Setting Up Tait HCS and Drag Links
On the V50 Single Shock and Twin Shock Phasars

by Eddie McDonnell June 2012

http://www.team-metiss.com/trainavantjbb.html makes this an easier read! The right hand animation particularly.

What I did on the Single Shock to eliminate or reduce :

flutter/weave on shut-off
weave/roll on braking
wander between 30 and 40 mph
(after owning the Twin Shock for 18 years)

1. (a) Reduce trail – shove top front rod-end bearing *forward* as far as you can. Length of thread on rod end is the limit. Leave at least 25 mm. Or maybe 20. There'll still be plenty of trail, in terms of Royce's and Tony Foale's recommendations.

Royce and Tony Foale say a lot of trail isn't needed for overall stability. It more just affects low-speed feel. I have had the top front rod-end bearing on the Twin Shock as far *back* as possible and 30 mph wander became quite strong. Not too dangerous but you had to oscillate between fighting it and relaxing on it. I also had it as far *forward* as possible and although it didn't cure the handling problem – that was bump steer, see **2.**, below – it was OK. And it's one of the things I've done to the Single Shock, the handling of which is better than ever.

Trail can be difficult to actually measure. It's not easy to locate the tyre's contact patch centre. I have found ways involving set squares, string, markers etc. Rake is easier to measure – set a spirit level vertical alongside the steered upright arm and measure the angle. Single Shock is about 15 degrees at the moment, gives about 65 mm measured trail. Royce says 55 to 65 is best.

1 (b) Match the rake of the handlebar column to that of the drop-link

(but see later comment about doing this last)

Royce also recommends this. In doing it you'd need to ensure the rear drag link bearing still lines up with the two rear wishbone pivots (with the bars centred.)

2. Adjust drag link settings to eliminate or minimise bump steer

Iain Hall suggested use of a laser pen attached to the handlebars to measure bump steer. I did this. Wonderful. Point the pen sideways to the workshop wall and it magnifies the bump steer as you work the suspension through its range. It worked a

treat on the Single Shock. I started with 30 mm deflection on the wall from full droop to full bump. Got it down to 2 mm. Which is only about 0.2 without the magnification.

In detail –

- an all-threaded bolt for the front rod end bearing of the drag link with, initially, enough thread to enable a lot of adjustment up or down until you find the correct height.

- no need to calculate virtual centres, no need to calculate *exact* heights for the two drag link mounts. Just take rough measurements between rear wishbone pivots, and front; to get rough rear and front heights of the drag link in the same proportions. The laser pen method will finally tell you what's correct. The front drag link mounting on the Single Shock was 7 to 8 mm too low by rough measurement! I started with the laser pen at this increased height and it remained roughly that. Although the fine tuning with the laser pen is essential.

- you need a way to exercise the HCS over the range of movement of the suspension. I've got an overhead crane and it was invaluable. Otherwise, there's ways with jacks and so on but not nearly as convenient as the crane. Have just one suspension unit on without it's spring. Even that could be too resistant to movement through friction on the seals and the damping action – it was a bit of a hindrance for me. Maybe a rope to limit the wishbones to the proper full droop position, and a marker to show when the upward movement has reached full bump?

- lash front and rear wheel together in straight-ahead position with a good straight edge and whatever packing is needed to compensate for tyre widths.

- attach the laser pen to the bars, pointing sideways to a wall. (Fine detail - I fitted a cable tie around the laser pen 'on' button to make a 'switch' so it stays on. Off is where the cable tie latch makes it deviate outwards from a round shape.)
Sheets of A4 paper or card blu-tacked to the wall, to mark pen position at full droop and full bump.

- get a rough measurement of the magnification the laser pen will give on the wall by measuring (a) centre of handlebar 'steering column' to wall and (b) centre of top wishbone rod end pivot to centre of front drag link bearing. The difference between the measurements gives your magnification. Was 11/1 for me.

- at full droop, mark the card stuck to the wall at the point where the pen shines.

- lift to full bump, observe movement and mark full bump and measure.

- the effect of altering Drag link **length** was obvious, soon established with a half or one turn either way, which was best.

- the effect of **height** adjustment was just as significant but far more finely-tuneable.

- at first the pen moved all one way, to 30 mm in one direction. That's 3mm at the drag link. (About 3 degrees, too.) As adjustment progressed and the pen's movement came down from 30 mm on the wall to 4 or 5 or less, the movement became an 'S' curve – from full droop, a little one way, then across central at mid-bump, a little the other way at full bump.

It seemed best to have it like this – slightly one way then slightly the other around a mid-point. The adjustability of the height was essential and proved effective. Even half a turn or even one flat on the adjusting nut had a readable effect on the pen position on the wall. As said, got it down to + 0.2 to – 0.2 mm real.

Drag Link Bearings Angular Range

After this, when you have your setting - and not until - you need to check the angular travel on the drag link bearings. To see that you don't run out of angle. One of the things that mis-led me from the start on the Twin Shock was that the bearings were clearly running out of movement at full bump and contacting their mounting bolt, peening over the bearing. I thought this was dangerous, especially in the riding conditions where you might go to full bump on the road. So I adjusted the drag link heights as best I could so the bearings didn't run out of angle, over the suspension range. With the methods I had at the time, it seemed I'd done it without creating bump steer. But with the problems I still had with the Twin Shock, which caused me to give up on it, it almost certainly did have some.

It might be possible to ensure movement is within the drag link rod-end's angular ranges by making the mounting bolts at *both ends* all-threaded, and juggle with both heights, while re-doing the laser test? But there's not a lot of room for lowering the rear mount, nor raising it, on the V50 Phasars.

Or – a bit of engineering work but necessary, I think - cut the steering arm that goes from the bottom of the handlebar column to the rear draglink bearing; weld circular vertical webs to each half; rotate the outer part to get sufficient angular movement on the rear draglink bearing. Clamp together and bolt or weld up your webs.

I doubt if this can be done without altering the height setting, and the alignment with lower and upper wishbone rear pivots. So probably best sort this out *before* re-setting the steering column rake, and do *that* job last, working around the fixed, necessary *height position* and *angle* of the rear draglink bearing.

(3) Lateral Adjustment of Wishbones

Shimming Top Wishbone –

To get lateral adjustment correct :

(a) - have both wheels lashed to a straight edge *along* ***the bottom*** *of each wheel* - in the usual view. If not so lashed, because of the rake, any turn on the steering tilts the front wheel a little away from vertical.

- then, *straight edges attached* ***vertically*** *to each wheel* and check if they line up vertically. If not, you need to move the top or bottom wishbone across, to get the vertical alignment right. Top is only feasible option on V50 Phasars. There's a tiny bit of adjustment on the lower if you make alternative spacers?

The wheels then may be parallel in the vertical but probably no longer lined up along the bottom of the wheels! The bottom of the front will have moved laterally. I've corrected that by shimming *the back wheel* across.

(b) to do this better - I plan to do this on the Single Shock –

- remove the front wheel and the whole steered upright arm assembly, which can mess up readings by being even slightly deflected from straight ahead

- strip the hub, remount the 'axle' in the front lower wishbone

- fit a plain steel rod (5/8" ?) through both top and bottom bearings, long enough to both rest on the floor and be high enough to view its alignment with a vertical straight edge on the rear wheel.

- adjust both wishbone rear pivots laterally so the rod is *parallel to the rear wheel in the vertical;*
- ***and*** the rod and with it *the hub centre bearing centres on the rear wheel*.

As said, adjustability of the pivots isn't provided except for top wishbone shimming so it may require serious re-engineering.

A prior stage would be to fit temporary extensions to *the swinging arm pivots*, *the front lower wishbone*, and *the front top wishbone*. Use them to check their parallelism in as many planes as your brain can handle. Re-engineer if necessary. *Then* do the wishbones lateral adjustment, as described.

It's because of the complications of all this and the lack of adjustability on most of the HCS mountings that I'd rather have an FF with a front fork and just get the main COG and Seating and Aerodynamic benefits of FF's without it being compromised by the numerous ways in which HCS alignment can be wrong and unadjustable.