A EN 201 – Agricultural Power Units
Using the Micrometer, Other Measuring Devices, & Small Engine Specialty Tools

Objectives:

The Student Will Be Able To:

1. Summarize use of the micrometer , (parts, reading, operation, handling, and care);
2. Identify and describe the uses of the flat feeler gauge;
3. Identify and describe the torque wrench and discuss the measures of torque;
4. Identify and describe various spark plug adjustment tools;
5. Describe the use of plastigage;
6. Describe the compression gauge and list the potential causes for a loss of compression;
7. Identify and describe each specialty tool; and
8. Operate each of the specialty tools discussed.

Required Reading For Quiz:

1. Chapter 12, Engines, Fundamentals of Service; John Deere
2. This laboratory chapter

I. The Micrometer:

One of the more common measuring devices used on engines is the micrometer, shown in Figure, 2.1. Since it is designed to measure machine work where tolerances are quite close, it is essential that the micrometer be very accurate. In most cases, the micrometer is an expensive but very useful instrument, which is quite easy to use once the main working parts and a few basic operating principals are understood.

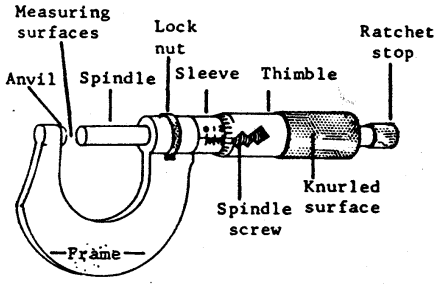


Fig. 2.1, An Outside One-Inch Micrometer

It is important to first understand the marks that are on the sleeve and the thimble. If you turn the thimble until the "0" marks on the thimble and the sleeve come together, the micrometer is at its smallest measurement possible. On the one- inch (1") micrometer, shown in Figure 2.2, the measurement is exactly 1.000". A micrometer should occasionally be checked for accuracy. Micrometer manufacturers will usually provide information on proper adjusting methods.

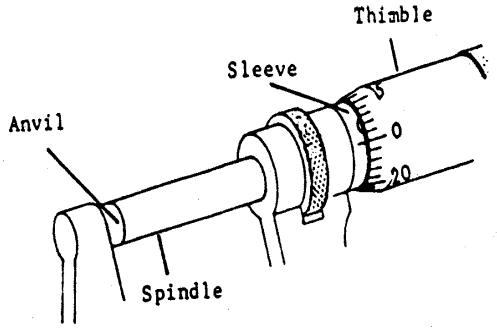
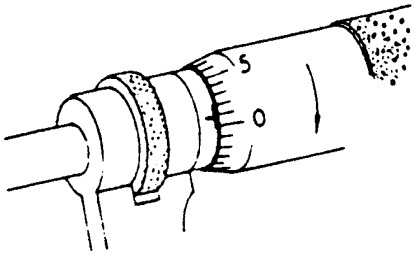


Fig. 2.2, Checking the Accuracy of a One-Inch Micrometer

The marks on the thimble represent .001 inch, (one thousandth of an inch), each. If you turn the thimble away from you to the very next mark on the thimble, as in Figure, 2.3, and if this is a one-inch micrometer, the spindle will be exactly .001 inch from the anvil.



0.001

Fig. 2.3, One Thousandths of an Inch (.001")

One complete revolution of the thimble is equal to .025 inch, (twenty five thousandths of an inch), because each complete revolution of the thimble moves it one full mark on the sleeve. In other words, each mark on the sleeve is equal to .025 inches of movement for the spindle. Every fourth line on the sleeve is a little longer than the other lines. These longer marks stand for .1 inch, (one tenth of an inch), each.

To find out how much the micrometer is open, (the distance between the measuring surfaces), the marks on the sleeve may read like an ordinary rule. Remember that the numbers 1, 2, and 3 mean .100 inch each, or .100 inch, .200 inch, and .300 inch. To this, add the thousandths that show on the thimble, (as discussed earlier). For example, the readings in Figure, 2.4 are: "A" = .300, and "B" = .337 (.300 + .025 + .012).

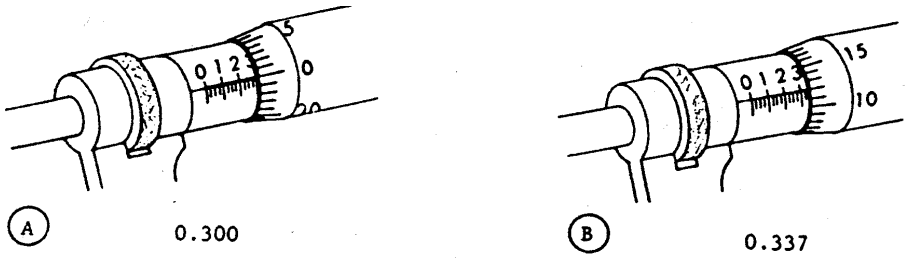


Fig. 2.4, Reading the Micrometer

A number of different types of micrometers are manufactured for special uses. The outside micrometer, (the type we have shown in Figures, 2.1-2.4), is the most common type. It is used to measure the outside diameter of round objects, and the width and/or thickness of flat pieces.

The inside micrometer is used to measure the diameter of a hole -- such as the inside of diameter of an engine cylinder sleeve. The depth micrometer, another common type, is used to measure the depth of holes, grooves, and /or slots. Regardless of type, micrometers are all read in the same manner.

Micrometers are usually designed to measure within a 1-inch range, such as a 1-inch micrometer would be able to measure distances between 0 inch and 1 inch. To measure an engine's piston that measures approximately 2 1/4 inches in diameter, you would need a 3-inch outside micrometer which would measure distances between 2 and 3 inches. Some larger micrometers have adapter rods, these permit their use over a longer range of distances, such as 0 through 8 inches.

How to Care for a Micrometer:

The micrometer is a delicate tool and should be handled carefully. These suggestions should be followed for the care of the micrometer in order to insure that it will continue to give accurate readings for many years.

1. Avoid dropping the micrometer. Handle it carefully and lay it where there is no danger of it falling.
2. Before using a micrometer, wipe it off and pull a piece of paper between the anvil and face of the spindle.
3. Open the spindle to insert the work. Do Not force or slide the work to be measured between the spindle and the anvil.
4. Some manufacturers suggest that the thimble be rolled along the hand or arm for rapid adjustments to the approximate size. Others suggest that the thimble be turned by the fingers only. Holding the thimble and twirling the frame to open and close the micrometer will cause excessive wear on the screw and this should never be done.
5. Learn how to tighten the spindle sufficiently to get an accurate reading. If the spindle is repeatedly tightened too much, the frame will be sprung and the micrometer made useless.
6. Heat will affect the accuracy of the micrometer and excessive heat can cause distortion of the parts. Use and store the micrometer so it is not affected by heat.

II. The Dial Caliper:

The dial caliper, Figure 2.4a, is also a tool used for precise measurements, but is usually not as accurate as the micrometer. What the dial caliper looses in accuracy is compensated for in convenience. The dial caliper reads in a manner that is very similar to that of the micrometer, with a standard accuracy of up to one thousandth of an inch, (0.001"). The single most important attribute that gives the dial caliper it's convenience is that it is able to measure a number of different spans and take a number of different measurements. That is, the dial caliper is one tool that could measure from zero to one inch or zero to six inches or any measurement between, and has the capability to measure Inside Diameters, Outside Diameters, and Depth.

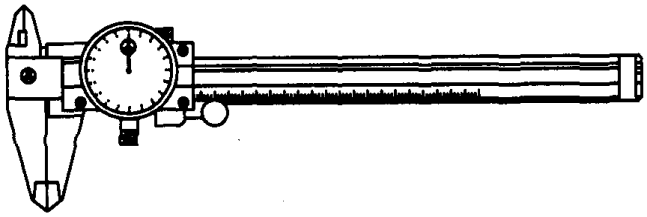


Fig. 2.4a, The Dial Caliper
Courtesy of Briggs & Stratton Corp.

III. Flat Feeler Gauge:

The Flat Feeler Gauge, shown in Figure, 2.5, this is one of the most widely used tools for gap measurement in mechanics situations. Made up of numerous flat metal blades of varying thickness, this tool is designed to precisely set and measure air gaps. An individual blade may be used, or several may be stacked together to obtain a particular thickness.

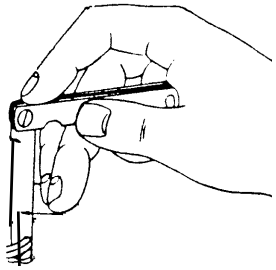


Fig. 2.5, Flat Feeler Gauge
Courtesy of Briggs & Stratton Corp.

IV. Torque Wrench:

The torque wrench, (Figure, 2.6), is another very important tool when working with small engines. The torque wrench is used to measure the amount of torque (tightness) applied to a nut or bolt. This measure of *tightness* is very important in situations when two or more nuts or bolts must be consistently torqued. The most common torque wrench is the *deflecting beam torque wrench* ,(pictured below), but more accurate wrenches such as micrometer adjustable and dial torque wrenches are available.

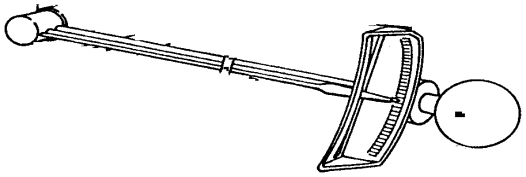


Fig. 2.6, Torque Wrench
Courtesy of Briggs & Stratton Corp.

Torque is commonly measured in *inch* or *foot pounds* , (in.lbs or ft.lbs). It is very important to use the proper measure of torque, whether it be inch or foot pounds. If the proper measure is not used, it could result in damage to the engine. Torque may also be measured in inch ounces, (in.oz.), centimeter kilograms, (cm.kg.), meter kilograms, (m.kg.), or Newton meters, (Nm).

V. Spark Plug Adjustment Tools:

Spark plug adjustment tools will commonly have the ability to measure and adjust a spark plug's electrode gap. Two common types of spark plug adjustment tools are the progressive dial type and the wire feeler gauge type, (pictured below in Figure, 2.7). Both work equally well to measure and adjust a spark plug's electrode gap. A properly gapped spark plug will ensure proper performance and longer spark plug life.

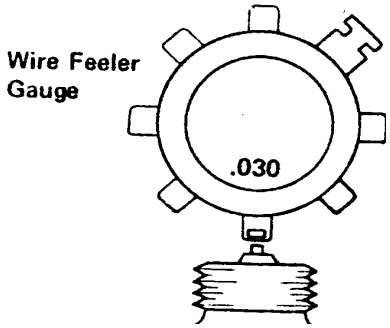


Fig. 2.7, Wire Feeler Gauge
Courtesy of Briggs & Stratton Corp.

VI. Plastigage:

Plastigage, (Figure, 2.8), is a tool that measures minute gaps between moving parts. Our main use for plastigage will be for measuring the clearance between the connecting rod and the crankshaft pin.

The thin plastic rod is placed in the gap to be measured. Next, the two pieces that make the gap are reassembled and carefully tightened to the correct torque. The two pieces are then again disassembled, revealing the flattened piece of plastigage. The width of the flattened plastigage is then compared to a chart which will give the corresponding clearance gap of the two connected moving parts.

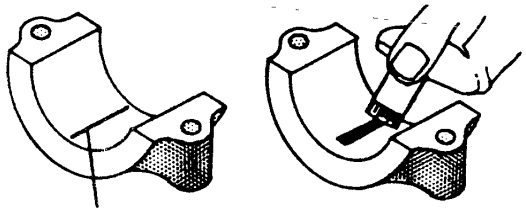


Fig. 2.8, Plastigage (Before/After)

VII. Compression Gauge:

The compression gauge, (Figure, 2.9), is used to determine how many pounds per square inch, (psi), of pressure the piston is exerting on the cylinder head. If a cylinder has lost compression it can not properly condense the air-fuel mixture created by the carburetor. Thus, there is a loss of power and efficiency that may later result in starting failure. A loss of compression can be caused by one, a combination of, or all of the following:

1. Loose spark plug;
2. Loose head bolts;
3. Faulty head gasket;
4. Worn or faulty rings;
5. Worn or faulty valves; and
6. Scared cylinder wall.

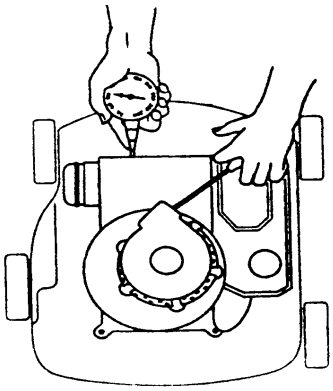
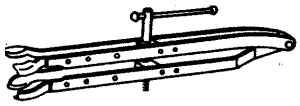


Fig. 2.9, Compression Gauge

VIII. Small Engine Specialty Tools:

A. Valve Spring Compressor:

•Used to remove and install valve springs.



Courtesy of Briggs & Stratton Corp.

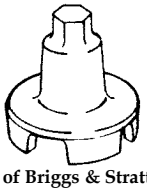
B. Flywheel Holder:

•Holds the flywheel secure while removing or installing the flywheel nut or starter clutch. Used in conjunction with the starter clutch wrench or socket wrench.

Courtesy of Briggs & Stratton Corp.

C. Starter Clutch Wrench:

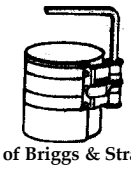
•Used to remove or install the starter clutch assembly. Used in conjunction with the flywheel holder.



Courtesy of Briggs & Stratton Corp.

D. Ring Compressor:

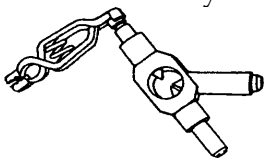
•Compresses the piston rings so that the piston is able to be returned to the cylinder.



Courtesy of Briggs & Stratton Corp.

E. Ignition Spark Tester:

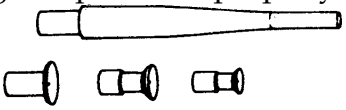
•Checks for ignition spark. There are several types and styles of ignition spark testers made and the majority of them are very effective.



Courtesy of Briggs & Stratton Corp.

F. Valve Lapping Tool:

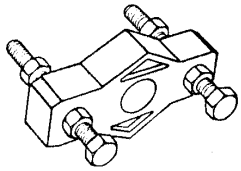
•Used along with a grinding compound to properly seat valves.



Courtesy of Briggs & Stratton Corp.

G. Flywheel Puller/Remover:

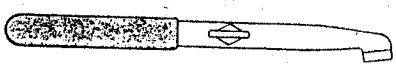
•Used in removing the flywheel.



Courtesy of Briggs & Stratton Corp.

H. Carburetor Screwdriver:

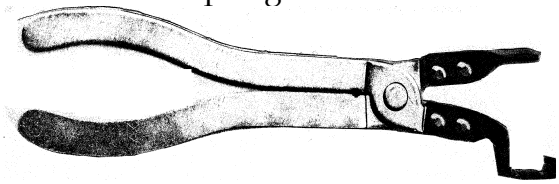
•Used to remove and install Pulsa-Jet carburetors and fuel tank for horizontal crankshaft models.



Courtesy of Briggs & Stratton Corp.

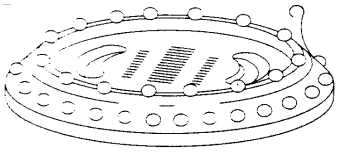
I. Condenser Spring Compressor Tool:

•Used to compress the condenser spring.



J. Wire Tachometer:

• Used to set idle and top no load RPM.



Courtesy of Briggs & Stratton Corp.

K. Carburetor Adjuster:

- Used to adjust Vacu-Jet and Pulsa-Jet carburetors

Courtesy of Briggs & Stratton Corp.

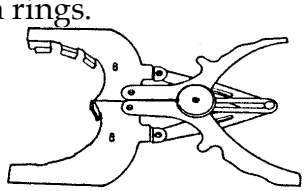
L. Telescoping Gauge:

- Measures cylinder boar.

Courtesy of Briggs & Stratton Corp.

M. Piston Ring Expander:

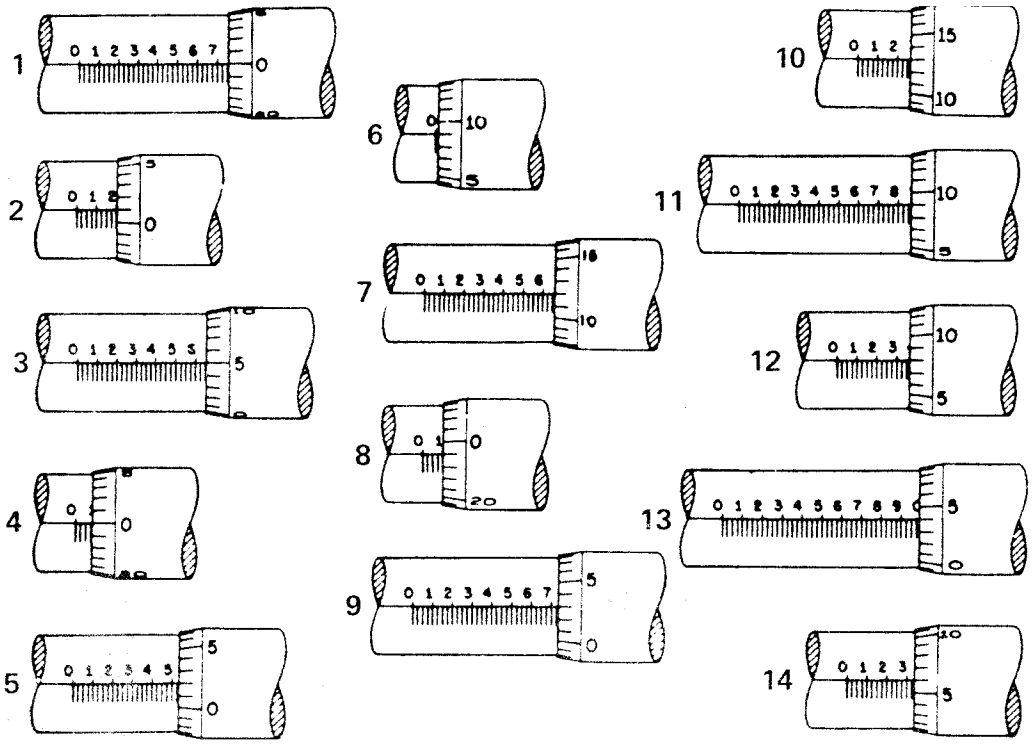
- Removes and installs piston rings.



Courtesy of Briggs & Stratton Corp.

VIII. Measuring Exercises:

1. Determine the following Micrometer readings:



1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____
9. _____
10. _____
11. _____
12. _____
13. _____
14. _____

2. Measuring each of the following using the one-inch micrometer or a dial caliper:

- Pencil:_____.
- Piece of Notebook Paper:_____.
- 5 Pieces of Notebook Paper:_____.
- A Standard Staple:_____.
- Other:_____.
- Other:_____.
- Other:_____.

Notes: