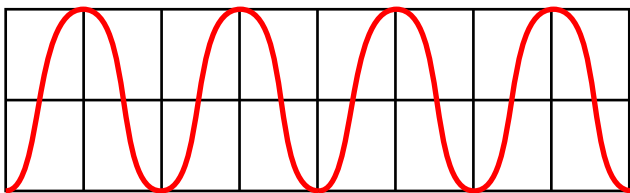


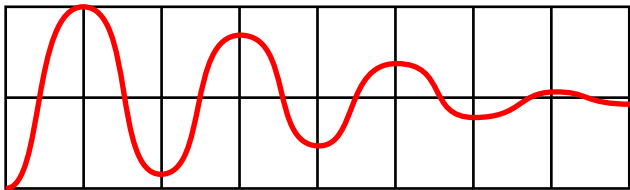
TECH: KART 'SUSPENSION'

KART SUSPENSION – DAMPING

Suspension has another important role in any race vehicle – smoothing inputs. All suspension designs are “Damped Harmonic Oscillators”. The output of a harmonic oscillator is a Sine Wave – or if maths was never your thing – a smooth curve. A DAMPED harmonic oscillator creates the same output, except the curve gets smaller over time.



ABOVE: OUTPUT OF A HARMONIC OSCILLATOR



ABOVE: OUTPUT OF A DAMPED HARMONIC OSCILLATOR

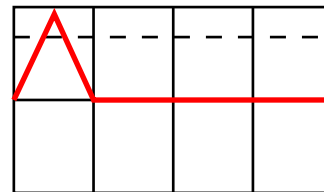
When you're driving along in your car and smack a pothole at 60 km/h, the suspension takes the sharp input of the pothole and smoothes the curve. Lucky it does too, otherwise the car would rattle itself to bits in no time! Fortunately our clubs take good care of the tracks we drive on – so potholes are not the problem. Smoothing the input of the road to the tyre, however, remains of critical importance.

Remember we were talking about grip really being the coefficient of friction between the tyre and the road? Well, just to make it interesting, I'll now mention that the tyre in fact has TWO coefficients of friction with the road. There is a coefficient of static friction (the amount of grip a tyre generates while rolling), and a coefficient of kinetic friction (the amount of grip a tyre generates while sliding). The rolling friction is a lot higher than the sliding friction – ie, you generate more ACTUAL GRIP when the tyres are rolling along the track, not sliding across it.

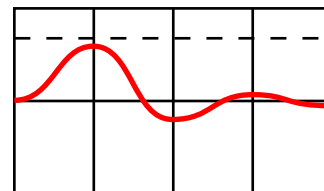
One more nasty term to learn – the limit of adhesion. The limit of adhesion is the maximum amount of lateral (or sideways) force the tyre can take (while rolling) before it cannot support any more, and begins to slide. The driver of a go-kart has an amazing ability to feel where the limit of adhesion is. When you're cutting a good lap – you are RIGHT on it. When you're in the pit and hear someone describe a kart as “on rails”, the kart is utilising the available grip well, and riding right

on the limit of adhesion.

Suspension, even on a kart, has the ability to smooth out inputs that would otherwise exceed the limit of adhesion and cause the kart to slide. By smoothing sharp input “spikes” we can keep the total load on the tyre below that limit, keeping the AVERAGE load supplied to the tyre as high as possible. In the graph below, the dotted line represents the limit of adhesion, the red line is an input spike that (without the aid of suspension) would exceed that limit and cause the tyre to slide.



Here's that input spike after the suspension (a damped harmonic oscillator) has smoothed it. Note that now, the maximum total load does not exceed the limit of adhesion, so the tyre will remain “in grip”.



Want a “real-world” example? Go out to a cold track, and put a hard axle, really long hubs, two sets of seat stays and a tight third bearing on your kart (all things that supposedly give you “more grip”), and see how much grip it actually makes. You'll slide around like a puppy on a skating rink. With such harsh suspension settings, and a low limit of adhesion (due to the cold weather) the slightest spike in force on a tyre will cause it to exceed that limit of adhesion and slide.

CONCLUSION

This article really isn't ready for a conclusion but if it gets any longer no-one will read it! Hopefully it has given you a better understanding of the tyres that attach you and your kart to the road, and provided some food for thought. In a future article, we'll take some of the theory discussed here and put it into practice.

As always, any and all comments are welcomed at info@phoenixracekarts.com.au