Unit C: Agricultural Power Systems

Lesson 3: Measuring Engine Components and Specifications

Student Learning Objectives:

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

1. Identify measuring and testing equipment for internal combustion engines.
2. Identify the specifications of an internal combustion engine.
3. Explain four major specifications to be checked on small engines.

Recommended Teaching Time: 2 hours

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

Briggs & Stratton. *Single Cylinder "L" Head Repair Manual*. 1999.

Hoerner, Harry J., et al. *Small Gasoline Engines, Operation, Repair and Maintenance*. Minneapolis, Minnesota: Hobar Publications, 1992.

List of Equipment, Tools, Supplies, and Facilities:

- Writing surface
- PowerPoint Projector
- PowerPoint Slides
- Transparency Masters
- Small gasoline engine
- Small gasoline engine tools and instruments

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

- Compression gage
- Dial indicator
- Flat feeler gage
- Inside micrometer set
- Micrometer caliper
- Plastigage
- Round-wire gage
- Tachometers
- Telescoping Gage
- Torque wrench

Interest Approach:

Display a specification chart of an internal combustion engine. Ask the students if they know how the specifications are determined.

SUMMARY OF CONTENT AND TEACHING STRATEGIES

Objective 1: Identify measuring and testing equipment for internal combustion engines.

Anticipated Problem: What are some of the instruments used for measuring internal combustion engines?

(PowerPoint Slide 3)

I. Proper selection and use of tools in an important asset to successful engine repair. The following tools are commonly used in measuring engine components.

A. The ***micrometer caliper*** is a precision measuring tool for taking outside measurements. It has accuracy to the nearest micrometer.

1. An ***inside micrometer*** may be used to determine the inside of the cylinder. It is a one piece micrometer with a handle that allows it to be inserted into the cylinder bore.
2. Often, a ***flat feeler gage*** is used to recognize the spacing between two surfaces. They measure in increments of .02 millimeters. Another tool performing the same type of measurements in the ***dial indicator***, which is made up of a movable tip that records the readings of the dial needle on a circular scale.

(PowerPoint Slides 4 and 5)

3. The ***round-wire gage*** is used in measuring the electrode gap of spark plugs. It typically measures in .02 millimeters.
4. ***Plastigage*** is a thin, plastic, threadlike material which is used to measure the clearance between the bearing journal on a crankshaft and the bearing rod cap.

(PowerPoint Slides 6 and 7)

B. It is important to follow the manufacturer's specification for the torque which bolts and nuts must be tightened to, depending on their size and grade. Every bolt has a torque specification. A ***torque wrench*** is the hand tool used for this purpose and will be one of three different designs: click-type, torsion-bar type, or flexible-beam type.

1. A ***compression gage*** is a rubber tipped or threaded dial instrument that helps in determining if there is a problem with the cylinder, piston rings, valves, or gaskets. It measures the compression pressure of the engine in pounds per square foot. In testing, one cylinder engines have normal readings between 400-1000 kilopascals (kPa).

(PowerPoint Slides 8 and 9)

2. The ***telescoping gage*** is a tool used for measuring inside diameter.
3. There are three common types of tachometers used with internal combustion engines. ***Tachometers*** are used for reading revolutions per

minute (RPM). The speedometer-type, vibration-type, and electronic-type are used to accurately check engine revolutions per minute.

Display TM: 3-1, TM: 3-2, and TM: 3-3. They will provide good illustrations of various measuring instruments. A good application would be to have students practice using the instruments on an engine in your shop or lab.

Objective 2: Identify the specifications of an internal combustion engine.

Anticipated Problem: What are the specifications of an internal combustion engine?

(PowerPoint Slide 10)

II. Charts are provided by engine manufacturers detailing the exact specifications to increase performance and prolong service life.
   A. Specifications are related to engine size and work requirements.
      1. The model number must be observed before determining the correct settings for any engine.
      2. Torque specifications are listed in Newton-centimeters. The flywheel nut, cylinder head, connecting rod cap, and crankcase cover are examples of items on a small engine chart.
   B. Clearances of the intake and exhaust valves are critical to the operation of four-stroke engines.
      1. The cylinder bore requirements may be found in the column listing standard measurements in centimeters.
      2. All other specifications center around the crankshaft and the areas it affects inside the engine.

Obtain a copy of the manufacturer's specifications for an engine. Review the specifications with the class. Use classroom discussion to identify any concepts that need to be covered in more detail.

Objective 3: Explain four major specifications to be checked on small engines.

Anticipated Problem: What are four major specifications that are commonly checked on small engines?

(PowerPoint Slide 11)

III. Every engine requires four basic elements to run. The specifications on these elements should be routinely checked in order to maintain engines in good running order.

(PowerPoint Slide 12)

   A. Fuel—engine owners should use only the fuel recommended by the manufacturer. Using improper types of fuel will lead to major engine problems. If fuel type is correct and the engine does not run properly, the carburetor may need to be adjusted. General guidelines for carburetor adjustments are as follows:
      1. Turning the needle valve clockwise will create a leaner fuel mixture.

2. Turning the needle counter clockwise will create a richer fuel mixture.

(PowerPoint Slide 13)

B. Oxygen—engines need to take in clean air in order for combustion to occur. Air filters should routinely be checked and cleaned to insure that the engine is supplied with the proper amounts of oxygen.

(PowerPoint Slide 14)

C. Compression—if the engine does not have compression, it can be indicative of more serious problems. A quick way to check if a small engine has compression is to pull the starter rope. If, when pulled, there is no resistance against the starter rope, the engine lacks compression.

(PowerPoint Slides 15 and 16)

D. Ignition—spark plugs should be routinely checked. This can be done by removing the plug. If the plug's electrode is covered with carbon deposits it may be cleaned with a wire brush or simply replaced. When the spark plug is reinstalled, the plug gap should be adjusted properly as recommended by the manufacturer.

TM: 3-4 will provide a good example of using a plug gap tool to set the gap in a spark plug. If these tools are available, have the students practice using them.

Review/Summary: The review and summary of the lesson may be accomplished by viewing the transparency masters with the students. **(PowerPoint Slide 17)** A discussion should be performed with students before proceeding with the laboratory activities and testing.

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

Fill-in-the-blank

1. Newton-centimeters
2. Needle valve
3. Cylinder
4. millimeters

Short Answer

1. Fuel, oxygen, compression, and ignition
2. Speedometer-type, vibration-type, and electronic-type

Sample Test

Measuring Engine Components and Specifications

Name: _____

Matching: *Match each word with the correct definition.*

a. compression gage	e. plastigage
b. dial indicator	f. telescoping gage
c. flat feeler gage	g. torque wrench
d. micrometer caliper	h. tachometer

_____ 1. Thread-like plastic material used to measure between parts.

_____ 2. A tool screwed or held to a spark plug opening measuring kilopascals.

_____ 3. Testing tool used for reading revolutions per minute (RPM).

_____ 4. Used for tightening parts by determining the rotary efforts placed upon a fastener.

_____ 5. Pieces of flat metal manufactured to predetermined thicknesses.

_____ 6. Tool having two movable spring loaded parts allowing for expanded measurements.

_____ 7. Displays a needle on a circular scale showing differences in dimensions.

_____ 8. Measuring tool for taking outside linear measurements.

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

1. Torque specifications are listed in _____
2. A rich carburetor mixture may be corrected by adjusting the _____ _____ clockwise.
3. The _____ bore requirements may be found in the column listing standard measures in centimeters.
4. The electrode gap of spark plugs is typically measured in _____.

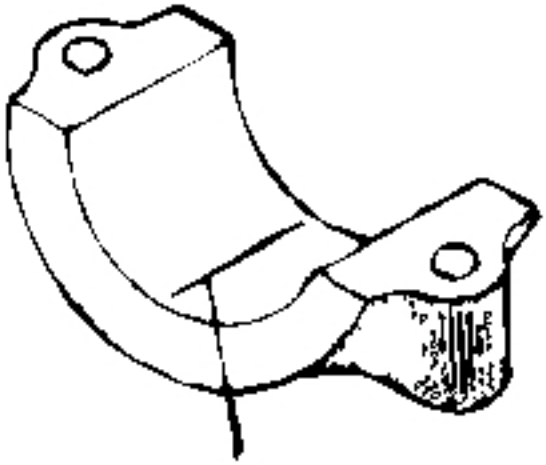
***Short Answer**: Answer the following questions*.

1. Name four basic elements engines require in order to run.

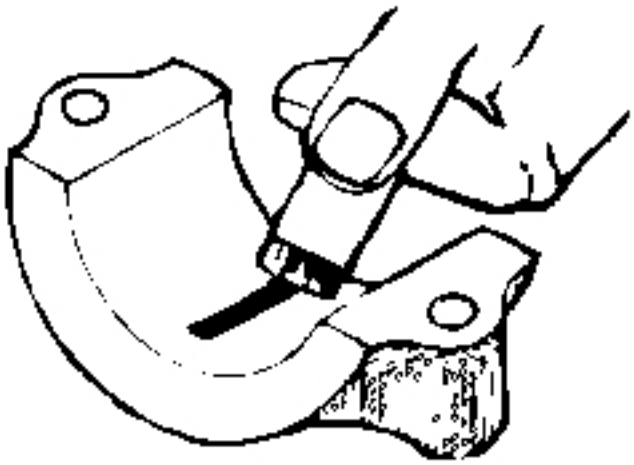
2. What are the three types of tachometers?

TM: 3-1

PLASTIGAGE

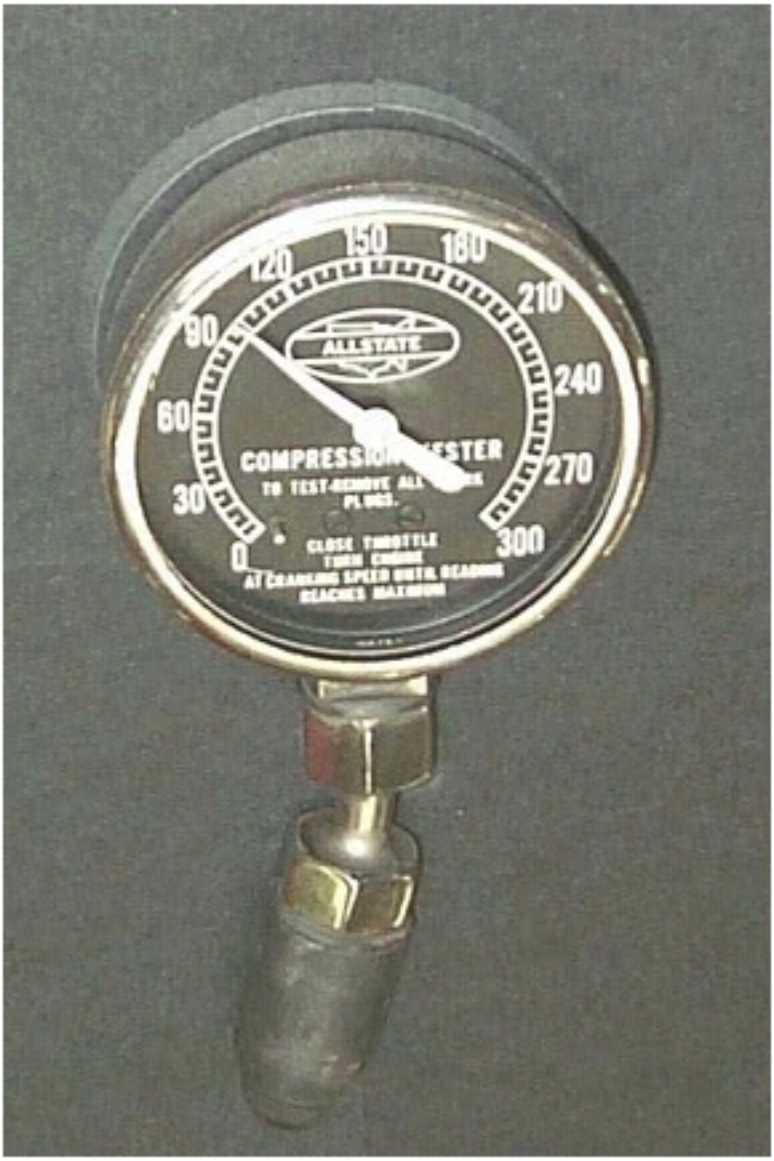


Plastigage



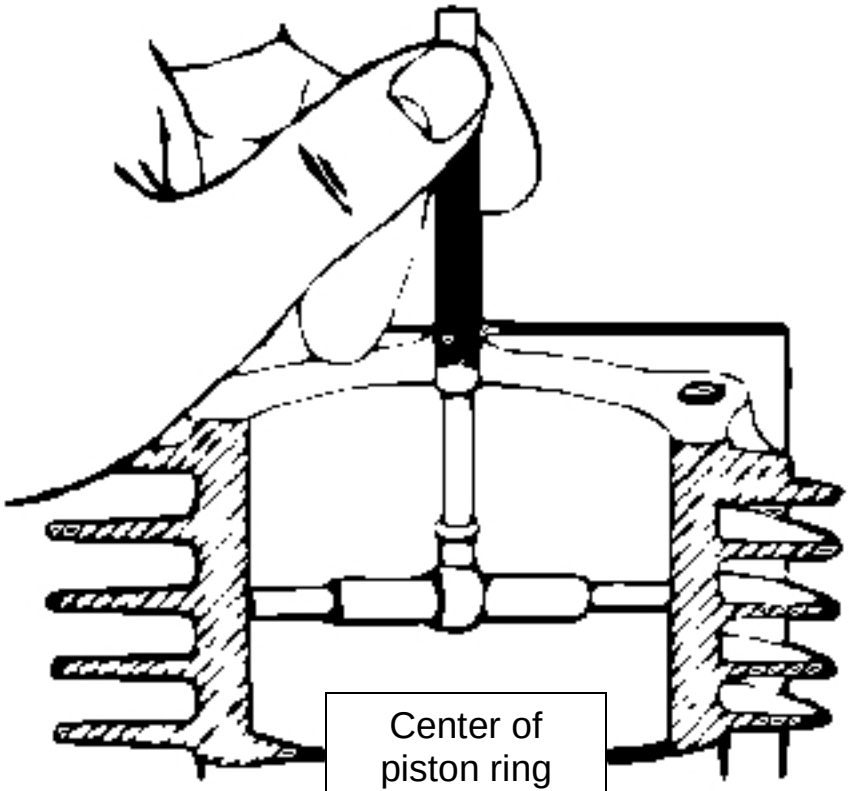
TM: 3-2

COMPRESSION GAGE



TM: 3-3

TELESCOPING GAGE



Center of piston ring travel

Measure at six points

TM: 3-4

SETTING THE GAP ON A SPARK PLUG