

# What is a Parabolic spring?

A parabolic spring is basically a leaf or a set of leaves, which are tapered in a parabolical way rather than a linear. So from the middle, where it is thick, to the ends, where it is thinner, the tapering steps down in a parabolical manner (every 1 mm the leaf tapers by a parabolical calculated value, see picture). The tapering in a single leaf handles the force distribution from the body to the axle and works as a complete multi leaf spring. The shape, camber, of the spring is not parabolical but semi-elliptical and sometimes referred to as parabolic by mistake.

Parabolic tapered springs may not be confused with linear tapered springs (every length step is tapered with the same value forming a wedge). Although linear tapered springs will look the same, at first glance, they will not be as good as the parabolically tapered springs since the stress inside the leaf is not constant (evenly distributed) but peaks at a certain given point, where it is obviously more likely to break.

The reason why the parabolic spring is more comfortable is simple but before I explain this I will first explain what happens with a (multi) leaf spring when it moves under force. When a multi leaf spring compresses the leafs will become longer since they are in a semi elliptic curve when they are without load and will go straight when they reach maximum load. So the leafs will tend to slide against each other when the spring compresses and thus it will cause friction. This 'interleaf friction' needs a certain amount of force to contra act this interleaf friction before the spring compression (inward) movement starts. This means that when you drive over a bump the spring will first have to overcome the interleaf friction and then it will start to move inward. By then the bump 'shock' has been transferred through the chassis and body giving the occupants bouncy ride. The ideal spring would have only one parabolical tapered leaf eliminating all interleaf friction at once but the stresses of off-road driving will not allow one leaf and thus there have to be 2 or even 3 leaves to compensate the stresses. These extra leaves will also be parabolical tapered and are not allowed to touch between the center and leaf ends like conventional multi leaf springs so poly urethane blocks will act as spacer and friction reducer in one. This is one of the reasons that a parabolic spring is more comfortable since it has little to no interleaf friction.

## The differences and advantages

- First of all, the parabolic tapering of the spring. This tapering is in a parabolic way to assure maximum force deflexion and transfer from the ends to the middle section. This gives the best results in both comfort and longevity.
- Second, the number of leaves. The front springs have only two leaves instead of nine or eleven. The rear springs have three (load level B) or four (load level C & D) instead of ten or eleven leaves.
- Third, the spring leaves do not rub against each other over their entire length. Instead, the lower leaves are shaped at the ends and 3 mm spacers are fitted between the leaves in the centre, thus leaving a space along the length of the spring with friction only at the ends.

**These differences provide several advantages**

- A much improved combination of spring characteristics with the reduced thickness at the ends of the springs provide improved comfort, where's the strong central part ensures a very good load capacity.
- Because the leaves are not rubbing together and the outer ends are separated by PU blocks, the problem of a build up of friction and rust is prevented.
- Un-sprung weight is reduced because, for example, the front springs weigh only about half as much as the standard type.