Waste Tire Math Reference

Prepared by CalRecycle Waste Evaluation and Enforcement Branch

Volumetric Calculations

Note—When counting whole tires, each tire counts as one tire regardless of size or mass.

Passenger Tire Equivalent (PTE)

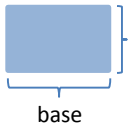
PTE is only to be used for volumetric calculations of Altered Waste Tires. Never calculate or incorporate PTE in any whole tire count. 20 lbs = 1 PTE (See 14 CCR 17225.770)

Calculating Area

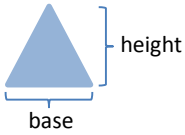
Area of Polygons

A **polygon** is a two dimensional (plane) shape with straight sides.

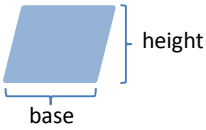
Area of a **rectangle** = base × height
Area of a **rectangle** = length x width



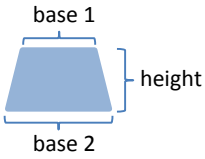
Area of a **triangle** = 1/2 base × height



Area of a **parallelogram** = base × height



Area of a trapezoid = 1/2 ($base_1$+$base_2$) × height



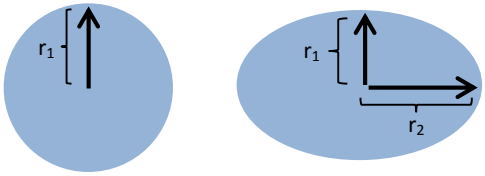
Area of Ellipse and Circle

An **oval** or **ovoid** is any curve that looks like an egg or an ellipse. It is not a precise term and there are many curves that get called "oval."

An **ellipse** is a regular oval shape, traced by a point moving in a plane so that the sum of its distances from two other points (the foci) is constant. Π, sometimes written pi, is a mathematical constant whose value is the ratio of any circle's circumference to its diameter. **π is approximately equal to 3.1416**.

Area of a **circle** = πr^2

Area of an **ellipse** = $\pi \times r_1 \times r_2$



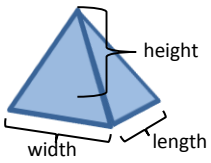
NOTE: Radius is diameter divided by 2.

Calculating Volume

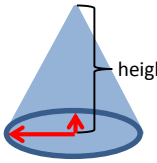
Volumes of cubes and cuboids = l × w × h

Volume of a pyramid = 1/3(area of base)×height

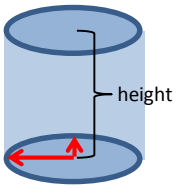
A pyramid has a base and triangular sides which rise to meet at the same point. The base may be any polygon such as a square, rectangle, triangle, etc.

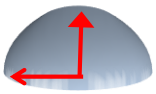


Volume of a cone = 1/3(area of base) × height



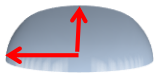
Volume of a circular cylinder = πr^2 × height
Volume of an elliptical cylinder = $\pi \times r_1 \times r_2$ × height





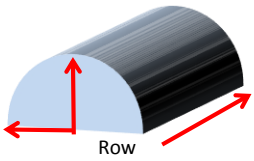
Dome
(radius = height)

Volume of hemispherical, circular-based dome (r = height) = 2/3(πr^2 × height)
Volume of a cap (A circular-based dome where r > height) = Volume = 0.52H x ($3R^2 + H^2$)
Volume of an elliptical dome = 2/3($\pi \times r_1 \times r_2$ × height)



Cap
(Radius is larger than height.)

Volume of a row = area of face × length
(Face could be any polygon, or a half circle, or a half ellipse)



Additional Notes

Deduct 20%—Volumetric Estimates, Count Averages, and Questionable Counts

Reduce any estimate by 20% (Multiply by 0.8.). This would apply to volumetric estimates, count averages, and direct counts of small tire piles where you cannot unquestionably count every tire, but where volumetric estimation would be less accurate. An example of a count average would be finding 19 stacks that appear to each be eight tires high. If you do not count each tire, but instead calculated 19 x 8 = 152, then list the total as 121.

Note—You might find a portion of tires present that you can unquestionably count, and another portion that you cannot. In such cases, deduct 20% from only the portion you cannot unquestionably count.

Converting Cubic Feet to Cubic Yards

Volume in cubic feet/27 = volume in cubic yards

Other Formulas to Use When Converting to CY

Sidewalls = 20 tires/cy
Treads = 20 tires/cy
Primary Shreds = 20 tires/cy
Shreds 2 inches or smaller = 40 tires/cy

Typical Conversions for Count Averages

1 whole tire = 2 sidewalls and 1 tread*
1 tread = 2 sidewalls*
4 sidewalls = 1 Tire*
2 treads = 1 Tire*
*Regardless of size

1 bale = 60 to 80 tires (Ask the operator)

Crumb Rubber

Waste tire material less than or equal to ¼ inch in size (6mm) is not regulated by CalRecycle. (See 14 CCR 17225.720 and 14 CCR 18450 (a) (38))

Tires per Cubic Yard

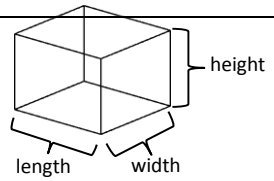
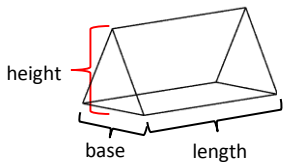
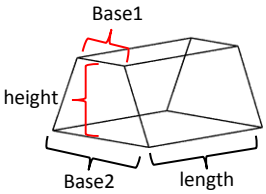
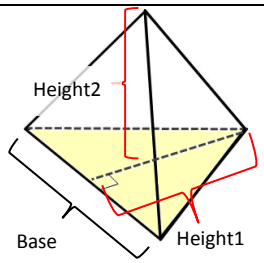
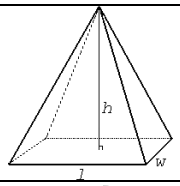
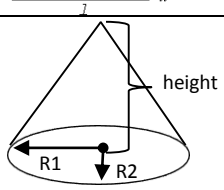
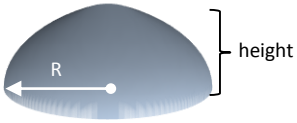
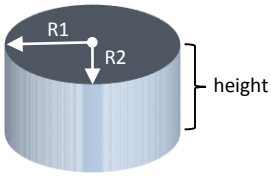
Whole Passenger and Light Truck Tires			
Stored Less than 15 Years			
Pile Height	**Less than 10 Feet**	**10 to 15 Feet**	**More than 15 Feet**
Loose Stacked	10 Tires/Cubic Yard	12 Tires/Cubic Yard	14 Tires/Cubic Yard
Barrel Stacked	12 Tires/Cubic Yard	14 Tires/Cubic Yard	16 Tires/Cubic Yard
Laced	14 Tires/Cubic Yard	16 Tires/Cubic Yard	18 Tires/Cubic Yard
Stored More than 15 Years			
Pile Height	**Less than 10 Feet**	**10 to 15 Feet**	**More than 15 Feet**
Loose Stacked	12 Tires/Cubic Yard	14 Tires/Cubic Yard	16 Tires/Cubic Yard
Barrel Stacked	14 Tires/Cubic Yard	16 Tires/Cubic Yard	18 Tires/Cubic Yard
Laced	16 Tires/Cubic Yard	18 Tires/Cubic Yard	20 Tires/Cubic Yard

Whole Semi-Truck Tires			
Stored Less than 15 Years			
Pile Height	**Less than 10 Feet**	**10 to 15 Feet**	**More than 15 Feet**
Loose Stacked	2.5 Tires/Cubic Yard	2.75 Tires/Cubic Yard	3.0 Tires/Cubic Yard
Barrel Stacked	4.2 Tires/Cubic Yard	4.4 Tires/Cubic Yard	4.6 Tires/Cubic Yard
Laced	4.1 Tires/Cubic Yard	4.3 Tires/Cubic Yard	4.5 Tires/Cubic Yard
Stored More than 15 Years			
Pile Height	**Less than 10 Feet**	**10 to 15 Feet**	**More than 15 Feet**
Loose Stacked	3.0 Tires/Cubic Yard	3.5 Tires/Cubic Yard	4.0 Tires/Cubic Yard
Barrel Stacked	4.4 Tires/Cubic Yard	4.6 Tires/Cubic Yard	4.8 Tires/Cubic Yard
Laced	4.3 Tires/Cubic Yard	4.5 Tires/Cubic Yard	4.7 Tires/Cubic Yard

Loose

Laced

Barrel Stacked

Cuboid (Box)		Volume = _____ x _____ x _____ = _____ feet^3 length width height
Triangular Row		Volume = 0.5 x _____ x _____ x _____ = _____ feet^3 Base height length Note: The height is the vertical distance perpendicular to the base, not the length of another side of the triangle.
Trapezoidal Row		Volume = 0.5 x (_____ + _____) x _____ x _____ = _____ feet^3 Base1 base2 height length (**DO THIS FIRST**) Before doing any multiplication you must first add base1 and base2 together.
Triangular Pyramid		Volume = 0.5 x _____ x _____ x _____ ÷ 3 = _____ feet^3 Base height1 height2 Note: The height1 is the horizontal distance perpendicular to the base, not the length of another side of the triangular base. Height 2 is the vertical distance perpendicular to the plane of the base triangle.
Rectangular Pyramid		Volume = _____ x _____ x _____ ÷ 3 = _____ feet^3 length width height
Cone		Volume = 3.14 x _____ x _____ x _____ ÷ 3 = _____ feet^3 R1 R2 height Note: For an elliptical base R1 should be measured along the widest diameter and R2 should be measured along the narrowest diameter. For a circle R1 and R2 will be the same.
Dome$_1$		Volume = 0.52H x (3R^2 + H^2) Note: This equation works for any dome shaped pile with a roughly circular base, and any height. See next dome equation for a simplified version but note the additional restrictions.
Dome$_2$		Volume = 2.1 x _____ x _____ x _____ = _____ feet^3 R R height Note: This equation is only accurate for domes that are approximately half of a complete sphere (elliptical or circular).
Cylinder		Volume = 3.14 x _____ x _____ x _____ = _____ feet^3 R1 R2 height Note: For an elliptical base R1 should be measured along the widest diameter and R2 should be measured along the narrowest diameter. For a circle R1 and R2 will be the same.