

## **CRITICAL ASPECTS of KART SEAT SELECTION & SET-UP – by Steve Tillett**

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One of the most difficult jobs to do on a kart is to fit the seat in such a way that is both comfortable for the driver and beneficial for the balance and handling of the chassis. Over the years I have been involved in karting I have picked up a lot of valuable information in relation to this and, hopefully, within this article I can pass on some of this to you.

### **SELECTING SEAT SIZE & SHAPE**

**A well fitting seat results in less driver fatigue both physically & mentally. This always has a positive effect on lap times especially towards the end of a race.**

The most important factor in correctly sizing a seat is that it must fit tightly to all parts of the body from the chest down to the hip area. Most damage to the body will occur when the torso is able to move independently of the seat rather than with it. The easiest test of whether a seat fits correctly is that if you are able to slide your fingers down between the torso and the seat without too much resistance, then the seat is too big in this area.

#### **Seat Sizing Issues – we aren't all a uniform shape:**

Because a driver's body shape will differ from person to person you may find that it's possible to have a seat that fits OK at the top but not at the bottom or vice versa (this is one of the reasons Tillett produce such a diverse range of seat shapes, and padding options)

The problem with having a seat that does not fit all the way is that it will put undue stress on the part of the body that is not restrained. A seat that is tight around the hip/waist area but is loose at the top will put a lot of energy through the ribcage area and is more likely to be the cause of rib problems than any other. I often have people ring me up to say that they have damaged their ribs because of an impact or grip levels encountered but are adamant that their seat fits perfectly and was not a contributory factor in the problem. When these same drivers have then come down to our workshops for a Ribtec fitting I can safely say that at least 90% have been using a seat that is 1 to 2 sizes too big for them.

When the situation is the other way round and the rib area is secured correctly but the hip/waist area is loose this is more like to be the cause of back problems as the lower half of the spine will be constantly twisted whilst the top will not. It is also the most common reason why you can end up with skin abrasions around the base of the spine after racing.

#### **Padding – a good solution but don't go to far:**

Some rib protection products (especially the thicker type) can cause the above problems to be exacerbated. If you have a situation where there is a reasonably large gap between the seat and the hips, it is best to pack this out with closed-cell foam until the gap has gone. A number of proprietary brands of this type of padding are sold specifically for kart seats including Tillett, Sparco and Righetti Ridolfi.

For most female drivers and also for a few of the male drivers, the main problem is that the lower part of the seat needs to be up to 2 sizes bigger than the upper part of the seat. This can lead to gap of 2 to 5 centimetres around the rib area that needs to be filled in order to correctly displace the bodyweight onto the sides of the seat. One way of reducing the gap is to wear a rib protector but this will only reduce the gap slightly. Another way could be to fill the void with additional closed-cell foam, but there exists a problem whereby too much foaming around the rib area will allow the

driver to wallow in the seat. This will then cause the bodyweight to be transferred inconsistently during cornering and for the chassis not to react correctly. Ideally there should be the minimum amount of padding between the driver and the seat edge and certainly no more than 5 -10mm each side. If you need to pad the seat out more than 10mm try cutting some rigid plastic sheet of the appropriate thickness to fit the seat under the foam padding, bolt it in place with the seat bolts and cover with the adhesive foam padding.

### **Cut-down Seats – free up arm movement for smaller drivers:**

For junior drivers one of the main problems can be a restriction in being able to turn the upper body due to the height of the back and sides of the seat. The seat must not encroach up to the armpit area or beyond and for this reason it is better to go for a low back (cut-down) version so as not to hinder their driving.

### **Make it the Seat of Your Choice!**

The shape of the seat has less of an effect on the handling of the kart when compared to seat positioning and the type of materials used in its construction (rigidity level), which do have a major effect.

When choosing a seat shape do not be afraid to pick one that is different from the one offered as standard by the kart dealer. The fit to *you*, the driver is the most important factor; so make sure you are sitting in the seat of *your* choosing.

## **SEAT POSITIONING**

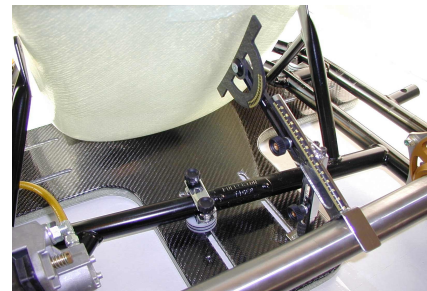
**Kart balance is critical to good performance. The driver & seat can make up half the weight of the kart and the biggest single mass to move around. Small adjustments can therefore have significant effect.**

There are three main areas that need to be addressed in the correct seat position and all three will have an effect on the balance of the kart. They are the position front to back in the chassis, the angle or tilt of the seat and the height at which it is mounted.

**Measuring to the axle – different seats differ in height and depth so be careful where you take your measurements from.**

Most kart manufacturers will have a recommended position for a seat but this is generally based on using a size 2 (MS) 'euro' style seat that they supply as standard and which has been tested with their works driver. This measurement will normally be based on the distance either from the top edge of the seat down to the axle surface or the distance from the front tubing (where your heel sits) to the most forward point of the seat (the toe). The only problem with these measurements is that an XS sized seat has a completely different height and seat depth to an XL, in these situations the dimensions given will be of little help. By all means use these dimensions with the original 'factory' seat to establish a baseline but then translate the dimension as follows.

The measurement that I always advise to use is taken from a point on the seat that is about 2cm either side of the spine depression and is then the shortest distance from this point to the front surface of the axle (see picture). By doing this it gives a very accurate way of attaining the actual position of the driver's back and is not influenced by the shape of the seat or the depth of the seat spine. Currently the average measurement used by race teams is around 18.5cm although it can be anything from 16.5 – 20cm.



### **Seat Angle – will effect balance, grip and driver control**

The angle or tilt of the seat is predetermined by the style of the seat, although this can be altered depending on the installation. As a general rule all Tillett seats will have a flat element on the base that can be more pronounced on some of the models than others. The main reason for this is to keep the bodyweight of the driver as low as possible within the kart. Holding this angle will ensure that the shoulders remain at the correct angle of attack for steering effectively. We currently work with mostly two angles on our seats. For seats that are designated T5, T7, T8 or T10 the angle is set at 63 degrees (from horizontal). For seats that are designated T9 or T11 the angle is set at 58 degrees. For many general karting and classes the 63 degree angle will be the most suitable with the main exception being for a taller than average driver to help keep the kart stable. Also for karts that will be racing in high grip conditions and using very soft tyres the 58 degree angle can be preferred in order to alter the forces acting on the tyres in a more lateral direction.

### **Seat Height & Centre of Gravity – effects on grip and weight transfer**

As for the mounting height of the seat within the kart, it is generally advisable to have approximately 1 to 1.5cm protruding below the level of the chassis rails (set with the kart on dry tyres) in order to achieve the optimum position for the driver's centre of gravity. The only situations a higher seating position may be advisable will be for wet conditions, using hard tyres or for a small driver, these being examples of where more weight transfer may need to be applied to the two outer tyres to obtain grip.

### **Overall Balance – check on-track in optimum conditions**

To establish the optimum position front to back whilst on the track you will need eliminate other factors that can influence the balance such as steering geometry. Therefore the best part of the track to judge whether the kart has understeer or oversteer due to the seat position and nothing else will be on a long fast corner where there is only a minimal amount of the steering input. A tight or slow bend will introduce factors like castor position and Ackerman angles which may be affecting the handling.

It must be remembered that the driver can make up nearly half the weight of the vehicle. Therefore if a kart needs the weight to be displaced in a certain position to give neutral handling, then the ideal position of the seat (front to back) will remain in fairly much the same position for all drivers. The only exceptions to this will be for very tall or very short drivers or for ultra grippy track conditions. With smart changes to steering geometry, axle, hubs, lead position and seat stiffness most of the discrepancy caused by driver height can be adjusted for on the kart.

### **Ballast – avoid seat damage as much as possible**

Before you attempt to find the optimum position for the seat do not forget to place any other add-ons to the seat especially the lead ballast. For drivers that need to run with amounts of lead on the kart it is generally better to keep these in smaller quantities on different parts of the seat rather than using one big slab which can tend to stiffen the seat and possibly create fractures and weaken the composite. This would ultimately lead to the seat effectiveness being diminished. It must also be remembered that large amounts of lead on the back of the seat will affect the handling of the kart and may require the seat to be moved further forward to redress the balance.

### **Seat Stays – one stay or two?**

Additional seat stays will have an affect on your handling and also need to be fitted before any assessment is made as to the chassis balance. One seat stay each side is a weight transfer device helping to lift and unweight the inside rear wheel whilst pushing down on the outside wheel. Once you run more than one seat stay this

actually starts to also stiffen up the kart across the rear working more like the rear removable bar. As a general rule as you add more additional stays the back of the kart will remain flatter through the corners.

### **Steering Position - adjust steering & pedals to suit the seat position, not the seat to suit the steering and pedals!**

Once the seat is fitted into its final position you will need to adjust the pedals and steering wheel to suit the driver. When setting the position for the steering wheel you will need to try and achieve a position whereby the forearms and your thighs are parallel. You will also need to make sure that at full steering lock the arms are not fully extended and straight. Being laid back too far may feel comfortable but if you are stretching for the wheel all of the time you cannot drive from the shoulders.

Adopting the correct position of arms and shoulders whilst turning the wheel is absolutely vital to getting the best out of the kart. Driving from the arms alone creates no power on the wheel and whilst this may not be a major problem on a wet or low grip track, it can cause major fatigue when things get a bit grippier. As in many other sports, you need to utilise the biggest muscle group available to the task in hand. Therefore whilst sat in a kart seat the biggest muscle groups available to use will be the deltoid (shoulder) muscles and the triceps of the upper arm. The steering movement needs to be created by pushing forward and up on the outside edge of the steering wheel (which utilises these muscle groups) and not pulling down on the inside edge of the wheel (which doesn't). It also allows you to push yourself back against the seat to create a rigid section between the steering wheel and the seat back, which will enable you to resist undulations in the track and kerbing moving the wheel. In high grip conditions it will also help to stop the kart from 'Wonging' as a driver not being able to hold the wheel with enough power normally induces this condition. Pulling down on the wheel with the inside hand will pull you out of the seat and cause you to adopt the 'Prawn' position (as it is affectionately known) and when hunched over the steering wheel you will end up steering only from the arms and not the shoulders. *[Insert Photo 3?]*

### **SEAT STIFFNESS (rigidity)**

#### **An opportunity to 'free up' or 'grip up' the kart without loosening fasteners**

Seat stiffness can cause an enormous difference to the handling of the kart and these differences will be accentuated more with higher grip tyres, this is the reason why Tillett seats are offered in a range of 'rigidities'.

The one thing to realise is that there is no golden rule as to whether a softer or harder seat is best, as it depends on a number of interacting factors. The type of chassis, tyres, engine, track surface and kart set up (steering, axle etc) that you are running all have an effect on this decision. The way of attaining grip from certain tyres and track surfaces can be significantly different so care must be taken not to put too many definite rules in place.

On some track surfaces or track conditions it may be better to achieve grip by putting as much of the tyre surface as possible in contact with the track, on others it may be that the only way to get grip is to increase the downward forces that act on the outside tyres.

This said, a rule of thumb to start with would be:

The softer & more flexible seat will generally soften the chassis, change the kart balance & weight transfer, reduce bogging out of turns, and improve lap times in high grip track conditions

The more rigid flexibility seat will generally stiffen the chassis and add grip.

**Testing is the opportunity to experiment:**

The one thing that you learn after many years in karting is to never have any fixed preconceived ideas about the chassis set-up as these will sometimes turn around and bite you in the rear when you least expect. The best rule of advice I could give to you when setting up the kart is not to necessarily go with the flow but to experiment in testing. You may be pleasantly surprised!

Ultimately your stopwatch is the best source of advice!