Machine Tool Technology (48.0501) T-Chart

Compare fractional/decimal values	=	Apply properties of rational and irrational numbers to solve real world or mathematical problems

Program Task: Use fractional/decimal dimensions.

Program Associated Vocabulary:
FRACTION, DECIMAL

Program Formulas and Procedures:
Machinists work daily with both decimal and fractional inch dimensions. The ability to recognize size relationships between these dimensioning systems is crucial because parts and blueprints frequently use both.

Example: A part requires the following size hole diameters to be drilled in a row from smallest to largest. Order the drill sizes from smallest to largest.

$\frac{7}{32}$ .625 $\frac{11}{16}$ .201 $\frac{3}{8}$

Convert the fractions to decimal form:

$\frac{7}{32}$ = .2188, .625, $\frac{11}{16}$ = .6875, .201, $\frac{3}{8}$ = .375

Then order from largest to smallest:

.201, $\frac{7}{32}$ = .2188, $\frac{3}{8}$ = .375, .625, $\frac{11}{16}$ = .6875

Example: The largest diameter of a project to be produced on the lathe is .288 inches. Bar stock is available in 1/16" diameter increments. What diameter is needed for the project?

One method of solving this problem is to list fractions in 1/16 increments along with their decimal equivalents and then see which fraction is closest to and larger than .288.

$\frac{1}{16}$ = .0625
$\frac{2}{16} = \frac{1}{8}$ = .125
$\frac{3}{16}$ = .1875
$\frac{4}{16} = \frac{1}{4}$ = .250
← .288
$\frac{5}{16}$ = .3125

So, 5/16" diameter material is needed.

PA Core Standard: CC.2.1.HS.F.2

Description: Apply properties of rational and irrational numbers to solve real world or mathematical problems.

Math Associated Vocabulary:
REAL NUMBER, RATIONAL NUMBER, IRRATIONAL NUMBER, DECIMAL, FRACTION, SQUARE ROOT

Formulas and Procedures:
It is relatively simple to compare numbers when they are in the same form. For example 0.15 is smaller than 0.25. The numbers are both in decimal form so are easily comparable. It becomes more difficult to compare numbers that are either in different forms, such as a fraction to a decimal, or in fractional form with different denominators, such as 3/5 and 5/9.

The easiest way to compare numbers that are in different forms is to convert each number to its decimal form.

Example: Which of the following numbers is largest?

6/25 3/14 0.2

1. Convert each number to its decimal equivalent:

   0.24 0.2142857... 0.2

2. Compare the digits in the tenth place, if they are the same move to the hundredths place, and so on until the order can be determined.

   For instance, we cannot round to the nearest tenth, because it would give us the same value of .2 for all of the numbers.

   Rounding to the nearest hundredth would make the numbers:

   0.24 0.21 0.2

3. Add zeroes to make all numbers have the same number of digits after the decimal.

   0.24 0.21 0.20

   For comparative purposes, it is important to add a zero so that the numbers 20/100, 21/100, and 24/100 can be compared.

   Since 24/100 is larger than 21/100 and 20/100, 0.24 (6/25) is the largest number.

Instructor's Script – Comparing and Contrasting

These examples in the machine tool field show the importance of the concept of comparing and ordering real numbers. In some careers people will work either mostly with decimals or mostly with fractions, but in this trade area people work with and need to understand and compare both types of numbers. There are also examples in other t-charts where the students need to work with irrational numbers and compare and order these numbers.

Common Mistakes Made By Students

Comparing decimals: Decimals are easier to compare if the number of digits after the decimal point is the same. For instance, students often think that 0.6 is less than 0.34 because 6 is less than 34. A zero must be added to the 6 to make the number .60 so that the student can compare 0.60 and 0.34

Comparing fractions: Fractions can be compared when they have a **common denominator**. For instance, 5/16 inches and 3/8 inches are two measurements on a ruler. In order to compare the two fractions, they must have a common denominator, 16. 3/8 is larger than 5/16.

$$\frac{3}{8} = \frac{\quad}{16} \qquad \frac{3 \times 2}{8 \times 2} = \frac{6}{16}$$

CTE Instructor's Extended Discussion

Another situation which requires machinists to comparing decimal and fractional dimensions is related to cutting tools. Tool diameters are normally available in only fractional sizes, so the machinist must know what fractional size tools are needed to produce decimal dimensions.

Example: A .835" wide slot must be machined in a plate. Since endmills are only available in 1/16" diameter increments, what is the largest diameter endmill that can be used to machine the slot?

This is similar to the bar stock sample, except that in this case the nearest 1/16" ***smaller*** than .835 is needed.

Further, another method that can be used to solve the problem is to use a proportion instead of listing fractions.

$.835 = \frac{835}{1000}$

so,

$\frac{835}{1000} = \frac{x}{16}$

$835(16) = 1000x$

$13360 = 1000x$

$x = 13.36$

A 13/16" diameter endmill is needed.

Problems	Career and Technical Math Concepts	Solutions
1. Sort the following diameters of O1 bar stock from smallest to largest for organization in the material room: $\frac{1}{2}$ $\frac{7}{16}$ $\frac{5}{16}$ $\frac{5}{8}$ $\frac{9}{32}$		
2. A blueprint specifies a .105 wide groove to be machined in a shaft. Grooving tools are available in 1/32" width increments. What maximum width tool could be used?		
3. An existing part has a 10 mm (.394") diameter hole. The hole must be reproduced in another part with the closest 1/64" size drill but cannot be smaller than the hole in the original part. What size drill can be used to produce the hole?		
Problems	**Related, Generic Math Concepts**	**Solutions**
4. Which of the following measurements is longest? 2 ½ inches, $2\ ^{3}/_{8}$ inches, $2\ ^{7}/_{16}$ inches		
5. Order the following measurements from least to greatest: $\sqrt{7}$ feet, 2 ½ feet, 2.6 feet		
6. Which of the following measurements is largest? 2π cm., $\sqrt{41}$ cm., 6.25 cm.		
Problems	**PA Core Math Look**	**Solutions**
7. Order the following numbers from least to greatest: 2.4, $\sqrt{5}$, $2\ ^{7}/_{8}$		
8. Order the following numbers from largest to smallest: 0.02, 0.223, 0.24, 0.243		
9. Order the following numbers from least to greatest: $\sqrt{10}$, π, $3\ ^{1}/_{5}$, 3.25		

Problems	Career and Technical Math Concepts	Solutions
1. Sort the following diameters of O1 bar stock from smallest to largest for organization in the material room: $\frac{1}{2}$ $\frac{7}{16}$ $\frac{5}{16}$ $\frac{5}{8}$ $\frac{9}{32}$	$\frac{1}{2} = .500$ $\frac{7}{16} = .4375$ $\frac{5}{16} = .3125$ $\frac{5}{8} = .625$ $\frac{9}{32} = .28125$	$\frac{9}{32} = .28125$ $\frac{5}{16} = .3125$ $\frac{7}{16} = .4375$ $\frac{1}{2} = .500$ $\frac{5}{8} = .625$
2. A blueprint specifies a .105 wide groove to be machined in a shaft. Grooving tools are available in 1/32" width increments. What maximum width tool could be used?	$\frac{1}{32} = .03125$ $\frac{2}{32} = \frac{1}{16} = .0625$ $\frac{3}{32} = .09375$ $\frac{4}{32} = \frac{1}{8} = .125$	$\frac{3}{32}$ maximum tool width
3. An existing part has a 10 mm (.394") diameter hole. The hole must be reproduced in another part with the closest 1/64" size drill but cannot be smaller than the hole in the original part. What size drill can be used to produce the hole?	$.394 = \frac{394}{1000} \rightarrow \frac{394}{1000} = \frac{x}{64} \rightarrow 394(64) = 1000x \rightarrow 25216 = 1000x$ $x = 25.216 \rightarrow$ Round up to $26 \rightarrow \frac{26}{64} = \frac{13}{32}$ Diameter drill	
Problems	**Related, Generic Math Concepts**	**Solutions**
4. Which of the following measurements is longest? 2 ½ inches, $2\ ^{3}/_{8}$ inches, $2\ ^{7}/_{16}$ inches	List numbers: 2 ½ inches, $2\ ^{3}/_{8}$ inches, $2\ ^{7}/_{16}$ inches Rewrite as decimals: 2.5 inches 2.375 inches, 2.4375 inches Round to the hundredth: 2.50 2.38 2.44 2 ½ inches is longest	
5. Order the following measurements from least to greatest: $\sqrt{7}$ feet, 2 ½ feet, 2.6 feet	List numbers: $\sqrt{7}$ ft. 2 ½ ft. 2.6 ft. Rewrite as a decimal: 2.646 2.5 2.6 Round to the nearest hundredth: 2.65 2.50 2.60 Least to greatest: 2 ½ ft., 2.6 ft., $\sqrt{7}$ ft.	
6. Which of the following measurements is largest? 2π cm., $\sqrt{41}$ cm., 6.25 cm.	2π cm. $\sqrt{41}$ cm. 6.25 cm. 6.28 cm. 6.40 cm. 6.25 cm. $\sqrt{41}$ cm is largest	
Problems	**PA Core Math Look**	**Solutions**
7. Order the following numbers from least to greatest: 2.4, $\sqrt{5}$, $2\ ^{7}/_{8}$	List numbers: 2.4 $\sqrt{5}$ $2\ ^{7}/_{8}$ Rewrite as a decimal: 2.4 2.2360… 2.875 Round to nearest tenth: 2.4 2.2 2.9 Least to greatest: $\sqrt{5}$, 2.4, $2\ ^{7}/_{8}$	
8. Order the following numbers from largest to smallest: 0.02, 0.223, 0.24, 0.243	Convert to thousandths: 0.020, 0.223, 0.240, 0.243 Order the converted numbers from largest to smallest: 0.243, 0.240,0.223, 0.020 Place final answer with numbers in original form: 0.243, 0.24, 0.223, 0.02	
9. Order the following numbers from least to greatest: $\sqrt{10}$, π, $3\ ^{1}/_{5}$, 3.25	List numbers: $\sqrt{10}$ π $3\frac{1}{5}$ 3.25 Rewrite as a decimal 3.16228… 3.14286… 3.2 3.25 Round to the hundredth: 3.16 3.14 3.20 3.25 Least to greatest: π, $\sqrt{10}$, $3\ ^{1}/_{5}$, 3.25	