






# Chapter 2 Part A: In-car engine repair procedures

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## Degrees of difficulty

<b>Easy, suitable for novice with little experience</b> 	<b>Fairly easy, suitable for beginner with some experience</b> 	<b>Fairly difficult, suitable for competent DIY mechanic</b> 	<b>Difficult, suitable for experienced DIY mechanic</b> 	<b>Very difficult, suitable for expert DIY or professional</b> 
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2A

## Specifications

### General

#### Displacement

##### 3-series, E30 body style

316i (1988 to 1991)	1596 cc (M40/4-cylinder engine)
316 (1983 to 1988) and 318i (1983 to 1987)	1766 cc (M10/4-cylinder engine)
318i (1987 to 1991)	1796 cc (M40/4-cylinder engine)
320i (1987 to 1991)	1990 cc (M20/6-cylinder engine)
325i (1987 to 1991)	2494 cc (M20/6-cylinder engine)

##### 5-series, E28 body style ("old-shape")

518 (1981 to 1985) and 518i (1985 to 1988)	1766 cc (M10/4-cylinder engine)
525i (1981 to 1988)	2494 cc (M30/6-cylinder engine)
528i (1981 to 1988)	2788 cc (M30/6-cylinder engine)
535i (1985 to 1988)	3430 cc (M30/6-cylinder engine)
M535i (1985 to 1988)	3430 cc (M30/6-cylinder engine)

##### 5-series, E34 body style ("new-shape")

518i (1990 to 1993)	1796 cc (M40/4-cylinder engine)
520i (1988 to 1991)	1990 cc (M20/6-cylinder engine)
525i (1988 to 1991)	2494 cc (M20/6-cylinder engine)
530i (1988 to 1991)	2986 cc (M30/6-cylinder engine)
535i (1988 to 1993)	3430 cc (M30/6-cylinder engine)

#### Firing order

Four-cylinder engine	1-3-4-2
Six-cylinder engine	1-5-3-6-2-4

### Lubrication system

#### Oil pressure (all engines)

At idle	0.5 to 2.0 bars
Running (for example, at 4000 rpm)	4 bars or above (typically)

#### Oil pump rotor clearance - M40 engine

(body-to-outer rotor/outer rotor-to-inner rotor)	0.12 mm to 0.20 mm
Oil pump pressure relief valve spring length - M40 engine	84.1 mm

## 2A•2 In-car engine repair procedures

<b>Torque wrench settings</b>	<b>Nm</b>
Timing chain tensioner plug	35
Timing belt tensioner bolts	22
Camshaft sprocket-to-camshaft bolt	
M10 and M30 engines	10
M20 and M40 engines	65
Flange to camshaft (M30 engine)	145
Timing chain or belt covers-to-engine	
M6 bolts	10
M8 bolts	22
M10 (bolt size) bolts	47
Crankshaft pulley bolts	22
Crankshaft hub bolt or nut	
M10 engine	190
M20 engine	410
M30 engine	440
M40 engine	310
Cylinder head bolts*	
M10 four-cylinder engine	
Stage 1	60
Stage 2 (wait 15 minutes)	Angle-tighten an additional 33°
Stage 3 (engine at normal operating temperature)	Angle-tighten an additional 25°
M20 six-cylinder engine with hex-head bolts	
Stage 1	40
Stage 2 (wait 15 minutes)	60
Stage 3 (engine at normal operating temperature)	Angle-tighten an additional 25°
M20 six-cylinder engine with Torx-head bolts	
Stage 1	30
Stage 2	Angle-tighten an additional 90°
Stage 3	Angle-tighten an additional 90°
M30 six-cylinder engine (up to and including 1987 model year)	
Stage 1	60
Stage 2 (wait 15 minutes)	Angle-tighten an additional 33°
Stage 3 (engine at normal operating temperature)	Angle-tighten an additional 33°
M30 six-cylinder engine (from 1988 model year)	
Stage 1	60
Stage 2 (wait 20 minutes)	80
Stage 3 (engine at normal operating temperature)	Angle-tighten an additional 35°
M40 four-cylinder engine	
Stage 1	30
Stage 2	Angle-tighten an additional 90°
Stage 3	Angle-tighten an additional 90°
Intake manifold-to-cylinder head bolts	
M8 bolt	22
M7 bolt	15
M6 bolt	10
Exhaust manifold-to-cylinder head nuts	
M6 nut	10
M7 nut	15
Flywheel/driveplate bolts	
Manual transmission	105
Automatic transmission	120
Intermediate shaft sprocket bolt (M20 engines)	60
Sump-to-block bolts	9 to 11
Oil pump bolts (except M40 engines)	22
Oil pump sprocket bolts (M10 and M30 engines)	10
Oil pump cover plate-to-engine front end cover (M40 engines)	9
Front end cover-to-engine bolts (M20 and M40 engines)	
M6 bolts	10
M8 bolts	22
Crankshaft rear oil seal retainer-to-block bolts	
M6 bolts	9
M8 bolts	22

\* BMW recommend that the cylinder head bolts are renewed as a matter of course.

## 1 General information

This Part of Chapter 2 is devoted to in-vehicle engine repair procedures. All information concerning engine removal and refitting and engine block and cylinder head overhaul can be found in Chapter 2B.

The following repair procedures are based on the assumption that the engine is still fitted in the vehicle. If the engine has been removed from the vehicle and mounted on a stand, many of the steps outlined in this Part of Chapter 2 will not apply.

The Specifications included in this Part of Chapter 2 apply only to the procedures contained in this Part. Chapter 2B contains the Specifications necessary for cylinder head and engine block rebuilding.

The single overhead camshaft four- and six-cylinder engines covered in this manual are very similar in design. Where there are differences, they will be pointed out.

The means by which the overhead camshaft is driven varies according to engine type; M10 and M30 engines use a timing chain, while M20 and M40 engines have a timing belt.

## 2 Repair operations possible with the engine in the vehicle

Many major repair operations can be accomplished without removing the engine from the vehicle.

Clean the engine compartment and the exterior of the engine with some type of degreaser before any work is done. It will make the job easier, and help keep dirt out of the internal areas of the engine.

Depending on the components involved, it may be helpful to remove the bonnet to improve access to the engine as repairs are performed (see Chapter 11 if necessary). Cover the wings to prevent damage to the paint. Special pads are available, but an old bedspread or blanket will also work.

If vacuum, exhaust, oil or coolant leaks develop, indicating a need for gasket or seal renewal, the repairs can generally be made with the engine in the vehicle. The intake and exhaust manifold gaskets, sump gasket, crankshaft oil seals and cylinder head gasket are all accessible with the engine in place.

Exterior components, such as the intake and exhaust manifolds, the sump, the oil pump, the water pump, the starter motor, the alternator, the distributor and the fuel system components, can be removed for repair with the engine in place.

The cylinder head can be removed without removing the engine, so this procedure is covered in this Part of Chapter 2. Camshaft, rocker arm and valve component servicing is

most easily accomplished with the cylinder head removed; these procedures are covered in Part B of this Chapter. Note, however, that the camshaft on the M40 engine may be removed with the engine in the vehicle since it is retained by bearing caps.

In extreme cases caused by a lack of necessary equipment, repair or renewal of piston rings, pistons, connecting rods and big-end bearings is possible with the engine in the vehicle. However, this practice is not recommended, because of the cleaning and preparation work that must be done to the components involved.

### 3 Top Dead Centre (TDC) for No 1 piston - locating



**Note 1:** *The following procedure is based on the assumption that the distributor (if applicable) is correctly fitted. If you are trying to locate TDC to refit the distributor correctly, piston position must be determined by feeling for compression at the No 1 spark plug hole, then aligning the ignition timing marks or inserting the timing tool in the flywheel, as applicable.*

**Note 2:** *The No 1 cylinder is the one closest to the radiator.*

**1** Top Dead Centre (TDC) is the highest point in the cylinder that each piston reaches as it travels up and down when the crankshaft turns. Each piston reaches TDC on the compression stroke and again on the exhaust stroke, but TDC generally refers to piston position on the compression stroke.

**2** Positioning the piston at TDC is an essential part of many procedures, such as timing belt or chain removal and distributor removal.

**3** Before beginning this procedure, be sure to place the transmission in Neutral, and apply the handbrake or chock the rear wheels. Also, disable the ignition system by detaching the coil wire from the centre terminal of the distributor cap, and earthing it on the engine block with a jumper wire. Remove the spark plugs (see Chapter 1).

**4** In order to bring any piston to TDC, the crankshaft must be turned using one of the methods outlined below. When looking at the front of the engine, normal crankshaft rotation is clockwise.

- (a) *The preferred method is to turn the crankshaft with a socket and ratchet attached to the bolt threaded into the front of the crankshaft.*
- (b) *A remote starter switch, which may save some time, can also be used. Follow the instructions included with the switch. Once the piston is close to TDC, use a socket and ratchet as described in the previous paragraph.*
- (c) *If an assistant is available to turn the ignition switch to the Start position in short bursts, you can get the piston close to TDC without a remote starter switch.*



**3.8** Align the notch in the pulley with the notch on the timing plate, then check to see if the distributor rotor is pointing to the No 1 cylinder (if not, the camshaft is 180 degrees out - the crankshaft will have to be rotated 360 degrees)

*Make sure your assistant is out of the vehicle, away from the ignition switch, then use a socket and ratchet as described in (a) to complete the procedure.*

**5** Note the position of the terminal for the No 1 spark plug lead on the distributor cap. If the terminal isn't marked, follow the plug lead from the No 1 cylinder spark plug to the cap (No 1 cylinder is nearest the radiator).

**6** Use a felt-tip pen or chalk to make a mark directly below the No 1 terminal on the distributor body or timing cover.

**7** Detach the distributor cap, and set it aside (see Chapter 1 if necessary).

**8** Turn the crankshaft (see paragraph 4 above) until the timing marks (located at the front of the engine) are aligned (see illustration). The M40 engine does not have any timing marks at the front of the engine, but instead has a timing hole in the flywheel which must be aligned with a hole in the rear flange of the cylinder block. On this engine, turn the crankshaft until the distributor rotor is approaching the No 1 TDC position, then continue to turn the crankshaft until a suitable close-fitting drill can be inserted through the hole in the cylinder block and into the flywheel.

**9** Look at the distributor rotor - it should be pointing directly at the mark you made on the distributor body or timing cover.

**10** If the rotor is 180 degrees out, the No 1 piston is at TDC on the exhaust stroke.

**11** To get the piston to TDC on the compression stroke, turn the crankshaft one complete turn (360°) clockwise. The rotor should now be pointing at the mark on the distributor or timing cover. When the rotor is pointing at the No 1 spark plug lead terminal in the distributor cap and the ignition timing marks are aligned, the No 1 piston is at TDC on the compression stroke. **Note:** *If it's impossible to align the ignition timing marks when the rotor is pointing at the mark, the timing belt or chain may have jumped the teeth on the sprockets, or may have been fitted incorrectly.*

## 2A•4 In-car engine repair procedures

12 After the No 1 piston has been positioned at TDC on the compression stroke, TDC for any of the remaining pistons can be located by turning the crankshaft and following the firing order. Mark the remaining spark plug lead terminal locations just like you did for the No 1 terminal, then number the marks to correspond with the cylinder numbers. As you turn the crankshaft, the rotor will also turn. When it's pointing directly at one of the marks on the distributor, the piston for that particular cylinder is at TDC on the compression stroke.

### 4 Valve cover - removal and refitting



**Caution:** If the radio in your vehicle is equipped with an anti-theft system, make sure you have the correct activation code before disconnecting the battery.

**Note:** If, after connecting the battery, the wrong language appears on the instrument panel display, refer to page 0-7 for the language resetting procedure.

#### Removal

- 1 Disconnect the battery negative cable.
- 2 Detach the breather hose from the valve cover.
- 3 On M20 engines, unbolt and remove the intake manifold support bracket and, if applicable, the bracket for the engine sensors or idle air stabiliser (it will probably be necessary to disconnect the electrical connectors from the sensors and stabiliser).
- 4 On M30 engines, disconnect the electrical connector for the airflow sensor. Unclip the electrical harness, moving it out of the way.
- 5 Where necessary on M30 engines, remove the hoses and fittings from the intake air hose, then loosen the clamp and separate the hose from the throttle body. Unscrew the mounting nuts for the air cleaner housing, and remove the housing together with the air hose and airflow sensor.
- 6 Remove the valve cover retaining nuts and washers (see illustrations). Where necessary, disconnect the spark plug lead clip or cover



4.6a Valve cover bolt locations (arrowed) on M10 four-cylinder engines

from the stud(s), and set it aside. It will usually not be necessary to disconnect the leads from the spark plugs.

7 Remove the valve cover and gasket. Discard the old gasket. On the M40 engine, also remove the camshaft cover (see illustrations). If applicable, remove the semi-circular rubber seal from the cut-out at the front of the cylinder head.

#### Refitting

8 Using a scraper, remove all traces of old gasket material from the sealing surfaces of the valve cover and cylinder head.



**Caution:** Be very careful not to scratch or gouge the delicate aluminium surfaces. Gasket removal solvents are available at motor factors, and may prove helpful. After all gasket material has been removed, the gasket surfaces can be degreased by wiping them with a rag dampened with a suitable solvent.

9 If applicable, place a new semi-circular rubber seal in the cut-out at the front of the cylinder head, then apply RTV-type gasket sealant to the joints between the seal and the mating surface for the valve cover gasket.

**Note:** After the sealant is applied, you should refit the valve cover and tighten the nuts within ten minutes.

10 Refit the camshaft cover (M40 engine), the valve cover and a new gasket. Refit the washers and nuts; tighten the nuts evenly and securely. Don't overtighten these nuts - they



4.6b Valve cover bolt locations (arrowed) on M20 six-cylinder engines

should be tight enough to prevent oil from leaking past the gasket, but not so tight that they warp the valve cover.

11 The remainder of refitting is the reverse of removal.

### 5 Intake manifold - removal and refitting



#### Removal

1 Allow the engine to cool completely, then relieve the fuel pressure on fuel-injection engines (see Chapter 4).

2 Disconnect the battery negative cable.



**Caution:** If the radio in your vehicle is equipped with an anti-theft system, make sure you have the correct activation code before disconnecting the battery.

**Note:** If, after connecting the battery, the wrong language appears on the instrument panel display, refer to page 0-7 for the language resetting procedure.

3 Drain the engine coolant (see Chapter 1) below the level of the intake manifold. If the coolant is in good condition, it can be saved and reused.

4 On fuel injection engines, loosen the hose clamp and disconnect the large air inlet hose from the throttle body. It may also be necessary to remove the entire air cleaner/inlet hose assembly to provide enough working room (see Chapter 4).



4.7a Removing the valve cover on the M40 engine



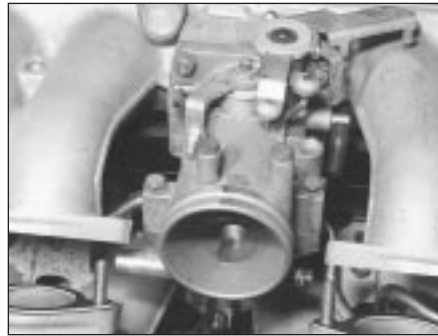
4.7b Removing the camshaft cover on the M40 engine



4.7c Removing the valve cover gasket on the M40 engine



5.9a On the M40 engine, remove the nuts and special bolts . . .



5.9b . . . and remove the upper part of the intake manifold . . .



5.9c . . . and gaskets

5 On carburettor engines, remove the complete air cleaner assembly (see Chapter 4).

6 Disconnect the coolant hoses from the throttle body/intake manifold as applicable.

7 Disconnect the throttle cable and, if applicable, cruise control cable (see Chapter 4).

8 Remove the EGR valve and line where applicable (see Chapter 6).

9 At this stage on the M40 engine, the upper part of the intake manifold should be removed by unscrewing the bolts and nuts. Remove the gaskets (see illustrations).

10 On fuel injection engines, disconnect the vacuum hose from the fuel pressure regulator, and disconnect the electrical connectors from the fuel injectors (see Chapter 4).

11 Disconnect the fuel lines from the fuel rail or carburettor, as applicable (see Chapter 4).

12 On the M40 engine, unbolt and remove the support bracket from the bottom of the intake manifold (see illustration).

13 Disconnect all remaining hoses and wires attached between the intake manifold/throttle body assembly and the engine or chassis.

14 Remove the bolts and/or nuts that attach the manifold to the cylinder head (see illustrations). Start at the ends and work toward the middle, loosening each one a little at a time until they can be removed by hand. Support the manifold while removing the fasteners so it doesn't fall. **Note:** You can remove the manifold without removing the throttle body, injectors, vacuum/thermo

valves, fuel pressure regulator or carburettor. If you're fitting a new manifold, transfer the components (see Chapter 4) and lines to the new manifold before it is fitted on the cylinder head.

15 Move the manifold up and down to break the gasket seal, then lift it away from the head and remove the gasket (see illustrations).

### Refitting

16 Remove the old gasket, then carefully scrape all traces of sealant off the head and the manifold mating surfaces. Be very careful not to nick or scratch the delicate aluminium mating surfaces. Gasket removal solvents are available at motor factors, and may prove helpful. Make sure the surfaces are perfectly clean and free of dirt and oil.

17 Check the manifold for corrosion (at the coolant passages), cracks, warping and other damage. Cracks and warping normally show up near the gasket surface, around the stud holes. If defects are found, have the manifold repaired (or renew it, as necessary).

18 When refitting the manifold, always use a new gasket. Where one side of the gasket has a graphite surface, this must face the cylinder head.

19 Refit the nuts and bolts and tighten them gradually, working from the centre out to the ends, to the torque listed in this Chapter's Specifications.

20 The remainder of refitting is the reverse of removal. On the M40 engine, renew the gaskets between the upper and lower parts of the manifold.



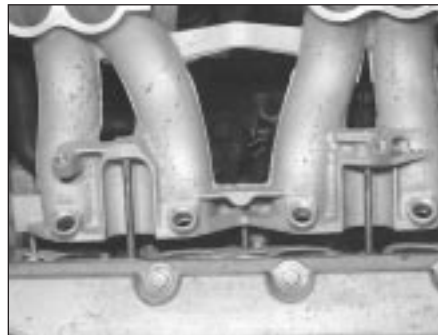
5.12 Removing the support bracket from the bottom of the intake manifold (M40 engine)



5.14a Remove the intake manifold nuts with a socket, ratchet and long extension (M20 engine)



5.14b Removing the lower intake manifold nuts (M40 engine)



5.15a Removing the lower intake manifold (M40 engine)



5.15b Removing the lower intake manifold gasket (M40 engine)

## 6 Exhaust manifold - removal and refitting



**Warning:** Make sure the engine is completely cool before beginning work on the exhaust system.



**Caution:** If the radio in your vehicle is equipped with an anti-theft system, make sure you have the correct activation code before disconnecting the battery.

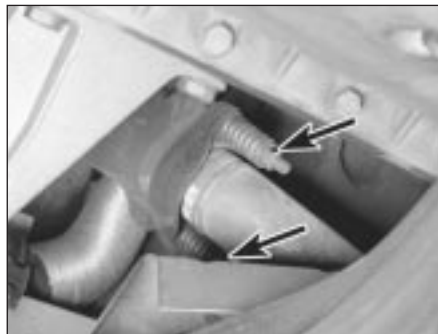
**Note:** If, after connecting the battery, the wrong language appears on the instrument panel display, refer to page 0-7 for the language resetting procedure.

- 1 Disconnect the battery negative cable.
- 2 On models where the air cleaner is on the exhaust manifold side of the engine, remove the air cleaner housing assembly and/or airflow sensor to provide sufficient working area (see Chapter 4, if necessary).



**Remove the windscreen washer reservoir from the right-hand side of the engine compartment to give more working room.**

- 3 Unplug the HT leads and set the spark plug lead harness aside (see Chapter 1).
- 4 Clearly label, then disconnect or remove, all wires, hoses, fittings, etc. that are in the way. Be sure to disconnect the oxygen sensor, where fitted.
- 5 Raise the vehicle, and support it securely on axle stands. Working from under the vehicle, separate the exhaust downpipe from the manifold. Use penetrating oil on the fasteners to ease removal (see illustrations).
- 6 Remove the axle stands, and lower the vehicle. Working from the ends of the manifold toward the centre, loosen the retaining nuts gradually until they can be removed. Again, penetrating oil may prove helpful.
- 7 Pull the manifold off the head, then remove the old gaskets (see illustrations). **Note:** Be very careful not to damage the oxygen sensor, where fitted.



6.5a Remove the exhaust manifold nuts (arrowed) from the exhaust pipe (M20 engine) - soaking the nuts with penetrating oil should make them easier to remove

- 8 Clean the gasket mating surfaces of the head and manifold, and make sure the threads on the exhaust manifold studs are in good condition.
- 9 Check for corrosion, warping, cracks, and other damage. Repair or renew the manifold as necessary.
- 10 When refitting the manifold, use new gaskets. Tighten the manifold-to-head retaining nuts gradually, starting at the centre and working out to the ends, to the torque listed in this Chapter's Specifications. Also tighten the downpipe-to-manifold nuts.
- 11 The remaining steps are simply a reversal of the removal procedure.

## 7 Timing chain covers - removal and refitting



**Note 1:** This procedure applies to M10 and M30 engines.

**Note 2:** The upper timing chain cover can be removed separately. If you need to remove both the upper and lower covers, special tools are required. Read paragraphs 8 and 9 before beginning work.

### Removal

- 1 Disconnect the battery negative cable.



6.5b Exhaust manifold-to-downpipe flange (M40 engine)



**Caution:** If the radio in your vehicle is equipped with an anti-theft system, make sure you have the correct activation code before disconnecting the battery.

**Note:** If, after connecting the battery, the wrong language appears on the instrument panel display, refer to page 0-7 for the language resetting procedure.

- 2 If you're removing the lower timing chain cover (the upper cover can be removed separately), remove the cooling fan and fan shroud, the radiator and the fan drivebelt pulley (see Chapter 3).
- 3 On the M10 engine only, remove the water pump (see Chapter 3).
- 4 On engines where the distributor cap is mounted directly to the timing chain cover, remove the cap, rotor and the black plastic cover beneath the rotor (see Chapter 1).
- 5 On the M30 engine fitted with the L-Jetronic fuel system, remove the distributor from the upper timing cover (see Chapter 5).
- 6 Remove the valve cover (see Section 4).
- 7 If you'll be removing the lower timing chain cover on the M30 engine, remove the crankshaft pulley from the vibration damper/hub. Hold the pulley stationary with a socket on the centre bolt, and remove the pulley bolts with another socket (see illustration).
- 8 If you'll be removing the lower timing chain



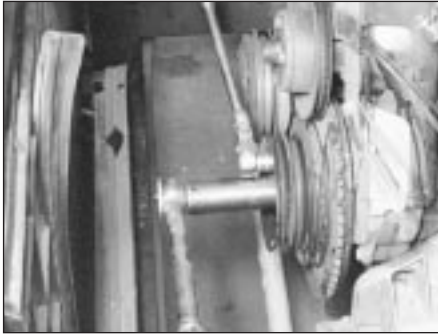
6.7a Removing the exhaust manifold (M40 engine)



6.7b Removing the exhaust manifold gasket (M40 engine)



6.7c Removing the exhaust manifold-to-downpipe gasket (M40 engine)



**7.7** Place a socket and ratchet on the centre bolt to keep the pulley stationary, and use another socket and ratchet to remove the smaller bolts attaching the pulley to the vibration damper

cover, remove the vibration damper/hub by locking the crankshaft in position and loosening the large centre bolt. Since the bolt is on very tight, you'll need to use an extension bar and socket to break it loose. On M30 engines, BMW recommends using a 3/4-inch drive socket and extension bar, since the bolt is extremely tight on these engines. To lock the crankshaft in place while the bolt is being loosened, use BMW special tool No. 11 2 100 (or equivalent).

**9** On the M10 engine, if the special tool listed in the previous paragraph is not available, you may try locking the crankshaft by removing the flywheel/driveplate inspection cover and jamming a wide-bladed screwdriver into the ring gear teeth. On the M30 engine, since the bolt is so extremely tight, we don't recommend substitute methods. Use the correct tool. On the M10 engine, after the centre bolt is removed, it will probably be necessary to use a jaw-type puller to pull the vibration damper off the crankshaft. Position the jaws behind the inner pulley groove, and tighten the puller centre bolt very slowly, checking the pulley to make sure it does not get bent or otherwise damaged by the puller.

**HAYNES**  
**HINT** *If the pulley seems to be sticking on the crankshaft, it may help to spray the hub area with some penetrating oil, and to gently tap on the hub area with a hammer.*

**10** Unscrew the plug and remove the timing chain tensioner spring (see illustration). The tensioner plunger may come out with the spring. If not, reach down into the hole where the tensioner spring was, and remove the plunger. To check the plunger for proper operation, see Section 8.



**Caution:** The spring is under tension, and this could cause the plug to be ejected from its hole with considerable force. Hold the tensioner plug securely as it's being



**7.10** Unscrew the plug from the timing chain cover, and remove the tensioner spring and plunger

unscrewed, and release the spring tension slowly.

**11** On the M30 engine, if you're removing the upper timing cover, unbolt the thermostat cover and remove the thermostat (see Chapter 3).

**12** On the M30 engine, if you're removing the lower timing cover, loosen the alternator mounting bolts, and swing the alternator to one side. Remove the front lower mounting bracket bolt, and loosen the other bolts. Also unbolt the power steering pump mounting bracket, and move it to one side.

**13** Remove the bolts and nuts securing the upper timing chain cover to the engine block, and remove the cover. Draw a simple diagram showing the location of the bolts, so they can be returned to the same holes from which they're removed. Remove the upper timing chain cover. If it sticks to the engine block, tap it gently with a rubber mallet, or place a piece of wood against the cover and hit the wood with a hammer. On the M30 engine fitted with the L-Jetronic fuel system, remove the distributor driveshaft.

**14** Remove the bolts and nuts attaching the lower timing chain cover to the engine block. Be sure to remove the three bolts from underneath that connect the front of the sump to the bottom of the front cover (see illustration). Loosen the remaining sump bolts.

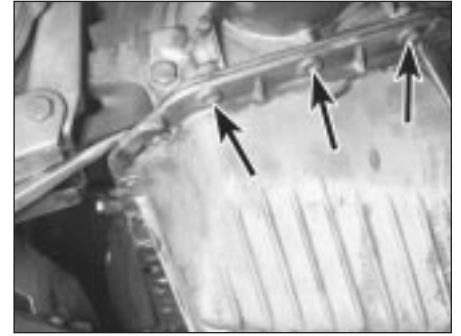
**15** Run a sharp, thin knife between the sump gasket and lower timing chain cover, cutting the cover free from the gasket. Be very careful not to damage or dirty the gasket, so you can re-use it.

**16** Break the lower timing chain cover-to-block gasket seal by tapping the cover with a rubber mallet, or with a hammer and block of wood. Do not prise between the cover and the engine block, as damage to the gasket sealing surfaces will result.

**17** Using a scraper, remove all traces of old gasket material from the sealing surfaces of the covers and engine block.



**Caution:** Be very careful not to scratch or gouge the delicate aluminium surfaces. Also, do not damage the sump gasket, and keep it clean. Gasket removal solvents are available at motor factors, and may prove helpful. After all gasket material has been



**7.14** From underneath the vehicle, remove the three bolts (arrowed) that connect the cover and the sump

removed, the gasket surfaces can be degreased by wiping them with a rag dampened with a suitable solvent.

### Refitting

**18** Renew the front oil seals (see Section 11). It's not wise to take a chance on an old seal, since renewal with the covers removed is very easy. Be sure to apply a little oil to the front oil seal lips.

**19** Apply a film of RTV-type gasket sealant to the surface of the sump gasket that mates with the lower timing chain cover. Apply extra beads of RTV sealant to the edges where the gasket meets the engine block. **Note:** If the sump gasket is damaged, instead of fitting a whole new gasket, you might try trimming the front portion of the gasket off at the point where it meets the engine block, then trim off the front portion of a new sump gasket so it's exactly the same size. Cover the exposed inside area of the sump with a rag, then clean all traces of old gasket material off the area where the gasket was removed. Attach the new gasket piece to the sump with contact-cement-type gasket adhesive, then apply RTV-type sealant as described at the beginning of this paragraph.

**20** Coat both sides of the new gasket with RTV-type gasket sealant, then attach the lower timing chain cover to the front of the engine. Refit the bolts, and tighten them evenly to the torque listed in this Chapter's Specifications. Work from bolt-to-bolt in a criss-cross pattern to be sure they're tightened evenly. **Note 1:** Tighten the lower cover-to-block bolts first, then tighten the sump-to-cover bolts. If the gasket protrudes above the cover-to-block joint, or bunches up at the cover-to-sump joint, trim the gasket so it fits correctly. **Note 2:** After applying RTV-type sealant, reassembly must be completed in about 10 minutes so the RTV won't prematurely harden.

**21** Refit the upper timing chain cover in the same way as the lower cover. If the gasket protrudes beyond the top of the cover and the engine block, trim off the excess with a razor blade.

**22** Refitting is otherwise the reverse of removal.

## 8 Timing chain and sprockets - removal, inspection and refitting



**Note:** This procedure applies to M10 and M30 engines.



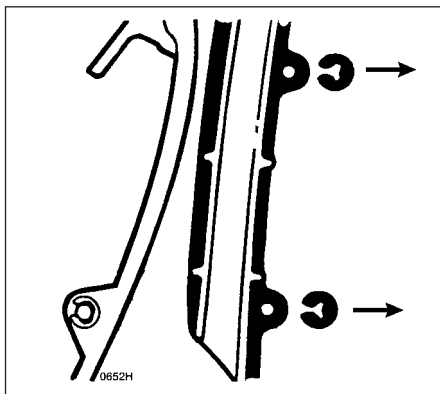
**Caution:** Once the engine is set at TDC, do not rotate the camshaft or crankshaft until the timing chain is reinstalled. If the crankshaft or camshaft is rotated with the timing chain removed, the valves could hit the pistons, causing expensive internal engine damage.

### Removal

1 Position the No 1 cylinder at Top Dead Centre (TDC) on the compression stroke (see Section 3).

2 Remove the valve cover (see Section 4). Double-check that the No 1 cylinder is at TDC on the compression stroke by making sure the No 1 cylinder rocker arms are loose (not compressing their valve springs).

3 Remove the upper timing chain cover (see Section 7). Note the location of the camshaft timing marks, which should now be aligned. On four-cylinder (M10) engines, there's usually a stamped line on the camshaft flange that aligns with a cast mark on the top of the cylinder head; also, the camshaft sprocket dowel pin hole will be at its lowest point. On six-cylinder (M30) engines, a line drawn through two of the camshaft sprocket bolts opposite each other would be exactly vertical, while a line drawn through the other two bolts would be horizontal. Additionally, the locating pin should be in the lower left corner (between the 7 and 8 o'clock positions). Be sure you've identified the correct camshaft TDC position before dismantling, because correct valve timing depends on you aligning them exactly on reassembly. **Note:** As the engine is mounted in the engine compartment at an



8.9 To remove the tensioner or chain guide rail, remove the circlips with a pointed tool or needle-nose pliers - the circlips tend to fly off when they're released, so make sure you catch them or they'll get lost (or, worse, wind up in the engine!)

angle, all references to horizontal and vertical whilst timing the camshafts are in relation to the crankshaft, and not the ground.

4 Hold the crankshaft stationary with a socket and ratchet on the vibration damper centre bolt, then loosen (but don't unscrew completely) the four bolts attaching the camshaft sprocket to the camshaft. Be very careful not to rotate the camshaft or crankshaft. **Note:** Some earlier models may have locking tabs for the camshaft sprocket bolts. Bend the tabs down before loosening the bolts. The tabs are no longer available from the manufacturer, and do not have to be used on refitting.

5 Remove the lower timing chain cover (see Section 7).

6 Unscrew and remove the four camshaft sprocket bolts, then disengage the chain from the crankshaft sprocket and carefully remove the chain and camshaft sprocket from the engine. It may be necessary to gently prise the camshaft sprocket loose from the camshaft with a screwdriver.

### Inspection

#### Timing sprockets

7 Examine the teeth on both the crankshaft sprocket and the camshaft sprocket for wear. Each tooth forms an inverted V. If worn, the side of each tooth under tension will be slightly concave in shape when compared with the other side of the tooth (i.e. one side of the inverted V will be concave when compared with the other, giving the teeth a hooked appearance). If the teeth appear to be worn, the sprockets must be renewed. **Note:** The crankshaft sprocket is a press fit on the crankshaft, and can be removed with a jaw-type puller after the Woodruff key and oil pump are removed (see Section 14). However, BMW recommends the new sprocket be pressed onto the crankshaft after being heated to 80° C (175° F) on the M10 engine, or to 200° C (390° F) on the M30 engine. For this reason, if the crankshaft sprocket requires renewal, we recommend removing the crankshaft (see Part B of this Chapter) and taking it to an engineering works to have the old sprocket pressed off and a new one pressed on.

#### Timing chain

8 The chain should be renewed if the sprockets are worn or if the chain is loose (indicated by excessive noise in operation). It's a good idea to renew the chain anyway if the engine is stripped down for overhaul. The rollers on a very badly worn chain may be slightly grooved. To avoid future problems, if there's any doubt at all about the chain's condition, renew it.

#### Chain rail and tensioner

9 Inspect the chain guide rail and tensioner rail for deep grooves caused by chain contact. Renew them if they are excessively worn. The rails can be renewed after removing the circlips with a pointed tool or needle-nose pliers (see illustration).

10 Shake the tensioner plunger, and listen for a rattling sound from the check ball. If you can't hear the ball rattling, renew the plunger.

11 To further check the tensioner plunger, blow through it first from the closed end, then from the slotted (guide) end. No air should flow through the plunger when you blow through the closed end, and air should flow through it freely when you blow through the slotted end. If the tensioner fails either test, renew it.

### Refitting

12 Refit the tensioner rail and chain guide rail, if removed.

13 Temporarily refit the lower timing chain cover and vibration damper, so you can check the crankshaft timing marks. Once you've verified the TDC marks are aligned, remove the damper and cover.

14 Loop the timing chain over the crankshaft sprocket, then loop it over the camshaft sprocket and, guiding the chain between the chain guide and tensioner rail, refit the camshaft sprocket on the camshaft. Make sure the camshaft timing marks are aligned.

15 The remainder of refitting is the reverse of removal. Be sure to tighten the fasteners to the correct torques (see this Chapter's Specifications).

## 9 Timing belt covers - removal and refitting



**Note:** This procedure applies to M20 and M40 engines.



**Caution:** If the radio in your vehicle is equipped with an anti-theft system, make sure you have the correct activation code before disconnecting the battery.

**Note:** If, after connecting the battery, the wrong language appears on the instrument panel display, refer to page 0-7 for the language resetting procedure.

- 1 Disconnect the battery negative cable.
- 2 Remove the fan clutch and fan shroud (see Chapter 3).
- 3 On the M20 engine, remove the radiator (see Chapter 3).
- 4 Remove the fan drivebelt pulley.



9.6a Unbolt the distributor cap (M40 engine) . . .





9.6b ... then unbolt the rotor ...



9.6c ... and remove the black plastic cover



9.8 Remove all the nuts/ bolts (arrowed) that attach the upper and lower covers (M20 engine - removed for clarity)



9.9a Remove the upper timing belt cover first, then the lower cover (M20 engine)

- 1 Upper timing belt cover
- 2 Lower timing belt cover

5 If applicable, disconnect the reference sensor wiring harness which runs across the front of the timing belt cover, and set it aside.

6 If the distributor cap is mounted directly to the upper timing belt cover, remove the cap, rotor and the black plastic cover beneath the rotor (see illustrations).

7 Remove the lower fan drivebelt pulley and vibration damper. Secure the crankshaft pulley centre bolt while you loosen the outer pulley/damper bolts (see illustration 7.7).

8 Remove the bolts/nuts attaching the timing belt covers to the engine (see illustration).

9 Remove the upper cover first, then the lower cover (see illustrations). **Note:** The upper cover has two alignment sleeves in the top bolt positions. Be sure these are in place upon reassembly.

10 Refitting is the reverse of the removal procedure. Tighten the cover bolts securely.

### 10 Timing belt and sprockets - removal, inspection and refitting



**Note 1:** This procedure applies to M20 and M40 engines.

**Note 2:** Before removing the camshaft sprocket on the M40 engine, it is necessary to obtain a tool to hold the camshaft for the refitting procedure (see paragraph 10).



9.9b Removing the upper timing belt cover on the M40 engine



**Caution:** If the radio in your vehicle is equipped with an anti-theft system, make sure you have the correct activation code before disconnecting the battery.

**Note:** If, after activating the battery, the wrong language appears on the instrument panel display, refer to page 0-7 for the language resetting procedure.

#### Removal

- 1 Disconnect the negative cable from the battery.
- 2 Remove the timing belt covers (see Section 9).
- 3 On the M40 engine, drain the cooling system (see Chapter 1), then disconnect the



9.9c Removing the lower timing belt cover on the M40 engine

hose, unbolt the thermostat housing and remove the thermostat (see Chapter 3).

- 4 Set the No 1 piston at TDC (see Section 3).



**Caution:** Once the engine is set at TDC, do not rotate the camshaft or crankshaft until the timing belt is refitted. If the crankshaft or camshaft is rotated with the timing belt removed, the valves could hit the pistons, causing expensive internal engine damage.

5 On the M20 engine, the crankshaft mark should be aligned with the mark on the inner cover (see illustration). The mark on the camshaft sprocket should be aligned with the stamped line on the cylinder head (see illustration). On the M40 engine, make an



10.5a Align the groove in the hub on the end of the crankshaft with the notch in the front inner cover (arrowed) and mark them for assembly reference later on



10.5b Align the mark on the camshaft sprocket with the mark on the cylinder head (arrowed)



10.6 Loosen the idler pulley bolts (arrowed) to relieve the tension on the timing belt so it can be removed



10.9b Removing the timing belt from the camshaft sprocket on the M40 engine



10.10 Removing the camshaft sprocket on the M40 engine



10.11a The BMW tool for holding the camshaft in the TDC position on M40 engines



10.9a When removing the timing belt on models with a two-piece crankshaft hub, it's a tight fit to remove it around the hub, but it's a lot easier than removing the crankshaft hub assembly, which is secured by a very tight bolt

alignment mark on the camshaft sprocket and rear timing cover to ensure correct refitting.

6 On the M20 engine, loosen the two tensioner roller retaining bolts a little, and push the tensioner towards the water pump (see illustration). With the timing belt tension relieved, re-tighten the retaining bolt.

7 On the M40 engine, loosen the tensioner retaining nut, and use an Allen key to rotate the tensioner clockwise. This will relieve the tension of the timing belt. Tighten the retaining nut to hold the tensioner in its free position.

8 If the same belt is to be refitted, mark it with an arrow indicating direction of rotation.

**Caution:** It is not advisable to refit a timing belt which has been removed unless it is virtually new. On the M40 engine, BMW recommend that the timing belt is renewed every time the tensioner roller is released.

9 Remove the timing belt by slipping it off the roller(s) and the other sprockets (see illustrations).

10 If it's necessary to remove the camshaft or the intermediate shaft sprocket, remove the sprocket bolt while holding the sprocket to prevent it from moving. To hold the sprocket, wrap it with a piece of an old timing belt (toothed side engaging the sprocket teeth) or



10.11b The BMW camshaft-holding tool in position on the M40 engine

a piece of leather, then hold the sprocket using a strap spanner. If a strap spanner is not available, clamp the ends of the piece of belt or leather tightly together with a pair of grips. Before loosening the bolt, make sure you have the necessary tool for positioning the camshaft as described in the following paragraph (see illustration).



**Caution:** Do not use the timing belt you're planning to refit to hold the sprocket. Also, be sure to hold the camshaft sprocket very steady, because if it moves more than a few degrees, the valves could hit the pistons.

**Note:** On the M40 engine, the sprocket is not directly located on the camshaft with a key, as the groove in the end of the camshaft allows the sprocket to move several degrees in either direction. The retaining bolt locks the sprocket onto a taper after positioning the camshaft with a special tool.

11 The BMW tool for positioning the camshaft on the M40 engine consists of a metal plate which locates over the square lug near the No 1 cylinder lobes on the camshaft - the valve cover must be removed first (see illustrations). If the BMW tool cannot be obtained, a home-made tool should be fabricated out of metal plate. The tool must be made to hold the square lug on the camshaft at right-angles to the upper face of the cylinder head (ie the contact face of the valve cover).

12 If it's necessary to remove the crankshaft sprocket, remove the crankshaft hub centre bolt while holding the crankshaft steady.

**Note:** The removal of the crankshaft hub mounting bolt requires a heavy-duty holding device because of the high torque used to tighten the bolt. BMW has a special tool, numbered 112150 (M20 engines) or 112170 (M40 engines), for this purpose. If this tool cannot be bought or borrowed, check with a tool dealer or motor factors for a tool capable of doing the job. Note that the tool number 112170 bolts on the rear of the cylinder head and engages with the flywheel ring gear, so it will only be possible to use this tool if the gearbox has been removed, or if the engine is out of the vehicle (see illustrations). On



10.12a Home-made tool for holding the crankshaft stationary while the crankshaft pulley bolt is being loosened (engine removed for clarity)

models with a two-piece hub, after removing the outer hub piece, you'll then need to remove the sprocket with a bolt-type puller (available at most motor factors). When using the puller, thread the crankshaft centre bolt in approximately three turns, and use this as a bearing point for the puller's centre bolt.

### Inspection

13 Check for a cracked, worn or damaged belt. Renew it if any of these conditions are found (see illustrations). Also look at the sprockets for any signs of irregular wear or damage, indicating the need for renewal.

**Note:** If any parts are to be renewed, check with your local BMW dealer parts department to be sure compatible parts are used. On M20 engines, later sprockets, tensioner rollers and timing belts are marked "Z 127". Renewal of the timing belt on M20 engines will mean that the later belt tensioner should also be fitted, if not already done.

14 Inspect the idler roller and, on M20 engines, the tension spring. Rotate the tensioner roller to be sure it rotates freely, with no noise or play. **Note:** When fitting a new timing belt, it is recommended that a new tensioner be fitted also.

### Refitting

15 On the M20 engine, refit the idler/tensioner/spring so that the timing belt can be fitted loosely.

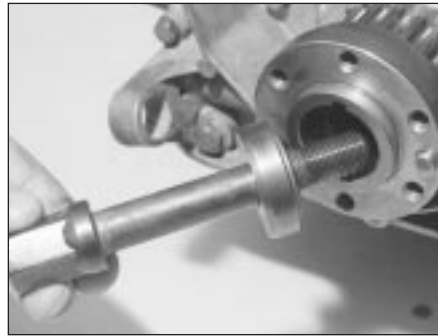
16 Refit the sprockets using a reversal of the removal procedure; tighten the retaining bolts to the specified torque. On the M40 engine, turn the camshaft sprocket clockwise as far as possible within the location groove, then tighten the retaining bolt to an initial torque of 1 to 3 Nm at this stage.

17 If you are refitting the old belt, make sure the mark made to indicate belt direction of rotation is pointing the right way (the belt should rotate in a clockwise direction as you face the front of the engine).

18 Refit the timing belt, placing the belt under the crankshaft sprocket first to get by



10.21 On the M20 engine, after the belt has been installed correctly around all sprockets and the tensioner pulley, lightly apply pressure to the tensioner, to be sure the tensioner isn't stuck and has full movement against the timing belt



10.12b Removing the crankshaft pulley bolt (M40 engine)

the housing. Guide the belt around the other sprocket(s).

19 Finally, place the belt over the idler/tensioner rollers.

20 On the M20 engine, loosen the tensioner bolts and allow the spring tension to be applied to the belt.

21 On the M20 engine, lightly apply pressure behind the tensioner to be sure spring pressure is being applied to the belt (see illustration). Don't tighten the bolts while applying pressure; lightly tighten the bolts only after releasing the tensioner.

22 On the M40 engine, unbolt and remove the valve cover, then use the special tool to hold the camshaft in the TDC position (see paragraph 11).

23 On the M40 engine, loosen the tensioner roller retaining nut, and use an Allen key to rotate the roller anti-clockwise until the timing belt is tensioned correctly. The 90°-twist method of checking the tension of the timing belt is not accurate enough for this engine, and it is strongly recommended that the special BMW tensioning tool is obtained if at all possible (apply  $32 \pm 2$  graduations on the tool) (see illustration). A reasonably accurate alternative can be made using an Allen key and a spring balance (see illustration). Make sure that the spring balance is positioned as shown, since the tensioner roller is on an eccentric, and different readings will be obtained otherwise. The spring balance should be connected 85 mm along the Allen key, and a force of 2.0 kg (4.4 lb) should be



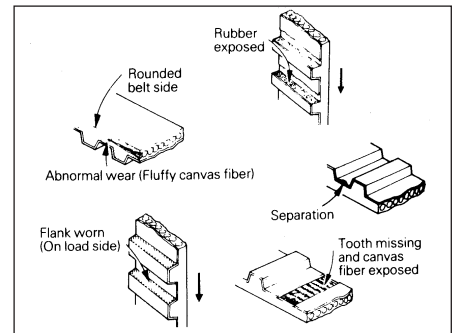
10.23a Using the special BMW tool to check the tension of the timing belt on the M40 engine



10.12c Removing the crankshaft sprocket from the front of the crankshaft



10.13a Inspect the timing belt carefully for cracking, as shown here. . .



10.13b . . . and any other damage



10.23b Using a spring balance and Allen key to adjust the tension of the timing belt on the M40 engine  
Dimension A = 85 mm

applied. Tighten the retaining nut to the specified torque to hold the tensioner in its correct position. **Note:** *It is important that the timing belt is tensioned correctly. If the belt is over-tightened, it will howl, and there is the possibility of it being damaged. If the belt is too slack, it may jump on the sprockets.*

**24** Check to make sure the camshaft and crankshaft timing marks are still aligned (see illustrations 10.5a and 10.5b).

**25** Turn the crankshaft clockwise through two complete revolutions. (Remove the camshaft positioning tool from the M40 engine first.)



**Caution:** *This is necessary to stretch the new belt. If not done, the belt tensioner will be too loose, and damage could result.*

**26** On the M20 engine, loosen the tensioner roller bolts, then tighten them to the torque listed in this Chapter's Specifications.

**27** On the M40 engine, loosen the tensioner roller retaining nut, and re-adjust the tension of the timing belt as described in paragraph 23. On completion, tighten the tensioner roller retaining nut, then fully tighten the camshaft sprocket bolt if previously loosened (see illustration).

**28** Verify that the timing marks are still perfectly aligned. If not, remove and refit the timing belt.

**29** The remainder of refitting is the reverse of removal.

### 11 Front oil seals - renewal



**Note:** *Oil seals are fitted with their sealing lips facing inwards (towards the engine).*

#### M10 and M30 (timing chain) engines

##### Camshaft front seal (M30 engines only)

**1** Remove the upper timing chain cover only (see Section 7).



10.27 Tightening the camshaft sprocket retaining bolt on the M40 engine

**2** Support the cover on two blocks of wood, and drive out the seal from behind with a hammer and screwdriver. Be very careful not to damage the seal bore in the process.

**3** Coat the outside diameter and lip of the new seal with multi-purpose grease, and drive the seal into the cover with a hammer and a socket slightly smaller in diameter than the outside diameter of the seal.

**4** The remainder of refitting is the reverse of removal.

##### Crankshaft front seal (M10 and M30 engines)

**5** Remove the crankshaft pulley and vibration damper (see Section 7).

**6** Carefully prise the old seal out of the cover with a large screwdriver. Be very careful not to damage the seal bore or the crankshaft with the tool. Wrap the tip of the screwdriver with a piece of tape to prevent damage.

**7** Clean the bore in the cover, and coat the outer edge of the new seal with engine oil or multi-purpose grease. Also lubricate the lips of the seal with multi-purpose grease. Using a socket with an outside diameter slightly smaller than the outside diameter of the seal, carefully drive the new seal into place with a hammer (see illustration). If a socket isn't available, a short section of large-diameter pipe will work. Check the seal after refitting to be sure the spring around the inside of the seal lip didn't pop out of place.

**8** The remainder of refitting is the reverse of removal.

#### M20 and M40 (timing belt) engines

##### Camshaft front seal (M20 and M40 engines)

**9** Remove the timing belt and camshaft sprocket (see Section 10).

**10** On the M20 engine only, remove the two screws, and separate the camshaft seal housing from the cylinder head by pulling it as you rotate it back and forth.

**11** On the M20 engine only, support the housing on two blocks of wood, and drive the seal out of the housing from behind using a

hammer and screwdriver. Be very careful not to damage the seal housing.

**12** On the M40 engine, prise the seal out from the cylinder head using a screwdriver, being careful not to damage the camshaft surface or the seal bore.

**13** Coat the lip and outside diameter of the new seal with multi-purpose grease.

**14** On the M40 engine, wrap some adhesive tape around the end of the camshaft to protect the new seal from the location groove as it is being fitted (see illustration).

**15** Carefully locate the new seal in position, and press it in by hand initially so that it enters the bore. Drive the new seal into the housing or cylinder head (as applicable) using a hammer and a socket with a diameter slightly smaller than the outside diameter of the seal. On the M40 engine, remove the adhesive tape from the end of the camshaft.

**16** On the M20 engine, renew the O-ring on the back of the seal housing, and work the lip of the seal over the end of the camshaft. Refit the screws and tighten them securely.

**17** The remainder of refitting is the reverse of removal.

##### Crankshaft and intermediate shaft front seals (M20 engines)

**18** Remove the timing belt and crankshaft and intermediate shaft pulleys as applicable (see Section 10). **Note:** *We recommend the timing belt be renewed any time it is removed.*

**19** Remove the bolts and nuts securing the front cover to the engine block. Be sure to remove the three bolts from underneath that connect the front of the sump to the bottom of the front cover (see illustration 7.14).

**20** Run a sharp, thin knife between the sump gasket and the front cover, cutting the cover free from the gasket. Be very careful not to damage the gasket, and keep it clean so you can re-use it.

**21** Break the front cover-to-block gasket seal by tapping the cover with a rubber mallet or block of wood and hammer. Do not prise between the cover and the engine block, as damage to the gasket sealing surfaces will result.



11.7 The crankshaft front oil seal is pressed into the front of the lower timing chain cover (cover removed from the engine for clarity)



11.14 Fitting a new camshaft oil seal on the M40 engine (note the adhesive tape around the end of the camshaft to protect the seal)

22 Using a scraper, remove all traces of old gasket material from the sealing surfaces of the covers and engine block.



**Caution:** Be very careful not to scratch or gouge the delicate aluminium surfaces. Also, do not damage the sump gasket, and keep it clean. Gasket removal solvents are available at motor factors, and may prove helpful. After all gasket material has been removed, the gasket surfaces can be degreased by wiping them with a rag dampened with a suitable solvent.

23 Support the cover on two blocks of wood, and drive out the seals from behind with a hammer and screwdriver. Be very careful not to damage the seal bores in the process.

24 Coat the outside diameters and lips of the new seals with multi-purpose grease, and drive the seals into the cover with a hammer and a socket slightly smaller in diameter than the outside diameter of the seal.

25 Apply a film of RTV-type gasket sealant to the surface of the sump gasket that mates with the front cover. Apply extra beads of RTV sealant to the edges where the gasket meets the engine block. **Note:** If the sump gasket is damaged, instead of fitting a whole new gasket, you might try trimming the front portion of the gasket off at the point where it meets the engine block, then trim off the front portion of a new sump gasket so it's exactly the same size. Cover the exposed inside area of the sump with a rag, then clean all traces of old gasket material off the area where the gasket was removed. Attach the new gasket piece to the sump with contact-cement-type gasket adhesive, then apply RTV-type sealant as described at the beginning of this paragraph.

26 Coat both sides of the new gasket with RTV-type gasket sealant, then attach the front cover to the front of the engine, carefully working the seals over the crankshaft and intermediate shaft. Refit the bolts and tighten them evenly to the torque listed in this Chapter's Specifications. Work from bolt-to-bolt in a criss-cross pattern, to be sure they're tightened evenly. **Note 1:** Tighten the front cover-to-block bolts first, then tighten the sump-to-cover bolts. **Note 2:** After applying RTV-type sealant, reassembly must be completed in about 10 minutes so the RTV won't prematurely harden.

27 The remainder of refitting is the reverse of removal.

### Crankshaft front seal (M40 engines)

28 Remove the timing belt and crankshaft sprocket (see Section 10).

29 Remove the Woodruff key from the groove in the end of the crankshaft.

30 Note the fitted position of the oil seal, then prise it out from the front cover using a screwdriver, but take care not to damage the bore of the cover or the surface of the

crankshaft. If the seal is tight, drill two small holes in the metal end of the seal, and use two self-tapping screws to pull out the seal. Make sure all remains of swarf are removed.

31 Coat the outside diameter and lip of the new seal with multi-purpose grease, then drive it into the cover with a hammer and a socket slightly smaller in diameter than the outside diameter of the seal. Make sure the seal enters squarely.

32 The remainder of refitting is the reverse of removal. Note that it is recommended that the timing belt be renewed - see Section 10.

## 12 Cylinder head - removal and refitting



### Removal

1 Relieve the fuel pressure on all fuel injection engines (see Chapter 4).

2 Disconnect the negative cable from the battery. Where the battery is located in the engine compartment, the battery may be removed completely (see Chapter 5).



**Caution:** If the radio in your vehicle is equipped with an anti-theft system, make sure you have the correct activation code before disconnecting the battery.

**Note:** If, after connecting the battery, the wrong language appears on the instrument panel display, refer to page 0-7 for the language resetting procedure.

3 Remove the air cleaner assembly (see Chapter 4).

4 Disconnect the wiring from the distributor (mark all wiring for position first, if necessary), and the HT lead from the coil (see Chapter 5).

5 Disconnect the lead from the coolant temperature sender unit (see Chapter 3).

6 Disconnect the fuel lines from the fuel rail or carburettor as applicable (see Chapter 4).

7 Drain the cooling system (see Chapter 3).

8 Clearly label then disconnect all other hoses from the throttle body, intake manifold, carburettor and cylinder head, as applicable.

9 Disconnect the throttle cable from the throttle linkage or carburettor (see Chapter 4).

10 Disconnect the exhaust manifold from the cylinder head (see Section 6). Depending on the engine type, it may not be necessary to disconnect the manifold from the exhaust pipe; however, on right-hand-drive models, the steering column intermediate shaft may not allow the manifold to clear the studs on the cylinder head.

11 Remove or disconnect any remaining hoses or lines from the intake manifold, including the ignition advance vacuum line(s), and the coolant and heater hoses.

12 On early carburettor models, disconnect the wiring from the alternator and starter motor.

13 Remove the intake manifold (see Section 5). Do not dismantle or remove any fuel injection system components unless it is absolutely necessary.

14 Remove the fan drivebelt and fan (see Chapter 3).

15 Remove the valve cover and gasket (see Section 4). Remove the semi-circular rubber seal from the front of the cylinder head, where this is not incorporated in the valve cover gasket.

16 Set No 1 piston at Top Dead Centre on the compression stroke (see Section 3).

17 Remove the timing chain or belt (see Section 8 or 10). **Note:** If you want to save time by not removing and refitting the timing belt or chain and re-timing the engine, you can unfasten the camshaft sprocket and suspend it out of the way - with the belt or chain still attached - by a piece of rope. Be sure the rope keeps firm tension on the belt or chain, so it won't become disengaged from any of the sprockets.

18 Loosen the cylinder head bolts a quarter-turn at a time each, in the reverse of the tightening sequence shown (see illustrations 12.30a, 12.30b, 12.30c or 12.30d). Do not dismantle or remove the rocker arm assembly at this time on M10, M20 and M30 engines.

19 Remove the cylinder head by lifting it straight up and off the engine block. Do not prise between the cylinder head and the engine block, as damage to the gasket sealing surfaces may result. Instead, use a blunt bar positioned in an intake port to gently prise the head loose.

20 Remove any remaining external components from the head to allow for thorough cleaning and inspection. See Chapter 2B for cylinder head servicing procedures. On the M40 engine, remove the rubber O-ring from the groove in the top of the oil pump/front end cover housing.

### Refitting

21 The mating surfaces of the cylinder head and block must be perfectly clean when the head is refitted.

22 Use a gasket scraper to remove all traces of carbon and old gasket material, then clean the mating surfaces with a suitable solvent. If there's oil on the mating surfaces when the head is refitted, the gasket may not seal correctly, and leaks could develop. When working on the block, stuff the cylinders with clean rags to keep out debris. Use a vacuum cleaner to remove material that falls into the cylinders.

23 Check the block and head mating surfaces for nicks, deep scratches and other damage. If the damage is slight, it can be removed with a file; if it's excessive, machining may be the only alternative.

24 Use a tap of the correct size to chase the threads in the head bolt holes, then clean the holes with compressed air - make sure that



12.24 The cylinder head bolt holes should be cleaned and restored with a tap (be sure to remove debris from the holes after this is done)



12.25 A die should be used to remove sealant and corrosion from the head bolt threads prior to installation



12.26 Fitting a new rubber O-ring in the groove in the top of the oil pump/front end cover on the M40 engine

nothing (including oil, water, etc) remains in the holes (see illustration).

25 BMW recommend head bolts are renewed, but if the old ones are re-used, mount each bolt in a vice, and run a die down the threads to remove corrosion and restore the threads. Dirt, corrosion, sealant and damaged threads will affect torque readings (see illustration). If the bolts or their threads are damaged, do not re-use the bolts - fit a new set.

26 Refit any components removed from the head prior to cleaning and inspection. On the M40 engine, locate a new rubber O-ring in the groove in the top of the oil pump/front end cover housing (see illustration).

27 Make sure the gasket sealing surfaces of

the engine block and cylinder head are clean and oil-free. Lay the head gasket in place on the block, with the manufacturer's stamped mark facing up (it usually says "UP," "OBEN" or something similar). Use the dowel pins in the top of the block to properly locate the gasket.

28 Carefully set the cylinder head in place on the block. Use the dowel pins to properly align it. Where the engine is tilted slightly (ie M40 engine) you may find it helpful to fit guide studs to ensure correct positioning of the cylinder head on the block. Use two old head bolts, one screwed into each end of the block. Cut the heads off the bolts, and use a hacksaw to cut slots in the tops of the bolts so they can be removed once

the cylinder head is in position (see illustration).

29 Fit the cylinder head bolts (see illustration).

30 Tighten the cylinder head bolts, in the sequence shown, to the torque listed in this Chapter's Specifications (see illustrations). Note that on some engines the final stage of tightening takes place after the engine has been run.

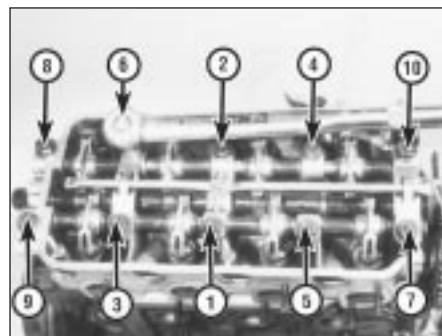
31 The remainder of refitting is the reverse of removal. Set the valve clearances on M10, M20 and M30 engines (see Chapter 1) before refitting the valve cover (check them again after the engine is warmed-up). Run the engine and check for leaks.



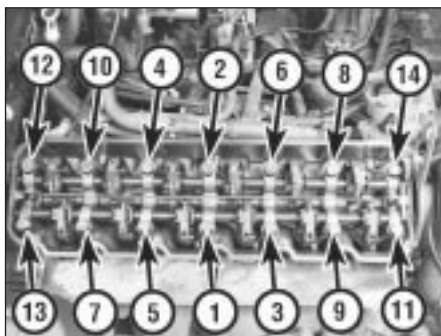
12.28 Lowering the cylinder head onto the block (M40 engine)



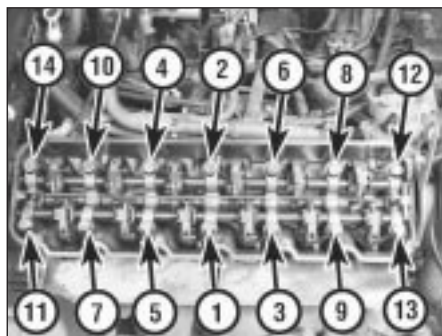
12.29 Inserting a cylinder head bolt (M40 engine)



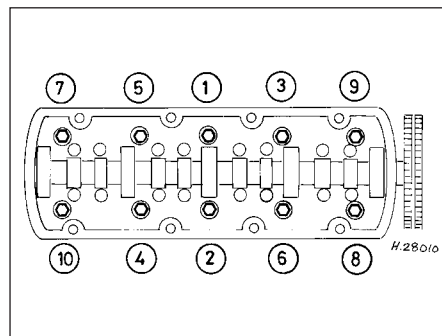
12.30a Cylinder head bolt TIGHTENING sequence for M10 (four-cylinder) engines



12.30b Cylinder head bolt TIGHTENING sequence for M20 (six-cylinder) engines



12.30c Cylinder head bolt TIGHTENING sequence for M30 (six-cylinder) engines



12.30d Cylinder head bolt TIGHTENING sequence for M40 (four-cylinder) engines



12.30e Angle-tightening the cylinder head bolts (M40 engine)



13.4 If applicable, remove the nut securing the power steering lines to the sump, and move the lines to one side to allow you to get at the sump bolts



13.5 If applicable, disconnect the oil level sensor connector at the left side of the engine, down near the power steering pump mounting bracket

### 13 Sump - removal and refitting



- 1 Drain the engine oil (see Chapter 1).
- 2 Raise the front of the vehicle and place it securely on axle stands.
- 3 Remove the splash shields from under the engine.
- 4 Where applicable, disconnect the hoses attached to the sump, and move them to one side (see illustration).
- 5 Where applicable, disconnect the oil level sensor electrical connector (see illustration).
- 6 Where applicable, remove the cast-aluminium inspection cover that covers the rear of the sump (see illustrations).
- 7 On models with the M40 engine, unbolt and remove the lower sump section and remove the gasket (this is necessary for access to the front mounting bolts). Unscrew the mounting bolt, and pull the oil dipstick tube from the sump (see illustrations). Check the condition of the O-ring, and renew it if necessary.
- 8 On models with the M40 engine, unscrew the engine mounting nuts on both sides, then attach a suitable hoist and lift the engine sufficiently to allow the sump to be removed. As a safety precaution, position axle stands or blocks of wood beneath the engine.
- 9 Remove the bolts securing the sump to the

engine block and front/rear covers (see illustration).

10 Tap on the sump with a soft-faced hammer to break the gasket seal, and lower the sump from the engine.

11 Using a gasket scraper, scrape off all traces of the old gasket from the engine block, the timing chain cover, the rear main oil seal housing, and the sump. Be especially careful not to nick or gouge the gasket sealing surfaces of the timing chain cover and the oil seal housing (they are made of aluminium, and are quite soft).

12 Clean the sump with solvent, and dry it thoroughly. Check the gasket sealing surfaces for distortion. Clean any residue from the

gasket sealing surfaces on the sump and engine with a rag dampened with a suitable solvent.

13 Before refitting the sump, apply a little RTV-type gasket sealant to the area where the front and rear covers join the cylinder block.. Lay a new sump gasket in place on the block. If necessary, apply more sealant to hold the gasket in place.

14 Carefully position the sump in place (do not disturb the gasket) and refit the bolts. Start with the bolts closest to the centre of the sump, and tighten them to the torque listed in this Chapter's Specifications, using a criss-cross pattern. Do not overtighten them, or leakage may occur.



13.6a Remove the four inspection cover bolts (arrowed) and . . .



13.6b . . . remove the cover to get to all the sump bolts



13.7a Main sump retaining bolts accessed after removal of the lower sump section on the M40 engine (engine on bench for clarity)



13.7b Removing the oil dipstick tube bracket mounting bolt



13.9 Remove the bolts holding the sump to the engine block and front cover, as shown here on a six-cylinder engine

15 The remainder of refitting is the reverse of removal. Fit a new gasket to the lower sump section on models with the M40 engine.

16 On completion refill the engine with oil (Chapter 1). Run the engine and check that there are no oil leaks from the sump gasket or other disturbed components.

**14 Oil pump - removal, inspection and refitting**



**Removal**

1 Remove the sump (see Section 13).

**M10, M20 and M30 engines**

2 On M10 and M30 engines, remove the three bolts that attach the gear to the front of the pump (see illustration). **Note:** Some models have a single centre nut attaching the gear to the oil pump.

3 Unbolt the oil pump from the engine block (see illustrations) and remove it.

4 On the M20 engine, the intermediate shaft drives the oil pump driveshaft, which drives the oil pump. To remove the driveshaft, remove the hold-down plate from the block, and lift out the plug. Check the condition of the O-ring, and renew it if necessary. Lift the driveshaft out and check both gears for wear, renewing them if worn or damaged (see illustration).

5 If the gear on the intermediate shaft is worn, or the intermediate shaft bearing is worn or damaged, the intermediate shaft must be removed. Remove the engine (see Chapter 2B), then remove the timing belt, crankshaft and intermediate shaft sprockets (see Section 10) and the engine front cover (see Section 11). The intermediate shaft can be slid out the front of the engine.

**M40 engines**

6 Remove the timing belt as described in Section 10.

7 Remove the cylinder head as described in Section 12.

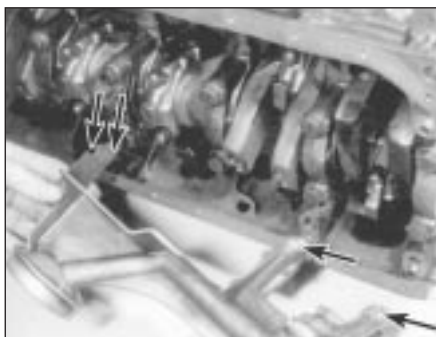
8 Unscrew the nut and remove the timing belt tensioner from the front end cover (see illustration). If necessary, unscrew the stud from the cylinder block.



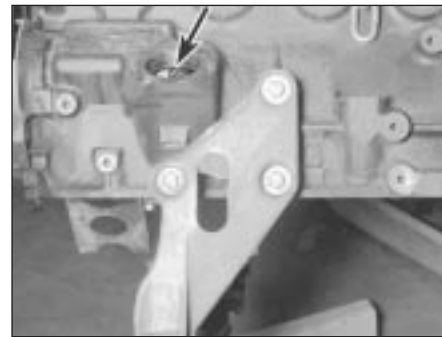
14.2 On M10 and M30 engines, remove the three bolts that hold the driven gear to the oil pump, and remove the gear



14.3a On M20 engines, the oil pump is bolted across the engine block from side to side, towards the front of the engine



14.3b On M10 and M30 engines, the oil pump is bolted to the front and centre of the engine block



14.4 If necessary on the M20 engine, remove the plug and oil pump driveshaft from the engine. Inspect the driveshaft gear, as well as this intermediate shaft gear in the engine block (arrowed)

9 Unscrew and remove the crankshaft hub bolt while holding the crankshaft stationary. The bolt is tightened to a very high torque, and it will be necessary to prevent the crankshaft turning. Ideally, a metal bar should be bolted to the sprocket, or the starter motor may be removed and the flywheel held using a wide-bladed screwdriver. Beware of possible damage to surrounding components if it is necessary to improvise some method of immobilising the crankshaft.

10 Remove the sprocket and spacer, noting that the shoulder on the spacer faces inwards.

11 Unscrew the bolts and remove the stabilising and guide rollers from the front end cover (see illustrations).

12 Using a small screwdriver or similar instrument, remove the key from the groove in the nose of the crankshaft (see illustration).

13 Pull the spacer ring off the crankshaft (see illustration).

14 Unscrew the remaining bolts, and remove the front end cover and oil pump from the cylinder block. Note the locations of the front cover bolts, as they are of different sizes. With the cover removed, extract the rubber O-ring from the groove in the nose of the crankshaft (see illustrations).

15 Note the fitted location of the oil seal, then prise it out of the housing.



14.8 Removing the timing belt tensioner (M40 engine)



14.11a Removing the stabilising roller from the front end cover (M40 engine)



14.11b Removing the guide roller from the front end cover (M40 engine)





14.12 Removing the key from the groove in the nose of the crankshaft (M40 engine)



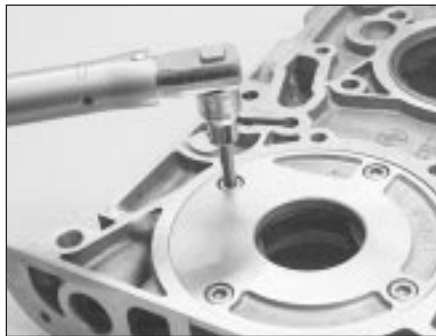
14.13 Removing the spacer ring from the front of the crankshaft



14.14a Front end cover and oil pump in position on the front of the M40 engine



14.14b Extract the rubber O-ring from the groove in the nose of the crankshaft (M40 engine)



14.21a Unscrew the bolts . . .



14.21b . . . and remove the oil pump cover (M40 engine)

### Inspection

**Note:** Considering that a malfunctioning oil pump can easily cause major engine damage, we recommend that the oil pump should always be renewed during engine overhaul, unless it's in as-new condition.

#### M10, M20 and M30 engines

16 Remove the cover and check the pump body, gears or rotors and cover for cracks and wear (especially in the gear or rotor contact areas).

17 Check the strainer to make sure it is not clogged or damaged.

18 Lubricate the gears with clean engine oil, then attach the pump cover to the body and tighten the bolts evenly and securely.

19 Before refitting the pump - new, rebuilt or original - on the engine, check it for proper operation. Fill a clean container to a depth of one inch with fresh engine oil of the recommended viscosity.

20 Immerse the oil pump inlet in the oil, and turn the driveshaft anti-clockwise by hand. As the shaft is turned, oil should be discharged from the pump outlet.

#### M40 engines

21 With the front end cover on the bench, unscrew the bolts and remove the cover plate to expose the oil pump rotors (see illustrations).

22 Identify the rotors for position, then remove them from the housing (see illustrations).

23 Clean the housing and the rotors thoroughly, then refit the rotors, making sure that they are in their previously-noted positions. The inner rotor must be fitted with the guide facing the body.

24 Using feeler blades, measure the clearance between the oil pump body and the outer rotor, then check the clearance between the outer and inner rotors (see illustrations).

25 If the clearance is not as given in the Specifications, the complete oil pump and front end cover should be renewed. If the clearance is within tolerance, remove the rotors, then pour a little engine oil into the housing. Refit the rotors and turn them to spread the oil around.



14.22a Removing the inner rotor . . .



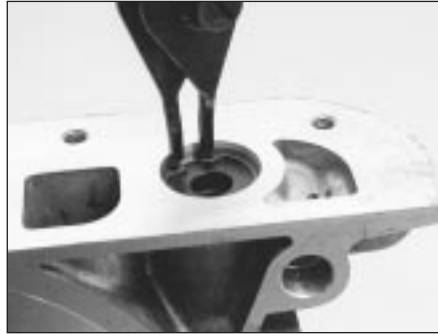
14.22b . . . and outer rotor from the oil pump (M40 engine)



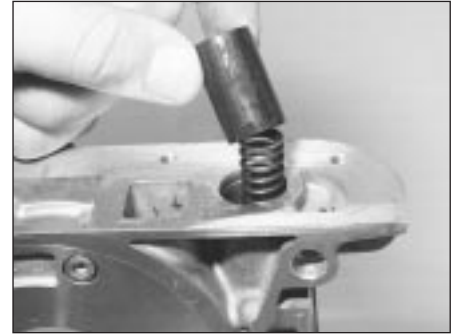
14.24a Measuring the clearance between the oil pump body and the outer rotor (M40 engine)



14.24b Measuring the clearance between the oil pump outer and inner rotors (M40 engine)



14.27a Extract the circlip from the oil pump (M40 engine) . . .



14.27b . . . and remove the sleeve . . .

26 Refit the cover plate and tighten the bolts to the specified torque.

27 To check the pressure relief valve, extract the circlip and remove the sleeve, spring and piston. Check that the length of the spring is as given in the Specifications (see illustrations). Reassemble the pressure relief valve using a reversal of the dismantling procedure.

### Refitting

#### M10, M20 and M30 engines

28 Make sure the mounting surfaces are clean, then insert the pump into the engine block recess. Refit the bolts and tighten them to the torque specified at the beginning of this Chapter.

29 Refitting is the reverse of removal.

#### M40 engines

30 Clean the mating surfaces, then refit the front end cover and oil pump to the cylinder block, together with a new gasket (see illustration). Tighten the bolts to the specified torque. Note that there are two sizes of bolts, and they have different torque settings.

31 Fit the spacer ring on the front of the crankshaft.

32 Apply engine oil to the lips of the new oil seal, then press it into the housing to its previously-noted position. To ensure the oil seal enters the housing squarely, use a large socket and the crankshaft pulley bolt to pull it into position (see illustration).

33 Refit the key to the groove in the nose of the crankshaft.

34 Refit the stabilising roller to the front end cover, and tighten the bolt.

35 Refit the sprocket, spacer and crankshaft pulley bolt. Tighten the bolt to the specified torque while holding the crankshaft stationary using one of the methods previously described.

36 Refit the timing belt tensioning roller, but do not tighten the bolt at this stage.

37 Refit the cylinder head as described in Section 12.

38 Refit the timing belt as described in Section 10.

39 Refit the sump (see Section 13).

### 15 Flywheel/driveplate - removal and refitting



1 Remove the transmission (on vehicles with manual transmission, see Chapter 7A; on vehicles with automatic transmission, see Chapter 7B).

2 On vehicles with manual transmission, remove the clutch (see Chapter 8).

3 Where necessary, mark the relationship of the flywheel/driveplate to the crankshaft, so it can be refitted the same way.

4 The flywheel/driveplate is attached to the rear of the crankshaft with eight bolts. Loosen and remove the bolts, then separate it from



14.27c . . . spring . . .



14.27d . . . and piston



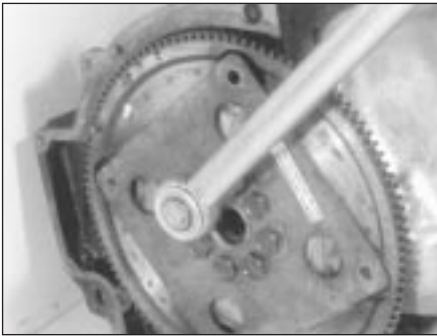
14.27e Checking the length of the pressure relief valve spring (M40 engine)



14.30 Locating a new gasket on the front of the cylinder block (M40 engine)



14.32 Using a large socket and the crankshaft pulley bolt to pull the oil seal into the housing (M40 engine)



**15.4** Using a socket and ratchet, remove the eight bolts that hold the flywheel/driveplate to the crankshaft flange - prevent the flywheel/driveplate from turning by locking the ring gear with a lever

the crankshaft flange (see illustration). Be careful - the flywheel is heavy.

**5** To refit the flywheel/driveplate on the crankshaft, use a liquid thread-locking compound on the bolts, and tighten them gradually, using a criss-cross pattern, to the torque listed in this Chapter's Specifications.

**6** The remainder of refitting is the reverse of removal.

## 16 Crankshaft rear oil seal - renewal



**1** Remove the flywheel or driveplate (see Section 15).

**2** Remove the bolts and/or nuts attaching the seal retainer to the engine block. Be sure to remove the two bolts (from underneath) connecting the rear of the sump to the bottom of the seal retainer (see illustration).

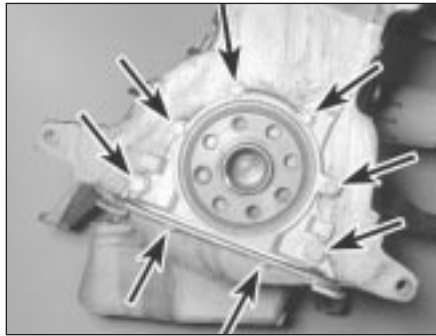
**3** Run a sharp, thin knife between the sump gasket and the seal retainer, cutting the retainer free from the gasket. Be very careful not to damage the gasket, and keep it clean so you can re-use it.

**4** Break the seal retainer-to-block gasket seal by tapping the retainer with a plastic mallet or block of wood and hammer. Do not prise between the retainer and the engine block, as damage to the gasket sealing surfaces will result.

**5** Using a scraper, remove all traces of old gasket material from the sealing surfaces of the retainer and engine block. Gasket removal solvents are available at car accessory shops, and may prove helpful. After all gasket material has been removed, the gasket surfaces can be degreased by wiping them with a rag dampened with a suitable solvent.

**Caution:** Be very careful not to scratch or gouge the delicate aluminium surfaces. Also, do not damage the sump gasket, and keep it clean.

**6** Support the retainer on two blocks of wood, and drive out the seal from behind with a hammer and screwdriver (see illustration).



**16.2** Remove the six bolts from the rear of the block and the two from underneath at the sump

Be very careful not to damage the seal bore in the process.

**7** Coat the outside diameter and lip of the new seal with multi-purpose grease, and drive the seal into the retainer with a hammer and a block of wood (see illustration).

**8** Apply a film of RTV-type gasket sealant to the surface of the sump gasket that mates with the seal retainer. Apply extra beads of RTV sealant to the edges where the gasket meets the engine block. **Note:** If the sump gasket is damaged, instead of fitting a whole new gasket, you might try trimming the rear portion of the gasket off at the point where it meets the engine block, then trim off the rear portion of a new sump gasket so it's exactly the same size. Cover the exposed inside area of the sump with a rag, then clean all traces of old gasket material off the area where the gasket was removed. Attach the new gasket piece to the sump with contact-cement-type gasket adhesive, then apply RTV-type sealant as described at the beginning of this paragraph.

**9** Coat both sides of the new retainer gasket with RTV-type gasket sealant, then attach the gasket to the seal retainer. Fit the seal retainer to the rear of the engine, then refit the bolts and tighten them evenly to the torque listed in this Chapter's Specifications. Work from bolt-to-bolt in a criss-cross pattern to be sure they're tightened evenly. **Note 1:** Tighten the retainer-to-block bolts first, then tighten the sump-to-retainer bolts. **Note 2:** After applying RTV-type sealant, reassembly must be



**16.7** Drive the new seal into the retainer with a block of wood, or a section of pipe, if you have one large enough - make sure the seal enters the retainer bore squarely



**16.6** After removing the retainer from the block, support it on two wood blocks, and drive out the old seal with a punch and hammer

completed in about 10 minutes so the RTV won't prematurely harden.

**10** Refit the flywheel/driveplate (see Section 15).

**11** Refit the transmission (on vehicles with manual transmission, see Chapter 7A; on vehicles with automatic transmission, see Chapter 7B).

## 17 Engine mountings - check and renewal



**1** Engine mountings seldom require attention, but broken or deteriorated mountings should be renewed immediately, or the added strain placed on the driveline components may cause damage or wear.

### Check

**2** During the check, the engine must be raised slightly to remove its weight from the mounts.

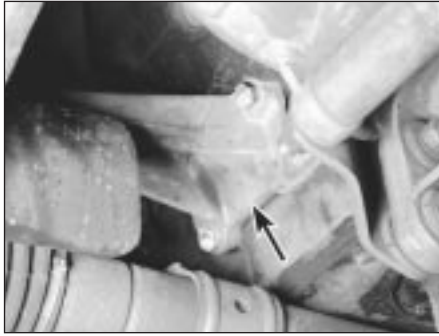
**3** Raise the vehicle and support it securely on axle stands, then position a jack under the engine sump. Place a large block of wood between the jack head and the sump, then carefully raise the engine just enough to take its weight off the mounts.



**Warning:** DO NOT place any part of your body under the engine when it's supported only by a jack!



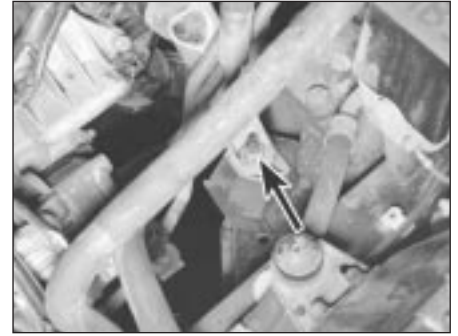
**17.4** As engine mountings wear or age, they should be inspected for cracking or separation from their metal plates



17.5 Lever gently between the block and the engine mounting attachment point (arrowed) - if there is movement, tighten the bolts



17.6 Engine mounting and damper on the M40 engine



17.10 To remove an engine mounting, first remove the stud nut (arrowed) - M30 engine shown, others similar

4 Check the mountings to see if the rubber is cracked (**see illustration**), hardened or separated from the metal plates. Sometimes the rubber will split right down the centre.

5 Check for relative movement between the mounting plates and the engine or frame (use a large screwdriver or lever to attempt to move the mountings). If movement is noted, lower the engine and tighten the mounting nuts or bolts (**see illustration**). Rubber preservative should be applied to the mountings, to slow deterioration.

6 On models with the M40 engine, check the condition of the dampers on each mounting by disconnecting them and attempting to

compress and expand them (**see illustration**). If there is very little resistance to movement, the dampers should be renewed.

#### **Renewal**

7 If the dampers on the M40 engine are to be renewed, simply unscrew the bolts, then fit the new dampers and tighten the bolts.

8 To renew the mountings, disconnect the battery negative cable, then raise the vehicle and support it securely on axle stands if you haven't already done so.



**Caution: If the radio in your vehicle is equipped with an anti-theft system, make sure you have the correct activation code**

**before disconnecting the battery.**

**Note: If, after connecting the battery, the wrong language appears on the instrument panel display, refer to page 0-7 for the language resetting procedure.**

9 Support the engine as described in paragraph 3.

10 Remove the large bracket-to-mounting nut (**see illustration**). Raise the engine slightly, then remove the lower mounting-to-frame bolts/nuts and detach the mounting

11 Refitting of the mountings is the reverse of removal. Use thread-locking compound on the mounting bolts/nuts, and be sure to tighten them securely.