

Taller or Wider?

Do you get more traction with a taller tire or a wider tire? If the surface area in contact with the ground is the same between the two, a taller tire is better the majority of the time assuming the aspect ratio (i.e. the height of the tire's sidewall) is the same. We will deal with differences in aspect ratio and their effects off road in our next newsletter, but suffice to say, a taller sidewall means more air in the tire and more air in the tire means more options off road.

Why is taller better than wider? 1) Taller tires have a longer footprint that is in line with the pull of the wheel. 2) The part of a tire that normally loses grip is smaller on a tall tire. 3) A contact point on a tall tire is in touch with the ground for a longer time than a wide tire. 4) Taller tires have a longer patch to conform to the structure of the ground therefore has better grip. 5) Taller tires are less abusive on wheel bearings. 6) Torque to the ground decrease with increased tire height. 7) Taller tires have less effect on the environment since they are less likely to spin or slip.

This all translates to a softer touch on the ground, less wheel spin, less mechanical abuse, and much less environmental impact.

A wider tire within this context will further enhance your vehicle's capability. And remember a taller sidewall will further increase capability.

So get as tall a tire as your wheel well clearance, gearing, articulation, and bearings can handle; then add width. The largest tire you can fit on your vehicle is the easy answer. Being realistic about what actually fits is more difficult

For a given surface area and aspect ratio a taller tire is better than a wider tire for a majority of technical off road driving

Summary:

- Taller tires have a long footprint. A long footprint means a surface area in line with vehicle movement.
- The part of a tire that normally loses grip is the point or line that the tire first contacts the ground, and the same but opposite point where it leaves the ground.
- A tall tire has a smaller area coming into or out of contact with the ground relative to the surface area of its contact patch compared to a wide tire.

- A taller tire has a longer patch parallel to the ground letting it to conform to the structure of the ground better for longer in the direction of travel
- A taller tire keeps the weight of the vehicles closer to the bearings of the wheels; so the bearings get less abuse per rotation.
- All this translates to a soft approach on the ground, less wheel spin, less mechanical abuse, and much less environmental impact. Air-down this same tire and you abuse on the ground, if you driver well that is, can be reduced even more.

The following is a breakdown of the positives of a tall vs. a wide tire in more detail. The points are presented in short specific paragraphs and are in no particular order. Please remember that the tires in question theoretically have the same aspect ratio and the same surface area (footprint) and are inflated to the same internal pressure.

A taller tire has a larger circumference, which equals both a longer footprint and a larger surface area arranged in the direction of the “pull” of the tire longitudinally (in line with) the direction of movement and inertia of the vehicle itself. It is normally grip or traction in line with these forces that is needed in order to either move forward (pull), or slow down (push). Having a greater area in line with movement means more grip and traction per pound of rotational force transferred to the ground.

A long footprint is better than a wide one since it allows for the pattern (tread of tire) and grip to be established for a longer period of time, and therefore, is more consistent as wheel’s rotational power is moving the vehicle over the ground. A wide footprint has less contact with the ground over time per unit area and renews its ground contact faster and leaves it faster. It helps to envision a bulldozer tread; a long tread is on the ground for a longer period than a short one. If there is a spot or patch on the ground that can hold the rotational force of the tire and wheel without breaking free of the ground surrounding it, the tread is on this spot for a longer period.

A long footprint means that a tire conforms around larger, taller ground, or more numerous ground conformations in the direction of pull for a longer period of time than a wide tire can. Basically it will contact more of the front and rear face of ground objects and have a better chance to not be lifted off the other ground around that ground object. As an example of just one of these points: a tall tire touching a 6 inch step will contact the whole face of the step and get a bit of itself on the top edge of the step (better grip), while a wider short would not.

Any tire as it rotates has an area where it comes in contact with the ground and leaves contact with the ground. The front and back of this contact “line” is where the tire changes its force-vector (force and mass) direction from down and rotating around the wheel’s center, to a more flat, consistent (not turning to wheels center) and parallel to the ground direction. Let’s call this the “force transition line”. A wide tire has a longer “force transition line”, (i.e. greater area in transition) coming in contact or leaving contact with the ground over any given period. It is this line that usually breaks grip on the ground and causes loss of traction. In other words, given an identical footprint area, a wide footprint has a great surface area in transition over time than a long footprint. The tall tire with a long footprint has more useful grip for longer.

As a tire’s width increases, the tire’s center moves away from where the wheel attached to the hub and axle of the vehicle. This, in turn, produces more load on many points such as the wheel bearings, axle bearings, constant velocity bearings, just to name a few. Keeping the wheel inboard and closer to the hub is better for most everything, though there are exceptions such as the added stability of wider track width. If you want a wide track width, then you will need to get tougher running gear.

A taller tire, with a longer foot print, means that the rotational force to the ground is less than a shorter tire with a wider footprint. The torque to the ground is reduced per rotation. This translates to pushing softer on the ground. As an example when walking on ice a person pushes on the ground very softly to move forward, too hard and grip will be lost. At any given time it is best to power forward as softly as possible; just enough to move and no more. Under the assumption that grip is always just about to give out. Under conditions of marginal grip, “heavy footed throttle” control will result in wheel spin.

Now with the above treatise in mind, consider “airing down” and its effects on everything mentioned so far. Airing down a tire makes for a longer footprint and not a wider one; to most off road drivers this is common knowledge. Airing down a tire results in the flat portion of the tire's contact point elongating in the direction of "pull" of the tire. Add to this that an aired down tire softens impact with the ground. Newton's third law of motion states, *“When one body exerts a force on a second body, the second body simultaneously exerts a force equal in magnitude and opposite in direction to that of the first body”*. An aired down tire, especially a high aspect ration one, can act as if it is a small suspension, dispersing impact laterally to the sides so the tire and wheel do not bounce up and off the ground (i.e. ultimate lose of grip). Top this off with the tires enhanced ability to conform to the ground topography better when aired down, clear dirt or snow out of the tread at the bend of the tire, and that tire’s ability to keep grip is greatly enhanced.

On the road (aired up of course) these things may not be an advantage depending on how tall and wide a tire is in use.

Remember, all modifications from the stock configuration of any vehicle are trade-offs. A larger tire changes the center of gravity and torque to the ground (changes gearing). The tires may not fit inside the wheel wells. As a wheel and tire mass increase, the stress on the wheel bearings, axle bearings, constant velocity joints, and other drive train components increase. So, larger tires may require other modifications. Tall, thin "pizza cutter" tires really only work in mud with some dry-ish stuff below, or in deep mud with high horsepower engines to clear the tire cleats. If the mud, sand, snow, etc is deeper than 2-4" above your differential clearance measurement, then you need a wider tire that will provide some flotation. A tall and thin tire is not as safe during cornering as a wider tire of the same height, because the lateral support is not as geometrically advantageous. Clearly, crazy, large tires all the time are not the answer, but with the right gear accounting and other modifications for the changes in forces, a larger tire is beneficial. Using wheel spacers or changing the wheel offset to increase track width to accommodate the larger tires adds a lot of extra stress, also. Keeping the wheel inboard is better for most everything, though the added stability of wider track width can be beneficial. If you want a wide track width, then additional modification may be in order.

A very important aspect of all this related directly to environmental impact; what is the impact of a taller vs. wide tire. Basically less spin and more surface area contact results in less ground abuse. This point is missed by most wheeler and overlanders alike. A wide tall tire does much less environmental abuse than a smaller tire on the same vehicle driven by the same person under the same conditions. Just to list a few points: Less soil compaction, less spinning, less lose of rubber, less vehicle bouncing leading to wheel spin, great braking so less sliding, etc, etc. Farmers have known this for some time--- wide tires give better floatation, less soil compaction, less damage to the plant themselves, and reduce soil erosion and soil loss. If you position yourself as environmentally concerned, then you have to see the logic of tall wide tire, but don't forget to learn how to drive well, or this is all just academic.

In closing, a tall high aspect ratio tire outfitted within the bounds of your vehicle and how you use it, will be the best place to start. Next make it as wide as practical and safe, air it up and down as conditions demand, and don't spin a wheel; that done and you are now one step closer to use your driver skills to their best advantage.