# KEY FACTORS FOR COMPACTION IN A LANDFILL

The most valuable asset in a landfill is unquestionably airspace. According to the Solid Waste Association the life cycle cost of an acre of landfill in North America can range from $1 million to $2 million. This is a large range and varies based on the cost of land, landfill construction costs, operational costs, and landfill closure costs. Even on the costs' low end, small improvements in compaction density will result in appreciable savings for every landfill.

## Ground Pressure

Simply stated, ground pressure is force exerted on the ground by the wheels/drums. Ground pressure is measured in pascals (Pa) which corresponds to the United States customary units of pounds per square inch (PSI). PSI, as it relates to landfill compactors, refers to the pressure the wheels/drums apply to the waste underneath it.

Manufacturers of four-wheel compactors claim their units have higher ground pressure due to the machine's weight spread over narrow wheels. Manufacturers of three-wheel or two-drum compactors claim their units achieve as good or better ground pressure because their wheels/drums have a smaller diameter and drum teeth layouts provide a design that achieves higher ground pressures.

## Consider the variables when calculating a compactor's Ground Pressure…….

To calculate ground pressure, it is necessary to consider several variables that should be applied to the assumption of how far the wheels/drums are sinking into the landfill waste. Also, while some landfills may construct a working face by using lifts between 12 inches and 18 inches, there are high intake landfills that use lifts over 24 inches. Every landfill is somewhat different in their approach and how compactors work in their landfill can be different than others. Calculating an accurate ground pressure requires an assumption of an accurate sinking depth of each landfill.

Variables

1. Wheels/drums width
2. Wheels/drums diameter
3. Weight of unit
4. Wheels/drums teeth layout and dimensions
5. **Assumption: sinking depth of wheels/drums into waste**

Surface Area must be calculated based on the above variables. After surface area is calculated then the weight of the machine can be applied to the surface area at the "assumed" sinking depth; therefore, providing a "Ground Pressure" number. Once "Ground Pressure" is known there is a standard calculation to go from "Ground Pressure" to pounds per square inch (PSI).

The best possible ground pressure results would be achieved by a "zero-depth sinking" into the landfill surface. This is not a realistic assumption when applying ground pressure on waste in a landfill. Make sure a good assumption of landfill surface depth is used and that the
depth assumption is used correctly for each brand and wheels/drums style.

What is a good depth assumption? Most landfill compactor wheels/drums style offer cleats/teeth that range from 6-9 inches from the base of the wheels/drums to the top of the cleats/teeth. This range is probably the most realistic assumption to use when trying to understand real "Ground Pressure" and "PSI" with a landfill compactor in a landfill.

Ground Pressure and PSI is important in understanding compaction results. They are factors that must be considered with other variables to achieve maximum compaction (density) in a landfill. For example, landfill compactor manufacturers could double their "Ground Pressure" by making their wheels/drums half their current widths. However, making the wheels half their current widths would not increase a landfills compaction or all manufacturers would change their wheels.

A correct combination of several compactor features must exist to achieve higher compaction.

**Beyond Ground Pressure…..**

It is certainly true that ground pressure is a key factor in achieving higher density in compacting waste. However, ground pressure is only one of several factors in achieving higher density in compacting waste. The calculation for ground pressure for a landfill compactor includes more than the width of the wheels/drums of the unit. The correct combination of ALL key factors is what allows any compactor to achieve its maximum compaction density.

**Consider these factors for achieving a greater compaction density!**

1. Tooth penetrations per foot of travel
2. Crushing force capability on unlevel surfaces
3. Clean "cleats" and wheel drum surfaces
4. Wheel/Drum Diameter and Width
5. Tooth shape
6. Elimination of Blowout
7. Ground clearance

## HOW DOES YOUR COMPACTOR COMPARE IN THESE CATEGORIES?

### 1. Tooth penetrations per foot of travel

The cleats/teeth on a compactor wheel/drum are used to cut/tear/shred waste. These functions are necessary to allow the unit to achieve the highest possible compaction density. The more strikes a cleat/teeth make every one foot of machine travel the more cutting, tearing, and shredding occurs; therefore, allowing the unit to achieve a higher compaction density.

*Neal Bolton, President of Blue Ridge, stated that "it is the opinion of Blue Ridge that (wheel) ground pressure is much less important than tooth penetrations. So, in order to compare that very important factor – tooth penetrations were calculated per foot of machine travel. Blue Ridge considers this to be a good indicator of a landfill compactor's ability to compact trash."*

The higher number of tooth penetrations the more the waste is cut and shred, removing bridges, filling air space, and allowing the highest density results possible.

Blue Ridge Services have calculated most compactor brands, sizes, and style of wheels/drums for their "Tooth Penetrations Per Foot of Travel". We would recommend contacting Blue Ridge Services and see how your compactor brand compares to others in the market.

### 2. Crushing force capability on uneven surfaces

Crushing force capability for a landfill compactor allows uneven and high surfaces to be compacted at a faster rate. A rigid frame compactor provides the best design to achieve the crushing force on uneven and high surface areas. Tana and CMI both utilize a rigid frame design. However, Tana's two drum design provides a design that allows 50% of the weight to be distributed on uneven and high surface areas. CMI's Trashmaster design only allows up to 33% of its weight to be distributed to these uneven and high surface areas; therefore, not providing the higher force of the Tana compactor. Four wheel design compactors like Caterpillar, Bomag, Aljon, and others have a oscillating axle design that will only allow 25% of the units weight to be applied at the most at any moment which does not assist in keeping a smooth tight service on the face of the landfill.

### 3. Clean “cleats” and wheel/drum surfaces

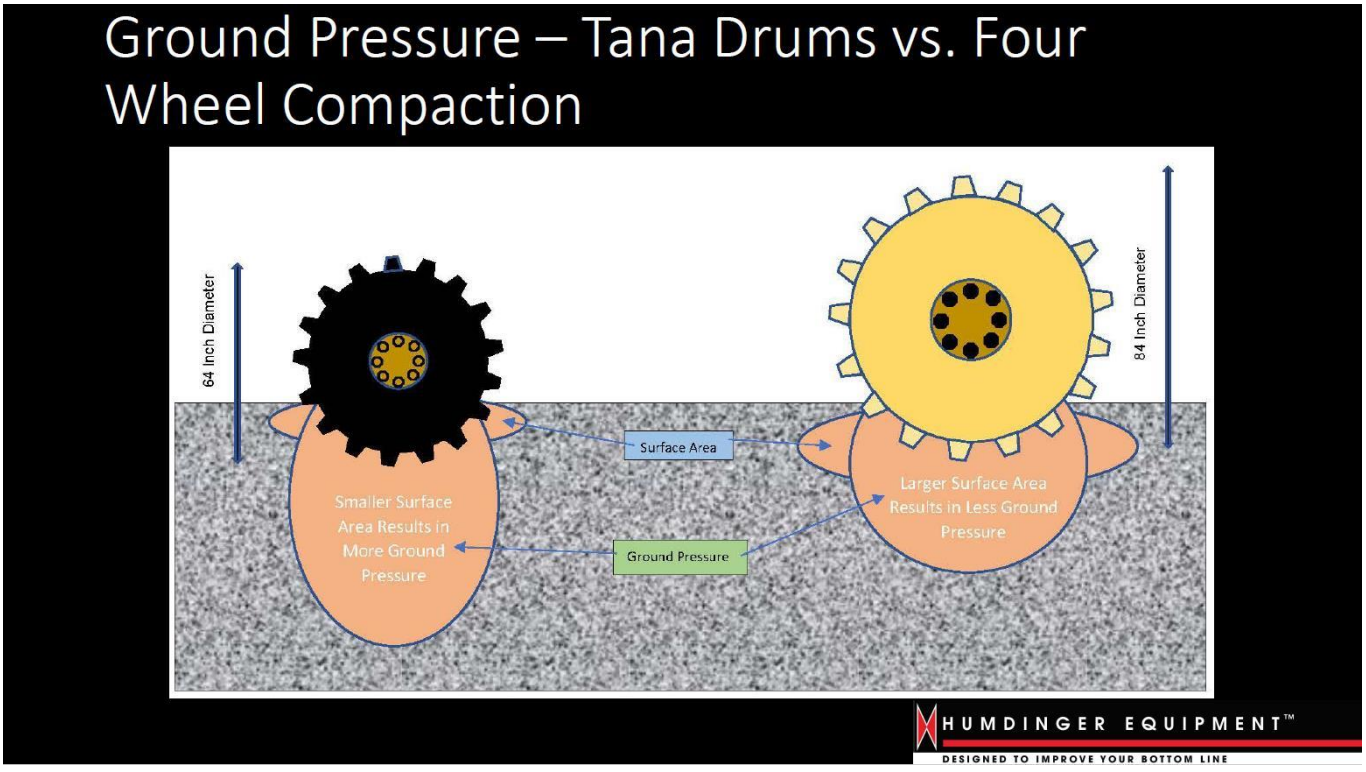
The cleanliness of the wheel/drum of a landfill compactor is as important as any other factor to be considered. As stated by Neal Bolton of Blue Ridge services, *“…the key to effectively compacting trash is to get as many teeth – full length teeth – as possible into the trash.…”*

What type of cleaning system does your compactor have and is if effective in maintaining a clean wheel/drum at all times?

### 4. Wheel/Drum Diameter

The smaller the wheel/drum diameter the less surface area it covers, allowing the ground pressure to push the wheel/drum further into the waste; therefore, achieving higher compaction density. A small diameter drum design provides for the ability to achieve higher ground pressure results than compactors with larger diameter wheels as shown in the graphic below. The smaller diameter of the wheels/drums allow for deeper penetration in soft material. Where the larger diameter wheels/drums cannot penetrate as the larger surface area cause them to float.

> *Neal Bolton, President of Blue Ridge, stated that “because the wheels/drums diameters can range from 8%-25% less than the other wheels/drum diameters of other compactors, the smaller diameter wheels/drums may provide somewhat greater ground pressure….”*



## 5. Tooth Shape

Landfill compactor wheels/drums come in many different styles, shapes, and material content. The reasons are manufacturers have tried to develop the most effective and longest lasting wheels/drums for their customers. Because of the many variations it makes it difficult to compare most wheels/drums to each other. Factors for an effective wheel/drum design include how many surfaces are contacting waste at any given moment and how effective is the wheel/drum design in cutting, tearing, and shredding the waste. Each surface plays a role in breaking up waste and pressing the waste into air voids. With each pass, smaller particles are forces together in multiple directions achieving the highest compaction possible.

## 6. Elimination of Blowout

Blowout is a term in the landfill compaction business that refers to the waste that a compactor runs over but then escapes through the ends of the wheels/drums. The more blowout a unit creates, the more difficult to achieve higher compaction density, and the longer it takes. How many locations does your compactor have that allows blowout? Compactor designs in the market have between 4-8 blowout locations where the waste can escape from the force of the compacting action.

## 7. Higher Ground Clearance

Simply measured at the kingpin, how much clearance does the bottom have to the ground. As the compactor passes over waste, there needs to be as much clearance at this location as possible. Those experienced in compacting on a real working face know the frustration of a carpet roll, mattress, cable, or other objects catching on the kingpin area and axles and being pulled up. This “uncompacts” the local area causing the operator to repack. What is the ground clearance your compactor provides, and does it continually pull up previously compacted waste?

In summary, “Ground Pressure” and “PSI” is an important part of any landfill compactors’ ability to achieve high compaction density but is only one of many variables required to achieve high compaction density. Every brand of landfill compactor has its own unique design and how each of the variables work together on that
machine is different than another machine. The next time you are looking at a landfill compactor ask the salesman how their brand of compactor compares in all When considering your next landfill compactor in all nine (9) categories.