

## Module 7: Pistons and Connecting Rods

- TERMS AND DEFINITIONS
- FUNCTIONS OF PISTON AND CONNECTING ROD COMPONENTS
- PARTS AND FUNCTIONS OF THE PARTS OF A PISTON
- COMMON PISTON DESIGNS
- TYPES OF PISTON CROWN DESIGNS
- TYPES OF PISTON RINGS AND THEIR FUNCTIONS
- COMMON TYPES OF PISTON RING END GAPS
- PISTON RING DESIGNS
- CONNECTING ROD PARTS AND THEIR DESCRIPTIONS
- COMMON CAUSES OF ABNORMAL PISTON WEAR
- POSSIBLE CAUSES OF HIGH OIL CONSUMPTION AND BLOW-BY

### Terms and Definitions

#### READY FOR REVIEW

- Blow-by is combustion gases that leak past the piston rings into the crankcase and causes oil contamination and leaks.
- Cam-ground is machining the piston slightly oval in shape to allow for uneven expansion; at operating temperatures, the piston becomes perfectly round.
- Match marks are identifying marks on the connecting rod and cap that allow them to be reassembled exactly as manufactured.
- Piston ring end gap is the amount of clearance between the split ends of the piston rings.
- Piston ring lands are the piston area that forms a wall between the ring grooves.
- Piston pin boss is the reinforced area on both sides of the piston that supports the piston pin.

### Functions of Piston and Connecting Rod Components

#### READY FOR REVIEW

- A piston crown moves back and forth in the cylinder to transmit engine force and motion, and converts heat into reciprocating motion.  
**Note:** Piston crown design affects compression ratios.
- A piston (wrist) pin provides the pivot point for the connecting rod and may be floating, bolted, or tapered to fit the bore.
- A piston pin bushing provides a replaceable wear surface for the piston pin.
- A piston pin retainer locks the piston pin in place, preventing it from contacting and damaging the cylinder wall, and can be either spring steel clips or Teflon® end plug.
- Piston rings seal the cylinder above the piston and contain the combustion gases and prevent blow-by.
- A connecting rod joins the piston to the crankshaft and transmits force and motion.
- A connecting rod cap holds the lower half of the bearing shell.

### Parts and Functions of the Parts of a Piston

#### READY FOR REVIEW

- A piston skirt guides the piston inside the cylinder, prevents cocking, and minimizes side wear.
- Oil holes allow oil to escape after the oil control rings wipe it off the cylinder wall.
- Piston ring lands support the piston rings.
- A bowl is a concave area in the crown that forms part of the combustion chamber.
- A piston crown receives the force of combustion.
- Piston ring grooves are machined areas that hold the piston rings.
- A piston pin bore (reinforced boss inside) receives the connecting rod end and piston pin to the form assembly.

### Common Piston Designs

#### READY FOR REVIEW

- Single piece trunk-type design
- Multipiece articulated or cross head design

## Types of Piston Crown Designs

READY FOR REVIEW

- A flat head has recombustion/indirect injection.
- Precombustion/indirect injection has direct injection.
- An irregular head has angled/side-loaded injectors.

## Types of Piston Rings and Their Functions

READY FOR REVIEW

- Top compression ring(s) (top ring)
  - Seals the cylinder above the piston, preventing hot gases from leaking into the crankcase
  - During the power stroke, hot gases flow behind the ring, forcing it against the cylinder wall.
  - Most diesel engines use at least two compression rings, and some use as many as four.
  - The top of the ring is usually identified with a dot or by the word "TOP"
  - Some top and intermediate compression rings have one edge beveled, and the instructions in the ring set will state whether the beveled edge goes up or down.
- Intermediate compression ring(s)
  - Provide a strong secondary gas seal to help contain combustion gases
  - The downward motion of the piston twists the ring in its groove, forcing the sharp ring edge against the cylinder wall.
- Oil control ring(s)
  - Prevent excess oil from flooding the combustion chamber
  - Usually is a multipiece ring, consisting of two scraper rails and an expander/spacer
  - On the downward stroke, the scraper rails remove excess oil from the cylinder walls, returning it to the crankcase, and a thin film is left behind for piston/ring lubrication.
- On the intake stroke, this prevents excess oil from being sucked into the upper cylinder, and on the power stroke, this aids the compression rings in sealing the cylinder.
- The top of the ring is usually identified with a dot or by the word "TOP"
 

**Note:** "TOP" doesn't mean it's the top ring; it just means it's the top side of this ring.

## Common Types of Piston Ring End Gaps

READY FOR REVIEW

- Step
- Angle
- Butt

## Piston Ring Designs

READY FOR REVIEW

- A rectangular ring is a common ring design that distributes sealing pressure along the entire face of the ring and is typically used on a top compression ring.
- A taper-faced ring concentrates sealing pressure along one narrow strip of the ring face, breaks in and seats quickly, and has better oil control than the rectangular ring, but only moderate blow-by control.
- A barrel-faced ring is a quick-seating ring with excellent blow-by control and is commonly used as a top compression ring.
- An inside bevel ring is designed to cock inside the ring groove during the downward stroke in order to concentrate all sealing pressure against a small, sharp edge, which provides an excellent seal and is generally used as an intermediate ring.
- A keystone ring uses tapered sides to improve sealing and minimize sticking and is available in many different face styles (barrel, taper) for specific applications, especially turbocharging.

## Connecting Rod Parts and Their Descriptions

### READY FOR REVIEW

- A piston pin bore (eye) is the little end of the rod that is machined to hold the piston pin bushing.
- A shank is the body of the rod, usually having an I-beam cross-section.
- Bearing inserts are replaceable load-bearing wear surfaces for the crankshaft rod journals.
- Connecting rod cap
  - A connecting rod and cap are forged as one piece, then precision machined and cut.
  - Rod caps are matched to each rod and should not be intermixed.
- Match marks allow the cap to be reinstalled correctly, and if the match marks are reversed, the connecting rod bearing will be destroyed.
- Rod caps may be straight (standard) or angled.
- A crankshaft pin bore (head) is the big end of the rod that is machined to hold the crankshaft bearing insert.
- Bolts are used to hold the connecting rod and cap together.

## Common Causes of Abnormal Piston Wear

### READY FOR REVIEW

- Scoring
  - Grit in the engine oil or fuel
  - Dust from unfiltered intake air
  - Carbon particles from the combustion chamber
  - Insufficient warm-up
  - Inadequate lubrication
  - Inadequate cooling
  - Lugging/overloading
- Corrosion
  - Water leaking into the cylinder
  - Low engine operating temperature
  - Incorrect engine oil
- Acids from condensation/combustion forming in the lubricating oil
- Ignition erosion
  - Timing set incorrectly (advanced/retarded)
  - Detonation damage to the piston crown
- Mechanical damage
  - Piston pin retainers installed incorrectly
  - Rings/lands damaged during piston installation
  - Connecting rod bent
  - Excessive crankshaft end play
  - Cylinder bore centerline not true

## Possible Causes of High Oil Consumption and Blow-By

### READY FOR REVIEW

- Worn rings
- Excess piston to cylinder wall clearance
- Rings installed incorrectly
- Broken rings
- Stuck rings
- Slots in the oil control ring clogged
- Mechanical damage to the piston or cylinder wall
- Worn connecting rod bearings
- Missing/leaking piston pin retainers