## Math-in-CTE Lesson Plan Template

Lesson Title: AT04-Brake Tolerances			Lesson # AT04		
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Occupational Area: Automotive/Heavy Equipment					
CTE Concept(s): How to measure brake drum diameter to determine acceptable serviceability					
Math Concepts: Measurement to the nearest .001 of an inch, subtraction of decimal numbers.					
Students will be able to correctly and accurately measure brake drum diameter and Lesson Objective:					
	determine if the brake drums are serviceable				
Supplies Needed:	Brake drum, brake drum measuring tools				

THE "7 ELEMENTS"	TEACHER NOTES (and answer key)
1. Introduce the CTE lesson.	Instructor will supply brake drum micrometer, brake drum, and manufacture specifications.
Today, gang, we are going to find out how to measure a brake drum and determine if it is serviceable with-in manufactures specifications.	
<ul><li>2. Assess students' math awareness as it relates to the CTE lesson.</li><li>"What is this?"</li><li>How do I know this is good to use?</li></ul>	Instructor shows the brake drum.

How do I measure it? What tool do I use?	
What tool could I use if I do not have the correct one? Which tools could I not use for this purpose?	The tool you need must be precise enough. You might not want to use a ruler since a ruler is not accurate enough. An "inside micrometer" or a brake drum micrometer will measure to the nearest .001 of an inch.
How do I accurately measure the diameter of a brake drum? What is important about the measurement locations and why?	It is important to be measuring the diameter and not another chord in the drum. It is also important to take at least three measurements at different locations to be sure the drum is not oblong or out-of-round. If the diameter measurements in different places on the same drum are not equal – that's an indication that it is out of round and
How a part wears depends on how it works or is used. What	will need to be machined.
happens to the brake drum diameter (and thickness) as it is used? How do you find out if it is too worn to pass inspection or to meet other codes?	A brake drum will wear when it is being used (due to heat and friction) and will enlarge in diameter over time.
What do you think of when you hear the word "tolerant" or "tolerance". Give me an example or use it in a sentence. Any other examples?"	Answers may vary (Tolerance for some behaviors and not otherstolerant people and some that are not so tolerant- no names!Tolerant or intolerant of heat or cold)
Do you know what acceptable brake drum tolerances are? How do you find out?	The manufacturer decides what a safe operating diameter is. The students will need to be able to locate the manufactures specifications from the appropriate source
3. Work through the math example <i>embedded</i> in the CTE lesson.	
Example One: This brake drum has a discard diameter of 15.750"	
I measured the drum diameter as 15.533"	
Subtract the current drum diameter from the discard diameter.	As long as the values have the same amount of decimal
15.750	0.533
<u>-15.533</u>	
.217	Point out that the decimal point must line up to add or subtract decimal values.

Example Two: Is there enough material left to machine the drum? First, let's measure this brake drum, it is 16.785" The discard diameter is 16.825" Since the discard diameter is larger then the drum has material left that can be removed. <b>Subtract the current drum diameter from the discard diameter.</b> 16.825 <u>-16.785</u> 0.040 0.040" of material remains before the drum must be discarded.	Example One shows the drum is worn beyond the allowable limit and will need to be replaced. Example Two shows that there is .040 of an inch of material left that can safely be removed before the drum needs to be replaced.
A Work through related contextual math-in-CTE examples	
How does 15.750" discard diameter compare to the 15.533" diameter that it is now? Subtract the current drum diameter from the discard diameter.	Demonstrate measuring multiple drums and work thru the math on the board with students
16.620 <u>-16.625</u> -0.005 *negative number* Can we machine the drum?	As long as the values have the same amount of decimal places we can compare the values, 0.625 is larger than 0.620 Point out that the decimal point must line up to add or subtract decimal values.
Where else would you see or use a tolerances inn an automobile?	Solicit answers from students.

See Operations with Decimals (students can take this with them as a resource)
Worksheet Brake Drum Measurement 1 (In-class practice);
Worksheet Brake Drum Measurement 2 (Homework)
Instructor will supply several brake drums and observe students using the proper procedure while measuring a drum using a drum micrometer
This assessment is part of a larger assessment of drum brake inspection. The student will be able to correctly perform measurement of a brake drum