


Automotive Engines

Chapter 7 Measuring Systems & Tools

Opening Your Class

KEY ELEMENT	EXAMPLES
Introduce Content	This course or class provides complete coverage of the components, operation, design, and troubleshooting. It correlates material to task lists specified by ASE and NATEF and emphasizes a problem-solving approach. Chapter features include Tech Tips, Frequently Asked Questions, Real World Fixes, Videos, Animations, and NATEF Task Sheet references.
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. <ol style="list-style-type: none">1. Describe how to read a ruler2. Explain how to use a micrometer and Vernier dial caliper.3. Describe how to use a telescopic gauge and a micrometer to measure cylinder and lifter bores.4. Discuss how to measure valve guides using a small-hole gauge.5. Calculate engine displacement and compression ratios.
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.

ICONS	Ch07 Measuring Systems & Tools
	<p>1. SLIDE 1 CH07 MEASURING SYSTEMS & TOOLS</p> <p>2. SLIDES 2-3 EXPLAIN OBJECTIVES & KEY TERMS</p> <p>Check for ADDITIONAL VIDEOS & ANIMATIONS @ http://www.jameshalderman.com/ WEB SITE REGULARLY UPDATED</p> <p>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 specifications to verify unit of measurement used.</p> <p>4. SLIDES 4-5 EXPLAIN English Customary Measuring System</p> <p>6. SLIDE 6 EXPLAIN Metric System of Measure</p> <p>7. SLIDE 7 EXPLAIN FREQUENTLY ASKED QUESTION</p> <p>8. SLIDE 8 EXPLAIN Linear Measurements (Tape Measure / Rule)</p> <p>9. SLIDE 9 EXPLAIN FIGURE 7-1 A rule showing that the larger the division, the longer the line.</p> <p>10. SLIDE 10 EXPLAIN FIGURE 7-2 A 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.</p> <p>READING AN INCH RULE http://www.jameshalderman.com/animations.html#a0</p> <p>READING METRIC RULE http://www.jameshalderman.com/animations.html#a0</p> <p>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.</p>

ICONS



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CONVERTING ENGLISH TO METRIC

<http://www.jameshalderman.com/animations.html#a0>










11. **SLIDE 11 EXPLAIN Micrometer & EXPLAIN FIGURE 7-3** micrometer showing names of the parts. Sleeve may also be called the barrel or stock.
12. **SLIDE 12 EXPLAIN FIGURE 7-4** All micrometers should be checked and calibrated using gauge rod.
13. **SLIDE 13 EXPLAIN FIGURE 7-5** 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.
14. **SLIDE 14 EXPLAIN FIGURE 7-6** Metric micrometer readings that use 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









Show **MICROMETER PARTS ANIMATION:**
www.myautomotivelab.com






http://media.pearsoncmg.com/ph/chet/chet_myautomotivelab_2/animations/A1_Animation/Chapter7_Fig_7_3/index.htm

Show **MICROMETER PARTS ANIMATION:**
<http://www.jameshalderman.com/animations.html#a0>

15. **SLIDE 15 EXPLAIN Crank measuring and FIGURE 7-7** Using micrometer to measure connecting rod journal: out-of-round & taper.
16. **SLIDE 16 EXPLAIN FIGURE 7-8** Crankshaft journal measurements. Each journal measured in at least 6 locations, but also in position A & B and at 120° intervals around journal.
17. **SLIDE 17 EXPLAIN camshaft measuring & FIGURE 7-9** Camshaft journals measured in 3 places 120° apart: check for out-of-round.
18. **SLIDE 18 EXPLAIN FIGURE 7-10** Checking camshaft for wear by measuring lobe height with micrometer.

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	<p><u>DEMONSTRATION:</u> 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.</p>
	<p><u>HANDS-ON TASK SHEET:</u> Have students use a gauge rod to calibrate a micrometer. Have students practice using a micrometer by <u>COMPLETING TASK SHEET</u></p>
	<p>19. SLIDE 19 EXPLAIN Telescopic Gauge & EXPLAIN FIGURE 7–11 When head is first removed, cylinder taper & out-of-round should be checked below ridge (a) and above piston when it is at bottom of stroke (b).</p>
	<p>20. SLIDE 20 EXPLAIN FIGURE 7–12 (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.</p>
	<p>21. SLIDE 21 EXPLAIN Small-hole Gauge & EXPLAIN FIGURE 7–13 Cutaway of a valve guide with a hole gauge adjusted to hole diameter.</p>
	<p>22. SLIDE 22 EXPLAIN FIGURE 7–14 outside of a hole gauge being measured with a micrometer.</p> <p><u>DEMONSTRATION:</u> Show students how to the 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.</p>
	<p><u>HANDS-ON TASK SHEET:</u> Use telescoping gauge together with a micrometer to measure a piston bore by <u>COMPLETING TASK SHEET</u></p>
	<p>23. SLIDE 23 EXPLAIN Vernier Calipers & FIGURE 7–15 (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 blade to reading on dial.</p>
	<p>24. SLIDE 24 EXPLAIN FREQUENTLY ASKED QUESTION</p>

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       	<p> Show <u>VERNIER CALIPER ANIMATION</u> www.myautomotivelab.com http://media.pearsoncmg.com/ph/chet/chet_myautomotivelab_2/animations/A1_Animation/Chapter_7_Fig_7_15(a)/index.htm </p> <p> Show <u>VERNIER DIAL CALIPER ANIMATION</u> http://www.jameshalderman.com/animations.html#a0 </p> <p> <u>DEMONSTRATION:</u> 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 </p> <p> <u>HANDS-ON TASK:</u> Have students measure a piston with a Vernier Caliper </p> <p> 25. SLIDE 25 EXPLAIN Feeler Gauge (thickness gauge) 26. SLIDE 26 EXPLAIN FIGURE 7–16 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. 27. SLIDE 27 EXPLAIN FIGURE 7–17 A feeler gauge, also called a thickness gauge, is used to measure the small clearances such as the end gap of a piston ring. 28. SLIDE 28 EXPLAIN Straightedge 29. SLIDE 29 EXPLAIN FIGURE 7–18 straightedge is used with a feeler gauge to determine if a cylinder head is warped or twisted. 30. SLIDE 30 EXPLAIN Dial Indicator 31. SLIDE 31 EXPLAIN FIGURE 7–19 dial indicator is used to measure valve lift during flow testing of a high-performance cylinder head. </p> <p> Show <u>DIAL INDICATOR ANIMATION:</u> www.myautomotivelab.com http://media.pearsoncmg.com/ph/chet/chet_myautomotivelab_2/animations/A1_Animation/Chapter_7_Fig_7_19/index.htm </p> <p> Show <u>DIAL INDICATOR ANIMATION:</u> http://www.jameshalderman.com/animations.html#a0 </p>

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    	<p>32. SLIDE 32 EXPLAIN Dial Bore Gauge & Depth Micrometer & EXPLAIN FIGURE 7–20 dial bore gauge is used to measure cylinders and other engine parts for out-of-round and taper conditions.</p> <p>33. SLIDE 33 EXPLAIN Depth Micrometer & FIGURE 7–21 A depth micrometer being used to measure the height of the rotor of an oil pump from the surface of the housing.</p> <p>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</p> <p>Show DIAL BORE INDICATOR</p> <p>ANIMATION: www.myautomotivelab.com http://media.pearsoncmg.com/ph/chet/chet_myautomotivelab_2/animations/A1_Animation/Chapter30_Fig_30_23/index.htm</p> <p>Talk through SUMMARY and questions</p> <p>HOMEWORK: complete Ch7 crossword puzzle: http://www.jameshalderman.com/links/book_engine_theory_serv_7/cw/crossword_ch_7.pdf</p>