# Waste Tire Math Reference Guide

**Prepared by the Waste Tire Enforcement Section**

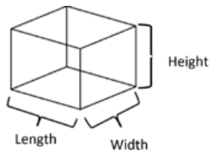
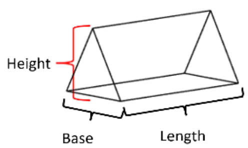
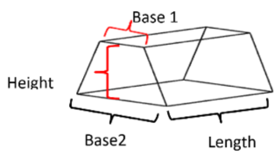
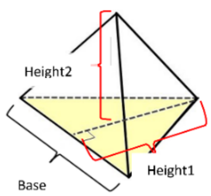
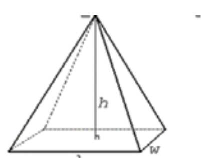
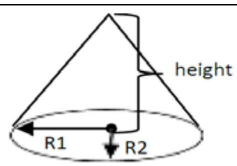
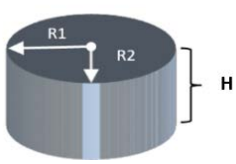
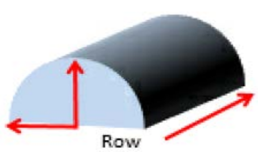
## Volumetric Calculations Count Method

The following steps in this guide make up the Volumetric Calculation Formula:

**(Step 1)** **(Step 2)** **(Step 3)**

(Calculate Tire Volume) **x** (Select Conversion Factor) **x** (Apply Deduction) = **Final Waste Tire Count**

## Step 1: Calculate Volume of Waste Tire Pile in Cubic Yards

| | | |
|---|---|---|
| Cuboid (Box) |  | Volume = Width x Height x Length = ___feet$^3$ / 27 = ___yd$^3$ |
| Triangular Row |  | Volume = 0.5 x Base x Height x Length = ___ft$^3$ / 27 = ___yd$^3$<br><br>Note: The height is the vertical distance perpendicular to the base, not the length of another side of the triangle. |
| Trapezoidal Row |  | V= 0.5 x (Base1 + Base2) x Height x Length =___ft$^3$ / 27 = ___yd$^3$<br>**(DO THIS FIRST)** Before doing any multiplication, you must first add Base1 and Base2 together. |
| Triangular Pyramid |  | Volume = 0.5 x Base x Height1 x Height2 / 3 = ___ft$^3$ / 27 =___yd$^3$<br><br>Note: Height 1 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 = Length x Width x Height / 3 = ___ft$^3$ / 27 =___yd$^3$ |
| Dome |  | Volume = 2/3 (Pi x R1 x R2 x Height) =___ft$^3$ / 27 =___yd$^3$<br><br>Note: This equation is only accurate for domes that are approximately half of a complete sphere (elliptical or circular). For a circular dome, R1 and R2 will be the same. |
| Cone |  | Volume = 3.14 x R1 x R2 x Height / 3 = ___ft$^3$ / 27 =___yd$^3$<br><br>Note: For an elliptical base, R1 should be measured along the widest diameter and R2 should be measured along the narrowest diameter. For a circular cone, R1 and R2 will be the same. |
| Cylinder |  | Volume = 3.14 x R1 x R2 x Height = ___ft$^3$ / 27 =___yd$^3$<br><br>Note: For an elliptical base, R1 should be measured along the widest diameter and R2 should be measured along the narrowest diameter. For a circular cylinder, R1 and R2 will be the same. |
| Row |  | Volume = Area of face x Row Length = ___ft$^3$ / 27 =___yd$^3$<br><br>Note: Area of face could be any polygon, half circle, or half ellipse. |

## Step 2: Select Pile Type Conversion Factor to Convert to Tires

### 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** | 10 Tires/Cubic Yard | 12 Tires/Cubic Yard | 14 Tires/Cubic Yard |
| **Barrel** | 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** | 12 Tires/Cubic Yard | 14 Tires/Cubic Yard | 16 Tires/Cubic Yard |
| **Barrel** | 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** | 2.5 Tires/Cubic Yard | 2.75 Tires/Cubic Yard | 3.0 Tires/Cubic Yard |
| **Barrel** | 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** | 3.0 Tires/Cubic Yard | 3.5 Tires/Cubic Yard | 4.0 Tires/Cubic Yard |
| **Barrel** | 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 |

**Other Conversion Factors for Altered Tires**

Sidewalls = 20 tires/cubic yard

Treads = 20 tires/cubic yard

Primary Shreds = 20 tires/cubic yard

Shreds 2 inches or smaller = 40 tires/cubic yard

Note: Conversion factors for altered tires stay the same regardless of the factors of pile height, configuration, and time stored.

Loose

Barrel

Laced

## Step 3: Apply Deduction

**Deduct 20% from Volumetric Estimates, Count Averages, and Questionable Counts**

Reduce any estimate by 20% (multiply by 0.8) (100%-20%=80% therefore the resulting volume is 80% of the original calculated estimate. 80% is calculated by multiplying 0.8 by the original calculated volume estimate.)

This deduction 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 8 tires high. If you do not count each tire, but instead calculate 19 x 8 = 152, then apply the deduction (152*0.8= 121) and 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.

## Putting the Equations Together

**To calculate the number of tires in a pile, use this formula:**

**(Step 1)** (Volume of Shape in Yards) **x** **(Step 2)** (Conversion Factor) **x** **(Step 3)** (0.8) =

**Final Waste Tire Count**

## Notes:

**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.

**Weight Conversion**
20 lbs.= 1 PTE (See 14 CCR 17225.770)

**Counting Whole Tires**
When counting whole tires, each tire counts as one tire regardless of size or mass.

**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))

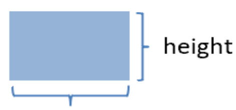
**Typical Conversions for Count Averages**
1 whole tire = 2 sidewalls and 1 tread*
1 tread = 2 sidewalls*
2 treads = 1 tire*
4 sidewalls = 1 tire*
*Regardless of size, 1 bale = 60 to 80 tires (Ask the operator)

**Volumetric Base**
“Base” does not refer to the bottom of a three-dimensional shape. A base is the side of a three-dimensional shape from which all the other dimensions are measured, and all geometric shapes applicable to tire piles have a base. Sometimes the base is the bottom, sometimes it is not.

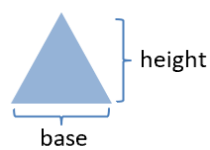
# Calculating Area

**Area of Polygons**
A polygon is a two-dimensional (plane) shape with straight sides.

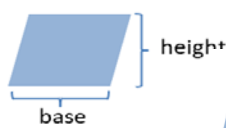
Area of a **rectangle** = base × height
Area of a **rectangle** = length x width



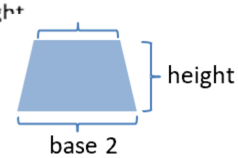

Area of a **triangle** = 1/2 base × height




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




Area of a **trapezoid** = 1/2 (base1+base2) × 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 Ellipse and Circle (Continued)**
Area of a **circle** = $\pi r^2$
Area of an **ellipse** = $\pi \times r_1 \times r_2$

NOTE: Radius is diameter divided by 2