

Minimising Bump Steer in the TR

Bump Steer is when your wheels steer themselves without input from the steering wheel. The undesirable steering is caused by bumps in the road interacting with improper length or angle of your suspension and steering linkages.

To achieve zero bump the tie rod end must travel on the same arc as the suspension when the suspension goes through it's travel. Simply matching lengths and arcs prevents any unwanted steering of the front tires.

If the tie rods were shorter than the suspension, then when the suspension travelled up or down, the tie rod would shorten much quicker through travel than the suspension and the car would toe in over bumps. Conversely there would be toe out if the dimensions were reversed.

Ideally you should run as little bump steer as possible as bump steer on rough surfaces causes the car to be unpredictable or just wander all over the road.

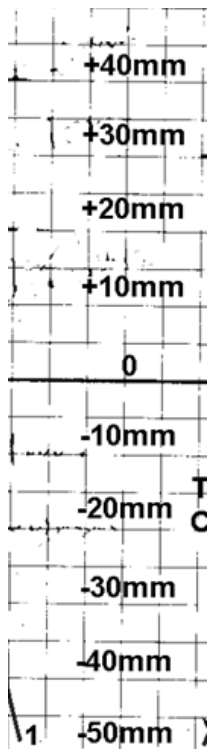
Bump in is almost always undesirable so more bump out is better than any bump in.

On the TR fitted with an Escort Rack & Pinion it is common to find that the Tie rod length **is too short relative to the suspension arms** which produces some toe in and also some toe out, as the suspension moves through its full travel. The effect of this on the stability of the car, greatly depends on where the centre of the arc of the tie rod end is in relation to normal driving.

If the Centre/rack is too low then there will be increasing toe in as the suspension moves upwards which will make the car most unpleasant to drive.

To see and understand the principals and effects of all these theories I devised a simple gauge to transpose what the wheels were doing throughout suspension travel.

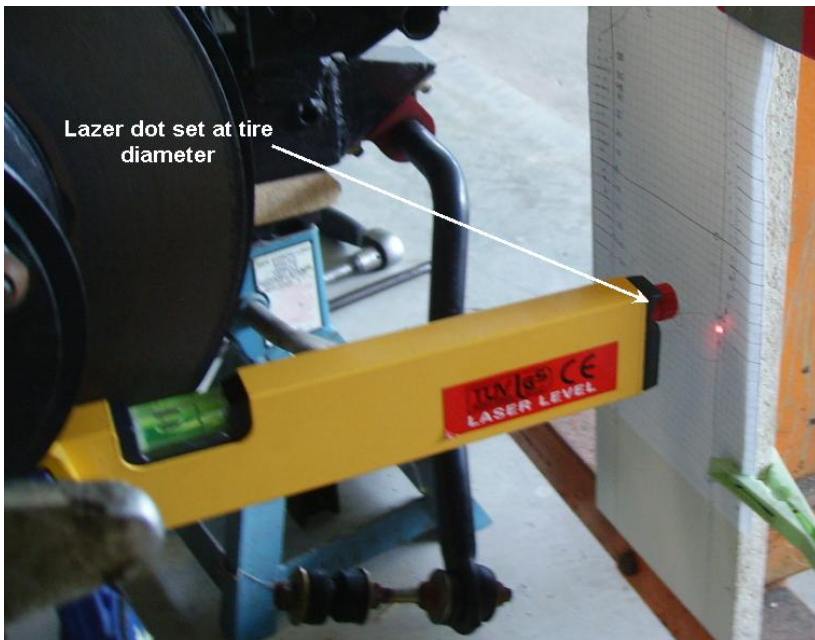
Before doing anything, find a reference standard height at rest which will become the mid point in all the suspension travel tests.



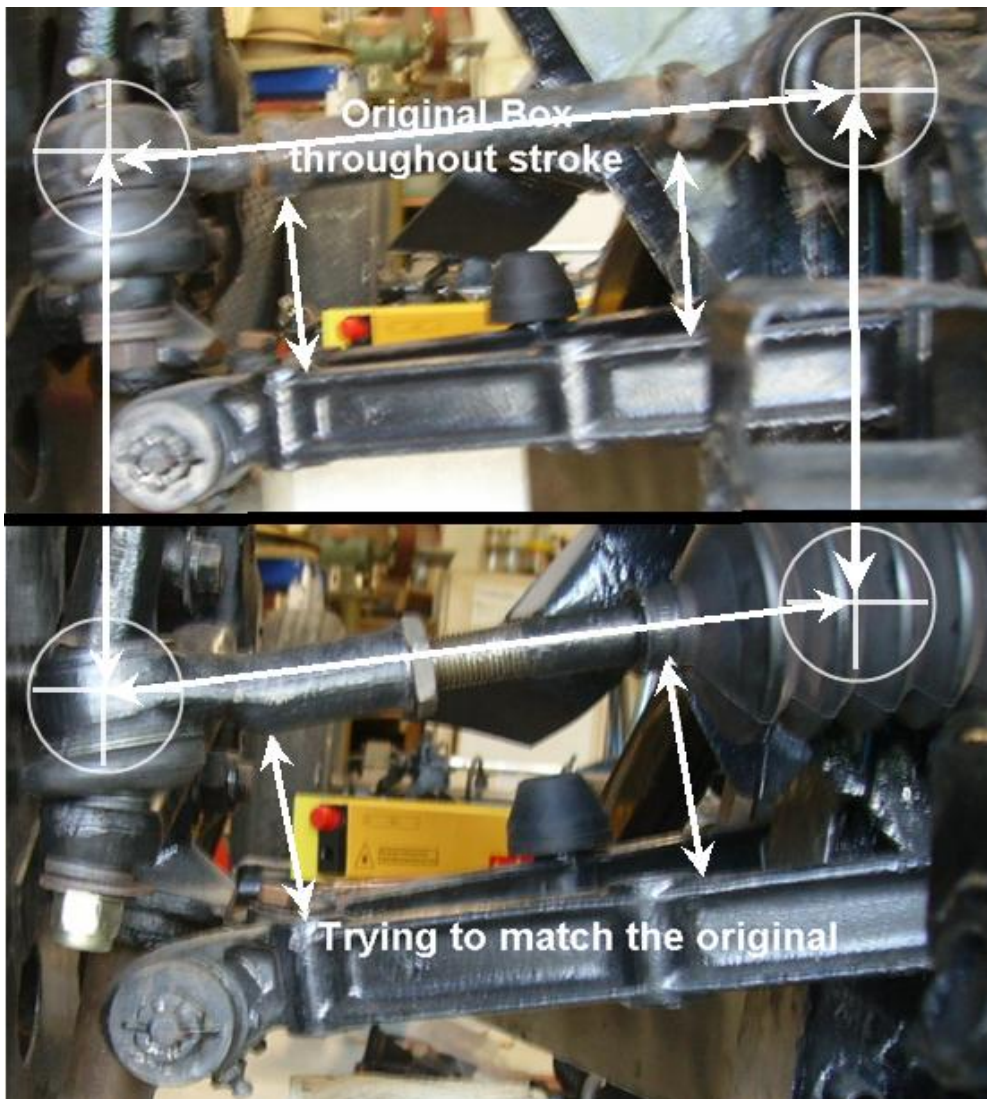
It is then necessary to remove the shock absorbers and springs to allow the suspension to be jacked through full travel easily. Set the steering dead ahead.

Take a small lazer level such that one gets from Bunnings and clamp it onto the disc/Drum such that the end is 250 to 300mm from Centre. Use a vertical Board on which is pinned a piece of Graph paper placed close to the end of the level. This will provide a concentrated dot on the paper.

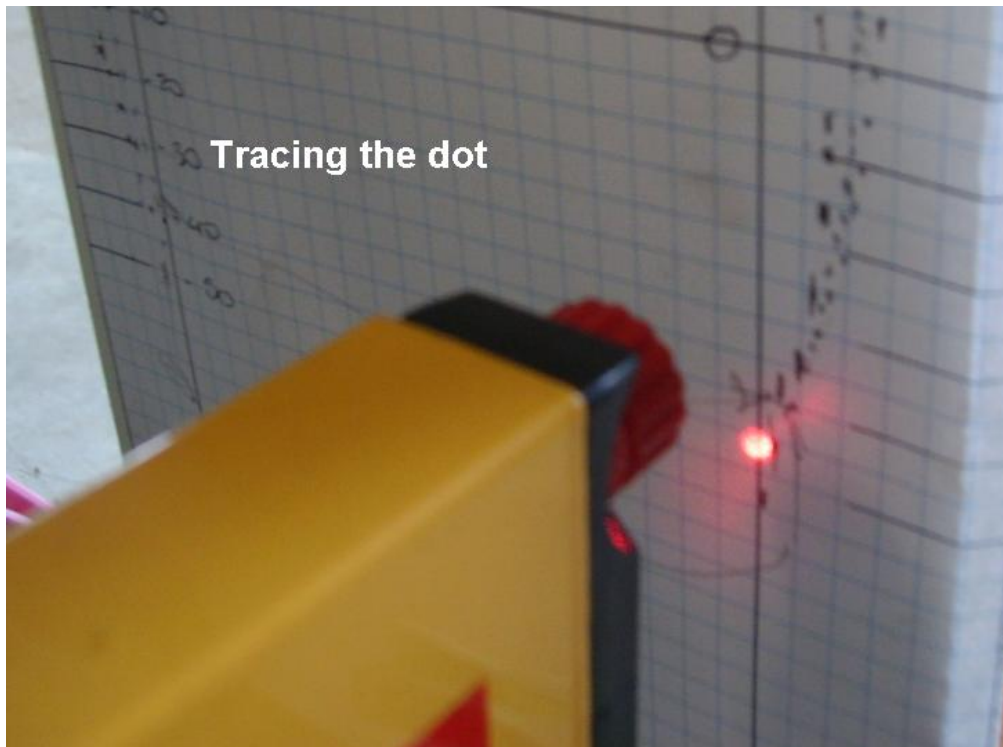
Mark out the graph paper with a Centre line and then 10mm increments up and down, representing the full travel of the suspension between top and bottom Bump Stops.



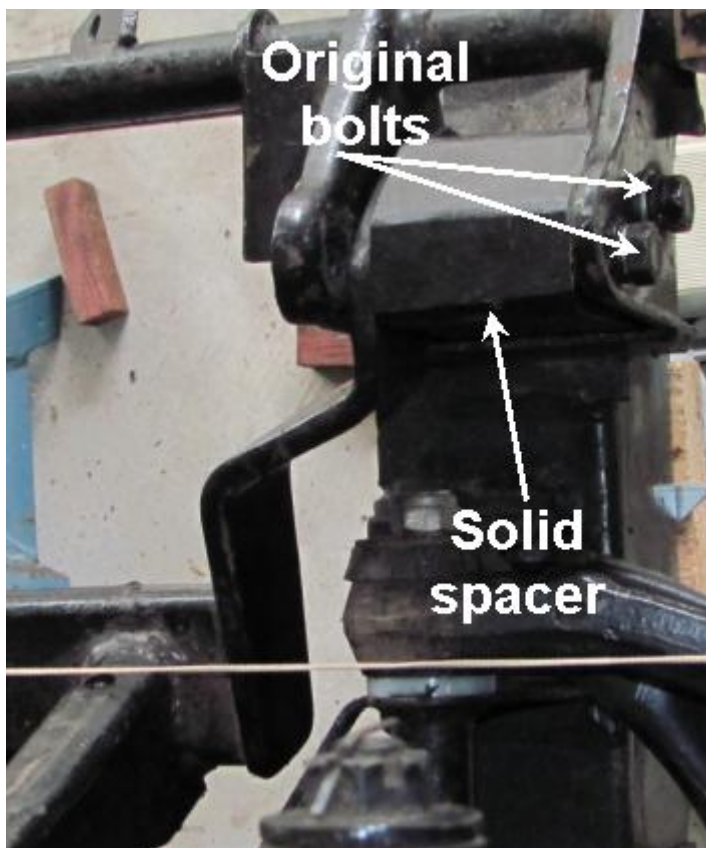
With the original steering box in place, measure the distances between tie rod and suspension at both ends and at top and bottom of suspension travel on each side, you will see that they are Parallel one hopes. The object is to keep these 2 Parallel at all stages of suspension travel when the new Rack system is fitted.



Now Trace the line at 1mm intervals throughout travel for both sides. This gives you a reference for the original setup. You may well find there are differences between L & R?



If you are using a "Goodall Rack Mount" fit a solid spacer in both sides to stiffen up the whole assembly. This applies to any rack bracket and then mirrors the original rigidity.



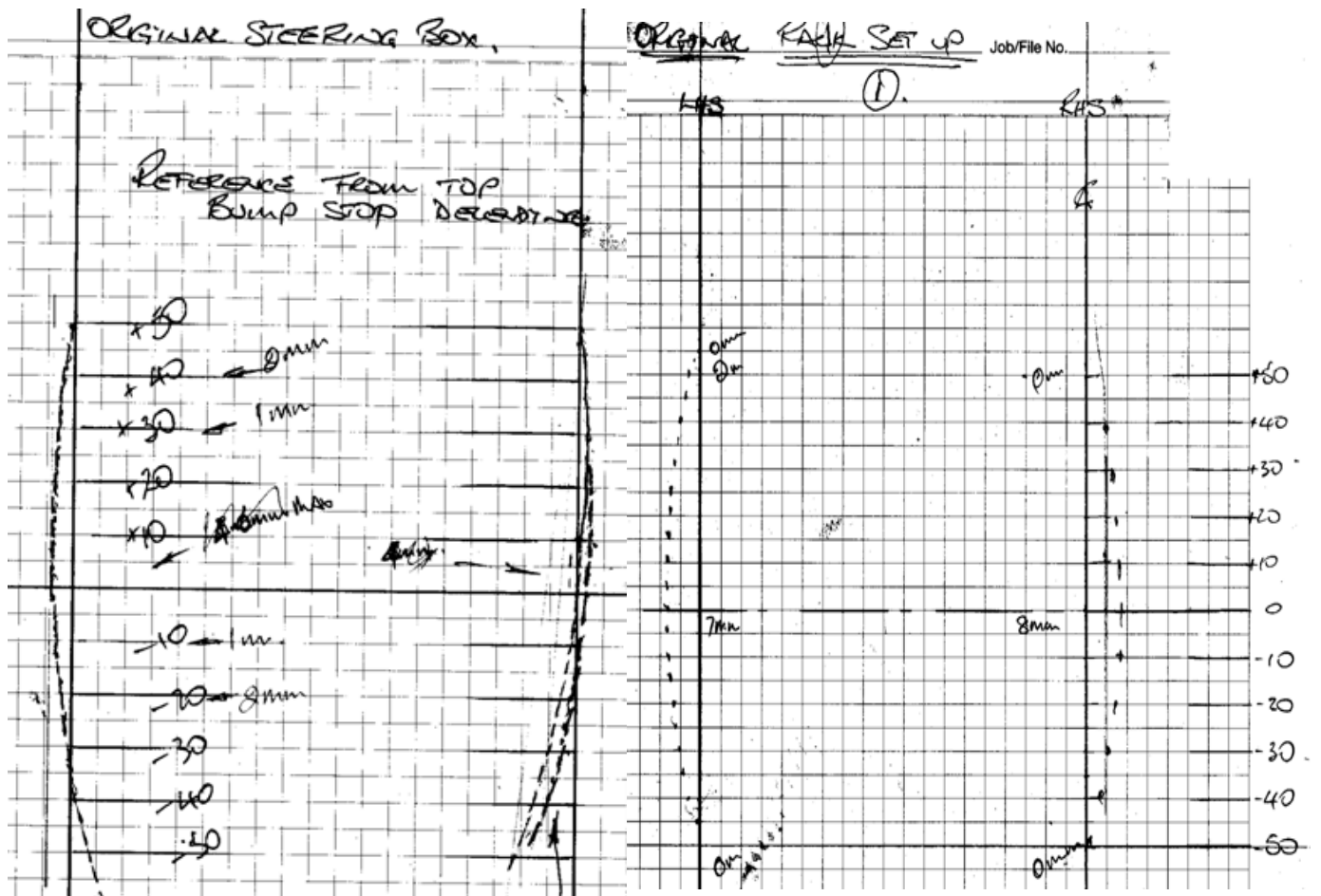
It will then pay to take some references from which you can measure the rack Centres both left and right.



There are various theories about fitting TR4 drop arms or bending them, however I just reversed them which means you can fit a longer Tie rod arm. The drop arms have a bias/twist in them so it very important after completing the rack set up to check the clearance between the ball joint and drop arm at full up travel to make sure there is some, otherwise there could be excess stress applied to the ball joint.

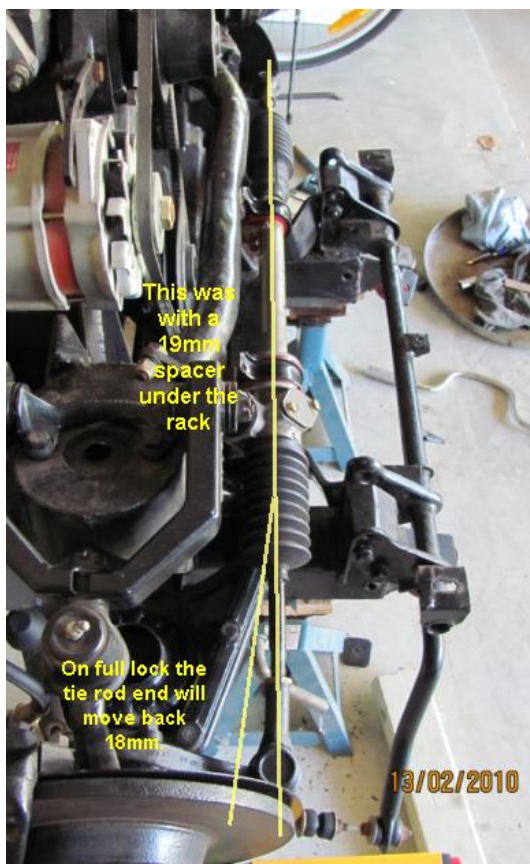
Fit the rack and assess the tie rod length before cutting and re-threading. You can always make it shorter if required.

Fit the rack and then trace the dot on both sides and see what you get.



The graph paper will provide real measurements of the toe out and in so you can see what is happening.

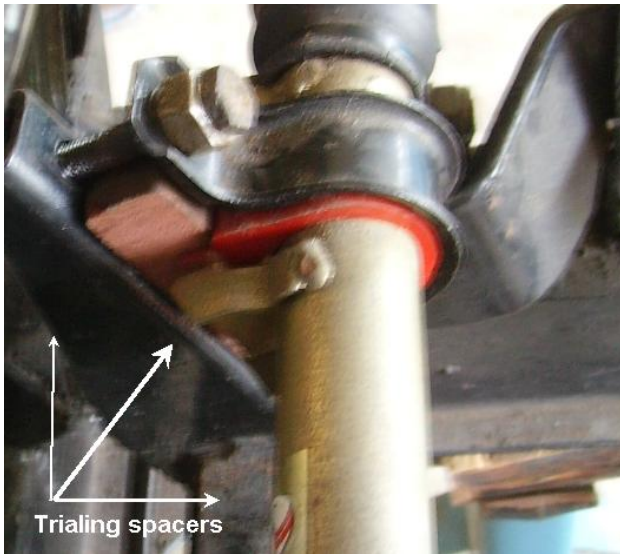
On my set up the first take on the new rack with standard set up I found I was getting up to 8mm of toe out and in for a full travel. I was looking to half this



Now the at rest point taken earlier will probably be about -30mm so track movements below this are probably not important as there will be no load on the steering anyway.

Now comes the tedious part. Spacers and testing, spacers and testing until you get the best compromise. The results will differ as the rack moves fore and aft or up and down, so having the rack positioned as close to the line between the 2 tie rod ball joint Centres will probably be the best starting point.

I has to be a compromise as the escort rack or most other racks are not perfect for the car. The geometry is such that there will also be some tyre scrubbing on full lock which will also slightly wear front tyre outers but the miles we do make this a non problem.



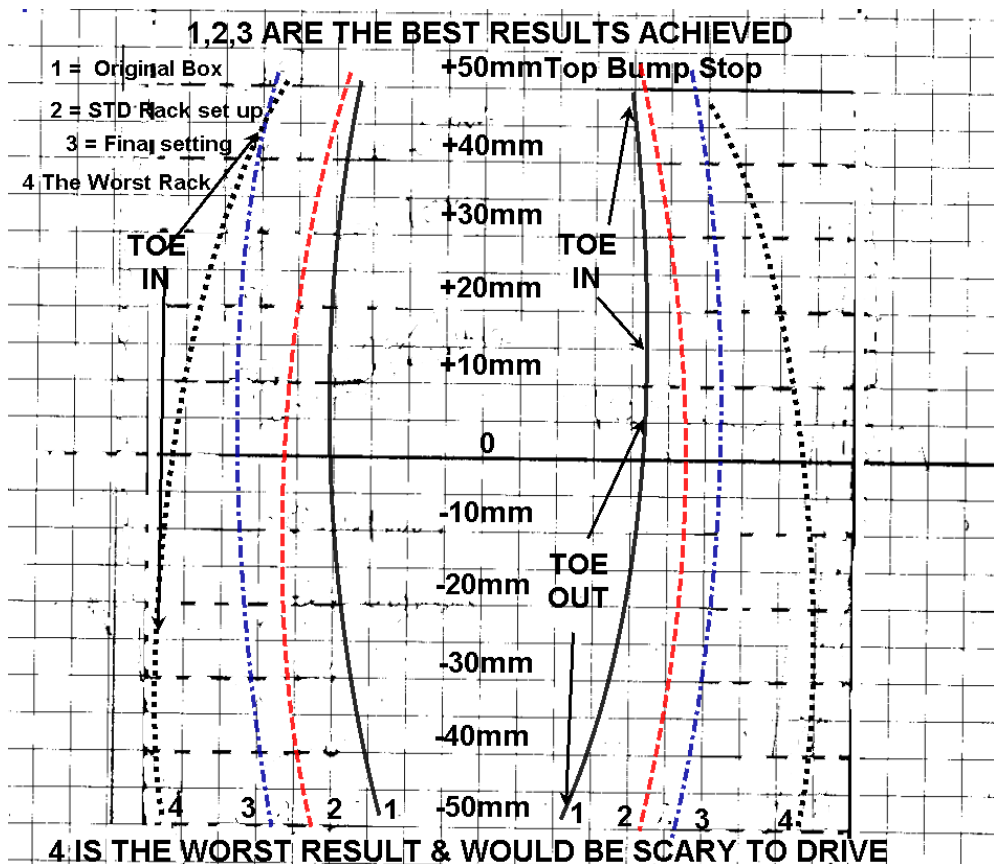
You might find that you have to set the rack up differently for each side to get an even result.

Using multiple thin spacers is the most flexible method. 1mm thick suited me.

I also suspect each car might end up with a slightly different setup depending on how good the chassis is etc.

I chose the final setting No 3 which very closely matches or betters the original settings and have no undesirable steering activity even under full bump on cornering, as in hitting a large hole or bump mid corner and I think it is better than the original based on the tests I did on my car.

This might be different for others.



I Hope this information is helpful.

Cheers

Rob Bradford