

# Automotive Engines Theory and Servicing

Ninth Edition

## Automotive Engines

### Theory and Servicing

Ninth Edition

James D. Halderman



## Chapter 26

### Cylinder Head and Valve Guide Service

ALWAYS LEARNING

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## OBJECTIVES (1 OF 2)

**26.1** Explain the design and construction of cylinder heads.

**26.2** Discuss intake and exhaust ports.

**26.3** Discuss cylinder head passages and cylinder head servicing.

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## OBJECTIVES (2 OF 2)

**26.4** Explain aluminum cylinder head straightening, cylinder head resurfacing, and intake manifold alignment.

**26.5** Explain valve guides and the procedure for valve guide replacement.

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## CYLINDER HEADS (1 OF 2)

- Construction
- Design Features
  - Squish area
  - Quench area
  - Spark plug placement
  - Surface-to-volume ratio
  - Valve shrouding
  - Crossflow valve placement

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## CYLINDER HEADS (2 OF 2)

- Combustion Chamber Designs
  - Wedge
  - Pentroof
  - Hemi
- Four-valve Cylinder Heads

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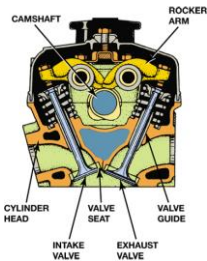
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**FIGURE 26-1** The seats and guides for the valves are in the cylinder head as well as the camshaft and the entire valve train if it is an overhead camshaft design.



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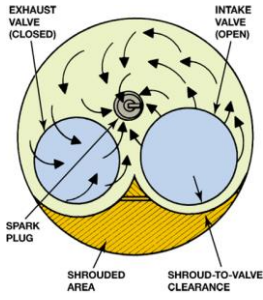
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**FIGURE 26-5** The shrouded area around the intake valve causes the intake mixture to swirl as it enters the combustion chamber.



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## INTAKE AND EXHAUST PORTS (1 OF 2)

- Purpose and Function
  - Allow the free flow of exhaust gases from the engine
- Intake Ports
  - The intake port in a cylinder head designed for use with a carburetor or throttle-body-type fuel injection is relatively long, whereas the exhaust port is short

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## INTAKE AND EXHAUST PORTS (2 OF 2)

- Exhaust Ports
  - The length of the exhaust ports is shorter than the intake ports to help reduce the amount of heat transferred to the coolant

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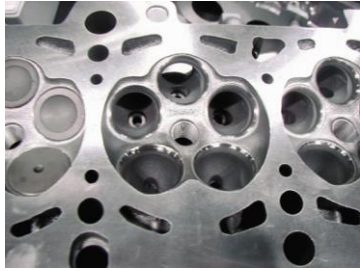
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**FIGURE 26-11** An Audi five-valve cylinder head, which uses three intake valves and two exhaust valves.



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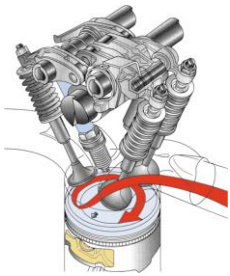
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**FIGURE 26-12** The intake manifold design and combustion chamber design both work together to cause the air-fuel mixture to swirl as it enters the combustion chamber.



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## CYLINDER HEAD PASSAGES

- Coolant Flow Passages
- Head Gasket Holes
- Lubricating Oil Passages



**FIGURE 26-14** A cutaway head showing the coolant passages in green.

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## CYLINDER HEAD SERVICING

- Cylinder Head Servicing Sequence
- Disassembling Overhead Camshaft Head
- Valve Train Disassembly
- Cylinder Head Inspection

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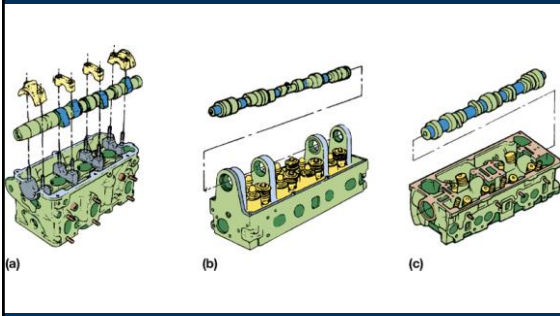
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**FIGURE 26–16** Overhead camshafts may be (a) held in place with bearing caps, (b) supported by towers, or (c) fitted into bearing bores machined directly into the head.



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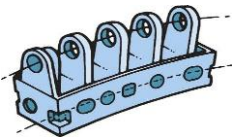
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## ALUMINUM CYLINDER HEAD STRAIGHTENING

- The best approach to restore a warped aluminum cylinder head (especially an overhead camshaft head) is to relieve the stress that has caused the warpage and to straighten the head before machining

**FIGURE 26–21** Warped overhead camshaft cylinder head. If the gasket surface is machined to be flat, the camshaft bearings will still not be in proper alignment. The solution is to straighten the cylinder head or to align bore the cam tunnel.



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## CYLINDER HEAD RESURFACING

- Refinishing Methods
  - Two common resurfacing methods are:
    - Milling or broaching
    - Grinding
- Surface Finish



**FIGURE 26-22** A cast-iron cylinder head being resurfaced using a surface grinder.

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## INTAKE MANIFOLD ALIGNMENT

- The intake manifold surface must be resurfaced to remove enough metal to rematch the ports and bolt holes
- Automotive machine shops that perform head resurfacing have tables that specify the exact amount of metal to be removed

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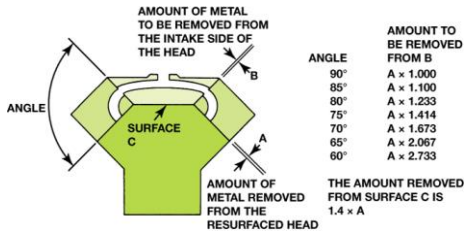
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**FIGURE 26-24** The material that must be removed for a good manifold fit.



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## VALVE GUIDES

- Types
- Valve Stem-to-guide Clearance
- Measuring Valve Guides
- Oversize Stem Valves

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**FIGURE 26-26** An integral valve guide is simply a guide that has been drilled into the cast-iron cylinder head.



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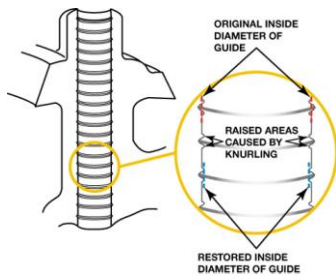
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**FIGURE 26-32** Sectional view of a knurled valve guide.



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## VALVE GUIDE REPLACEMENT (1 OF 2)

- Purpose
  - After the valve guide height is measured, the worn guide is pressed from the head with a proper fitting driver
  - Replacement valve guides can also be installed to repair worn integral guides

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## VALVE GUIDE REPLACEMENT (2 OF 2)

- Valve Guide Sizes
- Valve Guide Inserts
- Spiral Bronze Insert Bushings

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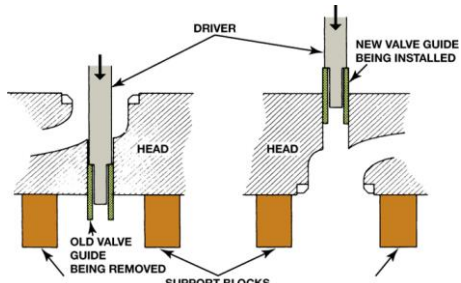
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FIGURE 26-33 Valve guide replacement procedure.



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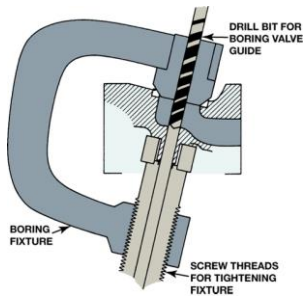
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**FIGURE 26-34** A type of fixture required to bore the valve guide to accept a thin-walled insert sleeve.



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**FIGURE 26-35** Trimming the top of the thin-walled insert.



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**FIGURE 26-36** Installed spiral bronze insert bushing.



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## SUMMARY (1 OF 2)

- The most commonly used combustion chamber types include hemispherical, wedge, and pentroof.
- Coolant and lubricating openings and passages are located throughout most cylinder heads.
- Cylinder head resurfacing machines include grinders and milling machines.

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## SUMMARY (2 OF 2)

- Valve guides should be checked for wear using a ball gauge or a dial indicator.
- Valve guide repair options include use of oversize stem valves, replacement valve guides, valve guide inserts, and knurling of the original valve guide.

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