How to Fit and Adjust a Sidecar on your Motorcycle; Three-wheeling.

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About the author

Daryl Hobbs has been a qualified motorcycle mechanic for over twenty years. During that time he has patched, tuned, fixed, repaired, reconditioned and restored over 70 makes of motorcycle – of course this number has been assisted by owning over 20 makes. Occasionally he would buy one just because he hadn’t worked on that make or model.

As a mechanic, accurate and useful information has always been important and the one area that doesn’t seem to have been catered for that well is information on fitting and adjusting sidecars.

The authors baptism into the world of sidecars was attaching a second had box to a Russian made Ural. Aware that he would have to readjust just about everything; the adjustments were left a little loose on ride number one. Unfortunately the first left hand corner was in front of a pub with the usual company assembled on the front verandah. The sidecar, realising there were spectators, took a bow (toward the ground) that veered the outfit into the weeds on the wrong side of the road. *If you own an outfit, tighten everything.*

The second outfit was a safer bet having been securely attached for over 30 years, it was a BSA M21 road painters outfit and very good indeed. The sidecar frame had comparable springing to the bike (not much), a comparable third motorcycle wheel that provides a good rolling and steering ability; you just had to leave a little earlier than everyone else to get places.

Subsequent outfits have sought to move the author’s riding experience further up the queue with a subsequent preference of not much less than 1000cc and a preference for gobs of torque.

Terminology

Chair Sidecar language for a sidecar that can be on or of the bike.

Outfit An expensive piece of clothing that is always described by how much was saved rather than what it costs.

Outfit An expensive piece of motorcycling history that is truly individual, has three wheels, and describes a sidecar attached to the motorcycle.

Ride An opportunity to wear an outfit in an outfit in a ridiculous attempt at symbiotic guilt minimisation.

Manoeuvrability Fun.

Flying Riding an outfit with the sidecar airborne (flying the chair [also fun]).

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A Brief History of Sidecars

For the purposes of this booklet, Australian motorcycling will be assumed. This means that the author is assuming that the sidecar is mounted on the left hand side of the motorcycle.

Sidecars were born out of the motoring era of “transport poverty”. That is, it was the cheapest motorised transport to buy, operate and park – apart from a solo motorcycle. Everybody has seen a comical script where the ‘chair’ and the motorcycle both go their own merry way, but ‘outfit’ motoring has recorded a significantly safer level of statistics than solo motorcyles. This outcome must be considered carefully because the statistic is not adjusted for the differences in vehicle population and it also rides on the history of lower powered motorcycles on poorer road surfaces where an outfit excels.

Because of this functional history, sidecar manufactures have abounded; from the home made chair, engineer designed accessory sidecars, to an original manufactured design for a designated motorcycle. There are literally a myriad of shapes, sizes and ideas within the industry. Apart from aesthetics, these include important variations of width and weight. It is the author’s recommendation that you either commission an outfit from a professional sidecar manufacturer or buy a used one that has such a history. However, this booklet is primarily written for those who ignore this advice for the purpose of adventure, economy or both. Additionally, this booklet is useful for an older set up that needs adjustment.

Choosing a Chair

The author is quite biased in this area and therefore recommends the lightest chair for the job – this is primarily driven by issues of speed, economy, the reduction of wear and tear on all components, and increased manoeuvrability. Additionally, it is generally considered a bonus (not essential) to choose a chair that is sprung to match the bike and has a similar sized wheel to the bike (see ‘sidecar springing’). That just means that you’ll both bounce down the road together with a little more harmony without corkscrewing each other. That being said – it’s of no use when the potholes aren’t matched on each side of your track. But, if you put a little wheel into a big hole there’s a definite ‘parking’ effect on that half of the vehicle. In the end the choice is often how it looks to you and will it carry the stuff that you want to carry.

Economy

One question that some people ask about outfit motorcycling is how much will it costs you to punt down the highway, and how often you have to pull over for fuel? The average report of a large Japanese tourer with a DJP sidecar seems to shift the solo range of from 250km down to approximately 150km or even less. If you look toward something with a bit more torque such as a BMW 1000, the shift may be from approximately 300 – 220km range. An enthusiastic economist would start thinking about stump pulling torque that’s not going to reduce fuel economy in the greater than 30% range. In fact doing just that with a HD you can get down to 10 – 15% fuel reduction. The author has combined a mid-weight chair with a Moto Guzzi to achieve such figures fully loaded (and well adjusted), resulting in a safe 250km range. Classic
outfits also tend to fall into the latter category although selection is rarely dependent on economy. Aesthetics are the issue here with as little agreement as choice of motorcycle.

Enjoyment looks and function are often the true determinants in the world of motorcycling. This reduces the term ‘economy’ to something that you use at parties for people who just don’t understand motorcycles; it helps with parents and partners too. I had a customer who was travelling on a Gold Wing with a double adult chair and he was getting less fuel economy than an average V8 car and he was enjoying the ride immensely. His only issue was that he had to stop quite frequently for fuel – and of course that just interrupts a good ride.

Solo-only motorcyclist often can’t comprehend the idea of enjoying the ride when you bugger up a perfectly good leaning machine with a hefty growth on the left hand side. I think both are fun and for me the choice is like selecting music – there are days. Most importantly it is my desire that this booklet will help you to engineer your adjustments and optimise the enjoyment of your three-wheeling days.

**Sidecar Springing**

I mentioned earlier that a sidecar that matched the spring of the chair was considered a bonus. This is a commonly held view that has come out of the school of suspension engineering and it is primarily directed at offering the same comfort to the passenger as the rider. Fair. But there are limitations and compromise (a common theme in three-wheeling). A sprung chair will shift the motorcycle lean-out whenever you add or remove weight. Additionally, a sprung moment (bump) will also alter the outfit’s geometry for its duration. Therefore the idea that corkscrewing belongs only to mismatched halves of the outfit is partially erroneous. Stability of geometry is actually found in rigid or firm designs that subsequently provide suspension for the body with passenger. The Globe on the front cover provides a firmly controlled swingarm for its wheel, and hangs the rear of the body on four rubber bands for the passenger just like the early Steibs.

**Riding an Outfit**

The first ride of an outfit is best conducted in wide open spaces. Like a car, you need to develop an intuition of cornering capability before the corner occurs and also like a car, there are consequences of both sliding and overturning – it is worth practising to the limit so that you can increase your rider safety in unknown terrain and unexpected traffic situations.

Taking off may seem to be an unnecessary comment however the take off, driven by the bike, will result in the drag of the chair pulling the outfit in the left direction and therefore requiring opposite steering compensation. Additionally, if you’ve ridden alone for a while; adding some kilos in the form of a passenger and camping gear will give you a new level of right hand compensation to pull out straight. It is important to note that similar forces are in action during braking and increasingly so with increased brake effort, in this case the outfit veer is naturally oriented toward the right.
Cornering

I will begin cornering with riding left as it is arguably easier with less tragedy. By utilising controlled acceleration, the motorcycle wheels will travel faster than the chair’s wheel resulting in enhanced cornering and reduced propensity to ‘fly the chair’. Of course it is important to learn to fly the chair at your own command rather than flying out of control. It is not as dangerous as it looks because gravitational pull wants to put it right back down again (sometimes with a thump). The fly effect is a simple result of lateral force. That is, the centrifugal force is acting on the centre of gravity of the outfit (positioned left of the rider, but high) due to a transferred direction of velocity. Of course, an overcooked left corner will result in a clean right hand rollover that is catastrophic for all. If you find yourself in that position it is wiser to dump the chair back down and crash it into the softest object in a forward direction. The author has mucked around to the degree where he can fly straight indefinitely, as well as through both left and right hand corners. Flight control is definitely easier on normally rounded motorcycle tyres.

Right hand cornering is deceptively ‘safe’ due to a sense of a chair wheel that seems to be able to load up a bucket full of lateral velocity. This is not true. An overcooked right hand approach WILL rapidly lift the motorcycle’s rear wheel, compressing the front suspension and gouging the front of the chair into the road surface. This configuration offers zero control or recovery strategy. I bet somebody out there is considering a little wheel for the front of their chair – if you keep on with that thought you will soon have developed a car. So, optimal riding right involves the opposite of left, by utilising deceleration or some rear wheel braking through the corner that will tend to propel the chair around the motorcycle.

In summary, all riding requires reading the road and configuring each corner before it is entered. The ability to do this is naturally reduced if you are following another vehicle closely; allowing them to direct your speed and configuration of acceleration and deceleration.

Head Shaking

Every motorcycle with a chair attached will ‘shake its head’ in a given speed range. In fact, every solo motorcycle will also ‘shake its head’ in a given speed range. This is more commonly called tank slapping and the steering engineering of most solo motorcycles would cause this to occur at speeds you would never expect to reach. But it can occur at lower speeds with tyre and suspension variations. On an outfit it will virtually always occur – that’s why you often see leading link front ends on some outfits. They are a definite advantage, but expensive and not totally necessary.

Head shaking is comparable to the shopping trolley wheel rattle from left to right repeatedly. It is a result of dynamic steering overcompensation that is actually attempting to straighten its alignment toward the direction of travel; it just over does it – again, again and again. It is due to excessive trail in the steering design. Trail is important to provide straight line stability, but a solo designed front end has too much trail for the physics of a hefty attachment with a wheel hanging off the left hand side.
**Trail**

Trail is measured by drawing a line down the centre of the steering head (the bit the steering bearings are in) to a point on the road surface, and another line dropped vertically from the centre of the front wheel’s axle to a second point on the road’s surface. The distance between these points is the trail.

Having learnt that, you can wonder through a motorcycle shop and notice engineering adjustments to trail. There are differences in the rake (angle of the steering head and therefore forks), triple clamp design that can locate the forks at different distances from the steering head (you can buy a custom triple clamp set for some bikes), front axle mount variations away from a typical fork centre design, and the adoption of leading links on some scooters, classic BMW’s, and custom engineered front ends for outfit motorcycling previously mentioned.

Having discovered the principle of trail, it can also be micro-adjusted via fork spring selection, clamping the forks a little further through the triple clamps, using lower profile tyres or even a smaller wheel. These adjustments are unlikely to eliminate head shaking, however they have the potential to reduce the power of the shake and the speed at which it occurs. For example an outfit that is tamed down to 10-15 kph is generally not troublesome and easily accelerated through. It is acceleration that is the best cure for shaking not to mention fitting a very good steering damper.

The trail on the average outfit should not exceed 85mm because that’s when it gets just too hard to manage even with the best of steering dampers. The experience of a 50mm trail provides for significantly more desirable and safer ride. Therefore the range is best between 50 to 85mm with a definite preference toward the former.

**Fitting your Sidecar**

For the purpose of avoiding a book on engineering and physics I will simply offer some basic but important tips here.

1. Unless you’re an engineer or equivalent – get help from clubs, engineers, and sidecar manufacturers.
2. Remember that your solo motorcycle was not designed for a sidecar. In the old days this wasn’t so bad because manufacturers ‘minimal engineering’ was not a primary mandate. This primary mandate is not a dreadful idea because it does encompass weight reduction but its major drawback is that it limits personal customisation (in some cases even the addition of luggage systems is not recommended). A sidecar is a very large example of personal customisation.
3. Never use a seat frame attachment as a seemingly sturdy bit of metal to ‘temporarily’ attach a sidecar to.
4. Check out common usage of frame reinforcement, or sidecar sub frame attachments for your particular motorcycle and do likewise.
5. Use four mounts unless it’s a lightweight outfit; then three will do. Four means two upper and two lower – all removable and adjustable. If your using ball and socket fittings, I’d recommend only two of these combined with a willingness to add a tack weld to the final adjustment.
6. Don’t weld anything to your beautiful high tensile heat sensitive motorcycle frame – use beautifully manufactured clamps.
7. Try to design the mounting in a way that will distribute the force toward the centreline of the frame. One example is using a frame centre cross brace if it is of similar dimension and strength to the rest of the frame (rare). A second example is either using (or as close as possible to) an engine mounting bolt that already distributes its force across both sides of the frame. A third example is to use a secondary brace that crosses over to the right hand side of the frame.

8. Check out service and repair procedures on the LEFT HAND side of your engine and mount the sidecar as close to the bike as possible with these in mind. A narrow track width will reduce stability but I believe that this is outweighed by the advantages of increased manoeuvrability and reduced drag combined with associated wear and tear of the motorcycle.

9. Spend time and effort building a mobile jig that will move the sidecar with control and will always be there for you if you want to park the sidecar back on it for a while.

10. If numbers 1 – 9 have turned you off the task, get somebody else to do it.

**Adjusting your Sidecar**

There are three principle adjustments that need to be attended to; these are lead, lean-out, and toe-in. We will begin with lead because it is hoped that once set, it will never require setting again. Adjustment assumes a vertical bike with the front wheel pointing straight forward that is not using either stand to stay there.

To set up your outfit, work on a level concrete floor, use lengths of long straight things, with weights to hold them down, string, a good tape measure, coke, pizza and a good mate. Avoid all your mates turning it into a new adventure and avoid substances that have been known to change the readings on your tape measure.

**Lead**

The lead is the distance that measures how far the sidecar wheel sits forward of the rear wheel of the bike. Hanging weights on strings from the axle points will help here. To get the centre of the axle, a loose noose in the string will do that automatically.

Lead’s very existence is an attempt to make up for the missing fourth wheel on most two track vehicles. Zero or negative lead would mean that we could bounce the nose of the sidecar onto the bitumen with considerable ease – this is an example of the triangle not being the optimum geometric shape.

The selection of lead is essentially compromise. For example, if the lead was set at 30cm and you placed the sidecar wheel on a piece of cardboard and simply moved the handlebars left – the wheel will just slide the cardboard without any indication of providing roll. This would transfer into a riding experience of a lot of drag, steering effort and tyre and component wear.

Conversely, 2cm of lead will maximise rolling ability with the minimum of lateral drag BUT the sidecar will also become airborne with ease. Therefore the compromise is between drag and flight. My preference is 12.5 – 15cm. If you have a left hand exhaust system, and it’s not a flat twin, the header pipe may influence your selection by the physical location of the front upper sidecar mount.
Not many sidecars provide lead adjustment resulting in the need for virtual refitting to change. But it’s worth the effort and adjustments in increments of 5 – 10mm are recommended. At least you should know which way to go.

**Toe-In**

The large lump of sidecar that you are attempting to hang of the LEFT HAND side of your bike means that it’s going to have a natural interest in exploring the greener pastures of to the left side of the road. So we invent toe-in to whip it into a configuration that will hopefully approximate the white lines found on the more modern bitumen roads. Naturally the heavier the lump the greater toe-in required.

Some people use toe-in as a form of outfit wheel alignment – I disagree. The lump is reasonably constant (give or take passenger and luggage weight) so therefore the toe-in is best considered as a reasonably fixed measurement: somewhat like lead.

Get a plank and place it down the outside of the motorcycle wheels and get really fancy by raising it a few centimetres to improve the accuracy of sitting up against nicely inflated tyres. Then get a parallel plank and do the same trick on the outside of the sidecar tyre. Then, un-parallel it all by having the front of the planks (choosing the spot at the front of your front motorcycle tyre) 38 – 50mm closer together than the back (choosing the spot at the back of your back motorcycle tyre). We could have done this by degrees but not everyone’s been to university. The reason for a toe-in range is that I don’t know how heavy your sidecar is. If I did know I still couldn’t pick an exact figure but I would have a sense of which end to work on.

**Lean-Out**

This is what I call the fine tuning adjuster, additionally it’s the easiest to modify on the trip and respond to changes such as having eaten and drunk the 6 months rations that you started the trip with.

Lean-out is the amount the motorcycle leans to the right of a vertical plane away from the sidecar. By providing the smallest level of inclination – the manoeuvrability will be enhanced.

Don’t believe me? Go and run around your back yard with a wheel barrow keeping the wheel perfectly vertical – then try it again allowing the wheel to incline at will. When you’ve done that, think up a story to tell anyone who was watching. There may be a story competition later.

Lean-out does have a similar effect as toe-in and this provides it with an advantage of fine tuning a toe-in measure that may be slightly out in catering for the actual weight of the sidecar. And like all fine tuning, it is best assessed by riding. In this case it is useful to test it on a road that represents the typical camber of the roads you ride on. A typical Australian road is cambered to run water off both sides. Then they invented freeways that run the water of in one direction only. You notice these things on sidecars.
If the sidecar is pulling to the left, increased lean-out will align the bike toward straight line riding. Conversely, if the sidecar is pulling to the right, reduced lean-out will align the bike toward straight line riding. A starting point before your test ride is about 2.5cm with adjustments changed in increments of 5mm.

**Luggage & Accessories**

All adjusted? Let’s ride.  
One of the wonderful things about a sidecar is that you have room for a lot of luggage and accessories. While I personally took a lot of pride in the solo holiday where I hung my billy off the back, tent across the front, thongs off the indicator shafts (oh you remember me now: shucks) and my/our tools, clothes, food and food in throwover saddlebags – it’s a huge relief to space out with a sidecar.

The potential accessories are endless – you can have a fridge and a gas stove – plunger coffee in the morning and the sophisticated sound of clinking ice in a glass of Green Ginger wine in the evening.

The key to accessorising your outfit is that there is no limit to your imagination: you can and probably must have a car battery on the left somewhere; fishing poles mounted out the front (a winch too?); rod mounts; a ladder rack for work; CD, CB, and C ya to everyday life.

**Conclusion**

Remember the cardboard on the floor trick, the wheelbarrow bit and the whole concept of drag? Well it’s my opinion that the finesse of all this thought, work and adjustment is basically buggered by the use of flat footed tyres for sidecars. While manufacturers are willing to sell them, I don’t recommend buying them. They simply increase drag and the front tyre loses the radius that it desperately needs. Therefore it considered important to choose a cheap and ordinary sort of tyre that does have a large vertical contact patch but also retains a radius for manoeuvrability.

During the course of this booklet I have emphasised manoeuvrability. The reason is that it is my hope for you that you will become highly skilled in the art of sidecar motorcycling and as a result you will enjoy a highly manoeuvrable machine instead of resting in the compromising dredge of drag.

Enjoy.