

# DUMP TRUCK AXLES

# 101

## Introduction to Understanding California's Laws of Weight, Lengths and Wheelbase in the Dump Truck Industry

Presented by the California Construction Trucking Association & Affiliates



**CalConTrk.org**

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Superior Trailer Works  
Rogue Truck Body  
Strong Industry



# Dump Truck Axles 101

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The California Construction Trucking Association and its Affiliates have helped its members and interested parties understand the structure of the vehicle axle limitations with in California. The research and information gathered is base only on facts and testimonials given, they are not to be taken as true statements or used in a court of law. Please make sure you understand the California vehicle code sections for your type of equipment.

### Vehicle Axles

Axles are an important structural component of a wheeled vehicle. The axles maintain the position of the wheels relative to each other and to the vehicle body. For most vehicles, the wheels are the only part touching the ground. The axles must bear the weight of the vehicle plus any cargo and also any acceleration forces between the vehicle and the ground.

In addition to the structural purpose, axles may serve one or more of the following purposes depending on the design of the vehicle:

- **Drive** - One or more axles may be an integral part of the drive train. A mechanical system (typically a motor) exerts a rotational force on the axle, which is transferred to the wheel(s) to accelerate the vehicle.
- **Braking** - Conversely a vehicle may be slowed by applying force to brake the rotation of the axle. Consumer vehicles' brakes are part of the wheel assembly and therefore exert friction on the wheels directly, but engine braking (Jake) may still be affected via the axle.
- **Steering** - The front axle of most vehicles is called a steering axle. The vehicle is maneuvered by controlling the direction of the front wheels' rotational axis relative to the body and rear wheels.

### Structural Features

A straight axle is a single rigid shaft connecting a wheel on the left side of the vehicle to a wheel on the right side. The wheels rotate in unison and about the same axis. Such a design can keep the wheel positions steady under heavy stress and can therefore support

heavy loads. Straight axles are used on rear axles of commercial trucks, and on heavy duty off-road vehicles. The axle can be protected and further reinforced by enclosing the length of the axle in housing.

A tandem axle is a group of two or more axles situated close together. Truck designs will use such a configuration to provide a greater weight capacity than a single axle. Semi trailers usually have a tandem axle at the rear.



*This 10-wheel dump truck has an airlift "Pusher" axle, shown in the raised position.*



*This 10-wheel dump truck has an airlift "Booster" axle, shown in the lowered position.*



*This 10-wheel dump truck has an airlift "Booster" axle, shown in the raised position.*



*This 10-wheel dump truck has an airlift "Pusher" axle, shown in the raised position.*

### Drive Axles

An axle that is driven by the engine is called a drive axle. In rear wheel drive vehicles, the engine turns a driveshaft which transmits rotational force to a drive axle at the rear of the vehicle. The drive axle may be a live axle, but modern vehicles generally use a split axle with a differential.

With all wheel drive (AWD) vehicles, the engine turns multiple drive shafts which transmits rotational force to each drive axle of the vehicle. The drive axles may be live axles, but modern small vehicles generally use a split axle with a differential.

### Auxiliary Lift Axles

Many ten-wheeler style dump trucks are configured with auxiliary airlift axles or also know as dead axles, which may be mechanically raised or lowered. A lift axle is not part of the drive train, but instead are free-rotating wheels. The axle is lowered to increase the weight capacity or to distribute the weight of the cargo over more wheels to cross a weight restricted bridge.

Many trucks and trailers use auxiliary axles for strictly load-bearing purposes. An auxiliary lift axle can be non-steerable and steerable axle.

### Pusher Axle Truck

A Pusher axle is located immediately in front of a drive axle tandem because it is designed to push up on the frame rail and load of the truck distributing the load or weight to more axles. Pusher axles normally have one tire on each side of the axle. Dump trucks in California with this type of axle configuration are commonly referred to as "Super-10's" or "Supertag" (See Diagram A through D).

For purposes of clarity,



CCTA's equipment directory refers to these trucks as a "10-wheeler with pusher axles". Typically in California this allows a truck specked like this at a (GVR) gross vehicle weight of 58,000 lbs. versus 54,000 lbs. 3 axle truck with out the assistance of a Pusher axle.

### Booster (Tag) Axle Truck

A Booster or also know as Tag axle is located far behind the drive axle's tandem. This name refers to the fact that these types of axles are attached to the ends of the tractor frame rails or truck box and boosts the load forward toward the center or cab area.

In California, most cement mixers are configured with booster axles, the added length and redirecting the load forward to the front axle is the key to hauling a bigger payload.

When these types of axles are in the down (or loaded) position distributing load weight to the back and front axle, 11 to 13 feet is added to the trucks bridge length – Typically in California, this allows a truck specked like this to gross 66,000 lbs. (See diagrams A through D).

Dump trucks with this type of axle configuration are commonly referred to as "Strong Arm dumps or Super 10's" even though other manufacturers offer similar axle designs. Strong Industries marketing materials refer to trucks with their booster axles as a "Superdump". For purposes of clarity, CCTA's equipment directory generally refers to these trucks as a "10-wheeler with booster axle".

### Booster v. Pusher - Understanding the Specs

Some of the advantages and disadvantages of each type are listed according to facts and research:

- **Pusher** — A pusher shoulders some of the weight that's otherwise carried by the tandem and the front axle. Placing one or more axles ahead of the tandem makes for a compact layout, since nothing sticks out the rear and the truck body can remain the same. The frame must have clear space ahead of the tandem and behind the fuel tank and battery box. A current 10-wheel dump truck, for example, might have enough frame space for one pusher axle, but seldom for two.

Pusher axles also add stability to the chassis, especially during cornering. In fact, they cause too much stability during sharp turns, which is why non-steerable pushers are raised just before the truck turns a corner. In most states the pusher will be legally considered part of the tandem, meaning the scalemaster looks at the tandem and the pusher axle(s) as a three- or four-axle group. If it's far enough away from the tandem, or if has special consideration in the law, it may be considered separately.

A disadvantage of the pusher is that it makes it more difficult to get maximum legal weight on the steer axle. Another drawback is that the pusher adds no legal "bridge" to the truck. In other words, the distance between the steer axle and the rearmost axle (called the "outer bridge") remains the same. This doesn't matter if the law specifically authorizes pusher axles, which is the case in some states.

- **Tag** — A tag axle not only adds physical capacity, but it also lengthens the legal outer bridge. Whenever it's on the ground and bearing its share of the load, the tag stretches out the distance between the steer and rearmost axles. This makes the truck less damaging to bridge spans and pavement. So bridge formula laws allow the resulting longer truck to carry more weight, and the tag axle will always allow more than the pusher axles under such laws.

As to weight distribution: When pressure is applied to the tag axle's suspension, the tag takes some weight off the tandem. It also pushes up the rear of the frame and transfers weight to the front steer axles. This can be a big help on a truck with a forward-set front axle. It can also overload the steer axle if it's a setback type.

This tag axle is a liftable axle mounted on a long arm attached to the rear of the frame or specially adapted truck body. It's also referred to as a "stinger", "trailing tag," or a "booster" after Boost-A-Load, a trade name in the business. When it's fully raised, its wheels are above most of the body, giving rise to still another nickname: "flying tag."

The trailing tag adds considerable length (12 to 15 feet) to the outer bridge, so is particularly valuable from a legal standpoint. Trailing tags have steering geometry that allows wheels to caster while the truck's underway. Any backing is usually done off road (as with a mixer or dump truck), and the driver raises the arm as soon as the truck leaves the pavement.

Because it extends beyond the rear of the truck and its body, the trailing tag can sometimes be installed on an existing truck. But usually it comes as part of the body. It works well on mixer trucks and on some dump trucks, though early models caused problems and operators now avoid them. A big advantage with the trailing tag is easy and quick unloading for guys accustomed to running truck-and-trailer dump rigs.

### Doing your homework

Before spec'ing out a truck among the type of duties you will perform, make sure you understand where those axles are placed on the chassis. This will determine how much extra weigh the truck can legally scale. A miscalculation of only one or two inches can cost thousands of pounds in payload, time and money. If you still don't understand the rules and regulation and what works for you, consult with your buddies or with knowledgeable vendors, like our affiliates who offer such equipment.



# LIVING WITH THE 'BRIDGE'

A 1944 algebraic equation still governs truck weight and length. Here's how to use the "bridge formula"

Living by the "bridge formula" is a way of life for truckers today. It's the law on the Interstates in every state with two exceptions: grandfather provisions that date back to 1956, or for states that stayed at the old federal maximum of 73,280 pounds gross after the national interstate weight limit was raised to 80,000 pounds in 1974.

Truck operators should understand the federal bridge formula - known as **Formula B** or **Bridge Law** - because it is the basis for determining what a vehicle can legally weigh and how long its wheel base must be.

Formula B involves both axle weights and axle spacing. There's an "**Inner Bridge**" and "**Outer Bridge**" that must be met (bridge in this case meaning the distance between various axles).

Original bridge formulas go back more than 50 years and started in the Western U.S. The idea was to protect marginal bridges by requiring a vehicle's weight to be spread out over axles spaced far apart. That way the full weight of the vehicle isn't concentrated on a short section of a bridge.

Many truckers in western states today use long wheel base trucks and tractors to get maximum "Bridge." And where multiple unit, over 80,000 pound combinations are allowed, bridge laws determine how much can be carried, based on number of axles and distance between them.

By comparison, many states in the East and New England have heavy axle limits and no restrictive axle spacing. An example is Pennsylvania, which on non-federal highways still will allow 73,280 pounds on a four-axle straight truck 40 feet long. This vehicle, with a normal 189 inch wheelbase, would be limited to 52,500 pounds when complying with the federal bridge law.

It's an accepted engineering principle that concentrated weight is what breaks bridges and pavement if they aren't designed for heavy loads. So the U.S. Bureau of Public Roads (now the Federal Highway Administration, FHA) adopted the bridge formula concept for federal roads in 1944 and except for modification in 1974, it's been with us ever since.

## How's the Bridge Law Figured?

The bridge formula was predicated originally on 32,000 pound tandem axles with a minimum distance between the tractor tandem and trailer tandem.

For weights less than 32,000 pounds, the distance was shorter on a sliding scale basis. The formula protected a certain type of bridge then common on our main highways.

Today's Formula B is based on a maximum of 34,000 pounds on each tandem, 20,000 pounds on a single axle, and a gross combination weight of 80,000 pounds.

To protect bridges and highways, the formula spells out the distances required between axle groups for a given weight. And it says that any consecutive two or more axles may not exceed the weight as computed by the formula, even though all axle weights and overall gross combination weights are within

the maximums spelled out.

So someone spec'ing a new five-axle rig for the maximum 80,000 pounds has to consider a lot more than just putting 34,000 pounds on each tandem and 12,000 pounds on the steer axles. Without the required spacing, or "Bridge," the rig is illegal. The same formula applies to all types of equipment, including heavy straight trucks.

The most popular 80,000 pound rig is the five-axle tractor-semi trailer combination, so we'll use it in our first example and number the axles 1 through 5. (see Figure 1.1 below)

While the bridge formula law applies to each combination of two or more axles, the distance between axles 1 and 3, 1 and 5 and 2 and 5 are the critical combinations. If they're okay, the others will be too.

Three "tests" of the bridge law must be met. They can be calculated with the actual formula, which is an algebraic equation or they can simply be looked up in the **Formula B table**, which was derived from the formula itself.

**TEST 1** is the "**Power Unit Bridge**", because it calculates the maximum weight allowed with given distances between axles 1 and 3 of the tractor.

**TEST 2** checks the "**External Bridge**", also called the "Outer Bridge," which is the distance from the front steer axle to the last axle, regardless of how many there are.

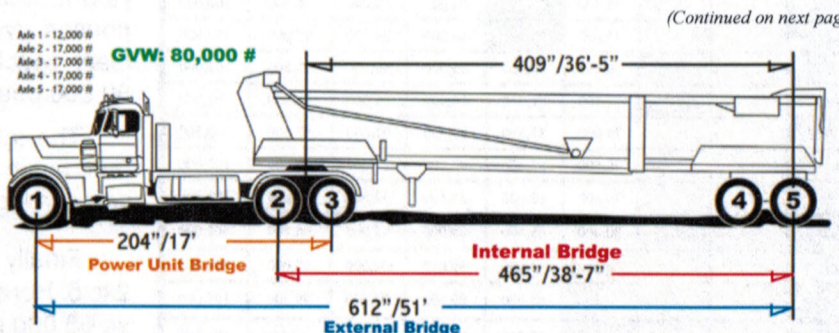
**TEST 3** is the "**Inner Bridge**" also called the "**Internal Bridge**", because it calculates the maximum gross weight allowed from axle 2 to the rear most axle.

To reach 80,000 pounds requires loading both the tractor and trailer tandems to as close to 34,000 pounds each as possible, totaling 68,000 pounds. This leaves 12,000 pounds (or more if tandems are below 34,000 pounds) for the front axle.

To perform the three bridge tests, we also must know three pieces of dimensional data: (Refer to Figure 1.1 below)

- **Tractor Bridge**; Axle 1 to Axle 3 (17 feet)
- **Inner Bridge**; Axle 2 to Axle 5 (38.7 feet)
- **Outer Bridge**; Axle 1 through Axle 5 (51 feet)

There are two parts to each test.



(Continued on next page)

\*drawing is not to scale

Figure 1.1



Formula B table (Federal Bridge Law)

Ft/In (L)	2 Axle	3 Axle	4 Axle	5 Axle	6 Axle	7 Axle	8 Axle	9 Axle
4'/48"	34,000							
5'/60"	34,000				Color represents a Dump Trucks legal load for California. This type of truck does not require moving permits.			
6'/50"	34,000							
7'/84"	34,000							
8'/96"	34,000	34,000						
9'/108"	39,000	42,500						
10'/120"	40,000	43,500						
11'/132"		44,000						
12'/144"		45,000	50,000					
13'/156"		45,500	50,000					
14'/168"		46,500	51,500					
15'/180"		47,000	52,000					
16'/192"		48,000	52,500	58,000				
17'/204"		48,500	53,500	58,500				
18'/216"		49,500	54,000	59,000				
19'/228"		50,000	54,500	60,000				
20'/240"		51,000	55,500	60,500	66,000			
21'/252"		51,500	56,000	61,500	66,500			
22'/264"		52,500	56,500	62,000	67,000			
23'/276"		53,000	57,500	62,500	68,000			
24'/288"		54,000	58,000	63,500	68,500	74,000		
25'/300"		54,500	58,500	64,000	69,000	74,500		
26'/312"		55,500	59,500	64,000	69,500	75,000		
27'/324"		56,000	60,000	64,500	70,000	76,500		
28'/336"		57,000	60,500	65,500	71,000	77,000	82,000	
29'/348"		57,500	61,500	66,000	71,500	77,500	82,500	
30'/360"		58,500	62,000	66,500	72,000	78,000	83,000	
31'/372"		59,000	62,500	67,500	72,500	78,500	83,500	
32'/384"		60,000	63,500	68,000	73,000	78,500	84,500	90,000
33'/396"			64,000	68,500	74,000	79,000	85,000	90,500
34'/408"			64,500	69,500	74,500	80,000	85,500	91,000
35'/420"			65,500	70,000	75,000	80,500	86,000	91,500
36'/432"		ATA	66,000	70,500	75,500	81,000	86,500	92,000
37'/444"		BUMP	66,500	71,500	76,000	81,500	87,000	92,000
38'/456"			67,500	72,000	77,000	82,000	87,500	93,000
39'/468"			68,000	72,500	77,500	82,500	88,500	94,000
40'/480"			68,500	73,000	78,000	83,500	89,000	94,500
41'/492"			69,500	73,500	78,500	84,000	89,500	95,000
42'/504"			70,000	74,000	79,000	84,500	90,000	95,500
43'/516"			70,500	75,000	80,000	85,000	90,500	96,000
44'/528"			71,500	75,500	80,500	85,500	91,000	96,500
45'/540"			72,000	76,000	81,000	86,000	91,500	97,500
46'/552"			72,500	76,500	81,500	87,000	92,500	98,000
47'/564"			73,500	77,500	82,000	87,500	93,000	98,500
48'/576"			74,000	78,000	83,000	88,000	93,500	99,000
49'/588"			74,500	78,500	83,500	88,500	94,000	99,500
50'/600"			75,500	79,000	84,000	89,000	94,500	100,000
51'/612"			76,000	80,000	84,500	89,500	95,000	110,500
52'/624"			76,500	80,500	85,000	90,500	95,500	101,000
53'/636"			77,500	81,000	86,000	91,000	96,500	102,000
54'/648"			78,000	81,500	86,500	91,500	97,000	102,500
55'/660"			78,500	82,500	87,000	92,000	97,500	103,000
56'/672"			79,500	83,000	87,500	92,500	98,000	103,500
57'/684"			80,000	83,500	88,000	93,000	98,500	104,000
58'/696"				84,000	89,000	94,000	99,000	104,500
59'/708"				85,000	89,500	94,500	99,500	105,000
60'/720"				85,500	90,000	95,000	100,500	105,500

First you must calculate actual weight on axles 1 to 3: (Axle 1) 12,000 + (Axle 2) 17,000 + (Axle 3) 17,000 = 46,000 pounds total axle weight allowed on tractor.

Then using the bridge formula to calculate the legal gross. The maximum legal gross determined by the formula must exceed, or at least equal, the actual gross weights on the three axles.

Using the formula:

$$W = 500 [LN / N - 1 + 12N + 36]$$

**L** - the distance in feet between the axles being tested (loaded)

**N** - the number of axles in a group under consideration

**LN** - the distance multiplied by the number of axles

**W** - the overall gross weight on any group of two or more consecutive axles to the nearest **500** pounds

**TEST 1** - We calculate the tractor based on its spec's:

$$W = 500 \times [17 \times 3 / 3 - 1 + (12 \times 3)] + 36$$

$$W = 500 \times [51 / 2 + (12 \times 3)] + 36$$

$$W = 500 \times [51 / 2 + 36 + 36]$$

$$W = 500 \times 97$$

$$W = 48,500 \text{ pounds}$$

**Conclusion:** On axles 1 to 3. The formula allows a maximum of 48,500 pounds. The actual weight is 46,000 pounds.

An easier way to get the same answer is to use the Formula B table on the left of this article. By reading down the left column to **17 feet**, then counting across to the **three-axle column**, the answer is the same worked out with the formula.

### Formula B table

Permissible gross loads for vehicles in regular operation

Based on weight formula:

$$W = 500 (LN/N - 1 + 12N + 36)$$

Distance in feet between the extremes of any group of 2 or more consecutive axles

Next, move on to **TEST 2** - the external bridge, or distance between axles 1 to 5. The weight on all the axles' totals 80,000 pounds. Apply the bridge formula or look at the table. **The "L" is 51 feet; "N" (number of axles) is 5.**

After doing the calculations, or looking it up in the Formula B table, the answer is 80,000 pounds.

**Conclusion:** 51-foot spacing, meets the bridge requirement. Had it been 50 feet, we would have been limited to 79,000 pounds gvw. Studying the table, we see that 51 feet is the least spacing necessary between axles 1 and 5 to gross 80,000 pounds.

The table continues with increasing weights beyond 51 feet, but in most states it does no good. 80,000 is as high as you can legally go with total **gross vehicle weight** (gvw).

Finally we get to **TEST 3** - the inner bridge between axles 2 to 5. Here, each of the four axles is loaded to 17,000 pounds, so 68,000 pounds are the actual weight.

(Continued on next page)



We have an inner bridge of 38 feet, 7 inches. The table says that for a four axle unit, we are limited to 67,500 pounds. Since our actual weight is 68,000 pounds, we're not legal. We must either reduce our payload, *(the part of a cargo producing revenue or income, usually expressed in weight)* or we must use a longer trailer so we can increase our inner bridge dimension to at least 39 feet.

If we're fortunate enough to have a sliding tandem on our semi trailer, maybe we can move it rearward five feet, which will meet the requirement. Again, approaching this from the specing perspective, we can see that for an 80,000 pound gw rig we must not exceed our outer external bridge (TEST 2) of 51 feet and a minimum inner bridge (TEST3) of 38 feet, 7 inches. There is an important exception to the inner bridge rule, which we'll cover in a bit.

In specing out a tractor and semi trailer, it's mandatory to work out trailer dimensions first as they control the inner bridge. Deciding on how long a wheelbase the tractor must have and whether you can or can't use a **setback** front axle will be governed by the length you must have to meet the outer external bridge.

Remember also that if you choose to spec a long wheelbase conventional with a big sleeper box, you'll have to set the fifth wheel as much as 28-inches ahead of the tandem center line if you are to get sufficient weight onto the front axle to make it to 12,000 pounds - the only way to legally gross 80,000 pounds. But moving the fifth wheel forward reduces the inner bridge dimension. You can see how closely these all interrelate.

Now there are exceptions as noted in the footnotes of the Formula B table ATA bump.

The Federal Highway Administration says 34,000 pounds can be carried on two consecutive sets of tandem axles, or 68,000 pounds total, with an inner bridge (axles 2 to 5) of 38.7 feet or more, not 39 feet. ***(The table shows a maximum of 67,500 pounds for 38.7 feet; 66,500 pounds for 37 feet and 68,000 pounds for 36 feet)***

This 68,000 pounds at 36 feet is known as the "ATA bump," as it was sought by the American Trucking Associate specifically so fleets could use 40 foot trailers and gross 80,000 pounds. It was the only way tank operators could reach 80,000 without adding axles.

A recent ruling by the FHWA states that dimensional and weight data can be rounded off to the nearest foot or nearest 1,000 pounds. Thus, an inner bridge dimension of 35 foot, 6 inches actually is treated as 36 feet; and when the rounded-off wheelbase dimension is inserted into the bridge formula, the weight is rounded upwards.

For example, 79,500 pounds is rounded up to 80,000 pounds.

On the basis of the ATA bump, the minimum dimension for an 80,000 pound rig must be:

- 51 feet outer bridge (axles 1 to 5)
- 38.7 feet inner bridge (axles 2 to 5), and
- The ability to get 12,000 pounds on the front axle.

This last item really is the clincher in many

cases. It often isn't practiced to stretch out a rig to meet the **bridge requirements, then offset the fifth wheel enough to get maximum weight transfer to the front axle.**

What we end up with is a "practical" gross weight. That is, 34,000 pound, on each pair of tandem axles and perhaps 9,000 to 12,000 pounds on the front axle.

An example is a four-axle tractor-dump trailer. The tractor has a 187-inch wheelbase and the semi trailer is a short 27 feet. The rig has a 37 foot external bridge and, with a 12-inch fifth wheel offset, a 24 foot internal bridge. A check of the bridge table shows that the legal maximum for axles 1 to 5 is 71,000 pounds, and for axles 2 to 5 it's 58,000 pounds.

You can see that the inner bridge limits the two sets of tandem axles to 58,000 pounds. That's 29,000 pounds per tandem, or 5,000 less than the normal maximum.

Weight transfer to the front axle is limited by the wheelbase and that 12-inch fifth wheel offset. Through separate calculations, it's determined that the front axle can only be loaded to 9,450 pounds. Maximum allowable gw then is 67,450 pounds.

But that's only theoretical. Even 67,450 isn't "practical" because it requires loading our dump trailer very precisely, with about 1,800 pounds more in the front than the rear. The "real world" legal gross weight on this rig is more like 63,000 to 65,000 pounds, depending on the skill of those who load it.

Longer end dump trailers - usually 32 or so feet are used to achieve higher gws. But they still can't get 80,000 pounds and 40 foot end dump trailers aren't safe because they become unstable when they're tipped to dump.

### Heavy Straight Trucks

Legal gws for straight trucks operating under the federal bridge formula face severe limitations, as we've seen

Calculations follow the same procedure used with tractor-trailers, except that Test 1 is omitted and only the outer bridge axles 1 to 4 and the inner bridge axles 2 to 4 are figured.

In this example, we'll assume we have a long wheelbase dump truck with three rear axles. The outer bridge is 23 feet, and the inner bridge is 9 feet.

Checking the 23 foot outer bridge on the table, we come up with 57,500 pounds allowable gw. The 9 foot inner bridge

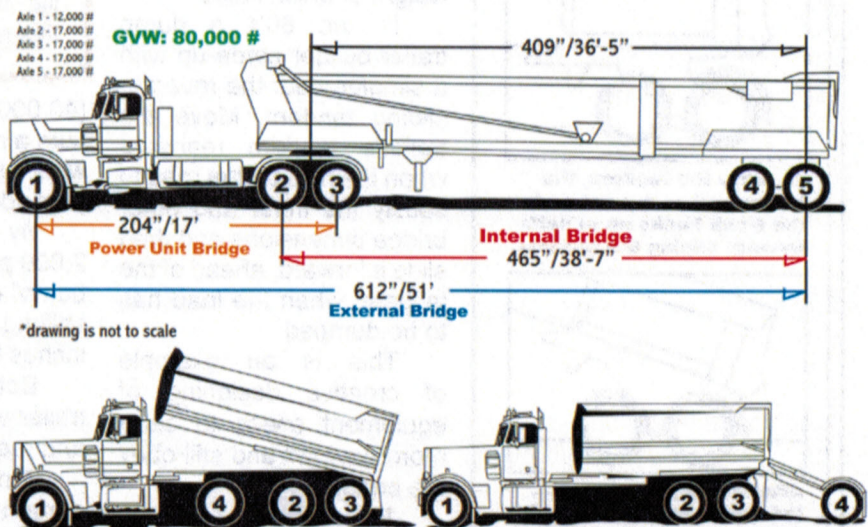


Figure 1.2



- in effect, the tri-axle or "tridem" is limited by the table to 42,500 pounds, or approximately 14,000 pounds per axle.

That means we have to get 15,000 pounds (57,500 minus 42,500) on the front axle - if we can get that much weight transfer - to achieve the maximum allowable gvw. Practically speaking, we can't. It's more like 12,000 pounds with this wheelbase. So, our dump truck actually grosses 54,500 pounds.

Eastern states allow many tons more, but not so in the West, where many states like the bridge concept. That's why you'll see three-axle dumps pulling two-axle pup or transfer trailers - or variations on that theme - in most states west of the Mississippi.

States like California follow the bridge formula using either the inner bridge or outer bridge, but not both. And federal authorities have been pressuring state officials to adopt Formula B for their own use, or at least enforce it on the Interstates.

If a truck operates at least part of the time - even a few miles of a regular haul - on an Interstate highway, it might be limited by Formula B. The key point to determine before spec'ing is whether you're working under state or federal regulations - or both.

With wheelbase, especially, you don't want to order a short, squat truck and find it should have been longer.

### Creative Solutions

In recent years, truckers running end dump semi trailers have gotten more payload by using a tridem under the trailer. This takes advantage of a quirk in the Formula B table which

allows 42,500 pounds to be carried on three axles with a bridge of 9 feet.

Truckers load the tridem to perhaps 40,000 pounds. The tractor tandem can then carry 32,000 and the steering axle gets 8,000. Federal and state authorities bought the idea and dump truckers got their 80,000 pounds - though at the expense and extra tare weight of a sixth axle.

In the 80's a dump trailer builder came up with a simpler idea: the reverse-sliding tandem. Move the trailer's tandem rearward when the rig's on the road to satisfy the inner and outer bridge dimensions and then slide it forward, ahead of the tailgate, when the load has to be dumped.

This is an example of creative designing of equipment specs to carry more payload and still obey the bridge law.

To achieve 72,000 pounds on the inner bridge

### STEERING FUNCTIONS - functions to consider:

- **Wheel Cut** - Obviously, wheels on the front axle must turn to the right or left to accomplish the steering function and the tighter they can swing the better the truck will maneuver. This is referred to as "wheel cut", which these days are often 45 to 50 degrees and sometimes as much as 55 degrees from the straight-ahead position. Setback front axles allow a tighter wheel cut than a forward-set axle. That's because the setback design leaves more clearance between the inner edges of the tires and steering arms, suspension pieces, etc. Common sense tells us that oversize "duplex" tires cannot be cut far before they approach something. Other obstructions, such as a "slave" power steering cylinder commonly used on the right side of an extra-high-capacity front axle, will also limit wheel cut. So steer axles with wide-base tires and wheels may cut a maximum of only 30 degrees.

- **Steering Geometry** - Also called "Ackerman geometry," this relates to how steering arms are set up relative to wheelbase lengths. Trucks or tractors with wheelbases between 150 and 240 inches are normal. But below or above that range, the steer axle's tires can scrub the grinding effect that quickly wears down tread. Ask how closely the truck OEM works with the axle maker to optimize chassis and axle design.

- **Camber Setting** - Camber is the vertical positioning of the tire and wheel relative to the road surface. When viewed from the front of the truck, the axle is said to be set at 0 degrees camber if the wheels appear perfectly vertical, or perpendicular to the pavement. If the bottoms of the tires are closer together than the tops, positive (+) camber is present. If the tops of the tires are closer together, the camber is negative (-). Camber affects tire wear, but things like axle alignment and driving habits have greater effects.

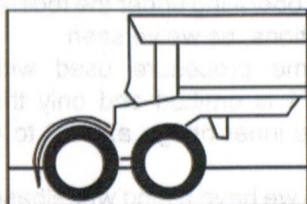
- **"Reduced-Maintenance" axles** - Certain models are available with lubed-for-life hubs (a high-tech innovation that also claims to eliminate seal-installation errors on truck builders' assembly lines) and fewer points that need greasing. This can save many labor dollars over a truck's life, but not if you take it in often anyway simply because this makes you feel better. If that's you, get a regular axle.

(40,000 + 32,000) requires a 38 foot inner bridge. It would take a minimum of a 40 foot long trailer with a zero inch fifth wheel setting to get to 38 feet inner bridge. Plus the third axle adds 2,000 pounds of additional weight.

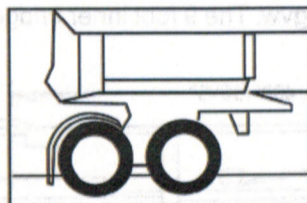
By comparison a 38 foot tandem axle trailer would get 2,000 pounds more payload by taking advantage of the "ATA bump" of 68,000 pounds on the inner bridge at 36 feet and shifting the fifth wheel and payload ahead approximate 20 inches to get weight transfer to the steering axle.

Both examples achieve 80,000 gross but the 3 axle trailer will be 2 feet longer (40 feet), 2,000 pounds heavier and require the extra expense of a 3rd axle.

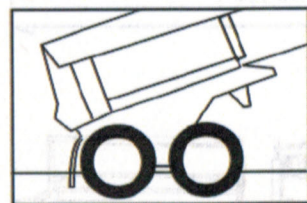
A more practical solution is a 32 foot Bridger type end dump trailer, that will legally axle out 80,000 pounds gross weight with water level loads.



In its running position, the Bridger extends the internal and external bridges and thus increases payload



To move the tandem, the trailer brakes are set and the truck backs up or pulls forward sliding the tandem



After locking the tandem, the trailer can be dumped as any other end dump

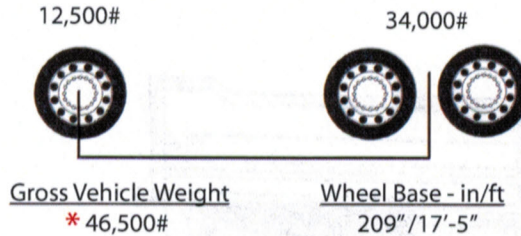


# DUMP TRUCK EQUIPMENT SPEC SHEET

## Typical 10-Wheeler (Transfer) Configuration

The following information is based on tandems center measurement and not the federal bridge outer external measurement.

Source: Superior Tractor Works



## 3 Axle Configuration's (10- Wheeler)

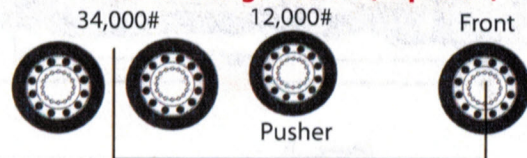


Front	Gross Vehicle Weight	Wheel Base - in/ft
12,500#	* 51,000 #	209" / 17'-5"
17,500#	* 51,500 #	221" / 18'-5"
18,500#	* 52,500 #	233" / 19'-5"
19,000#	53,000 #	245" / 20'-5"
20,000#	54,000 #	257" / 21'-5"
20,000#	54,500 #	269" / 22'-5"

\* - Optimum configurations for maximum hauling weight and operating function.

\* - Based on axle, tire and wheel weight limits, but can carry 51,000# on bridge

## 4 Axle Configuration's (Superten)



Gross Vehicle Weight

Gross Vehicle Weight	Wheel Base - in/ft	Gross Vehicle Weight
12,500#	* 51,000 #	209" / 17'-5"
17,500#	* 51,500 #	221" / 18'-5"
18,500#	* 52,500 #	233" / 19'-5"
19,000#	53,000 #	245" / 20'-5"
20,000#	54,000 #	257" / 21'-5"
20,000#	54,500 #	269" / 22'-5"

\* - Optimum configurations for maximum hauling weight and operating function.

\* - Based on axle, tire and wheel weight limits, but can carry 51,000# on bridge

## 4 Axle Configuration's (Superdump)



Gross Vehicle Weight      Wheel Base - in/ft

66,000 #      435" / 36'-3"

**Note** - Not to exceed over 40' from front bumper to back of tag tire

..... CALIFORNIA LEGAL ROUTES California Legal trucks (black trucks) can travel on STAA routes (green and blue routes), CA Legal routes (black routes), and Advisory routes (yellow routes). CA Legal trucks have access to the entire State highway system except where prohibited (some red routes).



### California Legal Truck Tractor - Semitrailer

Semitrailer length : no limit  
 KPRA : 40 feet maximum for two or more axles,  
 38 feet maximum for single-axle trailers  
 Overall length : 65 feet maximum



### California Legal Truck Tractor - Semitrailer - Trailer (Doubles)

Option A  
 Trailer length : 28 feet 6 inches maximum (each trailer)  
 Overall length : 75 feet maximum  
 Option B  
 Trailer length : one trailer 28 feet 6 inches maximum  
 other trailer may be longer than 28 feet 6 inches  
 Overall length : 65 feet maximum

TRACTOR-SEMI  
 OVER 40 FEET  
 KINGPIN TO  
 REAR AXLE  
 NOT ADVISED

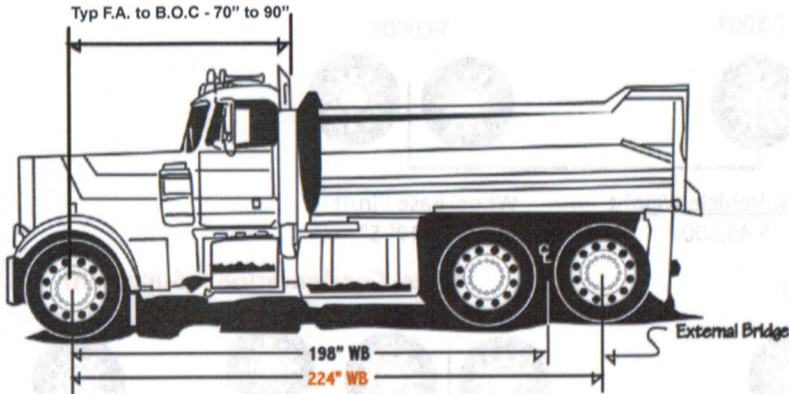
CALIFORNIA LEGAL ADVISORY ROUTES - CA Legal trucks only; however, **travel not advised** if KPRA length is over posted value. KPRA advisories range from 30 to 38 feet.

..... SPECIAL RESTRICTIONS - Route restricted for vehicle length or weight, cargo type, or number of axles.





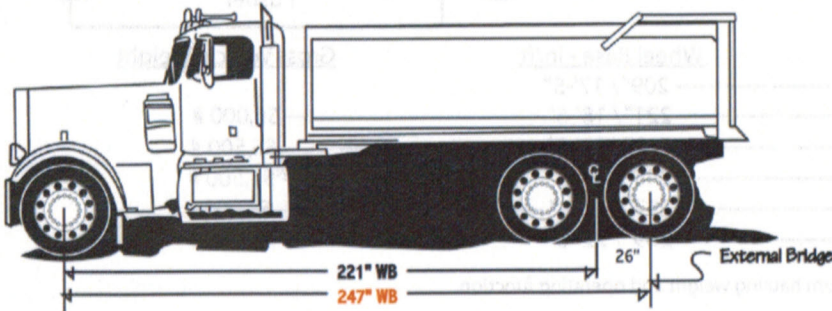
# DUMP TRUCK EQUIPMENT SPEC SHEET



## 10-Wheeler Transfer

GVW= 48,000 lbs

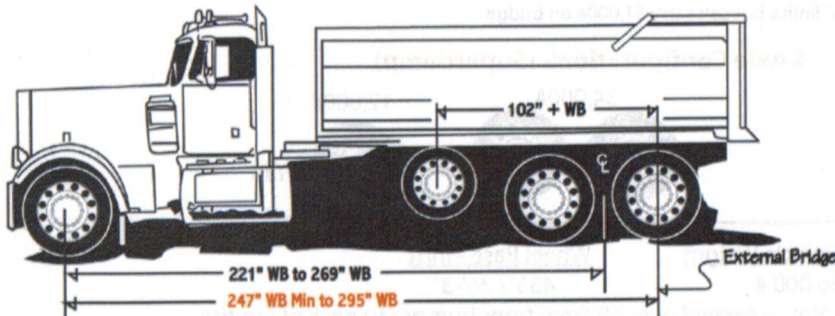
Up To 15 Ton Pay Load



## 10-Wheeler Standard Non-Transfer

GVW= 51,500 lbs

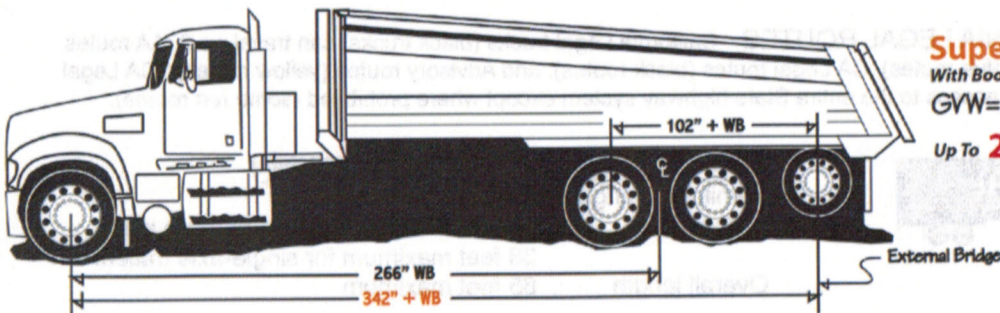
Up To 16 Ton Pay Load



## Super-10 With Pusher Axle

GVW= 58,000 lbs

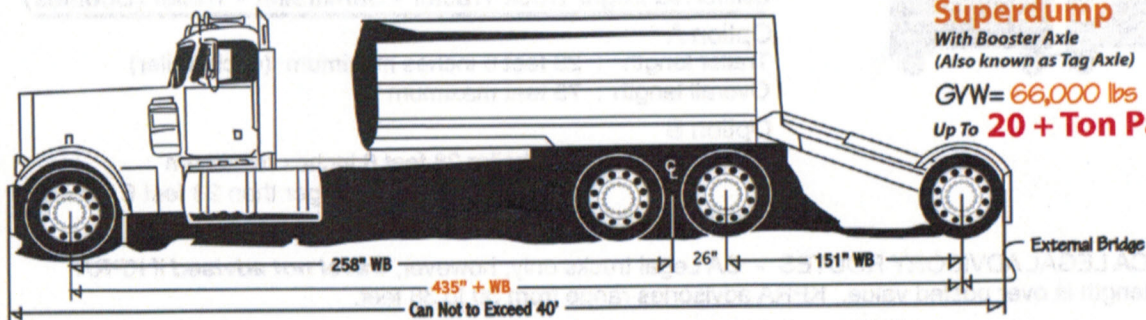
Up To 15 - 18 Ton Pay Load



## Supertag With Booster Axle

GVW= 61,500 lbs

Up To 20 Ton Pay Load



## Superdump

With Booster Axle  
(Also known as Tag Axle)

GVW= 66,000 lbs

Up To 20 + Ton Pay Load

Note: Booster and Tags are determined by wheel and tire weight

Rev. 5/09

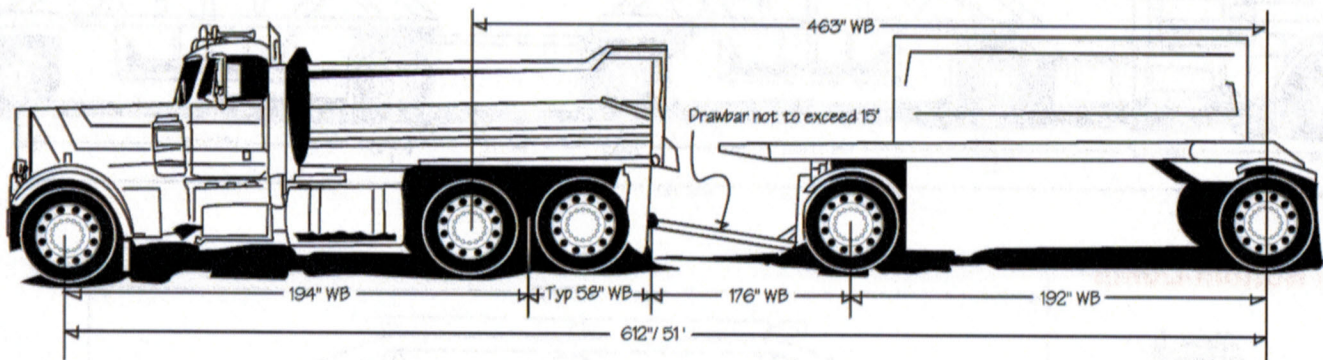
Graph Source: Superior Trailer Works



# DUMP TRUCK EQUIPMENT SPEC SHEET

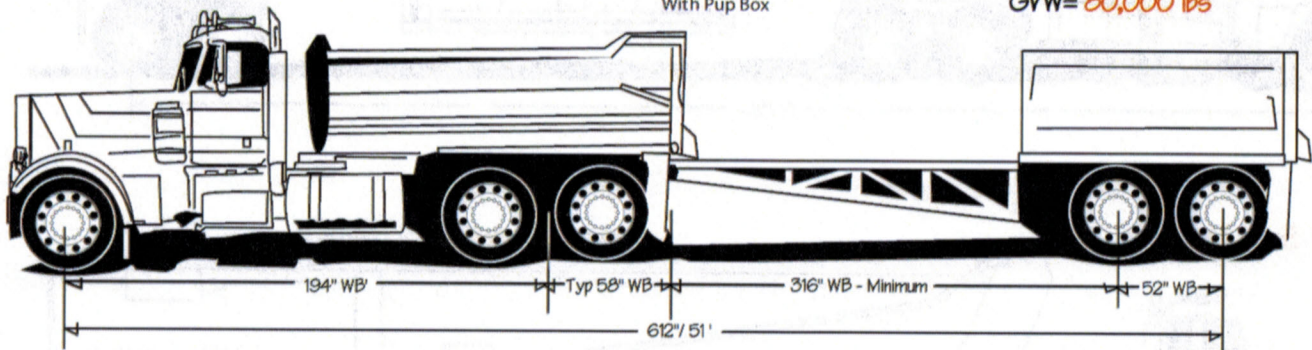
**Transfer Truck & Trailer**  
or 10-Wheeler With Transfer Box

GVW= 80,000 lbs



**10-Wheeler**  
With Pup Box

GVW= 80,000 lbs



Note: The Minimum length: 51 feet or 612 inches from the Outer Bridge for GVW of 80,000 lbs

## LEGAL TRUCK HISTORY

What federal laws cover Long Combination Vehicle's (LCV)? In 1956, federal regulations gave California and more than 20 other states the option to allow triple trailers and other long vehicles. However, California did not exercise that option. Then, in 1991, Congress passed the Intermodal Surface Transportation Efficiency Act (ISTEA) which prohibited the states from increasing the size and weight of combination vehicles beyond that already allowed on June 1, 1991. The ISTEA prohibition is reflected in US Code Title 23 Section 127 (d) and in the Code of Federal Regulations, Title 23, Section 658.23.

**California Legal:** The California Vehicle Code (CVC) Section 35401(a) states that no combination of vehicles may exceed a length of 65 feet. This section does not mention the maximum number of vehicles allowed. (However, Section 21715 limits the number of trailers to one if the towing vehicle is a passenger vehicle, or if the towing vehicle is under 4,000 pounds unladen.)

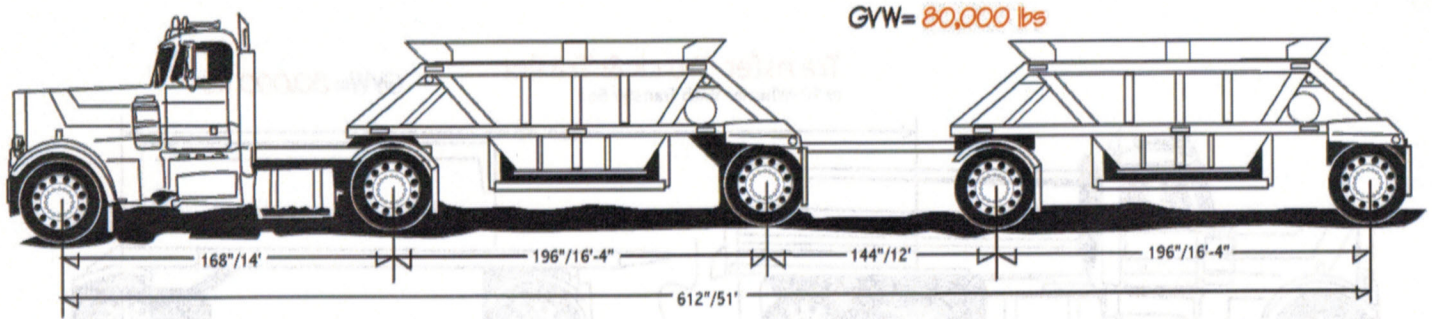
**California Legal:** CVC Section 35401(b)(1) states that a truck tractor, a semitrailer, and a semitrailer or trailer may not exceed 75 feet if neither the semitrailers nor the trailer exceeds 28 feet 6 inches. This section limits this particular combination to two trailers.

**STAA:** Section 35401.5(a)(2) states that, for a truck tractor, semitrailer, and trailer combination that uses the National Network and the Terminal Access and Service Access routes exclusively (a STAA vehicle), the overall length can be unlimited, but neither the semitrailer nor the trailer may exceed 28 feet 6 inches. This section limits this particular combination to two trailers.

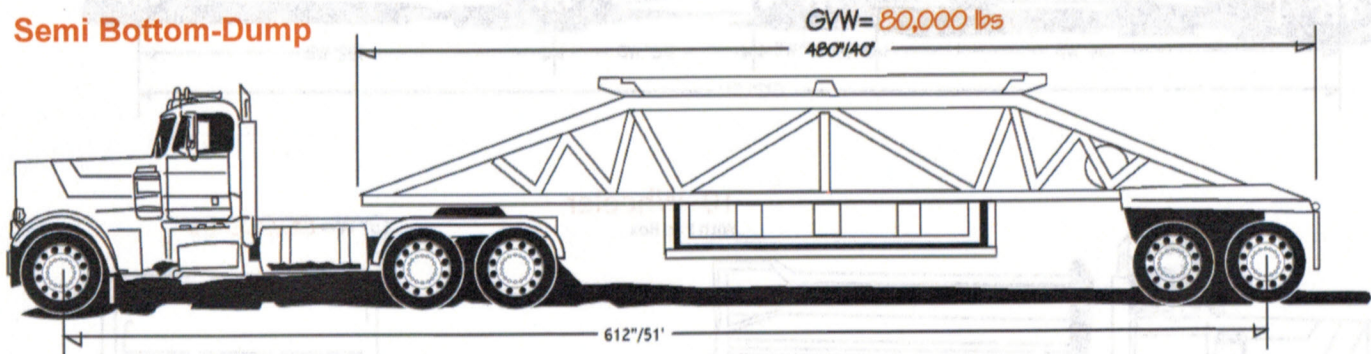
Source: [www.dot.ca.gov/hq/traffops/trucks/trucksize/fs-lcvs.htm](http://www.dot.ca.gov/hq/traffops/trucks/trucksize/fs-lcvs.htm)



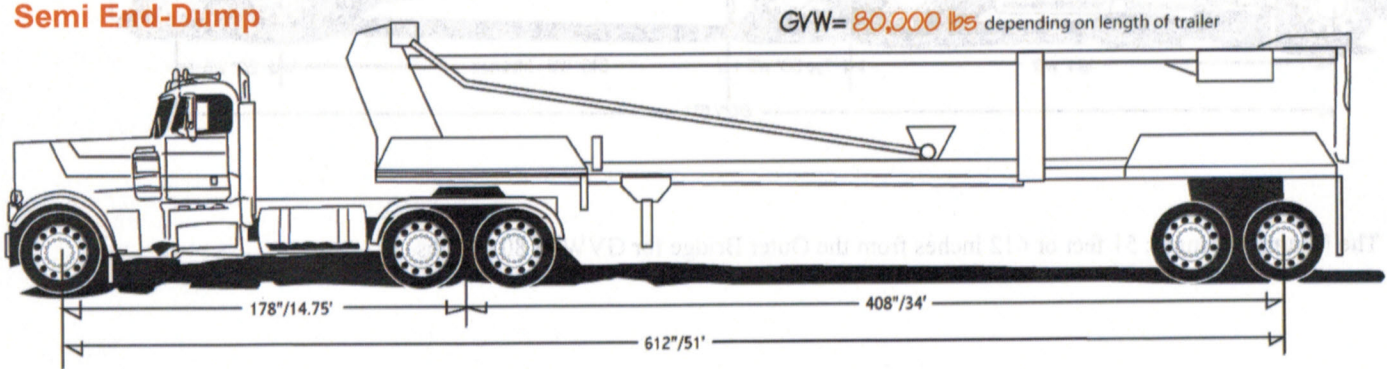
## Double-Bottom Dumps



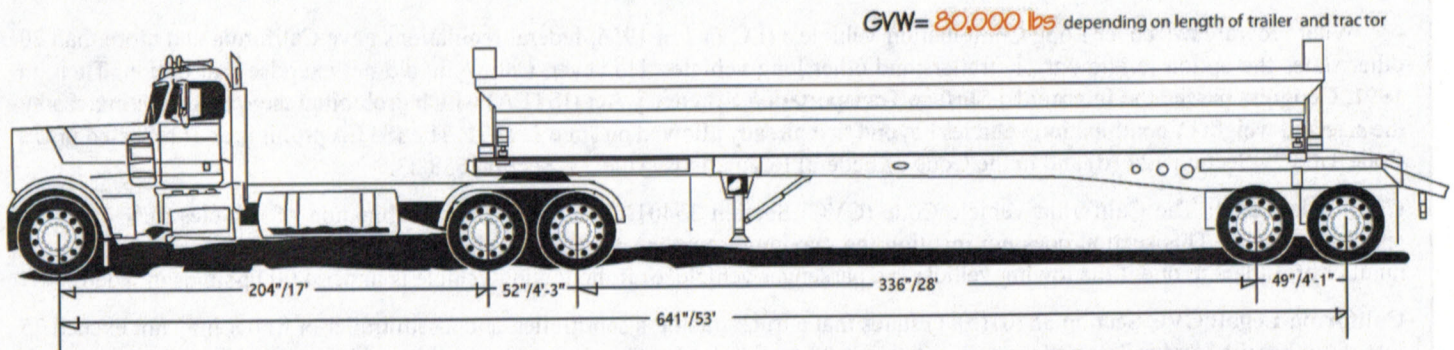
## Semi Bottom-Dump



## Semi End-Dump



## Semi Side-Dump



Note: The Minimum length: 51 feet or 612 inches, Maximum Overall length: 65 feet or 780 inches from the Outer Bridge.

### Source on trailer and tractor configuration:

Greg Dineen - Greg Dineen and Associates - [www.h-e-r-o.org](http://www.h-e-r-o.org)  
 Mark Sturdevant - LA Freightliner, Fontana CA. - [www.lafreightliner.com/FL\\_locations\\_IE.html](http://www.lafreightliner.com/FL_locations_IE.html)  
 Rick Lawrence - Smith Co. Side-Dumps Trailers - [www.sidedump.com](http://www.sidedump.com)  
 Jay Pocock - Superior Trailer Works - [www.superiortrailerworks.com](http://www.superiortrailerworks.com)  
 Keith Hill - Rogue Truck Body - [www.roguetruckbody.com](http://www.roguetruckbody.com)