

Unit D: Agricultural Equipment Systems

Lesson 1: Understanding Applications of Fluids and Lubricants in Agricultural Equipment

Terms

- Ash content
- bottom dead center
- cloud point
- compression ratio
- coolant
- dispersants
- E-10 blend
- E-85 blend
- flash point
- multi-grade
- multi-viscosity
- octane rating
- oxidative stability
- pour point
- top dead center
- thermostat
- viscosity
- volatility

Identify the fuels that are used in agricultural equipment & their characteristics.

- What are the fuels used in agricultural equipment and their characteristics?

Fuels Used

- Gasoline
- Diesel
- LP-gas



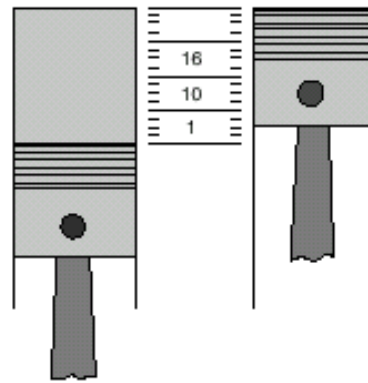
Gasoline

- Used in spark ignition engines
- Fuel and air taken in cylinder as a mixture, compressed, and ignited by the spark plug
- Compression ratio
 - 8 to 1
 - 9 to 1

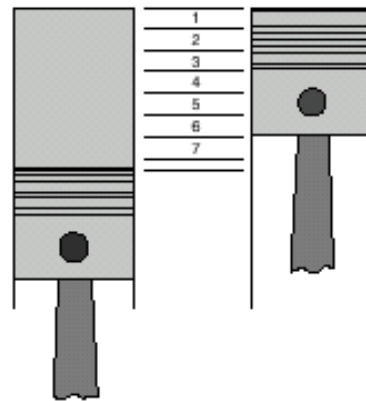
Terms

- ***Compression ratio***
 - relation between the total volume inside the cylinder when the piston is at bottom dead center compared to when it is at top dead center
- ***Bottom dead center***
 - when the piston is at its greatest distance from the cylinder head
- ***Top dead center***
 - piston is closest to the cylinder head

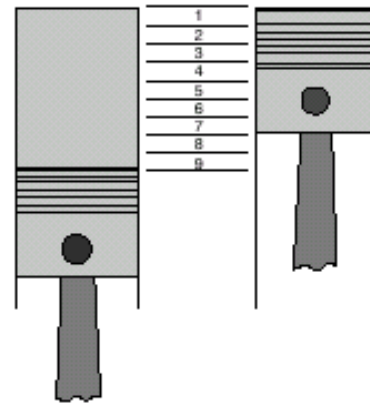
COMPRESSION RATIOS



RATIO 16 TO 1
(Diesel Engine)



RATIO 8.5 TO 1
(Gasoline Engine)



RATIO 9 TO 1
(LP-Gas Engine)

(Courtesy, Interstate Publishers, Inc.)

Diesel

- No spark to start the fuel burning
- air is compressed until it is so hot that fuel will burn spontaneously
- compression rate
 - average = 16 to 1
 - low = 14 to 1
 - high = 20 to 1

LP

- Cannot be used through a regular gasoline tank or carburetor
- stored and handled in high pressure containers to keep in liquid form
- use the vapor in top of the tank for easy starting because already vaporized
- compression rate
 - 8 to 1

Ethanol

- Product of fermentation
- derived energy from sugar
- ***E-10 fuel***
 - one unit of ethanol mixed with nine units of gasoline
- ***E-85 fuel***
 - gasoline containing 85% ethanol

Biodiesel

- Biodegradable, non-toxic and greatly reduces engine emissions
- can be used as 100% replacement for diesel
- can be easily mixed with conventional diesel
- ***flash point***
 - temperature which fuel will ignite when exposed to an open flame

Describe the selection & storage of fuels used in agricultural equipment.

- How is fuel for agricultural equipment selected and stored?

Principle qualities for a fuel

- Engines are designed to operate on regular grade gasoline
- ***octane rating***
 - method of comparing anti-knock qualities of fuels used in spark ignition engines
- names premium, regular, low grade used
- premium gasoline can be used but no major benefits

Qualities of fuel

- ***Volatility***
 - tendency to change from a liquid to vapor or evaporate
 - most important in starting and performance
- volatility is low - insufficient vapor = poor starting
- volatility is high - cause the carburetor vapor lock

Quality of fuel

- ***Oxidative stability***
 - tendency of gasoline to form gum in storage
- most gasoline is stabilized by antioxidants
- freedom from dirt and moisture depends on handling & storing
- additives added to raise octane number, reduce spark plug fouling, gum formation, rust, and deposits in intake system

Quality of fuel

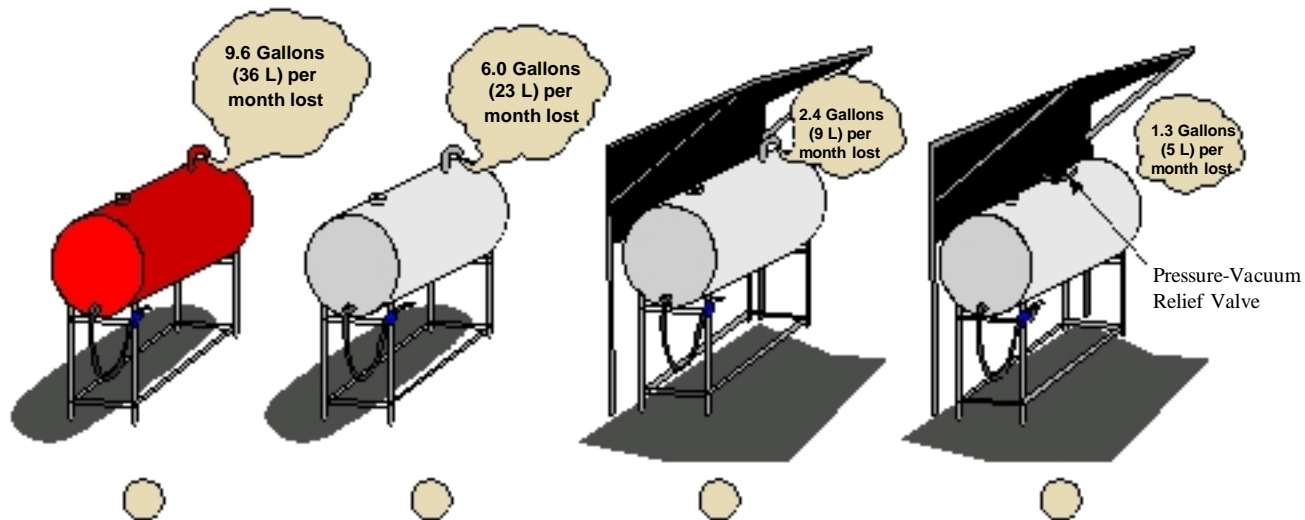
- ***Pour point***
 - diesel must be able to flow at the lowest expected temperature, when ceases to flow is known
- ***Cloud point***
 - diesel becomes cloudy and forms wax crystals at temperatures above pour point, temperature which clouding begins

Quality of fuel

- Injection pumps perform most effectively when fuel has proper viscosity
- ***viscosity***
 - measure of resistance of a fluid to flow

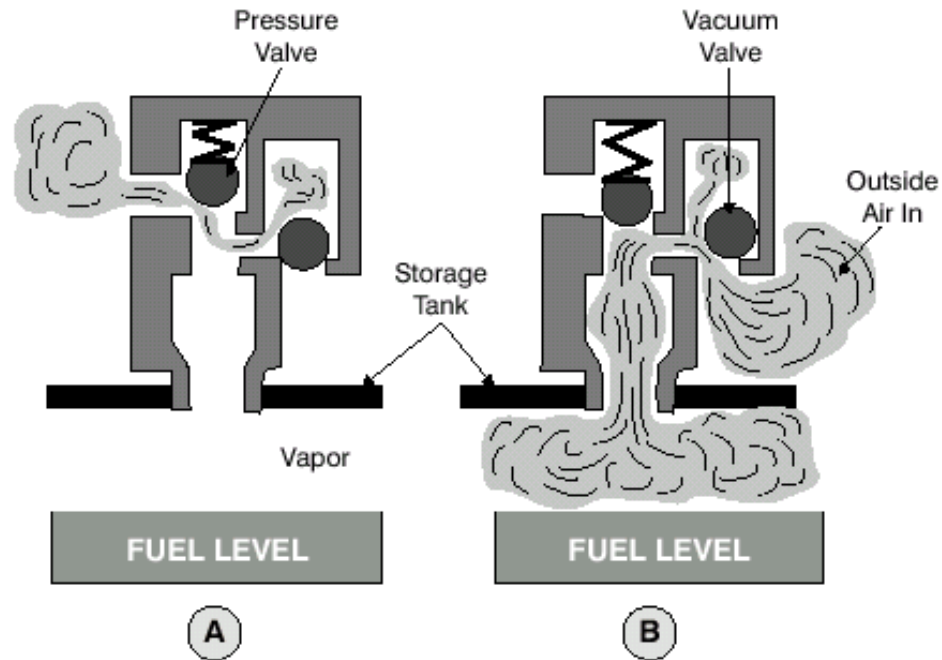
Storing of fuels

- Evaporation losses are sizable from above-ground tanks unless shade is provided
- evaporation losses can be reduced further by use of pressure-vacuum release vent



- A — Red Tank Exposed to Sun's Heat
- B — White or Aluminum Tank Exposed to Sun's Heat
- C — White Tank Protected by a Shade
- D — White Shaded Tank Equipped with a Pressure-Vacuum Relief Valve

CONTROLLING EVAPORATIVE LOSSES



When tank pressure rises above 3 psi (21 kPa), ball on pressure valve rises and allows enough gasoline vapor to escape to keep pressure at 3 Psi.

When storage tank cools or fuel is withdrawn, vacuum may develop, causing outside air to force past vacuum valve and enter tank. This keeps pressure inside tank near that on outside.

(Courtesy, Interstate Publishers, Inc.)

Storing fuels

- Gasoline will oxidize & form gum deposits if stored for a long period of time
- refiners add inhibitors that will protect fuel for 6 to 12 months in normal storage
- time is greatly reduced is exposed to sunlight and high temperatures

Storing diesel

- Keeping free of dirt and water is very important
- fuel injection system is fitted with parts held within millionths of an inch clearance
- dirt particles can ruin the parts and cause expensive repairs
- water can cause corrosion that ruins highly polished surfaces of the injectors

Ways to prevent dirt from entering diesel fuel system

- Do not use open container to transfer fuel
- Do not store diesel in galvanized tank
- Do not use a tank formerly used for gasoline
- Do not let suction pipe extend to bottom of tank
- Always drain the storage tank before refilling
- Keep storage tank shaded from direct sunlight

Identify the lubricants used in agricultural equipment and their characteristics.

- What are the lubricants used in agricultural equipment and what are their characteristics?



Engine oils

- Several functions
- keep a protective film on moving parts to resist corrosion and rusting
- reduces friction and wear caused by metal to metal contact of moving parts
 - must maintain enough viscosity or thickness to provide a cushion between the moving parts under all temperatures

Engine Oils

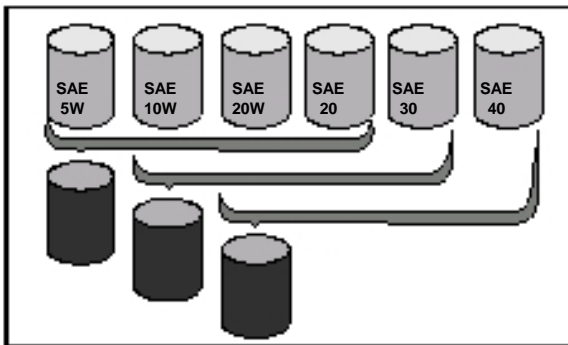
- Responsible for cooling moving parts
 - piston cooling by direct transfer through oil film to cylinder wall and on to the cooling system
- Keeps parts clean
 - prevent formation of contaminants that are not burned up

Oil viscosity

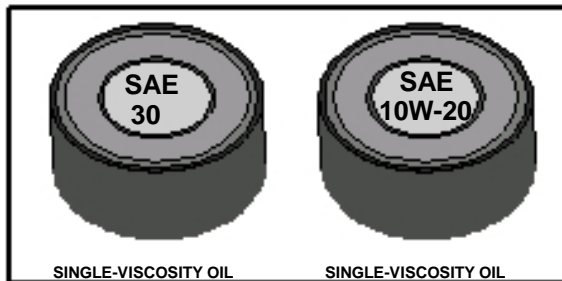
- Measure of the fluidity of fluidity of oil at a given temperature
- become more fluid as temperatures increase and less fluid as temperatures decrease
- lighter oils are intended for winter use
- all oils are tested under cold conditions

Engine oils

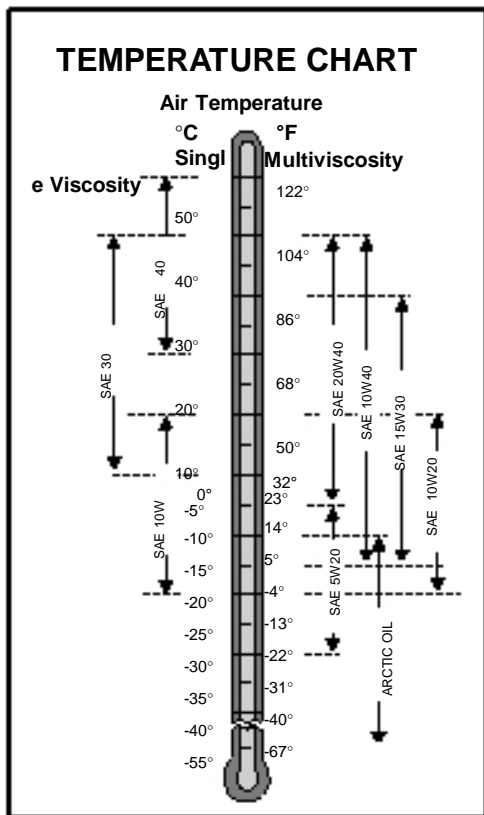
- ***Multi-grade or multi-viscosity***
 - oils are compounded to behave as light oils in cold temperature and as heavier oils at high temperatures



A multiviscosity oil can replace several single-viscosity oils (when recommended).



Oil viscosity is marked on oil containers.

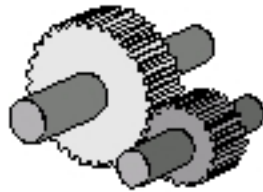


Gear oils

- Used in enclosed gear boxes to lubricate mechanical transmissions, differentials, and steering gears

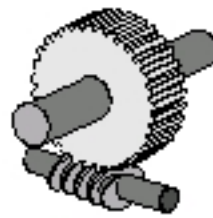
Automatic transmissions, torque converters, & hydraulic systems

- Protect heavily-loaded spiral gears with an oil film
- Performing as a non-foaming fluid
- operating as a hydraulic fluid between -30 and 300 degrees F.
- act as a wet clutch and transmission
- resist oxidation under heat & aeration



GEARS

Lower gear loads and less rubbing. Standard gears oils are often adequate.



WORM GEARS

Higher gear loads and more rubbing. Special gear oils are often needed.

AXLE AND MANUAL TRANSMISSION LUBRICANT VISCOSITY CLASSIFICATION			
SAE Viscosity Grade	Maximum Temperature for Viscosity of 150 000 cP. °C	Viscosity at 100°C	
		Minimum	Maximum
75W	-40	4.1	—
80W	-26	7.0	—
85W	-12	11.0	—
90	—	13.5	<24.0
140	—	24.0	<41.0
250	—	41.0	—

ENGINE OIL SAE VISCOSITY NUMBERS

SAE 5w	
SAE 10w	
SAE 20w	
SAE 20	
SAE 30	
SAE 40	
SAE 50	

GEAR OIL SAE VISCOSITY NUMBERS

SAE 75w	
SAE 80w	
SAE 90	
SAE 140	

To avoid confusion, higher SAE viscosity numbers are assigned to gear oils.

Lubricating grease

- Blend of lubricating oil and soap and stabilizers and additives
- calcium soap is used for pressure gun & chassis grease
- sodium soap is used for wheel bearing grease
- lithium soap used in multi-purpose grease

Describe the selection and storage of lubricants for agricultural equipment.

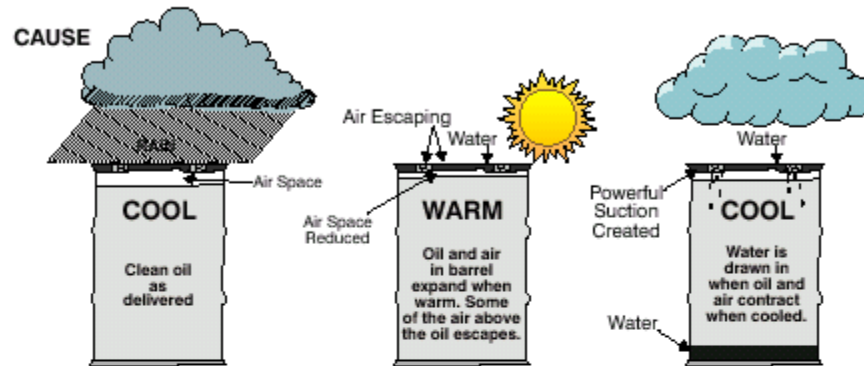
- How are lubricants selected and stored for agricultural equipment?

- Prevent early mechanical failure through proper care of air filter, oil filler breather cap, crankcase ventilator, regular and frequent oil and oil filter changes

Selecting lubricants

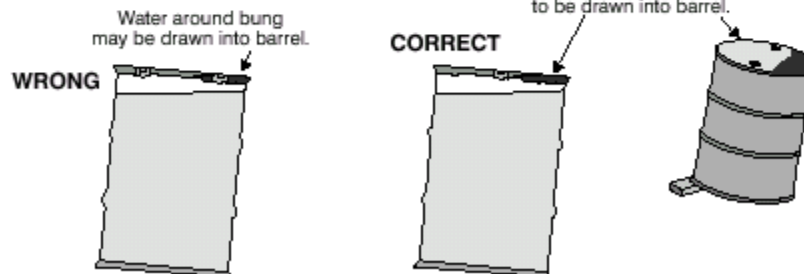
- Adding or changing oil, be sure the correct classification
- store lubricants in a clean, closed cabinets, keep containers covered and closed
- rinse oil containers and funnels in fuel after use
- wipe around filler cap when removing cap

STORING LUBRICANTS



PREVENTION

1. Keep bungs drawn tight.
Use wooden mallet to make sure.
2. Store barrels inside whenever possible.
3. If stored outside, lay barrels on their sides.
4. If barrels cannot be laid on their sides, tilt them slightly as shown below.



(Courtesy, Interstate Publishers, Inc.)

Hydraulic Oil

- Selection of proper oil is requirement for satisfactory performance and life
- check for recommendations in operator's manual
- use same care and precautions in storage and handling as engine oils

Lubricating grease

- Keep grease containers in a dust-free place
- wipe off the grease gun before filling it
- fill the grease gun without exposing to dirt
- always wipe off grease fittings before applying grease
- grease at the end of day when machine is warm

Identify the coolants that are used in agricultural equipment and their characteristics.

- What are the coolants used in agricultural equipment and their characteristics?

Cooling System

- Liquid cooling system is most common method used to get rid of heat
- $\frac{1}{3}$ of heat created turns the crankshaft
- $\frac{1}{3}$ is lost through the exhaust system
- $\frac{1}{3}$ removed by the cooling system
- failure to remove heat causes engine damage due to heat build up

2 basic methods

- Air can be forced through the engine by baffles, ducts, and blowers
- liquid can be circulated through the engine to carry away heat from engine components to a heat exchanger

Parts of the liquid cooling system

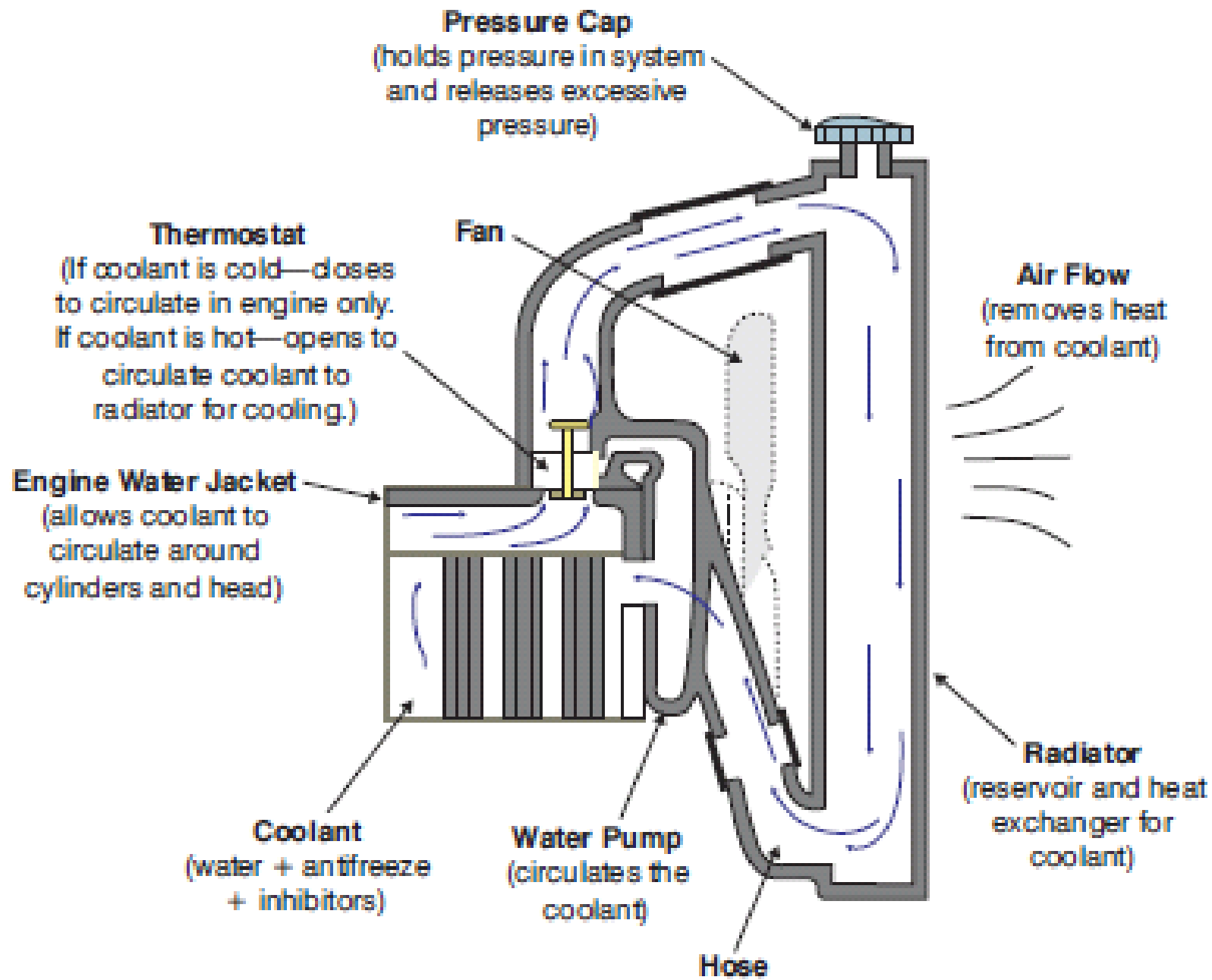
- Radiator
 - heat is released to atmosphere
 - provide reservoir for liquid to operate
- fan
 - forces cooling air through the radiator to dissipate the heat
- water pump
 - circulates the coolant through the system

Parts of the cooling system

- Distribution tubes and transfer holes
 - directs extra coolant to extra hot spots
- fan belt
 - transmits power from crankshaft to fan and pump
- connecting hoses
 - flexible connections between the engine and other parts

Parts of the cooling system

- ***Thermostat***
 - a heat operated valve that controls the flow of coolant to radiator to maintain correct operating temperatures
 - coolant is cold, thermostat closed to circulate coolant in engine for faster warm up
 - coolant warms up, thermostat opens to circulate coolant through radiator for normal cooling



Coolant

- Liquid that circulates through cooling system carrying heat from the engine to radiator
- water is not a good universal solvent but is a necessary ingredient in the cooling system
- contains salts, acids, and minerals
- unstable heat dissipating substance

Antifreeze

- Used when freezing temperatures are expected
- if freezes, it expands thus cracking engine block, head, and radiator

Requirements

- Prevent freezing at lowest expected temperature
- inhibit rust and corrosion of system
- chemically stable
- prevent electrolytic corrosion
- flow readily
- conduct heat readily
- resist foaming

Types of Anti-freeze

- Ethylene glycol
 - widely used in modern pressurized systems because high boiling point
- propylene glycol
 - give less protection against freezing at lower concentrations and higher protection at higher concentrations
- glycol ether
 - higher in price and odor

Describe the maintenance of fuel, lubricant, and cooling systems in agricultural equipment.

- How are fuel, lubricant, and coolant systems for agricultural equipment maintained?

Maintenance

- Follow the manufacturer's recommendations found in operators manual when performing maintenance

Fuel System

- Achieve maximum fuel economy and horsepower, periodic service must be performed
 - carburetor not adjusted correctly, fuel consumption can be excessive or power can be lost
 - strainer should be cleaned regularly
 - fuel filters changed at regular intervals

Diesel Fuel System

- Servicing injection pump and injector nozzles require special tools and equipment
- other components on low pressure side, fuel filters, sediment bowl, and tank should be carefully monitored
- fuel is drained, be sure to bleed air from lines

Lubricating system

- Serviced regularly to prevent premature wear and equipment damage
- consist of checking oil levels daily and changing oil and filters at regularly intervals
 - oil contamination reduces engine life more than any other factor
 - oil loses its lubricating qualities as it gets dirty and additive wear out

Cooling system

- Anything that slows down the movement of heat from the cylinders causes the engine to overheat
- regular maintenance
- repair leaks
- leakage into crankcase can dilute oil
- corrosion occurs

Corrosion in cooling system

- Chemical
 - direct chemical reaction reaction between coolant and metal parts
- Electrolytic
 - reaction between 2 different metals joined together, in contact with a solution which conducts electricity
- Erosive
 - mechanical abrasion from particles within system

Review

- What are the fuels used in agricultural equipment and their characteristics?
- How is fuel for agricultural equipment selected and stored?
- What are the lubricants used in agricultural equipment and what are their characteristics?

Review

- How are lubricants selected and stored for agricultural equipment?
- What are the coolants used in agricultural equipment and their characteristics?
- How are fuel, lubricant, and coolant systems for agricultural equipment maintained?