

Four-Stroke Engine: Components & Operation

-Student Notes

Directions:

Fill in the blanks.

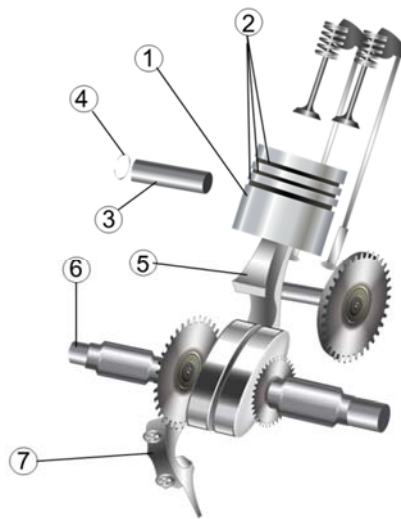
Engine Components Segment

1. Four-Stroke Engines

- Are composed of many components, including:
 - piston
 - _____
 - wrist pin or piston pin
 - connecting rod
 - crankshaft
 - _____
 - lifters
 - valves

2. Four-Stroke Engine

1.
2. Piston Rings
3. Wrist Pin/Piston Pin
4. Wrist Pin/Piston Pin Retaining Clip
5. Connecting Rod
6. Crankshaft
7.

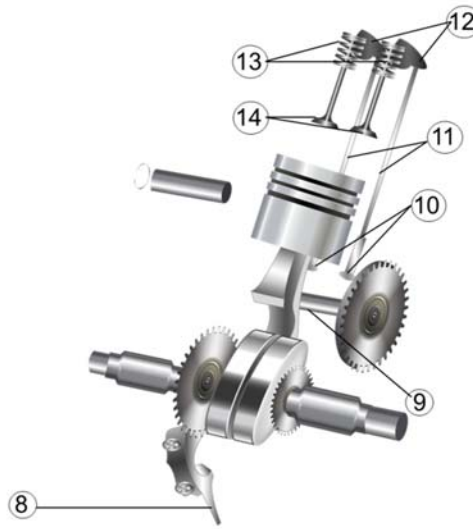


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3. Four-Stroke Engine

- 8.
- 9. Camshaft
- 10. Lifters
- 11. Pushrods
- 12. Rocker Arms
- 13. Valve Springs
- 14.



4. Piston

- Travels within the _____ of the cylinder
- Transfers combustion energy to the _____

Four-Stroke Fact: The cylinder wall and the piston expand at different rates, so enough clearance must be provided between them.

5. Piston Rings

- Are installed on the piston to form a _____ between the piston and the cylinder wall
- Are typically made of high-grade cast iron and steel
- Have the following functions:
 - provide a seal to hold the _____ in
 - retain as much oil as possible in the crankcase
 - transfer heat from the piston to the cylinder walls

6. Piston Rings

- Include three _____ types:
 - compression ring
 - scraper/wiper ring
 - _____ control ring

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7. Compression Ring

- Is installed in the top _____ on the piston
- Provides the seal for the cylinder by expanding out against the cylinder wall
 - the compression pressure will flow in behind the compression ring to increase _____ against the cylinder wall
- Is typically made of cast iron

8. Scraper/Wiper Ring

- Is located between the compression ring and the oil ring
- Is used to further _____ the combustion chamber and wipe the cylinder wall clean of excess _____

9. Oil Control Ring

- Is located in the groove closest to the crankcase
 - toward the bottom
- Wipes excess oil from the cylinder wall and _____ the oil back to the crankcase
 - the oil goes back to the crankcase through _____ machined in the ring and the piston ring groove

10. Wrist Pin/Piston Pin

- Attaches the piston to the upper end of the connecting rod
- Allows the piston to _____ on the end of the connecting rod
 - while the other end of the connecting rod is following the stroke of the crankshaft
- Can be pressed in or held in place by a _____ retaining clip at each end

11. Connecting Rod

- Connects the _____ to the crankshaft
 - the small end is attached to the piston with the wrist pin
 - the large end is usually split across the _____ of its opening to allow for assembly onto the crankshaft

Four-Stroke Fact: The reciprocating movement of the piston in the cylinder is converted to the rotational movement of the crankshaft

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12. Connecting Rod

- Connects the piston to the crankshaft
 - the lower half of the large end is the connecting rod _____ and is bolted to the upper half after placing it around the connecting rod _____ on the crankshaft

Four-Stroke Fact: The connecting rod and its connecting rod cap are manufactured as a unit and must always be kept together.

13. Crankshaft

- Converts the reciprocating movement of the piston into a _____ movement, creating torque which powers the machine the engine is attached to
- Has a mechanical link, usually _____, to the camshaft and mechanical governor

Four-Stroke Fact: The distance from the centerline of the crankshaft to the centerline of the connecting rod journal, multiplied by two, determines the stroke of the engine.

14. Camshaft

- Is at half speed of the crankshaft, usually through direct gear contact
- Will have a _____ to open each intake and exhaust valve
- Determines the timing when _____ open and close in relation to each other

15. Lifters

- Are also known as tappets
- Are located on the camshaft lobes
 - as the camshaft rotates, the lifter follows the profile of the camshaft lobe and moves the _____ up and down to move the rocker arm
- Include two types
 - _____
 - mechanical

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16. Hydraulic Lifters

- Have multiple parts and are usually replaced as a _____
 - through the use of a spring, inner and outer cylinders, and engine oil, the hydraulic lifter will be maintenance free
- Allow for constant _____ between the cam, lifter, pushrod, rocker arm and valve

17. Mechanical Lifters

- Are solid, without moving parts
 - these lifters typically require some _____ regularly as components wear
 - the most common form of adjustment is at the _____
- Are typically made of solid metal

18. Valves

- Are components which allow the air/fuel mixture in and exhaust out
- Are made of heat _____ materials
 - the exhaust valve is usually made from a separate alloy metal
- Include the use of valve seats
 - valve seats are inserted into the _____ for the valves to seal and transfer heat
 - valve seats are grounded to an angle which mates with the valve face, so a tight seal is created when the valve is closed

Engine Cooling Segment

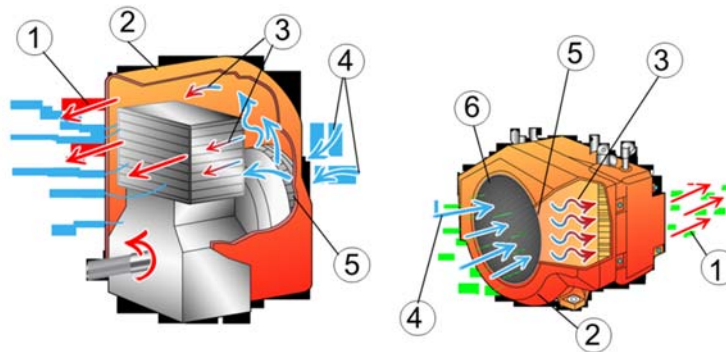
1. Air-Cooled Engines

- Generate heat which is _____ directly into the air
- Rely on the circulation of air to cool hot engine components
 - heat must be _____ from the engine to prevent permanent damage

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2. Air-Cooled Engines



1.
2. Shroud
3. Warm Air
4. Cool Air
5. Flywheel Fins
6.

3. Air

- Is brought in through an air intake screen by fins on the _____ and distributed through a shroud and then across the fins on the cylinder(s)
 - metal fins covering the outside of the cylinders are used to increase the _____ air can act on
 - the air movement across the cooling fin draws away excess heat

Four-Stroke Fact: In all combustion engines, a great percentage of the heat generated escapes though the exhaust.

4. Heat Energy

- May find its way into the oil, which although primarily meant for _____, also plays a role in heat dissipation
 - on an air-cooled engine, the addition of an _____ may greatly help in the dissipation of heat

5. Engine Overheating

- May occur if any part of the air flow is restricted by _____
- May also be caused by one or more of the following:
 - obstructions or blockage of air intake screen
 - obstructions on or in the flywheel fins
 - obstructions or damage to the _____
 - obstructions or damage to the cylinder cooling fins
 - obstructions or damage to the external cooler

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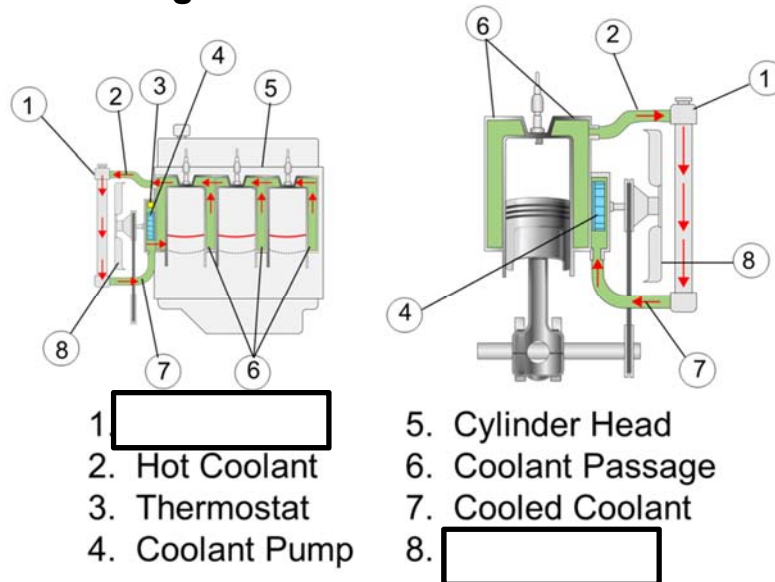
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6. Liquid-Cooled Engines

- Utilize a _____, coolant pump, thermostat, engine coolant passages, and the correct blend of coolant and water to regulate and dissipate _____

Four-Stroke Fact: Coolant, commonly called antifreeze, is a mixture of ethylene or propylene glycol and water.

7. Liquid-Cooled Engine



8. Liquid-Cooled Engines

- Operate in the following manner:
 - coolant is circulated from the coolant pump to the cylinders, engine block, cylinder head, valves and _____ chambers through a series of coolant passages
 - coolant exiting the engine flows through the thermostat housing
 - _____ flows through a check valve opening in the thermostat, enabling a fast warm-up period
 - the check valve also acts as a vent to allow air to escape while filling the cooling system
 - before engine warm-up, the thermostat is closed

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9. Liquid-Cooled Engines

- Operate in the following manner:
 - once the engine has reached full operating temperature, the thermostat will completely open, allowing maximum _____ through the upper radiator hose to the radiator top tank
 - coolant circulates through the radiator, dissipates heat and flows out the lower radiator _____ back to the coolant pump

10. Excessive Temperatures

- Will trigger the pressure cap to open to allow excess coolant to flow into the _____
 - when the coolant temperature drops, the pressure cap will close
 - as the coolant continues to cool, a vacuum will form in the radiator, opening a valve in the _____, allowing coolant to be siphoned from the expansion tank back into the radiator

11. Engine Coolant

- Will continue _____ throughout the system until the coolant temperature drops below the thermostat _____ rating, at which the thermostat begins to close and the sequence starts again
- Allows the engine to operate at an optimal temperature, facilitating clean, efficient operation

12. Engine Overheating

- May be caused by one or more of the following:
 - improper mixture of water and coolant/antifreeze
 - improper level of coolant
 - improper fan belt tension
 - internally _____
 - externally clogged cooling fins on radiator
 - thermostat opening slowly or not at all
 - collapsed hoses
 - faulty _____
 - blockage of water flow in the block or cylinder head

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Engine Oil & Lubrication Systems

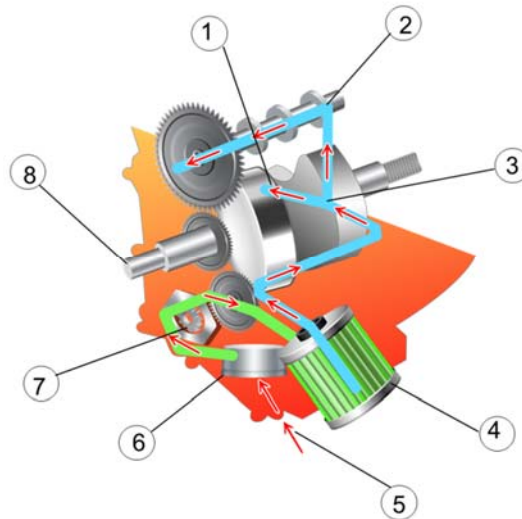
1. Pressure-Lubricated Engines

- Typically utilize a wet sump _____ system in which the oil pump is driven by the _____

Four-Stroke Fact: Most systems include a pressure regulation system which maintains a working pressure.

2. Pressure Lubrication System

1.
2. Camshaft Oil Passage
3. Main Bearing Oil Passage
4. Oil Filter
5. Oil from Sump
6. Pickup Strainer
7. Oil Pump
8.



3. Pressure-Lubricated Engines

- Operate in the following manner:
 - the rotation of the oil pump draws oil from the sump through the pickup _____
 - the sump is the lowest part of the engine
 - the oil is pumped into passages in the engine block, which route the oil to the components requiring _____
 - oil is routed to bearings, bushings, hydraulic lifters and rotating crankshaft assembly

4. Oil Pressure Switch

- Is situated in an engine block oil passage
- Alerts the operator of a _____ situation
 - the engine oil continues to a full-flow oil filter equipped with a bypass valve
 - if oil flow through the filter becomes _____, the bypass valve opens to allow engine oil to continue to circulate through the engine

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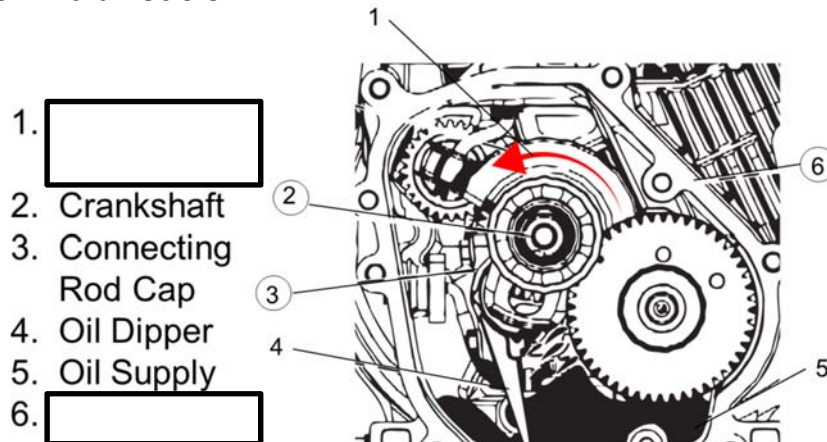
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5. Splash Lubrication System

- Uses an _____, attached to the connecting _____ in a horizontal-crankshaft engine

Four-Stroke Fact: In a vertical-crankshaft model, the oil dipper will be attached to a crankshaft counterweight, or it will be a separate component driven by the cam gear.

6. Splash Lubrication



7. Splash Lubrication System

- Operates in the following manner:
 - with each _____ of the crankshaft, the oil dipper reaches into the engine's oil supply like a small cup at the bottom of the crankcase, throwing _____ onto the internal engine parts

8. Engine Oil

- Is used in the lubrication system to perform the following _____ basic functions:
 - lubrication
 - sealing
 - _____
 - cleaning

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9. Choosing the Correct Oil

- Requires technicians to know how lubricating oils are rated
 - the oil should meet the manufacturer's _____ recommendations and performance

Viscosity- resistance to flow

Four-Stroke Fact: By law, a manufacturer cannot require users to run their oil. The manufacturer can only specify the specific oil quantity and grade.

10. Choosing the Correct Oil

- Can be accomplished with the help of the American _____ Institute (API) and Society of _____ Engineers (SAE) standards

11. API & SAE

- Are voluntary collaborations of the automotive and oil industries to ensure certain standards
- Place a symbol on oil containers which gives _____ consistent standards of information among oil brands and formulations
 - a container of engine oil bearing the API and SAE _____ conforms to the standards and specifications of each

12. API & SAE Symbols

- Contain information about the following:
 - _____ grade
 - oil performance classification
 - energy _____ rating

13. Oil Ratings

- Include API ratings which are expressed as C for compression ignition and S for _____
 - also includes codes which indicate the use of the oil in a certain engine
- Include SAE ratings to ensure the standards of the oil's viscosity
 - a _____ oil is commonly recommended

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14. Crankcase Breather System

- Is required to maintain a net-negative _____ in the crankcase
 - a net-negative (vacuum) is necessary to control oil consumption and manage crankcase vapor for _____ concerns

Four-Stroke Fact: Modern engines incorporate a closed crankcase breather system.