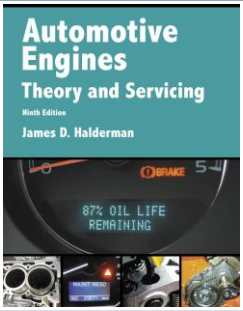
Automotive Engines Theory and Servicing

Ninth Edition



Chapter 29

Pistons, Rings, and Connecting Rods

ALWAYS LEARNING
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OBJECTIVES (1 OF 2)

29.1 Explain the purpose and function of pistons and piston construction.

29.2 Discuss piston pins and piston pin retaining methods.

29.3 Explain piston rings and construction of piston rings.

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OBJECTIVES (2 OF 2)

29.4 Discuss connecting rods and connecting rod service.

29.5 Explain piston and rod assembly and piston ring service.

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PISTONS (1 OF 2)

- All engine power is developed by burning fuel mixed with air in the combustion chamber.
  - Heat from the combustion causes the burned gas to increase in pressure.
  - The force of this pressure is converted into useful work through the piston, connecting rod, and crankshaft.

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PISTONS (2 OF 2)

- Therefore, the piston serves three purposes.
  - Transfers force.
  - Seals the combustion chamber.
  - Conducts heat.
- Parts Involved
- Piston Operation

FIGURE 29–1 The piston seals the bottom of the combustion chamber and is attached to a connecting rod.

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PISTON CONSTRUCTION (1 OF 2)

- Piston Ring Grooves
- Cast Pistons
- Hypereutectic Pistons
- Forged Pistons
- Piston Head Designs
- Slipper Skirt Pistons

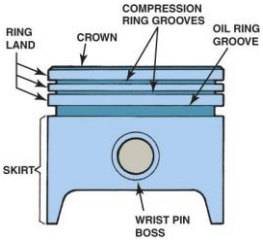

FIGURE 29–2 All pistons share the same parts in common.

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PISTON CONSTRUCTION (2 OF 2)

- Cam Ground Pistons
- Piston Finish
- Piston Head Size
- Piston Strut Inserts

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PISTON PINS (1 OF 2)

- Piston pins are used to attach the piston to the connecting rod.
  - The piston pin transfers the force produced by combustion chamber pressures and piston inertia to the connecting rod.

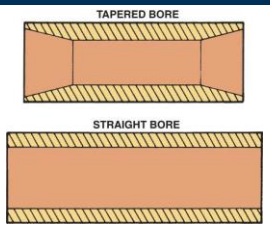

FIGURE 29–11 Most piston pins are hollow to reduce weight and have a straight bore. Some pins have a tapered bore to reinforce the pin.

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PISTON PINS (2 OF 2)

- Piston Pin Offset
  - Minor Thrust
  - Major Thrust
- Piston Pin Fit

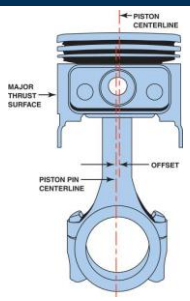

FIGURE 29–12 Piston pin offset toward the major thrust surface.

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PISTON PIN RETAINING METHODS

- Full Floating
  - Full-floating piston pins are free to "float" in the connecting rod and the piston.
- Interference Fit

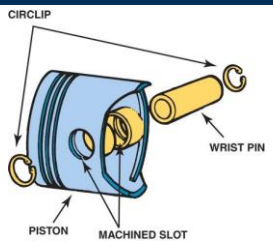

FIGURE 29–14 Circlips hold full-floating piston pins in place.

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PISTON RINGS (1 OF 2)

- Piston rings serve several major functions in engines.
  - They form a sliding combustion chamber seal that prevents the high-pressure combustion gases from leaking past the piston.
  - They keep engine oil from getting into the combustion chamber.

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PISTON RINGS (2 OF 2)

  - The rings transfer some of the piston heat to the cylinder wall, where it is removed from the engine through the cooling system.
- Classifications
- Compression Rings
- Oil Control Rings
- Ring Gap
- Piston Ring Shapes

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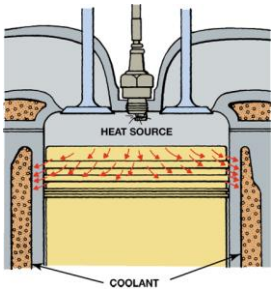
FIGURE 29–16 The rings conduct heat from the piston to the cylinder wall.



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PISTON RING CONSTRUCTION (1 OF 3)

- Piston Ring Materials
  - Plain cast iron
  - Pearlitic cast iron
  - Nodular cast iron
  - Steel
  - Ductile iron

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PISTON RING CONSTRUCTION (2 OF 3)

- Chromium Piston Rings
- Molybdenum Piston Rings
- Moly-chrome-carbide Rings
- Ceramic-coated Rings

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PISTON RING CONSTRUCTION (3 OF 3)

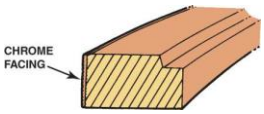

FIGURE 29–25 The chrome facing on this compression ring is about 0.004 in. (0.10 mm) thick.

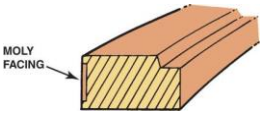

FIGURE 29–26 The moly facing on this compression ring is about 0.005 in. (0.13 mm) thick.

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CONNECTING RODS (1 OF 2)

- The connecting rod transfers the force and reciprocating motion of the piston to the crankshaft.
  - The small end of the connecting rod reciprocates with the piston.
  - The large end rotates with the crankpin.

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CONNECTING RODS (2 OF 2)

- Connecting Rod Design
- Cast Connecting Rods
- Forged Connecting Rods
- Powdered Metal Connecting Rods

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FIGURE 29–28 The I-beam shape is the most common (top connecting rod), but the H-beam shape is common in high-performance and racing engine applications.

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CONNECTING ROD SERVICE

- Removing Pistons From Rods
- Inspection
- Reconditioning Procedure

FIGURE 29–36 A press used to remove the connecting rod from the piston.

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PISTON AND ROD ASSEMBLY

- Interference Fit Rods
- Full-floating Rods

FIGURE 29–41 The small end of the rod is being heated in an electric heater and the piston is positioned properly so the piston pin can be installed as soon as the rod is removed from the heater.

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PISTON RING SERVICE

- Each piston ring, one at a time, should be placed backward in the groove in which it is to be run.
  - STEP 1 Check side clearance
  - STEP 2 Check ring gap
  - STEP 3 Installing the oil control ring
  - STEP 4 Installing the compression rings
  - STEP 5 Double-check everything

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FIGURE 29–42 The side clearance of the piston ring is checked with a feeler gauge.

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SUMMARY (1 OF 3)

- Pistons are cam ground so that when operating temperature is reached, the piston will have expanded enough across the piston pin area to become round.
- Replacement pistons should weigh the same as the original pistons to maintain proper engine balance.

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SUMMARY (2 OF 3)

- Some engines use an offset piston pin to help reduce piston slap when the engine is cold.
- Piston rings usually include two compression rings at the top of the piston and an oil control ring below the compression rings.
- If the ring end gap is excessive, blowby gases can travel past the rings and into the crankcase.

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SUMMARY (3 OF 3)

- Many piston rings are made of coated cast iron to provide proper sealing.
- If the connecting rod is twisted, diagonal wear will be noticed on the piston skirt.
- Powdered metal connecting rods are usually broken at the big end parting line.

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