Week of April 6-10, 2020

COON

All of these assignments are on google classroom. You must pick one of the 3 listed and complete by next Monday, April 13 for credit. If you would like to use google docs to complete the work that would be most efficient. However, paper copies can be returned to the school.

Class	Choice 1	Choice 2	Choice 3 (Enrichment)
Ag Science	Anatomy of Animal Reproduction Systems Part 1	Reproductive Development of Animals Part 2	FFA journal
Ag Business Mang	Personal Finances	Time Value of Money	Chart work experiences
BSAA	Heredity and DNA	Animal Growth and Development	Animal Nutrition
Landscape Design	Turf Grass part 1	Turf Grass part 2	Analyzing a Landscape
Intro To Ag	History of Ag part 1	History of Ag part 2	Supervised Ag Experience Part 1
Ag Mech.	Principles of Small Engines	Small Engines and their components	Small engines tear down

April 6-10th

Mr. Coon Ag Mech Date_____ Name_____

Checking Your Knowledge:

1. What are internal combustion engines?

2. What are the parts of four-cycle engines?

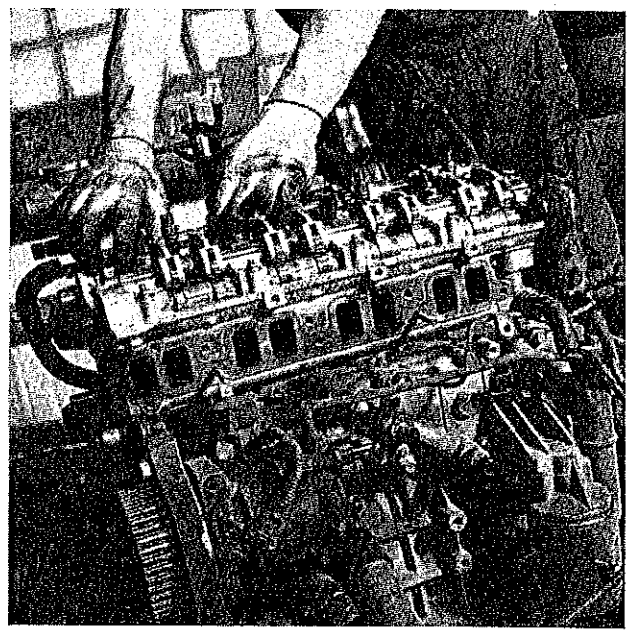
3. What are the major events that occur in the operation of the four-cycle engine?

4. How do the four-cycle engine and the two-cycle engine differ?

5. What are some careers that you could pursue in the area of internal combustion engines?

Principles of Operation of Internal Combustion Engines

WHEN THE UNITED STATES became its own country in 1776, it was estimated that more than 90 percent of colonists were farmers. During those times, farmers grew their own food and maintained their implements and tools to match their farming needs. During that time period, the family farm was the main career because it was necessary to grow food for survival. Now less than 10 percent of U.S. citizens work in producing crops, animals, and fibers for human use. Thus, agricultural production has become efficient with better farming methods and machinery.



Objective:

Explore careers associated with internal combustion engines, and identify as well as describe the parts and events associated with these engines.

Key Terms:

block
compression ratio
compression stroke
connecting rods
crankshaft
cylinder
diesel engines
engine displacement
exhaust stroke
exhaust valve
flat
four-cycle engine
gasoline engines
head
in-line
intake stroke
intake valve
internal combustion engine
multi-cylinder
piston
power stroke
reed valves
single-cylinder
two-cycle engine
Vee-block

The Internal Combustion Engine: Background and Operations

With the changes in U.S. agriculture and its machinery, jobs and careers became more prominent for those interested in working with engine repair and all that is included in this technologically changing field. People who choose to work with internal combustion engines must be technically competent in all facets of maintaining and repairing engines. This, too, has changed tremendously as computerized technology is now used as a mainframe to detect problems with newer and more sophisticated engines and machinery.

CAREERS

Agricultural mechanics remains an important career area in agriculture. In the mechanics area, a career path focusing on internal combustion engines provides the needs, care, and maintenance of many engine types.

Four-Cycle Engine

One career area focuses on working with the **four-cycle engine**, which is an engine that must complete four movements within a cycle to operate correctly. The four-cycle engine powers almost every tractor used in farming today. Careers in this area include tractor salesperson, equipment dealer, mechanic for internal combustion engines, engine parts specialist, mechanics for vehicles, and owner/operator of dealerships that sell this equipment.

Two-Cycle Engine

Another career area focusing on internal combustion engines is working with the **two-cycle engine**, which is an engine that completes the intake, compression, power, and exhaust stages all in two strokes. Equipment that contains a two-cycle engine includes chainsaws, trimmers that have a string/line, leaf blowers, shrub trimmers, and many other small power tools. Jobs or careers that focus on working with two-cycle engines include home repair shops (entrepreneurial), parts specialists at mechanics facilities, specialists in two-cycle engine repairs, and specialists at franchises.

Engine Systems and Parts

The career path of working with engine systems and their intricate parts is an area considered highly technical and requires a proper amount of training and practice to correct problems with engines. People who specialize in this area may be proficient in all parts of the engine, including the compression system, the fuel system, the ignition system, the cooling system, and the lubrication system.

If you are interested in any or all of the parts of the engine, you may pursue a career in auto mechanics and tractor mechanics. Some facilities (e.g., Jiffy Oil and Lube) offer oil changes,

tire rotations, and some engine work. These facilities (and similar places) provide good opportunities if you are interested in working with internal combustion engines.

If you are interested in teaching in the agricultural mechanics area, you may pursue a career teaching at the secondary, community college, or university level at institutions that have courses and/or programs in internal combustion engines.

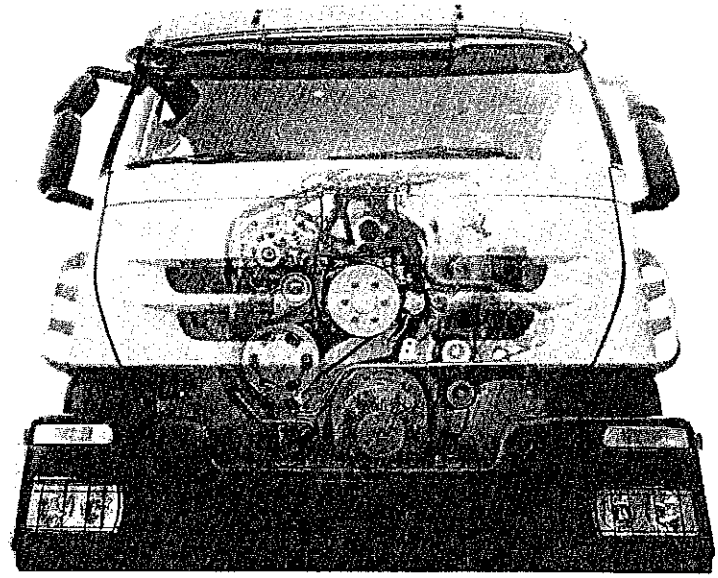


FIGURE 1. Engines have come a long way.

PARTS OF THE INTERNAL COMBUSTION ENGINE

Technological advancements have made the machines used in agriculture today extremely efficient. For example, the role of the **internal combustion engine**, which is an engine that provides power for machines (e.g., tractors and cars), is important in agriculture. Essentially, the internal combustion engine converts the energy contained in fuel into rotating power. It has evolved from the external combustion engine, which was an engine that powered steam engines during colonial times. Now the internal combustion engine is a highly technical engine that powers tractors used in modern agriculture.

Four-Cycle Engine

The four-cycle engine is an engine that operates on a series of four strokes, or piston movements, per cycle. The four-stroke engine houses various parts on the engine block.

Piston

The four-cycle engine has a **piston**, which is a sliding cylinder that fits inside a cylindrical vessel and receives the force of combusting fuel. The piston acts like a plunger with rings that fit against the inside cylinder walls, so it prevents air from seeping out.

Cylinder

The piston operates inside a **cylinder**, which is an engine cavity that holds the piston. The cylinder has a cap called a **head**, which is a device that seals the cylinder. The actual combustion force takes place in the cylinder.

Crankshaft

The entire piston and cylinder is connected to the crankshaft. The **crankshaft** is a metal piece that changes the pistons up-and-down motion into a rotary-type motion, which then

rotates a gear, a tire, an implement, or piece of equipment. The crankshaft has **connecting rods**, which are devices connected to offsets on the crankshaft. The connecting rods remain fastened by a wrist pin.

Block and Valves

The **block** is the mass of metal that contains the cylinder and two valves. The **intake valve** is a device that allows the fuel mixture to enter inside of it. In contrast, the **exhaust valve** is a device that allows the fumes to escape. In some modern and large engines, there may be four valves to each cylinder.

Horsepower

The four-cycle engine is what powers most tractors and automobiles. The tractor size dictates its power and is measured in horsepower. Most large engines that power tractors used in agricultural practices produce more than 25 horsepower. In contrast, small engines produce less than 25 horsepower. This is important because it allows the farmer to see how powerful the machine is that he or she is purchasing for use.

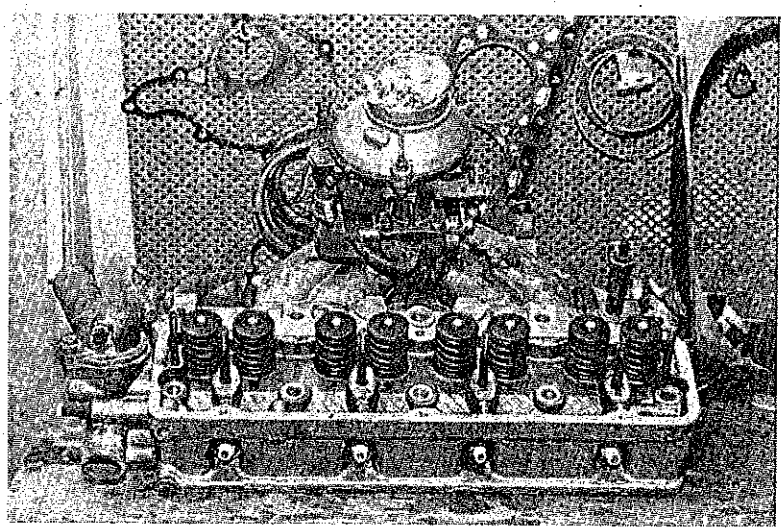


FIGURE 2. This disassembled automobile engine enables you to see its parts.

EVENTS OF THE FOUR-STROKE ENGINE

The four-cycle engine contains four major events that must occur for the engine to operate properly. This engine operates based on a cycle or a series of repeated events. The four strokes make up one cycle and include four events each time the engine cycles.

Intake Stroke

The first event is called the **intake stroke**, which is a situation in which the intake valve opens and a mixture of air and fuel enter into the cylinder. As this stroke operates and is completed, the piston is at the bottom of the cylinder. The intake valve is open, but the exhaust valve is closed.

Compression Stroke

The **compression stroke** is an action that carries the piston upward and allows the fuel mixture to be compressed tightly between the top of the piston and the cylinder head. The fuel

mixture is held at the top of the compression stroke and is held in a combustion chamber. During the compression stroke, the intake and exhaust valves are closed. The **compression ratio** is the relationship between the volume of the cylinder and the volume of the combustion chamber at the beginning and the end of the compression stroke. Most compression ratios for small gas engines are a ratio of 6 to 1 (6:1).

Power Stroke

The **power stroke** is an action that works as the piston nears the top of the cylinder and causes a spark from the spark plug that allows the burning mixture (fuel) to expand and push the piston downward. During the power stroke movement, the valves are closed tightly. A larger piston and cylinder have a more powerful engine.

Exhaust Stroke

The **exhaust stroke** is an action that occurs when the piston reaches the bottom and starts in an upward movement. As the piston moves upward, the exhaust valve opens, and fumes are forced out of the cylinder. The exhaust stroke is completed when the piston is at the top, dead center. The exhaust valve opens, and exhaust gasses are released. When the piston starts back downward, the exhaust valve closes and the intake valve opens. As a result, the intake stroke begins the cycle over again. The crankshaft makes two complete revolutions (or turns) in the cycle as it responds to the four strokes in the engine.

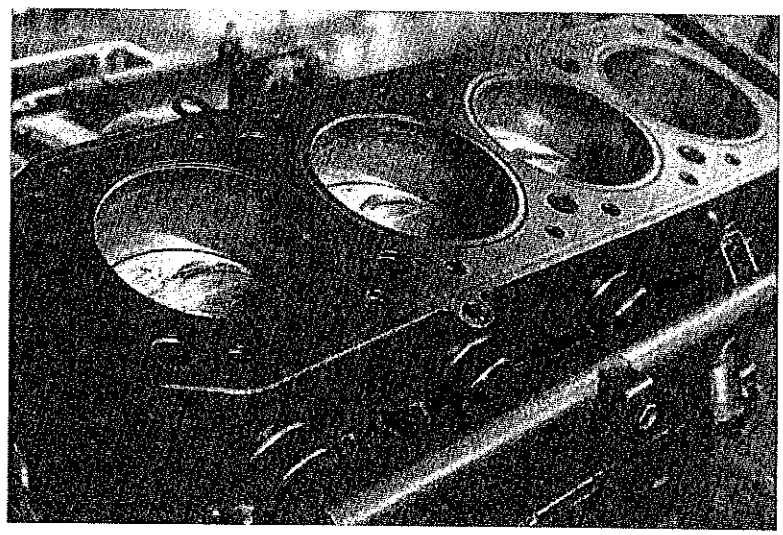


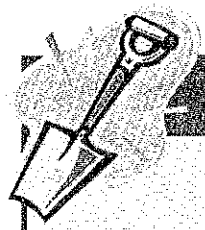
FIGURE 3. This is an open block of a four-cylinder engine.

Two-Cycle Engine

The two-cycle engine is different than the four-stroke engine as it completes the intake, compression, power, and exhaust in only two strokes. In this engine, the crankshaft does not contain oil. Instead, it is airtight and contains a reed valve to allow the air-fuel mixture from the carburetor when the piston migrates away from the crankshaft.

INTERNAL COMBUSTION ENGINE TYPES

The two types of internal combustion engines are the four-stroke engine and the two-stroke engine. The four-stroke engine provides the power for most sizes of tractors used in agriculture and automobiles. The two-stroke engine powers machines such as leaf blowers,



DIGGING DEEPER...

UNCOVERING ADDITIONAL FACTS: Agriculture Mechanization

Historically, internal combustion engines were studied in detail in the early 1800s by French physicist Nicholas Carnot. His book and readings outlined the basic principles of an engine that would be powered by the combustion efforts among gas, vapor, and air. In the mid- to late 1800s, Jean-Joseph-Étienne Lenoir presented the world with the first working internal combustion engine. His work provided a basic engine that uses combustion to power the smallest machines to larger machines, including tractors and cars.

How has agricultural mechanization changed since then? Check out the link below:

http://www.scienceclarified.com/He-In/Internal-Combustion-Engine.html

snow blowers, lawnmowers, and chainsaws. While each moves through a series of strokes, the operations are unique.

Four-Stroke Engine

As mentioned, the four-stroke engine completes a series of four events that occur in each completed cycle. In each stroke, this engine completes the intake, compression, power, and exhaust event. In the four-cycle engine, two valves allow the air and fuel mixture to move—the intake valve and the exhaust valve. To complete this cycle, the piston moves through these four events in one revolution or turn and then begins the cycle all over again.

Two-Stroke Engine

In contrast, the two-stroke system completes the same series of four events in two strokes. During the first stroke, the release of gasses drives the piston downward. In the second stroke, the release of gasses drives the piston downward. The two-cycle also contains **reed valves**, which are one-way directional valves that allow the air-fuel mixture to enter the crankcase.

CLASSIFICATION

Internal combustion engines are classified in several ways. They may be classified by their stroke, power, cylinder displacement, cylinder number, cylinder arrangement, and/or the fuel burned.

Stroke

Internal combustion engines are classified as being a four-stroke engine or a two-stroke engine. Additionally, they may be classified by the power they produce. For example, engines

producing less than 25 horsepower are considered small engines, such as those used in push-type lawnmowers. Internal combustion engines producing more than 25 horsepower are considered large engines, such as tractor engines.

Number of Cylinders

Internal combustion engines may be classified by the number of cylinders they contain. A **single-cylinder** is an engine that contains only one cylinder. A **multi-cylinder** is an engine that may have two, three, four, five, six, eight, or more cylinders.

Engine Displacement

The **engine displacement** is the total swept volume of the engine cylinders as the pistons complete one stroke. When working with engine displacement, it is expressed in cubic inches (cu. in.) or cubic centimeters (cc).

Cylinder Arrangement

Cylinder arrangement is another way to classify internal combustion engines. Two important arrangements in this classification are in-line and Vee-block. **In-line** is an engine with all of the cylinders in a straight line. A **Vee-block** is an engine in which all cylinders are arranged in a "V" pattern with two banks of cylinders on a 90-degree angle as it operates off of the same crankshaft. Some cylinder arrangements are **flat**—perpendicular in relation to the earth.

Fuel

Engines may be classified by the fuel they burn. **Gasoline engines** are machines with fuel powered by a spark ignition. However, **diesel engines** are machines that utilize glow plugs and fuel in a compression ignition.

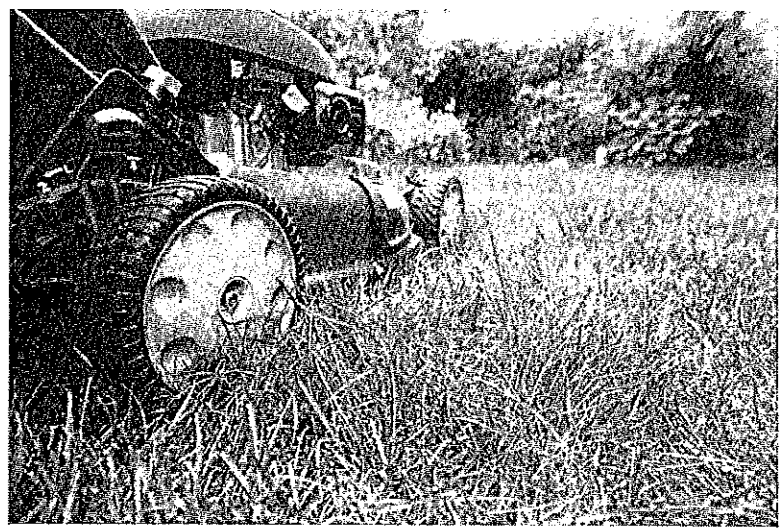


FIGURE 4. This is the gasoline engine of a lawnmower.

Summary:

The field of working with internal combustion engines is highly technical and requires a working knowledge of the parts, organization, and events that occur within the engine. Two types of internal combustion engines are the four-cycle engine and the two-cycle engine. Four-cycle engines operate on a series of four-strokes, or piston movements, per cycle. In contrast, two-cycle engines complete all

stages in just two strokes. Major parts of the four-cycle engine are the piston, cylinder, crankshaft, and block. Understanding how these engines work and operate are major factors in being able to repair and maintain them in proper working order.

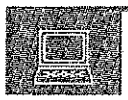
Checking Your Knowledge:

1. What are internal combustion engines?
2. What are the parts of four-cycle engines?
3. What are the major events that occur in the operation of the four-cycle engine?
4. How do the four-cycle engine and the two-cycle engine differ?
5. What are some careers that you could pursue in the area of internal combustion engines?

Expanding Your Knowledge:

Make a list of examples of small engines and large engines. Find a lawnmower engine and study the parts as well as how it operates. Do the same with a large engine from a tractor or an automobile. On your list, share how the engines differ. Do a search of the differences between gasoline engines and diesel engines. How do they differ? What happens if regular unleaded gasoline is put in a tractor that requires diesel? Record this information on your list. Then share your findings with your class.

Web Links:



Agricultural Mechanization
http://www.greatachievements.org/?id=3783

The Four-Cycle Engine
http://www.grc.nasa.gov/WWW/k-12/airplane/engopt.html

The Fuel and Engine History
http://www.carbibles.com/enginehistory.html

Internal Combustion Engine
http://cars.yoexpert.com/cars-general/how-does-the-internal-combustion-engine-work-549.html

April 6-10th

Mr. Coon Ag Mech Date_____ Name_____

Small engine components

Checking Your Knowledge:

1. What are the three major systems of the engine?

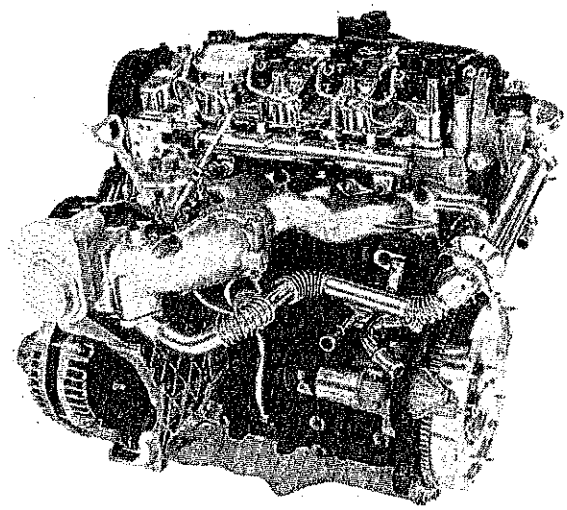
2. What are the functions of the compression system?

3. What are examples of the operating system in an engine?

4. Why is the lubrication system important?

Engine Systems and Their Components

THE INTERNAL COMBUSTION ENGINE operates through the coordination of several systems that must function properly for the engine to run smoothly. These systems are similar to the human body. If one part is working poorly, it may impact one or more parts. When an engine malfunctions, it may have an impact on the entire engine system. The malfunction may occur quickly and cause the engine to shut down. However, it may occur slowly and cause a series of other problems in the engine and cause the engine to continue to run inefficiently. Because of these items, it is important to note the differences among the categories of engine systems.



Objective:

Identify the components of each engine system, and explain their functions.

Key Terms:

accessory system
air cleaner
air-cooled system
air intake system
battery-type ignition system
breaker points
burned valve
camshaft
carburetor
compression
compression ignition system
compression stroke
compression system
condenser
distributor
distributor cam
electrical induction
electronic fuel injection system
engine cooling system
exhaust manifold
exhaust system
exhaust valves
flywheel
fuel filter
fuel injection system
fuel system
head gaskets
ignition coil
ignition system
intake valve
liquid cooling system
lubrication system
magneto system
mechanical fuel injection system
operating system
piston rings
power stroke
primary system
pushrod
radiator
spark ignition system
spring retainer
starting system
thermostat
valve guide
valve spring
water pump

Understanding Engine Systems and Their Components

Each system within the engine functions differently. Yet the systems depend on each other to keep the engine in proper working order. Mechanics must have a deep understanding of the engine systems when attempting to repair and provide maintenance on engine systems.

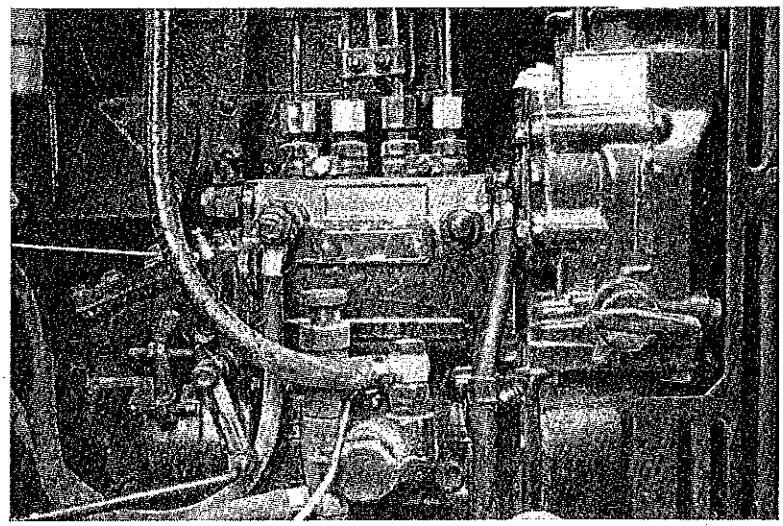


FIGURE 1. This is a tractor engine.

THREE MAJOR ENGINE SYSTEMS

The three major engine systems are primary, operating, and accessory.

The Primary System

The **primary system** (compression system) is an assemblage that represents the functions and interrelating parts of the compression that occurs within the internal combustion engine. **Compression** is the reduction in volume and increase in air pressure or combustible mixture before ignition. All internal combustion engines depend on the combustion process, and this must occur in the engine for the engine to operate effectively. The **compression system** is another name for the primary system because it is an assemblage that represents the combustion that occurs in the engine compression area. In addition, all internal combustion engines must have a method for achieving ignition in their cylinders to create combustion. It is important to note that engines use an electrical method or a compression ignition system.

The Operating System

The **operating system** is an assemblage that focuses on the engine parts that perform functions such as the electrical layout in the vehicle or tractor. If the electrical layout malfunctions or completely shuts down, the engine will not continue to operate. Other system components are the air intake system, the fuel system, the exhaust system, the engine system, the ignition system, the lubrication system, and the starting system. If any of these areas malfunction (depending on the severity of the problem), the engine may not continue to operate. However, repairs should be made soon after the malfunction so it does not result in other problems.

The Accessory System

The **accessory system** is an assemblage not dependent on the engine to operate. Interestingly, if an area of the accessory system malfunctions and is not connected to the engine, the engine continues to be operable. For instance, if the power steering system were to malfunction, the engine would still operate. Other examples of the accessory system are windshield wipers, belts and hoses used in various capacities, and the muffler system. If any of these systems malfunction, the engine may still be operable.

FUNCTIONS OF THE PRIMARY SYSTEM OR COMPRESSION SYSTEM

The primary (compression) system contributes a major role in the engine operating properly. You should understand all components of the compression system so if this system malfunctions, you may address and repair the problems accordingly. The overall goal in the compression system is to avoid leakage of the fuel mixture.

The First Two Strokes

In the first two strokes of the compression system, the cylinder should be tightly closed so leakage of air and/or fuel does not occur. The first stroke is the **compression stroke**—the upward movement of the piston as it fits into the cylinder that compresses gases into the combustion chamber at the top of the piston. Then the **power stroke**, or the downward movement of the piston, turns the crankshaft and creates power for the engine. If during these two strokes gases leak from the cylinder, the fuel mixture will not be compressed tightly enough for ignition to occur during the intake stroke. Additionally, power may be lost during the power stroke.

How Compression Is Lost

Compression may be lost in several ways. For example, it can be lost by the fit of the piston in the cylinder, a bad head gasket, or if the valves to do not close properly. However, the piston should not be so tight that it cannot migrate up and down freely. In addition, when the piston becomes hot, it expands due to the intense heat. The **piston rings** (fitting rings) are items made of cast iron or steel used in the grooves near the top of the piston. The rings keep a secure and solid fitting on the top of the piston to keep air, fumes, and gases safely inside the cylinder. The piston rings perform a spring action that will create a seal between the piston and the cylinder, so the fuel mixture cannot escape. The spring action allows for the flexibility of the rings so they may move up and down with the piston to keep leaks from occurring.

The Head Gaskets

The **head gaskets** are seals between the cylinder head and the block. If holes or worn areas exist in the gaskets, the fuel mixture could escape. The cylinder head forms at the top of

the combustion chamber. The cylinders and the crankshaft are located in the cylinder block. The head gaskets must be tight for combustion to take place and not allow for any fuel mixture to escape. If the head gaskets malfunction or are severely worn, the seal will break. The combustion chamber is not leak-proof.

The Valves

The valves in the compression system need to seal properly to keep air and the fuel mixture from escaping.

- The **intake valve** is the device that opens and seals the intake portal area.
- The **exhaust valve** (when open) is a device that seals the exhaust ports. If at any time during the combustion process the exhaust valve is left open, a burned valve may occur. A **burned valve** is a device in which the heat from the combustion destroys the edge of the valve. Essentially, this causes a gap in the open valve, thus creating an opening for the fuel mixture to continually escape.
- The **valve spring** is a device that closes the valve and holds it open at the appropriate times.
- The **spring retainer** is an essential device in that it holds the springs on the end.
- The **valve guide** is a device that supports the valve system as it moves back and forth.
- The **camshaft** is a device that opens and closes the valves.
- The **pushrod** is a device that transfers the rotating movement of the camshaft to the linear movement of the valves through cam lobes and valve lifters, which connect the camshaft to the pushrod.
- The valves must be seated properly, and they must be strong and tight.

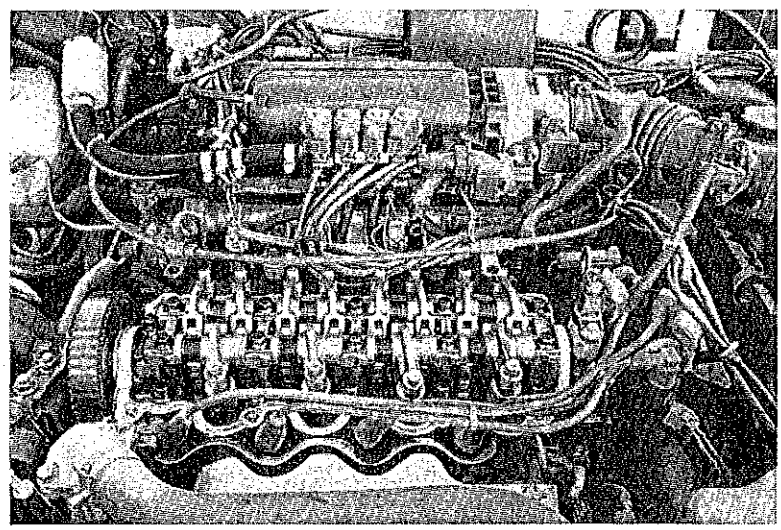


FIGURE 2. This is a three valve per cylinder car system.

THE OPERATING SYSTEM

The operating system of an engine (auxiliary system) includes functions of the engine that the compression system does not handle. The **air intake system** is an assemblage that functions as a clean air source for the combustion of the air-fuel mixture. The air must be cleaned

prior to it passing through the **air cleaner**, which is a filtering device located on the outside of the engine. Two types of air cleaners are used on (modern) internal combustion engines: dry element air cleaners and oil foam air cleaners.

The fuel and air are actually mixed in the **carburetor**, which is a part that provides fuel and air to the engine in the proper volume and proportions. While a carburetor may be used on some large engines (especially older models), it is still used on most small engines, too. However, many (modern) large engines are now fueled by injection systems. The fuel-air mixture migrates into the engine cylinder through the intake valves, as mentioned previously. They open and close the intake ports located above the cylinders.

The Fuel System

The **fuel system** is an assemblage that must deliver clean and proper amounts of fuel to the cylinder. The fuel not being used immediately is stored in the fuel tank. The fuel tank may store several ounces to many gallons of fuel, depending on machine size (e.g., car, tractor, or lawnmower). The fuel must be clean when it passes to the cylinder. The **fuel filter** is a device that cleans and filters the fuel as it passes through.

The role of the fuel pump is to ensure the correct amount of fuel is distributed throughout the rest of the system. The fuel pump ensures that the correct amount of pressure is reached as it moves the fuel through the system. The **fuel injection system** is an assemblage that injects fuel into the combustion chamber or into the intake manifold. The two types of injection systems are mechanical fuel injection system and electronic fuel injection system.

- The **mechanical fuel injection system** is an assemblage in which the use of mechanical pumps injects high-pressure fuel into the combustion chamber.
- The **electronic fuel injection system** is an assemblage in which electrically operated injectors are used to inject the fuel in the combustion chamber or the intake manifold.

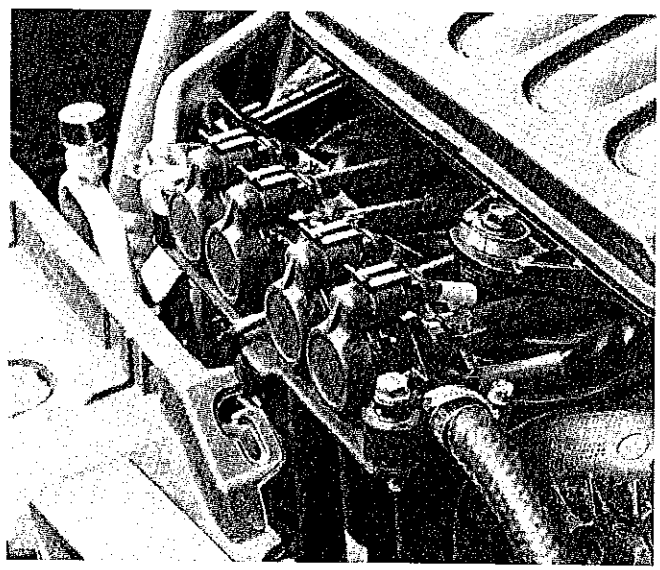


FIGURE 3. Fuel injection system.

The Exhaust System

The **exhaust system** is an assemblage that removes the exhaust gases and particles from the combustion chamber. It also reduces noise from the engine and plays a major role in heat transfer.

In the basic exhaust system, the exhaust valve opens and closes the exhaust ports. The ports allow gases and fumes to move through. The **exhaust manifold** is an area where several pas-

sages are together. It collects the gases that come from the cylinders. The exhaust manifold is connected to the exhaust pipe, which is a tube-like structure that connects the manifold to the muffler. Some engines do not have an exhaust pipe, and the muffler is attached directly to the exhaust manifold.

The Engine Cooling System

The **engine cooling system** is the part of the operating system that manages the heat produced by the combustion of the air-fuel mixture. It is important for the cooling system to keep the engine cooled so it may reach its ideal operating temperature.

Liquid Cooling System

The **liquid cooling system** is an assemblage that transfers heat produced by the engine to the surrounding air. The **radiator** is part of the liquid cooling system that functions by transferring heat and is a cooling and storage area for the liquid combination of water and antifreeze. In addition, the **water pump** is a device that allows the coolant to flow through the engine system. The **thermostat** is a flow control valve that regulates the temperature of the engine and regulates the liquid flow and cooling processes. Other components of the liquid cooling system are the radiator cap—placed on the opening of the radiator, the water jacket, the fan and fan belt, and the temperature gauge.

Air-Cooled System

The **air-cooled system** is an assemblage in which the heat from the engine is transferred directly to the surrounding air. This system type is common in most small engines rather than larger engines. In a small engine, it has been noted that the engine can fire and ignite the fuel mixture more than 2,000 times per minute. The combusted heat may be as high as 3,000°F. If the heat is allowed to build, the moving parts in the engine will expand and cause the engine to stop working. Therefore, the heat must be dissipated (lost) to allow the engine to operate at its proper temperature. The small engine air-cooled system generates a velocity of moving air by the use of fins on a flywheel. The fins serve as a fan to move air across and around the engine. Stationary fins on the engine head and block create more surface area for the rapidly moving air to circulate. A piece of sheet metal (a shroud) encircles the engine in an effort to route the air over the fins. If the fins are clean and the shroud is in place, the engine should run at the appropriate operating temperature.

The Ignition System

The **ignition system** (part of the operating system) is an assemblage that starts the combustion of the air-fuel mixture. When the fuel mixture enters the combustion chamber and has been compressed, a spark must occur for the fuel to ignite.

- A **compression ignition system** is an assemblage in which the temperature needed to burn the air and fuel mixture is provided by heat produced during the compression stroke

or cycle. Therefore, this system does not contain any unique parts compared to the next ignition system.

- The **spark ignition system** is an assemblage that uses a high-voltage electrical spark to ignite the compressed air and fuel mixture in the combustion chamber. The ignition system must create a spark with enough voltage to jump the gap of the spark plug and ignite the fuel. Two types of spark ignition systems are the magneto system and the battery-type ignition system.
  - The **magneto system** is an assemblage in which the spark is created by electrical induction. **Electrical induction** is an electric current. This process occurs as a low-voltage current generates when a strong magnet in the flywheel passes closely to an armature coil. The coil contains many layers of thin iron strips that have been bound together. As the magnet on the flywheel passes by the coil, a low-voltage electrical current is sent through the primary circuit. If the primary circuit is opened, the decaying magnetic field around the primary circuit sends a high-voltage charge through the secondary circuit. This activity can produce up to 40,000 volts of electricity. The charge then migrates to the spark plug.
  - The **battery-type ignition system** is an assemblage that uses energy from a battery or alternator (or both) to create an ignition spark. In the breaker point-type battery system, an ignition switch begins the process by activating the battery with an ignition coil, which is a device used to start the engine. The **ignition coil** is a cylindrical-shaped part that converts low voltage to a high voltage that creates a spark at the spark plug gap. The **distributor** is a device that sends the high-voltage current to the correct spark plug at the appropriate time. Inside the distributor, the **condenser** is a part that functions as a capacitor, which stores electrical energy. In addition, the **breaker points** are devices that provide a switch to initiate the spark in the engine. The **distributor cam** is a device that rotates inside the distributor, controls the opening and closing of the breaker points, and regulates—through the distributor rotor—the timing of the engine spark.

The Lubrication System

The **lubrication system** is an assemblage that keeps the internal engine parts coated with oil to reduce friction, enhance cooling, seal internal engine components, and clean many of the internal parts. Throughout the inside of the engine, metal parts move against each other repeatedly. Over time, the movement builds up friction that leads to severe wear and tear on the engine parts. Therefore, the major parts of the lubrication system must be kept clean and lubricated properly. The oil filter removes dust particles and foreign material from the oil. The pressure regulator, however, maintains the proper operating pressure of the lubrication system. A sump (oil pan) provides a reservoir for the engine oil. It is located under the cylinder block. Meanwhile, the oil pump circulates oil throughout the engine.

The Starting System

The **starting system** is an assemblage used to turn the engine crankshaft until the engine starts. Two basic types of starter engines are dependent on their size: manual system and electrical starting system.

The manual system is common in small engines. The engine is started by manually turning the crankshaft. A rope is pulled to start the engine. After it starts, the rope rewinds with the help of a spring and returns to its originating position.

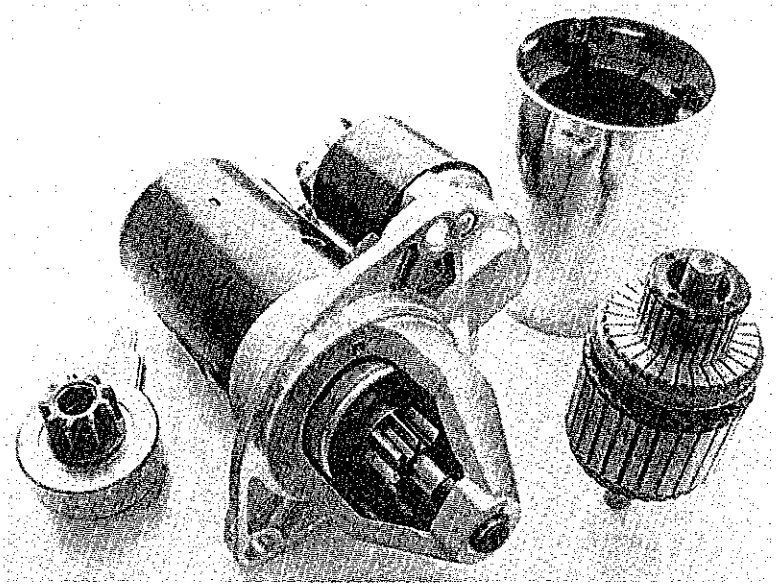


FIGURE 4. Car starter with spare parts.

In an electrical starting system, a solenoid-type switch controls the correct amount of voltage going to the starter. The **flywheel** is a large gear attached to the crankshaft. The starter motor is activated by engaging the starter shaft and is matched to the teeth on the flywheel, which turns the engine. If the starter switch is released from the start position, the starter disengages from the flywheel. As a result, the engine stops.

THE ACCESSORY SYSTEM

For each operating system, accessory system components are important to ensure that each system has what it needs to operate efficiently. While accessories are not a factor in making the

FURTHER EXPLORATION...

ONLINE CONNECTION: Change Your Car Oil

Do you know how to change the oil in your vehicle? One of the most important tasks in keeping an engine lubricated properly is keeping the oil changed. Changing the oil and putting in a new oil filter is essential as it keeps debris and dust particles out of your engine's system. Whether it is a car, truck, tractor, or lawnmower, changing the oil is imperative to the health (short term and long term) of the machine.

Many facilities can change the oil for you, but it is helpful to know how to do it in case you are ever faced with a situation in which you need to change the oil quickly. To learn the basic steps in changing the oil in your vehicle or tractor, check out this link:

http://www.familyhandyman.com/automotive/diy-oil-change/diy-car-maintenance-how-to-change-your-car-oil-yourself/view-all

engine start or stop, they are important for items such as power steering, electric windows verses roll-type windows, and body style of the car or tractor.

Although the accessory system focuses on areas unnecessary in making the engine run, this system does contribute to making a car or tractor more efficient in its use and is needed in many instances to assist in some of the engine's activities. For instance, air conditioning in a tractor is not a necessary item. But it certainly helps in the hot summer months when you are field cultivating your crops and sit inside the cab of the tractor for long periods. Yet the tractor will run with or without the air conditioning. Additionally, some of the accessories assist in moving liquids to and from the engine. For example, the radiator and heater hoses carry coolant to and from the engine. These accessories are needed to move the coolant, and it is an essential activity that must take place. The V-belt or fan belt (in the engine) transmits power from the front of the engine to accessories that need to be driven or powered (e.g., the air conditioning, the charging system, and fans).

Categories

Several categories of accessory systems should be reviewed. Each is unique to a certain area of the vehicle, tractor, or lawnmower. The belts and hoses system is essential to the cooling, air conditioning, and charging systems as it relates to the engine. The brake system is important so the tractor or vehicle may stop when needed. When pushing the brake pedal, the force generates hydraulic pressure in the master cylinder. The pressure flows through the hydraulic lines and hoses to the wheel cylinders and calipers, forcing the shoes against the drums (drum brakes) and the pads against the rotors (disc brakes). Brake systems (over time) do become worn and need to be checked on a regular basis.

Emission System

The emission system controls the emissions, exhaust, and pollutants. Essentially, the emission system substantially reduces harmful gases, such as carbon monoxide (CO), from escaping into the air. Also, the filters and fluids are used to eliminate contaminants from entering the engine cavity. The oil filter keeps the oil unrestricted as it travels down into the oil cavity. The fuel filter separates harmful contaminants that may cause problems with the carburetor or fuel injectors. The air filter traps dirt particles, which may cause damage to engine cylinders, walls, pistons, and piston rings. The lighting and windshield wipers play a role in safe driving. They should be checked regularly and replaced as needed.

Battery System

The battery system ensures dependable operation of the large engine. The battery stores electrical energy, and the starter converts that energy into mechanical force to turn the engine for starting. Steering and suspension systems are what maintain the relationship between the wheels and the frame. The suspension system interacts with the steering system to provide control over the vehicle or tractor. The transmission system works with the engine to provide

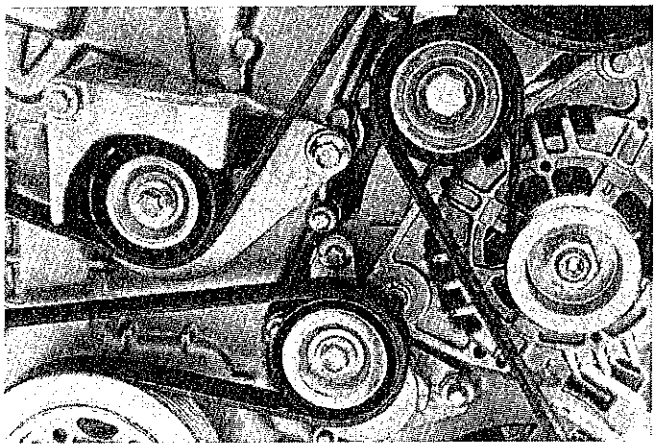


FIGURE 5. These belts are part of the accessory system.

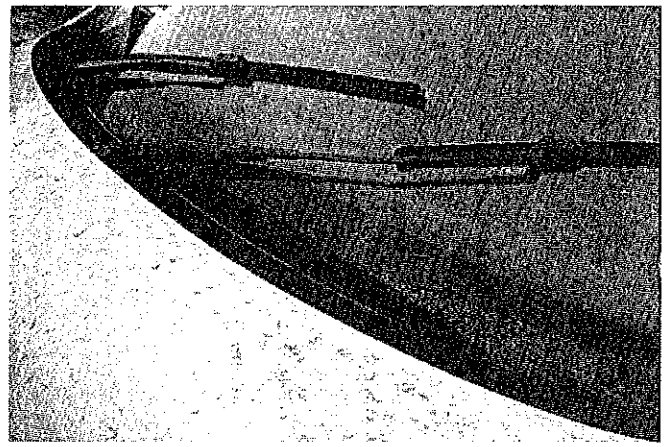


FIGURE 6. Windshield wipers are part of the accessory system.

power to the wheels of the tractor or vehicle. Whether automatic or manual, the transmission plays a major role in the performance of the tractor or vehicle.

Summary:

Many parts are involved in engines and their functions. Engine systems are categorized among three major areas: the primary or compression system, the operating system, and the accessory system. The primary system focuses on how the compression system operates with the main goal being that there are no leaks of the air and fuel mixture. The operating system focuses on the air-intake system, the fuel system, the exhaust system, the starter system, the lubrication system, and the ignition system. The accessory system focuses on parts such as the starter, the windshield wipers, the air conditioning unit, and the sound system.

Checking Your Knowledge:

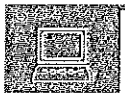
1. What are the three major systems of the engine?
2. What are the functions of the compression system?
3. What are examples of the operating system in an engine?
4. Why is the lubrication system important?
5. What are some examples of the accessory system? Why is it important?

Expanding Your Knowledge:

Make a list of the engine parts of the compression system and the operating system of a tractor. Look inside the tractor to see if you can find the various parts. Compare these parts to that of the engine parts of the push lawnmower. How does each differ

in operations? How are they similar? Write these down on your list, and share your findings with your class.

Web Links:



Lubrication System

http://auto.howstuffworks.com/engine-lubrication-system.htm

Engine Cylinders

http://www.dummies.com/how-to/content/how-to-check-an-engines-cylinder-compression.html

The Compression System

http://www.briggsandstratton.com/eu/en/support/faqs/compression-system

The Fuel and Engine History

http://www.carbibles.com/enginehistory.html

The Fuel System

http://www.autoeducation.com/autoshop101/fuel.htm

April 6-10th

Small Engine tear down

Checking Your Knowledge:

1. What are the major safety practices to follow when working with small engines?

2. What are material safety data sheets?

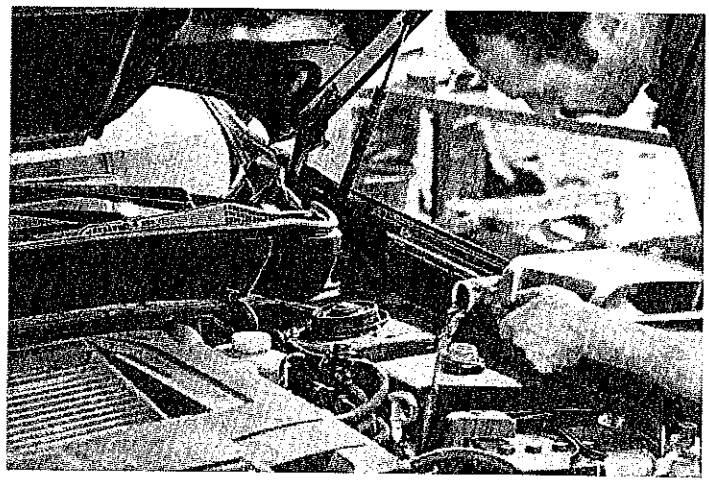
3. How is oil classified?

4. What are the steps in disassembling and reassembling a small engine?

5. What are the practices to follow when storing the small engine at the end of the season?

Small Engines

SAFETY around small engines is essential. Following safety practices is a priority in all fields of study, especially when working around engines. When working with engines (of any size, shape, and usage), safety practices should be followed to ensure that the mechanic does not become injured and that the engine is protected. Most safety practices are common sense. However, it is a good practice to have safety procedures listed and posted when working with small engines.



Objective:

List and describe safety practices, care and maintenance, and storage of small engines.

Key Terms:

air filter
block
connecting rods
crankshaft
cylinder
exhaust valve
head
intake valve
multiviscosity
octane rating
piston
service classification
viscosity

Understanding Small Engine Work

Small engines are in many types of equipment, so being familiar with them and knowledgeable with their parts may help you tremendously.

SAFETY PRACTICES

When working with engines of all sizes, you are faced with issues such as dropping tools on your feet and getting splashed with solvents. Therefore, personal protective equipment is necessary to ensure protection.

Personal Protective Equipment (PPE)

Eye injuries are the most common problem when working with engines. Wear safety glasses, shields, or goggles that have the designation of Z-87.1, which is a standard symbol for a quality safety material. Also, wear goggles when working with liquids.

Protecting your feet, ankles, and head is essential, too. Wear foot protection (e.g., steel-toed boots) and head protection (e.g., bump caps). Bump caps can protect against falling objects and prevent head bumps against the undercarriage.

In this field, you often handle hot, sharp metal possibly dripping with chemicals, solvents, and irritants. Therefore, always check with the material safety data sheet (MSDS) to determine proper hand protection when working with or around engines. When handling any type of fluid, oil, or fiberglass, wear hand protection (e.g., neoprene gloves) to protect bare skin. Also, proper ventilation in the work area is necessary to allow fumes and odors to escape. Proper maintenance on the ventilation system will ensure it is in proper working order.

To protect your ears from loud noise due to engines, compressors, and impact tool noises, disposable earplugs should be worn on a regular basis.

Fire Safety

Fire safety is essential. As a result, easy and efficient fire extinguishers should be placed throughout the shop. For small fires, the PASS method should be used. PASS stands for **p**ull the pin, **a**im, **s**queeze the handle, and **s**weep at the base of the fire. Fire extinguishers should be checked annually. In addition, monthly inspections should be performed to ensure all units are charged. The units should be removed if they are just partially charged. Avoid smoking or operating anything that causes a spark (e.g., radios, mobile devices, and communicator electronics) close to gasoline vapors or liquid. Gasoline is extremely flammable. If a spark occurs, fire will ignite immediately.

Safety Around Compressed Air Units

When working with compressed air units, safety practices are a must. All pipes, hoses, connectors, and fittings must have a rating of the maximum pressure of the compressor. Air supply shut-off valves should be as close as possible to the point of operation. In addition, air hoses should be kept free of grease and oil to avoid deterioration of hose material.

- Do not string hoses across an aisle way or where people commonly walk as they may cause tripping or falling.
- Keep hose ends secured to prevent whipping in case of an accidental cut or break.

- Pneumatic impact tools, such as riveting guns, should never be pointed at a person. Turn off the air supply before disconnecting pneumatic tools.
- Do not use compressed air to clean dirt and dust off of skin or clothing.
- People operating compressed air for cleaning purposes must wear goggles, face shields, or safety glasses.
- Static electricity may be generated through the use of pneumatic tools. Therefore, tools should be grounded or bonded if used in an area in which fuel, flammable vapors, or explosive atmospheres are present.

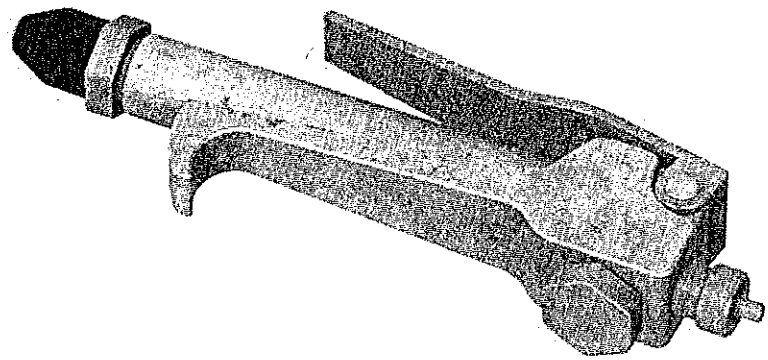


FIGURE 1. People operating compressed air for cleaning purposes must wear goggles, face shields, or safety glasses.

Mechanical Lifting

Mechanical lifting is a situation in which a vehicle, tractor, and engines of various sizes may be lifted hydraulically so you may work under them as they are lifted overhead. You should not work under suspended vehicles or engines, for example, without the items being properly supported by weight-bearing vehicle stands.

Proper Body Mechanics

Before lifting items with your arms, make sure you are strong enough to lift them. In addition, use proper body mechanics when lifting. For instance, turn the body and do not twist. Also, push heavy objects on carts, a dolly, or hand truck because pulling puts a strain on back muscles. Heavy objects should be stored higher than the waist area. Items should be lifted by using arm and leg muscles, not back muscles.

Manuals

Learn about all of the machines and tools used with engines. Keep the manufacturer's supply manuals with each machinery piece. In addition, learn the safeguarding techniques for each machine, and inspect machines before use to ensure all parts are in proper working order. Review the personal protective equipment (PPE) required for safe use of each machine, and be aware of the non-mechanical hazards (e.g., noise, chemical splashing, and excessive heat). Keep the area around tools and machines neat, clean, and well lit. Avoid wearing loose clothes and jewelry. Also, long hair should be worn back out of the facial area, not hanging where it may get caught in engine or machinery parts. When performing maintenance procedures, check all lockout techniques. In addition, power down the machines when not working with them. Keep all hand tools in a secure location, and put them away when finished working with them.

CLASSIFICATION OF SMALL ENGINES

Small engines are popular. They supply power to numerous machines that require a portable power source. Chainsaws, lawnmowers, weed eaters, snowmobiles, and ski boats are examples of equipment with small engines. The internal combustion engine is the actual source that powers these engines and can be classified as four-cycle or two-cycle. It may be classified by the functions of the crankshaft.

The Four-Cycle Engine

The four-cycle engine is an engine that operates on a series of four strokes, or piston movements, per cycle. The four-stroke engine houses various parts on the engine block. This engine has a **piston**, which is a sliding cylinder fitting inside a cylindrical vessel that receives the force of combusting fuel. The piston acts like a plunger with rings that fit against the inside cylinder walls. Thus, it prevents air from seeping out. The piston operates inside a **cylinder**, which is an engine cavity that holds the piston. The cylinder has a cap called a **head**, which is a device that seals the cylinder. The actual combustion force takes place in the cylinder.

The entire piston and cylinder is connected to the **crankshaft**, which is a metal piece that changes the piston's up-and-down motion into a rotary-like motion that rotates a gear, a tire, an implement, or piece of equipment. The crankshaft has **connecting rods**, which are devices joined to offsets on the crankshaft. The connecting rod remains fastened by a wrist pin. The **block**—mass of metal that contains the cylinder—contains two valves. The **intake valve** is a device that allows the fuel mixture to enter inside of it. In contrast, the **exhaust valve** is a device that allows the fumes to escape. In some modern large engines, there may be four valves to each cylinder.

The four-cycle engine powers some riding lawnmowers, snowmobiles, and all-terrain vehicles (e.g., four-wheelers). The size of the small engine dictates the amount of machine power, which is calculated in horsepower. Most large engines that power tractors used in agricultural practices produce more than 25 horsepower. However, small engines produce less than 25 horsepower. This is important because it allows the farmer to see how powerful the machine is that he or she is purchasing for use.

The Two-Cycle Engine

In contrast, the two-cycle engine completes its intake, compression, power, and exhaust stages in two strokes. The crankcase of the engine does not contain oil; it is airtight and uses a reed-valve to admit the air-fuel mixture from the carburetor as the piston moves away from the crankshaft. The mixture, therefore, is mixed when the piston returns toward the crankshaft. The crankcase then holds the mixture under pressure until the cylinder is ready to receive it. Thus, the oil is mixed with the gasoline to provide lubrication to the moving parts of the two-cycle engine. As a result, there is no need for oil in the crankcase as compared to the four-cycle engine.

IMPORTANCE OF SMALL ENGINES IN AGRICULTURE

Small engines play an important role in agriculture. For example, they are a source of power for portable weed cutters to cut bothersome weeds, conveyor belts to transport food or grain, four-wheelers used for crop inspection or soil testing in the field, and chainsaws to trim ornamental plants and trees. They also power garden tractors to perform garden work, lawnmowers, garden tillers, hay bale throwers, and elevators on farms. Additionally, they are lightweight, powerful, and fairly inexpensive. They are fairly easy to operate, maintain, and repair when needed. Agricultural practices depend on small engines in each of the areas mentioned and in many others.

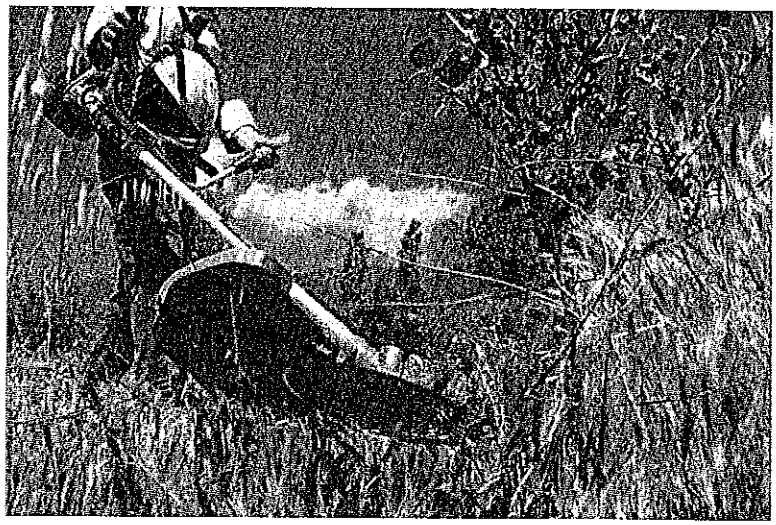


FIGURE 2. Small engine powering a hand-controlled mower.

NECESSARY TOOLS TO USE ON SMALL ENGINES

As with any machine, small engines need to be maintained and serviced often, especially if they are used on a daily basis. Many types of tools should be on hand when working on small engines, but the basic tools needed are a set of sockets as well as open-end and box wrenches ranging in size from 1/4 inch to 1 inch. A set of hex wrenches, 6-inch and 10-inch adjustable wrenches, slip-joint pliers, long-nose pliers, an 8 to 12 ounce ball-peen hammer, chisels, and punches are also useful. Additionally, there might be a need for other tools as the range of repair work increases.

MAINTENANCE AND REPAIR

Since small engines contain parts such as valves, pistons, rings, and bearings that require specialized tools for repair, it is important for the owner to read about these parts so he or she knows where to get the part and how to service it. All machines need periodic maintenance and repair. Gaining a deep understanding of the small engine is useful and will eliminate timely and costly repairs.

Fuel System

The fuel system in the small engine generally needs the most maintenance. Dirt particles and water in the fuel cause the engine to misfire or stall and may cause scratches in the cylin-

der and the cylinder walls. When this occurs, the engine will lose compression and power. The air filter must be clean to avoid these mishaps.

Air Filter

The **air filter** is a cleaner attached to the carburetor and is designed to remove dirt particles and dust from the air before it mixes with the fuel. If the air filter is not working properly, the engine will fail to operate. A good practice is to clean the air filter every 25 hours of work in windy and dusty conditions.

Several types of air filters are in small engines: an oil-foam filter, dry-element filter, dual-element filter, and oil-bath filter. The cleaning practices should be followed for each type by using the operating manual that comes with the small engine.

Octane Rating

Only clean gasoline should be used when filling up the fuel tank on the small engine. If gasoline has been in the fuel tank for a long period of time, it could have water mixed into it as condensation builds up in the tank. Use the proper **octane rating**, which is the ability of gasoline to prevent engine knock. Engines are designed to have a specific octane rating in the fuel tank. For small engines, the octane rating typically is 87. This indicates a lower octane rating than in motor vehicle engines. Using a higher or lower octane value is not advisable as it may harm the engine's ability to work properly and will cause a knocking noise.

The Carburetor

The carburetor is generally adjusted correctly at the factory in which it was built and seldom needs to be adjusted throughout the life of the engine. People may think the carburetor needs to be adjusted when something is wrong. Yet it is usually something else that needs to be repaired. If the suspected problem is the carburetor, the directions in the operating manual must be followed to maintain the proper adjustment on the carburetor. In fact, some states do not allow for adjustable carburetors, so they remain at the factory setting and cannot be tampered with.

Lubrication

The engine must be kept lubricated properly. It is important to keep the oil properly filled in the crankcase with the recommended oil type. The correct amount of oil is indicated on the dipstick by a line or mark. The oil level should be checked before operating the engine. If there is not an adequate amount of oil, the engine will not function efficiently. Therefore, it will become worn down and eventually not operate. The manufacturer's guidelines should be followed for proper oil types for the type of small engine being maintained.

The engine has four main functions: to lubricate, cool, seal, and clean by keeping contaminants away from the engine area. The proper oil to use is indicated by its **service classification**, which is a symbol that indicates the specific type of oil to be used. Most small engines

need service classifications (e.g., SE, SF, SD, or SC), which is clearly marked on the oil containers.

Oil is rated according to its **viscosity**, which is the thickness of the oil. It is extremely important that the proper oil with accompanying viscosity be used. Oil that is too thin or too thick will not lubricate properly. In addition, oil thickens as it gets cold. Lighter weight oil should be used in engines when temperatures outside drop. Therefore, with some engines, the oil must be changed as the seasons change. **Multiviscosity** is oil that may be used to satisfy the requirements of hot and cold temperatures. For example, oil rated as 10W-30 will have the viscosity of 10-weight oil during colder weather and 30-weight oil when the weather is hot. The Society of Automotive Engineers (SAE) rates the viscosity of oil. It is essential to check the operating manual for the manufacturer's recommendations when changing, checking, and monitoring oil levels and types in small engines.

Ignition System

The ignition system in small engines rarely needs to be serviced, except for the spark plugs. Most parts in the ignition system are sealed tightly and last a long time under good care and management. The spark plugs do, however, need to be checked periodically and replaced. In fact, most manufacturers recommend that the spark plugs be changed after about 100 hours of work. Historically, spark plugs were cleaned and then put back into small engines. However, they are relatively inexpensive, so it is less cumbersome to just purchase new ones as needed. The appropriate spark plugs recommended for the specific type of small engine are essential because the wrong type can cause engine damage. When screwing in the spark plugs, tighten just until snug. If it is screwed in too tightly, it can strip or damage the threads at the spark plug base. A spark tester connected between the spark plug and the spark plug wire may be used to check the spark output.

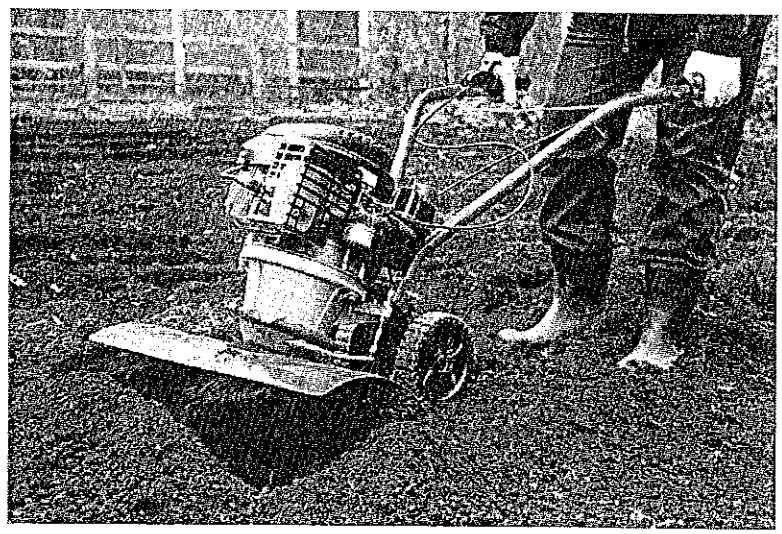


FIGURE 3. Always purchase the appropriate spark plugs recommended for the specific type of small engine.

The engine may have a series of belts and pulleys that may need to be tightened from time to time. Make sure they are in good operating order, without frays or breaks. Sometimes the tension on the belts may need to be adjusted according to the manufacturer's specifications.

The Battery

Checking the battery to make sure it is fully charged will ensure that the small engine will operate properly. A battery output tester can check this easily. For instance, the tester is placed

on the battery's electrodes and looks down into the "eye" of the battery. If it is red, the battery is not charged enough to perform. If it is green, the battery should be in proper working order. If the top is not kept wiped off and clean, corrosion could build up on the top area and cause the electrodes not to function properly. A light film of oil on the battery will help alleviate corrosion. It should be monitored at least weekly and kept free of dust and debris.

DISASSEMBLING THE ENGINE

Disassembling the engine sounds easy, but caution and care must be taken when taking the small engine apart. To clean all engine parts, disassembly is necessary. According to Briggs and Stratton, major steps to follow when disassembling an engine are as follows:

1. First, disconnect the spark plug wires, and remove the engine from its equipment.
2. Next, document engine information. Include the identification number and the model number and any other important reminders about the engine. This allows for a speedy reference when ordering parts.
3. Drain all fluids from the engine. Oil and fuel should be drained separately in safe containers.
4. Thoroughly clean the engine exterior of dirt, grease, and debris.
5. Remove the spark plugs.
6. Remove the air cleaner.

FURTHER EXPLORATION...

ONLINE CONNECTION: The Small Engine Industry

In the early 1900s, Briggs & Stratton developed the revolutionary stationary Type "P" engine. This was not something that had been accomplished in the four-cycle gasoline engine industry, so it set the course for Briggs & Stratton to become the world's largest manufacturer of air-cooled gasoline engines. This convenient, portable engine reliably powered many applications of machinery, including washing machines, garden tractors, cultivators, and generators.

Interestingly, by the mid-1900s, companies were bringing greater innovation to how small engines were designed. Yet in the early 1950s, Briggs & Stratton revolutionized the lawn and garden industry by developing the first lightweight, air-cooled aluminum engine. It improved the ease of use of lawnmowers, snow blowers, and generators. The small engine was further advanced in 1958 with the introduction of Kool-Bore (all aluminum) and Sleeve-Bore engines. Read more at the following site:

http://www.briggsandstratton.com/us/en/support/maintenance-how-to/push-mower-engines/history-of-the-small-engine

7. Remove the fuel tank, and disconnect the fuel line.
8. Remove the muffler.
9. Remove the blower housing and starter assembly.
10. Disconnect linkages and springs from the carburetor; remove the carburetor.
11. Remove the ignition coil or electronic ignition system.
12. Remove the flywheel.
13. Remove the cylinder head.
14. Remove the valves, valve springs, and valve spring retainers.
15. Remove the crankcase cover.
16. Remove the oil pump.
17. Remove the camshaft and valve lifters.
18. Disconnect the connecting rod from the crankshaft; remove the piston and connecting rod assembly from the block.
19. Remove the crankshaft.
20. Remove any bearings or seals in the crankcase.

Once all the parts are disassembled, check each carefully, and clean the parts with a soft cloth. Become familiar with each part, and be able to identify parts and their function in the operation of the engine.

REASSEMBLING THE SMALL ENGINE

To reassemble the engine, specific steps should be followed. Use the operating manual as a guide to provide detail for each step.

1. First, install the seals in the crankcase.
2. Next, install the crankshaft.
3. Check the clearance of the connecting rod bearing.
4. Set the piston ring end gap.
5. Install the piston rings on the piston.
6. Install the piston and connecting rod assembly.
7. Install valves, valve springs, and retainers.
8. Install valve lifters or tappets and camshaft.
9. Install the oil pump and crankcase cover.

10. Install the cylinder head.
11. Install the flywheel.
12. Install the ignition system (electronic ignition module or points and condenser).
13. Connect the linkages, and install the carburetor.
14. Install the blower housing.
15. Install the muffler.
16. Install the fuel tank, and connect the fuel line.
17. Install the air cleaner.
18. Install the spark plugs.
19. Add engine oil and fuel.
20. Install the engine to the piece of equipment and start the engine.

Keep the manufacturer's operating manual in an accessible location. Use the guidelines to assist when reassembling the engine. Take time to secure all parts to ensure the engine is reassembled snugly. Then start the engine and make sure it is operating properly.

END OF THE SEASON STORAGE

When the small gas engine is not in use, it should be stored in a dry place. At the end of the season, some guidelines must be followed to store the engine for a long period of time. When storing, the engine should be in good condition and should be ready to be checked before it is used again. If the machine is going to be stored for a long period, drain the fuel into a safe container (e.g., a gas can) and store it. Document any problems with issues on a notepad, and keep the notepad near the engine.

Clean all debris and dust from the engine and cooling fins. Remove the spark plugs. If they are old spark plugs, they may need to be replaced with new ones when using the engine again.

After removing the spark plugs, pour a few spoonfuls of engine oil into the opening. Then pull the starter rope slowly until the piston is at the top of the cylinder. Doing this spreads the oil out through the cylinder, the piston, and the

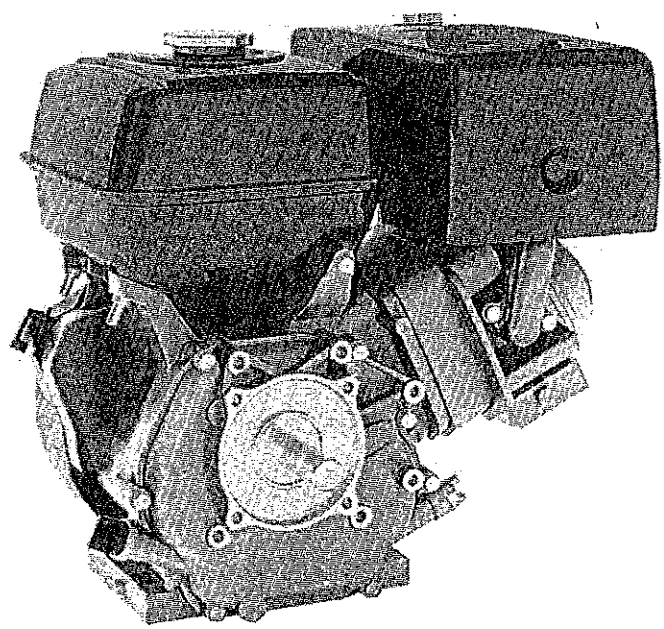


FIGURE 4. At the end of the season, some guidelines must be followed to store the engine for a long period of time.

combustion chamber. Make sure all linkages are cleaned and secured before storing the engine in a dry location.

Summary:

Safety practices must be an essential part of working with or around small engines. Wearing the proper protective equipment will protect eyes, ears, skin, and feet from becoming contaminated. In addition, learning about how small engines are classified is important. They are either four-cycle or two-cycle engines.

When disassembling an engine, it is essential to clean each part carefully before reassembling. At the end of the season, store it in a dry location, and drain the engine of fluids. Remove spark plugs, and keep the engine in a dry location out of the elements.

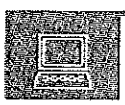
Checking Your Knowledge:

1. What are the major safety practices to follow when working with small engines?
2. What are material safety data sheets?
3. How is oil classified?
4. What are the steps in disassembling and reassembling a small engine?
5. What are the practices to follow when storing the small engine at the end of the season?

Expanding Your Knowledge:

Look at a small engine (if possible) at your home. Is the small engine in your lawnmower, snow blower, or all-terrain vehicle? Study the engine, and see if you can find where to change the oil and how to start the engine. Make a list of the basic tools used to repair and maintain the small engine. What are the engine specifications? Visit a small engine shop or mechanics shop. Ask if you may observe the mechanic as he or she works on the small engine. Take pictures of each of the parts to compare to the small engine at your home. Share your findings with your class.

Web Links:



Repair the Small Engine
http://home.howstuffworks.com/home-improvement/repair/how-to-repair-small-engines5.htm

Repair Small Engines

http://home.howstuffworks.com/home-improvement/repair/how-to-repair-small-engines1.htm

Small Engine Information

http://smallengineinformation.com/?page_id=512

Small Engine Parts and Operation

https://www.pennfoster.edu/~/media/Files/PDF/SampleLessons/089-Small%20Engine%20Repair%20Career%20Diploma.ashx