

## Math-in-CTE Lesson Plan Template

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| Lesson Title: AT-02- Micrometers  |  | Lesson # 02(TVannah revised version)   |
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| Occupational Area: Automotive Technician  |  |  |
| CTE Concept(s): Measurement – Micrometers   |  |  |
| Math Concepts: correct selection and usage of tools, correct reading of the scale and fractional equivalents of markings (quarters), place value, addition (decimals)with proper place value alignment. |  |  |
| Lesson Objective:   | Students will be able to properly use and read micrometer to produce accurate and precise measurements.  |  |
| Supplies Needed:  | Micrometers for each student or student pair. Car parts to measure for each student group and room stations; should include parts corresponding to each size micrometer (0-1", 1-2", etc.) and parts of multiple shapes. Micrometer diagram for overhead and informational handouts for each student, worksheets 1 and 2 for each student. |  |

| THE "7 ELEMENTS"  | TEACHER NOTES<br>(& Answer Key)  |
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| <p>1. Introduce the CTE lesson.</p> <p>Explain to them the importance of the lesson: "In order to be successful in the automotive industry you have to be able to perform accurate measurements to a thousandths of an inch. You need this skill to hold a Maine State Inspection License. This skill also applies to snowmobiles the marine industry – basically anything with a motor. This measurement practice and skill transfers onto other equipment and tools you may have to operate. Today we will learn to use an outside micrometer to take accurate measurement to one thousandth of an inch. Inside micrometers and depth micrometers are also used in auto</p> | <p>There should be an array of micrometers out in the classroom. Try to give a micrometer to each student or student pair. Have the micrometer diagram projected to the class. Handout micrometer diagrams and informational sheets to each student.</p> |

mechanics. A dial-indicator works in a similar way, your measurements will also be in thousandths of an inch. Torque wrenches are set the same way a micrometer is adjusted.”

“There are math skills that will be important to using a micrometer correctly. These skills include work with decimals, tenth, hundredth and thousandths places and addition.”

Discuss what the parts are and their functions.

Introduce some of the math skills that will be covered during the lesson.

#### Frame

The C-shaped body that holds the anvil and barrel in constant relation to each other. It is thick because it needs to minimize flexion, expansion, and contraction, which would distort the measurement. You will find the size of the micrometer on it. It is used to hold the micrometer when working with it.

#### Anvil

The shiny part that the spindle moves toward, and that the sample rests against.

#### Sleeve / Barrel / Stock & Spindle

The stationary round part with the linear scale on it. Contains the tenth and hundredth place graduations.

#### Lock nut / Lever

The lever that one can tighten to hold the spindle stationary, such as when momentarily holding a measurement.

#### Thimble

The part that one's thumb turns. Contains the one-thousandths graduations.

#### Ratchet Knob

Device on end of handle that limits applied pressure to prevent over tightening on the item being measured. Allows for a consistent measure when using the tool.

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| <p>"A micrometer is a precision instrument. It needs to be kept clean and protected.</p>  | <p>Reinforce proper care and maintenance of the tool.</p>  |
| <p>2. Assess students' math awareness as it relates to the CTE lesson.</p> <p>Ask "How do you think we measure with a micrometer?" "What do you think the markings on the barrel do?" "What about the markings on the thimble?"</p> <p>"Do you understand how we deal with decimals?" "Do you remember how to write a number in the tenth place?" "In the hundredth place?" "Thousandths place?"</p> <p>"Look at the handout. There is a number written to the thousandths place. The number would be said: Two inches and three hundred forty thousandths of an inch. The two is in the ones place. The three is in the tenth place. The four is in the hundredth place. The zero is in the thousandths place."</p> <p>Ask "How would you read this number out loud?"</p> <p>Ask "How would you write these numbers? Thirty five thousandths of an inch. Four inches and forty five thousandths of an inch. One inch and five hundred thousandths of an inch."</p> | <p>Listen to responses to see what, if any familiarity the students have with using a micrometer. Note which students have used the tool before, they may be able to assist others during the lesson.</p> <p>Listen to responses to assess readiness for addition with proper place value and the use of terminology.</p> <p>Use the handout to talk about the place values.(HO1)</p> <p>Practice reading and writing decimal values by presenting examples on the board and asking for class responses.</p> <p>Write the following values on the board 0.405", 0.021", 3.467" and have the students express the values verbally.</p> <p>0.405" = Four hundred five thousandths of an inch.</p> <p>0.021" = Twenty-one thousandths of an inch.</p> <p>3.007" = Three inches and seven thousandths.</p> <p>Ask the students to write the following values.</p> <p>Thirty five thousandths of an inch. = 0.035"</p> <p>Four inches forty five and thousandths of an inch = 4.045"</p> <p>One inch and five hundred thousandths of an inch = 1.500"</p> |

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|   | You may need to include additional examples to continue to reinforce the decimal places and proper terminology.   |
| <p>3. Using vehicle service information. We will find the difference between the gauging shim and the needed shim to set up the output gear bearing end play.</p> <p>Students will need to find the difference based on a pre-set shim –“ if you were in the shop and were doing this” . . . (randomly choose that is preset.)</p> <p>Give students 5-10 minutes to do this worksheet and then have them report out in pairs.</p> | <p>Refer to the drawing/chart for end play (credit all datadiy)</p> <p>Handout the 2 page handout (HO2)</p> <p>Have different random numbers chosen - end play tolerance, etc. from the chart (endplay gauging chart)</p> |

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| <p>4. Work through related, contextual math-in-CTE examples.</p> <p>“Let’s measure a part! Hold your micrometer by the frame and position it over the part you are measuring carefully tighten using the ratchet knob, when you have the proper adjustment lock it in place so you can remove the part and not change the reading. Go through the steps we’ve performed to come up with your measurement.”</p> <p>“Practice using the micrometer to obtain a measurement of some of the spare parts on your table.”</p> <p>Have students measure pre-selected shims.</p> | <p>Work through measuring an actual car part. Show students how to select the micrometer based on part size. Move through the steps outlined on the handout when working with real parts.</p> <p>Allow students to practice measuring a part on their own, tightening the ratchet knob appropriately and removing the part from the micrometer while maintaining an accurate measure. Students should also attempt to practice reading the numbers properly and combining them to come up with a measurement. Questions will begin to pop up regarding the addition of the decimal values.</p> |
| <p>5. Work through traditional math examples.</p> <p>“Before you work on your own, let’s practice some of the math you need to be successful with a micrometer. Remember to align the decimal places in each problem. Tenth place lines up with tenth place. Hundredth place lines up with hundredth place. Thousandths place lines up with thousandths place.”</p> <p>“Let’s review the solutions and then move onto micrometer problems”</p>   | <p>Handout worksheet #1(Practice decimal problems). Allow students to work to complete the addition problems. The second set of problems requires that the students line up the decimal place before completing the addition. Circulate around the classroom, encourage students to stay on task and assist others if possible.</p> <p>Solutions for worksheet#1.</p> <ol style="list-style-type: none"> <li>1. 4.099</li> <li>2. 7.486</li> <li>3. 13.452</li> <li>4. 14.148</li> <li>5. 7.024</li> <li>6. 19.109</li> <li>7. 29.506</li> <li>8. 6.122</li> </ol>                             |
| <p>6. Students demonstrate their understanding.</p> <p>“Let’s work on micrometer problems. These problems are like the example worked through at the start of class. Use the diagram of the micrometer to calculate the correct measurement to a thousandth of an inch. The handouts may be helpful for you to use to remind yourself</p>  | <p>Allow students to begin work on Worksheet #2(Micrometer Problems). While students are working circulate the classroom, answering questions and giving assistance as needed. Assess student understanding through their work on the worksheet. Encourage students who are having success</p>   |

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| <p>what numbers go where when completing the measurements.”</p> <p>Have students present their worksheet problems to the class. Assess individual and whole class understanding by checking their work.</p>  | <p>to assist other students. Encourage students to replicate the measure on their micrometers to help them connect the paper based work with the tool.</p> <p>Review the responses to the in class worksheet.</p> <ol style="list-style-type: none"> <li>1. 2.327”</li> <li>2. 2.229”</li> <li>3. 2.428”</li> <li>4. 3.438”</li> <li>5. 3.137”</li> <li>6. 3.336”</li> <li>7. 0.246”</li> <li>8. 0.148”</li> <li>9. 0.349”</li> </ol> <p>Move on to the practical measurement examples.</p> |
| <p>7. Formal assessment.</p> <p>“You will be assessed throughout the year in your use of a micrometer. Remember, in order to be successful in the automotive industry you have to be able to perform accurate measurements to thousandths of an inch.”</p> | <p>The final assessment will be an electude unit (<a href="http://www.electudes.com">www.electudes.com</a>) on micrometers. This will occur for the remainder of the year.</p>  |

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