

Unit C: Agricultural Power Systems

Lesson 4: Applying Preventive Maintenance Practices

Student Learning Objectives:

Instruction in this lesson should result in students achieving the following objectives:

1. Explain the importance of preventive maintenance on engines and equipment.
2. Explain the safety practices to follow when servicing equipment.
3. Identify common maintenance practices associated with major engine systems.

Recommended Teaching Time: 2 hours

Recommended Resources: The following resources may be useful in teaching this lesson:

- Johnson, Donald M., et al. Mechanical Technology in Agriculture. Danville, Illinois: Interstate Publishers, Inc. 1998. (Textbook, Chapter 12)
- Herren, Ray V., and Elmer L. Cooper. Agricultural Mechanics Fundamentals and Applications. Albany, New York: Delmar Publishers, Inc., 2002. (Textbook, Chapter 30)
- Phipps, Lloyd J., et al. Introduction to Agricultural Mechanics, Second Edition. Upper Saddle River, New Jersey: Prentice Hall Interstate, 2004. (Textbook and Activity Manual, Chapter 18)

List of Equipment, Tools, Supplies, and Facilities:

- Writing surface
- PowerPoint Projector
- PowerPoint Slides
- Transparency Masters
- Copies of student worksheets

Terms: The following terms are presented in this lesson (shown in bold italics and on PowerPoint Slide 2):

- Compression gage
- Flooding
- Preventive maintenance

Interest Approach:

Display a maintenance schedule of an agricultural tractor. Ask the students if they can list the reasons why it is important to follow the preventive maintenance schedule.

SUMMARY OF CONTENT AND TEACHING STRATEGIES

Objective 1: Explain the importance of preventative maintenance on engines and equipment.

Anticipated Problem: Why is it important to practice preventative maintenance on engines and equipment?

(PowerPoint Slides 3 and 4)

- I. For agricultural equipment to operate efficiently it must be properly maintained.
 - A. **Preventive maintenance** is the performing of practices to keep equipment in good working condition. These practices would include changing fluids, cleaning components, and replacing filters. Properly maintaining agricultural equipment requires skill, practice, and quality management.
 - B. Know the equipment by reading the operator's manual and follow the recommended maintenance schedule. For future reference keep a history record on the equipment you are maintaining. Follow all manufacturers' recommendations to maintain the value and extend the service life of the equipment.
 - C. It is important to keep equipment clean especially in the case of internal combustion engines. Use only fluids, filters, and products that meet or exceed the manufacturers' recommendations. Always be careful to measure the correct amount of fluids being added to engines or gearboxes.

Display a copy of the owner's manual from a piece of equipment. Using classroom discussion, reinforce the importance of practicing preventive maintenance.

Objective 2: Explain the safety practices to follow when servicing equipment.

Anticipated Problem: What are the safety rules to follow when servicing agricultural equipment?

- II. Operator safety is always the first concern when dealing with agricultural equipment. Whenever maintenance practices are undertaken the guidelines below should be followed:

(PowerPoint Slide 5)

- A. Read and follow all instructions in the operator's manual.
- B. Always follow the recommendations to use protective eyewear, clothing, and footwear.
- C. Use jackstands, engine stands, and other supports when working around raised or dismantled equipment.

(PowerPoint Slide 6)

- D. Observe caution around fuels and flammable materials while servicing equipment.
- E. Operate internal combustion engines only in well-ventilated areas.
- F. Place machines in park and lower implements before working on them.

(PowerPoint Slide 7)

- G. Work in well-lighted and properly ventilated areas.
- H. Regularly clean the floor and remove obstacles and fluids.
- I. Handle batteries safely since they produce hydrogen gas which is very explosive.
- J. Keep fire extinguishers and smoke detectors in shop work areas.

(PowerPoint Slide 8)

- K. Use caution when working around high pressure, such as in the pressurized cooling and hydraulic systems.
- L. Use protective hearing devices when working in loud areas for extended periods of time.
- M. Safely dispose of used fluids to protect people, animals, and the environment.
- N. Know all the safety emblems and warning signs used for agricultural equipment. There are nine safety colors recognized by national safety organizations. These nine colors are:

(PowerPoint Slides 9, 10, and 11)

1. Red = Danger
2. Orange = Warning
3. Yellow = Caution
4. Blue = Information
5. Green = Safety
6. Black and Yellow Diagonal Stripes = Radioactivity
7. White is used to mark the direction of traffic flows and to segregate work areas around objects.
8. White and black stripes are used as traffic markings.
9. Gray is used on floors or work areas in the shop.

Use TM: 4-1 to illustrate examples of safety emblems. Tie the content of this objective to previous units on safety procedures.

Objective 3: Identify common maintenance practices associated with major engine systems.

Anticipated Problem: What are some common maintenance practices carried out on engine systems?

- III. Even with proper preventive maintenance, engines will periodically experience problems and need repair. Locating the problem is important to correcting it. Usually, the problem can be traced to the ignition, fuel, or compression systems. If one of these three systems is not functioning properly, the engine will run poorly or not at all. The following are maintenance practices associated with these and other systems.

A. The ignition system provides the spark for spark ignition engines. The electrical spark may be generated from a magnetic field created by magnets in a magneto ignition system. A battery ignition system's spark is generated by the battery or charging system. Because several problems can be traced to the ignition system, it is important to check it in a logical sequence. A logical sequence is as follows:

(PowerPoint Slides 12 and 13)

1. Inspect the spark plug to insure that the correct plug is being used. Make sure the gap is set according to specifications.
 2. Inspect the spark plug wire to determine if it is correctly in place.
 3. Use a spark tester to check the spark output by connecting the tester between the spark plug and the spark plug wire. If there is a weak spark or no spark, it could indicate a bad armature or the wire is grounded. Inspect the wire for bare spots and to insure that the wire is not grounded. Lack of a spark on magneto ignition systems can be caused by corrosion on the flywheel or armature legs.
 4. If a strong spark is occurring, it could indicate that the timing of the spark may be off. This could mean that there is a problem with the flywheel. The flywheel is held in correct position with the crankshaft by a soft metal key. If the engine is subjected to an abrupt stop, the same key may be sheared off. The shearing of a key decreases the chances that the crankshaft will break. However, if the key is partially sheared, the timing will be off. The following is a list of steps in checking the key:
 - a. Remove the shroud from the engine.
 - b. Take off the screen and remove the flywheel nut using the correct tools. Some of the flywheel nuts will have left-hand threads.
 - c. Inspect the flywheel. A sheared or partially sheared key should be apparent. To replace the key, the flywheel will have to be removed by using special pullers that will not cause the flywheel to break. To pull the flywheel, remove the crankshaft nut, install and tighten the puller, and tap the center bolt of the puller with a light blow. The impact of the blow should cause the wheel to pop off of the tapered shaft.
 - d. Replace the defective key in the key way and reassemble the unit.
- B. Once problems with the ignition system have been ruled out, the next step is to check the fuel system. The fuel system's function is to deliver the correct amount of clean fuel to the combustion chamber. When checking for fuel system problems, the following items should be inspected.

(PowerPoint Slides 14 and 15)

1. A simple first step is to insure that there is gas in the gas tank. Although this is a very basic factor, it is one that is often overlooked.
2. If the engine refuses to start, remove the spark plug and check it for gasoline. If the odor of gasoline is present on the plug or in the cylinder, the fuel system is probably working correctly. If the spark plug is wet and shows signs of moisture, it could be fouled and should be dried and replaced.

3. If the spark plug does not smell of gasoline, the flow of gas from the fuel tank to the carburetor should be checked. Inspect for blockages in the fuel line or carburetor. The diaphragm of the carburetor may be torn. This prevents the gas from being transferred from the fuel line to the carburetor.
 4. Flooding might be another potential cause of the problem. **Flooding** is an excessive amount of gasoline in the carburetor. It may be caused by applying the choke for too long. Allowing the engine to sit for a few minutes permits the excess gasoline to be dispersed.
- C. The compression system is the most difficult to repair. It contains many parts. Most are located within the engine. Repairs require disassembly of the engine in order to reach the parts.

(PowerPoint Slide 16)

1. Compression of an internal combustion engine can be measured by performing compression tests. A **compression gage** is a tool used to determine compression pressure of the cylinder as recommended by the manufacturer. A common procedure for checking compression is to remove all spark plugs, install the compression gage in a spark plug port and turn the engine over. The compression gage should be used to check each cylinder. If the compression system is weak or defective, a decision has to be made whether to replace or overhaul the engine.
 2. The decision to rebuild an engine should not be taken lightly. It involves a great deal of disassembly and reassembly work.
- D. The engine cooling system is designed to manage the heat produced by the combustion of the air and fuel. There are two basic kinds of cooling systems, liquid cooled and air cooled. Common maintenance practices include:

(PowerPoint Slide 17)

1. General maintenance practices for liquid cooling systems are:
 - a. Visually check the hoses and belts for leaks and cracks.
 - b. Maintain the proper coolant level in the system.
 - c. Keep the system clean.
 - d. Use the recommended coolant in the required mixture, and change it according to manufacturer's recommendations.
 - e. Use a pressure tester to pressurize the system and check for leaks.
 - f. Use a coolant hydrometer to check the specific gravity of the coolant. This determines the proportion of antifreeze to water.
 - g. Check the condition of the system's fan. If the fan is electrical, the electrical sensor can be checked with an ohmmeter. If the system uses a mechanical fan, the fan belt should be checked for the correct amount of deflection.

(PowerPoint Slide 18)

2. General maintenance practices for air cooling systems are:
 - a. Keep the system clean by removing dirt that can clog air passages.
 - b. Make sure the precleaner which is usually a screen is in place.
 - c. Check the fan to make sure it is operating properly and can move air freely.

- d. Make sure that all shrouds and engine shields are in place to allow for proper circulation of air.

(PowerPoint Slide 19)

- E. Proper maintenance of the lubrication system of an internal combustion engine is critical. General maintenance practices include:
 1. Check the engine oil level regularly.
 2. Change the oil and filters according to manufacturer recommendations. Use the correct oil. The general procedure for changing oil and filters is as follows:
 - a. Make sure the machine or engine is in a safe level position.
 - b. Operate the engine until it has warmed up.
 - c. Shut off the engine and remove the drain plug. The draining oil should be caught in a safe container so that the oil can be recycled.
 - d. Allow the oil to drain for several minutes.
 - e. Clean dirt from the oil filter area and remove the filter.
 - f. Install a new filter. Be sure the filter gasket is oiled and properly installed. The filter should not be over tightened.
 - g. Fill the crankcase with the recommended amount of oil.
 - h. Start the engine and allow it to run for about two minutes. Check to make sure the system has the correct operating pressure.
 - i. Check the engine for leaks.
 - j. After shutting the engine off and waiting several minutes, recheck the engine oil level.
- F. The air intake system cleans dirt and other particles from the air and brings it into the combustion chamber. This should occur without severe restrictions to the free flow of the air, which would decrease the engine output. General procedures for testing the air intake system are:

(PowerPoint Slide 20)

1. Connect a vacuum gage to the intake manifold.
2. Allow the engine to run for a few minutes.
3. Record the gage reading with the engine operating at fast-idle speed.
4. Compare the readings with the manufacturer's specifications.
5. Inspect the intake system for possible restrictions and leaks.

The content of this objective has been presented in its basic form. Use TM: 4-2 to illustrate the major parts of the spark plug. TM: 4-3 will be effective in providing an example of the parts of a carburetor. Instruction and practice with an actual engine will help students to apply the objective's content.

Review/Summary: The review and summary of the lesson may be accomplished by viewing the transparency masters with the students. **(PowerPoint Slide 21)** A discussion should be performed with students before proceeding with the laboratory activities and testing.

Application: Application should involve the use of a student lab activity using the attached lab sheet.

Recognizing Safety Colors—LS: 4-1

Evaluation: Objectives should be reviewed by the students. Laboratory activities should be performed before the written test is given to students.

Answers to Sample Test:

Matching

1. A
2. D
3. B
4. C
5. G
6. F
7. E

Fill-in-the-blank

1. Manual
2. Park
3. Hydrogen gas
4. Intervals
5. Record
6. High pressure

Short Answer

1. Ignition, fuel, compression
2. Date, hours used, oil change, air cleaner service, spark plug service (Answers may vary.)

Applying Preventive Maintenance Practices

Name: _____

Matching: Match each word with the correct definition.

- | | |
|---------------------------|----------------------|
| a. preventive maintenance | d. flooding |
| b. maintenance intervals | e. air intake system |
| c. compression gage | |

- _____ 1. Performing periodic practices to keep equipment in good working condition.
- _____ 2. Indicates an excessive amount of gasoline in the carburetor.
- _____ 3. Service based upon length of time or operating conditions.
- _____ 4. Used to determine compression pressure of the cylinder.
- _____ 5. Cleans dirt and other particles from the air and brings it into the combustion chamber.

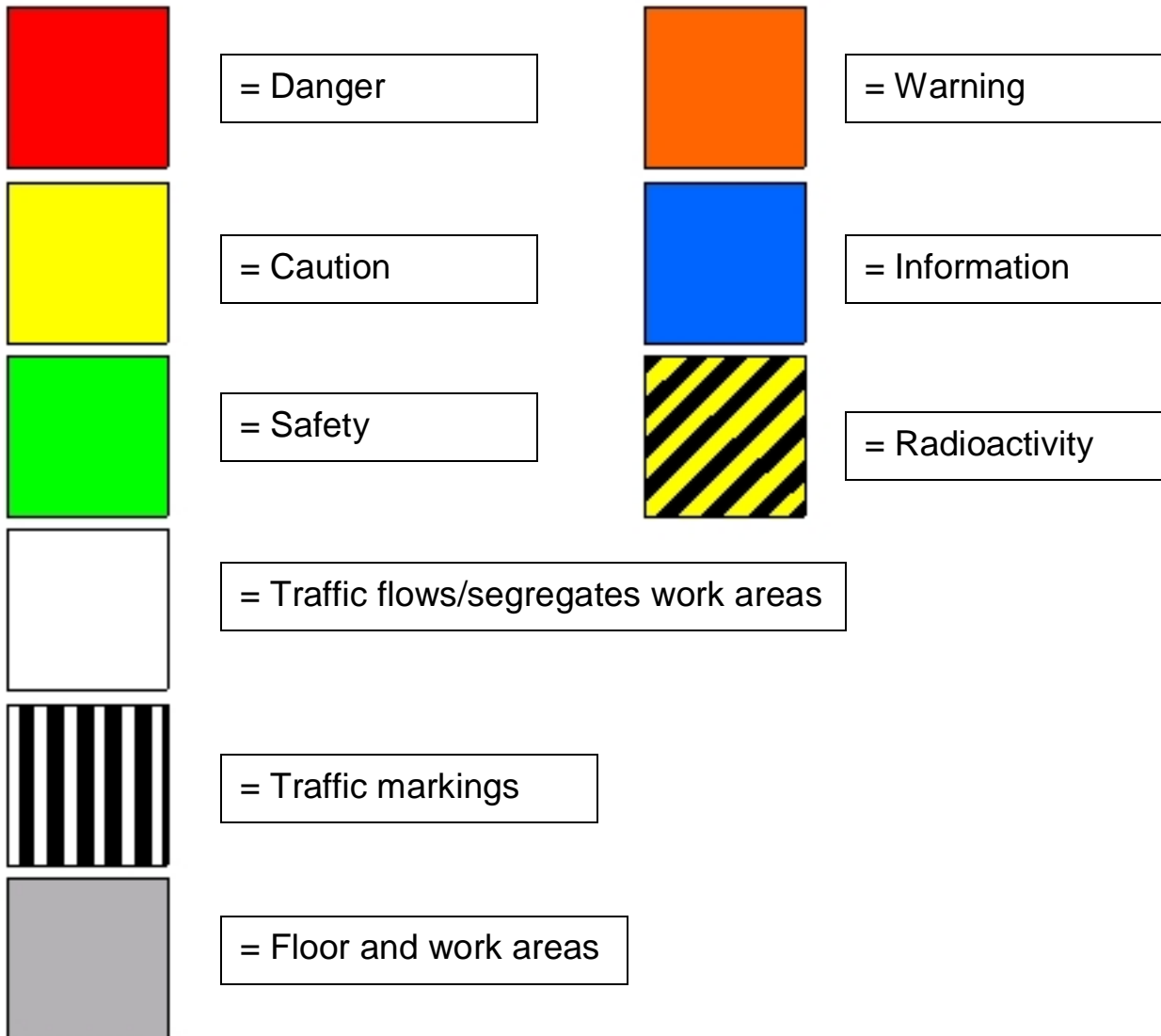
Fill-in-the-blank: Complete the following statements.

1. Know the equipment by reading the operator's _____ and follow the recommended maintenance schedule.
2. Always place machines in _____ and lower implements before working on them.
3. Handle batteries safely since they produce _____ which is very explosive.
4. Regular service _____ are always based on time in hours or seasonal considerations such as summer and winter.
5. Know and keep a history _____ on the equipment you are maintaining for future reference.
6. Use caution when working around _____ such as the pressurized cooling and hydraulic systems.

Short Answer: *Answer the following questions.*

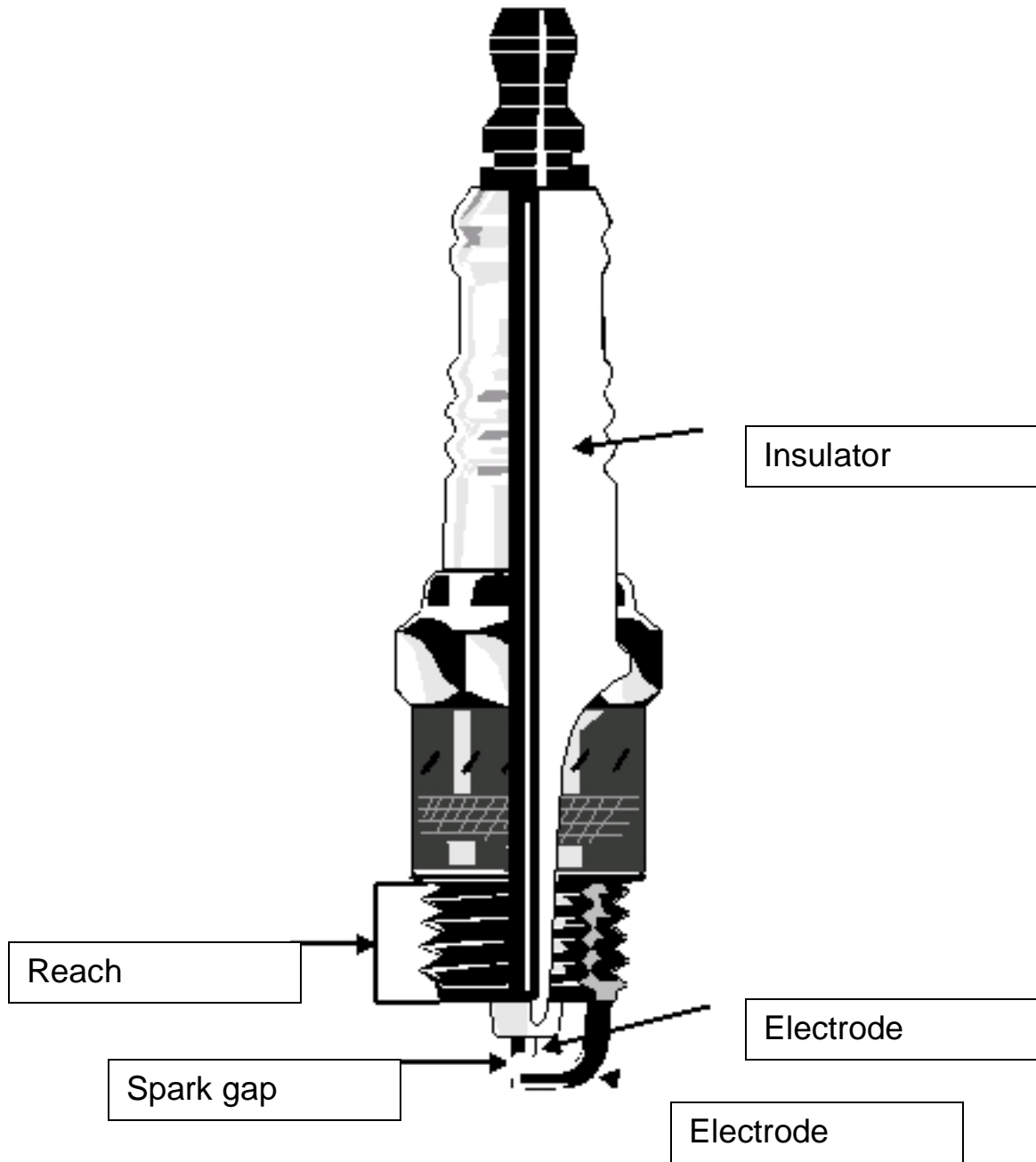
1. List the three systems to check if there are engine problems.
2. Name three items found and recorded on an engine log.

NINE NATIONALLY RECOGNIZED SAFETY COLORS

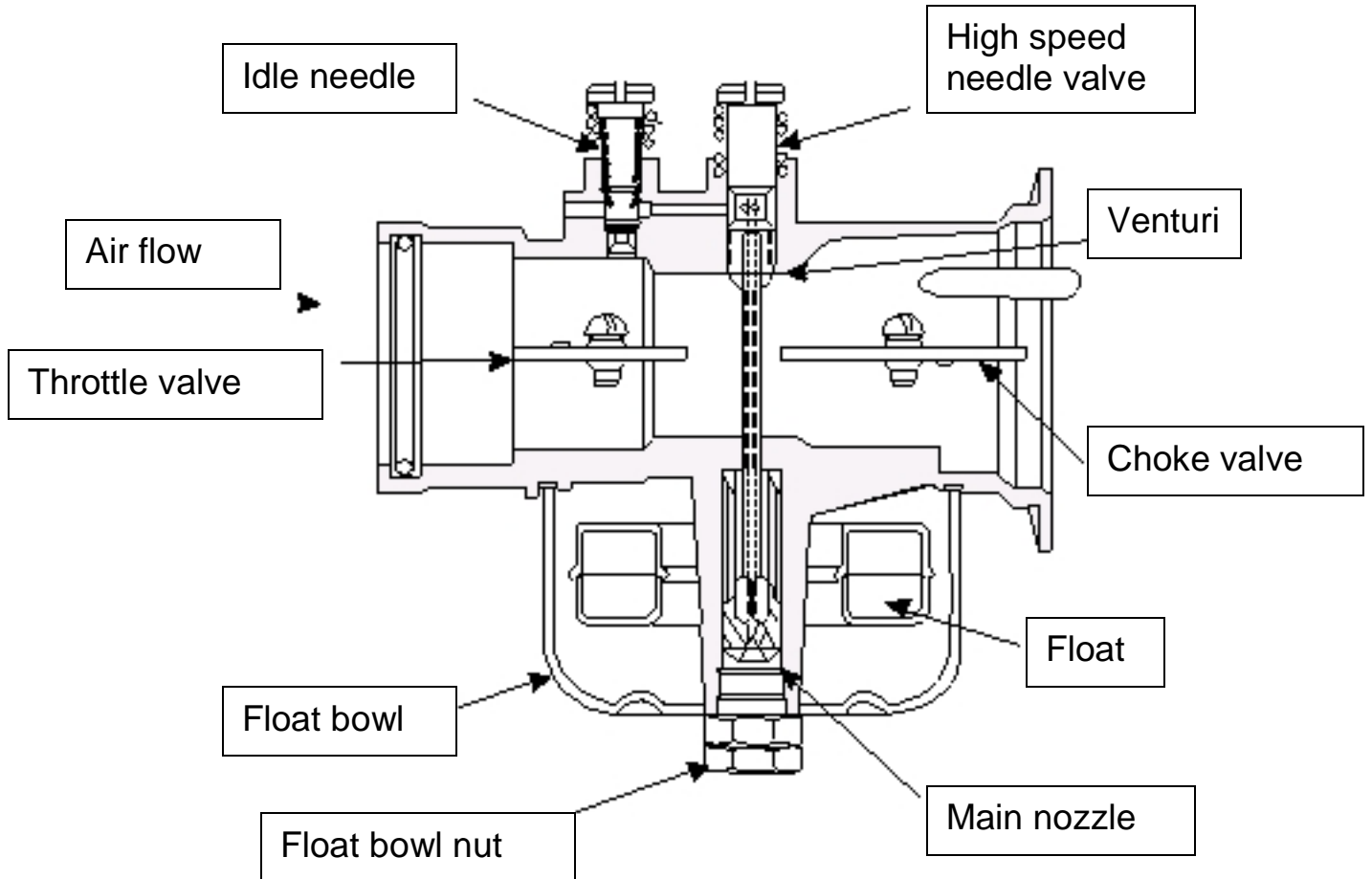


TM: 4-2

MAJOR PARTS OF A SPARKPLUG

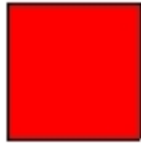
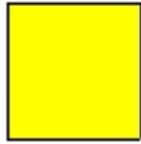
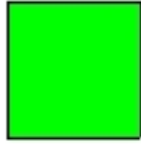
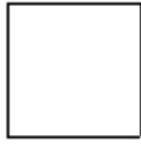
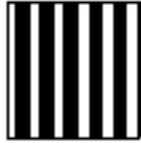

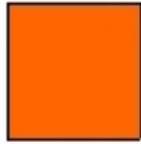




PARTS OF A CURBURETOR



RECOGNIZING SAFETY COLORS

Instructions: Next to each color block, list what the color stands for.

	= _____
	= _____
	= _____
	= _____
	= _____
	= _____
	= _____
	= _____
	= _____