

Crankshaft

Bearing journal diameters (standard):

Main bearings (nominal)	47.98 mm
Big-end bearings (nominal)	41.98 mm
Endfloat	0.05 to 0.26 mm

Torque wrench settings

SOHC (8-valve) engines

Refer to Chapter 2A Specifications.

DOHC (16-valve) engines

Refer to Chapter 2B Specifications.

1 General information

Included in this Part of Chapter 2 are details of removing the engine/transmission from the car and general overhaul procedures for the cylinder head, cylinder block/crankcase and all other engine internal components.

The information given ranges from advice concerning preparation for an overhaul and the purchase of new parts, to detailed step-by-step procedures covering removal, inspection, renovation and refitting of engine internal components.

After Section 5, all instructions are based on the assumption that the engine has been removed from the car. For information concerning in-car engine repair, as well as the removal and refitting of those external components necessary for full overhaul, refer to Part A or B of this Chapter (as applicable) and to Section 5. Ignore any preliminary dismantling operations described in Part A or B that are no longer relevant once the engine has been removed from the car.

2 Engine overhaul – general information

It is not always easy to determine when, or if, an engine should be completely overhauled, as a number of factors must be considered.

High mileage is not necessarily an indication that an overhaul is needed, while low mileage does not preclude the need for an overhaul. Frequency of servicing is probably the most important consideration. An engine which has had regular and frequent oil and filter changes, as well as other required maintenance, should give many thousands of miles of reliable service. Conversely, a neglected engine may require an overhaul very early in its life.

Excessive oil consumption is an indication that piston rings, valve seals and/or valve guides are in need of attention. Make sure that oil leaks are not responsible before deciding that the rings and/or guides are worn. Perform a compression test, as

described in Part A or B of this Chapter, to determine the likely cause of the problem.

Check the oil pressure with a gauge fitted in place of the oil pressure switch. If it is extremely low, the main and big-end bearings, and/or the oil pump, are probably worn out.

Loss of power, rough running, knocking or metallic engine noises, excessive valve gear noise, and high fuel consumption may also point to the need for an overhaul, especially if they are all present at the same time. If a complete service does not remedy the situation, major mechanical work is the only solution.

An engine overhaul involves restoring all internal parts to the specification of a new engine. During an overhaul, the cylinders are rebored (where applicable), the pistons and the piston rings are renewed. New main and big-end bearings are generally fitted; if necessary, the crankshaft may be reground, to restore the journals. The valves are also serviced as well, since they are usually in less-than perfect condition at this point. The end result should be an as-new engine that will give many trouble-free miles.

Note: *Critical cooling system components such as the hoses, thermostat and coolant pump should be renewed when an engine is overhauled. The radiator should be checked carefully, to ensure that it is not clogged or leaking. Also, it is a good idea to renew the oil pump whenever the engine is overhauled.*

Before beginning the engine overhaul, read through the entire procedure, to familiarise yourself with the scope and requirements of the job. Check on the availability of parts and make sure that any necessary special tools and equipment are obtained in advance. Most work can be done with typical hand tools, although a number of precision measuring tools are required for inspecting parts to determine if they must be renewed.

The services provided by an engineering machine shop or engine reconditioning specialist will almost certainly be required, particularly if major repairs such as crankshaft regrinding or cylinder reboring are necessary. Apart from carrying out machining operations, these establishments will normally handle the inspection of parts, offer advice concerning reconditioning or renewal and supply new components such as pistons, piston rings and bearing shells. It is recommended that the

establishment used is a member of the Federation of Engine Re-Manufacturers, or a similar society.

Always wait until the engine has been completely dismantled, and until all components (especially the cylinder block and the crankshaft) have been inspected, before deciding what service and repair operations must be performed by an engineering works. The condition of these components will be the major factor to consider when determining whether to overhaul the original engine or to buy a reconditioned unit. Do not, therefore, purchase parts or have overhaul work done on other components until they have been thoroughly inspected.

As a final note, to ensure maximum life and minimum trouble from a reconditioned engine, everything must be assembled with care, in a spotlessly-clean environment.

3 Engine/transmission removal – methods and precautions

If you have decided that the engine must be removed for overhaul or major repair work, several preliminary steps should be taken.

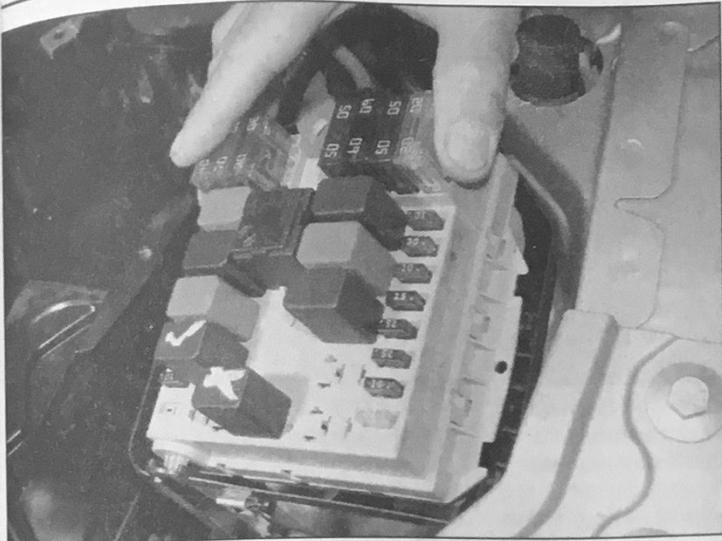
Locating a suitable place to work is extremely important. Adequate work space, along with storage space for the car, will be needed. If a workshop or garage is not available, at the very least, a flat, level, clean work surface is required.

Cleaning the engine compartment and engine/transmission before beginning the removal procedure will help keep tools clean and organised.

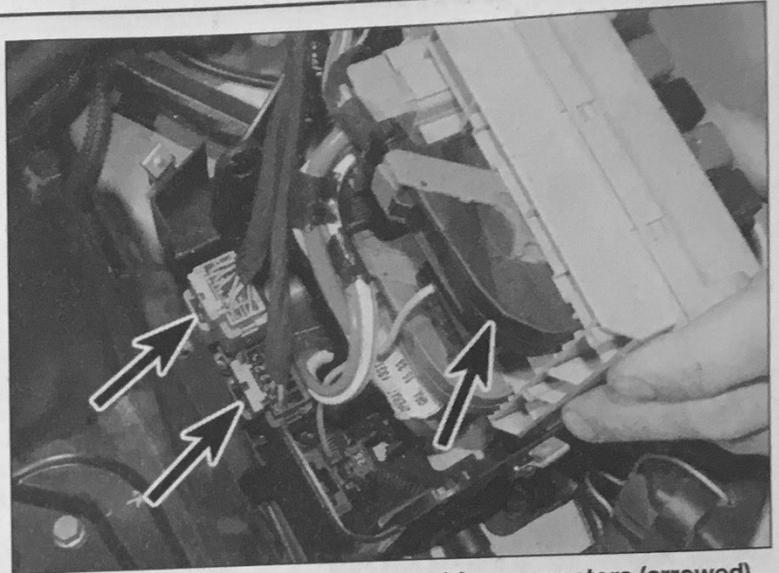
An engine hoist will also be necessary. Make sure the equipment is rated in excess of the combined weight of the engine and transmission. Safety is of primary importance, considering the potential hazards involved in removing the engine/transmission from the car.

The help of an assistant is essential. Apart from the safety aspects involved, there are many instances when one person cannot simultaneously perform all of the operations required during engine/transmission removal.

Plan the operation ahead of time. Before starting work, arrange for the hire of or obtain all of the tools and equipment you will need.



4.5a Remove the fuse/relay box from its mounting bracket . . .



4.5b . . . and disconnect the three wiring connectors (arrowed)

Some of the equipment necessary to perform engine/transmission removal and installation safely (in addition to an engine hoist) is as follows: a heavy duty trolley jack, complete sets of spanners and sockets as described in the rear of this manual, wooden blocks, and plenty of rags and cleaning solvent for mopping-up spilled oil, coolant and fuel. If the hoist must be hired, make sure that you arrange for it in advance, and perform all of the operations possible without it beforehand. This will save you money and time.

Plan for the car to be out of use for quite a while. An engineering machine shop or engine reconditioning specialist will be required to perform some of the work which cannot be accomplished without special equipment. These places often have a busy schedule, so it would be a good idea to consult them before removing the engine, in order to accurately estimate the amount of time required to rebuild or repair components that may need work.

During the engine/transmission removal procedure, it is advisable to make notes of the locations of all brackets, cable ties, earthing points, etc, as well as how the wiring harnesses, hoses and electrical connections are attached and routed around the engine and engine compartment. An effective way of doing this is to take a series of photographs of the various components before they are disconnected or removed; the resulting photographs will prove invaluable when the engine/transmission is refitted.

Always be extremely careful when removing and refitting the engine/transmission. Serious injury can result from careless actions. Plan ahead and take your time, and a job of this nature, although major, can be accomplished successfully.

The engine and transmission assembly is removed downwards from the engine compartment on all models described in this manual.

4 Engine and transmission – removal, separation, connection and refitting

Note: The engine is lowered from the engine compartment as a complete unit with the transmission; the two are then separated for overhaul.

Removal

- 1 Remove the bonnet as described in Chapter 11.
- 2 Remove the battery and battery tray as described in Chapter 5A.
- 3 Carry out the following operations, using the information given in Chapter 4A:
 - a) Remove the air cleaner assembly.
 - b) Depressurise the fuel system, and disconnect the fuel feed hose at the quick-release connection on the fuel rail.
 - c) On SOHC (8-valve) engines, disconnect the accelerator cable.
- 4 Remove the cover from the fuse/relay box on the left-hand side of the engine compartment.
- 5 Remove the fuse/relay box from its mounting bracket by disengaging the locating

lugs at each end. Disconnect the wiring multi-plug connector on the underside of the fuse relay box, and the two multi-plug connectors on the side of the fuse/relay box mounting bracket (see illustrations). Note that on certain models there is only one multi-plug connector on the fuse/relay box mounting bracket.

6 Prise out the grommet and disconnect the brake servo vacuum hose from the front of the servo unit. Release the hose from the retaining clip on the bulkhead.

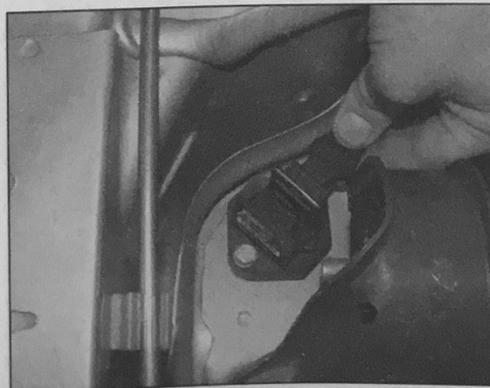
7 Disconnect the evaporative emission control hose at the quick-release connection on the inlet manifold.

8 On DOHC (16-valve) engines, disconnect the wiring connector at the acceleration sensor, and release the sensor wiring from the cable clips (see illustration).

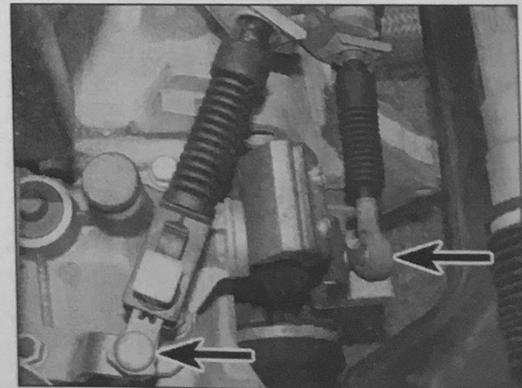
Manual transmission models

9 Disconnect the gearchange selector cable end fittings from the transmission lever ball-studs (see illustration). Undo the three bolts securing the selector cable support bracket to the transmission and move the bracket and cables to one side.

10 Unbolt the clutch slave cylinder from the top of the transmission then fit a cable-tie



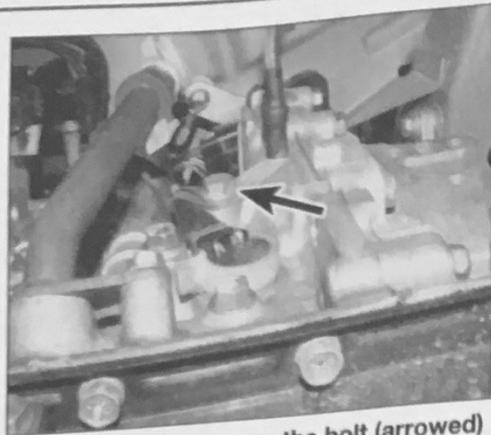
4.8 On DOHC (16-valve) engines, disconnect the wiring connector at the acceleration sensor (arrowed)



4.9 Disconnect the selector cable end fittings (arrowed) from the transmission lever ball-studs – manual transmission models



4.12a Disconnect the main wiring harness connector (arrowed) at the top of the transmission ...



4.12b ... then unscrew the bolt (arrowed) and disconnect the transmission earth lead - automatic transmission models



4.13 Extract the retaining clip (arrowed) and release the selector cable end fitting - automatic transmission models

around it to prevent the piston from being ejected. Position the cylinder to one side.

11 Disconnect the wiring connector from the reversing light switch on the front of the transmission, then unscrew the nut and disconnect the transmission earth lead from the top of the unit.

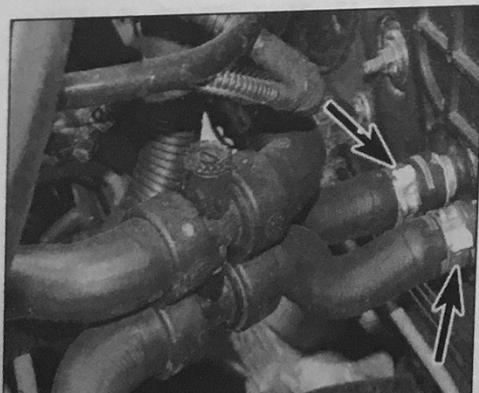
Automatic transmission models

12 Disconnect the main wiring harness connector at the top of the transmission, then unscrew the bolt and disconnect the transmission earth lead at the front of the unit (see illustrations).

13 Extract the retaining clip and release the selector cable end fitting from the starter inhibitor/reversing light switch (see illustration). Undo the two bolts securing the selector cable support bracket to the transmission and move the bracket and cable to one side.

All models

14 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 both front roadwheels. In order to remove the engine/transmission assembly in an upright position from under the vehicle, there must be a minimum clearance of approximately 700 mm between the floor and the front crossmember. Additional height is necessary if the assembly is to be lowered onto a trolley.



4.17 Disconnect the coolant heater hoses (arrowed) at their bulkhead connections

15 Remove the right-hand wheel arch liner main and centre panels.

16 Carry out the following with reference to Chapter 1:

- a) Drain the engine oil.
- b) Drain the cooling system.
- c) On models with automatic transmission, drain the automatic transmission fluid.
- d) On models with air conditioning, remove the auxiliary drivebelt.

17 Identify the coolant heater hoses on the bulkhead for position, then loosen the clips and disconnect the hoses (see illustration). Similarly disconnect the radiator top hose from the radiator and thermostat housing.

18 On models with air conditioning, unbolt the air conditioning compressor and secure it in a suitable position clear of the engine as far as the flexible hoses will allow. **Do not disconnect the air conditioning refrigerant pipes/hoses.**

19 On models with automatic transmission, remove the clips and disconnect the transmission fluid cooler hoses at their transmission connections.

20 Remove the exhaust manifold as described in Chapter 4A.

21 Undo the bolts securing the exhaust system mounting brackets to the underbody, then move the system to one side.

22 Unscrew the nuts retaining the track rod ends on the swivel hubs and use a balljoint separator tool to disconnect them.



4.24 Remove the gaiter retaining clip and pull the driveshaft and spider out of the CV joint body

23 Unscrew the two bolts securing the left-hand swivel hub assembly to the front suspension strut, then move the hub assembly outwards.

24 Remove the retaining clip securing the left-hand driveshaft inner CV joint gaiter to the joint body. Pull the driveshaft and spider out of the joint body and move the driveshaft clear of the engine/transmission (see illustration). Suitably cover the joint body and the driveshaft spider to prevent the escape of grease.

25 Repeat paragraphs 23 and 24 to disconnect the right-hand driveshaft.

26 Using suitable spacers and washers, refit the engine right-hand lifting eye which was previously removed with the exhaust manifold.

27 Attach a suitable hoist to the engine right-hand lifting eye and the left-hand lifting eye on the transmission. To prevent the engine/transmission assembly tipping backward during removal, a third lifting eye, fabricated from scrap metal or similar should be secured to a suitable location in the vicinity of the alternator. Attach the hoist to the additional eye and evenly take the weight of the engine/transmission.

28 Working beneath the car, unscrew the bolts and nuts securing the rear engine mounting to the subframe and transmission, and withdraw the mounting.

29 In the engine compartment, unscrew the nuts securing the right-hand engine mounting to the body and to the bracket on the cylinder head. Lift the mounting assembly off the studs and remove it from the engine compartment.

30 Unscrew the centre nut securing the left-hand engine/transmission mounting stud to the bracket on the body.

31 Carefully lower the engine/transmission from the engine compartment taking care not to damage the surrounding components. Ideally lower the unit onto a low trolley so that it may be withdrawn from under the car. Disconnect the hoist from the engine/transmission assembly.

Separation

32 Rest the engine/transmission assembly on a firm, flat surface, and use wooden blocks as wedges to keep the unit steady.

- 33 Disconnect all the individual wiring connectors from the various components on the engine and transmission to enable the main engine wiring harness to be removed. Make notes or attach labels to each connector to aid reconnection.
- 34 Detach the wiring harness support brackets and plastic ducting mountings, release the relevant cable ties and remove the complete harness assembly from the engine/transmission.
- 35 Remove the starter motor (Chapter 5A).
- 36 Undo the bolts and remove the support brace linking the transmission to the cylinder block.
- 37 Unbolt and remove the cover plate from the base of the transmission bellhousing.

Manual transmission models

- 38 Ensure that both engine and transmission are individually supported, then remove the remaining bolts securing the transmission bellhousing to the engine. Note the correct fitted positions of each bolt (and the relevant brackets) to aid refitting.
- 39 Withdraw the transmission from the engine, ensuring that the weight of the transmission is not allowed to hang on the input shaft while it is engaged with the clutch friction plate.
- 40 If they are loose, remove the locating dowels from the engine or transmission.

Automatic transmission models

- 41 Using a socket on the crankshaft sprocket centre bolt, turn the crankshaft in the normal direction of rotation until one of the four torque converter retaining bolts is accessible through the opening at the base of the transmission bellhousing (see illustration). Undo the first retaining bolt, then turn the crankshaft as necessary and undo the remaining three bolts as they become accessible.
- 42 Ensure that both engine and transmission are individually supported, then remove the remaining bolts securing the transmission bellhousing to the engine. Note the correct fitted positions of each bolt (and the relevant brackets) to aid refitting.
- 43 Make sure that the torque converter is pushed fully onto the transmission shaft, then

carefully withdraw the transmission from the engine. If they are loose, remove the locating dowels from the engine or transmission.

- 44 With the transmission removed, secure the torque converter in position by bolting a length of metal bar to one of the bellhousing flange holes.

Connection

- 45 If the engine and transmission have not been separated, proceed to paragraph 56.

Manual transmission models

- 46 Apply a smear of high melting-point grease to the splines of the transmission input shaft. Do not apply too much, otherwise there is a possibility of the grease contaminating the clutch friction plate.
- 47 Ensure that the locating dowels are correctly positioned in the engine or transmission, and that the release bearing is correctly engaged with the fork.
- 48 Carefully offer the transmission to the engine, until the locating dowels are engaged. Ensure that the weight of the transmission is not allowed to hang on the input shaft as it is engaged with the clutch friction plate.
- 49 Refit the engine-to-transmission bolts, ensuring that all the necessary brackets are correctly positioned, and tighten them to the specified torque.

Automatic transmission models

- 50 Ensure that the torque converter is correctly engaged with the transmission, then carefully offer the transmission to the engine, and engage it on the locating dowels. Refit the engine-to-transmission bolts, ensuring that all the necessary brackets are correctly positioned, and tighten them to the specified torque settings.
- 51 Align the torque converter holes with the those in the driveplate, and install the retaining bolts. Tighten the torque converter retaining bolts to the specified torque (see Chapter 7B).

All models

- 52 Refit the cover plate to the base of the transmission bellhousing.
- 53 Locate the support brace linking the transmission to the cylinder block, then insert the bolts hand-tight. With all the bolts inserted, tighten them securely.
- 54 Refit the starter motor (see Chapter 5A).
- 55 Refit and reconnect the wiring harness to the components on the engine/transmission assembly making sure it is routed correctly.

Refitting

- 56 Locate the engine/transmission assembly beneath the engine compartment and attach the hoist to the lifting eyes.
- 57 Carefully lift the assembly up into the engine compartment taking care not to damage the surrounding components.
- 58 Engage the left-hand engine/transmission mounting stud with the mounting, then refit the retaining nut, moderately tightened.

59 Locate the right-hand engine/transmission mounting over the studs, refit the nuts and tighten them to the specified torque. With the engine/transmission assembly now supported, tighten the left-hand mounting nut to the specified torque.

- 60 Working beneath the vehicle, refit the rear engine mounting and tighten the bolts to the specified torque.
- 61 Disconnect the hoist from the engine and transmission lifting eyes and remove the hoist from under the vehicle.
- 62 The remainder of the refitting procedure is the direct reverse of the removal procedure, noting the following points:
 - a) Ensure that all hoses are correctly routed and are secured with the correct hose clips, where applicable. If the hose clips cannot be used again; proprietary worm-drive clips should be fitted in their place.
 - b) Refill the engine and automatic transmission with the correct quantity and type of lubricant, as described in Chapter 1.
 - c) Refill the cooling system as described in Chapter 1.
 - d) Where applicable, check and if necessary adjust the accelerator cable with reference to Chapter 4A.
 - e) When the engine is started for the first time, check for air, coolant, lubricant and fuel leaks from manifolds, hoses, etc. If the engine has been overhauled, read the notes in Section 19 before attempting to start it.

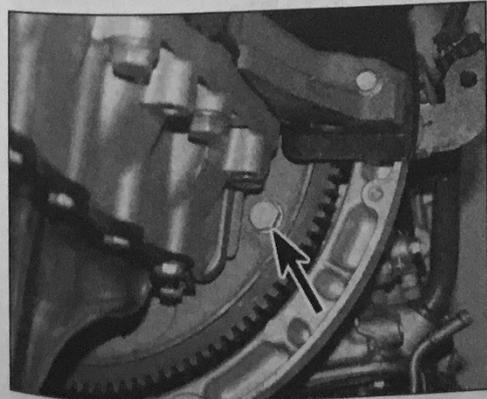
5 Engine overhaul – dismantling sequence

It is preferable to dismantle and work on the engine with it mounted on a portable engine stand. These stands can generally be hired from a tool hire shop. Before the engine is mounted on a stand, the flywheel/driveplate should be removed, so that the stand bolts can be tightened into the end of the cylinder block.

If a stand is not available, it is possible to dismantle the engine with it blocked up on a sturdy workbench, or on the floor. Be extra careful not to tip or drop the engine when working without a stand.

If a reconditioned engine is to be obtained, or if the original engine is to be overhauled, the external components in the following list must be removed first. These components can then be transferred to the reconditioned engine, or refitted to the existing engine after overhaul.

- a) Alternator (including mounting brackets, where fitted) (Chapter 5A).
- b) Engine mounting brackets (Chapter 2A and 2B).
- c) The ignition system and HT components including all sensors, HT leads and spark plugs (Chapters 1 and 5B).
- d) The fuel injection system components (Chapter 4A).



4.41 Torque converter retaining bolt (arrowed) accessible through the bellhousing opening – automatic transmission models