Michal Embie Bouchner

RC RALLY 1:10 CAR REBUILD MANUAL

EMBIERACING

PRE-INTRODUCTION

Hello! My name is Michal Bouchner and I created this manual by myself and alone, what's not such a big problem. But there is a problem with translation, which is also my own work. I'm not native English speaker. So please be forgiving about the translation and instead of getting angry please let me know, which part has some mistakes or is not understandable. If some of native English speakers reading this manual would be so good to help me with correction, please let me know - for contact info visit www.EmbieRacing.com.

INTRODUCTION

RC rally is very specific discipline, started its history about two decades ago in Czech Republic. It's just few years back, when RC rally started to conquer the world outside Czech Republic. That's why there are just few chassis, which would be ready to race in RC rally races directly from the box. This reason is forcing people to use onroad chassis or another chassis and rebuild them. Many of hints in this manual are not my ideas. I would like to thank my friends and other drivers to popularize their ideas, either by speaking about them or by posting them on web. This way became these improvements generally known and I'm now able to refer about them. All modifications you will find here are bespoke for onroad chassis, especially for Xray T2 and T3 chassis. Other chassis could vary, but the principals of this manual are aplicable for all the chassis in 1:10 category.

REQUIRED MODIFICATIONS

Basic modifications to create competitive RC rally 1:10 chassis are following:
- heighten ride height
- increasing a steering angle
- covering

RECOMMENDATION

I'll often speak about cutting or grinding. I recommend beginners not to use any machines and do everything manually and first think twice before cutting. If you use some dremel or another machine, you can do everything easier and quicker, but you can easily make a mistake. Then your part is not modified, but destroyed, so be careful.

RIDE HEIGHT INCREASING

At first, some theoretical basics:

MAXIMUM CHASSIS HEIGHT

Maximum ride height is distance between lower chassis deck and roadway in moment when your putting car down and wheels touch the ground first (dampers are not compressed by height of chassis).

RIDE HEIGHT

Ride height is the distance between the surface and lowest point of chassis, with the car fully loaded and ready to run, dampers are compressed by height of chassis. Ride height is lower than maximum chassis height (or equal, depends on setup)

If you want to compete in RC rally, you have to increase maximum chassis height and also ride height. In races your car should be able to run in the wood, through the roots, on gravel, car will jump and in general rides over some bumps on the road. This is the reason to make your suspension ready for it by increasing the range of its motions.
It is not neccesary to make huge ride height. It is okay to create a car which is ready to run over roots in wood, but only if it is needed. Some championships use lots of wood tracks for those is sure good big ride height. But if the most bumpy race in you championship is some lawn road, you dont need big ride height. Too much high car is not easy to built and also not easy to handle. Let’s speak about some numbers. I recommend you to built car with maximum chassis height about 25 - 28mm on new rally tyres. That’s high enough and sure usefull also at bumpy tracks. This is just number for beginners who don’t know anything about RC rally. Doesn’t mean that car with only 20mm maximum height is not good enough. Lower car also can have some benefits and conversely.

CHASSIS SANDING

Possible the biggest barrier for better ride height is lower chassis deck. You need cut or sand it to make more space for suspension to allow it going down. Those, who are afraid of making some mistake will take some rasper, more skilled racers could use some dremel style hand-tool and start grinding chassis under arms according Fig. 1 and 2. By cutting chassis edges you allow arms going under, which increases maximum chassis height.

Fig. 1 Chassis sanding under front arm

Fig. 2 Chassis sanding under rear arm

CHASSIS CUTTING

Next method to increase chassis height is to cut it. At first, draw lines on it and then cut it along them in space under suspension arms. As shown in Figure 3 chassis is under downstops not cutted. I recommend you not to cut chassis under downstops to preserve possibility of adjustment of downstops; it is helpfull not only for tarmac setups. By cutting be carefull and watch screw holes and cut far enough from the holes.

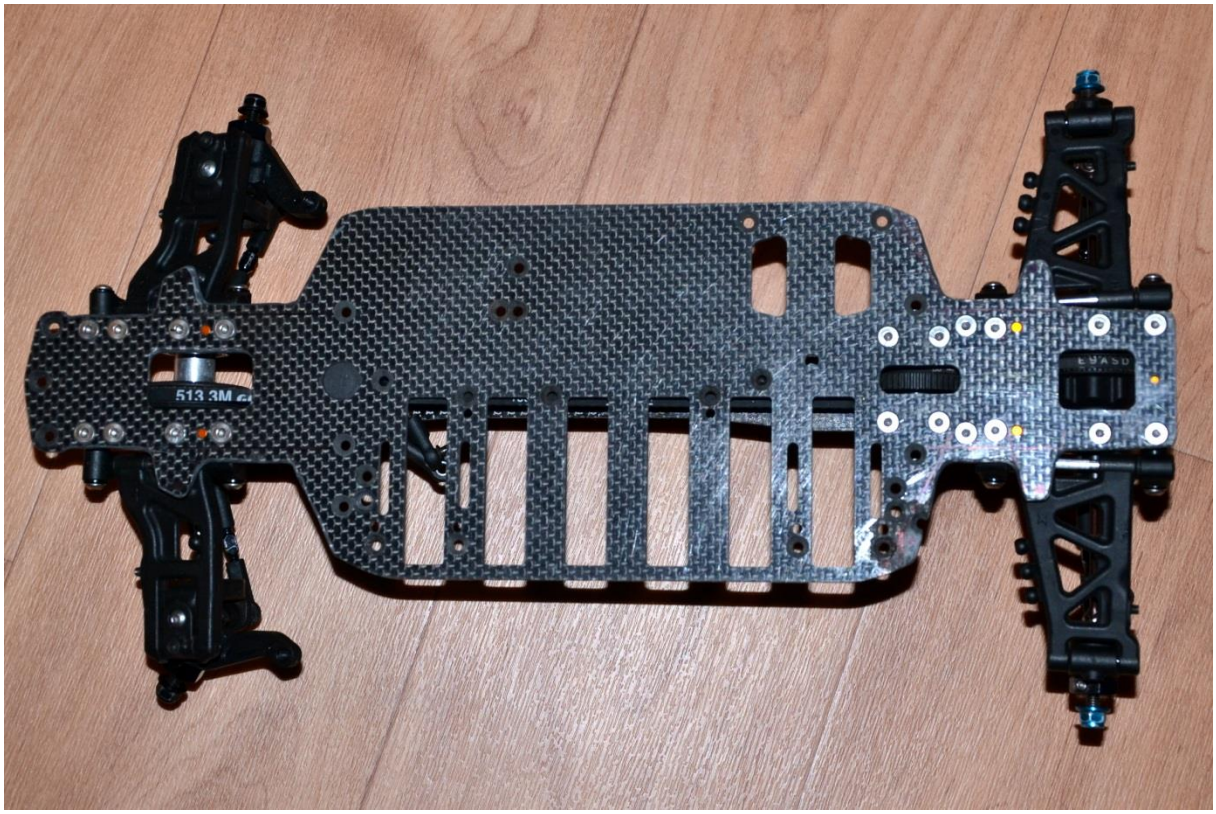

Fig. 3 Cutted chassis

Second variant has some benefits. First of them, under suspension is more space, so dirt can fall out and doesn't stuck on the chassis. Second advantage is that it makes chassis softer, which helps to better steering. In the next step you can also grind chassis under downstops as described above or you can heat chassis (only carbon!) under downstops by using heat gun, allowing bending them. When sanding and especially by cutting wear some protective equipment or mouth cover and do not do this in enclosed space! Carbon dust is very harmful! After cutting, spread super glue at cutted segments as shown in original Xray/Tamiya manual.

OWN CHASSIS

Last possibility is to make you own chassis or buy some tuning part. In this option you can make it by yourself and imagination has no limits, so you can make some other adjusments, as changing positions of components etc. You can also use another material of chassis. Most used are dural and carbon, carbon is high-tec and expansive material, therefore is sometimes replaced by fiberglass. In Figure 3.1 is shown one of chassis designed by EmbieRacing especially for RC rally.

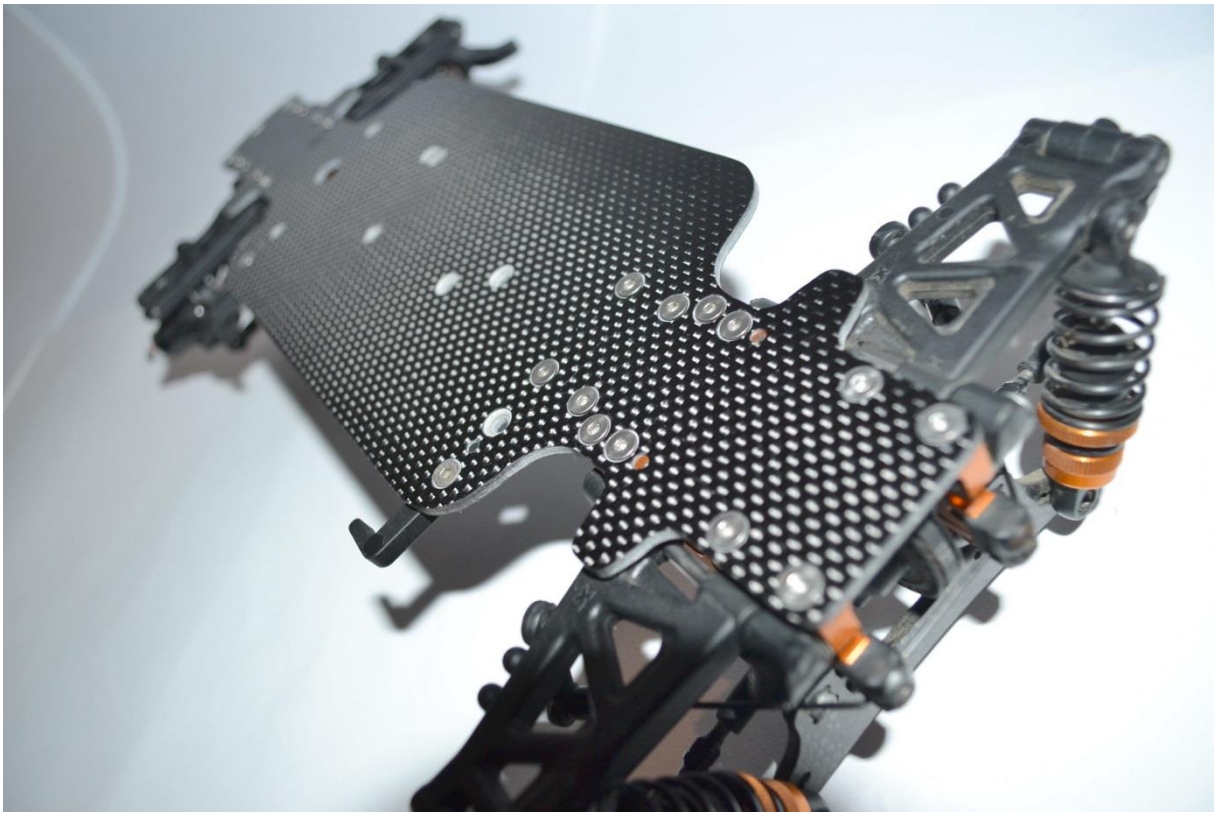

Fig. 3.1 Tunning lower graphite chassis for rally by EmbieRacing

REAR AXLE

The easiest part, because you made most of required adjustments by cutting the chassis.

FRONT AXLE

Here is it more complicated. To fully use all that space under suspension made by cutting the chassis you have to adjust arms and C-Hubs. Arms and C-Hubs have limited movements between each other so you have to cut the arm (Fig. 4) to allow the C-Hub move how needed. How needed means, that in maximal ride height you have to be able set on your car at least small negative camber (which means wheels making „A“ shape together).

Fig. 4 Arm cutting in space under C-Hub

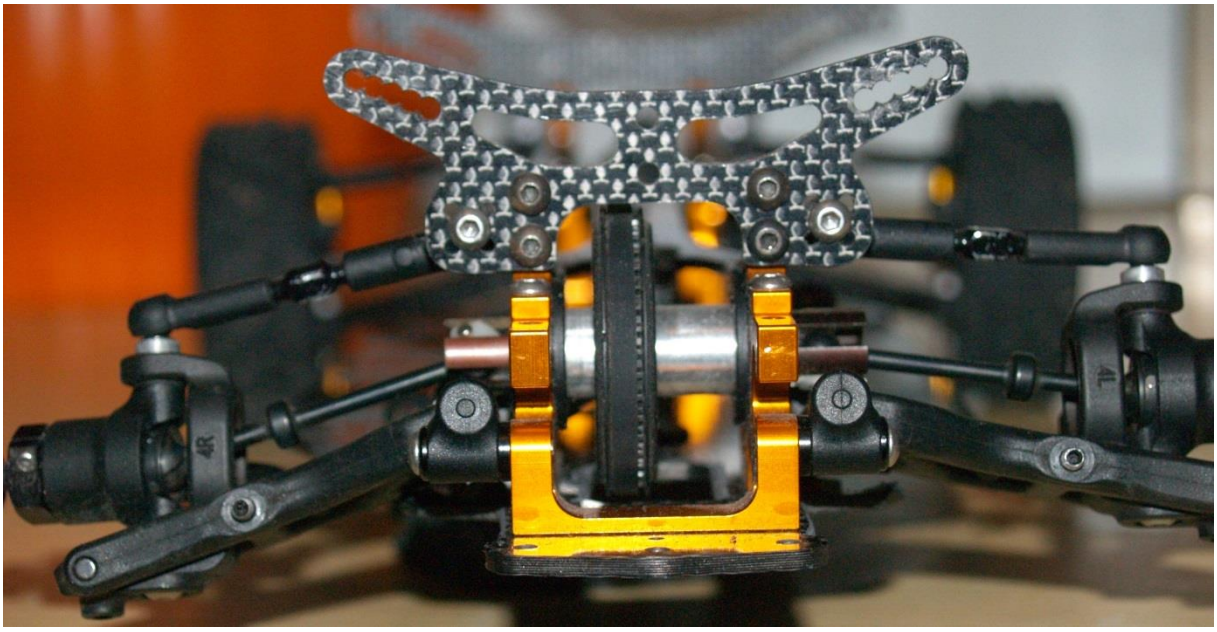

Fig. 5 After (left side of picture) and before (right) amrs cutting

Left arm in Figure 5 (in our view) is after modifikation. It is clear that this arm can go lower than right arm, which is not modified. At right side is it not chassis or downstop, what doesn't allows arm to go down, but arm and C-Hub are jammed together.

JOINTS

Other things limiting arms going up and down are ball joints. Figure 6 shows two types of joints: Right side shows older type of Xray joints. You can recognize it by screw going through the ball. This joint has small working angle and it's better to replace it by other type

of joint (Fig. 6 left). This type of joint, without screw going through, has bigger working angle and is not limiting for arms going up and down. I have experienced Tamiya (only steel made!) joints, which have nice working angle and are also durable.

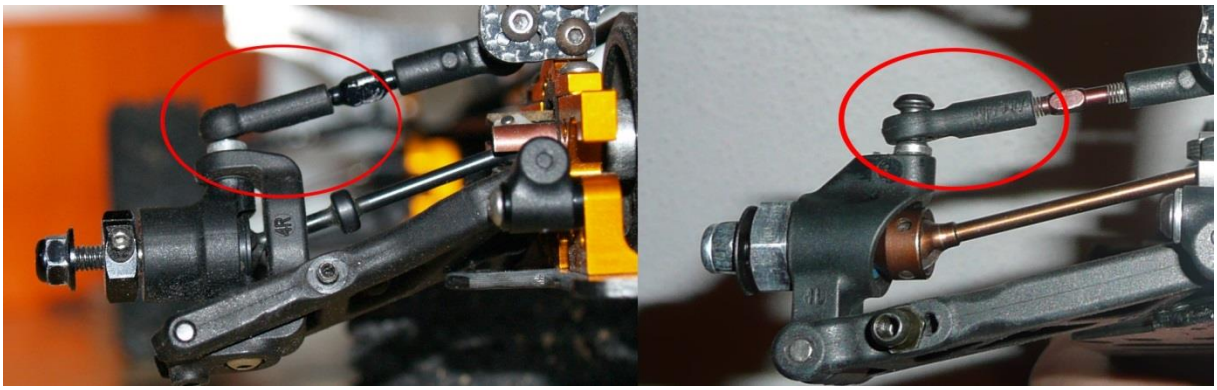

Fig. 6 Joint types

DAMPERS

Now there is nothing on chassis hampering to have bigger ride height and you can put on it longer dampers. It is difficult to give an advice about dampers, only longer dampers doesn't mean better dampers for rally. Also important statement to heed about is ratio between dampers length and its working length, which means difference between pulled up and pulled down damper length. For rallying, you need damper with sufficient working length, not every long damper has ample working lenght. Here are some of dampers I used to have and can recommend.

3Racing pro Mini Inferno Dampers

I personally use these for races (Fig. 7). They have nice working length and they fit well in Xray onroad cars I use for rally. Unfortunetaly I havent seen these in any store for a long time.

Tamiya CVA Dampers

Nice plastic dampers. Some people doesn't like them because of their look, they just look cheap and „plasty", but they are working well. Working length is nice. Small disadvantage is, that they have not adjusting ring and you need to use some washers to preload springs. In some specifications they have washer inside of its body, which limits its working length. If you have these, just remove the washer to use them at maximum.

You can use many other dampers with suitable length for your car. Another option, but just halfway house, is to make new holes for dampers closer to middle of axle. This adjusment brings another lever and so is car with short dampers able to run in rugged terrain.

Most dampers have improper basic setup. Piston in body of damper has holes inside of it to flow silicone oil through it. These holes are mostly too small and oil flows too heavily and damper is so cold „hard". To become softer setup use oil with lower viscosity (lower CST, ... numbers). But softer oil is sometimes not enough. Then you need to drill bigger/other holes in piston in damper. For very!!! soft damper setup use e.g. 3 holes with 1,5mm diameter for rear and 4 holes with 1,5mm diameter for front and use about 200cst silicone oil. But with holes

made in piston like this I recommend silicone oil about 600cst. For harder setup you can use many more viscous oils, for softer setup is the only option to drill holes into piston.
Don't forget to check dampers joints, they have to be necessarly clean and damper has to move on it easily without friction. Without good working joints are also nice dampers dysfunctional.

CHASSIS TO THE GROUND

Many racers want to have huge maximum ride height. It is cool, if you have car with 40mm ride height, but if with dampers pulled down is chassis still 15mm above the ground, it's not really good. It is absolutely better to have car which has not so big maximum ride height, but it can (with dampers pulled down) touch the ground. To insure this, you have to have dampers with optimal length. You can adjust damper length by using another shock ball joints or you can shorten them if neccesary (Fig. 8). If you want to have longer dampers, you have to use higher shock towers shown in Fig. 7.

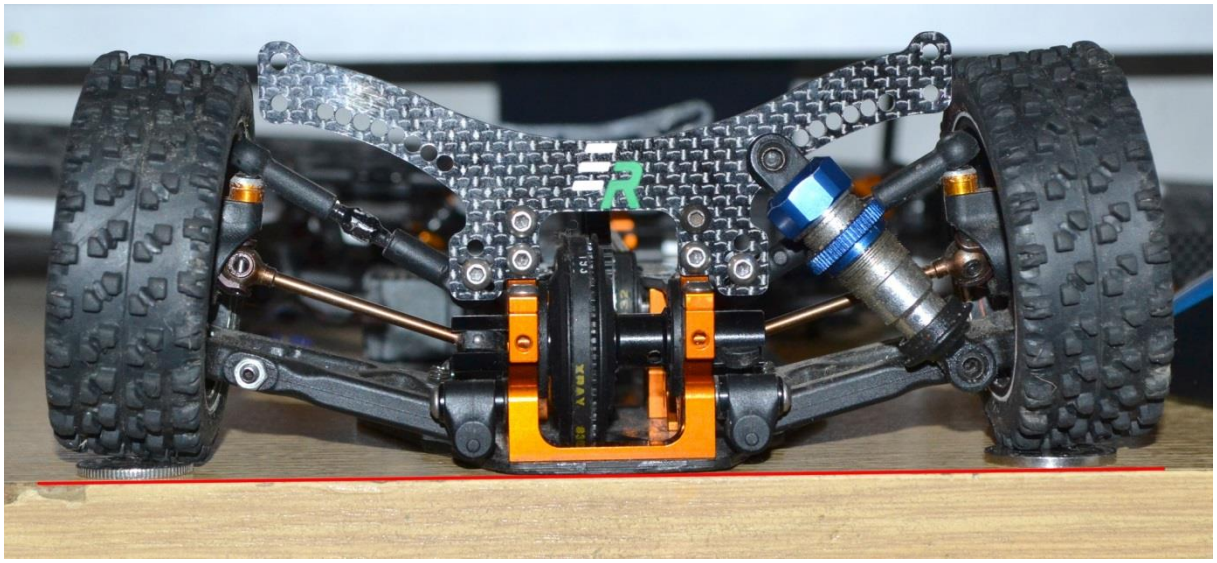

Fig. 7 Best, when chassis goes little deeper than the wheel

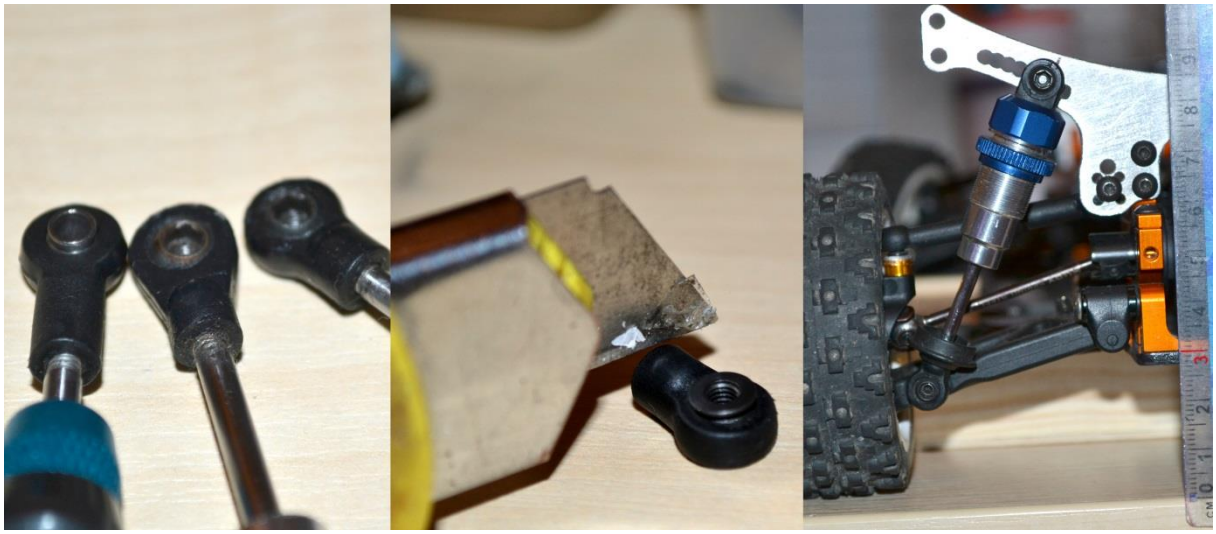

Fig. 8 From left: Various shock ball joints, shortening, sufficient clearance

SPRINGS AND CLEARANCE SETUP

Damper springs and setup of dampers at all you should make with possibility to make change to both ways: to higher clearance and to lower clearance. This means, that if you put your (ready to ride) car on the ground, it settles little down. So you have possibility to make higher setup still. Othewise chassis can't be so low, that it scrubs the ground. Some numbers for beginners: for tarmac use ca. 13-16mm ride height, for gravel 18mm and more. Front and rear axle should have similar height, if you make rear axle lower, you will get more steering. Stiffness of the springs is hard to describe. In general, use stiffer springs at front axle and softer at rear. Definitely onroad springs are too stiff, some spring sets for Mini Inferno or another small buggy could be good for you.

STEERING ANGLE

Onroad chassis (actually all chassis I know) haven't sufficient steering angle for rallying. Tracks for onroad are just much larger and corners are not as tight as in rally racing. It is clear then, that chassis without modifications of steering can't easily run very tight rally cornes. Therefore it is neccesary to modify your car to become better steering angle. This angle should be good enough. For extreme tunners - it does not have to be like some drift car steering angle, because than car becomes difficult to handle.

STEERING BLOCKS

When increasing steering angle, main (or only one) modification is on steering blocks. You have to cut them just that way as in Figure 9 at right. This is extreme case; you don't have to cut so much.

Fig. 9 Original and (extremely) modified steering block

Another, not so extremely modified block is in Figure 10.

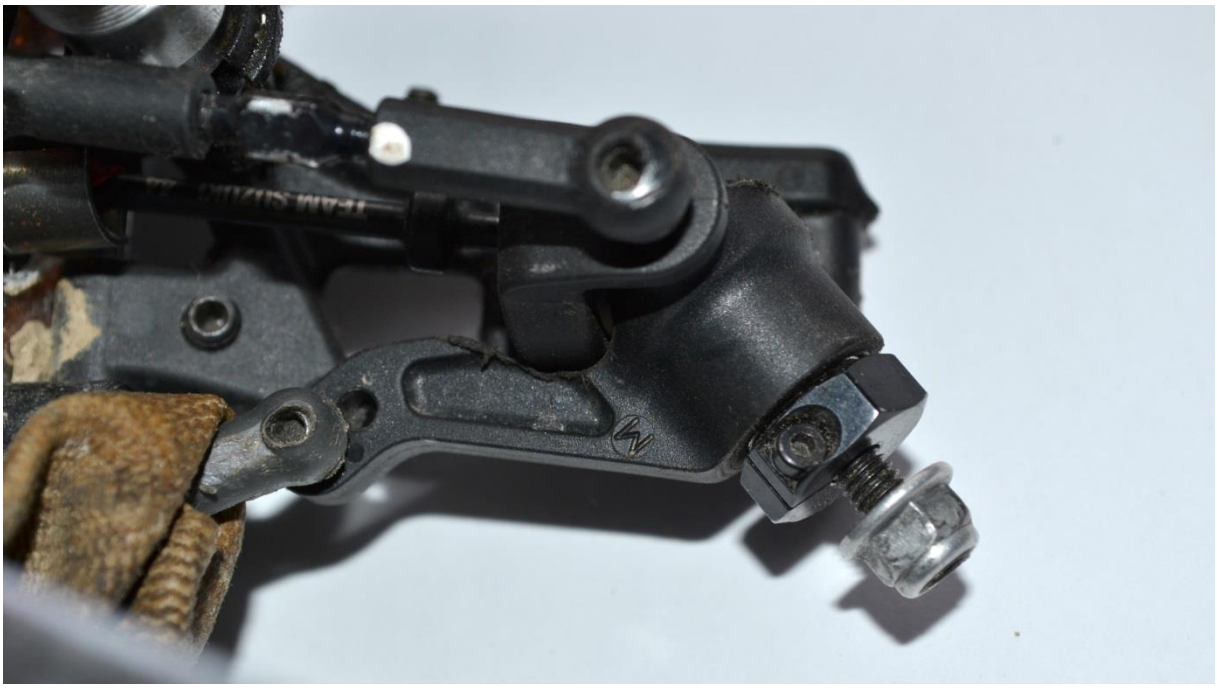

Fig. 10 Adequate cutted steering block

By increasing steering angle and also clearance of chassis could happen that steering block can hit the arm. In that case cut arm or/and steering block in place shown in Fig.11.

Fig. 11 Arm cuting under steering block

SERVOSAVER

Sometimes is longer steering arm needed to utilize that entire steering angle gained in previous adjustments. By Xray T2 and T3 you can manage this by extending servosaver,

which is adjustable. You have to grind longer groove on it to get to one or two more teeth further than original maximum length as in Fig. 12. By other chassis you can lenghten arm for example with some small alu plate.

Fig. 12 Servosaver extension (right)

When bigger ride height, it maybe can happen that turnbuckles hint lower chassis deck. Therefore it is better to place turnbuckles higher as shown in Figure 13. Halfway house is also put higher joint only at steering blocks, but this is not really good for your car geometry, because by damper compresion wheels are making toe-out. To make possible to put also second joint higher, you have to rearange the servosaver. Otherwise it is not place enough to do this between servosaver and upper chassis deck. To rearange servosaver you need to have looooot of endurance. At first, dismantle servosaver by taking down the retaining ring, than compose it in order shown in Fig. 14 and finally put the retaining ring back. In original order servosaver is composed like this: (from the bottom) spring, arm to servo, arm to steering blocks. In modified order it goes: (from the bottom) arm to steering blocks, arm to servo, spring. By modification don’t forget to put arm going to servo conversely. Ball joint to servo is better to put at the top (conversely than in Fig. 13 left). To handle this, you will need as low ball joint as possible.

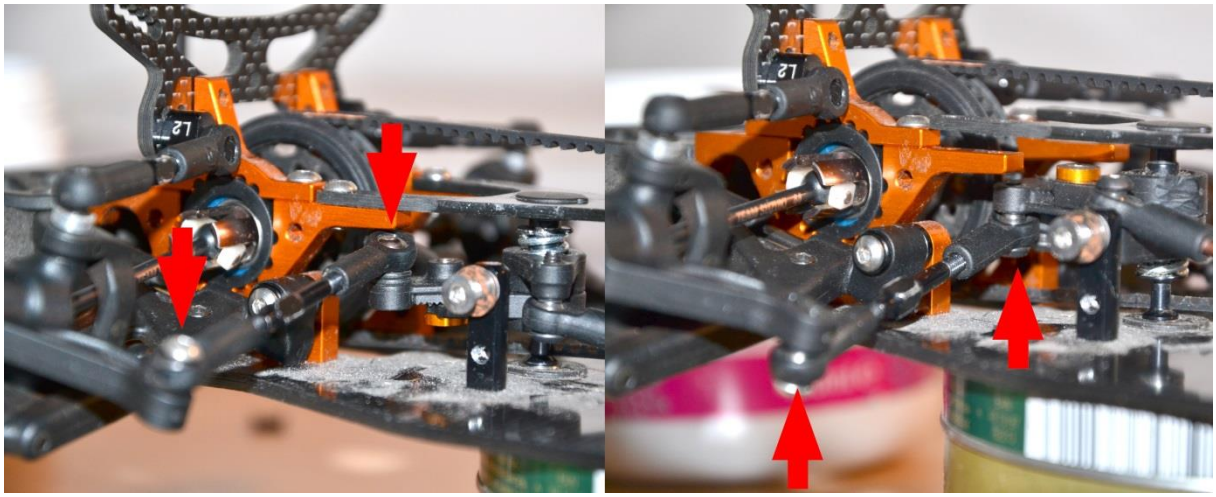

Fig. 13 Modified turnbuckle position (left) and original turnbuckle position (right)

Fig. 14 Modified servosaver (left), original servosaver (right)

DRIVE SHAFTS

When increasing steering angle, be carefull about drive shafts. You need drive shafts with working angle big enaugh. If you will increase steering angle too much and use shafts with unsufficient working angle, you will destroy them and maybe some other parts. In maximal steering angle driveshafts must be able to reach space marked by green arrow in Fig. 15. If they are able to reach only space marked by red arrow, is it not enough!

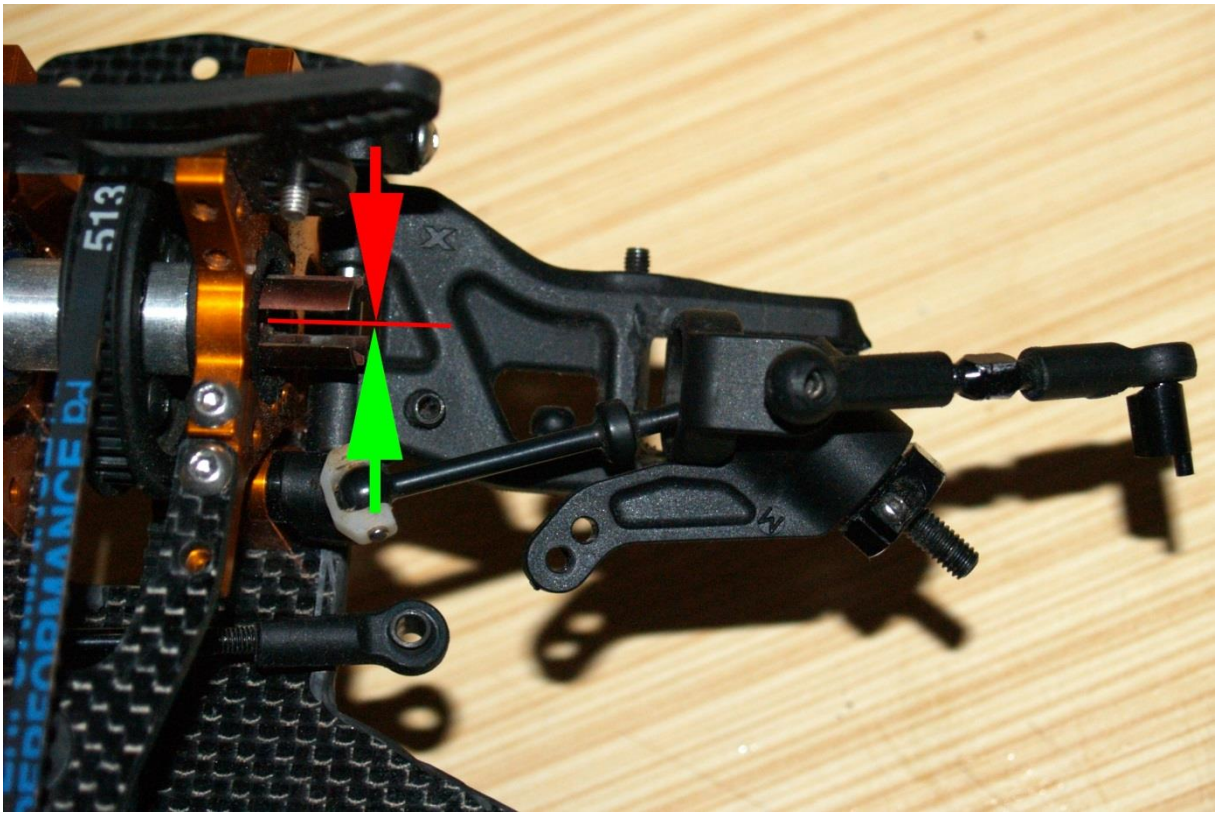

Fig. 15 Driveshaft angle check

That's why you have to replace driveshafts by such ones that have working angle sufficient. If you have so called "dog bones", replace them immediately. Good ones are SpecR double-jointed shafts, which also prevent from vibrations when cornering. It is also possible to increase driveshafts working angle by small modification of them.

Fig. 16 Drive axle chamfering

Modification has two steps. At first, chamfer the edge of drive axle as shown in Fig. 16. You won't need lathe necessary, it is possible to do well also in cordless drill with some rasper. Next step is grinding of joint. You can clamp small rasper with correct diameter to cordless drill and grind by rotating it to become wider (not bigger!) groove. Of course you can do second step manually. In both steps be careful, driveshafts are much stressed parts.

Fig. 17 Widering ball joint groove

CASTER AND ARM TILT

Caster influences steering in rally positively. Tilt of front arms has positive effect to drive through some bumps. You can increase caster two ways:

- use another C-Hubs with enlarged caster angle
- tilt whole arms

Personally I use second choice, because it also affects damping as described above. By some chassis it is possible to make it by turning of suspension holders (you also need change right and left holder) as shown in Fig. 18 on Xray T3. By another chassis (newer Xray's, Tamiya TRFxxx, Tamiya TB02, ...) you can make this by putting some washer under front suspension holder. Best way to do arm tilt would be to put front suspension holder higher and at the same time rear suspension holder lower. However it's not necessary and only front holder higher is good enough and functional solution.

Fig. 18 Original front suspension position (left) and tilted front suspension (right)

STEERING TURNBUCKLES

Sometimes, when increasing steering angle, turnbuckles could strike other chassis parts as suspension holders. You can solve this by using bended turnbuckles as shown in Fig. 19. You can use for this threaded rod, make own turbnuckles with left-right thread or use original part and bend it. Warning! Many of original turbuckles are aluminous and those could crack when bending or worse after bending in race.

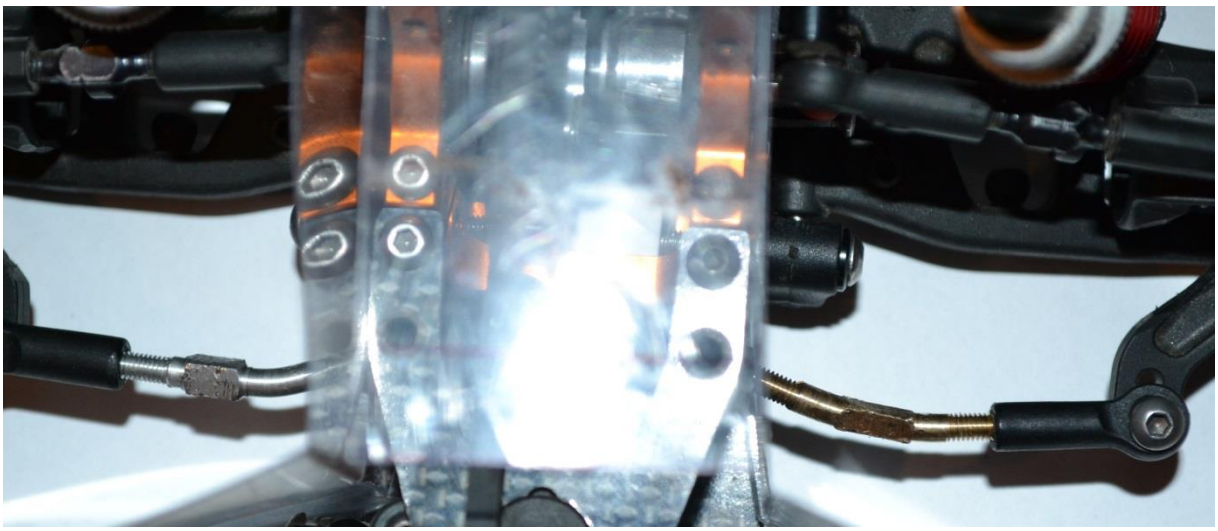

Fig. 19 Bended turnbuckles

COVERING

Radio controlled rally is sometimes raced in bad conditions, as rainy or dusty terms. Many chassis are constructed as belt-driven and also gears are uncovered. For construction like this any stone in gears may be destructive. In this way, shaft driven chassis could be better, because also gears are almost by shaft driven cars covered. Next reason to make the covering is electronics, which can be damaged by water or dust. In this manual I will describe covering of onroad belt-driven chassis, which could be little more difficult to cover than shaft driven chassis covering. Making the covering is maybe the most demanding part of making rally rebuild, sure it is very time-consuming. After managing this your car will be able to run in all conditions. When making covering more than by other parts of rebuild you are able to use your own creativity.

Starting to make covering is best, when all other modifications are done. This avoids situations that you make some modifications on covered chassis and covering doesn’t allow them or hampers it. Also don’t forget to electronics. It is better to have electronics installed in car to know, where you can or can’t put parts of covering.

For covering use some water resistant material, like plastic file folders, alu sheet. I personally use transparent material shown on photos, available at www.shop.embieracing.com. This transparent material has advantage, that you see thru you covering and it also doesn’t crack like some materials do.

DIFFERENTIALS COVERING

By onroad chassis is also covering of differentials needed. You have to make around them covering as shown in Fig. 20. Make left/right, upper, front or rear walls and duct tape them together. It is posible make some or all walls from part, duct taping isn't needed then.

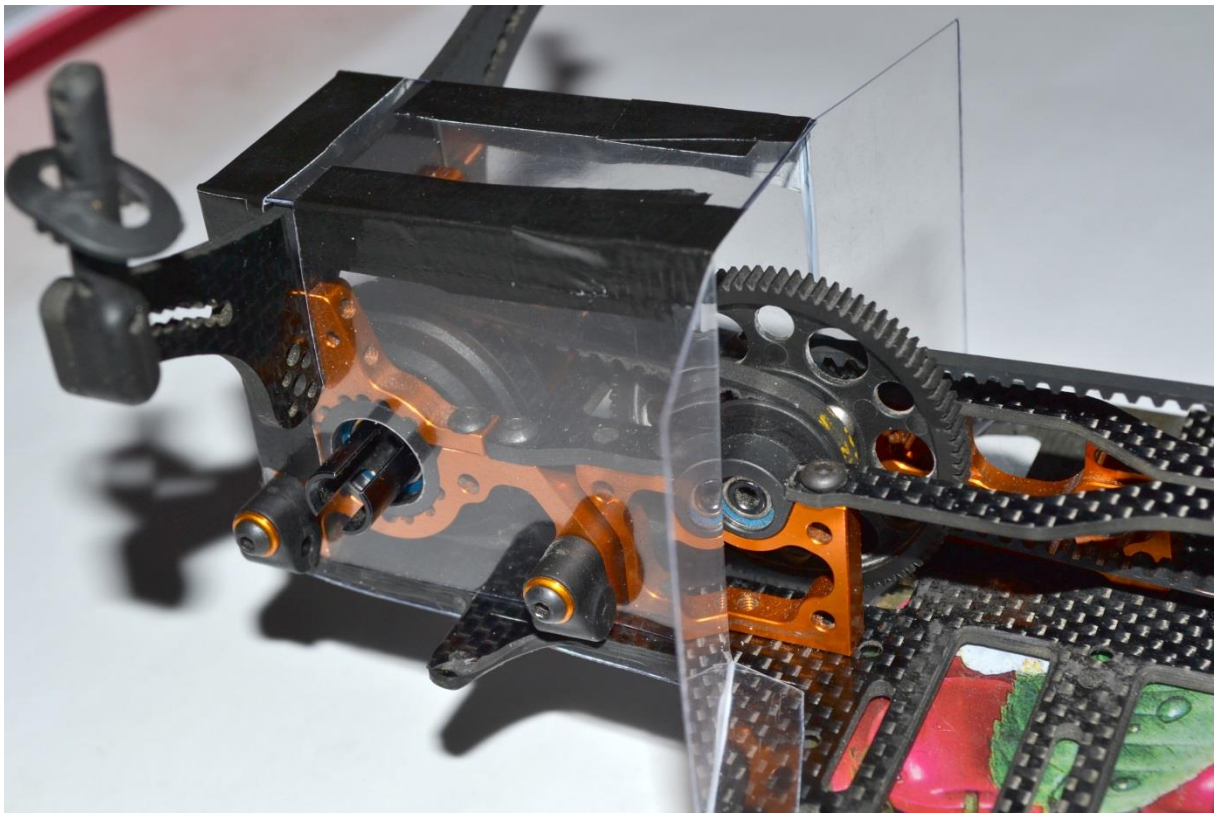

Fig. 20 Rear diff cover

Start by thinking about shape of your covering around diffs. I do it with „wings" at both sides (Fig. 20) curved by bending sideways. Material is easily bendable by using table desk edge or ruler edge. I use these wings for conection with other parts of cover. Overlaps at wings as shown at the bottom of the Figure 20 and in Figure 23 are helping to „seal" and you can put also screw thru them. Side walls need to have holes for suspension holders, diff outdrive adapters, shock towers and at front for steering turnbuckles, all shown in Fig. 21. You have to measure well these holes to have them big enough, but not too much, because dirt could go threw them. Especially holes for steering should be big enough, to not to hinder steering turnbuckles. Steering holes are too big, so you have to count also with another covering of them, so better do them about 1mm wider at each side. When measuring holes for steering you have to put front suspension on car and measure endpoints of turnbuckles when the steering goes left/right and also when the suspension goes up/down. Vertically you can measure from lower deck horizontally you can measure from suspension holder or another point on chassis.

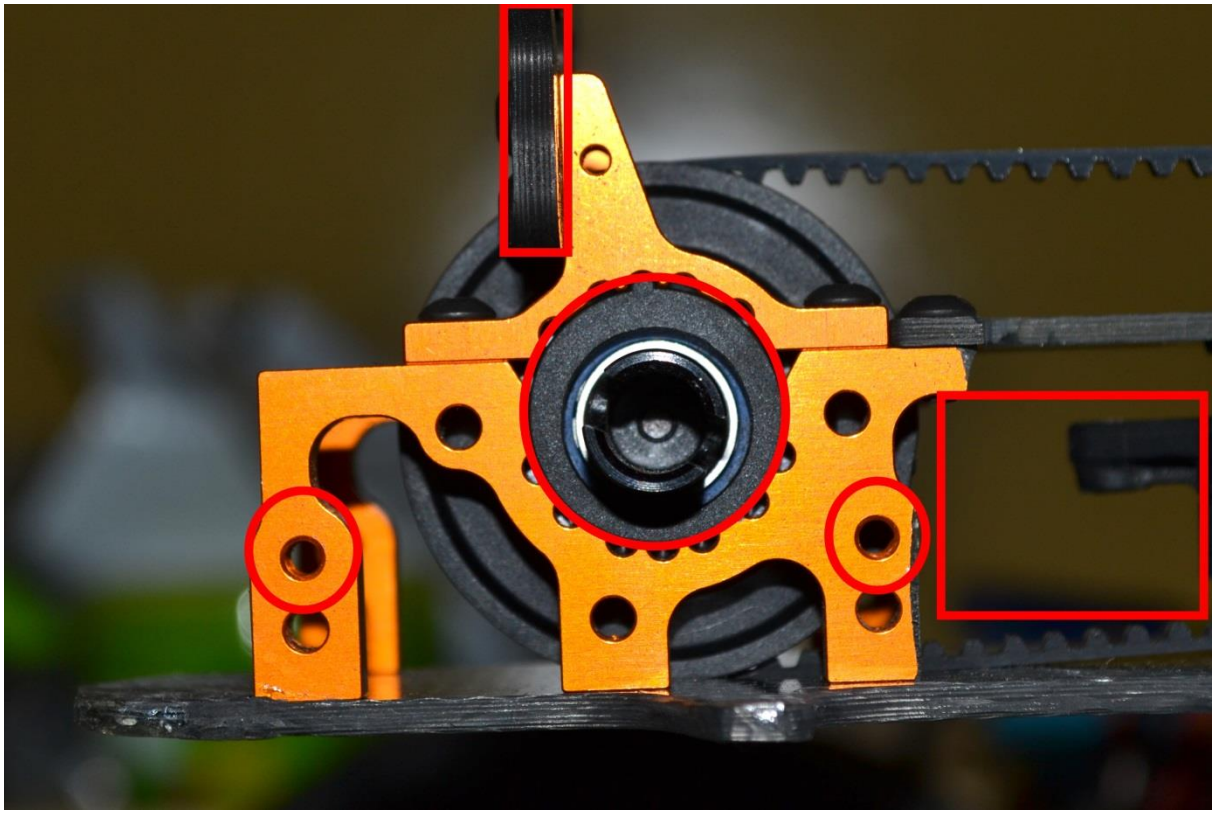

Fig. 21 Future holes in your covering (some not so big as shown)

I recommend you to think first about side wall, then draw it, measure and after that start to make it. Draw it on material you will use, cut out (Fig. 22) and bend, if needed.

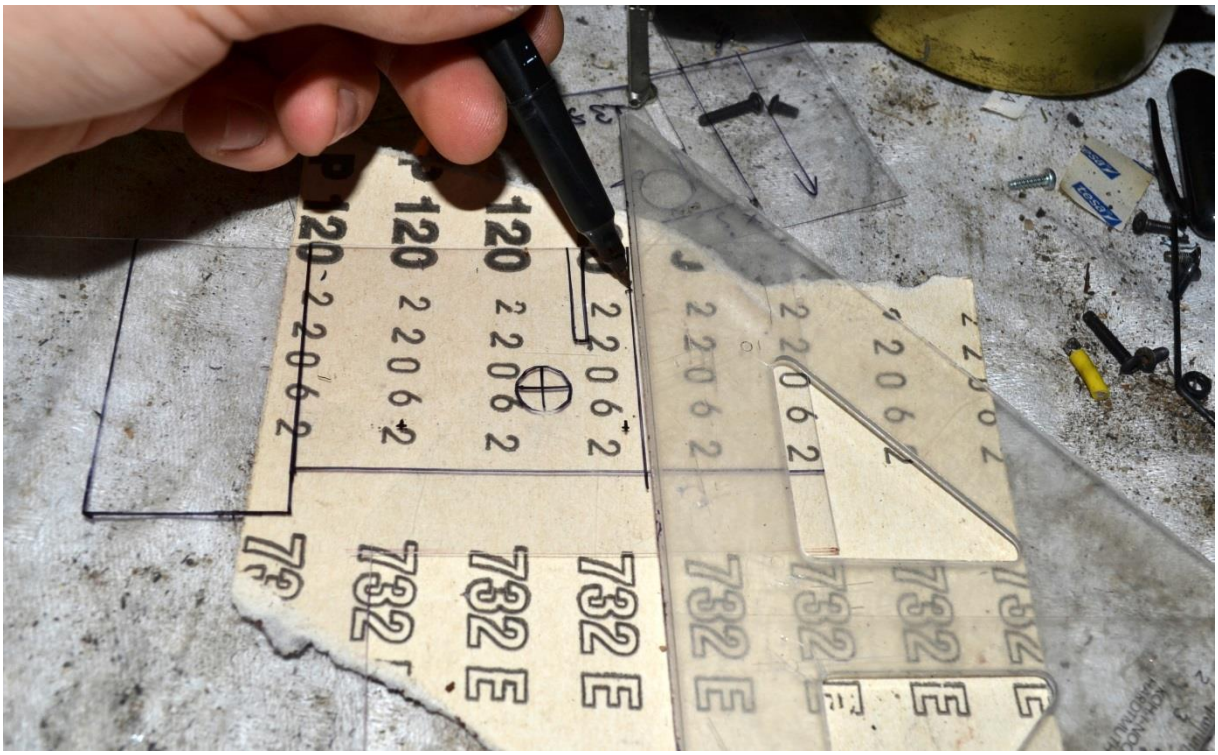

Fig. 22 Making the side wall of cover

Use the same process for rear/front diff. When sides done, put them on the chassis (Fig. 23) and join left and rear walls together by using stripes between them and duct tape them into shape shown in Fig. 24.

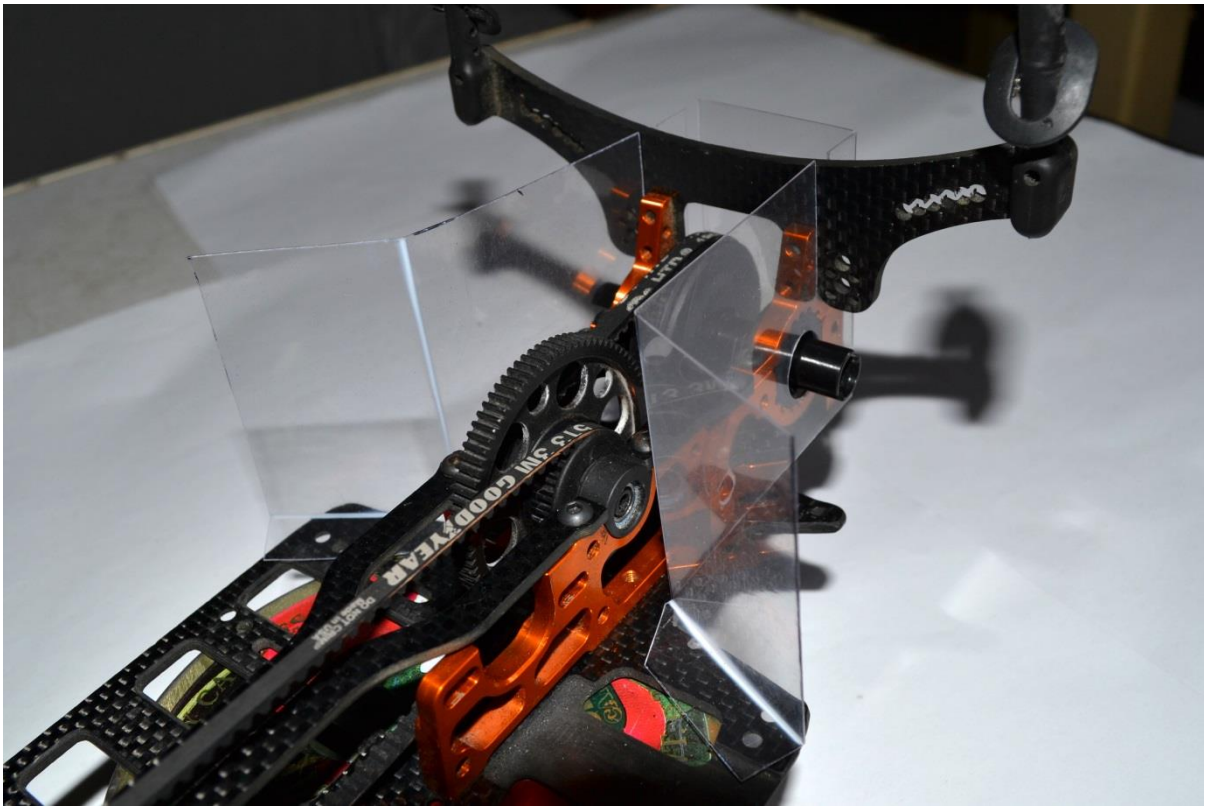

Fig. 23 Side walls

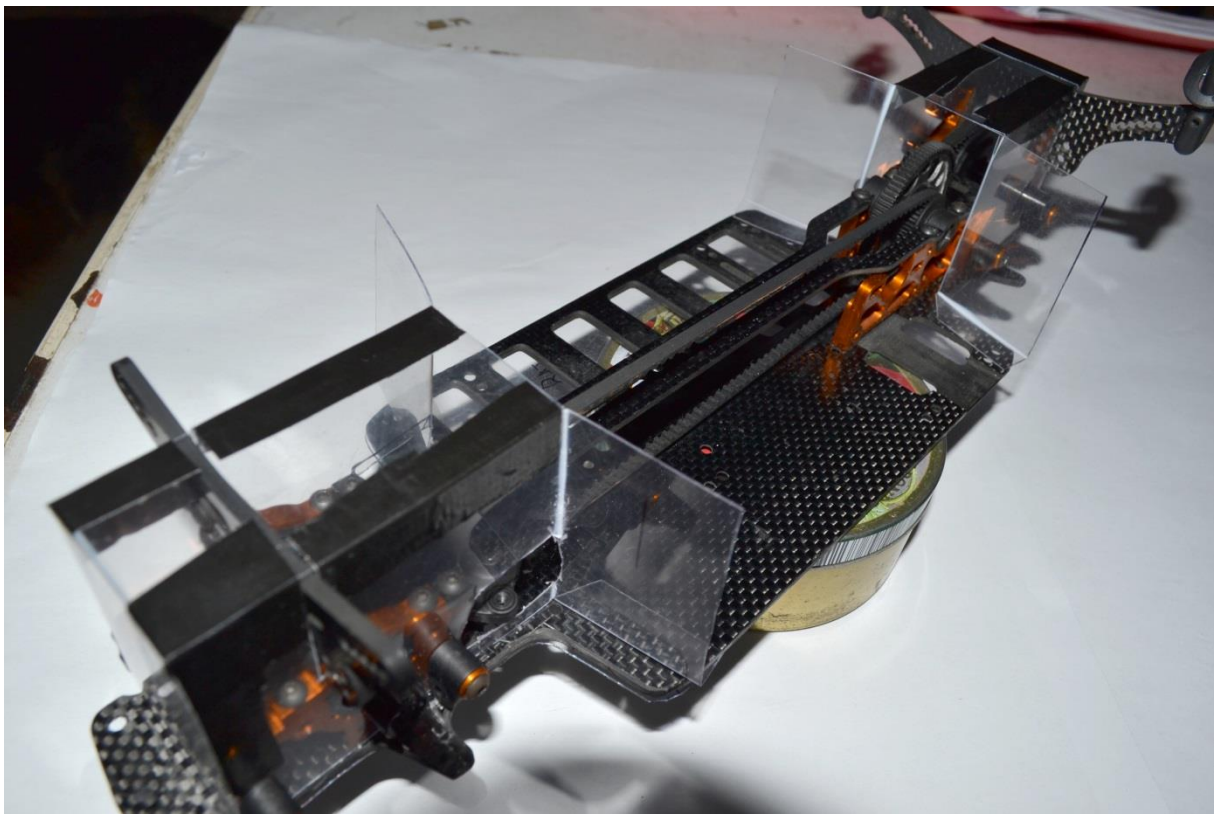

Fig. 24 Side walls completed with front/rear and top walls

STEERING COVERING

Around steering are still huge holes and you need to cover them better. If you wouldn't do that, there will be lot of dirt going into covering thru them, especially when steering. Best way to do that is to glue glove finger around the hole. Do small hole at the end of glove finger for turnbuckle, all is shown in Fig. 25. You can use working rubber glove, but it's not so soft and it creases and hinders in hole. In that way is better rubber medical glove, but on the other hand, this one is prone to chafing. In my opinion, best way is to use (made from weakest possible cloth) cloth gloves shown in Fig. 25. You can also take some cloth, thread, needle and try to be creative.

Fig. 25 Glove finger to cover hole for steering

Next glue glove finger into steering hole as in Fig. 26. Don't use super glue, because this glue makes material around glove brittle and it can break up. Best choice is some flexible glue shown in the Figure 26. Put the finger outways. It should fill the hole completely, sometimes helps putting it little angled. After that, „pour" glue around hole as in picture. Wait till glue stiffens completely (or be carefull when handling with it) and cut residue going into covering.

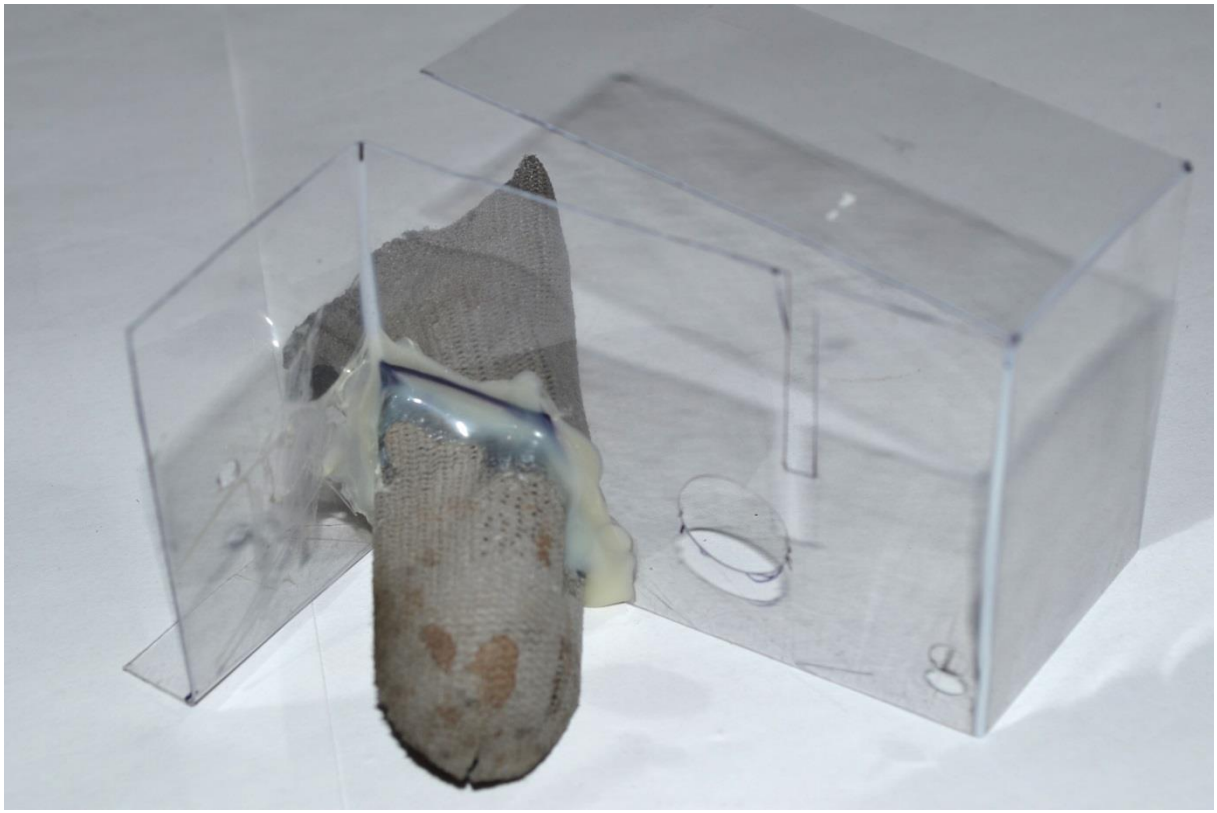

Fig. 26 Steering turnbuckle hole covering by glove finger

MIDDLE PART OF COVER

You have now covered space around differentials and steering and you need to connect these sections together by making middle part of cover. Finally it will look as in the Fig. 27.

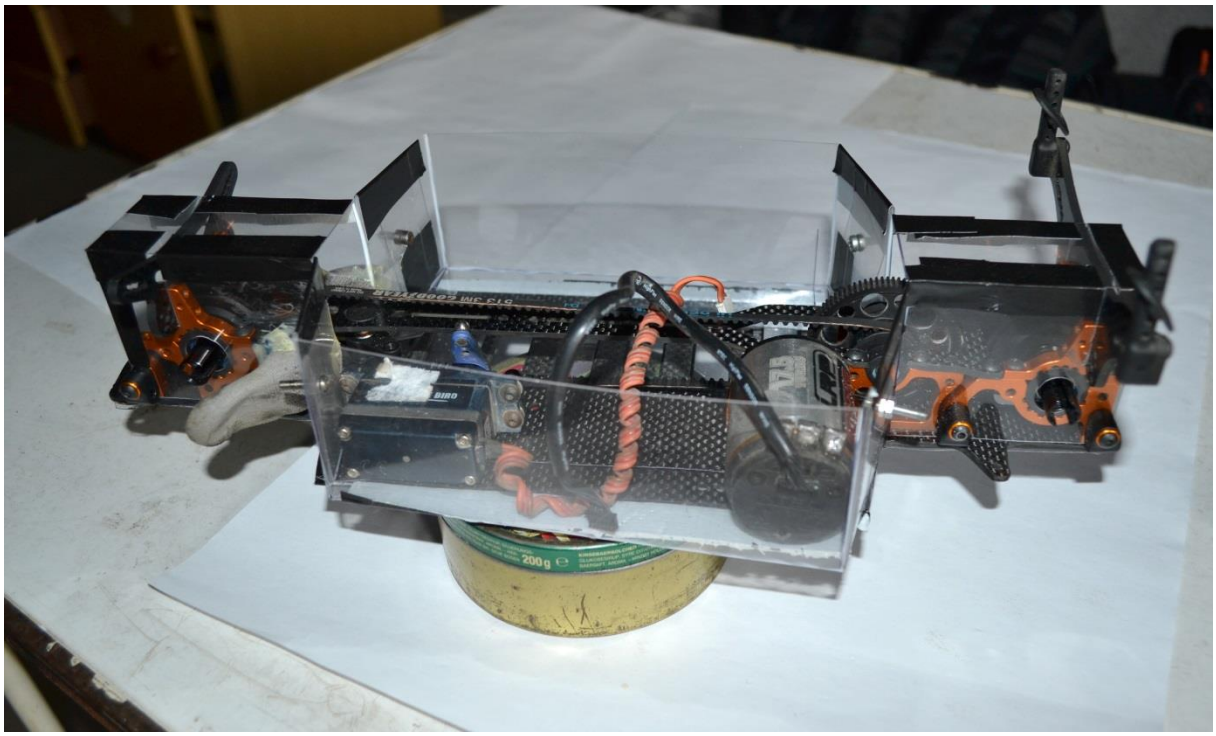

Fig. 27 Front and rear part of cover connected by middle part

Think out, in which distance from side of chassis will be middle part constructed (don't forget to electronics) and start to measure (Fig. 28).

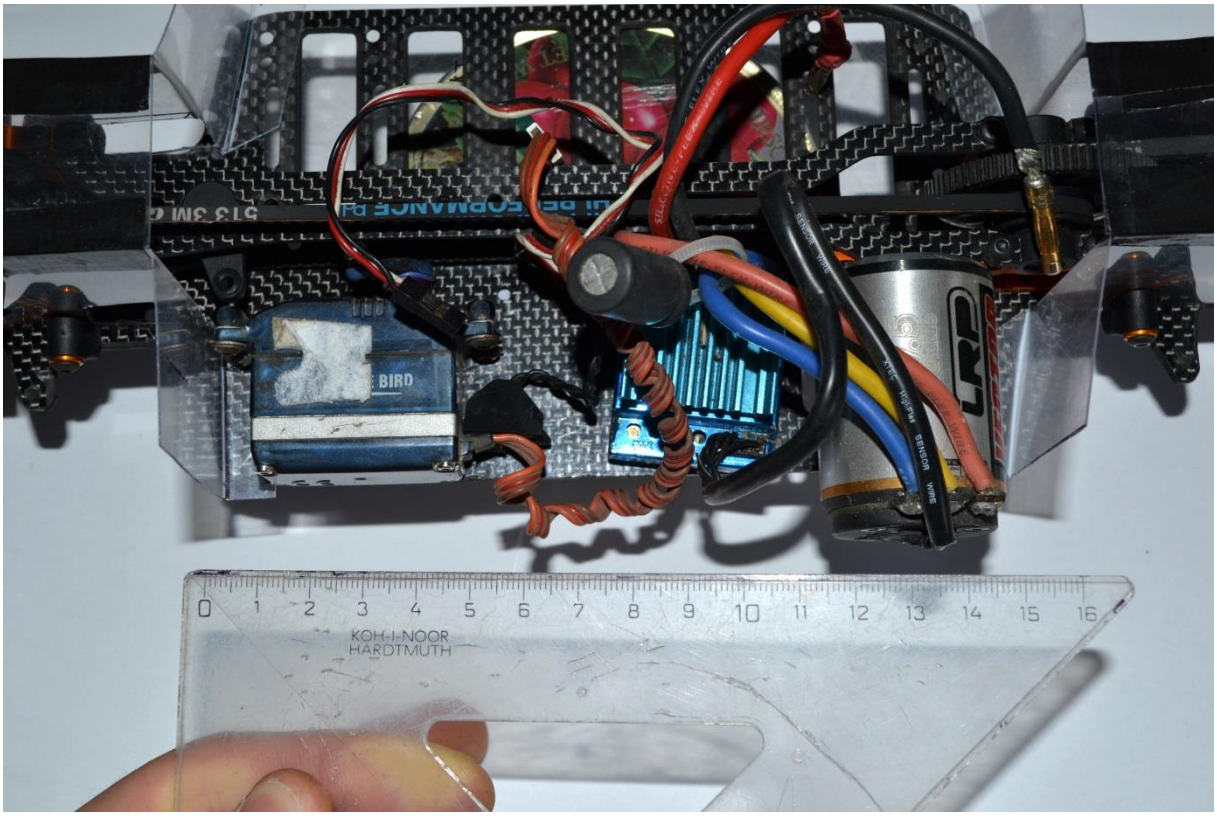

Fig. 28 Middle part measuring

First measure expectanced distance from side of diff cover part to side of middle cover part. Next measure length of middle part (similar to distance from front to rear „wing") and last measure distance between chassis edge and supposed side of middle cover part. To last distance add about 10mm to make cover little bit over the lower chassis deck. Then draw all dimensions at your material for cover and cut it as in Fig. 29. After that, bend parts of it shown in Fig. 29 into shape shown in Fig. 30. After that, just put it on the chassis.

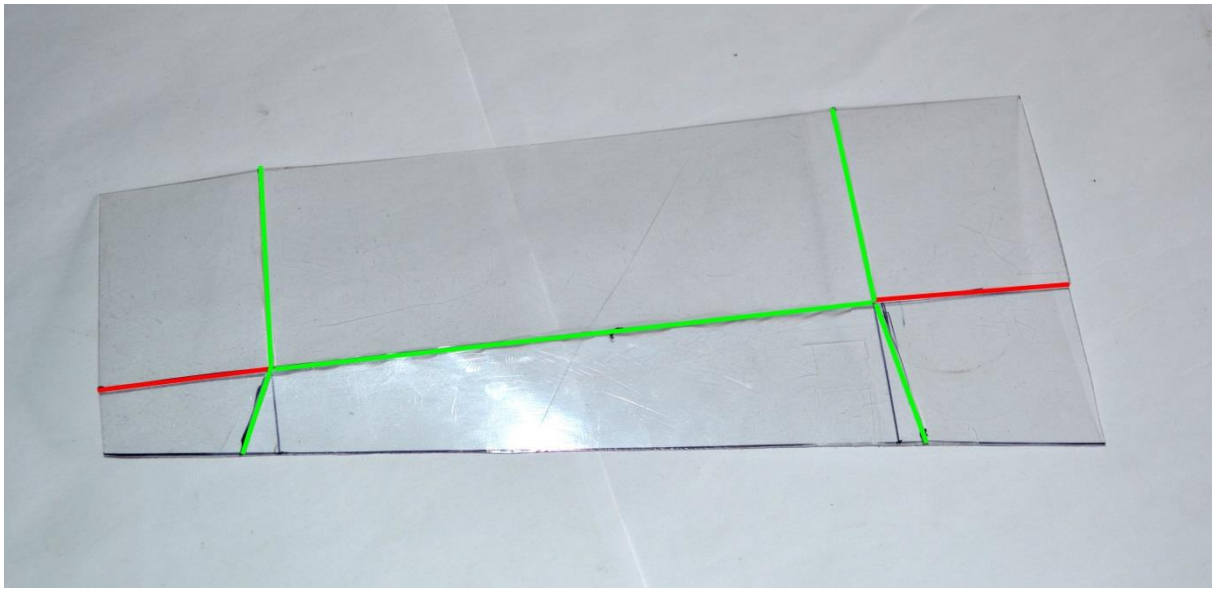

Fig. 29 Middle part. Green lines - bending, red lines - cutting

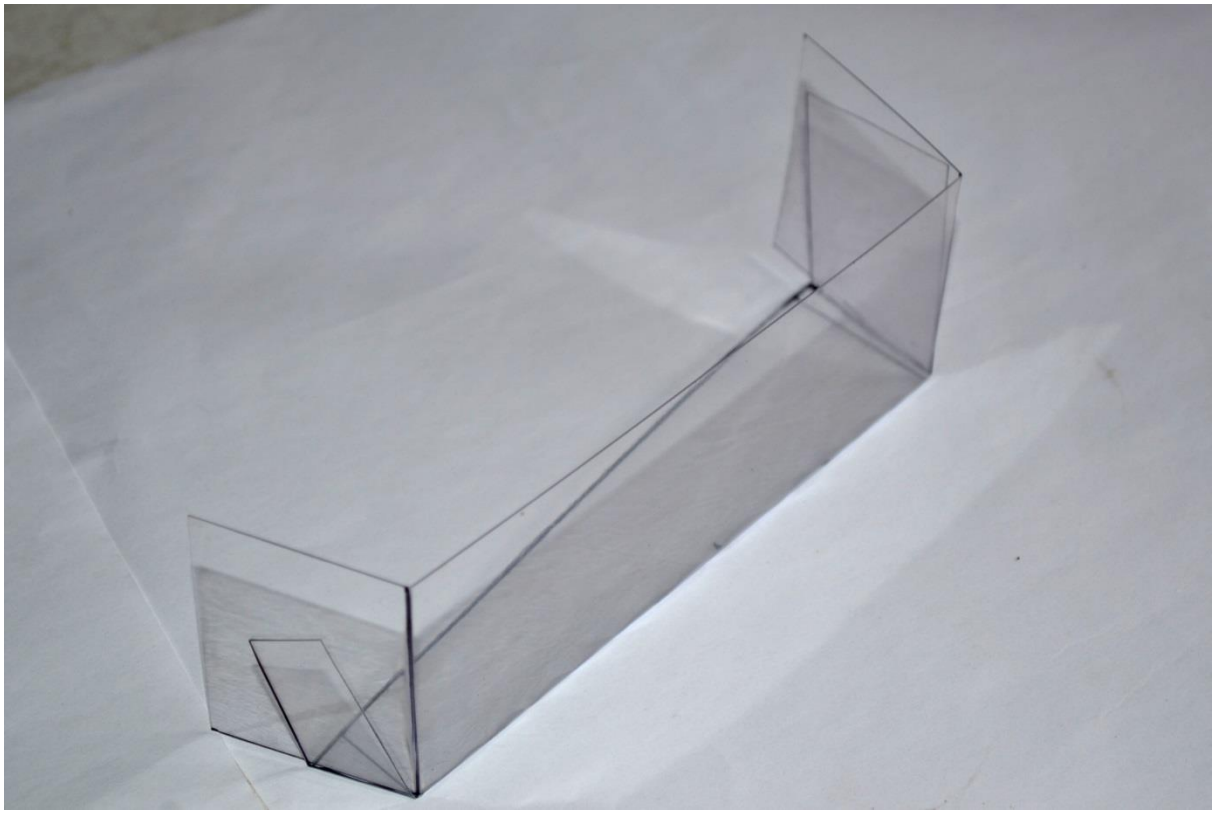

Fig. 30 Middle part done

When middle part fits good on chassis, duct tape it to chassis and to other parts of the cover. Put also put screw with nut thru middle and front/rear part of cover and secure the connection of them as in Fig. 31. Use longer screws as in picture, they will be used later.

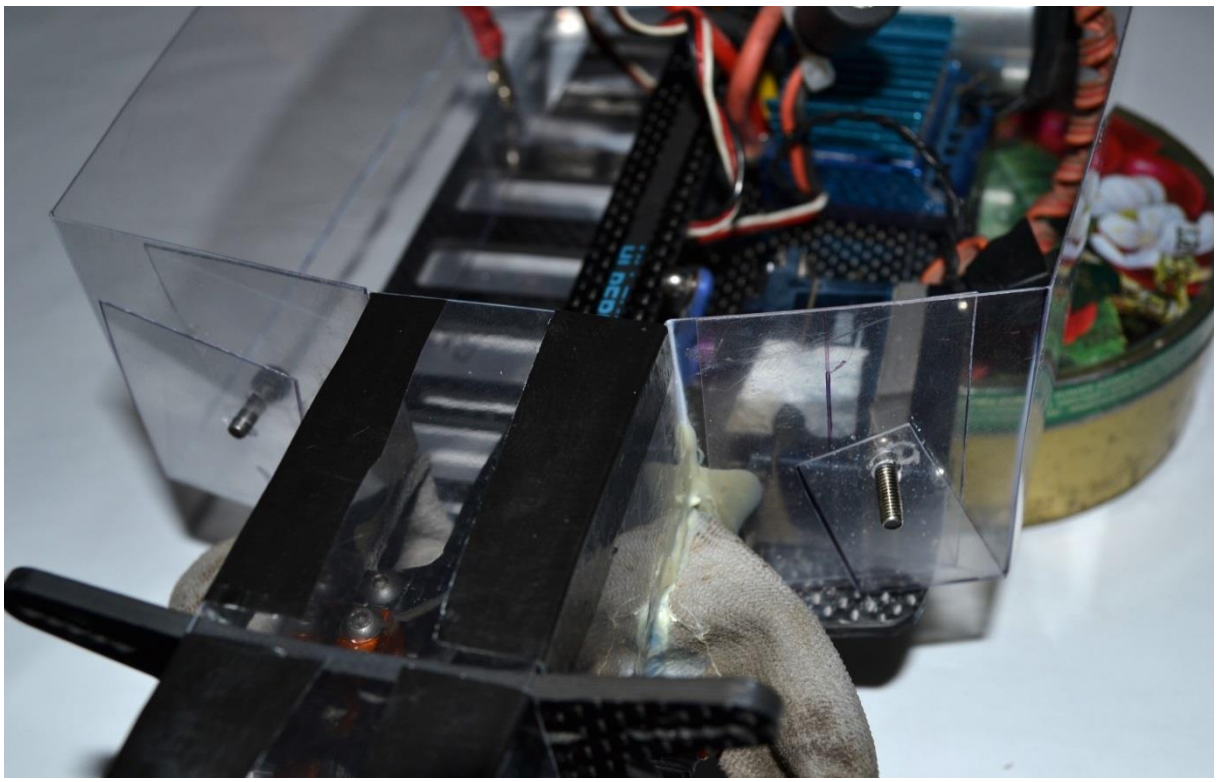

Fig. 31 Bolting of front and middle part together (nuts will be added)

It's possible to make left and right middle part in one piece. Than they have to be connected under the lower chassis deck. It also protects lower deck of chassis. Protection of lower chassis deck can be made separately, described later.

UPPER PART OF COVER

When your cover looks like in Fig. 27, trace the shape of cover to your material (here comes big advantage of clear material) as in Fig. 32 left. Next make about 20 mm wide strip on each side and cut (Fig. 32 middle). In last step bend sides and duct tape everything as in Fig. 32 right.

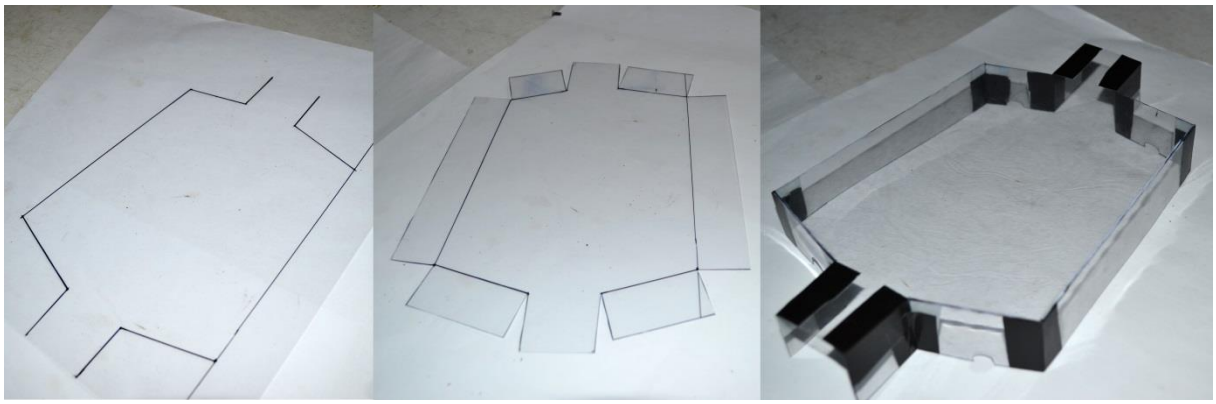

Fig. 32 Tracing, cutting and finishing upper part of cover

Finally, put on the upper part and use elastic band as in Fig. 33. If upper part is hitting screws, just cut it around screws.

Fig. 33 Covering (almost) done

LOWER CHASSIS DECK PROTECTION

In most of lower chassis are holes under differentials or spur and some unused screw holes. You have to prevent chassis from dirt going thru this holes. Three possibilities here: Easiest one - just duct tape them all. I used to make this before I constructed my own lower chassis deck without holes, which is the second and best possibility (Fig. 3.1). Third one, shown in Fig. 34 is to trace your lower chassis deck and cut it of your used material for covering. Screws should be thru this covering part, because if you need to repair or achieve something screwed on chassis, it is possible. Disadvantage of last choise is that between protection and chassis could stuck some small stones or dust. This part could be made as one with middle part, as described earlier.

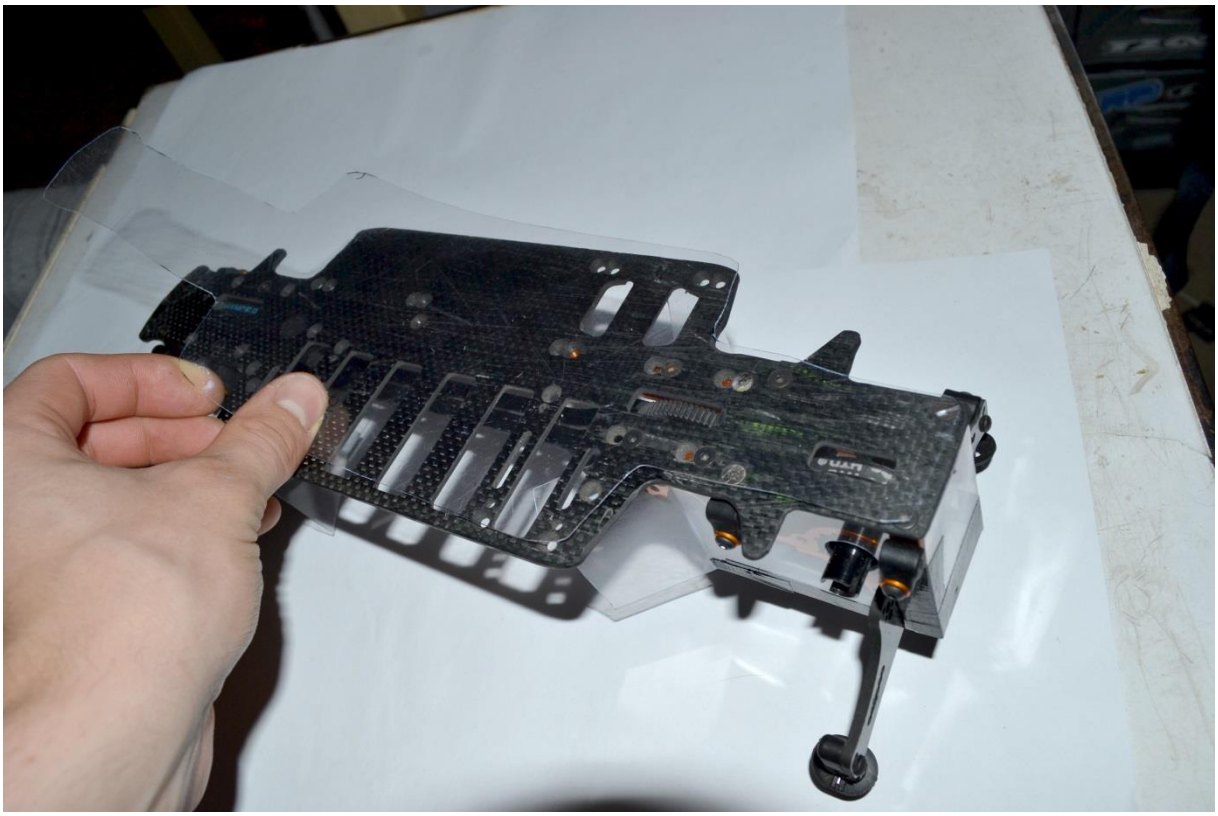

Fig. 34 Lower deck protection

ACCES TO COVERED CHASSIS PARTS AND ELECTRONICS

By covering chassis, it could be difficult to reach some screws or parts of chassis. To reach screws, make some holes thru cover (Fig. 35) and duct tape them subsequently.

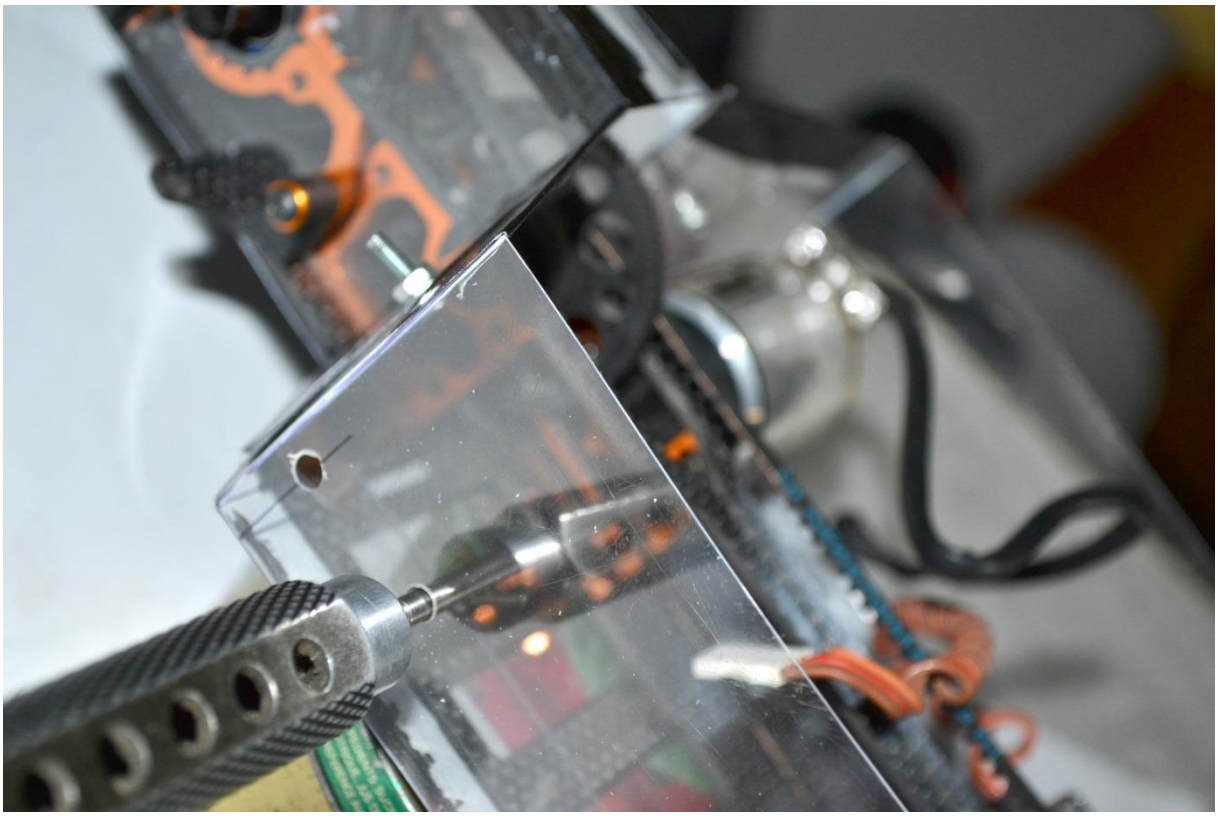

Fig. 35 Motor screws reaching

When reaching differential, take off duct tape and upper wall above it and cut cover around it and flex it as in Fig. 36. Next duct tape the cut. It's not neccesary to make this straight, cut in moment when it is needed to reach diff.

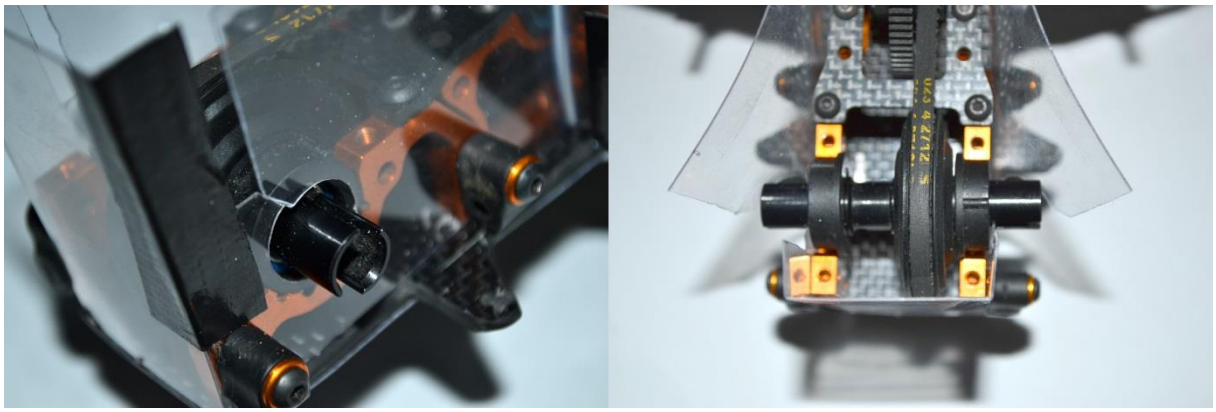

Fig. 36 Diff reaching

BASIC SETUP

OK guys, I'm exhausted from translation, maybe later... :)

CONCLUSION

This manual shows modifications of RC car for RC rally. Modifications described here are definitely not the only possible. There are many racers which made another adjustements than shown in this manual. Also you can modify some described procedures but I hope that beginners without experience will find here lot of advices. On last page of this manual you can watch, which version of this manual you read and you can check on my website, if some newer edition is available. I'm sure, in this manual is lots of solecism, so please be forgiving and in best way, let me know, how to fix them, because I'm not native English speaker.

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