

Chassis modifications, tuning and trimming for Eagle SS

This is one man's idea of both the ultimate and the most practical chassis modifications based on his experience over the past 30 years of tinkering with beetles and kit cars as well working on some of the weirdest and toughest cars made including Baja buggies, dragsters and prototypes including the Scorpion fast attack and recon. buggy as used by the SAS in the gulf and of course, a couple or three kit cars, Charger, Eagle SS, etc. and all have been tried and tested, HARD!

There are several ways to tackle the modification of a VW beetle chassis for use under the exotic body of a sports kit car, practical and affordable or ultimate and usually expensive. However with a bit of work, some basic skills and a good relationship with your local scrap yard / breakers, a very good result can be achieved for very little outlay. It tends to be a balancing act between the two ways of achieving any result; you can do it yourself if possible or pay someone else to do it for you if you can't.

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The beetle has had many chassis designs during its long life but basically fall into three groups. In the following we refer to the chassis as being the floor pan with suspension fitted and the floor pan as that single item alone.

Chassis types

- 1) **Earlier 1200cc, 1300 cc.** These chassis came with the swing arm rear suspension and the double torsion bar and trailing arm front end and drum brakes. Later chassis had swinging arms about 6cm longer and are therefore the ones to go for.
- 2) **1302, 1303 and 1303S.** These are 1300cc and 1600cc cars but with McPherson strut front suspension which is wholly unsuitable for our use as they require upper supports but they do have independent rear suspension (IRS), some have disc brakes and wider rear drums, which is preferable.
- 3) **1500.** These are much rarer than the above, have 1500cc engines and have both the IRS and the torsion arm front we require and also have disc brakes.
- 4) **Hybrid.** These are made by cutting off the front (frame head) of a 1302 / 1303/S floor pan and welding on a frame head with torsion arm type thereby getting the best of both worlds. Another option seen is welding a framework onto the 1303 chassis head to support wishbone suspension and coil over shocks as on the 'UVA Ultima' chassis produced to take that companies McLaren inspired kit car.
- 5) **Custom made.** These are made from steel section and sheet and apart from having the same foot print as the VW floor pan and therefore fit any VW beetle based kit's body shell; they bare no resemblance to the VW item. An example of this is the Ford based Eagle SS where the chassis was designed to interface between the VW body shell and the Ford running gear. Although it would take a great deal of knowledge and skill, these can also be made from scratch, it would therefore be possible to incorporate all the innovations one could devise such as independent front suspension using wish bones and inboard coil over shocks, four wheel drive from the Ford range, rack and pinion steering, trailing arm or wishbone rear independent suspensions, disc brakes all round and a variety of engine/gearbox options including front, mid or rear set ups, the only criteria being, does the body fit over the end result?.

But back to basics for the time being. The wonderful thing about Beetle floor pans is that they are readily available from beetle parts suppliers and relatively inexpensive, the down side is that complete beetles are becoming increasingly rare in our scrap yards and the value of a restored beetle now precludes it being scrapped or becoming a donor car unless the running gear and engine/gearbox are the only salvageable parts on it. The frame heads to convert them to torsion arm and all the front axle / arm assemblies to complete the job are still available from several suppliers. So it's really a case of what you are prepared to pay, what the limits of your skills and resources are. If you are just building a 'fun car' do you really need to go mad when a box standard chassis will do?

Parts from; <http://www.bigboyztoys.co.uk>.

FLOOR PAN

Requires:

Approx. 2' x 3' x 16g Sheet of steel

Pop-rivets and gun

Welder

Angle grinder with steel cutting disc

"Finnegan's number 1" Primer and under seal

1 pair high back seats

2 pairs of runners and fittings, (8 x 8mm x 20mm stainless bolts, self locking nuts and "penny washers").

Piece of marking chalk.

Seats

As a lot of the following depends on the seat position, at this stage I would recommend to the builder to pop down their local breakers for a pair of seats from a Bedford Midi van, Nissan Vanette, Rascal, or similar Jap wagon, these are the correct width, low profile, high back recliners and fairly cheap and adapt to a pair of off the shelf runners available from any "sport seat" supplier for about £25.00 (Demon-Tweaks, Europa, etc.) and when recovered (by Intatrim, Telford or Frank Rouse, Cheltenham), etc, really look the business and as cheap as chips.

When modifying a floor pan it is always best to strip it right down, de-rust, repair and paint it first, (not forgetting the inside of the tunnel) and then precede one stage at a time, starting with the floor pan on low trestles with just the gearbox, axle/suspension and gear change shaft fitted, make sure you can get underneath comfortably but also make sure it is a solid and safe support.

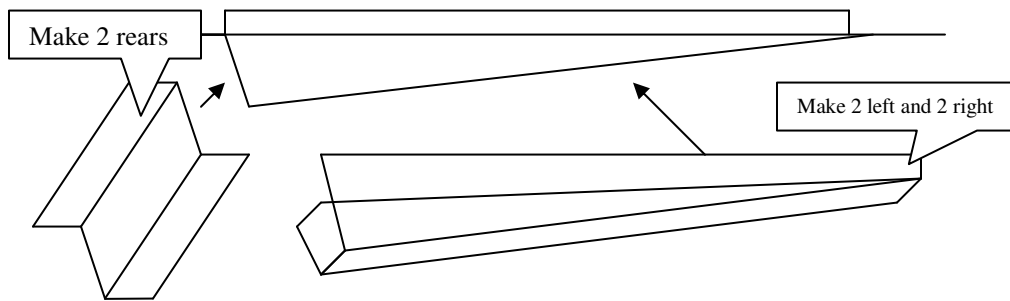
At this stage loosely fit the body, lining it up so the rear arches centre on the axles and drill for a couple of bolts to line it up for later use if a new body is being used.

Floor pan

Fit the runners to the seats and place the seats, with the runners in the centre position, (if you have done what I said and got the seats first, or some sort of seating about 4" thick with a back support, on the floor if you didn't) and get into something like the position you will end up in and with your feet comfortably on the pedals, knees slightly bent, you can adjust the distance and therefore obtain the approximate position you will be driving in and mark the seat runners position front and rear so you can bolt the them down in the same place later after you have knocked it all over the place getting out of the car. Remember, as you will be lowering the floor, the seating will be a little further forward than on the flat floor and therefore is only a rough guide. Having sat in the seats and found out your head would stick out of the roof, it is imperative that the floor be lowered to prevent it. In the case of the beetle and an Eagle SS with a 5'10" driver this is in the region of 3" at the rear and a body angle of about 45 degrees. Measurements are "about" and "roughly" as they vary according to driver size, etc.

After lifting out the seats and lifting the body off, proceed by cutting the floor across the rear each side, but only on the flat floor area, about where the rear passengers feet used go, this should be about 3" behind where you have marked the rear of the seat runners will be and this will allow the seat to slide backwards

for a taller driver. Clean all under seal, mastic and Styrofoam from 1 ½” either side of the cutting marks ready for welding. Cut straight forward from the rear about two foot close to the centre tunnel and outside mounting area and bend the floor down about 3” at the rear. Now from the sheet steel cut a piece the same width as the cut by 5” high, (remember, you can always trim a bit off, but it’s a sod sticking a bit on), bend this into a “Z” shape 1” x 3” x 1” and with a few pop-rivets just to locate it, fit it into the gap, over the floor and under the dropped section so it’s self supporting. Now make up the “V” shaped side pieces, 5” by 25” and bend into shape again allowing an overlap of about an inch under the dropped section of floor and 1” up the sides of the tunnel and outside of the floor pan and a 1” flap on the rear at right angles to join it to the rear section, pop-rivet in place as above and if happy, weld all in place with a continuous weld as required by SVA and MoT, paint with “Finnegan’s Number One Primer” or similar and then under seal. (Tip. To bend a sheet in a straight line, clamp the sheet between two pieces of wood 2” x 1”, slightly longer than the metal, along the bend line in a vice and gently, a little at a time, fold the metal over using a smaller piece of wood and a hammer.



FLOOR PAN ADDITIONS

Required:

Skoda Estelle 1300 or Rapide 1300 (not 1200) gear change assemble.

8 x 6mm Rivnuts and tool, (these are like pop-rivets but with a thread in them).

8 x 6mm x 25mm bolts and washers

Volvo 240 series hand brake assemble.

2 x Mitsubishi Colt hand brake cables or similar, you can get custom ones made by www.Speedycables.co.uk

Positioning

Having plonked the body on and loosely located it with the couple of bolts for safety and alignment and fitted the seats, get back into the now bolted down seat and adjust the runners so that your feet are again comfortably on the pedals, knees slightly bent and the back angle adjusted to bring your head below the roof line by about 2”, the seat back should be about 40° from the vertical. Hold your arms about a 18” from your chest, (NO, we do not have our arms straight out, you can’t control the car that way), this is where the steering wheel needs to be and where you wish for an fully adjustable column like the Triumph one which also incorporates the indicators, dip switch, horn, light and ignition switches. You now have three positions fixed, feet, bum, hands, this will now determine the position of the gearshift knob, (a natural drop from the wheel is fine) and the hand brake position on the centre tunnel is then controlled by that, needing to be about two inches clear of the rear most gear lever position. As you drop your hand you will notice it is a foot short of the original gear stick position and comes into contact with the original hand brake, no good, both need to be removed and binned.

Although one can re-use the original sloppy gear shift unit and bend the lever like a boat tiller and end up with about a foot of travel or cut out a section of the centre tunnel with lever assembly complete and move it back wards with a shortened rod and a shortened and angled hand brake lever, (lots of work). I used a

Skoda 1300 gear change unit, this strong, self contained, alloy unit of the sliding bar type with an 8mm bolt at the rear for connecting the rod. This is ideal as both cars are rear engine and it results in a smooth, tight and slick change.

Skoda gear shift conversion.

Remove the original gear lever from the tunnel and bin it, Later block off the gear change lever hole with a blanking plate, (I found the 8mm bolts to be excellent for earthing the dash and centre console electrics). Completely remove the hand brake assembly and cables from the tunnel and bin those. The next part definitely requires a little skill, patience and measure twice, cut once certainly applies. Cut a hole as wide as the Skoda unit's rod supports and slightly longer, centered on your ideal gear knob position and drop the Skoda unit in, check it fits O.K. and then mark the position of the four fixing points and then remove it and drill and tap 4 x 6mm or better still, fit 4 x steel 6mm "Rivnuts". With the Skoda unit in 'neutral' lay it on the centre tunnel sideways lined up with the fixings you've just made and mark where the 8mm shift rod connecting bolt touches the tunnel, remove to one side. Check the gearbox is in neutral and mark across the shift rod inline with the bolt mark on the tunnel. *(The trade tip is make a 8cm wire "[from an old coat hanger making sure the ends are the same when measured 90° down from the top tip, pass the wire tool into the hole and line the tip of the top arm with the mark on the tunnel, mark the rod where the lower arm tip touches the rod,)* this is where you will be drilling the 8mm hole to connect the two later, also make a mark along the rod to indicate the upper most point of the rod so you will know where 'top' is when it's out. Disconnect the gear shift rod from the gear box shaft through the access panel at the rear of the tunnel and pass it through to the frame head and out of the front access panel. Cut 15mm forward of the mark you made for the bolt position and flatten it vertically for about 6 cm and drill an 8mm clearance hole where the bolt mark is, file a slight radius on the rod end to tidy it up. Pass the shortened shaft back into the tunnel and working through the hole cut for the shifter, connect to the Skoda unit with a rubber washer between them using a self locking nut (do not tighten, it should just flex). Lower the rod / shift assembly into the hole and connect the shaft to the gearbox coupling and with the assembly fully in the tunnel, bolt down the assembly with 4 x 6mm bolts, flat and spring washers, minor adjustments can be made by sliding the assembly on the 4 bolts before gently tightening them. The gear stick height can now be marked to suit allowing for the knob height, usually a bit lower than the bottom of the steering, It can now be cut and threaded to accept your super doper sports gear knob, (thread only if needed as many sports knobs (Momo, Simoni, etc. fit with three small Allen screws directly onto the shaft).

Hand brake lever.

Having binned the hand brake lever one has to replace it with a suitable twin pull assembly that is flat on the floor mounted and easy to obtain. I found the unit from the Volvo 240 series just the job, not too big, built in switch, flat on the floor, four mounting holes and twin alloy quadrants and holders for the cable outers, perfect.

This unit simply bolts on the top of the tunnel behind the gear shift in the same manner as the Skoda gear shift did, given there should be about 3cm between the gear lever and the release knob when the lever is up and the shift is fully back.

The cables are the biggest problem as the Beetle ones run partly in flexible outers and then in tubes from the rear of the chassis to the lever. I found Mitsubishi Colt ones the correct length and with the following changes work well or one can call on the services of Speedy Cables as above who will make some to your design. File a small amount from the 'eye' of the cable so it fits freely onto the operating arm of the brake assembly and fit as usual onto the brake back plates but instead of running through the tubes in the chassis go over the top of rear chassis close as possible to the tunnel and up the side of the tunnel to the hand brake unit. Cut off about ½ the threaded part of the end and fit to the quadrants, you will now be able to judge how much needs to be removed from the outer cable, (about 10cm), mark this and after pulling the end caps off the outer and slide forward out of the way, carefully file through the plastic and steel spiral outer and with a couple of pairs of pliers unwind the spiral outer from the inner. Slide the end caps back and refit then replace outer cable in retainers and fit to bracket, connect threaded parts to quadrants with adjuster nuts. Job done.

Suspension:

As previously mentioned in the opening paragraphs there are a variety of suspension options available to the chassis 'tuner' but the one thing we must have is a completely unsupported front suspension system relying solely on the chassis, either the older torsion bar and arm type or the UVA 'Ultima' wishbone set up for the 1303 chassis.

I think most people will find that the older torsion bar and arm set up will be more than adequate for the job and there are many modifications we can do to improve it.

Bushes and adjustable height conversion;

Requires;

One set of eight polyurethane bushes.

One pair of adjustable ride height conversion inserts.

Four new dust seals for trailing arms

Hacksaw,

Large jubilee clip to fit over beam tubes

Welding equipment, piece of timber to fit in tubes about two foot long

Piece of ½" bar to drift out old bearings

Hammer

Chassis paint

Grease

There are a total of eight bearings that sit inside the two torsion bar tubes and they are rather prone to ingress from water and dirt and are usually clapped out. Replacing them with polyurethane bushes is easy and fairly cheap; they can be purchased from most VW beetle parts and accessory suppliers.

As we have to pay attention to the ride high as well, which requires us to cut the two tubes half; it's a must to replace the bearings with the bushes afterwards.

The adjustable ride height conversion come with full instructions and requires a good quality of welding, so unless you are a competent welder by now after doing the floor pan, give the job to someone who is competent or buy a new beam assembly ready done and converted, (recommended).

But here is a run down of the procedure if you feel brave.

Strip out the front suspension arms, centre locking bolts and torsion bars.

Using a long piece of bar, knock out the old inner and outer bearings from the opposite ends.

Place the adjustable units on the tubes in the centre and mark the tubes either side of the units.

(Tip, undo and slip over the tube a large jubilee clip, line up with the cutting mark, tighten and cut alongside, this will ensure a straight and vertical cut)

In order to maintain alignment ONLY CUT AND WELD ONE tube at a time. Cut ONE of the tubes on the marks, (two cuts). Insert the adjustable units according to the instructions so that the adjustment moves downwards from the original position and weld all around.

(Tip, using the same jubilee clip half over the tube and half over one side of the adjuster it will hold and align the two parts while you weld the opposite side)

Repeat on the other tube. Check both unit rotate freely when unlocked.

Clean up the tubes and paint

Measure the distance from the end of the arm shafts outer bearing surface to the outer part of the inner bearing surface, this will give you the insertion depth and insert the new inner bushes carefully using a wooden drift only slightly smaller than the tubes and marked with the insertion depth, careful not to push then in too far!

The outer bushes simply go in until they butt up against the end of the tube. DO NOT GREASE the bushes as this attracts dirt and retains it, leave them dry.

Grease and insert the torsion bars through the centers.

Lightly grease and insert the arms and outer dust seals to the bars. (The bottom ones hang down further than the top ones).

Shims and angles;

Requires;

One or two sets of alloy anti-caster shims according to height lowered.

Two 12mm frame head bolts 20mm longer

Because the angle of the arms in relation to the chassis has now changed upwards there is a modification that needs to be done to compensate for this change in geometry.

As the arms move upwards the vertical angle of the uprights carrying the brakes and front wheels alters, this is the castor angle which helps to keep the car in a straight line and also makes the inboard wheel 'tip over' more than the outboard one in a corner and to compensate for this reduced angle you need to buy alloy half moon shaped shims which go between the frame head and the tubes of the previously modified beam assembly, on a fully lowered conversion of about 6" from lower tube to the ground I used two shims on each which in turn requires slightly longer lower beam mounting bolts. Job done.

Front uprights, dampers and brakes;

One pair of upper ball joints for lowered suspension

One pair of lower ball joints for lowered suspension

One pair of dampers for lowered suspension.

Brake parts as required

Because of the increased angle between the trailing arms of the front suspension and the uprights the ball joints fitted top and bottom of the upright will be at the limit of their movement so special ball joints that allow for this must be fitted. This is just a straight case of substitution.

Shorter dampers must also be fitted as the standard units would 'bottom out'; these are available especially for the job from the usual sources.

As far as brakes go there is a wide choice off the shelf and as such I have not included them in the list of required parts above. The main thing is to loose the old five stud drums and use the later four stud ones or discs which will be four studs anyway. Drum brakes are actually quite up to the job unless a bit of tuning is done with speeds in excess of 90mph occurring but with a greatly reduced front end weight rather prone to locking and skidding. As the ball joint type suspension is universal on the torsion arm type cars, one can also fit the disc brake units from a 1500 to the 1300 /1600 arms. Conversion kits are also available with new uprights, discs and calipers including Brembo ® sets which completely replace the old units. Always fit new flexible pipes whatever you do.

Rear end;

Requirements;

One polyurethane rear suspension rear suspension arm bush kit.

One pair shorter dampers.

(Option) Adjustable suspension arms.

One set polyurethane gearbox mountings.

The rear suspension is in some ways is a lot simpler than the front, but more difficult in others. Basically there is a single heavy torsion bar either side fixed by unequal splines to the centre of the chassis, supported by bushes on the outer end and carrying a rear facing swing arm onto the rear axle from the gearbox, but that much you know already, right? No? Oh!

There are, as previously mentioned in opening, two main types of rear suspension: swinging arm and independent rear suspension, (IRS), the advantages IRS are obvious with the rear wheels at a more or less constant vertical angle being fixed to the trailing arm as where as the swing arm type, as the name implies, alters this angle as the wheel is fixed to the axle and the axle swings through an arc.

It is not possible to easily convert the one to the other as the axles exit from the gearbox via a completely different type of joint, the swing axle has a sliding dish shaped joint built into the transaxle, as we call the gearbox / axle unit and the IRS has an external universal joint , however one can change the transaxle side plates from one type to another as the cases are universal but this still leaves the torsion bars and arms, these unfortunately are not easily interchangeable as it requires the changing of everything from the frame outwards it is a lot easier to start with an IRS chassis and if need be change the frame head and beam assembly.

As far as the swinging arm type is concerned they are quite up to the job and as long as the post 1966 axles are used which are 2½“ longer there is no problem as the extra distance is on the outer end between the arm mountings and the brakes, it also helps fill out those huge wheel arches with 10” rims on. The only thing you need to watch when doing this it the fit between the flat ends of the half shafts and the slots in the transaxle are O.K. as these are matched up at the factory.

One accessory that can be fitted to both types is adjustable arms. These have the front of the arm secured to the torsion arm in the normal way but are only a few inches long with an block and bolt type adjuster at the bottom rear corner, a conventional arm is fitted to the outside this and freely pivots at the front instead of being fixed to the torsion arm and sits on the adjuster, by adjusting the bolt, the fine angle of the arm can be adjusted or altered to lower or raise the car a small amount with both sides equal.

Changing the rear torsion arm bearings is a simple matter once the arms have been unbolted from the axles. **Beware!! These are under considerable tension and will snap downwards when released!!** Remove the four bolts and side plates that hold the outer bushes, these are different in that the swing axle ones are solid and the IRS ones have a hole in for an extended torsion shaft. the arms can now be released from the torsion shafts, but always first mark the position of the torsion shafts relative to the chassis tube and the trailing arms on them so you can put them in the same position as this can alter the suspension height if you get them on different splines, this is because the splines are not the same cut, one being courser than the other and moving the inner splines up one and the arm down one gives a completely different setting. So watch it as it will take ages to get both sides the same from scratch. Having removed the outer plates and possibly binned them as they are usually rotten, replace the rubber bushes either side of the arms with polyurethane kits, left dry as on the front.

At this point whilst the axles are free from the constraints of the suspension one can disconnect the gear change rod, (again) and the reverse switch (replace if dodgy as they are a sod to get to in the chassis) and the clutch cable (or hydraulic), lift out the complete transaxle and change the mountings for a polyurethane set, which whilst transmitting a bit more vibration will last forever and reduce movement, then place it back in, reconnect the gear shift rod, switch and clutch.

On reassembling the arms for both types, moving the arm one spline up will normally be too much so you have to move the torsion bars down one as well as they are not the same thickness this results in a 'half spline' movement, experiment only one up or down at a time and never loose track of the original settings incase you get lost and have to start from scratch. The rear dampers should also be changed for the special shorter ones so they don't bottom.

Brakes;

The drum brakes on the early models were very narrow and can be replaced by the much wider units of the 1303 /1306 type or one can get rear disc conversions but these are not really needed and will have the four stud fittings required as well.

Tuning, engine strip and rebuilding

Rather than spend hours typing in what is already available by very competent authors I recommend to you all the following web sites.

<http://www.bug-bits.freemove.co.uk/bugbits/tech.htm>

<http://www.bug-bits.freemove.co.uk/bugbits/howto.htm>