Unit Conversion and Conversion Factors

A unit conversion expresses the same property as a different unit of measurement. For instance, time can be expressed in minutes instead of hours, while distance can be converted from miles to kilometers, or feet, or any other measure of length. Often measurements are given in one set of units, such as feet, but are needed in different units, such as chains. A conversion factor is a numeric expression that enables feet to be changed to chains as an equal exchange.

A conversion factor is a number used to change one set of units to another, by multiplying or dividing. When a conversion is necessary, the appropriate conversion factor to an equal value must be used. For example, to convert inches to feet, the appropriate conversion value is 12 inches equal 1 foot. To convert minutes to hours, the appropriate conversion value is 60 minutes equal 1 hour.

A unit cancellation table is developed by using known units, conversion factors, and the fact that a unit of measure ÷ the same unit of measure cancels out that unit. The table is set up so all the units cancel except for the unit desired. To cancel a unit, the same unit must be in the numerator and in the denominator. When you multiply across the table, the top number will be divided by the bottom number, and the result will be the answer in the desired units.

Example 1 - Ralph wants to know how many seconds are in 3 hours and 36 minutes.

Step 1. Change 3 hours and 36 minutes to the same units. This unit can be hours or minutes. Using minutes is easier because the end time value will need to be in seconds.

The appropriate conversion factor is: 1 hour = 60 minutes.

$$\left|\begin{array}{c|c} 3\,\text{hr} & 60\,\text{min} \\ & 1\,\text{hr} \end{array}\right| = 3 \times 60 = 180\ \text{minutes}$$

3 hours and 36 minutes = 180 minutes plus 36 minutes = 216 minutes

Step 2. Set up the cancellation table so all units will cancel, except the desired unit, seconds.

The appropriate conversion factor is:
1 minute = 60 seconds.

$$\frac{216\ \text{min}}{} \left| \frac{60\ \text{sec}}{1\ \text{min}} \right. = 216 \times 60 = 12{,}960\ \text{seconds}$$

There are 12,960 seconds in 3 hours 36 minutes.

Notice that the hour units on the top and bottom cancel along with the minutes, leaving seconds as the only unit.

Setting up a unit cancellation table helps keep units straight, even for the most seasoned professional firefighter. These tables are particularly important when more than one unit conversion is necessary to obtain the desired unit. Answers should always be presented with the appropriate number of significant digits. For information about significant digits and rounding, please review Section 1.6, Using Decimals.

Example 2 - How many pints are in a 5-gallon pail? How many cups are in a 5-gallon pail?

Step 1. Find the appropriate conversion factors in Table 2.1 at the end of this chapter.
1 gallon = 4 quarts, 1 quart = 2 pints, 1 pint = 2 cups

Step 2. Set up the cancellation table so all units will cancel, except the desired unit, pints.

$$\frac{5\ \text{gallons}}{} \left| \frac{4\ \text{quarts}}{1\ \text{gallon}} \right| \frac{2\ \text{pints}}{1\ \text{quart}} = 40\ \text{pints}$$

There are 40 pints in 5 gallons.

$$\frac{40\ \text{pints}}{} \left| \frac{2\ \text{cups}}{1\ \text{pint}} \right. = 80\ \text{cups}$$

There are 80 cups in 5 gallons.

Example 3 - Javier constructed 2,678 feet of dozer line. How many chains of dozer line did he construct?

Step 1. Find the appropriate conversion factor in Table 2.1 . 1 chain = 66 feet

Step 2. Set up the cancellation table so all units will cancel, except the desired unit, chains.

$$\frac{2{,}678\ \text{feet}}{} \left| \frac{0.0152\ \text{chains}}{1\ \text{foot}} \right| = 40.7\ \text{chains} = 41\ \text{chains}$$

Javier constructed 41 chains of dozer line.

Notice that Table 2.2 has two conversions for each set of units. When setting up the cancellation table, it is not important which conversion factor is used. What is important is that the appropriate units cancel so that the correct end result is achieved.