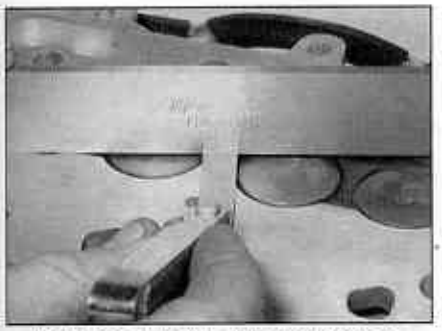
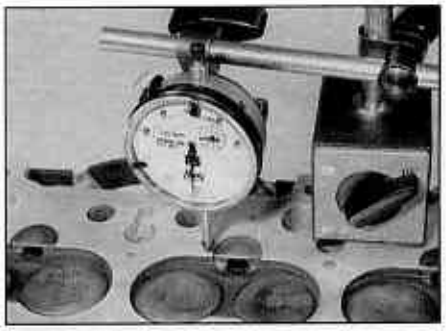


6.25 Checking the cylinder head for distortion

6.27 Checking the valve guides and valves for wear



6.29a Diesel swirl chamber protrusion can be checked using a dial gauge . . .

scrape off the majority of the deposits with a blunt blade first, then use the wire brush.

Caution: Do not erode the sealing surface of the valve face.

23 Thoroughly clean the remainder of the components using solvent and allow them to dry completely. On 8-valve petrol and diesel engines, discard the oil seals, as new items must be fitted when the cylinder head is reassembled.

Inspection

Cylinder head

24 Inspect the head very carefully for cracks, evidence of coolant leakage, and other damage. If cracks are found, a new cylinder head should be obtained.

25 Use a straight-edge and feeler blade to check that the cylinder head gasket surface is not distorted **(see illustration)**. If it is, it may be possible to have it machined, provided that the cylinder head thickness is not excessively reduced. As no specifications as to permissible distortion limits or cylinder head thickness tolerances are given by the manufacturer, seek the advice of an engine overhaul specialist if distortion is apparent.

26 Examine the valve seats in each of the combustion chambers. If they are severely pitted, cracked, or burned, they will need to be renewed or re-cut by an engine overhaul specialist. If they are only slightly pitted, this can be removed by grinding-in the valve heads and seats with fine valve-grinding compound, as described below.

27 Check the valve guides for wear by inserting the relevant valve, and checking for side-to-side motion of the valve **(see illustration)**. A very small amount of movement is acceptable. If the movement seems excessive, remove the valve. Measure the valve stem diameter at several points, and renew the valve if it is worn. If the valve stem is not worn, the wear must be in the valve guide, and the guide must be renewed. The renewal of valve guides should be carried out by an engine overhaul specialist, who will have the necessary tools required.

28 If renewing the valve guides, the valve seats should be re-cut or re-ground only *after* the new guides have been fitted.

29 On diesel engines, inspect the swirl chambers for burning or damage such as cracking. Small cracks in the chambers are acceptable; renewal of the chambers will only be required if chamber tracts are badly burned and disfigured, or if they are no longer a tight fit in the cylinder head. If there is any doubt as to the swirl chamber condition, seek the advice of a Fiat dealer or a suitable repairer who specialises in diesel engines. Swirl chamber renewal should be entrusted to a specialist. Using a dial test indicator, check that the difference between the swirl chamber and the cylinder head surface is within the limits given in the Specifications. Alternatively feeler blades and a straight-edge may be used **(see illustrations)**. Zero the dial test indicator on the gasket surface of the cylinder head, then measure the protrusion of the swirl chamber. If the protrusion is not within the specified limits, the advice of a Fiat dealer or suitable repairer who specialises in diesel engines should be sought.

Camshaft

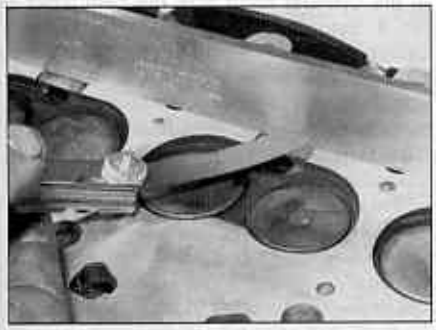
30 Inspect the camshaft for wear on the surfaces of the lobes and journals. Normally their surfaces should be smooth and have a dull shine; look for scoring and pitting. Accelerated wear will occur once the hardened exterior of the camshaft has been damaged.

31 Examine the bearing cap and journal surfaces for signs of wear.

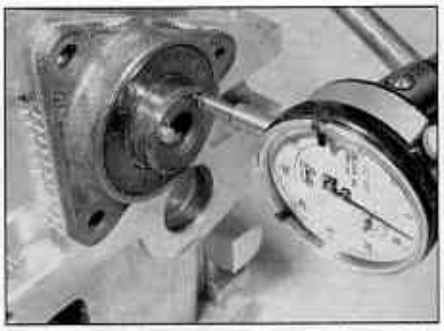
32 To measure the camshaft endfloat, temporarily refit the camshaft then push the camshaft to one end of the cylinder head as far as it will travel. Attach a dial test indicator to the cylinder head and zero it, then push the camshaft as far as it will go to the other end of the cylinder head and record the gauge reading. Verify the reading by pushing the camshaft back to its original position and checking that the gauge indicates zero again **(see illustration)**.

33 The camshaft bearing running clearance may be checked using Plastigauge as described later in this Chapter.

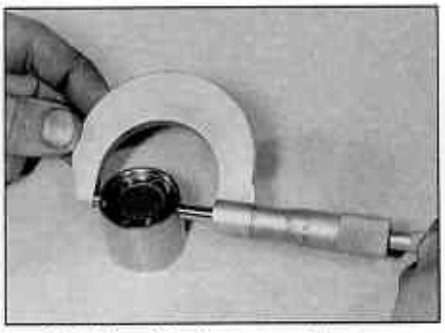
34 Where the camshaft and bearings are worn excessively consider renewing the complete cylinder head together with camshaft and cam followers. A reconditioned head may be available from engine repairers. Wear of cam followers may be checked using a micrometer **(see illustration)**.



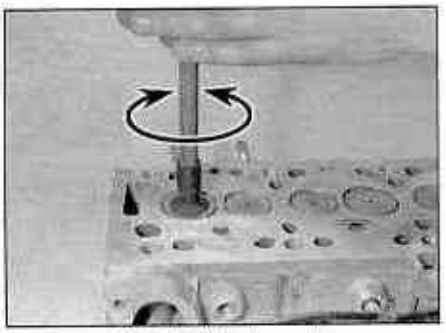
6.29b . . . or feeler blades



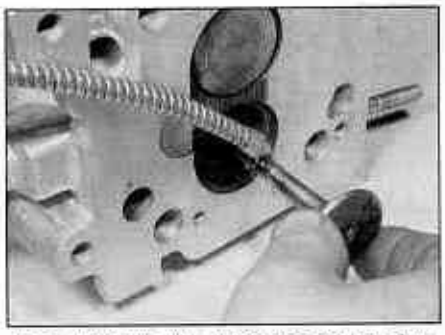
6.32 Checking the camshaft endfloat with a dial gauge



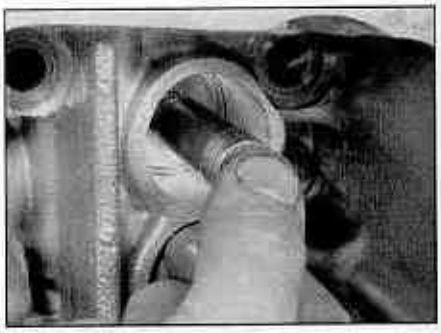
6.34 Checking the wear of the cam followers



6.39 Grinding-in a valve



6.45 Lubricate the valves before locating them



6.46 Using a socket to press the valve stem seals onto the guides

Valves and associated components

35 Examine the head of each valve for pitting, burning, cracks, and general wear. Check the valve stem for scoring and wear ridges. Rotate the valve, and check for any obvious indication that it is bent. Look for pits or excessive wear on the tip of each valve stem. Renew any valve that shows any such signs of wear or damage.

36 If the valve appears satisfactory at this stage, measure the valve stem diameter at several points using a micrometer. Any significant difference in the readings obtained indicates wear of the valve stem. Should any of these conditions be apparent, the valve(s) must be renewed.

37 If the valves are in satisfactory condition, they should be ground (lapped) into their respective seats, to ensure a smooth, gas-tight seal. If the seat is only lightly pitted, or if it has been re-cut, fine grinding compound *only* should be used to produce the required finish. Coarse valve-grinding compound should *not* be used, unless a seat is badly burned or deeply pitted. If this is the case, the cylinder head and valves should be inspected by an expert, to decide whether seat re-cutting, or even the renewal of the valve or seat insert (where possible) is required.

38 Valve grinding is carried out as follows. Place the cylinder head upside-down on blocks on a bench.

39 Smear a trace of (the appropriate grade of) valve-grinding compound on the seat face, and press a suction grinding tool onto the valve head. With a semi-rotary action, grind the valve head to its seat, lifting the valve occasionally to redistribute the grinding compound **(see illustration)**. A light spring placed under the valve head will greatly ease this operation.

40 If coarse grinding compound is being used, work only until a dull, matt even surface is produced on both the valve seat and the valve, then wipe off the used compound, and repeat the process with fine compound. When a smooth unbroken ring of light grey matt finish is produced on both the valve and seat, the grinding operation is complete. *Do not* grind-in the valves any further than absolutely necessary, or the seat will be prematurely sunk into the cylinder head.

41 When all the valves have been ground-in, carefully wash off *all* traces of grinding compound using paraffin or a suitable solvent, before reassembling the cylinder head.

42 Examine the valve springs for signs of damage and discoloration. If possible compare the length of the springs with new ones and renew them if necessary.

43 Stand each spring on a flat surface, and check it for squareness. If any of the springs are damaged, distorted or have lost their tension, obtain a complete new set of springs. It is normal to renew the valve springs as a matter of course if a major overhaul is being carried out.

44 Renew the valve stem oil seals regardless of their apparent condition.

Reassembly

45 Lubricate the stems of the valves, and insert the valves into their original locations **(see illustration)**. If new valves are being fitted, insert them into the locations to which they have been ground.

46 Refit the spring seat then, working on the first valve, dip the new valve stem seal in fresh engine oil. Carefully locate it over the valve and onto the guide. Take care not to damage the seal as it is passed over the valve stem. Use a suitable socket or metal tube to press the seal firmly onto the guide **(see illustration)**.

47 Locate the valve spring on top of its seat, then refit the spring retainer.

48 Compress the valve spring, and locate the split collets in the recess in the valve stem. Release the compressor, then repeat the procedure on the remaining valves **(see illustration)**.

> **HAYNES HiNT** ***Use a dab of grease to hold the collets in position on the valve stem while the spring compressor is released.***

49 With all the valves installed, place the cylinder head on blocks on the bench and, using a hammer and interposed block of wood, tap the end of each valve stem to settle the components.

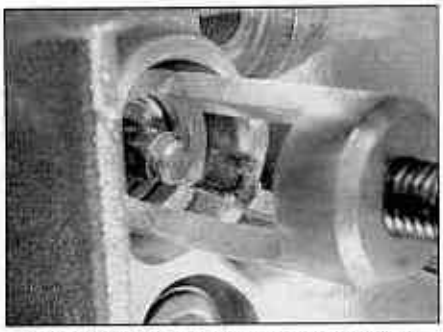
50 On diesel engines, refit the swirl chambers together with their washers and tighten the retaining collars to the specified torque.

51 Oil the cam followers and locate them in their correct positions in the cylinder head. Locate the shims in the cam followers making sure they are in their original positions.

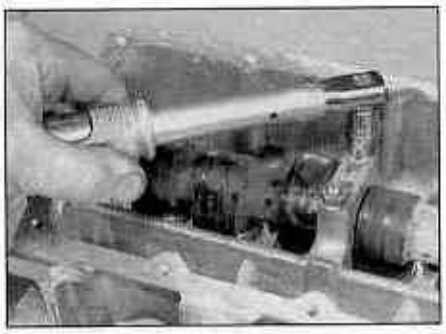
52 Oil the journals then locate the camshaft in the cylinder head with the cam lobes of No 1 cylinder facing upwards (ie No 1 cylinder at TDC).

53 Refit the bearing caps in their correct positions and progressively tighten the nuts/bolts to the specified torque **(see illustration)**. On petrol engines locate the lubrication pipe on the head and press in the oil feed stub before refitting the bolts.

54 On diesel engines fit a new oil seal to the right-hand side mount, then refit both side mounts together with new gaskets. Tighten the right-hand mount bolts. Also refit the coolant cover and thermostat housing together with new gaskets **(see illustrations)**.



6.48 Compressing the valve spring and fitting the split collets



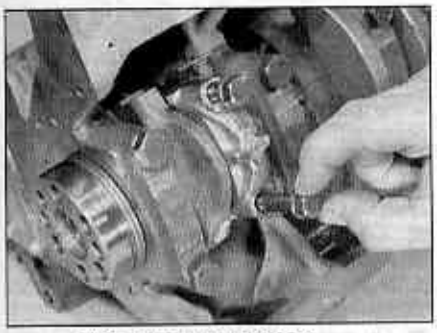
6.53 Tightening the camshaft bearing cap nuts (diesel engines)

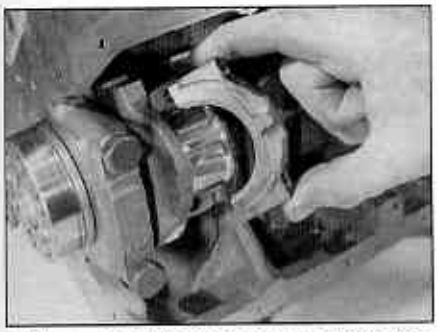
55 On diesel engines, fit new O-ring seals to the vacuum pump then refit it to the left-hand end of the cylinder head and tighten the nuts **(see illustrations)**.
56 Refit the camshaft sprocket with reference to Chapter 2A or 2C.
57 Refit the spark plugs, glow plugs and injectors as applicable.
58 If required, refit the inlet and exhaust manifolds at this point. The valve clearances can also be checked now. The cylinder head is now ready for refitting as described in Part A, B or C of this Chapter (as applicable).

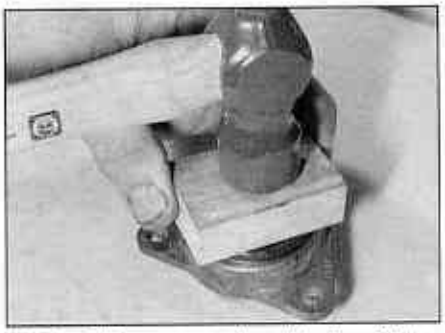
7 Pistons and connecting rods - removal, inspection, and big-end running clearance check

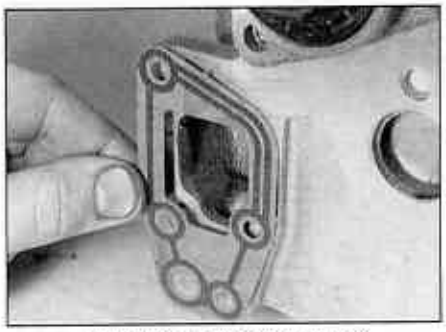
Removal

1 Remove the sump and gasket with reference to Chapter 2A, 2B or 2C.
2 Unbolt and remove the oil pump pick-up/filter screen assembly. On 16-valve engines, unbolt and remove the anti-vibration plate from the main bearing caps.
3 The big-end bearing shells can be renewed without having to remove the cylinder head, if the caps are unbolted and the piston/connecting rod pushed gently up the bore slightly (the crankpin being at its lowest point). If these shells are worn, however, the main bearing shells will almost certainly be worn as well. In this case, the crankshaft should be removed for inspection.
4 To remove the pistons and connecting rods, remove the cylinder head first with reference to Chapter 2A, 2B or 2C.
5 Check to see if the big-end caps and connecting rods are numbered. If no numbers are visible, use a hammer and centre-punch, paint or similar, to mark each connecting rod and big-end cap with its respective cylinder number on the flat machined surface provided.
6 Turn the crankshaft as necessary to bring the first crankpin to its lowest point, then unscrew the bolts and remove the big-end cap and shell bearing **(see illustrations)**.
7 Push the piston/rod assembly up the bore and out of the cylinder block. There is one reservation; if a wear ridge has developed at the top of the bores, remove this by careful scraping before trying to remove the piston/rod assemblies. The ridge will otherwise prevent removal, or will break the piston rings during the attempt.
8 Remove the remaining pistons/rods in a similar way. If the bearing shells are to be used again, tape them to their respective caps or rods **(see illustrations)**.

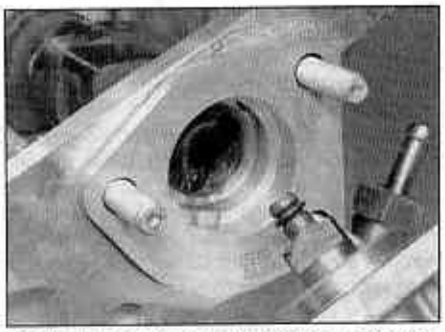

7.6a Unscrew the bolts . . .


7.6b . . . and remove the big-end cap and shell bearing


6.54a Fitting a new oil seal to the right-hand side mount

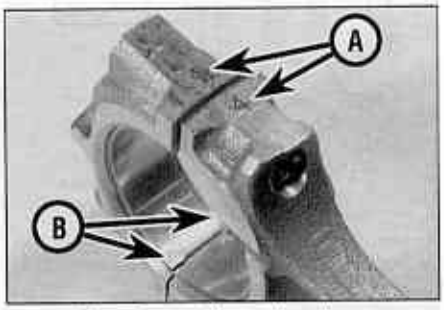

6.54b Coolant cover gasket


6.55a Fitting a new large O-ring on the vacuum pump

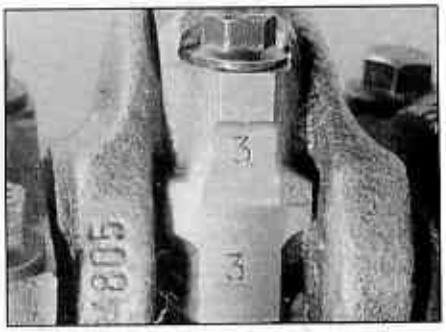

6.55b Fitting the vacuum pump - note the small O-ring on the end of the shaft

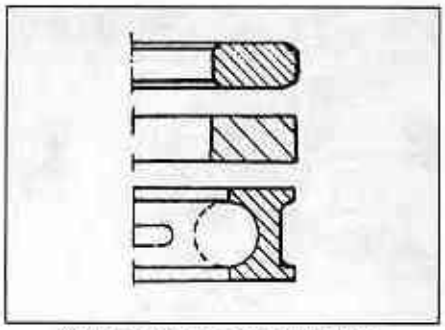
Inspection

9 Before the inspection process can begin, the piston/connecting rod assemblies must be cleaned, and the original piston rings removed from the pistons.
10 Carefully expand the old rings over the top of the pistons. The use of two or three old feeler blades will be helpful in preventing the rings dropping into empty grooves. Be careful not to scratch the piston with the ends of the ring. The rings are brittle, and will snap if they are spread too far. They are also very sharp - protect your hands and fingers. Always remove the rings from the top of the piston. Keep each set of rings with its piston if the old rings are to be re-used.

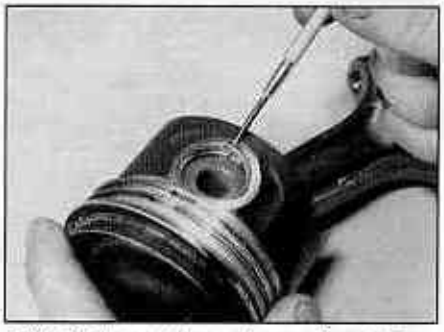


7.8a Connecting rod and cap (diesel engine) showing cylinder numbering (A) and shell location tags (B)


7.8b Connecting rod and cap numbers (petrol engine)



7.13 Positioning of piston rings (petrol engine)



7.22 Prising out the gudgeon pin retaining circlips

11 Scrape away all traces of carbon from the top of the piston. A hand-held wire brush (or a piece of fine emery cloth) can be used, once the majority of the deposits have been scraped away.

12 Remove the carbon from the ring grooves in the piston, using an old ring. Break the ring in half to do this (be careful not to cut your fingers - piston rings are sharp). Be careful to remove only the carbon deposits - do not remove any metal, and do not nick or scratch the sides of the ring grooves.

13 Once the deposits have been removed, clean the piston/connecting rod assembly with paraffin or a suitable solvent, and dry thoroughly. Make sure that the oil return holes in the ring grooves are clear. Fit the rings to their respective grooves making sure they are positioned the correct way round where applicable **(see illustration)**.

14 If the pistons and cylinder bores are not damaged or worn excessively, and if the cylinder block does not need to be rebored, the original pistons can be refitted. Normal piston wear shows up as even vertical wear on the piston thrust surfaces, and slight looseness of the top ring in its groove. New piston rings should always be used when the engine is reassembled.

15 Carefully inspect each piston for cracks around the skirt, around the gudgeon pin holes, and at the piston ring lands (between the ring grooves).

16 Look for scoring and scuffing on the piston skirt, holes in the piston crown, and burned areas at the edge of the crown. If the skirt is scored or scuffed, the engine may have been suffering from overheating, and/or abnormal combustion which caused excessively high operating temperatures. The cooling and lubrication systems should be checked thoroughly. Scorch marks on the sides of the pistons show that blow-by has occurred. A hole in the piston crown, or burned areas at the edge of the piston crown, indicates that abnormal combustion has been occurring. If any of the above problems exist, the causes must be investigated and corrected, or the damage will occur again. The causes may include incorrect ignition/injection pump timing, or a faulty injector (as applicable).

17 Corrosion of the piston, in the form of pitting, indicates that coolant has been leaking into the combustion chamber and/or the crankcase. Again, the cause must be corrected, or the problem may persist in the rebuilt engine.

18 Examine each connecting rod carefully for signs of damage, such as cracks around the big-end and small-end bearings. Check that the rod is not bent or distorted. Damage is highly unlikely, unless the engine has been seized or badly overheated. Detailed checking of the connecting rod assembly can only be carried out by an engine repair specialist with the necessary equipment.

19 Although not essential, it is highly recommended that the big-end cap bolts are renewed as a complete set prior to refitting.

20 On petrol engines piston and/or connecting rod renewal should be entrusted to an engine repair specialist, who will have the necessary tooling to remove and install the interference fit gudgeon pins.

21 On diesel engines, the gudgeon pins are of the floating type, secured in position by two circlips. On these engines, the pistons and connecting rods can be separated as follows.

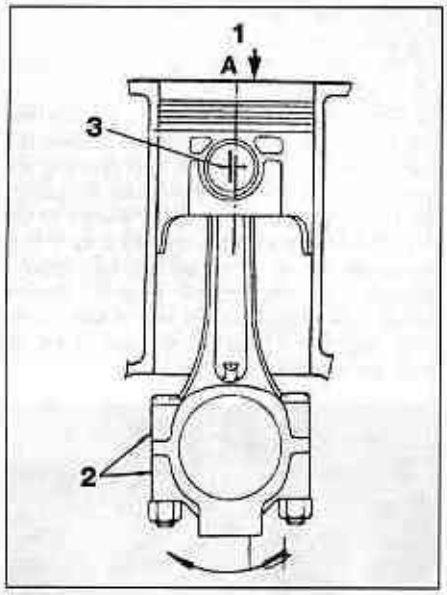
22 Using a small flat-bladed screwdriver, prise out the circlips, and push out the gudgeon pin **(see illustration)**. Identify the piston and rod to ensure correct reassembly. Discard the circlips - new ones *must* be used on refitting.

23 Examine the gudgeon pin and connecting rod small-end bearing bush for signs of wear or damage. Bush renewal should be entrusted to an engine overhaul specialist.

24 The connecting rods themselves should not be in need of renewal, unless seizure or some other major mechanical failure has occurred. Check the alignment of the connecting rods visually, and if the rods are not straight, take them to an engine overhaul specialist for a more detailed check.

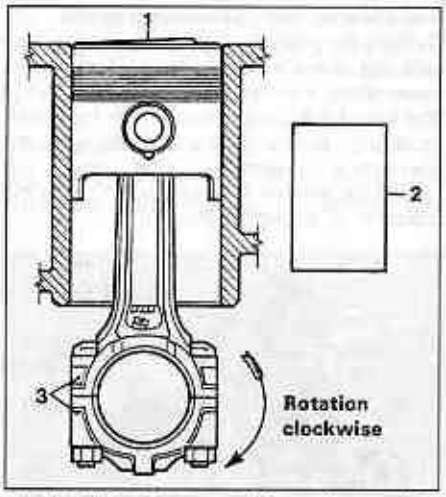
25 Examine all components, and obtain any new parts as necessary. If new pistons are purchased, they will be supplied complete with gudgeon pins and circlips.

26 On reassembly position the piston on the connecting rod as shown **(see illustrations)**.



7.26a Piston to connecting rod assembly (petrol engine)

1 Piston grade (A) and directional arrow on piston crown (towards timing belt end)
2 Connecting rod/cap matching numbers
3 Gudgeon pin offset in piston (0.9 to 1.1 mm)
Arrow indicates direction of crankshaft rotation



7.26b Piston to connecting rod assembly (diesel engine)

1 Piston crown
2 Injection pump location
3 Connecting rod/cap matching numbers

7.26c Piston crown on diesel engines

Apply a smear of clean engine oil to the gudgeon pin. Slide it into the piston and through the connecting rod small-end. Check that the piston pivots freely on the rod, then secure the gudgeon pin in position with two new circlips. Ensure that each circlip is correctly located in its groove in the piston.

Refitting and big-end bearing running clearance check

27 Prior to refitting the piston/connecting rod assemblies, it is recommended that the big-end bearing running clearance is checked as follows.

Big-end bearing running clearance check

28 Clean the backs of the bearing shells, and the bearing locations in both the connecting rod and bearing cap.

29 Press the bearing shells into their locations, ensuring that the tab on each shell engages in the notch in the connecting rod and cap. Take care not to touch any shell's bearing surface with your fingers. If the original bearing shells are being used for the check, ensure that they are refitted in their original locations. The clearance can be checked in either of two ways.

30 One method is to refit the big-end bearing cap to the connecting rod, ensuring that they are fitted the correct way around, with the bearing shells in place. With the cap retaining bolts correctly tightened, use an internal micrometer or vernier caliper to measure the internal diameter of each assembled pair of bearing shells. If the diameter of each corresponding crankshaft journal is measured and then subtracted from the bearing internal diameter, the result will be the big-end bearing running clearance.

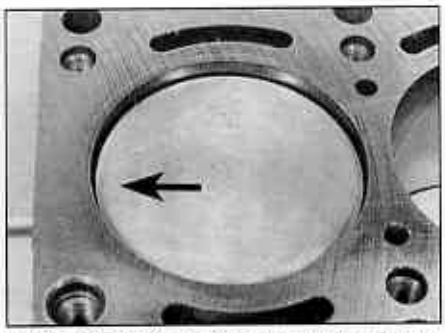
31 The second, and more accurate method is to use a product called Plastigauge. Ensure that the bearing shells are correctly fitted then place a strand of Plastigauge on each (cleaned) crankpin journal.

32 Refit the (clean) piston/connecting rod assemblies to the crankshaft, and refit the big-end bearing caps, using the marks made or noted on removal to ensure that they are fitted the correct way around.

33 Tighten the bearing cap bolts taking care not to disturb the Plastigauge or rotate the connecting rod during the tightening sequence.

34 Dismantle the assemblies without rotating the connecting rods. Use the scale printed on the Plastigauge envelope to obtain the big-end bearing running clearance.

35 If the clearance is significantly different from that expected, the bearing shells may be the wrong size (or excessively worn, if the original shells are being re-used). Make sure that no dirt or oil was trapped between the bearing shells and the caps or block when the clearance was measured. If the Plastigauge was wider at one end than at the other, the crankshaft journal may be tapered.



7.40a The arrow on the piston crown must point towards the timing belt end of the engine (petrol engine)

36 On completion, carefully scrape away all traces of the Plastigauge material from the crankshaft and bearing shells. Use your fingernail, or some other object which is unlikely to score the bearing surfaces.

Final piston/connecting rod refitting

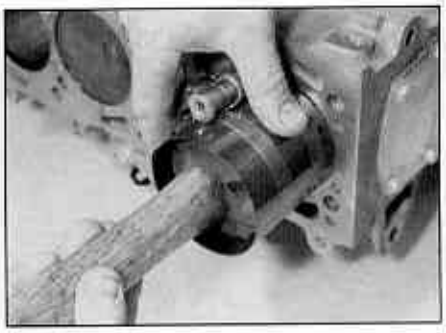
37 Ensure that the bearing shells are correctly fitted. If new shells are being fitted, ensure that all traces of the protective grease are cleaned off using paraffin. Wipe dry the shells and connecting rods with a lint-free cloth.

38 Lubricate the cylinder bores, the pistons, and piston rings, then lay out each piston/connecting rod assembly in its respective position.

39 Start with assembly No 1. Position the piston ring gaps 120° apart, then clamp them in position with a piston ring compressor.

40 Insert the piston/connecting rod assembly into the top of cylinder making sure it is the correct way round. On petrol engines, ensure that the arrow on the piston crown is pointing towards the timing belt end of the engine and on diesel engines, ensure that the cloverleaf-shaped cut-out on the piston crown is towards the front (oil filter side) of the cylinder block. Using a block of wood or hammer handle against the piston crown, tap the assembly into the cylinder until the piston crown is flush with the top of the cylinder **(see illustrations)**.

41 Ensure that the bearing shell is still correctly installed. Liberally lubricate the crankpin and both bearing shells. Taking care not to mark the cylinder bores, pull the piston/connecting rod assembly down the bore and onto the crankpin.



7.40b Inserting the piston/connecting rod assembly into the cylinder bore using a hammer handle (diesel engine)

42 Refit the big-end bearing cap, tightening its retaining bolts finger-tight at first. Note that the faces with the identification marks must match (which means that the bearing shell locating tabs abut each other).

43 Tighten the bearing cap retaining bolts evenly and progressively to the specified torque setting. On diesel engines tighten the bolts to the Stage 1 torque then angle-tighten them to the specified Stage 2 angle using an angle-measuring gauge. **(see illustrations)**

44 Once the bearing cap retaining bolts have been correctly tightened, rotate the crankshaft. Check that it turns freely; some stiffness is to be expected if new components have been fitted, but there should be no signs of binding or tight spots.

45 Refit the remaining three piston/connecting rod assemblies in the same way.

46 Refit the cylinder head, anti-vibration plate (16-valve engines), oil pump pick-up/filter screen assembly and sump with reference to Chapter 2A, 2B or 2C.

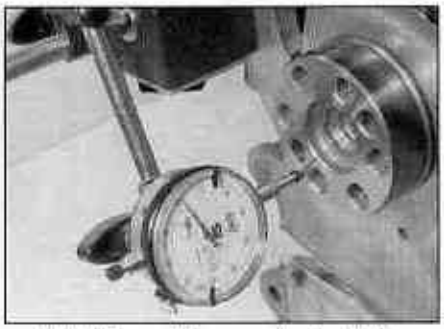
8 Crankshaft - removal and inspection

Removal

1 Remove the sump, oil pump and pick-up tube, and flywheel/driveplate with reference to the relevant Sections of Chapter 2 Parts A, B or C. On 16-valve engines, unbolt and remove the anti-vibration plate from the main bearing caps.

7.43a Torque-tightening the big-end bearing cap bolts (diesel engine)

7.43b Angle-tightening the big-end bearing cap bolts (diesel engine)



8.4 Using a dial gauge to check the crankshaft endfloat

8.6 Main bearing markings (petrol engine)

2 Remove the pistons and connecting rods, as described in Section 7. However, if no work is to be done on the pistons and connecting rods there is no need to remove the cylinder head, or to push the pistons out of the cylinder bores. The pistons should just be pushed far enough up the bores that they are positioned clear of the crankshaft journals.

3 Unbolt the crankshaft rear oil seal housing from the cylinder block and recover the gasket where fitted.

4 Before removing the crankshaft, check the endfloat using a dial gauge. Push the crankshaft fully one way, and then zero the gauge. Push the crankshaft fully the other way, and check the endfloat **(see illustration)**. The result can be compared with the specified amount, and will give an indication as to whether new thrustwashers are required.

5 If a dial gauge is not available, feeler blades can be used. First push the crankshaft fully towards the flywheel end of the engine, then use feeler blades to measure the gap - on petrol engines measure between the centre main bearing thrustwasher and the crankshaft web, and on diesel engines measure between the rear main bearing and the crankshaft web.

6 Note the markings on the main bearing caps which vary according to type. On 8-valve petrol engines there is one line on the cap nearest the timing belt end, two on the second cap, C on the centre cap, then three and four lines on the remaining caps **(see illustration)**. On 16-valve petrol engines, the caps are marked one to five with a series of lines (one line for the cap nearest the timing belt end, two for the next cap and so on). On diesel engines the caps are marked one to five in the same way but with notches instead of lines. Note also that on some diesel engines the cap nearest the timing belt end is not marked and the notches therefore start with No 2 cap.

7 Loosen and remove the main bearing cap retaining bolts, and lift off each bearing cap. Recover the lower bearing shells, and tape them to their respective caps for safe-keeping. On some diesel engines note that the centre main bearing cap bolts are longer than the other bolts.

8 Lift the crankshaft from the crankcase and remove the upper bearing shells from the crankcase. If the shells are to be used again, keep them identified for position. Also remove the thrustwashers from their position either side of the centre main bearing (petrol engines) or rear main bearing (diesel engines) **(see illustrations)**.

Inspection

9 Wash the crankshaft in a suitable solvent and allow it to dry. Flush the oil holes thoroughly, to ensure that they are not blocked - use a pipe cleaner or a needle brush if necessary. Remove any sharp edges from the edge of the holes which may damage the new bearings when they are installed.

10 Inspect the main bearing and crankpin journals carefully; if uneven wear, cracking, scoring or pitting are evident then the crankshaft should be reground by an engineering workshop, and refitted to the engine with undersize bearings.

11 Use a micrometer to measure the diameter of each main bearing journal. Taking a number of measurements on the surface of each journal will reveal if it is worn unevenly. Differences in diameter measured at 90° intervals indicate that the journal is out of round. Differences in diameter measured along the length of the journal, indicate that the journal is tapered. Again, if wear is detected, the crankshaft can be reground by an engineering workshop and refitted with undersize bearings.

12 Check the oil seal journals at either end of the crankshaft. If they appear excessively scored or damaged, they may cause the new seals to leak when the engine is reassembled. It may be possible to repair the journal; seek the advice of an engineering workshop.

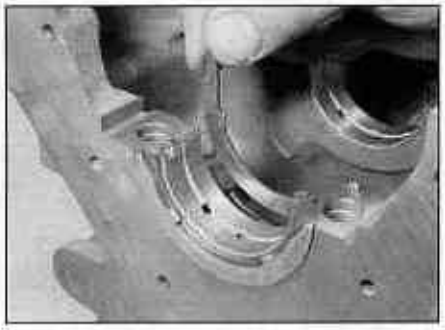
13 Measure the crankshaft runout by setting up a DTI gauge on the centre main bearing journal and rotating the shaft in V - blocks. The maximum deflection of the gauge will indicate the runout. Take precautions to protect the bearing journals and oil seal mating surfaces from damage during this procedure. A maximum runout figure is not quoted by the manufacturer, but use the figure of 0.05 mm as a rough guide. If the runout exceeds this figure, crankshaft renewal should be considered - consult your Fiat dealer or an engine rebuilding specialist for advice.

14 Refer to Section 10 for details of main and big-end bearing inspection.

9 Cylinder block/crankcase - cleaning and inspection

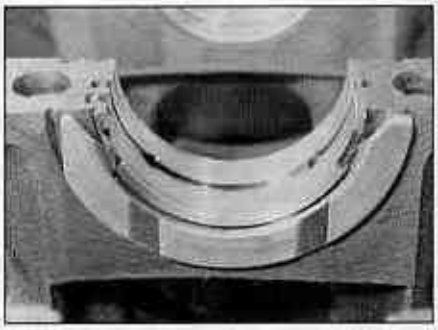
Cleaning

1 Remove all external components, brackets and electrical switches/sensors from the block including the rear engine plate, injection pump/oil filter bracket and gasket, intermediate shaft bracket, oil vapour breather casing, and coolant pump. Also unbolt and remove the oil return tube from the crankcase **(see illustrations)**. For complete cleaning, the core plugs should ideally be removed. Drill a small hole in the plugs, then insert a self-tapping screw into the hole. Pull out the plugs by

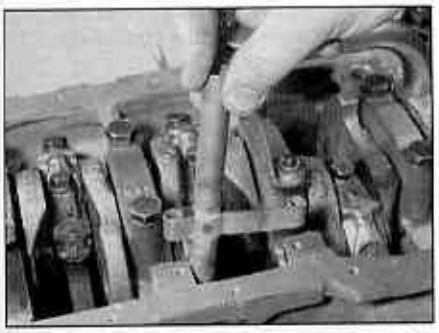


8.8a Removing the thrustwashers . . .

8.8b . . . and upper bearing shells (diesel engine)

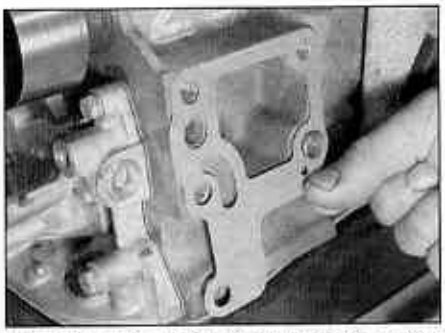


8.8c Thrustwashers located on the centre main bearing (petrol engine)



9.1a Removing the oil return tube from the crankcase

9.1b Removing the injection pump/oil filter bracket



9.1c Removing the injection pump/oil filter bracket gasket from the cylinder block

pulling on the screw with a pair of grips, or by using a slide hammer.

2 Where applicable, undo the retaining bolts and remove the piston oil jet spray tubes from inside the cylinder block.

3 Scrape all traces of gasket from the cylinder block/crankcase, taking care not to damage the gasket/sealing surfaces.

4 Remove all oil gallery plugs (where fitted). The plugs are usually very tight - they may have to be drilled out, and the holes re-tapped. Use new plugs when the engine is reassembled.

5 If the block is very dirty have it steam-cleaned, otherwise use paraffin to clean it.

6 Clean all oil holes and oil galleries again and dry thoroughly, then apply a light film of oil to all mating surfaces, to prevent rusting. Smear the cylinder bores with a light coating of oil.

7 All threaded holes must be clean, to ensure accurate torque readings during reassembly. To clean the threads, run the correct-size tap into each of the holes to remove rust, corrosion, thread sealant or sludge, and to restore damaged threads **(see illustration)**. If possible, use compressed air to clear the holes of debris produced by this operation.

8 Apply suitable sealant to the new oil gallery plugs, and insert them into the holes in the block. Tighten them securely.

9 Where applicable, refit the piston oil jet spray tubes to the cylinder block, and securely tighten the retaining bolts. Bend over the tabs to lock the bolts **(see illustration)**.

10 Fit the new core plugs with sealant applied to their perimeters before using a suitable metal tube to drive them into position.

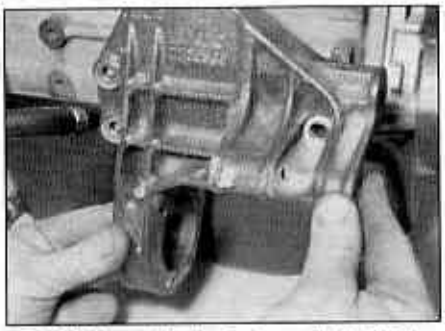
11 Refit the oil return tube to the crankcase and tighten the mounting bolts.

12 Refit the injection pump/oil filter bracket together with a new gasket and tighten the bolts.

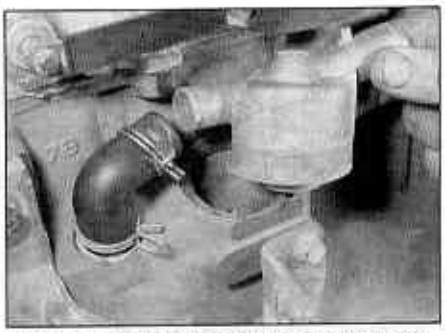
13 Refit the rear engine plate and tighten the bolts. Also refit any other removed brackets etc.

Inspection

14 Visually check the cylinder block for cracks and corrosion. Look for stripped threads in the threaded holes. If there has been any history of internal water leakage, it may be worthwhile having an engine overhaul



9.1d Removing the intermediate shaft bracket



9.1e Removing the oil vapour breather casing

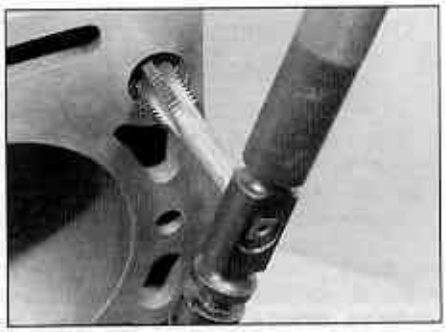
specialist check it with special equipment.

15 Check each cylinder bore for scuffing and scoring. Check for signs of a wear ridge at the top of the cylinder, indicating that the bore is excessively worn.

16 If the necessary measuring equipment is available, measure the bore diameters at the top (just under the wear ridge), centre, and bottom, parallel to the crankshaft axis.

17 Next, measure the bore diameters at the same three locations, at right-angles to the crankshaft axis. If there is any doubt about the condition of the cylinder bores seek the advice of a Fiat dealer or suitable engine reconditioning specialist.

18 If the engine is not going to be reassembled right away, cover it with a large plastic bag to keep it clean and prevent rusting. If the engine is ready for reassembly, refit all the components and brackets removed.



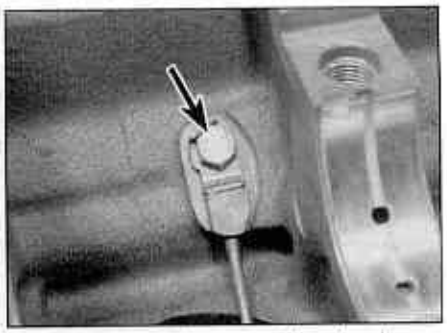
9.7 To clean the cylinder block threads, run a correct-size tap into the holes

10 Main and big-end bearings - inspection and selection

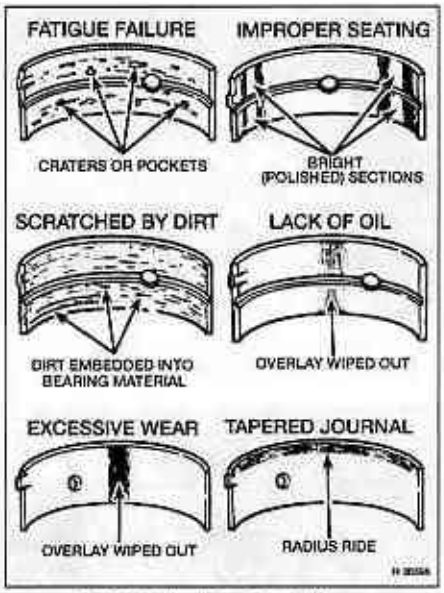
Inspection

1 Even though the main and big-end bearings should be renewed during the engine overhaul, the old bearings should be retained for close examination, as they may reveal valuable information about the condition of the engine **(see illustration overleaf)**. The bearing shells are available in different thicknesses to match the diameter of the journal.

2 Bearing failure can occur due to lack of lubrication, the presence of dirt or other foreign particles, overloading the engine, or corrosion. Regardless of the cause of bearing



9.9 Piston oil jet spray tube showing locking tab



10.1 Typical bearing failures

failure, the cause must be corrected (where applicable) before the engine is reassembled, to prevent it from happening again.

3 When examining the bearing shells, remove them from the cylinder block/crankcase, the main bearing caps, the connecting rods and the connecting rod big-end bearing caps. Lay them out on a clean surface in the same general position as their location in the engine. This will enable you to match any bearing problems with the corresponding crankshaft journal. *Do not* touch any shell's bearing surface with your fingers while checking it.

4 Dirt and other foreign matter gets into the engine in a variety of ways. It may be left in the engine during assembly, or it may pass through filters or the crankcase ventilation system. It may get into the oil, and from there into the bearings. Metal chips from machining operations and normal engine wear are often present. Abrasives are sometimes left in engine components after reconditioning, especially when parts are not thoroughly cleaned using the proper cleaning methods. Whatever the source, these foreign objects often end up embedded in the soft bearing material, and are easily recognised. Large particles will not embed in the bearing, and will score or gouge the bearing and journal. The best prevention for this cause of bearing failure is to clean all parts thoroughly, and keep everything spotlessly-clean during engine assembly. Frequent and regular engine oil and filter changes are also recommended.

5 Lack of lubrication (or lubrication breakdown) has a number of interrelated causes. Excessive heat (which thins the oil), overloading (which squeezes the oil from the bearing face) and oil leakage (from excessive bearing clearances, worn oil pump or high engine speeds) all contribute to lubrication breakdown. Blocked oil passages, which can be the result of misaligned oil holes in a bearing shell, will also oil-starve a bearing, and destroy it. When lack of lubrication is the cause of bearing failure, the bearing material is wiped or extruded from the steel backing of the bearing. Temperatures may increase to the point where the steel backing turns blue from overheating.

6 Driving habits can have a definite effect on bearing life. Full-throttle, low-speed operation (labouring the engine) puts very high loads on bearings, tending to squeeze out the oil film. These loads cause the bearings to flex, which produces fine cracks in the bearing face (fatigue failure). Eventually, the bearing material will loosen in pieces, and tear away from the steel backing.

7 Short-distance driving leads to corrosion of bearings, because insufficient engine heat is produced to drive off the condensed water and corrosive gases. These products collect in the engine oil, forming acid and sludge. As the oil is carried to the engine bearings, the acid attacks and corrodes the bearing material.

8 Incorrect bearing installation during engine assembly will lead to bearing failure as well. Tight-fitting bearings leave insufficient bearing running clearance, and will result in oil starvation. Dirt or foreign particles trapped behind a bearing shell result in high spots on the bearing, which lead to failure.

9 *Do not* touch any shell's bearing surface with your fingers during reassembly; there is a risk of scratching the delicate surface, or of depositing particles of dirt on it.

10 As mentioned at the beginning of this Section, the bearing shells should be renewed as a matter of course during engine overhaul; to do otherwise is false economy.

Selection

11 Main and big-end bearings are available in standard sizes and a range of undersizes to suit reground crankshafts - refer to the Specifications for details. The engine reconditioner will select the correct bearing shells for a machined crankshaft.

12 The running clearances can be checked when the crankshaft is refitted with its new bearings.

11 Engine overhaul - reassembly sequence

1 Before reassembly begins, ensure that all new parts have been obtained, and that all necessary tools are available. Read through the entire procedure to familiarise yourself with the work involved, and to ensure that all items necessary for reassembly of the engine are at hand. In addition to all normal tools and materials, thread-locking compound will be needed. A tube of sealant will also be required for the joint faces that are fitted without gaskets.

2 In order to save time and avoid problems, engine reassembly can be carried out in the following order:

a) Crankshaft (Section 12).
b) Piston/connecting rod assemblies (Section 7).
c) Oil pump (see Part A, B or C - as applicable).
d) Sump (see Part A, B or C - as applicable).
e) Flywheel/driveplate (see Part A, B or C - as applicable).
f) Cylinder head (see Part A, B or C - as applicable).
g) Coolant pump (see Chapter 3)
h) Timing belt tensioner and sprockets, and timing belt (See Part A, B or C - as applicable).
i) Engine external components.

3 At this stage, all engine components should be absolutely clean and dry, with all faults repaired. The components should be laid out on a completely clean work surface.

12 Crankshaft - refitting and main bearing running clearance check

Crankshaft - initial refitting

1 Crankshaft refitting is the first stage of engine reassembly following overhaul. At this point, it is assumed that the crankshaft, cylinder block/crankcase and bearings have been cleaned, inspected and reconditioned or renewed.

2 Place the cylinder block on a clean, level work surface, with the crankcase facing upwards. Where necessary, unbolt the bearing caps and lay them out in order to ensure correct reassembly. If they are still in place, remove the bearing shells from the caps and the crankcase and wipe out the inner surfaces with a clean rag - they must be kept spotlessly clean.

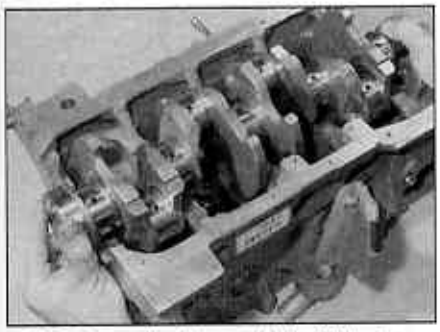
3 Clean the rear surface of the new bearing shells with a rag and fit them on the bearing saddles. Ensure that the orientation lugs on the shells engage with the recesses in the saddles and that the oil holes are correctly aligned. Do not hammer or otherwise force the bearing shells into place. It is critically important that the surfaces of the bearings are kept free from damage and contamination.

4 Give the newly fitted bearing shells and the crankshaft journals a final clean with a rag. Check that the oil holes in the crankshaft are free from dirt, as any left here will become embedded in the new bearings when the engine is first started.

5 Carefully lay the crankshaft in the crankcase, taking care not to dislodge the bearing shells **(see illustration)**.

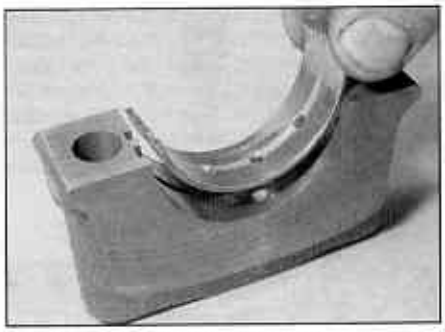
Main bearing running clearance check

6 When the crankshaft and bearings are refitted, a clearance must exist between them

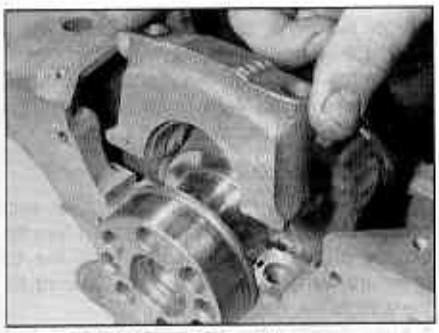


12.5 Lowering the crankshaft into the crankcase

12.7 Lay the Plastigauge on the main bearing journals

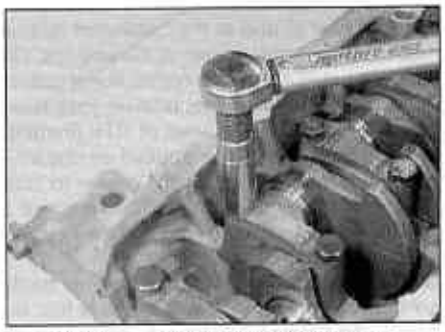


12.8 Locating a lower half main bearing shell in its cap



12.9 Fit the main bearing caps . . .

12.10a . . . insert the bolts . . .



12.10b . . . and torque-tighten them

to allow lubricant to circulate. This clearance is impossible to check using feeler blades, however Plastigauge can be used. This consists of a thin strip of soft plastic that is crushed between the bearing shells and journals when the bearing caps are tightened up. Its width then indicates the size of the clearance gap.

7 Cut off five pieces of Plastigauge, just shorter than the length of the crankshaft journal. Lay a piece on each journal, in line with its axis **(see illustration)**.

8 Wipe off the rear surfaces of the new lower half main bearing shells and fit them to the main bearing caps, again ensuring that the locating lugs engage correctly **(see illustration)**.

9 Fit the caps in their correct locations on the bearing saddles, using the manufacturers markings as a guide **(see illustration)**. Ensure that they are correctly orientated - the caps should be fitted such that the recesses for the bearing shell locating lugs are on the same side as those in the bearing saddle.

10 Insert and tighten the bolts until they are all correctly torqued **(see illustrations)**. Do not allow the crankshaft to rotate at all whilst the Plastigauge is in place. Progressively unbolt the bearing caps and remove them, taking care not to dislodge the Plastigauge.

11 The width of the crushed Plastigauge can now be measured, using the scale provided **(see illustration)**. Use the correct scale, as both imperial and metric are printed. This measurement indicates the running clearance - compare it with that listed in the Specifications.

If the clearance is outside the tolerance, it may be due to dirt or debris trapped under the bearing surface; try cleaning them again and repeat the clearance check. If the results are still unacceptable, re-check the journal diameters and the bearing sizes. Note that if the Plastigauge is thicker at one end, the journals may be tapered and as such, will require regrinding.

12 When you are satisfied that the clearances are correct, carefully remove the remains of the Plastigauge from the journals and bearings faces. Use a soft, plastic or wooden scraper as anything metallic is likely to damage the surfaces.

Crankshaft - final refitting

13 Lift the crankshaft out of the crankcase. Wipe off the surfaces of the bearings in the crankcase and the bearing caps. Fit the thrust bearings using grease to hold them in position. Ensure they are seated correctly in the machined recesses, with the oil grooves facing outwards

14 Liberally coat the bearing shells in the crankcase with clean engine oil **(see illustration)**.

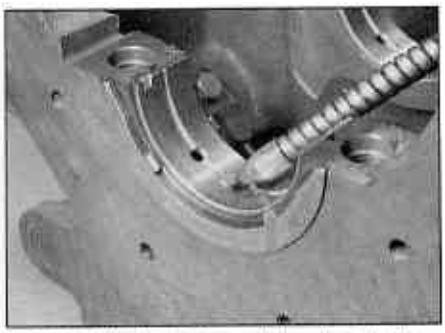
15 Lower the crankshaft into position in the crankcase.

16 Lubricate the lower bearing shells in the main bearing caps with clean engine oil. Make sure that the locating lugs on the shells are still engaged with the corresponding recesses in the caps.

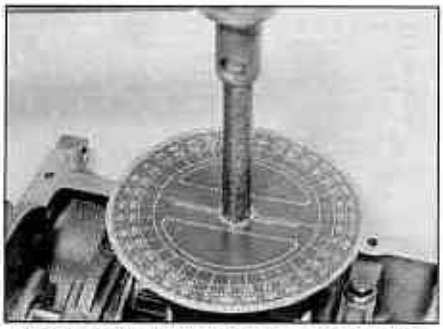
17 Fit the main bearing caps in the correct order and orientation. Insert the bearing cap bolts and hand tighten them only.

18 Working from the centre bearing cap outwards, tighten the retaining bolts to their specified torque. On petrol engines, tighten all the bolts to the first stage, then angle-tighten them to the Stage 2 angle **(see illustration)**.

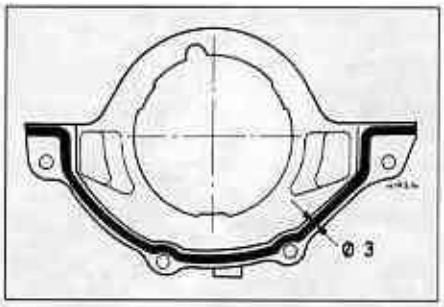
12.11 Use the special scale card to determine the main bearing running clearance



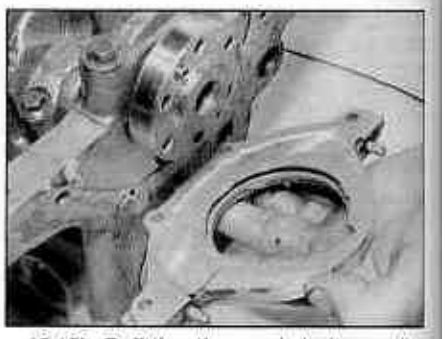
12.14 Lubricate the main bearing shells before final assembly



12.18 Angle-tightening the main bearing cap bolts (petrol engine)



12.19a Application area for silicone instant gasket on crankshaft rear oil seal housing (petrol engine)



12.19b Refitting the crankshaft rear oil seal housing (petrol engine)

19 Fit a new oil seal to the crankshaft rear oil seal housing. Apply grease to the seal lips. On 1108 cc petrol engines a conventional gasket is not used at the oil seal retainer joint face, but a 3 mm diameter bead of RTV (instant) silicone gasket must be applied as shown - allow at least one hour for the gasket to cure before oil contacts it. On all other engines a gasket is fitted . Securely tighten the housing bolts **(see illustrations)**.

20 Check that the crankshaft rotates freely by turning it by hand. If resistance is felt, re-check the running clearances, as described above.

21 Carry out a check of the crankshaft endfloat as described at the beginning of Section 8. If the thrust surfaces of the crankshaft have been checked and new thrust washers have been fitted, then the endfloat should be within specification.

22 Refit the pistons and connecting rods as described in Section 7.

23 Refit the flywheel/driveplate, anti-vibration plate (16-valve engines), oil pump and pick-up tube, and sump with reference to the relevant Sections of Parts A, B or C of this Chapter.

13 Engine - initial start-up after overhaul and reassembly

1 With the engine refitted in the vehicle, double-check the engine oil and coolant levels. Make a final check that everything has been reconnected, and that there are no tools or rags left in the engine compartment.

Petrol engine models

2 Remove the spark plugs, then disable the ignition system by disconnecting the LT wiring plug to the ignition coils.

3 Turn the engine on the starter until the oil pressure warning light goes out. Refit the spark plugs, and reconnect the LT wiring.

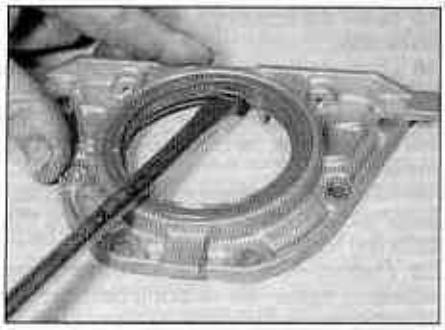
Diesel engine models

4 Disconnect the wiring from the stop solenoid on the injection pump, then turn the engine on the starter motor until the oil pressure warning light goes out. Reconnect the wire to the stop solenoid.

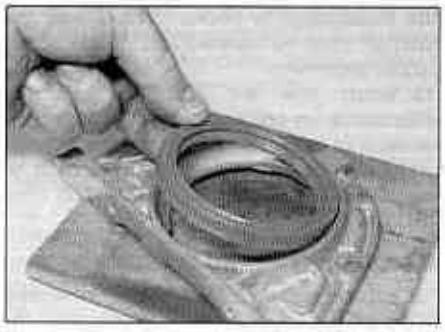
5 Fully depress the accelerator pedal, turn the ignition key to its first position and wait for the preheating warning light to go out.

All models

6 Start the engine, noting that this may take a little longer than usual, due to the fuel system components having been disturbed.



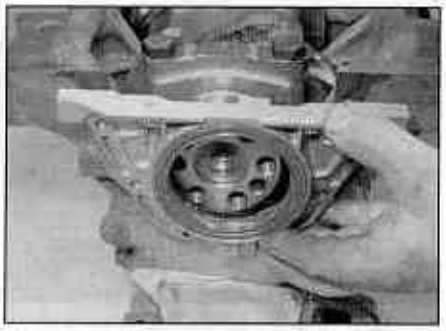
12.19c On diesel engines use a screwdriver to prise out the rear oil seal



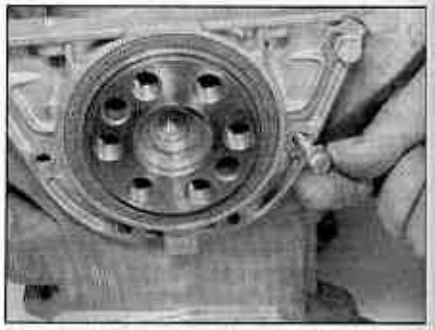
12.19d Locate the new oil seal in the housing (diesel engine) . . .

12.19e . . . and use a block of wood to drive it in

12.19f On Diesel engines fit the gasket to the cylinder block . . .



12.19g . . . then locate the rear oil seal housing . . .



12.19h . . . and insert the bolts

7 While the engine is idling, check for fuel, water and oil leaks. Don't be alarmed if there are some odd smells and smoke from parts getting hot and burning off oil deposits.

8 Assuming all is well, keep the engine idling until hot water is felt circulating through the top hose, then switch off the engine.

9 Recheck the oil and coolant levels as described in Chapter 1A or 1B, and top-up as necessary.

10 There is no need to re-tighten the cylinder head bolts once the engine has first run after reassembly.

11 If new pistons, rings or crankshaft bearings have been fitted, the engine must be treated as new, and run-in for the first 500 miles (800 km). *Do not* operate the engine at full-throttle, or allow it to labour at low engine speeds in any gear. It is recommended that the oil and filter be changed at the end of this period.

Chapter 3
Cooling, heating and ventilation systems

Contents

Degrees of difficulty

Easy, suitable for novice with little experience 

Fairly easy, suitable for beginner with some experience 

Fairly difficult, suitable for competent DIY mechanic 

Difficult, suitable for experienced DIY mechanic 

Very difficult, suitable for expert DIY or professional 

Specifications

General

Expansion tank relief valve opening pressure	0.98 bar
Coolant pump impeller-to-casing clearance:	
Diesel engine models	0.53 to 1.37 mm
Petrol engine models	0.4 to 0.9 mm

Thermostat

Diesel engine models:	
Opening temperature:	
Starts to open	78 to 82°C
Fully open	88°C
Maximum valve travel (approximate)	7.5 mm
Petrol engine models:	
Opening temperature:	
1108 cc and 1242 cc (8-valve) engines:	
Starts to open	85 to 89°C
Fully open	100°C
1242 cc (16-valve) engines:	
Starts to open	81 to 85°C
Fully open	103°C
Maximum valve lift (approximate)	7.5 mm

Electric cooling fan

Petrol engine models with single speed fan:	
Cut-in temperature	90 to 94°C
Cut-out temperature	85 to 89°C
Diesel engine models with twin speed fan:	
Cut-in temperature:	
Primary fan	86 to 90° C
Secondary fan	90 to 94°C
Cut-out temperature:	
Primary fan	81 to 85°C
Secondary fan	85 to 89°C

Torque wrench settings

	Nm	lbf ft
Coolant pump pulley securing bolts (diesel engine models)	23	17
Coolant pump securing bolts:		
Diesel engine models	23	17
Petrol engine models	8	6
Coolant pump securing nuts (petrol engine models)	10	7

1 General information and precautions

General information

The engine cooling/cabin heating system is of pressurised type, comprising a coolant pump driven by the camshaft timing belt (petrol engine models) or auxiliary drivebelt (diesel engine models), a crossflow radiator, a coolant expansion tank, an electric cooling fan, a thermostat, heater matrix, and all associated hoses and switches.

The system functions as follows: the coolant pump circulates cold water around the cylinder block and head passages, and through the inlet manifold, heater matrix and throttle body to the thermostat housing.

When the engine is cold, the thermostat remains closed and prevents coolant from circulating through the radiator. When the coolant reaches a predetermined temperature, the thermostat opens, and the coolant passes through the top hose to the radiator. As the coolant circulates through the radiator, it is cooled by the in-rush of air when the car is in forward motion. The airflow is supplemented by the action of the electric cooling fan, when necessary. As the temperature of the coolant in the radiator drops, it flows to the bottom of the radiator by convection, and passes out through the bottom hose to the coolant pump - the cycle is then repeated.

When the engine is at normal operating temperature, the coolant expands, and some of it is displaced into the expansion tank. Coolant collects in the tank, and is returned to the radiator when the system cools. On petrol engine models, the expansion tank is integrated into the side of the radiator. On diesel engine models, and certain petrol engine models with air conditioning, the tank is a separate unit, mounted on the right hand side of the engine compartment.

On turbo diesel engine models, the coolant is also passed through a supplementary engine oil cooler, to assist in controlling the engine lubricant temperature.

The electric cooling fan mounted in front of the radiator is controlled by a thermostatic switch. At a predetermined coolant temperature, the switch/sensor actuates the fan to provide additional airflow through the radiator. The switch cuts the electrical supply to the fan when the coolant temperature has dropped below a preset threshold (see Specifications).

Precautions

⚠ ***Warning: Do not attempt to remove the expansion tank pressure cap, or to disturb any part of the cooling system, while the engine is hot, as there is a high risk of scalding. If the expansion tank pressure cap must be removed before the engine and radiator have fully cooled (even though this is not recommended), the pressure in the cooling system must first be relieved. Cover the cap with a thick layer of cloth, to avoid scalding, and slowly unscrew the pressure cap until a hissing sound is heard. When the hissing stops, indicating that the pressure has reduced, slowly unscrew the pressure cap until it can be removed; if more hissing sounds are heard, wait until they have stopped before unscrewing the cap completely. At all times, keep your face well away from the pressure cap opening, and protect your hands.***

⚠ ***Warning: Do not allow antifreeze to come into contact with your skin, or with the painted surfaces of the vehicle. Rinse off spills immediately, with plenty of water. Never leave antifreeze lying around in an open container, or in a puddle in the driveway or on the garage floor. Children and pets are attracted by its sweet smell, but antifreeze can be fatal if ingested.***

⚠ ***Warning: If the engine is hot, the electric cooling fan may start rotating even if the engine and ignition are switched off. Be careful to keep your hands, hair, and any loose clothing well clear when working in the engine compartment.***

2 Cooling system hoses - disconnection and renewal

1 The number, routing and pattern of hoses will vary according to model, but the same basic procedure applies. Before commencing work, make sure that the new hoses are to hand, along with new hose clips if needed. It is good practice to renew the hose clips at the same time as the hoses.

2 Drain the cooling system, as described in Chapter 1A or 1B, saving the coolant if it is fit for re-use. Apply a little penetrating oil onto the hose clips if they are corroded.

3 Release the hose clips from the hose concerned. Three types of clip are used; worm-drive, spring and 'sardine-can'. The worm-drive clip is released by turning its screw anti-clockwise. The spring clip is released by squeezing its tags together with pliers, at the same time working the clip away from the hose stub. The sardine-can clips are not re-usable, and are best cut off with snips or side cutters.

4 Unclip any wires, cables or other hoses which may be attached to the hose being removed. Make notes for reference when reassembling if necessary.

5 Release the hose from its stubs with a twisting motion. Be careful not to damage the stubs on delicate components such as the radiator, or thermostat housings. If the hose is stuck fast, the best course is often to cut it off using a sharp knife, but again be careful not to damage the stubs.

6 Before fitting the new hose, smear the stubs with washing-up liquid or a suitable rubber lubricant to aid fitting. Do not use oil or grease, which may attack the rubber.

7 Fit the hose clips over the ends of the hose, then fit the hose over its stubs. Work the hose into position. When satisfied, locate and tighten the hose clips.

8 Refill the cooling system as described in Chapter 1A or 1B. Run the engine, and check that there are no leaks.

9 Recheck the tightness of the hose clips on any new hoses after a few hundred miles.

10 Top-up the coolant level if necessary.

3 Radiator - removal, inspection and refitting

Removal

Note: *If leakage is the reason for removing the radiator, bear in mind that minor leaks can often be cured using proprietary radiator sealing compound, with the radiator in situ.*

1 Disconnect the battery negative terminal (refer to *Disconnecting the battery* in the Reference Section of this manual). On diesel engine models, unbolt the relay bracket from the side of the battery tray.

2 Drain the cooling system as described in Chapter 1A or 1B.

3 On 1242 cc (16-valve) petrol engine models, remove the air cleaner and inlet ducts as described in Chapter 4B.

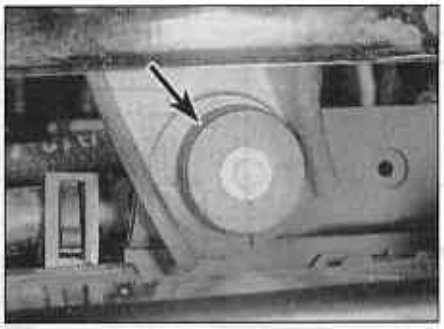
4 Slacken the clips and disconnect the top and bottom coolant hoses from the radiator. In addition on diesel engine models, and petrol engine models with a remotely-sited expansion tank, disconnect the expansion tank coolant hose from the right hand side of the radiator **(see illustrations)**.

5 Unscrew the fixings and lift the plastic trim panel from above the front bumper. Unscrew the bolt(s) securing the radiator to the upper body panel **(see illustration)**. Note that the radiator and cooling fan assembly share the same upper mounting bolt.

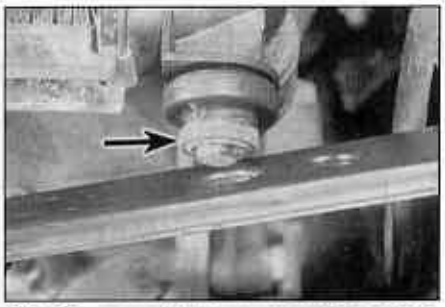
6 Unbolt the cooling fan(s) and shroud assembly from the rear of the radiator, as described in Section 5.

3.4a Slacken the clip and disconnect the radiator bottom hose

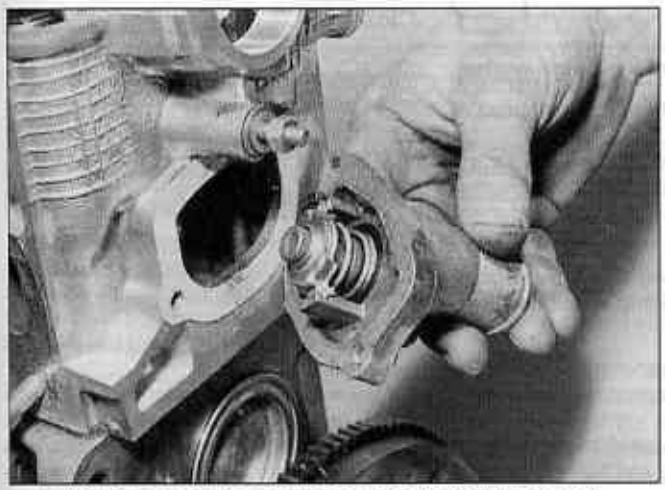
3.4b On diesel engine models, disconnect the expansion tank coolant hose from the radiator



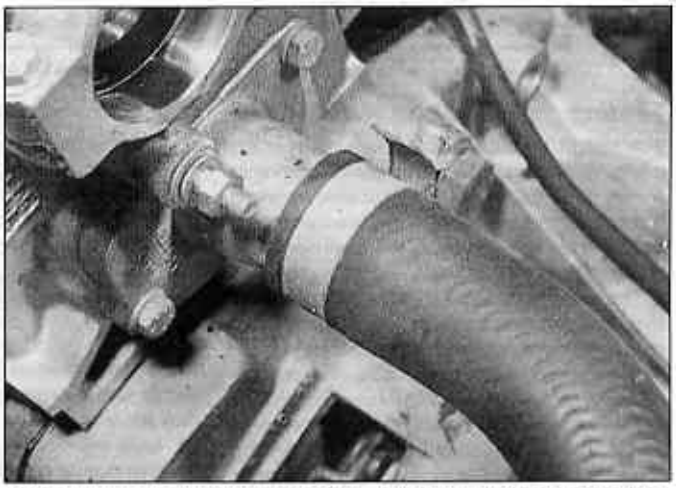
3.5 Unscrew the bolts securing the radiator to the upper body panel



3.8 Disengage the lower mountings studs from the engine compartment lower crossmember



4.6a Removing the thermostat housing (petrol engine)



4.6b Thermostat housing location - ignition distributor removed for clarity (petrol engine)

7 Withdraw the mounting brackets (where applicable), and recover the upper mounting rubbers.

8 Carefully tilt the radiator back towards the engine, then disengage the lower mountings studs from the crossmember and lift the radiator from the engine compartment **(see illustration)**. Recover the lower mounting rubbers if they are loose.

Inspection

9 If the radiator has been removed due to suspected blockage, it may be flushed out as described in Chapter 1A or 1B. Clean dirt and debris from the radiator fins, using an air line (in which case, wear eye protection) or a soft brush. Be careful, as the fins are sharp, and can also be easily damaged.

10 If necessary, a radiator specialist can perform a flow test on the radiator, to establish whether an internal blockage exists.

11 A leaking radiator must be referred to a specialist for permanent repair. Do not attempt to weld or solder a leaking radiator, as damage to the plastic components may result. **Note:** *In an emergency, minor leaks from the radiator can often be cured by using a suitable radiator sealing compound, in accordance with its manufacturer's instructions, with the radiator in situ.*

12 If the radiator is to be sent for repair or is to be renewed, remove all hoses (and where applicable, the cooling fan switch).

13 Inspect the radiator mounting rubbers, and renew them if necessary.

Refitting

14 Refitting is a reversal of removal, bearing in mind the following points:

a) Ensure that the radiator lower lugs engage correctly with the lower mounting rubbers.

b) On completion, refill the cooling system as described in Chapter 1A or 1B.

4 Thermostat - removal, testing and refitting

General

1 The thermostat housing is bolted to the left hand end of the cylinder head. The thermostat itself cannot be separated from the housing and can only be renewed as part of a complete assembly.

Removal

2 Drain the cooling system as described in Chapter 1A or 1B.

3 On diesel engine models, unbolt the wiring harness/fuel hose support bracket from the housing. On 1242 cc (16-valve) petrol engine models, remove the air cleaner and inlet ducts as described in Chapter 4B.

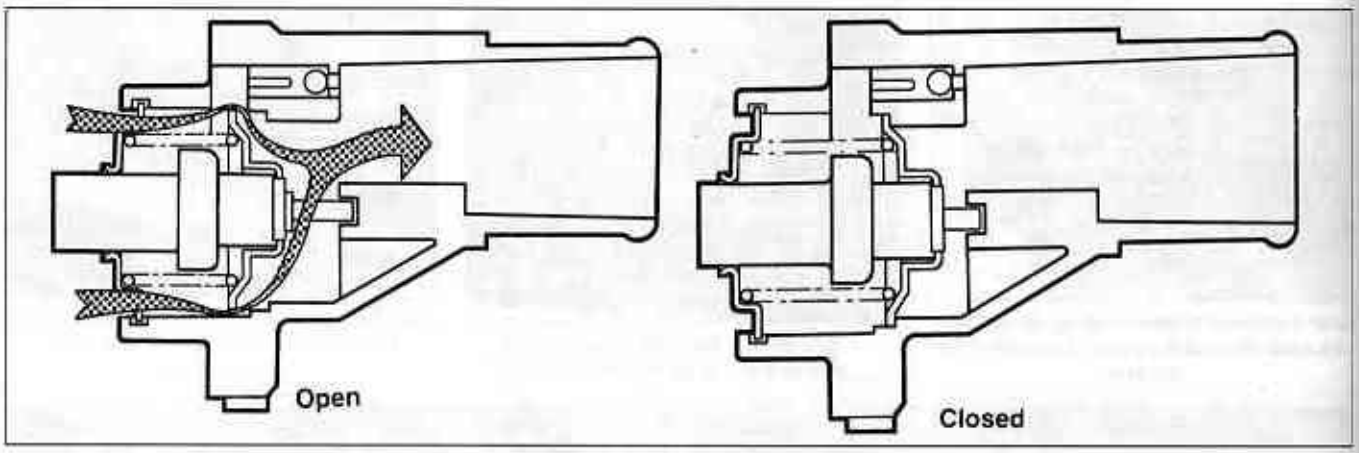
4 Slacken the clip(s) and detach the coolant hose(s) from the thermostat housing. Make a careful note of their orientation to aid refitting.

5 Where applicable, disconnect the wiring plug from the cooling fan switch and coolant temperature sensor, which are threaded into the thermostat cover.

6 Unscrew the securing bolts, and remove the thermostat housing from the cylinder head **(see illustrations)**. If it sticks, tap it gently first on one side and then the other to free it - do not lever between the mating faces. Recover the remains of the old gasket.

4.6c Removing the thermostat housing (diesel engine)

3



4.7a Thermostat operation (petrol engine)

Testing

7 A rough test of the thermostat may be made by suspending it with a piece of string in a container full of water. Heat the water to bring it to the boil and observe the movement of the valve shaft through the inlet port **(see illustrations)**.

8 The thermostat valve must be fully open, by the time the water boils. If not, renew the complete thermostat/housing assembly.

9 If a thermometer is available, the precise opening temperature of the thermostat may be determined; compare with the figures given in the Specifications. The opening temperature is also marked on the thermostat housing.

10 Note that a thermostat which fails to close completely as the water cools must also be renewed.

Refitting

11 Ensure that the cylinder head and thermostat housing mating surfaces are completely clean and free from all traces of the old gasket material.

12 Lay a new gasket in position on the cylinder head, then fit the thermostat housing and insert retaining bolts, tightening them securely.

Caution: Do not over-tighten the retaining bolts, as the alloy casting could easily be damaged

13 Where applicable, transfer the cooling fan switch and coolant temperature sensor to the new housing.

14 Refit the coolant hose(s) to the ports on the thermostat housing and tighten the clips securely.

15 Where applicable, refit the harness/hose support bracket to the thermostat housing and tighten the bolts securely. Also refit the air cleaner and inlet ducts as described in Chapter 4B

15 Refill the cooling system as described in Chapter 1A or 1B.

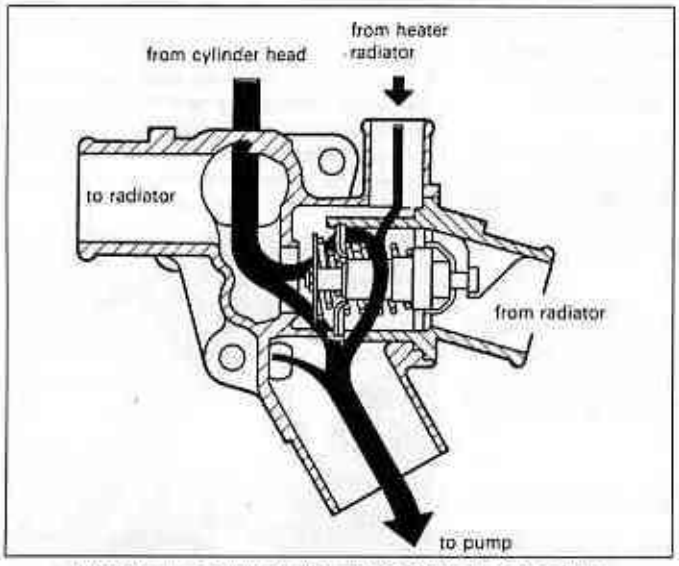
5 Electric cooling fan(s) - testing, removal and refitting

Testing

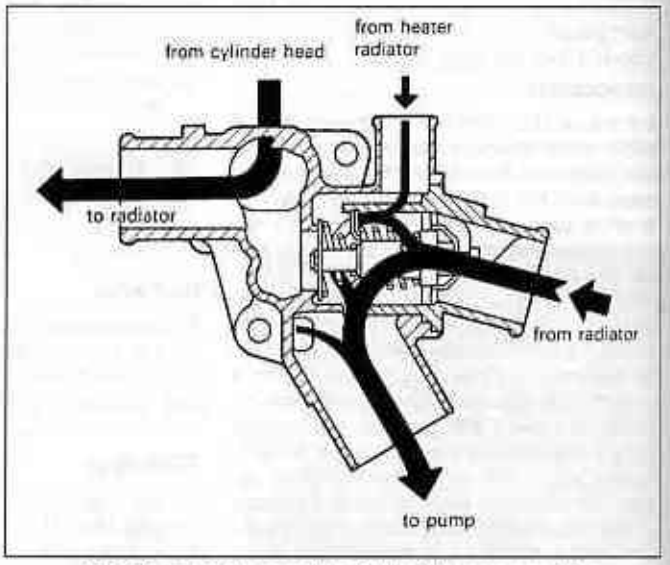
1 Detailed fault diagnosis should be carried out by a Fiat dealer using dedicated test equipment, but basic diagnosis can be carried out as follows.

2 If the fan does not appear to work, run the engine until normal operating temperature is reached, then allow it to idle. The fan should cut in within a few minutes (before the temperature gauge needle enters the red section). If not, switch off the engine and disconnect the cooling fan motor wiring connector.

3 The motor can be tested by disconnecting it from the wiring loom, and connecting a 12-volt supply directly to it. The motor should operate - if not, the motor, or the motor wiring, is faulty.



4.7b Thermostat operation in the fully closed position (diesel engine)



4.7c Thermostat operation in the fully open position (diesel engine)

4 If the motor operates when tested as described, the fault must lie in the engine wiring harness or the temperature sensor. The temperature sensor/switch can be tested as described in Section 6. Any further fault diagnosis should be referred to a suitably-equipped Fiat dealer - **do not** attempt to test the electronic control unit.

Removal

5 Disconnect the battery negative terminal (refer to *Disconnecting the battery* in the Reference Section of this manual).
6 On diesel engine models, unbolt the relay bracket from the side of the battery tray to improve access. On 1242 cc (16-valve) petrol engine models, remove the air cleaner and inlet ducts as described in Chapter 4B.
7 Disconnect the motor wiring connector(s).
8 Unbolt the shroud from the rear of the radiator, then lift out the cooling fan assembly.

Refitting

9 Refitting is a reversal of removal.

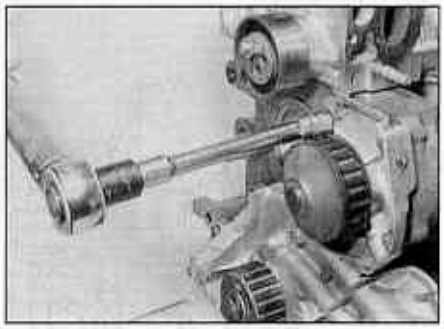
6 Cooling fan switch - testing, removal and refitting

Testing

1 The switch is threaded into the lower left hand corner of the radiator.
2 The switch can be tested by removing it, and checking that the switching action occurs at the correct temperature (heat the sensor in a container of water, and monitor the temperature with a thermometer).
3 There should be no continuity between the switch terminals, until the specified cooling fan cut-in temperature is reached, when continuity (and zero resistance) should exist between the terminals.

Removal

4 Disconnect the battery negative terminal (refer to *Disconnecting the battery* in the Reference Section of this manual).
5 Allow the engine to cool completely, then drain the cooling system as described in Chapter 1A or 1B.
6 Disconnect the wiring plug from the sensor.



7.4a Unscrew the securing bolts . . .

7 Carefully unscrew the sensor and, where applicable, recover the sealing ring.

Refitting

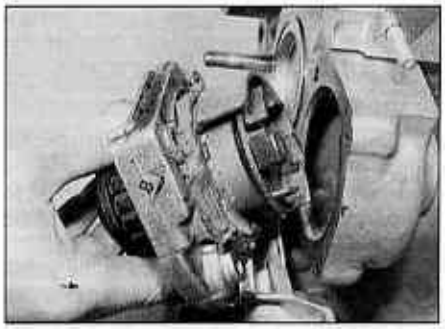
8 If the sensor was originally fitted using sealing compound, clean the sensor threads thoroughly, and coat them with fresh sealing compound.
9 If the sensor was originally fitted using a sealing ring, use a new sealing ring on refitting.
10 Refitting is a reversal of removal, but refill the cooling system as described in Chapter 1A or 1B.
11 On completion, start the engine and run it until it reaches normal operating temperature. Continue to run the engine until the cooling fan cuts in and out correctly.

7 Coolant pump - removal, inspection and refitting

Removal

Petrol engine models

1 Disconnect the battery negative terminal (refer to *Disconnecting the battery* in the Reference Section of this manual).
2 Drain the cooling system and remove the auxiliary drivebelt(s) as described in Chapter 1A.
3 Remove the timing belt as described in Chapter 2A or 2B.
4 Unscrew the securing bolts/nuts, and withdraw the coolant pump **(see illustrations)**.

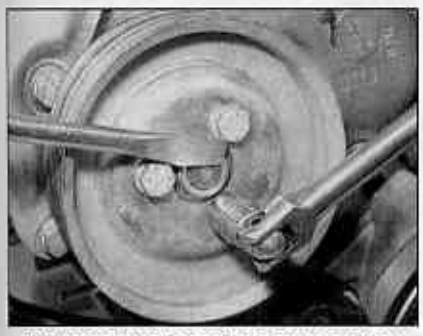


7.4b . . . and withdraw the coolant pump (petrol engine)

If the pump is stuck, tap it gently using a soft-faced mallet - **do not** lever between the pump and cylinder block mating faces.

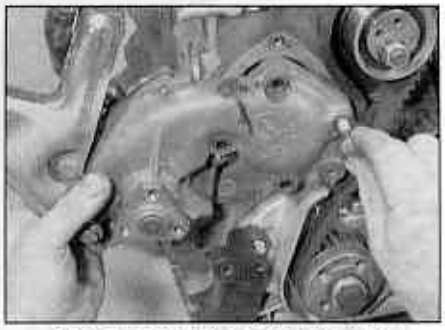
Diesel engine models

5 Disconnect the battery negative terminal (refer to *Disconnecting the battery* in the Reference Section of this manual).
6 Drain the cooling system as described in Chapter 1B.
7 Remove the auxiliary drivebelt(s) as described in Chapter 1B.
8 On models fitted with power steering, refer to Chapter 10 and remove the power steering pump from its mountings; this can be achieved without disconnecting the power steering fluid hoses from the pump. Tie the pump away from the work area, taking care to avoid kinking the fluid hoses.
9 Unscrew the securing bolts, and remove the coolant pump pulley. It will be necessary to counterhold the pulley in order to unscrew the bolts, and this is most easily achieved by wrapping an old drivebelt tightly around the pulley to act in a similar manner to a strap wrench. Alternatively, a stout screwdriver can be braced between two of the pulley bolts while the third is slackened **(see illustrations)**.
10 Disconnect the bypass hoses from the coolant pump outlet stubs.
11 Unscrew the securing bolts, and withdraw the coolant pump assembly. Note that the pump must be detached from the transfer pipe than runs behind the cylinder block to the thermostat housing **(see illustration)**. The pipe is a push fit in the port on the rear of the coolant pump



7.9a Unscrew the coolant pump pulley bolts . . .

7.9b . . . and lift off the pulley (diesel engine)



7.11 Removing the coolant pump assembly (diesel engine)

12 If the pump is stuck, tap it gently using a soft-faced mallet - **do not** lever between the pump and cylinder block mating faces.

Inspection

13 Check the pump body and impeller for signs of excessive corrosion. Turn the impeller, and check for stiffness due to corrosion, or roughness due to excessive end play.

14 Check the clearance between the pump impeller and the casing using a feeler blade **(see illustration)**. If the clearance is different to that given in the *Specifications*, the pump must be renewed. No spare components are available; the pump can only be renewed as a complete assembly.

15 On diesel engine models, remove the O-ring at the end of the transfer pipe, which runs behind the cylinder block and fits into the rear of the coolant pump. A new O-ring should be fitted as a matter of course.

Refitting

Petrol engine models

16 Commence refitting by thoroughly cleaning all traces of sealant from the mating faces of the pump and cylinder block/pump housing.

17 Apply a continuous bead of sealant (liquid gasket) to the cylinder block mating face of the pump, taking care not to apply excessive sealant, which may enter the pump itself **(see illustration)**.

18 Place the pump in position in its housing, then refit and tighten the bolts/nuts to the specified torque.

19 Refit the timing belt as described in Chapter 2A or 2B.

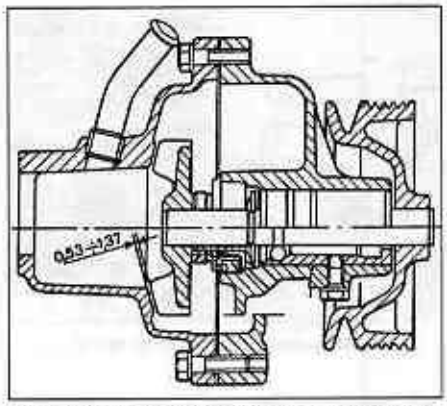
20 Refit the auxiliary drivebelt(s) and refill the cooling system as described in Chapter 1A.

21 Reconnect the battery negative terminal.

Diesel engine models

22 Commence refitting by thoroughly cleaning all traces of old gasket from the mating faces of the pump housing and cylinder block.

23 Place a new gasket in position on the cylinder block, locate the pump in position, then refit and tighten the bolts **(see illustration)**. Ensure that the end of the coolant transfer pipe seats firmly in the port at the rear of the coolant pump, without displacing the O-ring seal.



7.14 Checking the clearance between the pump impeller and the casing using a feeler blade (diesel engine)

24 Refit the pump pulley, then refit the securing bolts and tighten to the specified torque. Counterhold the pulley using the same method employed during removal.

25 Where applicable, refit the power steering pump with reference to Chapter 10.

26 Refit and tension the auxiliary drivebelt(s) as described in Chapter 1B.

27 Refill the cooling system as described in Chapter 1B.

28 Reconnect the battery negative terminal.

8 Heater/ventilation components - removal and refitting

Complete heater assembly

Warning: On models fitted with air conditioning, do not attempt to remove the cooling unit, which is located between the heater blower motor casing and the main heater assembly. Removal of the cooling unit entails disconnection of refrigerant lines - refer to Section 10 for precautions to be observed. If in any doubt as to the procedure to follow on models with air conditioning, consult a Fiat dealer for advice.

Note: This is an involved procedure, and it is recommended that the following Section is read thoroughly before commencing work. Plenty of time should be allowed to complete the operation. During dismantling, make notes on the routing of all wiring and cables, and the locations of all fixings, to aid reassembly.

Removal

1 Disconnect the battery negative terminal (refer to *Disconnecting the battery* in the Reference Section of this manual).

2 Set the heater control to HOT, then drain the cooling system as described in Chapter 1A or 1B.

3 Working in the engine bay, slacken the clips and detach the heater unit coolant hoses from the ports at the bulkhead **(see illustration)**. Recover the rubber grommets.

4 Refer to Chapter 11 and remove the entire facia assembly from the vehicle bulkhead. Rest the assembly on the front seats.

5 At this stage, access to the air inlet/distribution/blending control cables is possible. These can be easily disconnected from their respective control levers and renewed if required.

6 Working from the engine bay, remove the protective plastic caps to expose the heater assembly mounting studs and remove the nuts.

7 Label the electrical connections to the heater assembly, to aid correct refitting later and then unplug them at the connectors.

8 Slacken and remove the nuts and lift the heater assembly off its mounting studs.

Refitting

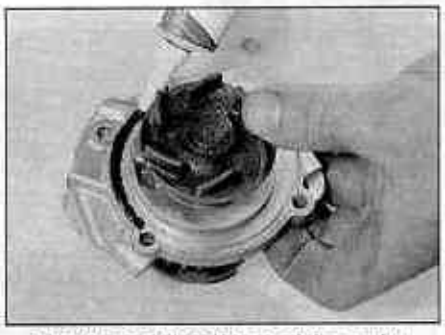
9 To refit the assembly, reverse the steps described for removal, bearing in mind the following points:

a) Make sure that all wiring and cables are routed as noted during dismantling.

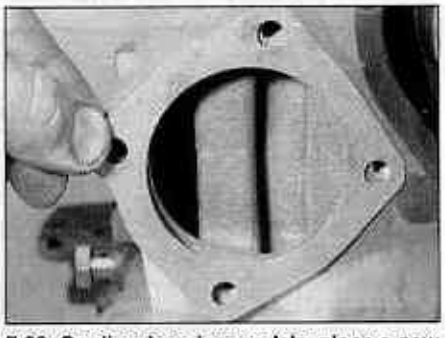
b) Make sure that all air ducts are securely reconnected.

c) Refit the facia components with reference to Chapter 11.

d) On completion, refill the cooling system as described in Chapter 1A or 1B.



7.17 On petrol engine models, apply a continuous bead of sealant (liquid gasket) to the pump mating face



7.23 On diesel engine models, place a new gasket in position on the cylinder block

8.3 Slacken the clips (arrowed) and detach the heater unit coolant hoses from the ports at the bulkhead

Heater matrix

Removal

10 Remove the complete heater assembly as described previously in this Section.

11 Slacken and remove the securing screws, then withdraw the heater matrix from the heater assembly casing.

Refitting

12 Refitting is a reversal of removal; refit the heater assembly as described previously in this Section.

Heater blower motor

Removal

13 Disconnect the battery negative terminal (refer to *Disconnecting the battery* in the Reference Section of this manual).

14 Unplug the wiring from the blower motor at the connector.

15 Working in the passenger front footwell, under the glovebox, remove the securing screws and lower the blower motor and rotor assembly from its casing **(see illustration)**.

Refitting

16 Refitting is a reversal of removal.

Heater blower motor resistor

Removal

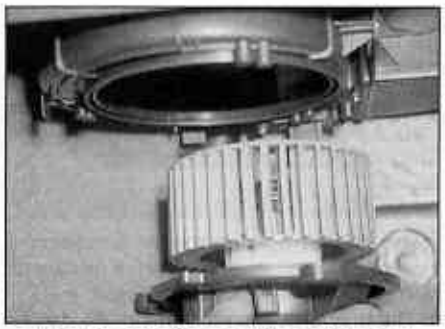
17 The resistor is located at the bottom of the heater casing, behind the blower motor.

18 Disconnect the battery negative terminal (refer to *Disconnecting the battery* in the Reference Section of this manual).

19 For improved access, remove the blower motor as described in the previous sub-Section.

20 Disconnect the wiring plug from the resistor.

21 Working under the glovebox, remove the two securing screws, and withdraw the resistor from the blower unit case **(see illustrations)**.



8.15 Remove the securing screws and lower the blower motor and rotor assembly from its casing

Refitting

22 Refitting is a reversal of removal.

Heater control panel

Removal

23 Pull the ventilation fan speed control knob from the panel.

24 Unscrew and remove the three screws securing the panel cover. Two screws are under the lower edge of the panel, whilst the remaining screw is located in the ventilation fan speed control knob recess. Remove the panel.

25 Unscrew and remove the four screws securing the control panel to the facia. The screws are located in each corner of the panel.

26 Remove the facia as described in Chapter 11.

27 Make a careful note of the cable and electrical connections. Unscrew the cable clamps and unclip the inner cables from the controls. Unplug the ventilation fan speed control.

28 Unclip and remove the control panel from the heater distributor box assembly.

Refitting

29 Refitting is a reversal of removal.

9 Air conditioning system - general information and precautions

General information

An air conditioning system is available on certain models. It enables the temperature of incoming air to be lowered, and also dehumidifies the air, which allows rapid demisting and increased comfort.

The cooling side of the system works in the same way as a domestic refrigerator. Refrigerant gas is drawn into a belt-driven compressor where the increase in pressure causes the refrigerant gas to turn to liquid. It then passes through a condenser mounted on the front of the radiator, where it is cooled. The liquid then passes through an expansion valve to an evaporator, where it changes from liquid under high pressure to gas under low pressure. This change is accompanied by a drop in temperature, which cools the evaporator and hence the air passing over it. The refrigerant returns to the compressor, and the cycle begins again.

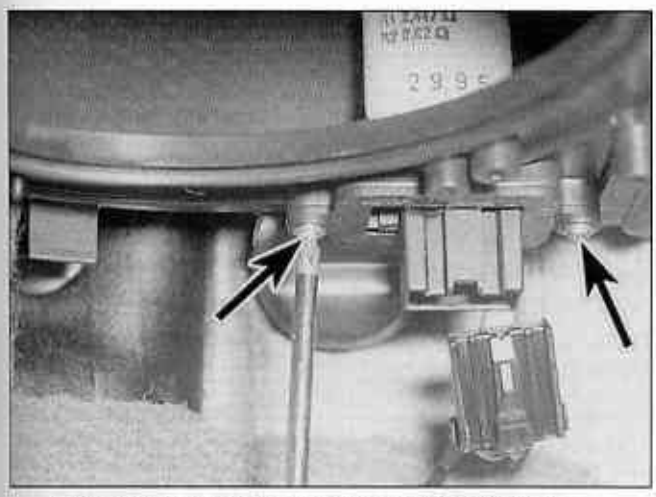
The air blown through the evaporator passes to the air distribution unit where it is mixed, if required, with hot air blown through the heater matrix to achieve the desired temperature in the passenger compartment.

The heating side of the system works in the same way as on models without air conditioning (see Section 8).

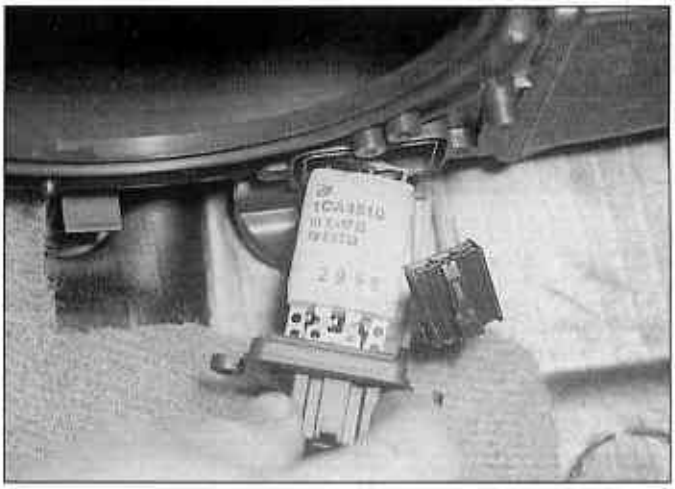
The system is electronically-controlled. Any problems with the system should be referred to a Fiat dealer.

Precautions

With an air conditioning system, it is necessary to observe special precautions whenever dealing with any part of the system, or its associated components. If for any reason the system must be disconnected, it is



8.21a Remove the two securing screws (arrowed) . . .



8.21b . . . and withdraw the resistor from the blower unit case

essential that you entrust this task to your Fiat dealer or a refrigeration engineer.

Warning: The refrigeration circuit contains a liquid refrigerant and it is dangerous to disconnect any part of the system without specialist knowledge and equipment.

The refrigerant is potentially dangerous, and should only be handled by qualified persons. If it is splashed onto the skin, it can cause severe frostbite. It is not itself poisonous, but in the presence of a naked flame (including a cigarette), it forms a poisonous gas. Uncontrolled discharging of the refrigerant is dangerous and potentially damaging to the environment.

10 Air conditioning components - removal and refitting

Note: *Do not operate the air conditioning system if it is known to be short of refrigerant, as this may damage the compressor.*

1 The only operation which can be carried out easily without discharging the refrigerant is renewal of the auxiliary (compressor) drivebelt - this procedure is described in Chapter 1A or 1B. All other operations must be referred to a Fiat dealer or an air conditioning specialist.

2 If necessary for access to other components, the compressor can be unbolted and moved aside, *without disconnecting its flexible hoses*, after removing the drivebelt.

Warning: Do not attempt to open the refrigerant circuit. Refer to the precautions given in Section 9.

Chapter 4 Part A:
Fuel system - single-point petrol injection models

Contents

Degrees of difficulty

Easy, suitable for novice with little experience 

Fairly easy, suitable for beginner with some experience 

Fairly difficult, suitable for competent DIY mechanic 

Difficult, suitable for experienced DIY mechanic 

Very difficult, suitable for expert DIY or professional 

4A

Specifications

System type	Weber-Marelli integrated single-point fuel injection/ignition system
Fuel system data	
Fuel pump type	Electric, immersed in fuel tank
Fuel pump delivery rate	110 litres/hour minimum
Regulated fuel pressure	1.0 ± 0.2 bar
Crankshaft TDC sensor resistance at 20°C	650 to 720 ohms
Injector duration (at idle)	1.5 ms
Recommended fuel	
Minimum octane rating	95 RON unleaded

Torque wrench settings	**Nm**	**lbf ft**
Coolant temperature sensor	3	2
Fuel filter collar nut	5	4
Fuel tank	28	21
Idle control stepper motor	4	3
Inlet manifold	27	20
Inlet union to filter	31	23
Outlet union to filter	15	11
Throttle body to manifold	7	5
Throttle potentiometer	3	2

1 General information and precautions

General information

The IAW Weber-Marelli single point injection (SPI) system is a self-contained engine management system, which controls both the fuel injection and ignition **(see illustration)**. This Chapter deals with the fuel injection system components only - refer to Chapter 5B for details of the ignition system components.

The fuel injection system comprises a fuel tank, an electric fuel pump, a fuel filter, fuel supply and return lines, a throttle body with an integral electronic fuel injector, and an Electronic Control Unit (ECU) together with its associated sensors, actuators and wiring.

The fuel pump delivers a constant supply of fuel through a cartridge filter to the throttle body, and the fuel pressure regulator (integral with the throttle body) maintains a constant fuel pressure at the fuel injector and returns excess fuel to the tank via the return line. This constant flow system also helps to reduce fuel temperature and prevents vaporisation.

The fuel injector is opened and closed by an Electronic Control Unit (ECU), which calculates the injection timing and duration according to engine speed, throttle position and rate of opening, inlet air temperature, coolant temperature and exhaust gas oxygen content information, received from sensors mounted on the engine.

Inlet air is drawn into the engine through the air cleaner, which contains a renewable paper filter element. The inlet air temperature is regulated by a vacuum operated valve mounted in the air ducting, which blends air at ambient temperature with hot air, drawn from over the exhaust manifold.

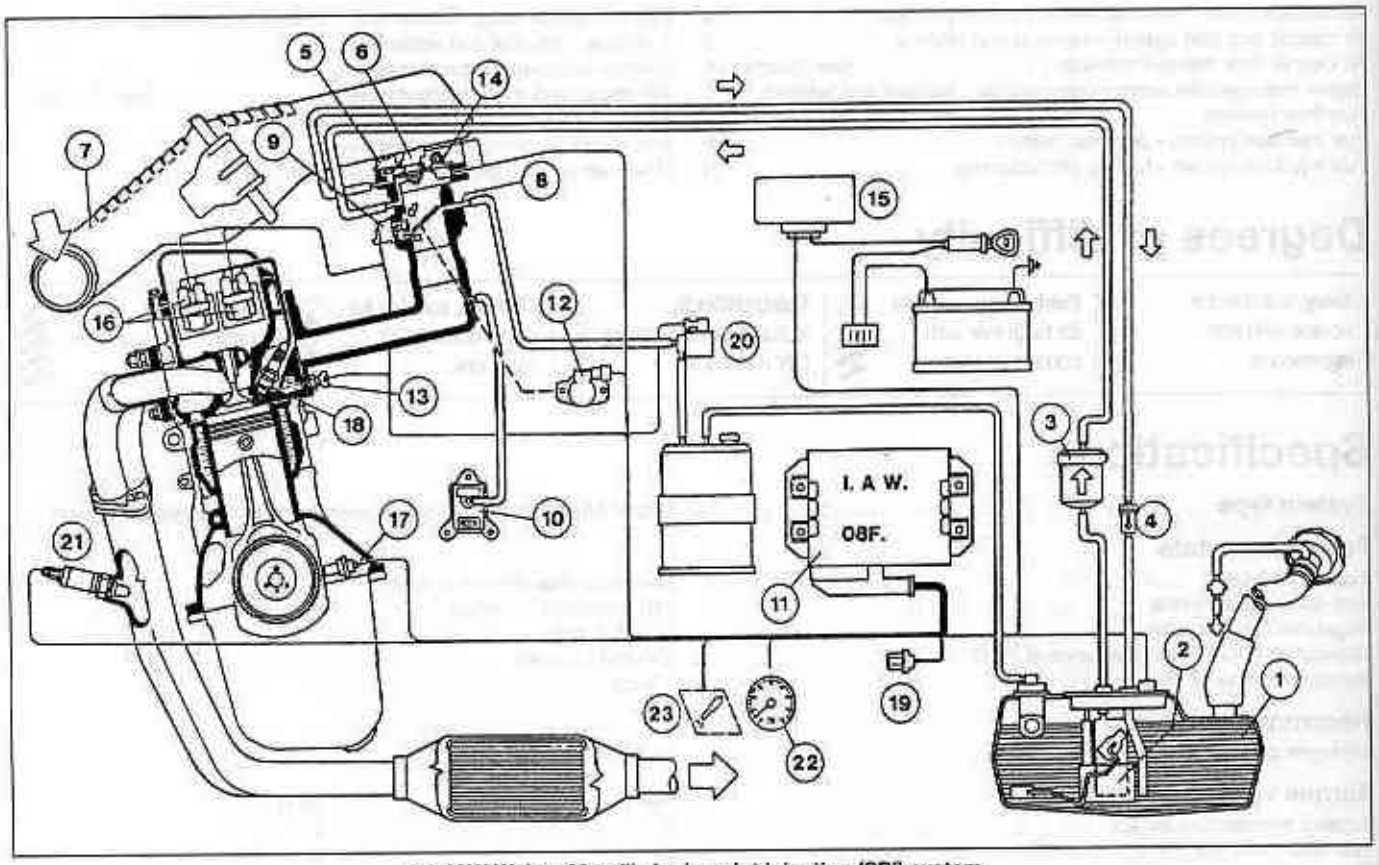
Idle speed is controlled by a stepper motor located on the side of the throttle body. Cold starting enrichment is controlled by the ECU using the coolant temperature and inlet air temperature parameters to increase the injector opening duration.

The exhaust gas oxygen content is constantly monitored by the ECU via the Lambda (oxygen) sensor, which is mounted in the exhaust downpipe. The ECU then uses this information to modify the injection timing and duration to maintain the optimum air/fuel ratio. An exhaust catalyst is fitted to all SPI models. The ECU also controls the operation of the activated charcoal filter evaporative loss system - refer to Chapter 4D for further details.

It should be noted that fault diagnosis of the IAW Weber-Marelli system is only possible with dedicated electronic test equipment. Problems with the system should therefore be referred to a Fiat dealer for assessment. Once the fault has been identified, the removal/refitting procedures detailed in the following Sections can then be followed.

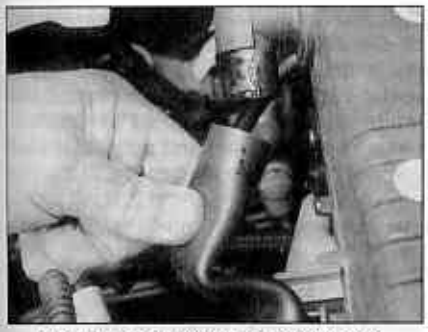
Precautions

⚠ ***Warning: Many procedures in this Chapter require the removal of fuel lines and connections, which may result in fuel spillage. Before carrying out any operation on the fuel system, refer to the precautions given in Safety first! at the beginning of this manual, and follow them implicitly. Petrol is a highly dangerous and volatile liquid, and the precautions***

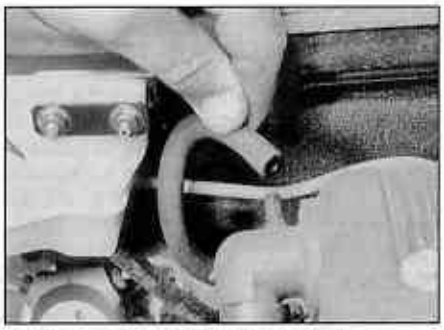


1.1 IAW Weber-Marelli single point injection (SPI) system

1 *Fuel tank*
2 *Fuel pump*
3 *Fuel filter*
4 *Anti-reflux valve*
5 *Fuel pressure regulator*
6 *Injector*
7 *Air cleaner*
8 *Fuel vapour trap*
9 *Idle stepper motor*
10 *Absolute pressure sensor*
11 *Injection/ignition ECU*
12 *Throttle position sensor*
13 *Engine coolant temperature sensor*
14 *Intake air temperature sensor*
15 *Injection/ignition dual relay*
16 *Ignition coils*
17 *Rpm and TDC sensor*
18 *Spark plugs*
19 *Diagnostic socket*
20 *EVAP solenoid*
21 *Lambda/oxygen sensor*
22 *Rev counter*
23 *IAW failure warning light*



2.4a Disconnect the large breather hose . . .



2.4b . . . and the small breather hose . . .

necessary when handling it cannot be overstressed. Note that residual pressure will remain in the fuel lines long after the vehicle was last used, When disconnecting any fuel line, first depressurise the fuel system (see Section 8).

2 Air cleaner and inlet system - removal and refitting

Removal

1 Remove the air cleaner element as described in Chapter 1A.
2 Disconnect the outer section from the hot air tube and the inlet air duct and remove it from the engine compartment.
3 If necessary remove the inlet air duct.
4 Disconnect the large and small breather hoses from the inner section of the air cleaner, then unscrew the retaining nuts and lift the section from the throttle body **(see illustrations)**.
5 Recover the sealing ring. Check the ring for condition and renew it if necessary.
6 Wipe clean the inner surfaces of both the inner and outer sections of the air cleaner.

Refitting

7 Refitting is a reversal of removal but renew the element if necessary.

3 Inlet air temperature regulator - removal and refitting

Removal

1 The thermostatically-controlled cold air flap opener is located in the air cleaner outer casing section. To check the unit, disconnect the air inlet duct with the engine cold and use a mirror to check that the flap is positioned to admit only hot air from the shroud on the exhaust manifold. Next, warm up the engine and check that the flap moves to admit only cold air from the inlet duct. If the unit is faulty it must be renewed.
2 Remove the air cleaner element as described in Chapter 1A.
3 Unscrew the retaining screw and remove the regulator from the air cleaner outer section.

Refitting

4 Refitting is a reversal of removal.

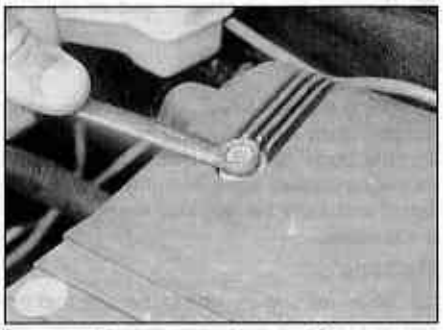
4 Accelerator cable - removal, refitting and adjustment

Removal

1 Remove the air cleaner and air inlet ducting as described in Section 2.
2 To release the cable from the throttle body, unscrew the outer cable locknuts, then disengage the inner cable from the throttle cam, and release the outer cable from its mounting bracket.
3 Working under the instrument panel inside the vehicle, unhook the cable from the fork at the top of the pedal arm.
4 Release the bulkhead grommet and withdraw the accelerator cable from inside the engine compartment.

Refitting and adjustment

5 Refitting is a reverse of the removal process, but adjust the cable (by means of the outer cable locknuts) so that there is only a very small amount of free play present at the throttle body end of the inner cable. Have an assistant depress the accelerator pedal, and check that the throttle cam opens fully and returns to the at-rest position, then securely tighten the cable locknuts. On Selecta models, check the kickdown cable adjustment as described in Chapter 7B before adjusting the accelerator cable - in its rest position the accelerator pedal should have approximately 8.0 mm free travel.



2.4c . . . then remove the retaining nuts . . .

5 Engine management system components - removal and refitting

Note: *Refer to the warning given in Section 1 before proceeding.*

Throttle body assembly

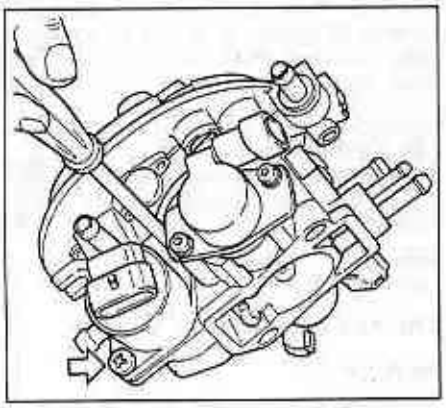
Removal

1 Remove the air cleaner and air duct as described in Section 2.
2 Disconnect the wiring connectors from the throttle potentiometer, idle control stepper motor, inlet air temperature sensor and the injector wiring loom connector situated on the front of the throttle body.
3 Depressurise the fuel system with reference to Section 8, then release the retaining clips and disconnect the fuel feed and return hoses from the throttle body assembly. If the original Fiat retaining clips are still fitted, cut the clips and discard them; replace them with standard fuel hose clips on refitting.
4 Slacken the accelerator cable locknuts, then disengage the inner cable from the throttle cam and free the outer cable from its retaining bracket. Position the cable clear of the throttle body.
5 Disconnect the EVAP purge valve hose, and the MAP sensor hose from the rear of the throttle body.
6 Slacken and remove the four bolts securing the throttle body assembly to the inlet manifold, then remove the assembly along with its insulating spacer.

Refitting

7 Refitting is a reversal of the removal procedure, bearing in mind the following points:
a) Examine the insulating spacer for signs of damage, and renew if necessary.
b) Ensure that the throttle body, inlet manifold and insulating spacer mating surfaces are clean and dry, then fit the throttle body and spacer, and securely tighten the retaining bolts.

2.4d . . . and remove the air cleaner inner section



5.18 Removing the idle control stepper motor

c) Ensure that all hoses are correctly reconnected and, where necessary, that their retaining clips are securely tightened.
d) Adjust the accelerator cable as described in Section 4.

Fuel injector

Note: *If a faulty injector is suspected, before condemning the injector, it is worth trying the effect of one of the proprietary injector cleaning treatments.*

Removal

8 Remove the air cleaner and air duct as described in Section 2.
9 Disconnect the wiring then unscrew the mounting screws and remove the injector from the throttle body.

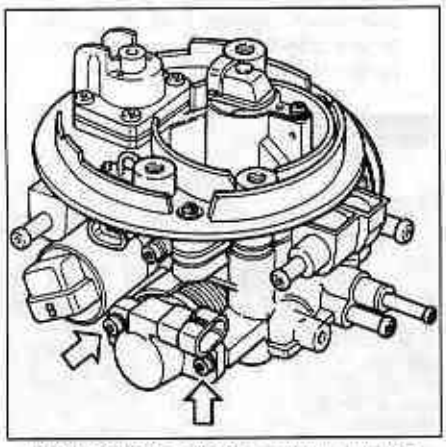
Refitting

10 Refitting is a reversal of removal.

Fuel pressure regulator

Removal

11 Remove the air cleaner and air duct as described in Section 2.
12 Using a marker pen, make alignment marks between the regulator cover and the throttle body, then undo the four retaining screws. As the screws are loosened, place a rag over the cover to catch any fuel spray which may be released.
13 Lift off the cover, then remove the spring and withdraw the diaphragm, noting its correct fitted orientation. Remove all traces of dirt, and examine the diaphragm for signs of splitting. If damage is found, it will be necessary to renew the complete upper throttle body assembly.



5.22 Throttle potentiometer mounting screws

Refitting

14 Refitting is a reversal of removal ensuring that the diaphragm and cover are fitted the correct way round, and that the retaining screws are securely tightened.

Idle control stepper motor

Removal

15 Disconnect the battery negative terminal (refer to *Disconnecting the battery* in the Reference Section of this manual), then remove the air cleaner and air duct as described in Section 2.
16 Using a crosshead screwdriver, unscrew the mounting screws and remove the stepper motor from the throttle body. Recover the gasket **(see illustration).**
17 Clean the unit and check for damage and wear.

Refitting

18 When refitting the unit use a new gasket and make sure that the plunger is inserted correctly using the following procedure. Insert the unit and refit the mounting screws loosely. Reconnect the wiring then switch on the ignition several times so that the unit centralises itself. Finally fully tighten the mounting screws to the specified torque. **Note:** *The mounting screws are covered with a locking agent and must be renewed every time they are removed.*
19 Leave the battery negative terminal disconnected for about 20 minutes - the injection/ignition ECU will position the idle control stepper motor correctly the first time the engine is started. Reconnect the battery negative terminal.

Throttle potentiometer

Removal

20 Remove the air cleaner and air duct as described in Section 2.
21 Disconnect the wiring from the throttle potentiometer.
22 Using an Allen key unscrew the mounting screws then withdraw the unit from the throttle body **(see illustration). Note:** *The mounting screws are covered with a locking agent and must be renewed every time they are removed.*

Refitting

23 When refitting the unit make sure that the pin is correctly engaged, and tighten the mounting screws to the specified torque.
24 If a Fiat test instrument is available, the operation of the throttle potentiometer can be checked at this stage. Before connecting the wiring first turn the ignition key to position MAR and wait a few seconds, then return the key to the STOP position. Reconnect the wiring and connect the test instrument. Turn the ignition key to the MAR position and cancel the error that will appear. The throttle position indicated should be between 0° and 4°. If greater than this, check that the accelerator cable is correctly adjusted however if the correct reading cannot be obtained renew the unit.

Inlet air temperature sensor

Removal

25 Remove the throttle body assembly as described earlier in this Section.
26 Extract the plastic pins and remove the press-fit cover from the top of the throttle body.
27 Invert the cover then unscrew the mounting screws and remove the inlet air temperature sensor from the cover.

Refitting

28 Refitting is a reversal of removal.

Manifold absolute pressure (MAP) sensor

Removal

29 The manifold absolute pressure sensor is located on the left-hand side of the bulkhead.
30 Unscrew the mounting screws and remove the sensor from the bulkhead. Disconnect the wiring and vacuum pipe.

Refitting

31 Refitting is a reversal of removal, but check the condition of the vacuum pipe and renew it if necessary.

Coolant temperature sensor

Removal

32 The coolant temperature sensor is located on the left-hand side of the inlet manifold. Drain the cooling system as described in Chapter 1A before removing it.
33 Disconnect the wiring.
34 Unscrew the sensor and remove it from the inlet manifold. If using a socket take care not to damage the wiring connector on the sensor.

Refitting

35 Refitting is a reversal of removal but tighten the sensor to the specified torque. **Do not** exceed the specified torque otherwise the unit may be damaged.

Crankshaft TDC sensor

Removal

36 The crankshaft TDC sensor is located on the front side of the crankshaft pulley. Firmly apply the handbrake, then jack up the front of the car and support it securely on axle stands (see *Jacking and vehicle support*). Remove

the right-hand front roadwheel and the protective plastic cover under the wheelarch.
37 Disconnect the sensor wiring plug on the front of the engine.
38 Detach the sensor from its mounting.

Refitting

39 After refitting the sensor use a feeler blade to check that the gap between sensor and the serrated part of the crankshaft pulley is between 0.5 and 1.5 mm. No adjustment is possible and if the gap is incorrect the sensor and pulley should be checked for possible damage.

Electronic control unit (ECU)

Removal

Note: *The engine management system has a learning capability which allows the ECU to store details of the engine's running characteristics in its memory. This memory will be erased by the disconnection of the battery cables, with the result that the engine may idle roughly, or lack performance for a while, until the engine's characteristics are re-learnt.*

40 The ECU (electronic control unit) is located on the right-hand inner wing **(see illustration)**. The 3-pin socket by the ECU is for connection of diagnostic test equipment.
41 Disconnect the battery negative terminal (refer to *Disconnecting the battery* in the Reference Section of this manual).
42 Disconnect the ECU wiring connector, then undo the retaining nuts and remove the unit from the bracket in the engine compartment.

Refitting

43 Refitting is a reversal of removal making sure that the wiring connector is securely reconnected.

Inertia safety switch

Removal

44 The inertia safety switch is located by the left-hand side passenger seat. First pull back the carpet for access.
45 Disconnect the wiring then unbolt the switch.

Refitting

46 Refitting is a reversal of removal.

Fuel injection system relays

Removal

47 The fuel injection system relay is located under a plastic cover on the bulkhead. The MAP sensor is also located under the same cover.
48 Two separate relays are incorporated in the single housing; the left-hand relay has a 5 amp fuse and the right-hand relay has a 25 amp fuse. The main purpose of the relays is to supply current to the fuel pump, ignition coils, oxygen sensor, injectors and EVAP solenoid. The main relay is controlled by the ignition switch.

5.40 ECU located on the right-hand inner wing

49 Remove the cover and pull the relay directly from its socket.

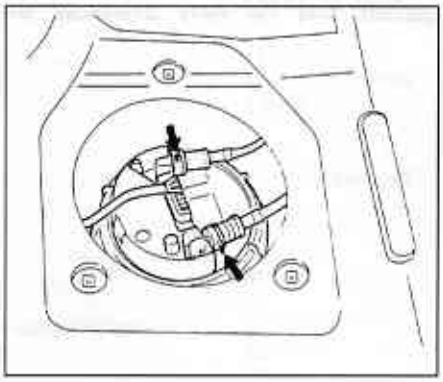
Refitting

50 Refitting is a reversal of removal.

6 Fuel pump/fuel gauge sender unit - removal and refitting

Removal

Note: *Refer to the warning given in Section 1 before proceeding.*
1 Disconnect the battery negative terminal (refer to *Disconnecting the battery* in the Reference Section of this manual).
2 Remove the rear seat as described in Chapter 11. Prise the fuel pump access cover out of the floor panel to gain access to the pump unit.
3 Disconnect the wiring connector.
4 Bearing in mind the warning given in Section 1, disconnect the fuel supply and return lines from the pump unit by pressing the tabs **(see illustration)**. Plug the ends of the lines or cover them with adhesive tape.
5 Using a suitable tool, unscrew the large ring nut and carefully withdraw the fuel pump/fuel tank sender unit assembly from the fuel tank, along with its sealing ring.
6 If necessary, the unit can be dismantled and the pump and sender unit separated. If this is the case, carefully note the correct fitted positions of all components while dismantling the unit, and use these notes on reassembly to ensure that all items are correctly fitted.



6.4 Press the tabs indicated to disconnect the fuel supply and return lines

Refitting

7 Refitting is a reversal of the removal procedure using a new sealing ring. Prior to refitting the access cover, reconnect the battery, then start the engine and check the feed and return unions for signs of leakage.

7 Fuel tank - removal and refitting

Note: *Refer to the warning given in Section 1 before proceeding.*

Removal

1 Before removing the fuel tank, all fuel must be drained from the tank. Since a fuel tank drain plug is not provided, it is therefore preferable to carry out the removal operation when the tank is nearly empty. Before proceeding, disconnect the battery negative terminal (refer to *Disconnecting the battery* in the Reference Section of this manual), and syphon or hand-pump the remaining fuel from the tank.
2 Remove the fuel pump/fuel gauge sender unit as described in Section 6.
3 Chock the front wheels, then jack up the rear of the vehicle and support on axle stands (see *Jacking and vehicle support*).
4 Loosen the clip and disconnect the filler pipe from the right-hand side of the fuel tank.
5 Undo the tank flange and strap mounting bolts, then lower the tank out of position until it is possible to access the hose connections on top of the tank.
6 Loosen the clips and disconnect the EVAP purge hose and breather hose from the fuel tank. If necessary, the filler neck can be detached from the body.
7 Check that all hoses and wiring is disconnected, then remove the tank from underneath the vehicle.

Refitting

8 Refitting is a reversal of the removal procedure, ensuring all hoses are correctly routed and securely reconnected.

8 Fuel injection system - depressurisation

Note: *Refer to the warning given in Section 1 before proceeding.*

Warning: The following procedure will merely relieve the pressure in the fuel system - remember that fuel will still be present in the system components and take precautions accordingly before disconnecting any of them.

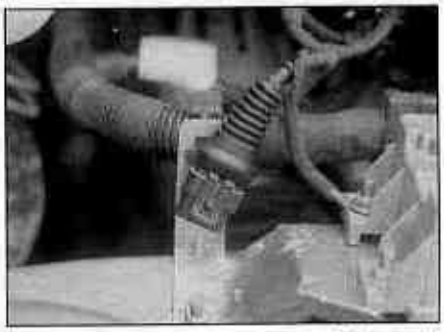
1 The fuel system referred to in this Section is defined as the tank-mounted fuel pump, the fuel filter, the throttle body and pressure regulator components, and the metal pipes and flexible hoses of the fuel lines between these components. All these contain fuel which will be under pressure while the engine is running and/or while the ignition is switched on. The pressure will remain for some time after the ignition has been switched off, and must be relieved before any of these components are disturbed for servicing work.
2 Disconnect the battery negative terminal (refer to *Disconnecting the battery* in the Reference Section of this manual).
3 Place a container beneath the relevant connection/union to be disconnected, and have a large rag ready to soak up any escaping fuel not being caught by the container.
4 Slowly loosen the connection or union nut (as applicable) to avoid a sudden release of pressure, and wrap the rag around the connection to catch any fuel spray which may be expelled. Once the pressure is released, disconnect the fuel line, and insert plugs to minimise fuel loss and prevent the entry of dirt into the fuel system.

9 Inlet manifold - removal and refitting

Note: *Refer to the warning given in Section 1 before proceeding.*

Removal

1 Remove the throttle body assembly as described in Section 5.
2 Drain the cooling system as described in Chapter 1A.
3 Disconnect the wiring connector from the coolant temperature sensor (situated on the left-hand side of the manifold).
4 Undo the bolt securing the accelerator cable mounting bracket to the manifold, and position it clear of the manifold.
5 Slacken the retaining clip and disconnect the coolant hose from the rear of the manifold.
6 Disconnect the brake vacuum hose.
7 Undo the seven manifold retaining nuts and bolts, and remove the manifold from the engine. Remove the gasket and discard it; a new one should be used on refitting.



10.2 The diagnostic connector is located behind the ECU

Refitting

8 Refitting is a reverse of the removal procedure, noting the following points:
a) Ensure that the manifold and cylinder head mating surfaces are clean and dry, and fit a new manifold gasket. Refit the manifold and securely tighten its retaining nuts.
b) Ensure that all relevant hoses are reconnected to their original positions and are securely held (where necessary) by the retaining clips.
c) Refit the throttle body assembly with reference to Section 5.
d) On completion, refill the cooling system as described in Chapter 1A.

10 Fuel injection system - testing and adjustment

Testing

1 If a fault appears in the fuel injection system, first ensure that all the system wiring connectors are securely connected and free of corrosion. Then ensure that the fault is not due to poor maintenance; ie, check that the air cleaner filter element is clean, the spark plugs are in good condition and correctly gapped, that the valve clearances are correctly adjusted, and that the engine breather hoses are clear and undamaged.
2 If these checks fail to reveal the cause of the problem, the vehicle should be taken to a suitably-equipped Fiat dealer for testing. A wiring block connector is incorporated in the engine management circuit, into which a special electronic diagnostic tester can be plugged; the connector is situated behind the ECU **(see illustration)**. The tester will locate the fault quickly and simply, alleviating the need to test all the system components individually, which is a time-consuming operation that carries a high risk of damaging the ECU.

Adjustments

3 As mentioned above, the idle speed and mixture adjustment are all monitored and controlled by the ECU, and are not adjustable. Experienced home mechanics with a considerable amount of skill and equipment (including a good-quality tachometer and a good-quality, carefully calibrated exhaust gas analyser) may be able to check the exhaust CO level and the idle speed. However, if these are found to be in need of adjustment, the car must be taken to a suitably-equipped Fiat dealer for testing using the special test equipment which is plugged into the diagnostic connector.

11 Unleaded petrol - general information and usage

Note: *The information given in this Chapter is correct at the time of writing. If updated information is thought to be required, check with a Fiat dealer. If travelling abroad, consult one of the motoring organisations (or a similar authority) for advice on the fuel available.*
1 All petrol models are fitted with a catalytic converter and must be run on unleaded fuel only - the fuel recommended by Fiat is given in the Specifications of this Chapter. Under no circumstances should leaded fuel (UK 4-star) be used, as this may damage the converter.
2 Super unleaded petrol (98 octane) can also be used in all models if wished, though there is no advantage in doing so.