

CUSTOMARY SYSTEM OF MEASUREMENT

Measurements are approximations of lengths. First, we'll look at measuring to the nearest 16th of an inch when given a ruler divided into 8ths. Sixteenths fall on the eighths and also between the eighths. For example: $\frac{3}{8}$ ths is the same as $\frac{6}{16}$ ths; $\frac{4}{8}$ ths is the same as $\frac{8}{16}$ ths. The sixteenth that falls halfway between $\frac{3}{8}$ ths and $\frac{4}{8}$ ths is $\frac{7}{16}$ ths. We will estimate to the nearest sixteenth using our knowledge of eighths and knowing that some sixteenths fall halfway between the eighths on the ruler.

After estimating to the nearest sixteenths with a ruler marked in eighths, we'll look at measuring to the nearest 16th using a rule divided into sixteenths.

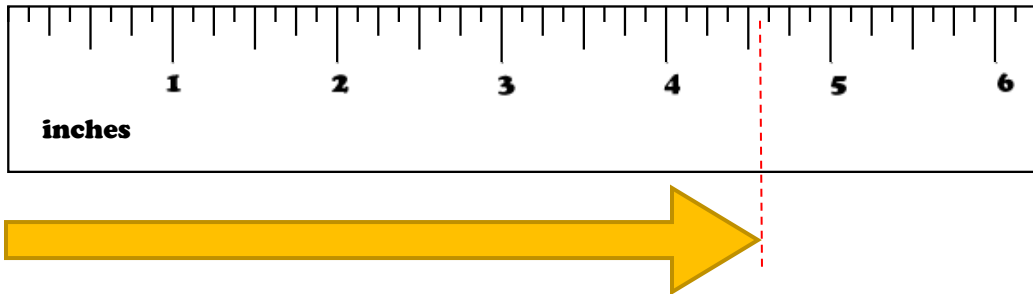
The customary units of measurement are used in the United States. Units of measurement may be expressed in larger or smaller equivalent units. We'll examine a conversion chart of customary units and ways to convert within the customary measurement system. First we'll look at converting customary units of length, weight, and capacity.

Customary units of area are used in everyday life such as measuring carpet or surveying land. We will look at a chart of customary units of area and how to convert area measurements into equivalent areas measurements of a different unit.

Softened concrete is sold in cubic yards. Cubic yards are a customary unit of volume. We'll examine a chart of customary units of volume and how to convert volume measurements into equivalent volume measurements of a different unit.

Estimating Measurements

This ruler is divided into 8ths of an inch. Estimate the length of the arrow to the nearest 16th of an inch.



The arrow's tip falls between $4\frac{1}{2}$ and $4\frac{5}{8}$ inches.

Change both $4\frac{1}{2}$ and $4\frac{5}{8}$ to 16ths.

$$4\frac{1}{2} = 4\frac{8}{16} \qquad 4\frac{5}{8} = 4\frac{10}{16}$$

Halfway between $\frac{8}{16}$ and $\frac{10}{16}$ is $\frac{9}{16}$.

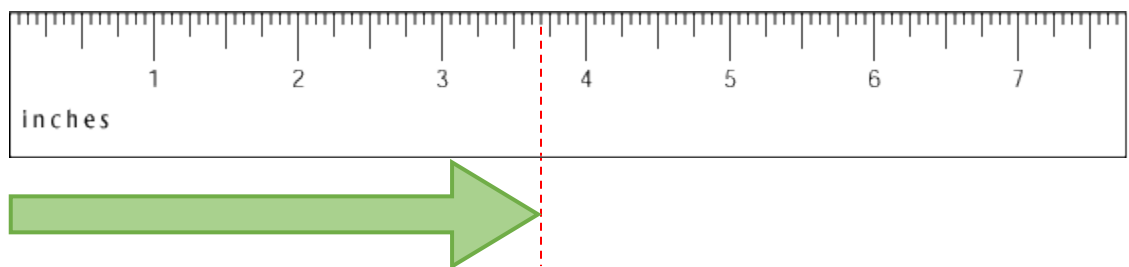
The arrow measures approximately $4\frac{9}{16}$ inches.

Measuring to the Nearest 16th Inch

This ruler is divided into 16ths of an inch.

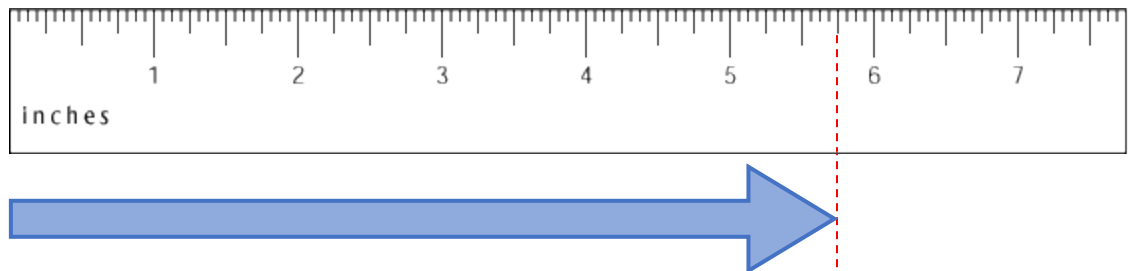
To measure to the nearest 16th of an inch, count the spaces between the marks from the beginning of one whole inch up to and including the mark of the measurement. Write the measurement in 16ths, and then reduce if possible.

Example 1: How long is the green arrow?



The arrow's tip falls on $\frac{11}{16}$; therefore, the arrow's length is $3\frac{11}{16}$ inches.

Example 2: How long is the blue arrow?



The arrow's tip falls on $\frac{12}{16}$; thus, the arrow's length is $5\frac{12}{16}$ inches, which reduces to $5\frac{3}{4}$ inches.

Customary Units – Conversion Charts

Use these customary unit equivalences to make conversions, to add measurements, and to subtract measurements.

Units of length – inch, foot, yard, mile	
1 foot (ft)	12 inches (in)
1 yard (yd)	3 ft or 36 in
1 mile (mi)	1760 yd or 5280 ft

Units of weight – ounce, pound, ton	
1 pound (lb)	16 ounces (oz)
1 ton (T)	2000 lb

Units of capacity – ounce, cup, pint, quart, gallon	
1 cup (c)	8 fluid ounces (fl oz)
1 pint (pt)	2 c
1 quart (qt)	2 pt
1 gallon (gal)	4 qt

Units of time – seconds, minutes, hour, day, week, month, year	
1 minute (min)	60 seconds (s)
1 hour (hr)	60 min
1 day (d)	24 hr
1 week (wk)	7 d
1 year (y)	52 wk, 12 months (mo), 365 d

Customary Units Conversions and Computations

To express a **larger unit as a smaller unit**, *multiply* by the conversion factor.

Example 1: How many ounces are in 7 pounds?

$$7 \text{ lb} \times 16 = 112 \text{ oz} \quad (1 \text{ lb} = 16 \text{ oz})$$

There are 112 ounces in 7 pounds.

Example 2: How many inches are in 5 feet 4 inches?

$$5 \text{ feet} \times 12 = 60 \text{ inches} + 4 \text{ extra inches makes } 64 \text{ inches. } (1 \text{ ft} = 12 \text{ in})$$

There are 64 inches in 5 feet 4 inches.

To express a **smaller unit as a larger unit**, *divide* by the conversion factor.

Example 3: How many gallons make 18 quarts?

$$18 \text{ qt} \div 4 = 4\frac{1}{2} \text{ gal} \quad (1 \text{ gal} = 4 \text{ qt})$$

$$\begin{array}{r} = 4\frac{2}{4} = 4\frac{1}{2} \\ 4 \overline{)18} \\ \underline{16} \\ 2 \end{array}$$

There are 4 1/2 gallons in 18 quarts.

Here are some sample problems for computing within the customary system of measurement.

Example 4: Add.

$$\begin{array}{r} 5 \text{ feet } 7 \text{ inches} \\ + 2 \text{ feet } 8 \text{ inches} \\ \hline 7 \text{ feet } 15 \text{ inches} \end{array} \begin{array}{l} \text{Simplify} \\ \rightarrow 7 \text{ feet } 15 \text{ in} = 7 \text{ feet} + 12 \text{ in} + 3 \text{ in} \\ 7 \text{ feet } 15 \text{ in} = 7 \text{ feet} + 1 \text{ ft} + 3 \text{ in} \\ \leftarrow 8 \text{ feet } 3 \text{ inches} \end{array}$$

The sum of 5 ft 7 in and 2 ft 8 in equals 8 ft 3 in.

Example 5: Subtract.

Since 22 is smaller than 45, borrow to get 5 hr 82 min

$$\begin{array}{r} 6 \text{ hr } 22 \text{ min} = 5 \text{ hr } 82 \text{ min} \longrightarrow 6 \text{ hr } 22 \text{ min} = 5 \text{ hr} + 1 \text{ hr} + 22 \text{ min} = \\ -3 \text{ hr } 45 \text{ min} = 3 \text{ hr } 45 \text{ min} \longleftarrow 5 \text{ hr} + 60 \text{ min} + 22 \text{ min} = \\ \hline 2 \text{ hr } 37 \text{ min} \qquad \qquad \qquad 5 \text{ hr} + 82 \text{ min} \end{array}$$

The difference between 6 hr 22 min and 3 hr 45 min is 2 hr 37 min.

Customary Units of Area

Use the table of customary units of area to find equivalent areas in solving the problems below.

Unit	Abbreviation	Equivalence
square mile	sq mi or mi ²	1 sq mi = 640 acres 1 sq mi = 102,400 square rods
acre		1 acre = 4840 square yards 1 acre = 43,560 square feet
square rod	sq rd or rd ²	1 sq rd = 30.25 square yards 1 sq rd = 0.006 acres
square yard	sq yd or yd ²	1 sq yd = 1296 square inches 1 sq yd = 9 square feet
square foot	sq ft or ft ²	1 sq ft = 144 square inches 1 sq ft = 0.111 square yards
square inch	sq in or in ²	1 sq in = 0.007 square feet 1 sq in = 0.00077 square yards

Solve.

5 square yards = _____ square feet

$$\frac{1}{9} = \frac{5}{n} \longrightarrow \text{Cross-multiply}$$

$$n = 45 \text{ sq ft}$$

Following the **conversion chart**, we state square yards to square feet on both sides of the proportion. On the left, we compare 1 sq yd to 9 sq ft. On the right, we compare 5 sq yd to “*n*” sq ft. We then cross-multiply and divide to solve.

Solve.

72 square inches = _____ square feet

$$\frac{1}{0.007} = \frac{72}{n} \longrightarrow \text{Cross-multiply}$$

$$n = 0.504 \text{ sq ft or approximately a half square foot.}$$

Following the **conversion chart**, we state square inches to square feet on both sides of the proportion. On the left, we compare 1 sq in to .007 sq ft. On the right, we compare 72 sq in to “*n*” sq ft. We then cross-multiply and divide to solve.

Solve.

2420 square yards = _____ acres

$$\frac{1}{4840} = \frac{n}{2420} \quad \longrightarrow \quad \text{Cross-multiply}$$

$$4840 n = 2420$$

$$n = 2420 \div 4840$$

$$n = 0.5 \text{ or } \frac{1}{2} \text{ acre}$$

square yards on both sides of the proportion.
On the left, we compare 1 acre to 4840 sq yd
On the right, we compare “ n ” acres to 2420 sq yd.
We then cross-multiply and divide to solve.

Customary Units of Volume

Unit	Abbreviation	Equivalence
cubic yard	cu yd or yd ³	1 cu yd = 27 cubic feet 1 cu yd = 46,656 cubic inches
cubic foot	cu ft or ft ³	1 cu ft = 1728 cubic inches 1 cu ft = 0.0370 cubic yards
cubic inch	cu in or in ³	1 cu in = 0.00058 cubic feet 1 cu in = 0.000021 cubic yards

Solve.

$$10 \text{ cubic yards} = \underline{\hspace{2cm}} \text{ cubic feet}$$
$$\frac{1}{27} = \frac{10}{n} \quad \longrightarrow \quad \text{Cross-multiply}$$
$$n = 270 \text{ cubic feet}$$

Following the **conversion chart**, we state cubic yards to cubic feet on both sides of the proportion. On the left, we compare 1 cu yd to 27 cu ft. On the right, we compare 10 cu yd to “*n*” cu ft. We then cross-multiply and divide to solve.