

Automotive Technology 6th Edition

Chapter 12 Measuring Systems & Tools

Opening Your Class

KEY ELEMENT	EXAMPLES
Introduce Content	This Automotive Technology 6th text provides complete coverage of automotive components, operation, design, and troubleshooting. It correlates material to task lists specified by ASE and ASEEducation (NATEF) and emphasizes a problem-solving approach. Chapter features include Tech Tips, Frequently Asked Questions, Case Studies, Videos, Animations, and ASEEducation (NATEF) Task Sheets.
Motivate Learners	Explain how the knowledge of how something works translates into the ability to use that knowledge to figure why the engine does not work correctly and how this saves diagnosis time, which translates into more money.
State the learning objectives for the chapter or course you are about to cover and explain this is what they should be able to do as a result of attending this session or class.	Explain the chapter learning objectives to the students as listed: <ol style="list-style-type: none"> 1. Compare the English customary measuring system and the metric system of measure. 2. Discuss the purpose of tape measures, and micrometers. 3. Discuss the purpose of telescopic gauges, small-hole gauges, and Vernier dial calipers. 4. Discuss the purpose of straightedges, dial indicators, feeler gauges, dial bore gauges, and depth micrometers.
Establish the Mood or Climate	Provide a WELCOME , Avoid put downs and bad jokes.
Complete Essentials	Restrooms, breaks, registration, tests, etc.
Clarify and Establish Knowledge Base	Do a round robin of the class by going around the room and having each student give their backgrounds, years of experience, family, hobbies, career goals, or anything they want to share.

NOTE: This lesson plan is based on the 6th Edition Chapter Images found on Jim's web site @ www.jameshalderman.com

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[automotive_principles.html](http://www.jameshalderman.com/automotive_principles.html)NOTE: You can use Chapter Images or possibly Power Point files:

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1. SLIDE 1 CH12 MEASURING SYSTEMS & TOOLS



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Crossword Puzzle (Microsoft Word) (PDF)

Word Search Puzzle (Microsoft Word) (PDF)



Reading a Rule, Inch (View) (Download)

Reading a Rule, Metric (View) (Download)

Torque to Angle (View) (Download)



DISCUSSION: Ask students to discuss differences between metric and English measurement systems. Have students conjecture about why metric system has not been totally adopted in the United States.



Be sure to check the specifications to verify unit of measurement used.



DISCUSS FREQUENTLY ASKED QUESTION: What Weighs a Gram? To better understand the metric system measurements, it is often helpful to visualize a certain object and relate it to a metric unit of measure. For example, following objects weigh about 1 gram.

- **Dollar bill**
- **Small paper clip**

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2. **SLIDE 2 EXPLAIN FIGURE 12–1** rule showing that the larger the division, the longer the line.
3. **SLIDE 3 EXPLAIN FIGURE 12–2** plastic rule that has both inches and centimeters. Each line between the numbers on the centimeters represents 1 millimeter because there are 10 millimeters in 1 centimeter.

DEMONSTRATION: Show students metric equivalents of common units of measure for linear, volumetric, and weight measurements, and discuss how to convert between English and metric.

4. **SLIDE 4 EXPLAIN FIGURE 12–3** micrometer showing names of the parts. Sleeve may also be called the barrel or stock.
5. **SLIDE 5 EXPLAIN FIGURE 12–4** All micrometers should be checked and calibrated using gauge rod.
6. **SLIDE 6 EXPLAIN FIGURE 12–5** Three micrometer readings are (a) 0.0212 in.; (b) 0.0775 in.; (c) 0.5280 in. These measurements used Vernier scale to arrive at ten-thousandth measurement. Number that is aligned represents digit in ten-thousandth place.
7. **SLIDE 7 EXPLAIN FIGURE 12–6** Metric micrometer readings that use the Vernier scale on the sleeve to read to the nearest 0.001 millimeter. The arrows point to the final reading for each of the three examples.

MICROMETER ANIMATION

Micrometer (View) (Download)

8. **SLIDE 8 EXPLAIN FIGURE 12–7** Using micrometer to measure connecting rod journal: out-of-round & taper.
9. **SLIDE 9 EXPLAIN FIGURE 12–8** Crankshaft journal measurements. Each journal measured in at least 6 locations, but also in position A & B and at 120° intervals around journal.

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10. SLIDE 10 **EXPLAIN** FIGURE 12–9 Camshaft journals measured in 3 places 120° apart: check for out-of-round.

11. SLIDE 11 **EXPLAIN** FIGURE 12–10 Checking camshaft for wear by measuring lobe height with micrometer.

DEMONSTRATION: Show students how to use a micrometer (English/Metric) to take out-of-round & taper measurements of connecting rod & main bearing journals on a camshaft. Show how to use a micrometer, using Vernier Scale.

HANDS-ON TASK SHEET: Have students use a gauge rod to calibrate a micrometer. Have students practice using a micrometer by **COMPLETING** Micrometer Task Sheet Page 16

DISCUSS FREQUENTLY ASKED QUESTION: What Is Difference Between Word Gage & Gauge? The word gauge means “measurement or dimension to a standard of reference.” The word gauge can also be spelled gage. So, in most cases, the words mean the same.

INTERESTING NOTE: One OEM representative told me that gage was used rather than gauge because even though it is the second acceptable spelling of the word, it is correct and it saved the company a lot of money in printing costs because the word gage has one less letter! One letter multiplied by millions of vehicles with gauges on the dash and word gauge used in service manuals adds up to a big savings to the manufacturer.

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12. **SLIDE 12 EXPLAIN FIGURE 12–11A** When head is first removed, cylinder taper & out-of-round should be checked below ridge

13. **SLIDE 13 EXPLAIN FIGURE 12–11B** above the piston when it is at the bottom of the stroke.

14. **SLIDE 14 EXPLAIN FIGURE 12–12A** (a) A telescopic gauge being used to measure the inside diameter (ID) of a camshaft bearing. (b) An outside micrometer used to measure telescopic gauge.

15. **SLIDE 15 EXPLAIN FIGURE 12–12B (continued)** (a) A telescopic gauge being used to measure the inside diameter (ID) of a camshaft bearing. (b) An outside micrometer used to measure the telescopic gauge.

16. **SLIDE 16 EXPLAIN FIGURE 12–13** Cutaway of a valve guide with a hole gauge adjusted to hole diameter.

17. **SLIDE 17 EXPLAIN FIGURE 12–14** outside of a hole gauge being measured with a micrometer.



DEMONSTRATION: Show students how to use a telescopic gauge and micrometer to measure a piston bore. NEXT DEMO using a small-hole gauge together with a micrometer to measure a valve guide bore.



HANDS-ON TASK SHEET: Use telescoping gauge together with a micrometer to measure a piston bore by [COMPLETING PAGE 21 TASK SHEET](#)



18. **SLIDE 18 EXPLAIN FIGURE 12–15A** (a) A typical Vernier dial caliper. This is a very useful measuring tool for automotive engine work because it is capable of measuring inside, outside, and depth measurements. (b) To read a Vernier dial caliper, simply add the reading on the blade to the reading on the dial.

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19. SLIDE 19 **EXPLAIN** FIGURE 12–15B (continued)

(a) A typical Vernier dial caliper. This is a very useful measuring tool for automotive engine work because it is capable of measuring inside, outside, and depth measurements. (b) To read a Vernier dial caliper, simply add the reading on the blade to the reading on the dial.

Show [VERNIER CALIPER ANIMATION Vernier Dial Caliper \(View\) \(Download\)](#)

DEMONSTRATION: Show students how to use a Vernier dial caliper to measure outside diameter or length of an object, and discuss its automotive service or repair applications. Show students how to measure depth with a vernier dial caliper. **PASS the tool around**

HANDS-ON TASK:

Complete Vernier Dial Caliper Task Sheet

20. SLIDE 20 **EXPLAIN** FIGURE 12–16 A group of feeler gauges (also known as thickness gauges), used to measure between two parts. The long gauges on bottom are used to measure the piston-to-cylinder wall clearance.

21. SLIDE 21 **EXPLAIN** FIGURE 12–17 A feeler gauge, also called a thickness gauge, is used to measure the small clearances such as the end gap of a piston ring.

22. SLIDE 22 **EXPLAIN** FIGURE 12–18 straightedge is used with a feeler gauge to determine if a cylinder head is warped or twisted.

HANDS-ON TASK:

COMPLETE **Feeler Gauge Task Sheet**

COMPLETE **Straight Edge Task Sheet**

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23. **SLIDE 23 EXPLAIN FIGURE 12–19** dial indicator is used to measure valve lift during flow testing of a high-performance cylinder head.



Show DIAL INDICATOR ANIMATION
[Dial Indicator With Gear \(View\)](#) ([Download](#))



24. **SLIDE 24 EXPLAIN FIGURE 12–20** dial bore gauge is used to measure cylinders and other engine parts for out-of-round and taper conditions.
25. **SLIDE 25 EXPLAIN FIGURE 12–21** A depth micrometer being used to measure the height of the rotor of an oil pump from the surface of the housing.



DISCUSSION: Host a discussion on what a Dial Bore Gauge is used to measure and what other tools can be used in its place when one is not available



HANDS-ON TASK:
Complete Dial Indicator Task Sheet



SEARCH INTERNET-HISTORY: Have students research the work of one of the following scientists who were important in the history of mathematics and measuring: Gabriel Fahrenheit, Anders Celsius, or Pierre Vernier on the Internet and prepare to discuss it tomorrow