Math-in-CTE Lesson Plan Template

Lesson Title: QC Tolerance		**Lesson # M16**
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Occupational Area: Machine Tool/ Welding Fabrication		
CTE Concept(s): Tolerance/Limits M 16		
Math Concepts: Adding/Subtracting/Compound Inequalities		
Lesson Objective:	To show the students why Tolerance and Limits are important in Machining.	
Supplies Needed:	Parts to be measure and the corresponding print. Steel Rule Micrometer Whiteboard & markers Traditional math example worksheets Final Assessment Rubric Math for Machine Technology 6 ed. Delmar Cengage Learning page 142, 145.	

THE "7 ELEMENTS"	TEACHER NOTES (and answer key)
1. Introduce the CTE lesson. *"Now that you all have been making parts, today we will be learning how to work toward a tolerance."*	Taking a part that the students have made, have them select which part they want. They will need all measuring tool needed to measure to all given tolerances.
2. Assess students' math awareness as it relates to the CTE lesson. *What is the meaning of the word Tolerance?* *Does everyone know what the word variation means? What is the root word in variation? It means to vary.* *What is the meaning of the word Limits? In English, it is as far as the dimension can go in either direction.*	**TOLERANCE- IS THE AMOUNT OF VARIATION PERMITTED ON THE DIMENSIONS OR SURFACES OF MAUFACTURED PARTS.** **LIMITS- ARE THE EXTREME PERMISSIBLE DIMENSIONS OF A PART.** **TOLERANCE IS EQUAL TO THE DIFFERENCE BETWEEN THE MAXIMUM AND MINIMUM LIMITS OF ANY SPECIFIED DIMENSION OF A PART.** **TOLERANCE = MAXIMUM LIMIT – MINIMUM LIMIT**

3. Work through the math example *embedded* in the CTE lesson. *"To find your maximum or high limit, you would add the maximum limit to the given measurement.* *In Example 1 measurement is 3.7500", so you would write it as:* *Maximum limit is 3.7500 + 0.000 or 3.7500.* *To find your minimum or low limit, you would subtract the minimum limit from the given measurement, you would write it as:* *3.7500 – 0.0016 or 3.7484.* *Now, try Example 2 on your own."* *62.79 ± 0.04* *Maximum Limit: 62.79 + 0.04 = 62.83* *Minimum Limit: 62.79 – 0.04 = 62.75*	I In math class we might see the tolerance as: $3.7484" \le x \le 3.7500"$. So, the measurement (*x*) is between (literally) the limits of 3.7484" and 3.7500". You can also use a number line as something more visual. Give example 2 to the kids without the answers!
4. Work through *related, contextual* math-in-CTE examples. Customary System Examples: Tolerance / Maximum Limit / Minimum Limit A.   B. 7'  7'  C. 0.003" 16.76" D. 0.007" 0.904" E. 1.7001" 1.6998" F. 0.004" 10.999 "	This is where I give the students more tolerance examples. Answers: a.  b.  c. 16.73" d. 0.911" e. 0.0003" f. 11.003"

Metric Examples:

	Tolerance	Maximum Limit	Minimum Limit
A.		50.7 mm	49.9 mm
B.		26.8 cm	26.66cm
C.	0.04mm		258.03 cm
D.	0.120mm	79.65 mm	
E.	0.006 cm		12.731 cm
F.		4.01 mm	3.98 mm

The metric is an option if you work with metric, or for your advanced students who can adapt to metric.

Answers:

a. 0.8
b. 0.2
c. 258.07
d. 79.53
e. 12.737
f. 0.03

Page 145, Mathematics for Machine Technology.

5. Work through *traditional math* examples.

"Lets start with something fairly familiar. Lets look at 12 ± 4*. How many answers are there? Why are there two? What are the two answers?*

Try to do the following examples:

Ex1) 16 ± 7

Ex2) 23 ± 5.500

Ex3) $28.250 \pm .0750$

Ex4) 6.375 + 0.150 and 6.375 – 1.753

Answers:

Ex1) 23 and 9

Ex2) 28.5 and 17.5

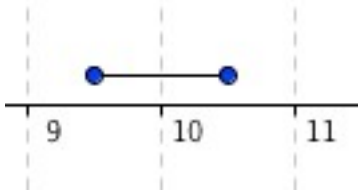
Ex3) 28.325 and 28.175

Ex4) 6.525 and 4.622

Ex5) $14.500 \le x \le 14.600$

Ex6) $11.625 \le x \le 21.375$

Ex7) $32.900 \le x \le 37.020$

Now lets take the expressions and write an inequality where x is the measurement. Lets look at 10 ± 0.5000. *The two answers for this are, 9.5000 and 10.5000, so these are our limits. As a compound inequality it would be written as,* $9.5000 \le x \le 10.5000$. *This would mean that your measurement is greater than or equal to 9.5000 and less than or equal to 10.5000. These could also be graphed on a number line.* *Try doing the following examples:* *Ex5)* 14.550 ± 0.050 *Ex6)* 16.500 ± 4.875 *Ex7) 34.675 + 2.345 and 34.675 – 1.675*	 *For Ex 5-7 remind students that for these examples they should be using solid/closed dots to signal the less than or* ***equal to*** *or greater than or* ***equal to.*** *The open dots are for just less than or greater than. On the number line the line would represent the dimension of your part.* *Ex 5)*  *Ex 6)*  *Ex 7)*  *, and*  *Or your students may write*  *and*  *(this is okay!!!!!!! Just make sure that the inequality signs are facing the correct direction)*
6. Students demonstrate their understanding. Take these example parts (and print with dimensions) and measure them.	Have a few parts with measurements and have the students measure them. Remind the students of the tolerance levels Two place decimal +/- .010 Three place decimal +/- .005 Fractional dimension +/- .015
7. Formal assessment. Now take your finished project, and measure it. Do all of your measurements fit the tolerances? *"Now take your part and measure it. If your part meets the*	Have the students retrieve the parts that they have made along with the original print. Remind the students of the tolerance levels

specifications then you can send it off to your client. If it does not meet the specifications then the part needs to be reworked or remade." *See rubric and score your project."*	Two place decimal +/- .010 Three place decimal +/- .005 Fractional dimension +/- .015 Make a rubric and score part.

NOTES: