Part 2:

Now that you have the vehicle all nice and leveled, we can attack the actual alignment procedures. Before proceeding to any of the actual measurements or adjustments, be sure that you load your van in such a way as to represent its typical road going position. For example, at the very least, the van should be half full of fuel and you will want to add weight to the driver's seat to represent the driver. You can carry this as far as you like really. Just make sure that you present an accurate state of the vehicle on its typical day.

CHECKING CASTER ANGLE -

To check the caster in this example, I am going to be using a tool made by RPW. It only costs $59.99 (in April 2017) and can check camber and caster angles. This tool is plenty accurate for our usages and will net you an alignment worthy of a high dollar alignment shop…and probably better than some. The operation of the tool will be described later.

http://www.maximummotorsports.com/Camber-Gauge-P192.aspx

The first order of business is to have the vehicle on your leveled pads with the front wheels positioned facing straight forward. If you are confident that you can get the wheels pointed straight ahead using only the steering wheel as your reference, fine, however accuracy pays off here so I would suggest that you set up the string jig as described in the toe section (below) so that you can accurately position the wheels so that they are pointing absolutely straight forward. If you choose to set up the string jig to get the wheels straight, it's probably best to temporarily remove it to complete the caster and camber work. The string can tend to get in the way and make it difficult to work on the vehicle. If you mark all of the positions of your string jig and don't move the vehicle, you can put the string jig back into place and not have to go through the entire set-up procedure again, although you should do a quick check just to be sure that nothing has moved.

Once the wheels are facing straight forward, you will need to use something as a straight edge that is tall enough that it will sit up against the tire's sidewall about 6-10" up from the ground and is long enough that it will give you an accurate measurement. The piece that I used here is a chunk of aluminum plate that measures 6" tall and 23" long. A 2x6 or 2x8 would work well as would a short section of wood shelving.

Place the straight edge up against the tire making sure that it makes contact evenly with both sidewalls. The bulge at the bottom of the tire will prevent the straight edge from standing 90º to the ground, but as long as the upper edge is making contact with the tire evenly, you are good to go.

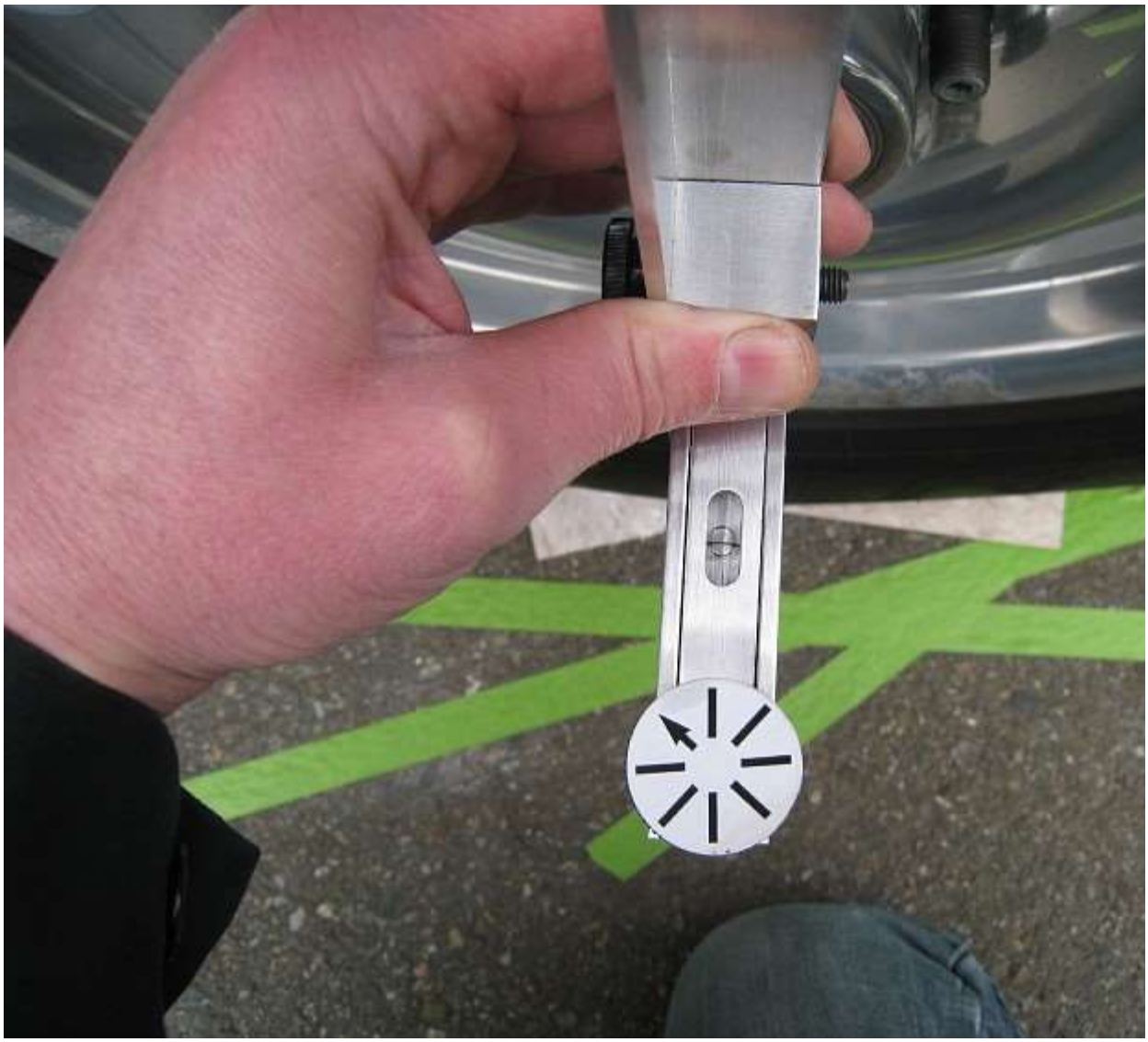
I used masking tape to mark the ground with a straight line the length of the straight edge. You could use chalk, permanent marker, or whatever gives you a clear line.

Then you will need some type of tool that will help you indicate 20º to the first line on the ground. I used a 12” plastic angle finder. Turn the front wheel until the wheel is 20º to the first line as indicated by both the angle finder and the straight edge. Make a second line on the ground just like you did for the first. Now turn the wheel the opposite direction and repeat, making another line at 20º to the first line.

The reason for making the lines at 20º to the first line is that the Vanagon's caster alignment specs are based off of rotating the front wheels 20º to the right and 20º to the left (from straight ahead) and measuring the difference between the two different camber angles to help determine the caster angle. If this seems confusing, it should become clearer by reading on and looking at the pictures. And just for the record, 1 1/8 turns of a non-power steering Vanagon's steering wheel is exactly 20º. While this would be okay to use for a rough alignment, I would not trust it for any real accuracy. Power steering-equipped Vanagons (or non-power steering-equipped Vanagons with power steering uprights) would have a different steering ratio. While I don't know this for sure, my guess is that it would be closer to one full turn for those vans.

With the set up completed, we can move on to actually measuring the caster. To do this, we will use our new fancy tool from RPW. This tool is incredibly simple in its construction and use. It consists of a piece of aluminum angle that has a fixed peg on one end and a peg on the other end that can be moved to different holes to adjust for varying wheel diameters. The description of the tool on the sales site says that it good for up to 16" wheels, but the newest models are good for wheel sizes ranging from 12" up to 17". Attached to the aluminum angle is a bubble level with an adjusting knob. On top of the knob are a series of eight lines.

To use the tool, you first adjust the pegs to suit your wheel diameter. My wheels are 16” so the upper peg was moved to the second to the last hole towards the top. To check the caster angle, you must first turn the wheel to the right until it is lined up exactly with your 20º mark. Use your straight edge to be sure. Accuracy is important here as any deviation will throw off your caster calculations. With the wheel in position, place the tool vertically onto the wheel so that the pegs touch both the upper and lower lips of the wheels as shown in the picture. Turn the knob in the direction necessary to center the bubble under the centering line. The bubble will move somewhat slowly, so work carefully. It is sometimes necessary to turn the knob back and forth in order to make sure that the bubble is perfectly centered.



Being careful not to change the position of the knob, set the tool down and proceed to move the wheel to the left until it lines up with your other 20º mark, again making sure that you are being accurate. Now place the tool up against the rim lips just as before, but this time you will notice that the bubble is way off from the centering line. You will need to count the number of marks that pass as you turn the knob clockwise until the bubble is centered again. On my van, it took 40 marks to center bubble. Write this number down. I suggest that you do this procedure a few times so that you can be sure that you are being accurate with your placement of the wheels as well as with your counting of the marks. The more accurate you are here, the more accurate your final alignment will be.

With the number of marks accurately counted, you need to convert the number of marks to number of full turns of the knob. The knob has eight marks on it, so we just need to divide the total number of marks that we counted by eight. In my case, 40 ÷ 8 = 5. In order to find out the angle of caster in degrees, we then have to multiply that last number by 1.5. So in my case, the complete number sequence looks like this:
40 ÷ 8 = 5, then 5 x 1.5 = 7.5º of positive caster.

If you look in the Bentley manual, you will see that the caster specs for an empty 2WD Vanagon are +7º 15' ± 15'. This translates to a perfect caster of 7º 15' with a tolerance of plus or minus 15 minutes.
In other words, a caster angle of anywhere between 7º 0' and 7º 30' is acceptable.

The ' symbol after the 15 indicates minutes. Minutes are 1/60th of one degree. To convert these to degrees, divide the number of minutes by 60. 15' equates to 0.25º. This gives us a caster angle tolerance of 7º to 7.5º.

CHECKING CAMBER ANGLE -

We can use the RPW tool to check the camber, but I will also show you how to make a simple camber checking device just in case you choose not to purchase the RPW tool and only plan to tackle the camber and toe adjustments or plan to use a digital angle finder to take the place of the RPW tool.

While I do not have pictures of the entire process, using the RPW tool to check the camber is really easy. With the tool adjusted to fit your wheel diameter, you need to zero out the bubble level. You do this by lining up the center portion of the bubble level bracket with the outer portion of the bracket so that the two pieces are parallel and the arrow is pointing toward the bubble, like this:

Then it is a simple matter of positioning the pegs on the tool onto the rim lips so that the tool is held vertically. Then turn the knob in the direction necessary to allow the bubble to be centered, counting the marks that it takes to do so. If you have to turn the knob counter clockwise to level the bubble, you have negative camber and if you have to turn the knob clockwise, you have positive camber.

Each one of the marks on the knob represents 1/8 of a degree. If you had to turn the knob three marks to achieve a level bubble, you would have 3/8 of a degree camber. Since the camber specs are not given in a fractional number, we need convert the 3/8 of a degree into a decimal number.

Just Google "fraction to decimal chart" and you will be greeted with many options for this. In our example, 3/8 would be converted to 0.375. In other words, we have 0.375 degrees of negative camber.

If you want to read the camber in minutes (as specified in the Bentley manual), Mr. Hurley was kind enough to list the following for us:

"You can use the list below for quick reference to find minutes for any amount of marks. Each time you make a full turn, just add a full degree and start counting the minutes again, or you can just think of the dial like a clock and read it accordingly, adding a degree for every full turn or hour. Too bad the dial doesn't have an hour (degree) hand to keep track for us.

1 mark is 7.5'
2 marks is 15'

3 marks is 22.5'
4 marks is 30' or half a degree (or hour if that helps)

5 marks is 37.5'
6 marks is 45'

7 marks is 52.5
8 marks is 60' or one full degree (think hour)."

If you decide not to buy the RPW tool, but still want a way to check your camber, here is how to build a simple too to do so. (Note, this explanation was done at an earlier time and was done using millimeters and includes a similar description for obtaining the camber angle in degrees)

First, measure the distance between the rim lips on your wheels and mark this on a length of metal rod, bar, angle or tube. Anything perfectly straight and easy to handle will do. Then cut this bar approximately 3/8-1/2" longer than your mark. Find a bolt that is long enough to go all the way through the bar and protrude out the other side by at least one inch. Drill a hole straight through the tube, right at your rim distance mark, just small enough to allow you to thread the bolt through the holes.

If your bolt spins too freely in the bar, add a lock nut to the outside so that you can keep it secure after you taking your measurement (to be explained further on).

Now get yourself a bubble level that will fit onto the bar that you made without making any contact with the tires, the ground or the vehicle bodywork. That is all that you need for tools to take camber measurements.

Some wheels have center spokes or center caps that protrude past the rim lips. In these cases, you will need to improvise in order to get your bar to clear these obstacles. A simple way of doing this would be to cut short section of the same material that the bar is made from and tape them in place where the bar contacts the rim lips. There are many other options so just choose one that works for you. Just make sure that whatever you add to spacer the bar out, the bar always remains parallel to the rim lips. This means that your spacers will each need to be exactly the same thickness or it will through off your measurements.

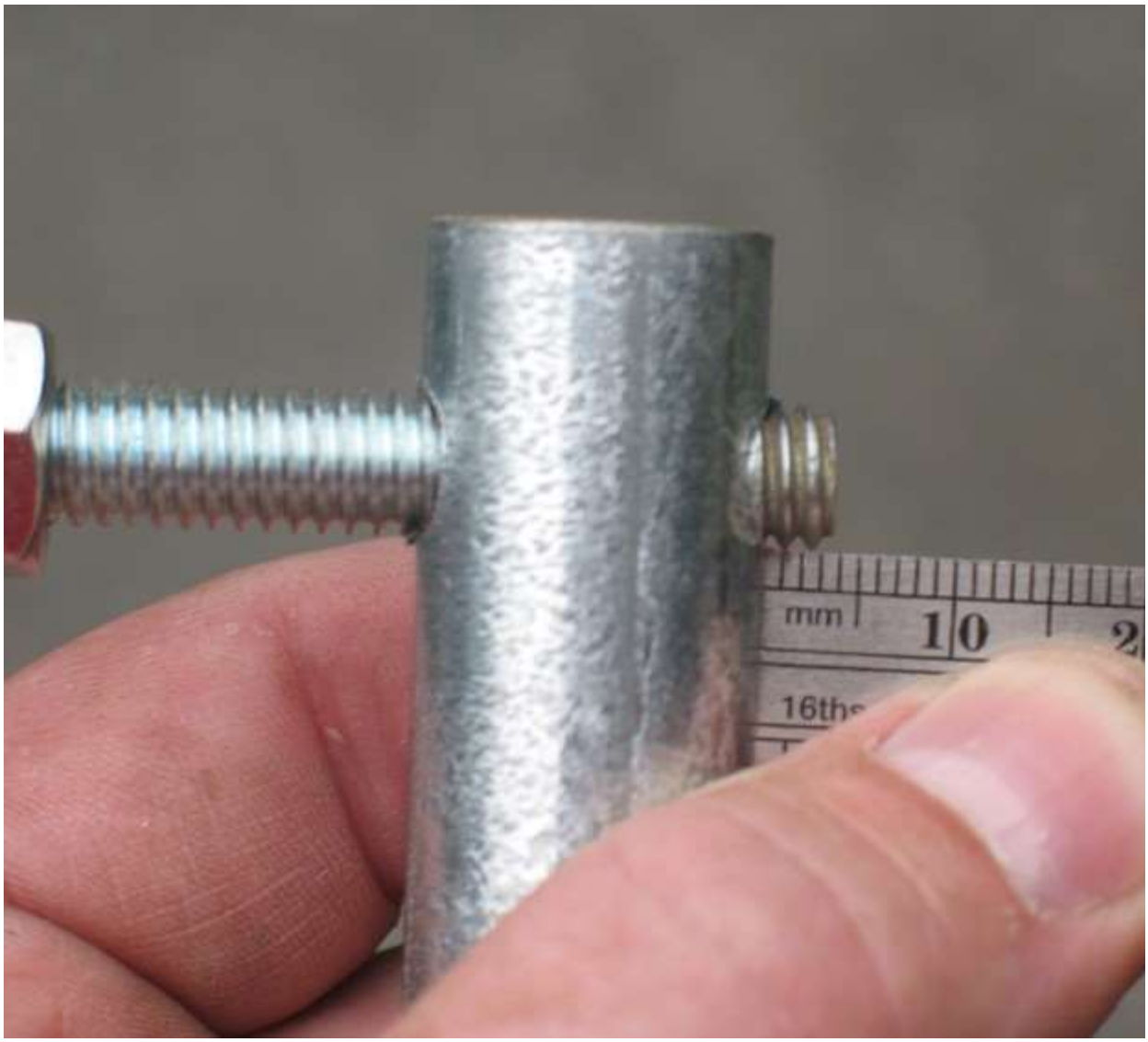
If you have a digital angle finder, you can forgo the bolt in the bar and simply read the camber angle off of the angel finder. Since not everyone has a digital angle finder (typical needle and weight style angle finders are not accurate enough for precision alignments, but they are better than nothing), I will show you how to find the camber angle without one. If you choose to use a digital angle finder (and I highly recommend it), make sure that your bar rests on the rim lips and does not get hung out on the tire. You want to have a perfectly parallel line from wheel lip to wheel lip.

The bar shown in the photos below does not exactly fit the wheel as properly as it should. It was built for another set of wheels. Even so, as long as one was careful to be sure that the bar was positioned correctly, it could be used just as it is.

Using the bar with the bubble level held tightly against it (taping the level to the bar helps), rest the bar up against the rim lips making sure that the bar points straight up and down. Adjust the bolt in the bar out until the bubble in the level shows perfectly level.

Note that if your vehicle shows positive camber at the time of measurement, you will have to invert the bar so that the bolt is on the bottom and the resulting calculations for camber angle will be for positive camber, not negative camber.

Now it's just a matter of measuring how far that bolt sticks out past the edge of the bar and doing some calculations to find the camber angle.



The Bentley manual calls for 0' (minutes) camber plus or minus 30' (minutes) front wheel camber. One minute is 1/60th of one degree. Plus or minus 30' means that the front wheel camber can be anywhere between -30' and +30' to be considered within specs. In other words, the specs call for the front wheels to be within -0.5º and +0.5º (30' ÷ 60 = 0.5º).

In order to know what the camber angle is in the example portrayed in the picture above (exaggerated to 4mm), we will have to convert the measurement into degrees.

Since I am an absolute math idiot, I have to rely on some of the many online calculators for help. Using the right triangle angle calculator on this page, http://www.csgnetwork.com/righttricalc.html , and converting my 9mm measurement to inches (9 ÷ 25.4 = 0.157"), I can plug in my numbers and it will spit out my camber angle in degrees.

Enter the length that the bolt protrudes past the rod in inches (0.157) into the slot labeled "Side A" and the overall length of my rod as measured from the two contact points on the rim lip (end of rod to the center of the bolt in this case), 17.5, into the slot labeled "Side B" and push "Calculate". The slot labeled "Angle A or B" is where you read the camber angle. In this case, the camber angle will read 0.51º.

That's it for camber! Now you can probably see why it is easier to use a digital angle finder, but the math method is accurate and works well too.

Click here to continue to part 3: