18. Remove the coolant reservoir from its mountings without disconnecting any of the hoses. On 1984 through 1987 models, remove the two mounting bolts. See Fig. 4-59. On 1988 and later models, carefully pull the reservoir from its mountings. Set the reservoir out of the way.

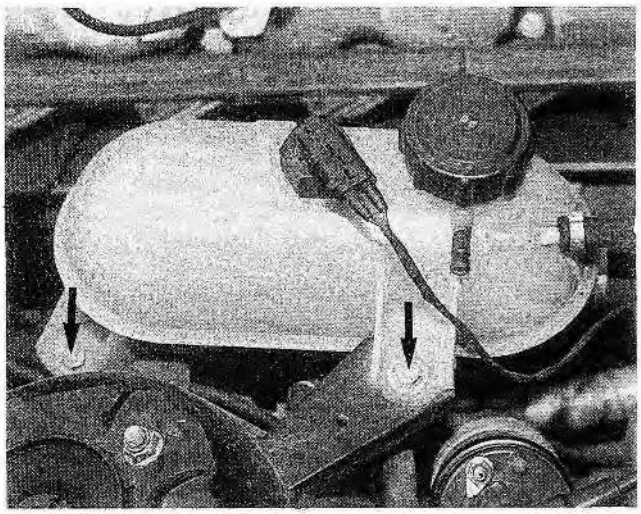


Fig. 4-59. Mounting bolts on coolant reservoir installed on 1984 through 1987 models (arrows).

19. On 1988 and later models, remove the two mounting bolts from the plastic coolant pipe that passes in front of the engine. Disconnect the hoses from each end of the pipe and remove the pipe.

20. Disconnect the fuel return line from the fuel pressure regulator. See Fig. 4-60. Disconnect the fuel supply line at the union beneath the intake manifold.

WARNING

Fuel will be expelled when the fuel lines are removed. Do not smoke or work near heaters or other fire hazards. Have a fire extinguisher handy.

21. Using a socket wrench on the center vibration damper (crankshaft pulley) bolt, rotate the crankshaft clockwise until the engine is at Top Dead Center (TDC or O/T) of the No. 1 cylinder. See Fig. 4-61.

22. Remove the cylinder head cover as described under **4.1 Cylinder Head Cover and Gasket**.

23. Remove the camshaft drive belt as described under **4.2 Camshaft Drive Belt (6-cylinder engine)**.

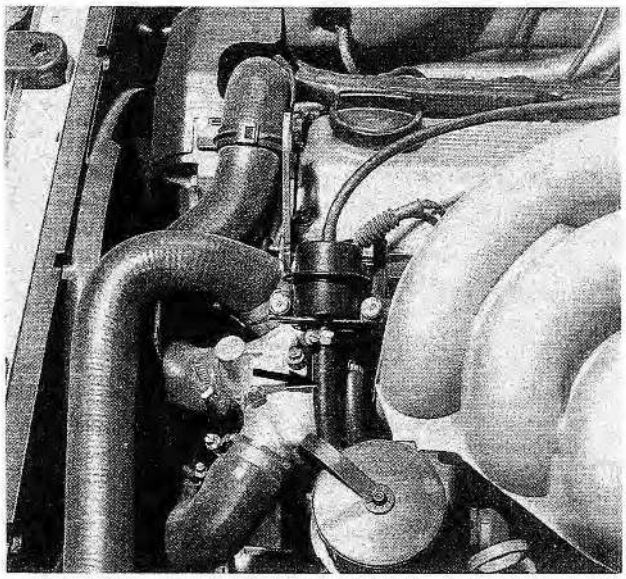


Fig. 4-60. Fuel return hose at fuel pressure regulator (arrow).

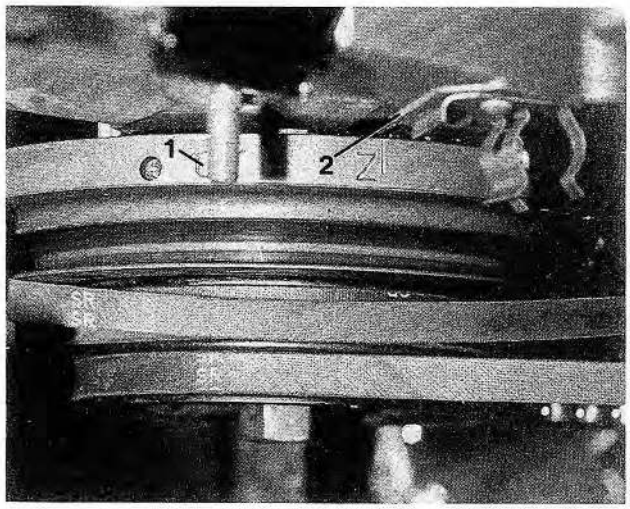


Fig. 4-61. Top Dead Center (TDC or 0/T) mark (**1**) on vibration damper should be aligned with mark on drive belt cover (**2**).

24. Gradually and evenly loosen and remove the cylinder head bolts using the sequence shown in Fig. 4-62. Carefully remove the cylinder head, making sure all wires, hoses, and fittings are free and clear of the cylinder head. If the head is stuck, use a soft-faced mallet or pry gently with a wooden stick.

NOTE

A crankcase ventilation tube is connected between the intake manifold and the crankcase breather assembly. The vent tube is spring loaded. A special tool is available from BMW (BMW Tool No. 11 1 290) to compress the spring and hold the tube in position while the cylinder head is removed.

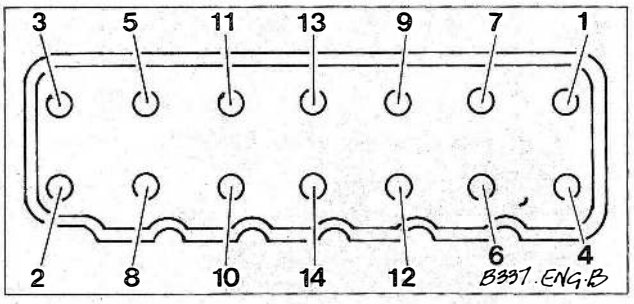


Fig. 4-62. Cylinder head bolt loosening sequence.

To install (6-cylinder engines):

1. Clean the cylinder head and the gasket surface of the cylinder block. Clean the threads of the head bolts and bolt holes with a thread chaser and remove all oil and foreign matter from the bolt holes. Avoid letting debris into the cylinders or oil passages in the cylinder block.

CAUTION

Do not use a metal scraper or wire brush to clean the aluminum cylinder head or pistons. These tools may damage the cylinder head. Instead, use a solvent to soften carbon deposits and old sealing materials. If necessary, use a hard wooden or plastic scraper.

2. Check the gasket surface of the cylinder head and the cylinder block for warpage as described under **4.9 Disassembly, Assembly, and Reconditioning Cylinder Head**.

3. Place a new cylinder head gasket on the surface of the cylinder block. The cylinder head gasket will fit correctly in only one orientation. The word "OBEN", found printed on the gasket, should face up.

CAUTION

Cylinder head gaskets will make a reliable seal only once. Always use a new cylinder head gasket that has not been previously compressed by tightening the cylinder head bolts.

NOTE

Head gaskets on some early 6-cylinder engines may have the engine displacement code stamped on the gasket flange as shown in Fig. 4-63. On 325, 325e, and 325es models, the code number is 2.7. On 325i, 325is and 325i Convertible models, the code number is 2.5. Replacement gaskets supplied by BMW no longer have the code number.

4. Place the cylinder head in position on the cylinder block. Check that the vent tube is correctly positioned. Loosely install the head bolts and their washers, then thread them in until they are finger tight. Guide the vent tube into its opening as the cylinder head bolts are tightened.

CAUTION

BMW recommends replacing hex-head cylinder head bolts with the Torx-head bolts whenever the cylinder head is removed or if any bolts are found to be faulty (such as a broken off bolt head). When replacing bolts with the head installed, remove and install one bolt at a time until all 14 are replaced. The hex-head bolt was originally installed in all 6-cylinder 3-series engines up to April 1989. All 3-series engines produced after this date use the new Torx-head bolt.

NOTE

To help install the cylinder head, insert two 8 in. long by ⅜ in. round wooden dowels into two of the outermost head bolt holes. The dowels will hold the gasket in position as the cylinder head is installed. Thread in several bolts, then remove the dowels and install the remaining bolts.

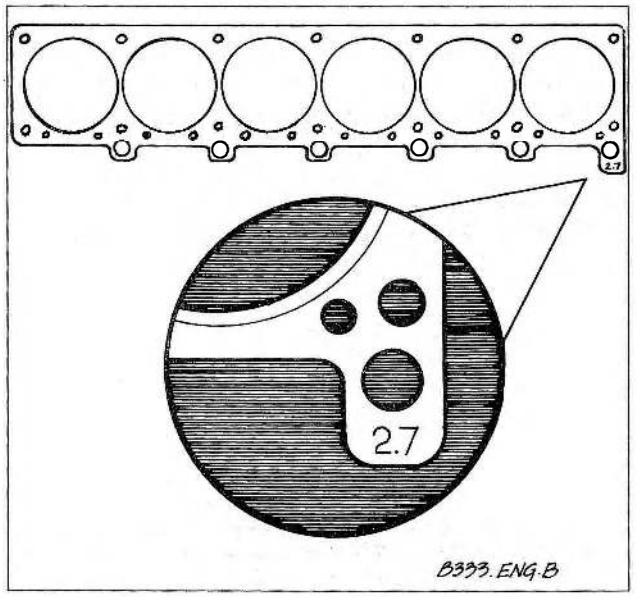


Fig. 4-63. Engine displacement code stamp on cylinder head gasket flange.

5. Tighten the cylinder head bolts in the sequence shown in Fig. 4-64. The bolts should be tightened in three stages as listed in **Table h**. The final stage(s) requires using a special tool (BMW Tool No. 11 2 110) or a suitable protractor to tighten the bolts to a specified torque angle.

CAUTION

The cylinder head bolt torque is critical to proper engine operation. Tighten the bolts in the stages listed in the Table h.

NOTE

On engines with Torx®head bolts, the torque angles can be done with engine cold. There is no specified waiting time or engine temperature.

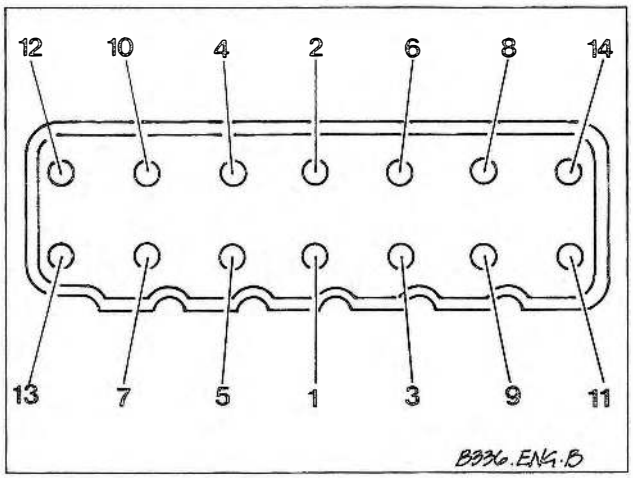


Fig. 4-64. Cylinder head bolt tightening sequence for 6-cylinder engine.

Table h. Cylinder Head Tightening Torques (6-cylinder engines)

	Stage 1	Stage 2	Stage 3
Torx®head bolts	30 Nm (22 ft. lb.)	90°	90°
Hex-head bolts	40 $^{+5}_{-0}$ Nm (30 $^{+4}_{-0}$ ft. lb.)	60 $^{+5}_{-0}$ Nm (44 $^{+4}_{-0}$ ft. lb.) after waiting 15 minutes	25 $^{+5°}_{-0}$ after running engine for 25 minutes

Installation of the remaining parts is the reverse of removal. Adjust the valve clearances as described under **4.4 Valve Adjustment**. Install the camshaft drive belt as described under **4.2 Camshaft Drive Belt (6-cylinder engines)**. Install the front pipe to the exhaust manifold with CRC® copper paste or equivalent on the mounting studs. Replace the gasket if necessary. Refill and bleed the cooling system as described in **COOLING SYSTEM**. Change the engine oil and filter as described in **LUBRICATION AND MAINTENANCE.** Adjust idle speed and idle mixture as described in **FUEL SYSTEM.** Adjust the accelerator cable as described in **FUEL SYSTEM.** Adjust the transmission throttle cable as described in **AUTOMATIC TRANSMISSION.**

4.9 Disassembly, Assembly, and Reconditioning Cylinder Head

Disassembly, assembly, and reconditioning procedures for the BMW cylinder heads covered in this manual are similar to those for most other modern water-cooled engines. For anyone with the proper tools and equipment and basic experience in cylinder head reconditioning, this section provides the specifications and special reconditioning information necessary to repair the cylinder heads covered by this manual.

If machine shop services are not readily available, one alternative is to install a remanufactured cylinder head. Remanufactured cylinder heads are available from an authorized BMW dealer parts department.

4

Cylinder Head Assembly

The cylinder head should be carefully inspected for warpage and cracks. Always decarbonize and clean the head before inspecting it. A high quality straight edge can be used to check for warpage. See Fig. 4-65. Visually inspect the cylinder head for cracks. If a cracked cylinder head is suspected and no cracks are detected through the visual inspection, have the head further tested for cracks by an authorized BMW dealer. A cracked cylinder head should be replaced.

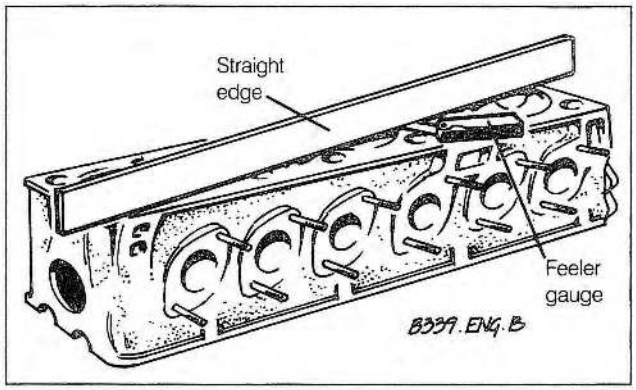


Fig. 4-65. Straight edge and feeler gauge being used to check straightness of cylinder head gasket surface.

A warped cylinder head can be machined provided no more than 0.3 mm (0.012 in.) of material is removed. If further machining is required, the head should be replaced. Removing more than this amount will reduce the size of the combustion chamber and adversely affect engine performance.

NOTE

A special gasket is available from an authorized BMW parts department for machined heads. The special gasket is 0.3 mm thicker than the original standard gasket.

Before machining the head to correct for warpage, measure the total height of the cylinder head as shown in Fig. 4-66. **Table i** lists the minimum resurfacing height specifications. If the cylinder head height will not meet the minimum height dimension after machining, the cylinder head should be replaced.

NOTE

When machining cylinder heads on 4-cylinder engines, the upper camshaft chain cover must be bolted to the cylinder head so that an identical amount of material is removed from each. Otherwise the upper camshaft chain cover would protrude below the cylinder head, preventing the cylinder head gasket from sealing properly.

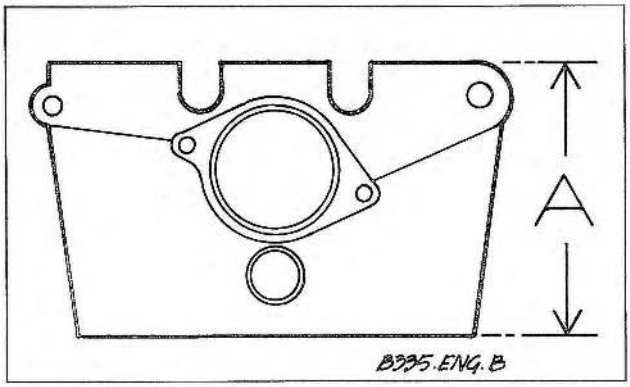


Fig. 4-66. Front view of cylinder head showing minimum resurfacing dimension (**A**). 6-cylinder engine shown.

Table i. Cylinder Head Resurfacing Specifications

Engine	Minimum permissible height (dimension a)	
	new	after machining
6-cylinder	125.1 ± 0.1 mm (4.925 ± .004 in.)	124.7 mm (4.909 in.)
4-cylinder	129.0 ± 0.1 mm (5.079 ± .004 in.)	128.6 mm (5.063 in.)

Valve Guides

Special tools and a press are required to replace valve guides. It is also necessary to heat the cylinder head and to chill the valve guides. Check valve guide wear with a new valve as shown in Fig. 4-67. Inspect the valve seats to ensure that the cylinder head can be reconditioned before installing new valve guides.

NOTE

- If valve guide wear is greater than 0.8 mm (0.031 in.), but less than 1.0 mm (0.039 in.), the valve guide may be reamed out to accept valves with oversized stems as listed in **Table j**.
- If the radial clearance exceeds 1.0 mm (0.039 in.), the valve guide should be replaced.
- If valves with oversized stems are installed, the valve seat must also be machined to accept the new valve.

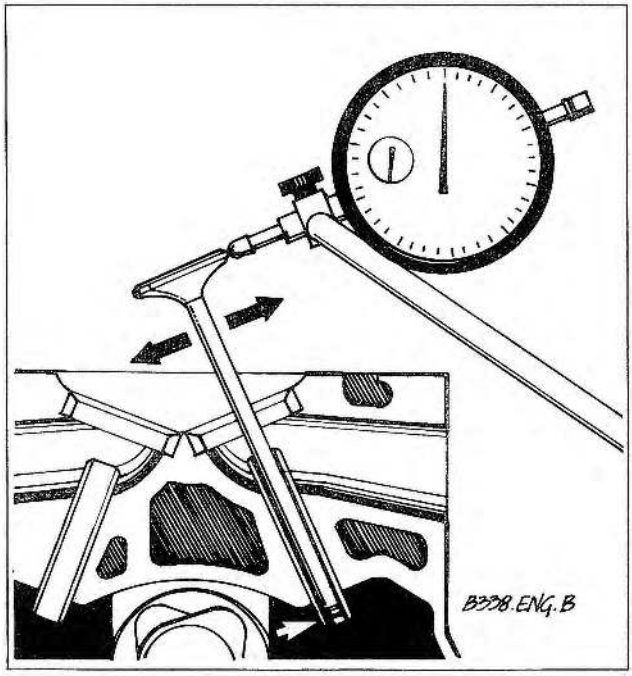


Fig. 4-67. Valve guide wear being checked with dial indicator. Insert new valve until stem end is flush with end of guide (white arrow). Play should not exceed 0.8 mm (0.031 in.).

Worn valve guides are driven out from the camshaft side of the cylinder head. The valve guides should be removed at room temperature. Install new valve guides from the camshaft side of the cylinder head with the stepped end of the valve guide facing the camshaft. Valve guide specifications, including correct installation temperatures, are listed in **Table j**.

Table j. Valve Guide Specifications

Specifications	4-cylinder engine	6-cylinder engine
Valve guide wear, maximum (measured with new valve)	0.8 mm (0.031 in.)	0.8 mm (0.031 in.)
Valve stem diameter		
standard	8.0 mm (0.315 in.)	7.0 mm (0.275 in.)
oversize 1	8.1 mm (0.319 in.)	7.1 mm (0.279 in.)
oversize 2	8.2 mm (0.323 in.)	7.2 mm (0.283 in.)
Valve guide inside diameter (tolerance per ISO allowance H7)		
standard	8.0 mm (0.315 in.)	7.0 mm (0.275 in.)
oversize 1	8.1 mm (0.319 in.)	7.1 mm (0.279 in.)
oversize 2	8.2 mm (0.323 in.)	7.2 mm (0.283 in.)
Valve guide outside diameter (tolerance per ISO allowance u6)		
standard		
old version	14.0 mm (.5512 in.)	13.0 mm (.5118 in.)
new version	NA	13.2 mm (.5197 in.)
oversize 1		
old version	14.1 mm (.5551 in.)	13.1 mm (.5157 in.)
new version	NA	13.3 mm (.5236 in.)
oversize 2		
old version	14.2 mm (.5590 in.)	13.2 mm (.5197 in.)
new version	NA	13.4 mm (.5276 in.)
oversize 3	14.3 mm (.5630 in.)	13.3 mm (.5236 in.)

continued

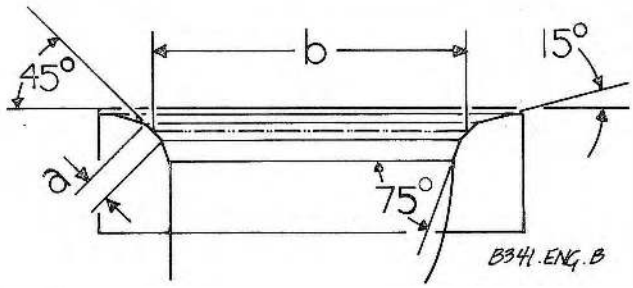
Table j. Valve Guide Specifications (continued)

Specifications	4-cylinder engine	6-cylinder engine
Valve guide bore diameter in cylinder head (tolerance per ISO allowance M7)		
standard		
old version	14.0 mm (.5512 in.)	13.0 mm (.5118 in.)
new version	NA	13.2 mm (.5197 in.)
oversize 1		
old version	14.1 mm (.5551 in.)	13.1 mm (.5157 in.)
new version	NA	13.3 mm (.5236 in.)
oversize 2		
old version	14.2 mm (.5590 in.)	13.2 mm (.5197 in.)
new version	NA	13.4 mm (.5276 in.)
oversize 3	14.3 mm (.5630 in.)	13.3 mm (.5236 in.)
Special tools		
removal	BMW Tool No. 11 1 100	BMW Tool No. 11 1 330
installation	BMW Tool No. 11 1 160	BMW Tool No. 11 1 320
Valve guide installation temperature		
cylinder head	122°F (50°C)	122°F (50°C)
valve guide	−238°F (−150°C)	−238°F (−150°C)
Installed depth (height above cylinder head surface)	15.0 mm (0.5910 in.)	14.5 mm (0.5709 in.)

Valve Seats

The valve seats should be resurfaced whenever new valves or valve guides are installed. Cutters or stones of 15°, 45°, and 75° are required to resurface the seats. **Table k** lists valve seat dimensions. **Table l** lists valve seat replacement specifications, including correct installation temperatures. As with valve guides, replacing the valve seats requires heating the cylinder head, and chilling the valve seat.

Table k. Valve Seat Dimensions



	1984–1987 325, 325e, 325es	1988 325 and all 325i	1984 and 1985 318i
Valve seat width (a)			
intake	1.65 ± 0.35 mm (0.065 ± 0.014 in.)	1.65 ± 0.35 mm (0.065 ± 0.014 in.)	1.3–2.0 mm (0.051–0.079 in.)
exhaust	1.65 ± 0.35 mm (0.065 ± 0.014 in.)	1.65 ± 0.35 mm (0.065 ± 0.014 in.)	1.3–2.0 mm (0.051–0.079 in.)
Valve seat diameter (b)			
intake	38.6 mm (1.520 in.)	40.6 mm (1.598 in.)	44.6 mm (1.756 in.)
exhaust	32.6 mm (1.283 in.)	34.6 mm (1.362 in.)	36.6 mm (1.441 in.)

Table l. Valve Seat Replacement Specifications.

	1984–1987 325, 325e, 325es models	1988 325 and all 325i models	1984 and 1985 318i models
Valve seat insert outside diameter (tolerance as per ISO allowance g6)			
intake			
standard	42.15 mm (1.6594 in.)	43.15 mm (1.6988 in.)	47.15 mm (1.8563 in.)
oversize 0.2 mm	42.35 mm (1.6673 in.)	43.35 mm (1.7067 in.)	47.35 mm (1.8642 in.)
oversize 0.4 mm	42.55 mm (1.6752 in.)	43.55 mm (1.7146 in.)	47.55 mm (1.8720 in.)
exhaust			
standard	37.65 mm (1.4823 in.)	37.65 mm (1.4823 in.)	40.15 mm (1.5807 in.)
oversize 0.2 mm	37.85 mm (1.4902 in.)	37.85 mm (1.4902 in.)	40.35 mm (1.5886 in.)
oversize 0.4 mm	38.05 mm (1.4980 in.)	38.05 mm (1.4980 in.)	40.55 mm (1.5964 in.)
Valve seat bore diameter in cylinder head (tolerance as per ISO allowance H7)			
intake			
standard	42.00 mm (1.6535 in.)	43.00 mm (1.6929 in.)	47.00 mm (1.8504 in.)
oversize 0.2 mm	42.20 mm (1.6614 in.)	43.20 mm (1.7008 in.)	47.20 mm (1.8583 in.)
oversize 0.4 mm	42.40 mm (1.6693 in.)	43.40 mm (1.7086 in.)	47.40 mm (1.8661 in.)
exhaust			
standard	37.50 mm (1.4764 in.)	37.50 mm (1.4764 in.)	40.00 mm (1.5748 in.)
oversize 0.2 mm	37.70 mm (1.4842 in.)	37.70 mm (1.4842 in.)	40.20 mm (1.5827 in.)
oversize 0.4 mm	37.90 mm (1.4921 in.)	37.90 mm (1.4921 in.)	40.40 mm (1.5905 in.)
Installation temperature			
cylinder head	122°F (50°C)	122°F (50°C)	122°F (50°C)
valve seat insert	−238°F (−150°C)	−238°F (−150°C)	−238°F (−150°C)

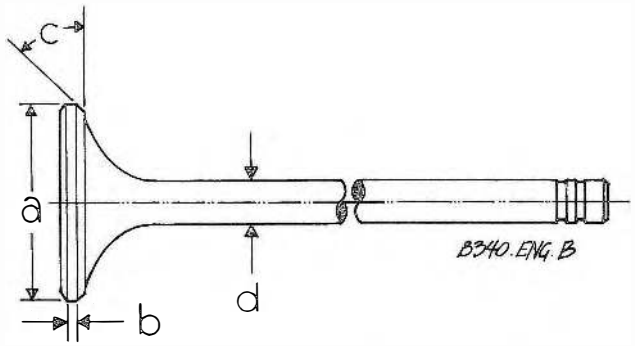
Valves

Valves should be machined using standard valve-grinding techniques. **Table m** lists valve specifications. Remove carbon from the valves using a wire brush or wire wheel.

Testing Valves for Leakage (cylinder head removed)

The valves and their seats can be easily tested for leakage. With the camshaft and the rocker arm assemblies removed, install the valve assemblies and the spark plugs in each cylinder. Place the cylinder head on a workbench with the combustion chamber facing upward. Fill each combustion chamber with water. After fifteen minutes, check the level of the water. If the level of the water in any cylinder drops, that cylinder is not sealing properly.

Table m. Valve Specifications



Specification	1984–1987 325, 325e, 325es	1988 325 and all 325i	1984 and 1985 318i
Valve head diameter (**a**)			
intake	40 mm (1.575 in.)	42 mm (1.654 in.)	46 mm (1.811 in.)
exhaust	34 mm (1.339 in.)	36 mm (1.417 in.)	38 mm (1.496 in.)
Minimum valve head thickness (**b**)			
intake	1.3 mm (0.051 in.)	1.3 mm (0.051 in.)	1.3 mm (0.051 in.)
exhaust	2.0 mm (0.079 in.)	2.0 mm (0.079 in.)	2.0 mm (0.079 in.)
Valve face angle (**c**)	45°	45°	45°
Valve stem diameter (**d**)			
standard	7.0 mm (0.275 in.)	7.0 mm (0.275 in.)	8.0 mm (0.315 in.)
oversize 1	7.1 mm (0.279 in.)	7.1 mm (0.279 in.)	8.1 mm (0.319 in.)
oversize 2	7.2 mm (0.283 in.)	7.2 mm (0.283 in.)	8.2 mm (0.323 in.)

5. Removing and Installing Engine

Before removing the engine it is first necessary to remove the transmission as described in **MANUAL TRANSMISSION AND CLUTCH** or **AUTOMATIC TRANSMISSION**. Remanufactured engines are available from an authorized BMW dealer.

Removing (4-cylinder engines)

The air conditioning compressor and the power steering pump should be unbolted and set aside without disconnecting any of the refrigerant lines or the power steering fluid lines. The hood should be either removed from the car or supported in its fully open position.

To remove:

1. Disconnect the cables at the battery, removing the negative (−) battery cable first. Remove the small bolt holding the wire to the positive (+) battery cable clamp. Cut the wire ties that secure the battery cable harness to the firewall. Disconnect the ground strap from the rear of the cylinder head cover.

> ***CAUTION***
> *BMW anti-theft radios can be damaged by disconnecting the battery cables. See your owner's manual for more information.*

2. Disconnect the hood support from the fitting on the hood. Securely support the hood in its fully open position, use care not to damage the front grille assembly. As an alternative, the hood can be removed from the car.

> **NOTE**
> A special tool (BMW Tool No. 51 2 120) to hold the hood in the fully open position is available from an authorized BMW dealer parts department.

3. Drain the engine coolant and remove the radiator as described in **COOLING SYSTEM**. Disconnect the coolant hoses from the front of the engine. Disconnect the heater hoses from the heater core.

4. Peel back the protective cover from the ignition coil. Remove the high tension wire from the center of the ignition coil. Disconnect and label the two wires from the coil. See Fig. 5-1. Unclip the ignition coil wiring harness from the mounting on the side of the shock tower. Separate the harness connector from the wire leading out of the coil wiring harness.

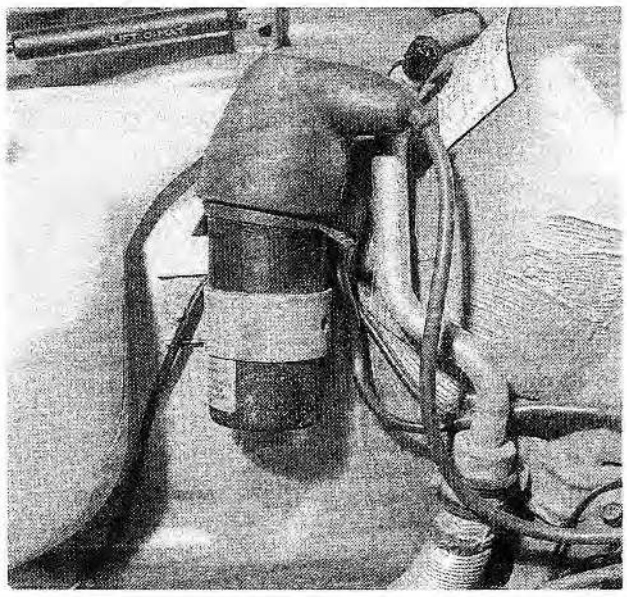


Fig. 5-1. Ignition coil with protective cover.

5. Disconnect the oxygen sensor wire. The connector is clipped to the side of the battery tray.

6. Remove the trim panel from above the glove compartment. Carefully disconnect the harness connectors from the idle speed control unit and the L-Jetronic control unit. Disconnect the white (3-point) harness connector leading out of the L-Jetronic wiring harness. See Fig. 5-2. Working from the engine compartment, pull the idle speed and L-Jetronic control unit wiring harness into the engine compartment.

7. On models with automatic transmission, disconnect the connectors from the temperature switch located in the firewall behind the distributor.

8. Disconnect the harness connector(s) from the ignition control unit. Disconnect the harness connector and the two vacuum hoses from the vacuum advance solenoid. See Fig. 5-3. Cut the wire ties that secure the harness to the firewall.