0.018)	0.25 to 0.45 (0.010 to 0.018)
	Oil control ring	0.30 to 0.45 (0.012 to 0.018)	0.25 to 0.40 (0.010 to 0.016) 0.25 to 0.50 (2) (0.010 to 0.011) (2)	0.25 to 0.40 (0.010 to 0.016)	0.25 to 0.40 (0.010 to 0.016)

(1) Fitted in checking fixture or cylinder liner

(2) For 061.34 engine only

## ENGINE MAIN MECHANICAL UNIT

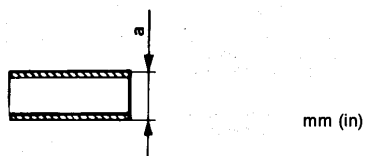
### Pistons



Description		Engine			
		1600	1800	2000	
		(016.00 - 061.00)	(016.78 - 062.02 - 061.34)	(016.55 - 061.12)	(017.13)
Piston diameter (1)	(a) Class A (Blue)	77.945 to 77.955 (3.0687 to 3.0691)	79.945 to 79.955 (3.1474 to 3.1478) 79.935 to 79.945 (4) (3.1470 to 3.1474) (4)	83.935 to 83.945 (3.3045 to 3.3049)	
	Class B (Pink)	77.955 to 77.965 (3.0691 to 3.0695)	79.955 to 79.965 (3.1478 to 3.1482) 79.845 to 79.955 (4) (3.1435 to 3.1478) (4)	83.945 to 83.955 (3.3049 to 3.3053)	
	Class C (Green)	77.965 to 77.975 (3.0695 to 3.0699)	79.965 to 79.975 (3.1482 to 3.1486) 79.555 to 79.965 (4) (3.1320 to 3.1482) (4)	83.955 to 83.965 (3.3059 to 3.3057)	
Top compression ring groove width	(b)	1.535 to 1.555 (2) (0.0604 to 0.0612) (2) 1.525 to 1.545 (3) (0.0600 to 0.0608) (3)	1.525 to 1.545 (0.0600 to 0.0608)		
2nd compression ring groove width	(c)	1.775 to 1.795 (0.0699 to 0.0707) 1.525 to 1.545 (0.0600 to 0.0608) (4)			
Oil control ring groove width	(d)	4.015 to 4.035 (0.1581 to 0.1589) 3.515 to 3.535 (0.1384 to 0.1392) (4)	4.515 to 4.535 (0.1778 to 0.1785)	3.515 to 3.535 (0.1384 to 0.1392)	
Pin bore dia.	(e) Black	22.000 to 22.002 (0.86614 to 0.86622)	22.001 to 22.003 (0.86617 to 0.86626) (4)		
	White	22.003 to 22.005 (0.86626 to 0.86634)			

- (1) Measure at right angles to pin bore and at the following distance from lower edge of skirt:  
 1600 engine [Borgo piston, 17 mm (0.67 in) — Mondial piston, 20 mm (0.79 in)] - 1800 engine (15 mm, 0.59 in) - 2000 engine (17 mm, 0.67 in)  
 (2) Borgo piston (3) Mondial piston (4) For 061.34 engine only

### Piston pins



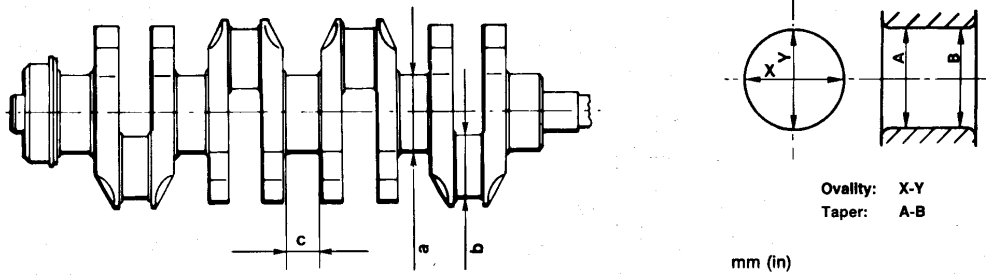
Description		Engine			
		1600	1800	2000	
		(016.00 - 061.00)	(016.78 - 062.02 - 061.34)	(016.55 - 062.12)	(017.13)
Pin diameter	(a) Black	21.994 to 21.997 (0.8659 to 0.8660)			
	White	21.997 to 22.000 (0.8660 to 0.8661)			
Pin clearance	Black	0.003 to 0.008 (0.0001 to 0.0003)	0.004 to 0.009 (0.0002 to 0.0004) (1)		
	White	0.003 to 0.008 (0.0001 to 0.0003)			

- (1) For 061.34 engine only

**ENGINE MAIN MECHANICAL UNIT**

**CRANKSHAFT, ENGINE BLOCK, CONNECTING RODS, BEARINGS AND FLYWHEEL**

**Crankshaft**



Description		Engine			
		1600	1800	2000	
		(016.00)	(016.78 - 062.02)	(016.55 - 017.13)	(062.12)
Main journal diameter	(a) Standard Blue	59.951 to 59.961 (2.3603 to 2.3607)		59.956 to 59.966 (2.3605 to 2.3609)	
	Standard Red	59.961 to 59.971 (2.3607 to 2.3611)		59.966 to 59.976 (2.3609 to 2.3613)	
Crankpin diameter	(b) Standard Blue	49.978 to 49.988 (1.9676 to 1.9680)			
	Standard Red	49.988 to 49.998 (1.9680 to 1.9684)			
Center main bearing journal width	(c) Standard	30.000 to 30.035 (1.1811 to 1.1825)			
Max permissible main journal and crankpin ovality		0.007 (0.0003)			
Max. permissible main journal and crankpin taper		0.01 (0.0004)			
Max. crankpin misalignment relative to main journals		0.015 (0.0006)			
Max. main journal eccentricity		0.04 (0.0016)			
Max. crankpin offset (crankpin centerline to main journal centerline)		0.3 (0.012)			

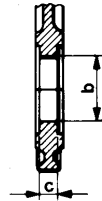
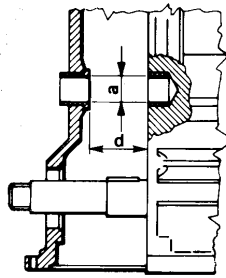
Description		Engine		
		1600	1800	
		(061.00)	(061.34)	
Main journal diameter	(a) Standard Blue (1)	59.956 to 59.966 (2.3605 to 2.3609)		
	Standard Red	59.966 to 59.976 (2.3609 to 2.3613)		
Crankpin diameter	(b) Standard Blue (1)	49.978 to 49.988 (1.9676 to 1.9680)		
	Standard Red	49.988 to 49.998 (1.9680 to 1.9684)		
Center main bearing journal width	(c) Standard	30.000 to 30.035 (1.1811 to 1.1825)		
Max permissible main journal and crankpin ovality		0.007 (0.0003)		
Max. permissible main journal and crankpin taper		0.01 (0.0004)		
Max. crankpin misalignment relative to main journals		0.015 (0.0006)		
Max. main journal eccentricity		0.04 (0.0016)		
Max. crankpin offset (crankpin centerline to main journal centerline)		0.3 (0.012)		

(1) Standard Light Blue for 061.34 engine only



## ENGINE MAIN MECHANICAL UNIT

### Engine block



mm (in)

Description		Engine			
		1600	1800	2000	
		(016.00 - 061.00)	(016.78 - 062.02) (061.34)	(016.55 - 062.12)	(017.13)
Timing idler jackshaft bushing fitted I.D. (after reaming) (1)	(a)	20.677 to 20.698 (0.8141 to 0.8149)			
Main bearing housing bore width	(b)	63.647 to 63.666 (2.5058 to 2.5065) [63.652 to 63.671 (3)] [(2.5060 to 2.5067) (3)]			
Center main bearing housing width over thrust faces	(c)	25.15 to 25.20 (0.990 to 0.992)			
Width between timing idler jackshaft bushings (2)	(d)	47.720 to 47.820 (1.8787 to 1.8827)			

- (1) Should replacement become necessary, always replace both bushings  
 (2) Check with cover and gasket installed and tightened  
 (3) For 1600 (061.00) - 1800 (062.02 and 061.34) and 2000 (062.12) engines only

### Connecting rod

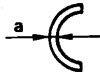


mm (in)

Description		Engine			
		1600	1800	2000	
		(016.00 - 061.00)	(016.78 - 062.02) (061.34)	(016.55 - 062.12)	(017.13)
Small end bore I.D.	(a)	22.005 to 22.015 (0.8663 to 0.8667)			
Big end bore dia.	(b)	53.695 to 53.708 (2.1140 to 2.1145)			

## ENGINE MAIN MECHANICAL UNIT

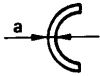
### Connecting rod bearings



mm (in)

Description		Engine			
		1600	1800	2000	
		(016.00 - 061.00)	(016.78 - 062.02) (061.34)	(016.55 - 062.12)	(017.13)
Connecting rod bearing wall thickness (a)	Standard Blue	1.835 to 1.841 (0.0722 to 0.0725)			
	Standard Red	1.829 to 1.835 (0.0720 to 0.0722)			

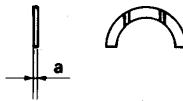
### Main bearings



mm (in)

Description		Engine			
		1600	1800	2000	
		(016.00 - 061.00)	(016.78 - 062.02) (061.34)	(016.55 - 062.12)	(017.13)
Main bearing wall thickness (a)	Standard Blue	1.835 to 1.841 (0.0722 to 0.0725)			
	Standard Red	1.829 to 1.835 (0.0720 to 0.0722)			

### Thrust rings



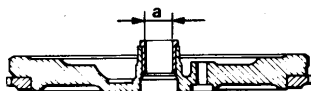
mm (in)

Description		Engine			
		1600	1800	2000	
		(016.00 - 061.00)	(016.78 - 062.02) (061.34)	(016.55 - 062.12)	(017.13)
Thrust ring thickness (a)	Standard	2.310 to 2.360 (0.0909 to 0.0929) 2.311 to 2.362 (0.0910 to 0.0930) (1)			

(1) For 061.34 engine only

## ENGINE MAIN MECHANICAL UNIT

### Flywheel

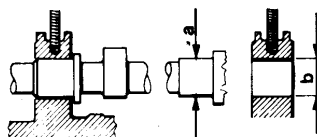


mm (in)

Description		Engine			
		1600	1800	2000	
		(016.00 - 061.00)	(016.78 - 062.02) (061.34)	(016.55 - 062.12)	(017.13)
Center bushing fitted I.D.	(a) After reaming	26.010 to 26.023 (1.0240 to 1.0245)			

### CAMSHAFT, TAPPET, SPRINGS, CYLINDER HEAD AND VALVES

#### Camshaft



mm (in)

Description		Engine			
		1600	1800	2000	
		(016.00 - 061.00)	(016.78 - 062.02) (061.34)	(016.55 - 062.12)	(017.13)
Camshaft journal diameter	(a)	26.959 to 26.980 (1.0614 to 1.0622)			
Camshaft journal housing bore dia.	(b)	27.000 to 27.033 (1.0630 to 1.0643)			

#### Tappet



mm (in)

Description		Engine			
		1600	1800	2000	
		(016.00 - 061.00)	(016.78 - 062.02) (061.34)	(016.55 - 062.12)	(017.13)
Tappet diameter	(a) Standard	34.973 to 34.989 (1.3698 to 1.3775)			
	Oversize	35.173 to 35.189 (1.3848 to 1.3854)			

**ENGINE MAIN MECHANICAL UNIT**

**Springs**

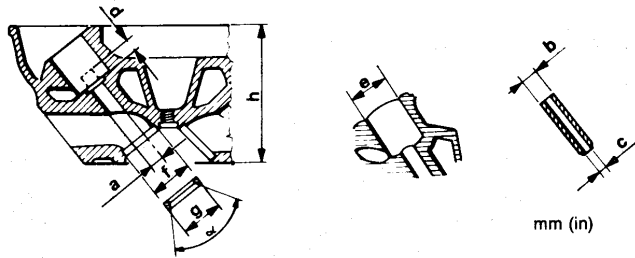


Description			Engine			
			1600	1800	2000	
			(016.00)	(016.78)	(016.55)	(017.13)
Spring length with valve open (a)	Outer spring	mm (in)	27.5 (1.08)		25.5 (1.00)	
	Inner spring	mm (in)	26 (1.02)		23.5 (0.93)	
Load at length (a)	Outer spring	kg (lb)	35.67 to 37.33 (78.6 to 82.3)	38.7 to 40.3 (85.3 to 88.3)	46.10 to 47.90 (101.6 to 105.6)	
	Inner spring	kg (lb)	22.24 to 23.16 (49.0 to 51.1)		24.87 to 25.73 (54.8 to 56.7)	

Description			Engine			
			1600	1800	2000	
			(061.00)	(062.02 - 061.34)	(062.12)	
Spring length with valve open (a)	Outer spring	mm (in)	25.5 (1.00)			
	Inner spring	mm (in)	23.5 (0.93)			
Load at length (a)	Outer spring	kg (lb)	46.10 to 47.90 (101.6 to 105.6)			
	Inner spring	kg (lb)	24.87 to 25.73 (54.8 to 56.7)			

# ENGINE MAIN MECHANICAL UNIT

## Cylinder head

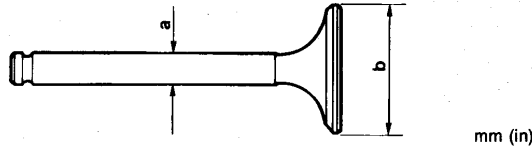


Description		Engine			
		1600		2000	
		(016.00 - 061.000)	(016.78 - 062.02) (061.34)	(016.55 - 062.12)	(017.13)
Valve guide housing bore dia.	(a)	13.990 to 14.018 (0.5508 to 0.5519)			
Valve guide O.D.	(b)	Intake	14.033 to 14.044 (0.5525 to 0.5529)		
		Exhaust	14.033 to 14.044 (0.5525 to 0.5529) 14.048 to 14.059 (0.5531 to 0.5535) (4)		
Valve guide fitted I.D. (after reaming)	(c)	9.000 to 9.015 (0.3543 to 0.3549)			
Valve guide stand-out	(d)	Intake	13.300 to 13.500 (0.5236 to 0.5315) 11.800 to 12.000 (0.4646 to 0.4724) (3)		
		Exhaust	16.300 to 16.500 (0.6417 to 0.6496)		
Tappet housing bore dia.	(e)	Standard	35.000 to 35.025 (1.3780 to 1.3789)		
		Oversize	35.200 to 35.225 (1.3858 to 1.3868)		
Valve seat insert housing bore dia.	(f)	Intake (1)	42.532 to 42.557 (1.6745 to 1.6755)	45.000 to 45.025 (1.7717 to 1.7726)	
		Exhaust (1)	38.532 to 38.557 (1.5170 to 1.5180)	41.000 to 41.025 (1.6142 to 1.6152)	
		Intake (2)	42.832 to 42.857 (1.6863 to 1.6873)	45.300 to 45.325 (1.7835 to 1.7844)	
		Exhaust (2)	38.832 to 38.857 (1.5288 to 1.5298)	41.300 to 41.325 (1.6260 to 1.6270)	
Valve seat insert O.D.	(g)	Intake (1)	42.597 to 42.632 (1.6770 to 1.6784)	45.065 to 45.100 (1.7742 to 1.7756)	
		Exhaust (1)	38.597 to 38.632 (1.5196 to 1.5209) 38.642 to 38.658 (1.5213 to 1.5220) (4)	41.065 to 41.100 (1.6167 to 1.6181)	
		Intake (2)	42.897 to 42.932 (1.6889 to 1.6902)	45.365 to 45.400 (1.7860 to 1.7874)	
		Exhaust (2)	38.897 to 38.932 (1.5314 to 1.5328) 38.942 to 38.958 (1.5331 to 1.5338) (4)	41.365 to 41.400 (1.6285 to 1.6299)	
Seat insert face angle	(α)	120°			
Min. cylinder head height after dressing	(h)	111,5 (4.39)			
Max. parallelism error between head faces		0.087 (0.0034)			
Max. head bottom face warpage		0.05 (0.002)			

- (1) Standard  
 (2) Oversize  
 (3) For 1600 (061.00) and 2000 (017.13) engines only  
 (4) For 061.34 engine only

**ENGINE MAIN MECHANICAL UNIT**

**Valves**



Description		Engine			
		1600	1800	2000	
		(016.00)	(016.78)	(016.55)	(017.13)
Valve stem diameter	(a) Intake	8.972 to 8.987 (0.3532 to 0.3538)			
	Exhaust	8.935 to 8.960 (0.3518 to 0.3528)			
Valve head dia. - ATE type	(b) Intake	41.000 to 41.200 (1.6142 to 1.6220)	44.010 to 44.150 (1.7327 to 1.7382)		
	Exhaust	37.000 to 37.200 (1.4567 to 1.4646)	40.010 to 40.150 (1.5752 to 1.5807)		
Valve head dia. - Eaton-Livia type	(b) Intake	41.000 to 41.150 (1.6142 to 1.6201)	44.000 to 44.150 (1.7327 to 1.7382)		
	Exhaust	37.000 to 37.150 (1.4567 to 1.4626)	40.000 to 40.150 (1.5752 to 1.5807)		

Description		Engine			
		1600	1800	2000	1800
		(061.00)	(062.02)	(062.12)	(061.34)
Valve stem diameter	(a) Intake	8.972 to 8.987 (0.3532 to 0.3538)	8.972 to 8.987 (0.3532 to 0.3538)		8.972 to 8.987 (2) (0.3532 to 0.3538) (2)
	Exhaust	8.935 to 8.960 (0.3518 to 0.3528)	8.935 to 8.960 (0.3518 to 0.3528) (1)		8.940 to 8.960 (0.3520 to 0.3528) (2) 8.945 to 8.960 (2) (0.3522 to 0.3528) (2)
Valve head dia. - Ate type	(b) Intake	41.000 to 41.200 (1.6142 to 1.6220)	41.000 to 41.200 (1.6142 to 1.6220)	44.000 to 44.150 (1.7323 to 1.7382)	41.000 to 41.200 (1.6142 to 1.6220)
	Exhaust	37.000 to 37.200 (1.4567 to 1.4646)	37.000 to 37.200 (1.4567 to 1.4646)	40.010 to 40.150 (1.5752 to 1.5807)	37.000 to 37.200 (1.4567 to 1.4646)
Valve head dia. - Eaton-Livia type	(b) Intake	41.850 to 42.000 (1.6476 to 1.6535)	41.850 to 42.000 (1.6476 to 1.6535)	44.000 to 44.150 (1.7323 to 1.7382)	41.850 to 42.000 (1.6476 to 1.6535)
	Exhaust	37.000 to 37.150 (1.4567 to 1.4626)	37.000 to 37.150 (1.4567 to 1.4626)	40.000 to 40.150 (1.5748 to 1.5807)	37.000 to 37.150 (1.4567 to 1.4626)

(1) ATE exhaust valve stem diameter is 8.940 to 8.960 mm (0.3520 to 0.3528 in) for 2000 engine (062.12)

(2) For Eaton-Livia valve

## ENGINE MAIN MECHANICAL UNIT

### FITTING DATA

mm (in)

Description	Engine			
	1600	1800	2000	
	(016.00 - 061.00)	(016.78 - 062.02) (061.34)	(016.55 - 062.12)	(017.13)
Liner/piston clearance	0.030 to 0.049 (0.0012 to 0.019) 0.040 to 0.059 (0.0016 to 0.0019) (3)		0.040 to 0.059 (0.0016 to 0.0023)	
Ring/groove clearance	Top compression ring	0.045 to 0.077 (1) (0.0018 to 0.0030) (1) 0.035 to 0.067 (2) (0.0014 to 0.0026) (2)	0.035 to 0.067 (0.0014 to 0.0026)	
	2nd compression ring	0.035 to 0.067 (0.0014 to 0.0026)		
	Oil control ring	0.025 to 0.057 (0.0010 to 0.0022)		
Pin/piston bore clearance	Black	0.003 to 0.008 (0.0001 to 0.0003) 0.004 to 0.009 (0.0002 to 0.0003) (3)		
	White	0.003 to 0.008 (0.0001 to 0.0003)		
Pin/small end clearance	Black	0.008 to 0.021 (0.0003 to 0.0008)		
	White	0.005 to 0.018 (0.0002 to 0.0007)		
Main bearing journal running clearance	Blue	0.004 to 0.045 (0.0002 to 0.0018)		
	Red	0.006 to 0.047 (0.0002 to 0.0019)		
Crankpin running clearance	Blue	0.025 to 0.060 (0.0010 to 0.0024)		
	Red	0.027 to 0.062 (0.0011 to 0.0024)		
Crankshaft end play	0.080 to 0.265 (0.0031 to 0.0104)			
Big end end play	0.2 to 0.3 (0.008 to 0.012)			
Camshaft journal running clearance	0.020 to 0.074 (0.0008 to 0.0029)			
Camshaft end play	0.065 to 0.182 (0.0026 to 0.0072)			
Tappet working clearance	0.011 to 0.052 (0.0004 to 0.0020)			
Valve stem/guide	Intake	0.013 to 0.043 (0.0005 to 0.0017)		
	Exhaust	0.040 to 0.080 (0.0016 to 0.0031) 0.040 to 0.075 (0.0016 to 0.0030) (3) 0.040 to 0.070 (0.0016 to 0.0028) (4)		
Valve guide interference fit	Intake	0.015 to 0.054 (0.0006 to 0.0021)		
	Exhaust	0.015 to 0.054 (0.0006 to 0.0021) 0.030 to 0.069 (0.0012 to 0.0027) (3)		
Seat insert interference fit	Intake	0.04 to 0.10 (0.002 to 0.004)		
	Exhaust	0.04 to 0.10 (0.002 to 0.004) 0.085 to 0.126 (0.0033 to 0.050) (3)		

(1) Borgo piston      (2) Mondial piston      (3) For 061.34 engine only      (4) For Eaton-Livia valve

### SHRINK-FIT TEMPERATURE

Component	Temperature
Cylinder head (valve seat installation)	100°C (212°F) 140°C (284°F) (1)
Starter ring gear	120° to 140°C (248 to 284°F)

(1) For 061.34 engine only

**ENGINE MAIN MECHANICAL UNIT**

**GENERAL REQUIREMENTS**

**FLUIDS AND LUBRICANTS**

Application	Type	Name	Quantity - kg (lb)
Rear main bearing cap seals	FLUID	UNION CARBIDE CHEMICALS CO: Ucon Lubricant 50HB-5100 MILLOIL: Lubricant for rubber Part No. 4500-17502	As required
Crankshaft seals (front and rear) — Outer surface — Lip	OIL GREASE	AGIP SINT 2000 10W50 Part No. 3631-69352 ISECO Part No. 3671-69841	As required As required
Engine oil - full oil pan  Filter Difference between max et min level on dipstick Routine changes - pan and filter Cylinder head well (1)	OIL	AGIP SINT 2000 10W50 Part No. 3631-69352 IP SINTIAX 10W40 Part No. 3631-69352	4.5 (9.9)  0.5 (1.1) 1.150 (2.54) 5 (11) 0.415 (0.91) per well (2)
Spark plug threads	OIL	ISECO: Molykote A Part No. 4500-18304	As required

- (1) Fill only after camshaft removal  
(2) With cylinder head completely dry

**SEALANTS**

Application	Type	Name	Quantity
Front cover screws (to head) (1)	SEALING COMPOUND	DIRING: Curil Part No. 3522-00017	As required
Camshaft cover contact surface (1)	SEALING COMPOUND	DIRING: Heldite Part No. 3522-00015	As required
Flywheel screws (2)	SEALING COMPOUND	LOCTITE 270 (green) Part No. 3524-00009	As required
Timing variator spigot on camshaft (2)	SEALING COMPOUND	DIRING Heldite DOW CORNING: Hermetite Part No. 3522-00015	As required

- (1) To remove traces of old gasket from cylinder head or block faces use butyl acetate or methylketone  
(2) Before applying sealing compound, remove all traces of old sealant from threads using a suitable brush and compressed air  
Always degrease threads using trichloroethylene or chlorothene

**ABRASIVES**

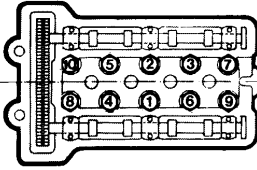
Application	Type	Name	Quantity
Valves and valve seats	GRINDING PASTE	SIPAL AREXONS: CarboSilicium for valves Part No. 4100-31502	As required



## ENGINE MAIN MECHANICAL UNIT

### TIGHTENING TORQUES

Nm (kgm; ft.lb)

Part	Engine			
	1600	1800	2000	
	(016.00 - 061.00)	(016.78 - 062.02) (061.34)	(016.55 - 062.12)	(017.13)
Main bearing cap nuts (wet)	46 to 49 (4.7 to 5; 33.9 to 36.1)			
Flywheel screws (with specified sealant)	110 to 113 (11.2 to 11.5; 81.1 to 83.3)			
Connecting rod cap nuts (wet)	49 to 52 (5 to 5.3; 36.1 to 38.4)			
Crankshaft pulley nut (wet)	187 to 195 (19 to 20; 137.9 to 143.8)			
Variator on camshaft				98 to 117 (10 to 12; 72.3 to 86.3)
Variator gear lockring (wet)				108 to 118 (11 to 12; 79.7 to 87.0)
Cylinder head nut tightening sequence (1)				
a) On head installation proceed as follows: — with engine cold, tighten progressively in proper sequence with washers, nuts and threads lubricated  — with engine warm, tighten without slackening	77 to 79 (7.9 to 8.1; 56.8 to 58.3)	71 to 73 (7.2 to 7.4; 52.3 to 53.8)	77 to 79 (7.9 to 8.1; 56.8 to 58.3)	
b) After 1000 km (620 mi.), slacken nuts one at a time by one turn in proper sequence when engine is cold, lubricate washer and nut contact surfaces and re-tighten	82 to 83 (8.4 to 8.5; 60.5 to 61.2)	75 to 76 (7.6 to 7.7; 55.3 to 56.1)	82 to 83 (8.4 to 8.5; 60.5 to 61.2)	
	86 to 88 (8.8 to 9; 63.4 to 64.9)	76 to 78 (7.8 to 8; 56.1 to 57.5)	86 to 88 (8.8 to 9; 63.4 to 64.9)	
Camshaft bearing cap nuts (wet)	20 to 22 (2 to 2.25; 14.8 to 16.2)			
Main bearing locknut (wet)	11 to 13 (1.1 to 1.3; 8.1 to 9.6)			
Camshaft cover knobs	14 to 20 (1.4 to 2; 10.3 to 14.8)			
Front cover and water pump nuts	14 to 22 (1.36 to 2.25; 10.3 to 16.2)			
Spark plugs	25 to 34 (2.5 to 3.5; 18.4 to 25.1)			
Coolant temperature sending unit on intake manifold	34 to 39 (3.5 to 4; 25.1 to 28.8)			
High coolant temperature indicator sending unit on cylinder head	20 to 25 (2 to 2.5; 14.8 to 18.4)			
Thermostat cover screws (2)	10 to 16 (1 to 1.6; 7.4 to 11.8)			
Nuts securing turbocharger to exhaust manifold (3)		38 to 47 (3.9 to 4.8; 28 to 34.6)		
Nuts securing turbocharger exhaust gas union to turbine (3)		38 to 47 (3.9 to 4.8; 28 to 34.6)		
Bolts securing turbocharger exhaust gas union to exhaust pipe (3)		19 to 24 (1.9 to 2.4; 14 to 17.7)		
Nuts securing exhaust manifold to cylinder head (3)		19 to 24 (1.9 to 2.4; 14 to 17.7)		
Bolts securing turbocompressor lower support to engine block (3)		19 to 24 (1.9 to 2.4; 14 to 17.7)		
Bolts securing turbocharger to lower support (3)		19 to 24 (1.9 to 2.4; 14 to 17.7)		
Bolts securing oil delivery hose to turbocompressor (3)		19 to 24 (1.9 to 2.4; 14 to 17.7)		
Nut securing oil filter support (3)		19 to 24 (1.9 to 2.4; 14 to 17.7)		
Bolt securing oil delivery hose union to engine block (3)		40 to 50 (4.0 to 5.0; 29.5 to 36.8)		
Bolt securing water delivery hose union to turbocharger (3)		50 to 62 (5.0 to 6.2; 36.8 to 45.7)		
Bolt securing water delivery hose union to engine block (3)		50 to 62 (5.0 to 6.2; 36.8 to 45.7)		

(1) Proceed as described in paragraph b) for service coupons A and B

(2) Excluding 061.34 engine

(3) For 061.34 engine only

**ENGINE MAIN MECHANICAL UNIT**

**TROUBLESHOOTING**

<b>Defect</b>	<b>Possible cause</b>	<b>Remedy</b>
Engine noisy. Crankshaft knocks	Excessive bearing journal or crankpin clearance and/or excessive play at thrust rings	Replace bearings and/or thrust rings
Pistons and connecting rods knock	<ul style="list-style-type: none"> <li>• Improper installation</li> <li>• Pin shifts sideways</li> </ul>	Remove and install correctly Remove and install correctly
Camshafts and valves knock	<ul style="list-style-type: none"> <li>• Excessive valve clearance</li> <li>• Bad tappet fit</li> <li>• Failed valve spring</li> <li>• Worn camshafts</li> </ul>	Adjust Replace Replace Replace
Water pump noisy	Excessive impeller shaft bearing clearance	Replace water pump

**Other mechanical problems**

Burnt valves	<ul style="list-style-type: none"> <li>• Incorrect valve clearance</li> <li>• Failed valve spring</li> </ul>	Replace and adjust clearance Replace
Excessive piston and cylinder liner wear	<ul style="list-style-type: none"> <li>• Bad piston fit</li> <li>• Poor quality oil</li> <li>• Air cleaner dirty or ineffective</li> <li>• Fuel mixture too rich</li> </ul>	Install correctly Use suitable oil Replace air cleaner Adjust or replace carburetter
Damaged connecting rod bearing	<ul style="list-style-type: none"> <li>• Oil starvation</li> <li>• Poor quality oil</li> <li>• Crankpins worn or out-of-round</li> <li>• Crankpin/bearing grade mismatched</li> </ul>	Check lubrication system Use suitable oil Re-condition or replace Replace
Damaged main bearing	<ul style="list-style-type: none"> <li>• Oil starvation</li> <li>• Poor quality oil</li> <li>• Main bearing journals worn or out-of-round</li> <li>• Main journal/bearing grade mismatched</li> </ul>	Check lubrication system Use suitable oil Re-condition or replace Replace
Timing chain and chain tensioner noisy	<ul style="list-style-type: none"> <li>• Worn chain</li> <li>• Incorrect chain tension</li> <li>• Noisy tensioner</li> </ul>	Replace Adjust tensioner Replace
Incorrect ignition timing	Distributor incorrectly installed	Adjust

**Lubrication**

Oil leakage	<ul style="list-style-type: none"> <li>• Loose drain plug</li> <li>• Leakage past oil pan gasket</li> <li>• Leakage past camshaft cover gasket and/or seals</li> <li>• Leakage past crankshaft seals and gaskets</li> <li>• Leakage past filter gasket</li> </ul>	Tighten Replace gasket Replace gasket and seals Replace worn gasket and seals Tighten filter
Low oil pressure	<ul style="list-style-type: none"> <li>• Clogged pressure regulating valve</li> <li>• Poor quality oil</li> </ul>	Clean valve Change oil

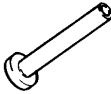
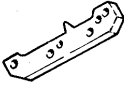
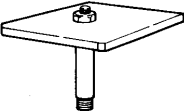

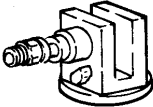
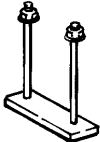
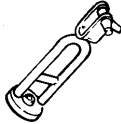
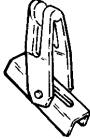
## TURBOCHARGER TROUBLESHOOTING

Defect	Possible cause	Remedy
Turbocharger noisy or vibrating	<ul style="list-style-type: none"> <li>• Inefficient lubrication of rotor arm bearings</li> <li>• Leakage into the intake or exhaust manifold</li> <li>• Rotor shaft unbalanced</li> </ul>	Check engine oil pressure and turbocharger oil ducts Tighten screws of defective connections and/or replace gaskets Replace turbocharger
Supercharging pressure too low (check pressure gauge) or insufficient engine power	<ul style="list-style-type: none"> <li>• Leakage in the section between turbocharger and cylinder head</li> <li>• Waste-gate valve badly adjusted</li> <li>• Waste-gate valve does not close</li> <li>• Supercharging pressure regulating valve open</li> <li>• Exhaust pipe clogged</li> <li>• Air filter clogged</li> <li>• Intercooler clogged</li> </ul>	Tighten the retaining screws and/or replace defective gaskets Adjust waste-gate valve and replace if necessary  Check valve  Clear or replace Replace air filter Clean intercooler
Supercharging pressure too high (check pressure gauge)	<ul style="list-style-type: none"> <li>• Waste-gate valve badly adjusted</li> <li>• Waste-gate valve blocked in closed position (stem bent)</li> </ul>	Adjust waste-gate valve Replace waste-gate valve
Oil leakage from rotor shaft gaskets (blue exhaust fumes)	<ul style="list-style-type: none"> <li>• Faulty oil return to engine</li> <li>• Oil leakage into turbine</li> <li>• Engine oil filter clogged</li> <li>• Turbocharger rotor gasket worn</li> </ul>	Check for obstruction Excessively worn rotor segments Replace turbocharger Replace oil filter Replace turbocharger

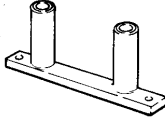
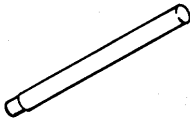
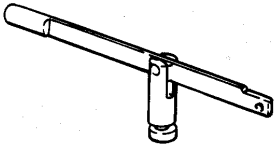


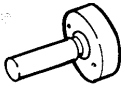
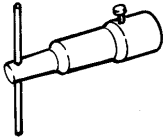
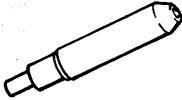
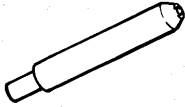
**NOTE:**

Supercharged engines are also subject to all the classic troubles (noise, etc.) of induction engines.

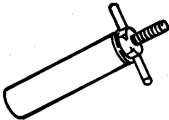

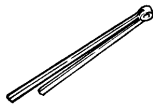
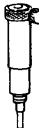

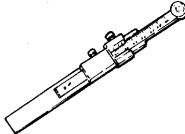

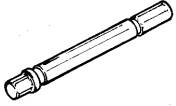

## SERVICE TOOLS

Reference number	Description	Page
A.2.0117	Cylinder liner retainer (2 pieces) 	01-29
A.2.0145	Flywheel retainer 	01-31
A.2.0146	Cylinder head removal tool 	01-29
A.2.0192	Valve support 	01-34
A.2.0195	Cylinder head support base 	01-33
A.2.0196	Cylinder head support fork 	01-33
A.3.0103/0006	Valve spring compressor 	01-34
A.3.0103/0010	Valve spring compressor lever support 	01-34

## ENGINE MAIN MECHANICAL UNIT

Reference number	Description	Page
A.3.0113	Rear main bearing cap seal installer 	01-47
A.3.0134	Valve guide remover 	01-37
A.3.0139/0001	Rear main bearing cap remover lever 	01-32
A.3.0139/0002	Rear main bearing cap puller 	01-32
A.3.0146	Front crankshaft seal installer 	01-50
A.3.0178	Rear crankshaft seal installer 	01-47
A.3.0210	Timing idler bushing puller, adjustable from 15 to 22 mm (0.6 to 0.9 in) dia. 	01-40
A.3.0244	Intake valve guide seal installer 	01-44
A.3.0246	Intake valve guide installer 	01-38

**ENGINE MAIN MECHANICAL UNIT**

Reference number	Description	Page
A.3.0247	Valve guide seal remover 	01-34
A.3.0324	Valve spring compressor lever 	01-34
A.5.0103	Camshaft rotator 	01-51
C.6.0122	Top dead center gauge 	01-52
C.6.0148	Cylinder liner/piston standout gauge 	01-40
C.6.0168	Valve clearance gauge 	01-45
C.8.0103	Idler gear bushing plug gauge 	01-40
U.2.0040	Idler gear bushing roughing reamer 	01-47
U.2.0041	Idler gear bushing finishing reamer 	01-47

## INSTALLATION

For the following operations refer to «Underbody» view of vehicle in question.

### CAUTION:

Proceed with great care to avoid damaging the servo-assisted steering box.

#### 1. Preliminary operations

- Fit the operating lever on the engine rear support.
- Hook the engine on the appropriate lifting bracket, and using a hoist, drop it slowly into the engine compartment, positioning it as necessary with the operating lever.
- Centre the engine in its compartment, resting it on the two side supports, and make sure that the screw and stud holes correspond on both supports.
- Insert and lock on both sides, screws (24) securing the flexible supports to the body.
- Lift the vehicle, screw and lock, on both sides, nuts (22) securing the lower part of the flexible supports to the body.
- Remove the operating lever from the engine rear support.

#### 2. Installation of propeller shaft

- Reinstall the complete propeller shaft unit on the vehicle by reversing the removal procedure and observing the following instructions.
  - Lubricate propeller shaft front bush and the rear coupling spherical seat with 5 cm<sup>3</sup> (0.30 u-In) of ISECO MOLYKOTE BR2 grease.
  - Rotate the propeller shaft a little at a time, blocking it in a suitable way, and tightening the flexible couplings bolts and nuts to the prescribed torque.

**T** : Tightening torque  
Nuts and bolts securing the propeller shaft flexible couplings to the engine flywheel and clutch fork

55 to 57 N·m  
(5.6 to 5.8 kg·m  
40.5 to 42.0 ft·lb)

- Lock the nuts securing propeller shaft centre support to vehicle floor.

**T** : Tightening torque  
Nuts securing propeller shaft centre support

93 to 103 N·m  
(9.5 to 10.5 kg·m  
70.0 to 77.4 ft·lb)

- Secure engine rear support pin (3) to body.
- Refit engine flywheel protective cover (6).
- Reconnect rod (14) to speed gear lever with bolt (13), then fit boot (15).
- Secure centre cross member (7) to the body.

#### 3. Installation of exhaust pipe

- Position exhaust pipe on retaining rings (8).
- Loosen bolts (18).
- Connect the centre section of the exhaust pipe to the end section without tightening clamp (17).
- Secure the exhaust pipes to the corresponding manifolds inserting new gaskets.
- Shake the exhaust pipe several times to ensure that it is correctly aligned.
- Tighten bolts (18) and clamp (17) on end section.

For the following operations refer to «View of engine compartment» of vehicle in question.

#### 4. Installation of power steering

- Position power steering pump (20), secure it to front bracket (26), and lock both screws.
- Screw, without locking, the two screws securing the pump to the rear bracket.
- Fit the drive belt on the pulleys, move the pump outwards to obtain prescribed belt tension, then lock the securing screws on front and rear brackets.

Load to be applied to belt centre:  
P = 15 to 30 kg (33.1 to 66.1 lb)

Deflection:  
F = 13 mm (0.51 in)

#### 5. Installation of air conditioner compressor

- Reconnect compressor lower bracket to engine block securing it from under the vehicle with the corresponding screws.
- Refit compressor drive belt, and lock nut (48).
- Restore correct tension to compressor drive belt and lock nut (47).

Load to be applied to belt centre:  
P = 20 to 35 kg (44.1 to 77.2 lb)

Deflection:  
F = 14 mm (0.55 in)

- If hose unions (50) are disconnected, secure them to compressor (46).

#### 6. Installation of radiator

Refit radiator together with electric fan, then reconnect cooling system tubing by reversing the order of the procedure described in «Removal» - step 5.

#### 7. Electrical connections

Restore electrical connection, reversing the order of the procedure described in «Removal» - step 3.

#### 8. Installation of accelerator control cable

- Insert the accelerator control cable with sheath under the intake air box, and position it on bracket (9).
- Rotate lever (7) and hook up the end of the accelerator control cable.

#### 9. Air and fuel supply system

Restore air and fuel supply system by reversing the procedure described in «Removal» - step 2.

#### 10. Final operations

- Reconnect servobrake vacuum intake hose (14) to single - acting valve on intake air box.
- Position battery in its compartment and secure it with the appropriate bracket.
- Refill and adjust the following (see: «WORKSHOP MANUAL»

Alfa 90

Alfa 75

Group 00, Group 80.

- Engine oil
- Engine coolant
- Power steering system oil level
- Air conditioning system Freon
- Timing check
- Accelerator control cable adjustment
- Engine idle speed adjustment
- Adjustment of percentage off exhaust CO at idle
- Electric fan activation check on engine at normal running temperature

## ENGINE MAIN MECHANICAL UNIT

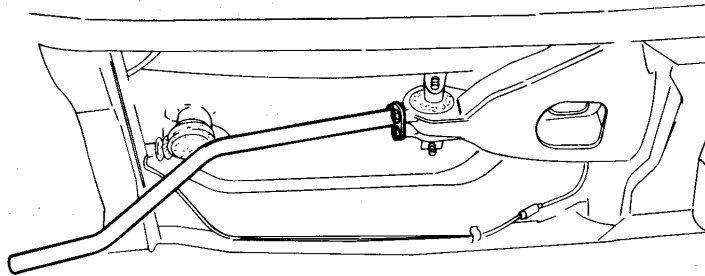
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- d. Release the bonnet, support it and reconnect bolts securing hinges on both sides of the vehicle.
- e. Alfa 90: if previously disconnected, restore connections of engine compartment lamp ground and power supply cables, then connect battery terminals.
- f. Alfa 90: refit windscreen wipers.



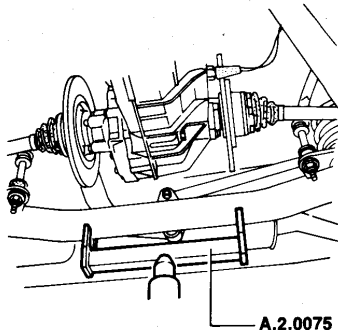
**10. Exhaust pipe**

- a. Back off nuts retaining down pipe (5) to manifolds.
- b. Back off three screws (20) retaining bracket (19) to bell housing.
- c. Slacken clip (17) and separate center pipe to tail pipe.
- d. Remove down pipe and center pipe together releasing four straps (8).



**11. Propeller shaft**

- a. Back off retaining screws and remove center crossmember (7).
  - b. Slide off dust excluder (15), back off bolt (13) and disconnect link (14). If necessary, back off four screws from support (12) and move support to facilitate propeller shaft removal.
  - c. Back off bolts and remove flywheel protector (6).
  - d. With transmission in neutral, suitably turn propeller shaft and remove each nut (2) and bolt (16) retaining shaft to flywheel and clutch fork respectively.
  - e. Back off two screws (4) and disconnect rear engine mount pivot (3) from body.
  - f. Back off two nuts (10) and disconnect center bearing (11) from body.
  - g. Back off screws retaining rear crossmember to body.
  - h. Raise rear axle using a platform lift with cradle A.2.0075.
- Remove propeller shaft from clutch fork.



- i. Lower the platform lift and remove the propeller shaft.

**12. Final operations**

- a. Install a suitable service handle on rear engine mount to facilitate engine removal.
- b. Back off nuts (22) retaining side mounts (23) at bottom.
- c. Lower platform lift, and back off screws (24) retaining side mounts (23) at top.
- d. Secure engine to lifting brackets, hoist engine and lift clear of engine compartment guiding it with the service handle.

**NOTE:**

Pay the utmost attention to prevent damaging power steering housing.

**INSTALLATION**

For the following operations refer to bottom view of vehicle in question.

**NOTE:**

Pay the utmost attention to prevent damaging power steering housing.

**1. Preliminary operations**

- a. Install service handle on rear engine mount.
- b. Fasten engine to lifting bracket and, using a suitable hoist, lower powerplant slowly in engine compartment guiding it with the service handle.
- c. Centralize engine in engine compartment over the two side mounts and ensure that holes for screws and studs are correctly aligned on both mounts.
- d. Start and tighten screws (24) retaining cushion mounts to body on both sides.

- e. Raise vehicle, start and tighten nuts (22) retaining mounts to body at bottom on both sides.
- f. Remove service handle from rear engine mount.

**2. Propeller shaft**

- a. Reverse the removal sequence and adhere to the following instructions:
  - Lubricate shaft front bushing and rear joint spherical seat using 5 cm<sup>3</sup> (0,2 fl-oz) of ISECO MOLYKOTE BR2 grease.
  - Restrain shaft by suitable means and tighten nuts and bolts of flex. couplings each in turn to the specified torque.

**T : Tightening torque**

Nuts and bolts retaining shaft flex. couplings to flywheel and clutch fork  
 55 to 57 N-m  
 (5.6 to 5.8 kg-m  
 40.6 to 42.0 ft-lb)

- Tighten nuts retaining center bearing to underbody.

**T : Tightening torque**

Center bearing nuts  
 93 to 103 N-m  
 (9.5 to 10.5 kg-m  
 68.6 to 76.0 ft-lb)

- b. Fasten rear engine mount pivot (3) to body.
- c. Install flywheel protector (6).
- d. Connect remote control link (14) to gear lever using bolt (13) and position dust excluder (15).
- e. Fasten center crossmember (7) to body.

## ENGINE MAIN MECHANICAL UNIT

### 3. Exhaust system

- a. Position exhaust pipe over straps (8).
- b. Finger tighten bolts (18).
- c. Connect center pipe to rail pipe without tightening clip (17).
- d. Fasten down pipes to manifolds installing **new** gaskets.
- e. Rock exhaust pipe to obtain proper alignment.
- f. Tighten bolts (18) and clip (17) on tail pipe.

In order to follow the following steps of the procedure consult the figure «View of the Engine Compartment» of the vehicle in question.

### 4. Steering pump

- a. Position steering pump (55), fasten to front bracket (57) and tighten two capscrews.
- b. Start two screws retaining pump to rear bracket.
- c. Install drive belt on pulleys, move pump outward to obtain correct tensioning and tighten screws on front and rear brackets.

### Force to be applied to belt at mid-leg:

P = 15 to 30 kg (33.1 to 66.1 lb)

#### Belt yield:

F = 13 mm (0.5 in)

### 5. Air conditioner compressor

- a. Install compressor bottom bracket to block and secure with the associated screws from vehicle underside.
- b. Install compressor drive belt and tighten nut (52).
- c. Tension belt and tighten nut (51).

### Force to be applied to belt at mid-leg:

P = 20 to 35 kg (44.1 to 77.2 lb)

#### Belt yield:

F = 14 mm (0.6 in)

- d. If previously disconnected, install fittings of pipes (54) to compressor (53).

### 6. Radiator

Install radiator with attached fan, and connect coolant lines adopting a reversal of the removal sequence, op. 6.

### 7. Electrical connections

Establish electrical connections, adopting a reversal of the removal sequence, op. 4.

### 8. Accelerator cable

Connect accelerator cable adopting a reversal of the removal sequence, op. 5.

### 9. Air and fuel system

Establish connections of air induction and fuel system adopting a reversal of the removal sequence, ops. 2 and 3.

### 10. Final operations

- a. Connect brake servo vacuum pipe (1) to right cylinder head connection.
- b. Install battery in its recess, secure with bracket and connect terminal clamps.
- c. For references and adjustments see specifications of appropriate groups.
- d. Release hood, prop up and install hinge bolts on both sides of vehicle.
- e. Install wiper arms.

## ENGINE REMOVAL AND INSTALLATION

GTV 6 2.5

## FOREWORD

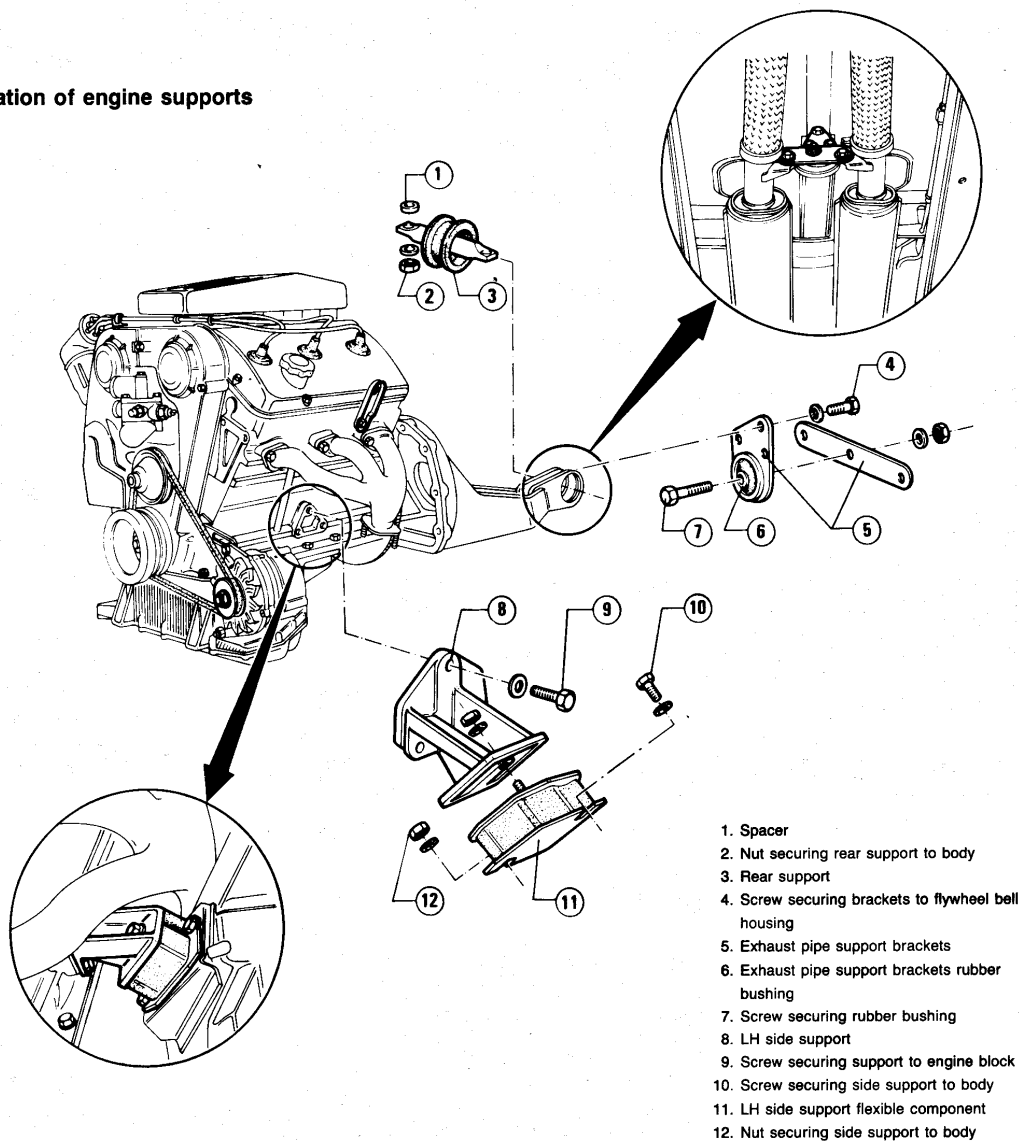
This section contains all the data and procedures relating to the removal and installation of the engine fitted on the following Alfa Romeo vehicle:

GTV 6 2.5 (016.48)

Given that the operations involved in removing and installing the engine are somewhat numerous, the operator is urged to read the intervention procedures carefully and to examine with care the illustration of the assembly that give an indispensable but of course incomplete overall view of the engine.

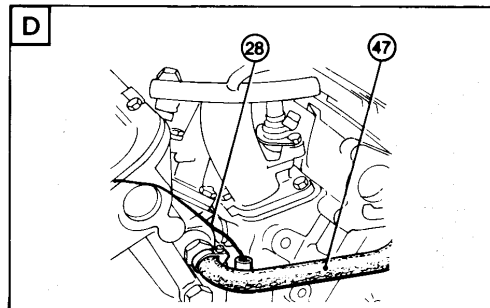
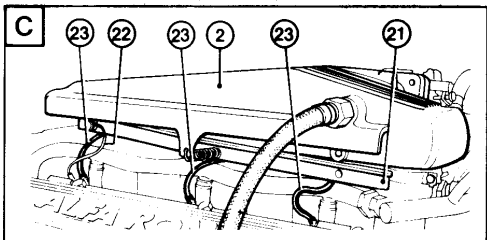
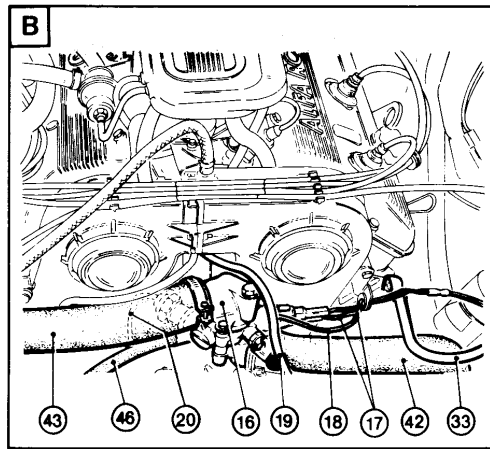
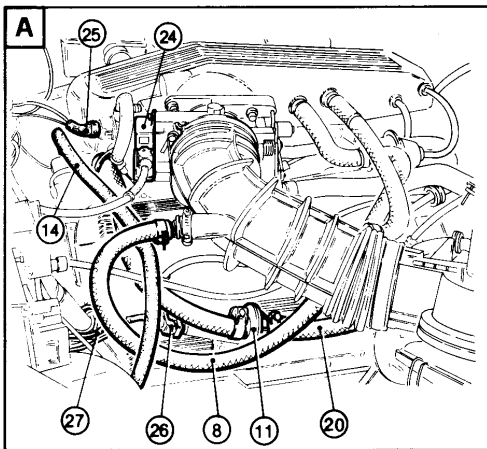
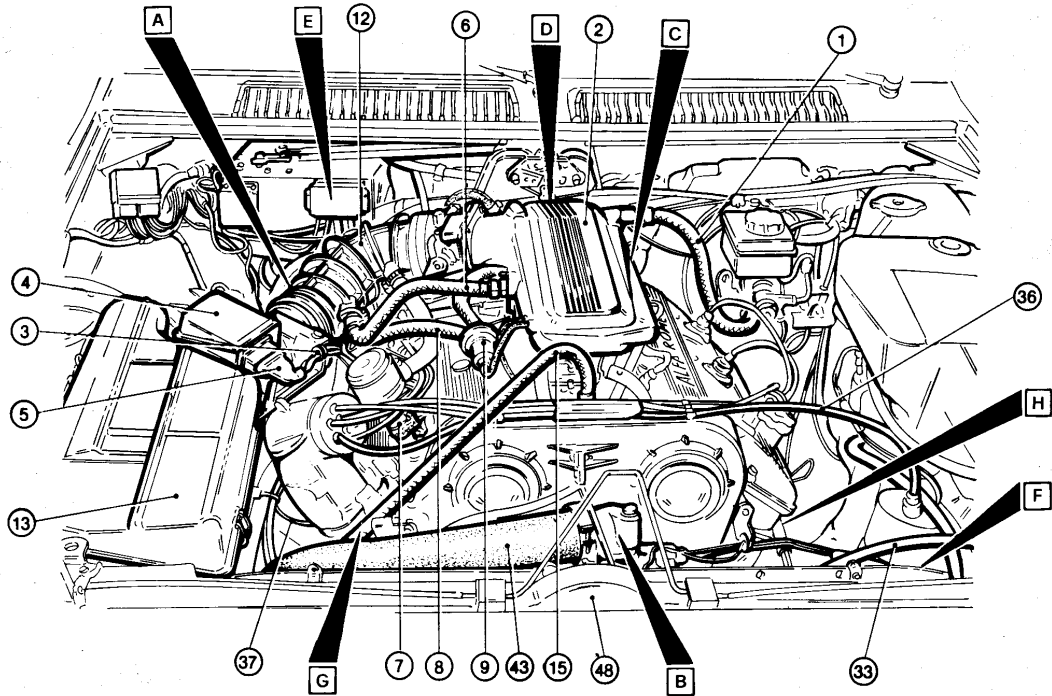
Following the above advice permits the correct operational techniques to be acquired and familiarizes the technician with the technical data, and caution and warning captions.

## Location of engine supports

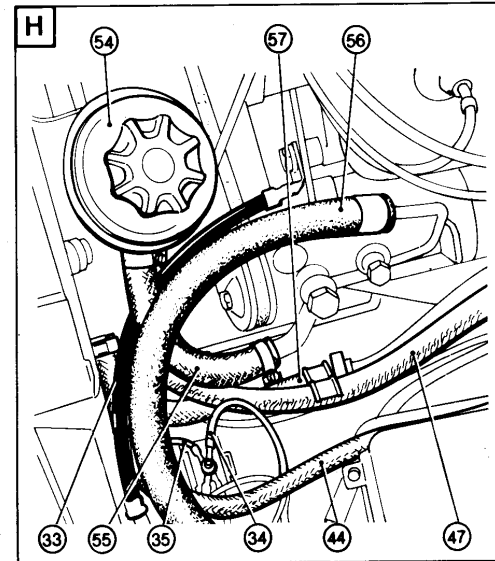
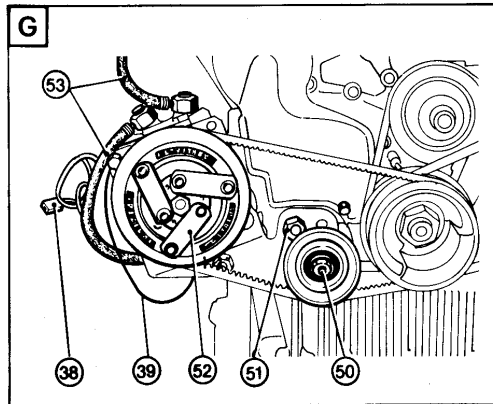
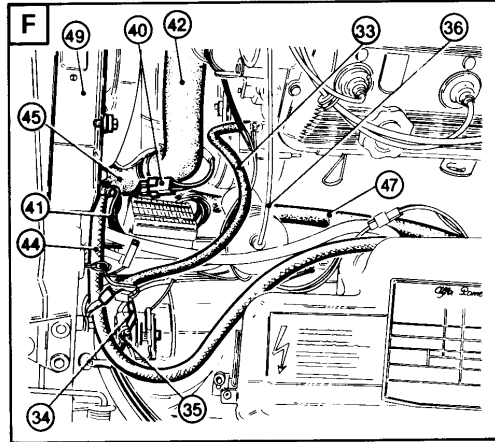
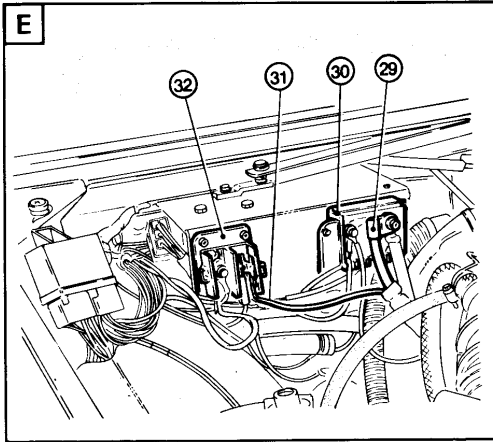


ENGINE MAIN MECHANICAL UNIT

VIEW OF ENGINE COMPARTMENT GTV 6 2.5 (016.46)



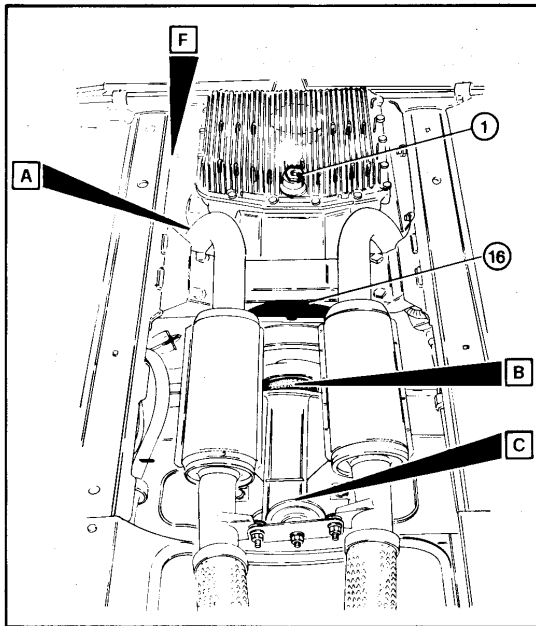
# ENGINE MAIN MECHANICAL UNIT



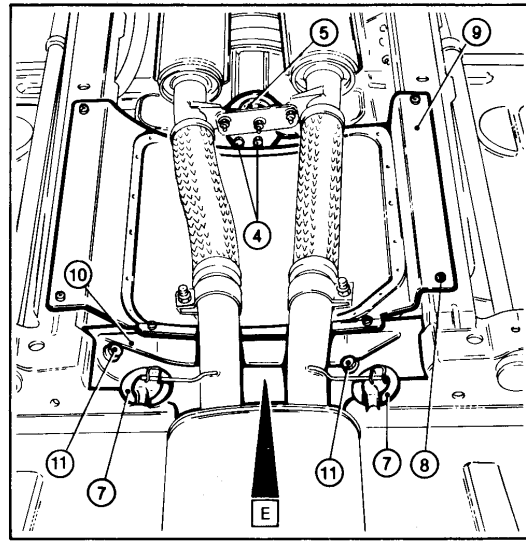
- |   |   |   |
|---|---|---|
| <ul style="list-style-type: none"> <li>1. Vacuum servo line</li> <li>2. Air intake box</li> <li>3. Air supply measurement cable</li> <li>4. Air supply measuring device</li> <li>5. Bracket</li> <li>6. Idling adjustment by-pass line</li> <li>7. Oil vapour vent pipe</li> <li>8. Vacuum regulating valve air intake line<br/>(versions: Switzerland, Sweden, Australia)</li> <li>9. Vacuum regulating valve<br/>(versions: Switzerland, Sweden, Australia)</li> <li>10. Auxiliary air delivery line for cold starting</li> <li>11. Auxiliary air solenoid valve</li> <li>12. Corrugated sleeve</li> <li>13. Air filter cover</li> <li>14. Fuel delivery line to manifold</li> <li>15. Excess fuel return line</li> <li>16. Thermostat group</li> <li>17. Coolant temperature warning light and indicator cables</li> <li>18. Thermostat group earth cable</li> </ul> | <ul style="list-style-type: none"> <li>19. Cable transmitting coolant temperature to ECU</li> <li>20. Cold starting thermal switch cable</li> <li>21. Air intake box guard</li> <li>22. Earth plait</li> <li>23. Electrical supply cables</li> <li>24. Throttle opening position sender cable</li> <li>25. Electro-injector supply cable for cold starting</li> <li>26. Auxiliary air solenoid valve supply cable</li> <li>27. Earth cable</li> <li>28. Oil pressure sender cable</li> <li>29. Starter supply cable</li> <li>30. Terminal board</li> <li>31. Energizing cable</li> <li>32. Terminal board</li> <li>33. Engine earth cable</li> <li>34. Generator supply cable</li> <li>35. Battery re-charging cable</li> <li>36. Coil high voltage cable</li> <li>37. Low voltage cable</li> </ul> | <ul style="list-style-type: none"> <li>38. Compressor electro-magnetic coupling supply cable</li> <li>39. Conditioner compressor earth cable</li> <li>40. Right and left fan supply cable</li> <li>41. Fan enabling cable</li> <li>42. Coolant return sleeve to thermostat group</li> <li>43. Coolant return sleeve to radiator</li> <li>44. Radiator vent pipe</li> <li>45. Coolant outlet sleeve from radiator</li> <li>46. Liquid return line from heater</li> <li>47. Radiator filling line</li> <li>48. Radiator fixing screws</li> <li>49. Radiator</li> <li>50. Compressor belt stretcher retaining nut</li> <li>51. Belt stretcher bracket retaining screw</li> <li>52. Conditioning system compressor</li> <li>53. Compressor Freon inlet/outlet lines</li> <li>54. Power steering oil reservoir</li> <li>55. Power steering oil reservoir line</li> <li>56. Pressure line</li> <li>57. Return line</li> </ul> |
|---|---|---|

ENGINE MAIN MECHANICAL UNIT

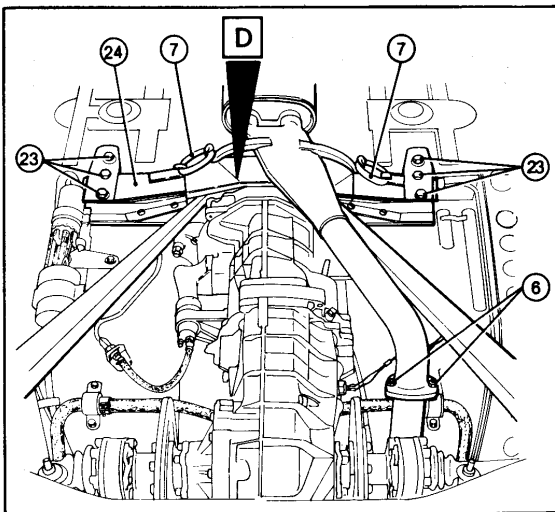
VIEW OF UNDERBODY GTV 6 2.5 (016.46)



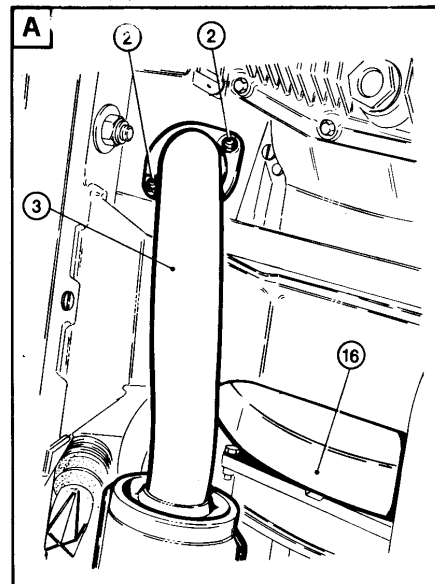
FRONT SECTION



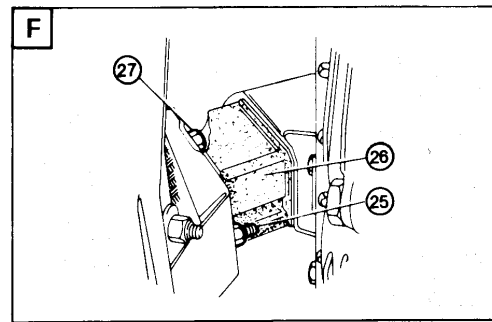
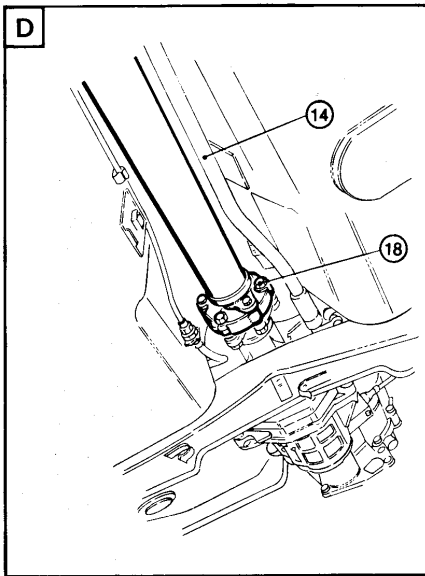
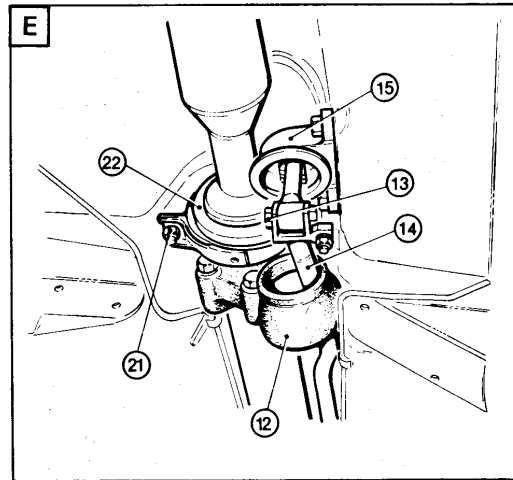
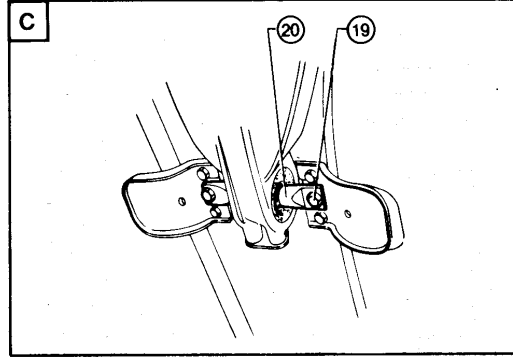
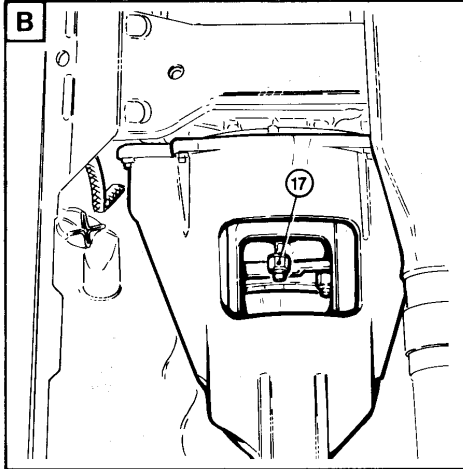
CENTRE SECTION



REAR SECTION



# ENGINE MAIN MECHANICAL UNIT



1. Oil drain plug
2. Exhaust pipe (front section) retaining nuts
3. Exhaust pipe (front section)
4. Exhaust pipe support bracket retaining bolts
5. Exhaust pipe support bracket
6. Exhaust pipe (centre section) retaining nuts
7. Retaining rings
8. Propeller shaft guard retaining screws
9. Propeller shaft guard

10. Centre cross member
11. Centre cross member retaining bolts
12. Boot
13. Gear control rod lever connecting bolt
14. Gear control rod
15. Gear control lever support
16. Engine flywheel protection plate
17. Front flexible coupling retaining nuts
18. Rear flexible coupling bolts
19. Bolts securing engine rear support to body shell

20. Engine rear support pin
21. Propeller shaft centre support retaining nuts
22. Propeller shaft centre support
23. Rear cross member retaining bolts
24. Rear cross member
25. Engine side support lower retaining nut
26. Engine side support
27. Engine side support upper retaining bolt

**REMOVAL**

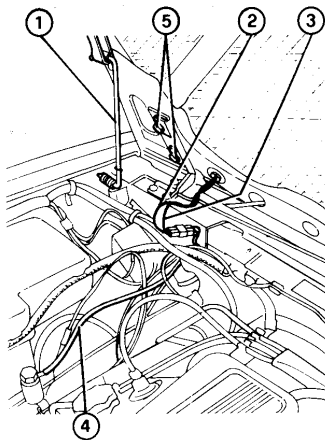
**1. Preliminary operations**

- a. Place the vehicle over a garage lift and chock front wheels.  
Open bonnet and secure in open position with associated strut (1).

**WARNING:**

**When the engine is hot, proceed with caution to avoid burns.**

- b. Disconnect positive and negative terminals from the battery in the boot.  
c. Disconnect power supply cable (2) and earth cable (3) from the engine compartment light.  
d. Remove windscreen washer hose (4) from the electric pump on the reservoir.  
e. Support bonnet and remove screws (5) and associated shims which retain bonnet to hinges.  
Retrieve shims, which must be replaced in the same positions upon hood installation to ensure correct centralization.  
f. Remove hood and protect contact areas with suitable soft materials.



1. Hood strut  
2. Engine compartment light supply cable  
3. Ground cable  
4. Windshield washer hose  
5. Hood retaining screws

For the following steps see the figure «View of the engine compartment».

- g. Disconnect brake vacuum servo line (1) from the one-way valve on the air intake box (2).

**2. Removal of air and fuel supply circuit**

- a. Disconnect cable (3) from air flow sensor (4) and run it through the bracket (5).  
b. Disconnect the following lines, removing them from the side indicated:  
• Line (6), from the air intake box fitting.  
• Line (7), from tappet cover.  
• Line (8), from vacuum regulating valve (9) (Switzerland, Sweden, Australia versions only).  
• Line (10), from auxiliary air solenoid valve (11).  
• Corrugated sleeve (12), from throttle body.  
c. Unhook the retaining springs and remove the air filter cover (13) together with air flow sensor (4), corrugated sleeve (12) and the lines connected to it.  
d. Remove the filter element, loosen the screws and nuts retaining the air filter container and remove it from the vehicle.  
e. Disconnect the fuel supply lines, removing them from the side indicated:  
• Line (14), from the fitting on the manifold.  
• Line (15), from the pressure regulator.

**WARNING:**

- Proceed with caution: the supply system may be under pressure.
  - Keep tubing pointing upwards to prevent fuel escaping.
- Ensure also, that the workshop is correctly equipped to enable operations to be performed safely.

- f. Disconnect accelerator cable.

**3. Disconnect of electrical cables**

- a. Disconnect cables (17), (18), (19) and (20) from the thermostat group (16).  
b. Release the above wiring harness from the support brackets fixed to the thermostat group and to the timing belt guard.  
c. Unscrew the two retaining screws and remove guard (21) from the air intake box (2).  
One of the two screws secures the rela-

tive grounding plait (22) to the air intake box.

- d. Disconnect the following electrical cables, removing them from the side indicated:

- Cable (23), from the electro-injectors.
- Cable (24), from the switch on the throttle.
- Cable (25), from the electro-injector for cold starting.
- Cable (26) and (27), from the auxiliary air solenoid valve.
- Cable (28), from bulb on the cylinder block.
- Cable (29), from terminal board (30) on the engine bulkhead.
- Cable (31), from terminal board (32) on the engine bulkhead.
- Cable (33), from the left head.
- Cable (34) and (35), from the terminal board on the left wing.
- Cable (36), from the coil.
- Cable (37), from the distributor.
- Cable (38), from the conditioner compressor electro-magnetic connection (if installed).
- Cable (39), from the conditioner compressor (if installed).
- Cable (40), from the respective mobile connections.
- Cables (41), from the thermal switch on the lower side of the radiator.

**CAUTION:**

**Detach the electric cables from any clamps, separate them from the propeller unit to prevent them obstructing the units removal.**

**4. Cooling circuit disconnection**

- a. Disconnect the following lines and sleeves, preferably removing them from the side indicated:  
• Sleeve (42), from the thermostat group.

**Place a suitable container under the vehicle to collect drained coolant.**

- Sleeve (43), from the thermostat group.
- Line (44), from the radiator.
- Sleeve (45), from the 3-way connector.
- Line (46), from the thermostat group.
- Line (47), from the connector on the left head.



- b. Unscrew screw (48) securing radiator (49).  
Remove radiator together with the electric fans.

**5. Conditioner compressor removal**

- a. Slacken nut (50) securing the chain stretcher pulley; slacken the belt driving the compressor and remove it.
- b. Unscrew nut (51) and, from under the vehicle, the two screws securing the lower bracket to the block.
- c. Move compressor (52) on the right side of the the vehicle and secure it in a suitable way.
- d. If it is considered necessary, discharge the Freon and disconnect hoses (53) from the compressor.

**6. Power steering circuit removal**

- a. Discharge, or suck, using a syringe, the oil from reservoir (54).
- b. Disconnect lines (55), (56) and (57) from the power steering pump.

For the following steps see the figure «View of underbody».

**7. Oil discharge (if required by the operations to be performed)**

- a. Raise the vehicle on the garage lift.
- b. Unscrew plug (1) and drain engine oil. Screw plug on again after the job has been completed.

**8. Exhaust pipe removal**

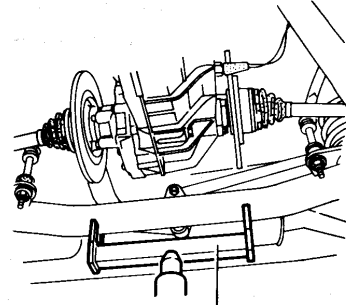
- a. Unscrew nuts (2) retaining the front part of the exhaust pipe (3) to exhaust manifolds.
- b. Remove the 3 bolts (4) fixing bracket (5) to the end of the flywheel cover.
- c. Remove the 3 nuts (6) and separate the centre and rear sections of the exhaust pipe.
- d. Remove the front and centre sections of the exhaust pipe and free from the rubber support rings (7).

**9. Propeller shaft removal**

- a. Remove the 6 screws (8) and the propeller shaft guard (9).
- b. Remove the centre cross member (10) and unscrew the 4 bolts (11) securing the body shell.
- c. Take off boot (12), unscrew and remove bolt (13), disconnecting rod (14).  
If it is considered necessary, unscrew the

4 screws retaining support (15) and move it to facilitate the removal of the propeller shaft.

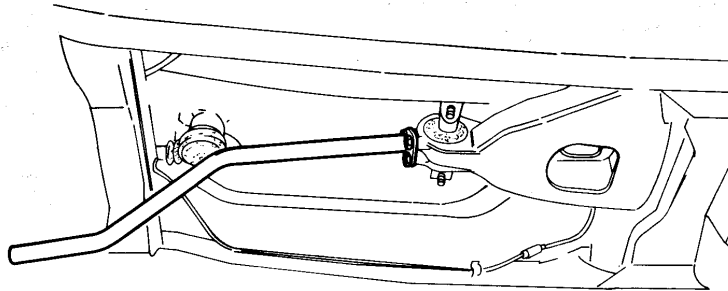
- d. Unscrew the bolts and remove flywheel guard (16).
- e. With the gearbox in neutral, rotating the propeller shaft as necessary, alternately unscrew nuts (17) and bolts (18) connecting it, respectively, to the flywheel and clutch yoke.
- f. Unscrew the 2 bolts (19) and disconnect engine rear support pin (20) from the body shell.
- g. Unscrew the 2 nuts (21) and disconnect propeller shaft centre support (22) from the body shell.
- h. Remove the 6 bolts (23) fixing the rear cross member (24) to the body shell.
- i. Raise the rear axle using a column lift provided with cradle A.2.0075 and then extract propeller shaft from the clutch yoke.
- j. Lower the column lift and remove the propeller shaft.



A.2.0075

**10. Final operations**

- a. Fit a suitable operating lever on the engine rear support to aid engine removal operations.
- b. Unscrew and remove nuts (25) securing the lower part of side supports (26).
- c. Lower the garage lift, unscrew and remove upper bolts (27) securing side supports (26).
- d. Hook the engine on the lifting brackets, lift it out of the engine compartment with a hoist, positioning it with the operating lever.



## INSTALLATION

For the following operations refer to «Underbody» view of vehicle in question.

### 1. Preliminary operations

- Fit the operating lever on the engine rear support.
- Hook the engine on the appropriate lifting bracket, and using a hoist, drop it slowly into the engine compartment, positioning it as necessary with the operating lever.
- Centre the engine in its compartment, resting it on the two side supports, and make sure that the screw and stud holes correspond on both supports.
- Install and lock the bolts (27) securing the flexible supports to the body shell on both sides of the engine.
- Lift the vehicle, screw and lock, on both sides, nuts (25) securing the lower part of the flexible supports to the body.
- Remove the operating lever from the engine rear support.

### 2. Install of propeller shaft

- Reinstall the complete propeller shaft unit on the vehicle by reversing the removal procedure and observing the following instructions.
  - Lubricate propeller shaft front bush and the rear coupling spherical seat with 5 cm<sup>3</sup> (0.30 cu-in) of ISECO MOLYKOTE BR2 grease.
  - Rotate the propeller shaft a little at a time, blocking it in a suitable way, and tightening the flexible couplings bolts and nuts to the prescribed torque.

**T** : Tightening torque  
**Nuts and bolts securing the propeller shaft flexible couplings to the engine flywheel and clutch fork**  
 55 to 57 N·m  
 (5.6 to 5.8 kg·m  
 40.5 to 42.0 ft·lb)

- Lock the nuts securing propeller shaft centre support to vehicle floor.

**T** : Tightening torque  
**Nuts securing propeller shaft centre support**  
 95 to 105 N·m  
 (9.5 to 10.5 kg·m  
 68.7 to 75.9 ft·lb)

- Secure engine rear support pin (20) to body.
- Refit engine flywheel protective cover (16).
- Reconnect rod (14) to speed gear lever with bolt (13), then fit boot (12).
- Secure centre cross member (10) to the body.

### 3. Exhaust pipe installation

Connect exhaust pipe to tail pipe in the opposite order to that described in «Removal», step 8.

Fix the front part of the pipe to the relative manifolds.

Use new gaskets.

For the location of parts identified by reference numbers below see «View of engine compartment» for the vehicle in question.

### 4. Power steering circuit connection

- Re-connect lines (55), (56) and (57) to the power steering pump.

The tightening torques are:

**T** : Tightening torques  
**Oil return line connector (55) on power steering pump connector**  
 45 to 50 N·m  
 (4.3 to 5.1 kg·m  
 34.4 to 36.8 ft·lb)

**Oil delivery line connector (56) on power steering pump connector**  
 28 to 31 N·m  
 (2.9 to 3.2 kg·m  
 20.1 to 23.1 ft·lb)

- Top up the tank with specified oil (AGIP ATF DEXRON B 11297; IP DEXRON FLUID B 11297) to the limit.
- On the pump fitting, loosen the return pipe fitting (55) until a little oil flows out and all air is bled.
- Lock the fitting to the specified torque.
- Start the engine and feed the tank until level settles.
- With the engine running, carry out a few full steering locks to right and left, then top up the oil in the tank to the «MAX» mark.
- Reassemble the tank plug.

### 5. Installation of air conditioner compressor

- Reconnect compressor lower bracket to engine block securing it from under the vehicle with the corresponding screws.
- Refit compressor drive belt, and lock nut (51).
- Restore correct tension to compressor drive belt and lock nut (50).

Load to be applied to belt centre:

P = 20 to 35 kg (44.1 to 77.2 lb)

Deflection:

F = 14 mm (0.55 in)

- If hose unions (52) are disconnected, secure them to compressor (53).

### 6. Installation of radiator

Refit radiator together with electric fan, then reconnect cooling system tubing by reversing the order of the procedure described in «Removal» - step 4.

### 7. Electrical connections

Restore electrical connection, reversing the order of the procedure described in «Removal» - step 3.

### 8. Air and fuel supply system

Restore air and fuel supply system by reversing the procedure described in «Removal» - step 2.


### 9. Final operations

- Reconnect servobrake vacuum intake hose (1) to single - acting valve on intake air box.
- Refill and adjust the following:
  - Engine oil
  - Engine coolant
  - Power steering system oil level
  - Air conditioning system Freon
  - Timing check
  - Accelerator control cable adjustment
  - Adjustment of percentage of exhaust CO at idle
  - Electric fan action check on engine at normal running temperature.
- Replace the hood (bonnet) by proceeding in the opposite order to that described in «Preliminary operations».

# ENGINE DISASSEMBLY

Alfa 90 2.5  iniezione

Alfa 90 2.0 6V iniezione

Alfa 75  6V iniezione

GTV 6 2.5

## PRELIMINARY OPERATIONS

a. Remove the engine group from the vehicle using the procedures described in the paragraph «Engine Removal and Installation» for the vehicle in question.

b. Prepare the engine assembly for installation on the rotating engine overhaul stand by placing it on the bench and lifting it by means of a suitable hoist (if possible a hydraulic type).

### c. Removal of the exhaust manifolds and starting motor

— From the right side of the engine remove the nuts with washers ① and unscrew the three screws ② retaining the exhaust manifolds to the right cylinder head.

— Remove the exhaust manifolds ③ and heat shield ④ protecting the starting motor.

— Slacken and remove nuts and washers ⑤ from screws ⑥ retaining the starting motor.

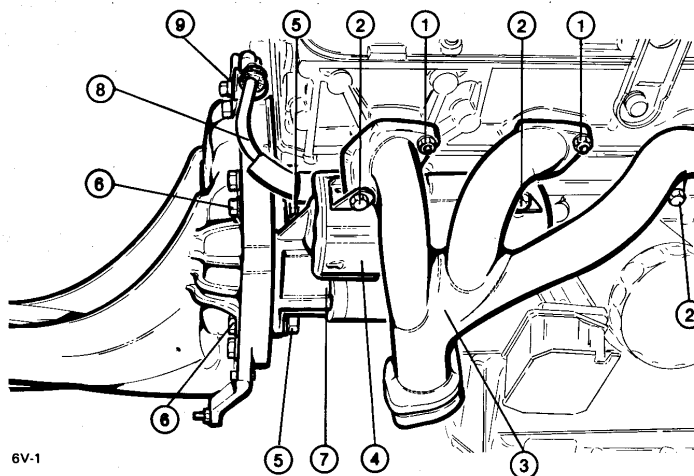
— Remove the starting motor ⑦ with relative wiring ⑧ by sliding it out from the brackets ⑨ on the rear cover.

— Proceed in a similar way for the removal of the exhaust manifolds from the left side of the engine.

### d. Removal of rear cover

— Unscrew the two upper screws ① to recover the two brackets ② supporting the starting motor wiring bundle.

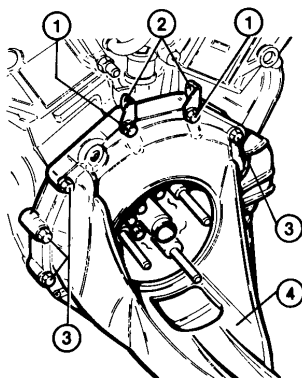
— Unscrew the remaining screws ③ and remove the rear cover ④.



6V-1

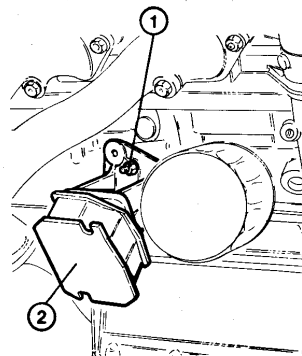
1. Nuts and washers
2. Screws
3. Exhaust manifolds
4. Heat shield
5. Nuts and washers

6. Screws
7. Starting motor
8. Wiring
9. Brackets



6V-2

1. Upper screws
2. Wiring support brackets
3. Screws
4. Rear cover



6V-3

e. Slacken and remove the washers and nuts ① and remove the engine supports ② on both sides of the engine block.

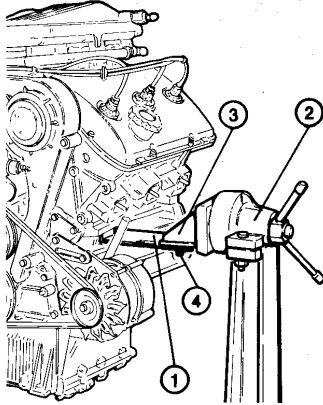
1. Nuts and washers
2. Engine supports

## ENGINE MAIN MECHANICAL UNIT

f. Install the motor support brackets (1) and secure them to the engine block by means of the nuts with washers for fixing the engine supports.

g. Place the engine assembly on the overhaul stand (2) using a suitable hoist. Secure the engine support brackets (1) to supports (3) of the rotating engine overhaul stand by means of bolts (4).

h. Remove the engine oil dipstick; remove the drain plug of the lower sump and drain the engine oil (operation to be performed if the oil has not been discharged during the «Engine Removal»).



6V-4

1. Engine support brackets
2. Rotary engine overhaul stand
3. Rotary stand supports
4. Bolts

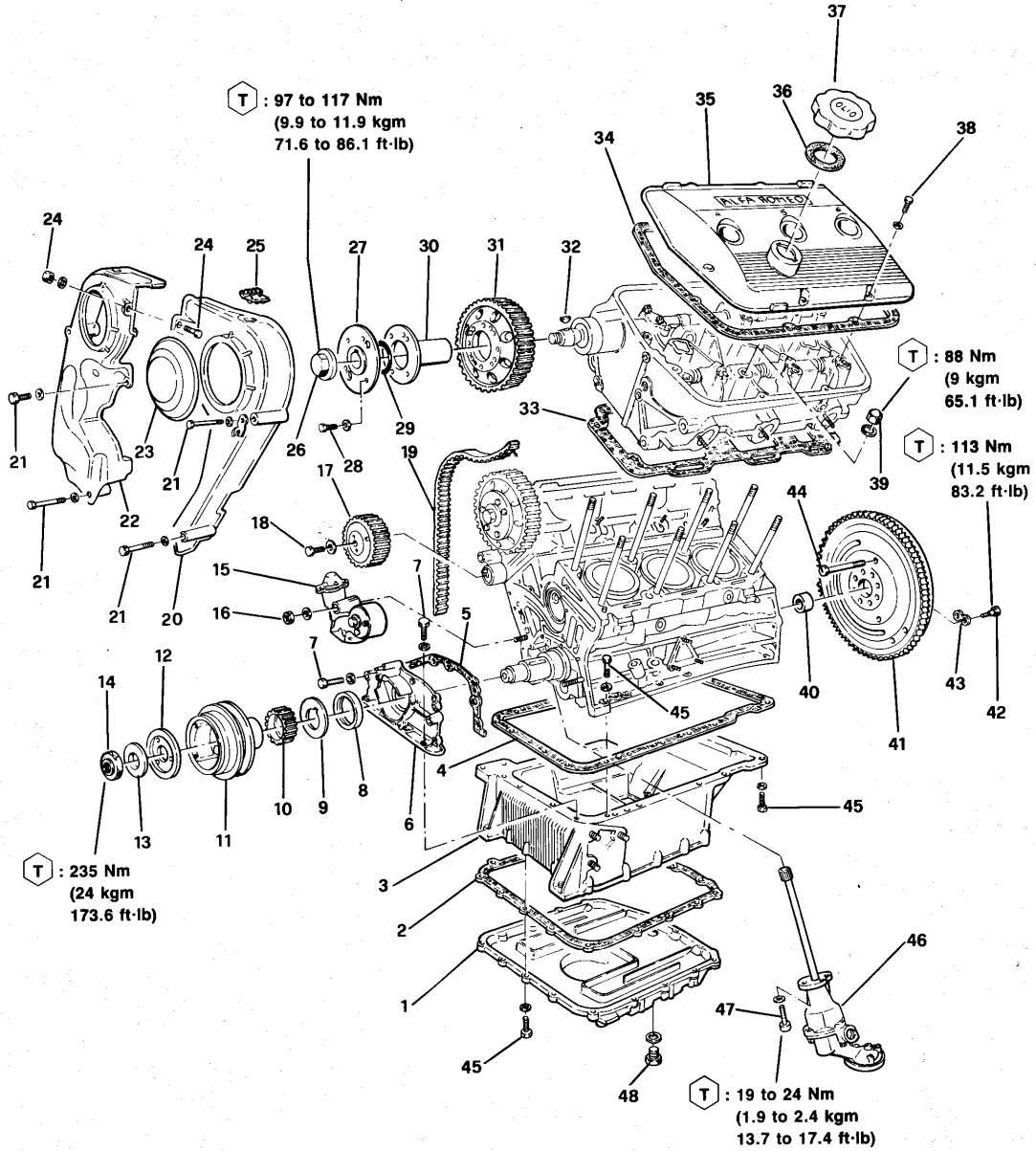
1. Oil sump cover
2. Oil sump cover gasket
3. Oil sump
4. Oil sump gasket
5. Front cover gasket
6. Front cover
7. Front cover retaining screws
8. Front oil seal
9. Back up washer
10. Camshaft drive pulley
11. Crankshaft pulley
12. Spacer
13. Lock washer
14. Crankshaft pulley locknut
15. Hydraulic belt stretcher
16. Belt stretcher locknut
17. Distributor and oil pump drive belt

18. Pulley retaining screws
19. Camshaft drive belt
20. Left guard
21. Guard retaining screws
22. Right guard
23. Camshaft hub covers
24. Guard joining bolt
25. Spark plug cable clamps
26. Toothed pulley locknut
27. Toothed pulley hub
28. Hub retaining screws
29. Seal ring
30. Hub and toothed pulley support
31. Camshaft drive pulley
32. Camshaft drive key
33. Cylinder head gasket
34. Cylinder head cover gasket

35. Cylinder head cover
36. Plug gasket
37. Oil filler plug
38. Cylinder head cover screws
39. Nuts securing cylinder head to engine block
40. Rear bushing or bearing of crankshaft
41. Engine flywheel
42. Screws securing flywheel to crankshaft
43. Lock washer
44. Screws securing flywheel to clutch group
45. Oil sump retaining screws
46. Oil pump
47. Oil pump retaining screws
48. Oil drain plug

ENGINE MAIN MECHANICAL UNIT

EXTERNAL PARTS (Cylinder heads and engine block)



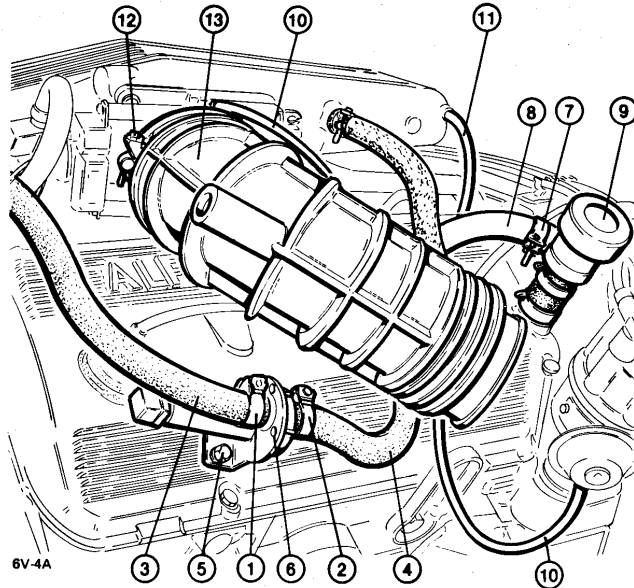
**REMOVAL OF FUEL SYSTEM COMPONENTS**

Alfa 90 2.5  iniezione

Alfa 75  6V iniezione

GTV 6 2.5

- a. Slacken clamps (1) and (2) and disconnect supplementary air feed pipe (3) from plenum chamber and pipe (4) feeding air to the supplementary air solenoid valve.
- b. Unscrew screws (5) and remove supplementary air solenoid valve (6) from right cylinder head cover.
- c. Slacken clamp (7) and disconnect oil vapour recirculation pipe (8) from oil vapour separator (9).
- d. Disconnect vacuum pipe (10) of the pneumatic spark advance regulator from the intake capacity and the distributor.
- e. Disconnect vacuum pipe (11) from the intake capacity and from the pressure regulator.
- f. Slacken clamp (12) and disconnect the corrugated sleeve (13) from the throttle housing.

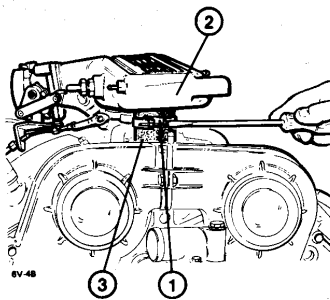


1. Clamp
2. Clamp
3. Supplementary air pipe to the plenum chamber
4. Air feed pipe to the supplementary air solenoid valve
5. Screws

6. Supplementary air solenoid valve
7. Clamp
8. Oil vapour recirculation pipe
9. Oil vapour separator
10. Vacuum pipe for spark advance pneumatic regulator

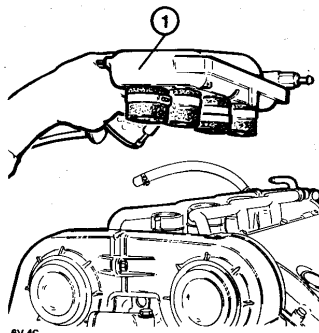
11. Vacuum pipe for pressure regulator
12. Clamp
13. Corrugated sleeve

- g. Slacken clamps (1) fixing the plenum chamber (2) to the rubber sleeves (3) of the intake manifolds.



1. Clamp
2. Plenum chamber
3. Rubber sleeve connecting plenum chamber to intake manifold

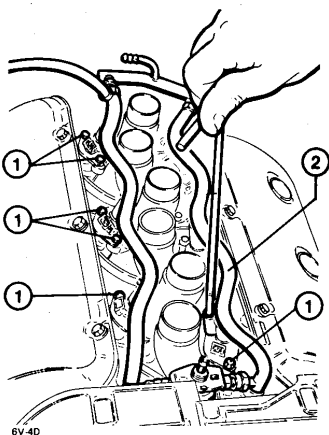
- h. Remove the plenum chamber (1) complete with throttle housing and rubber sleeves forming the connection with the intake manifolds.



1. Plenum chamber

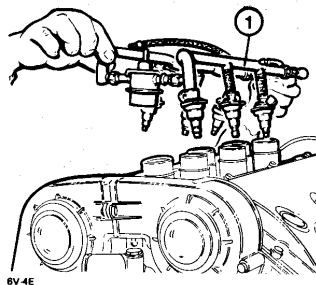
## ENGINE MAIN MECHANICAL UNIT

i. Unscrew the screws ① securing the electro-injectors to the air feed manifold (two for each injector) and to the petrol intake throat ②.



- 1. Electro-injector retaining screws
- 2. Petrol intake throat

j. Remove the petrol intake throat ① together with the electro-injectors.



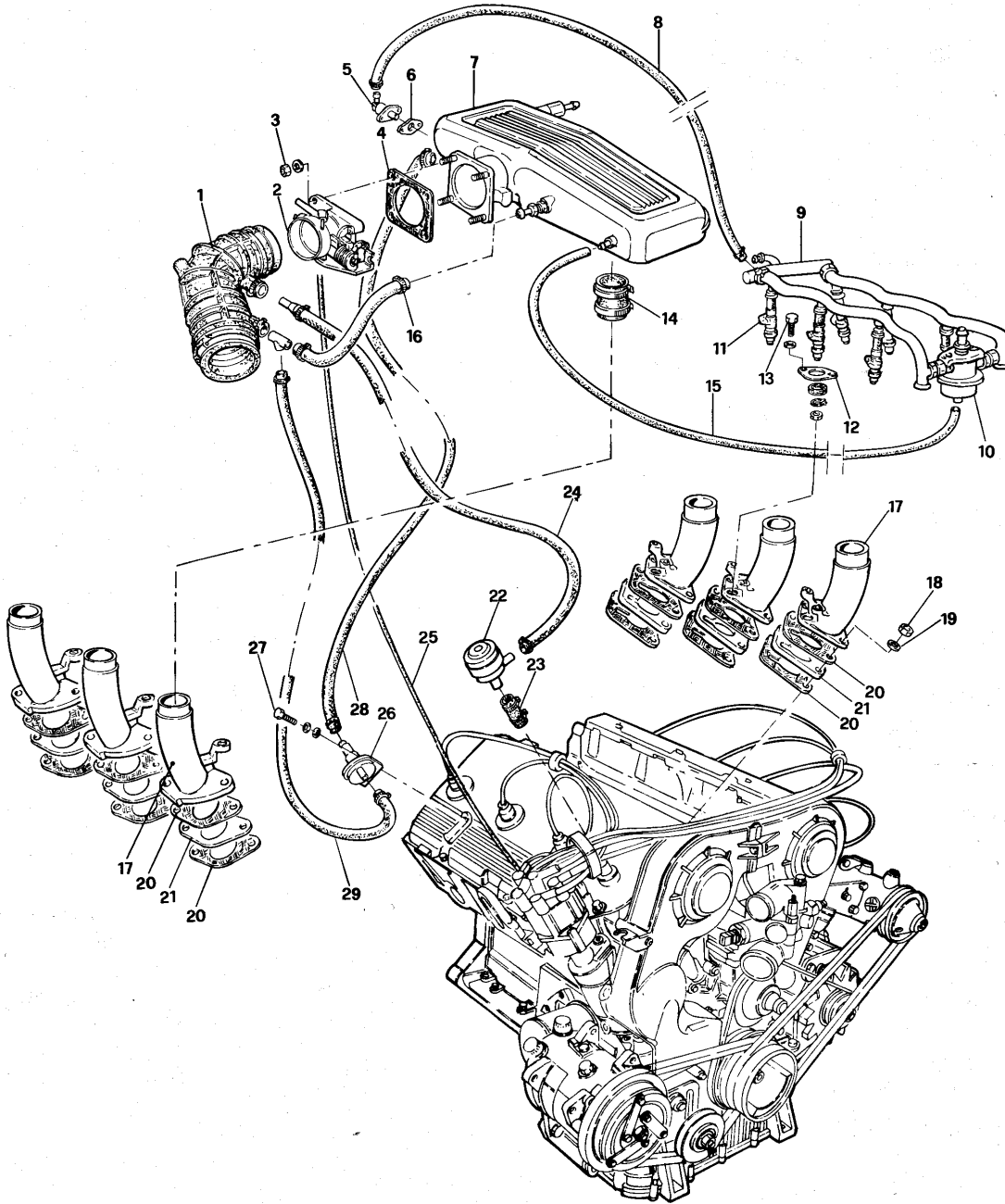
- 1. Petrol intake throat

### NOTE:

For further disassembly and/or checks of the fuel supply system refer to Group 04 «FUEL SYSTEM» for Alfa 90, Alfa 75 and GTV - 6 cylinders.

ENGINE MAIN MECHANICAL UNIT

FUEL SYSTEM COMPONENTS (L-JETRONIC System)





1. Corrugated sleeve
2. Throttle housing
3. Throttle housing locknuts
4. Gasket
5. Cold starting electro-injectors
6. Gasket
7. Plenum chamber
8. Cold starting electro-injector feed pipe
9. Fuel supply manifold
10. Fuel pressure regulator
11. Electro-injectors
12. Electro-injector flange

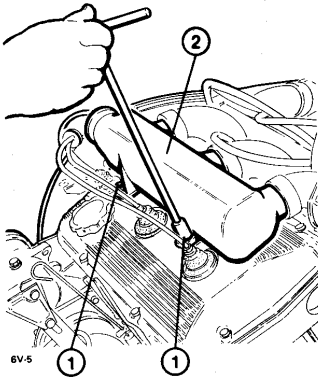
13. Screws securing electro-injectors to intake stub pipes
14. Sleeve connecting intake capacity to respective stub pipes
15. Vacuum take-off pipe for pressure regulator
16. By-pass pipe for idling adjustment
17. Intake stub pipes
18. Stub pipe lock nuts
19. Washer
20. Gaskets
21. Insulating gasket

22. Oil vapour separator
23. Oil recovery pipe
24. Oil vapour re-circulation pipe
25. Vacuum offtake pipe for pneumatic spark advance regulator
26. Supplementary air solenoid valve
27. Solenoid valve retaining screws
28. Pipe taking supplementary air to the plenum chamber
29. Pipe taking air to the supplementary air solenoid valve

## REMOVING FUEL SYSTEM COMPONENTS

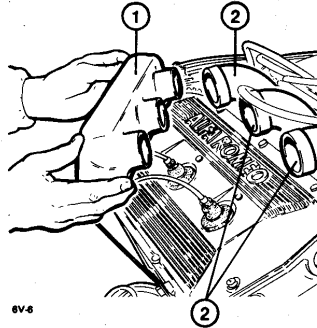
Alfa 90 2.0 16V iniezione

a. Slacken the two nuts with washers ① securing the left air collector box ② to the cylinder heads.



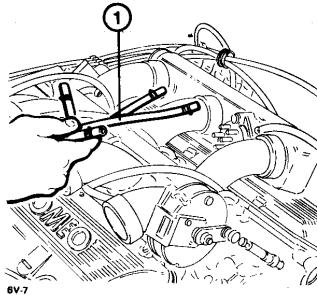
1. Nuts and washers
2. Left air box

b. Remove the left air box ① by extracting it from the three rubber sleeves ②.



1. Left air box
2. Rubber sleeves

c. Disconnect the six small tubes ① connected to the idling air fittings of the respective cylinders from the idling air block on the right air collector box.

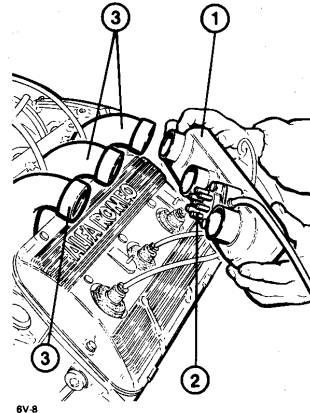


1. Small air intake tubes connecting the idling air block to the cylinder air fittings

d. Slacken the two nuts with washers securing the right collector box to the cylinder head.

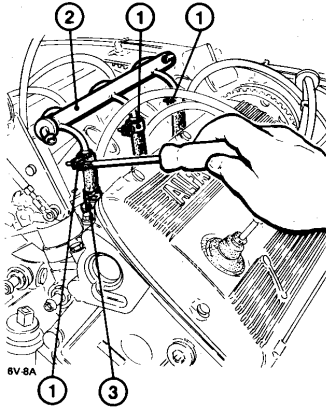
Remove the right box ① complete with idling air block ②, extracting it from the three sleeves ③ connecting it to the throttle housing.

Remove the six rubber sleeves.



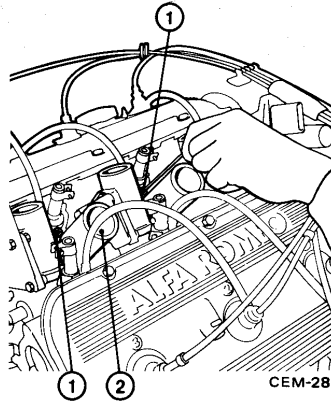
1. Right collector box
2. Idling block
2. Rubber sleeves

e. Slacken the six clamps ① securing the distribution tube ② to electro-injectors ③.



- 1. Clamps
- 2. Distribution tube
- 3. Electro-injectors

g. Slacken and remove the twelve socket screws ① securing the three throttle housings ② (front-centre-rear) to the respective lower intake stub pipes.

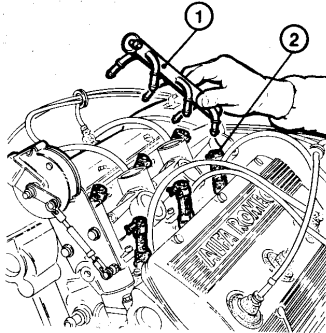


- 1. Socket screws (twelve)
- 2. Throttle housings

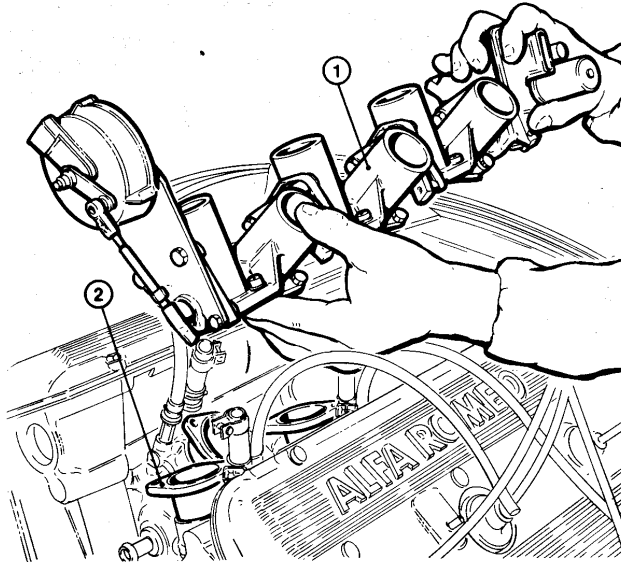
h. Remove the throttle assembly ① by raising the respective lower intake stub pipes ② and release the earthing plait connected to the left cylinder head.

- 1. Throttle assembly (front-centre-rear)
- 2. Lower intake stub pipes

f. Remove the distribution tube ① extracting it from the feed tube of the electro-injectors ②.



- 1. Distribution tube
- 2. Electro-injector feed tubes



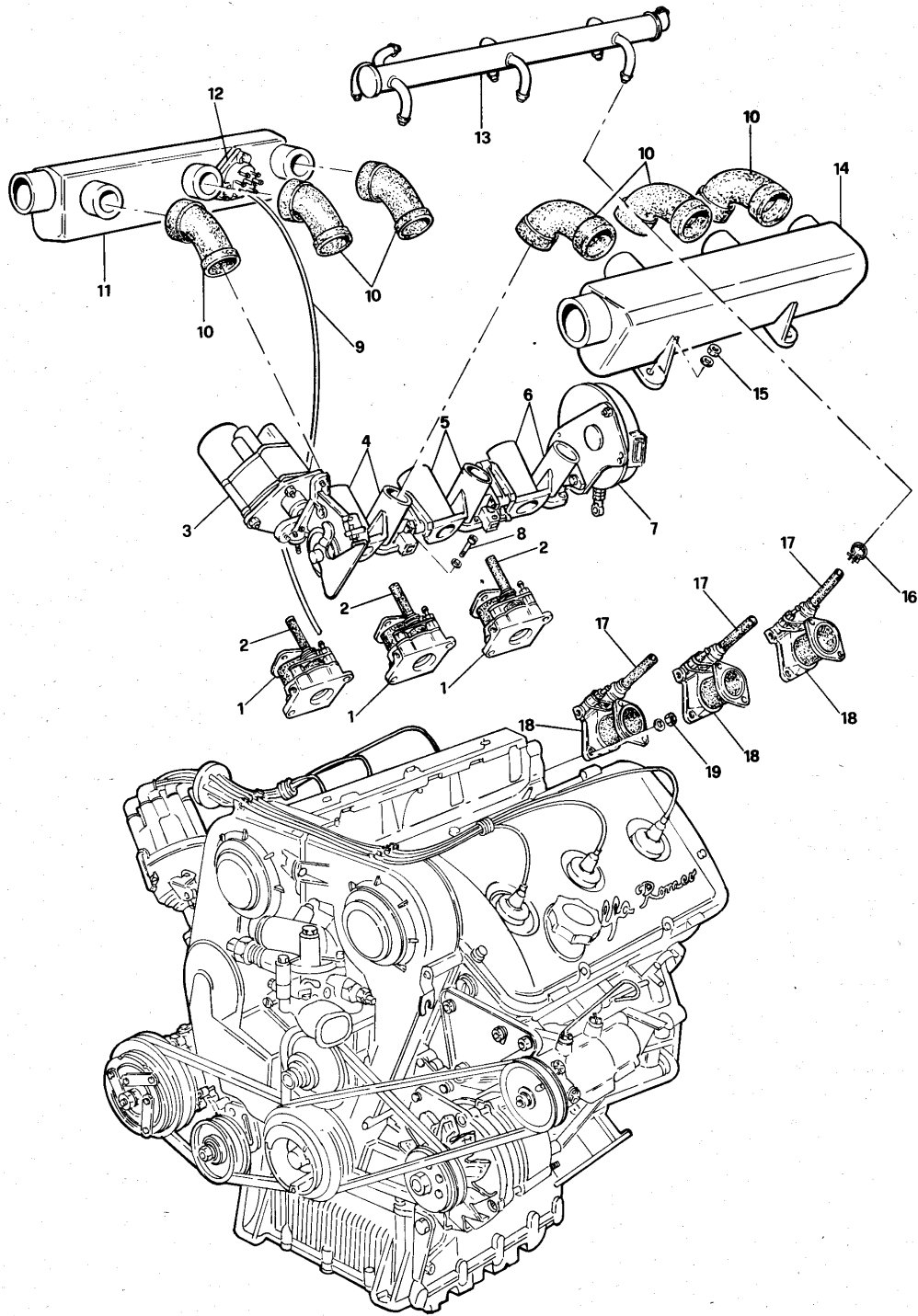
6V-9A

- 1. Lower intake stub pipes (right side)
- 2. Electro-injectors (right side)
- 3. Constant idling actuator
- 4. Front - throttle housing
- 5. Centre - throttle housing
- 6. Rear - throttle housing
- 7. Throttle angle sensor

- 8. Screws securing throttle housing to the lower intake stub pipes
- 9. Idling air offtake pipe (six, one for each cylinder)
- 10. Rubber sleeves
- 11. Right box (plenum chamber)
- 12. Idling air block

- 13. Petrol distributor pipe
- 14. Left box (plenum chamber)
- 15. Box locknuts
- 16. Clamp fixing electro-injectors to distribution pipe
- 17. Electro-injectors (left side)
- 18. Lower intake stub pipes (left side)
- 19. Intake stub pipe locknut

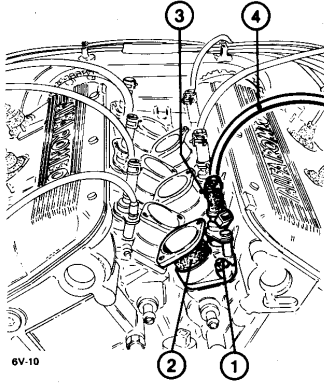
FUEL SYSTEM COMPONENTS (CEM System)



i. Slacken the two nuts ① (two for each stub pipe) securing the lower intake stub pipe ② to the cylinder head. Remove stub pipe ② complete with electro-injector ③ and minimum air tube ④; proceed in the same way for the removal of the remaining stub pipes.

**NOTE:**

For further disassembly and/or checking of the fuel supply system refer to Group 04 «FUEL SYSTEM» for the Alfa 90 2.0 - 6V iniezione.



- 1. Nuts and washers
- 2. Lower intake stub pipe
- 3. Electro-injector
- 4. Idling air intake tube

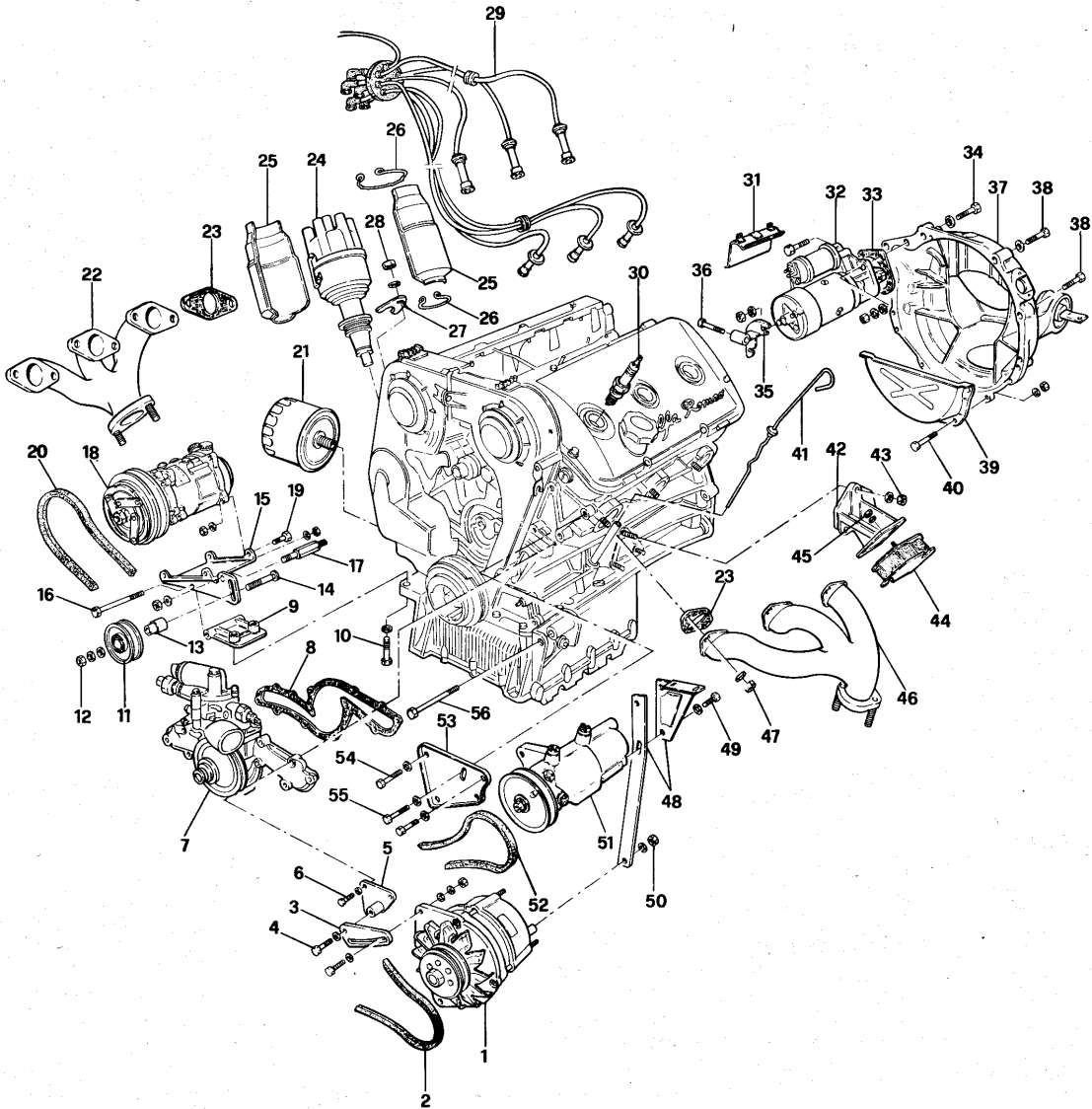
- 1. Generator
- 2. Drive belt  
(generator and water pump)
- 3. Regulation bracket
- 4. Bracket retaining screws
- 5. Generator support
- 6. Support and water pump retaining screws
- 7. Water pump complete with thermostat group
- 8. Water pump gasket
- 9. Bracket fixing compressor to oil sump
- 10. Bracket retaining screws
- 11. Belt stretcher
- 12. Belt stretcher locknut
- 13. Belt stretcher pulley hub
- 14. Belt stretcher fixing pin
- 15. Compressor support
- 16. Screws fixing support to bracket
- 17. Pin fixing support to cylinder block
- 18. Air conditioner compressor

- 19. Compressor retaining screw
- 20. Drive belt
- 21. Engine oil filter
- 22. Exhaust manifold (right side)
- 23. Gasket
- 24. Distributor
- 25. Shields
- 26. Retaining springs
- 27. Retaining bracket
- 28. Locknut
- 29. High voltage wires complete with suppressors
- 30. Spark plug
- 31. Starting motor shield
- 32. Starting motor
- 33. Gasket
- 34. Screws fixing starting motor
- 35. Starting motor rear support
- 36. Support retaining screws
- 37. Rear cover

- 38. Rear cover retaining screws
- 39. Flywheel lower guard
- 40. Guard retaining screws
- 41. Engine oil dipstick
- 42. Engine side support
- 43. Support locknut
- 44. Rubber shock absorber
- 45. Shock absorber locknut
- 46. Exhaust manifold (left side)
- 47. Exhaust manifold locknut
- 48. Power steering pump rear bracket
- 49. Screw fixing pump to bracket
- 50. Nut fixing pump to generator
- 51. Power steering pump
- 52. Drive belt
- 53. Bracket fixing pump to engine block
- 54. Bracket retaining screw
- 55. Power steering pump retaining screws
- 56. Lower screw fixing generator

ENGINE MAIN MECHANICAL UNIT

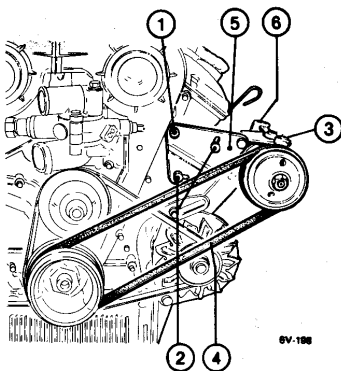
EXTERNAL COMPONENTS (Accessories)



**REMOVAL OF ACCESSORIES**

**a. Removal of power steering pump**

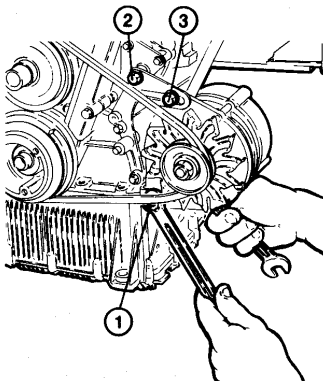
- Slacken screw ① securing the power steering, screws ② determining the tension of the V-belt and the bolt securing the rear bracket ⑥.
- Move the power steering pump ③ towards the cylinder head and remove the V-belt ④ from the crankshaft pulley.
- Unscrew completely screws ① and ② and the rear bracket bolt (already slackened) and remove the power steering pump ③ complete with support bracket ⑤.



1. Retaining screws
2. Adjustment screws
3. Power steering pump
4. V-belt
5. Support bracket
6. Rear bracket

**b. Removal of the generator**

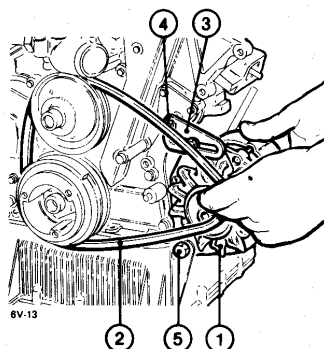
- Slacken nuts ① and ② and nut ③ which determine the tension of the V-belt.



6V-12

1. Lock nut
2. Lock nut
3. Adjustment nut

- Move the generator ① towards the engine block and remove the V-belt ② from the crankshaft and water pump pulleys.
- Remove the generator ① together with the adjustment bracket ③, after having unscrewed bolts ④ and ⑤ completely.

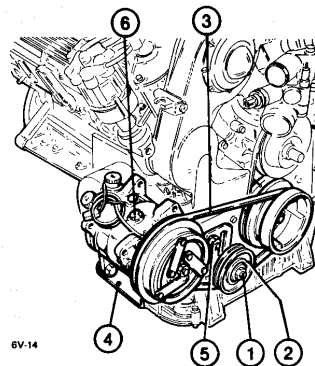


6V-13

1. Generator
2. V-belt
3. Adjustment bracket
4. Retaining bolt
5. Retaining bolt

**c. Removal of the conditioning system compressor**

- Slacken nut ① securing the belt stretcher ②.
- Slip off the V-belt ③ from the compressor pulley and from the crankshaft pulley (to facilitate this turn the crankshaft).
- Slacken and then completely unscrew the screws fixing the support brackets ④ of the compressor to the oil sump.
- Slacken and unscrew bolt ⑤ and remove the compressor ⑥.

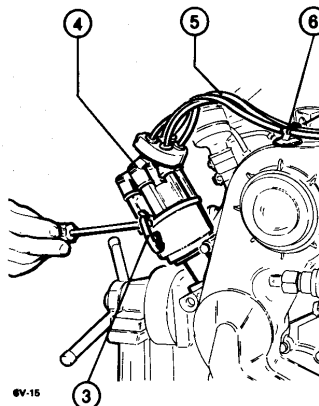


6V-14

1. Nut
2. Belt stretcher
3. V-belt
4. Support bracket
5. Bolt
6. Compressor of conditioning system

**d. Removal of distributor cap**

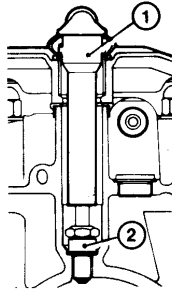
- Disconnect suppressors ① from spark plugs ②.
- Free springs ③ securing the distributor cap.
- Remove cap ④ from the distributor complete with the high voltage wires ⑤ after removing them from the respective cable clamps ⑥ located above the distributor belt guard.
- Remove spark plugs ②.



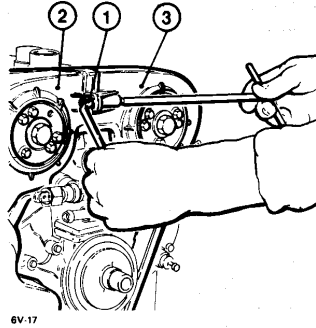
6V-15

# ENGINE MAIN MECHANICAL UNIT

## DETAIL OF SPARK PLUG AREA

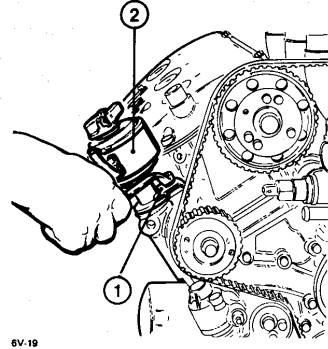


- 1. Suppressors
- 2. Spark plugs
- 3. Spring
- 4. Distributor cap
- 5. High voltage cables
- 6. Cable clamp



6V-17

- 1. Guard joining bolt
- 2. Right guard
- 3. Left guard

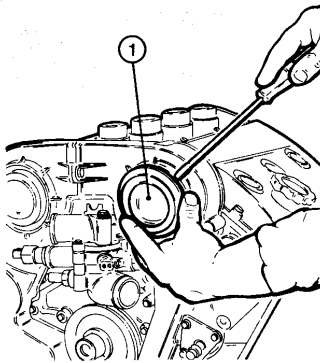


6V-19

- 1. Connecting plate
- 2. Distributor

### e. Removal of timing belt guard

- Remove covers (1) from the toothed timing belt guard.

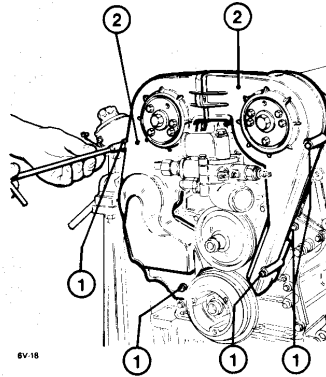


6V-18

- 1. Covers

- Unscrew bolt (1) that joins right guard (2) to left guard (3).

- Release and remove screws (1) securing guards (2) to the engine.



6V-18

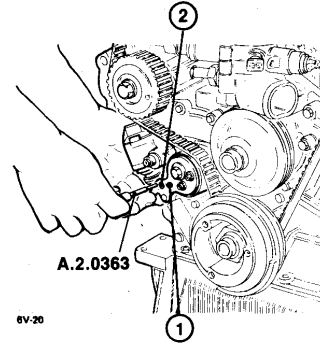
- 1. Retaining screws
- 2. Guards

### f. Removal of distributor

- Release and remove the nut securing the connecting plate (1).
- Remove connecting plate (1).
- Extract distributor (2).

### g. Removal of hydraulic belt stretcher and timing belt

- Stop the hydraulic belt stretcher from rotating (of the distributor belt, raise the arm of the belt stretcher (1) and use tool A.2.0363 to lock the belt stretcher. To insert tool A.2.0363 seating hole (2) must coincide with that on the belt stretcher body.



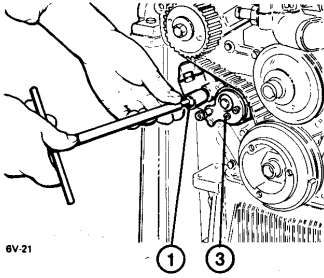
6V-20

A.2.0363

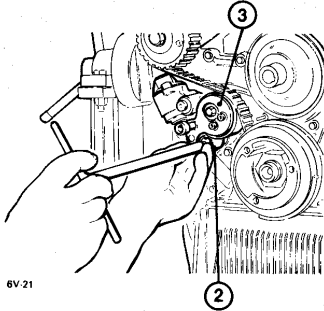
- 1. Belt stretcher arm
- 2. Tool insertion seat

## ENGINE MAIN MECHANICAL UNIT

- Slacken nuts (1) and (2) securing the body of belt stretcher (3) to the engine block.



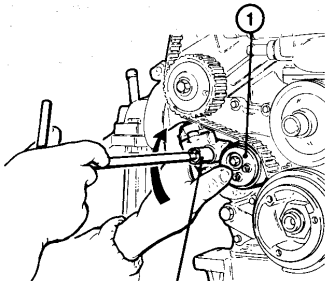
6V-21



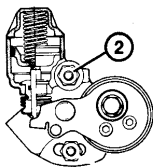
6V-21

1. Locknut
2. Locknut
3. Hydraulic belt stretcher

- Rotate the hydraulic belt stretcher (1) upward and lock it in this position by tightening nut (2), previously slackened.



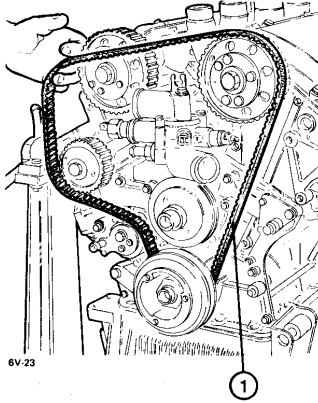
6V-22



1. Hydraulic belt stretcher
2. Locknut

December 1985

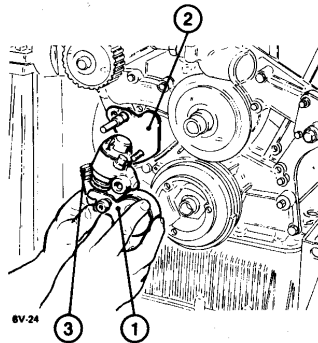
- Slip off and remove timing belt (1) from the toothed pulleys installed on the cylinder heads and slide out from the crankshaft front pulley.



6V-23

1. Toothed timing belt

- Unscrew the two screws fixing the belt stretcher body to the cylinder block. Remove the hydraulic belt stretcher (1) together with the spring and plate (2) holding the belt stretcher spring (3).

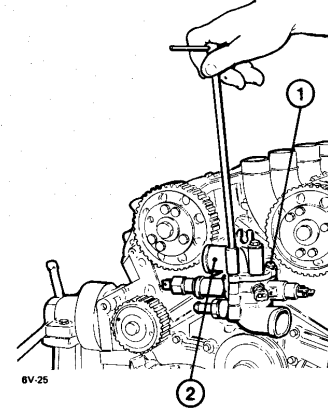


6V-24

1. Hydraulic belt stretcher
2. Plate
3. Belt stretcher spring

### h. Removal of thermostat group

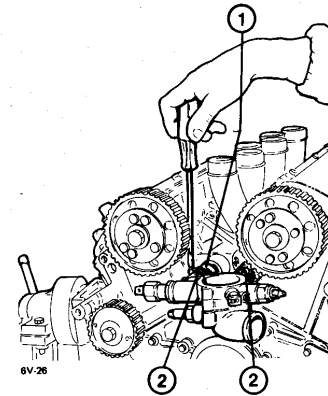
- Unscrew the three screws with washers (1) fixing the cover of the thermostat group. Remove cover (2) complete with thermostat valve.



6V-25

1. Screws with washers
2. Cover with thermostat valve

- Open metal clamps (1) holding the rubber sleeves (2) to the cooling ducts of each cylinder head.



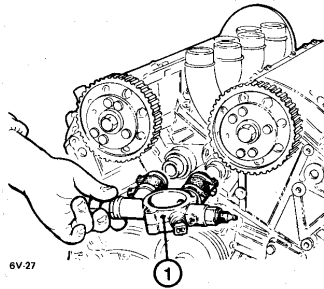
6V-26

1. Metal clamps
2. Rubber sleeves



## ENGINE MAIN MECHANICAL UNIT

- Remove housing (1) of the thermostat group by sliding it out from the cooling ducts of each cylinder head.



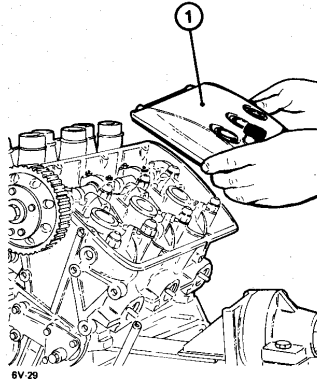
6V-27

1. Thermostat group housing

### NOTE:

For the disassembly and/or checking of the setting of the thermostat valve refer to Group 07 «COOLING SYSTEM» for Alfa 90, Alfa 75 and GTV - 6 cylinders.

- b. Remove the valve cover (1) and relative gasket under it.



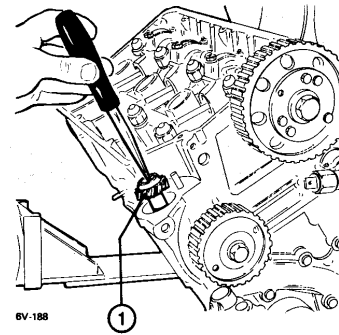
6V-29

1. Valve cover

### NOTE:

Perform the above mentioned operations on both cylinder heads.

- c. Remove packings (1) from the six spark plug wells.



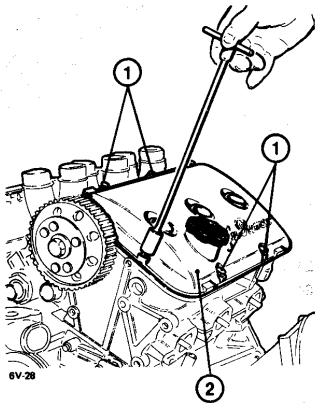
6V-188

1. Intermediate gear

- e. Slacken and remove nuts with washers (1) (eight for each head) securing the cylinder heads to the block. Remove cylinder heads (2), paying particular attention not to damage the studs of the engine block while lifting the heads.

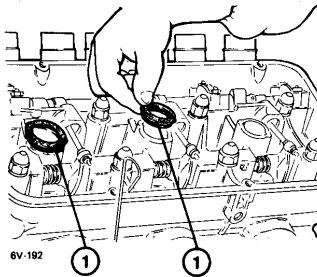
## REMOVAL OF THE CYLINDER HEADS

- a. Slacken and remove screws with washers (1) securing the valve cover (2) to the cylinder head.



6V-28

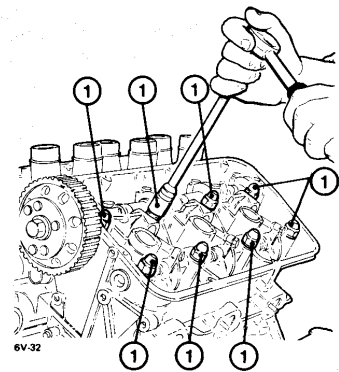
1. Screws with washers  
2. Valve cover



6V-192

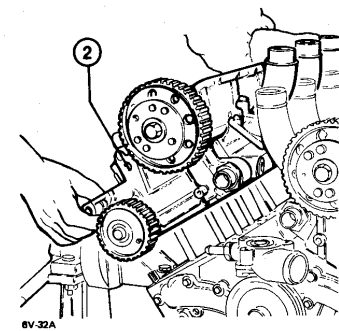
1. Rubber packing

- d. Extract intermediate gear (1) operating the distributor and oil pump from the right cylinder head.



6V-32

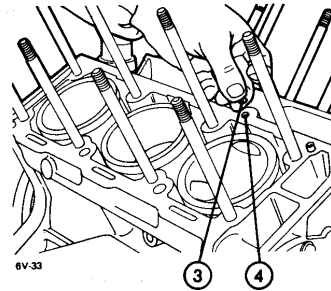
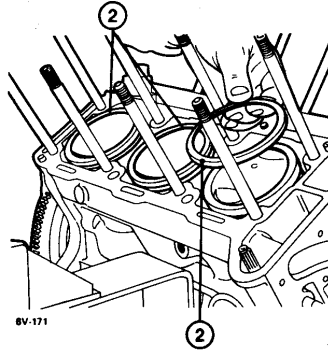
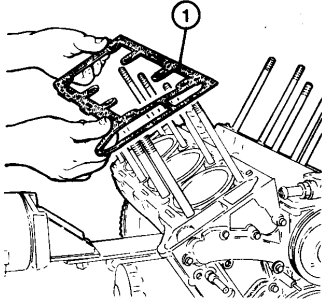
1. Nuts with washers  
2. Cylinder heads



6V-32A

## ENGINE MAIN MECHANICAL UNIT

- f. Remove the following from the engine block:
- ① cylinder head gasket;
  - ② flameproof rings (fitted on each cylinder liner);
  - ③ O-ring for lubrication pipe ④ (one for each side of the cylinder block).



1. Cylinder head gasket
2. Flameproof rings
3. O-ring
4. Lubrication pipe

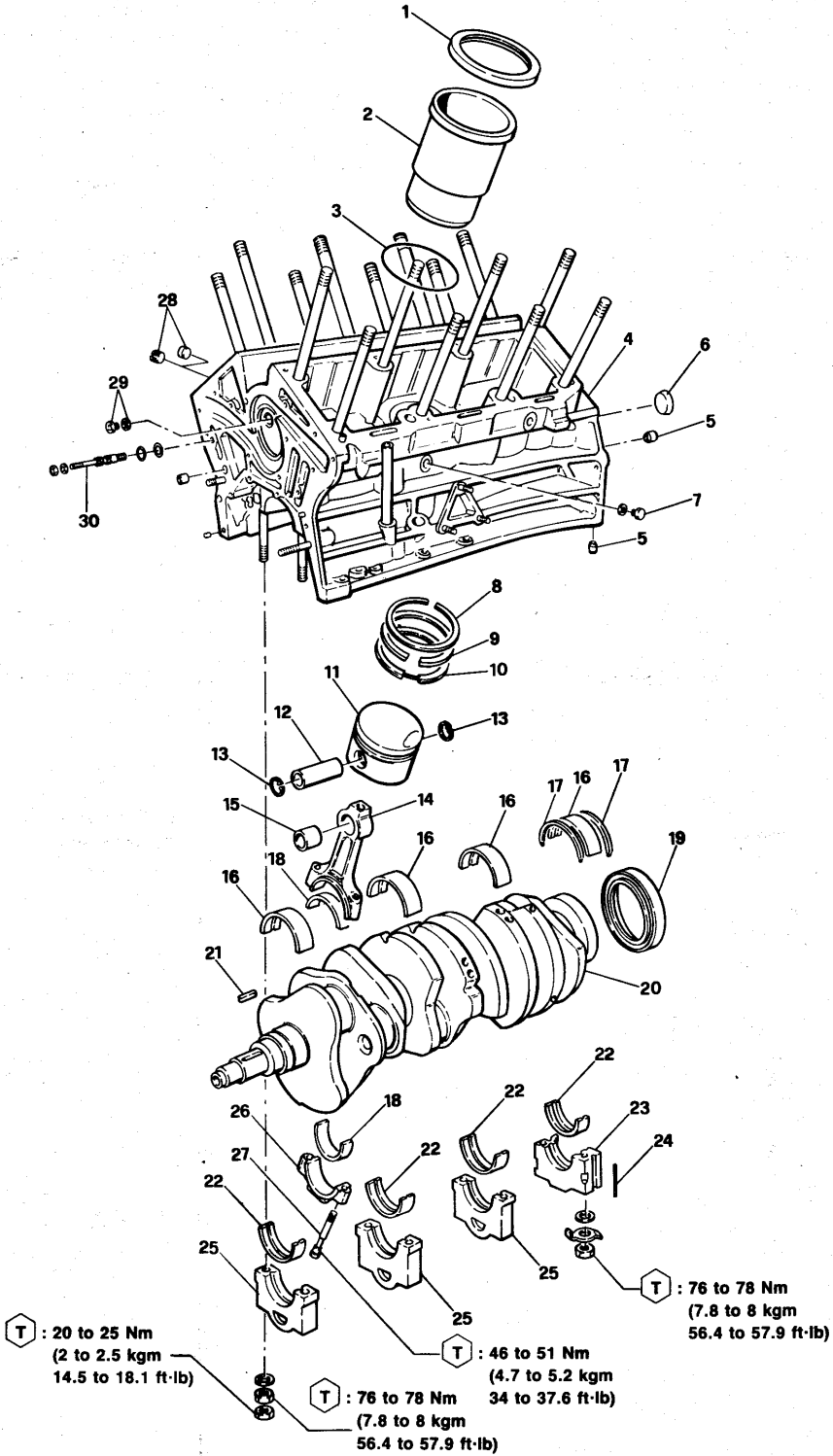
1. Flameproof ring
2. Cylinder liner
3. Seal ring
4. Engine block
5. Lubrication ducts
6. Plug
7. Water cooling circuit plug
8. First seal ring
9. Second seal ring
10. Oil scraper ring
11. Piston

12. Gudgeon pin
13. Lock ring
14. Connecting rod
15. Bushing
16. Upper main half-bearings (four)
17. Rear thrust half rings (two)
18. Upper and lower rod half-bearings (twelve)
19. Seal ring (rear)
20. Crankshaft
21. Key for crankshaft pulley
22. Lower main half-bearings (four)

23. Rear main bearing cap
24. Grommets
25. Main bearing caps (three)
26. Connecting rod caps (six)
27. Special screw for fixing con rod caps (twelve)
28. Plugs
29. Plug for cooling system
30. Pin for hydraulic belt stretcher

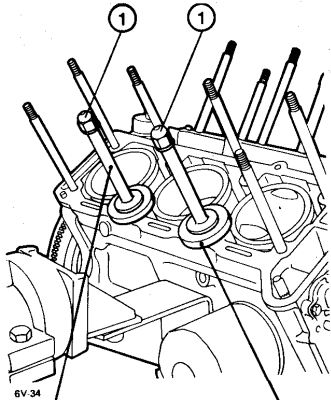
ENGINE MAIN MECHANICAL UNIT

ENGINE BLOCK



**REMOVAL OF COMPONENTS FROM ENGINE BLOCK**

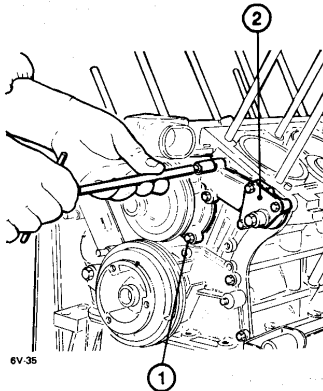
a. Insert cylinder liner locking tool **A.2.0117** with the respective complementary washers (**A.2.0362**), in the engine block studs as shown in the figure. Lock tools **A.2.0117** with the nuts and washers **1** used to fix the cylinder head.



**A.2.0117** **A.2.0362**

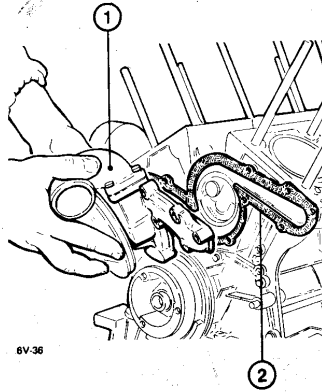
1. Nuts and washers

b. Slacken and remove all the screws with washers **1** fixing the water pump to the engine block. Remove support **2** which secures the generator adjustment bracket.



1. Screws and washers  
2. Support for generator bracket

c. Remove water pump **1** and put the gasket **2** aside.

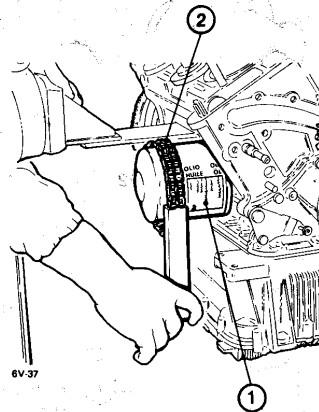


1. Water pump  
2. Gasket

**NOTE:**

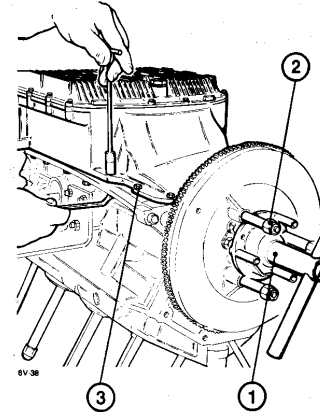
For the inspection and/or testing of the water pump refer to Group 07 «COOLING SYSTEM» for Alfa 90, Alfa 75 and GTV - 6 cylinders.

d. Remove engine oil filter **1** by unscrewing it from the engine block using a suitable spanner **2** (belt or chain type).



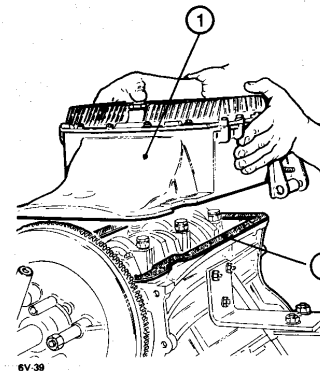
1. Engine oil filter  
2. Filter removal spanner

e. Free the overhaul stand and turn the engine assembly 180°. Fit a suitable tool **1** to the flywheel to permit the rotation of the crankshaft and lock it by means of the self-locking nuts **2**. Unscrew all the screws and washers **3** holding the oil sump to the engine block.



1. Tool for rotation  
2. Self-locking nuts  
3. Screws and washers securing oil sump

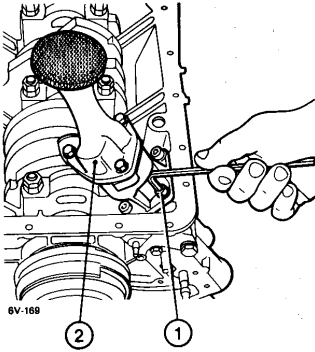
f. Remove the oil sump **1** complete and the relative gasket **2**. If necessary, remove traces of sealant on the oil sump or engine block.



1. Sump  
2. Gasket

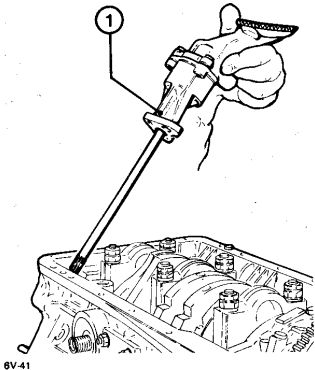
## ENGINE MAIN MECHANICAL UNIT

- g. Unscrew the three socket screws ① securing sump ② to the engine block.



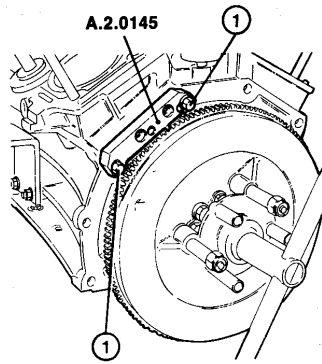
1. Socket screws
2. Oil pump

- h. Extract oil pump ① from the engine block (pull it upwards and save the seal ring).



1. Oil pump, complete

- i. Free the engine overhaul stand and turn the engine assembly 180°. Fit tool A.2.0145 to lock the rotation of the flywheel. Ensure, before locking it with screws ①, that the tooth is perfectly aligned with those of the toothed crown of the flywheel.



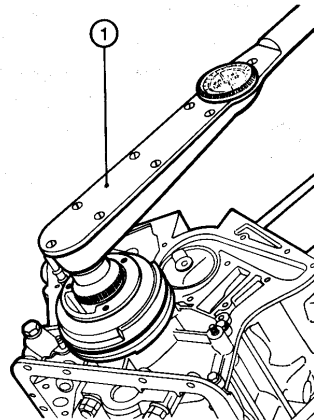
6V-42

1. Tool retaining screws

- j. **Removal of crankshaft front pulley**  
Working on the front side remove the crankshaft pulley.

Proceed as follows:

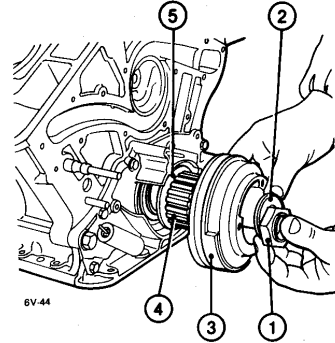
- Eliminate the calking from the collar of the nut securing the pulley.
- Using a torque spanner ① with adequate extension slacken and unscrew the nut fixing the pulley.



6V-159

1. Torque spanner

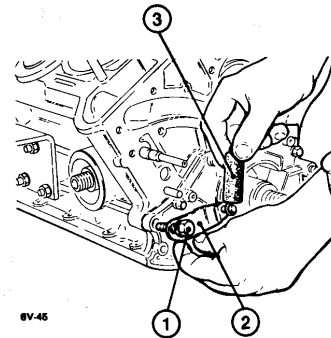
- Unscrew nut ① completely and remove in order: washer ②, crankshaft pulley ③, toothed pulley ④ of timing belt and cup washer ⑤ (the convex part of the washer faces inwards), which serves as a shoulder for the timing drive belt.



6V-44

1. Nut
2. Washer
3. Crankshaft pulley
4. Toothed pulley
5. Cup washer

- k. Unscrew screw with washer ① and remove the plate ② securing hydraulic belt stretcher spring ③.

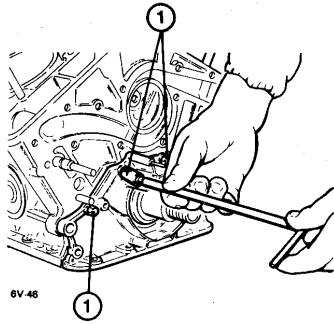


6V-45

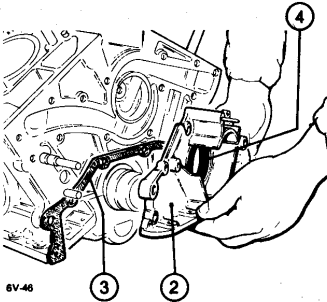
1. Screws and washers
2. Securing plate
3. Hydraulic belt stretcher spring

## ENGINE MAIN MECHANICAL UNIT

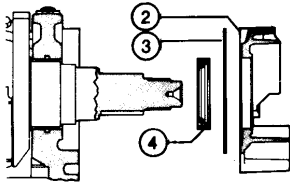
**l.** Slacken and remove screws with washers ① securing the front cover. Remove front cover ② and retrieve the gasket under it ③. Extract seal ring ④ from the front cover.



6V-46



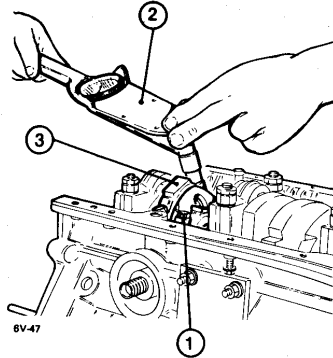
6V-46



1. Screws with washers
2. Front cover
3. Gasket
4. Seal ring

### **m. Removal of piston liners, pistons and connecting rods**

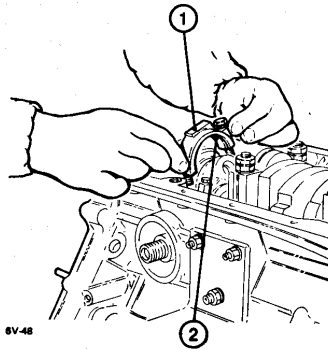
— Remove tool **A.2.0145** which prevents the rotation of the engine flywheel. Turn the crankshaft so as to make screws ① securing the con rod caps to the con rods accessible. Slacken and remove screws ①, using a torque spanner ②, which secure the con rod caps ③.



6V-47

1. Screws securing con rod caps
2. Torque spanner
3. Con rod caps

— Remove con rod caps ① complete with respective lower half-bearings ②. Proceed in the same way for the remaining con rod caps.



6V-48

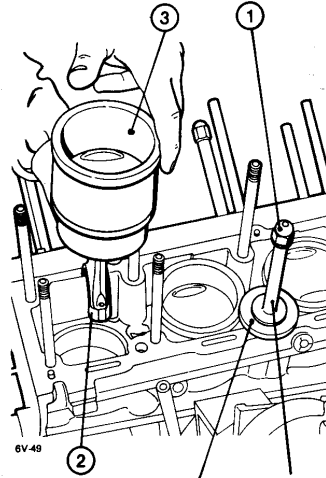
1. Con rod caps
2. Con rod lower half-bearings

— Free the overhaul stand and turn the engine 180°.

Unscrew nut with washer ① and remove the liner locking tool **A.2.0117** and respective washer **A.2.0362**.

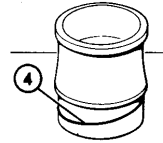
Extract all the con rod-piston groups ② complete with con rod upper half-bearings and together with the cylinder liners ③.

Remove seal ring ④ from each cylinder liner.



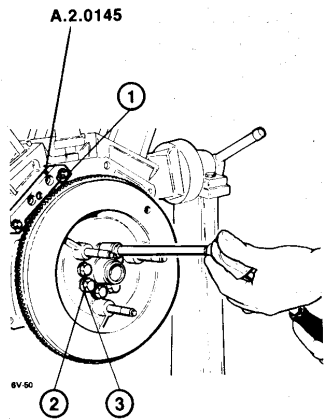
6V-49

**A.2.0117**  
**A.2.0362**



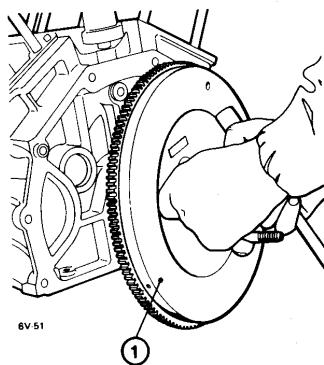
1. Nut with washer
2. Con rod-piston group
3. Cylinder liner
4. Seal ring

n. Tilt the cylinder block slightly and fit tool **A.2.0145** again.  
Lock with screws **1**.  
Remove the tool from the engine flywheel to permit the rotation of the crankshaft.  
Unscrew screws **2** securing the flywheel to the crankshaft (the screws securing the flywheel are sealed on mounting with **LOC-TITE 270** (green) cement P/N 3524-00009).  
Remove screws **2** and lock washers **3**.



1. Tool fixing screws
2. Flywheel fixing screws
3. Lock washers

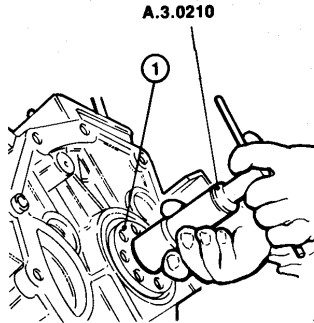
o. Remove tool **A.2.0145** and remove flywheel **1**.



1. Engine flywheel

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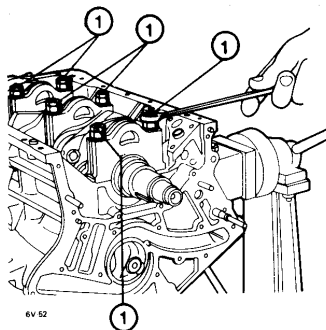
p. Extract the flywheel center bushing from the rear flange of crankshaft **1**; the bushing should be extracted with extracting tool **A.3.0210**.



1. Crankshaft rear flange

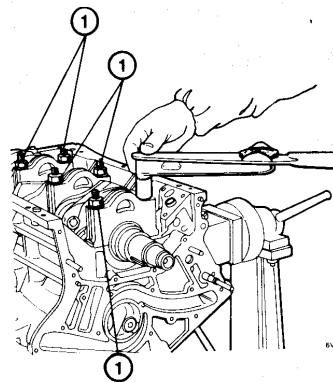
q. Removal of crankshaft

1. Remove the three front main bearing caps as follows:
  - Remove lock nuts **1** using a suitable spanner.



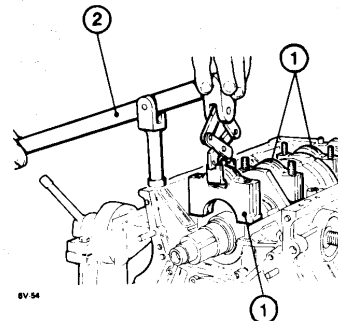
1. Lock nuts

- Slacken and unscrew, using a torque spanner, the remaining nuts and washers **1** fixing the front main bearing caps (six).



1. Nuts and washers fixing the front main bearing caps

- Remove the three front main bearing caps **1**, using a suitable extracting tool **2** if necessary.

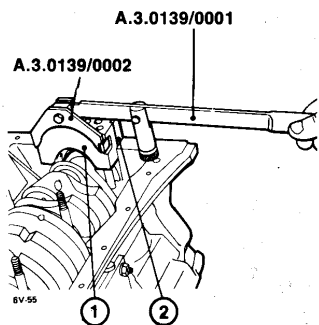


1. Front main bearing caps
2. Extracting tool

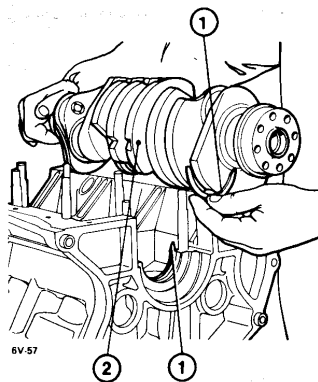
2. Remove the rear main bearing cap as follows:

- Straighten the safety tabs which secure the nuts of the rear main bearing cap.  
Slacken and remove the nuts with the respective tabs.
- Remove the rear main bearing cap **1** using the extraction tool composed of lever **A.3.0139/0001** and fork **A.3.0139/0002**.  
Retrieve the grommets **2** on the sides of the rear main bearing cap.

ENGINE MAIN MECHANICAL UNIT

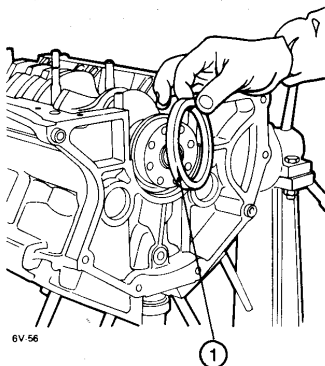


- 1. Rear main bearing cap
- 2. Grommets



- 1. Thrust half-rings
- 2. Crankshaft

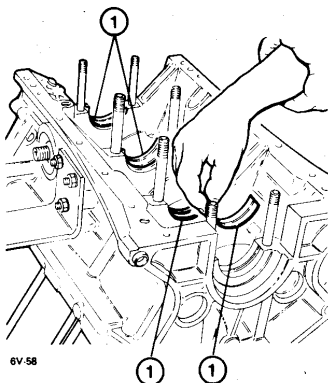
3. Remove the seal ring ① from the rear flange of the crankshaft.



- 1. Rear seal ring

4. Extract the two rear thrust half-rings ① and turn the crankshaft to facilitate its extraction. Remove the crankshaft ② from the cylinder block.

5. Remove the upper main half-bearings ① located in their respective seats on the main bearings. Mark the reciprocal position of the half-bearings ① in case they are re-utilized when re-assembling.

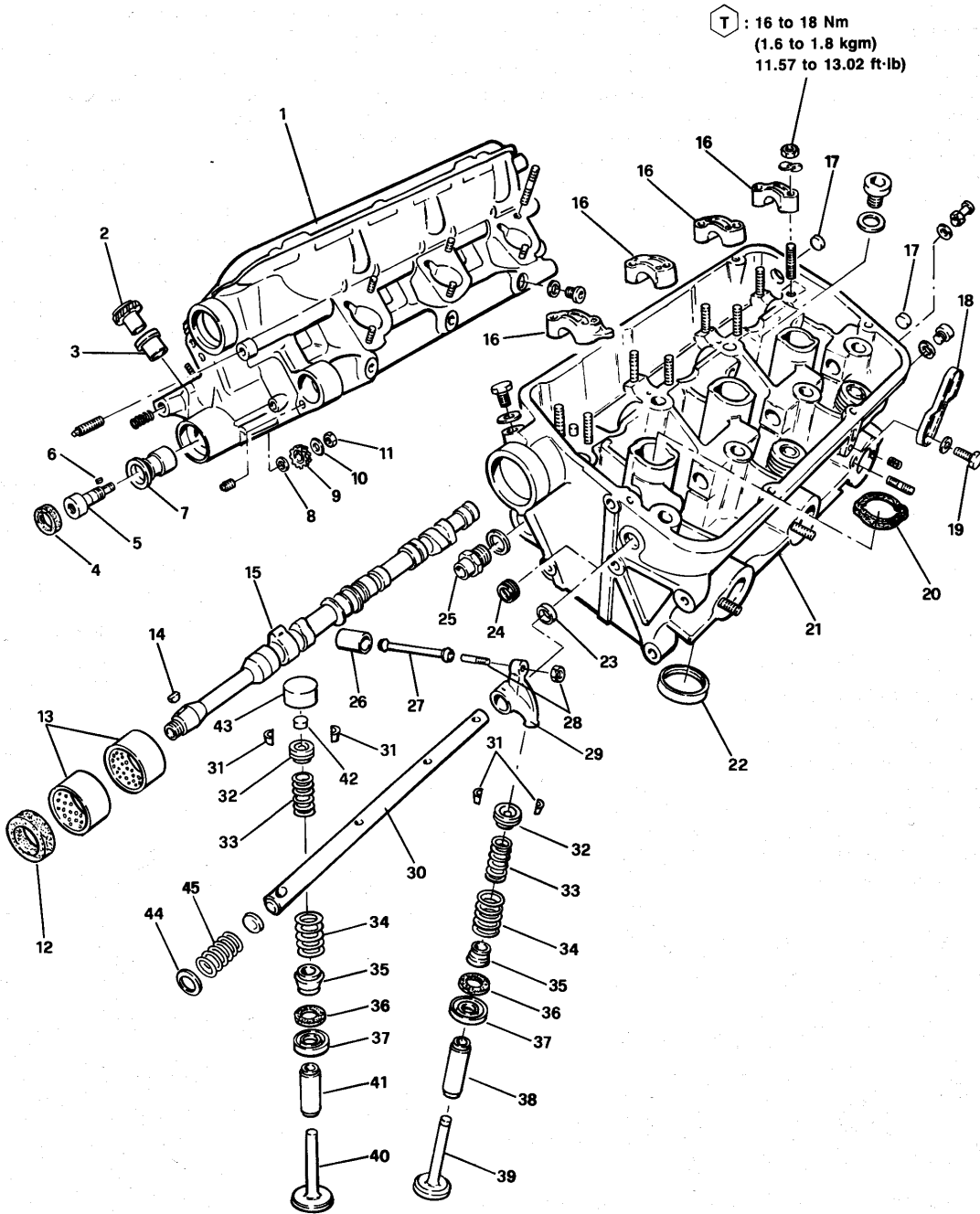


- 1. Upper main half-bearings



ENGINE MAIN MECHANICAL UNIT

CYLINDER HEAD



## ENGINE MAIN MECHANICAL UNIT

1. Right cylinder head, complete
2. Idle gear
3. Bushing
4. Seal ring
5. Shaft for toothed pulley
6. Key
7. Bushing
8. Spacer
9. Distributor and oil pump drive gear
10. Lock washer
11. Lock nut
12. Seal ring
13. Bushings
14. Key
15. Camshaft
16. Camshaft caps (four)

17. Plugs
18. Engine lifting bracket
19. Retaining screws
20. Spark plug well gasket
21. Left cylinder head
22. Valve seats
23. Rocker shaft bushing
24. Plug
25. Cylinder head cooling union
26. Exhaust valve tappet
27. Rods
28. Exhaust valve adjustment screw and nut
29. Rockers
30. Rocker shaft
31. Cotters
32. Upper cap

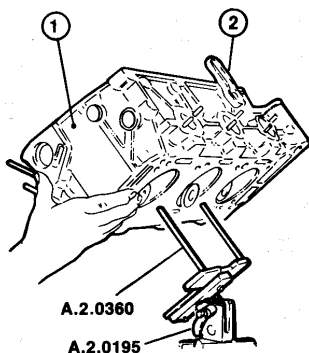
33. Inner spring
34. Outer spring
35. Grommet
36. Stop ring
37. Lower cap
38. Exhaust valve guide
39. Exhaust valve
40. Intake valve
41. Intake valve guide
42. Adjustment cap for intake valve
43. Intake valve tappet
44. Washer
45. Spring

### DISASSEMBLY OF THE CYLINDER HEAD ON BENCH

The disassembly operation described here is for the right cylinder head. To disassemble the left cylinder head proceed in the same way.

#### PRELIMINARY OPERATIONS

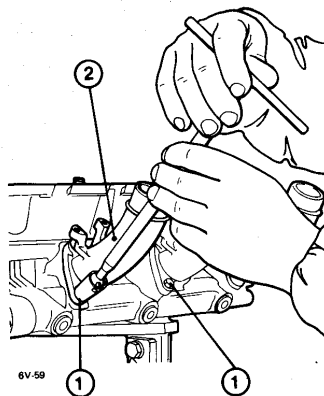
- a. Lock revolving support (tool **A.2.0195**) in a vice, fit the fork to support the cylinder head (tool **A.2.0360**) and fix it to the revolving support.
- b. Place cylinder head **1** on the fork and fix it with two lock nuts of the cylinder head (removed previously).
- c. Remove engine lifting bracket **2**.



1. Cylinder head
2. Engine lifting bracket

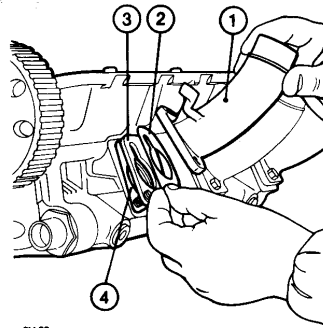
### REMOVAL OF INTAKE STUB PIPES (Only for vehicles with L-JETRONIC injection)

- a. Slacken and remove nuts with washers **1** securing the intake stub pipes **2** to the cylinder head.



1. Nuts and washers
2. Intake stub pipes

- b. Remove the intake stub pipes **1** and then remove, in order, the following parts: gasket **2**, insulating gasket **3** and gasket **4**.



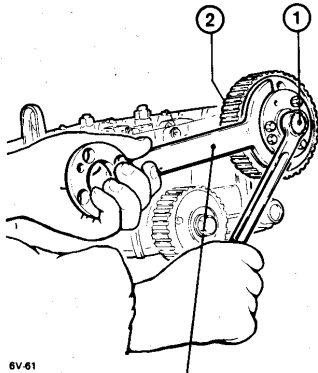
ev-80

1. Intake stub pipes
2. Gasket
3. Insulating gasket
4. Gasket

**REMOVAL OF THE CAMSHAFT PULLEY**

Remove the toothed pulley driving the camshaft in the following way:

- a. Unscrew nut (1).
- Use the lever (tool A.2.0361) to prevent toothed pulley (2) from rotating.

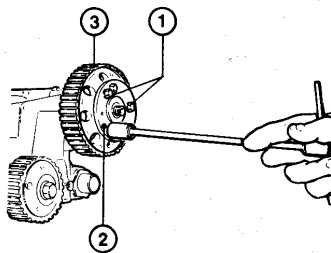


6V-61

A.2.0361

- 1. Nut
- 2. Toothed pulley

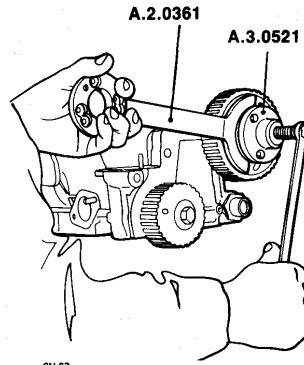
- b. Slacken and unscrew screws (1) fixing the support hub (2) to the toothed pulley (3).



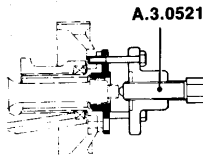
6V-62

- 1. Screws
- 2. Support hub
- 3. Toothed pulley

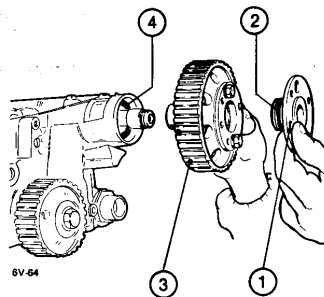
- c. Free the support hub, which is interference-fitted, using the puller (tool A.3.0521) and lever (tool A.2.0361).



6V-63



- d. Slide out hub (1) complete with seal (2). Extract toothed pulley (3) and retrieve seal (4).



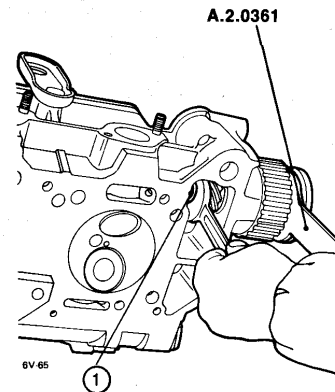
6V-64

- 1. Hub
- 2. Seal ring
- 3. Toothed pulley
- 4. Seal ring

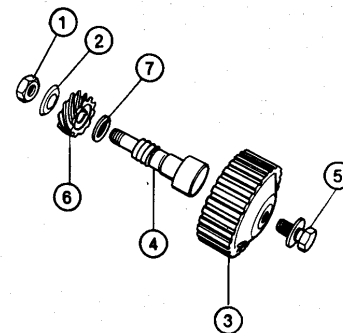
**REMOVAL OF DISTRIBUTOR AND OIL PUMP DRIVE PULLEY**

- a. Raise the safety tab of nut (1) securing the gear.
- b. Slacken nut (1) (use lever - tool A.2.0361 to maintain it).
- c. Unscrew and remove nut (1) with relative washer (2).
- d. Slide out toothed pulley (3) complete with drive shaft (4) secured by screw with washer (5).

At the same time retrieve gear (6) and relative spacer (7) from the lower part of the cylinder head.

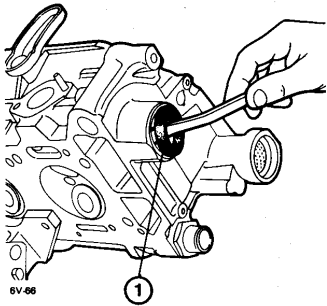


6V-65



- 1. Nut
- 2. Lock washer
- 3. Toothed pulley
- 4. Drive shaft
- 5. Screw with washer
- 6. Gear
- 7. Spacer

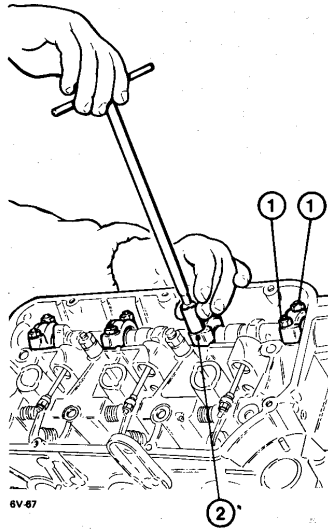
e. Remove the oil ring ① from under the cylinder head.



1. Seal (oil ring)

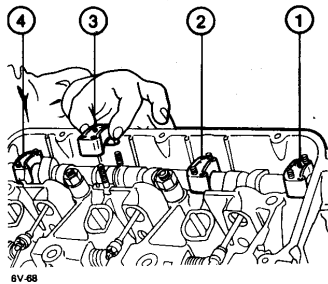
**REMOVAL OF CAMSHAFT**

a. Slacken and remove nuts with washers ① securing the caps ② of the camshaft.



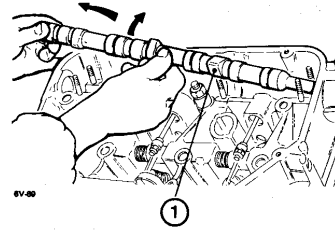
1. Nuts with washers  
2. Camshaft caps

b. Remove caps. The camshaft caps are numbered progressively (1-2-3 etc.). Cap ① is located on the front part of the cylinder head. When reassembling fit the caps in the same order.



1. Cap no. 1  
2. Cap no. 2  
3. Cap no. 3  
4. Cap no. 4

c. Remove camshaft ① by raising the rear part first and then sliding it out in the direction indicated by the arrows in the figure.

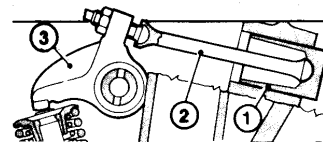
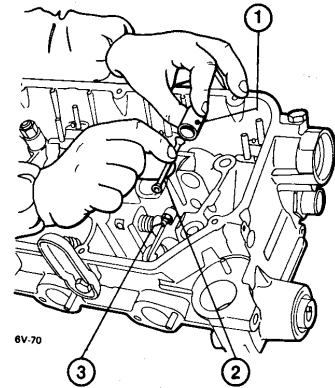


1. Camshaft

**REMOVAL OF ROCKER ARM SHAFT AND VALVES**

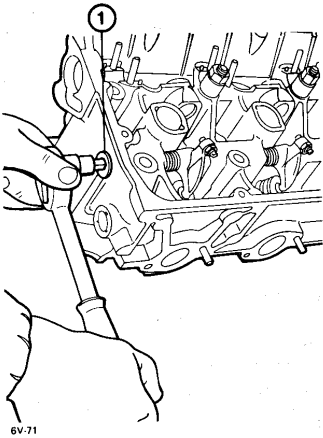
Disassemble the rocker arm support shaft as follows:

a. Remove tappets ① from their seats in the cylinder head.  
b. Slide out push rods ② operating rocker arms ③ of the exhaust valves.



1. Tappet  
2. Push rods  
3. Rocker arms

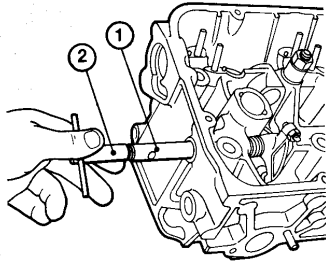
c. Slacken and unscrew plug ① sealing the rocker arm support shaft.



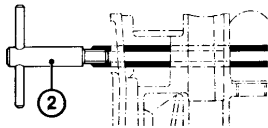
6V-71

1. Plug

d. Screw a suitable tool ② to the threaded shank of the rocker arm support shaft ①.



6V-72

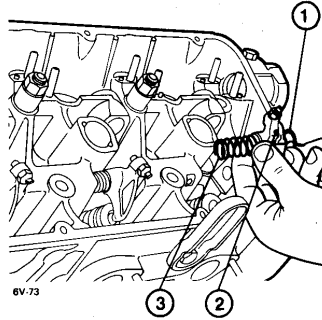


1. Rocker arm support shaft  
2. Tool for removing shaft

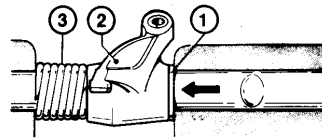
e. Gradually extract the rocker arm shaft and retrieve, one at a time, the following parts:

- washer ①.

- rocker arms ②;
- spring ③.

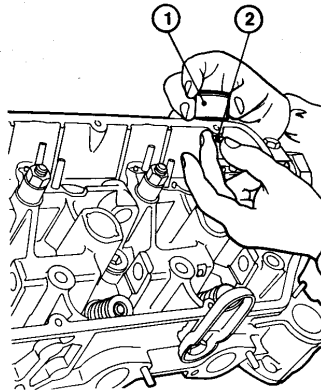


6V-73



1. Washer  
2. Rocker arms  
3. Spring

f. Slide out tappets ① located on the intake valves, complete with cap nut ② which determines valve clearance. Remove in sequence so that they can be replaced in the same order.

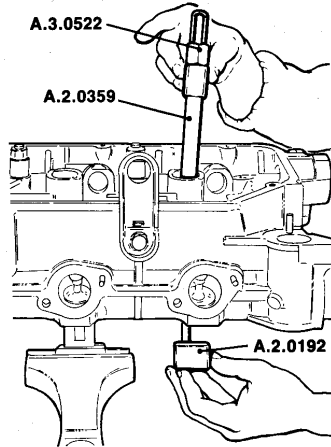


6V-74

1. Intake valve tappets  
2. Valve clearance adjustment cap nut

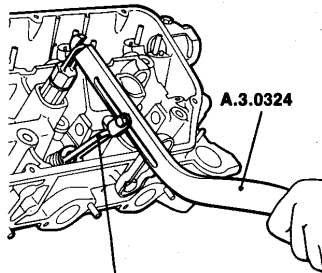
g. Disassemble the valves in the following way and using the following tools:

- Insert tool A.2.0192 to support the valves by passing it under the spark plug well and lock it with special nut (tool A.2.0359). Screw support (tool A.3.0522) to the threaded shank of tool A.2.0359.



6V-75

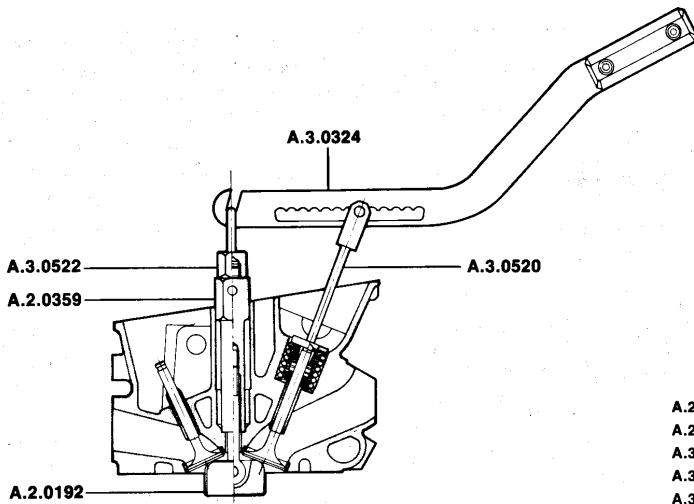
- Fit the cage for the removal and refitting of the cotters (tool A.3.0520) to the lever (tool A.3.0324) and fit the group to the tools already mounted, as shown in the figure.



6V-76

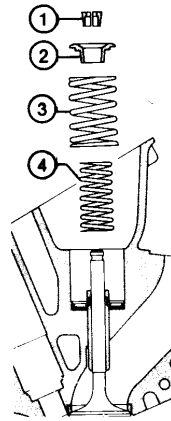
A.3.0520

ENGINE MAIN MECHANICAL UNIT

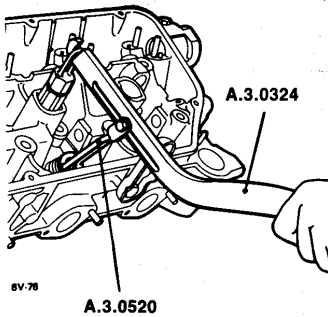
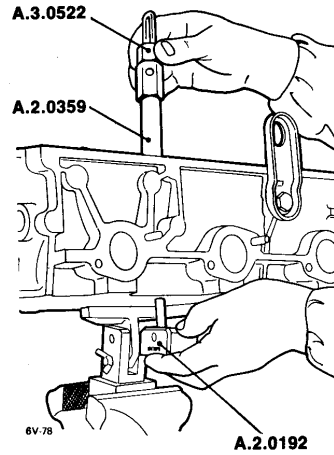


- A.2.0192 Support for valves
- A.2.0359 Special nut to secure A.2.0192
- A.3.0522 Support for lever A.3.0324
- A.3.0324 Lever for disassembly
- A.3.0520 Cage for disassembling cotters

— Disassemble each pair of valves (intake and exhaust) and move the tool group each time.  
 Press the lever (tool A.3.0324) to overcome the resistance of the valve springs and remove cotters ① (for this operation use a small screwdriver).  
 Then disassemble in the following order: upper cap ②, outer spring ③ and inner spring ④.

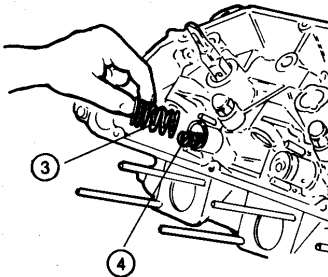


- 1. Cotters
- 2. Upper cap
- 3. Outer spring
- 4. Inner spring

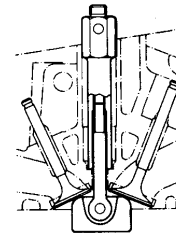


6V-78

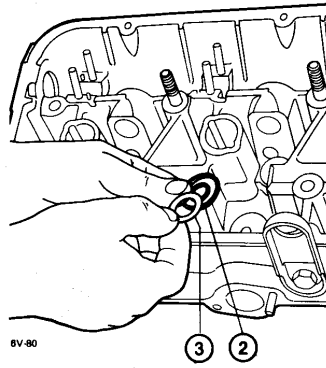
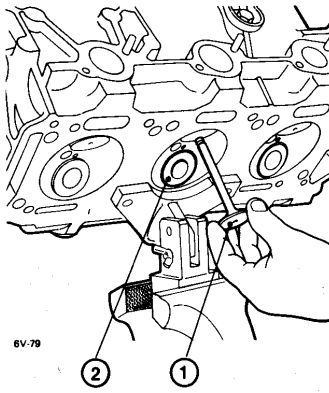
A.3.0520



— Unscrew special nut (tool A.2.0359) complete with support (tool A.3.0522) from valve support (tool A.2.0192).



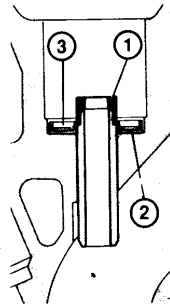
— Withdraw pair of valves (exhaust valve ① and intake valve ②) from the respective guides.  
 Repeat the operations described for the remaining pairs of valves.



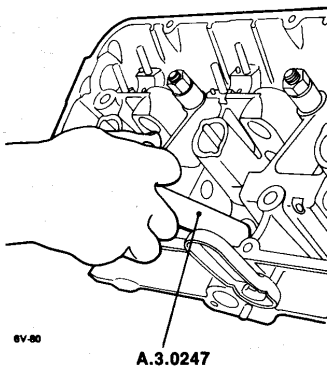
- 1. Exhaust valves
- 2. Intake valves

**h. Removal of rubber oil seals and lower caps from the valves**

— Using tool A.3.0247 remove rubber oil seals ① from the guides of the intake and exhaust valves.  
Remove lower caps ② from both intake and exhaust valves, complete with spring seat rings ③.



- 1. Rubber oil seals
- 2. Lower caps
- 3. Spring seat rings



## CHECKING AND TESTING THE CYLINDER HEADS

### CHECKING AND TESTING CYLINDER HEAD AND VALVES

- a. Examine visually and with care, the casting and all the parts making up the cylinder head to check for cracks, burns, seizing or signs of excessive wear.
- b. If this inspection should indicate the possibility of re-utilizing one or more parts check, according to the instructions given and after thorough cleaning of the head, the dimensions of the same.

1. Straight edge
2. Thickness gauge

**Maximum flatness error of the lower surface of the cylinder head:**  
**A = 0.05 mm (0.002 in)**

- c. If the lower surface of the cylinder head should prove to be excessively deformed it must be levelled. Levelling must be performed on both heads.

### CHECKING CYLINDER HEAD BUSHINGS

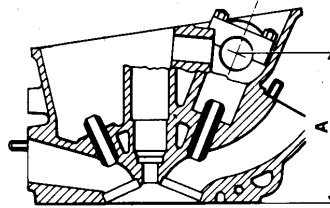
- a. Measure the diameter of the following bushings mounted on the cylinder head:
  - «A», bushing for the distributor and oil pump drive gear;
  - «B», bushing for the distributor and oil pump drive pulley shaft;
  - «C», bushings for the shaft of the toothed pulley driving the camshaft.

**NOTE:**

Bushings «A» and «B» are not mounted on the left cylinder head.

### CHECKING CYLINDER HEAD FLATNESS

- a. Thoroughly clean the surfaces of the cylinder head to remove any gasket fragments. Use butyl acetate or methylethylketone.
- b. The checking of the flatness of the lower surface of the cylinder head must be performed by means of a straight edge ① placed on the lower surface of the head; the extent of deformation should be measured with a suitable thickness gauge ②.



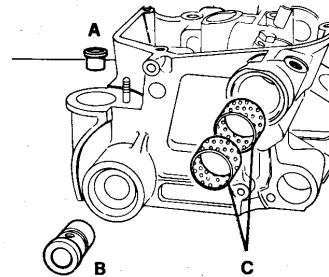
A. Distance between camshaft axis and lower surface of cylinder head

**Min. permitted height of cylinder head after regrinding:**  
**A = 124.5 mm (4.902 in)**

**CAUTION:**

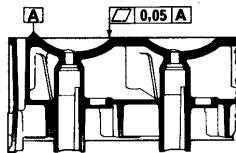
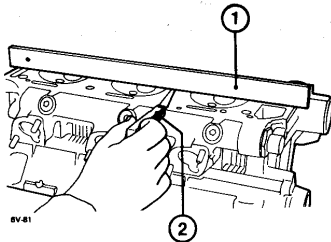
Do not exceed the minimum limit permitted as this can cause serious engine malfunctions.

- d. Check that the lower surface of the head is well-finished.



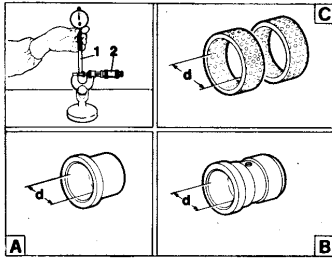
- A. Distributor and oil pump bushing
- B. Distributor and oil pump bushing toothed pulley
- C. Camshaft toothed pulley bushing

- b. Measure the internal diameter as follows:
  - using a micrometer ② establish dimension «d» to be measured (refer to the table);





- fit the most suitable bore gauge (1) to the stem of the dial indicator;
- zero-set the dial indicator at the dimension established on the micrometer and then measure diameter «d» of the bushings measured on 120° of the circumference.

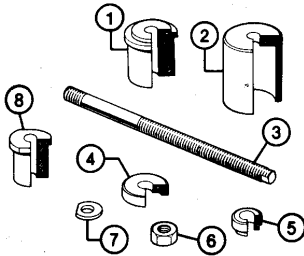


«d» mm (in)  
(bushing I.D.)

Bushing		
A	B	C
19.000 to 19.021 (0.7480 to 0.7489)	19.000 to 19.021 (0.7480 to 0.7489)	32.000 to 32.025 (1.2598 to 1.2608)

1. Bore gauge and dial indicator
2. Micrometer

c. If the values obtained are not within the prescribed limits replace the bushings involved. For removal and installation use the tool illustrated (A.3.0528) as shown below.

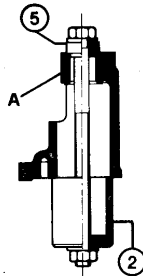
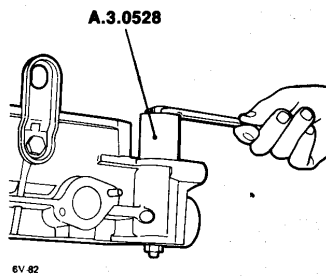


**Components of tool A.3.0528**

1. Spool
2. Bowl
3. Tie rod
4. Flange
5. Special washer
6. Hex nut (M10 x 1.25)
7. Shaped washer
8. Spool

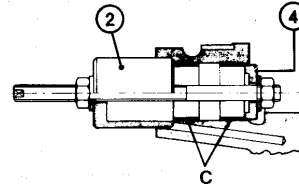
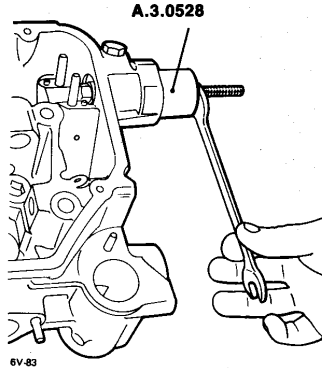
**d. Removal of bushings**

- Bushing «A» of the gear operating the oil pump and the distributor should be withdrawn using special washer (5) as a pusher, and using bowl (2) as a support (which will accompany the bushing as it is extracted).



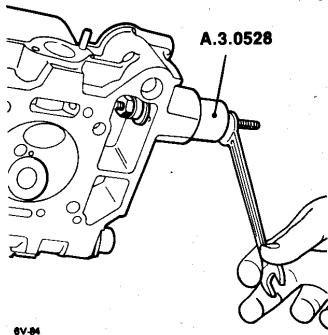
- A. Bushing
2. Bowl (A.3.0528)
5. Special bushing (A.3.0528)

- Proceeding in the same way as described above, withdraw the two bushings «C» of the toothed pulley support shaft operating the camshaft. Use flange (4) as a pusher, together with cup (2).

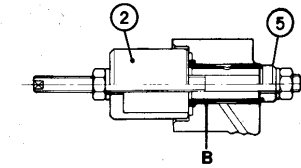
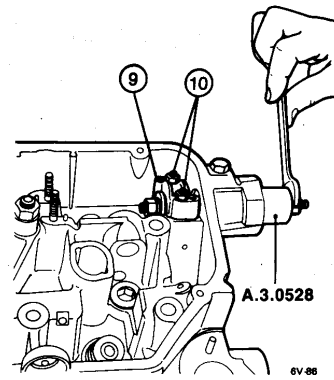
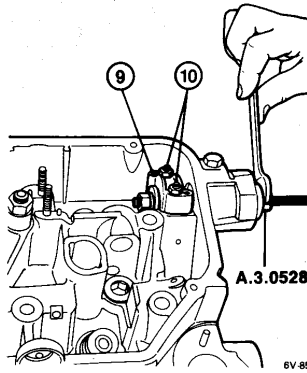


- C. Bushings
2. Bowls (A.3.0528)
4. Flange (A.3.0528)

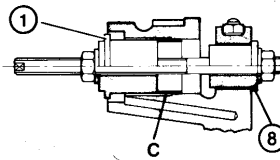
- Extract bushing «B» for the shaft of the pulley operating the oil pump and the distributor using, in addition to cup (2), special washer (5) as a pusher.



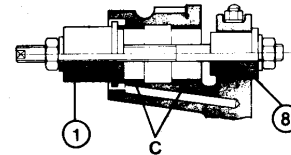
Insert until the lip of spool ① touches the bushing seat.



- B. Bushing  
 2. Cup (A.3.0528)  
 5. Special washer (A.3.0528)



- C. Bushing  
 1. Spool (A.3.0528)  
 8. Spool (A.3.0528)  
 9. Cap  
 10. Nuts



- C. Bushings  
 1. Spool (A.3.0528)  
 8. Spool (A.3.0528)  
 9. Cap  
 10. Nuts

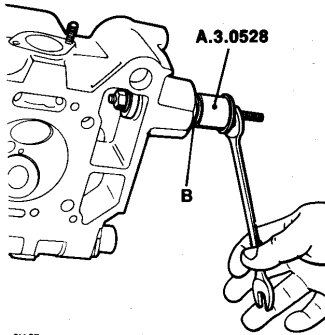
**e. Installation of the bushings**

— Bushings «C», made of antifriction metal, for the shaft of the pulley operating the camshaft, must be inserted in the following way.  
 Temporarily fit cap ⑨ of the camshaft and lock it with nuts ⑩.  
 Place the rear bushing «C», recognizable because it is thinner, so that it is sufficiently centered in its seat.  
 Place, as illustrated in the figure, tool A.3.0528 comprising spool ① which acts as a pusher, and spool ⑧.

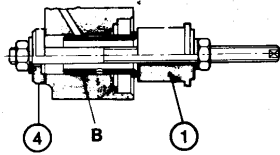
— To insert the front bushing «C» proceed in the same way but use spool ① in inverted position as illustrated in the following figure so as to obtain the correct position of the bushing.

— Insert bushing «B» for the shaft of the toothed pulley operating the oil pump and the distributor using spool ① as a pusher and flange ④ as a support.

# ENGINE MAIN MECHANICAL UNIT

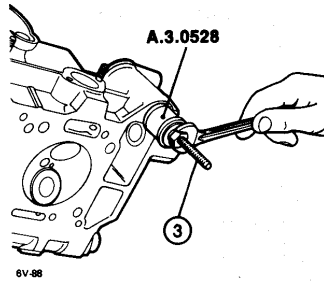


6V-87

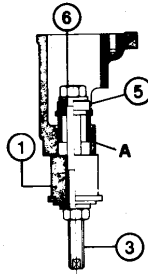


- B. Bushing**  
 1. Spool (A.3.0528)  
 4. Flange (A.3.0528)

— Insert, from the upper side of the distributor seat, bushing «A» for the distributor and oil pump drive gear. Place tool **A.3.0528** in the following way: insert tie rod ③ complete with nut ⑥ and special nut ⑤ (as pusher); from the opposite side insert support spool ① in the tie rod and complete the insertion of the bushing «A» in this way.



6V-88

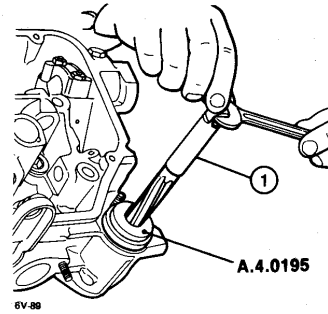


- A. Bushing**  
 1. Spool (A.3.0528)  
 3. Tie rod (A.3.0528)  
 5. Special washer (A.3.0528)  
 6. Nut (A.3.0528)

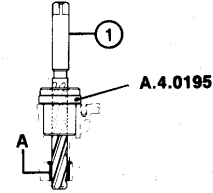
### f. Reaming bushings «A» and «B»

After inserting the two bushings «A» and «B» for the distributor and oil pump drive mechanism, they must be reamed to the prescribed dimensions.

— Bushing «A»; insert tool **A.4.0195** and then, using a suitable reamer ① [19 mm H7 (0.7480 to 0.7489 in)] bore as prescribed.



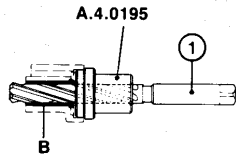
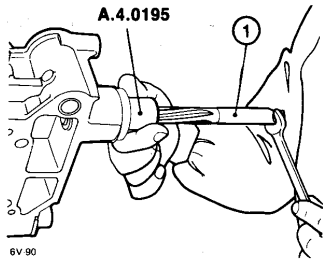
6V-89



- A. Bushing**  
 1. Reamer [19 mm H7 (0.7480 to 0.7489 in)]

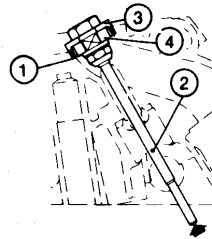
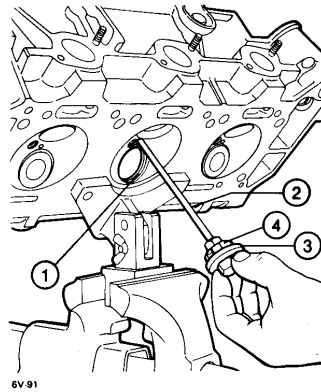
**Diameter after reaming;  
 bushing for distributor and  
 oil pump drive gear shaft:  
 19.000 to 19.021 mm  
 (0.7480 to 0.7489 in)**

— Bushing «B»; insert guide tool **A.4.0195** and then, using a suitable reamer ① [19 mm H7 (0.7480 to 0.7489 in)] bore as prescribed.

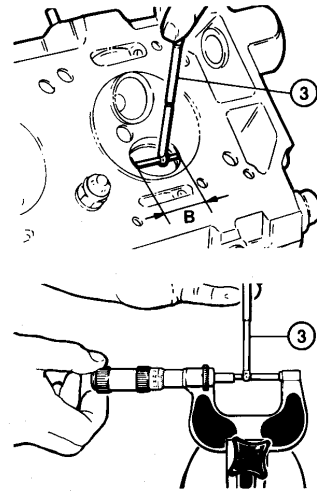


B. Bushing  
1. Reamer [19 mm H7 (0.7480 to 0.7489 in)]

**Diameter after reaming;  
bushing for distributor and  
oil pump drive pulley shaft:  
19.000 to 19.021 mm  
(0.7480 to 0.7489 in)**



1. Valve seat  
2. Mandrel for extraction  
3. Stop ring  
4. Screw tap for threading the valve seats to be extracted

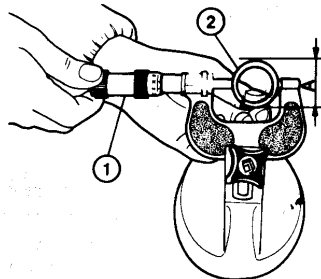


1. Micrometer  
2. Valve seat  
3. Bore meter

**CHECKING VALVE SEATS**

- a. Check that the valve seats do not exhibit scoring, cracking or burning and that they are well-fitted in their respective seats on the cylinder head - if necessary replace them.
- b. Withdraw the valve seats (1) using a suitable tool as illustrated in the figure. Proceed as follows:
  - fit and lock stop ring (3) and screw tap (4) (selected according to the diameter of the valve seat to be extracted) on mandrel (2);
  - insert the group thus formed in the valve guide until screw tap (4) comes into contact with the valve seat (1);
  - thread the valve seat by means of a no. 22 mm spanner on the head of the mandrel until ring (3) touches the surface of the valve seat - then unscrew a half turn;
  - tap the extremity of the mandrel protruding from the head to extract the valve seat.

c. Use a micrometer (1) to measure the diameter of the new valve seat (2) and a bore meter (3) to measure that of the respective seat in the cylinder head to check the correct fitting interference. Compare the values obtained with those given in the table.



Valve		Engine 062.10
Valve seat O.D.	Normal	i. 37.565 to 37.600 (1.4789 to 1.4803)
		e. 32.565 to 32.600 (1.2821 to 1.2835)
A = mm (in)	Oversize	i. 37.865 to 37.900 (1.4907 to 1.4921)
		e. 32.865 to 32.900 (1.2939 to 1.2953)

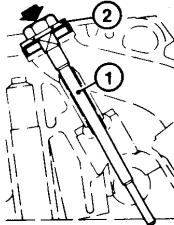
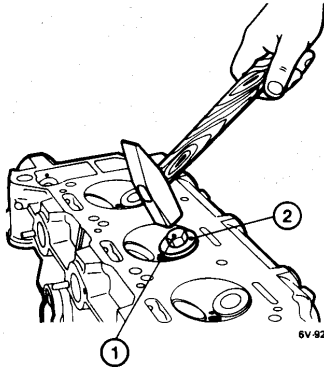
Valve		Engine 016.46
Valve seat O.D.	Normal	i. 42.065 to 42.100 (1.6561 to 1.6575)
		e. 37.065 to 37.100 (1.4593 to 1.4606)
A = mm (in)	Oversize	i. 42.365 to 42.400 (1.6679 to 1.6693)
		e. 37.365 to 37.400 (1.4711 to 1.4724)

Valve		Engine 062.10
Valve seat housing I.D.	Normal	i. 37.500 to 37.525 (1.4764 to 1.4774)
		e. 32.500 to 32.525 (1.2795 to 1.2805)
B = mm (in)	Oversize	i. 37.800 to 37.825 (1.4882 to 1.4892)
		e. 32.800 to 32.825 (1.2913 to 1.2923)

Valve		Engine 016.46
Valve seat housing I.D.	Normal	i. 42.000 to 42.025 (1.6535 to 1.6545)
		e. 37.000 to 37.025 (1.4567 to 1.4577)
B = mm (in)	Oversize	i. 42.300 to 42.325 (1.6654 to 1.6663)
		e. 37.300 to 37.325 (1.4685 to 1.4695)

i. = Intake valve e. = Exhaust valve

- d. Pre-heat the cylinder head in a suitable oven to 120°C (274°F).
- e. Insert the valve seat (of intake and exhaust valves) using the tool used for the removal in the following way:
- fit and lock stop ring (2) (selected according to the diameter of the valve seat to be fitted) on mandrel (1);
  - insert the group thus formed into the valve guide until stop ring (2) comes into contact with the valve seat;
  - tap the extremity of mandrel (1) protruding from the head, to insert the valve seat.



1. Mandrel for insertion  
2. Stop ring

### CHECKING VALVE GUIDES

Determine the clearance between valve guide and the stem.

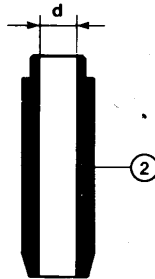
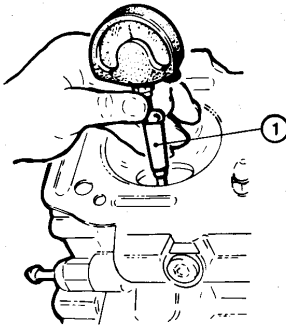
If the clearance exceeds the permitted tolerance replace the worn parts.

a. **Determination of clearance**

- Using a micrometer measure the diameter of the valve stem in three

places and in directions at right angles to each other.

- Using a bore gauge (1) measure the I.D. of the valve guide «d».



1. Bore gauge  
2. Valve guide

**Valve guide I.D. (intake and exhaust):**

$$d = 9.000 \text{ to } 9.015 \text{ mm} \\ (0.3543 \text{ to } 0.3549 \text{ in})$$

- Calculate the clearance, subtracting the maximum diameter of the valve stem from the I.D. of the valve guide.

**Radial clearance between valve stem and valve guide I.D.:**

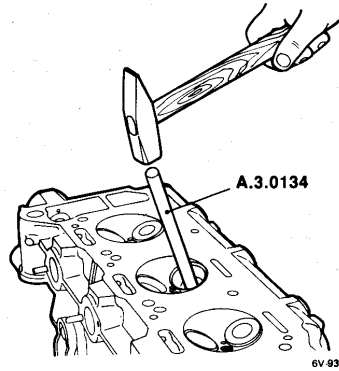
Intake: 0.013 to 0.043 mm  
(0.0005 to 0.0017 in)

Exhaust: 0.040 to 0.080 mm  
(0.0016 to 0.0031 in)

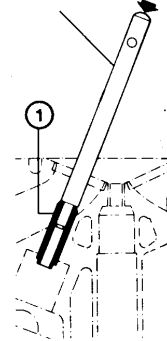
b. **Replacing the valve guide**

- Visually check the valve guides, ensuring that there is no scoring or traces of seizing and that they have not undergone deformation or moved from mounting position.

- If necessary remove the worn valve guides (1) using extracting tool A.3.0134 as illustrated in the figure.



A.3.0134



1. Valve guide

c. **Insertion of the valve guide**

- Check the I.D. of the valve guide seat and the O.D. of the new valve guide; the fitting interference should be within the prescribed limits (the values are valid for both intake and exhaust valves).

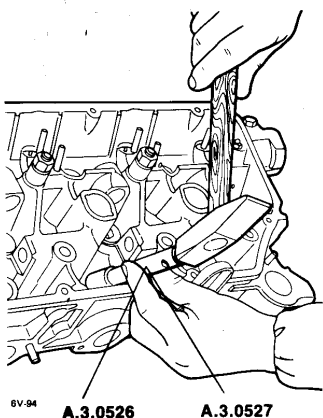
**Valve guide seat I.D.:**  
13.990 to 14.018 mm  
(0.5508 to 0.5519 in)

**Valve guide O.D.:**  
14.033 to 14.044 mm  
(0.5525 to 0.5529 in)

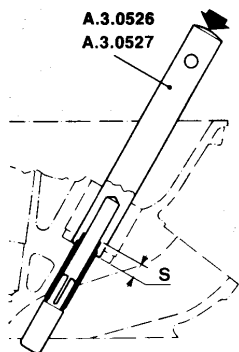
**Interference between valve guide and seat of valve guide:**

0.015 to 0.054 mm  
(0.0006 to 0.0021 in)

- Insert the new valve guides using tool A.3.0526 for the intake valve guides and tool A.3.0527 for the exhaust valve guides.

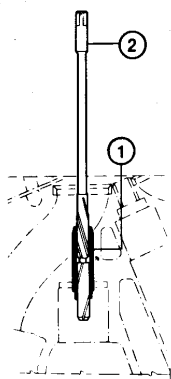
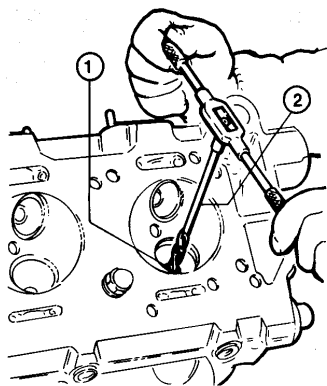


- These tools ensure the correct protrusion of the valve guides with respect to the support surface of the lower spring cap on the cylinder head.



**Protrusion of the valve guides from the cylinder head:**  
 $S = 10.2 \text{ to } 10.6 \text{ mm}$   
 (0.402 to 0.417 in)

- d. Reaming the valve guides**
- Ream intake and exhaust valve guides ① using a 9 mm H7 (0.3543 to 0.3549 in) reamer ② to calibrate the holes to the prescribed diameter and then measure the I.D. of the valve guides.



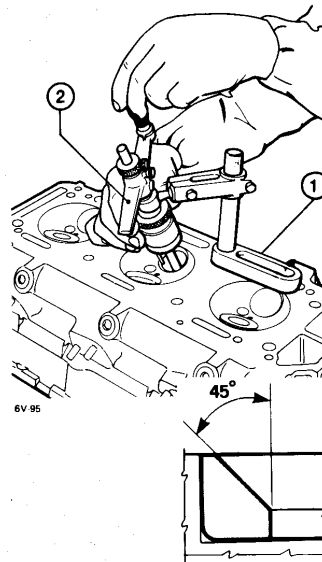
1. Valve guides  
 2. Reamer  
 [diameter 9 mm H7 (0.3543 to 0.3549 in)]

**I.D. of the intake and exhaust valve guides:**  
 9.000 to 9.015 mm  
 (0.3543 to 0.3549 in)

- e. Turning the valve seats**
- Wait until the cylinder head is cooled and perform the turning of the valve seats in the following way.
  - Position support ① of the portable lathe ② on the cylinder head and secure it in a suitable way.
  - The angle of turning, which is identical for both intake and exhaust, should be:

**Taper of intake and exhaust valve seats:**  
 $\alpha = 90^\circ$

- Taper  $\alpha$  is obtained with the tool of the portable lathe at  $45^\circ$  (for both intake and exhaust valves).



1. Portable lathe support  
 2. Portable lathe

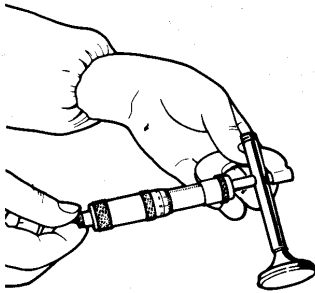
**CAUTION:**

The turning of the valve seats which do not require replacing is suitable for the elimination of minor defects of the working area: however, ascertain, before performing the operation, that there is sufficient machining allowance.

**CHECKING THE VALVES**

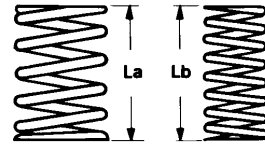
Check that the valves are not scored or burnt or do not exhibit mating marks (steps) with the corresponding seats on the cylinder head. Renew them if necessary.

a. If the valves are in good condition check the diameters of the stem and heads (which must be within the tolerances given in the table).

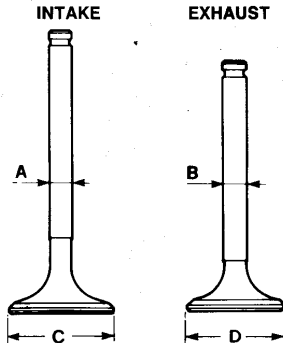


**GRINDING OF THE VALVES AND VALVE SEATS**

- a. After checking the valves and valve guides grind as follows:
- spread polishing paste (SIPAL AREXONS Carboasilicium for valves - P/N 4100-31502);
  - use engine oil to lubricate the valve stem;
  - attach the lower surface of the head of the valve to the suction cup of the pneumatic grinder ①;
  - insert the valve in its guide, turn on the pneumatic grinder ① and grind.

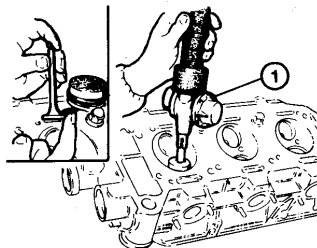


Length of free springs [mm (In)]		
External spring	La	44.6 (1.756)
Internal spring	Lb	44.1 (1.736)



Diameter of valve stem [mm (In)]		
Reference		Engine 062.10
Intake valve	A	8.972 to 8.987 (0.3532 to 0.3538)
Exhaust valve	B	8.940 to 8.955 (0.3520 to 0.3526)
Reference		Engine 016.46
Intake valve	A	8.972 to 8.987 (0.3532 to 0.3538)
Exhaust valve	B	8.935 to 8.960 (0.3518 to 0.3528)

Diameter of valve head [mm (In)]		
Reference		Engine 062.10
Intake valve	C	36.350 to 36.500 (1.4311 to 1.4370)
Exhaust valve	D	32.450 to 32.600 (1.2776 to 1.2835)
Reference		Engine 016.46
Intake valve	C	40.850 to 41.000 (1.6083 to 1.6142)
Exhaust valve	D	36.400 to 36.600 (1.4331 to 1.4409)

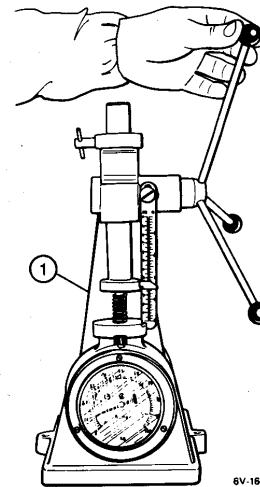


1. Pneumatic grinder for valves and valve seats

- Grind and then carefully clean the valves and valve seats using petrol or solvent.

**CHECKING VALVE SPRINGS**

- a. Carefully examine the valve springs and, if there are no signs of excessive wear or yielding, check that:
- the terminal turns must be parallel and perpendicular to the axis of the spring (max. error 2°);
  - the length of the «free» springs corresponds to the following values;



1. Dynamometer

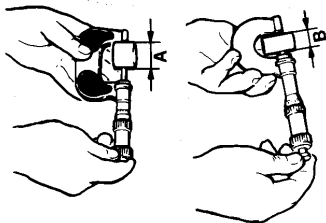
External spring		
Spring length	mm (in)	Test force
With valve closed	32.5 (1.280)	24.80 to 25.66 kg (243.2 to 251.6 N) (54.6 to 56.5 lb)
With valve open	23.5 (0.925)	47.95 to 49.75 kg (470.2 to 487.8 N) (105.7 to 109.7 lb)

Internal spring		
Spring length	mm (in)	Test force
With valve closed	30.5 (1.201)	12.82 to 13.28 kg (125.7 to 130.2 N) (28.3 to 29.3 lb)
With valve open	21.5 (0.846)	22.67 to 23.53 kg (222.3 to 230.7 N) (50.0 to 51.9 lb)

### CHECKING TAPPETS AND TAPPET SEATS

a. Check that the external surface of the tappets and the upper surface on which the cams operate are free from any trace of seizing, scoring or abnormal wear. If they can be re-utilized check the dimensions.

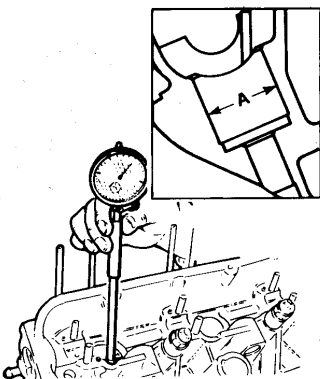
- Using a micrometer check the outside diameters are within the prescribed limits.



**A = intake tappet diameter:**  
34.973 to 34.989 mm  
(1.3769 to 1.3775 in)

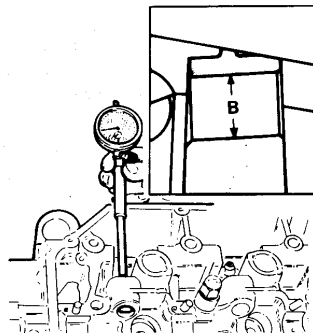
**B = exhaust tappet diameter:**  
21.971 to 21.989 mm  
(0.8650 to 0.8657 in)

- Check the tappet seats formed in the cylinder head casting and check the dimensions with a bore gauge applied to a dial indicator. Compare the value obtained for the tappet seat of the intake valve with the prescribed tolerance.



**A = intake valve tappet seat diameter:**  
35.000 to 35.025 mm  
(1.3780 to 1.3789 in)

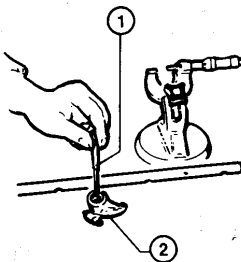
- In the same way as described previously measure the value for the exhaust valve tappet seat and compare it with that prescribed.



**B = exhaust valve tappet seat diameter:**  
22.000 to 22.021 mm  
(0.8661 to 0.8670 in)

### CHECKING ROCKER ARMS AND ROCKER ARM SHAFT

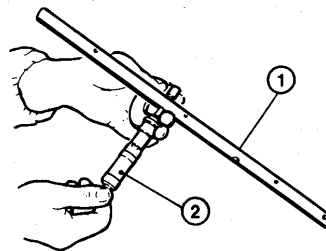
- Use bore gauge (1) to measure the I.D. of the rocker arms (2) and check that they are within the prescribed tolerances.



- 1. Bore gauge
- 2. Rocker arms

**A = diameter of shaft hole in rocker arm:**  
16.016 to 16.034 mm  
(0.6306 to 0.6313 in)

- Measure the O.D. of the rocker arm shaft with a micrometer (1) and compare the values with those prescribed.



- 1. Rocker arm shaft
- 2. Micrometer

**B = rocker arm shaft diameter:**  
15.988 to 16.000 mm  
(0.6294 to 0.6299 in)

### CHECKING CAMSHAFTS AND JOURNAL BEARINGS

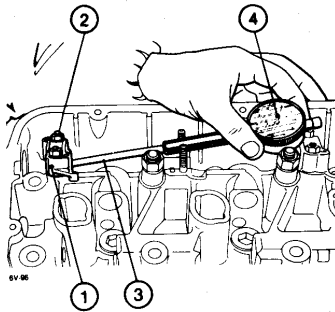
a. Check the dimensions of the camshaft journal bearings in the following way:

- Fit caps (1) in the order indicated by the numbers stamped on the caps themselves - cap no. 1 must be fitted towards the front of the cylinder head.
- Screw nuts (2) fixing the caps of the camshaft, lubricate them and tighten to the torque prescribed.

**T**: Torque wrench setting  
Camshaft cap lock nuts  
16 to 18 N-m  
(1.6 to 1.8 kg-m  
11.57 to 13.02 ft-lb)



- Check, using a bore gauge (3) applied to a dial indicator (4) the diameter of the camshaft journal bearings and compare the values measured with those prescribed.

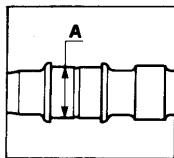
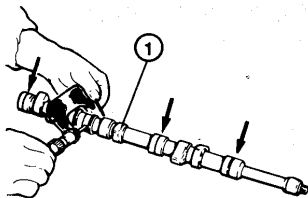


1. Camshaft caps
2. Lock nuts
3. Bore gauge
4. Dial indicator

**Diameter of camshaft main journal seat:**  
 27.000 to 27.033  
 (1.0630 to 1.0643 in)

- Carefully examine the working area of the cams and the main journals of the camshaft and ensure they are free from scoring, traces of seizing or signs of overheating or abnormal wear. Check the diameters of the camshaft main journals as follows:

- Measure the diameter of the camshaft main journals (1) at the four points indicated by the arrows in the figure and compare them with the prescribed values.



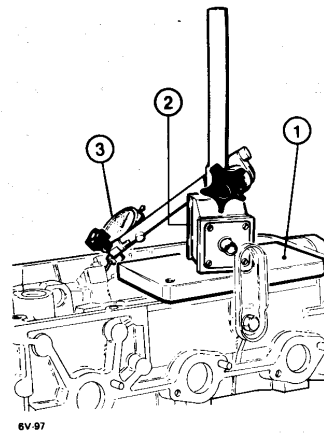
1. Camshaft

**A = diameter of camshaft main journals:**  
 26.949 to 26.970 mm  
 (1.0610 to 1.0618 in)

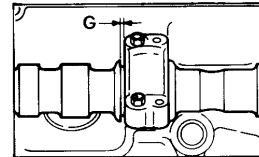
- Check the eccentricity of the camshaft main journals between two supports by means of a dial indicator.
- Measure the height of the cams with a dial indicator. If the cam height is less than the prescribed value replace the shaft.

**Minimum cam height [mm (in)]**

Intake valve cam	9 (0.354)
Exhaust valve cam	6.4 (0.252)



6V.97



1. Support plate
2. Magnetic base
3. Dial indicator

**G = camshaft end float:**  
 0.065 to 0.200 mm  
 (0.0026 to 0.0079 in)

### CHECKING END FLOAT OF CAMSHAFT

- Fit the caps, noting the sequence indicated by the numbers stamped on the caps themselves.

Cap no. 1 must be fitted towards the front part of the cylinder head.

- Screw on the nuts securing the camshaft caps, lubricate them and tighten.

**T : Torque wrench setting**  
**Camshaft cap lock nuts**  
 16 to 18 N·m  
 (1.6 to 1.8 kg·m)  
 11.57 to 13.02 ft·lb)

- Place plate (1) on the upper surface of the cylinder head.
- Apply magnetic base (2) to the plate (1) and place the sensor of dial indicator (3) so that it is in contact with the camshaft as illustrated in the figure.
- Move the camshaft axially and measure the end play; check that the value is within the limits prescribed. If not the camshaft must be replaced.

## ASSEMBLY OF THE CYLINDER HEADS (ON BENCH)

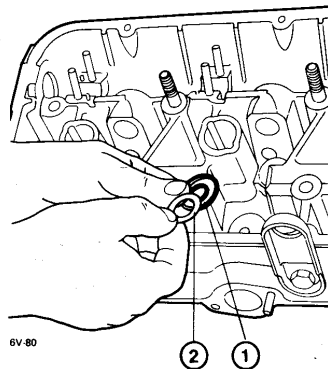
### INSTALLATION OF VALVES AND ROCKER ARM SHAFTS

**CAUTION:**

The re-fitting of the valves is performed by using the same set of tools used for removal.

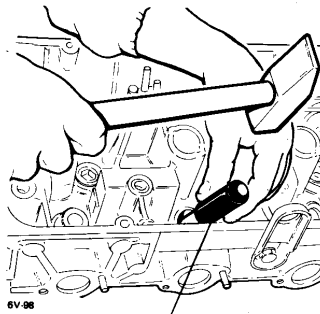
It is therefore necessary to reinstall the pair of valves (intake and exhaust) of each cylinder by moving the tool group each time.

a. Insert the lower caps (1) and stop washers (2) on the guides of the intake and exhaust valves.

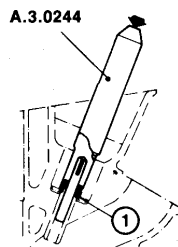


- 1. Lower caps
- 2. Stop washers

b. Fit rubber oil seals (1) on the guides of the intake and exhaust valves using tool A.3.0244.

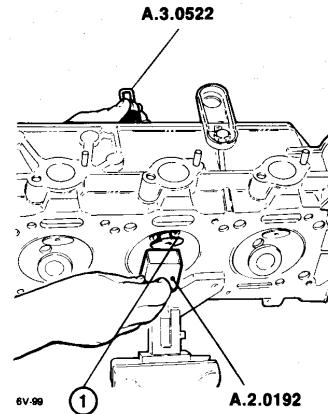


A.3.0244

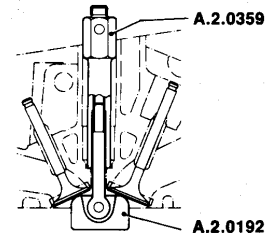


- 1. Rubber oil seal

c. Lubricate the stem of the valve with clean engine oil, insert valves (1) into the respective guides and support them with tool A.2.0192 which, in turn must be fixed to the spark plug well by means of special nut A.2.0359, complete with support for valve fitting, tool A.3.0522.



A.2.0192



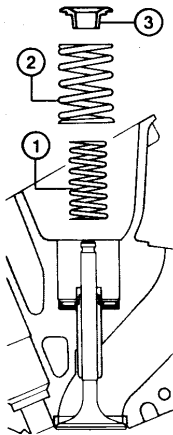
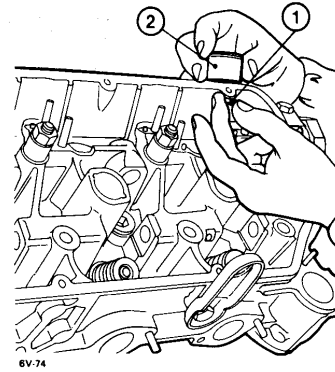
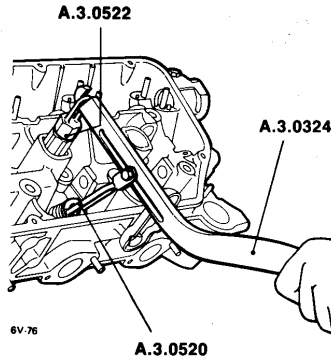
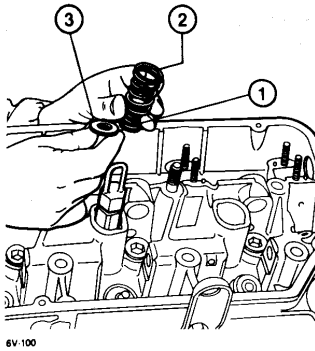
- 1. Intake and exhaust valves

d. Complete fitting by inserting the following in the sequence given, on the valve stem:

- inner springs (1);
- outer springs (2);
- upper caps (3).

**NOTE:**

The damping coils of the springs must be facing downwards.

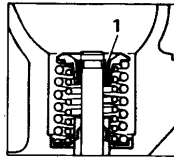


- 1. Inner springs
- 2. Outer springs
- 3. Upper caps

e. Connect lever (tool **A.3.0324**) complete with cage (tool **A.3.0520**) to support (tool **A.3.0522**).

Using lever **A.3.0324** compress the spring and insert cotters **1**.

During fitting ensure that the cotters are correctly seated in the channel in the valve stem.



- 1. Cotters

**f. Checking tightness of valves and valve seats**

Insert the spark plugs in their seats. Put a little petrol in a combustion chamber so that the valve head being examined is just covered.

Introduce low pressure air into the intake and exhaust ducts and check that there are no air bubbles in the petrol.

If there is leakage ensure that the valves are perfectly seated and repeat the tightness test.

If the result is negative the grinding of the valve seats must be repeated as specified in the paragraph «CHECKING VALVES AND VALVE SEATS».

g. After fitting all the valves mount the caps **1** (which determine the clearances) on the intake valves.

The positions should be the same as those before removal.

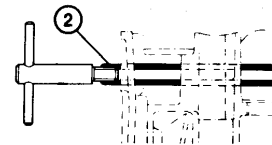
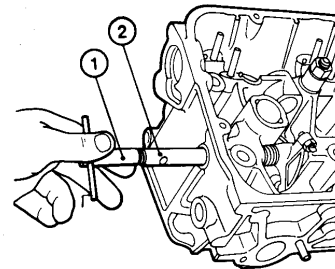
Lubricate tappets **2** with clean engine oil and insert them in their respective seats.

- 1. Caps
- 2. Bowls

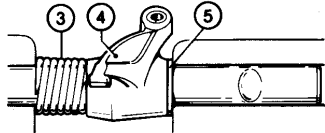
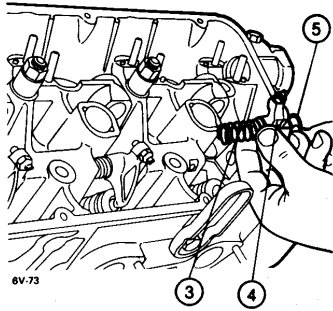
**h. Re-fitting of rocker arms and rocker arm shaft**

Perform the following operations to re-fit the shaft and rocker arms which operate the exhaust valves:

- screw on a suitable tool **1** to the threaded shank of the rocker arm shaft **2**;
- insert the shaft, suitably lubricated with engine oil, in the seat in the cylinder head and, on this, in sequence: springs **3**, rocker arms **4** and washers **5**, previously lubricated with engine oil.

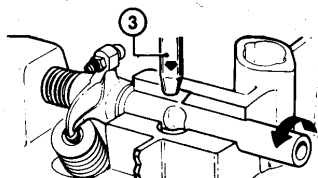
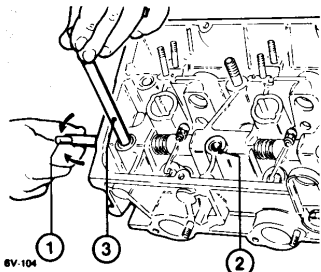


## ENGINE MAIN MECHANICAL UNIT



1. Shaft insertion tool
2. Rocker arm shaft
3. Springs
4. Rocker arms
5. Washers

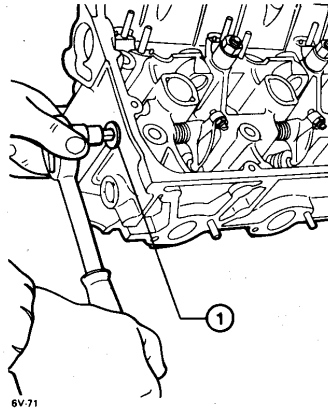
— After completing the re-fitting of the rocker arms rotate the shaft using tool ① until the notches on the shaft are aligned with holes ② in order to permit the passage of the cylinder head support studs; to check that this is so use a 12 mm (0.472 in) dia. pin ③.



PA3469B0000002

1. Tool
2. Stud holes
3. 12 mm (0.472 in) dia. pin

— Remove the tool from the rocker arm shaft and re-screw plug ① with relative gasket.



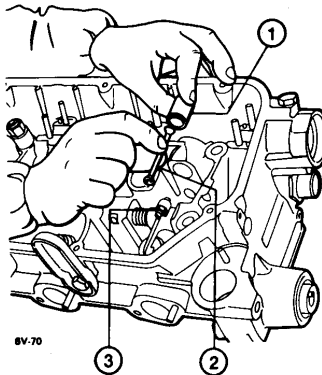
1. Plug with gasket

### i. Re-fitting of push rods and exhaust valve tappets

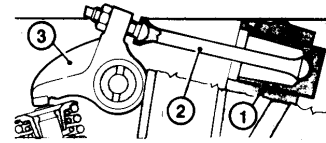
Lubricate tappets ① with engine oil and insert them in their respective seats in the cylinder head.

Reinstall push rods ② (after lubricating them) taking care to:

- rotate rocker arm ③ forwards and downwards to facilitate fitting;
- position the ball head of the rod in the seat provided in the tappet.



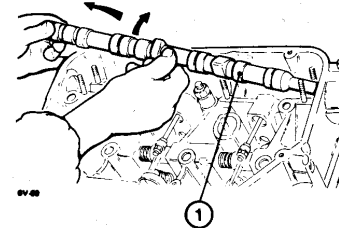
01-88/57



1. Tappets
2. Rods
3. Rocker arms

## INSTALLATION OF CAMSHAFT

a. Using clean engine oil lubricate the journals of camshaft ① and the respective seats on the cylinder head on which the shaft must be placed (as shown by the arrows).



1. Camshaft

b. Position caps ① in sequence according to the numbers (no. 1 should be fitted on the front of the cylinder head); place and tighten the nuts with respective washers ② in oil to the required torque.

### T : Torque setting

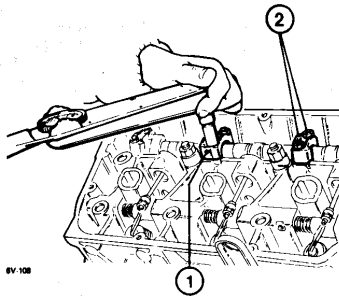
Camshaft cap stop nuts (in oil)

16 to 18 N·m

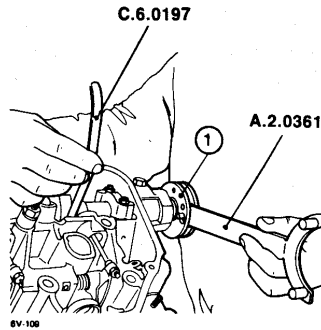
(1.6 to 1.8 kg·m)

11.57 to 13.02 ft·lb)

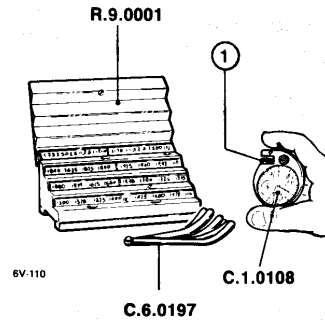
December 1985



- 1. Camshaft caps
- 2. Nuts and washers



- 1. Hub for toothed pulley operating the camshaft



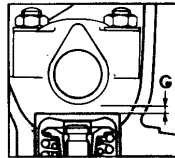
- 1. Caps

## VALVE CLEARANCE ADJUSTMENT

### a. Checking the intake valve clearance

After re-fitting the camshaft check the intake valve clearance in the following way:

- temporarily fit hub ① which serves to fix the toothed pulley operating the timing system;
- rotate, using lever A.2.0361, the camshaft until it is possible to fit thickness gauge C.6.0197 on the cam of the valve of which the clearance is to be measured (cams in rest position facing upwards);
- note the values for each valve and compare them with those prescribed.



**G = clearance between lowest radius of the cam and the crown of the tappet operating the intake valve:**  
**0.475 to 0.500 mm**  
**(0.018) to 0.0197 in)**

### b. Adjustment of intake valve clearance

If necessary adjust valve clearance as follows:

- Remove the caps fixing the camshaft and the camshaft itself;
- withdraw the tappets and retrieve caps ① underneath;
- measure the thickness of the caps using specific gauge C.1.0108 and then, on the basis of the difference with respect to the values obtained previously, select from the set of caps (R.9.0001) those which will restore the correct clearance of each valve.

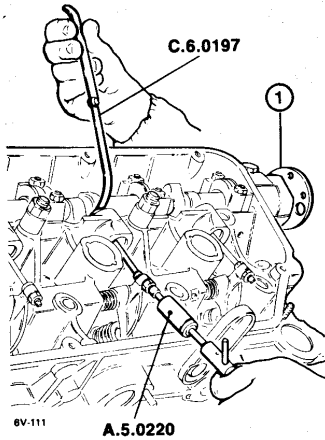
Reinstall tappets, camshaft and caps. Tighten the nuts on camshaft caps to the prescribed torque and check valve clearance again.

### c. Checking and adjustment of exhaust valve clearance

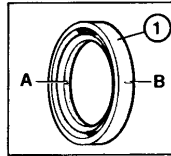
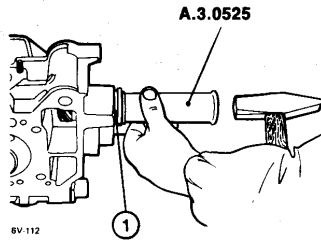
Adjust the exhaust valve clearance to restore the clearance between the crown of the tappet and the lowered radius of the cams.

For the adjustment use special spanner (tool A.5.0220) as follows:

- temporarily install hub ① which serves to fit toothed pulley operating the timing system;
- rotate, using lever A.2.0361, the camshaft until it is possible to fit thickness gauge C.6.0197 on the cam of the valve of which the clearance is to be measured (cams in rest position facing the opposite side of the tappet);
- note the values measured for each valve and compare them with those prescribed;
- slacken lock nut ② securing adjustment screw ③ using the lever of the spanner (tool A.5.0220) combined 3 and 11 mm (0.12 and 0.43 in) spanner;
- rotate screw ③ using spanner A.5.0220 until the prescribed value is obtained (determine by means of a blade-type thickness gauge C.6.0197);
- tighten lock nut ② and check the exhaust valve clearance again.

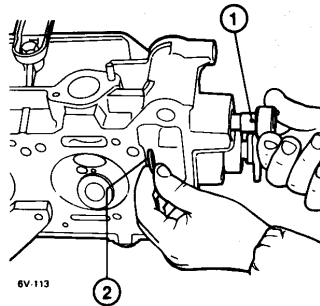


a. Lubricate the sealing lip «A» of seal ring ① with the prescribed grease and the outer surface «B» with clean engine oil. Then insert ring using tool A.3.0525.



1. Seal ring  
 A. Sealing lip: lubricate with ISECO Molykote BR2  
 B. Outer surface: lubricate with clean engine oil

b. Insert operating shaft ① in its seat and insert spacing washer ② from the other side.

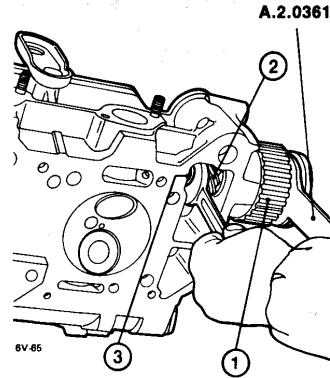


1. Drive shaft  
 2. Spacing washer

c. Fit toothed pulley ① on the drive shaft and then fit gear ② operating the distributor and the oil pump.

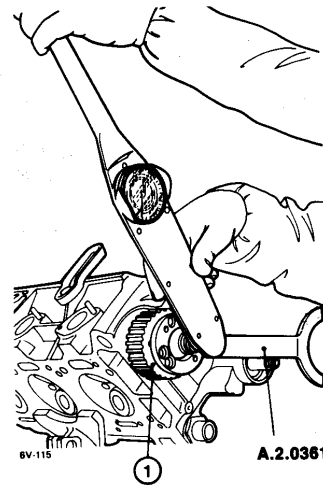
Lock the gear with the relative nut ③ complete with washer having a safety tab: prevent the rotation of the pulley using the lever of tool A.2.0361.

After tightening the nut bend the safety tab over.

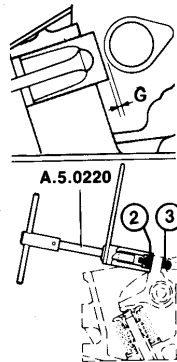


1. Toothed pulley  
 2. Gear operating camshaft and oil pump  
 3. Lock nut

d. Tighten the screw with washer fixing pulley ① to its shaft. Prevent the rotation of the pulley with lever (tool A.2.0361) and then lock the screw using a torque spanner.



1. Toothed pulley



1. Hub  
 2. Lock nut  
 3. Adjustment nut

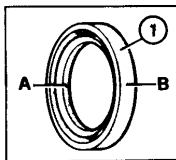
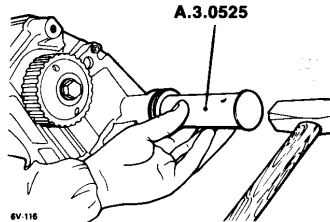
G = clearance between lowered radius of the cam and crown of the tappet operating the exhaust valve:  
 0.225 to 0.250 mm  
 (0.0089 to 0.0098 in)

### INSTALLATION OF DISTRIBUTOR AND OIL PUMP DRIVE PULLEY

Re-fit the toothed pulley which operates, together with the relative gear, the distributor and oil pump.

### INSTALLATION OF CAMSHAFT DRIVE PULLEY

a. Remove the hub of the toothed pulley, mounted temporarily, and refit the seal ring of the camshaft (after having lubricated the outer surface «B» with engine oil and sealing lip «A» with the prescribed grease). Seal ring (1) must be fitted using insertion tool A.3.0525.



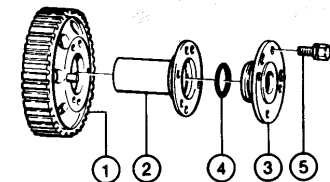
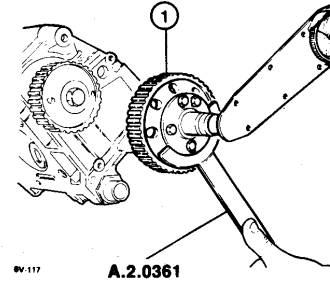
1. Seal ring

- A. Sealing lip: lubricate with ISECO Molykote BR2 grease
- B. Outer surface: lubricate with clean engine oil

b. Lubricate surface «A» of the anti-friction bushings using clean engine oil. Fit toothed pulley (1) on the shank of the camshaft; re-fit pulley support (2) and hub (3) complete with rubber ring (4) and tighten screws (5) fixing it to the pulley.

c. Tighten the nut fixing the toothed pulley (1) to the camshaft; prevent the rotation of the pulley with the lever (tool A.2.0361) and tighten the nut to the prescribed torque. Also fully tighten screws (5) fixing the hub to the pulley.

**T** : Torque setting  
**Nut securing front hub of camshaft**  
 97 to 117 N·m  
 (9.9 to 11.9 kg·m  
 71.6 to 86.1 ft·lb)



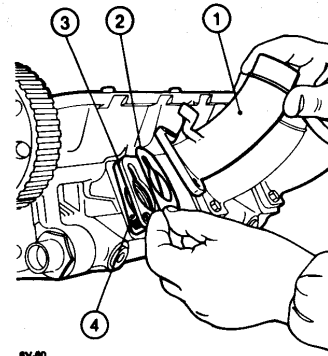
- 8V-117
- 1. Toothed pulley
  - 2. Pulley support
  - 3. Hub
  - 4. Rubber ring
  - 5. Hub securing screws

### INSTALLATION OF INTAKE STUB PIPES

a. Only for vehicles with L-JETRONIC fuel system

Install the intake stub pipes (1) as follows:

- insert gasket (2) in the studs of the cylinder head;
- insert insulating gasket (3);
- insert gasket (4);
- fix intake stub pipes (1) to the studs of the cylinder head by means of the nuts with relative washers.

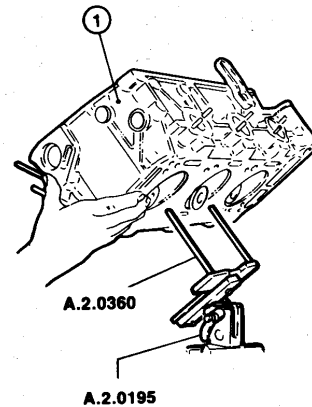


- 8V-80
- 1. Intake stub pipes
  - 2. Gasket
  - 3. Insulating gasket
  - 4. Gasket

### REMOVAL OF CYLINDER HEAD FROM THE BENCH

After the re-assembly of the cylinder head remove the head (1) from the support yoke (tool A.2.0360) after removing the two lock nuts.

Remove the support yoke complete with adjustable support (tool A.2.0195) from the vice.

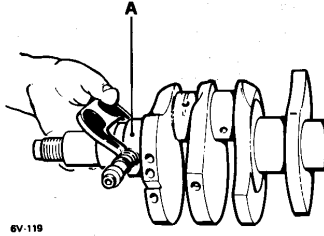


1. Cylinder head

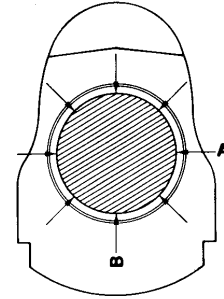
# CHECKING THE ENGINE BLOCK

## CHECKING THE ENGINE BLOCK

- a. Check the block visually for cracks and signs of excessive wear of the sliding surfaces.
- b. Carefully clean the surfaces of the block to remove any gasket fragments. Use butyl acetate or Methyl ethyl ketone.



6V-119



## CRANKSHAFT

- a. Check that the working area of the main and rod journals do not exhibit signs of abnormal wear, scoring or traces of seizing or overheating.

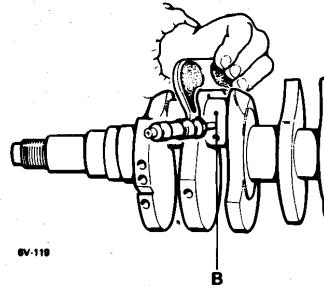
**WARNING:**

The chrome-molybdenum steel crankshaft has been subjected to a nitriding treatment and thus cannot be ground. For this reason the crankshaft must be replaced if it exhibits signs of excessive wear.

- b. Place the crank shaft on the bench between supports and measure the diameter of main journals «A» and rod journals «B» and compare them with the prescribed values.

**WARNING:**

The range of tolerances permitted for the machining of the main and rod journals has been divided into two classes. It is possible to identify the class of the journal being checked as the respective counterweights have indelible RED or BLUE marks.



6V-119

- A. Main journals
- B. Rod journals

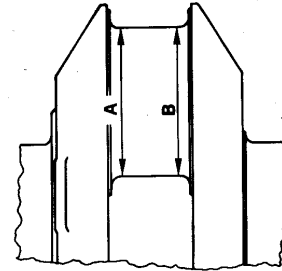
Class		RED [mm (in)]
Diameter of main journal	A	59.961 to 59.971 (2.3607 to 2.3611)
Diameter of main journal for oversized crankshaft	A	59.971 to 59.981 (2.3611 to 2.3615)
Diameter of rod journal	B	51.990 to 52.000 (2.0433 to 2.0472)
Class		BLUE [mm (in)]
Diameter of main journal	A	59.951 to 59.961 (2.3603 to 2.3607)
Diameter of main journal for oversized crankshaft	A	59.961 to 59.971 (2.3607 to 2.3611)
Diameter of rod journal	B	51.980 to 51.990 (2.0465 to 2.0469)

**c. Also check the following:**

- Check the ovalization (○) of the rod journals and main journals by comparing the diameter at various points of their circumference.

**Maximum main or rod journal ovalization error:**  
A-B = 0.004 mm (0.0002 in)

- Check the taper (∩) of the main and rod journals by comparing the diameter at the ends of the journal.



**Maximum main or rod journal taper error:**  
A-B = 0.010 mm (0.0004 in)

- Check the concentricity (⊙) between the centre main journals and front and rear main journals.

**Maximum eccentricity of main journals:**  
0.040 mm (0.0016 in)

- Check the parallelism (//) between the centerlines of the main and rod journals.

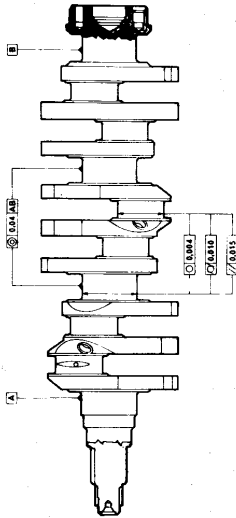
**Maximum parallelism error between main and rod journals:**  
0.015 mm (0.0006 in)



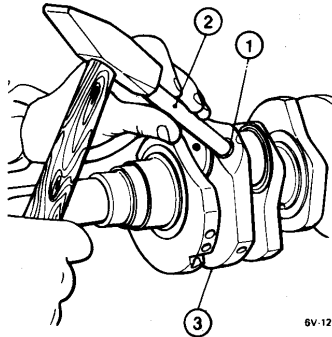
- Check the length of the rear main journal (which must be within the prescribed values).

**Maximum length of the rear main journal:**

**C = 31.300 to 31.335 mm  
(1.2323 to 1.2337 in)**



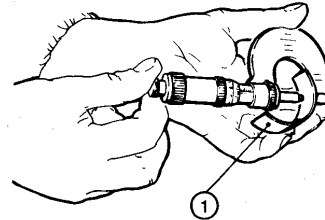
- Clean the oil passages with a steel wire pipe brush.
- Wash the shaft and oil passages with hot solvent and dry with compressed air (paying particular attention to the oil passages).
- Apply sealant (LOCTITE 270 Green) to the new plugs (1) and seal the holes in the oil passages with new plugs (using a suitable tool (2)).



- 1. Plugs
- 2. Insertion tool
- 3. Crankshaft

### MAIN AND CONNECTING ROD HALF-BEARINGS

- Clean the main and con rod half-bearings and check visually for signs of scoring or seizing.
- If there are signs of excessive wear replace all the half-bearings.
- The fitting of main and rod half-bearings to the crankshaft must be performed by pairing pieces of the same dimensional class, identifiable by a mark of the same colour **RED** or **BLUE** on the side of the half-bearing and on the relative journal of the crankshaft.
- Using a micrometer measure the width of the half-bearings (1) and compare the values with those given in the table; replace the half-bearings if their values are not within the prescribed tolerances.

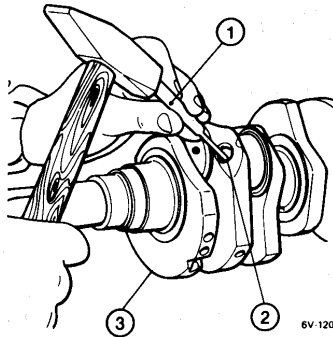


- 1. Main and rod half-bearings

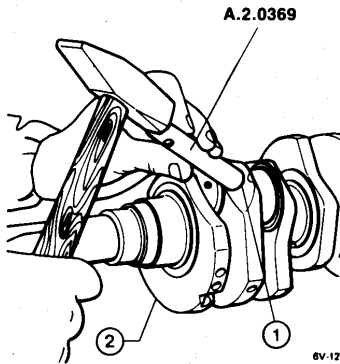
- If, after these checks, the shaft can be re-utilized, proceed with the cleaning of the drilled oil passages:

- Use a punch (1) to make a hole in plugs (2) sealing the extremities of the oil passages. Extract plugs and eliminate any burrs created by the previous calking.

- After completing the sealing of the oil passages calk the edges of plugs (1) with a suitable tool A.2.0369.



- 1. Punch
- 2. Plugs
- 3. Crankshaft



- 1. Plugs
- 2. Crankshaft

Class	Half-bearings [mm (in)]	
Red	Main	1.829 to 1.835 (0.0720 to 0.0722)
	Rod	1.737 to 1.745 (0.0684 to 0.0687)
Blue	Main	1.835 to 1.841 (0.0722 to 0.0725)
	Rod	1.741 to 1.749 (0.0685 to 0.0689)
Green	Rod	1.845 to 1.851 (1) (0.0726 to 0.0729) (1)

(1) Only to be used on a non-oversized crankshaft if the end play between journal and half-bearing is greater than 0.050 mm (0.0020 in) after checking the dimensions of each individual journal.

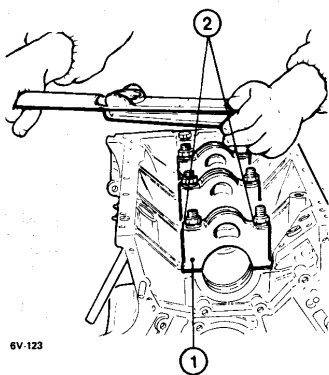
## MAIN BEARINGS AND MAIN BEARING CAPS

- a. Fit the main bearing caps (1) on the main bearings, positioning them according to the numbering on them (cap no. 1 must be fitted on the front part of the main bearings).
- b. Tighten in oil the nuts, with respective washers (2) securing the main bearing caps, to the required torque.

### T : Torque setting

Nuts securing the main bearing caps to the cylinder block supports

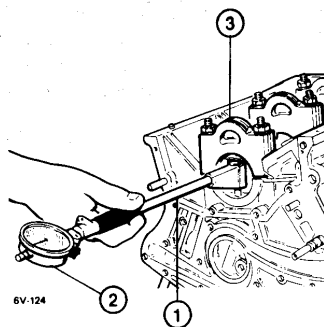
76 to 78 N·m  
(7.8 to 8 kg·m)  
56.4 to 57.9 ft·lb)



1. Main bearing caps
2. Nuts and washers

- c. Using bore gauge (1) fitted to a dial indicator (2) measure the diameter of the main bearings (3) and check that they are within the prescribed tolerances.

**Main bearing diameter:**  
63.657 to 63.676 mm  
(2.5062 to 2.5069 in)



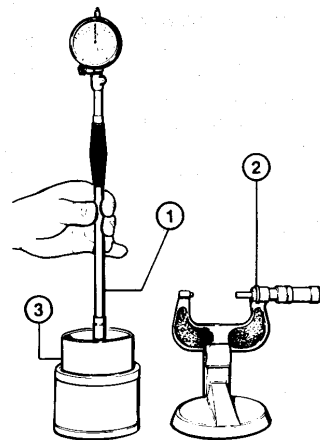
1. Bore gauge
2. Dial indicator
3. Main bearings

- d. Check the length of the shoulder of the rear main bearing.

**Length of the shoulder of the rear main bearing:**  
26.450 to 26.500 mm  
(1.0413 to 1.0433 in)

- b. To check the dimensions proceed as follows:

- Zero set bore gauge (1) using a suitable micrometer (2).
- Use the bore gauge (1) fitted to a dial indicator to measure the I.D. of the cylinder liners (3) measured at 120° of the median, upper and lower circumference included in the «area of measurement» illustrated in the figure.
- Check that the values obtained are within the prescribed tolerances (divided into classes) given in the table.
- Check that the maximum taper and ovalization are within the prescribed values.



6V-125

1. Bore gauge
2. Micrometer
3. Cylinder liner

## THRUST RINGS

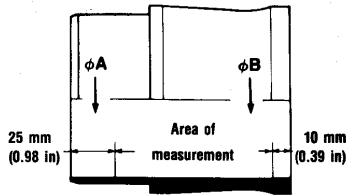
- a. Check the thickness of the thrust rings (fitted on the rear main bearing). The value must be within the prescribed tolerances.

**Thrust ring thickness:**  
2.310 to 2.360 mm  
(0.0909 to 0.0929 in)

## CYLINDER LINERS

- a. Determine the class of the cylinder liners and then check the dimensions. The liners are divided, on the basis of their I.D., into three classes «A», «B» and «C» and are identifiable by indelible spots of paint - BLUE, PINK and GREEN - on the outside of each cylinder liner.

## ENGINE MAIN MECHANICAL UNIT



Maximum taper of the liner:  
A-B = 0.01 mm (0.0004 in)

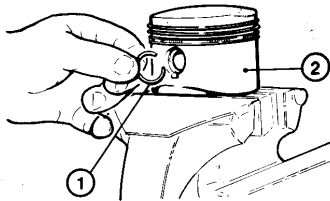
Maximum ovalization of the liner:  
X-Y = 0.01 mm (0.0004 in)

Class	Cylinder liner diameter [mm (in)]	
	Engines	
	062.10	016.46
A (Blue)	79.985 to 79.994 (3.1490 to 3.1494)	87.985 to 87.994 (3.4640 to 3.4643)
B (Pink)	79.995 to 80.004 (3.1494 to 3.1498)	87.995 to 88.004 (3.4644 to 3.4647)
C (Green)	80.005 to 80.014 (3.1498 to 3.1502)	88.005 to 88.014 (3.4648 to 3.4651)

### DISASSEMBLY OF CONNECTING ROD-PISTON ASSEMBLY

Before making measurements divide the con rod-piston assembly as follows:

a. Using a suitable screwdriver extract the two snap rings (1) securing the pin holding the con rod to the piston (2).



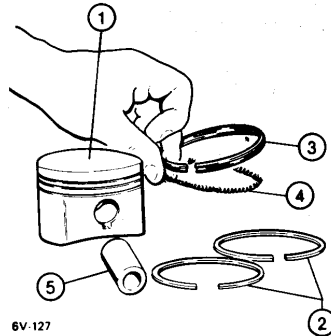
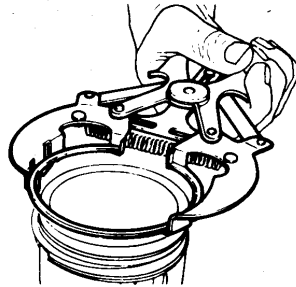
6V-126

1. Snap rings
2. Piston

b. Extract seal rings (2) and oil scraper ring (3) from piston (1) using a suitable tool; proceed with care to avoid the accidental breaking of rings which could be re-utilized.

Retrieve spring (4).

c. Withdraw gudgeon pin (5) and separate the piston from the connecting rod.



6V-127

1. Piston
2. Seal rings
3. Oil scraper ring
4. Spring
5. Gudgeon pin

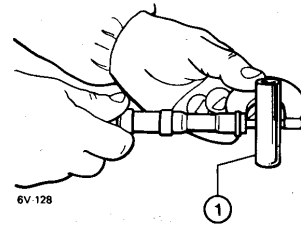
### PISTONS AND GUDGEON PINS

The pistons and gudgeon pins are paired when fitting according to the dimensional class (established by the different machining tolerances).

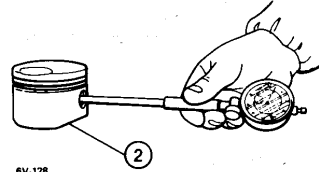
It is possible to identify the class by the paint marks **WHITE** or **BLACK**, inside the gudgeon pin and on the outside of the piston boss.

a. Using a micrometer, measure the O.D. of the gudgeon pin (1) and, using a bore gauge, measure the diameter of the hole for the connection to piston (2).

b. Ensure that the values are within the tolerances given for the various dimensional classes in the table.



6V-128



6V-128

1. Gudgeon pin
2. Piston

Diameter of gudgeon pin hole in piston [mm (in)]

Engines	BLACK	WHITE
062.10	22.000 to 22.003 (0.86614 to 0.86626)	22.003 to 22.005 (0.86626 to 0.86634)
016.46	22.003 to 22.006 (0.86626 to 0.86638)	22.006 to 22.009 (0.86638 to 0.86650)

#### Gudgeon pin O.D.:

**Black** = 21.994 to 21.997 mm  
(0.86591 to 0.86602 in)

**White** = 21.997 to 22.000 mm  
(0.86602 to 0.86614 in)

c. Check that the seats of the gudgeon pin in the connecting rod small end and in the piston bosses are not excessively worn.

d. Carefully examine the piston before measuring for deep scoring of the skirt or the grooves of the rings, which would require replacing.

## ENGINE MAIN MECHANICAL UNIT

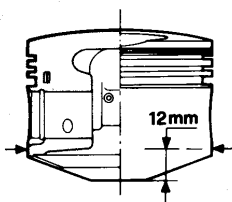
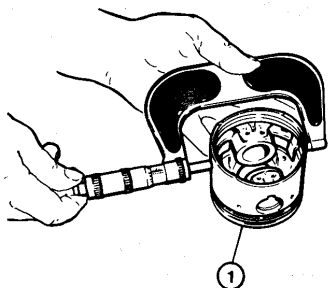
The pistons, like the cylinder liners, are divided into three classes according to the machining tolerances.

In this case too the classes are called «A», «B» and «C» and identified by indelible paint marks (BLUE, PINK and GREEN) on the piston top.

e. Check the O.D. of piston ① with a micrometer.

The O.D. must be measured perpendicular to the gudgeon pin hole at a distance of 12 mm (0.47 in) from the lower edge of the skirt.

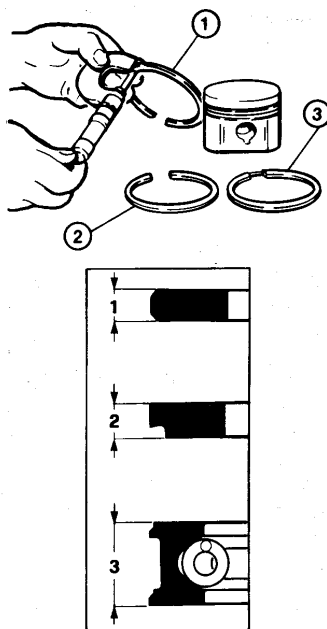
f. Compare the value measured with the prescribed tolerances, according to the class, in the table.



1. Piston

Class	Piston diameter [mm (in)]	
	Engines	
	062.10	016.46
A (Blue)	79.945 to 79.955 (3.1474 to 3.1478)	87.935 to 87.945 (3.4620 to 3.4624)
B (Pink)	79.955 to 79.965 (3.1478 to 3.1482)	87.945 to 87.955 (3.4624 to 3.4628)
C (Green)	79.965 to 79.975 (3.1482 to 3.1486)	87.955 to 87.965 (3.4628 to 3.4632)

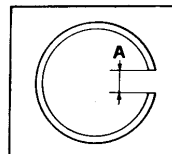
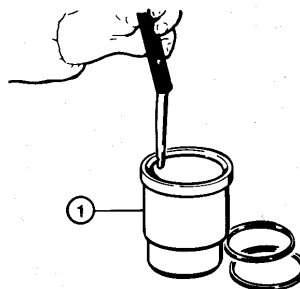
g. Measure the thickness of compression rings ① and ② and that of oil control ring ③; check that the values measured are within the tolerances given in the table.



1. First compression ring
2. Second compression ring
3. Oil control ring

Piston ring thickness [mm (in)]	
Engine 062.10	
First ring	1.478 to 1.490 (0.0582 to 0.0587)
Second ring	1.728 to 1.740 (0.0680 to 0.0685)
Oil control ring	3.478 to 3.490 (0.1369 to 0.1374)
Engine 016.46	
First ring	1.478 to 1.490 (0.0582 to 0.0587)
Second ring	1.728 to 1.740 (0.0680 to 0.0685)
Oil control ring	3.978 to 3.990 (0.1566 to 0.1571)

h. Insert the piston rings in the cylinder liner ① and check gap «A» using a feeler gauge.

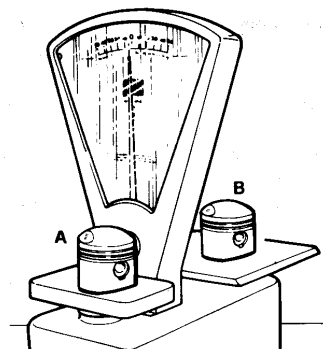
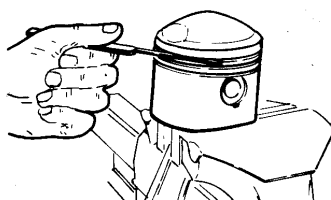
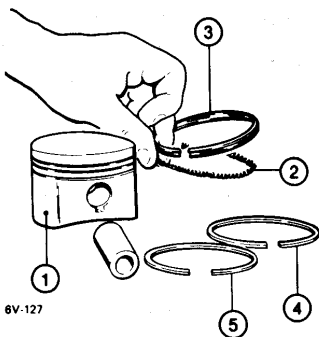


1. Cylinder liners

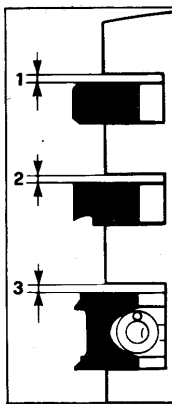
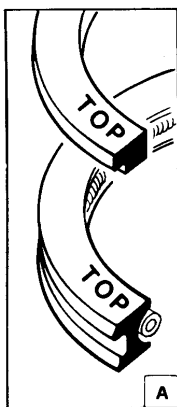
Piston ring gap (A) [mm (in)]	
Engine 062.10	
First ring	0.30 to 0.50 (0.012 to 0.020)
Second ring	0.30 to 0.50 (0.012 to 0.020)
Oil control ring	0.25 to 0.50 (0.010 to 0.020)
Engine 016.46	
First ring	0.30 to 0.45 (0.012 to 0.018)
Second ring	0.30 to 0.45 (0.012 to 0.018)
Oil control ring	0.25 to 0.40 (0.010 to 0.016)

i. Lubricate the piston rings with clean engine oil and reinstall them in their respective seats on the piston ①, taking care to insert, in sequence:

- spring ② and oil control ring ③ in the third groove, bearing in mind that the spring joint must be at 180° with respect to the cut of the ring;
- compression rings ④ and ⑤ in the second and first groove respectively. Position the rings so that the word «TOP» stamped on the rings is facing upwards.



A-B = 4 grams (0.14 oz) (max)



- 1. First compression ring
- 2. Second compression ring
- 3. Oil control ring

- 1. Piston
- 2. Spring
- 3. Oil control ring
- 4. Second compression ring
- 5. First compression ring

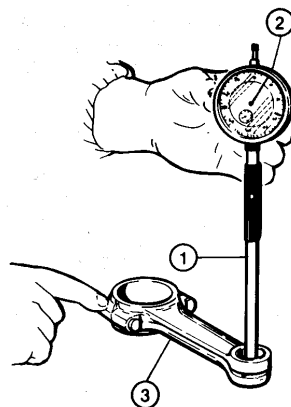
j. Measure the clearance between piston grooves and rings using a feeler gauge.

Clearance between piston grooves and rings [mm (in)]	
First ring	0.035 to 0.067 (0.0014 to 0.0026)
Second ring	0.035 to 0.067 (0.0014 to 0.0026)
Oil control ring	0.025 to 0.057 (0.0010 to 0.0022)

k. Examine the gudgeon pins in order to pair them with pistons marked with paint of the same colour (**White** or **Black**). The mark is located on the external surface of the boss and on the inside of the gudgeon pin.

l. If the parts are to be re-utilized bear in mind that the working areas, in particular the seat of the gudgeon pin in the piston should be free from even the slightest scoring.

m. Insert the gudgeon pin in each piston (selected according to the class - **Black** and **White**); lock with the snap rings and, using a balance similar to the one illustrated check that the difference between the weights of the pistons is no greater than 4 grams (0.14 oz).

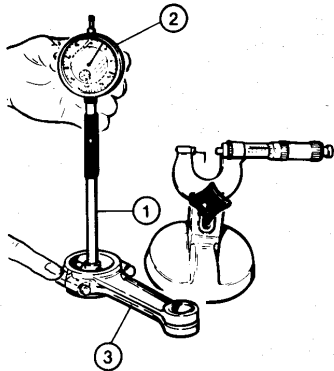


- 1. Bore gauge
- 2. Dial indicator
- 3. Connecting rod

**Bushing I.D. - Connecting rod small end:**  
 22.005 to 22.015 mm  
 (0.8663 to 0.8667 in)

c. Fit the con rod caps, tightening the respective screws in oil to the prescribed torque. Check the diameter of the con rod small end as described in point b.

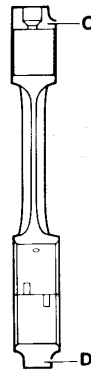
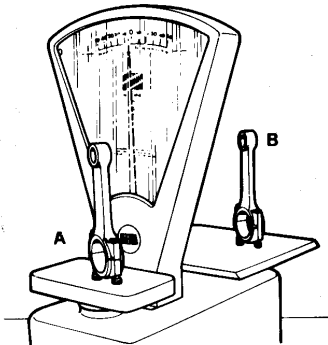
**T** : Torque setting  
**Screws retaining con rod caps (in oil)**  
 46 to 51 N·m  
 (4.7 to 5.2 kg·m)  
 34 to 37.6 ft·lb



- 1. Bore gauge
- 2. Dial indicator
- 3. Connecting rod

**Connecting rod I.D.:**  
 55.511 to 55.524 mm  
 (2.1855 to 2.1860 in)

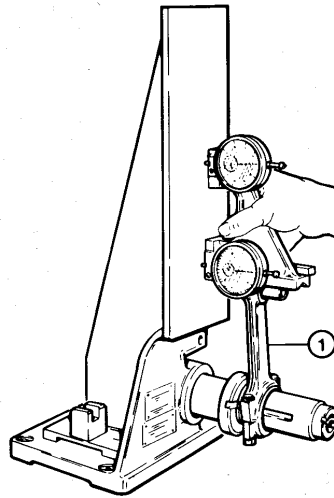
d. Using a balance similar to the one illustrated, check that the difference between the weights of the two con rods (complete with caps, half-bearings and screws) is **no greater than 2 grams (0.07 oz)**. To restore the exact weight remove the excess metal from parts «C» and «D».



A-B = 2 grams (0.07 oz) (max)

- C. } area to be machined to
- D. } obtained the exact weight

e. Check the perpendicularity of connecting rods (1) using a jig similar to the one illustrated.



- 1. Connecting rods

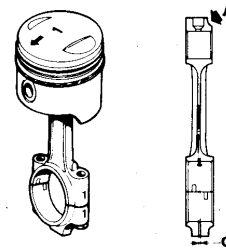
**WARNING:**

If the connecting rod is not true it must be replaced to avoid abnormal stress during engine running and consequent irregular wear of the piston and the con rod itself.

**REASSEMBLY OF THE CONNECTING ROD-PISTON ASSEMBLY**

Reassemble the assembly formed by the connecting rod and the piston considering that:

- a. If the previously disassembled pistons and con rods are to be re-utilized the initial pairing (i.e. piston no. 1 with con rod no. 1) must be restored.
- b. The connecting rods for the **right** side of the engine which match pistons no. 1, 2, 3, must be fitted with the offset towards the rear of the engine while those for the **left** side which match pistons no. 4, 5 and 6, must be fitted with offset towards the front.
- c. Remember that the arrow stamped on the top of the piston should face toward the front of the engine.

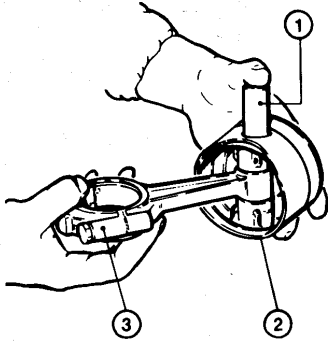


A: the notch to which the arrow points indicates the offset side «d».

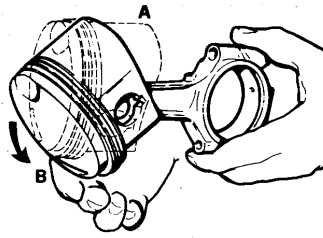
d. The piston and the gudgeon pin must belong to the same dimensional class (this can be seen from the **White** or **Black** paint marks on the piston boss and inside the gudgeon pin).

e. The gudgeon pin (1) should enter the piston (2) easily with the pressure of the thumb alone.

## ENGINE MAIN MECHANICAL UNIT



1. Gudgeon pin
2. Piston
3. Connecting rod



### Clearance between con rod small end bushing hole and gudgeon pin:

Black	= 0.008 to 0.021 mm (0.0003 to 0.0008 in)
White	= 0.005 to 0.018 mm (0.0002 to 0.0007 in)

f. After mounting the snap rings retaining the gudgeon pin the piston should move freely but be quite precise; to check this position the assembly as in the figure and ensure that the piston, as a result of its own weight, passes **slowly** from position «A» to position «B».

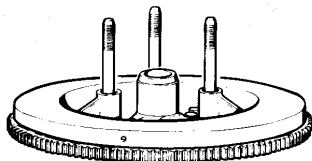
### Clearance between piston hole and gudgeon pin:

engine 062.10	= 0.003 to 0.008 mm (0.0001 to 0.0003 in)
engine 016.46	= 0.006 to 0.012 mm (0.0002 to 0.0005 in)

### REPLACING FLYWHEEL RING GEAR

Check the flywheel ring gear and, when necessary, replace it as follows:

- a. Heat the flywheel in a suitable oven, until the prescribed temperature is reached.
- b. Remove the flywheel from the oven and, using a suitable mallet, separate the ring gear from the flywheel.
- c. Heat the new ring gear uniformly up to the required temperature and then mount it on the engine flywheel, taking care that it is positioned correctly.



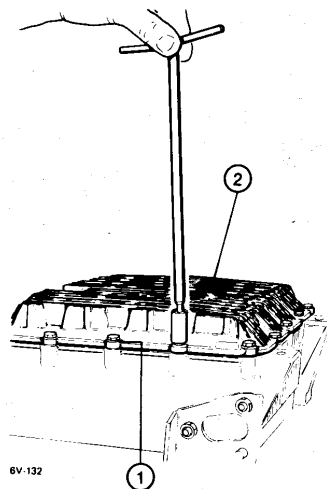
6V-131

**Temperature to which the ring gear should be heated for fitting/removing on/from the engine flywheel:**  
120 to 140°C (248 to 284°F)

### REPLACING OIL SUMP COVER

If necessary it is possible to replace the oil sump cover in the following way:

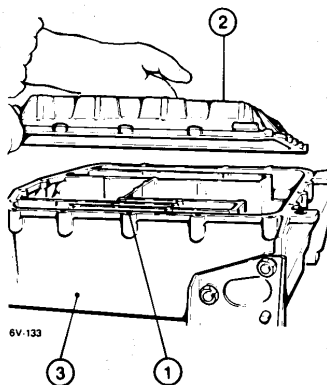
- a. Slacken and unscrew screws with washers (1) which fix cover (2) to the oil sump.
- b. Remove the gasket bearing in mind that it was spread with sealant during assembly.



6V-132

1. Screws and washers
2. Oil sump cover

- c. Carefully clean the contact surface of the oil sump and its cover, fit a new gasket (1) covered with the prescribed sealant on both sides.
- d. Replace cover (2) on oil sump (3), screw all the screws (with washers) and oil drain plug.



6V-133

1. Gasket
2. Cover
3. Oil sump

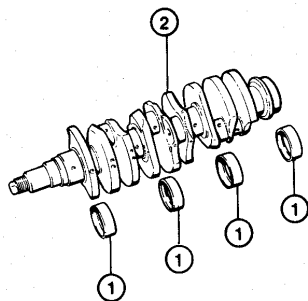


# ASSEMBLY OF ENGINE BLOCK

## CRANKSHAFT

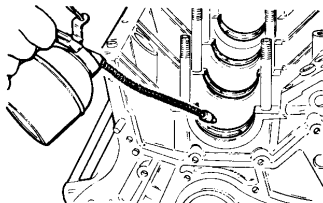
Mount the crankshaft on the block in the following way:

- a. Select the main half-bearings pairing them with the relative shaft journals (according to the dimensional class).
- b. The assembly on the crankshaft must be performed by pairing parts of the same dimensional class, identified by paint marks of the same colour **Red** or **Blue**, on the side of semi-bearing ① and on crankshaft journal ②.

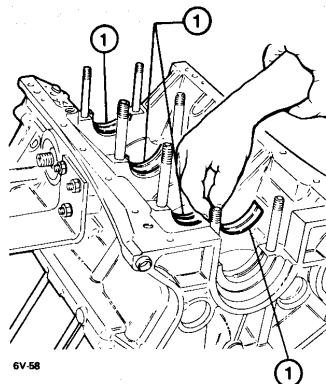


1. Main half-bearings
2. Crankshaft

- c. Clean the main bearings, lubricate them with clean engine oil and then position the upper main half-bearings ①, taking care that, during fitting, that the safety notches are in their respective seats in the cylinder block.



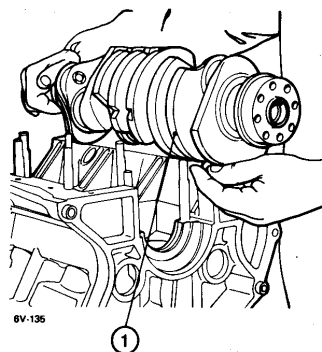
6V-134



6V-58

1. Upper main half-bearings

- d. Lubricate the main bearings and crankshaft journals again with clean engine oil and place the shaft ①, correctly positioned, on the main bearings.



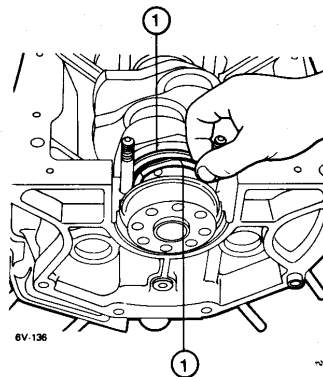
6V-135

1. Crankshaft

- e. Insert thrust half-rings ① and settle them by rotating the crankshaft.

### CAUTION:

The half-rings must be fitted ensuring that the lubrication grooves are facing towards the shoulders of the crankshaft.

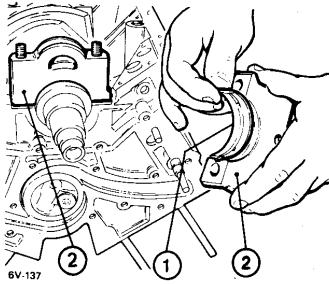


6V-136

1. Thrust half-rings

## MAIN BEARING CAPS

- a. Place the lower main half-bearings ① in the respective main bearing caps ② after lubricating them with clean engine oil; check that the safety notches are correctly positioned.



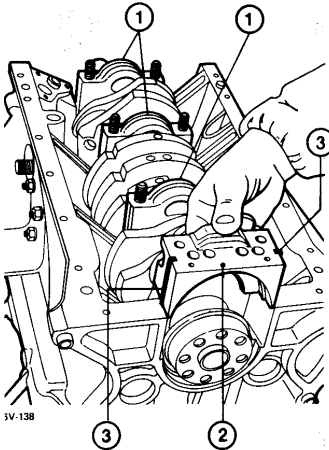
- 1. Lower main half-bearings
- 2. Main bearing caps

b. Re-fit caps ① on the first three main bearings.

They must be oriented so that the safety notches coincide with those of the cylinder block; their position and orientation should be according to the numbers stamped on them (cap no. 1 should be fitted on the front bearing).

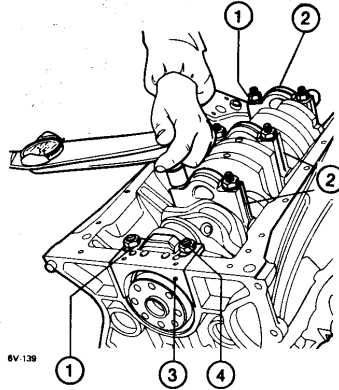
c. Re-fit rear main bearing cap ②, taking care not to damage the rubber seals ③.

Lubricate rubber seals ③ using lubricant 50HB-5100 or MILLOIL (Norm. 4500-17502).



- 1. Front main bearing caps
- 2. Rear main bearing cap
- 3. Rubber seals

d. Tighten, in oil, nuts with washers ① fixing main bearing caps ②. Use the prescribed torque setting. The nuts fixing the rear main bearing cap ③ are provided with safety tabs ④ which, temporarily must not be removed.

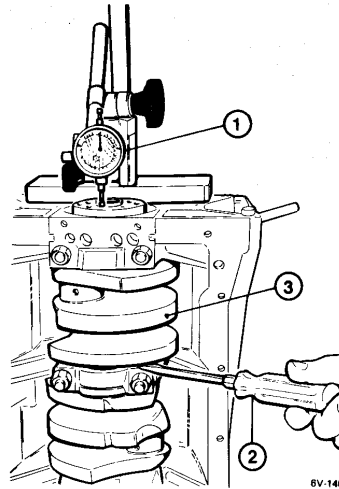


- 1. Nuts and washers
- 2. Front main bearing caps
- 3. Rear main bearing cap
- 4. Safety tab

**T** : Torque setting  
**Main bearing cap fixing screws**  
 (in oil)  
 76 to 78 N·m  
 (7.8 to 8 kg·m  
 56.4 to 57.9 ft·lb)

**e. Checking the crankshaft end float**

- Apply a dial indicator ① with magnetic base so that the sensor of the instrument is in contact with the crankshaft parallel to the shaft axis.
- Using a screwdriver ② move the crankshaft ③ and use the dial indicator to check that the end float is within the prescribed limits.
- Compare the value with that prescribed and, if necessary replace the thrust half-rings.
- To replace them it is necessary to remove the rear main bearing cap again.

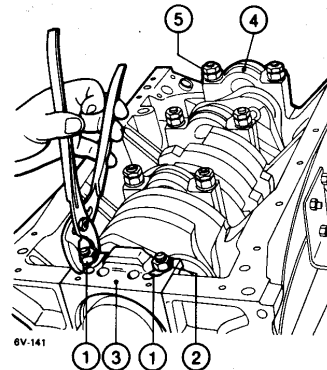


- 1. Dial indicator
- 2. Screwdriver
- 3. Crankshaft

**End float of crankshaft:**  
 0.080 to 0.265 mm  
 (0.0031 to 0.0104 in)

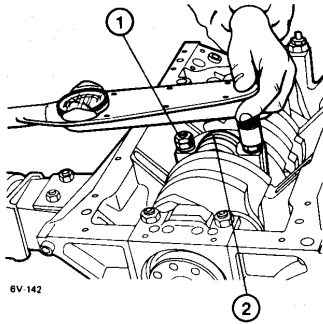
f. After fitting the new half-rings check the crankshaft end float and, if it is within the prescribed tolerance, bend the safety tabs ① of nuts ② of the rear main bearing cap ③.

g. Screw locknuts ⑤ on the remaining front main bearing caps ④.



- 1. Safety tabs
- 2. Nuts
- 3. Rear main bearing cap
- 4. Front main bearing caps
- 5. Locknuts

h. Tighten locknuts (1) of the front main bearing caps (2) to the prescribed torque.

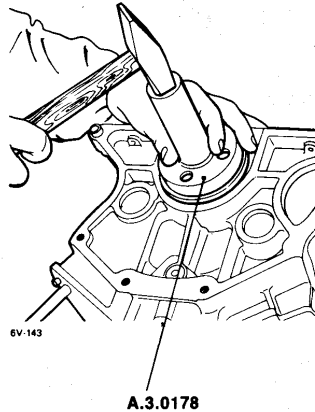


- 1. Locknuts
- 2. Front main bearing caps

**T** : Torque setting  
**Locknuts securing main bearing caps (in oil)**  
 20 to 25 N·m  
 (2 to 2.5 kg·m  
 14.5 to 18.1 ft·lb)

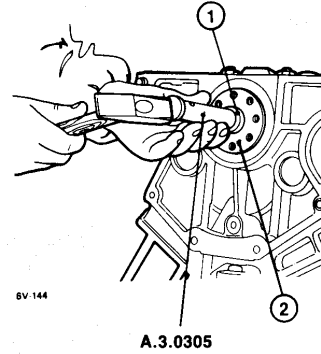
### OIL SEAL (REAR)

- a. Lubricate the outer surface and the lip of the rear oil seal with clean engine oil.
  - b. Contain the internal spring of the rear oil ring by applying a thin layer of ISECO Molykote BR2 grease (P/N 3671-69841).
  - c. Place the oil seal on the flared surfaces of the centering ring of tool A.3.0178.
- Fit the oil seal using tool A.3.0178; ensure that it is in the correct position during mounting.



### ENGINE FLYWHEEL

- a. Fitting of flywheel center bushing
  - Mount bushing (1) on the rear flange of the driving shaft (2) using inserting tool A.3.0305.



- 1. Flywheel center bushing
- 2. Crankshaft rear flange

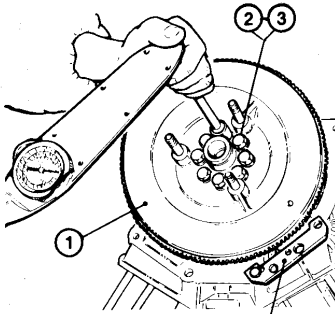
- b. Fit the engine flywheel in the following way:
  - clean the crankshaft flange and the contact surface of the flywheel carefully;
  - rest the flywheel (1) on the flange. The flywheel can only be mounted in one position due to the fact that the mounting holes are not equidistant; position safety washer (2) in the same way;
  - finger tighten screws (3) securing the flywheel (after spreading the prescribed sealant over them).

**CAUTION:**

Before applying the sealant to the threads of the screws (LOCTITE 270 - Green) eliminate any trace of the old sealant by brushing and blowing air over the threads. In any case remove any grease from the threads with trichloroethylene or chloroethene.

- fit tool A.2.0145 to prevent the rotation of flywheel ①;
  - tighten securing screws ③ to the prescribed torque.
- Before mounting lubricate the screws with engine oil.

**T** : Torque setting  
Screws securing flywheel to crankshaft  
113 N·m  
11.5 kg·m  
83.2 ft·lb)

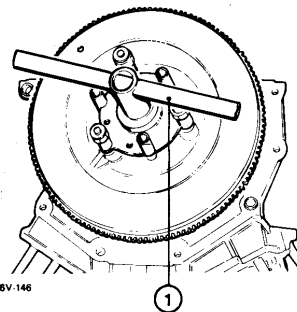


6V-146

A.2.0145

1. Engine flywheel
2. Safety washers
3. Retaining screws

- [ c. Fit a suitable tool ① on the flywheel that will permit the rotation of the crankshaft and remove the stop device previously fitted (tool A.2.0145).

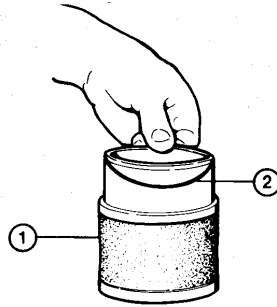


6V-146

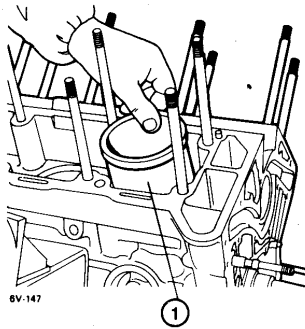
1. Tool for turning crankshaft

### CYLINDER LINERS, PISTONS AND CONNECTING RODS

- a. Clean the cylinder liners ① carefully and fit seal ②. Then insert the liners in the block, ensuring that they go all the way.



6V-147



6V-147

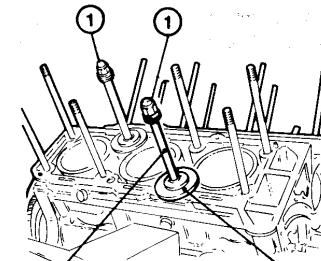
1. Cylinder liners
2. Seal ring

#### b. Checking the protrusion of the cylinder liners

If it is necessary to check the protrusion of the cylinder liners with the seal rings fitted proceed as follows:

- Fix the cylinder liners to the block by means of cylinder liner fixing tool A.2.0117 (complete with additional rings A.2.0362).
- Secure the liner fixing tools and tighten the respective nuts ① to the prescribed torque.

**T** : Torque setting  
Cylinder liner locknuts  
10 to 15 N·m  
(1 to 1.5 kg·m  
7.2 to 10.8 ft·lb)

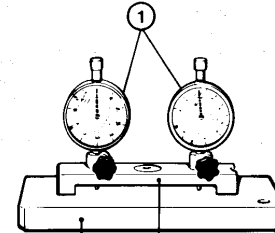


A.2.0117

A.2.0362

1. Cylinder liner locknuts

- Apply the dial indicators ① to the gauge, tool C.6.0148. Place the group on a surface plate ② and zero the indicators.



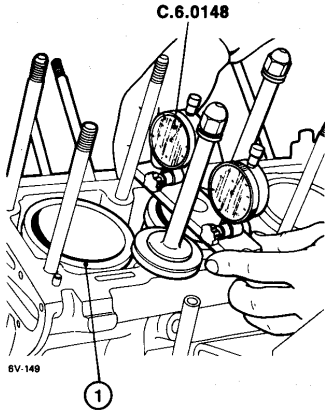
6V-148

C.6.0148

1. Dial indicators
2. Surface plate

# ENGINE MAIN MECHANICAL UNIT

- Apply gauge, tool **C.6.0148** to the cylinder block so that the sensors of the dial indicators rest on the edge of the cylinder liner (1) indicating the protrusion.
- Check that the values obtained are within the prescribed tolerances.



1. Cylinder liners

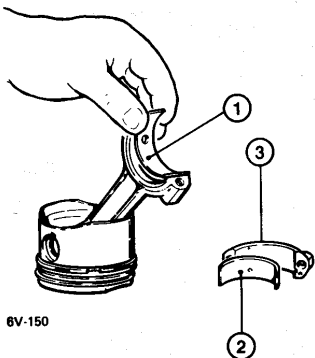
**Protrusion of cylinder liner from cylinder block:**

**0.01 to 0.06 mm (0.0004 to 0.0024 in)**

- Remove the liner fixing tools, **A.2.0117** complete with additional washers, **A.2.0362**.

**c. Fitting pistons and connecting rods**  
Fit the previously selected half-bearings on the connecting rod big end and on the respective caps. Proceed as follows:

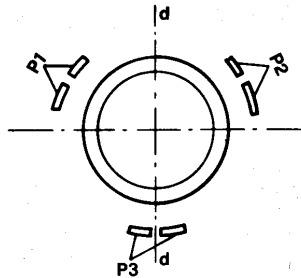
- Position the half-bearings (1) and (2) in the con rod big end and in cap (3) respectively, after having lubricating them with clean engine oil.



6V-150

1. Upper half-bearings
2. Lower half-bearings
3. Connecting rod cap

- Using clean engine oil, lubricate the piston and position the respective piston rings so that the cuts (openings) are staggered as in the figure.



- P1. Position of first compression ring
- P2. Position of second compression ring
- P3. Position of oil control ring
- aa. Gudgeon pin axis
- dd. Direction of thrust

- Insert the con rod-piston group in the respective liner, ensuring that the arrow stamped on the top of the piston is facing towards the front of the engine; a suitable guide tool (1) must be used for insertion.

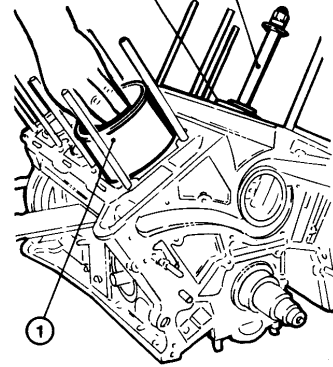
**CAUTION:**

To avoid scoring the cylinder liners the con rod must be guided during the insertion of the piston.

- Fix the cylinder liners with suitable tools **A.2.0117** complete with additional washers **A.2.0362**.

**A.2.0117**

**A.2.0362**

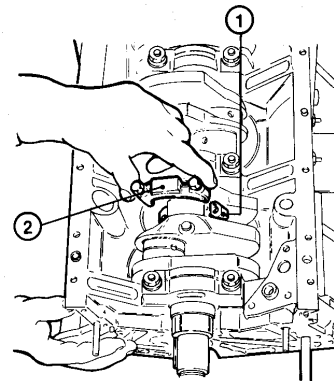


1. Guide [I.D. 88 mm (3.465 in)] for the insertion of the pistons in the cylinder liners

- Lubricate the con rod caps and respective crankshaft journals with clean engine oil.

Free the cylinder block from the rotating stand and turn it over.

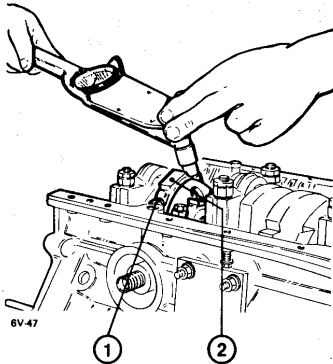
Bring con rod (1) to the respective journal of the crankshaft and fit con rod cap (2) so that it matches the notches of the half-bearings.



6V-151

1. Connecting rod  
2. Connecting rod cap

- Insert screws ① securing the con rod caps ② and tighten them to the prescribed torque (after lubricating them with engine oil).



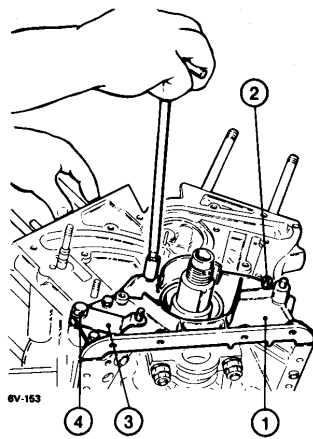
1. Retaining screws
2. Connecting rod caps

**T** : Torque setting  
**Retaining screws of con rod caps**  
 (in oil)  
 46 to 51 N·m  
 (4.7 to 5,2 kg·m  
 34.0 to 37.6 ft·lb)

### FRONT COVER

Free the overhaul stand and turn the cylinder block over (restoring it to normal position).

- Before fitting the front cover clean the cylinder block support surfaces and the cover itself to remove any fragments of gasket.
- Use butyl acetate or methylethylketone.
- Insert the gasket over the studs.
- Fit the cover ① and screw and lock retaining screws ②.
- Mount plate ③, for the pre-loading spring of the hydraulic belt stretcher, on the front cover and fix it by means of screw with washer ④.

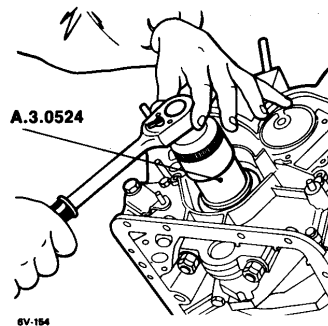


1. Front cover
2. Retaining screws
3. Plate
4. Retaining screw

### CRANKSHAFT FRONT PULLEY

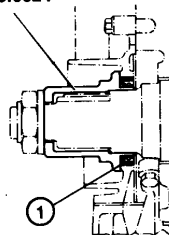
Re-fit crankshaft seal ring on the front cover.

- Lubricate the outer surface of the seal ring ① with clean engine oil and the respective lip with ISECO Molykote BR2 grease (P/N 3671-69841).
- Drive the seal ring ① onto the crankshaft using tool A.3.0524.



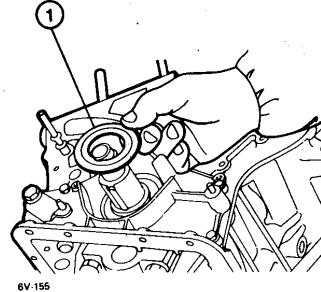
6V-154

A.3.0524



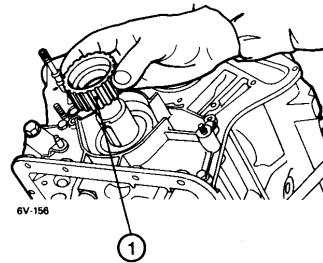
1. Seal ring

- Stop the flywheel from rotating by means of tool A.2.0145.
- Mount ring ① on the crankshaft. This serves as a shoulder for the timing mechanism toothed belt; the crown of the ring must face inwards.



1. Shoulder ring

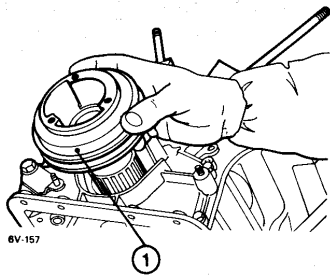
- Mount the timing mechanism drive toothed pulley ① on the crankshaft.



6V-156

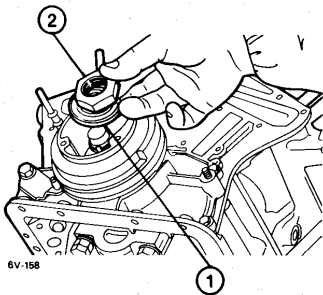
1. Toothed pulley

- Mount the front pulley ① fitting it into respective slot with the key on the crankshaft.



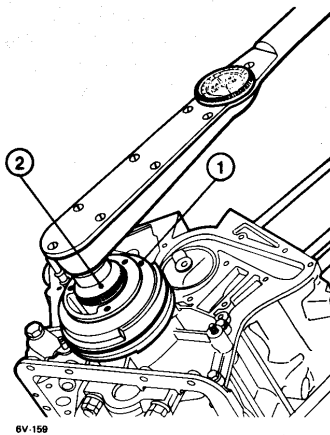
1. Front pulley

g. Fit washer (1) onto the crankshaft and finger tighten the locknut (2).



1. Washer  
2. Locknut

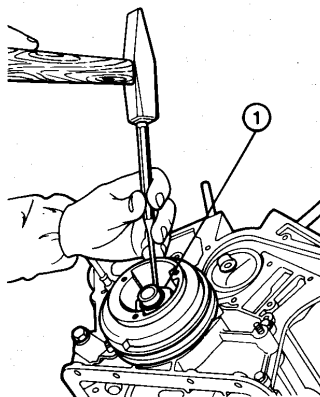
h. Tighten the nut securing the front pulley (1) (in oil) to the required torque; use a suitable tool (2) to tighten the nut.



1. Front pulley  
2. Nut tightening tool

**T** : Torque setting  
Nut securing crankshaft front pulley (in oil)  
235 N·m  
(24 kg·m  
174 ft·lb)

i. Caulk the collar of nut (1) after tightening to the prescribed torque.

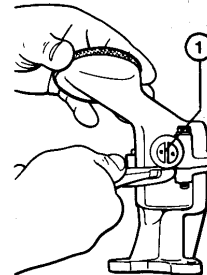


1. Front pulley locknut

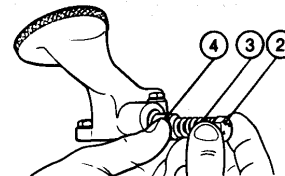
## OIL PUMP

### Disassembly

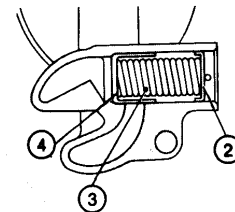
a. Maintain the oil pump in a vice and disassemble the pressure regulation group:  
— remove the cotter pin (1);  
— extract, in sequence: cover (2), spring (3) and piston (4).



6V-161



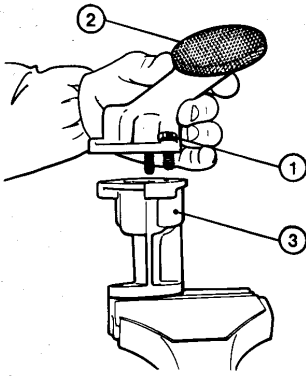
6V-161



1. Cotter pin  
2. Cover  
3. Spring  
4. Piston

b. Separate the oil suction housing (2) from the pump housing (3) after removing screws (1).

# ENGINE MAIN MECHANICAL UNIT



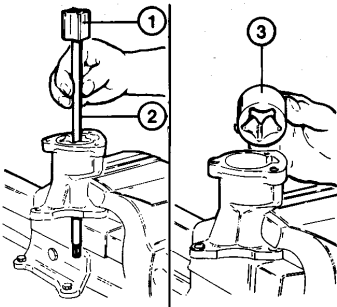
6V-162

1. Retaining screws
2. Oil suction housing
3. Pump housing

c. Extract the inner rotor (1), complete with spindle (2) and the driven rotor (3) from the pump housing.

**IMPORTANT:**

Inner rotor (1) must not be removed from spindle (2).



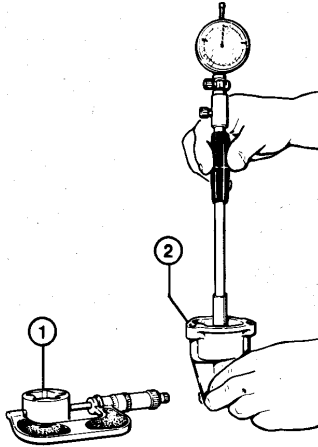
1. Inner rotor
2. Spindle
3. Driven rotor

## Checking

Check the rotors visually for deep scoring or evidence of seizure; check the piston of the valve regulating the oil pressure in the same way.

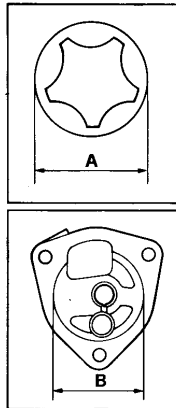
a. Using a micrometer measure the O.D. of the driven rotor (1) and, using a bore gauge, measure the I.D. of the pump housing (2).

Ensure that the values obtained are within the prescribed tolerances.



6V-163

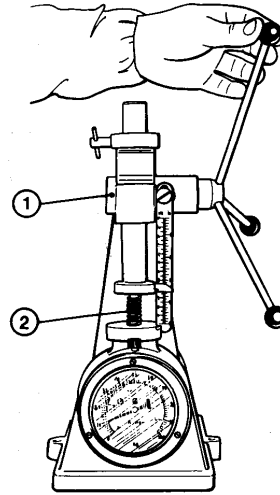
1. Inner driven rotor
2. Pump housing



**A = O.D. of driven rotor:**  
49.100 to 49.155 mm  
(1.9331 to 1.9352 in)

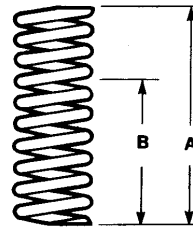
**B = I.D. of rotor seat in pump housing:**  
49.325 to 49.375 mm  
(1.9419 to 1.9439 in)

b. Use a dynamometer (1) to check the flexibility of the spring (2) operating the oil pressure regulation valve; see table for prescribed values.



6V-164

1. Dynamometer
2. Spring

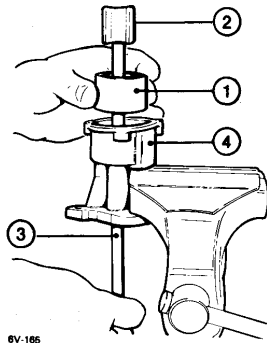


Test load		17.31 to 17.97 kg (38.2 to 39.6 lb)
Length of free spring	A	49.29 mm (1.941 in)
Length of loaded spring	B	31.90 mm (1.256 in)

## Re-assembly

a. Re-assemble the oil pump as follows:  
— insert driven rotor (1) in the pump housing (4) and then insert the inner rotor (2) complete with spindle (3).

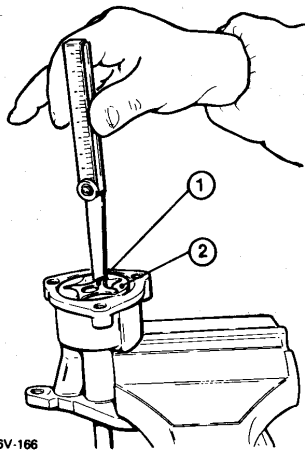




6V-165

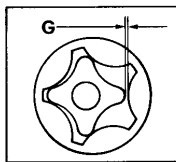
1. Driven rotor
2. Inner rotor
3. Spindle
4. Pump housing

— position the rotors as indicated in the figure and measure the clearance «G» that exists between the lobe of the inner rotor (1) and that of the driven rotor (2); compare the clearance with that prescribed.



6V-166

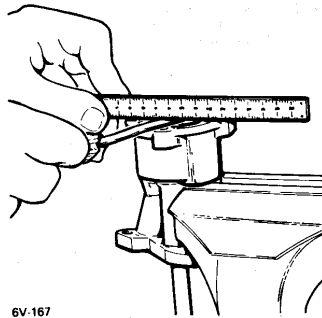
1. Inner rotor
2. Driven rotor



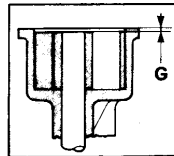
PA3469B0000002

**G = Clearance between driven rotor and inner rotor of the oil pump:**  
0.040 to 0.290 mm  
(0.0016 to 0.0114 in)

— check the end float «G» of the two rotors with respect to the pump housing surface; this is done with a thickness gauge placed between the rotors themselves and the test roller resting on the surface.



6V-167

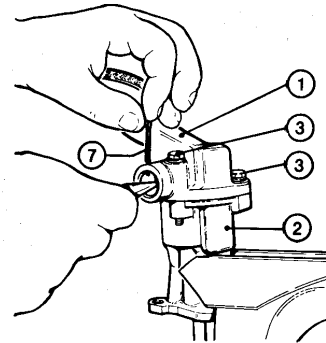


**G = End float between the two rotors with respect to the pump housing surface:**  
0.025 to 0.075 mm  
(0.0010 to 0.0030 in)

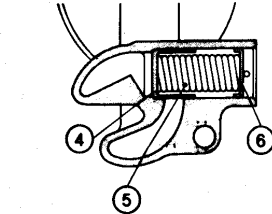
b. Re-assemble the oil movement group (1) complete with suction rose on the pump housing (2) and secure with screws and washers (3).

Re-assemble the valve regulating the oil pressure by reinstalling: piston (4), spring (5) and cover (6).

Overcome, with the aid of a pair of long-nosed pliers, the force of the valve spring and insert safety cotter (7).



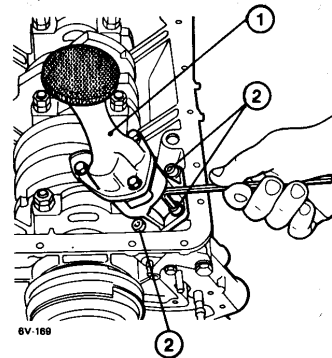
6V-168



1. Oil movement group
2. Pump housing
3. Screws and washers
4. Piston
5. Spring
6. Cover
7. Safety cotter

### Re-fitting the oil pump to the block

- a. Insert the oil drive shaft in its seat in the cylinder block.
- b. Fix the oil pump (1) to the base using the three socket head screws (2).

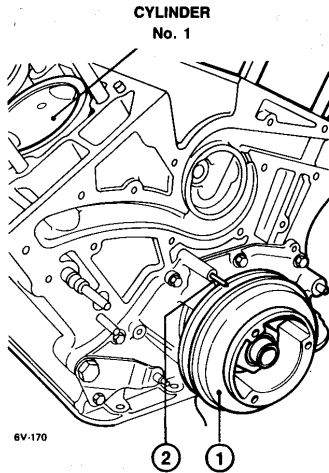


6V-169

1. Oil pump
2. Retaining screws

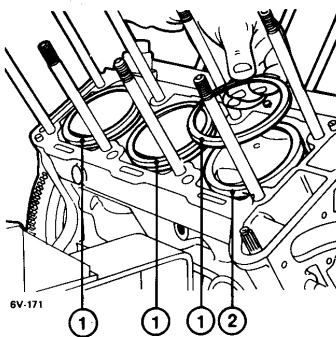
## REINSTALLATION OF CYLINDER HEADS

- a. Free the overhaul stand and turn the block over.  
Remove tool **A.2.0145** preventing the rotation of the flywheel.
- b. Turn the crankshaft until the piston of cylinder no. 1 is in T.D.C. position during explosion stroke; this position is assured by the collimation of the notch on the engine pulley ① and mark ② on the front cover.



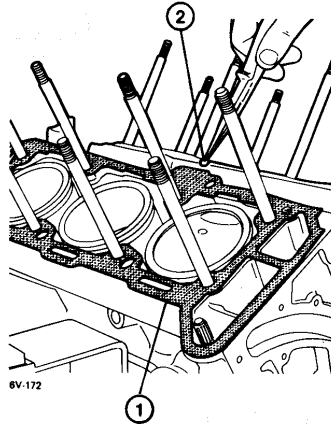
1. Engine pulley  
2. Reference mark

- c. Remove the cylinder liner fixing tools **A.2.0117** and additional washers **A.2.0362**, insert the fireproof gasket ① on the cylinder liners ②.



1. Fireproof gasket  
2. Cylinder liners

- d. Insert gasket ① of the cylinder head and position seal ring ② of the lubrication oil pipes.

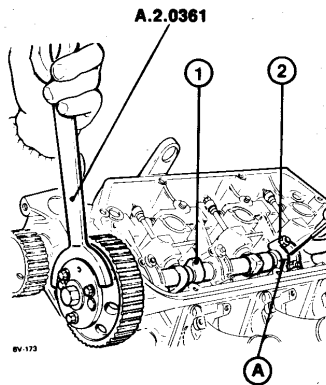


1. Cylinder head gasket  
2. Seal ring

- e. Prepare, as described, the two cylinder heads for re-fitting on the block:

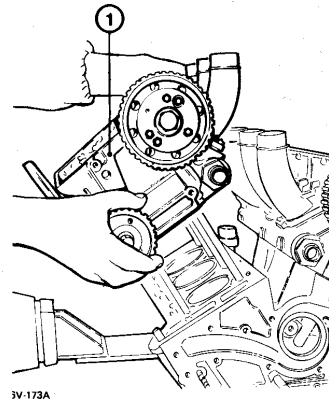
- with lever (tool **A.2.0361**), turn camshaft ① of each head until the timing notches (ref. A) coincide with the timing notches of the specified fixing caps ②.

On the RIGHT head the notch corresponds with the third cap, while on the LEFT head it is on the second cap.



1. Camshaft  
2. Camshaft cap  
A. Timing notches

- f. Fit the cylinder heads ① to the block and lubricate the threads of the studs, the washers and locknuts with clean engine oil; proceed with care so as not to damage the studs.

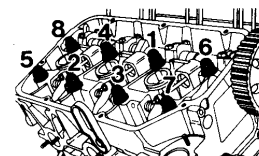
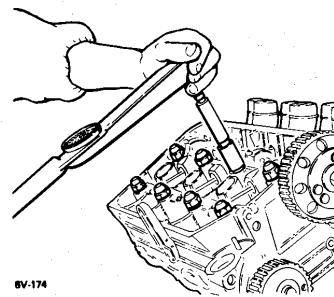


1. Cylinder head

- g. Screw and tighten (to the required torque) the eight locknuts of the cylinder heads according to the sequence indicated in the following figure.

**NOTE:**

The operation illustrated is that for the RIGHT head.  
For the LEFT head the tightening order is symmetrical.



- T** : Torque setting  
 Nuts securing cylinder head to block  
 78 N·m  
 (8 kg·m  
 57.9 ft·lb)

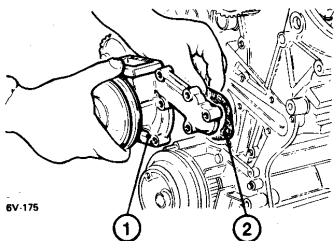
**CAUTION:**  
 After about 1000 km, with a cold engine, slacken the nuts by 1 turn one at a time in the order indicated.  
 Moisten the surfaces between washer and nut with oil and re-tighten to the following torque:

88 N·m  
 (9 kg·m) (65.1 ft·lb)

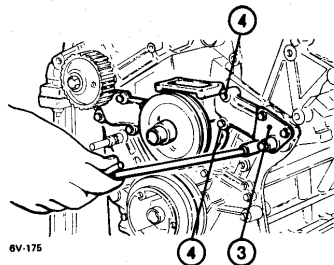
**REINSTALLING OF ACCESSORIES**

**WATER PUMP**

- Fit the water pump ① complete with the new gasket ②, to the front part of the cylinder block.
- Mount support ③ for the generator regulation bracket and secure the water pump ① tightening screws with washers ④ to the required torque.



6V-175

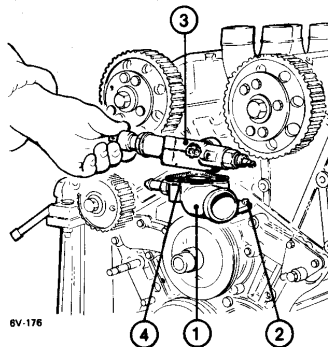


6V-176

- Water pump
- Gasket
- Support
- Screws with washers

- T** : Torque setting  
 Water pump retaining screws  
 14 to 22 N·m  
 (1.36 to 2.25 kg·m  
 9.8 to 16.3 ft·lb)

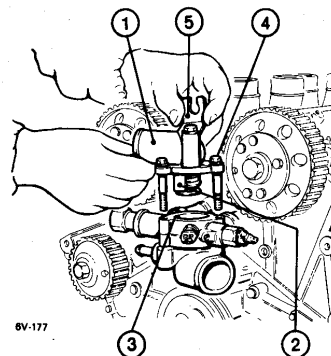
- Mount union ① on the water pump, first fitting a new gasket, and secure by tightening screws ②.
- Mount intermediate union ③ (fitting a new gasket ④) and simultaneously connecting rubber sleeves with clamps to the cylinder head cooling pipes.



6V-177

- Water pump union
- Retaining screws
- Intermediate union
- Gasket

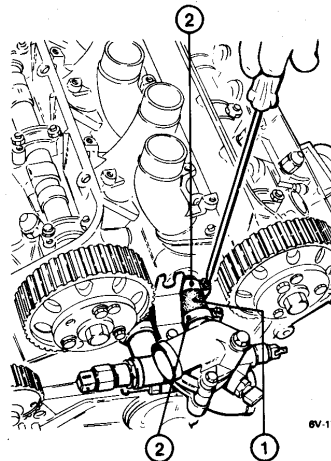
- Fit cup ① complete with thermostat ②, inserting a new gasket ③ and securing the entire group by tightening screws ④.
- Fit plate ⑤ for the thermostat group wiring harness on the thermostat cup.



6V-178

- Cup
- Thermostat
- Gasket
- Retaining screws
- Plate

- Finally connect rubber sleeves ① to the cylinder head cooling pipes. Tighten clamps ②.



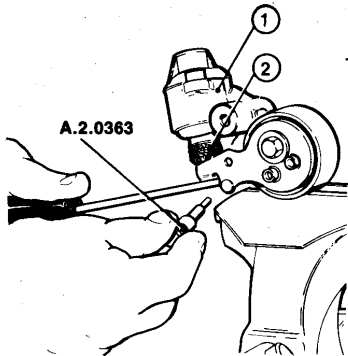
6V-179

- Rubber sleeves
- Clamp

**HYDRAULIC BELT STRETCHER**

**Disassembly**

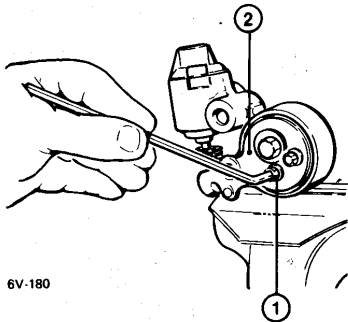
a. Lock the hydraulic belt stretcher (1) in a vice and, proceeding as illustrated in the figure, extract the pin (tool A.2.0363) to relieve the internal spring (2).



6V-179

- 1. Hydraulic belt stretcher
- 2. Spring

b. Unscrew socket head screws (1) and disassemble the belt stretcher plate (2).

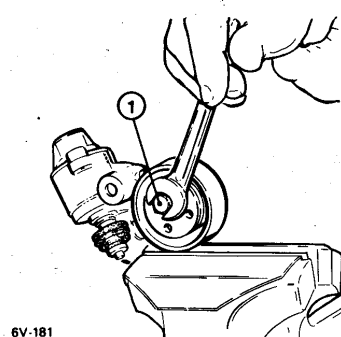


6V-180

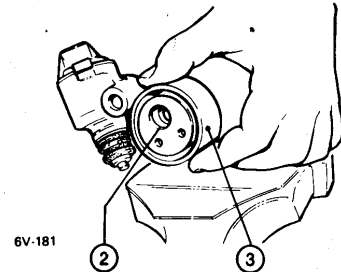
- 1. Retaining screws
- 2. Belt stretcher plate

c. Disassemble the belt-stretcher pulley as follows:

- unscrew screw (1) and remove spacer below;
- retrieve seal ring (2) from the pulley pin;
- withdraw pulley (3) and retrieve the inner seal ring.



6V-181

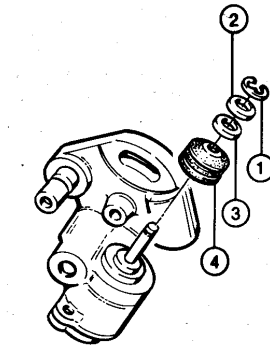


6V-181

- 1. Retaining screws
- 2. Seal ring
- 3. Pulley

d. Disassemble the piston in the following manner:

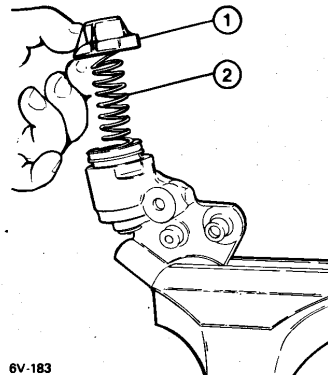
- remove snap ring (1) and slide washer (2) from the rod of the piston;
- then extract rubber (3) and bellows (4).



6V-182

- 1. Snap ring
- 2. Washer
- 3. Rubber
- 4. Bellows

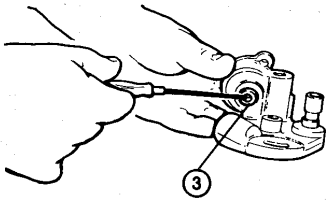
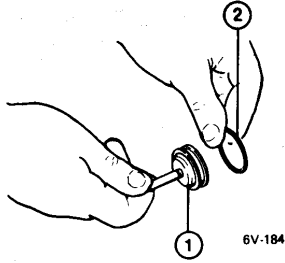
— slacken and unscrew the screws, remove cover (1) and, simultaneously retrieve spring (2) and the cover gasket.



6V-183

- 1. Cover
- 2. Spring

— extract piston ① from the belt stretcher housing and retrieve seal ring ②; then remove ring ③ from the lower part of the belt stretcher housing.



- 1. Piston
- 2. Seal ring
- 3. Seal ring

**Checks**

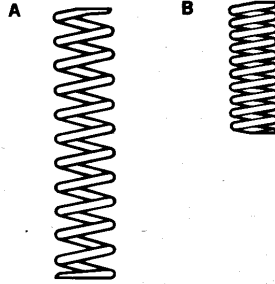
Subject the disassembled parts to a thorough visual examination in order to ascertain if there are signs of excessive wear; in the same way check the pin of the belt stretcher pulley for excessive wear.

**CAUTION:**

It is advisable to replace all the rings each time the belt stretcher is overhauled.

a. Also inspect spring «A», which acts on the piston and spring «B» which determines the pre-loading of the hydraulic belt stretcher.

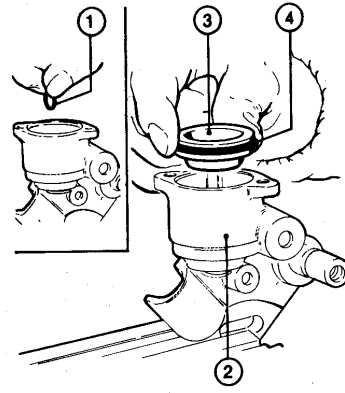
Then check that the setting corresponds to that given in the table.



Belt stretcher spring	A	B
No. of useful coils	12	9
Length of free spring	93 mm (3.66 in)	45.5 mm (1.79 in)
Static test load	93.16 N 9.5 kg (20.9 lb)	98 N 10 kg (22 lb)
Length of spring under load	48 mm (1.89 in)	30 mm (1.18 in)

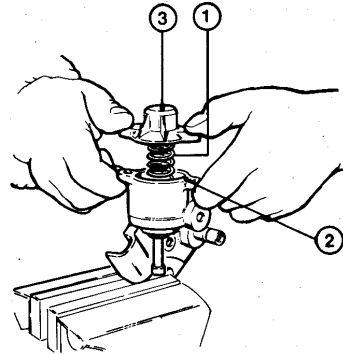
**Reassembly**

a. Insert seal ring ①, suitably lubricated with engine oil and place it in the lower bushing of the belt stretcher housing ②. Insert piston ③ complete with seal ring ④, suitably lubricated with engine oil.



- 1. Seal ring
- 2. Belt stretcher housing
- 3. Piston
- 4. Seal ring

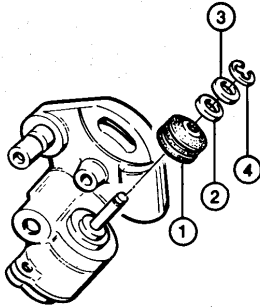
b. Position spring ① on the piston and gasket ② on the belt stretcher housing. Then, compressing the spring close cover ③ and fix it with the relative Allen screws ④.



- 1. Spring
- 2. Gasket
- 3. Cover
- 4. Retaining screws

# ENGINE MAIN MECHANICAL UNIT

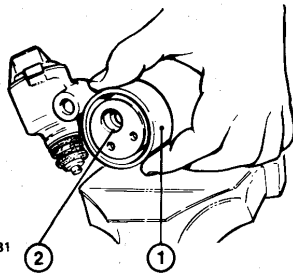
c. Reinstall bellows (1) on the piston rod, taking care to fit it on the lower bushing of the belt stretcher housing, and then install rubber (2), washer (3) and safety snap ring (4).



6V-182

- 1. Bellows
- 2. Rubber
- 3. Washer
- 4. Snap ring

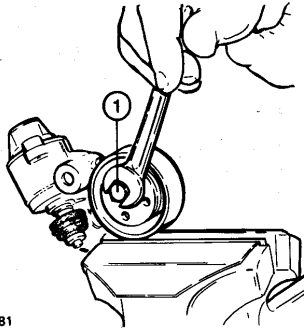
d. Position the inner seal ring on the pulley, reassemble pulley (1) on the belt stretcher pin suitably lubricated with ISECO Molykote BR2 grease, and fit the outer seal ring (2).



6V-181

- 1. Pulley
- 2. Outer seal ring

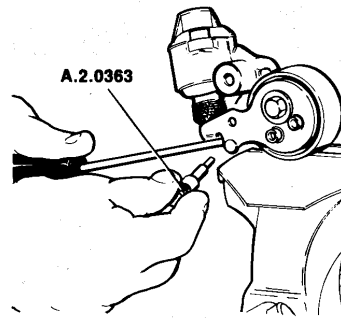
e. Re-fit the spacer and screw in screw (1) securing the pulley. Then tighten the screw to the prescribed torque.



6V-181

- 1. Pulley retaining screw

g. When reassembly is complete lock the belt stretcher plate in spring compressed position using the pin (tool A.2.0363).

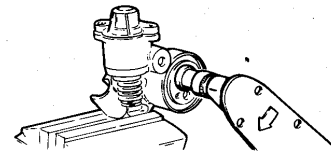


6V-179

## Reinstallation on the cylinder block

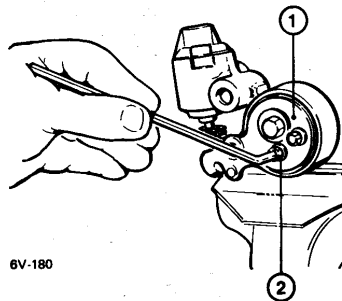
To reinstall the hydraulic belt stretcher proceed as follows:

- a. Mount plate (1) restraining the spring placing it over the belt stretcher support pin.
- b. Position rubber seals (2) and (3) on the belt stretcher support pin.



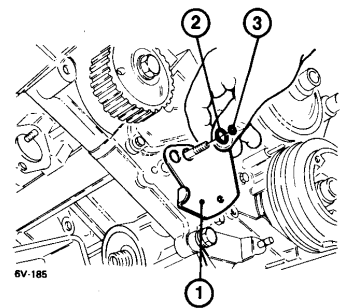
**T** : Torque setting  
 Screw securing belt stretcher pulley to the support pin  
 17 to 20 N·m  
 (1.7 to 2 kg·m  
 12.30 to 14.47 ft·lb)

f. Fit the belt stretcher plate (1) and, after having positioned it correctly re-tighten the two Allen screws (2).



6V-180

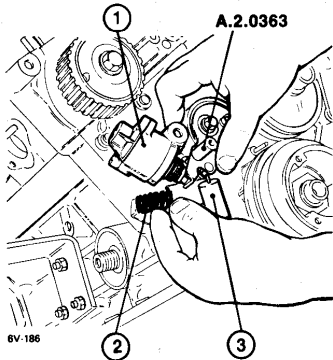
- 1. Belt stretcher plate
- 2. Retaining screws



6V-185

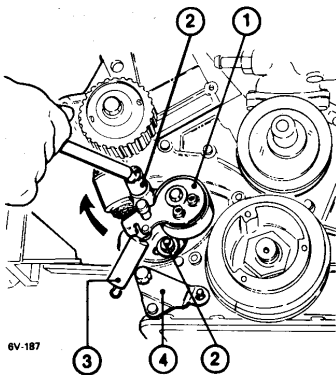
- 1. Spring restraining plate
- 2. Rubber seal
- 3. Rubber seal

c. Check that belt stretcher (1) is locked by the pin (tool A.2.0363) and then mount it on the support pin complete with pre-loading spring (2) and reaction spring (3).



- 1. Hydraulic belt stretcher
- 2. Pre-loading spring
- 3. Reaction spring

d. Fix belt stretcher (1) to the cylinder block, turning it clockwise as far as it goes and screwing the nuts washers (2); fit reaction spring (3) on the pin of plate (4).

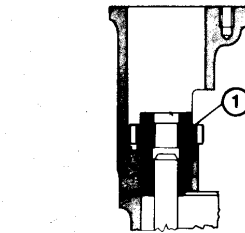
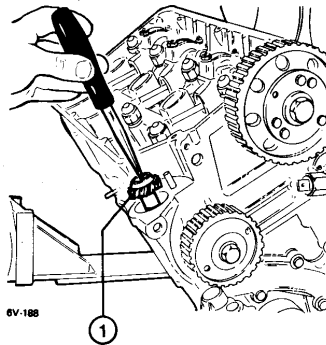


- 1. Belt stretcher
- 2. Nuts and washers
- 3. Reaction spring
- 4. Plate

PA3469B0000002

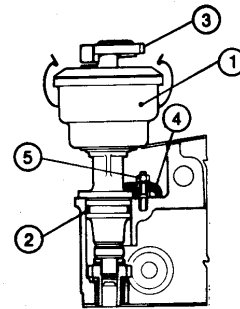
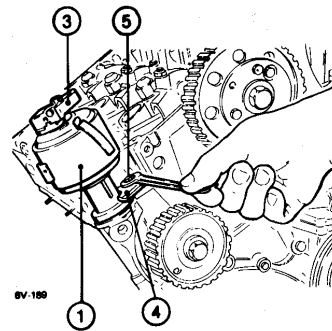
**DISTRIBUTOR**

a. After lubricating it with engine oil, insert gear (1). This engages the oil pump spindle and drives the pump and the distributor.



- 1. Gear

b. Fit the distributor (1), with a new seal ring (2). Position rotating brush (3) towards the cylinder no. 1, and thus with the notch on the distributor housing. Mount plate (4) and secure the distributor with nut and washer (5); do not tighten nut (5) at this time.



- 1. Distributor
- 2. Seal ring
- 3. Rotating brush
- 4. Plate
- 5. Nut and washer

**INSTALLATION OF TIMING BELT AND CHECK OF ENGINE TIMING**

a. Mount tool C.6.0183 complete with dial indicator in the spark plug seat of the 1st cylinder.

b. Turn the crankshaft in the normal direction until piston of cylinder no. 1 reaches T.D.C. position during the compression stroke (with both valves closed); this condition is indicated by the static period between the clockwise and anti-clockwise oscillations of the dial indicator pointer.

c. Check that in this position the following conditions occur:

- notch «P» on the engine pulley (1) must be aligned with reference pin (2) on the cylinder block;
- notches (3) and (4) on the camshaft must be aligned with the corresponding reference notches on the relative caps;

## ENGINE MAIN MECHANICAL UNIT

- rotating brush (5) of the distributor must be facing towards cylinder no. 1 and aligned with the reference notch on the distributor housing.

### CAUTION:

During all the belt re-fitting operations check that there is still alignment.

- d. Fit the timing belt (6) on the pulleys, maintaining the driving legs taught and respecting the following assembly order:

- A. Crankshaft toothed pulley;
- B. Left cylinder head toothed pulley;

- C. Right cylinder head toothed pulley;
- D. Camshaft and oil pump drive pulley;
- E. Hydraulic belt stretcher pulley.

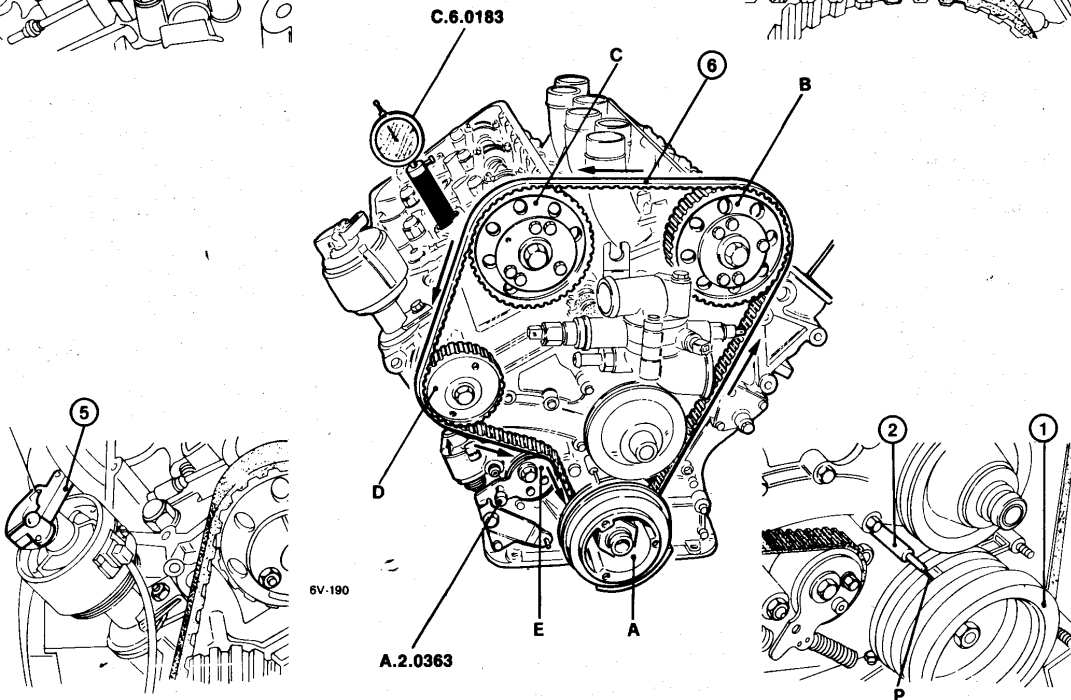
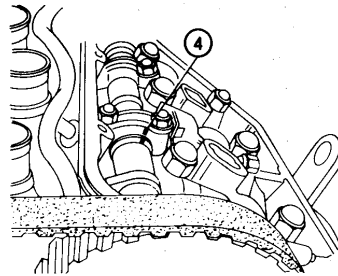
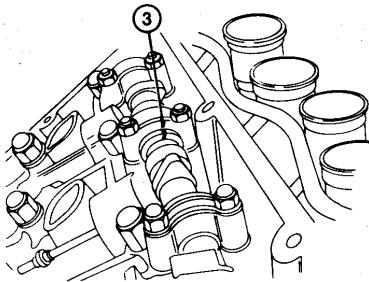
- e. Slacken the nuts securing the hydraulic belt stretcher and seat the timing belt by means of the device fixed to the flywheel and turning the crankshaft in the normal rotation direction for two or three complete turns, taking care to maintain the drive legs of the toothed belt taught.

- f. Keep the belt taught, press the pulley of the belt stretcher against the belt itself and lock the belt stretcher with the two screws.

- g. Raise the belt stretcher arm slightly, remove pin A.2.0363 and release the arm.

- h. Bring the piston of cylinder no. 1 to T.D.C. once more and check that all the alignment and timing conditions listed in steps b. and c. are fulfilled.

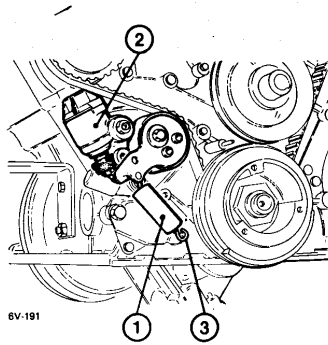
- i. If the notches on the camshafts and relative caps are not aligned proceed with the timing procedure as described in the WORKSHOP MANUAL Alfa 90 or Alfa 75 — ENGINE MAINTENANCE - in the paragraph entitled «Checking the Timing and Drive Belt Tension».



- 1. Crankshaft pulley
- 2. Reference pin
- 3. Notches on right camshaft
- 4. Notches on left camshaft
- 5. Rotating brush
- 6. Camshaft toothed belt



- j. Hook reaction spring (1) to hydraulic belt stretcher (2) and to the pin of plate (3).



1. Reaction spring  
2. Hydraulic belt stretcher  
3. Plate

**CYLINDER HEAD COVERS**

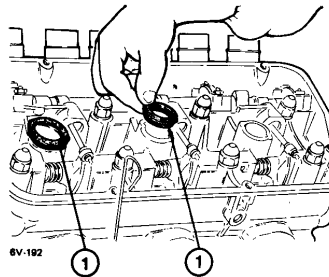
- a. Mount gaskets (1) on the spark plug holes.  
b. Fill the wells of the camshaft bearings after checking that they are perfectly dry. Use the prescribed engine oil.

**Quantity of oil required for each well:**  
0.450 kg (1 lb)

- c. Clean the support face of the cylinder head covers to remove any fragments of gasket remaining. Use butyl acetate or methylethylketone.

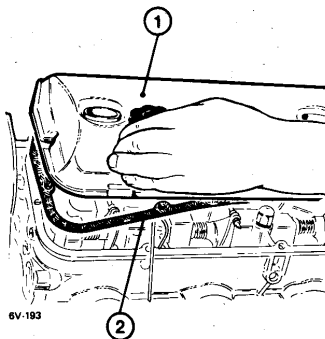
**CAUTION:**

**Before mounting the head covers spread the prescribed cement (DIRING Heldtite) over the gaskets (only surfaces in contact with the head).**



1. Spark plug hole gaskets

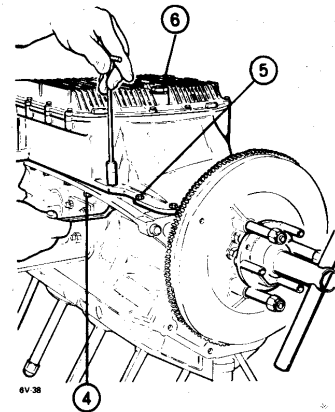
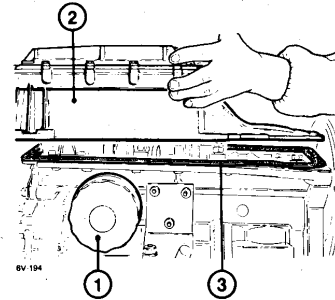
- d. Place covers (1) on the cylinder heads complete with respective gaskets (2) and fix them with the respective screws and washers.



1. Cylinder head covers  
2. Gaskets

**OIL SUMP**

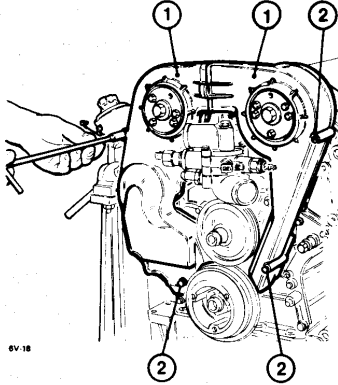
- a. Rotate the engine assembly by unlocking the overhaul stand and fit the oil filter (1) using a suitable spanner.  
b. Apply the prescribed cement (DIRING Heldtite P/N 3522-00015) uniformly over the gasket.  
c. Before applying the cement eliminate any trace of the old cement by de-greasing the surface.  
d. Fit the oil sump (2) complete with gasket (3) and tighten with lag screws (4) and through screws (5). Screw the oil discharge plug (6) to the oil sump.  
e. Free the engine assembly from the overhaul stand and turn the assembly over again.



1. Oil filter  
2. Oil sump  
3. Gasket  
4. Lag screws  
5. Through screws  
6. Oil discharge plug

**TIMING BELT GUARD**

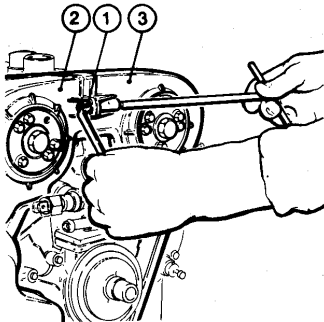
a. Place plastic guards (1) covering the timing belt in position and fix them to the cylinder block and cylinder heads with screws (2).



6V-18

- 1. Guard
- 2. Retaining screws

b. Connect guards (2) and (3) with bolt (1).

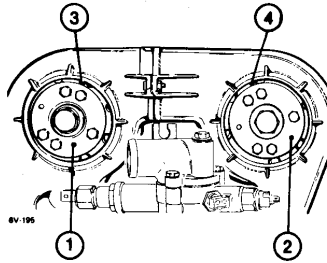


6V-17

- 1. Connecting bolt
- 2. Right guard
- 3. Left guard

**CAUTION:**

To check that the engine timing is correct, with engine installed, ensure that the notches on the hubs of toothed pulleys (1) and (2) are aligned with the respective tabs (3) and (4) on the belt guards.



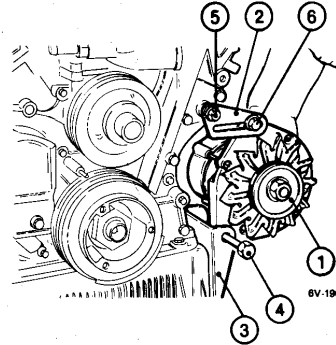
6V-195

- 1. Right toothed pulley hub
- 2. Left toothed pulley hub
- 3. Right guard tab
- 4. Left guard tab

c. Reinstall the covers of the toothed pulley hubs on the guards.

**GENERATOR**

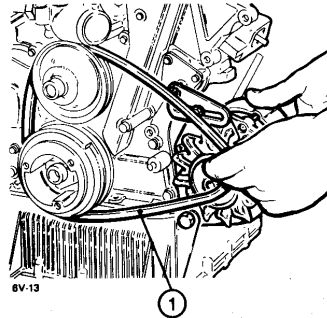
a. Fit generator (1) complete with regulation bracket (2) on support (3) of the oil sump, insert screw (4) and secure without tightening the respective nut.  
 b. Turn without tightening screw (5) and bolt (6).



6V-196

- 1. Generator
- 2. Regulation bracket
- 3. Generator support
- 4. Screw and nut
- 5. Screw
- 6. Bolt

c. Move the generator toward the cylinder block and slide the V-belt (1) onto the crankshaft and water pump pulleys.



6V-13

- 1. V-belt

d. Move generator (1) outwards, levering it as shown in the figure, until the correct tension of the V-belt (2) is obtained.

## ENGINE MAIN MECHANICAL UNIT

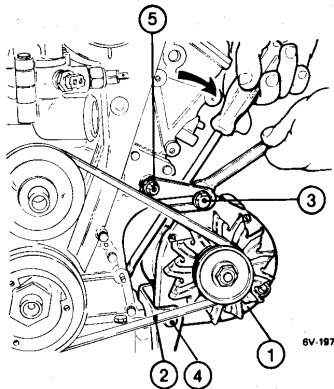
The tension of the belt is correct if, when subjected to a load of about

**147 to 294 N**  
(15 to 30 kg; 33 to 66 lb)

at the centre point, the belt deflection is:

**12 to 16 mm (0.47 to 0.63 in)**

e. Secure the generator tightening in sequence: bolt (3), bolt (4) and screw (5).



1. Alternator
2. V-belt
3. Bolt
4. Bolt
5. Screw

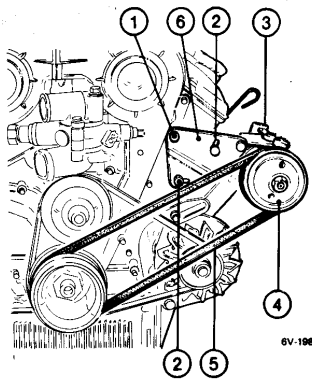
The tension is correct if, when subjected to a load of about

**147 to 294 N**  
(15 to 30 kg; 33 to 66 lb)

at the centre point, the belt deflection is:

**11 to 13 mm (0.43 to 0.51 in)**

d. Tighten the adjustment screws (2), screw (1) fixing the support bracket (6) and the bolt fixing the rear bracket (3).



1. Retaining screw
2. Adjustment screws
3. Rear bracket
4. Power steering pump
5. V-belt
6. Support bracket

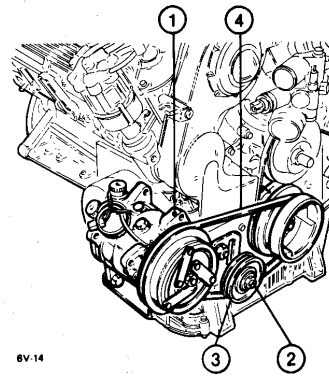
The tension is correct when a load of about

**196 to 343 N**  
(20 to 35 kg; 44 to 77 lb)

at the centre of the belt causes a belt deflection of about

**12 to 14 mm (0.47 to 0.55 in)**

e. Fully tighten nut (2) securing the belt stretcher pulley (3).



1. Compressor
2. Nut
3. Belt stretcher pulley
4. V-belt

### POWER STEERING PUMP

- a. Place the pump, complete with support bracket, on the cylinder block without locking screw (1), adjustment screws (2) and the locking bolt of the rear bracket (3).
- b. Move the power steering pump (4) towards the cylinder block and slide the V-belt (5) onto the crankshaft pulley and onto that of the power steering pump.
- c. Move the power steering pump outwards until the correct tension of the belt is obtained.

### CONDITIONER COMPRESSOR

- a. Place the compressor of the air conditioner (1) complete with its support bracket, on the flange of the oil sump and secure it with the two screws.
- b. Slacken nut (2) securing belt stretcher pulley (3).
- c. Slide the V-belt (4) onto the crankshaft pulley, onto the belt stretcher pulley and onto the compressor pulley.
- d. Lower the belt stretcher pulley (3) until the correct belt tension is obtained.

## INSTALLATION OF FUEL SYSTEM COMPONENTS

Alfa 90 2.5  iniezione

Alfa 90 2.0  6V iniezione

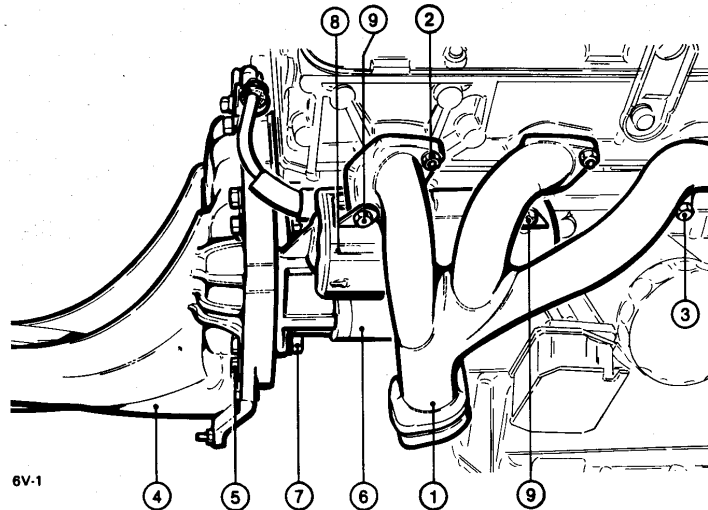
Alfa 75  6V iniezione

GTV 6 2.5

a. To reinstall the components of the fuel system proceed in the opposite order to that described for removal and follow these instructions.

b. For Alfa 90, Alfa 75 and GTV 6 vehicles with L-Jetronic fuel supply. For further checks and/or final adjustments refer to GROUP 04 - FUEL SYSTEM - L-Jetronic Fuel Supply.

c. For Alfa 90 - 2.0 vehicle with CEM fuel supply system. For further checks and/or final adjustments refer to GROUP 04 - FUEL SYSTEM - CEM Fuel Supply.



6V-1

- |                      |                     |
|----------------------|---------------------|
| 1. Exhaust manifolds | 6. Starting motor   |
| 2. Nuts and washers  | 7. Nuts and washers |
| 3. Screws            | 8. Heat shield      |
| 4. Rear cover        | 9. Screws           |
| 5. Screws            |                     |

### FINAL OPERATIONS

a. Remove the tool previously fixed to the flywheel so that the flywheel rotates freely.

b. Fit right exhaust manifolds (1) with relative gaskets to the cylinder head and lock them with nuts and washers (2) and screws (3).

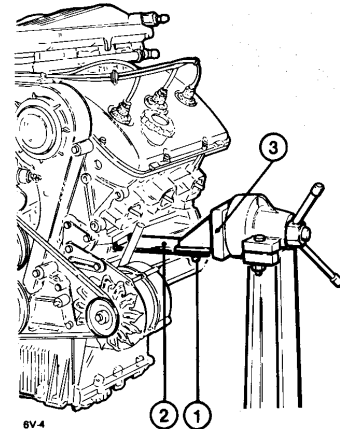
c. Proceed in the same way for the exhaust manifolds to be mounted from the left side of the engine.

d. Fit the rear cover (4) to the rear flange of the cylinder block and lock it with screws (5).

e. Position the spacer and starting motor (6) on the rear cover, screw on nuts with washers (7) and tighten.

f. Install the heat shield (8) protecting the starting motor and fix it with screws (9).

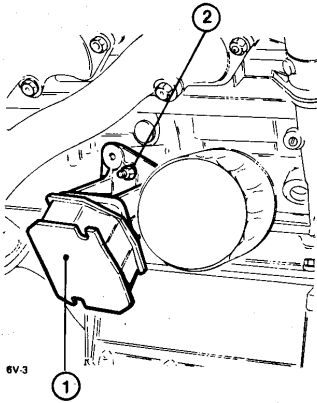
g. Hook a suitable hoist to the lifting brackets and, maintaining a slight tension, slacken bolts (1) connecting brackets (2) and (3) fixed to the overhaul stand.



6V-4

- |                            |
|----------------------------|
| 1. Bolts                   |
| 2. Engine support brackets |
| 3. Overhaul stand supports |

h. Replace the brackets fixed to the cylinder block with right and left engine supports ①; lock nuts and washers ② on the cylinder block studs.



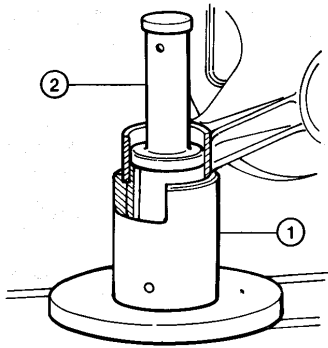
- 1. Engine supports
- 2. Nuts and washers

i. Install the engine group in the vehicle following the procedure described in the paragraph «ENGINE REMOVAL AND INSTALLATION» for the vehicle in question.

### REPLACING THE REAR COVER SILENTBLOC

To replace the silentbloc of the rear cover proceed as follows:

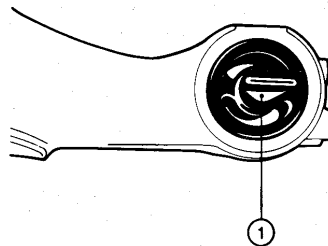
- a. Provide a suitable base ① for the extraction of the Silentbloc and position it as illustrated in the figure.
- b. Using a suitable punch ② extract the Silentbloc.
- c. Fit the new Silentbloc using the same equipment.



- 1. Base
- 2. Punch

**CAUTION:**

The Silentbloc ① must be placed parallel to the side of the bevel in the seat on the rear cover as shown in the figure.



- 1. Silentbloc

## LUBRICATION SYSTEM

### DESCRIPTION

The engine lubrication system is of the forced flow type with replaceable filter element.

The oil circulation is provided by a rotating lobe pump which is operated by the toothed timing belt through a toothed pulley and an auxiliary shaft.

The oil pump is installed in the lower part of the cylinder block.

The oil pressure is regulated by a maximum pressure valve in the pump housing.

The oil is filtered, with total passage, during suction by means of a screen fitted on the oil feed housing of the pump and then by a cartridge filter (total flow) on the delivery pipe.

The filter cartridge is provided with a bypass valve permitting the normal circula-

tion of the oil even if the cartridge is completely clogged.

The oil filler is located on the cover of the left cylinder head.

The right cylinder head cover is provided with fittings for the re-circulation of the oil vapour at idling and high speed.

Insufficient oil pressure is signalled on the instrument panel by means of an indicator light connected to a pressure sender on the main channel of the cylinder block.

### CHECKING THE OIL PRESSURE

a. Start the engine and let the engine oil heat up to normal running temperature (90°C; 194°F). Then stop the engine.

- b. Remove the oil pressure sender.
- c. Apply a pressure gauge to the sender hole.
- d. Start the engine and read the oil pressure indicated on the pressure gauge.

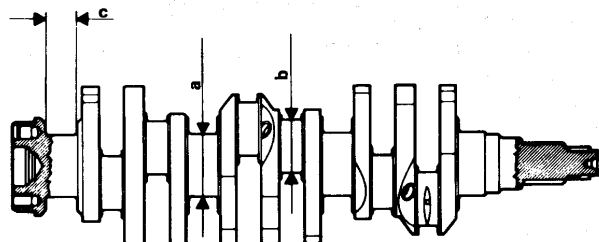
Engine speed (rpm)	Engine oil pressure	
800 to 900	kPa	49.03 to 147.01
	bar	0.49 to 1.47
	kg/cm <sup>2</sup>	0.5 to 1.5
	psi	7.1 to 21.3
5500	kPa	343.21 to 490.3
	bar	3.43 to 4.90
	kg/cm <sup>2</sup>	3.5 to 5
	psi	49.8 to 71

- e. Remove the pressure gauge and re-fit the sender.
- f. If the oil pressure is not within the limits indicated in the table check the oil pump.

# ENGINE MAIN MECHANICAL UNIT

## CRANKSHAFT, CRANKCASE, CONNECTING RODS, BEARINGS AND FLYWHEEL

### Crankshaft

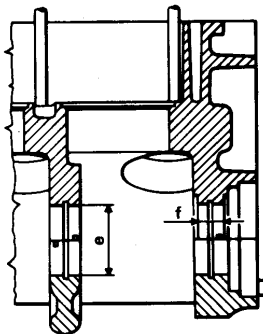


Unit: mm (in)

Check dimensions		Engine	
		2000	2500
		(062.10)	(016.46)
Main journal diameter	(a) Red	59.961 to 59.971 (2.3607 to 2.3610) 59.971 to 59.981 (2.3610 to 2.3614) (1)	
	Blue	59.951 to 59.961 (2.3603 to 2.3607) 59.961 to 59.971 (2.3607 to 2.3610) (1)	
Crankpin	(b) Red	51.990 to 52.000 (2.0468 to 2.0472)	
	Blue	51.980 to 51.990 (2.0465 to 2.0468)	
Length of rear main journal		(c)	31.300 to 31.335 (1.2323 to 1.2336)
Maximum permissible ovality for main journals and crankpins		0.004 (0.0002)	
Maximum permissible taper for main journals and crankpins		0.01 (0.0004)	
Maximum variation in parallelism between main and crankpins		0.015 (0.0006)	
Maximum eccentricity between main journals		0.04 (0.002)	

(1) Oversize crankshaft

### Crankcase

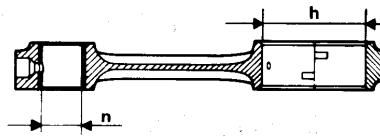


Unit: mm (in)

Check dimensions		Engine	
		2000	2500
		(062.10)	(016.46)
Main bearing support bore diameter	(e)	63.657 to 63.676 (2.5062 to 2.5069)	
Length of rear main bearing support shoulder	(f)	26.45 to 26.50 (1.041 to 1.043)	

## ENGINE MAIN MECHANICAL UNIT

### Connecting rod



Unit: mm (in)

Check dimensions		Engine	
		2000	2500
		(062.10)	(016.46)
Big end bore diameter	(h)	55.511 to 55.524 (2.1854 to 2.1860)	
Small end bush hole diameter	(n)	22.005 to 22.015 (0.8663 to 0.8667)	

### Main bearings



Unit: mm (in)

Check dimensions		Engine	
		2000	2500
		(062.10)	(016.46)
Thickness of main bearing	(l) Red	1.829 to 1.835 (0.0720 to 0.0722)	
	Blue	1.835 to 1.841 (0.0722 to 0.0725)	
	Green	1.845 to 1.851 (0.0726 to 0.0729) (1)	

(1) Only to be used on standard (**non-oversized**) crankshafts if the radial mating clearance between pin and half-bearings is greater than 0.050 mm (0.0020 in) (after checking the dimensions of each single bearing)

### Big end bearings



Unit: mm (in)

Check dimensions		Engine	
		2000	2500
		(062.10)	(016.46)
Thickness of big end bearing	(l) Red	1.737 to 1.745 (0.0684 to 0.0687)	
	Blue	1.741 to 1.749 (0.0685 to 0.0689)	



## ENGINE MAIN MECHANICAL UNIT

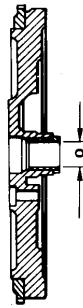
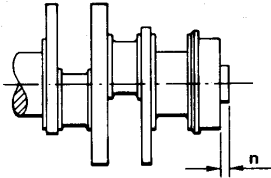
### Thrust rings



Unit: mm (in)

Check dimensions		Engine	
		2000	2500
		(062.10)	(016.46)
Thickness of thrust ring	(m)	2.31 to 2.36 (0.091 to 0.093)	

### Flywheel



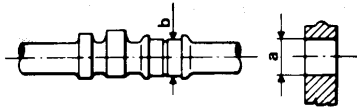
Unit: mm (in)

Check dimensions		Engine	
		2000	2500
		(062.10)	(016.46)
Protrusion of flywheel center bushing from rear surface of crankshaft	(n)	4 (0.2)	
I.D. of flywheel centre bushing (reamed)	(o)	26.010 to 26.023 (1.0240 to 1.0245)	

**ENGINE MAIN MECHANICAL UNIT**

**CAMSHAFT, ROCKERS, BOWLS, SPRINGS, VALVES AND CYLINDER HEAD**

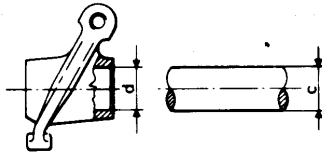
**Camshaft**



Unit: mm (in)

Check dimensions		Engine	
		2000	2500
		(062.10)	(016.46)
Camshaft journal seat diameter	(a)	27.000 to 27.033 (1.0630 to 1.0643)	
Camshaft journal diameter	(b)	26.949 to 26.970 (1.0610 to 1.0618)	

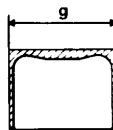
**Rockers**



Unit: mm (in)

Check dimensions		Engine	
		2000	2500
		(062.10)	(016.46)
Rocker shaft diameter	(c)	15.988 to 16.000 (0.6294 to 0.6299)	
Rocker shaft bore diameter	(d)	16.016 to 16.034 (0.6305 to 0.6313)	

**Bowls**

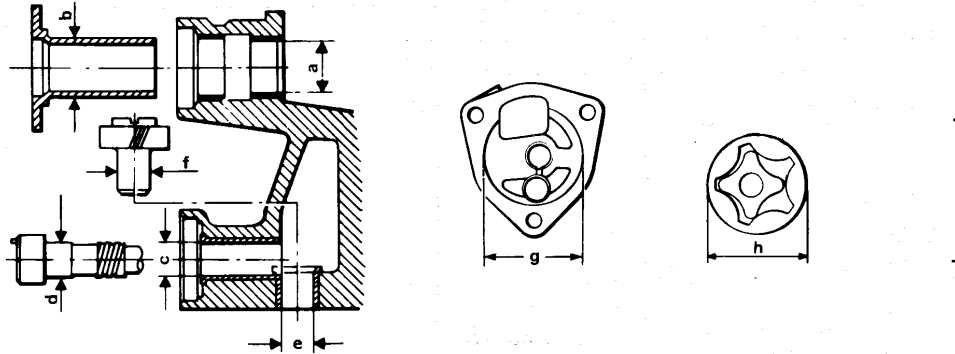


Unit: mm (in)

Check dimensions		Engine	
		2000	2500
		(062.10)	(016.46)
Valve Bowl diameter	(g)	34.973 to 34.989 (1.3769 to 1.3775)	
		21.971 to 21.989 (0.8650 to 0.8657)	

**ENGINE MAIN MECHANICAL UNIT**

**CAMSHAFT DRIVE — OIL PUMP**



Unit: mm (in)


Check dimensions		Engine	
		2000	2500
		(062.10)	(016.46)
Diameter of camshaft pulley hub bush (reamed)	(a)	32.000 to 32.025 (1.2598 to 1.2608)	
Diameter of camshaft pulley hub	(b)	31.959 to 31.975 (1.2582 to 1.2589)	
Diameter of bush for distributor/oil pump drive pulley hub (reamed) (1)	(c)	19.000 to 19.021 (0.7480 to 0.7489)	
Diameter of distributor/oil pump drive gear hub (reamed) (1)	(d)	18.967 to 18.980 (0.7467 to 0.7472)	
Diameter of distributor/oil pump drive gear hub (reamed) (1)	(e)	19.000 to 19.021 (0.7480 to 0.7489)	
Diameter of distributor/oil pump drive gear hub (1)	(f)	18.967 to 18.980 (0.7467 to 0.7472)	
Diameter of outer rotor seat in oil pump housing	(g)	49.325 to 49.375 (1.9419 to 1.9439)	
Outside diameter of outer oil pump rotor	(h)	49.100 to 49.155 (1.9330 to 1.9352)	

(1) Only on RH cylinder head

## ENGINE MAIN MECHANICAL UNIT

### ASSEMBLY INTERFERENCE FITS AND CLEARANCES

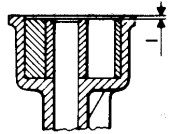
Unit: mm (in)

Check dimensions		Engine	
		2000	2500
		(062.10)	(016.46)
Piston clearance in cylinder		0.030 to 0.049 (0.0012 to 0.0019)      0.040 to 0.059 (0.0016 to 0.0023)	
Compression rings end float in groove	Compression ring no. 1	0.035 to 0.067 (0.0014 to 0.0026)	
	Compression ring no. 2	0.035 to 0.067 (0.0014 to 0.0026)	
	Oil scraper ring	0.025 to 0.057 (0.0010 to 0.0022)	
Gudgeon pin clearance in piston		0.003 to 0.008 (0.0002 to 0.0003)      0.006 to 0.012 (0.0002 to 0.0004)	
Gudgeon pin clearance in small end bush	Black	0.008 to 0.021 (0.0003 to 0.0008)	
	White	0.005 to 0.018 (0.0002 to 0.0007)	
Running clearance between main bearings and main journals	Red	0.016 to 0.057 (0.0006 to 0.0022) 0.006 to 0.047 (0.0002 to 0.0018) (3)	
	Blue	0.014 to 0.055 (0.0006 to 0.0022) 0.004 to 0.045 (0.0002 to 0.0018) (3)	
Running clearance between big end bearings and crankpins	Red	0.021 to 0.060 (0.0008 to 0.0024)	
	Blue	0.023 to 0.062 (0.0009 to 0.0024)	
Crankshaft end-float		0.080 to 0.265 (0.0031 to 0.0104)	
Big end-float		0.2 to 0.3 (0.008 to 0.012)	
Running clearance between journal and camshaft seat		0.030 to 0.084 (0.0012 to 0.0033)	
Camshaft end-float		0.065 to 0.200 (0.0026 to 0.0079)	
Running clearance between rockers and rocker shaft		0.016 to 0.048 (0.0006 to 0.0018)	
Running clearance between valve bowl and seat	Intake	0.011 to 0.052 (0.0004 to 0.0020)	
	Exhaust	0.011 to 0.050 (0.0004 to 0.0020)	
Valve stem running clearance in valve guide	Intake	0.013 to 0.043 (0.0005 to 0.0017)	
	Exhaust	0.040 to 0.080 (0.0016 to 0.0031)	
Interference fit of valve guide in cylinder head		0.015 to 0.054 (0.0006 to 0.0021)	
Interference fit of valve seat in cylinder head		0.040 to 0.100 (0.0016 to 0.0039)	
Clearance between inner and outer oil pump rotors (1)	(i) 	0.040 to 0.290 (0.0016 to 0.0114)	

(CONTINUED)

## ENGINE MAIN MECHANICAL UNIT

Unit: mm (in)

Check dimensions		Engine	
		2000	2500
		(062.10)	(016.46)
Rotor end-float in oil pump body (1)		0.025 to 0.075 (0.0010 to 0.0030)	
Running clearance between outer rotor and oil pump body		0.170 to 0.275 (0.0067 to 0.0108)	
Running clearance between bush and camshaft pulley hub		0.025 to 0.066 (0.0010 to 0.0026)	
Running clearance between bush and distributor/oil pump pulley hub (2)		0.020 to 0.054 (0.0008 to 0.0021)	
Running clearance between bush and distributor/oil pump drive gear hub (2)		0.020 to 0.054 (0.0008 to 0.0021)	

- (1) Measure with the rotors in the position illustrated  
 (2) Only on RH cylinder head  
 (3) Only on oversize crankshaft

### HEATING TEMPERATURES

Component	Temperatures
Cylinder head temperature for fitting valve seats	120°C (248°F)
Starter ring gear temperature for shrinking onto flywheel	120° to 140°C (248 to 284°F)

**ENGINE MAIN MECHANICAL UNIT**

**GENERAL REQUIREMENTS**

**FLUIDS AND LUBRICANTS**

Application	Type	Name	Q.ty [kg (lb)]
Gasket for rear main bearing cap	FLUID	UNION CARBIDE CHEMICALS CO Ucon Lubricant 50 HB-5100 MILLOIL: Lubricant for rubber sections Part No. 4500-17502	—
Crankshaft oil seals — Front: outer surface	OIL	AGIP SINT 2000 10W50 IP Sintiax 10W40 Part No. 3631-693/52	—
Lip — Rear: outer surface	GREASE	ISECO Molykote BR2 Part No. 3671-69841	—
Lip	OIL	IP Sintiax 10W40 Part No. 3631-693/52	—
Cylinder head support pumps (1)  Engine oil sump	OIL	AGIP Sint 2000 10W50 IP Sintiax 10W40 Part No. 361-639/52	0.450 (0.99)  6.0 (13.23)  5.5 (12.13) 0.5 (1.10)  2.0 (4.41)
The quantity indicated includes the following capacities: — Sump at max. level — Filter and corresponds to periodic replacements during maintenance — Difference between min and max level on dipstick			
Camshaft oil seals Sealing ring for distributor/oil pump drive pulley shaft — Outer surface	OIL	AGIP Sint 2000 10W40 IP Sintiax 10W40 Part No. 3631-693/52	—
— Lip	GREASE	ISECO Molykote BR2 Part No. 3671-69841	—
Pin for hydraulic tensioner	GREASE	ISECO Molykote paste G Part No. 3671-69840	—

(1) Refill only if disassembled (cylinder head dry)

## TROUBLE DIAGNOSIS AND CORRECTIONS

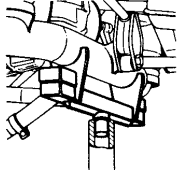
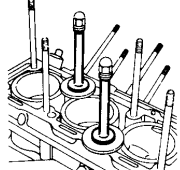
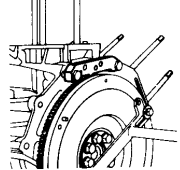
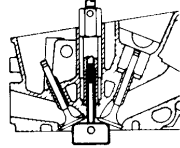
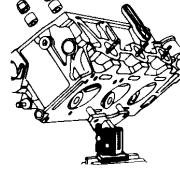
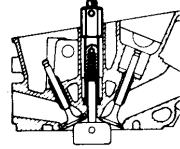
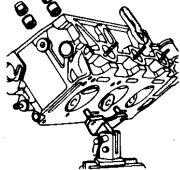
Condition	Probable cause	Corrective action
Noisy engine knocking of crankshaft	Excessive crankshaft running clearance on bearings and/or end play on semi-thrust rings	Replace bearings and/or semi-thrust rings
Piston and connecting rod knocking	• Fit incorrect	Adjust
	• Pin end float	Adjust
Camshaft and valves knocking (intake side)	• Excessive valve clearance	Adjust
	• Valve bowls incorrect fit	Replace
	• Valve spring broken	Replace
	• Camshafts worn	Replace
Water pump noisy	Rotor shaft excessive backlash	Replace water pump
Other mechanical troubles		
Valve seat seized	• Improper valve clearance	Replace and adjust
	• Valve spring broken	Replace
Cylinders and pistons excessively worn	• Fit surfaces defective	Restore correct installation
	• Poor oil quality	User proper oil
	• Air cleaner dirty or inefficient	Replace filter
Big end bearings faulty	• Shortage of engine oil	Check lubrication system
	• Poor engine oil quality	Use proper oil
	• Crank pins worn or out-of-round	Grind or replace
	• Big end bearing - crankpin coupling incorrect	Replace

## ENGINE MAIN MECHANICAL UNIT

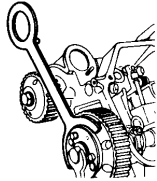
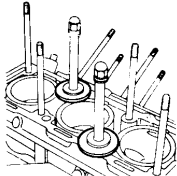
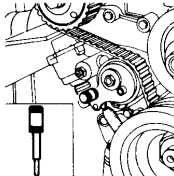
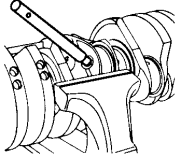
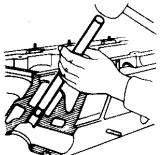
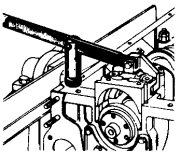
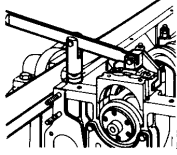
Condition	Probable cause	Corrective action
Main bearings faulty	<ul style="list-style-type: none"> <li>• Shortage of engine oil</li> <li>• Poor engine oil quality</li> <li>• Main journal worn or out-of-round</li> <li>• Main bearings main journal coupling incorrect</li> </ul>	<p>Check lubrication system</p> <p>Use proper oil</p> <p>Grind or replace</p> <p>Replace</p>
<b>Lubrication</b>		
Oil leakage	<ul style="list-style-type: none"> <li>• Oil sump drain plug loosened</li> <li>• Oil leakage from sump gasket</li> <li>• Oil leakage from camshaft seal-rings</li> <li>• Oil leakage from engine gaskets and seal rings</li> <li>• Oil leakage from oil filter gasket</li> </ul>	<p>Tighten</p> <p>Replace gasket</p> <p>Replace seal rings</p> <p>Replace seal rings and worn gaskets</p> <p>Tighten filter</p>
Pressure decreases	<ul style="list-style-type: none"> <li>• Pressure regulating valve dirty</li> <li>• Poor engine oil quality</li> </ul>	<p>Clean</p> <p>Replace</p>



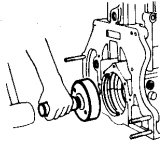
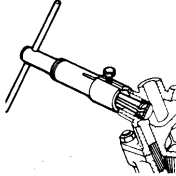
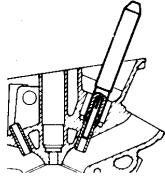
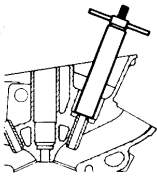
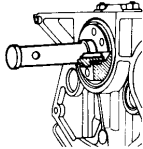
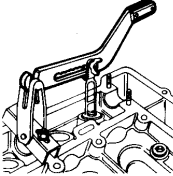
**SPECIAL TOOLS**

Reference number	Description	Page
A.2.0075	Vehicle lift support 	01-88/5 01-88/13
A.2.0117	Cylinder liner retainer (4 pieces - to be used with tool A.2.0362) 	01-88/32
A.2.0145	Flywheel retainer (for overhaul on bench) 	01-88/33
A.2.0192	Valve support (to be used with tools A.2.0359 and A.3.0522) 	01-88/41
A.2.0195	Cylinder head support (to be used with tool A.2.0360) 	01-88/38
A.2.0359	Special nut for valve supporting tool (to be used with tools A.2.0192 and A.3.0522) 	01-88/41
A.2.0360	Yoke for cylinder head support (to be used with tool A.2.0195) 	01-88/38

**ENGINE MAIN MECHANICAL UNIT**

Reference number	Description	Page
A.2.0361	Tool for rotating camshaft and auxiliary control pulleys 	01-88/39
A.2.0362	Washer for stopping cylinder liners (4 pieces are necessary - to be used with tool A.2.0117) 	01-88/32
A.2.0363	Stop pin for hydraulic belt stretcher device 	01-88/27
A.2.0369	Tool for caulking crankshaft oil passage plugs 	01-88/62
A.3.0134	Valve guide remover 	01-88/50
A.3.0139/0001	Rear main bearing cap remover lever (to be used with tool A.3.0139/0002) 	01-88/36
A.3.0139/0002	Rear main bearing cap puller (to be used with tool A.3.0139/0001) 	01-88/36

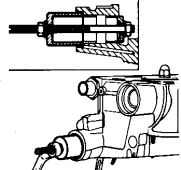
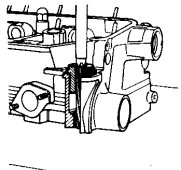
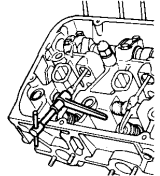
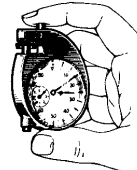
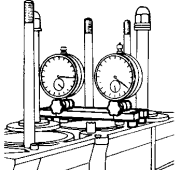
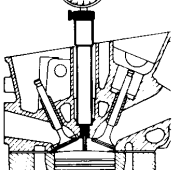
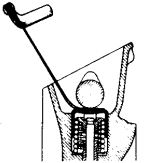
**ENGINE MAIN MECHANICAL UNIT**

Reference number	Description	Page
A.3.0178	Rear crankshaft seal installer 	01-88/73
A.3.0210	Extractor (expandable pincers) for crankshaft rear bearing 	01-88/35
A.3.0244	Valve guide seal driver 	01-88/55
A.3.0247	Valve guide seal remover 	01-88/43
A.3.0305	Flywheel bushing driver 	01-88/73
A.3.0324	Valve spring compressor lever (to be used with tools A.3.0520, A.2.0192, A.2.0359 and A.3.0522) 	01-88/41


**ENGINE MAIN MECHANICAL UNIT**

Reference number	Description	Page
A.3.0520	Yoke for assembling and disassembling valve (to be used with tools A.2.0192, A.3.0324, A.3.0522 and A.2.0359)	01-88/41
A.3.0521	Puller of camshaft pulley	01-88/39
A.3.0522	Loop for assembly and disassembly of valves (to be used with tools A.3.0324, A.2.0359, A.2.0192 and A.3.0520)	01-88/41
A.3.0524	Driver of crankshaft front oil seal	01-88/76
A.3.0525	Driver of front oil seal on camshafts and auxiliary controls	01-88/59
A.3.0526	Intake valve guide driver	01-88/51
A.3.0527	Exhaust valve guide driver	01-88/51

**ENGINE MAIN MECHANICAL UNIT**

Reference number	Description	Page
<b>A.3.0528</b>	Puller-driver of oil pump shaft, camshaft bushings and ignition distributor 	01-88/46
<b>A.4.0195</b>	Guide for reaming of the bush seats of distributor control shaft [use with dia.: 19 mm (0.75 in) reamer] 	01-88/48
<b>A.5.0220</b>	Combined 3 mm and 11 mm wrench for adjusting exhaust side tappets 	01-88/58
<b>C.1.0108</b>	Dial gauge for checking valve caps 	01-88/58
<b>C.6.0148</b>	Cylinder liner/piston standout gauge 	01-88/74
<b>C.6.0183</b>	Tool for checking T.D.C. 	01-88/85
<b>C.6.0197</b>	Feeler gauge for checking valve clearance 	01-88/58

# ENGINE MAIN MECHANICAL UNIT

Reference number	Description	Page
R.9.0001	Container for valve clearance adjustment caps 	01-88/58