Cheater's Way: Building the Champion Turbo-Flex Chassis

The first step is to make certain the center section is completely and totally FLAT. When you can push down on any part of the center section without it tilting up anywhere else, then the chassis is flat. Use hammers, assorted pliers, the edge of a surface plate or table, and your hands to bend, tweak, and twist the center section until it is totally flat, i.e. no rocking at all on the surface plate. There will be lots of trail and error during this process, with frequent checking of the chassis on the surface plate. This degree of flatness is not easy to achieve, but it can be accomplished with this chassis if you're patient, persistent, and know when to pound it with the hammer!

The worst area, needing the most work, is the area around the stamping operation for the guide tongue. And this is also the most important area to get flat. It usually takes a big pair of linesman's pliers to tilt down the "points" on either side of the guide tongue. Closely check the rear corners of the chassis, as the folding operation for the rear axle uprights tends to lift the rear corners. Sometimes it takes a few minutes to get a center section flat, sometimes it takes more than an hour. It's done when you can push down vertically at any point on the center section's top surface without having the chassis lift off the surface plate at all, not even .001 inch.

Next use a small drafting triangle to make certain that all four axle uprights stand 90-degrees to the chassis. Use a pair of pliers to correct any that aren't square. Then round off all sharp edges on the center section (and the top pan) with emery cloth or a fine file. Generously round off and taper the front lower edges and tips of the wings to prevent them from digging into the track in the turns.

Another item to check on the center section is the front hook height; one hook will usually be higher than the other. Use a flat needle file to raise the shorter hook to the height of the taller one. Feeler gauges can be used to measure the hook height, but you can also stick a piece of .063 wire sideways into the hook and see how far you can lift it; when the lift is the same on each side, it's done. The actual height of the front hooks doesn't really matter; just make certain both sides are the same.

Next, use a Dremel with a grinding bit to "hog out" the rear motor mount bracket, leaving about 1/16-inch thickness on the two vertical members and the top horizontal member, and grinding the bottom horizontal member almost completely away, but leaving curved "gussets" going into the vertical members on the ends. This is legal by the USRA rules and it removes a lot of weight from the rear of the chassis.

Flatten the top pan, aluminum or steel, in the same way as with the center section. It is flat when all four edges of each side or pan stay on the surface plate when you push down anywhere on the pan's top. Because of the way the metal rolls up to the outer edge of the pan, it can be difficult to get the pan to be completely flat at this edge, especially on the steel pan.

Which top pan to use depends on the track and on the body being used: flatter track and lower downforce body usually means steel; swoopy track and higher downforce body usually means aluminum, but not always. A critical issue with the top pans is the coining operation that offsets the horizontal crossmembers which pass over the center section. The offset is rarely stamped accurately. The ideal is to have the top pan hang at exactly the same height as the center section, but most hang below it when new. To check this, assemble the two chassis parts and place it on your surface plate (you do have a big ultra-flat plate to use in building chassis, don't you? I use a 9-x 12-inch black granite surface plate bought for about $20 from a tool and machinery parts vendor, but any FLAT plate of metal or thick glass will work.) Carefully pick up ONLY the center section; the top pan should rise off the surface plate at the exact same moment as the center section. Most of the time, the center section will lift first, then as it rises and hits the crossmembers of the top pan, the top pan will lift off the plate.

Fixing this is a challenge. With the aluminum pan, you can re-bend the coined offsets, but it's a serious pain getting everything flat after that. It is difficult to rebend a steel pan successfully. Another approach is to use various methods to take up the extra clearance between the center section and the top pan. You can use small tape squares on the center section as well as small squares of Lexan of various thicknesses, stuck on with CA. Another method is to place solder dots on the center section, filing each dot to give the thickness needed. You normally need four squares or dots, two front and two rear, as the crossmembers are rarely exactly parallel to the surface plate, though this can normally be corrected without too much trouble. Lately, my preferred method is to use layers of tape strips on the underside of the crossmembers to take up the extra clearance, either strapping tape or an adhesive Teflon tape (not the pipe-sealing Teflon tape) or both. If one side or corner needs extra tape, rebend the crossmember if you can and add a tiny square of tape where needed if you can't. Just make certain that the top pan is at least perfectly even with the bottom of the center section, especially in front. If you can't get it even, make the front a little higher. The tape on the crossmembers seems to add a tiny bit of damping that helps, too.

Next carefully put a very, very slight “up” bend in the very front of the top pan on each side, with the bend line running from the inner corner of each front square section and angling back toward the wheel. This keeps the front outer corners of the pan from digging into the track when the body rotates. For the same reason, use a fine file to chamfer the front edges and corners of the outer rails of the top pan.

Next, double plate the guide tongue by soldering a trimmed Slick 7 guide tongue atop the chassis’s integral tongue. The doubler and the chassis are first filed/sanded on the surfaces to be soldered (don’t use a Dremel here!) and then both are tinned completely, with the tinned sections being refiled flat after tinning. Use old guide flags to clamp the tongue doubler in place before soldering it along its back edge (which is trimmed to match the circular coining of the chassis), then remove the guide, spacers, and nut to complete the soldering on the other edges.

Using the guide as a clamp makes it easy to check that the guide angle is correct (which should be done before soldering the doubler, of course). At this time we want the guide parallel to the bottom of the chassis or ever so slightly tilted up. Also check that the guide tongue is not twisted, that is, doesn't have one side higher than the other. Tom Marsteller's trick of using a long bolt, nuts, and washers tightened to the guide tongue hole as a bending handle is the best way to correct this, if the problem is present. You want complete solder coverage between the doubler and the chassis so as a last step use a small torch to carefully reheat the doubler, making certain it doesn't move. This last operation "floats" the doubler on the solder, helping to make certain the top surface is exactly parallel to the bottom.

To further insure this, use a Magnehone diamond guide tool and a guide with an uncut shaft to hone the top and bottom surfaces of the guide tongue after doubling it. Hold the guide in place from one side and use the projecting shaft on the other side to pilot the hone. You'll find that a lot of times the bottom of the tongue is not very flat and the hone will take care of this problem. Also slightly enlarge the guide tongue hole after doubling, using a small grinding bit in the Dremel, and chamfer the edges of the hole on both sides. Having the guide shaft fit loosely in the hole actually seems to help somewhat, but the main concern is to make certain the hole is smooth inside and that there are no sharp edges. Having a smooth-turning guide with no wobble is very important.

At this time use your Dremel and an appropriate bit to grind the plating off the places on the chassis where you will be soldering: both sides of the front axle uprights, both sides of the rear axle uprights, the areas where the motor will be soldered on: the top inside of the motor bracket, and front and rear areas of the center section's motor "box" (always solder the rear as well for the big races or main events), and between the rear axle uprights (where the upright brace will be soldered). All of these areas get tinned, using acid flux. Keep tinning until you have 100% solder coverage of these areas.

Next the car is placed in the chassis jig. Some chassis jigs have a strong magnet to hold the chassis in place; if your jig doesn't, use pieces of duct tape to hold the chassis in the correct position while soldering the rear bushings. On a non-magnetized jig, you also can use a big spring clamp to hold the rear of the chassis firmly to the jig's baseplate. Getting the rear bushings EXACTLY the same height on each side is the most critical operation in building a chassis. Use the most-accurate jig wheels you can buy and to test your work, use dial calipers to check that each bushing is exactly the same distance from the bottom of the chassis when you're finished. Install a straight axle and measure from the top of the axle, next to each bushing on the inside of the upright, to the bottom of the chassis.

It is also important to get the rear axle exactly 90-degrees to the centerline of the chassis. To achieve this 90-degree angle, carefully scribe a centerline on your chassis jig as well as at the rear of your chassis and line the two marks up.

When soldering rear bushings, try for a 360-degree solder bond; rotating the bushings while soldering them helps to achieve this. Having a 360-degree bond along with solder fillets completely around the bushings on both the inner and outer sides makes the rear uprights much stronger; just don't go overboard with the solder amounts for weight reasons. Use desoldering braid to remove excess solder if needed. (This braid also works very well for removing excess solder from the larger tinned areas, too, like the places where the motor is to be soldered in.)

The best way to align the rear bushings is to use the largest rear axle you can find that will still pass through the bushings. Get out the dial calipers or micrometer and check every axle you have to find the largest one. Always oil the bushings heavily before soldering them in place; as the bushings cool that oil will be sucked back into the oillite mesh. It's best to use synthetic oil here, as the heat is not likely to damage it. The bushings should be located by the axle passing through them, NOT by piloting on the chassis holes. Once you have used a grinding bit on the rear chassis holes to set the bushings for your desired tire size, then put the chassis on the jig with the axle and jig wheels, and make certain that the rear axle bushings will slide into place without touching the chassis except at the bushing flanges. You want a tiny bit of clearance between the bushing's small diameter and the chassis all the way around and if it's not there, grind some more but only just enough to achieve a flange-only fit. BTW, it is worth testing a selection of rear axle oillites for weight and for running clearance; there is quite a bit of variance in these parameters among brands. It is a good idea to run the lightest rear oillites you can find, as long as they have reasonably tight running clearances.

Brace the rear axle assembly using a Slick 7 rear upright brace (or a homemade piano wire brace), but trim its "up" legs so that the brace can be installed directly beneath the rear axle. Again, sand every surface of the brace and tin it completely before soldering it in place. You want a small solder fillet on every edge of the brace where it touches the chassis. On banked tracks, running fast C-cans, a rear upright brace is necessary to keep the rear axle from binding in the banks; as the rear of the chassis will flex under the loads it sees. You can usually see this yourself on an unbraced chassis: space the motor from the axle with a piece of paper when soldering it in place, and then take a black magic marker and color the axle for about 1/4 inch at the point where the can is nearest the axle. After racing a while, you will usually see that the can has been touching the axle, as evidenced by a silver stripe in the black mark.

For the front axle, cut a piece of .063 piano wire to the length that will position the wheels inside the front wings on each side by 1/16-1/8 of an inch. This will "hide" the front wheels behind the wings, giving them a bit of extra protection from bending, but also giving a shorter, lighter front axle. I normally use the upper holes to mount the front axle, as it is easier to check a straight axle for bends and this gives more room under the axle for the lead wires.

The front axle-to-chassis solder joints are the most critical joints on the chassis in terms of strength; these joints will break if you don't get them strong enough. Sand and tin the front axle completely, tip to tip; this helps the joint strength, it helps to keep it from rusting, and it helps to keep the front wheels from seizing due to corrosion. Install one Slick 7 .063 wheel collar to gusset the axle on the inside of each front upright. Solder this joint with StayBrite, Speedshop, or other brand silver-bearing solder for extra strength, making certain to use enough acid flux and heat to flow solder into the spaces between the axle and the collars, and between the axle and the chassis, with moderately-large solder fillets on both sides of the uprights. Use Paul Ciccarello's trick of taking the o-rings off the wheels and soldering the wheels to be level with the bottom of the chassis. This makes it easy to rebend the front axle to the proper location after crashes; just flip off the o-rings and bend the axle to place the wheels level with the bottom of the chassis. Run the lightest front wheels you can find; right now the flat, drilled Kelly front wheels are the ones I'm using, though they will bend if you crash hard enough. A stronger wheel that will not bend is the Parma PSE drilled front, but it is heavier. Front wheels are installed with a Slick 7 .063 wheel collar on each side.

This completes the construction phase. Be certain to wash the chassis with dish soap and a toothbrush under hot water to remove the acid flux residue, unless you just like rust!

Now we need to check for movement amounts. Install the top pan and its cotter pin on the chassis and check for front and rear upward movements. The front lift is determined by the hook heights. How much movement you want here is a function of the track, your driving style, and the body being used. Make certain there is some clearance, as using tape under the front crossmembers may raise it enough to take up all of the clearance, in which case you will need to file the hooks to allow some movement here. Some tracks want a lot, some not. Adjust the front lift using small squares of strapping (or other type) tape placed on the top surface of the front crossmember between the crossmember and the hook. Shoot for about .010-inch movement here as a start and measure it using feeler gauges. If less movement is desired, add another piece of tape. For more movement, take the tape out, or if necessary, remove the top pan and file on the hooks.

At the rear, lift is adjusted using .005 and .010 Teflon guide spacers under the cotter pin. The rear lift can vary enormously between center sections due to the way the cotter pin tab is manufactured (the cotter hole is punched before the tab is bent up). And in some cases, having a large amount of lift works really well. Normally, you want to shoot for .010-.015 of lift at the rear, but if you have more than this amount, decrease it only after testing.

The next topic is guide spacing and front ride height. Here's what you want: when the car goes into a turn and tilts, you want the front edge of the outside wing to touch the track along as much of its length as possible. When looking at the track dirt or grunge on the bottom of the chassis, you want to see it building up along the length of each front wing, not just at the tip. This requires a very precise guide spacer stack and in some cases it will require you to bend the front wings every-so-slightly up, so that when the chassis rolls a tiny bit, the wing it's rolling toward lays flat on the track. This works better than having just the tips drag. Having the whole edge contact the track won't tend to dig in and it also seems to stabilize the car better. This technique doesn't work as well on really bumpy tracks and/or on tracks with widely varying braid heights and sometimes you will simply have to raise the car up above this setting.

It's worth mentioning that testing guide spacer height is extremely important. Once you get the stack height you think is best, it is almost always worth testing stacks of plus and minus .005- and .010-inch, as you will often find the car feels better or is faster with one of the other stack heights. In general, you want the front of the chassis to just barely clear the track surface on the straights, about the thickness of a piece of typing paper. But again, the quality of the track will affect this, which is why you have to test guide spacer height on the track.

On the subject of weighting, it is best to build cars as light as possible so you can add weight to make them easier to drive. Ease of driving is almost more important than pure speed, as the winner is the racer with the most laps, not the fastest lap. Always give up speed for handling if necessary, as staying in the slot just one more time over a heat by giving up 0.1-second in speed means you're going to make more laps than the faster guy almost every time. The TurboFlex seems to need a small piece of weight between the front uprights, perhaps 3/16-inch wide and the width of the uprights. A small square of weight at the back of each pan, about half the side of a normal postage stamp, will really help if the car feels twitchy. This location provides the longest moment arm for resisting the tendency of the car to roll out of the slot. Putting weight at the back of the pans is very noticeable and can really settle a car down.

Random thoughts:

Motor angle is normally as flat as it will go, using a piece of paper between the axle and the can as a spacer while soldering the motor in place. If too much traction is an issue, you can angle the motor forward a bit to move weight toward the front and off the tires.

Carefully bend the now-flimsier motor bracket to give maximum contact with the can before soldering that joint. Make certain bottom of the motor can fits tightly into the inside bottom angle of the motor bracket.

Put the spur gear as close to the axle bushing as possible; run two .003 Slick 7 spacers between the gear and the bushing. The closer you can get the pinion-spur contact patch to the can bushing, the less the can bushing will wear and the less bending moment will be imparted to the arm shaft.

On tracks with a donut turn, it can help to offset the rear wheels to help punch that turn. On a King, for example, run one thick and one thin Slick 7 axle spacer between the RR wheel and the bushing, with as many spacers as needed on the LR side to make the 3-1/4-inch width. This can hurt speed in the lead-on turn and if so, put a small piece of lead inside the left pan rail to help in that turn. Sometimes you will not want to run the maximum offset or any offset at all and you have to test to know this. On other track designs, you can offset in the opposite direction to help in a particularly troublesome or important turn.

For many years, I soldered my earring back for the lead wires atop or beneath the front axle (depending on whether I mounted the front axle in the upper or lower set of holes), but in the last year or so I've gone to placing the earring back atop a short piece of wire (I use the shaft of a straight pin) soldered across the chassis slot about 3/4-inch behind the axle, and to using "California loops" for the centering action. This keeps wire weight lower and uses a bit less lead wire length. The centering action is also not quite so strong, which may help as well.

Use wide bronze or steel guide spacers, rather than Teflon, though using a .005 Teflon spacer directly under the guide nut is fine. Tall stacks of Teflon spacers are not good, as Teflon "cold flows" under pressure. Always use the widest and tallest guide nut you can find, as most short ones have barely two threads engaging the guide shaft. The drilled Koford guide nuts are my favorites, when they are available, as they have almost three threads and are quite wide where they contact the tongue.

To set guide tilt, install the largest set of tires you will use on the chassis; for me, this is normally .765 or .760 tires on a chassis set for .750 tires. Bend the guide tongue so that the guide is exactly flat and it will then have some tilt when .750 tires are fitted. Having the guide almost flat is the best, though up to 5-degrees or so of tilt can help on certain tracks. To check for guide tilt, tighten the guide nut firmly to eliminate play, then push straight down on the guide itself to flatten the braid hard against a tech block (this only works if the guide has braid in it and assumes the guide is lower than the front wheels). The rear wheels should lift evenly off the tech block between roughly 1/32-1/8-inch depending on the track. If one wheel is higher than the other when lifted, then the guide tongue is twisted. Learn to read the contact pattern on your braid and strive for having as much of the braid flat to the track braid as possible. Any degree of downward tilt is a VERY BAD THING and will make the chassis handle terribly. Clean your braid with lighter fluid and then crosshatch it with a black magic marker before running a lap and you can easily see your braid contact pattern.

To dampen the movement of the top pan, strapping tape is used on the underside of the chassis to join the two pieces. My normal tape job is a single piece of thin strapping tape 1/8-3/16-inch wide at the front of the chassis, centered on the square front notches of the center section between the front wheels, running edge to edge of the pan. Again, this is something that you want to test, as it will not help on every track. Sometimes you will find that taping at the rear works better, or taping just one side, rather than all the way across. Sometimes no tape is best. Again, testing is necessary to learn what the chassis wants on any given track.

This is getting way too long, so we won't go deeply into body mounting, except to say that lightest is best, though some reinforcement is necessary for most bodies. Look at ways to accomplish the reinforcement needed with the least amount of weight. One method is to cut 1/16-1/8 strips of Lexan bulletproofing; run these along the lower edge of the body (especially on the front of GTP/GT1 bodies) and to use the same strips angled up into the rear corners to reinforce there.

Clips are the lightest way to mount the body to the chassis and they also allow by far the fastest body removal and reinstallation when thrashing between heats. Use small squares of Lexan bulletproofing to reinforce the clip holes; enlarging the holes in the bulletproofing with the tip of a hobby knife so the clips have the proper movement. Place the point of the body clip facing forward, after bending it about 30-45 degrees toward the centerline of the chassis to ease body installation and removal. Adjust the rear "latch" of the body clip so that the clip snaps firmly into place but which also allows the clip to "rattle" or to move slightly front to back when fully seated. Tape the clips to the body but never tape the body to the chassis, as the movement between the chassis and the body is beneficial.

A chassis built from these instructions is very strong and can be driven very, very hard on most tracks, much harder than the average stamped steel chassis and much harder than a Parma Flexi-1, for example. It will corner better under power than during coast and on a banked track can be driven more like a wing car than a normal scale car. Quick blips will be all that most banked turns require and with high-downforce bodies certain banked turns can be punched in some lanes. For example, this chassis with a high-downforce GTP body will run the finger turn on most Kings punched, at least in the outer three or four lanes, and on certain Kings it has only required two blips a lap on black and purple!