

# Chapter 1






## Routine maintenance and servicing

### Contents

Air filter renewal	20	Fuel system check	21
Automatic transmission fluid and filter change	28	Introduction	1
Automatic transmission fluid level check	8	Manual transmission lubricant change	31
Battery check, maintenance and charging	13	Manual transmission lubricant level check	16
Brake system check	26	Power steering fluid level check	7
Cooling system - draining, flushing and refilling	29	Routine maintenance	2
Cooling system check	22	Service light resetting	34
Differential lubricant change	32	Spark plug check and renewal	14
Differential lubricant level check	17	Spark plug HT leads, distributor cap and rotor - check and renewal	15
Driveshaft gaiter check	25	Steering and suspension check	24
Drivebelt check, adjustment and renewal	11	Throttle linkage - check and lubrication	19
Engine idle speed and CO level check and adjustment	12	Tyre and tyre pressure checks	5
Engine oil and filter change	6	Tyre rotation	9
Engine timing belt renewal	35	Tune-up general information	3
Exhaust system check	23	Underbonnet hoses - check and renewal	10
Evaporative Emissions Control (EVAP) system check	33	Valve clearances - check and adjustment	18
Fluid level checks	4	Wiper blades - check and renewal	27
Fuel filter renewal	30		

1

### Degrees of difficulty

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

### Specifications

#### Engine

Oil filter	
M10 engines	Champion C121
M20 engines	Champion C160
M30 engines	
3-Series	Champion C160
5-Series	Champion X115
M40 engines	Champion X120
Valve clearances (intake and exhaust)	
M10 engines	
Cold	0.20 mm
Hot	0.25 mm
M20 engines	
Cold	0.25 mm
Hot	0.30 mm
M30 engines	
Cold	0.30 mm
Hot	0.35 mm
M40 engines	Hydraulic adjusters

#### Cooling system

Antifreeze mixture	40% antifreeze/60% water
--------------------	--------------------------

**Fuel system**

## Idle speed

## 3-Series, E30

316 with M10/B18 engine	850 ± 50 rpm
316i with M40/B16 engine	800 ± 40 rpm
318i with M10/B18 engine (manual transmission)	850 ± 50 rpm
318i with M10/B18 engine (automatic transmission)	750 ± 50 rpm
318i with M40/B18 engine	800 ± 40 rpm
320i with M20/B20 engine (L-Jetronic)	800 ± 50 rpm
320i with M20/B20 engine (Motronic)	760 ± 40 rpm
325i with M20/B25 engine	760 ± 40 rpm

## 5-Series, E28 ("old-shape")

518 and 518i with M10/B18 engine	800 ± 50 rpm
All other models	850 ± 50 rpm

## 5-Series, E34 ("new-shape")

518i with M40/B18 engine	800 ± 40 rpm
520i with M20/B20M engine	760 ± 40 rpm
525i with M20/B25M engine	760 ± 40 rpm
530i with M30/B30M engine	800 ± 50 rpm
535i with M30/B35M engine	850 ± 50 rpm

## CO% at 3000 rpm

## 3-Series, E30

316 with M10/B18 engine	0.5 to 1.0
316i and 318i with M40/B16 engine	0.7 ± 0.5
318i with M10/B18 engine	1.0 maximum
320i with M20/B20 engine (L-Jetronic)	1.0 ± 0.5
320i with M20/B20 engine (Motronic)	0.7 ± 0.5
325i with M20/B25 engine	1.0 ± 0.5

## 5-Series, E28 ("old-shape")

518 and 518i with M10/B18 engine	1.0 maximum
525i with M30/B25 engine	1.0 ± 0.5
528i with M30/B28 engine	1.5 maximum
535i with M30/B34 engine	0.3 to 1.5
M535i with M30/B34 engine	0.3 to 1.5

## 5-Series, E34 ("new-shape")

All models	0.7 ± 0.5
------------	-----------

## Air filter element

M10 engines	Champion W155 (round) or U504 (square)
M20 engines	Champion U504 or U527
M30 engines	Champion U504 or U527
M40 engines	Champion U527

## Fuel filter (all fuel injection engines)

Champion L206

**Ignition system**

## Spark plug type

M10, M20 and M30 engines	Champion N9YCC
M40 engines	Champion C9YCC

## Spark plug gap\* . . . . . 0.8 mm

## Spark plug (HT) leads . . . . . Champion type not available

\* The spark plug gap quoted is that recommended by Champion for their specified plugs listed above. If spark plugs of any other type are to be fitted, refer to their manufacturer's spark plug gap recommendations.

**Brakes**

Disc brake pad thickness (minimum) . . . . . 2.0 mm

Drum brake shoe lining thickness (minimum) . . . . . 2.0 mm

**Wiper blades**

## Windscreen

3-Series	Champion X-5103
3-Series passenger side from 1991	Champion X-5103 (20 inch) or Champion X-5303 (21 inch)
5-Series, E28 ("old-shape")	Champion X-4503
5-Series, E34 ("new-shape")	Champion type not available

## Tailgate

3-Series	Champion X-4503
5-Series	Champion type not available

## Tyre pressures (cold) - bars (psi)

	Front	Rear
3-Series, E30		
316 .....	1.9 (28)	2.1 (30)
316i .....		
Saloon .....	2.0 (29)	2.1 (30)
Estate .....	2.0 (29)	2.2 (32)
318i .....	1.8 (26)	1.9 (28)
320i .....	1.9 (28)	2.0 (29)
325i .....	2.2 (32)	2.3 (33)
5-Series, E28 ("old-shape")		
518 and 518i .....	2.0 (29)	2.0 (29)
525i and 528i .....	2.2 (32)	2.2 (32)
535i and M535i .....	2.3 (33)	2.5 (36)
5-Series, E34 ("new-shape")		
518i .....	2.0 (29)	2.0 (29)
520i .....	2.2 (32)	2.1 (30)
525i, 530i and 535i .....	2.0 (29)	2.3 (33)

## Torque wrench settings

	Nm
Automatic transmission sump bolts	
Three-speed .....	8 to 9
Four-speed .....	5 to 7
Spark plugs	
M10 engines .....	20 to 30
Except M10 engines .....	30 to 33
Oxygen sensor .....	30 to 33
Wheel bolts .....	100

## Lubricants and fluids

### Component or system

	Lubricant type/specification
Engine .....	Multigrade engine oil, viscositySAE 10W/40 to 20W/50, to API SG
Cooling system .....	Ethylene glycol-based antifreeze with corrosion inhibitors
Manual transmission* .....	Gear oil, viscosity SAE 80 to API-GL4, or single-grade mineral-based engine oil, viscosity SAE 20, 30 or 40 to API-SG
Automatic transmission .....	Dexron II type ATF
Final drive .....	BMW-approved hypoid gear oil, viscosity SAE 90**
Brake and clutch hydraulic systems .....	Hydraulic brake fluid to SAE J 1703 or DOT 4
Power steering .....	Dexron II type ATF

\* E34 520i & 525i with air conditioning, E34 530i & 535i - Dexron II type ATF)

\*\* Only available in bulk; refer to your BMW dealer

## Capacities\*

Engine oil		Manual transmission	
M10 engines .....	4.0 litres	ZF .....	1.2 litres
M20 engines .....	4.3 litres	Getrag .....	1.0 to 1.5 litres
M30 engines .....	5.8 litres	Automatic transmission (refill)	
M40 engines .....	4.0 litres	3-speed .....	2.0 litres
Cooling system		4-speed .....	3.0 litres
M10 engines .....	7.0 litres	Final drive capacity (drain and refill)	
M20 engines .....	10.5 litres	3-Series, E30 .....	0.9 litres
M30 engines .....	12.0 litres	5-Series, E28 ("old-shape") .....	0.9 litres
M40 engines .....	7.0 litres	5-Series, E34 ("new-shape") .....	1.7 litres
Fuel tank		*All capacities approximate	
3-Series, E30			
Saloon .....	55 litres (early), 64 litres (later)		
Estate .....	63 litres (early), 70 litres (later)		
5-Series			
E28 ("old-shape") .....	70 litres		
E34 ("new-shape") .....	81 litres		

## Maintenance schedule

The following maintenance intervals are based on the assumption that the vehicle owner will be doing the maintenance or service work, as opposed to having a dealer service department do the work. Although the time/mileage intervals are loosely based on factory recommendations, most have been shortened to ensure, for example, that such items as lubricants and fluids are checked/changed at intervals that promote maximum engine/driveline service life. Also, subject to the preference of the individual owner interested in keeping his or her vehicle in peak condition at all times, and with the vehicle's ultimate resale in mind, many of the maintenance procedures may be performed more often than recommended in the following schedule. We encourage such owner initiative.

When the vehicle is new, it should be serviced initially by a factory-authorised dealer service department, to protect the factory warranty. In many cases, the initial maintenance check is done at no cost to the owner (check with your dealer service department for more information).

### Every 250 miles or weekly, whichever comes first

- ☐ Check the engine oil level (Section 4)
- ☐ Check the engine coolant level (Section 4)
- ☐ Check the brake fluid level (Section 4)
- ☐ Check the clutch fluid level (Section 4)
- ☐ Check the washer fluid level (Section 4)
- ☐ Check the tyres and tyre pressures (Section 5)

### Every 6000 miles or 6 months, whichever comes first

*All items listed above, plus:*

- ☐ Change the engine oil and oil filter (Section 6)
- ☐ Check the power steering fluid level (Section 7)
- ☐ Check the tyres, and rotate if necessary (Section 9)
- ☐ Check the automatic transmission fluid level (Section 8)
- ☐ Check the underbonnet hoses (Section 10)
- ☐ Check/adjust the drivebelts (Section 11)
- ☐ Check engine idle speed and CO (Section 12)

### Every 12 000 miles or 12 months, whichever comes first

*All items listed above, plus:*

- ☐ Check/service the battery (Section 13)
- ☐ Check the spark plugs (Section 14)
- ☐ Check/renew the HT leads, distributor cap and rotor (Section 15)
- ☐ Check/top-up the manual transmission lubricant (Section 16)
- ☐ Check the differential oil level (Section 17)
- ☐ Check the valve clearances, and adjust if necessary - does not apply to M40 engines (Section 18)
- ☐ Check and lubricate the throttle linkage (Section 19)
- ☐ Renew the air filter (Section 20)
- ☐ Check the fuel system (Section 21)
- ☐ Inspect the cooling system (Section 22)
- ☐ Inspect the exhaust system (Section 23)
- ☐ Inspect the steering and suspension components (Section 24)
- ☐ Check the driveshaft gaiter(s) (Section 25)
- ☐ Inspect the brakes (Section 26)
- ☐ Inspect/renew the windscreen wiper blades (Section 27)

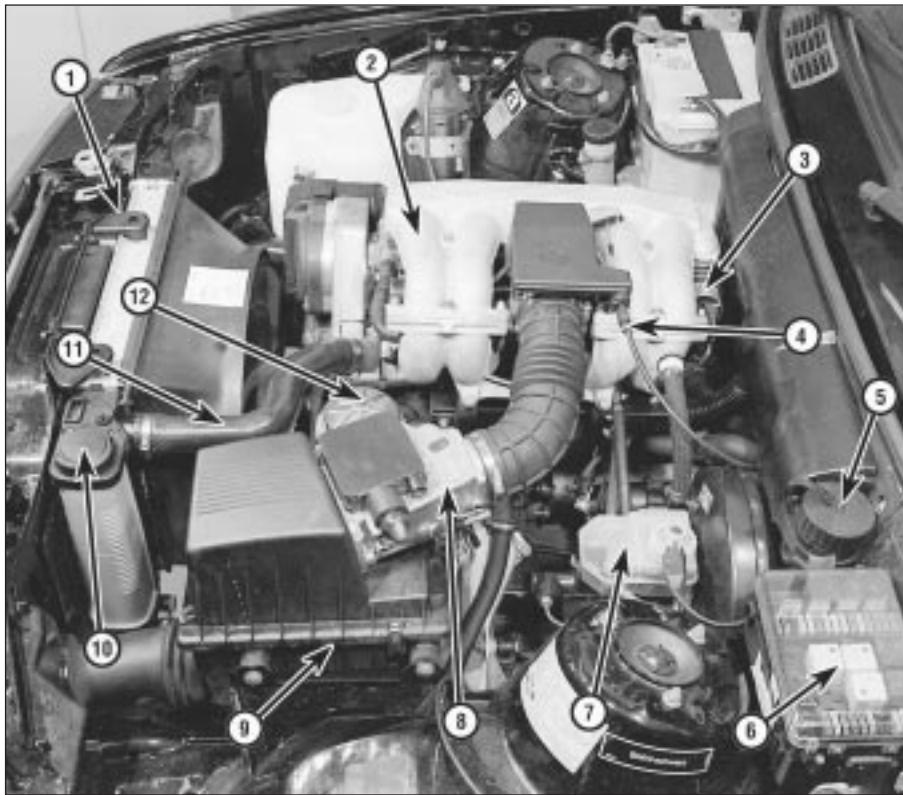
### Every 24 000 miles or 2 years, whichever comes first

*All items listed above plus:*

- ☐ Change the automatic transmission fluid and filter (Section 28)
- ☐ Drain, flush and refill the cooling system (Section 29)
- ☐ Renew the spark plugs (Section 14)
- ☐ Check/renew the spark plug HT leads (Section 15)
- ☐ Renew the fuel filter (Section 30)
- ☐ Change the manual transmission lubricant (Section 31)
- ☐ Change the differential oil (Section 32)
- ☐ Check the evaporative emissions system, where applicable (Section 33)
- ☐ Reset the service indicator lights (Section 34)
- ☐ Renew brake fluid by bleeding (see Chapter 9)
- ☐ Check the handbrake operation (see Chapter 9)

### Every 60 000 miles

- ☐ Renew the timing belt (Section 35)



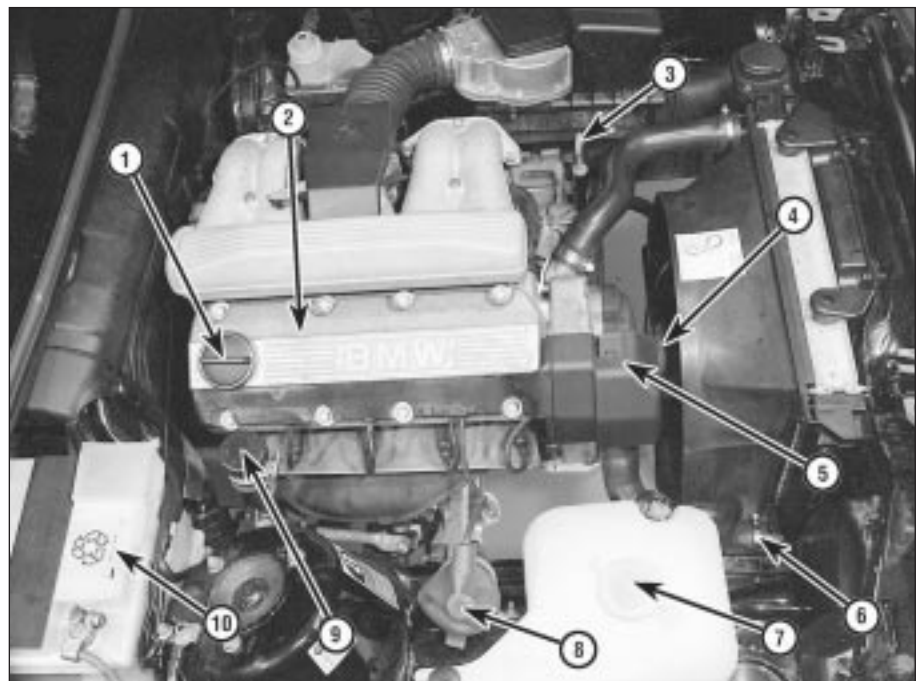
Underbonnet view (left-hand side) of a UK model 318i (1988)

- 1 Radiator
- 2 Intake manifold
- 3 Idle control valve
- 4 Accelerator cable
- 5 Diagnostic/service indicator resetting socket
- 6 Fuse/relay box
- 7 Brake hydraulic fluid reservoir
- 8 Airflow meter
- 9 Air cleaner unit
- 10 Radiator filler cap
- 11 Radiator top hose
- 12 Oil filter housing

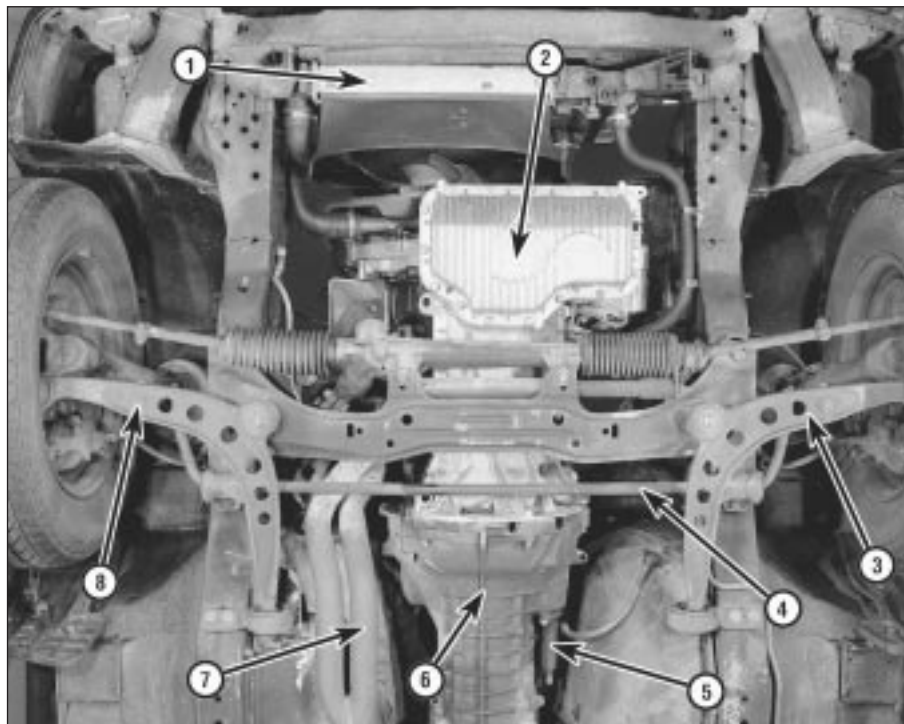
1

Underbonnet view (right-hand side) of a UK model 318i (1988)

- 1 Oil filler cap
- 2 Valve cover
- 3 Engine oil filler dipstick
- 4 Viscous cooling fan
- 5 Distributor cap cover
- 6 Bottom hose
- 7 Windscreen washer fluid reservoir
- 8 Ignition coil
- 9 Clutch hydraulic fluid reservoir
- 10 Battery

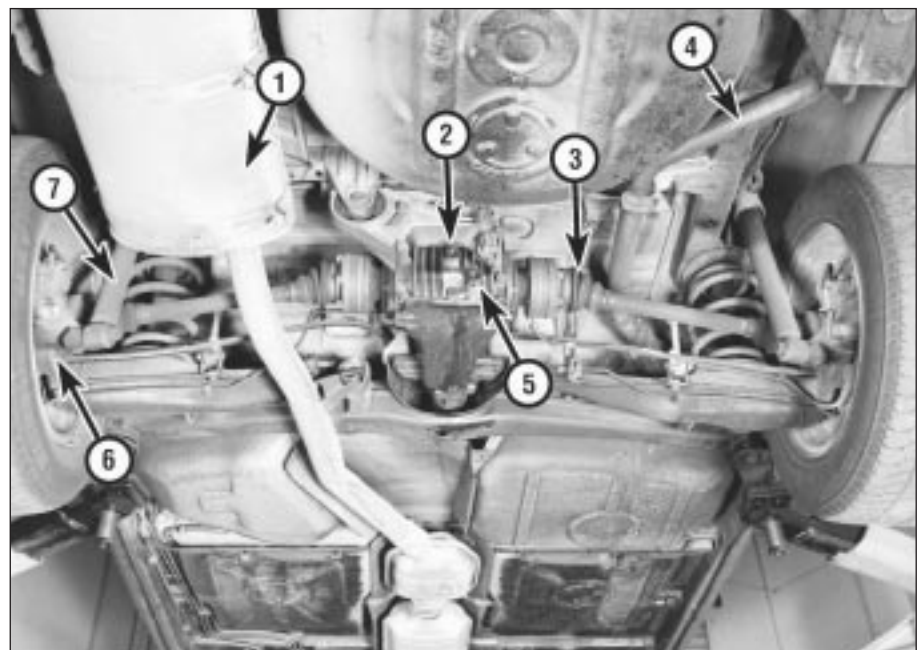






Front underbody view of a UK model 318i (1988)

- 1 Radiator
- 2 Engine oil drain plug
- 3 Front suspension control arm (left-hand side)
- 4 Front anti-roll bar
- 5 Clutch slave cylinder
- 6 Transmission
- 7 Exhaust downpipe
- 8 Front suspension control arm (right-hand side)



Typical rear underside components

- 1 Exhaust system
- 2 Differential fill/check plug
- 3 Driveshaft boot
- 4 Fuel tank filler tube
- 5 Differential drain plug
- 6 Rear brake
- 7 Rear shock absorber

## 1 Introduction

This Chapter is designed to help the home mechanic maintain his or her vehicle with the goals of maximum performance, economy, safety and reliability in mind. Included is a master maintenance schedule, followed by procedures dealing specifically with each item on the schedule. Visual checks, adjustments, component renewal and other helpful items are included. Refer to the accompanying illustrations of the engine compartment and the underside of the vehicle for the locations of various components. Servicing the vehicle, in accordance with the mileage/time maintenance schedule and the step-by-step procedures, will result in a planned maintenance programme that should produce a long and reliable service life. Keep in mind that it is a comprehensive plan, so maintaining some items but not others at specified intervals, will not produce the same results.

## 2 Routine maintenance

As you service the vehicle, you will discover that many of the procedures can - and should - be grouped together, because of the nature of the particular procedure you're performing, or because of the close proximity of two otherwise-unrelated components to one another. For example, if the vehicle is raised for chassis lubrication, you should inspect the exhaust, suspension, steering and fuel

systems while you're under the vehicle. When the wheels are removed for other work, it makes good sense to check the brakes, since the wheels are already removed. Finally, let's suppose you have to borrow a torque wrench. Even if you only need it to tighten the spark plugs, you might as well check the torque of as many critical nuts and bolts as time allows.

The first step in this maintenance programme is to prepare yourself before the actual work begins. Read through all the procedures you're planning to do, then gather up all the parts and tools needed. If it looks like you might run into problems during a particular job, seek advice from a mechanic or an experienced do-it-yourselfer.

## 3 Engine "tune-up" - general information

The term "tune-up" is used in this manual to represent a combination of individual operations rather than one specific procedure.

If, from the time the vehicle is new, the routine maintenance schedule is followed closely, and frequent checks are made of fluid levels and high-wear items, as suggested throughout this manual, the engine will be kept in relatively good running condition, and the need for additional work will be minimised.

More likely than not, however, there will be times when the engine is running poorly due to a lack of regular maintenance. This is even more likely if a used vehicle, which has not received regular and frequent maintenance checks, is purchased. In such cases, an engine tune-up will be needed outside of the regular maintenance intervals.

The first step in any tune-up or diagnostic procedure to help correct a poor-running engine is a cylinder compression check. A compression check (see Chapter 2B) will help determine the condition of internal engine components, and should be used as a guide for tune-up and repair procedures. If, for instance, a compression check indicates serious internal engine wear, a conventional tune-up will not improve the performance of the engine, and would be a waste of time and money. Because of its importance, the compression check should be done by someone with the right equipment, and the knowledge to use it properly.

The following procedures are those most often needed to bring a generally poor-running engine back into a proper state of tune.

### Minor tune-up

- Check all engine-related fluids (Section 4)
- Check all underbonnet hoses (Section 10)
- Check and adjust the drivebelts (Section 11)
- Clean, inspect and test the battery (Section 13)
- Renew the spark plugs (Section 14)
- Inspect the spark plug HT leads, distributor cap and rotor (Section 15)
- Check the air filter (Section 20)
- Check the cooling system (Section 22)

### Major tune-up

- All items listed under minor tune-up, plus . . .
- Check the ignition system (see Chapter 5)
- Check the charging system (see Chapter 5)
- Check the fuel system (see Chapter 4)
- Renew the spark plug HT leads, distributor cap and rotor (Section 15)

## Weekly checks

### 4 Fluid level checks



**Note:** The following are fluid level checks to be done on a 250-mile or weekly basis. Additional fluid level checks can be found in specific maintenance procedures which follow. Regardless of intervals, be alert to fluid leaks under the vehicle, which would indicate a fault to be corrected immediately.

1 Fluids are an essential part of the lubrication, cooling, brake and windscreen washer systems. Because the fluids gradually become depleted and/or contaminated during normal operation of the vehicle, they must be periodically replenished. See "Lubricants and fluids" at the beginning of this Chapter before adding fluid to any of the following components. **Note:** The vehicle must be on level ground when any fluid levels are checked.

### Engine oil

2 Engine oil is checked with a dipstick, which is located on the side of the engine (refer to the underbonnet illustrations in this Chapter for dipstick location). The dipstick extends through a metal tube down into the sump.

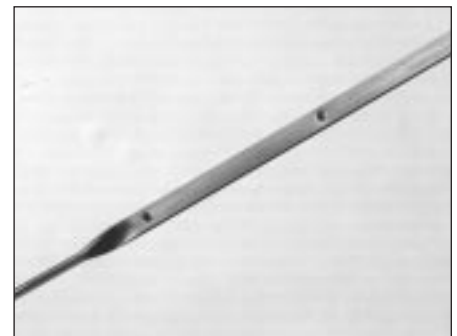
3 The engine oil should be checked before the vehicle has been driven, or at least 15 minutes after the engine has been shut off.

**HAYNES**  
**HINT** If the oil is checked immediately after driving the vehicle, some of the oil will remain in the upper part of the engine, resulting in an inaccurate reading on the dipstick.

4 Pull the dipstick out of the tube, and wipe all of the oil away from the end with a clean rag or paper towel. Insert the clean dipstick all the way back into the tube, and pull it out again. Note the oil at the end of the dipstick. At its highest point, the oil should be between

the two notches or marks (see illustration).

5 It takes one litre of oil to raise the level from the lower mark to the upper mark on the dipstick. Do not allow the level to drop below the lower mark, or oil starvation may cause



4.4 The oil level should be kept between the two marks, preferably at or near the upper one - if it isn't, add enough oil to bring the level to the upper mark



**4.6a** The threaded oil filler cap is located in the valve cover - always make sure the area around the opening is clean before unscrewing the cap



**4.6b** Topping-up the engine oil



**4.9a** On some models, the expansion tank (coolant reservoir) is mounted on the radiator - make sure the level is kept at or near the FULL mark (arrowed)

engine damage. Conversely, overfilling the engine (adding oil above the upper mark) may cause oil-fouled spark plugs, oil leaks, or oil seal failures.

**6** To add oil, remove the filler cap located on the valve cover (see illustrations). After adding oil, wait a few minutes to allow the level to stabilise, then pull the dipstick out and check the level again. Add more oil if required. Refit the filler cap, tightening it by hand only.

**7** Checking the oil level is an important preventive maintenance step. A consistently low oil level indicates oil leakage through damaged seals or defective gaskets, or oil burning (internal leakage past worn rings or valve guides). The condition of the oil should also be noted. If the oil looks milky in colour or has water droplets in it, the cylinder head gasket may be blown, or the head or block may be cracked. The engine should be repaired immediately. Whenever you check the oil level, slide your thumb and index finger up the dipstick before wiping off the oil. If you see small dirt or metal particles clinging to the dipstick, the oil should be changed (see Section 6).

### Engine coolant



**Warning:** Do not allow antifreeze to come in contact with your skin, or with the vehicle

*paintwork. Rinse off spills immediately with plenty of water. Antifreeze is highly toxic if ingested. Never leave antifreeze lying around in an open container, or in puddles on the floor; children and pets are attracted by its sweet smell, and may drink it. Check with local authorities about disposing of used antifreeze. Local collection centres may exist, to see that antifreeze is disposed of safely.*

**8** All vehicles covered by this manual are equipped with a pressurised coolant recovery system. On most models, a white plastic expansion tank (or coolant reservoir) located in the engine compartment is connected by a hose to the radiator. As the engine heats up during operation, the expanding coolant fills the tank. As the engine cools, the coolant is automatically drawn back into the cooling system, to maintain the correct level.

**9** The coolant level in the reservoir (see illustrations) should be checked regularly. Add a 40%/60% mixture of ethylene glycol-based antifreeze to water (see illustration).



**Warning:** Do not remove the expansion tank cap or radiator cap to check the coolant level, unless the engine is completely cold! The level in the reservoir varies with the temperature of the engine. When the engine is cold, the coolant level should be

above the LOW mark on the reservoir. Once the engine has warmed up, the level should be at or near the FULL mark. If it isn't, allow the engine to cool, then remove the cap from the reservoir.

**10** Drive the vehicle and recheck the coolant level. If only a small amount of coolant is required to bring the system up to the proper level, plain water can be used. However, repeated additions of water will dilute the antifreeze. In order to maintain the proper ratio of antifreeze and water, always top-up the coolant level with the correct mixture.

**11** If the coolant level drops consistently, there must be a leak in the system. Inspect the radiator, hoses, filler cap, drain plugs and water pump (see Section 29). If no leaks are noted, have the expansion tank cap or radiator cap pressure-tested by a BMW dealer.

**12** If you have to remove the cap, wait until the engine has cooled completely, then wrap a thick cloth around the cap and turn it to the first stop. If coolant or steam escapes, let the engine cool down longer, then remove the cap.

**13** Check the condition of the coolant as well. It should be relatively clear. If it's brown or rust-coloured, the system should be drained, flushed and refilled. Even if the coolant appears to be normal, the corrosion



**4.9b** On other models, the expansion tank (coolant reservoir) is located on the side of the engine compartment - remove the cap to add coolant



**4.9c** On some 5-Series models, the expansion tank (coolant reservoir) is located on the bulkhead



**4.9d** Adding antifreeze mixture





4.15 Adding hydraulic fluid to the clutch fluid reservoir



4.16 The brake fluid level should be kept above the MIN mark on the translucent reservoir - unscrew the cap to add fluid



4.22 The windscreen washer fluid reservoir is located in the right front corner of the engine compartment on most models

inhibitors wear out, so it must be renewed at the specified intervals.

### Brake and clutch fluid



**Warning:** Brake fluid can harm your eyes and damage painted surfaces, so use extreme caution when handling or pouring it. Do not use brake fluid that has been standing open or is more than one year old. Brake fluid absorbs moisture from the air, which can cause a dangerous loss of brake effectiveness. Use only the specified type of brake fluid. Mixing different types (such as DOT 3 or 4 and DOT 5) can cause brake failure.

14 The brake master cylinder is mounted at the left rear corner of the engine compartment. The clutch fluid reservoir (manual transmission models) is mounted on the right-hand side.

15 To check the clutch fluid level, observe the level through the translucent reservoir. The level should be at or near the step moulded into the reservoir. If the level is low, remove the reservoir cap to add the specified fluid (see illustration).

16 The brake fluid level is checked by looking through the plastic reservoir mounted on the master cylinder (see illustration). The fluid level should be between the MAX and MIN lines on the reservoir. If the fluid level is low, first wipe the top of the reservoir and the cap with a clean rag, to prevent contamination of the system as the cap is unscrewed. Top-up with the recommended brake fluid, but do not overfill.

17 While the reservoir cap is off, check the master cylinder reservoir for contamination. If rust deposits, dirt particles or water droplets are present, the system should be drained and refilled.

18 After filling the reservoir to the proper level, make sure the cap is seated correctly, to prevent fluid leakage and/or contamination.

19 The fluid level in the master cylinder will drop slightly as the disc brake pads wear. There is no need to top up to compensate for this fall provided that the level stays above the MIN line; the level will rise again when new pads are fitted. A very low level may indicate

worn brake pads. Check for wear (see Section 26).

20 If the brake fluid level drops consistently, check the entire system for leaks immediately. Examine all brake lines, hoses and connections, along with the calipers, wheel cylinders and master cylinder (see Section 26).

21 When checking the fluid level, if you discover one or both reservoirs empty or nearly empty, the brake or clutch hydraulic system should be checked for leaks and bled (see Chapters 8 and 9).

### Windscreen washer fluid

22 Fluid for the windscreen washer system is stored in a plastic reservoir in the engine compartment (see illustration).

23 In milder climates, plain water can be used in the reservoir, but it should be kept no more than two-thirds full, to allow for expansion if the water freezes. In colder climates, use windscreen washer system antifreeze, available at any car accessory shop, to lower the freezing point of the fluid. This comes in concentrated or pre-mixed form. If you purchase concentrated antifreeze, mix the antifreeze with water in accordance with the manufacturer's directions on the container.



**Caution:** Do not use cooling system antifreeze - it will damage the vehicle's paint.



5.2 Use a tyre tread depth indicator to monitor tyre wear - they are available at car accessory shops and service stations, and cost very little

## 5 Tyre and tyre pressure checks



1 Periodic inspection of the tyres may save you the inconvenience of being stranded with a flat tyre. It can also provide you with vital information regarding possible problems in the steering and suspension systems before major damage occurs.

2 Tyres are equipped with bands that will appear when tread depth reaches 1.6 mm, at which time the tyres can be considered worn out. This represents the legal minimum tread depth; most authorities recommend renewing any tyre on which the tread depth is 2 mm or less. Tread wear can be monitored with a simple, inexpensive device known as a tread depth indicator (see illustration).

3 Note any abnormal tyre wear (see illustration overleaf). Tread pattern irregularities such as cupping, flat spots and more wear on one side than the other are indications of front end alignment and/or wheel balance problems. If any of these conditions are noted, take the vehicle to a tyre specialist to correct the problem.

4 Look closely for cuts, punctures and embedded nails or tacks. Sometimes, after a nail has embedded itself in the tread, a tyre will hold air pressure for a short time, or may



5.4a If a slow puncture is suspected, check the valve core first to make sure it's tight

leak down very slowly. If a slow puncture persists, check the valve stem core to make sure it is tight (**see illustration**). Examine the tread for an object that may have embedded itself in the tyre, or for a previous repair that may have begun to leak. If a puncture is suspected, it can be easily verified by spraying a solution of soapy water onto the puncture (**see illustration**). The soapy solution will bubble if there is a leak. Unless the puncture is unusually large, a tyre specialist can usually repair the tyre.

**5** Carefully inspect the inner sidewall of each tyre for evidence of brake fluid leakage. If you see any, inspect the brakes immediately.

**6** Correct air pressure adds miles to the life span of the tyres, improves fuel economy, and enhances overall ride quality. A tyre pressure gauge is essential.



**Keep an accurate gauge in the glove compartment. The pressure gauges attached to the nozzles of air hoses at service stations are often inaccurate.**

**7** Always check the tyre pressures when the tyres are cold (ie before driving the vehicle).



**5.4b** If the valve core is tight, raise the vehicle, and spray a soapy water solution onto the tread as the tyre is turned slowly - leaks will cause small bubbles to appear



**5.8** To extend the life of the tyres, check the air pressure at least once a week with an accurate gauge (don't forget the spare!)

Checking the pressures when the tyres are warm, or hot, will result in higher readings, due to heat expansion. On no account should air be let out of the tyres in this case, or the tyres will effectively be under-inflated when cold.

**8** Unscrew the valve cap protruding from the wheel or hubcap, and push the gauge firmly onto the valve stem (**see illustration**). Note the reading on the gauge, and compare the

figure to the recommended tyre pressures shown in the Specifications listed at the beginning of this Chapter. Be sure to refit the valve cap to keep dirt and moisture out of the valve stem mechanism. Check all four tyres and, if necessary, add enough air to bring them to the recommended pressure.

**9** Don't forget to keep the spare tyre inflated to the specified pressure.

## Tyre tread wear patterns



### Shoulder Wear

#### Underinflation (wear on both sides)

Under-inflation will cause overheating of the tyre, because the tyre will flex too much, and the tread will not sit correctly on the road surface. This will cause a loss of grip and excessive wear, not to mention the danger of sudden tyre failure due to heat build-up.

*Check and adjust pressures*

#### Incorrect wheel camber (wear on one side)

*Repair or renew suspension parts*

#### Hard cornering

*Reduce speed!*



### Centre Wear

#### Overinflation

Over-inflation will cause rapid wear of the centre part of the tyre tread, coupled with reduced grip, harsher ride, and the danger of shock damage occurring in the tyre casing.

*Check and adjust pressures*

*If you sometimes have to inflate your car's tyres to the higher pressures specified for maximum load or sustained high speed, don't forget to reduce the pressures to normal afterwards.*



### Uneven Wear

Front tyres may wear unevenly as a result of wheel misalignment. Most tyre dealers and garages can check and adjust the wheel alignment (or "tracking") for a modest charge.

#### Incorrect camber or castor

*Repair or renew suspension parts*

#### Malfunctioning suspension

*Repair or renew suspension parts*

#### Unbalanced wheel

*Balance tyres*

#### Incorrect toe setting

*Adjust front wheel alignment*

**Note:** The feathered edge of the tread which typifies toe wear is best checked by feel.

# Every 6000 miles or 6 months, whichever comes first

## 6 Engine oil and filter change



**Warning:** Prolonged skin contact with used engine oil is hazardous. Use a barrier cream and wear gloves during this procedure. Change out of oil-soaked clothing immediately.



**Frequent oil changes are the most important preventive maintenance procedures that can be done by the home mechanic. As engine oil ages, it becomes diluted and contaminated, which leads to premature engine wear.**

1 Make sure that you have all the necessary tools before you begin this procedure (see illustration). You should also have plenty of rags or newspapers handy for mopping up oil spills



6.1 These tools are required when changing the engine oil and filter

- 1 **Drain pan** - It should be fairly shallow in depth, but wide enough to prevent spills
- 2 **Rubber gloves** - When removing the drain plug and filter, you will get oil on your hands (the gloves will prevent burns)
- 3 **Socket bar** - Sometimes the oil drain plug is tight, and a long bar is needed to loosen it. The correct-size ring spanner may work just as well
- 4 **Socket** - To be used with the bar or a ratchet (must be the correct size to fit the drain plug - six-point preferred)
- 5 **Filter spanner** - This is a metal band-type spanner, which requires clearance around the filter to be effective. This tool is not required on all engines.
- 6 **Filter spanner** - This type fits on the bottom of the filter and can be turned with a ratchet or breaker bar (different-size spanners are available for different types of filters) This tool is not required on all engines.

2 Start the engine and allow it to reach normal operating temperature - oil and sludge will flow more easily when warm. If new oil, a filter or tools are needed, use the vehicle to go and get them, thus warming up the engine oil at the same time.

3 Park on a level surface, and switch off the engine when it's warmed up. Remove the oil filler cap from the valve cover.

4 Access to the oil drain plug and filter will be improved if the vehicle can be lifted on a hoist, driven onto ramps, or supported by axle stands.

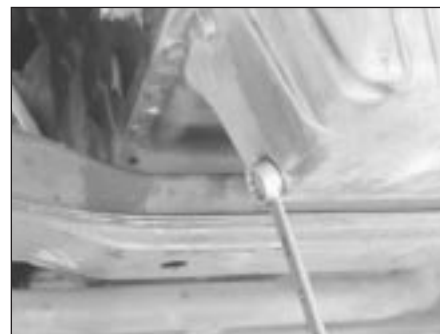


**Warning:** DO NOT work under a vehicle supported only by a hydraulic or scissors-type jack - always use axle stands!

5 If you haven't changed the oil on this vehicle before, get under it, and locate the drain plug and the oil filter. Note that on some engines, the oil filter is located on the top left-hand side of the engine. The exhaust components will be hot as you work, so note how they are routed to avoid touching them.

6 Being careful not to touch the hot exhaust components, position a drain pan under the plug in the bottom of the engine.

7 Clean the area around the plug, then remove the plug (see illustration). It's a good idea to wear a rubber glove while unscrewing the plug the final few turns, to avoid being scalded by hot oil. Hold the drain plug against



6.7 Using a ring spanner to remove the oil drain plug



6.16 Lubricate the oil filter sealing ring with clean engine oil before refitting the filter on the engine

the threads as you unscrew it, then pull it away from the drain hole suddenly. This will place your arm out of the way of the hot oil, as well as reducing the chances of dropping the drain plug into the drain pan.

8 It may be necessary to move the drain pan slightly as oil flow slows to a trickle. Inspect the old oil for the presence of metal particles, which could give early warning of engine wear.

9 After all the oil has drained, wipe off the drain plug with a clean rag. Any small metal particles clinging to the plug would immediately contaminate the new oil.

10 Refit the plug and tighten it securely. Use a new washer if necessary.

11 Move the drain pan into position under the oil filter.

### Canister-type oil filter

12 Loosen the spin-off type oil filter by turning it anti-clockwise with a filter spanner. Any standard filter spanner will work.

13 Sometimes the spin-off type oil filter is screwed on so tightly that it can't be easily loosened. If it is, punch a metal bar or long screwdriver directly through it, and use it as a T-bar to turn the filter. Be prepared for oil to spurt out of the canister as it's punctured.

14 Once the filter is loose, use your hands to unscrew it from the block. Just as the filter is detached from the block, immediately tilt the open end up to prevent oil inside the filter from spilling out.

15 Using a clean rag, wipe off the mounting surface on the block. Also, make sure that none of the old sealing ring remains stuck to the mounting surface. It can be removed with a scraper if necessary.

16 Compare the old filter with the new one, to make sure they are the same type. Smear some engine oil on the rubber sealing ring of the new filter, and screw it into place (see illustration). Overtightening the filter will damage the sealing ring, so don't use a filter spanner. Most filter manufacturers recommend tightening the filter by hand only. Normally, they should be tightened three-quarters of a turn after the sealing ring contacts the block, but be sure to follow the directions on the filter or container.



6.17a Unscrew the bolt . . .





6.17b ... remove the cover ...



6.17c ... and lift out the cartridge



6.19 Renewing the rubber O-ring in the cover

### Cartridge-type oil filter

17 Some models are equipped with a cartridge-type oil filter. Unscrew the bolt, remove the cover, and lift the filter out (see illustrations).

18 Compare the new cartridge with the old one, to make sure they are the same type, then lower it into the housing.

19 Using a clean rag, wipe off the mounting surface of the housing and cover. If necessary, renew the rubber O-ring (see illustration). Smear some clean oil on the O-ring and refit the cover and bolt. Tighten the bolt securely.

### All models

20 Remove all tools and materials from under the vehicle, being careful not to spill the oil from the drain pan, then lower the vehicle.

21 Add new oil to the engine through the oil filler cap in the valve cover. Use a funnel to prevent oil from spilling onto the top of the engine. Pour the specified quantity of fresh oil into the engine. Wait a few minutes to allow the oil to drain into the sump, then check the level on the dipstick (see Section 4 if necessary). If the oil level is correct, refit the filler cap.

22 Start the engine and run it for about a minute. The oil pressure warning light may take a few seconds to go out while the new filter fills with oil; don't rev the engine while the light is on. While the engine is running, look under the vehicle, and check for leaks at the sump drain plug and around the oil filter. If

either one is leaking, stop the engine and tighten the plug or filter slightly.

23 Wait a few minutes, then recheck the level on the dipstick. Add oil as necessary.

24 During the first few days after an oil change, make it a point to check frequently for leaks and proper oil level.

25 The old oil drained from the engine cannot be re-used in its present state, and should be discarded. Oil reclamation centres and some service stations will accept the oil, which can be recycled. After the oil has cooled, it can be transferred into a container for transport to a disposal site.



**Note: It is antisocial and illegal to dump oil down the drain. To find the location of your local oil recycling bank, call this number free.**

## 7 Power steering fluid level check



1 Check the power steering fluid level periodically to avoid steering system problems, such as damage to the pump. Proceed as follows.



7.2 The power steering fluid reservoir (arrowed) is located on the left side of the engine compartment



7.4 The power steering fluid level should be kept between the two arrows near the upper step on the dipstick



7.6 Adding fluid to the power steering reservoir



**Caution: Do not hold the steering wheel against either stop (full-left or full-right lock) for more than five seconds. If you do, the power steering pump could be damaged.**

2 On some models, the power steering fluid reservoir is located on the left side of the engine compartment, and has a twist-off cap with an integral fluid level dipstick (see illustration). Other models use a hydraulic power steering and brake servo system which combines the fluid in one reservoir, located at the right rear corner of the engine compartment.

3 Park the vehicle on level ground, and apply the handbrake.

4 On models with a fluid dipstick, run the engine until it has reached normal operating temperature. With the engine at idle, turn the steering wheel back and forth several times to get any air out of the steering system. Switch off the engine, remove the cap by turning it anti-clockwise, wipe the dipstick clean, and refit the cap. Remove the cap again, and note the fluid level. It must be between the two lines (see illustration).

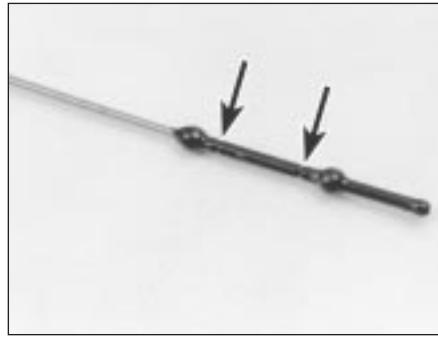
5 On hydraulic servo models, pump the brake pedal about ten times or until the pedal is firm. Remove the nut, lift the cap off, and make sure the fluid is within 6.0 mm of the top of the reservoir.

6 Add small amounts of fluid until the level is correct (see illustration).

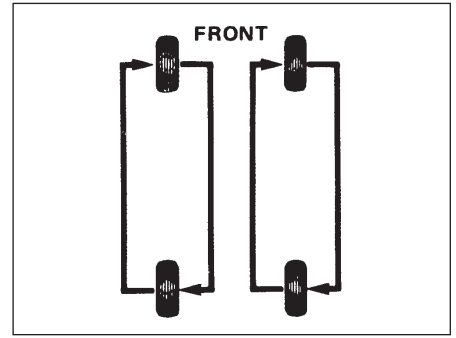




8.5 The automatic transmission fluid dipstick (arrowed) is located near the bulkhead on the left side of the engine compartment



8.6 With the fluid hot, the level should be kept between the two dipstick notches, preferably near the upper one



9.2 The tyre rotation pattern for these models



**Caution:** Do not overfill the reservoir. If too much fluid is added, remove the excess with a clean syringe. Refit the cap.

7 If frequent topping-up is needed, check the power steering hoses and connections for leaks and wear (see Section 10).

8 Check the condition and tension of the drivebelt (see Section 11).

## 8 Automatic transmission fluid level check



**Caution:** The use of transmission fluid other than the type listed in this Chapter's Specifications could result in transmission malfunctions or failure.

1 The automatic transmission fluid should be carefully maintained. Low fluid level can lead to slipping or loss of drive, while overfilling can cause foaming and loss of fluid. Either condition can cause transmission damage.

2 Since transmission fluid expands as it heats up, the fluid level should only be checked when the transmission is warm (at normal operating temperature). If the vehicle has just been driven over 20 miles (32 km), the transmission can be considered warm. You can also check the fluid level when the transmission is cold. If the vehicle has not been driven for over five hours and the fluid is about room temperature (20°C), the transmission is cold. However, the fluid level is normally checked with the transmission warm, to ensure accurate results.



**Caution:** If the vehicle has just been driven for a long time at high speed or in city traffic, in hot weather, or if it has been pulling a trailer, an accurate fluid level reading cannot be obtained. Allow the transmission to cool down for about 30 minutes.

3 Immediately after driving the vehicle, park it on a level surface, apply the handbrake and start the engine. While the engine is idling, depress the brake pedal and move the

selector lever through all the gear ranges, beginning and ending in Park.

4 The automatic transmission dipstick tube is located in the left rear corner of the engine compartment.

5 With the engine still idling, pull the dipstick out of the tube (see illustration), wipe it off with a clean rag, push it all the way back into the tube and withdraw it again, then note the fluid level.

6 The level should be between the two marks (see illustration). If the level is low, add the specified automatic transmission fluid through the dipstick tube - use a clean funnel, preferably equipped with a fine mesh filter, to prevent spills.



**Caution:** Be careful not to introduce dirt into the transmission when topping up.

7 Add just enough of the recommended fluid to fill the transmission to the proper level. It takes about half a litre to raise the level from the low mark to the high mark when the fluid is hot, so add the fluid a little at a time, and keep checking the level until it's correct.

8 The condition of the fluid should also be checked along with the level. If the fluid is black or a dark reddish-brown colour, or if it smells burned, it should be changed (see Section 28). If you are in doubt about its condition, purchase some new fluid, and compare the two for colour and smell.

## 9 Tyre rotation



1 The tyres can be rotated at the specified intervals, or whenever uneven wear is noticed. However, bear in mind that if rotation succeeds in making all the tyres wear evenly, you will eventually have to renew all four at once. Since the vehicle will be raised and the wheels removed anyway, check the brakes also (see Section 26). **Note:** Even if you don't rotate the tyres, at least check the wheel bolt tightness.

2 It is recommended that the tyres be rotated

in a specific pattern (see illustration) so that their direction of rotation remains the same.

3 Refer to the information in "Jacking and towing" at the front of this manual for the proper procedure to follow when raising the vehicle and changing a tyre.

4 The vehicle must be raised on a hoist or supported on axle stands to get all four tyres off the ground. Make sure the vehicle is safely supported!

5 After the rotation procedure is finished, check and adjust the tyre pressures as necessary, and be sure to check the wheel bolt tightness.

## 10 Underbonnet hose check and renewal



**Warning:** Renewal of air conditioning hoses must be left to a dealer service department or air conditioning specialist having the equipment to depressurise the system safely. Never disconnect air conditioning hoses or components until the system has been depressurised.

### General

1 High temperatures under the bonnet can cause deterioration of the rubber and plastic hoses used for various systems. Periodic inspection should be made for cracks, loose clamps, material hardening, and leaks.

2 Information specific to the cooling system can be found in Section 22, while the braking system is covered in Section 26.

3 Most (but not all) hoses are secured with clamps. Where clamps are used, check to be sure they haven't lost their tension, allowing the hose to leak. If clamps aren't used, make sure the hose has not expanded and/or hardened where it slips over the fitting, allowing it to leak.

### Vacuum hoses

4 It's quite common for vacuum hoses, especially those in the emissions system, to be colour-coded or identified by coloured

stripes moulded into them. Various systems require hoses with different wall thicknesses, collapse resistance and temperature resistance. When fitting new hoses, be sure the new ones are made of the same material.

**5** Often the only effective way to check a hose is to remove it completely from the vehicle. If more than one hose is removed, be sure to label the hoses and fittings to ensure correct refitting.

**6** When checking vacuum hoses, be sure to include any plastic T-fittings in the check. Inspect the connections for cracks which could cause leakage.

**7** A small piece of vacuum hose can be used as a stethoscope to detect vacuum leaks. Hold one end of the hose to your ear and probe around vacuum hoses and fittings, listening for the "hissing" sound characteristic of a vacuum leak.



**Warning:** When probing with the vacuum hose stethoscope, be careful not to touch moving engine components such as the drivebelt, cooling fan, etc.

### Fuel hoses

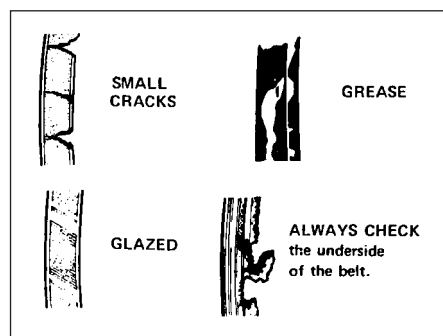


**Warning:** There are certain precautions which must be taken when servicing or inspecting fuel system components. Work in a well-ventilated area, and do not allow open flames (cigarettes, appliance pilot lights, etc.) or bare light bulbs near the work area. Mop up any spills immediately, and do not store fuel-soaked rags where they could ignite. If you spill any fuel on your skin, rinse it off immediately with soap and water. When you perform any kind of work on the fuel system, wear safety glasses, and have a fire extinguisher on hand.

**8** The fuel hoses are usually under pressure, so if any fuel hoses are to be disconnected, be prepared to catch spilled fuel.



**Warning:** On vehicles equipped with fuel injection, you must depressurise the fuel system before servicing the fuel hoses. Refer to Chapter 4 for details.



**11.3** Here are some of the more common problems associated with drivebelts (check the belts very carefully to prevent an untimely breakdown)

**9** Check all rubber fuel hoses for deterioration and chafing. Check especially for cracks in areas where the hose bends, and just before connectors, such as where a hose attaches to the fuel pump or fuel filter, for example.

**10** Only high-quality fuel hose should be used. Never, under any circumstances, use unreinforced vacuum hose, clear plastic tubing or water hose for fuel hoses.

**11** Band-type clamps are commonly used on fuel hoses. These clamps often lose their tension over a period of time, and can be "sprung" during removal. Renew all band-type clamps with screw clamps whenever a hose is renewed.

### Metal lines

**12** Sections of metal line are often used between the fuel pump and fuel injection system. Check carefully to make sure the line isn't bent, crimped or cracked.

**13** If a section of metal line must be renewed, use seamless steel tubing only, since copper and aluminium tubing do not have the strength necessary to withstand the vibration caused by the engine.

**14** Check the metal brake lines where they enter the master cylinder and brake proportioning or ABS unit (if used) for cracks in the lines and loose fittings. Any sign of brake fluid leakage calls for an immediate thorough inspection of the braking system.

### Power steering hoses

**15** Check the power steering hoses for leaks, loose connections and worn clamps. Tighten loose connections. Worn clamps or leaky hoses should be renewed.

## 11 Drivebelt check, adjustment and renewal



### Check

**1** The drivebelts, sometimes called V-belts or simply "fan" belts, are located at the front of the engine, and play an important role in the overall operation of the vehicle and its

components. Due to their function and material make-up, the belts are prone to failure after a period of time, and should be inspected and adjusted periodically to prevent major engine damage.

**2** The number of belts used on a particular vehicle depends on the accessories fitted. Drivebelts are used to turn the alternator, power steering pump, water pump, and air conditioning compressor. Depending on the pulley arrangement, a single belt may be used to drive more than one of these components.

**3** With the engine switched off, open the bonnet and locate the various belts at the front of the engine. Using your fingers (and a torch, if necessary), move along the belts, checking for cracks and separation of the belt plies. Also check for fraying and glazing, which gives the belt a shiny appearance (see illustration). Both sides of the belts should be inspected, which means you will have to twist each belt to check the underside.

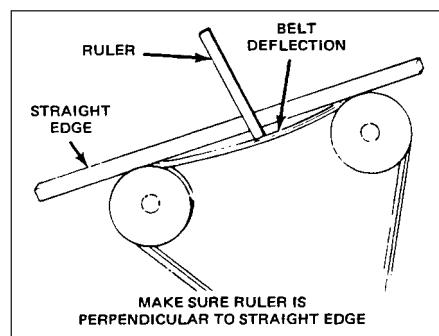
**4** The tension of each belt is checked by pushing firmly with your thumb and seeing how much the belt moves (deflects). Measure the deflection with a ruler (see illustration). A good rule of thumb is that the belt should deflect 6 mm if the distance from pulley centre-to-pulley centre is between 180 and 280 mm. The belt should deflect 13 mm if the distance from pulley centre-to-pulley centre is between 300 and 400 mm.

### Adjustment

**5** If it is necessary to adjust the belt tension, either to make the belt tighter or looser, it is done by moving a belt-driven accessory on its bracket. (When the same belt drives more than one accessory, normally only one accessory is moved when making adjustment.)

**6** For each component, there will be an adjusting bolt and a pivot bolt. Both bolts must be loosened slightly to enable you to move the component. On some components, the drivebelt tension can be adjusted by turning an adjusting bolt after loosening the lockbolt (see illustration).

**7** After the two bolts have been loosened,



**11.4** Measuring drivebelt deflection with a straightedge and ruler



**11.6** Loosen the nut on the other end of the adjuster bolt (arrowed) and turn the bolt to increase or decrease tension on the drivebelt



12.3 Idle speed adjustment screw on the 2B4 carburettor (shown with the carburettor removed)

move the component away from the engine to tighten the belt, or towards the engine to loosen the belt. Hold the accessory in position, and check the belt tension. If it is correct, tighten the two bolts until just tight, then recheck the tension. If the tension is still correct, tighten the bolts.

8 It will often be necessary to use some sort of lever to move the accessory while the belt is adjusted. If this must be done to gain the proper leverage, be very careful not to damage the component being moved, or the part being prised against.

### Renewal

9 To renew a belt, follow the instructions above for adjustment, but remove the belt from the pulleys.

10 In some cases, you will have to remove more than one belt, because of their arrangement on the front of the engine. Because of this, and the fact that belts will tend to fail at the same time, it is wise to renew all belts together. Mark each belt and its appropriate pulley groove, so all renewed belts can be fitted in their proper positions.

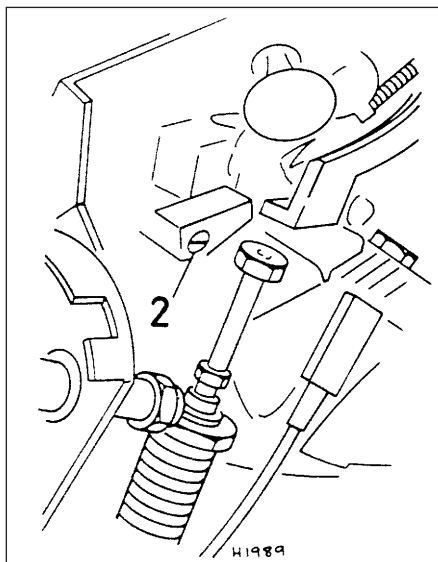
11 It is a good idea to take the old belts with you when buying new ones, in order to make a direct comparison for length, width and design.

12 Recheck the tension of new belts after a few hundred miles.

## 12 Engine idle speed and CO level check and adjustment



**Note:** The engine should be at normal operating temperature, with correct ignition timing and valve clearances (where adjustable). The air filter should be in good condition, and all electrical components (including the air conditioning, where fitted) should be switched off.



12.5 Mixture adjustment screw (2) on the 2B4 carburettor

### Carburettor

1 Connect a tachometer and exhaust gas analyser (CO meter) to the engine.

2 Start the engine and allow it to idle.

3 Check that the idle speed is as given in the Specifications. Adjustment of the idle speed is only possible on the 2B4 carburettor. Turn the carburettor idle speed adjustment screw until the engine idles at the correct speed (see illustration).

4 If the idle speed is low on the 2BE carburettor, and all wiring to the carburettor is in good condition, it is possible to connect a resistance into the control circuit. This should be carried out by your BMW dealer.

5 Check that the CO reading is as given in the Specifications. If not, turn the carburettor idle mixture adjustment screw until the mixture is correct (see illustration).

### L-Jetronic

6 Connect a tachometer and CO meter to the engine. BMW technicians use a special CO tester with a probe connected into the exhaust manifold, but the normal type of tester which locates in the exhaust tailpipe can be used instead. Note however that on models with a catalytic converter, meaningful CO readings will not be obtained at the tailpipe.

7 Start the engine and allow it to idle.

8 Check that the idle speed is as given in Specifications. If not, remove the tamperproof cap from the throttle housing, and turn the idle adjustment screw until the speed is correct.

9 Check that the CO reading is as given in the Specifications. The mixture control screw is located on the airflow meter, and a special



12.12a Removing the tamperproof plug from the airflow meter

tool (BMW number 13 1 060) may be required to make the adjustment.

### Motronic

10 Connect a tachometer and CO meter to the engine. BMW technicians use a special CO tester with a probe connected into the exhaust manifold, but the normal type of tester which locates in the exhaust tailpipe may be used instead. Note however that on models with a catalytic converter, meaningful CO readings will not be obtained at the tailpipe.

11 It is not possible to adjust the idle speed manually, as the idle air stabiliser valve is activated by the electronic control unit. If the idle speed is not within the specified range with the engine at normal operating temperature, check for a leak in the air inlet system, and also check the operation of the idle air stabiliser valve (see Chapter 4).

12 Check that the CO reading is as given in the Specifications. If adjustment is required, prise out the tamperproof plug from the airflow meter, and turn the adjustment screw to set the CO content (on some models, an Allen key will be required). Fit a new tamperproof plug on completion (see illustrations).



12.12b Adjusting the CO on the Motronic system



## Every 12 000 miles or 12 months, whichever comes first

### 13 Battery check, maintenance and charging



#### Check and maintenance



**Warning:** Certain precautions must be followed when checking and servicing the battery.

Hydrogen gas, which is highly flammable, is always present in the battery cells, so keep lighted tobacco and all other flames and sparks away from it. The electrolyte inside the battery is actually dilute sulphuric acid, which will cause injury if splashed on your skin or in your



13.1 Tools and materials required for battery maintenance

- 1 **Face shield/safety goggles** - When removing corrosion with a brush, the acidic particles can easily fly up into your eyes
- 2 **Baking soda** - A solution of baking soda and water can be used to neutralise corrosion
- 3 **Petroleum jelly** - A layer of this on the battery posts will help prevent corrosion
- 4 **Battery post/cable cleaner** - This wire-brush cleaning tool will remove all traces of corrosion from the battery posts and cable clamps
- 5 **Treated felt washers** - Placing one of these on each post, directly under the cable clamps, will help prevent corrosion
- 6 **Puller** - Sometimes the cable clamps are very difficult to pull off the posts, even after the nut/bolt has been completely loosened. This tool pulls the clamp straight up and off the post without damage
- 7 **Battery post/cable cleaner** - Here is another cleaning tool which is a slightly different version of No 4 above, but it does the same thing
- 8 **Rubber gloves** - Another safety item to consider when servicing the battery; remember that's acid inside the battery!

eyes. It will also ruin clothes and painted surfaces. When disconnecting the battery cables, always detach the negative cable first, and connect it last!

1 Battery maintenance is an important procedure, which will help ensure that you are not stranded because of a dead battery. Several tools are required for this procedure (see illustration).

2 Before servicing the battery, always switch off the engine and all accessories, and disconnect the cable from the negative terminal of the battery.



**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 A low-maintenance battery is standard equipment. The cell caps can be removed and distilled water can be added, if necessary. Later models may be fitted with a "maintenance-free" battery, which is sealed.

4 Remove the caps and check the electrolyte level in each of the battery cells. It must be above the plates. There's usually a split-ring indicator in each cell to indicate the correct level. If the level is low, add distilled water only, then refit the cell caps.



13.8a Battery terminal corrosion usually appears as light, fluffy powder



13.8c Regardless of the type of tool used on the battery posts, a clean, shiny surface should be the result



**Caution:** Overfilling the cells may cause electrolyte to spill over during periods of heavy charging, causing corrosion and damage to nearby components.

5 If the positive terminal and cable clamp on your vehicle's battery is equipped with a rubber protector, make sure that it's not torn or damaged. It should completely cover the terminal.

6 The external condition of the battery should be checked periodically. Look for damage such as a cracked case.

7 Check the tightness of the battery cable clamps to ensure good electrical connections. Check the entire length of each cable, looking for cracked or abraded insulation and frayed conductors.

8 If corrosion (visible as white, fluffy deposits) is evident, remove the cables from the terminals, clean them with a battery brush, and reconnect them (see illustrations). Corrosion can be kept to a minimum by fitting specially treated washers available at car accessory shops, or by applying a layer of petroleum jelly or suitable grease to the



13.8b Removing a cable from the battery post with a spanner - sometimes special battery pliers are required for this procedure, if corrosion has caused deterioration of the nut (always remove the earth cable first, and connect it last!)



13.8d When cleaning the cable clamps, all corrosion must be removed (the inside of the clamp is tapered to match the taper on the post, so don't remove too much material)



terminals and cable clamps after they are assembled.

**9** Make sure that the battery carrier is in good condition, and that the hold-down clamp bolt is tight. If the battery is removed (see Chapter 5 for the removal and refitting procedure), make sure that no parts remain in the bottom of the carrier when it's refitted. When refitting the hold-down clamp, don't overtighten the bolt.

**10** Corrosion on the carrier, battery case and surrounding areas can be removed with a solution of water and baking soda. Apply the mixture with a small brush, let it work, then rinse it off with plenty of clean water.

**11** Any metal parts of the vehicle damaged by corrosion should be coated with a zinc-based primer, then painted.

**12** Additional information on the battery and jump starting can be found in Chapter 5 and at the front of this manual.

## Charging

**Note:** The manufacturer recommends the battery be removed from the vehicle for charging, because the gas which escapes during this procedure can damage the paint or interior, depending on the location of the battery. Fast charging with the battery cables connected can result in damage to the electrical system.

**13** Remove all of the cell caps (if applicable), and cover the holes with a clean cloth to prevent spattering electrolyte. Disconnect the

battery negative cable, and connect the battery charger leads to the battery posts (positive to positive, negative to negative), then plug in the charger. Make sure it is set at 12 volts if it has a selector switch.



**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.

**14** If you're using a charger with a rate higher than two amps, check the battery regularly during charging to make sure it doesn't overheat. If you're using a trickle charger, you can safely let the battery charge overnight after you've checked it regularly for the first couple of hours. Where a maintenance-free battery is fitted, special precautions may be necessary when charging it (for example, the charge rate is normally very low). There may be a warning label on the battery, but if not, consult a BMW dealer or auto-electrician.

**15** If the battery has removable cell caps, measure the specific gravity with a hydrometer every hour during the last few hours of the charging cycle. Hydrometers are available inexpensively from car accessory shops - follow the instructions that come with the hydrometer. Consider the battery charged when there's no change in the specific gravity reading for two hours, and the electrolyte in the cells is gassing (bubbling) freely. The specific gravity reading from each cell should be very close to the others. If not, the battery probably has a bad cell(s), and a new one should be fitted.

**16** Some maintenance-free (sealed) batteries have built-in hydrometers on the top, indicating the state of charge by the colour displayed in the hydrometer window. Normally, a bright-coloured hydrometer indicates a full charge, and a dark hydrometer indicates the battery still needs charging. Check the battery manufacturer's instructions to be sure you know what the colours mean.

**17** If the battery is sealed and has no built-in hydrometer, you can connect a digital voltmeter across the battery terminals to check the charge. A fully-charged battery should read 12.6 volts or higher.

**18** Further information on the battery and jump starting can be found in Chapter 5 and at the front of this manual.

## 14 Spark plug check and renewal

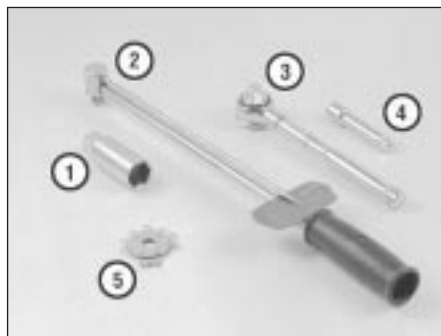


**1** Before beginning, obtain the necessary tools, which will include a spark plug socket and a set of feeler blades. Special spark plug gap gauges can be obtained from certain spark plug manufacturers (see illustration).

**2** The best procedure to follow when renewing the spark plugs is to purchase the new spark plugs beforehand, adjust them to the proper gap, and then renew each plug one at a time. When buying the new spark plugs, it is important to obtain the correct plugs for your specific engine. This information can be found in the Specifications section in the front of this Chapter.

**3** With the new spark plugs at hand, allow the engine to cool completely before attempting plug removal. During this time, each of the new spark plugs can be inspected for defects and the gaps can be checked.

**4** The gap is checked by inserting the proper thickness gauge between the electrodes at the tip of the plug (see illustration). The gap between the electrodes should be the same as that given in the Specifications. The wire should just touch each of the electrodes. If the gap is incorrect, use the notched adjuster to bend the curved side of the electrode slightly until the proper gap is achieved (see illustration). **Note:** When adjusting the gap of a new plug, bend only the base of the earth electrode, do not touch the tip. If the earth electrode is not exactly over the centre electrode, use the notched adjuster to align the two. Check for cracks in the porcelain insulator, indicating the spark plug should not be used.

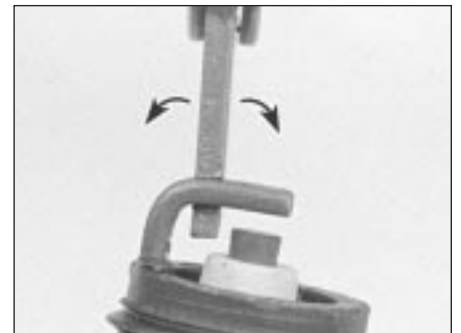


**14.1 Tools required for changing spark plugs**

- 1 Spark plug socket** - This will have special padding inside to protect the spark plug's porcelain insulator
- 2 Torque wrench** - Although not mandatory, using this tool is the best way to ensure the plugs are tightened properly
- 3 Ratchet** - Standard hand tool to fit the spark plug socket
- 4 Extension** - Depending on model and accessories, you may need special extensions and universal joints to reach one or more of the plugs
- 5 Spark plug gap gauge** - This gauge for checking the gap comes in a variety of styles. Make sure the gap for your engine is included. Feeler blades may be used instead



**14.4a Spark plug manufacturers recommend using a wire-type gauge when checking the gap - if the wire does not slide between the electrodes with a slight drag, adjustment is required**



**14.4b To change the gap, bend the earth electrode only, as indicated by the arrows, and be very careful not to crack or chip the porcelain insulator surrounding the centre electrode**



**14.5** When removing the spark plug HT leads, pull only on the connector

**5** With the engine cool, remove the HT lead from one spark plug. Do this by grabbing the connector at the end of the wire, not the lead itself (see illustration). Sometimes it is necessary to use a twisting motion while the connector and HT lead are pulled free.

**6** If compressed air is available, use it to blow any dirt or foreign material away from the spark plug area. A common bicycle pump will also work. The idea here is to eliminate the possibility of debris falling into the cylinder as the spark plug is removed.

**7** Place the spark plug socket over the plug, and remove it from the engine by turning it anti-clockwise (see illustration).

**8** Compare the spark plug with those shown in the accompanying photos to get an indication of the overall running condition of the engine.

**9** Apply a little copper-based anti-seize compound to the threads of the new spark plug. Locate the plug into the head, screwing it in with your fingers until it no longer turns, then tighten it with the socket. If available, use a torque wrench to tighten the plug to ensure that it is seated correctly. The correct torque figure is included in this Chapter's Specifications.

### TOOL TIP



Where there might be difficulty in inserting the spark plugs into the spark plug holes, or the possibility of cross-threading them into the head, a short piece of rubber or plastic tubing can be fitted over the end of the spark plug. The flexible tubing will act as a universal joint to help align the plug with the plug hole, and should the plug begin to cross-thread, the hose will slip on the spark plug, preventing thread damage.



**14.7** Use a socket spanner with an extension to unscrew the spark plugs

**10** Before pushing the HT lead onto the end of the plug, inspect it as outlined in Section 15.

**11** Attach the HT lead to the new spark plug, again using a twisting motion on the connector until it is firmly seated on the spark plug.

**12** Follow the above procedure for the remaining spark plugs, renewing them one at a time to prevent mixing up the spark plug HT leads.

## 15 Spark plug HT leads, distributor cap and rotor - check and renewal



**1** The spark plug HT leads should be checked at the recommended intervals, and whenever new spark plugs are fitted in the engine.

**2** Begin this procedure by making a visual check of the spark plug HT leads while the engine is running. In a darkened garage (make sure there is ventilation) start the engine and observe each HT lead. Be careful not to come into contact with any moving engine parts. If there is a break in the wire, you will see arcing or a small spark at the damaged area. If arcing is noticed, make a note to obtain new HT leads, then allow the engine to cool.

**3** 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.



**15.11a** On later models, loosen the screws and detach the distributor cap up so you can inspect the inside

**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.

**4** The HT leads should be inspected one at a time to prevent mixing up the firing order, which is essential for proper engine operation.

**5** Disconnect the HT lead from the spark plug. Do not pull on the lead itself, only on the connector.

**6** Inspect inside the connector for corrosion, which will look like a white crusty powder. Push the HT lead and connector back onto the end of the spark plug. It should be a tight fit on the plug end. If it is not, remove the lead and use pliers to carefully crimp the metal terminal inside the connector until it fits securely on the end of the spark plug.

**7** Using a clean rag, wipe the entire length of the HT lead to remove any built-up dirt and grease. Once the lead is clean, check for burns, cracks and other damage. Do not bend the lead excessively, since the conductor might break.

**8** Disconnect the HT lead from the distributor. Again, pull only on the connector. Check for corrosion and a tight fit in the same manner as the spark plug end. Renew the HT lead in the distributor if necessary.

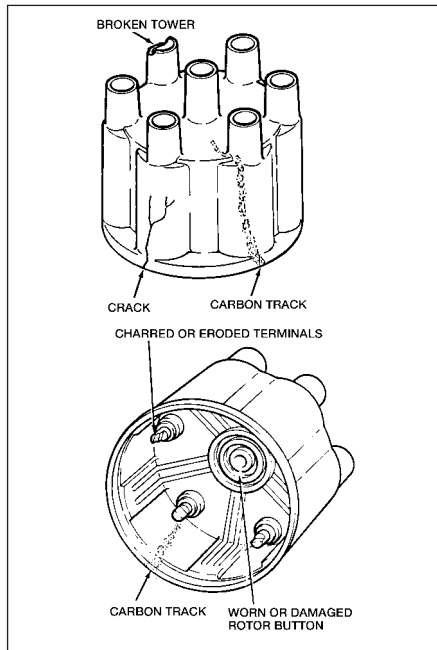
**9** Check the remaining spark plug HT leads, making sure they are securely fastened at the distributor and spark plug when the check is complete.

**10** If new spark plug HT leads are required, purchase a set for your specific engine model. Lead sets are available pre-cut, with the connectors already fitted. Remove and renew the HT leads one at a time, to avoid mix-ups in the firing order.

**11** Loosen the screws or detach the clips and remove the distributor cap (see illustration). Remove the screws (if applicable) and pull the rotor off the shaft (see illustration). Check the distributor cap and rotor for wear. Look for cracks, carbon tracks and worn, burned or loose contacts (see illustrations). Renew the cap and rotor if defects are found. It is common practice to fit a new cap and rotor whenever new spark plug HT leads are fitted. When fitting a new cap, remove the HT leads from the old cap one at a time, and attach



**15.11b** Use an Allen key to remove the screws, then lift the rotor off the shaft (later models)



**15.11c** Shown here are some of the common defects to look for when inspecting the distributor cap (if in doubt about its condition, fit a new one)

them to the new cap in the exact same location - do not simultaneously remove all the HT leads, or firing order mix-ups may occur.

## 16 Manual transmission lubricant level check

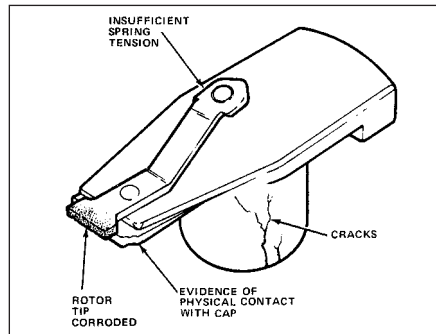


1 The transmission has a filler/level plug which must be removed to check the lubricant level. If the vehicle is raised to gain access to the plug, be sure to support it safely - do not crawl under a vehicle which is supported only by a jack! **Note:** The vehicle should be level to give an accurate lubricant check.

2 Remove the plug from the side of the



**16.2** Use a large Allen key to remove the filler/level plug (arrowed) and check the lubricant level with your little finger. It should be level with the bottom of the hole - if it's low, add lubricant



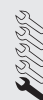
**15.11d** The rotor arm should be checked for wear and corrosion as indicated here (if in doubt about its condition, buy a new one)

transmission (see illustration) and use your little finger to reach inside the plug from the housing and feel the lubricant level. It should be at or very near the bottom of the plug hole. 3 If it isn't, add the recommended lubricant through the plug hole with a syringe or squeeze-bottle, until it just starts to run out of the hole. Refer to "Lubricants and fluids" at the beginning of this Chapter for the correct lubricant type. The manual transmissions on some later or high-performance models are filled with automatic transmission fluid (ATF). Such transmissions normally carry a sticker to this effect near the filler/level plug. Refer to a BMW dealer if still in doubt.

4 Refit the plug and tighten securely. Check for leaks after the first few miles of driving.

5 If regular topping-up is required, this can only be due to a leak which should be found and repaired before it becomes serious.

## 17 Differential lubricant level check



1 The differential has a filler/level plug which must be removed to check the lubricant level. If the vehicle is raised to gain access to the plug, be sure to support it safely - do not



**17.2** Remove the differential filler/level plug with an Allen key, and make sure the lubricant is level with the bottom of the hole

crawl under the vehicle when it's supported only by the jack! **Note:** The vehicle should be level to give an accurate lubricant check.

2 Remove the filler/level plug from the differential (see illustration). Use an Allen key to unscrew the plug.

3 Use your little finger as a dipstick to make sure the lubricant level is up to the bottom of the plug hole. If not, use a syringe or squeeze-bottle to add the recommended lubricant until it just starts to run out of the hole.

4 Refit the plug and tighten it securely.

5 If regular topping-up is required, this can only be due to a leak which should be found and repaired before it becomes serious.

## 18 Valve clearances - check and adjustment



**Note:** This procedure does not apply to the M40 engine, which has automatic adjusters.

1 The valve clearances can be checked with the engine hot or cold, but note that different values are specified, depending on engine temperature. If it is wished to check/adjust the valve clearances with the engine hot, if necessary start and run the engine until it reaches normal operating temperature, then shut it off.

**Caution:** If the clearances are checked with the engine hot, extra care must be taken to avoid burns.

2 Remove the valve cover from the engine (see Chapter 2A).

3 Turn the engine as necessary until No 1 piston (front) is at Top Dead Centre (TDC) on the compression stroke (see Chapter 2A).

4 Check the valve clearances for No 1 cylinder. The valve clearances can be found in the Specifications Section at the beginning of this Chapter.

5 The clearance is measured by inserting the specified size feeler gauge between the end of the valve stem and the rocker arm adjusting eccentric. You should feel a slight amount of



**18.6** The valve clearance is adjusted by turning the eccentric with a wire hook - once the specified clearance is obtained, tighten the locknut with a spanner, then remove the feeler gauge





**19.3 Check and lubricate the throttle linkage at the points shown (arrowed) - fuel injection engine shown**



**20.4 Detach the duct from the air cleaner housing**



**20.5 Use a screwdriver to detach the air cleaner cover clips**

drag when the feeler gauge is moved back and forth.

**6** If the gap is too large or too small, loosen the locknut, insert a hook made from large-diameter metal wire, and rotate the eccentric to obtain the correct gap (see illustration).

**7** Once the gap has been set, hold the eccentric in position with the hook, and retighten the locknut securely. Recheck the clearance - sometimes it'll change slightly when the locknut is tightened. If so, re-adjust until it's correct.

**8** On the M10 engine, the valves are adjusted in the firing order, which is 1-3-4-2. After adjusting No 1 cylinder valves, rotate the crankshaft half a turn (180°), then check and adjust the valves on No 3 cylinder. Repeat the procedure on the remaining cylinders.

**9** On M20 and M30 engines, the valves are adjusted following the firing order, which is 1-5-3-6-2-4. After adjusting No 1 cylinder valves, rotate the crankshaft a third of a turn (120°), then check and adjust the valves on No 5 cylinder. Repeat the procedure for the remaining cylinders.

**10** Refit the valve cover (use a new gasket) and tighten the mounting nuts evenly and securely.

**11** Start the engine and check for oil leakage between the valve cover and the cylinder head.

## 19 Throttle linkage - check and lubrication



**1** The throttle linkage should be checked and lubricated periodically to ensure its proper operation.

**2** Check the linkage to make sure it isn't binding.

**3** Inspect the linkage joints for looseness, and the connections for corrosion and damage, renewing parts as necessary (see illustration).

**4** Lubricate the connections with spray lubricant or lithium-based grease.

## 20 Air filter renewal



### Carburettor engines

**1** Release the spring clips, then unscrew the centre nut and lift off the cover.

**2** Remove the air filter element, and wipe clean the air cleaner body and cover

**3** Fit the new air filter element, then refit the cover using a reversal of the removal procedure.

### Fuel injection engines

**4** Loosen the clamp on the air intake duct, and detach the duct (see illustration).



**20.6a Rotate the cover upwards . . .**



**20.6b . . . and lift the air filter element out**

**5** Release the air cleaner cover retaining clips (see illustration).

**6** Rotate the cover up, lift it off and lift the element out, noting which way round it is fitted (see illustrations).

**7** Wipe the inside of the air cleaner housing with a clean cloth, then fit the new element. If the element is marked TOP, be sure the marked side faces up.

**8** Refit the cover and secure the clips.

**9** Connect the air duct and tighten the clamp screw.

## 21 Fuel system check



**Warning: Fuel is extremely flammable, so take extra precautions when you work on any part of the fuel system. Don't smoke, or allow open flames or bare light bulbs, near the work area. Don't work in a garage where a natural gas-type appliance (such as a water heater or clothes dryer) with a pilot light is present. Work in a well-ventilated area. If you spill any fuel on your skin, rinse it off immediately with soap and water. When you perform any kind of work on the fuel system, wear safety glasses, and have a fire extinguisher on hand. Mop up spills immediately, but do not store fuel-soaked rags where they could ignite.**

**1** If you smell fuel while driving or after the vehicle has been sitting in the sun, inspect the fuel system immediately.

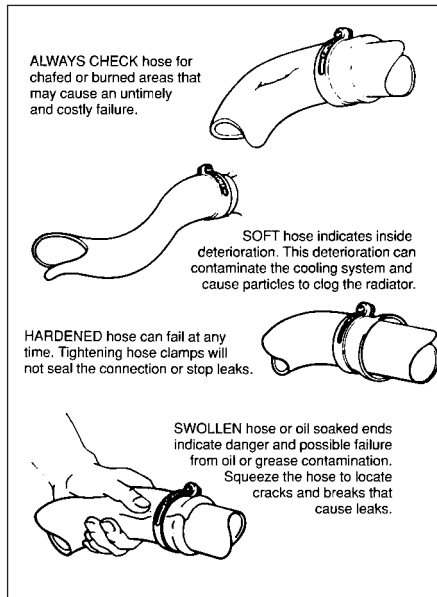
**2** Remove the fuel filler cap and inspect it for damage and corrosion. The gasket should have an unbroken sealing imprint. If the gasket is damaged or corroded, fit a new cap.

**3** Inspect the fuel feed and return lines for cracks. Make sure that the connections between the fuel lines and the carburettor or fuel injection system, and between the fuel lines and the in-line fuel filter, are tight.



**Warning: On fuel injection models, the fuel system must be depressurised before servicing fuel system components, as outlined in Chapter 4.**





**22.4 Hoses, like drivebelts, have a habit of failing at the worst possible time - to prevent the inconvenience of a blown radiator or heater hose, inspect them carefully as shown here**

4 Since some components of the fuel system - the fuel tank and some of the fuel feed and return lines, for example - are underneath the vehicle, they can be inspected more easily with the vehicle raised on a hoist. If that's not possible, raise the vehicle and support it on axle stands or ramps.

5 With the vehicle raised and safely supported, inspect the fuel tank and filler neck for punctures, cracks or other damage. The connection between the filler neck and the tank is particularly critical. Sometimes a rubber filler neck will leak because of loose clamps or deteriorated rubber. Inspect all fuel tank mounting brackets and straps, to be sure the tank is securely attached to the vehicle.



**Warning:** Do not, under any circumstances, try to repair a fuel tank (except rubber components). A welding torch or any naked flame can easily cause fuel vapours inside the tank to explode.

6 Carefully check all flexible hoses and metal lines leading away from the fuel tank. Check for loose connections, deteriorated hoses, crimped lines, and other damage. Repair or renew damaged sections as necessary (see Chapter 4).

## 22 Cooling system check



1 Many major engine failures can be attributed to cooling system problems. If the vehicle has automatic transmission, the engine cooling system also plays an important

role in prolonging transmission life, because it cools the transmission fluid.

2 The engine should be cold for the cooling system check, so perform the following procedure before the vehicle is driven for the day, or after it has been switched off for *at least* three hours.

3 Remove the radiator cap, doing so slowly and taking adequate precautions against scalding if the engine is at all warm. Clean the cap thoroughly, inside and out, with clean water. Also clean the filler neck on the radiator. The presence of rust or corrosion in the filler neck means the coolant should be changed (see Section 29). The coolant inside the radiator should be relatively clean and clear. If it's rust-coloured, drain the system and refill with new coolant.

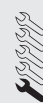
4 Carefully check the radiator hoses and the smaller-diameter heater hoses. Inspect each coolant hose along its entire length, renewing any hose which is cracked, swollen or deteriorated (see illustration). Cracks will show up better if the hose is squeezed. Pay close attention to hose clamps that secure the hoses to cooling system components. Hose clamps can pinch and puncture hoses, resulting in coolant leaks.

5 Make sure all hose connections are tight. A leak in the cooling system will usually show up as white or rust-coloured deposits on the area adjoining the leak. If wire-type clamps are used on the hoses, it may be a good idea to replace them with screw-type clamps.

6 Clean the front of the radiator (and, where applicable, the air conditioning condenser) with compressed air if available, or a soft brush. Remove all flies, leaves, etc., embedded in the radiator fins. Be extremely careful not to damage the cooling fins or to cut your fingers on them.

7 If the coolant level has been dropping consistently and no leaks are detected, have the radiator cap and cooling system pressure-tested.

## 23 Exhaust system check



1 The engine should be cold for this check, so perform the following procedure before the vehicle is driven for the day, or after it has been switched off for *at least* three hours. Check the complete exhaust system from the engine to the end of the tailpipe. Ideally, the inspection should be done with the vehicle on a hoist, to give unrestricted access. If a hoist isn't available, raise the vehicle and support it securely on axle stands or ramps.

2 Check the exhaust pipes and connections for evidence of leaks, severe corrosion, and damage. Make sure that all brackets and mountings are in good condition, and that they are tight (see illustration).

3 At the same time, inspect the underside of the body for holes, corrosion, open seams,

etc. which may allow exhaust gases to enter the passenger compartment. Seal all body openings with suitable sealant.

4 Rattles and other noises can often be traced to the exhaust system, especially the mountings and heat shields. Try to move the pipes, silencers (and, where applicable, the catalytic converter). If the components can come in contact with the body or suspension parts, re-hang the exhaust system with new mountings.

5 The running condition of the engine may be checked by inspecting inside the end of the tailpipe. The exhaust deposits here are an indication of the engine's state of tune. If the pipe is black and sooty, the engine may be running too rich, indicating the need for a thorough fuel system inspection.

## 24 Steering and suspension check



**Note:** The steering linkage and suspension components should be checked periodically. Worn or damaged suspension and steering linkage components can result in excessive and abnormal tyre wear, poor ride quality and vehicle handling, and reduced fuel economy. For detailed illustrations of the steering and suspension components, refer to Chapter 10.

### Strut/shock absorber check

1 Park the vehicle on level ground, turn the engine off and apply the handbrake. Check the tyre pressures.

2 Push down at one corner of the vehicle, then release it while noting the movement of the body. It should stop moving and come to rest in a level position with one or two bounces.

3 If the vehicle continues to move up and down, or if it fails to return to its original position, a worn or weak strut or shock absorber is probably the reason.

4 Repeat the above check at each of the three remaining corners of the vehicle.

5 Raise the vehicle and support it on axle stands.

6 Check the struts/shock absorbers for evidence of fluid leakage. A light film of fluid is



**23.2 Check the exhaust system rubber mountings for cracks**



**24.10 Inspect the balljoint boots for tears (arrowed)**

no cause for concern. Make sure that any fluid noted is from the struts/shocks, and not from any other source. If leakage is noted, renew the struts or shock absorbers in axle pairs (or as a full set).

**7** Check the struts/shock absorbers to be sure that they are securely mounted and undamaged. Check the upper mountings for damage and wear. If damage or wear is noted, renew the struts or shock absorbers.

**8** If the struts or shock absorbers must be renewed, refer to Chapter 10 for the procedure. Always renew both units on the same axle, or the safety of the vehicle may be compromised. If possible, renew all four as a set.

### Steering and suspension check

**9** Inspect the steering system components for damage and distortion. Look for leaks and damaged seals, boots and fittings.

**10** Clean the lower end of the steering knuckle. Have an assistant grasp the lower edge of the tyre and move the wheel in and out, while you look for movement at the steering knuckle-to-axle arm balljoints. Inspect the balljoint boots for tears (see illustration). If there is any movement, or the boots are torn or leaking, the balljoint(s) must be renewed.

**11** Grasp each front tyre at the front and rear edges, push in at the front, pull out at the rear and feel for play in the steering linkage. If any free play is noted, check the steering gear mountings and the track rod balljoints for looseness. If the steering gear mountings are loose, tighten them. If the track rods are loose, the balljoints may be worn (check to make sure the nuts are tight). Additional steering and suspension system information can be found in Chapter 10.

### 25 Driveshaft gaiter check

**1** The driveshaft gaiters are very important because they prevent dirt, water and foreign material from entering and damaging the constant velocity (CV) joints. External oil and grease contamination can cause the gaiter



**25.2 Gently probe the driveshaft boots to check for cracks**

material to deteriorate prematurely, so it's a good idea to wash the gaiters with soap and water.

**2** Inspect the gaiters for tears and cracks, as well as for loose clamps (see illustration). If there is any evidence of cracks or leaking lubricant, the gaiter must be renewed (see Chapter 8).

## 26 Brake system check



**Warning:** Dust produced by lining wear and deposited on brake components may contain asbestos, which is hazardous to your health. Do not blow it out with compressed air, and don't inhale it! Do not use petroleum-based solvents to remove the dust. Brake system cleaner or methylated spirit should be used to flush the dust into a drain pan. After the brake components are wiped with a damp rag, dispose of the contaminated rag(s) and the drain pan contents into a covered and labelled container. Try to use asbestos-free new parts whenever possible.

**Note:** In addition to the specified intervals, the brake system should be inspected each time the wheels are removed or a malfunction is indicated. Because of the obvious safety considerations, the following brake system checks are some of the most important maintenance procedures you can perform on your vehicle.

### Symptoms of brake system problems

**1** The disc brakes have built-in electrical wear indicators which cause a warning light on the dash to come on when they're worn to the renewal point. When the light comes on, renew the pads immediately, or expensive damage to the brake discs could result.

**2** Any of the following symptoms could indicate a potential brake system defect:

- a) Vehicle pulls to one side when the brake pedal is depressed
- b) Brakes make squealing or dragging noises when applied
- c) Brake pedal travel excessive



**26.11 Look through the caliper inspection window to inspect the brake pads - the pad lining which rubs against the disc can also be inspected by looking through each end of the caliper**

d) Brake pedal pulsates (normal if ABS is working)

e) Brake fluid leaks (usually on the inner side of the tyre or wheel)

**3** If any of these conditions are noted, inspect the brake system immediately.

### Brake lines and hoses

**Note:** Steel brake pipes are used throughout the brake system, with the exception of flexible, reinforced hoses at the front wheels and as connectors at the rear axle. Periodic inspection of all these lines is very important.

**4** Park the vehicle on level ground, and switch off the engine. Remove the wheel covers. Loosen, but do not remove, the bolts on all four wheels.

**5** Raise the vehicle and support it securely on axle stands.

**6** Remove the wheels (see "Jacking and towing" at the front of this book, or refer to your owner's handbook, if necessary).

**7** Check all brake lines and hoses for cracks, chafing of the outer cover, leaks, blisters, and distortion. Check the brake hoses at front and rear of the vehicle for softening, cracks, bulging, or wear from rubbing on other components. Check all threaded fittings for leaks, and make sure the brake hose mounting bolts and clips are secure.

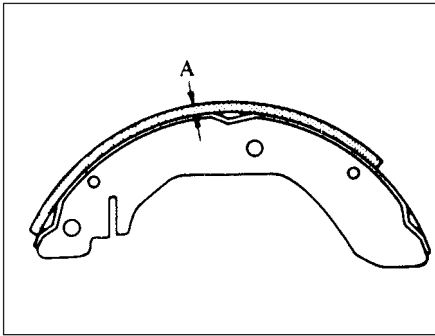
**8** If leaks or damage are discovered, they must be repaired immediately. Refer to Chapter 9 for detailed brake system repair procedures.

### Disc brakes

**9** If it hasn't already been done, raise the vehicle and support it securely on axle stands. Remove the front wheels.

**10** The disc brake calipers, containing the pads, are now visible. Each caliper has an outer and an inner pad - all pads should be checked.

**11** Note the pad thickness by looking through the inspection hole in the caliper (see illustration). If the lining material is 2.0 mm thick or less, or if it is tapered from end to end, the pads should be renewed (see Chapter 9). Keep in mind that the lining



**26.15** If the lining is bonded to the brake shoe, measure the lining thickness from the outer surface to the metal shoe, as shown here (A); if the lining is riveted to the shoe, measure from the lining outer surface to the rivet head

material is bonded to a metal plate or shoe - the metal portion is not included in this measurement. Always renew the pads on both sides of the vehicle (in axle sets), even if only one pad of the four is worn, or uneven braking may result.

**12** Remove the calipers without disconnecting the brake hoses (see Chapter 9).

**13** Check the condition of the brake disc. Look for score marks, deep scratches and overheated areas (they will appear blue or discoloured). If damage or wear is noted, the disc can be removed and resurfaced by an engineering workshop; otherwise, it will have to be renewed. In either case, both discs should be involved, even if only one is worn. Refer to Chapter 9 for more detailed inspection and repair procedures.

### Drum brakes

**14** Refer to Chapter 9 and remove the rear brake drums.

**15** Note the thickness of the lining material on the rear brake shoes, and look for signs of contamination by brake fluid or grease (see illustration). If the material is within 2.0 mm of the recessed rivets or metal shoes, renew the brake shoes. The shoes should also be renewed if they are cracked, glazed (shiny lining surfaces), or contaminated with brake fluid or grease. See Chapter 9 for the renewal procedure.

**16** Check the shoe return and hold-down springs and the adjusting mechanism. Make sure all these components are fitted correctly,



**27.5** Press the retaining tab in, then slide the wiper blade assembly down and out of the hook in the end of the wiper arm

and are in good condition. Deteriorated or distorted springs, if not renewed, could allow the linings to drag and wear prematurely.

**17** Check the wheel cylinders for leakage by carefully peeling back the rubber boots. Slight moisture behind the boots is acceptable. If brake fluid is noted behind the boots or if it runs out of the wheel cylinder, the wheel cylinders must be overhauled or renewed (see Chapter 9).

**18** Check the drums for cracks, score marks, deep scratches and high spots, which will appear as small discoloured areas. If imperfections cannot be removed with emery cloth, both drums must be resurfaced by a specialist (see Chapter 9 for more detailed information).

**19** Refer to Chapter 9 and fit the brake drums.

**20** Refit the wheels, but don't lower the vehicle yet.

### Handbrake

**21** The easiest, and perhaps most obvious, method of checking the handbrake is to park the vehicle on a steep hill with the handbrake applied and the transmission in Neutral (stay in the vehicle while performing this check). If the handbrake doesn't prevent the vehicle from rolling, refer to Chapter 9 and adjust it.

### 27 Wiper blades - check and renewal



**1** Road film can build up on the wiper blades and affect their efficiency, so they should be



**27.6** Detach the end of the wiper element from the end of the frame, then slide the element out

washed regularly with a mild detergent solution.

### Check

**2** The wiper and blade assembly should be inspected periodically. If inspection reveals hardened or cracked rubber, renew the wiper blades. If inspection reveals nothing unusual, wet the windscreen, turn the wipers on, allow them to cycle several times, then switch them off. An uneven wiper pattern across the glass, or streaks over clean glass, indicate that the blades should be renewed.

**3** The operation of the wiper mechanism can loosen the retaining nuts, so they should be checked and tightened, as necessary, at the same time the wiper blades are checked (see Chapter 12 for further information regarding the wiper mechanism).

### Wiper blade renewal

**4** Pull the wiper/blade assembly away from the glass.

**5** Press the retaining tab in, and slide the blade assembly down the wiper arm (see illustration).

**6** If you wish to renew the blade rubbers separately, detach the end of the rubber from the wiper blade frame, then slide the rubber out of the frame (see illustration).

**7** Compare the new rubber with the old for length, design, etc.

**8** Slide the new rubber into place, and insert the end in the wiper blade frame to lock it in place.

**9** Refit the blade assembly on the arm, then wet the glass and check for proper operation.

## Every 24 000 miles or 2 years, whichever comes first

### 28 Automatic transmission fluid and filter change



**1** At the specified intervals, the transmission fluid should be drained and renewed. Since the fluid will remain hot long after driving,

perform this procedure only after the engine has cooled down completely.

**2** Before beginning work, purchase the specified transmission fluid (see "Lubricants and fluids" at the beginning of this Chapter) and a new filter.

**3** Other tools necessary for this job include axle stands or ramps to support the vehicle in a

raised position, a drain pan capable of holding at least 4.5 litres, and newspapers and clean rags.

**4** Raise the vehicle and support it securely.

**5** Loosen the dipstick tube collar, then detach the dipstick tube and let the fluid drain (see illustrations).

**6** Remove the transmission sump mounting bolts and brackets (see illustration).





28.5a Unscrew the dipstick tube collar



28.5b Detach the tube and let the fluid drain



28.6 Use a socket and extension to remove the bolts and brackets

7 Detach the sump from the transmission and lower it, being careful not to spill the remaining fluid (see illustration).

8 Carefully clean the sump-to-transmission contact surface.

9 Pour the fluid from the sump into a suitable container, then clean the sump with solvent and dry it with compressed air. Be sure to clean any metal filings from the magnet, if applicable.

10 Remove the filter from inside the transmission (see illustrations).

11 Fit the O-ring and a new filter, being sure to tighten the bolts securely.

12 Make sure that the sump gasket contact surfaces are clean, then fit the new gasket. Offer the sump up to the transmission, and refit the brackets and bolts. Working around

the sump, tighten each bolt a little at a time until the torque listed in this Chapter's Specifications is reached. Don't overtighten the bolts! Connect the dipstick tube, and tighten the collar securely.

13 Lower the vehicle, and add the specified amount of fluid through the filler tube (see Section 8).

14 With the transmission in Park and the handbrake applied, run the engine at fast idle, but don't race it.

15 Move the gear selector through each position, and back to Park. Check the fluid level.

16 Check under the vehicle for leaks after the first few trips.

## 29 Cooling system - draining, flushing and refilling



**Warning:** Do not allow antifreeze to come in contact with your skin, or with the painted surfaces of the vehicle. Rinse off spills immediately with plenty of water. Antifreeze is highly toxic if ingested. Never leave antifreeze lying around in an open container or in puddles on the floor; children and pets are attracted by its sweet smell, and may drink it. Check with local authorities about disposing of used antifreeze. Local collection centres may exist to see that antifreeze is disposed of safely.



28.7 Lower the sump from the transmission



28.10a Use a Torx key to remove the filter bolts . . .



28.10b . . . then remove the fluid filter from the transmission



28.10c Remove the O-ring from the transmission. If it is in good condition, clean it and transfer it to the new fluid filter; otherwise, renew it

1 Periodically, the cooling system should be drained, flushed and refilled. This will restore the effectiveness of the antifreeze mixture and prevent formation of rust and corrosion, which can impair the performance of the cooling system and cause engine damage. When the cooling system is serviced, all hoses and the radiator cap should be checked and renewed if necessary.

## Draining

2 If the vehicle has just been driven, wait several hours to allow the engine to cool down before beginning this procedure.

3 Once the engine is completely cool, remove the expansion tank cap or radiator cap. If the cap must be removed while the engine is still warm, unscrew it slowly, and take adequate precautions to avoid scalding.

4 Move a large container under the radiator to catch the coolant. Where a drain plug is fitted, unscrew it (a pair of pliers or screwdriver may be required to turn it, depending on the model) (see illustration). Where there is no drain plug, it will be necessary to disconnect the bottom hose from the radiator.

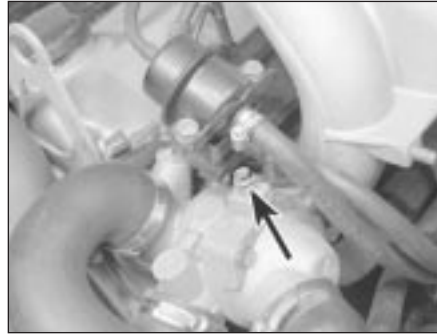
5 While the coolant is draining, check the condition of the radiator hoses, heater hoses and clamps (see Section 21 if necessary).

6 Renew any damaged clamps or hoses (see Chapter 3 for detailed renewal procedures).

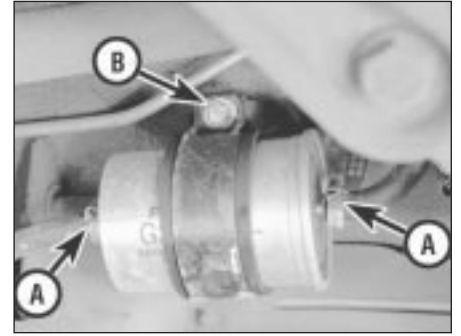




29.4 Radiator drain plug location (arrowed) - not fitted to all models



29.16 The bleed screw (arrowed) is located on the thermostat housing (six-cylinder models)



30.5 To renew the fuel filter, disconnect the hoses (A), then unscrew the nut (B) and detach the filter from the bracket (fuel injection type shown)

## Flushing

7 Once the system is completely drained, flush the radiator with fresh water from a garden hose until the water runs clear at the drain or bottom hose. If the radiator is severely corroded, damaged or leaking, it should be removed (see Chapter 3) and taken to a radiator repair specialist.

8 Flushing in this way will remove sediments from the radiator, but will not remove rust and scale from the engine and cooling tube surfaces. These deposits can be removed by using a chemical cleaner. Follow the procedure outlined in the cleaner manufacturer's instructions. Remove the cylinder block drain plug before flushing the engine.

9 On models so equipped, remove the overflow hose from the coolant recovery reservoir. Drain the reservoir and flush it with clean water, then reconnect the hose.

## Refilling

10 Tighten the radiator drain plug, or reconnect the radiator bottom hose. Refit and tighten the cylinder block drain plug.

### Four-cylinder engines

11 Slowly add new coolant (a 40%/60% mixture of antifreeze to water) to the radiator until it is full. Add coolant to the reservoir up to the lower mark.

12 Leave the radiator cap off, and run the engine in a well-ventilated area until the thermostat opens (coolant will begin flowing through the radiator, and the upper radiator hose will become hot).

13 Turn the engine off, and let it cool. Add more coolant mixture to bring the coolant level back up to the lip on the radiator filler neck. On the M40 engine, unscrew the bleed screw from the top of the radiator, and add coolant until it comes out of the bleed screw hole. Refit and tighten the bleed screw.

14 Squeeze the upper radiator hose to expel air, then add more coolant mixture if necessary. Refit the radiator cap.

15 Start the engine, allow it to reach normal operating temperature, and check for leaks.

### Six-cylinder engines

16 Loosen the bleed screw in the thermostat housing (see illustration)

17 Fill the radiator with a 40%/60% solution of antifreeze and water until it comes out of the bleed screw opening. Tighten the bleed screw.

18 Refit the radiator cap, and run the engine until the thermostat opens (the upper radiator hose will become hot). Slowly loosen the bleed screw until no bubbles emerge, then tighten the screw.

19 Repeat the procedure until the air is bled from the system.

## 30 Fuel filter renewal



**Warning:** Fuel is extremely flammable, so take extra precautions when you work on any part of the fuel system. Don't smoke, or allow open flames or bare light bulbs, near the work area. Don't work in a garage where a natural gas-type appliance (such as a water heater or clothes dryer) with a pilot light is present. If you spill any fuel on your skin, rinse it off immediately with soap and water. When you perform any kind of work on the fuel system, wear safety glasses, and have a fire extinguisher on hand.

1 On fuel injection engines, depressurise the fuel system (see Chapter 4).

2 The fuel filter is located in the engine compartment on the bulkhead, or under the vehicle adjacent to the fuel tank.

3 Because on some models the filter is located adjacent to the starter motor, fuel could leak onto the electrical connections. For safety reasons, therefore, disconnect the battery negative cable before beginning work.

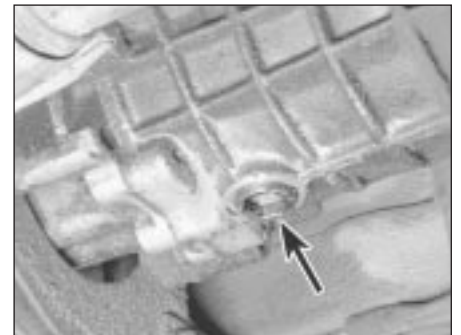


**Caution:** If the radio in your vehicle is equipped with an anti-theft system, make sure you have the correct activation code before disconnecting the battery.

## 31 Manual transmission lubricant change

1 Tools necessary for this job include axle stands to support the vehicle in a raised position, an Allen key to remove the drain plug, a drain pan, newspapers and clean rags. The correct amount of the specified lubricant should also be available (see "Lubricants and fluids" at the start of this Chapter).

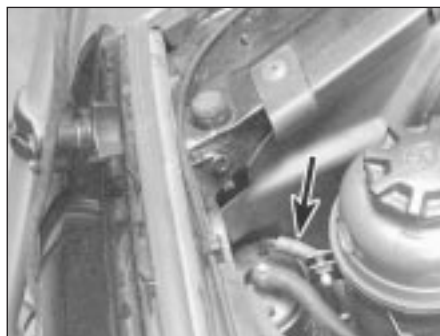
2 The lubricant should be drained when it is hot (ie immediately after the vehicle has been driven); this will remove any contaminants better than if the lubricant were cold. Because



31.5 Use an Allen key to remove the drain plug (arrowed) from the bottom of the transmission



**32.4 Remove the differential drain plug with an Allen key**



**33.2 Inspect the hoses (arrowed) at the top of the evaporative emissions charcoal canister for damage**



**34.2a The earlier 15-pin connector (arrowed) is mounted near the front of the engine. The 20-pin connector used on later models is located in the left rear corner of the engine compartment**

the lubricant will be hot, it would be wise to wear rubber gloves.

**3** Raise the vehicle and place it on axle stands. Make sure it is safely supported, and as level as possible.

**4** Move the necessary equipment under the vehicle, being careful not to touch any of the hot exhaust components.

**5** Place the drain pan under the transmission, and remove the filler/level plug from the side of the transmission. Loosen the drain plug (see illustration).

**6** Carefully remove the drain plug. Be careful not to burn yourself on the lubricant.

**7** Allow the lubricant to drain completely. Clean the drain plug thoroughly, then refit and tighten it securely.

**8** Refer to Section 16 and fill the transmission with new lubricant, then refit the filler/level plug, tightening it securely.

**9** Lower the vehicle. Check for leaks at the drain plug after the first few miles of driving.

## 32 Differential lubricant change



**1** Drive the vehicle for several miles to warm up the differential lubricant, then raise the vehicle and support it securely on axle stands.

**2** Move a drain pan, rags, newspapers and an Allen key under the vehicle. Since the lubricant will be hot, wear rubber gloves to prevent burns.

**3** Remove the filler/level plug from the differential; this is the upper of the two plugs.

**4** With the drain pan under the differential, loosen the drain plug; this is the lower of the two plugs (see illustration).

**5** Carefully unscrew the drain plug until you can remove it from the case.

**6** Allow all the oil to drain into the pan, then refit the drain plug and tighten it securely.

**7** Refer to Section 17 and fill the differential with lubricant.

**8** Refit the filler/level plug and tighten it securely.

**9** Lower the vehicle. Check for leaks at the drain plug after the first few miles of driving.

## 33 Evaporative emissions control (EVAP) system check



**1** The function of the evaporative emissions control system is to draw fuel vapours from the tank and fuel system, store them in a charcoal canister, and then burn them during normal engine operation. This system is normally only fitted to those vehicles equipped with a catalytic converter.

**2** The most common symptom of a fault in the evaporative emissions system is a strong fuel odour in the engine compartment. If a fuel odour is detected, inspect the charcoal canister and system hoses for cracks. The canister is located in the front corner of the engine compartment on most models (see illustration).

**3** Refer to Chapter 6 for more information on the evaporative emissions system.

## 34 Service indicator light resetting



### Service indicator lights

**1** All models covered in this manual are equipped with various service indicator lights on the fascia, which automatically go on when the mileage interval is reached. These lights can only be turned off by using a special tool which plugs into the service connector located in the engine compartment.

**2** Although the service light resetting tool can be obtained from a dealer, reasonably-priced alternatives may also be available from aftermarket sources. When obtaining a tool, it is important to know the vehicle year and model, and whether the service connector has 15 or 20 pins (see illustrations). Once the proper tool is obtained, it is a simple matter to plug it into the service connector and, following the tool manufacturer's instructions, reset the service lights. **Note:** The brake warning light will not automatically reset if the sensor on the brake pad (or its wiring) is



**34.2b An aftermarket service light resetting tool such as this one can be plugged into the service connector and used to reset the service lights**

*damaged because it is worn through: it must be repaired first.*

**3** The service lights are controlled by the Service Indicator (SI) board in the instrument cluster, which is powered by rechargeable batteries. Should these batteries fail, problems will develop in the SI board. Symptoms of failed batteries include the inability to reset the service lights and malfunctions affecting the tachometer, temperature gauge and radio operation. Refer to Chapter 12 for more information on the SI board.

## Every 60 000 miles

### 35 Engine timing belt renewal



**Note:** This is not included in the manufacturer's maintenance schedule, but is strongly recommended as a precaution against the timing belt falling in service. If the timing belt fails while the engine is running, extensive engine damage could be caused.

Refer to Chapter 2A, Section 10.