A EN 201 – Agricultural Power Units
Engine Lubrication Systems

Objectives:
The Student Will Be Able To:
1. Obtain a score of 75% or greater on a quiz focusing on Chapter 9, in John Deere's Engines: FOS;
2. List the two common types of lubrication systems and describe how each works;
3. Identify, compare and contrast the sources of lubricants;
4. List the functions of lubricants;
5. Describe the basic lubrication principles;
6. Describe, compare/contrast, and utilize SAE and API ratings; and
7. Describe the basic function of PCV valves.

Required Reading For Quiz:
1. Chapter 9, Engines, Fundamentals of Service; John Deere

I. Introduction:
The internal combustion engine would be unable to operate if it were not for some sort of lubricating material and corresponding system for providing lubricants. Lubricating systems are challenged with providing an engine with an ample source of lubricant, which is free of abrasives and other harmful materials. It is the operator's responsibility to provide the lubricating system with engine oil that is of the appropriate quality and viscosity.

This laboratory and required reading will introduce students to lubrication system basics, lubrication principles, as well as technical information concerning the grading characteristics which lubricants are required to uphold. The lab will consist of a required reading quiz, brief lecture, and finally, a viscosity experiment. The following pages consist of Power Point notes and lab sheets.

Required Materials:
- Eye Protection
- Red Rags
- Calculator
- Lab Manual

Functions:

The oil in the crankcase serves five functions. **Oil:**

1. Helps cool the engine by removing heat from the cylinder and moving parts.
2. Cleans by removing particles from the cylinder and moving parts;
3. Seals the rings to the cylinder wall;
4. Reduces friction by serving as a slippery film between all moving parts; and
5. Protects machined parts from rust and corrosion.

Oil Circulation:

The oil can be circulated throughout the engine by several methods. Some engines use a dipper attached to the connecting rod, (Figure, 1.1), which dips into the oil as the connecting rod moves. The oil is splashed so that all points within the block are constantly sprayed with oil.

An oil slinger,(Figure, 1.2), is used on some engines and is driven by the camshaft. As the slinger rotates, the "ears" on the slinger throw oil throughout the inside of the engine.

Various styles of oil pumps have been used in the lubrication systems of small engines. The pump is normally submersed in oil and directs oil to the connecting rod and main bearings by tubes or orifices in the discharge tube. The other parts of the engine are lubricated by the oil which is "thrown off" of the connecting rod and crankshaft. A "barrel type" oil pump is shown in Figure, 1.3.

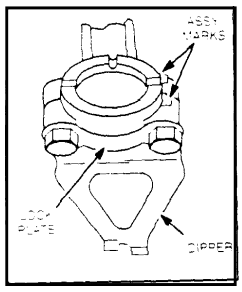

Fig. 1.1, Oil Dipper
Courtesy of Briggs & Stratton Corp.

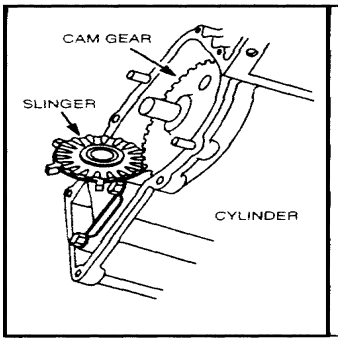

Fig. 1.2, Oil Slinger
Courtesy of Briggs & Stratton Corp.

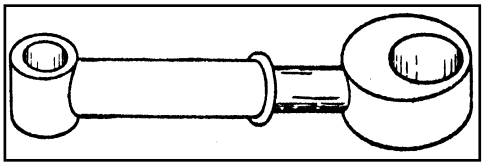

Fig. 1.3, Barrel Type Oil Pump
Courtesy of Briggs & Stratton Corp.

Oil & The Oil Change:

The oil level should be checked before starting the engine and after every 5 or 6 hours of operation. The oil level should be maintained to the full mark as recommended by the engine manufacture. When checking or adding oil, care should be taken to prevent any dust or dirt from entering the engine. The engine oil should be changed when it is warm so that all the oil will drain from the engine with ease. Change the oil at least every 25 hours of engine operation or seasonally if used less than 25 hours.

Selecting Oil for Your Engine:

When selecting oil for an engine there are three very important considerations. They are:

1. Air Temperature the engine will operate in;
2. SAE (Society of Automotive Engineers) Viscosity Grade; and
3. API (American Petroleum Institute) Engine Service Classification.

Air Temperature & SAE Viscosity Grade:

Because oil's ability to flow changes with changing temperatures, they are graded according to that ability, or their Viscosity. Oil is graded by testing it's viscosity at two standard temperatures, which are 0^{o} Fahrenheit and 210^{o} Fahrenheit. Zero degrees will designate a winter grade and 210^{o} a summer grade. Oils receive a winter or a summer grade according to their ability to flow at either of the above temperatures.

An oil's winter grade will be designated by a number, and a lower case "w", such as 5w, 10w, or 20w ("w" standing for winter). These oils will receive one of these grades if they flow properly at 0^{o} F.

Oils that meet flow specifications at 210^{o} F will receive a two digit designation such as 10, 20, or 30. So, in other words, some oils work better in cold weather, while others may work better in hot weather.

This causes a dilemma! What if we lived in an area, (let's say Texas!), where temperatures in the winter could drop below freezing and temperatures in the summer were commonly over 100^{o} F. A single grade oil would not be sufficient for year round use! Would you change oil grades with the changing seasons? You could, if you used the engine year round, but it would be very inconvenient and costly to constantly switch. This is why Multi-Viscosity oils, such as 10w 30, were developed. But were multi-viscosity oils developed mainly for small gas engines? No, small gas engines can usually rely on a single viscosity oil because they are seasonal. For Example: If old Jim Bob in Boston uses an SAE 10w motor oil in his snow blower during January, he doesn't need to be concerned with changing to a high temperature oil for the summer, because there shouldn't be any use for a snow blower in July! The same principle applies with lawn equipment in Texas. However, there are situations in which a small engine will require a Multi-Viscosity oil. Many small engines are not seasonal, such as generators. In such cases the use of Multi-Viscosity oils are very valuable.

Multi-Viscosity oils were primarily developed for year-round engine use, such as in the engine of a car or truck. This is simply a convenience that allows us to use the same grade oil year round. These oils are a mixture or blend of different oils and certain additives that allow

the oil to meet SAE flow requirements at *both* 0° F and 210° F. Thus, a "smart oil" that knows what the temperature is, and changes accordingly!

It is recommended that the small engines in our lab use an SAE 30 motor oil in temperatures above 40° F and an SAE 10w 30 if the engine operates in temperatures that may reach 0° F and above.

Figure 1.4 gives temperature ranges and their oil recommendations:

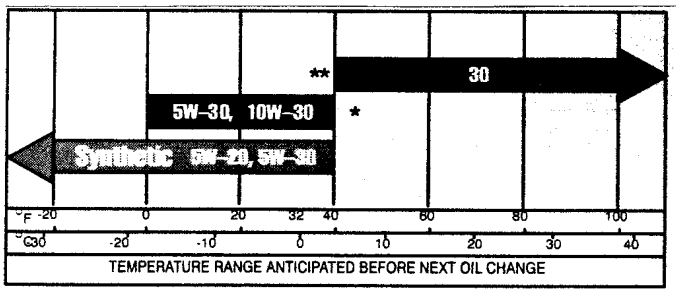

Fig. 1.4, SAE grades relative to temperature
Courtesy of Briggs & Stratton Corp.

API Engine Service Classification

The API system is an attempt to set a consistent standard of oil quality between engine manufactures, petroleum producers, and the consumer. Figure 1.5 is an example of an API engine service classification symbol.

Fig. 1.5, Engine Service Classification Symbol
Courtesy of Briggs & Stratton Corp.

The API rating consists of two digits. The first digit designates the type of ignition system the oil may be used with, of which there are only two; (S)park Ignition and (C)ompression Ignition (diesel engines). The second digit for both ignition types indicates the severity of service the individual oil may withstand, and is designated by a letter of the alphabet beginning with "A" as the first and oldest classification. The most current rating for Spark Ignition engines is **SH**, while the most current rating for Compression Ignition engines is **CF-4**. A more current sub-rating system for Spark Ignition engines has recently been developed. This system was created for oils that have the ability to promote fuel economy and are known as (E)nergy Conserving. The API Engine Oil Service Classifications are as follows:

(S)park Ignition		**(C)ompression Ignition**
	Least Severe Service	
SA		CA
SB		CB
SC		CC
SD		CD
SE		CE
SF		CF-4
SG		CG-4
SH		CH-4
SJ		
	Most Severe Service	

(E)nergy Conserving

EC
EC II

So, when considering oil for an engine, the following should be considered:

1. Air Temperature the engine operates in;
2. SAE Viscosity Grade required; and
3. API Engine Service Classification required.

*In lab, our Briggs & Stratton engines require an SAE 30 grade motor oil with a minimum API rating of SE.

***Detergent & Non-Detergent Oils**:*

Detergent oils are recommended for almost all engines because of their ability to keep the engine cleaner and retard the formation of gum and varnish deposits. Non-Detergent oils do not possess this ability.

Synthetics & Additives**: **You make the call!

The following excerpt from Kohler Engines will shed some light on the controversy surrounding synthetics oils and oil additives.

"Synthetic Oils, Oil Additives

Service Bulletin 193 contains our recommendations for lubricating oil and fuel, but it does not specifically address the use of synthetic oil or oil additives. The following information is presented to clarify the position of Kohler Co. and help you answer any questions from customers or end users.

Synthetic Oils

Synthetic oils were originally developed for use in gas turbine engines. In most cases they are capable of maintaining their viscosity for longer periods of use and under much greater temperatures and pressures than petroleum products. Common synthetics used for engine lubrication are *olefin oligomers* (like Mobil 1) and *dibasic acid* (like Amsoil). They are fully compatible with conventional oils and can be mixed, provided their ratings match. In fact, some products on the market are a blend of synthetic and mineral oil. Synthetics and synthetic blends offer a wider range of protection than standard petroleum products. However, this extended protection usually reaches into an area of temperature and pressure beyond what actually

occurs in gasoline engines. In other words, if you use them, you are buying "overkill protection, it's not going to hurt anything ; it's just unnecessary. So, in most cases the decision to use synthetics becomes economic. Can you justify three times the cost for overkill protection? Perhaps, if you're a commercial cutter in Texas or Florida; if you are a homeowner, synthetic oil is probably a waste of money.

Oil Additives

There are a variety of oil additives available on the market. Some of them claim to coat the moving parts to reduce wear and friction. Others claim to remove sludge, varnish, carbon etc. Make deposits! Remove deposits! It makes you wonder who's got the right approach. We at Kohler believe that the right approach is to avoid them completely!
Oil additives have been extensively tested by independent laboratories, state universities, and at least one government research center. The conclusion is usually the same, the additives offer no significant benefit, and in some cases can be detrimental. Avco Lycoming, a major manufacturer of aircraft engines, states, "We have tried every additive we could find on the market, and they are all worthless." The best selling oil additive promotes the "coat with Teflon" theory. But DuPont, the company that invented Teflon stated, "Teflon is not useful as an ingredient in oil additives or oils used for internal combustion engines." Who would you believe?

We said earlier that synthetic oils are hard to justify because of cost, even though quality and performance are excellent. Industry experts estimate that the cost to produce most additives is one-tenth to one-twentieth of the retail asking price. Even at discount store prices you're paying five times what the stuff is worth, and it doesn't do anything. Does the old adage "throwing money down the rathole" come to mind? The only ones to benefit from oil additives are those who make them and sell them ."