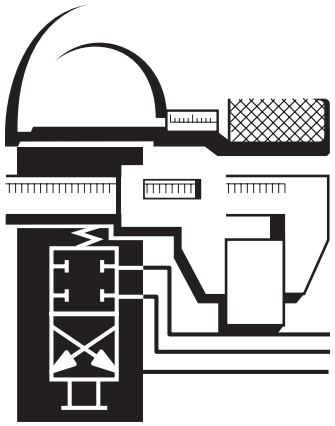
Table of Contents

BLUEPRINT READING FOR WELDERS

Lesson One

Shop Math and Measurement



41601

TPC Training Systems

Lesson

1 Shop Math and Measurement

TOPICS

Fractions
Common Fractions
Reducing Common Fractions
Improper Fractions
Mixed Numbers
Calculations Involving Common Fractions
Shortcuts for Working with Common Fractions
Decimal Fractions
Calculations Involving Decimal Fractions
Converting Common Fractions to Decimal Fractions
Converting Decimal Fractions to Common Fractions
Standard Rules and Tape Measures
Reading a Rule or Tape Measure
Using a Calculator

OBJECTIVES

After studying this lesson, you should be able to…

- Define and identify *common fractions* and *decimal fractions*.
- Define the term *equivalent fraction*.
- Perform calculations using common fractions and decimal fractions.
- Convert between common fractions and decimal fractions.
- Read and perform measurements using a standard rule or tape measure.
- Explain the use of calculators in welding.

KEY TECHNICAL TERMS

Fraction 1.01 number less than 1 but greater than 0
Common fraction 1.04 fraction written above and below a diagonal line
Denominator 1.04 bottom number of a common fraction
Numerator 1.04 top number of a common fraction
Equivalent fractions 1.10 fractions that are different names for the same number
Lowest terms 1.11 no common factor exists for the numerator and denominator
Proper fraction 1.14 numerator is less than the denominator
Improper fraction 1.15 numerator is greater than or equal to the denominator
Mixed number 1.18 whole number followed by a fraction
Decimal fraction 1.30 proper fraction based on the number 10
Scale 1.47 series of equally spaced lines on the edge of a rule
Graduation 1.47 line in a scale

We use units of measurement every day to indicate distance. In the United States, distance is generally measured by the inch, foot, yard, and mile. Typically the welding industry only uses the inch and the foot. Although other units of measure are possible, the examples in this lesson use the inch. The basic math concepts covered here apply to all units of measure.

For accuracy, you will often be required to read and calculate measurements that fall between whole inches. A machinist may require that an inch be divided into a thousand or even ten thousand equal parts for the required accuracy. In the general weld shop, dividing the inch into 16 equal parts is usually satisfactory. The distance that falls between the whole numbers of inches is expressed by a fraction.

You will use fractions almost daily in your job—both common fractions and decimal fractions. This lesson reviews mathematical operations using fractions. It also explains how to convert common fractions to decimal fractions and back again. Finally, it gives tips on reading the scale on a rule and using a calculator.

Fractions

1.01 A *fraction* is a number that is less than 1 but greater than 0. It tells you that 1 has been divided into two or more equal parts, and that you have a certain number of these parts.

1.02 Fractions are definite amounts that you can add, subtract, multiply, and divide, just as you can whole numbers. Many of the numbers used as dimensions and measurements in the welding shop are expressed as fractions, either common fractions or decimal fractions.

1.03 A fraction indicates that you are dealing with a part of a whole. Just as one quarter ($0.25) indicates a part of a whole unit (1 dollar), one quarter of an inch indicates a part of a whole unit (1 inch). In both cases, you are dealing with one part of a unit that has been divided into four parts. It takes four quarters to make a dollar, and it takes four 1/4 inches to make 1 inch, as shown in Fig. 1-1.

Common Fractions

1.04 *Common fractions* (often simply called fractions) are written above and below a diagonal line, as shown in Fig. 1-2. The bottom number of a fraction is called the *denominator*. It indicates the number of parts the whole has been divided into. The top number, called the *numerator*, indicates how many of these parts you are dealing with.

1.05 For example, 2/3 is a fraction. This number tells you two things. First it tells you that something has been divided into three equal parts. Each part is called a third. Second, it tells you that you have two of these parts. In other words, you have two thirds of 1.

1.06 Figure 1-3, on the following page, shows several shapes divided into equal parts. There are two parts of the triangle, three parts of the circle, four parts of the square, five parts of the pentagon, and four parts of the

Fig. 1-1. Four quarters equals one whole

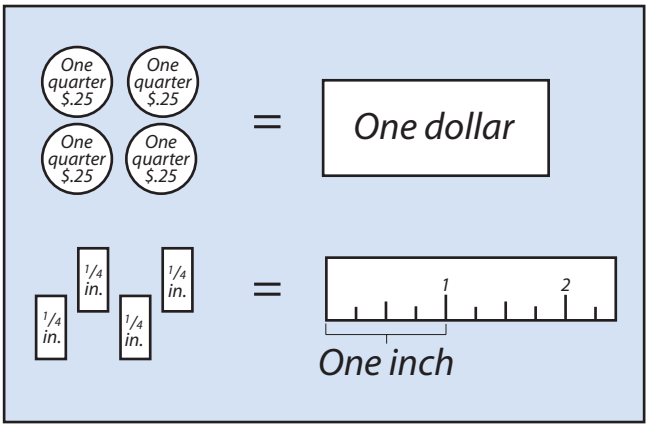


Fig. 1-2. Parts of a common fraction

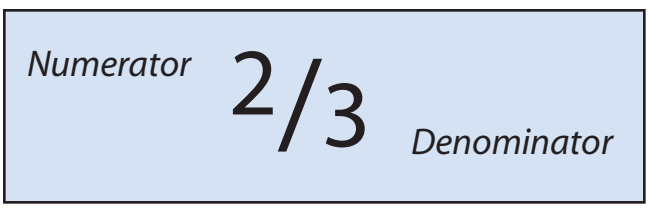
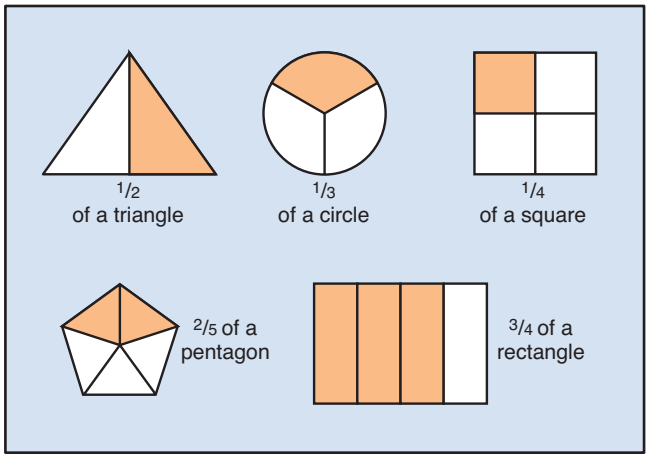


Fig. 1-3. Fractions



rectangle. The numerals that represent these numbers become the denominators of the fractions.

1.07 The shaded sections show how many of these parts are taken to make each fraction. The numerals that stand for these numbers become the numerator of fractions. Thus, we write 1/2 of a triangle, 1/3 of a circle, 1/4 of a square, 2/5 of a pentagon, and 3/4 of a rectangle.

1.08 Every fraction has a value. If the denominators of two fractions are equal, the fraction with the larger numerator has the greater value. For example, compare the fractions 3/8 and 5/8. The 3 stands for three of eight equal parts. The 5 stands for five of eight equal parts. Therefore, 5/8 is the larger of the two fractions.

1.09 If the numerators of two fractions are the same but the denominators are different, the fraction with the larger denominator has the smaller value. Figure 1-4 shows two equal circles divided into different numbers of parts. Each eighth is smaller than each fourth. In other words, 1/8 is smaller than 1/4. By the same reasoning, 4/10 is smaller than 4/5.

1.10 When two or more fractions are different names for the same number, they have the same value and are called *equivalent fraction*s. Look at Fig. 1-5. The fractions 1/2, 2/4, 3/6, and 4/8 all name the number halfway between 0 and 1.

Reducing Common Fractions

1.11 Adding, subtracting, multiplying, or dividing is easiest if you start by reducing each fraction to its *lowest terms*. When a fraction is in this form, the numerator and denominator are the lowest possible numerals.

1.12 To reduce a fraction to its lowest terms, you must be able to divide the numerator and the denominator by the same number, with the answers for both being whole numbers. For example, in the fraction 5/20 both the numerator and the denominator can be divided by 5, as follows:

$$5 \div 5 = 1$$
$$20 \div 5 = 4$$

1.13 If the top and bottom numbers can be divided by several numbers, use the largest possible number as

Fig. 1-4. Circles divided into parts

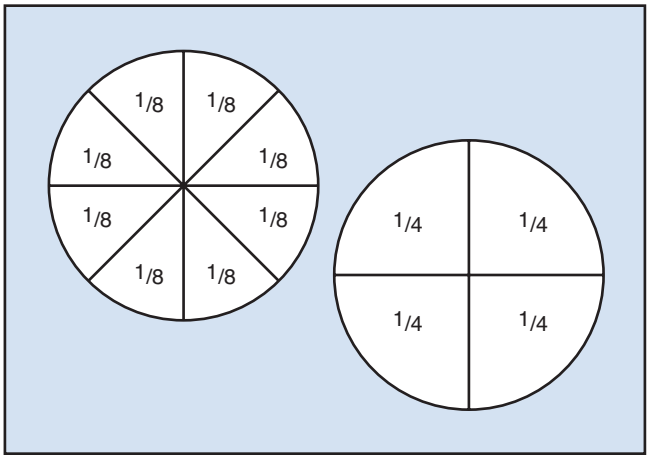
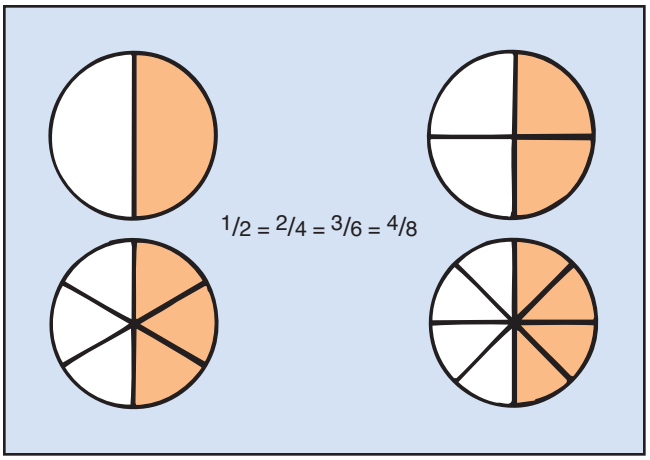


Fig. 1-5. Different fractions representing half of a circle



the divider. For example, $^{25}/_{100}$ can be divided by 5 or by 25. In both cases, both the numerator and denominator will be whole numbers, but you will save yourself a step by using the larger number, as follows:

$$25 \div 25 = 1$$
$$100 \div 25 = 4$$

Improper Fractions

1.14 Recall that a fraction is defined as a number less than 1 but greater than 0. Such a fraction is called a *proper fraction*. In a proper fraction, the numerator is less than the denominator, as in the example $^{2}/_{3}$.

1.15 You will sometimes see numerals written like fractions, but with the numerator equal to or greater than the denominator. An example is $^{4}/_{3}$. Such a numeral represents a number equal to or greater than 1. Therefore, it is called an *improper fraction*. Other examples of improper fractions include $^{8}/_{8}$ and $^{30}/_{20}$.

1.16 Improper fractions have many uses in shop math because they make certain problems easier to solve. There is nothing wrong with writing numbers as improper fractions. But if your final answer is an improper fraction, you should change it to a whole number or to a mixed number.

Mixed Numbers

1.17 Many numbers fall between whole numbers. For example, the number halfway between 2 and 3 is $2^{1}/_{2}$. This number is the sum of a whole number (2) and a fraction ($^{1}/_{2}$). The standard way to write the number is to write the numerals without the addition sign ($2^{1}/_{2}$).

1.18 A *mixed number* is a whole number followed by a fraction. Other examples of mixed numbers include:

$3^{1}/_{4}$
$5^{7}/_{8}$
$12^{1}/_{3}$
$152^{21}/_{32}$

Calculations Involving Common Fractions

1.19 Occasionally fractions must be calculated to end up with a specific measurement on a print. Use the following steps when calculating fractions.

1.20 **Adding fractions.** To add fractions, you must first find the lowest common denominator. It is easy to add $^{3}/_{10} + {}^{5}/_{10}$, because they have the same denominator. But you cannot add $^{2}/_{5}$ and $^{3}/_{8}$ without first giving them the same denominator.

1.21 One way to give two fractions a common denominator is to multiply the numerator and denominator of each fraction by the denominator of the other. For example, suppose you want to add $^{2}/_{10} + {}^{3}/_{8}$. You can first multiply the numerator and denominator of the first fraction ($^{2}/_{10}$) by the denominator (8) of the second fraction. Next multiply the numerator and denominator of the second fraction ($^{3}/_{8}$) by the denominator (10) of the first fraction. The result is a denominator of 80 for each fraction.

1.22 Once you have found the lowest common denominator, add the numerators and place the answer on top of the denominator, as shown below. Reduce the resulting fraction to its lowest terms, if necessary. When adding mixed numbers, follow the same steps and then add the whole numbers.

$$^{1}/_{4} + {}^{1}/_{2} = {}^{1}/_{4} + {}^{2}/_{4} = {}^{3}/_{4}$$

Practice Problems
Add the following fractions:

A. $^{3}/_{8} + {}^{3}/_{16} =$ _____
B. $^{3}/_{4} + {}^{3}/_{4} =$ _____
C. $^{1}/_{2} + {}^{1}/_{16} =$ _____

(Answers are found on page 18.)

1.23 **Subtracting fractions.** When subtracting fractions, first find the lowest common denominator. Subtract the numerators and place the answer on top of the denominator, as shown below. Reduce the fraction to its lowest terms. When subtracting mixed numbers, follow the same steps and then subtract the whole numbers.

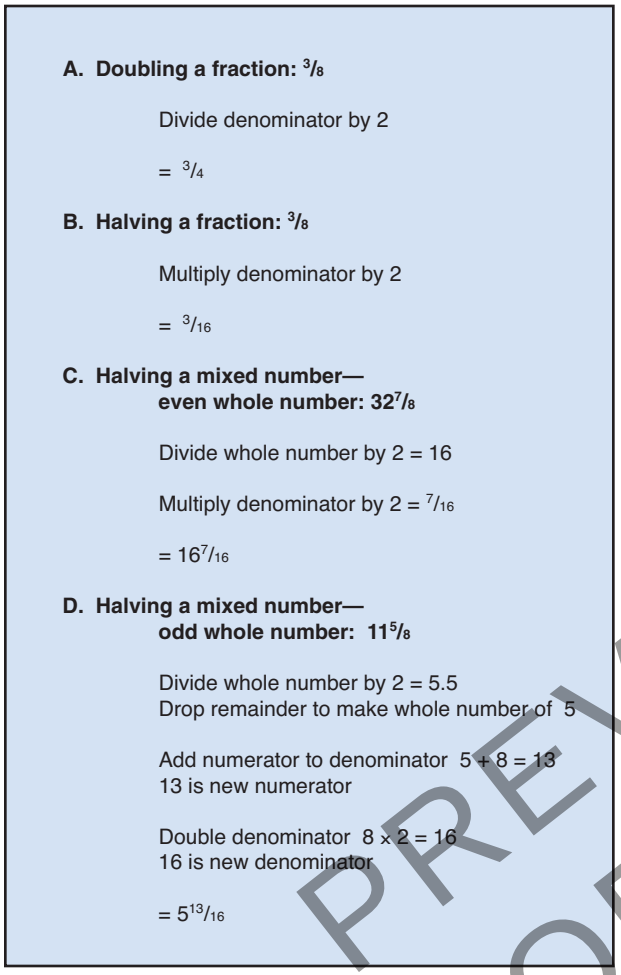
$$^{7}/_{8} - {}^{1}/_{4} = {}^{7}/_{8} - {}^{2}/_{8} = {}^{5}/_{8}$$

Practice Problems
Subtract the following fractions:

A. $1^{1}/_{2} - {}^{3}/_{8} =$ _____
B. $^{3}/_{16} - {}^{1}/_{8} =$ _____
C. $^{3}/_{4} - {}^{3}/_{8} =$ _____

(Answers are found on page 18.)

Fig. 1-6. Shortcuts using common fractions



1.24 **Multiplying fractions.** To multiply fractions, first multiply the numerators, then multiply the denominators. Write the answers in a fractional form, as shown below. Reduce to its lowest terms, if necessary.

$3/4 \times 3/8 = 9/32$
$1/4 \times 1/2 = 1/8$

Practice Problems
Multiply the following fractions:

A. $1/8 \times 2 =$ _____
B. $2\,1/2 \times 9/16 =$ _____
C. $1/4 \times 1/2 =$ _____

(Answers are found on page 18.)

1.25 **Dividing fractions.** Write down the problem. Invert (switch) the numerator and denominator in one of the fractions. Multiply the numerators. Multiply the denominators. Write answers in a fractional form, as shown. Reduce to lowest terms, as necessary.

$1/2 \div 1/4 = 1/2 \times 4/1 = 2$
$3/16 \div 1/8 = 3/16 \times 8/1 = 24/16 = 1\,1/2$

Practice Problems
Divide the following fractions:

A. $23/4 \div 1/16 =$ _____
B. $1/4 \div 1/2 =$ _____
C. $1\,1/2 \div 6 =$ _____

(Answers are found on page 18.)

Shortcuts for Working with Common Fractions

1.26 **Doubling a fraction.** An easy way to double a fraction is to divide the denominator by 2, as shown in Fig. 1-6A. Of course this only works with fractions that have an even number for the denominator. The measuring fractions used by welders are all based on even numbers, for example: $1/2$, $1/4$, $1/8$, and $1/16$.

Practice Problems
Double the following fractions:

A. $3/8 =$ _____
B. $3/4 =$ _____
C. $15/16 =$ _____
D. $5/32 =$ _____

(Answers are found on page 18.)

1.27 **Halving a fraction.** To divide a fraction in half, you have been taught to invert and multiply. As a shortcut, simply multiply the denominator by 2, as shown in Fig. 1-6B.

Practice Problems
Divide the following fractions in half:

A. $3/4 =$ _____
B. $3/8 =$ _____
C. $15/16 =$ _____
D. $1/4 =$ _____

(Answers are found on page 18.)

1.28 **Halving mixed numbers.** To divide mixed numbers in half, separate the mixed numbers into two

categories. The first category is mixed numbers with even whole numbers, and the second category is mixed numbers with odd whole numbers. Example: $32\frac{7}{8}$ belongs in the first category (mixed numbers with even whole numbers), as shown in Fig. 1-6C. In this case, divide the whole number by 2, use the shortcut for dividing a fraction, and add them back together.

1.29 The number $11\frac{5}{8}$ belongs in the second category (mixed numbers with odd whole numbers). In this case, divide the whole number by 2, as shown in Fig. 1-6D. Drop the remainder to make it a whole number of 5. Add the numerator to the denominator, 13 is the new numerator. When you put the two together again the fraction is $\frac{13}{16}$. Your final answer is $5\frac{13}{16}$.

The Programmed Exercises on the following page will tell you how well you understand the material you have just read. Before starting the exercises, remove the REVEAL KEY from the back of your book. Read the instructions printed on the Reveal Key. Follow these instructions as you work through the Programmed Exercises.

1-1. A fraction is a number that is less than _____ and greater than _____.	1-1. 1; 0 Ref: 1.01
1-2. The bottom number of a common fraction is called the _____. The top number is called the _____.	1-2. DENOMINATOR; NUMERATOR Ref: 1.04
1-3. If the denominators of two fractions are equal, the fraction with the _____ numerator has the greater value.	1-3. LARGER Ref: 1.08
1-4. Circle the smaller fraction in each pair. $^{1}/_{8}$, $^{1}/_{16}$ $^{2}/_{5}$, $^{3}/_{5}$	1-4. $^{1}/_{16}$, $^{2}/_{5}$ Ref: 1.08, 1.09
1-5. List equivalent fractions for $^{1}/_{2}$: $^{2}/_{?}$, $^{?}/_{6}$, $^{4}/_{?}$, $^{?}/_{16}$ _____	1-5. $^{2}/_{4}$, $^{3}/_{6}$, $^{4}/_{8}$, $^{8}/_{16}$ Ref: 1.10
1-6. Reduce each fraction to its lowest terms: $^{2}/_{4}$, $^{3}/_{9}$, $^{15}/_{25}$, $^{13}/_{39}$ _____	1-6. $^{1}/_{2}$, $^{1}/_{3}$, $^{3}/_{5}$, $^{1}/_{3}$ Ref: 1.11–1.13
1-7. The fraction $^{16}/_{8}$ is an example of a(n) _____ fraction.	1-7. IMPROPER Ref: 1.15
1-8. A mixed number is a(n) _____ followed by a(n) _____.	1-8. WHOLE NUMBER; FRACTION Ref: 1.18

Decimal Fractions

1.30 When you hear someone talking about "fractions," you probably think of common fractions, as discussed in the first part of this lesson. However, other fractions are also useful in the shop—*decimal fractions*, sometimes simply referred to as "decimals." Decimal fractions look much like whole numbers. These fractions have denominators that are multiples of 10 (10, 100, 1000, 10,000, . . .).

1.31 Decimal fractions are written in a special way. The denominator is left out. Only the numerator is written. A decimal point to the left of the numerator shows that the denominator is a multiple of 10.

1.32 Decimal fractions are usually easier to work with than common fractions. More importantly, you can treat them almost like whole numbers in calculations. Problems that are difficult to solve with common fractions are much easier to solve with decimal fractions.

1.33 Each digit in a decimal fraction has a place value, just like the digits in a whole number. Figure 1-7 shows these place values. In reading a decimal fraction, look at how many digits appear to the right of the decimal point. This number of digits tells you the denominator of the fraction.

Calculations Involving Decimal Fractions

1.34 Decimal fractions are calculated the same way as whole numbers. However, the decimal points must line up vertically.

1.35 **Adding decimals.** Write the decimal numbers vertically with all the decimal points aligned. Add the numbers as whole numbers, and place the decimal point in the same place as it is aligned in the problem, as shown below.

$$\begin{array}{r} 2.750 \\ +\ 0.500 \\ \hline 3.250 \end{array}$$

Practice Problems
Add the following decimals:

A. 12.25 + 0.0625 = _____
B. 0.5 + 1.125 = _____
C. 6.0 + 3.375 = _____

(Answers are found on page 18.)

Fig. 1-7. Place values in decimal fractions

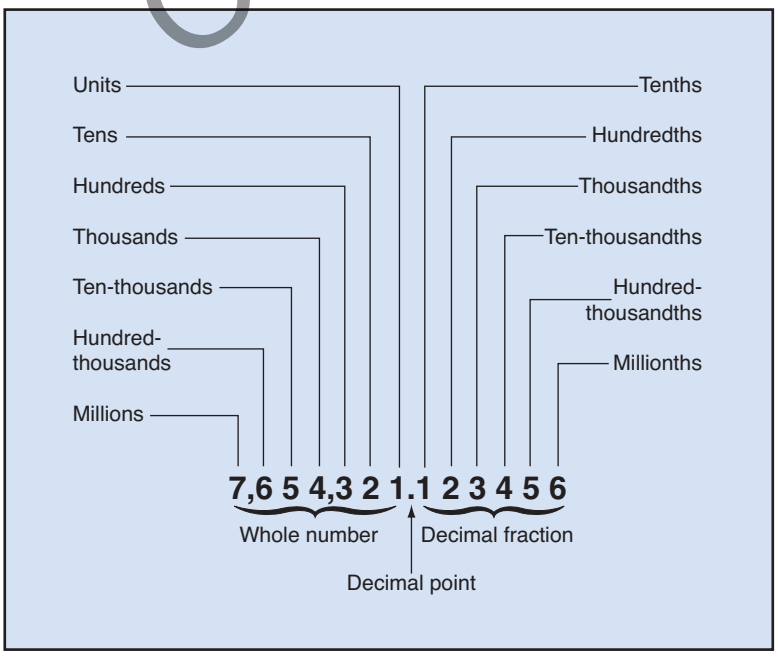
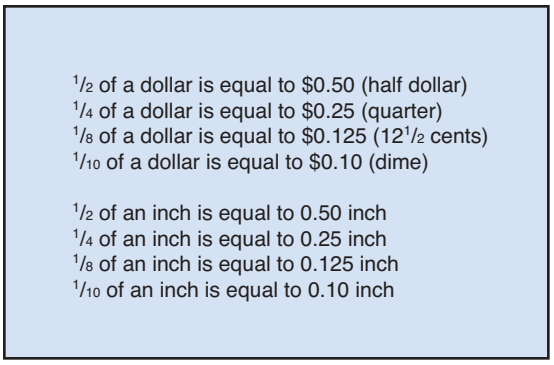


Fig. 1-8. Common fractions and decimal equivalents



1.36 **Subtracting decimals.** When subtracting decimal numbers, follow the same steps as when adding but subtract the numbers as whole numbers. Place the decimal point in the same place as it is aligned in the problem.

Practice Problems
Subtract the following decimals:

A. 5.75 – 1.875 = _____
B. 0.9325 – 0.625 = _____
C. 2.50 – 1.375 = _____

(Answers are found on page 18.)

1.37 **Multiplying decimals.** Multiply the numbers as if they were whole numbers. Count the number of decimal places of all numbers in the problem. Then place the decimal point in the answer by counting from right to left the same number of places in the problem, as shown below.

1.375 (3 places)
0.50 (2 places)
0.68750 (5 places)

1.38 **Dividing decimals.** To divide decimals, set up the problem the same way you would divide whole numbers. Move the decimal point of the dividing number to the far right. Move the decimal point of the divided number the same number of spaces to the right as you did the dividing number, as in the examples below. Place the decimal point above the bar directly above the decimal point of the divided number. Divide the same way as whole numbers.

2.55) 10.20

3.75) 10.000000

Table 1-1. Decimal equivalents

1/32	0.03125	17/32	0.53125
1/16	0.0625	9/16	0.5625
3/32	0.09375	19/32	0.59375
1/8	0.125	5/8	0.625
5/32	0.15625	21/32	0.65625
3/16	0.1875	11/16	0.6875
7/32	0.21875	23/32	0.71875
1/4	0.25	3/4	0.75
9/32	0.28125	25/32	0.78125
5/16	0.3125	13/16	0.8125
11/32	0.34375	27/32	0.84375
3/8	0.375	7/8	0.875
13/32	0.40625	29/32	0.90625
7/16	0.4375	15/16	0.9375
15/32	0.46875	31/32	0.96875
1/2	0.5	1	1.000000

Converting Common Fractions to Decimal Fractions

1.39 Common fractions are used when measuring distances in the shop or field. The fractions are then converted to decimals to perform calculations. After the calculations, fractions are again needed for measurements, so the decimals are converted back to fractions. The conversions are necessary because of the differences between the measuring tools and the calculating tools.

1.40 We use conversion of fractions and decimals every day. Our monetary system is based on the decimal system. Just as fractions of a dollar can be converted into decimals, fractions of an inch can be converted into decimals, as shown in Fig. 1-8. The line or bar between the numerator and the denominator of a fraction acts as a division bar.

1.41 It is easy to convert a common fraction to a decimal. Simply divide the numerator by the denominator. The answer will be the decimal that is equal to that fraction. For example, 9/16 = 0.5625. You can use a conversion chart like the one shown in Table 1-1, but you can save a lot of time by learning to do the calculation. Using a calculator makes this even easier.

Practice Problems
Convert the following common fractions to decimals:

A. $^5/_8$ = _____
B. $^1/_4$ = _____
C. $^1/_2$ = _____

(Answers are found on page 18.)

Converting Decimal Fractions to Common Fractions

1.42 In the shop, calculations are often made to obtain a needed measurement. Decimals are used in calculations, but measurements are made in fractions, so you will need to convert your final calculations to fractions.

1.43 To convert a decimal of an inch (0.375) to a fraction of an inch ($^3/_8$), simply reverse the method you used to convert a fraction to a decimal. Multiply the decimal of an inch by the denominator you will be using. Since the accuracy generally needed in the welding industry is based on $^1/_{16}$ in., 16 is the denominator you will most often use. If more accuracy is needed, you can use 32. The nearest whole number of the answer will be the numerator, as shown here.

0.375 (decimal of an inch)
16 (desired denominator)
6.000 (numerator)

You now have the fraction $^6/_{16}$, which can be reduced to $^3/_8$.

1.44 When working problems, seldom do you end up with a decimal that will convert to an even sixteenth. You must round off the numerator to the nearest whole number. Remember when rounding off to the nearest whole number, if the decimal is 0.5 or more you go up to the next whole number. If the decimal is below 0.5 use the existing number. For example, 3.49 will round down to 3, and 3.5 will round up to 4.

Practice Problems
Convert the following decimals to common fractions:

A. 0.625 = _____
B. 0.25 = _____
C. 0.5 = _____

(Answers are found on page 18.)

Standard Rules and Tape Measures

1.45 Steel rules (or rulers) and tape measures are the most common measuring tools used by welders. Two steel rules are shown in Fig. 1-9. To make accurate measurements you must know how to use these tools and how to read both inch and millimeter measurements. Metric measurement (millimeters) will be covered in a later lesson.

1.46 Before you can use any measuring tool properly, you must understand the unit of measurement involved. Most fractional measurements are indicated by lines on the measuring tool rather than by numbers. Therefore, you must understand their placements and meaning.

1.47 Each steel rule or tape is divided into a series of equally spaced lines along each edge, as shown in Fig. 1-9. These lines are called the *scales*. Each line in a scale is called a *graduation*. So if your rule or tape had a scale with eight graduation lines to each inch, the scale would be $^1/_8$ in. If your rule had a scale with sixteen graduation lines to each inch, the scale would be $^1/_{16}$ in. Notice that these numbers are indicated on the rules shown as 8, 16, 32, and 64. As a welder, the scales you will use most often are the eighth and sixteenth.

Fig. 1-9. Steel rules showing various scales

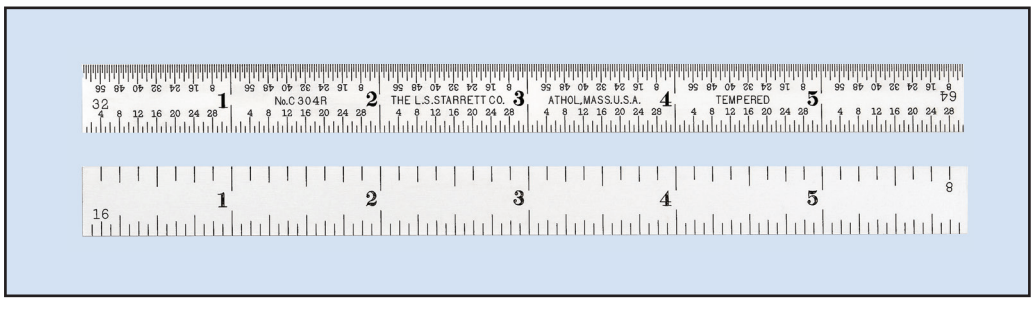
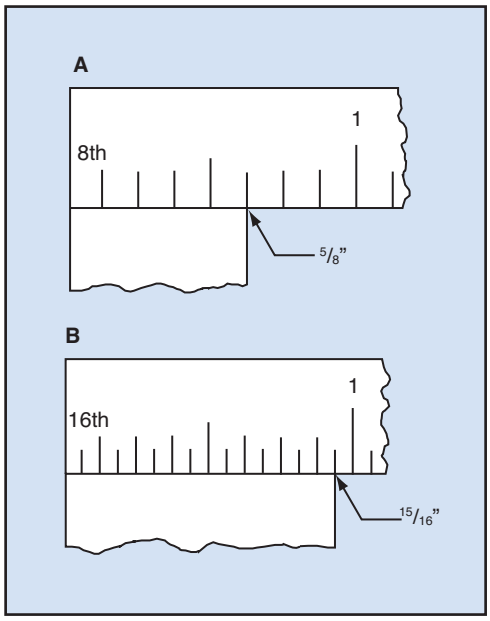


Fig. 1-10. Reading a steel rule



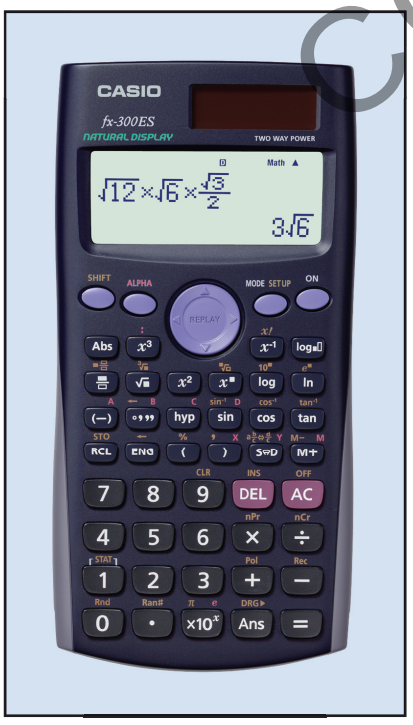
Reading a Rule or Tape Measure

1.48 The first step in measuring with a rule or tape is to select the proper scale. If the blueprint you are working with specifies a measurement of 1/2 in., then either the eighth or sixteenth can be used, because both have a 1/2 in. graduation. But if the blueprint calls for 9/16 in. measurement, only the 1/16 in. scale can be used. It is the only scale that will divide an inch into sixteen parts. Figure 1-10A shows a 1/8 in. scale. The object it is measuring is 5/8 in. Figure 1-10B shows a 1/16 in. scale measuring an item that is 15/16 in.

1.49 Every graduation on a fractional rule or tape represents one-half of the next higher graduation. For example, 1/2 in. is one-half of 1 in. The next smaller measurement is 1/4 in. (one-forth of 1 in.), which is half of 1/2 in. Half of 1/4 in. is 1/8 in. And finally, half of 1/8 in. is 1/16 in.

1.50 Some of the marks on a rule indicate equivalent fractions. For example, the mark at 1/4 in. indicates 1/4, 2/8, and 4/16 of an inch. When reading a rule, you will often need to reduce a measurement to its lowest terms. For example, 8/16 in. = 4/8 in. = 2/4 in. = 1/2 in. The correct reading would be 1/2 in. Technically all of these fractions are equal to 1/2 in.; however, they are not reduced to their lowest terms. Practice making measurements and reducing to lowest terms until you become proficient enough to read the scale accurately and quickly. You might find it easier to count each graduation when you first start.

Fig. 1-11. Scientific calculator



Using a Calculator

1.51 Handheld calculators are frequently used in the plant, including the welding shop. They are as easy to carry on the job as a steel measuring tape. Everyone can use a basic calculator, often without any special instructions. More complicated calculators require time and effort if you want to learn to use them to their full potential.

1.52 You can do everything a calculator can do, but the calculator can do it much faster. It may take you 2 minutes to solve a certain math problem. The calculator can display the answer almost as soon as you press the last key. In addition, nothing can distract the calculator from its job, so it does not make mistakes. You and your calculator form a team. You do the thinking, and the calculator does the math. After you have figured out the method for solving a mathematical problem, the calculator can process the numbers for you, quickly and accurately.

1.53 Nearly all handheld calculators have certain basic functions in common. For example, they can all

add, subtract, multiply, and divide. The keys for these functions are the same on all calculators. Other functions are usually found only on calculators intended for special uses. For example, the calculator shown in Fig. 1-11 has a key that allows you to enter fractional measurements exactly as they appear on a blueprint. Results can also be displayed as common fractions.

1.54 Every new calculator comes with a detailed instruction book that tells you exactly how to use it. This instruction book will help you understand how to choose the right kind of calculator and use it to its full potential.

1-9. Decimal fractions have denominators that are multiples of _____.	1-9. 10 Ref: 1.30
1-10. When adding decimal fractions, make certain the _____ line up vertically.	1-10. DECIMAL POINTS Ref: 1.34
1-11. _____ fractions are used when measuring lengths in the shop; these fractions are then converted to _____ fractions to perform calculations.	1-11. COMMON; DECIMAL Ref: 1.39
1-12. The easiest way to convert a common fraction to a decimal is to use a _____ to divide the _____ by the _____.	1-12. CALCULATOR, NUMERATOR; DENOMINATOR Ref: 1.41
1-13. The denominator you will most often use in welding measurements is _____.	1-13. 16 Ref: 1.43
1-14. When rounding to the nearest whole number, round 2.49 to _____; round 2.50 to _____.	1-14. 2; 3 Ref: 1.44
1-15. The series of equally spaced lines on the edge of a steel rule is called a(n) _____. Each line is called a(n) _____.	1-15. SCALE; GRADUATION Ref: 1.47
1-16. What is the first step in measuring with a rule?	1-16. SELECT THE PROPER SCALE Ref: 1.48

Answer the following questions by marking an "X" in the box next to the best answer.

1-1. The numeral above the line in a common fraction is called the

- ☐ a. integral
- ☐ b. numerator
- ☐ c. ratio number
- ☐ d. term

1-2. Which of the following fractions has the largest value?

- ☐ a. $^{9}/_{10}$
- ☐ b. $^{9}/_{100}$
- ☐ c. $^{9}/_{1000}$
- ☐ d. $^{99}/_{1000}$

1-3. Reducing a fraction to its lowest terms involves giving it the lowest possible

- ☐ a. denominator
- ☐ b. numerator
- ☐ c. numerator and denominator
- ☐ d. value

1-4. An improper fraction has a value that is always

- ☐ a. less than 1
- ☐ b. equal to 1
- ☐ c. 1 or more
- ☐ d. greater than 2

1-5. Before adding or subtracting common fractions, you must find their

- ☐ a. average numerator
- ☐ b. common denominator
- ☐ c. divisible factor
- ☐ d. lowest term

1-6. An easy way to double a fraction is to _____ the denominator by _____.

- ☐ a. divide; 2
- ☐ b. divide; the numerator
- ☐ c. multiply; 2
- ☐ d. multiply; the numerator

1-7. Decimal fractions have denominators that are multiples of

- ☐ a. 2
- ☐ b. 10
- ☐ c. 100
- ☐ d. the numerator

1-8. In the number 0.79, what is the denominator?

- ☐ a. 1
- ☐ b. 10
- ☐ c. 100
- ☐ d. 1000

1-9. What is the decimal equivalent of $^{5}/_{32}$?

- ☐ a. 0.078125
- ☐ b. 0.156250
- ☐ c. 0.312500
- ☐ d. 0.625000

1-10. As a welder, the scales you will use most often when measuring are the

- ☐ a. half and quarter
- ☐ b. quarter and eighth
- ☐ c. eighth and sixteenth
- ☐ d. sixteenth and thirty-second

SUMMARY

A fraction is a number less than 1 but greater than 0. Common fractions are written above and below a diagonal line. The bottom number (denominator) indicates the number of parts the whole has been divided into. The top number (numerator) indicates how many of these parts you are dealing with. Decimal fractions look much like whole numbers. These fractions have denominators that are multiples of 10. Decimal fractions are usually easier to work with than common fractions. You can treat them almost like whole numbers in calculations.

Converting back and forth between these kinds of decimals is commonly done in welding work. Handheld calculators make this task simple. You can do everything a calculator can do, but the calculator can do it much faster.

Answers to Self-Check Quiz

1-1. b. Numerator. Ref: 1.04

1-2. a. $^{9}/_{10}$. Ref: 1.08, 1.09

1-3. c. Numerator and denominator. Ref: 1.11

1-4. c. 1 or more. Ref: 1.15

1-5. b. Common denominator. Ref: 1.20, 1.23

1-6. a. Divide; 2. Ref: 1.26

1-7. b. 10. Ref: 1.30

1-8. c. 100. Ref: 1.33, Fig. 1-7

1-9. b. 0.156250. Ref: 1.41

1-10. c. Eighth and sixteenth. Ref: 1.47

Answers to Practice Problems

Paragraph 1.22
A. $^{9}/_{16}$
B. $1^{1}/_{2}$
C. $^{9}/_{16}$

Paragraph 1.23
A. $1^{1}/_{8}$
B. $^{1}/_{16}$
C. $^{3}/_{8}$

Paragraph 1.24
A. $^{1}/_{4}$
B. $1^{13}/_{32}$
C. $^{3}/_{8}$

Paragraph 1.25
A. 44
B. $^{1}/_{2}$
C. $^{1}/_{4}$

Paragraph 1.26
A. $^{3}/_{4}$
B. $1^{1}/_{2}$
C. $1^{7}/_{8}$
D. $^{5}/_{16}$

Paragraph 1.27
A. $^{3}/_{8}$
B. $^{3}/_{16}$
C. $^{15}/_{32}$
D. $^{1}/_{8}$

Paragraph 1.35
A. 12.3125
B. 1.625
C. 9.375

Paragraph 1.36
A. 3.875
B. 0.3075
C. 1.125

Paragraph 1.41
A. 0.625
B. 0.25
C. 0.5

Paragraph 1.44
A. $^{5}/_{8}$
B. $^{1}/_{4}$
C. $^{1}/_{2}$

Contributions from the following sources are appreciated:

Figure 1-9. The L.S. Starrett Co.
Figure 1-11. Photo courtesy of Casio America, Inc.