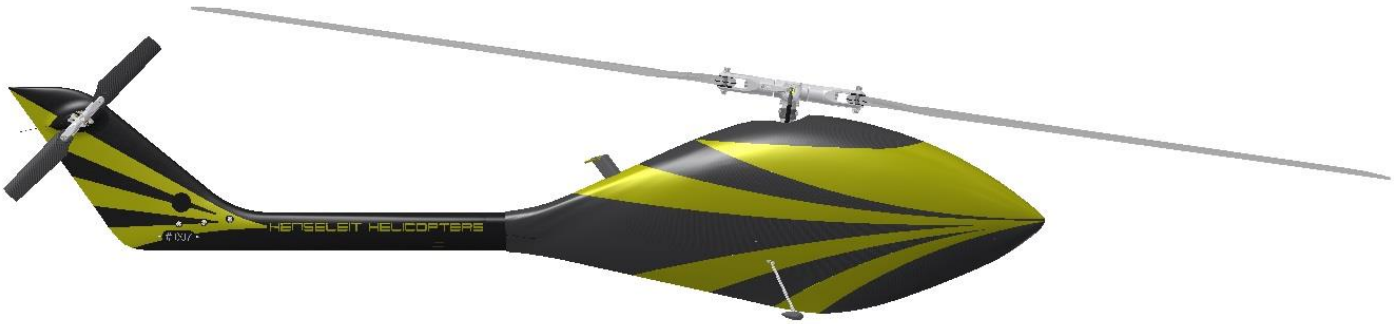
Three-Dee-Speed



M A N U A L

Release January 2019

Jan Henseleit

A T T E N T I O N ! I M P O R T A N T !

Please read the manual before opening the bags!

Beside the building instructions you can find explanations why sometimes extra ordinal technical solutions have been realized.

Index Three-Dee-Speed

Safety Precautions:

A remote controlled model helicopter is not a toy. Keep strictly out of reach for children. A model helicopter will only perform reliably if assembled properly and regularly maintained after each flight.

Keep sufficient safety distance from the model. Always assume technical failure could happen at any given moment, which may cause the model to become out of control.

Only apply original spare parts in case of repair. Such may be acquired directly through me. Sloppy assembly or repair work, as well as lack of experience in mastering a remote control, may cause the model to become out of control and become a lethal hazard. The enormous rotating energy of the main blades impose a permanent threat to anyone in the vicinity of the model.

Careless handling may cause any given sort of lethal injuries or property damage. Therefore, refrain from overflying pedestrians and vehicles by all means.

Safety is the highest commandment within the scope of your sole responsibility.

The particular hazards involved are explicitly mentioned here, due to the fact that neither the manufacturer nor the seller of these kit products has any influence on their use and operation.

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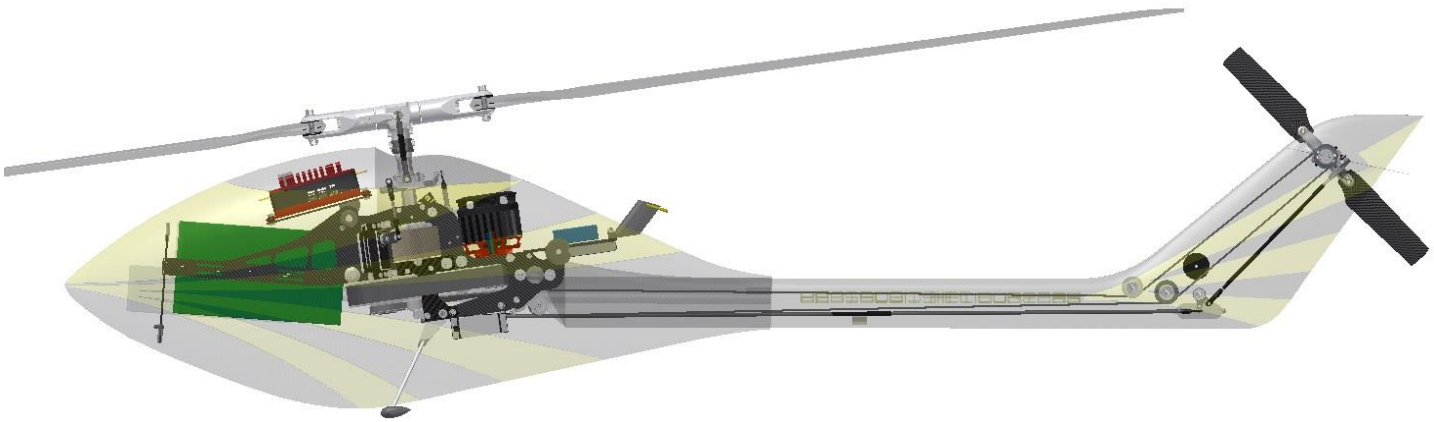
Jan Henseleit.



TDSpeed - the ultimative Speedmachine -

Compliant to the new FAI rules for world record trials with a 10S-Setup and below 5kg.

The **TDS** was presented in a first version in 2013, but just produced in the trainer version of the TDR-II with closed canopy and a normal standard tail. The TDR-II has worldwide made a name as the fastest serial speed machine and is the actual world record holder.
Nevertheless it was a concern to me to start again with the design of the **TDS** as a pure speed machine, as there are further advantages due to the better aerodynamic. The tail fin supporting the tail rotor during speed flights and the 8° tilting of the rotor shaft will provide further advantages.
Due to the tilt angle of the rotor shaft the complete fuselage is lying better in the air stream during speed phases in the measuring track.
The asymmetrical shaped side fin supports respectively unloads the tail rotor with increasing speed so the flybarless system is reducing the pitch angle of the tail rotor blades automatically and therefore more power is available for the main rotor.
Theoretically at speeds above 200km/h the machine could fly without a tail rotor without the fuselage yawing from the vertical axis.
A symbiosis has created based on the large experience of the last years with the TDR-II related to a compact design with high loadable gears and the TDFun concerning extreme lightweight design, which is similar to a Formula 1 race car designed just for speed flying or a wide range elegant flight style.

Attention! Due to the aerodynamically completely closed fairing, the tail design and the rotor respectively swash plate control system this machine is not suited for 3D flights!
All possible combinations of large loops, long rolls or extreme long knife flights can be done perfectly.
In contradiction to the initial concept of the TDR-II everything which adds additional weight was omitted.
Also my linear drive system was not used because it could not be realized due to space and weight reasons.
The control geometry was designed that with a pre pitch angle of **+5°** and a range of **+/- 12°** is giving enough range and there is no geometrical mistake arising with max collective and additional cyclic control input. So you get a collective pitch range of **-7°** to **+17°** which is the optimum for speed flying, enabling emergency autorotation and a sensitive pitch management at high RPM.
To get more reserves for an emergency autorotation the tail rotor is not rotating jointly with. In case of a motor stop the tail rotor stops immediately rotating and you get an acoustical sign as the tail rotor is easily to hear. So you can react also in large distance before the main rotor stops and you can rescue the helicopter. The side fin is stabilizing the tail also at low forward speed allowing you to reach the landing area and land safely.

The servo **MKS HBL575 SL - X6-Series** is foreseen for the swash plate and the tail rotor. This Servo stitches by its performance data. It has standard dimensions in length and width but has an essentially reduced height.
For a machine as the **TDS** I did not want to make any compromise so this servo is part of the design.
Attention! Servos with other dimensions will not fit.

Due to the gear concept derived from the TDR-II the core mechanics could have been designed even more compact and even so transfer tremendous power. The inner chassis width of only 30mm together with very small bearing plates result in a high stiffness at smallest weight.
The servos are completely moved to the outside and everything is very good accessible even so the design is very compact. A similar gear as used for the TDR-II which is nearly undestroyable was used in the second stage.
In the first stage I used this time a belt drive. The intermediate shaft is now located in front of the rotor shaft to improve the CG location and allow the compact design. Also the tail with the tail fin could be located more to the front. With these measures the CG problems of the initial **TDS** are solved now.
Due to the 3 different toothed belt discs for the motor with **22, 23 respectively 24 teeth** gear ratios of **9,64:1 / 9,22:1** respectively **8,84:1** are possible.
The tail rotor has a low ratio of **1:4,27**, so the rotation speed is not so extremely high with the high main rotor RPM. This results in a pleasant meaty sound as the main rotor sound is not predominated by a screaming tail rotor.
Starting from the presentation of the new **TDS** at the Rotor Live in spring 2018 until the first delivery in January 2019 I did a lot of test flights and trials to optimize this machine.
Several modifications have been implemented. E.g. the machine has now a variable dampening controlled by the rotation speed, allowing a flapping below 1700-1800 RPM and blocked flapping with a hard dampening at 2000 RPM or higher.
This measure was necessary to prevent dangerous ground resonance of the stiff, compact and light machine. Also a small horizontal stabilizer was added to the tail which increases the stability in high speed flight. You can find more detailed explanations in the different chapters.
Please take into account all my hints and recommendations concerning the equipment. This model is very special so bad surprises might pop up when doing experience on your own. All components of the complete system is similar to a formula 1 race car optimized to each other to get the best results and best performance.
Please also consider my recommendations for the motor. Due to the light weight and the aerodynamic design I dissuade from overpowering this machine senseless.
Much more important for good results is a harmonic and stabile flight behavior to enable a precise flight through the race track. Don't waste your time with questionable tuning measures but use your time to train the challenging speed flights. An experience I did again and again during competitions. The most successful pilots were the one who spend their time for optimizing the setup of their flybarless system and for training and not the one with the supposed strongest motors and a lot of modifications of their machine. ☺

Technical data and recommendation for the equipment:

Name	**TDS**peed
Manufacturer and Distribution	Henseleit Helicopters
Main rotor diameter	1600mm
Main rotor blades	700mm-720mm / 210g-250g / 5mm hole / small pre track
Recommended main rotor blades	**X-Blades 713s²** (State Jan. 2019 / the best speed-rotor blade at the time being)
Tail rotor blades (recommended)	100-110mm Carbon blades (**X-Tail Blade 106** or Dominik Hägele **DH-Blades 107**)
Empty weight of the mechanic	**1930g** inclusive canopy and tail
Take off weigth	4,9kg to 5,5kg - depending on motor and battery
Lenght – tip of the canopy to tail fin	1400mm
Total heigth	325mm
Max width of the landing gear	150mm
Max width of the canopy	110mm
Recommended motor	**KONTRONIK** **For 14S - Setup** **PYRO 850-50-Competition** (Shaft length from tip to flange 32 to 33mm with flat area for grub screw) This motor can be purchased from me with a fitting shaft. The shouldered 8mm shaft is lengthened to 32,5mm. (Weight of the motor with cables **615g**) **For 10S FAI - Setup** **PYRO 800-68-Competition** (Shaft length from tip to flange 32 to 33mm with flat area for grab screw) I can purchase this motor in a special edition with a fitting shaft. It is the optimum motor to provide the maximum power which you can get from a very good battery at the time being. A lot of test flights have shown this motor is thermically healthy and reliable. Peaks of 12,5kW are possible with this 10S setup. (Weight of the motor with cables **530g**)
Recommended ESC	**KONTRONIK Cool KOSMIK 250**
Posible gear ratios	22Z 9,64 : 1 **23Z** 9,22 : 1 recommended for the **14S**-setup with Pyro 850-50 Competition **24Z** 8,84 : 1 recommended for the **10S**-setup with Pyro 800-68 Competition
Gear ratio main- to tail rotor	1 : 4,27
Recommended main rotor RPM	**1600**U/min (for starting, landing and hovering / head dampening is unlocked) **2100**U/min (fast and wide range flight / head dampening is locked) **2600**U/min (Speed flight at 80 till 90% ESC opening / head dampening is locked) Hint: Due to the low rotation speed of the tail rotor higher main rotor speeds are not so easily acoustically noticeable compared to normal helicopters. I disadvice from using lower rotation speeds as **1600**RPM due to the low tail rotor performance at this rotation speed.

Required Servos

The **MKS HBL575 SL - X6-Serie** is required for the swash plate and the tail rotor. These Servos stitch by their performance data (about 19kgcm and 0,06sec/60° at 8V BEC-voltage / weight 53g). They have standard dimensions in length and width but have an essentially reduced height.
These servos are part of the design. Attention! Servos with other dimensions will not fit.

Recommended Flybarless System

Off course there is a huge selection of Flybarless-Systems on the marked, fulfilling their function more or less on normal helicopters. But using them at the physical limits with speed ambitions a lot of them come to their limits and the choice of useful system s is limited. The VStabi-Neo from Mikado fits absolutely perfect to this helicopter. Due to his low drag the helicopter gets very fast also with low rpm, coming quickly to the physical limits. With investing in a good system you are able to use the abilities this helicopter is offering. Thanks to the good pitch up suppression the limits will be extended a lot.

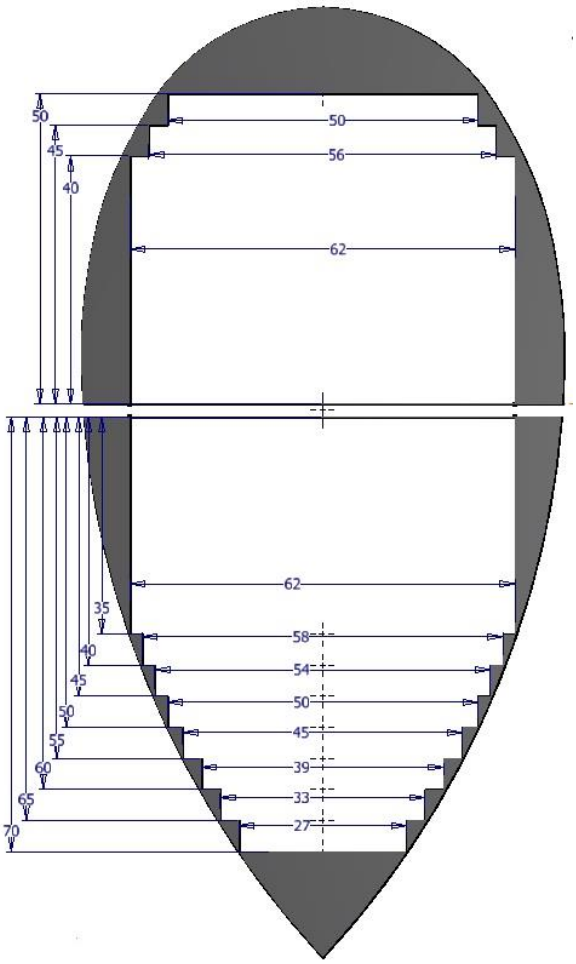
Recommended batteries

The **TDS** is designed for batteries consisting of two single packs. The total weight of these two packs should be at least **1,4kg** and maximum **1,9kg** to ensure the position of the CG in the area of the rotor shaft or slightly in front of it.

For a 14S setup you can use two equal sized 7S packs with a length up to 172mm. The max width and height can be identified by the cascaded cross section pattern (see sketch below).

The sketch shows the maximum seize at about 10mm before the front stop of the battery. The limits are given by the canopy cross section at this position.

Shorter batteries might have a larger cross section as the battery can be positioned more to the rear were the cross section of the canopy is larger. Please contact me in case of doubt, I can evaluate with the CAD model if the batteries will fit under the canopy or not.



On the left you can see the maximum cross sections at different combinations of height and width of the upper and lower battery at a maximum length of 172mm.

Attention! The maximum width should not exceed 63mm as the inner width of the battery tray is 64mm.
The maximum height of the upper battery has to be below 50mm otherwise the ESC will touch the canopy.

Take into account the space needed for the cables which should be placed to the front to ensure a proper routing. Possibly a trimming of the batteries shrink tube is necessary to allow the bending of the cables in the right direction.

Note! For a 10S setup I recommend to use a 6S battery at the top and a 4S battery below. The canopy support frame has a milled notch allowing the lower 4S battery to be placed 30mm to the front if the battery is positioned upright. The maximum cross section for the battery is maximum 37mm x 48mm than.

The total weight of a 10S battery should not exceed 1,4kg so the max. FAI weight limit of 5kg can be kept.
For training beside competitions heavier batteries can be used off course 😉

General information for the assembly (very important!)

Before you start, you should try to get an overview of the assembly by scrolling through the manual. It is recommended to assemble the helicopter next to your computer. You can also print the manual.

Please start at the beginning of the manual and keep with the sequence of the assembly instructions. It makes no sense to start in the middle of the manual. You can become easily stuck and lose track. Before starting a new assembly group, first read the whole chapter description and then start mounting. **It is not sufficient to view only the images because the text contains important instructions that have to be considered in any case.**

Explanations about backgrounds of certain solutions are written in green.

The assembly groups are packaged in sequence of the different assembly steps. Complex assembly groups with a great number of small parts are separated into several smaller bags that can be clearly identified.

In every stage of the assembly, please open only the bags you need. The first digit specifies the assembly group and indicates the first digit of the order number of the parts of the assembly group (such as the order numbers of all parts of servo linkage start with 06).

The biggest mistake would be to open all bags at once. In the parts list of each chapter, you can find all parts of the according assembly group. Sometimes there are screws inside, which have to be used later to fix different assembly groups together. This is always described.

Attention! The helicopter is generally build as an clockwise turning system and the blade linkage comes from the back side of the main blade grips.

A lot of parts of the helicopter are already pre-assembled. Nevertheless, this manual contains detailed instructions for these parts. These instructions may be helpful in case you have to disassemble or to change parts. There is **no** need for you to check the pre-assembled parts or to disassemble or tighten them! Also, the screws are secured with Loctite already if necessary.

Attention! Screws, which need to be tightened with **L**octite, are marked with a red "**L**". Use the blue Loctite (medium strength) or a similar product. Especially with the small grub screws, do not use too much **L**octite. Otherwise, you may have problems unscrewing the grub screws.

It is not necessary to tighten all screws of the electric helicopter with **L**octite because they do not get loose depending on the kind of stress. The lens-head screws can especially be hard to unscrew if using **L**octite because of their small hexagon.

In general, all grub screws and threaded link balls, as well as the 0911 screws of the tail centre hub, have to be degreased and tightened with Loctite. The hex socket screws allowing attachment of the gear to the corresponding flange also have to be tightened with **L**octite because the plastics sets after a certain time and the screws may thus become released.

Attention! Parts that you need to pay extra attention to are marked with a red "**!**". You will also find notes for these parts in the text.

In case some items do not fit, do not use excessive force. Re-think why it may not fit together and see if a little reworking might solve the problem. If you cannot solve the problem on your own, please contact me.

Have a look at the carbon-fiber reinforced parts. Use a strip of flexible sandpaper to chamfer the sharp edges if necessary.

Attention! When sanding Carbon fiber, use a fitted dust protection mask!

The helicopter consists of numerous screws and small parts. It may therefore occur that a part is missing or that the screws are not shaped correctly or that they are rejects. Unfortunately, we are not able to check every single screw. In these cases, please send us a short e-mail and we will immediately deliver the spare part.

You will find a bag with some special tools and special grease for the gears. A small extra bag (Reserve Parts) containing some established replacement screws is also included there. Some replacement parts are available if a screw is missing or a part is defective.

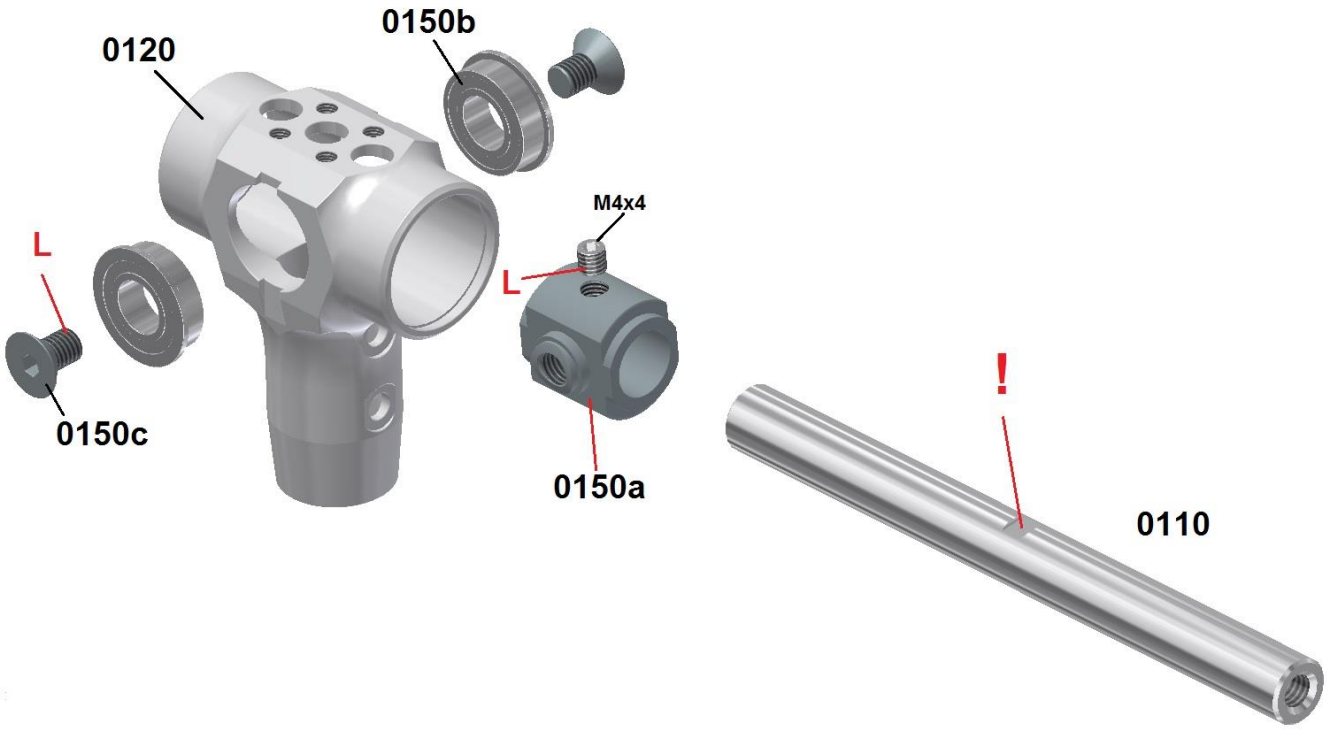
All in all, the assembly is not very demanding and does not require, besides some basic technical understanding, any special skills. Please take your time and work diligently to avoid problems that later on might be more expensive and time-consuming.

Now I wish you a lot of fun assembling the helicopter!

Assembly step – 1 Rotorhead

1.1 Feathering spindle seesaw (already assembled)

	0110	Feathering spindle 10x109	1x
	0120	Centre hub	1x
	0150a	Feathering spindle seesaw	1x
	0150b	Flanged bearing 8x16x5	2x
	0150c	Countersunk screw M5x8	2x
	G0404	Grub screw M4x4	1x



Fix the feathering spindle 0110 centric in the feather spindle seesaw 0150a by using the grub screw M4x4.
Attention! Ensure the correct positioning of the milled flat area which should be centered under the thread hole. Tighten the grub screw just slightly, while turning the feather spindle around the longitudinal axis. Also move the feathering spindle forwards and backwards. This ensures the correct alignment of the flat area of the feathering spindle by the end face of the grub screw. A control measurement of both ends of the both sides of the feathering spindle should show a difference of less than 0,2mm. Tighten the grub screw properly.
Then insert the seesaw with the grub screw showing to the top into the Center hub 0120. Fix it with the two bearings 0150b. Press the bearings one after the other into their fit and ensure that the bearing is not canted inside the fit or on the pin of the seesaw. Heat the center hub if the bearing is not sliding in easily (do not use high force).
Screw the seesaw through the inner rings of the bearings with the two M5x8 countersunk screws 0150c.
To ease the demounting of the two bearings a notch has been milled into the two faces of the center hub. You can place screw drivers on both sides of the bearing and by tilting them you can lever out the bearings. Take care not to scratch the center hub.

1.2 Seesaw lock – centrifugal force controlled (already assembled)

	0105	C-cilp	2x
	0150d	Rubber cone	2x
	0150e	Centrifugal force cone	2x

Attention! Grease the feathering shaft 0110 in the area inside the center hub and the centrifugal force cone 0150e at the outer side of the cone. The brass cone has to slide easily on the feathering shaft. Slide the brass and the rubber cone 0150d on both sides until the stop into the center hub and secure the parts with the C-clip rings 0105.

Use a spring-ring pliers or a small needle-nosed pliers for inserting the C-clip (you can also grind the tips an old needle-nosed pliers to fit to the C-clip holes)

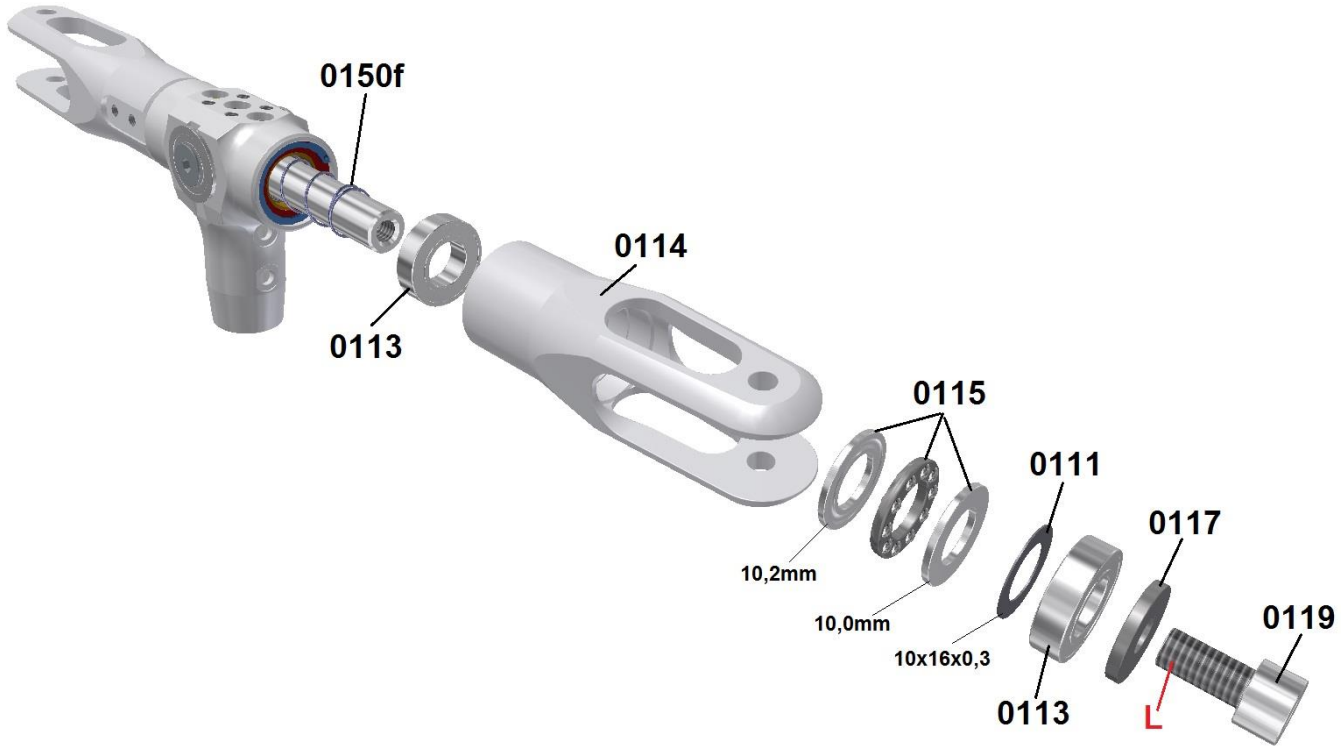
C-clips are punched out of sheet metal. They always have one sharp-edged side and one rounded-off side. Assemble the sharp side facing outward so that the rubber cones will have their seat onto the rounded side.

If the C-clip has correctly snapped into its groove it can be rotated. Now turn the open side of the C-clip to the position displayed in the drawing i.e. the open side should be sideward.

The explanation of the function can be found at the end of the chapter.

1.3 Blade holder

	0111	Spacer washer 10x16x0,3	2x
	0113	Radial bearing 10x19x5	4x
	0114	Blade holder	2x
	0115	Axial bearing 10x18x5,5	2x
	0117	Spacer washer 6x16x2	2x
	0119	Hex socket screw M6x12-10.9	2x
	0150f	Compression spring	2x



First assemble the blade holder with all bearings. Attention! To avoid any mistake it is important to follow a specific sequence. Both of the radial bearings 0113, which are pointing toward the center hub, are pressed into each blade holder. If necessary expand the blade holder with hot air. Make sure not to insert the bearing aslant. Now insert the axial bearing 0115 through the fork of the blade holder. Apply enough lubricant onto all parts of the axial bearing in advance (viscose grease into hollow side of ball cage). Pay attention to the correct sequence as displayed in the drawing. Each ring has to be inserted laterally through the fork. At the beginning of the fork where the bore of the blade holder begins, the rings are swiveled into rectangular position and pushed into the bore. Make sure the rings do not swivel by 180° and carefully reassure that the grooves of the rings always point to the bearing balls. This procedure can be simplified with the aid of a pin inserted from the other side, onto which you may align the rings. The first ring to be inserted has a 10.2mm inner diameter. Then the ball cage follows with its hollow side pointing toward the center hub. Then you insert the ring with an inner diameter of 10.0mm, followed by a spacer washer 0111 (10x16x0,3) and finally the second radial bearing 0113. If the bearing cannot be inserted force free, expand the blade holder with hot air. Make sure not to insert the bearing aslant.

Slide both blade holders onto the feathering spindle. Insert first the compression spring 0150f between the brass cone 0150e and the pre-mounted blade grip.

If the pre-mounted blade grip cannot be slide on completely, even the bearings are fitting easily to the feathering spindle, the reason is often a moved spacer washer 0111 which is not centered correctly. In this case take a pen and center the washer to the holes of the bearings in the blade grip.

Now, secure the blade holder with washers 0117 and hex socket screw 0119. Tighten both screws 0119 with Allen keys. The screws have their seat at the stop of the washers.

Attention! The screws 0119 are made of high-grade steel and may only be replaced by original spare parts. The use of conventional screw types bears the danger of tearing.

Attention! Tighten the screws forcefully by turning two angled allen keys against each other at the same time. The force will now not be transferred unnecessarily via the feathering spindle and the small grub screw.

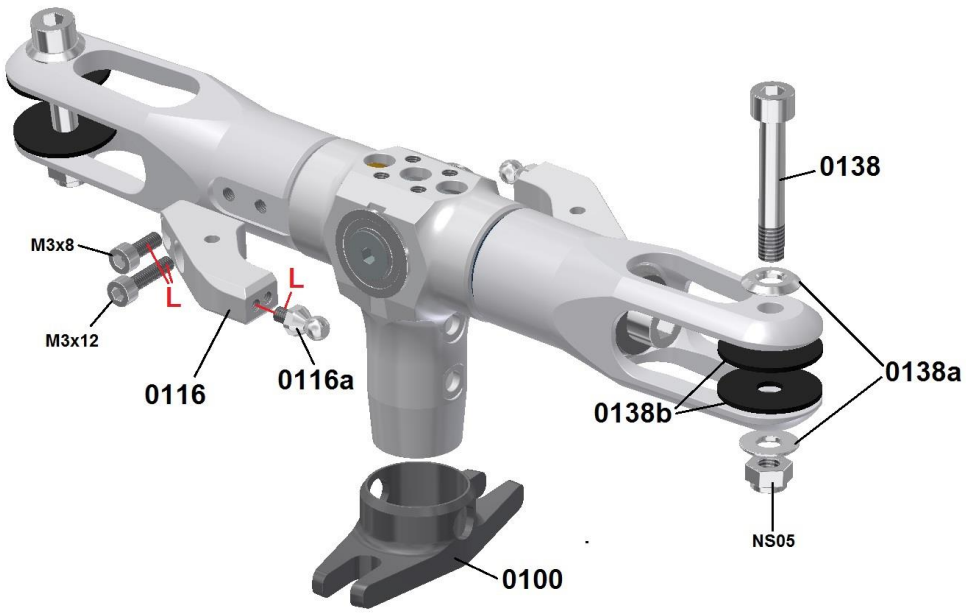
Proceed in the same way when disassembling. It will happen that one of the screws is opening first. For the second screw you can hold the central hub.

Do not try to pull the feathering spindle out of the bearings from the bent side after crashing. Always try to use the side that remained fairly straight.

Check on the first visible bearings 0113. The other bearings usually never take any damage. Turn the inner ring of the bearings with a finger and check for smooth movement. These two bearings may be extracted without removing all other parts of the blade grip unit. Push out the bearing from the fork side with a 8mm shaft positioned aslant at the inner ring of the bearing.

1.4 Pitch arms

	0100	Swash plate driver	1x
	0116	Pitch arm	2x
	0116a	Threaded ball pin M3x4 / 6	2x
	0138	Blade bolt M5x31 – 10.9	2x
	0138a	Special washer 5x12x1,5	4x
	0138b	Spacer for rotor blade 5x20x1	4x
	NS05	Nyloc nut M5	2x
	M0308	Hex socket screw M3x8	2x
	M0312	Hex socket screw M3x12	2x



The pitch arms 0116 have to be mounted to the blade grips so the control rod is connected at the rear side of the bladde grips (see picture). The position of the notch is turned by 5° . So with the centered position of the swash plate and horizontal position of the pitch arms the blades allready have an pitch angle of +5°.

Explanation of the balde grip control used for TDS:
The position of the pitch arm at the rear does not change the principal function. The only difference is that for increase of positive pitch angle the swash plate must be moved downwards and not as usual upwards. The direction of the cyclic control remains the same.
The advantage of this layout is the optimization of the control geometry during speed flight as the TDS does not have a linear drive system as used for my other models.
During speed flight with max pitch angle the swashplate will be located in the lowest position. To prevent the machine from pitching the nose up the FBL system increases with increasing speed the elevator input forward, which means the swash plate is tilting forward. For a 120° swash plate the upwards travel of the elevator function at the rear servo is twice as high as the two front servos are moving downwards.
With a standard layout with a swash plate being on the upper limit the rear lever is allready on a upper position with a horizontal swash plate. With increasing elevator input the servo lever will get into a nearly streigth position. This prevents further corrections due to minimal possible forward elevator input.
With the TDS control layout the rear elevator servo lever moves into the oposite direction so the possible correction input is getting bigger. AS the front servos are just moving the half way the negative impact is smaller. There will be another explanation concerning the +5° pre angle in the chapter „basic adjustments“.

Fix the ball studs 0116a at the outer holes of the pitch arms 0116 (see picture).
Attention! Do not use an open-end wrench to tighten the ball stud. Use a 5,5mm socket wrench in order to not damage the external hex.

The pitch arms will be mounted to the blade grip with a M3x8 and a M3x12 hex socket screw. Ensure the pitch arms are fitting properly into the notches of the blade grips.

The swash plate driver will be slided onto the center hub from below so the holes are aligned with the lower holes of the center hub.
Mount the blade bolts 0138 and the washer 0138a and 0138b loose at the blade holder by the M5 nylon nut not to lose them.

Attention! The bolts 0138 are made of high-grade steel fabric and may only be replaced by original spare parts. Standard bolts bear the great danger of tearing.

1.5 Push rod for blade control

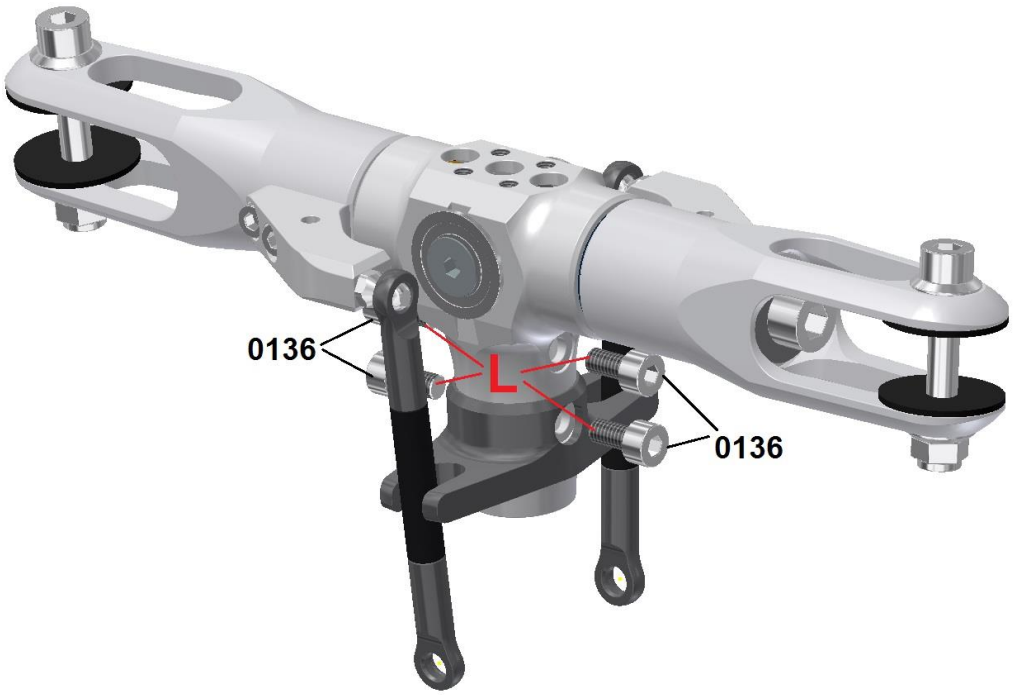
0121a	Ball link 19mm reinforced	4x
0121b	Spacer3x6x26,8	2x
0121c	Stud bolt M3x48	2x

Slide the spacer 0121b on the stud bolt 0121c and screw the ball links 0121a on both sides completely on until they touch the spacer. Adjust the ball links to a 90° angle between them (see picture).

Attention! Do not tighten the ball links when they already touch the spacer. A small pressure is ok, but turn back the ball link if the angle to reach the 90° is too large. A small gap doesn't care. Later on during fine adjustment of the blade angles it might get necessary to turn out one of the ball links to get the same blade angle.

Attention! To press the reinforced ball link onto the threaded link balls of the swash plate and the blade grip arms a lot of force is needed. Take a little piece of wood or something like that if the pain on your fingers gets to much.

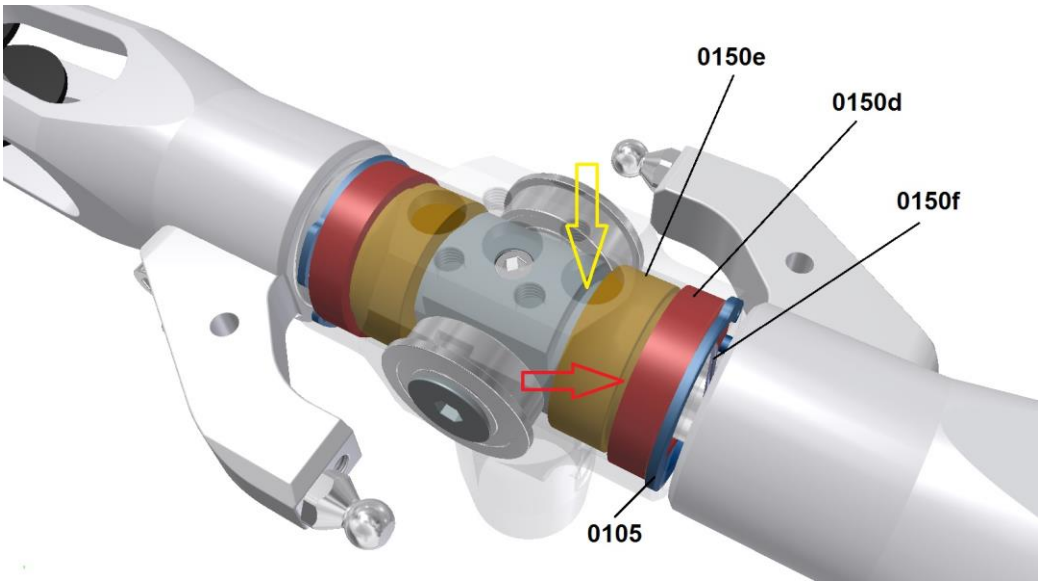
0136 Hex socket screw M4x8-10.9 4x



The 4 Hex socket screws 0136 (M4x8 -10.9) will later on be used for the fixation of the rotor head to the main rotor shaft.

Attention! The screws 0136 are made of high-grade steel and may only be replaced by original spare parts. The use of conventional screw types bears the danger of tearing.

Explanation for the centrifugal force controlled feathering shaft daampening of the TDS:



There is a gap of 0,5mm (see red arrow) between the movable brass cone 0150e and the red counter cone 0150d, which is made out of a special elastomer.
A compression spring 0150f, located between the first radial bearing of the blade grip and a sunk in the brass cone, is pressing the brass cone with a force of 6N towards the rotor head center against the face of the seesaw.
In this condition there is a gap between the cones which enables the seesaw to tilt up and down a little bit.
This leads to a decoupling of the rotor plane from the rotor shaft.
The TDS has a very compact and stiff design in combination with a small distance of the CG of the mechanics to the rotor plane.

At rotation speed between 700 and 1000 RPM of the rotor head there is the danger that the helicopter gets into resonance, especially during RPM increasing and decreasing on ground. This can lead in extreme cases together with a hard rotor head dampening to situation where the helicopter can be destroyed by this ground resonance.
Due to the seesaw suspension which is creating a decoupling this danger does not exist. But during flight this suspension has several drawbacks.
Therefore I developed especially for the TDS this special RPM controlled damping system. The brass cones have a weight of 14g each.
At RPM`s between1700 and 1800 the centrifugal force is overriding the force of the spring and is moving outwards into the counter cone. Now there is a form fit preventing a flapping of the feathering spindle. As the counter cone is made of an elastomeric material some damping remains similar to classical rotor head dampening with O-rings. A complete stiff system would also not work as there frequent oscillations might occur.

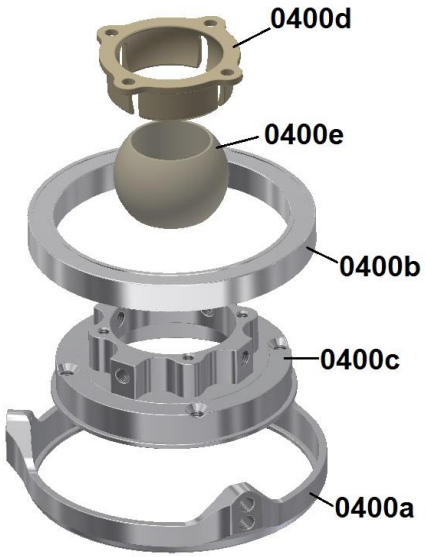
To test this principle on ground you can place a screw driver with a 4 to 5mm wide blade carefully into one of the two holes from above. (see yellow arrow) and position it in the small gap between seesaw and brass cone.
Then teeter with one hand the blade grip and turn the screw driver. The cone will slide to the outside and you will recognize that the flapping is stopping.

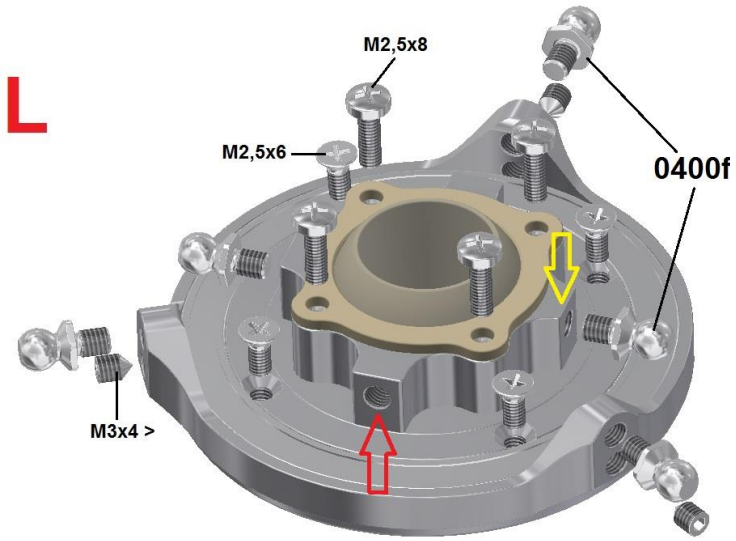
Take care later on during flight to reduce the rpm to the required lower rotation speed of 1600RPM before landing to ensure the brass cones are moving back to the center and allow flapping.
I recommend a small test in before landing to prevent that one cone is stuck inside the counter cone.
Hover above the landing area and give a small elevation impulse so the fuselage is moving under the rotor plane. You can see the fuselage teetering under the rotor plane and you can hear a slight chattering due to the flapping of the feathering spindle. In case of a fixed cone this will loosen now latest.

Assembly step – 2 Main shaft unit

2.1 Swash plate (already assembled)

	0400a	Swash plate outer ring	1x
	0400b	Radial bearing 45x55x6	1x
	0400c	Swash plate inner ring	1x
	0400d	Ball shell	1x
	0400e	Ball	1x
	0400f	Threaded ball pin M3x4 / 4 long	5x
	G0304s	Grub screw M3x4 with tip	3x
	P2508	Phillips screw M2,5x8	4x
	C2506	Countersunk head screw M2,5x6	4x



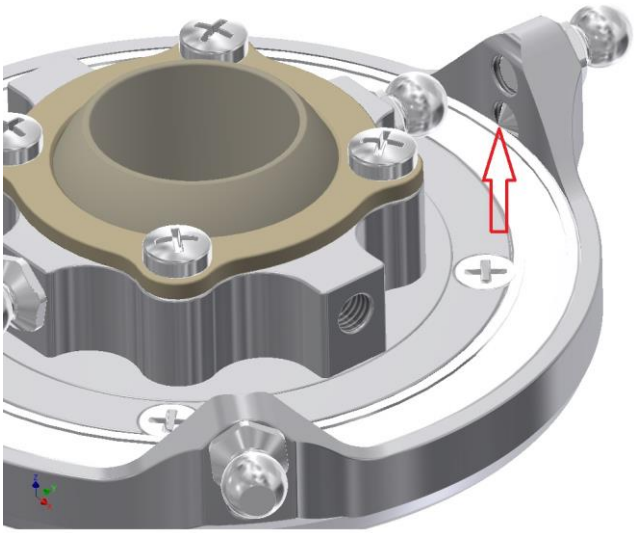


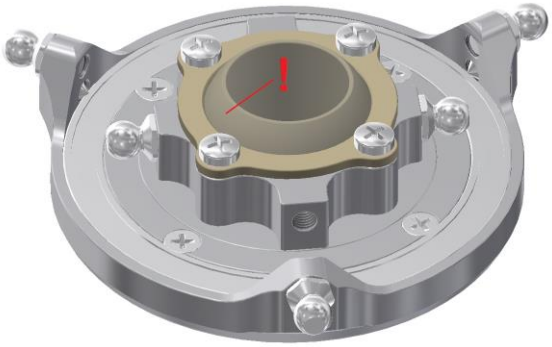
The base body of the swash plate will generally be delivered finally assembled. In case of a damage of the bearing the swashplate can be disassembled to all single parts.
The proceeding of the assembly will be described in the following chapter. So in case of an exchange of the bearing you understand the proceeding and what to take care about.

The bearing 0400b will be placed into the outer ring of the swashplate from above, without tilting. Slightly heating the ring will ease the insertion significantly.

Secure the bearing with the three tapered grub screws M3x4 (see detail picture next page – top left), placed in the lower radial hole of the outer ring (use **L**octite at the thread of the hole).

Attention! Tighten the grub screws carefully with feeling. Tighten them so that the tips just touch with light pressure the upper radius of the ball bearing, securing it from slipping to the top.





Attention! Use Dry-Fluid Gear which you will find in the kit for greasing the surface of the ball and the ball shell.

Slide the inner ring of the swashplate 0400c from below into the ball bearing up to the shoulder. The ring should slide with low force into the bearing. Grease the shoulder if necessary.

Now the inner ring will be secured by four M2,5x6 countersunk screws from sliding downwards. Also these screws have to be tightened carefully until the cone sits on the radius of the ball bearing inner ring (use **L**octite). Now there should be now axial play between the swashplate inner ring and the ball bearing inner ring.

If the ball bearing itself has too much play between inner and outer ring (visible tilting) you can decrease this play by stepwise tightening the three tapered grub screws. Tighten all three screws at the same level. This presses the outer bearing ring some hundredths mm to the inside putting a little bit pressure on the balls.

Attention! Just tighten the grub screws so far that the bearing is still running smoothly.

With this method you can also correct an older worn bearing when it got too much play.

Grease the pivot bearing at the outside of the ball 0400e and the inside of the shell 0400d with Dry Fluid Gear (shake before use). Then press the ball into the shell from the lower side. Insert the pivot bearing in the hole of the inner ring of the swashplate and fix it with four Phillips screws M2,5x8.

Attention! Tighten the screws carefully and use **L**octite.

In no case the ball is allowed to stick. A small axial play has no influence on the precision of the control.

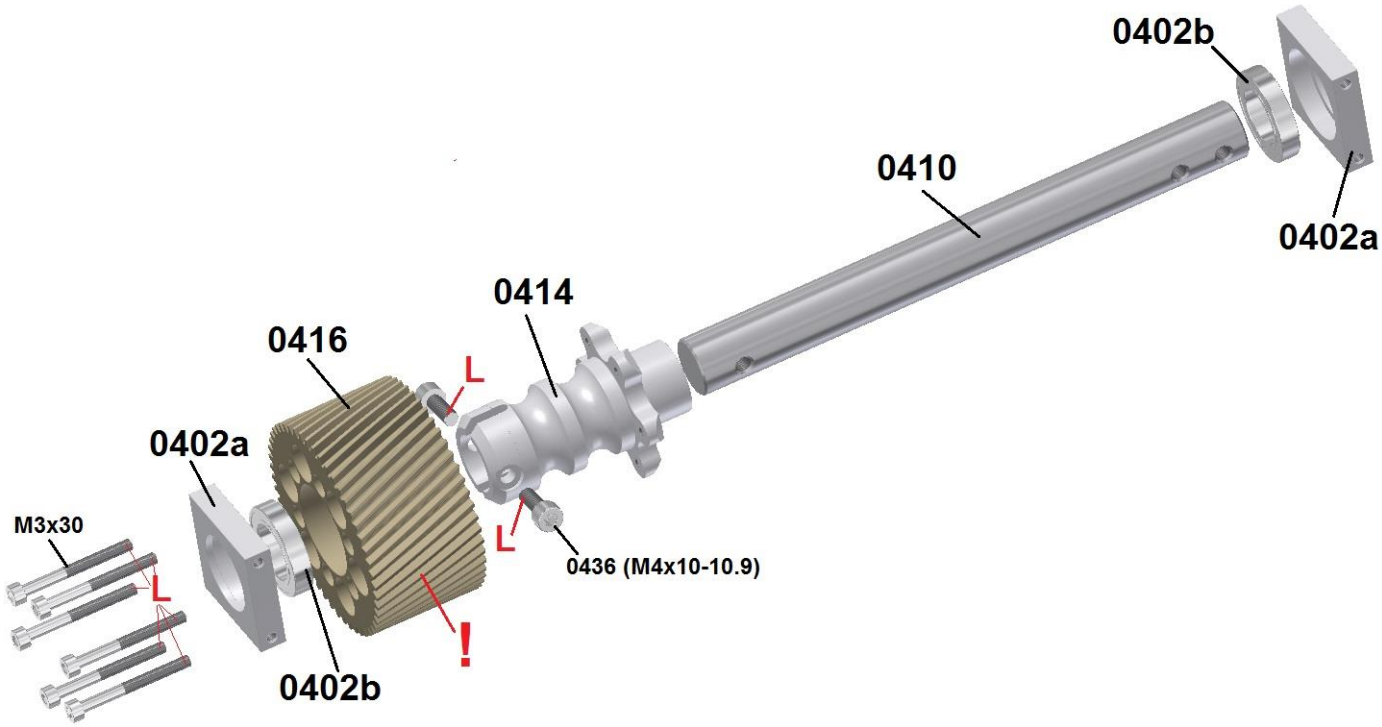
The ball pins 0400f at the outer ring and the at the inner ring have to be secured with **L**octite.

Attention! Do not use an open-end wrench but a 5,5mm socket wrench to prevent the hexagon of the ball pins from damage.

With the ball studs of the inner ring, it is possible to screw these onto two different attachment points. Two of the surfaces are closer to the center than the other two surfaces. By default, the inner positions are used to obtain smaller cyclic deflections and thereby more force and precision. If necessary, however, the position can be changed later if necessary.

2.2 Main gear flange (already assembled)

	0402a	Main shaft bearing plate	2x
	0402b	Bearing 15x24x5	2x
	0410	Rotor shaft 15x150	1x
	0414	Main shaft gear flange	1x
	0416	Main shaft gear 51T	1x
	0436	Hex socket screw M4x10 -10.9	2x
	M0330	Hex socket screw M3x30	6x



The peek-gear 0416 is manufactured with a very tight fitting. So it will sit tight on the flange 0414 even when heated up during use. Therefore it has to be heated to about 60° - 70° with a blow dryer or in a baking oven, before sliding on the flange, to allow easy sliding and positioning. Align the gear to the holes and let it cool down.

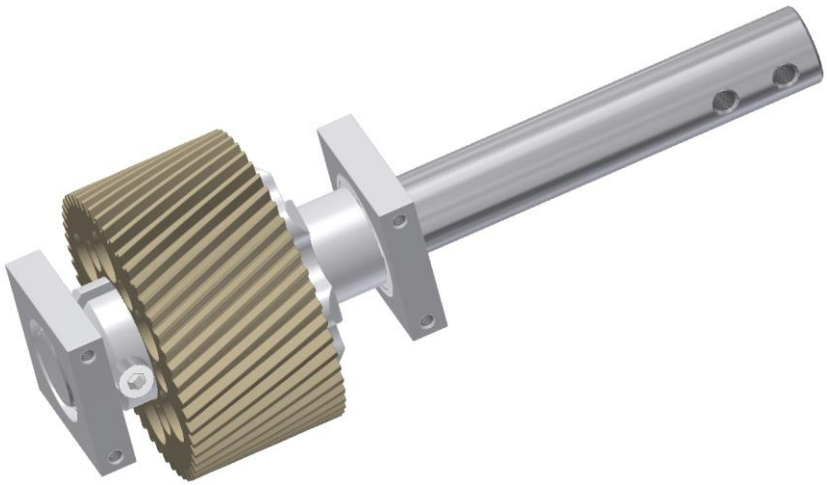
Take care to tighten the hex socket screws equally and crosswise, not to distort the gear. **L**octite has to be used here.

Tighten the screws at the end again as the plastic material is setting a little bit.

Slide the flange on the rotor shaft side with the single M4- hole according to the drawing and tighten the hex socket screws 0436 (M4x10- 10.9) hard with an angled hex wrench.

The flange should be held by the clamping friction and not the shearing force of the screws!

Apply **L**octite in such a way that nothing will spill into the gap between the main shaft and flange. Otherwise, it could get tough if a disassembly is needed. Apply the **L**octite directly into the M4 threads and wipe any remains on the surface of the main shaft. Upon insertion of the screws, any surplus **L**octite will be pushed into the hole of the main shaft, where it will not bother.

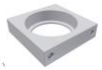


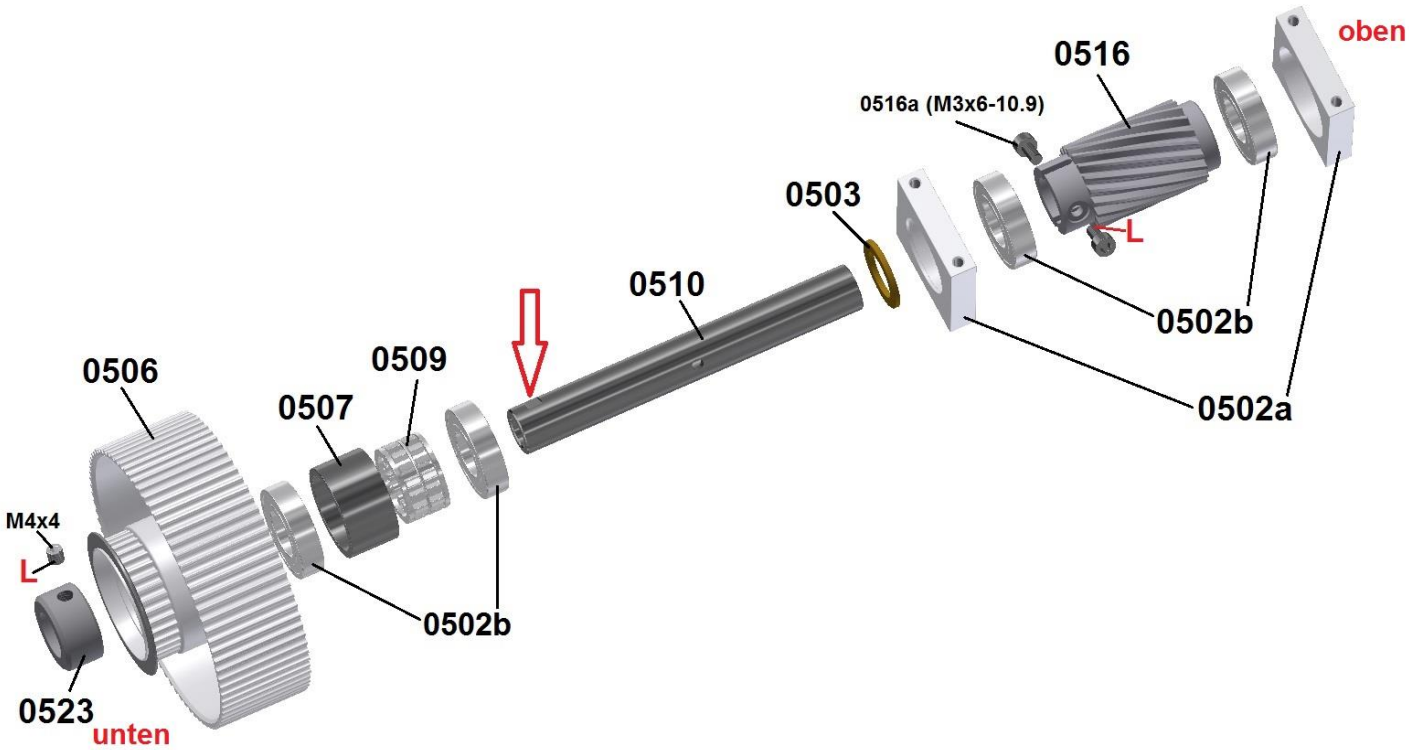
Press the two bearings 0402b into the bearing plates 0402a.

Place the two bearing plates with the side from which you pressed in the bearings facing towards the flange on the rotor shaft. Slide them to the gear flange. As the bearings are fixed by the shoulder in the bearing plates the rotor shaft is fixed in both directions and cannot move.

Assembly step – 3 Intermediate shaft unit

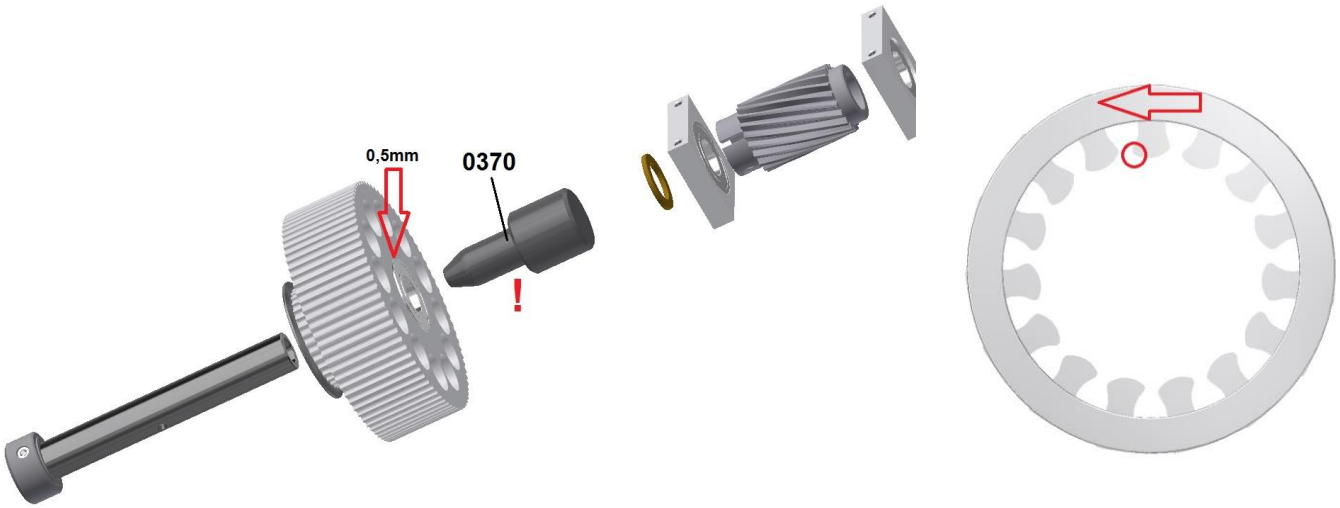
(already assembled)

	0502a	Intermediate shaft bearing plate	2x
	0502b	Bearing 12x24x6	4x
	0503	Spacer 12x18x1,5	1x
	0506	Belt pulley main- and tail belt	1x
	0507	One way drive sleeve	1x
	0509	One way drive	1x
	0510	Intermediate shaft hollow	1x
	0516	Intermediate shaft pinion 19T	1x
	0516a	Hex socket screw M3x6 -10.9	2x
	0523	Fixing collar 12x20	1x
	G0404	Grub screw M4x4	1x



Also this unit is already assembled by us, as it is helpful to have special tools available for inserting of the one way drive. To know how to proceed in case of a repair the necessary steps are following. Important is the tool 0370 (see picture next page) which is needed for inserting the intermediate shaft into the belt pulley unit. In any case mount first the fixing collar 0523 aligned to the lower end of the intermediate shaft 0510. The red arrow shows the flattening of the shaft where the grub screw M4x4 has to be placed.

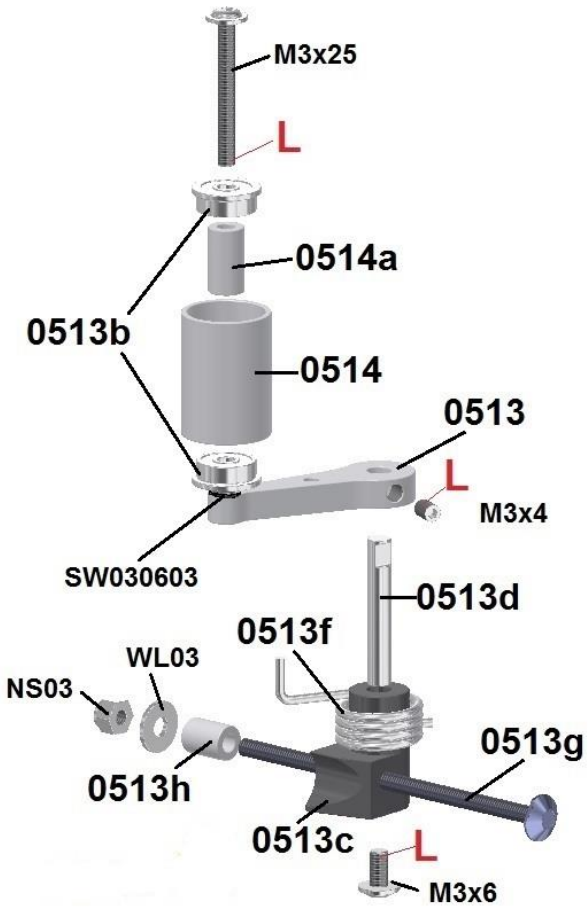
Press the two bearings 0502b and the one way bearing sleeve 0507 from the lower side (the slide of the pressed in tail belt pulley) into the good heated belt pulley 0506. The first bearing has to be completely pressed in until it is looking out by 0,5mm (see red arrow down left) from the upper side of the belt pulley.
Press the bearings on their outer ring, never on the inner ring. For this purpose it is advisable to manufacture a corresponding press-in mandrel. As a press you can use e.g. a stable upright drilling machine. You can use two 0,5mm sheet metals placed on the left and right side as a scaler to press through the bearing by the necessary 0,5mm.
Press in the one way drive sleeve next after the bearing. The direction of the clamping bodies as seen from above is shown in the right picture.
The clamping bodies have on one side a little nose which has to show into the rotation direction (red arrow) to the left (see red circle). Grease the one way drive with ball bearing grease before.

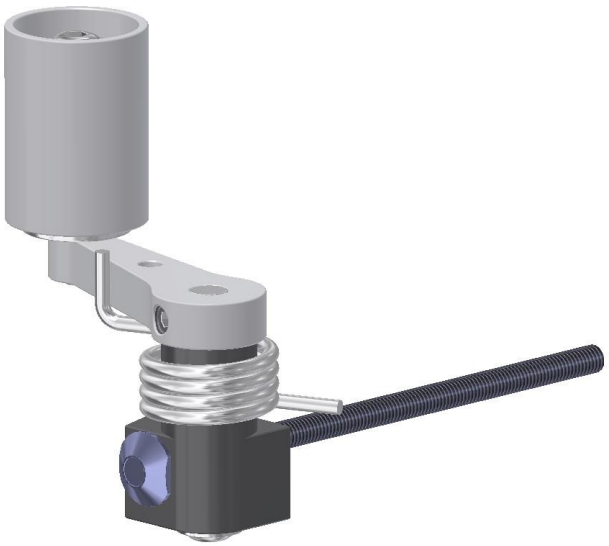


Slide the support tool 0370 into the bearing unit from above. Due to the cone the clamping bodies will be spread apart. A small turning to the left eases the spreading of the clamping bodies.
Now the intermediate shaft 0510 with the fixing collar can be inserted from below. The support tool will be pressed out to the top.
Slide the spacer 0503, and the bearing plates 0502a with the bearings 0502b and the intermediate shaft pinion 0516 on the shaft. Take care that similar to the main shaft unit the bearings are placed towards the pinion.
When everything is stick together align the hole of the pinion with the M3 holes of the intermediate shaft and tighten the (M3x6 -10.9) Screws 0516a with an angled key hard (use **L**octite).

Assembly step – 4 **B e l t - t e n s i o n e r**

	0513a	Tension lever	1x
	0513b	Flanged bearing 3x10x4	2x
	0513c	Tension lever bracket	1x
	0513d	Axis 4x25	1x
	0513f	Torsion spring	1x
	0513g	Special screw	1x
	0513h	Rubber band fixing	1x
	0514	Pressure roll	1x
	0514a	Spacer	1x
	G0304	Grub screw M3x4	1x
	L0325	Lens head screw M3x25	1x
	L0306	Lens head screw M3x6	1x
	SW030603	Spacer washer 3x6x0,3	1x





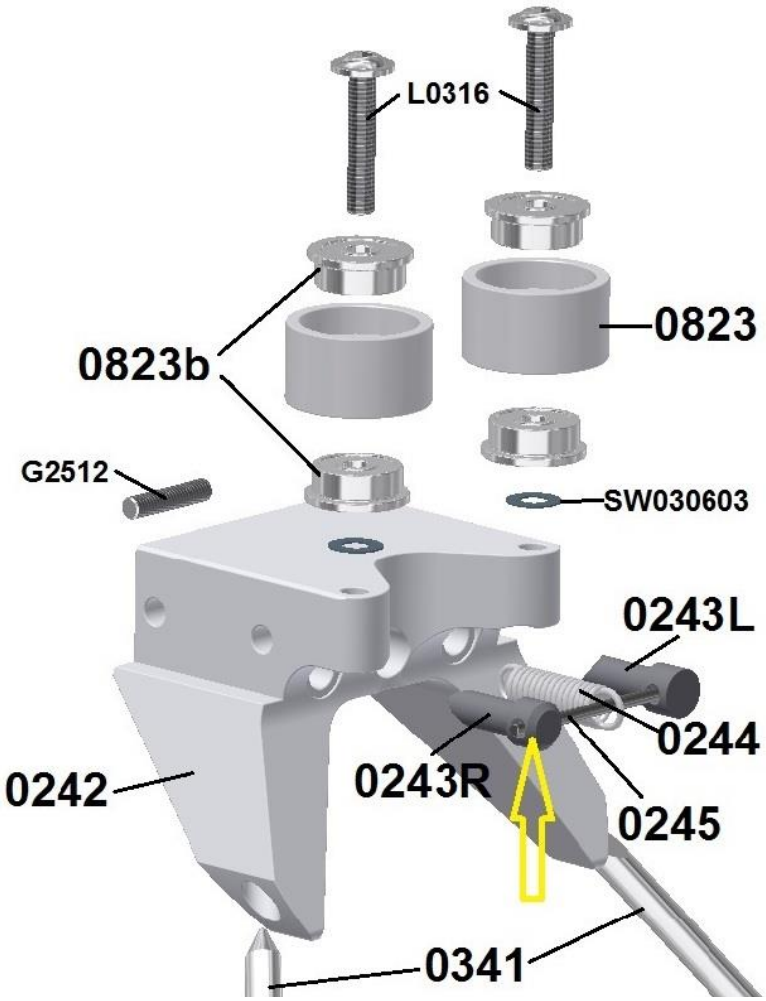
(Already assembled)

You can see the design of the belt tensioner in the explosion view on the left.
It will be screwed during the chassis assembly with the special screw 0513g.

Assembly step – 5 L a n d i n g - g e a r

(Already assembled – please read at least the description of the function on the next page)

	0242	Landing gear bracket	1x
	0243R	Locking bolt right	1x
	0243L	Locking bolt left	1x
	0244	Spring	1x
	0245	Spring steel pin 1,5x28	1x
	0339	Drop profile	2x
	0341	Spring steel leg	2x
	0823	Tail belt idler pulley	2x
	0823b	Flanged bearing 3x10x4	4x
	G2512	Grub screw M2,5x12	1x
	SW030603	Sacer washer 3x6x0,3	2x
	L0316	Lens head screw M3x16	2x



The two tail belt idler pulleys will be mounted with the two M3x16 lens head screws to the landing gear bracket 0242. There is no thread in the holes, but the holes have a smaller diameter so the threads are pressed into the plastics. Please tighten the screws carefully not to over torque them.

Attention! Take care of the correct position of the two locking bolts. There is a right 0243R and a left 0243L bolt, which differ by the angle of the flat tip towards the hole for the spring steel pin 0245.

The right bolt is marked by a large chamfer at the front face (see yellow arrow).

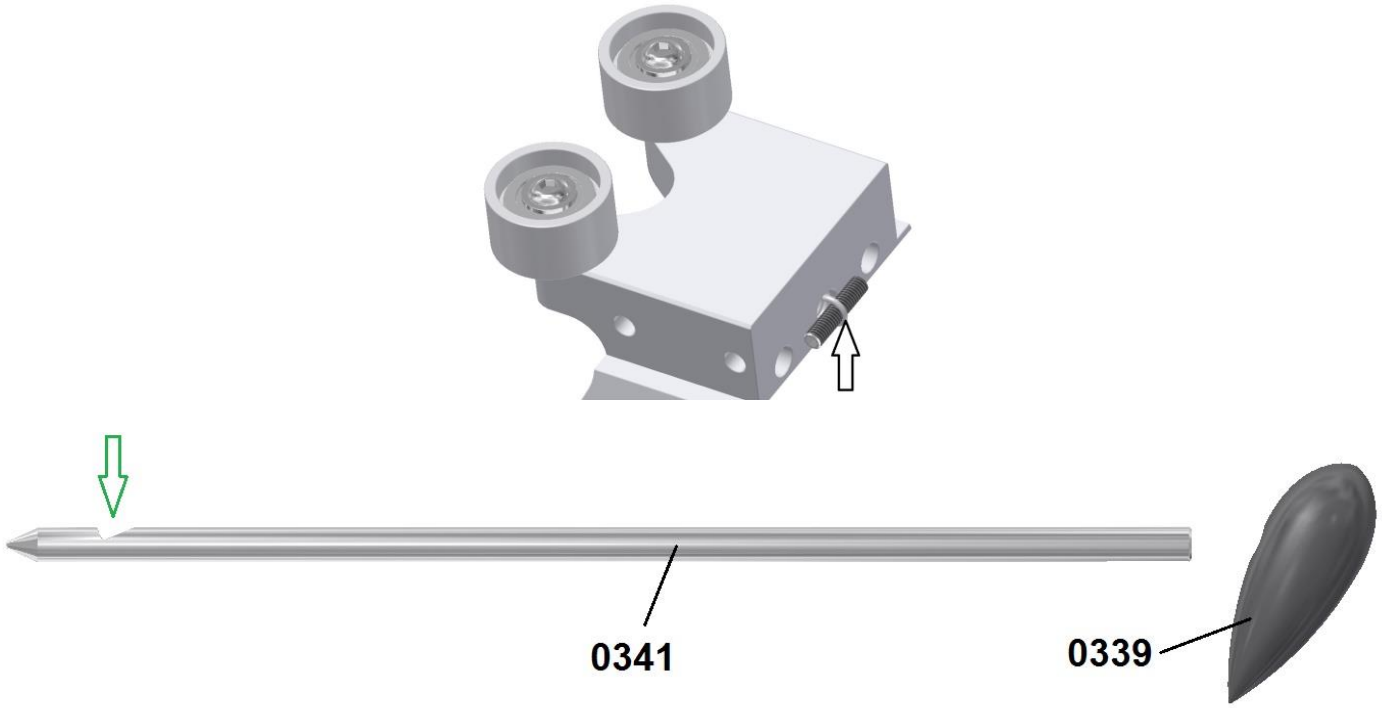
Please grease the bolts before inserting them into the holes.

Afterwards the spring 0244 will be inserted into the center hole of the landing gear bracket. Then the spring steel pin 0245 will be inserted in the holes of the bolts and the eye of the spring.

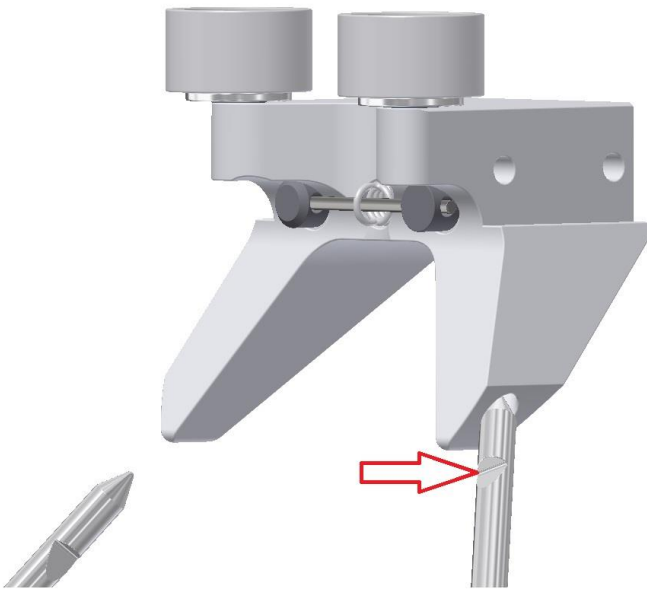
Use a needle nose plier or prepare a small hook to pull the spring through the bracket from the back side (see picture on the next page, black arrow).

To secure the spring 0244 the M2,5x12 threaded pin G2512 will be inserted into the eye of the spring.

The spring is now pre tensioned and is loading the two locking bolts by the spring pin (Description of the function – see next page).



Press the drop profile 0339 onto the spring steal leg 0341 with the longitudinal axis aligned with the milled notch (green arrow) (see picture above). Fix the leg in a bench vice (use wooden or aluminium vice jaws). Press the drop profile while simultaneous turning onto the leg until the stop. If the drop profile is not fixed after mounting secure it with a drop of super glue. Super glue is creeping into the gap by the capillary effect.



Explanation of function:

Grease the upper end of the leg in the area of the cone and the milled notch (see red arrow).
When inserting the leg the tip is first touching the locking bolt. Best way override the resistance by pressing the leg upwards and alternately turning it at the same time.
The bolt will move backwards so the leg can be moved approximately further 12mm into the landing gear bracket.

Attention! Turn the leg alternately until you can hear the locking bolt snapping in.
Now the drop profile should be aligned in flight direction.

Assure yourself before each flight that the legs are fixed. Otherwise you can lose a leg during flight.

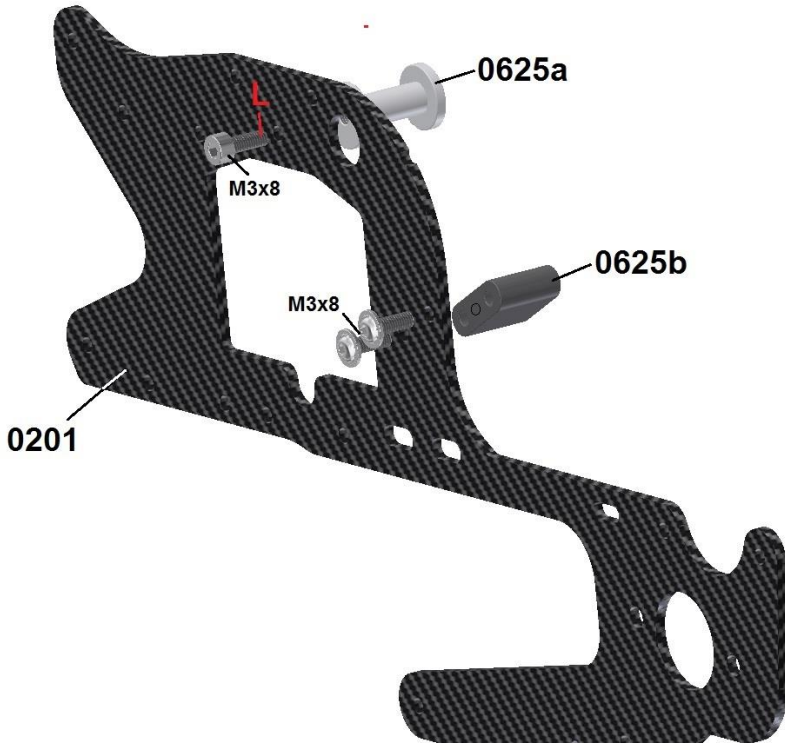
Remember you have to remove the legs before mounting or demounting the canopy. This is a little bit uncomfortable but is the only way to realize it for this lightweight model with perfect aerodynamic and high power.

In a later chapter I will give you some hints how to ease this procedure with a small supporting device.

Assembly step – 6 Chassis

6.1 Preparation rIght chassis plate

	0201	Chassis side plate	1x
	0625a	Space-Elevator servo	1x
	0625b	Elevator servo lower bracket	1x
	M0308	Hex socket screw M3x8	1x
	L0308	Lens head screw M3x8	2x



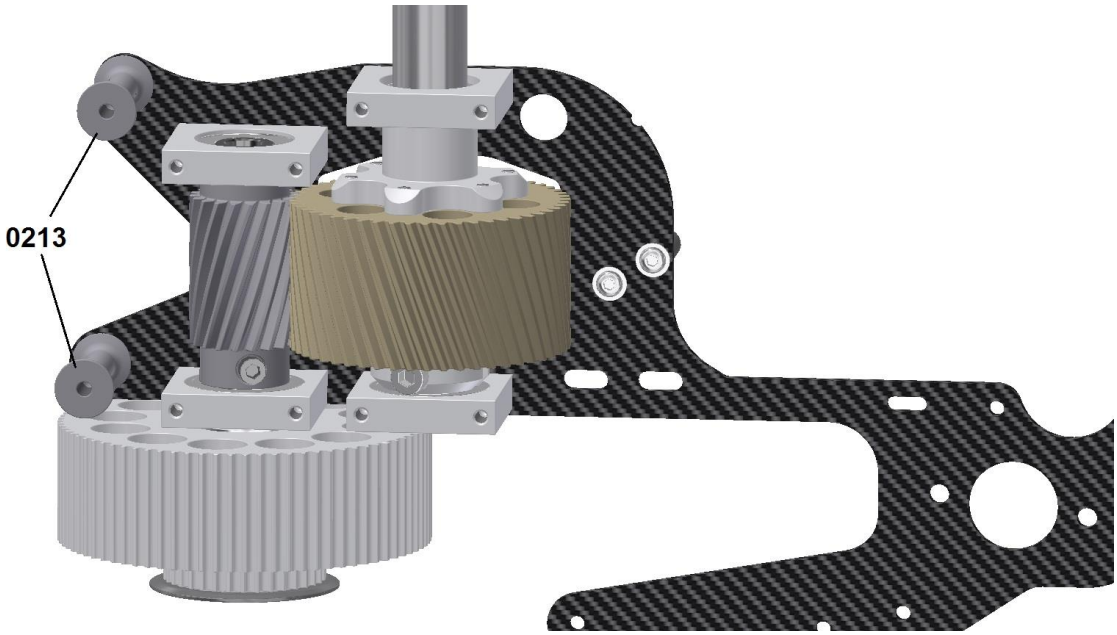
(drawing left)

First mount the spacer 0625a with a hex socket screw M3x8 to the right chassis plate 0201 (use **L**octite).

Then screw the lower elevator servo bracket 0625b to the two slanted positioned holes of the chassis plate, using two lens head screws M3x8.

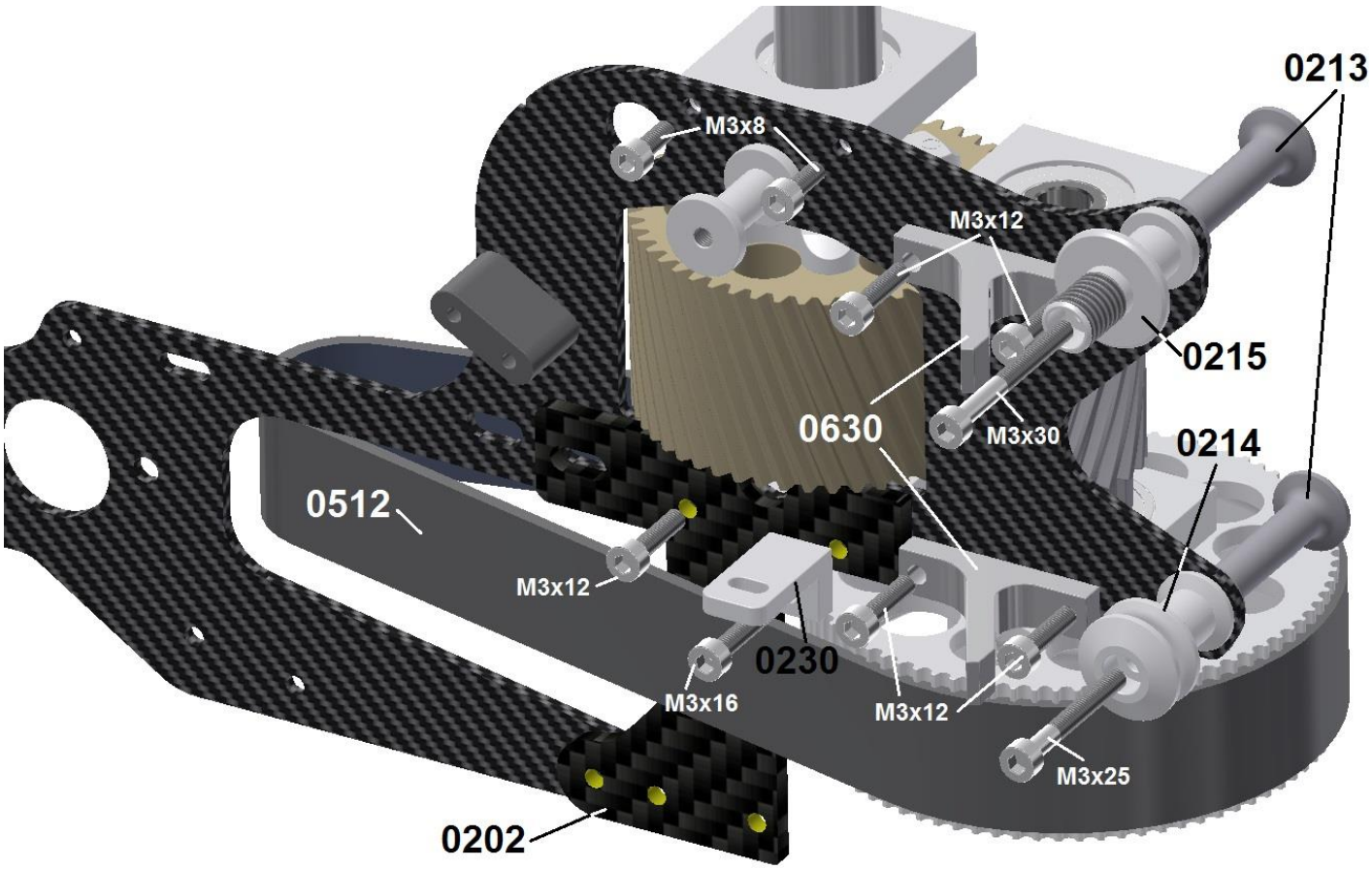
Attention! The elevator servo bracket has stepped holes having on one side a diameter of 2,7mm and on the other side a diameter of 2,1mm.
For easy identification there is a third hole on the side of the 2,7mm holes.
This side has to be mounted towards the chassis plate.

In the lower picture you can see how the gear unit has to be positioned on the chassis plate. The screwing oft the units will be described at the next page.



6.2 Mounting of the gear units on the rigth chassis plate

	0202	Chassis stiffener	1x
	0213	Cross stiffening bolt	2x
	0214	Battery holder - bolt	1x
	0215	Battery holder – Threaded bolt	1x
	0216	Battery holder – tightening nut	1x
	0230	Cable support	1x
	0512	Main – Transmission belt	1x
	0630	Aileron servo bracket	2x
	M0308	Hex socket screw M3x8	2x
	M0312	Hex socket screw M3x12	5x
	M0316	Hex socket screw M3x16	1x
	M0325	Hex socket screw M3x25	1x
	M0330	Hex socket screw M3x30	1x

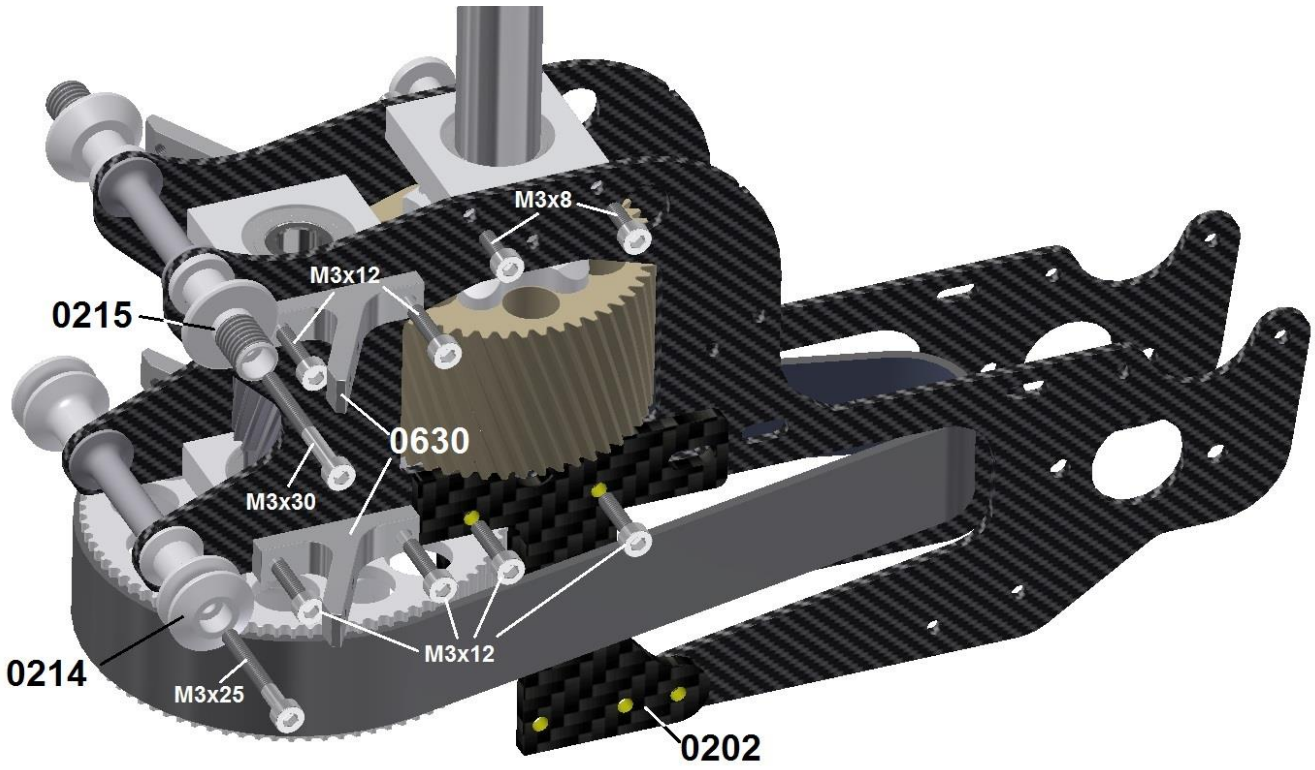


Description see next page

Fix the two gear units and the two aileron servo brackets 0630 (but not the chassis stiffener 0202 and the cable support 0230) loose to the chassis plate.
Tighten the screws slightly, to ensure the parts can move. The long screws M3x25 and M3x30 used for the battery bolts should be coated at the thread with a little amount of **L**octite. For the other screws this is not necessary.
Place the belt and mount the chassis stiffener 0202 together with the cable support angle 0230 afterwards. Theoretically you can place the belt later by pressing together the chassis plates so there is a gap between the chassis plate and the chassis stiffener. But doing it now is much easier.
Do not tighten the screws now. First mount the left chassis plate (see next assembly step).

6.3 Mounting of the left chassis plate

	0202	Chassis stiffener	1x
	0214	Battery holder - bolt	1x
	0215	Battery holder – threaded bolt	1x
	0216	Battery holder – tightening nut	1x
	0630	Aileron servo bracket	2x
	M0308	Hex socket screw M3x8	2x
	M0312	Hex socket screw M3x12	6x
	M0325	Hex socket screw M3x25	1x
	M0330	Hex socket screw M3x30	1x

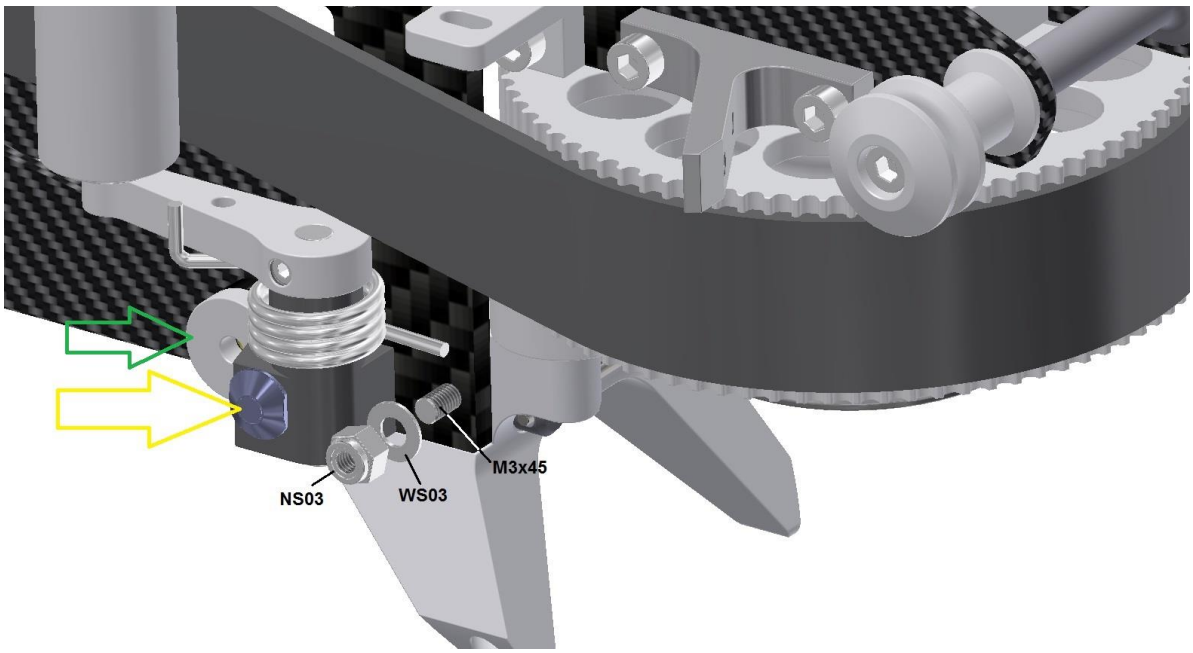


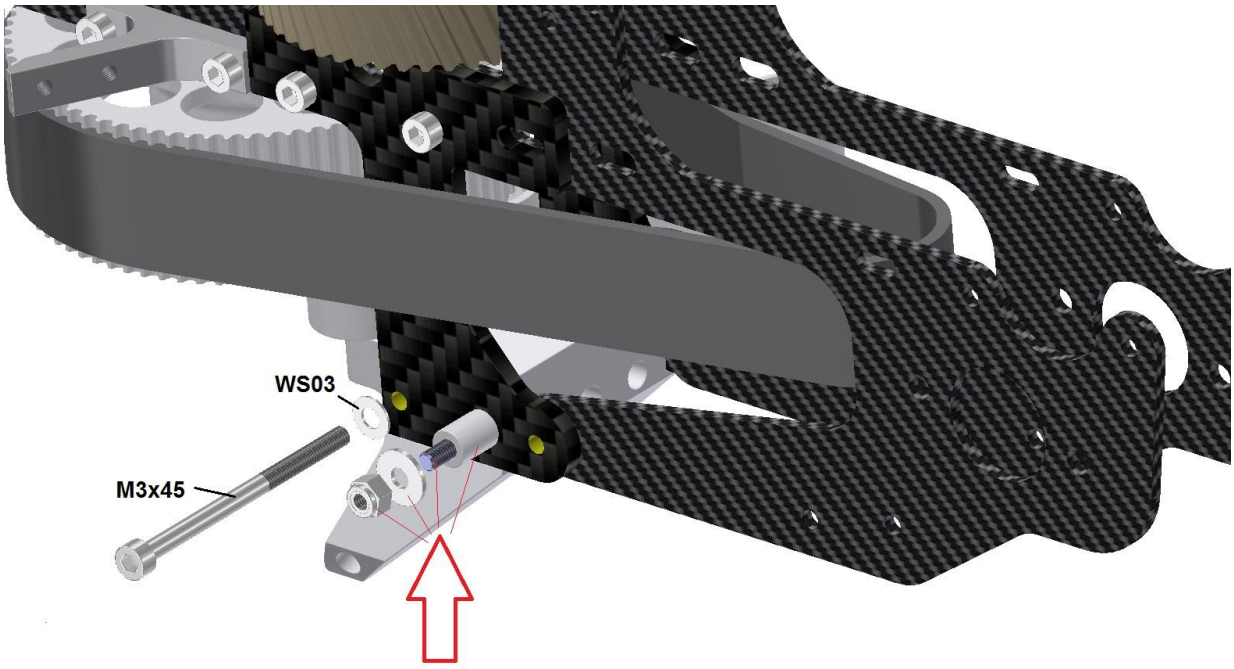
Mount the left chassis plate 0201 in the same way as the right chassis plate together with the battery holder bolts but without a cable support. At this place a M3x12 Allen screw will be used instead of an M3x16 Allen screw.

Subsequently all screws on both sides will be tightened alternating one after the other. This prevents a distortion of the mechanics. Finally tighten the screws strongly with an angled Allen key.

6.4 Mounting - landing gear bracket and belt tensioner

	M0345	Hex socket screw M3x45	1x
	WS03	Washer M3 small	2x
	NS03	Nyloc nut M3	1x





The two pictures above show the fixation of the landing gear bracket and the belt tensioner. The parts marked with a green, yellow and a red arrow belong to the belt tensioner (see chapter 4). Just the hex socket screw M3x45 with the two small M3 washers and the M3 nyloc nut are added.

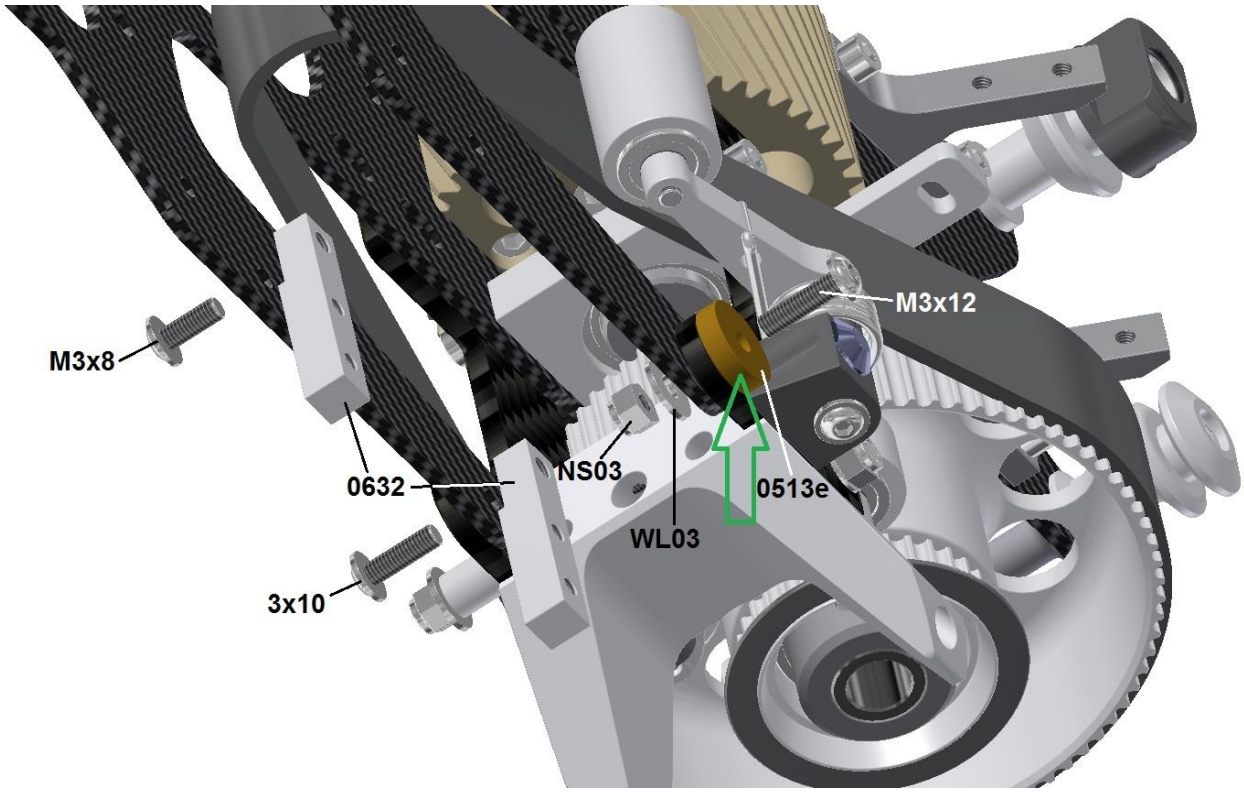
The special screw 0513g (yellow arrow) just has a small conical head; because of there is no space under the canopy in this area. Due to the two small spanner flats the screw can be fixed while tightening the nyloc nut which is fixing the rubber band support 0513h (red arrow) on the opposite side. The anti-twist device 0513e (green arrow) is shown here on the picture on its later position. The device will be fixed in the next step (see next page).

Initially the two screws of the landing gear bracket will just be fixed loosely. They will be tightened correctly after the next mounting step 6.5.

Tighten the nuts of the belt tensioner in general sensitively. As the guiding spindle of the tension lever is supported in a plastic support there is the danger to squeeze the hole and to jam the tension lever spindle.

6.5 Tail servo brackets

	0632	Tail servo bracket	2x
	WL03	Washer M3 large	1x
	NS03	Nyloc nut M3	1x
	L0308	Lens head screw M3x8	1x
	L0310	Lens head screw M3x10	1x
	L0312	Lens head screw M3x12	1x
	0513e	Anti-twist device 3x12x3	1x



Align the two tail servo brackets 0632 perpendicular to the lower edge of the chassis. Fix them with the small shoulder on the inner side of the left chassis plate. Take care of the different lengths of the different M3- Lens head screws.

For the front fixation the M3x10 Screw will be used as the screw has to be feed through the chassis plate and the chassis stiffener, as the M3x8 screw only has to be feed through the chassis plate.

The anti-rotation device (green arrow) will be fixed on the right side of the chassis with a M3x12 Lens head screw, a large washer M3 and a M3 nylon nut.

Now tighten the two screws of the landing gear bracket and check if the belt tensioner can move freely. The tensioner should be able to tilt a little into the notch of the chassis.

Assembly step – 7 Tail belt deflection

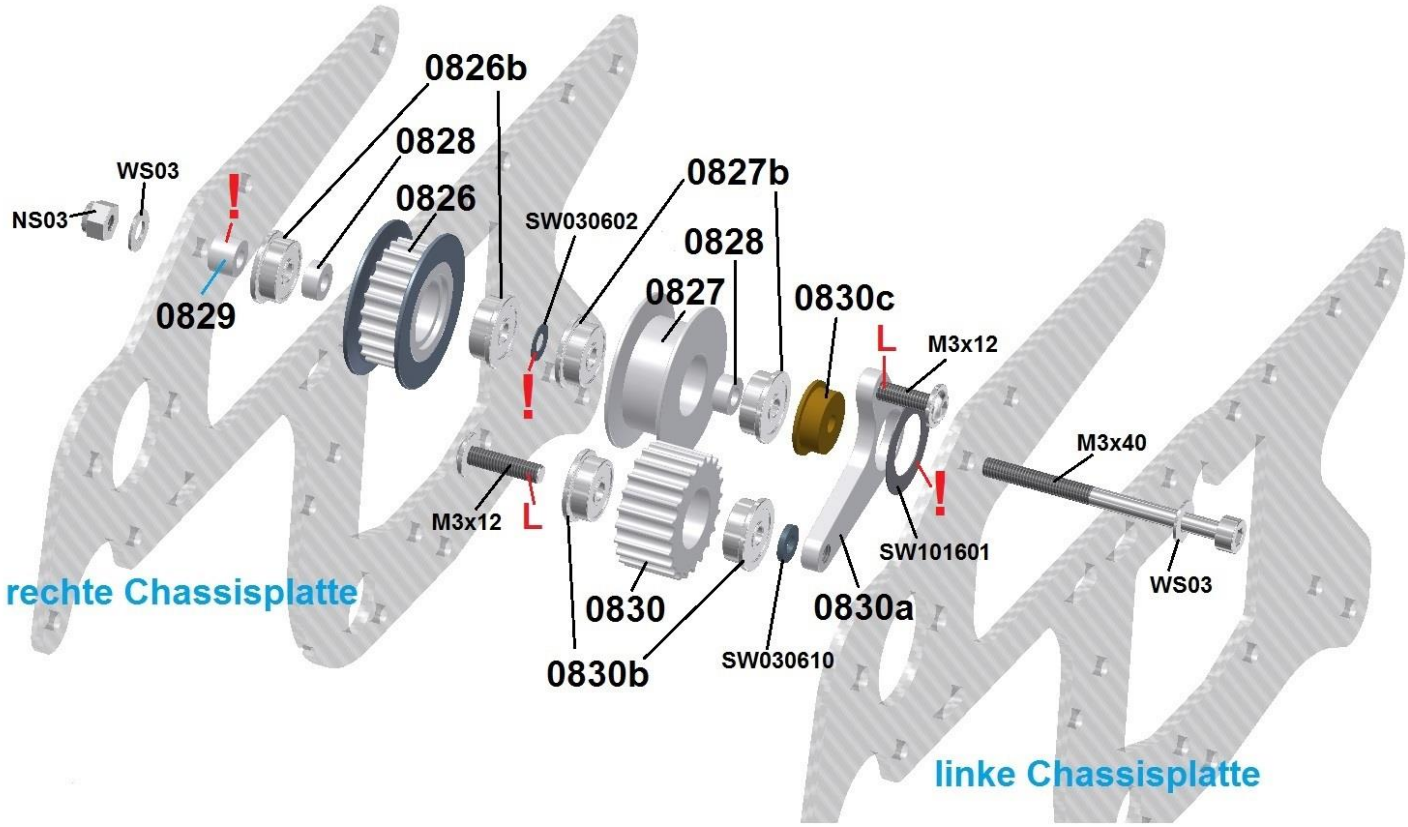
(already preassembled)

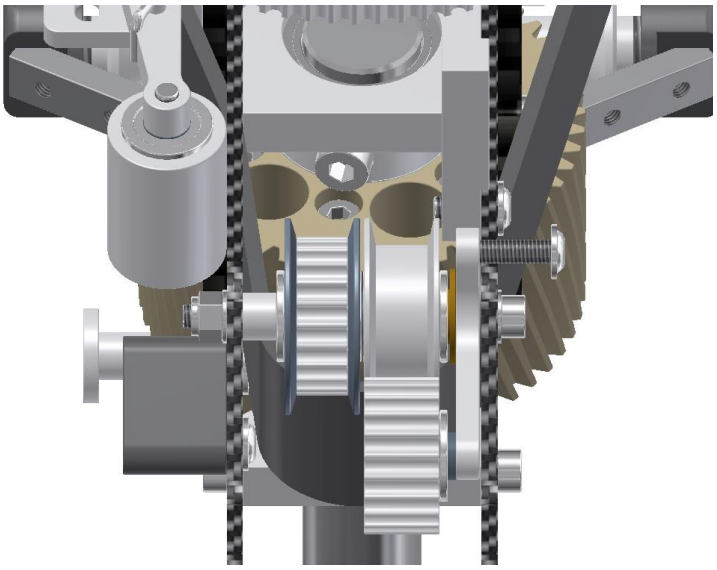
	0826	Belt pulley 22T – belt deflection	1x
	0826b	Flanged bearing 3x10x4	2x
	0827	Idler pulley – belt deflection	1x
	0827b	Flanged bearing 3x10x4	2x
	0828	Kugellagerdistanzring 3x6x2,65	2x
	0829	Bearing spacer ring 3x6x4,25	1x
	0830	Belt pulley 22T – Tail belt tensioner	1x
	0830a	Belt tensioner – bearing lever	1x
	0830b	Flanged bearing 3x10x4	2x
	0830c	Plain bearing bush – brass	1x
	M0340	Hex socket screw M3x40	1x
	L0312	Lens head screw M3x12	2x
	SW101601	Spacer washer 10x16x0,1	1x
	SW030610	Spacer washer 3x6x1	1x
	SW030602	Spacer washer 3x6x0,2	1x
	WS03	Washer M3 small	2x
	NS03	Nyloc nut M3	1x

Explanation:

The tail belt deflection is rather complex as it has to fulfill several tasks at the TDS (see next page).

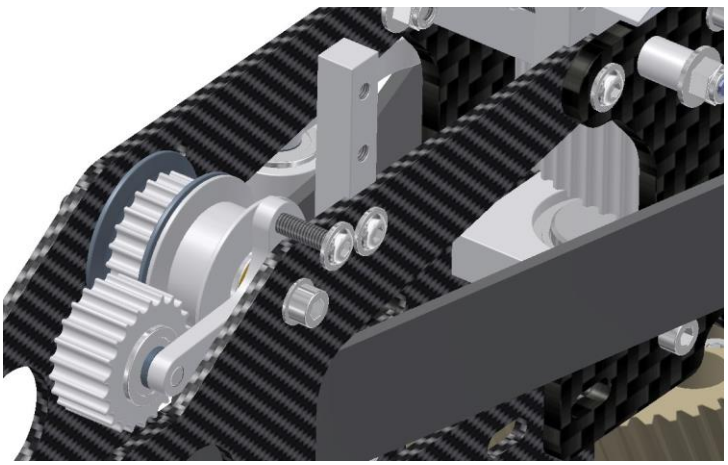
As the TDS has the special feature of a mechanic tilted by 8° to the longitudinal axis, the belt deflection has the task to twist the belt from horizontal to vertical on a short distance starting from the front pulley. From the vertical plane of the two idler pulleys 0826 and 0827 the two belt strands will be twisted by 8° downwards. The unloaded strand (trailing belt strand) will be deflected to a lower plane by a further pulley 0830 which is also used as a belt tensioner. From there on the two belt strands are going without any further twisting to the two deflection pulleys in the side fin where they are again deflected upwards to the tail rotor. The belt tensioner is located on the L-shaped bearing lever 0830a which is sitting on a plain bearing bushing 0830c made of brass. This bearing lever will be tensioned by a rubber later on. The tail belt is tensioned to a constant level by the belt tensioner also under load, preventing the belt from swinging up or jumping over.





The unit is pre-assembled. The Allen screw M3x40 is just loosely placed to hold the unit together in the right order.
While installing the unit take care not to exchange or turn around one of the parts. Insert the long M3x40 screw (don't forget the washer WS03) from the left chassis side into the foreseen hole and place one after the other all parts inside the both plates onto this spindle.
The pictures show the view from the rear below.
As all pulleys are already equipped with bearings the most important thing to take care is the right direction and position on the correct side of the plain bearing bushing 0830c. Grease the bearing before placing the lever 0830a.

Attention! The large spacer washer 10x16x0,1 SW101601 has to be placed on the plain bearing bushing between the bearing lever and the chassis plate. The washer is preventing the lever from whetting at the chassis plate.
The step of the plain bearing bushing is dimensioned to hold the lever and the washer without play. Therefore the spacer washer is sliding easily of during mounting.
Take care the spacer washer is kept in place while torqueing the nylon nut. Otherwise the washer will be stacked between bearing and chassis plate.



The easiest way is to paste the washer with some grease to the lever and slide it one the bushing together.

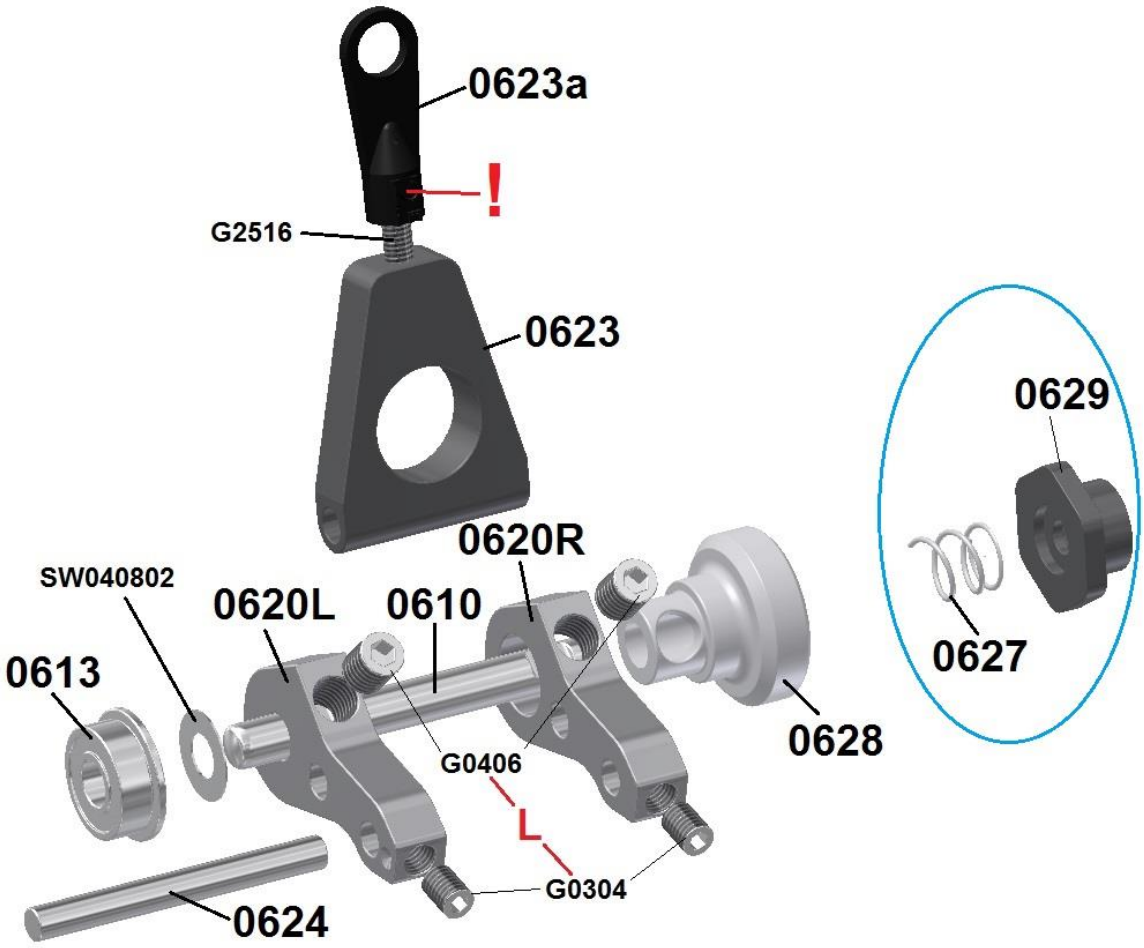
Position the two pulleys 0826 and 0827 in a way that the two flanged bearings which are in level with the face of the pulleys are facing to each other. This reduces the gap between them.

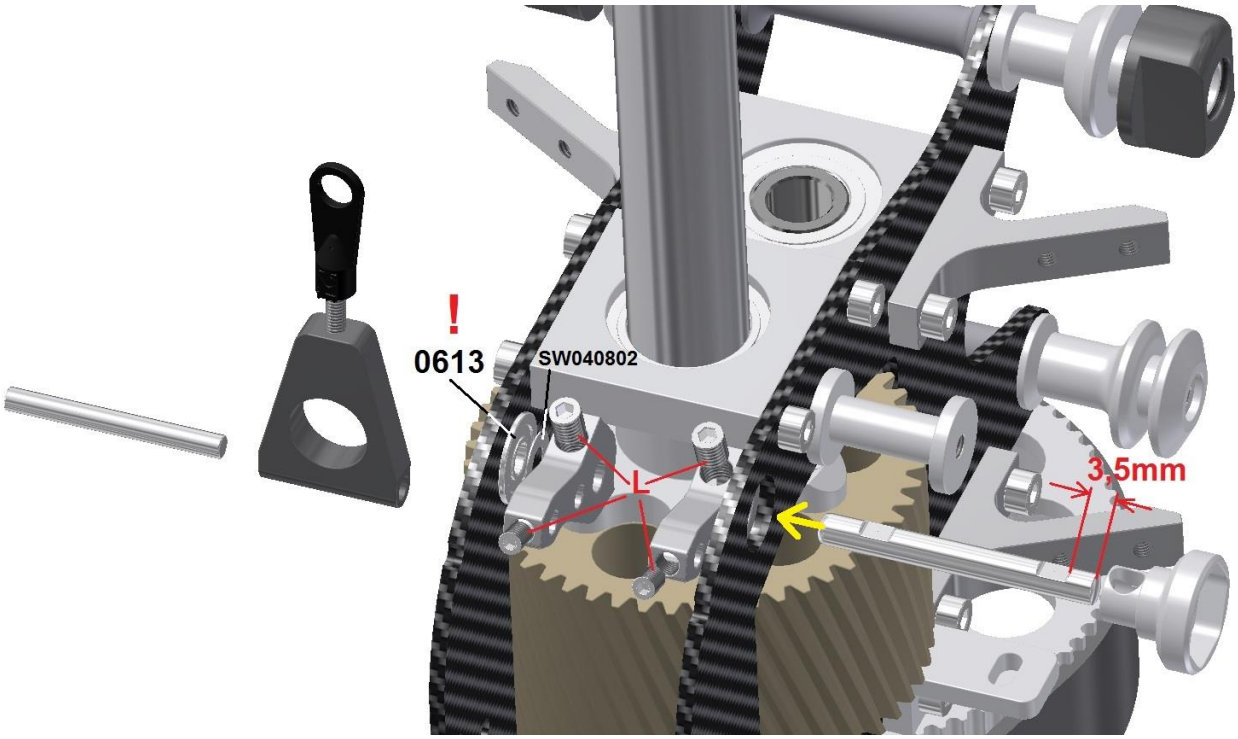
Attention! Don't forget to place the small fitting washer 3x6x0,2 (SW030602) between the flanged bearings of the two pulleys. Otherwise the two pulleys will whet on each other.

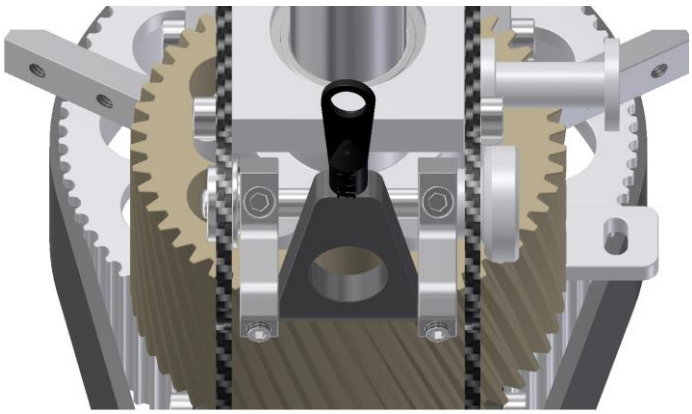
The spacer 3x6x4,25 0829 is the last part to be placed between the right chassis plate and the belt pulley 0826.
After tightening the M3 nylon nut check NS03 the centric seating of the spacer washer SW101601 on the bushing 0830c.
The lever should turn without sticking after tightening the nut.

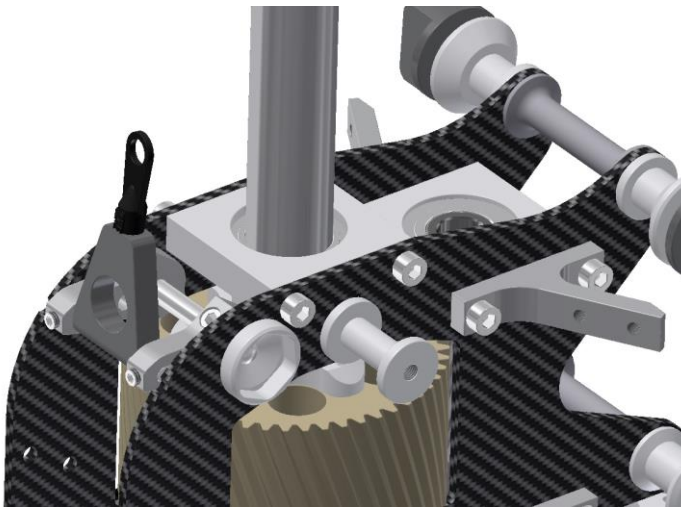
Assembly step – 8 Elevator linkage

	0610	Elevator lever spindle	1x
	0613	Flanged bearing 4x10x4 (allready glued into the chassis plate)	1x
	0620L	Elevator lever - left	1x
	0620R	Elevator lever – right	1x
	0623	Elevator lever joint	1x
	0623a	Ball link 15mm	1x
	0624	Pin 3x28	1x
	0628	Clutch bell – hexagon coupling	1x
	G2516	Grub screw M2,5x16	1x
	G0304	Grub screw M3x4	2x
	G0406	Grub screw M4x6	2x
	SW040802	Spacer washer 4x8x0,2	1x









The elevator linkage is placed inside the chassis and is connected to the elevator servo outside on the right side by the clutch bell (hexagon coupling) 0628 and the servo hexagon 0629
The elevator lever spindle 0610 is placed on the left side in the ball bearing 0613 and will be centered on the hexagon part which will be screwed to the servo.
Take care not to load the elevator lever unnecessarily as long as the lever is not mounted.
Attention! The flanged bearing 0613 is glued to the left chassis plate with **L**octite.
The elevator lever joint 0623 will be connected to the 15mm ball link 0623a by the stud bolt M2,5x16 G2516. When installing the joint, make sure that the lettering of the ball joint points to the rear.
Due to its double-sided support, the joint simultaneously acts as a swash plate anti-twist device.

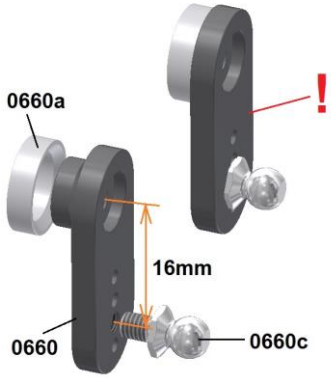
Insert the pitch lever axle 0610 from the outside through the chassis bore so that the shorter end (3.5mm from the edge of the flat to the face) is to the right.
The clutch bell 0628 sits with her heel in the hole of the right elevator lever 0620R. Continue pushing the axle through the left pitch lever 0620L and then through the shim 4x8x0,2 SW040802 into the bearing.
The spindle can look a bit out of the bearing on the left. Aline the cross hole of the bell with the M4 grub screw hole of the right lever and position it centered above the right flattening of the pitch lever axis 0610.
Push the left lever all the way to the left against the shim. The elevator joint is positioned between the two levers and the 3x28mm pin 0624 is pushed from the side through all the holes.

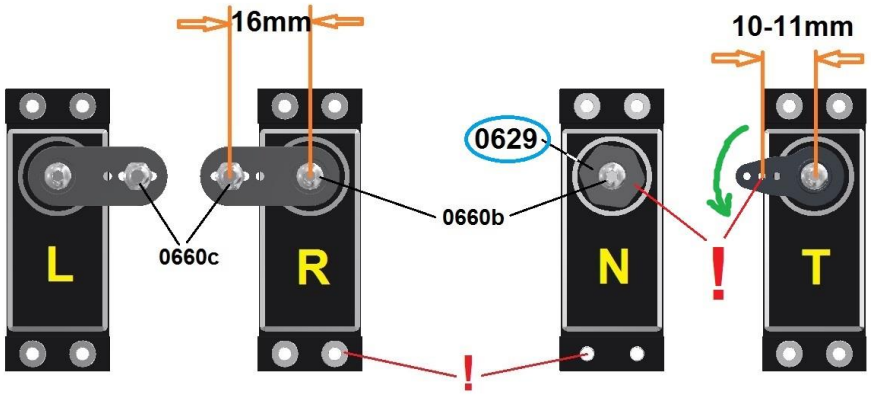
First, tighten the two M4x6 grub screws so that the levers align with the flats. Now also tighten the two M3x4 grub screws for the 3x28 pin.
Only cover the grub screws with **L**octite on the threaded surfaces and do not insert **L**octite into the threaded holes, as otherwise this will be pushed down through to the shafts which will glued to the levers. A subsequent dismounting is therefore hardly possible.
The servo hexagon coupling piece 0629 and the compression spring 0627 are used later when installing the pitch servo.

Assembly step – 9 Servo installation

9.1 Servo preparation

	0627	Compression spring	1x
	0629	Servo hexagon coupling piece	1x
	0625	Elevator servo bracket top	1x
	0660	Servo lever – Aileron servos	2x
	0660a	Servo lever reinforcement ring	2x
	0660b	Servo lever screw	(delivered with servo)
	0660c	Threaded ball pin M3x4 / 4	2x
	P2510	Phillips screw M2,5x10	16x
	M0308	hex socket screw M3x8	1x





The **TDS** is designed as an uncompromising speed machine so that there is no freedom in servo selection. Please use the **MKS HBL575 SL** from the **X6-Serie** for all 4 servos. The servos will be prepared as shown above on the picture.

Attention! First, insert all metal grommets into the rubber dampers of the servos. Only at the lower flange of the **N** elevator servo, the grommets are pressed from below and not from above like all others.
Attention! For the two **L**eft and **R**ight aileron servos, please only use the servo lever 0660 included in the kit, in which the threaded ball pin 0660c is screwed in a 16mm radius.
A different radius must not be used, as this radius corresponds to the fixed radius of the elevator. Other dimensions would give a differentiated articulation with different angles for control inputs. First, you can connect the two roll servos directly to a receiver, without a flybarless system in between. Take for example the receiver outputs for aileron and elevator (do not take the throttle or collective pitch output). At the transmitter, all trims must be neutral in the middle position. Turn on the system so that the servos are in neutral and leave the system on to prevent the servos from twisting again when mounting the levers. Alternatively, you can connect the servos directly to the flybarless system and move to the servo neutral position in the basic swashplate setup menu.

Now put the lever provisionally on the servo shaft and look at the position exactly from above (see picture).

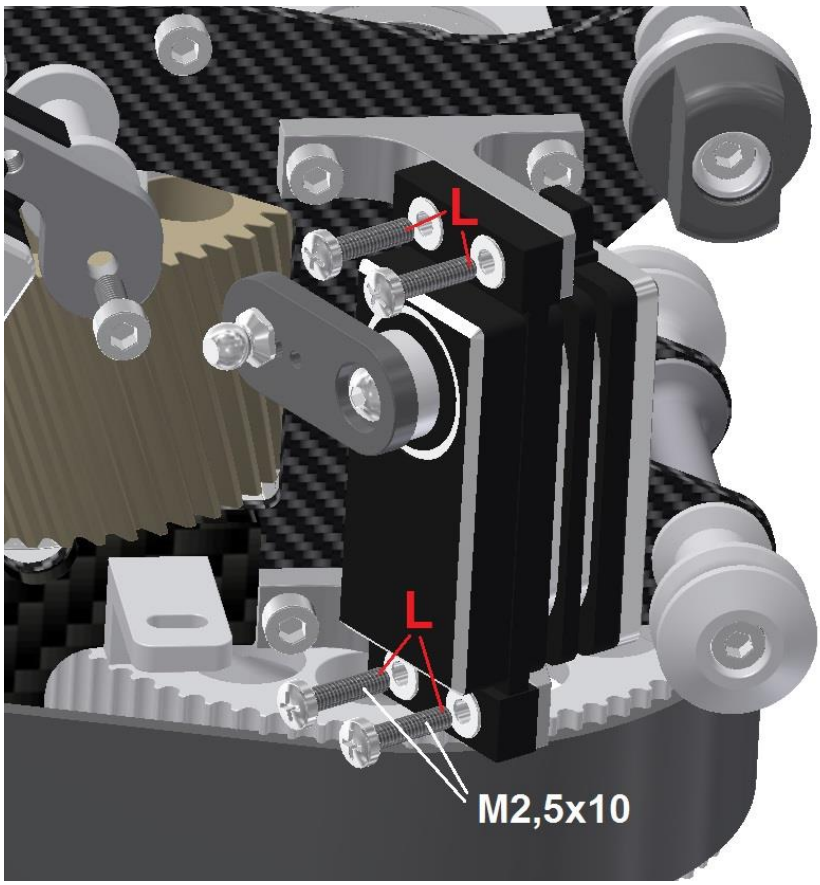
Always press the lever just a little bit on the multi-tooth of the servo shaft, so that it just grabs the positioning. Now find an optimal position by positioning the lever so that it is as perpendicular as possible to the housing. You can see by tendency, whether it gets worse or better, and can change accordingly so that it comes as close as possible to the 90 ° angle. You can also achieve a better combination by swapping the two roll servos. Small differences are later compensated by the electronic trim. Finally, secure the lever with the enclosed lens head screw (use **L**octite)

Attention! Because of the servo lever reinforcement ring 0660a there is a lot of force needed to press down the lever until the end. The best way is to use the servo lever screw which will simplify this job.

Attention! The tail servo (**T**ail) allows you to use a conventional servo lever with 1.6mm bore in a radius between 10mm and 11mm. Also for this servo, the servo lever should be positioned at right angles to the housing according to the drawing in the neutral position or better up to 10° counter clockwise (look at the green arrow).

The servo-hex coupling piece 0629 of the elevator servo **N** is not yet mounted.

9.2 Aileron servo installation

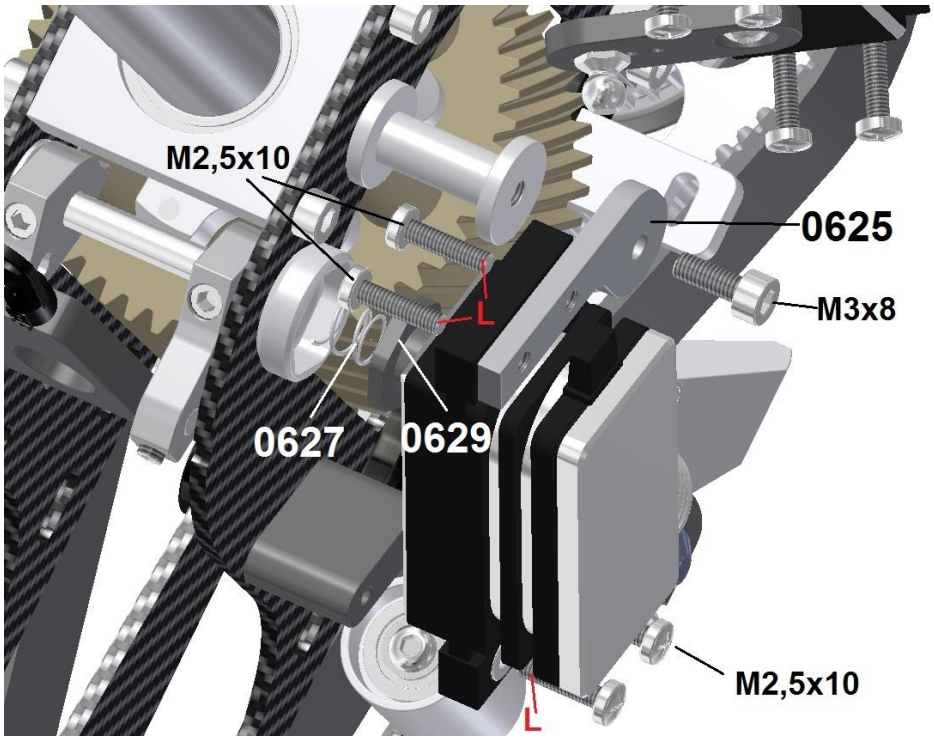


The picture on the left shows the assembly of the right aileron servo.
Use the M2.5x10 phillips screws (use **L**octite).

Do the same with the left aileron servo on the other side mirror wise.

Note: If you have not purchase the servos from us, you will need to extend the two cables of the aileron servos later, as they will not stretch back to the position of the flybarless system.

9.3 Elevator servo installation



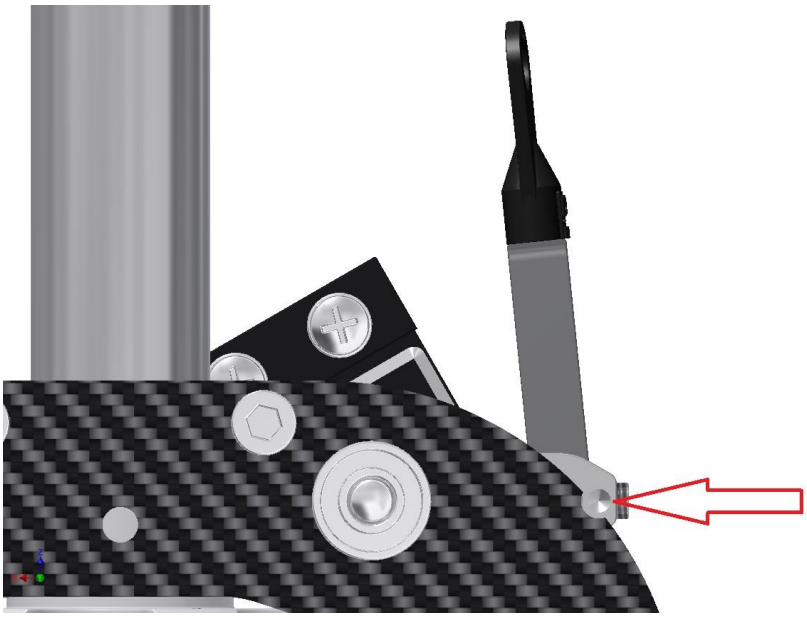
First attach the upper elevator servo mount **0625** as shown on the left with two M2.5x10 Phillips screws (use **L**octite).
The spring **0627** is not needed yet. Because before the final assembly of the elevator servo the correct position of the servo hexagon coupling piece **0629** has to be determined first.

First bring the elevator lever to the neutral position. For this purpose, a small milled marking is provided in the chassis plate and in the left elevator lever is a small marking hole (see red arrow / picture next page - above).

To center the markings, look at the chassis from the left side at a right angle.

You can fix the elevator lever in this position by placing some cardboard between the right elevator lever and the right chassis plate.

Attention! Make sure that the Nick lever axis is not tilted, as it is currently only stored in the left chassis plate.

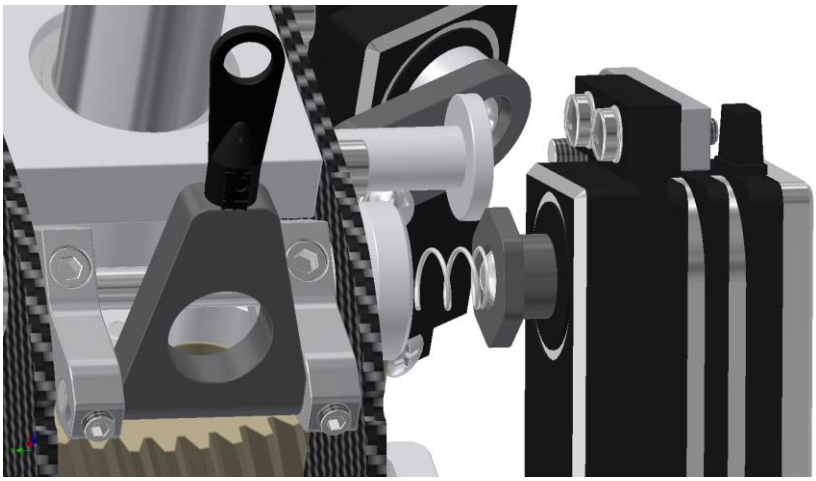


Picture left - bring the marking in line with the chassis cutout (red arrow).

First, connect the elevator servo to the electronics as described for the aileron servos to bring and hold it in neutral position. A rotation of the servo output shaft during the adjustment work must be prevented.

Then, loosely attach the servo hex coupler 0629 to the servo yoke and place the servo in front of the hex drive of the elevator linkage so that the mounting hole on the top elevator servo mount coincides with the standoff M3 thread and the bottom two servo holes in line with the two holes of the lower servo holder (see also picture on previous page).

Now try to find a position where the hexagon covers as exactly as possible with the hexagon of the clutch bell by repositioning the coupling on the serrated tooth of the servo.

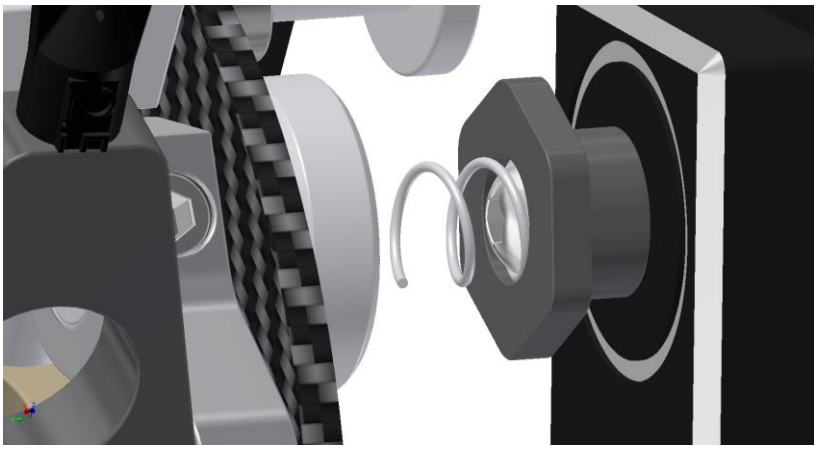


To do this, remove the hexagon from the servo shaft and turn it to another position until the surfaces are as parallel as possible to those of the clutch bell surfaces.

It can be a bit of a hassle, but the fact that you can turn the hexagon by 60 ° in case of large differences; there are plenty of opportunities to find a relatively good match.

Again, a fine adjustment is made later on the electronics.

Attention! Finally tighten the hexagon with the lens head screw supplied with the servo slightly (use **L**octite).
Don´t tighten this screw to hard because it will squeeze the plastic of the hexagon so that it is very hard to place it into the clutch bell – hexagon coupling.

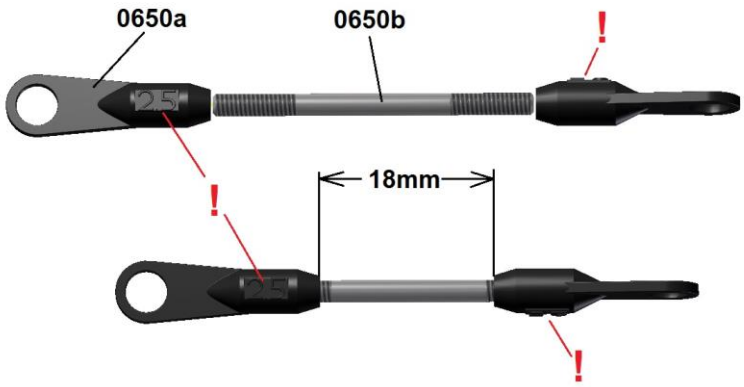


Insert the small compression spring 0627 (as shown on the drawing left) with the flattened side into the counter bore of the servo hexagon.

Now slide the servo with the hexagon into the clutch bell and secure it with the M3x8 Allen screw on the top of the standoff bolt respectively with the M2.5x10 Phillips screws on the bottom of the servo mount.

9.4 Swash plate linkage

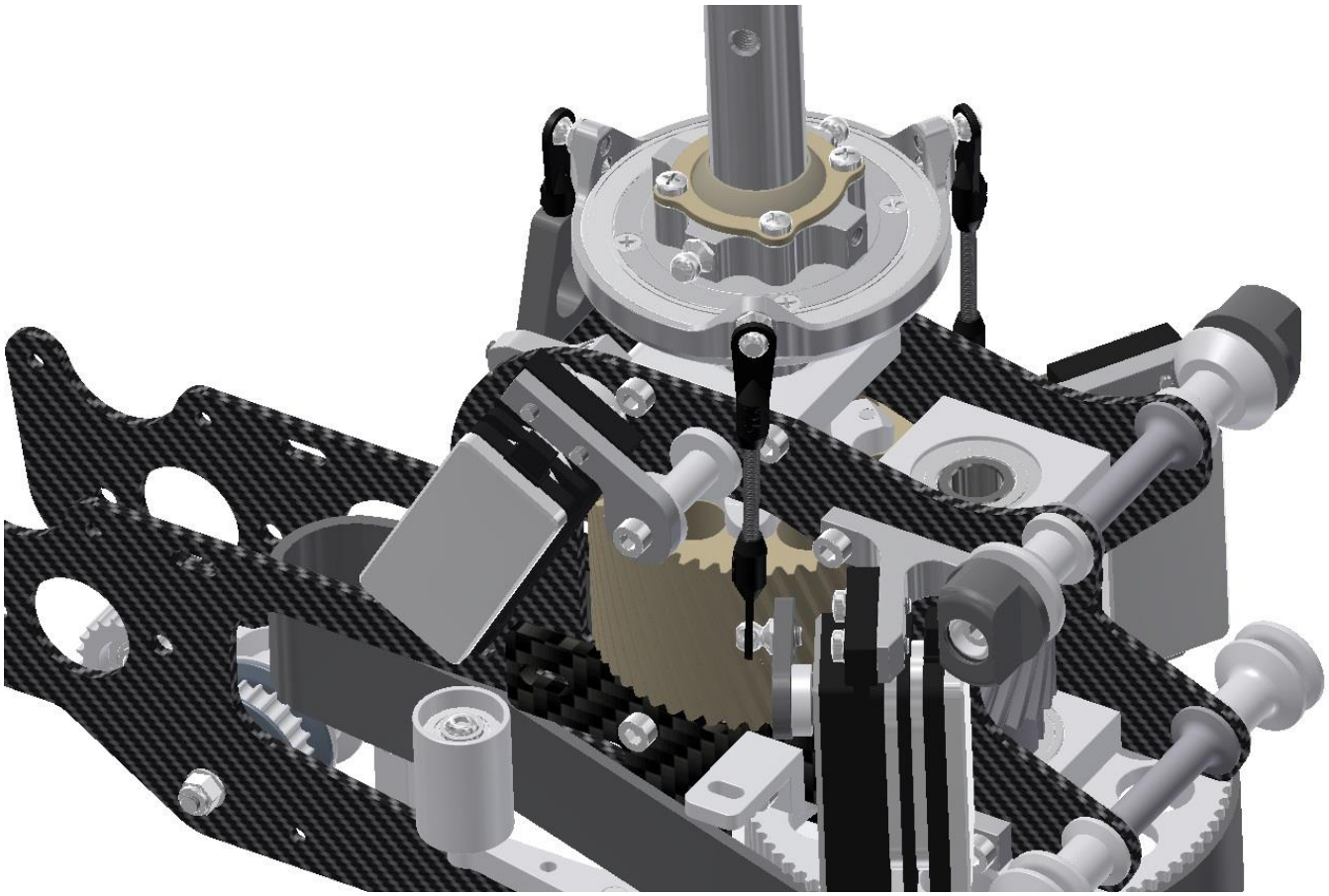
0650a	Ball joint 19mm	4x
0650b	Aileron rod 36mm	2x



The two aileron rod links 0650b are prepared on the left according to the picture so that between the end faces of the ball joints 0650a remains a distance of about 18mm.
Attention! Turn the ball joints at a 90 ° angle to each other so that the inscription "2.5" points once in one direction and once in the opposite direction.

The rods are now mounted on the left and right side so that the lettering always points away from the respective threaded link ball.

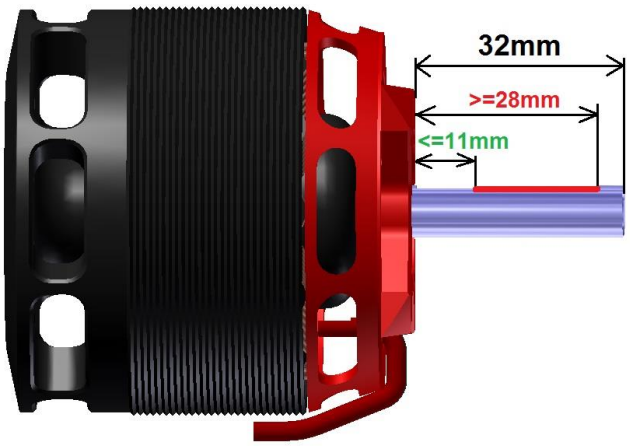
It would very difficult to press on the ball joints the other way around.

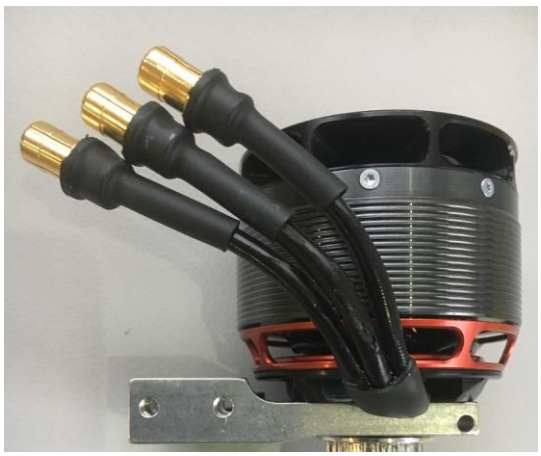


The exact fine adjustment and alignment of the swash plate will be described later in the chapter "**Basic Settings**".

Assembly step – 10 Motor installation

10.1 Motor preparation



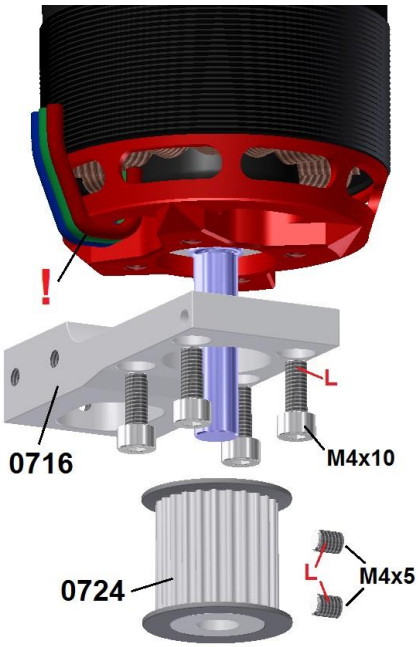


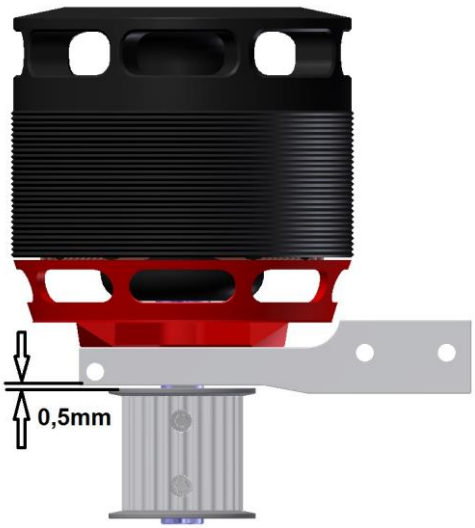
Attention! The motor must have an 8mm shaft which is about 32mm long from the face of the motor flange.
There must be a flattening for the two grub screws of the pulley, which starts at the latest 11mm from the front of the engine and ends at the earliest 28mm from the end face, so that the grub screws do not touch a round surface or edge.

Provide the three cables of the motor with high quality plugs with a diameter from 6mm to 8mm diameter. With the Pyro you can leave the motor cables in their original length and solder the plugs to the pre-tinned wire ends. Be sure to create a high quality solder with the wire ends completely embedded in the solder. The currents are so high that a low quality cold solder joint can unsolder during operation.

10.2 Motor installation on the motor support

	0716	Motor support	1x	
	M0410	Hex socket screw M4x10	4x	
	0724	Belt pulley	1x	(packed separately)
	G0405	Grub screw M4x5	2x	(packed separately)



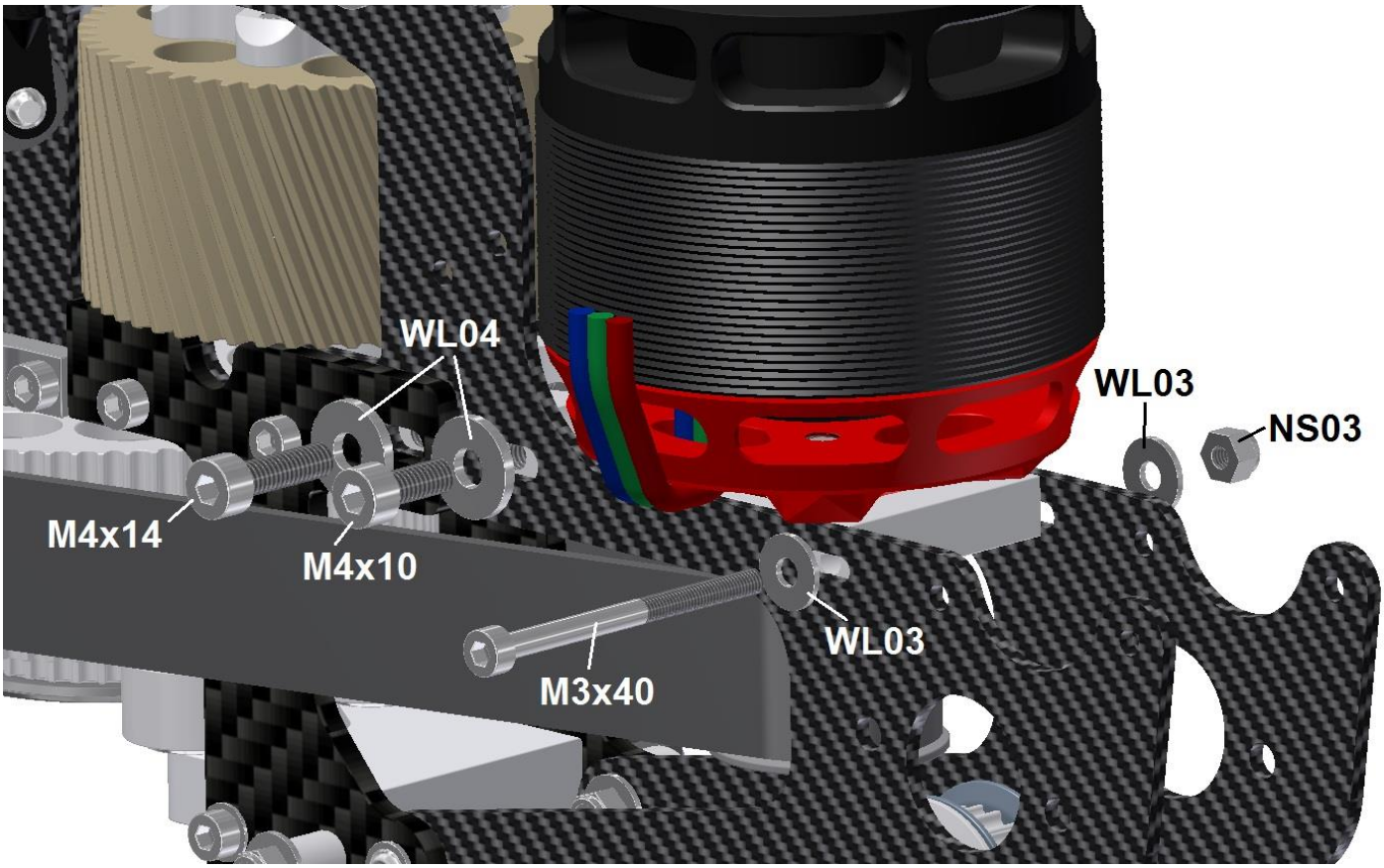


Screw the motor to the motor support 0716 as shown in the diagram on the left with the four M4x10 hex socket screws.

Attention! Make sure that the motor cables are positioned to the left as shown in the drawing.
Tighten the screws well and secure with **L**octite.
The toothed belt pulley 0724 is fixed on the motor shaft with the two grub screws M4x5 so that a gap of 0.5 mm remains between the motor plate and the pulley.
Just slide a 0.5mm feeler gauge in between.
Secure grub screws with **L**octite and tighten firmly. Place **L**octite only on the grub screw and never in the hole.

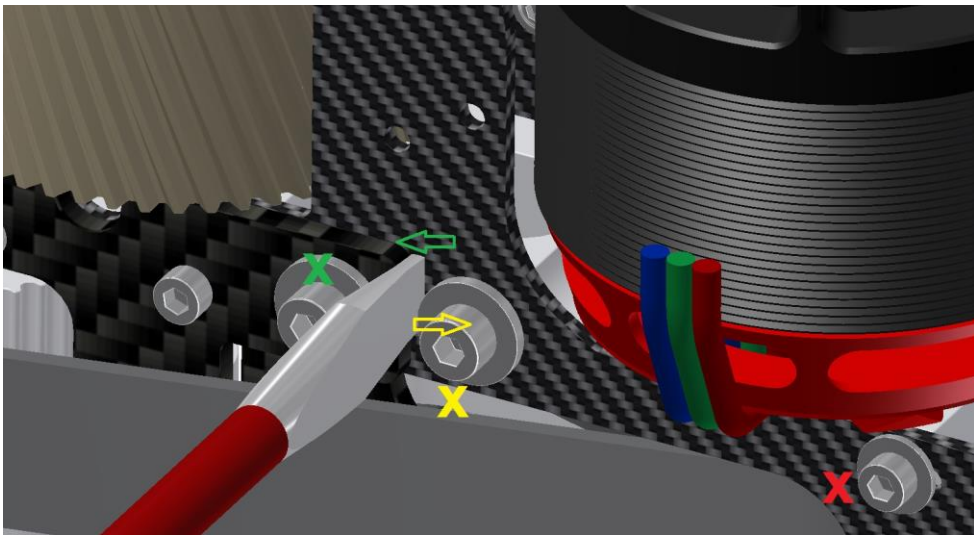
10.3 Installation of the motor support into the chassis

	WL04	Washer M4 large / 1,5 thick	4x
	M0410	Hex socket screw M4x10	2x
	M0414	Hex socket screw M4x14	2x
	M0340	Hex socket screw M3x40	1x
	WL03105	Washer M3 large	2x
	NS03	Nyloc nut M3	1x



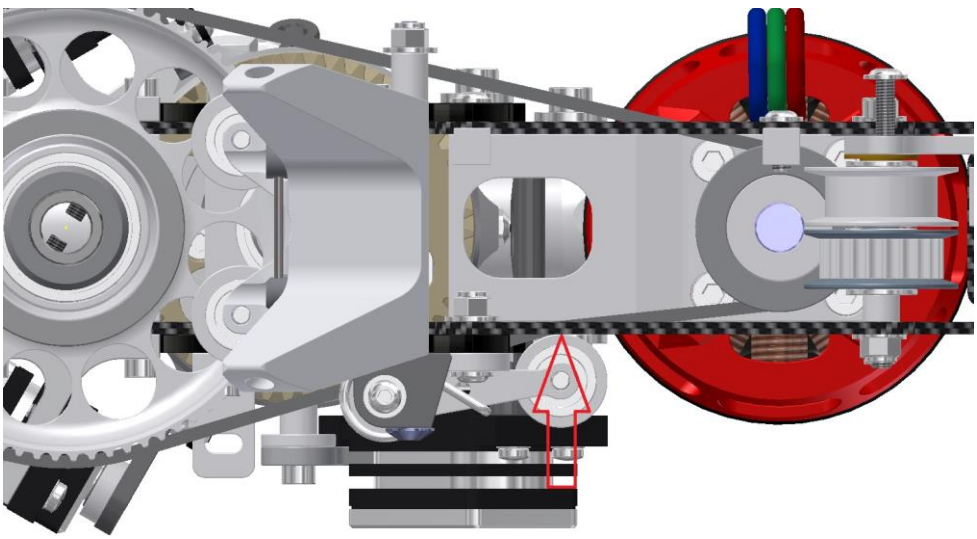
When mounting the engine mount in the mechanics, proceed as follows:
First remove the belt from the front of the large pulley so that you can pull it a little further back.
Tighten the belt tensioner pulley on the right side of the chassis slightly against the pressure of the torsion spring so that it does not push the belt inward into the chassis (if necessary, clamp a thin rod or screwdriver between the lever and the side plate to lock it there).
Then slide the motor with its support diagonally from the top back between the two chassis plates so that the pulley dips into the belt.
Now push the support forward as far as it will go and put the front strap over the big pulley so that it is horizontal to the chassis.
Then pull the motor support back to the rear so that you can see the respective motor mount holes through the slots in the chassis plates in order to screw in the screws.
First of all, screw the M4x14 and M4x10 socket head screws just loosely into the threaded holes on both sides and push the M3x40 Allen screw through the through-hole at the back. On both sides, the respective large washers M4 or M3 are put under and the rear M3 screw will be secured loosely with the M3 nyloc nut.
Attention! All screws are initially only turned on so far that they rest lightly on the U-washers and the engine support can still be moved back and forth. Pull the engine mount backwards with your hand as far as it will go so that the belt tightens slightly.
Further procedure - see next page.

You need two screwdrivers with a blade width of about 8mm as well as a person who helps you to turn the screws while tightening the belt.



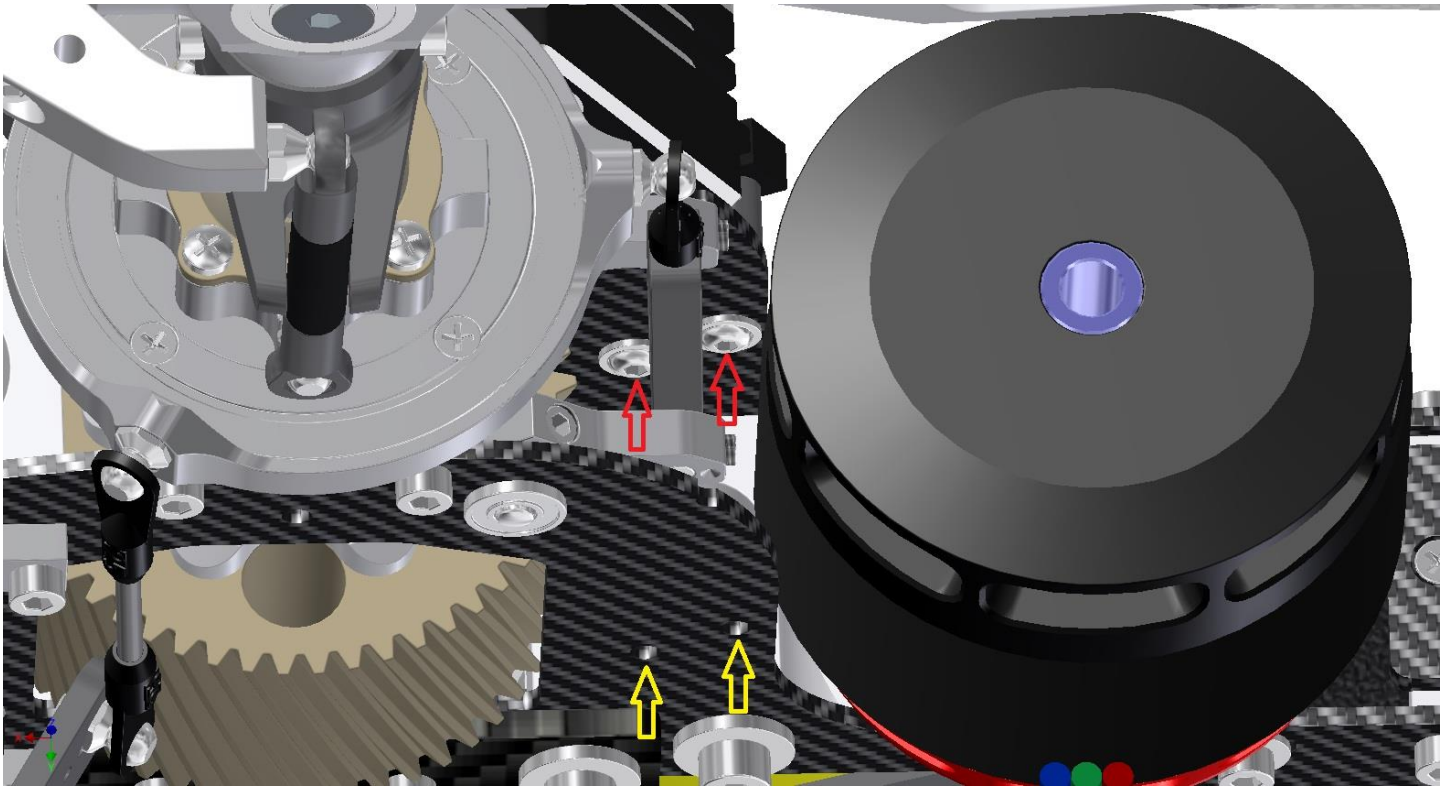
In the picture on the left you can see how the screwdrivers have to be placed between the stiffening plate (green arrow) and the washer of the M4x10 screw (yellow arrow).
If possible, use two similar screwdrivers with the same blade width and place them offset from the center so that a lever is created when turning them.
Look for a helper who can tighten the two M4x14 front hex socket screws (green X) with a socket wrench while you push the belt backwards by evenly twisting the two screwdrivers.

If the two front screws are tightened, you can remove the screwdriver and tighten the other screws (yellow and red X) slightly for the beginning.



Now remove the rod with which you have pushed the belt tensioner outwards so that it can spring against the belt.
The tensioner should now feather with its outer edge of the roller no further than to the chassis outer edge (red arrow - bottom left image), otherwise the belt is not stretched tight enough yet.
Pull the tensioner slightly off the belt several times, then slowly release it so that it touches against the belt. So you see how the tensioner is positioned on average.
Finally, tighten all screws very well with an Allen wrench to avoid moving the support during the flight.

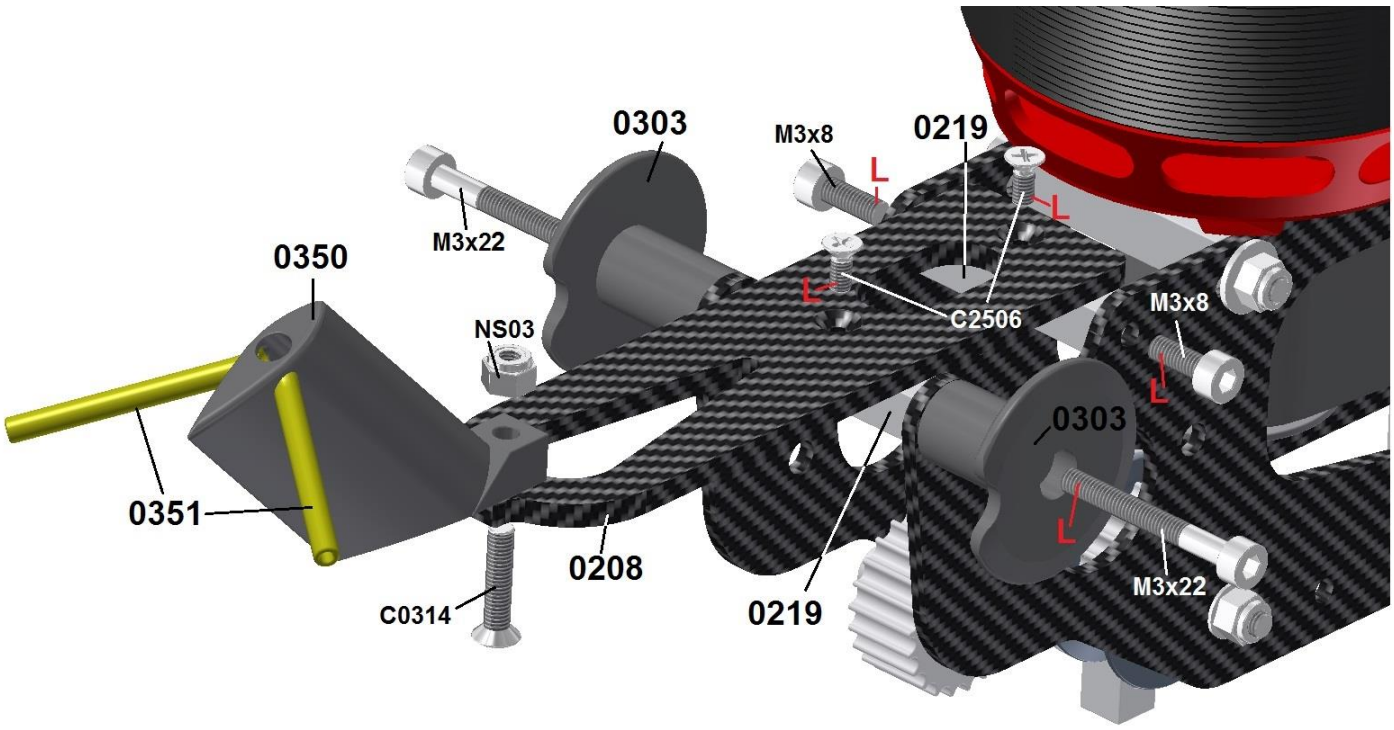
Notes for removing and installing the engine with already assembled tail boom:



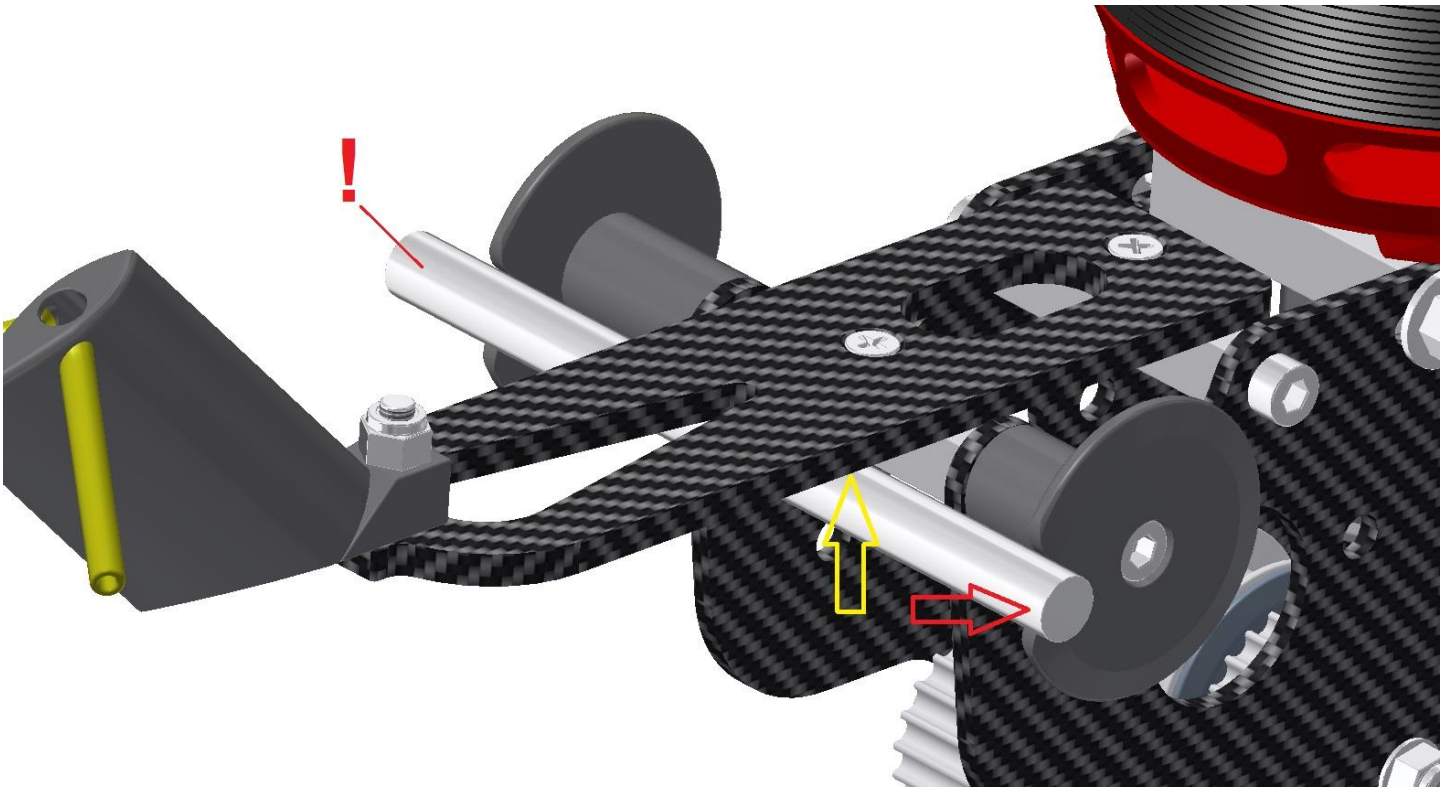
If at some point in the future you want to remove the engine without having to remove the tail boom, proceed as follows.
First remove all fastening screws of the engine mount.
In addition, the two lens head screws fixing the lower pitch servo mount on the right chassis plate (red arrows) must be removed.
To do this, insert a long hex socket wrench through the two opposing holes in the left chassis plate (yellow arrows) to access the screw heads.
Push the engine as far forward as possible to be able to strip off the belt at the front of the large pulley. Afterwards, the motor with its support in the chassis can be pushed far enough up to be able to pull it out.

Assembly step – 11 R C – s u p p o r t

	0208	Flybarless-Support	1x
	0219	Flybarless- Support fixation	2x
	0303	Canopy bolt support	2x
	0350	Antenna support	1x
	0351	Antenna support -tube 3x40	2x
	NS03	Nyloc nut M3	1x
	C0314	Countersunk screw M3x14	1x
	C2506	Countersunk screw M2,5x6	2x
	M0308	Hex socket screw M3x8	2x
	M0322	Hex socket screw M3x22	2x



First, screw the two square support fixations 0219 under the flybarless support plate 0208. The holes in the plate on the top side have a countersunk. Slightly tighten the two M2,5x6 phillips countersunk screws so that you can still align the ledges when positioning between the chassis side plates.
The antenna support 0350 can now also be fixed on the back of the plate with the cross-head countersunk screw M3x14 and the M3 stop nut as shown in the picture.
The two heat shrink tubes 0351, which act as antenna holding tubes, are needed later when inserting the antennas.
The front rail is attached to the chassis with the M3x8 hex socket screws. The rear rail is fastened to the chassis together with the two canopy bolt supports 0303, with M3x22 hex socket screws.
Each of the canopy bolt supports have a semicircular notch, which must be aligned at right angle to the rear. Please see a description of the procedure on the next page.
First of all, tighten the M3x22 rear screws only slightly, so that the supports can still be adjusted. The two M2,5x6 countersunk screws are tightened before, so that the two rails just rest on the plate.

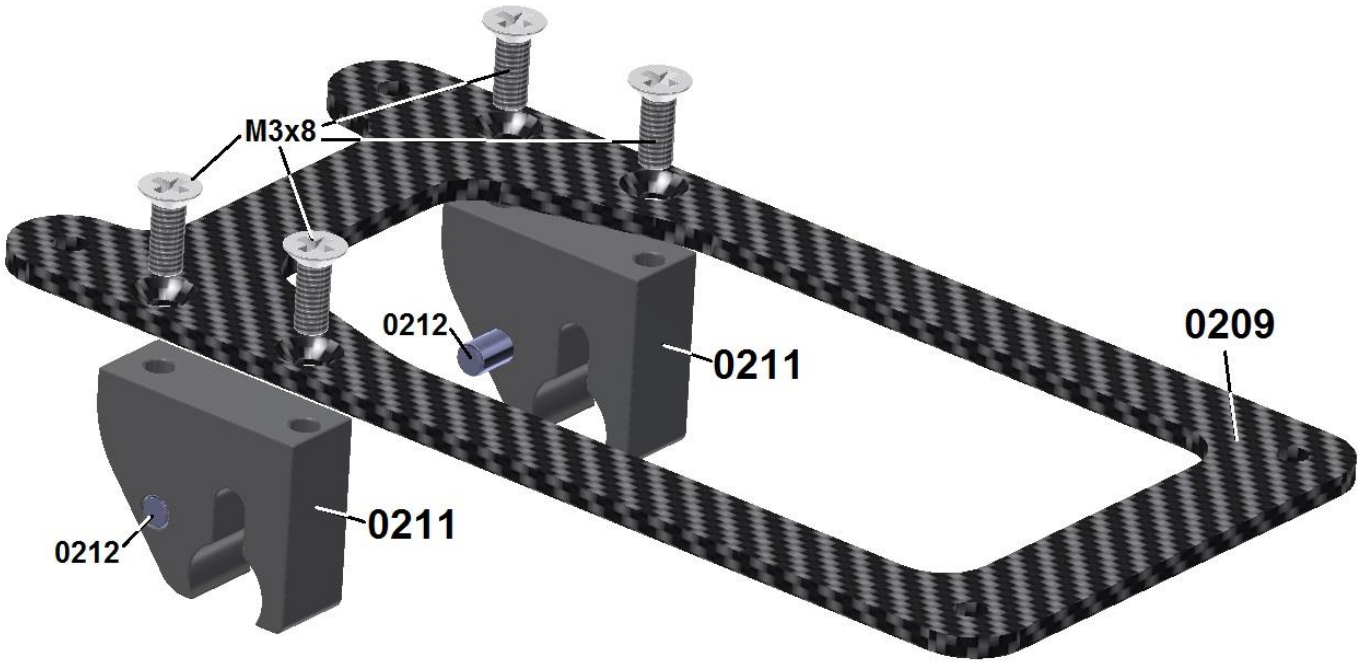


Attention! The easiest way to align the two 0303 Canopy bolts is to use a 6mm diameter pin or shaft.
Press this pin against the plate from below (yellow arrow) and then push it into the recess as far as it will go.
In doing so, turn the holders on both sides into the correct position so that their notches are centered cleanly on the pin. Here, a second helper may be useful, taking care that the pin really rests horizontally on the bottomside of the plate.
When tightening the screws, hold them firmly by hand to prevent them from turning and slowly tighten the screws while constantly checking the correct position in between. The screws should be tightened well because the plastic still settles a bit.
Note: Later, it is possible to adjust the fit of the canopy by slightly correcting the cut-out positions, should tolerances of the canopy holes require height compensation.
.

Assembly step – 12 ESC Installation

12.1 ESC- support plate

	0209	ESC - support plate	1x
	0211	ESC - plate holder	2x
	0212	Pin 3x12	2x
	C0308	Countersunk screw M3x8	4x

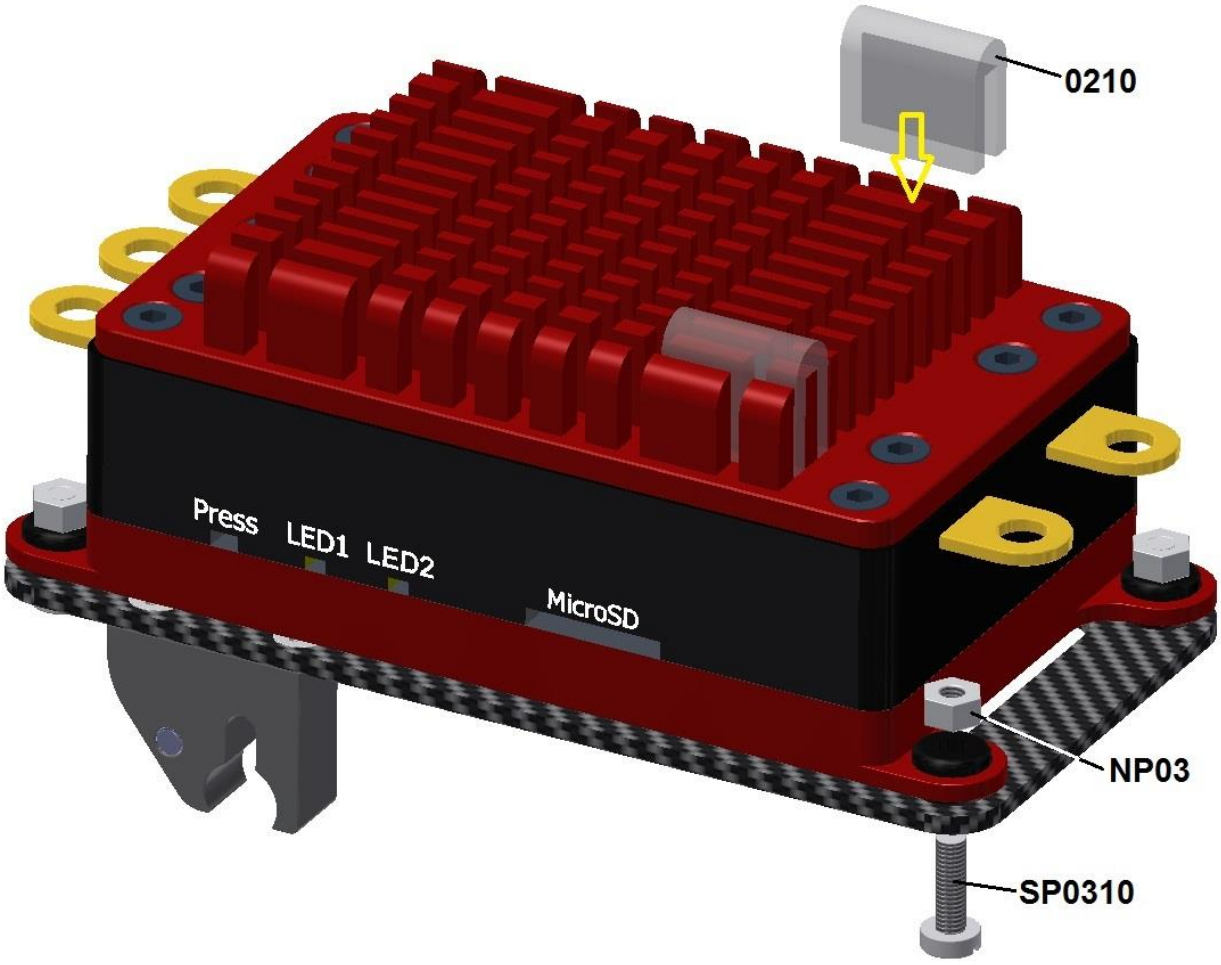


First push the pins 0212 into the ESC plate holder 0211 in such a way that they finish flush on the outside. They will then look inward a few millimeters and prevent the regulator plate from swinging too far up.

Screw the two ESC holders 0211 to the ESC plate 0209 with the four countersunk screws M3x8.
The screws cut into the slightly smaller holes in the plastic blocks.
Attention! Tighten with feeling so as not to turn the screws through.

12.2 Installation of the Kosmik–ESC

	0210	Silicone protection	2x
	SP0310	Plastic screw M3x10	4x
	NP03	Plastic nut M3	4x
	L0408	Lens head screw M4x8	5x
	NS04	Nyloc nut M4	5x



The KOSMIK ESC is screwed to the carbon plate with four M3 plastic screws and nuts. The screws are inserted from below into the plate and the nuts screwed from above and secured with a drop of silicone or hot melt adhesive.

The two connection lugs for the power supply should point forward (see picture).

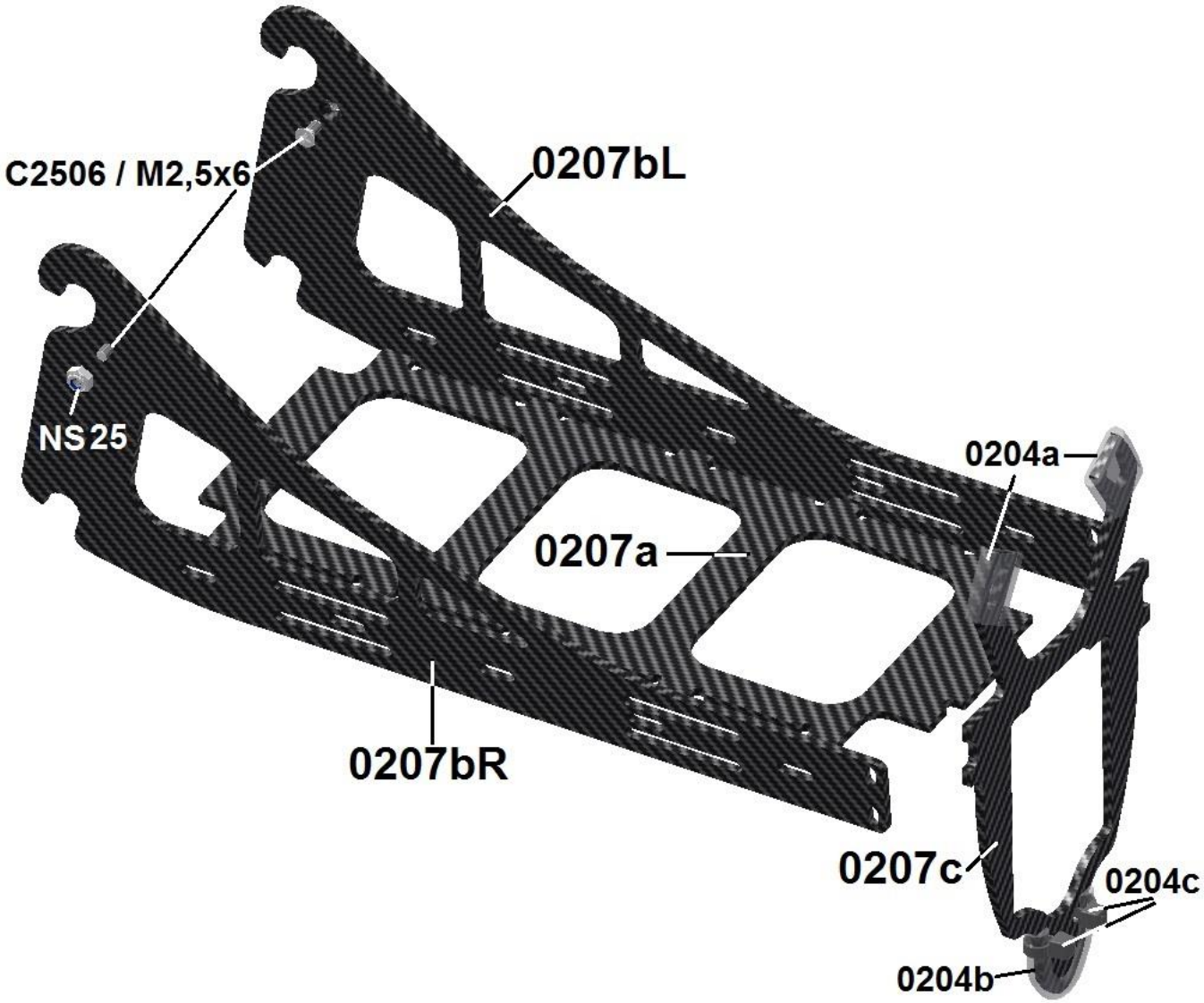
The procedure for connecting the cables will be described in a later chapter. Put aside the five Allen head screws M4x8 and M4 stop nuts provided for this purpose.

The two 15mm longitudinal cut silicone tubes 0210 are attached to the very front of the second cooling rib from the outside. They support the ESC, which is later pivotally mounted on the battery holder threaded bolt 0215, against the canopy, so that it can not swing upwards.
If you ever want to fly without a canopy, the regulator has to be secured by rubber bands on the battery tray.

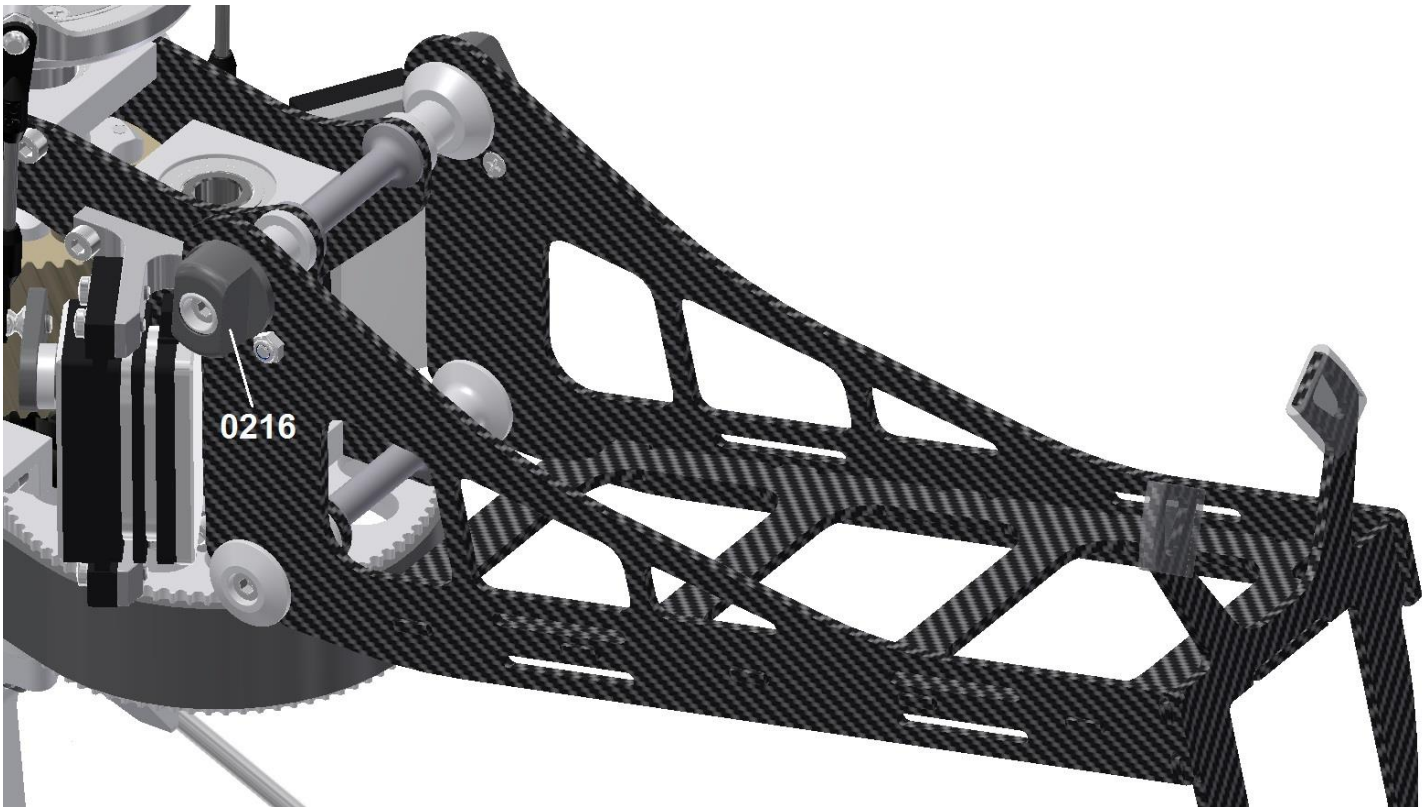
Attention! Don´t mount the ESC at the chassis yet.

Assembly step – 13 Battery tray assembly

	0207a	battery tray bottom plate	1x
	0207bL	battery tray side plate left	1x
	0207bR	battery tray side plate right	1x
	0207c	battery tray canopy support	1x
	0204a	Silicone support top	2x
	0204b	Silicone support bottom	1x
	0204c	Cable tie	2x
	C2506	Countersunk screw M2,5x6	2x
	NS25	Nyloc nut M2,5	2x



Installation description next page



First mount the two M2,5x6 countersunk screws on the left and right battery tray plates 0207bL and 0207bR respectively. The screws are placed in each of the holes with the countersink so that the head of the screw is laterally in the countersink on the inside and the nut on the outside.

Then hook the two battery tray side plates into the mounting posts to check that they fit. The plates must be able to be pressed down so far that they rest with the radius touching the pins of the bolts. If the hooks are stuck and can not be pushed all the way down, you can rework the places where it sticks with a round file.

Attention! Do not file the recesses too big, because the battery holder should later sit on the bolt without any play, if possible. The best way to test whether the upper or lower hook fits easily on the respective pin by attaching the plate at an angle and only hook in at the top or at the bottom.

Put the carbon plates of the battery holder loosely together now, according to the drawing on the previous page.

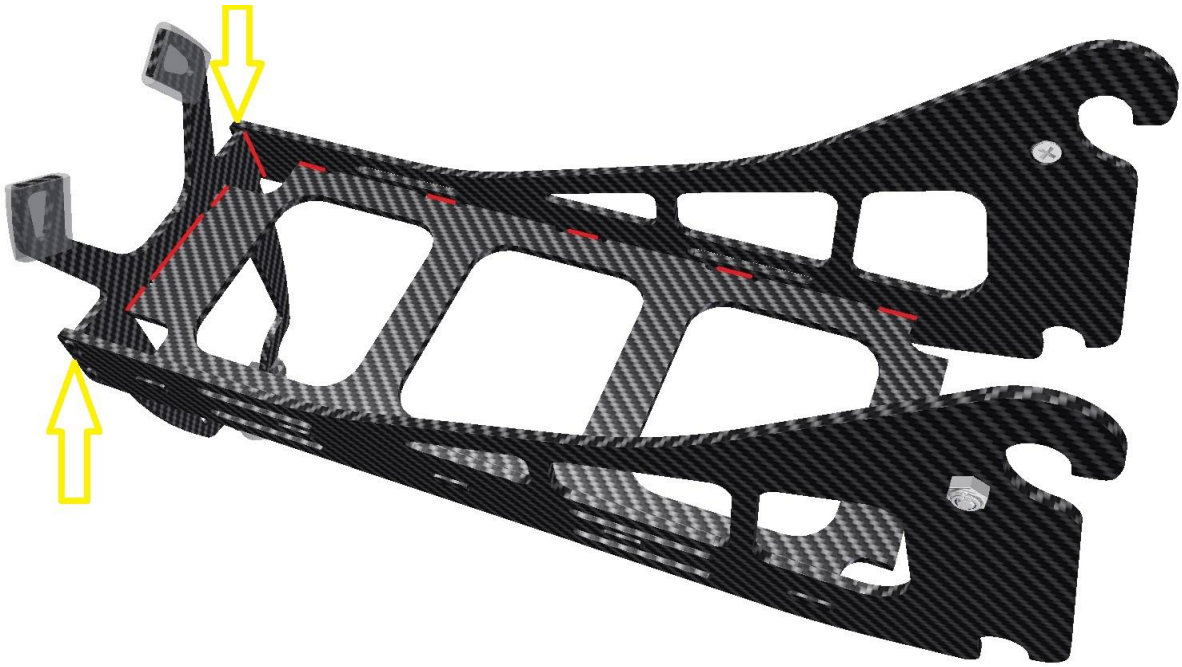
You can secure the two side plates in the front area just behind the canopy support 0207c with a rubber band, which you can pass over the two plates.

Now attach the whole unit to the mechanics fixing pin and clamp the two plates to the chassis with the two threaded bolt plastic nuts 0216. The hooks of the plates must be pressed on their pins completely downwards, so that they are aligned with the chassis plates on top and bottom and sit at the same height.

Attached to the chassis, the panels are exactly aligned and perpendicular positioned before they are glued together. Look at the mechanics again from above and align the plates 0206 sideways so that they are not crooked. Since there is play in the taps, this is easily possible.

Attention! In order to loosen or fix the battery holder, the two plastic nuts 0216 must always be unscrewed so far that the distance to the side plate is greater than the height of the protruding M3 nut in the battery tray plates. Otherwise it can not be pulled upwards. This is an additional security device. If a nut loosens, the battery holder can not immediately slip up as long as the nut still sits far enough on the thread.

Go on next page:



Now take thin superglue and place at all of the red marked areas on the inside of the spigot joints some glue in the gaps. On the two front sides of the bottom plate 0207a front superglue is used over the entire length of the connection. The vertical joints of frames 0204a and 0207b L + R are glued from both sides with superglue.

Please follow the same procedure at the bottom side of the battery tray. Due to the capillary effect, the superglue runs into the fine gaps, resulting in a very strong connection.

There is no need to apply superglue from the outside of the side plates. That only can result in unsightly traces. Also, avoid applying too much superglue at a time, otherwise it will run everywhere where it should not go.

Allow the whole unit to dry for at least half an hour before removing it from the chassis.
The superglue around the splices creates a white veil most of the time. You can wipe it off with a cloth when everything has dried.

Attention! Finally sand or file a strong chamfer on the side edge of the left and right side plate (see **yellow** arrow) and round off the corners, as these edges may later touch the canopy.

The three silicone tubes 0204a and 0204b are used later on as support for the canopy. The two upper pads 0204a made of thick silicone tube are simply pushed onto the two tongues, so that they still protrude about 1mm upwards. It is a good idea to deburr the edges of the carbon frame 0204 in the area of the silicone tubing so that they are not so sharp and cut the silicone tubing.

The lower cut-open silicone tube 0204b is first fixed on one side only as shown in the picture below with a cable tie 0204c.

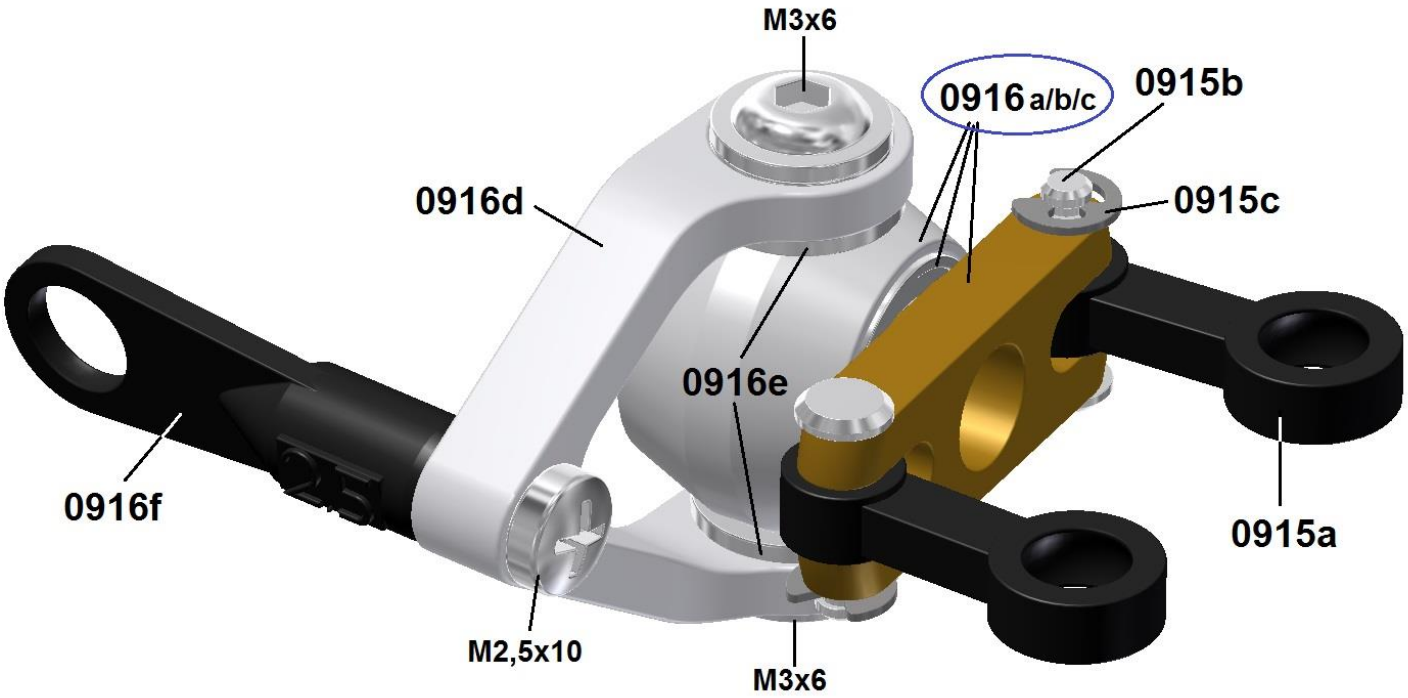
Attention! The cable tie closure must be aligned to the front and to the middle.

Then pull the other side of the hose tightly around the lower radius of the carbon frame so that it does not kink anywhere, and also fix the second end with a tie wrap.

Assembly step – 14 Tail rotor

14.1 Tail pitch slider (already assembled)

	0915a	Pitch slider arm	2x
	0915b	Pin for the Pitch slider arm	2x
	0915c	C-clip	2x
	00916abc	Tail pitch slider complete	1x
	0916d	Pitch slider fork	1x
	0916e	Flanged bearing 3x7x3	2x
	0916f	Ball link 17mm	1x
	L0306	Lens head screw M3x6	2x
	P2510	Phillips screw M2,5x10	1x



The tail pitch slider 0916a / b / c will be delivered as a complete unit under order number 0916, since the sleeve ring is crimped with the two bearings on the pitch bridge.

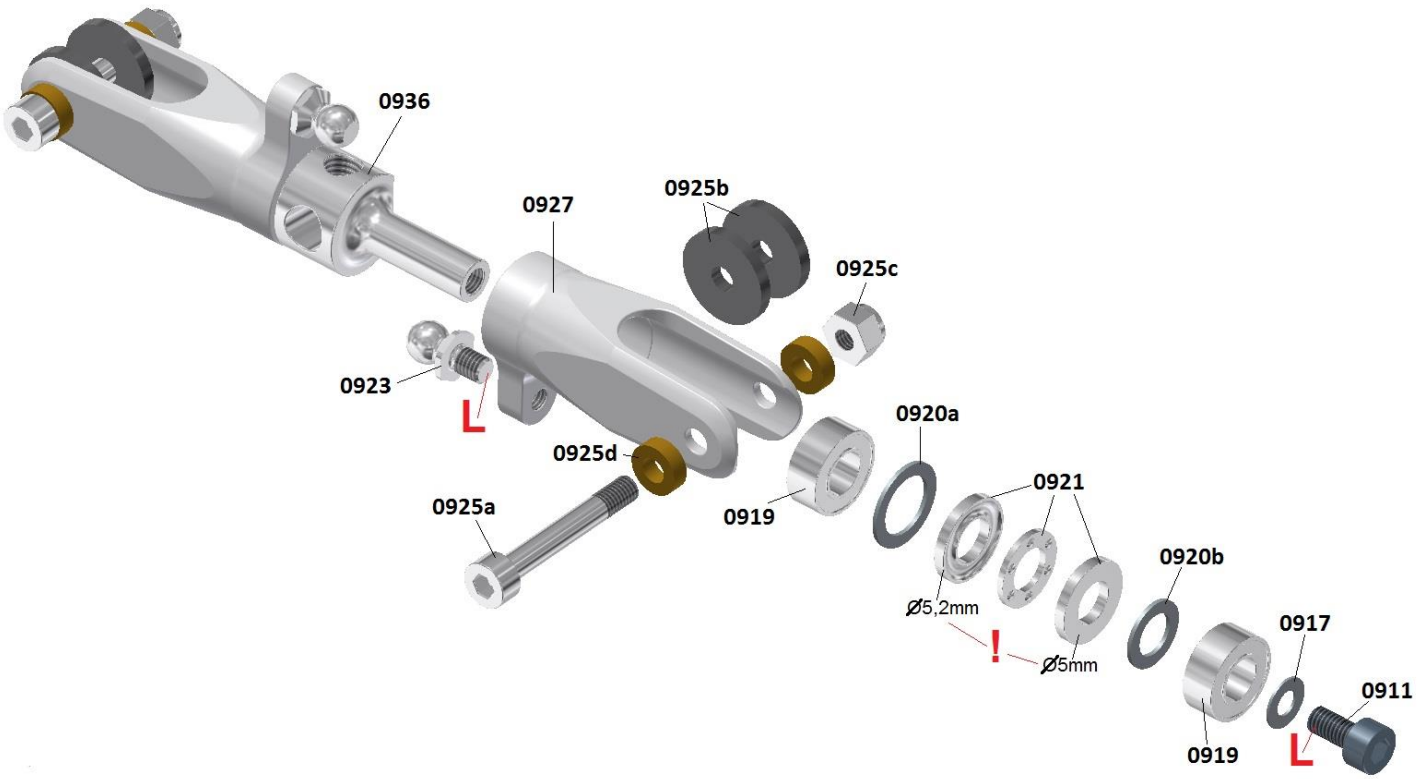
The pitch slider arm 0915a, as well as the pins 0915b and the C-clip 0915c are also available individually, since in most cases crash only the arms.

The pitch slider fork 0916d with the two 0916e flanged bearings, which are mounted with the collar seated inwards, is bolted to the control bridge.

Secure the two M3x6 lens head screws with **L**octite.

14.2 Tail center hub with tail blade holders

	0911	Hex socket screw M3x6 - 10.9	2x
	0917	Spacer washer 3x6x1	2x
	0919	Radial bearing 5x10x4	4x
	0920a	Spacer washer 7x10x0.5	2x
	0920b	Spacer washer 5x8x0.5	2x
	0921	Axial bearing 5x10x4	2x
	0923	Threaded ball pin M3x4 / 4mm	2x
	0925a	Hex socket screw shanked M3x21	2x
	0925b	Spacer for tail blade	4x
	0925c	Nyloc nut M3 (NS03)	2x
	0925d	Compensation weight 3x6x2	4x
	0927	Tail blade holder	2x
	0936	Center hub	1x
	G0404	Grub screw M4x4	1x



The assemblies of the tail blade grips are done in the following procedure: (see next page)

First push the radial bearing (5x10x4) 0919 into the blade holder 0927 until it stops. The bearing has to be pushed to the recess in the rear (expand the blade grip with heat if needed). It is followed by the largest of the three spacer washers (7x10x0.5) 0920a.

Thereafter, insert the three greased parts of the axial bearing 0921 in correct order. First the ring with the larger 5.2mm bore, then the ball cage and finally the ring with 5mm bore. Make sure the rings do not swivel 180° upon inserting them. Perhaps you make use of a pin and draw the parts over the pin into the blade grip. The circular milled groove of the rings must always face the ball cage. Then comes the spacer washer 0920b (5x8x0.5) followed by the second axial bearing 0919.

Attention! A faulty assembly may lead to blocking blade holders later on during flight.

The complete pre-assembled blade holder is now slid onto the rotor hub 0936. If the blade holder does not slide all the way to the flange of the hub, the cause in most cases will be that the spacer washer 0920b has slipped sideways. Try again after centering the spacer washer with a pin.

The complete unit is then screw tightened with screw 0911 and washer (3x6x1) 0917 to the tail rotor hub 0936.

Attention! For the purpose of attaching the unit to the tail rotor hub 0936, exclusively use the special screw 0911 (M3x6 hardness 10.9). Fasten this screw tight with **L**octite.

After assembly, the blade hubs have a remaining axial lash of a few tenth millimeters on the hub. This is meant to prevent the bearings from clamping. This has no disadvantages for the common flight practice.

The centrifugal forces pull the blade holders to their outer stops.

Enclosed are appropriate 1.5mm plastic washers to fasten 5mm tail blades 0925b. If possible, please do not use any other washers. The screws 0925a, for the purpose of fastening the tail blades, are only tightened fast enough to keep blades swiveling lightly. Only use this particular sized shaft screw. Any other normal screw with a complete thread will cut its way through the thin sleeves of the bore.

Fasten the threaded ball pin 0923 to the blade holders with **L**octite and assemble the tail blades later so that the link balls are positioned forward into the direction of rotation.(see also next chapter).

Attention! The complete hub will be assembled later at the tail rotor shaft.

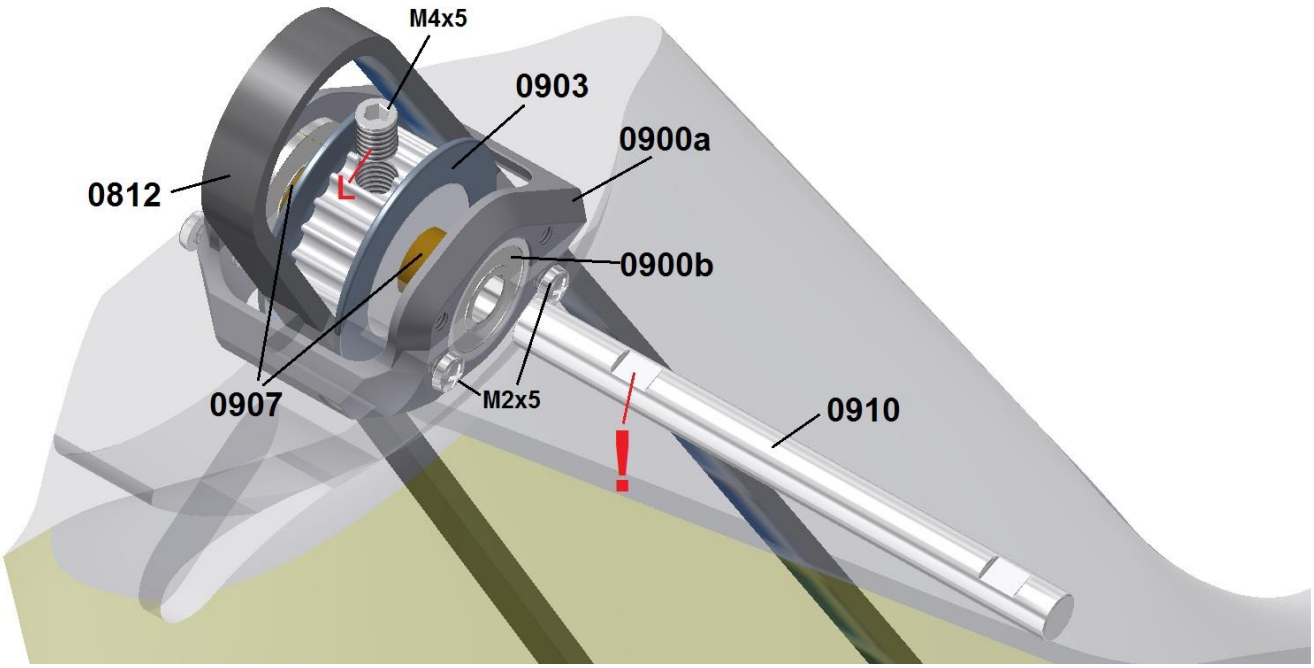
Assembly step – 15 T a i l b o o m

Attention! Since the tail boom is a very compact and optimized component in which some assembly steps are a bit more demanding and tricky, this is already delivered completely pre-assembled by us.
Nevertheless, I recommend reading the following assembly steps to understand how everything is structured. In addition, the attachment to the mechanics is described at the end of the chapter (in any case from page 57 - continue reading with assembly group 15.4).

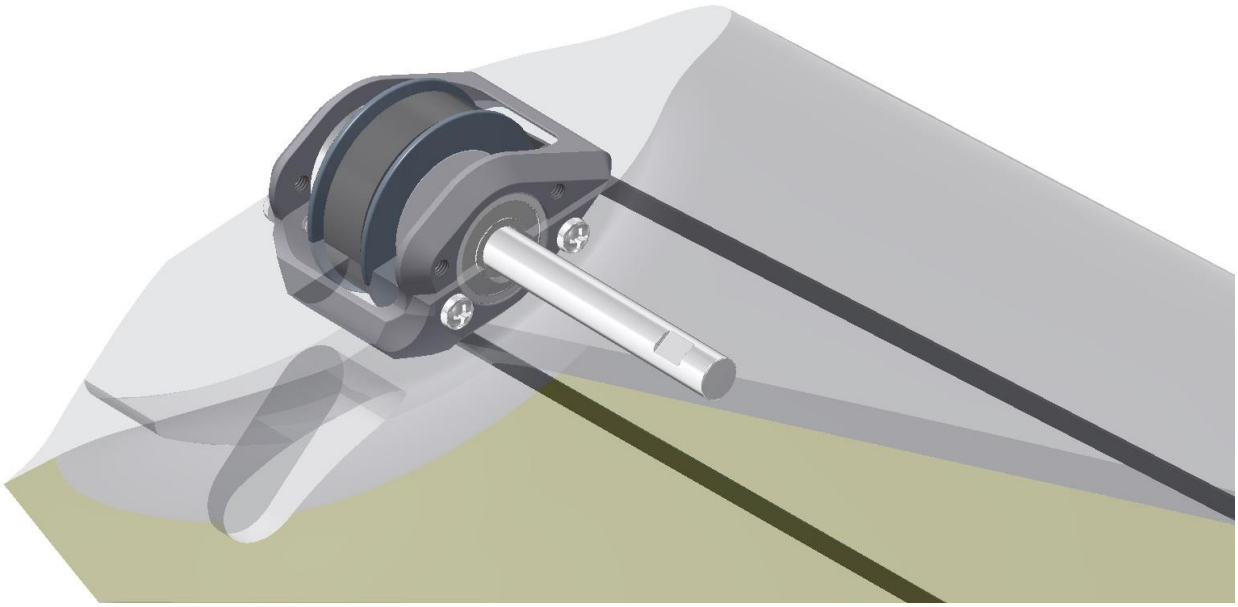
In case of eventually repairs, you can look here how to proceed. In general, when ordering spare parts, the actual CFK tail boom is in principle delivered only with a fin tip plus horizontal fin and the bolted and additionally glued gear housing. All other components can also be ordered individually as required.

15.1 T a i l g e a r

	0800	Tail boom complete	1x	
	0307	Rubber band (cannopy lock)	3x	(already mounted at the boom)
	0812	Toothed belt 2100mm / 6 wide	1x	
	0900a	Tail gear box housing	1x	
	0900b	Flanged bearing 5x13x4	2x	
	0903	Belt pulley 22T	1x	
	0907	Spacer 5x7x4	2x	
	0910	Tail rotor shaft 5x61	1x	
	G0405	Grub screw M4x5	1x	
	P0205	Phillips screw M2x5	2x	



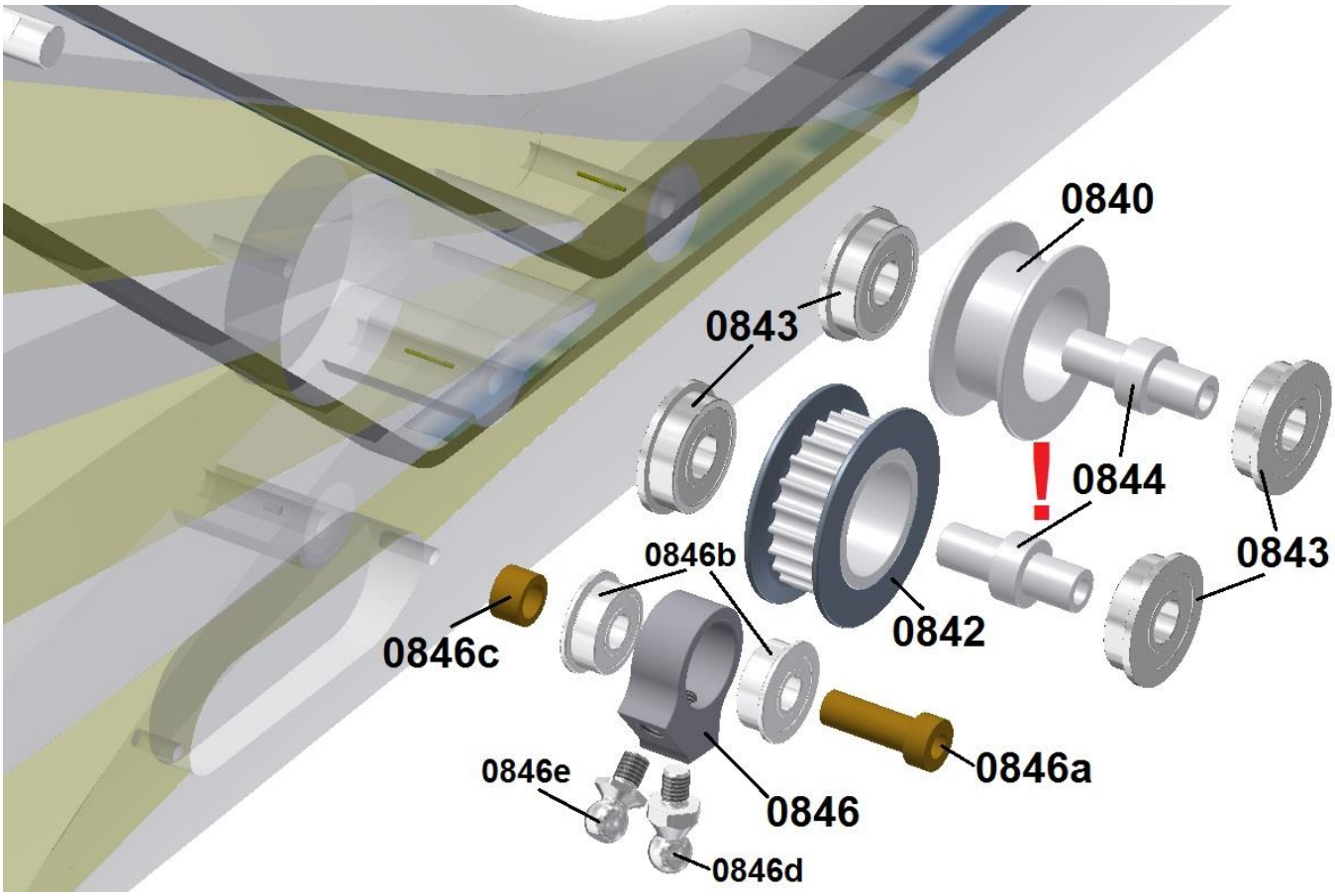
Assembly see next page



The tail gear housing 0900a is already screwed and glued as already mentioned in the CFK tail boom.
From the inside, press the flange bearings carefully into the fits of the housing so that they lie flush against the housing. First, pull the tail belt 0812 into the tail boom. It makes sense to bend a 1.5 to 2mm thick steel wire with at least 1 meter in length to support the threading of the belt. Make sure that the belt is not twisted in itself and pull it out of the tail well enough so that the 0903 belt pulley can be mounted. First insert the tail rotor shaft 0910 from the right side through the bearing so that it looks out far enough inside to be able to thread the first spacer bushing 0907.
Attention! Pay attention to the right side where the flattening has a greater distance to the face. Then insert the pulley and push the shaft a little bit further. Then place the second spacer into the remaining gap on the other side and push the shaft through until the flattening coincides with the hole for the M4x5 grub screw. Tighten the grub screw slightly first to see if you have hit the surface by gently turning it back and forth. Secure the grub screw, but do not use **L**octite in the hole, just on the thread flank of the grub. Tighten the grub screw sensitively and not too tight, otherwise the shaft can bend a little bit. Remove excessed **L**octite from the pulley teeth before pulling the belt down.

15.2 Belt- and control rod deflection

	0840	Idler pulley	1x
	0842	Deflection pulley	1x
	0843	Flanged bearing 5x13x4	4x
	0844	Axle	2x
	0846	Bell crank 45°	1x
	0846a	Bearing bolt	1x
	0846b	Flanged bearing 4x10x4	2x
	0846c	Spacer	1x
	0846d	Threaded ball pin M3x4 / 6	1x
	0846e	Threaded ball pin M3x4 / 4	1x

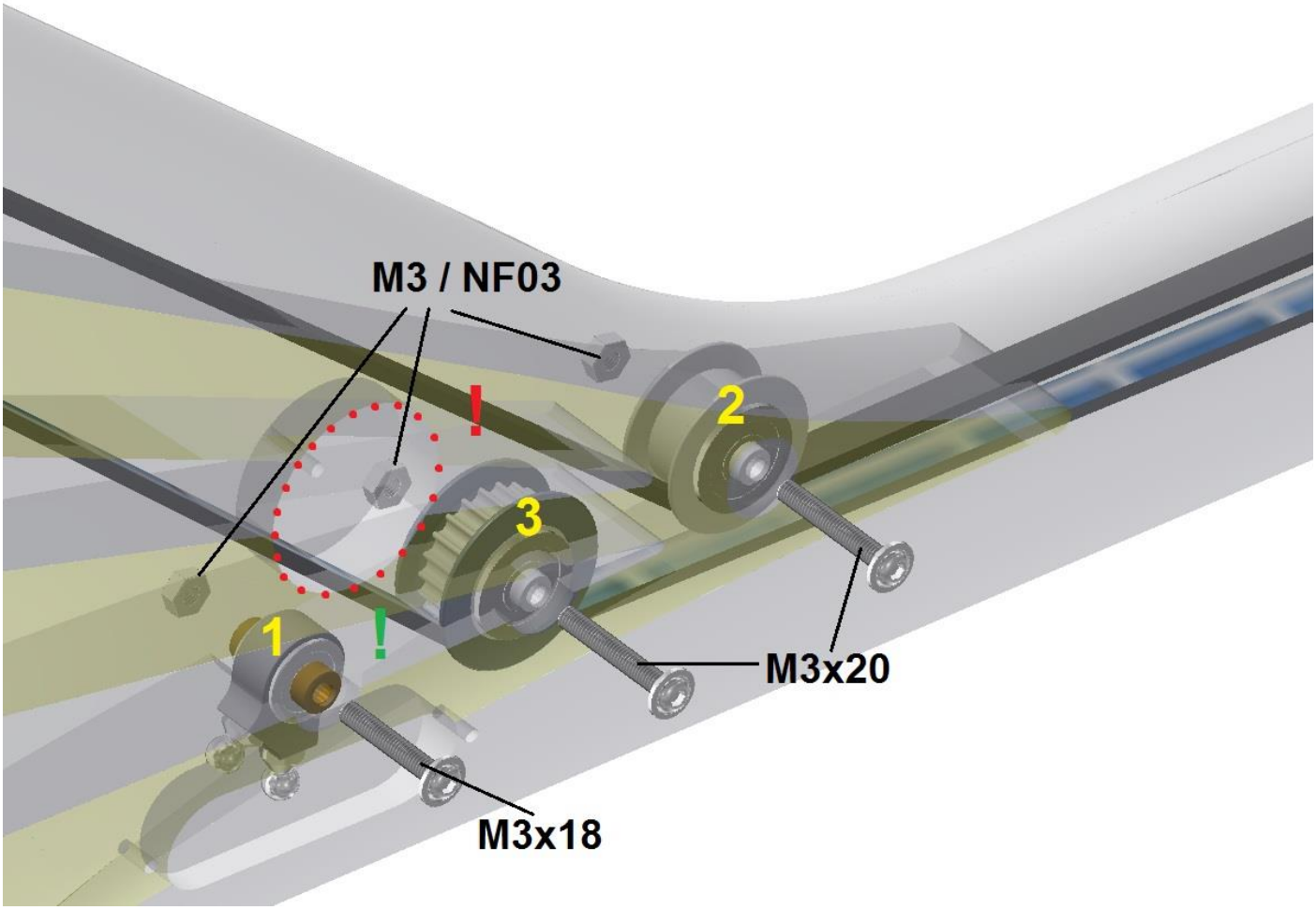


Attention! When installing the axles 0844 between the two flanged bearings 0843, make sure that the two sides have different lengths. The shorter side must be for both pulleys on the right in the direction of flight. This is later to be considered when inserting into the tail boom, as the tail boom in the rear area is asymmetrical and the rollers would otherwise not sit centred. First push one bearing into the pulley as far as possible and then push the pulley axle into the bearing hole from the other side. When pushing in the second bearing, you may need a piece of tube with an inside diameter of at least 6mm to have clearance for the axle. The force must always be applied to the outer rings of the bearing. The lever 0846 has to be equipped with the two different length ball pins 0846d and 0846e and the two bearings 0846b have to be pressed in. The longer ball pin comes to the flattening, which has a greater distance to the bearing bore of the lever.
The bearing bolt 0846a is pushed in from the right side.
Attention! Again, the side may not be exchanged later during assembly in the tail boom. The spacer 0846c is pushed onto the bearing pin on the other side. Since the spacer initially sits only loosely until the unit is bolted to the tail boom later, it makes sense to secure it with a tiny drop of superglue so that it does not fall off during assembly.

Assembly of the units in the tail boom see next page:

	NF03	Nut M3 – flat	3x
	L0318	Lens head screw M3x18	1x
	L0320	Lens head screw M3x20	2x

Attention! Read through the procedure of the assembly steps completely and also follow this order, because it is the easiest way.



On the right side of the tail boom there are two maintenance openings in the rear of the tail boom. A circular hole (red dots) at the top and an oblong hole below.
Begin by assembling the bell crank (1) as shown in the drawing above.

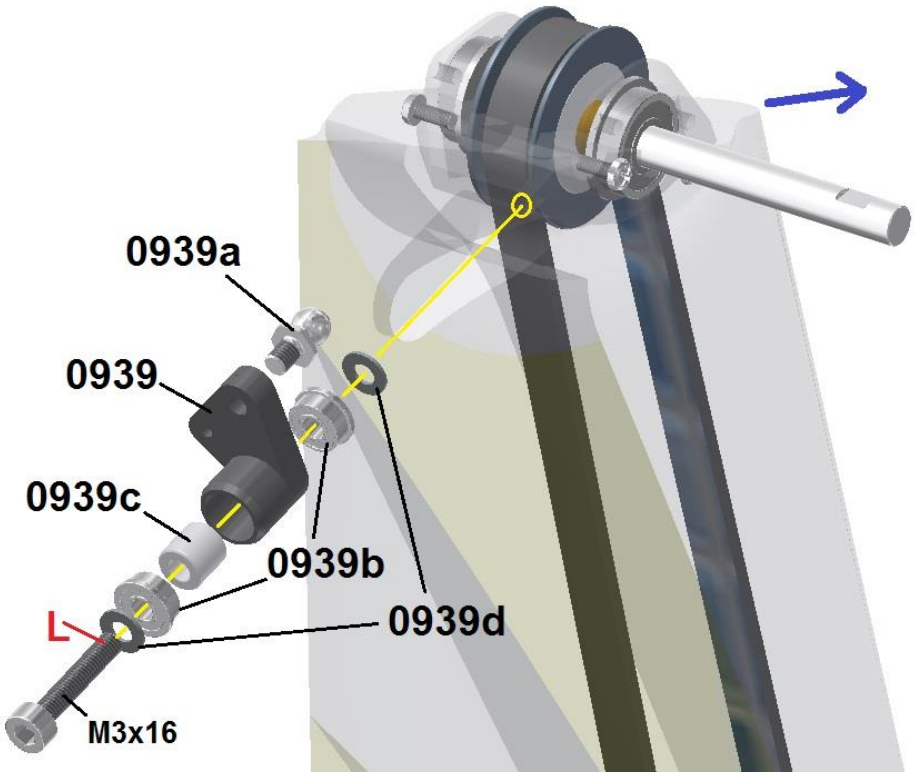
Attention! Always take care that the belt is not twisted and that the tension side is top (!) and the back side is below (!) and is located on the correct position relative to the respective rollers.
In the event of a later belt change, only the deflection toothed belt pulley (3) has to be removed. Pulley (2) and the lever (1) can remain in the tail boom.
Insert the bell crank through the round service hole in the tail boom and align it with the rear of the three mounting holes to pass the M3x18 lens head screw.
As already mentioned on the last page, make sure that the bell crank is mounted correctly. The flat M3 nut on the other side must be secured with **L**octite!
Next, insert the front smooth idler pulley (2) into the service hole right way around and push it forward until it aligns with the front of the three holes.
It may be helpful to take a thin pointy pin (such as a 3mm or smaller diameter needle) to line up the bearing pin hole with the holes in the tail boom

Attention! Before inserting the pulley (2) through the maintenance opening, push both sides of the belt all the way to the left to the bell crank. None of the belt strands may later lie over this roller (see picture above). Now attach this roll with an M3x20 lens head screw and a flat M3 nut (use **L**octite).

Finally, the belt pulley (3) is also installed, making sure that the tension side (!) is lying on the right respectively over the toothed belt pulley and the back side (!) is lying on the left respectively under the toothed belt pulley (see picture above).

15.3 Installation of the bell crank at the tail gear box

	0939	Bell crank top	1x
	0939a	Threaded ball pin M3x4 / 4 long	1x
	0939b	Flanged bearing 3x7x3	2x
	0939c	Spacer 3x6x6	1x
	0939d	Spacer washer 3x6x0,5 (SW030605)	2x
	M0316	Hex socket screw M3x16	1x



First, the lever will be preassembled according to the drawing with the shown components 0939 / 0939b / 0939c. The ball pin 0939a must be tightened sensitive so that the thread does not over-tighten in the plastic. On both sides of the bearing a spacer washer 0939d (3x6x0.5) has to be placed. Mounting the lever at the designated M3 threaded hole at the rear side of the gearbox (**yellow circle**) is not easy, because the space is very limited (the blue arrow points forward in the direction).

Do not yet insert the M3x16 screw with the rear shim through the lever. It is very helpful if you first fix the front shim with a tiny drop of superglue centric on the bearing inner ring of the front bearing. To do this, degrease the end face of the bearing inner ring with a cloth and brake cleaner (do not spray the brake cleaner directly onto the bearing, otherwise the grease will be washed out of the bearing).

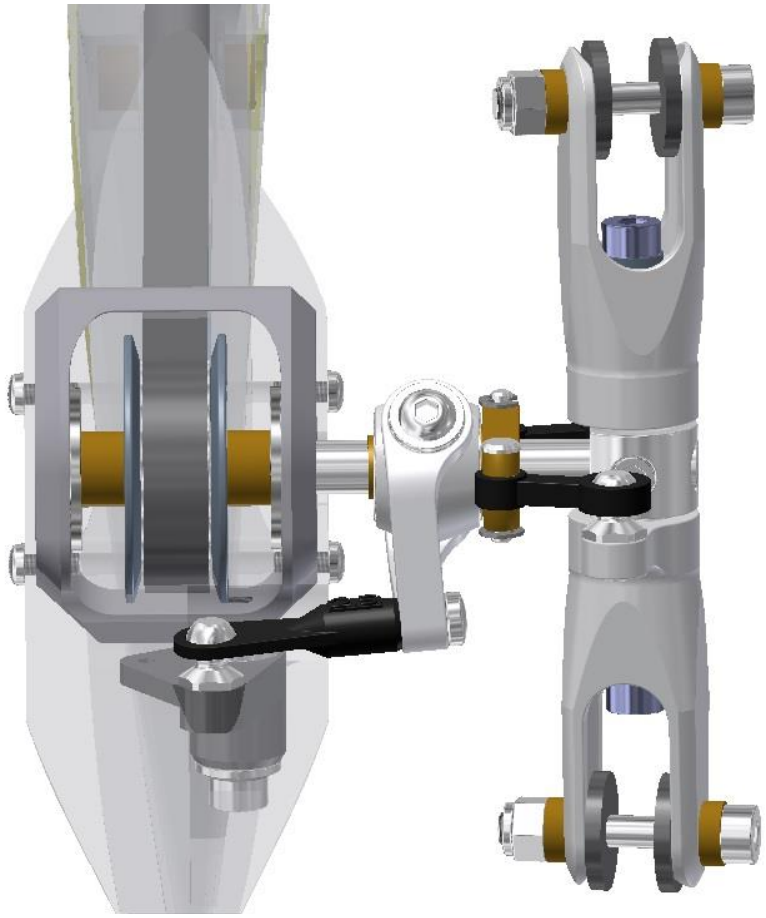
Attention! It must not penetrate super glue in the bearing.

Then insert the lever from above into the open tail unit and thread the M3x16 screw with the second shim from behind through the opening of the tail unit. It is best to use an Allen key screwdriver (use **L**octite).

Attention! It is important that the lever is positioned all the way to the housing in the far right corner and is held at an angle at right angles to the support surface of the housing while tightening the screw.

Feel that the screw is gripping and also easy to turn. In no case continue to turn, if you notice that it only grips at the tip and is then tilted, because of the angle is not correct. The fillet with the M3 thread in the housing is only 3mm thick therefore very sensitive. If the thread is destroyed during assembly, there is hardly a chance to do anything, since the housing is glued in the tail boom and there is no room for a nut.

15.4 Assembly of the pitch slider and the tail rotor hub

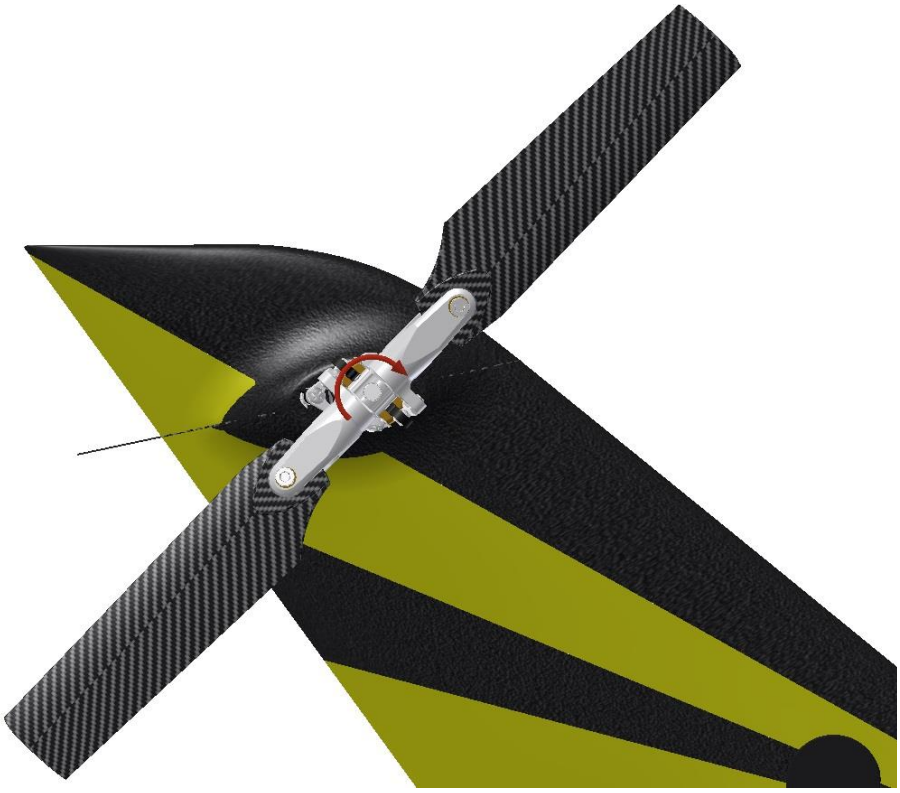


First push the tail pitch slider onto the tail rotor shaft. Lubricate shaft with Dry Fluid Gear before.

The ball link is pressed onto the ball pin so that the lettering points forward in the direction of flight.

Align the ball joint so that the flattened sides are parallel to the lever in vertical alignment, and then tighten the Phillips head screw holding the ball joint to the control fork properly.

Attention! If the pitch slider can only be moved very sluggishly after applying the ball joints, it helps to press with a pair of flat pliers from outside on the plastic of the mounted joint. As a result, the ball pushes a little into the circumferential groove, so that it is slightly widened.
In general, the entire tail control moves through the many deflections is slightly heavier than usual. But that does not matter, because the tail servo with its force of 19kgcm is more than sufficiently strong dimensioned.



Attention! Pay attention to the correct direction of rotation when mounting the tail rotor hub (see red arrow picture left).

The tail rotor turns clockwise when looking at the tail fin from the right.

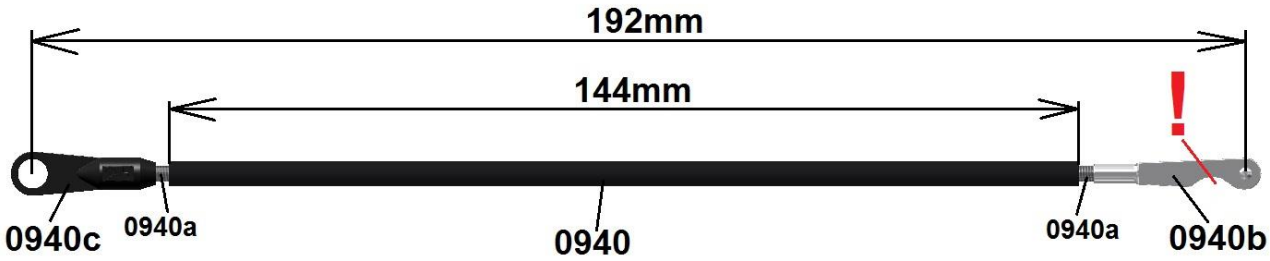
The tail rotor hub has to be pushed onto the tail rotor shaft so that its flattening area is facing towards the gearbox housing so that more control path is available for the pitch slider (see picture above left).

Secure the grub screw M4x4 with **L**octite. Do not put **L**octite in the hole, just on the grub itself, so that the hub does not stick to the shaft.

Position the hub so that its right face coincides with the end of the tail rotor shaft.

15.5 Assembly - control rod in tail fin

	0940	CFK-tube 2,5x4x144	1x
	0940a	Threaded pin M2,5x25	2x
	0940b	Fork head special	1x
	0940c	Ball link 19mm	1x



Screwing on the plastic ball links 0940c on the 0940a threaded pin for the first time can be quite hard. I recommend screwing the ball pin on the threaded pin first and then unscrewing it again before the pins are glued in place. Hold the threaded pin with a pair of pliers in the later gluing area. In this area it does not hurt, if the thread is a bit damaged.

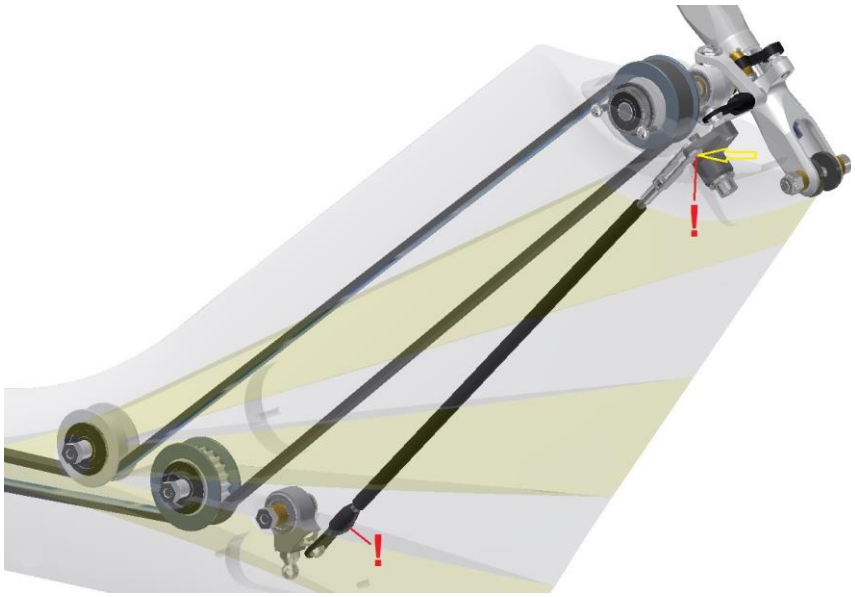
Glue the two threaded pins 0940a with thin superglue on both sides of the push rod that they look out about 12mm. Do not force the stud bolts if the bore of the push rod is a bit too tight.

The CFK tube consists only of thin longitudinal fibers and splits easily when it is pushed apart from the inside. Take a matching small round file and carefully file up the hole a little bit, or clamp the threaded pin into a drill and grind it outside in the gluing area to make it fit.

After the superglue is hardened, firstly screw the ball joint 0940c onto one of the two ends of the push rods so that a distance of approx. 2-3 mm remains between the end face of the push rod and the end face of the ball joint.

On the other side, the fork head special 0940b is screwed on as shown in the picture above. The lettering of the ball joint 0940c faces to the front. The distance of both articulation points should be approx. 192mm.

Attention! The semi-circular cutout has to be necessarily aligned with the upper bell crank in the vertical tail, pointing to the right to the shoulder of the bell crank 0939. Otherwise, the lever could not move far enough, because the fork head is mounted very close to the hinge due to the minimal space available.

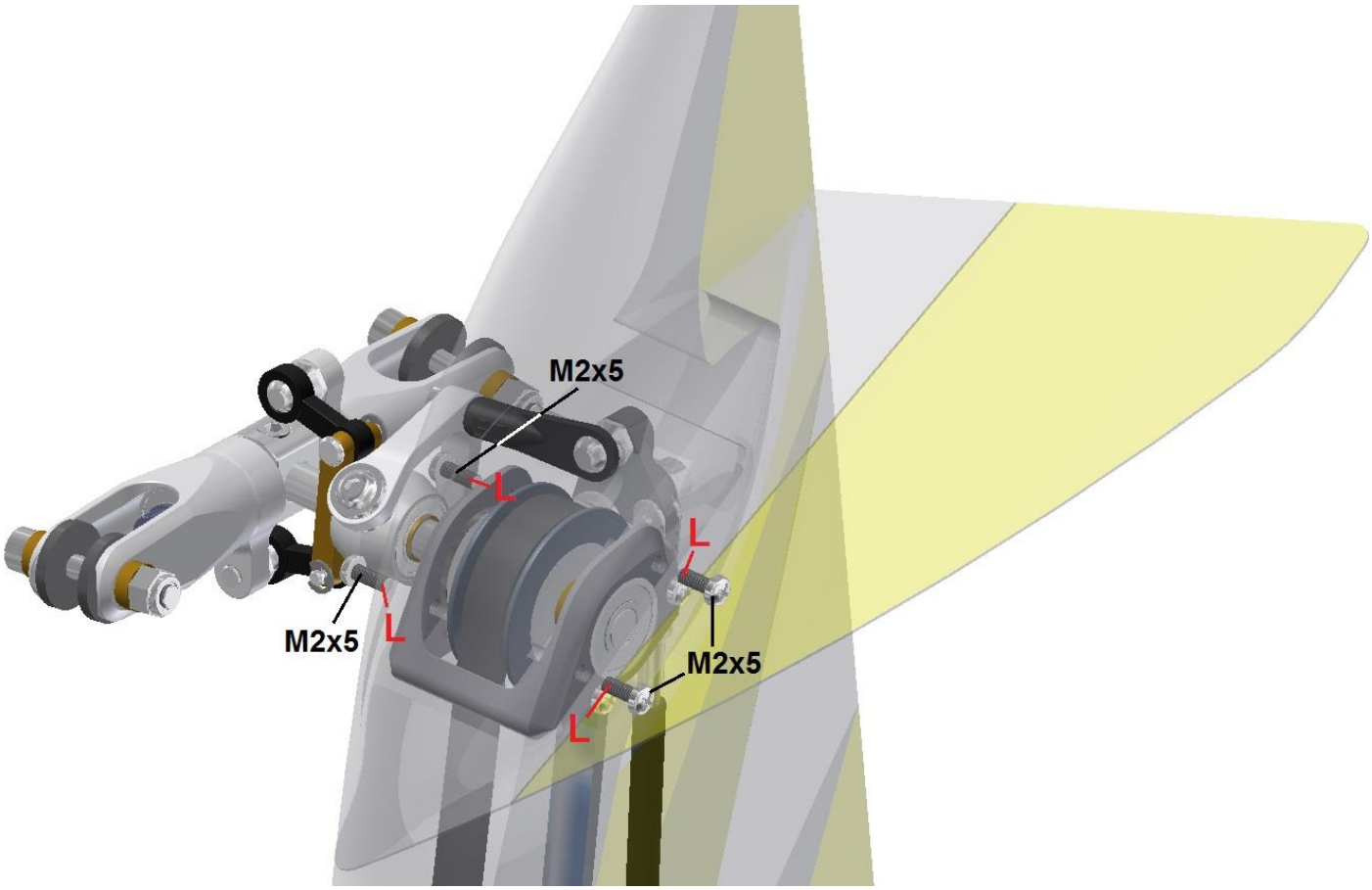


To mount the rod, swing the upper bell crank up as far as possible to hook the fork head into the 1.6mm hole.
To do this, insert the linkage from above into the vertical stabilizer, so that the lower end, which will later be attached to the bottom of the 45 ° lever, will definitely be behind it and not in front of it (see picture left).

Attention! Carefully spread the fork link with a screwdriver so that you can insert the pin into the hole.
The pin is mounted on the back of the fork link (yellow arrow). Gently squeeze the fork link so that the pin snaps back into place on its opposite side. Finally, the ball joint is also pressed on the 45 ° - lever.
.

15.6 Installation of tip on the tail fIn

P0205 Phillips screw M2x5 4x

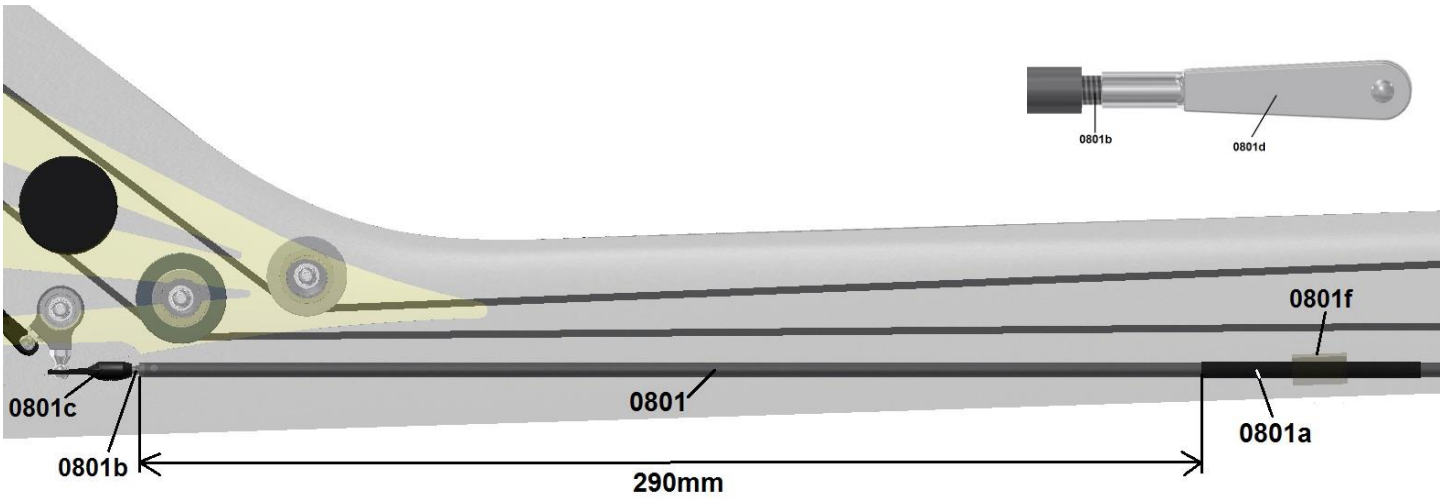


The tip is already delivered with the glued horizontal fin. The tip is screwed to the upper holes in the gearbox housing with the four M2x5 Phillips screws. Sometimes, it may be necessary to make small adjustments in the area of the cut out for the Pitch slider linkage.
To do this, put on the tip and see if the ball joint touches the cutout anywhere. If necessary, enlarge the cut out by grinding a little bit at these points of contact with a Dremel or a round file.
Secure the small screws only with a small amount of Loctite so that they can be easily removed later for maintenance or inspection!
The screw, which is a bit hidden behind the right, can be easily reached through the control bridge fork with a thin Phillips screwdriver, if you turn the tail rotor hub to a favorable position before.

Attention! Please do not come up with the idea to remove the horizontal fin. It is not appropriate for optical reasons. It has been proven in many flight tests that it has significantly stabilizing effects on the attitude stability around the pitch axis. This is especially important for speed flights, because the systems are already at the physical limit anyway.
Due to its negative angle of attack, it generates a moment at higher speeds which pushes the tail upwards and thus acts as if the helicopter has been heavily top-heavy with heavy batteries, which also has a stabilizing effect.
This is especially important with the 10S FAI setup while maintaining the maximum permissible weight, as it only uses batteries that allow a neutral center of gravity, but no top-heaviness.
At almost maximum speed in the horizontal fast flight through the measuring section the fuselage is inclined forward so far that the horizontal stabilizer is almost horizontal to the direction of flow and thus no longer produces air resistance. Only when pulling up the machine, a typical critical point, it unfolds its full effect again.

15.7 Preparation of the tail push rod

	0801	CFK-push rod 2,5x4x692mm	1x
	0801a	Shrink tube 5x60	1x
	0801b	Threaded pin M2,5x25	2x
	0801c	Ball link 19mm	1x
	0801d	Fork link	1x



First place the 60mm long shrink tube 0801a onto the CFK push rod 0801 and position it at a distance of 290mm from the back, then shrink it.

It serves as protection in the push rod guide 0801f, which is generally already glued in the tail boom. Grease the shrink tubing slightly from the outside after shrinking.

Since the plastic ball joints 0801c can be screwed very hard on the 0801b set screws the first time, I recommend screwing and unscrewing them on the threaded pins first before the threaded pins are glued. Hold the threaded pin with a pair of pliers in the later gluing area. There it does not matter, if the thread will be damaged a bit.

Glue the two threaded pins 0801b with thin superglue on both sides of the push rod that they look out about 12mm.

Do not press in the threaded pins with force in case the bore of the push rod is a bit too tight.

Proceed in exactly the same way as described on page 58 for the "control linkage in the vertical stabilizer".

The details of the front push rod side can be seen in the small picture on the right above the tail boom.

Attention! the rear ball link is initially not attached to the push rod. It is important for this link that it can be relatively easily screwed and unscrewed on the threaded pin.

First press the ball joint with the lettering facing downwards on the still free ball pin of the 45 ° lever.

Then push the push rod into the tail boom from the front and insert it through the already glued push rod guide 0801f.

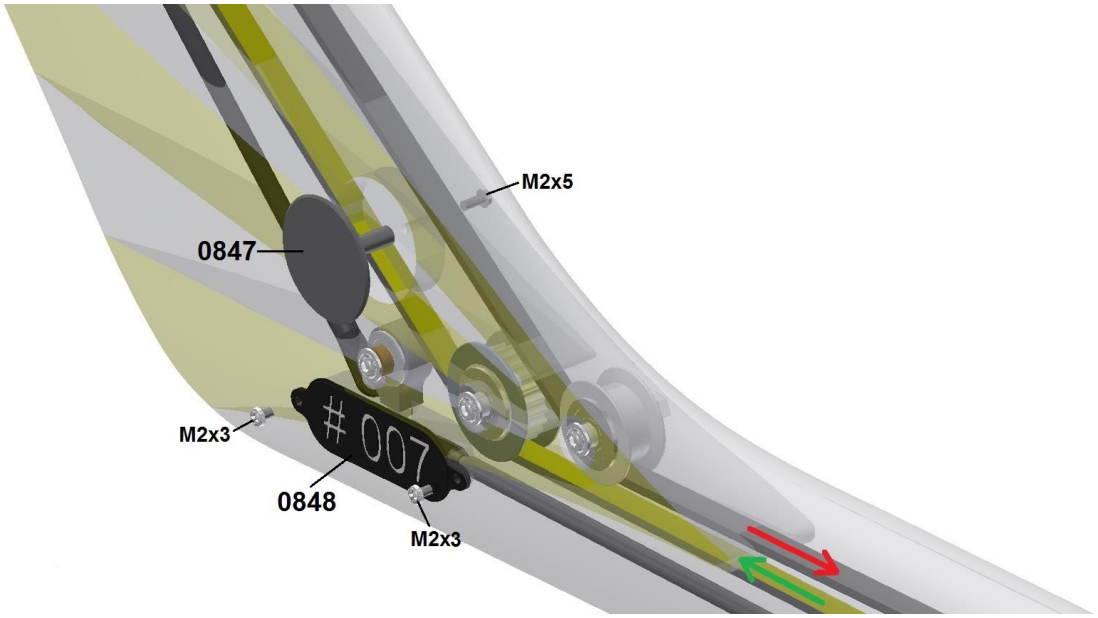
Attention! First pull the tail belt tight and hold the tail boom with the tail down, so that the belt lays on the upper side of the tail boom.

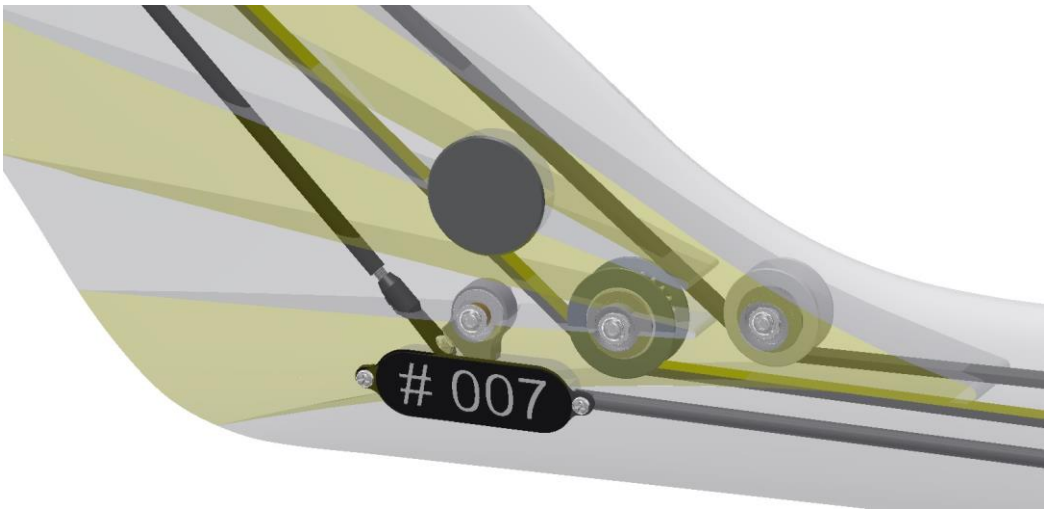
It must be avoided in any case, that the push rod is inserted in any way through the belt. Ask for help if necessary. Someone who is illuminating the tail boom from behind while you insert the push rod from the front through the push rod guide. Also make sure that the side with 290mm distance is at the back because the heat shrink tubing is not centered.

Push the push rod backwards until you see the end in the longitudinal maintenance window. While doing so, push up the push rod at the front so that it moves down at the rear and it does not collide with the pulleys or tangles with the belt at the rear. Finally, align the already hinged ball joint level and bring the threaded pin of the push rod in a line with the ball link. This allows you to turn and push the front of the push rod until the thread engages. Adjust to a distance of 2-3mm between the ball joint and the push rod end face.

15.8 Fixation of maintenance cover

	0847	Maintenance cover top	1x
	0848	Maintenance cover with serial number	1x
	P0203	Phillips screw M2x3	2x
	P0205	Phillips screw M2x5	1x





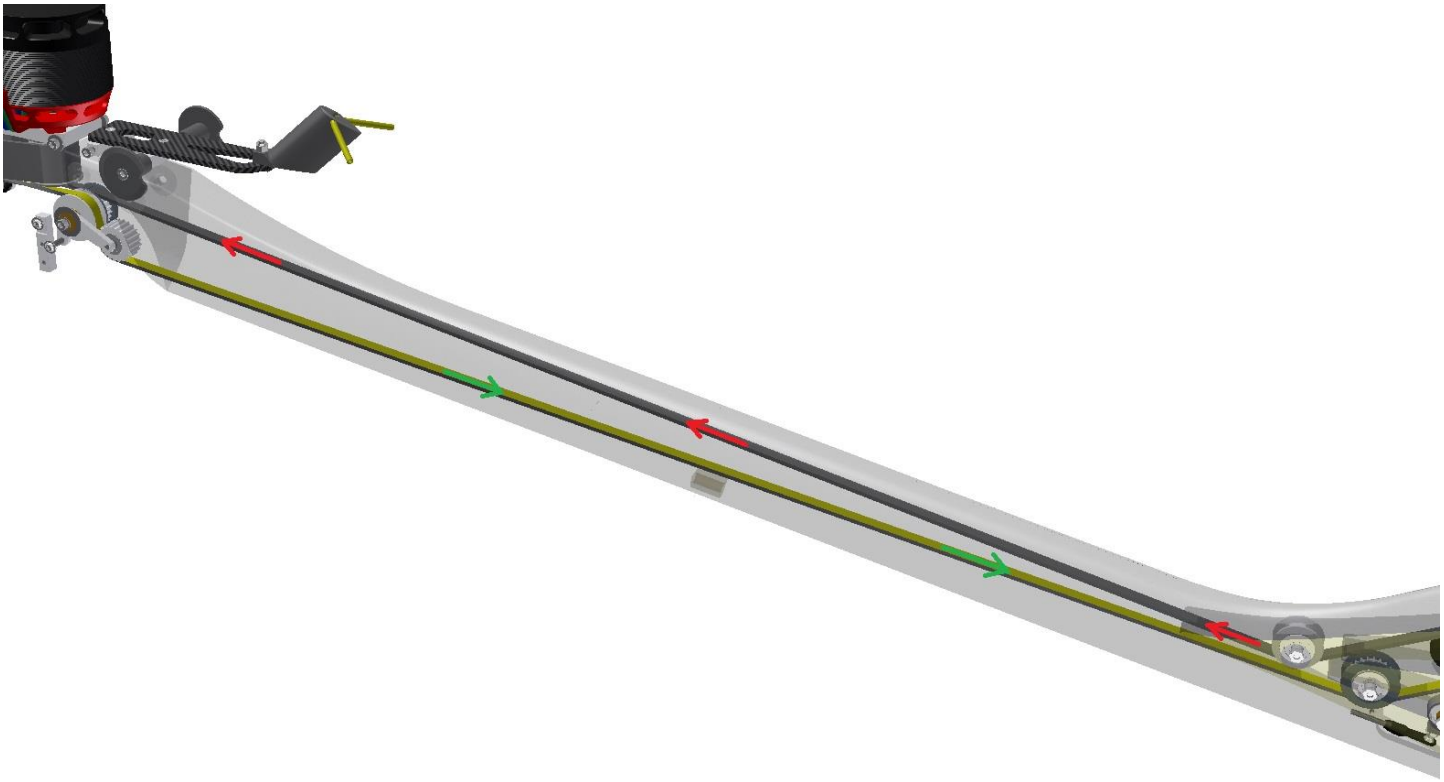
First mount the lower maintenance cover 0848 with incorporated the serial number of the helicopter.
First insert the cover through the opening into the tail unit. Then press the cover with its heel from the inside against the cutout. Use the upper maintenance cut out for access. Then screw the cover with two M2x3 Phillips screws (use a small amount of **L**octite).

The upper maintenance cover 0847 is then inserted with its small step in the round maintenance cut out and screwed with the M2x5 Phillips screw from the opposite side. Tighten the screw sensitively so that the thread does not twist.

On the upper picture, the direction of the toothed belt is shown once again (red arrow is the tension side and green arrow is the returning unloaded side). The side with the belt teeth is shown in **yellow**.

15.9 Fixation of the tail boom to the chassis

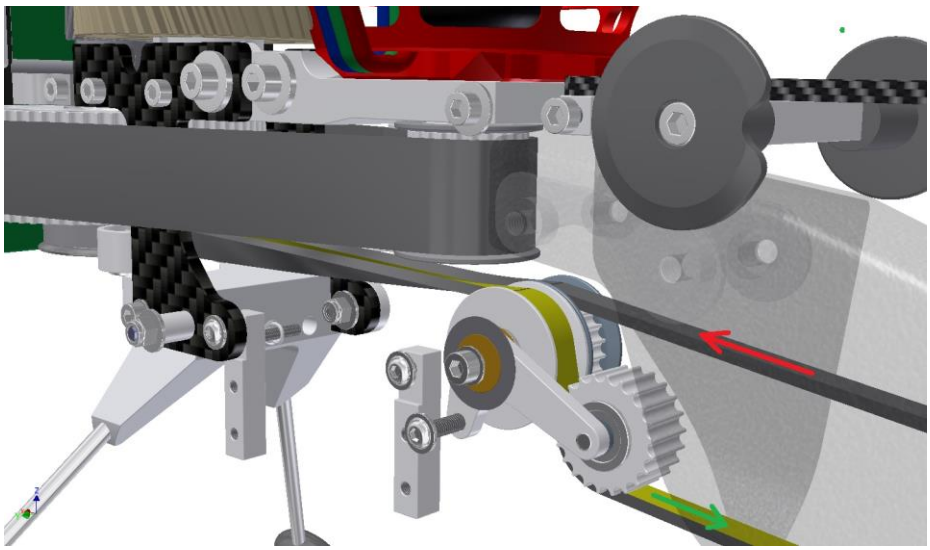
Attention! On the next three pages you will see different pictures with short comments concerning the belt routing in the mechanics. Since the belt routing is somewhat more complex than usual due to the 8 ° down-angled tail boom, it is important that you are absolutely clear about the correct routing and the respective rotations and deflections and there are no building errors. The tension side of the belt is marked with red arrows and the returning unloaded side with green arrows.
In order to always be able to clearly distinguish the inside and outside of the belt, the inside (tooth side) is highlighted "**yellow**".



On the picture above, the general routing of the belt can be seen again, as it leads into the mechanics (the belt tensioning pulley being positioned as it is subsequently in operation). When inserting the tail boom, it is advantageous to swing the pulley upwards to get as much belt available as possible.

Attention! The belt is secured with cable ties at the front of the pre-assembled tail boom in the correct position. Remove the cable ties, but be careful not to twist the belt !

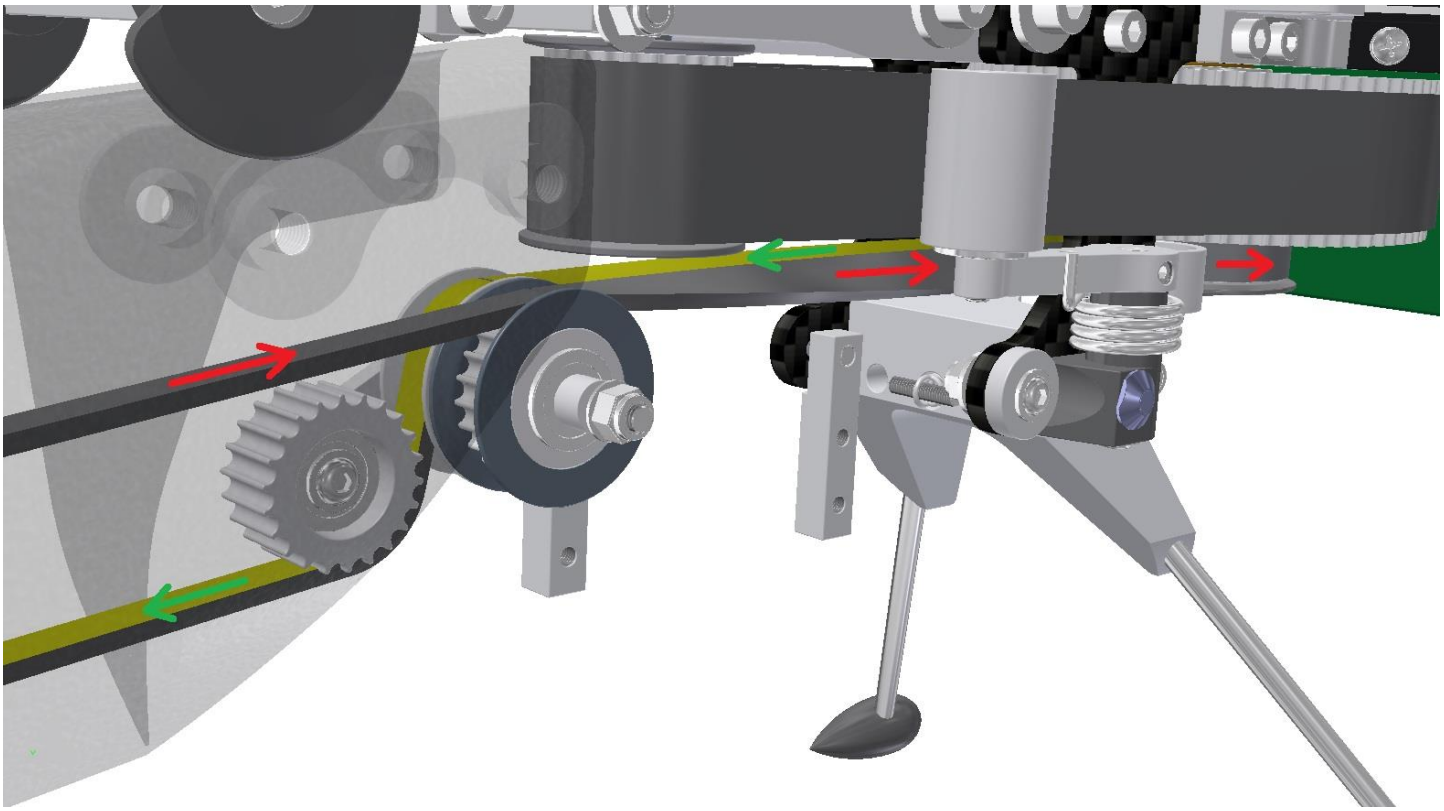
First, pull the rear belt out of the tail boom without twisting it. The loop has a vertical position. If you pull on the upper side of the belt (red arrows), the tail rotor must turn clockwise when viewed from the right (see also p.57).



See picture next page

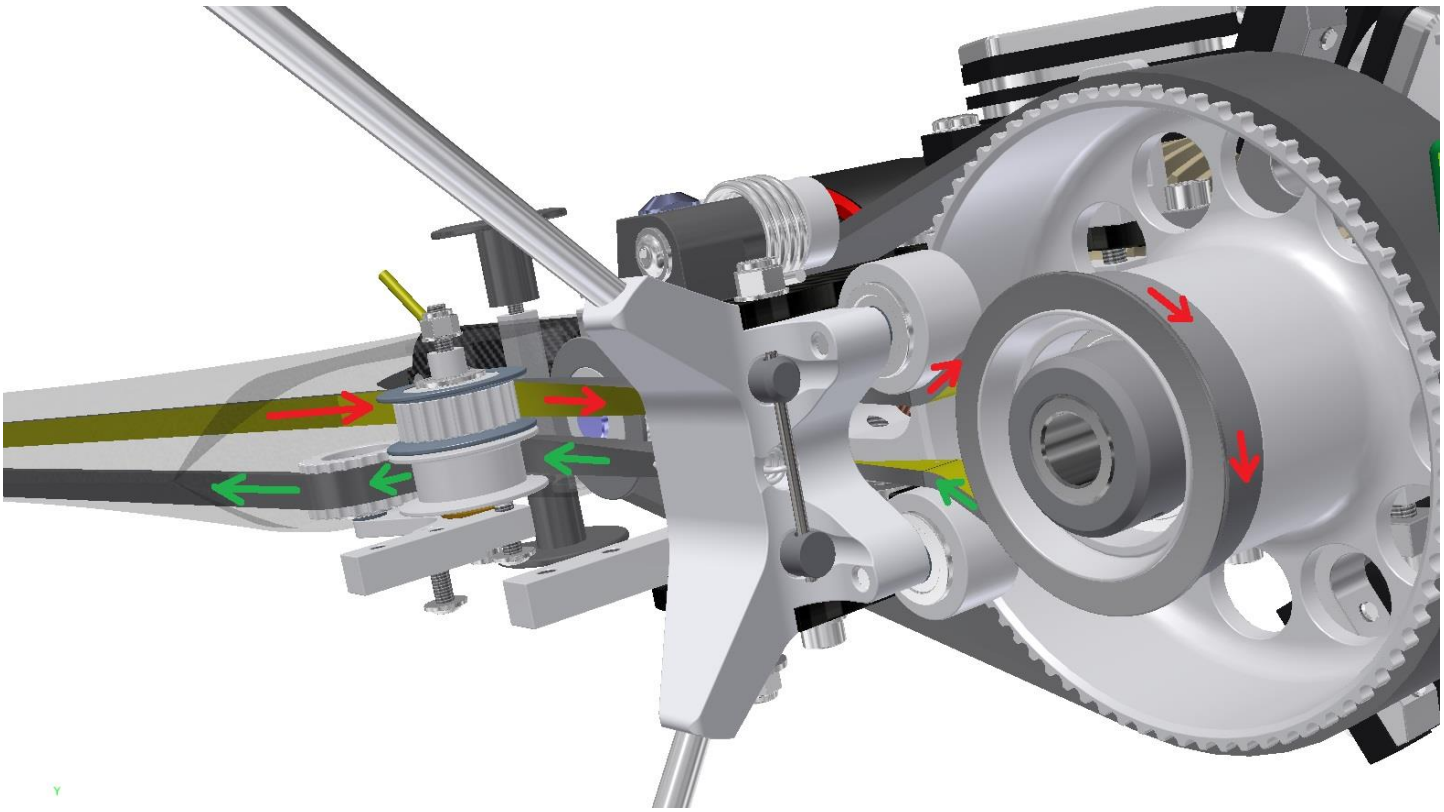
In the picture on the left you can see how the belt routing splits horizontally.
The two chassis side plates are not viewed for better visibility.
The upper side of the belt (tension side) runs slightly to the right over the toothed belt pulley.
The lower returning side is routed under the tension pulley and then runs with the back on top over the smooth left roll. This is where the deflection of the belt takes place.
Slide the tail boom slightly downwards inclined between the two chassis plates, pulling the belt forwards between the two front pulleys at the landing gear support. The belt is rotated by 90 ° to the left (counterclockwise) when looking from the front to the tail boom.

Here you can see the same area again from the other (right) chassis side.

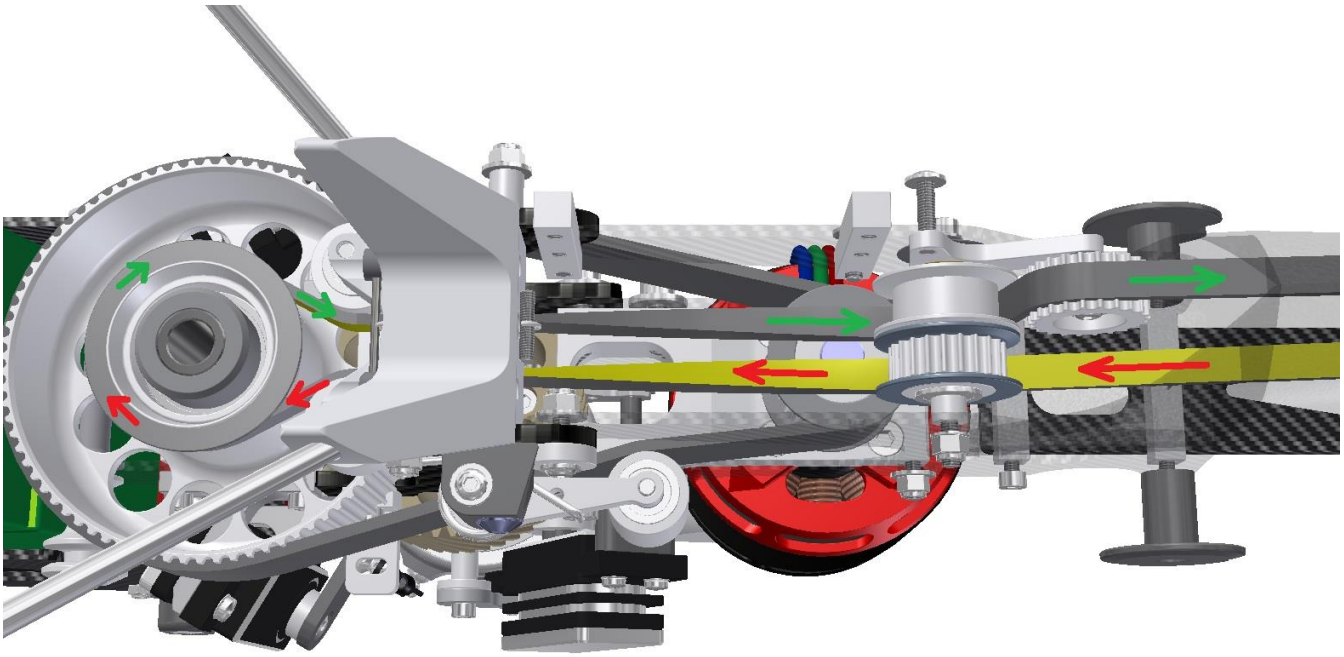


The next image below shows how the belt is rotated by 90 ° to the left, passing between the two belt merging pulleys (which are attached to the landing gear bracket) forward to the drive pulley on the intermediate shaft. Push the tail boom slightly inclined as far forward as possible, in order to be able to lever the belt carefully over the flange of the front toothed belt pulley. Caution, do not use high force.

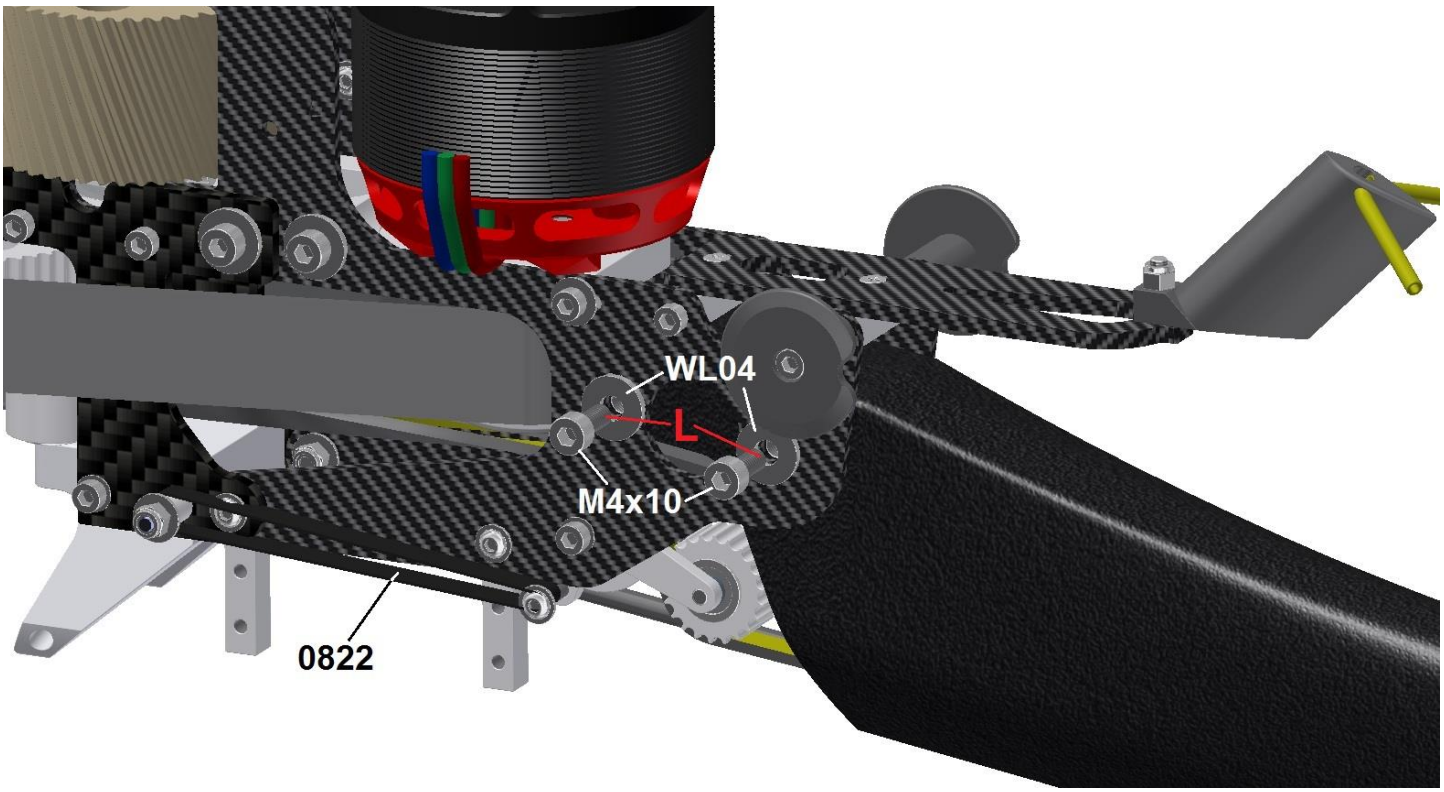
Attention! To be able to place the belt over the front of the pulley, the tail boom between the side plates may need to be pivoted relatively far down.



Here the belt routing is seen from another perspective.



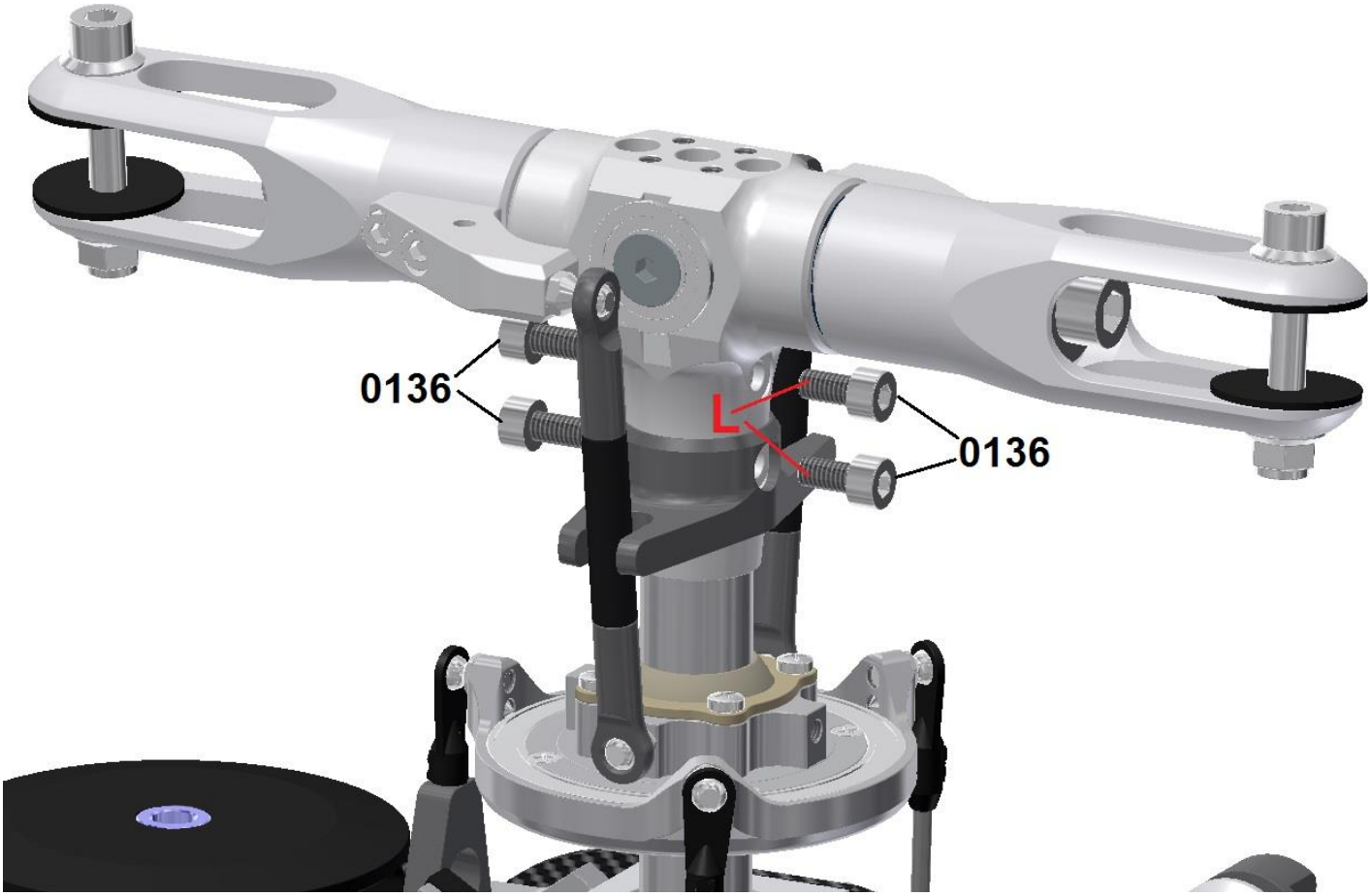
	M0410	Hex socket screw M4x10	4x
	WL04	Washer M4 large / 1,5 thick	4x
	0822	Belt tensioner – rubber band	1x



Finally, the tail boom is screwed in the matching, fixed holes. So it reaches his position and the correct angle. The belt tension and length compensation are carried out exclusively via the tension pulley of the belt tensioner. It will be stretched by a rubber band 0822 which is stretched from the lens head screw of the lever forward to the rubber suspension bolt of the chassis holder at the landing gear support.

Assembly step – 16 Final assembly

16.1 Installation of main rotor head on the main rotor shaft



Attach the rotor head to the rotor shaft.

Attention! Do not apply force if it does not fit. The rotor shaft made of aluminum is anodized, but there is a risk of fretting more than with a hardened steel shaft. Grease the rotor shaft slightly in the upper area if necessary.

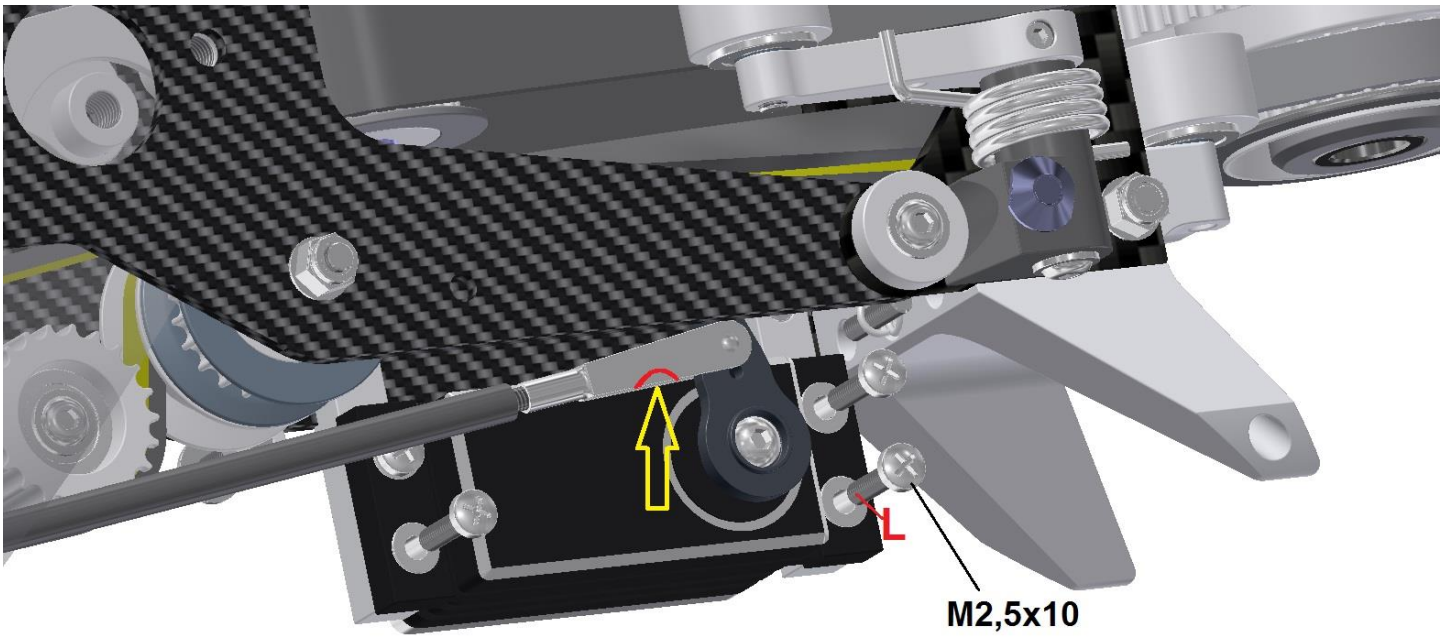
A small amount of **L**octite is placed in the threaded hole of the shaft to secure the screws. Do not place the **L**octite on the screw flanks, to avoid that the **L**octite is stripped when tightening the screw and then flows into the gap between the shaft and the center hole.

Tighten the screws firmly with an angled Allen key.

Finally, the linkage will be attached to the bottom of the ball stud of the inner ring of the swash plate.

Attention! The ball joints can only be pressed with great force on the ball studs. This is intended to prevent you from jumping off during the flight.
If necessary, take a small wooden block or similar to help, which you can be pressed with both thumbs against the plastic joint.

16.2 Installation of tail servo



The tail servo is screwed with M2.5x10 phillips screws on the two supports according to the drawing above.

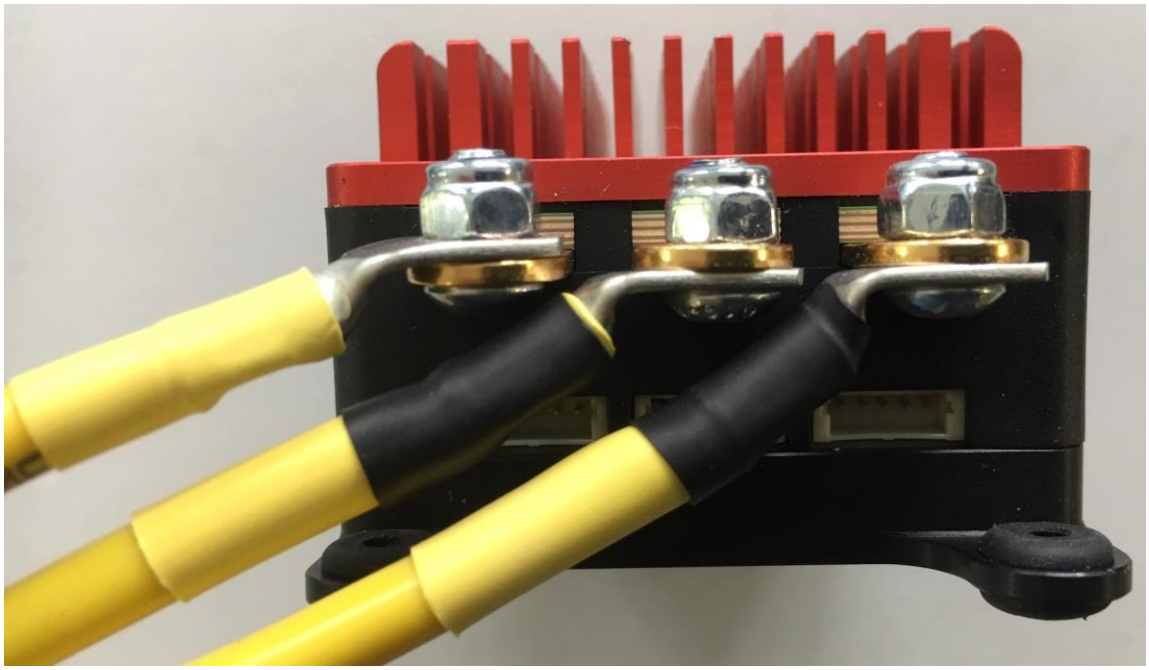
Attention! Depending on the design of your servo lever, there may be the danger that the fork head at its rear is touching the shoulder of the servo flange with the servo lever is at its maximum angle to the front.
Under certain circumstances, the reverse side must then be grinded semicircular with a Dremel at the appropriate place (see correspondingly indicated red semicircular line - yellow arrow).
But you can also generally position respectively trim the servo lever a little more pointing backwards in the neutral position, so that the fork link has a little less risk of collision.

Distance of the servo lever hole to the center of the servo shaft should be 10mm to 11mm.

The exact adjustment of the control rod lengths and ways will be described in more detail later in the settings chapter.

Assembly step – 17 Electronic components

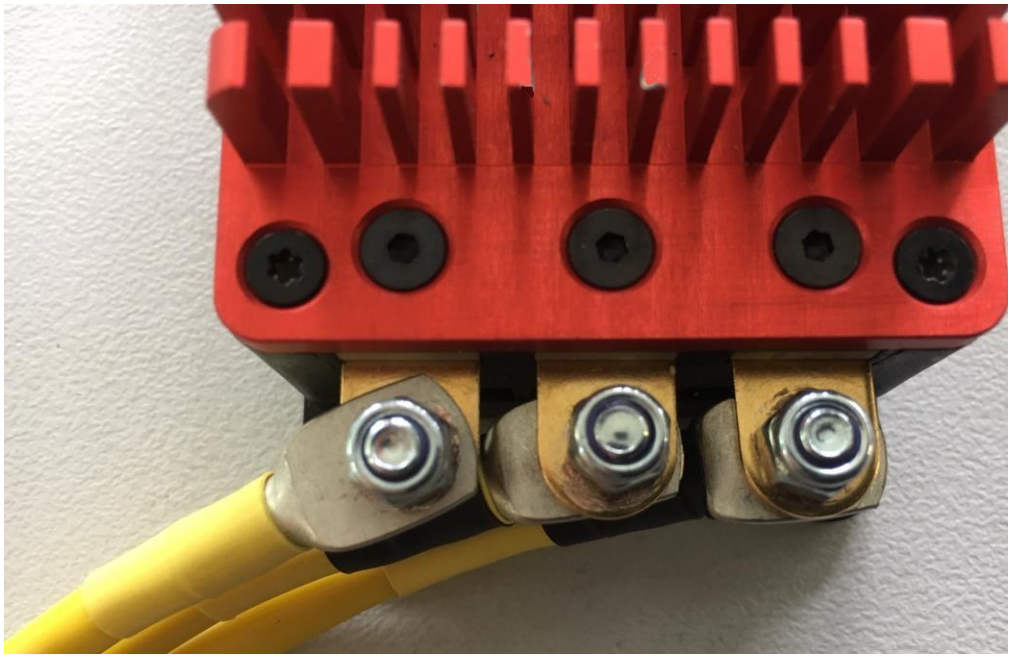
17.1 ESC cabling and installation

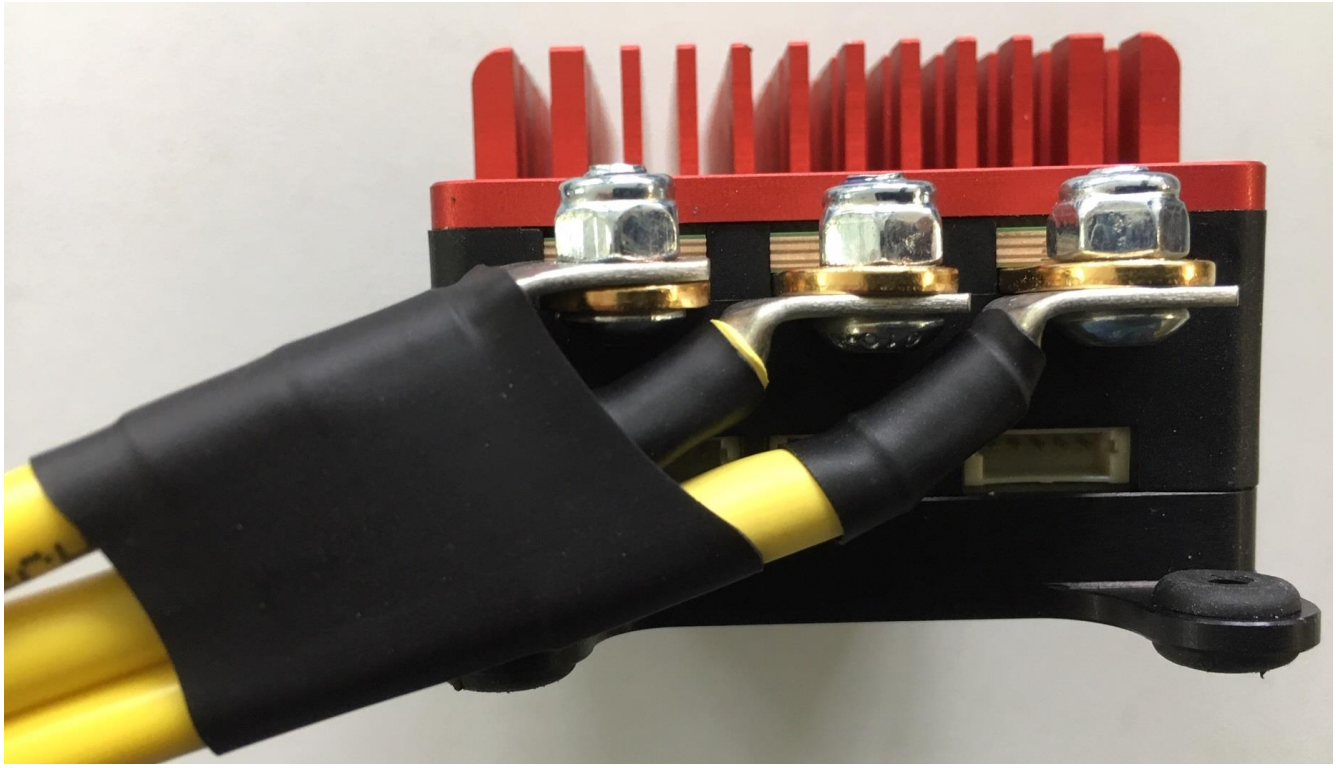


Take the M4x8 lens head screw and the corresponding M4 Nyloc nuts out of the bag for the ESC fixation plate. The original screws from the KOSMIK are far too big.

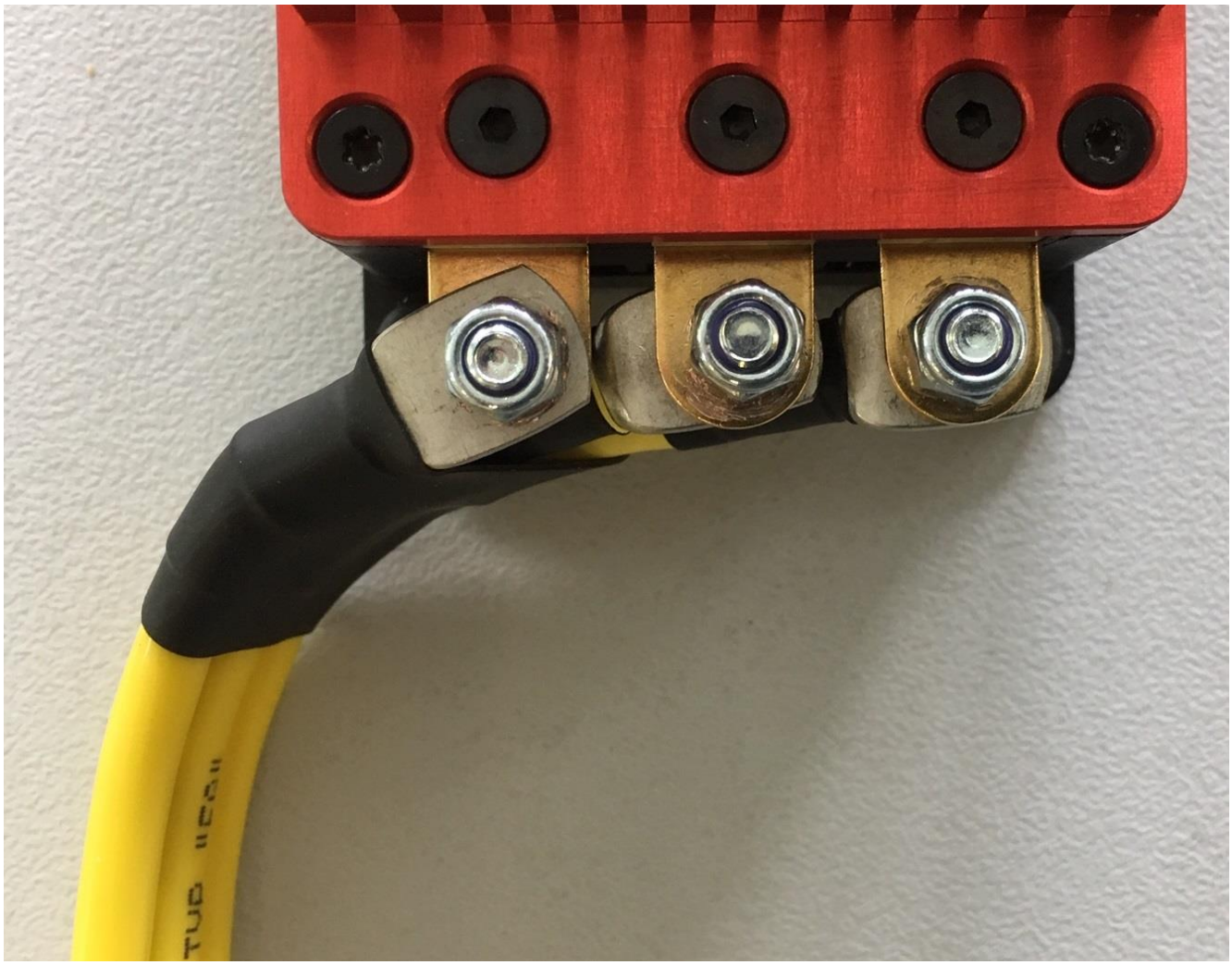
Bend the cable lugs of the yellow motor cables as shown in the photo with flat-nose pliers and pull over a second shrinking tube above the yellow one. Mount the lugs as shown in the picture to the ESC. The left cable will be screwed above the link and the middle, respectively. The right cable will be screwed below the link. A slight touch of the shrinking tube with the lens head screw of the next cable doesn't matter, but a high pressure has to be avoided. Start with the left cable; otherwise, you will have no access with the Allen key to the screw head.

As the 4mm screw has play in the 5mm hole, you can pull the middle cable to the left and push the right cable to the right. You get more space and the lugs will not have to be bent so much. The nuts facing upward should be covered with a short piece of shrinking tube to avoid a short circuit in case they touch the carbon canopy.

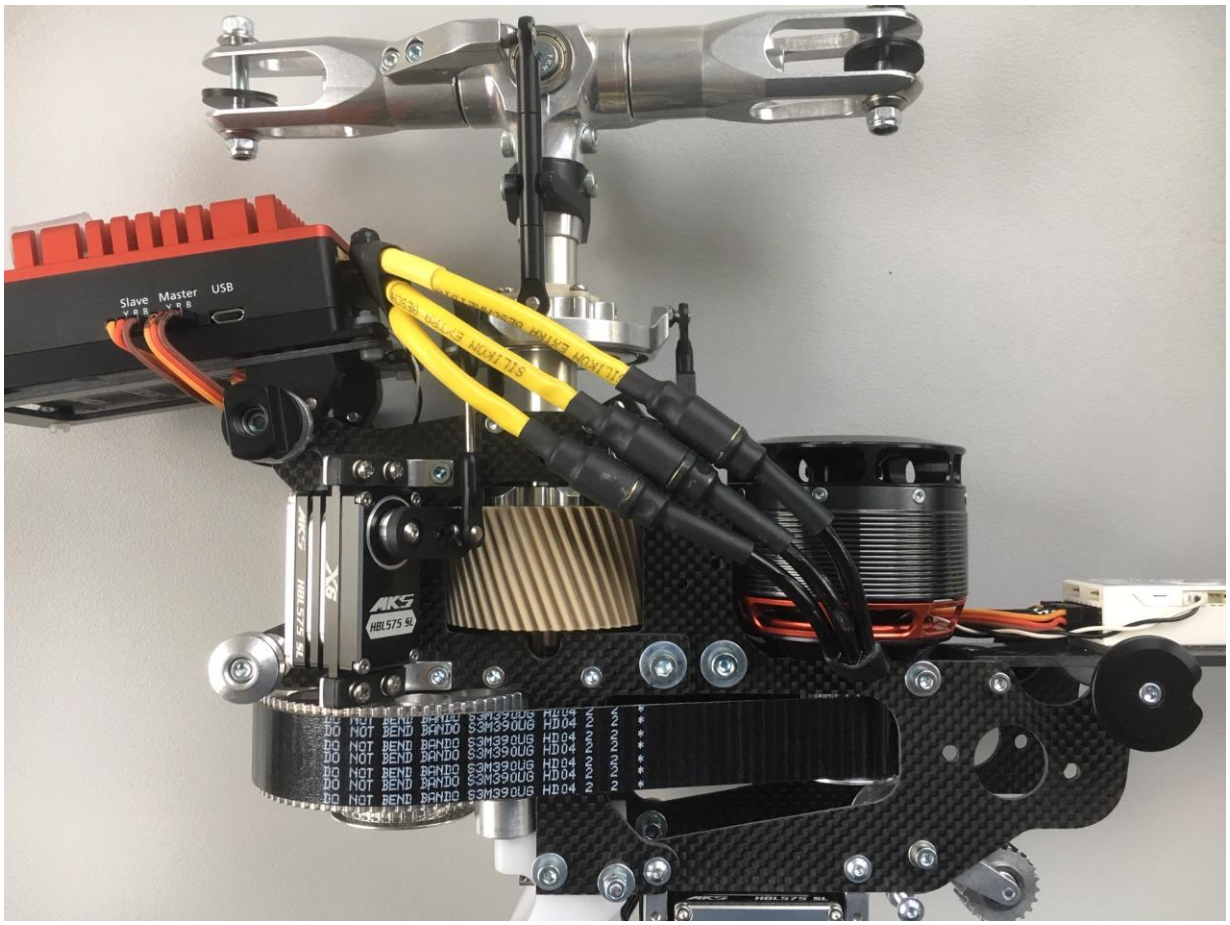




Finally, pull a short heat-shrink tube over all three cables to hold them together nicely.



The cables are bent as close as possible to the rear.

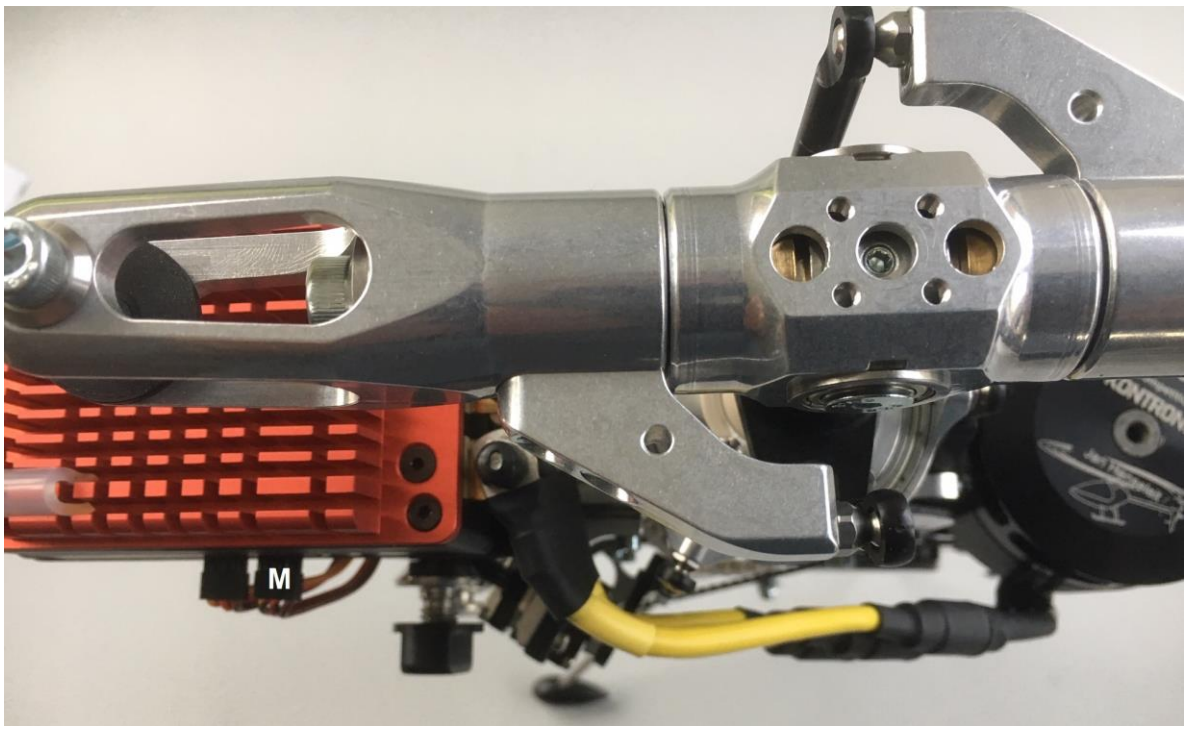


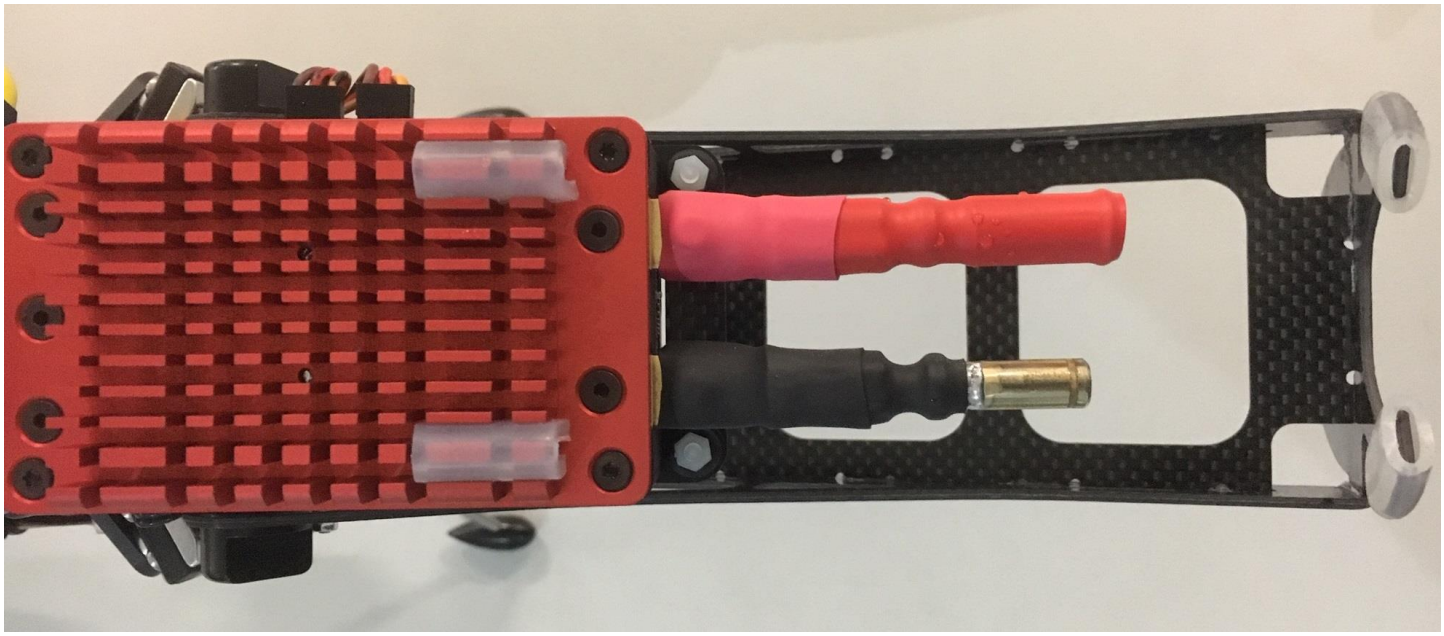
Insert the pre-assembled mounting plate with the ESC from above onto the undercuts of the threaded bolts of the battery tray fixation. Press it firmly from above so the two plastic holders will snap into place.

First of all you have to bend the motor cables as exactly as possible into the right position. Guide the cables evenly in an arc forward. Although the cables may run relatively close to the rotating motor bell, they must not touch them (see picture below).

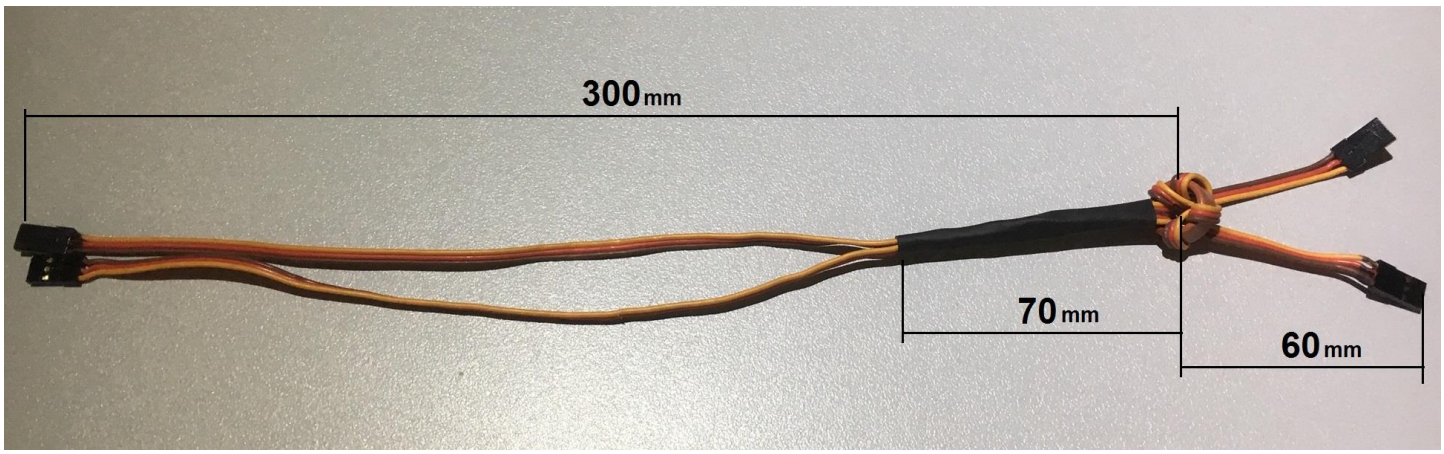
Then temporarily plug the bushings onto the motor plugs and shorten the cables coming from the ESC in the different necessary lengths as exactly as possible so that they have the right length after soldering.

Attention! Make sure that the ESC is positioned slightly tilted forward at the correct angle as shown in the picture above.





The two cables for the battery connection will be attached to the front of the ESC. The length should be kept as short as possible.
Especially for the 10S version I recommend 7mm or 8mm plugs and thick cables with corresponding cable lugs because of the high currents.
The original cables that come with the KOSMIK are good for the 14S version, but should be doubled for the 10S version or replaced by thicker cables.

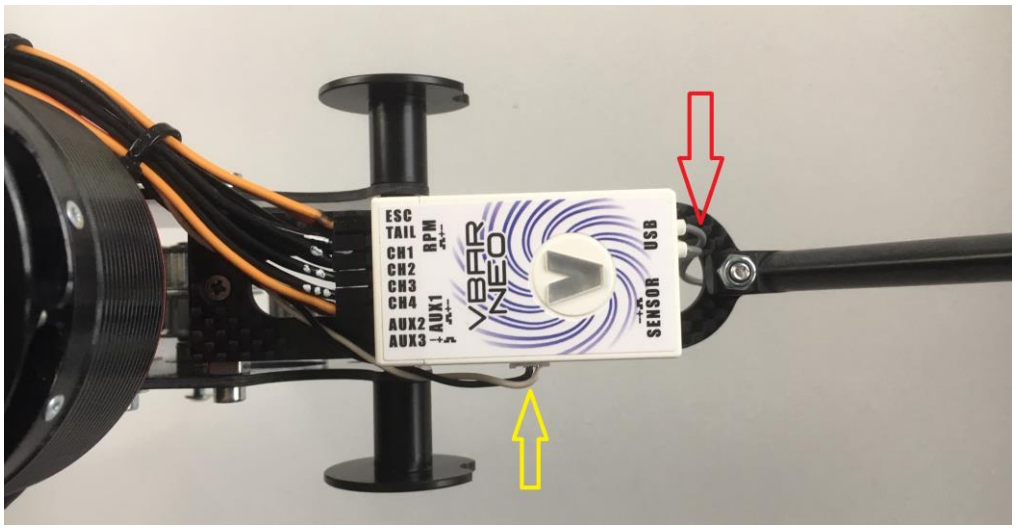


I recommend combining the two BEC cables of the KOSMIK only in one ring core to save space.

To do this, wrap the cables approx. 2 times in the same ring so that the ends look out as shown in the drawing above on one side approx. 60mm and on the other side approx. 300mm from the middle of the ring to the connector end.

An approximately 70mm long shrink tube is pushed over the two cables on the long side to the ring core and shrunk together.

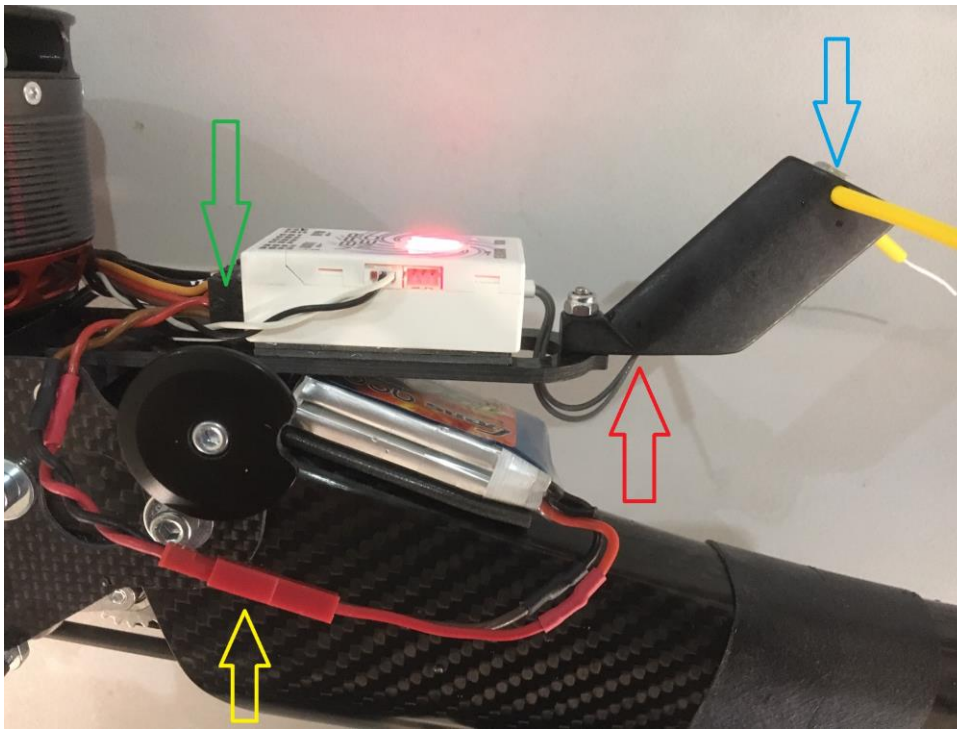
17.2 Flybarless–system installation and cabling



Route the antennas down through the recess of the panel (red arrow) so that they will not be kinked.

The telemetry cable (**yellow arrow**) is led forward together with the servo cables and the BEC cables.

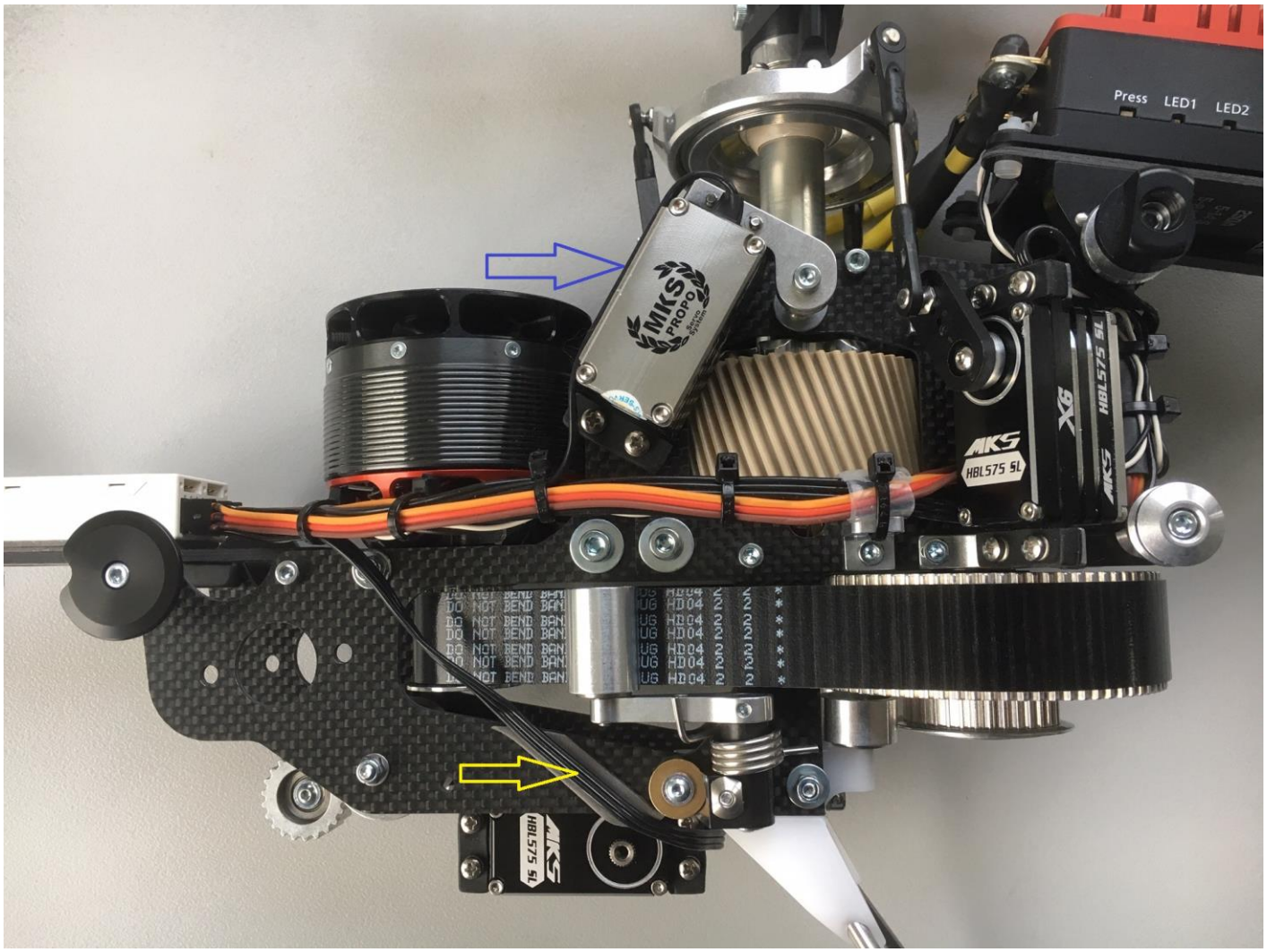
Most suitable for the **TDS** is the "VBAR NEO" with integrated Mikado receiver. Due to the compactness and the outstanding speed flight performance, it has emerged as the first choice for the speed pilots.
Stick it with the enclosed pads (doubled / two superimposed) on the plate provided so that there is a maximum distance to the motor, but there is still enough space for the antennas to pass underneath the board (see picture below).
The front of the VBAR lies approximately in the middle above the rear plate fixing screw. If you need to use a separate receiver or satellite, it should be as flat as possible so that you can attach it to the bottom of the plate at the rear.
On the picture below you can see a 450mAh backup battery as an emergency power supply in the event of a BEC or battery failure. Please do not glue it to the underside of the plate, but directly onto the flat upper side of the tail boom so that as little mass as possible is attached to the plate. Make sure that the plate itself is not touched.
If there is a separate receiver attached under the plate, the support battery can also be attached to the side of the tail boom.



To insert the antennas, route them one at a time from the bottom (red arrow) through the antenna holder until the end appears at the top of one of the side exit holes. Then push the end with a small screwdriver from the top (blue arrow) to the side, so that it inserts through the hole as you push it further. The same procedure has to be applied to the second antenna on the opposite side.
Afterwards the two heat shrink tubes will be pushed onto the antennas. The heat shrink tubing is a bit too thick, so you first need to heat the ends minimally until they slide a little into the side 3mm holes. Then apply one drop of silicone or hot glue from above (blue arrow) into the through hole to fix the shrink tubing. First the antennas are adjusted in a way they describe a nice bow below and if possible do not touch the carbon plate.
Finally, the shrink tubing can be heated a little more so that they shrink.

The backup battery can be connected via a small plug (**yellow arrow**) to a free output (**AUX 2**) of the VBAR (green arrow) or the receiver.

17.3 Servo- and BEC–cable routing



If you have purchased the servos in a shop, the two cables of the roll servos must be extended somewhat, otherwise they will not reach to the Flybarless system or receiver. The cables of the elevator servo or the tail servo are long enough.
When the servos have been purchased from us, the cables are as long that they will be long enough in any case. Elevator and tail servo cables must then be routed with a loop at the back.
Attention! First read the whole chapter through to the end before you start laying the cable.

The two aileron servo cables, the two BEC cables (Master & Slave) and the telemetry cable should be routed in parallel to each other without further loops (see pictures on the following pages).

The cable harness is attached to the cable bracket at the front with a tie wrap and a piece of protective hose, before the cables are separated and routed forward through the narrow gap between the aileron servo housing and the chassis plate (see pictures on the following pages for details).

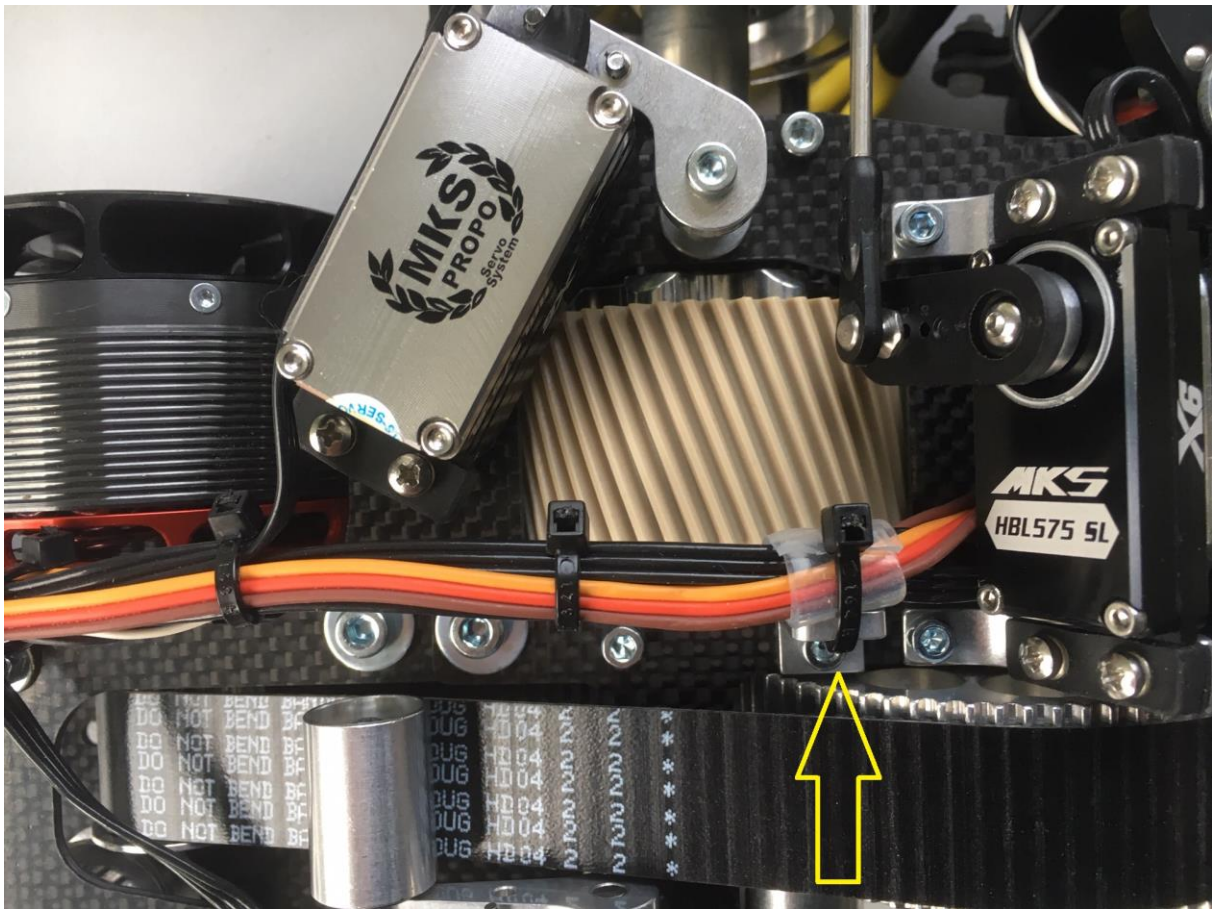
The aileron servo cables first are routed out of the housing in an arc to the front (in the direction of the servo floor) and then in an arc through the gap.

Stick the elevator servo cable with double-sided adhesive tape to the rear facing servo housing wall (blue arrow). It then unites below the servo with the rest of the cable harness.

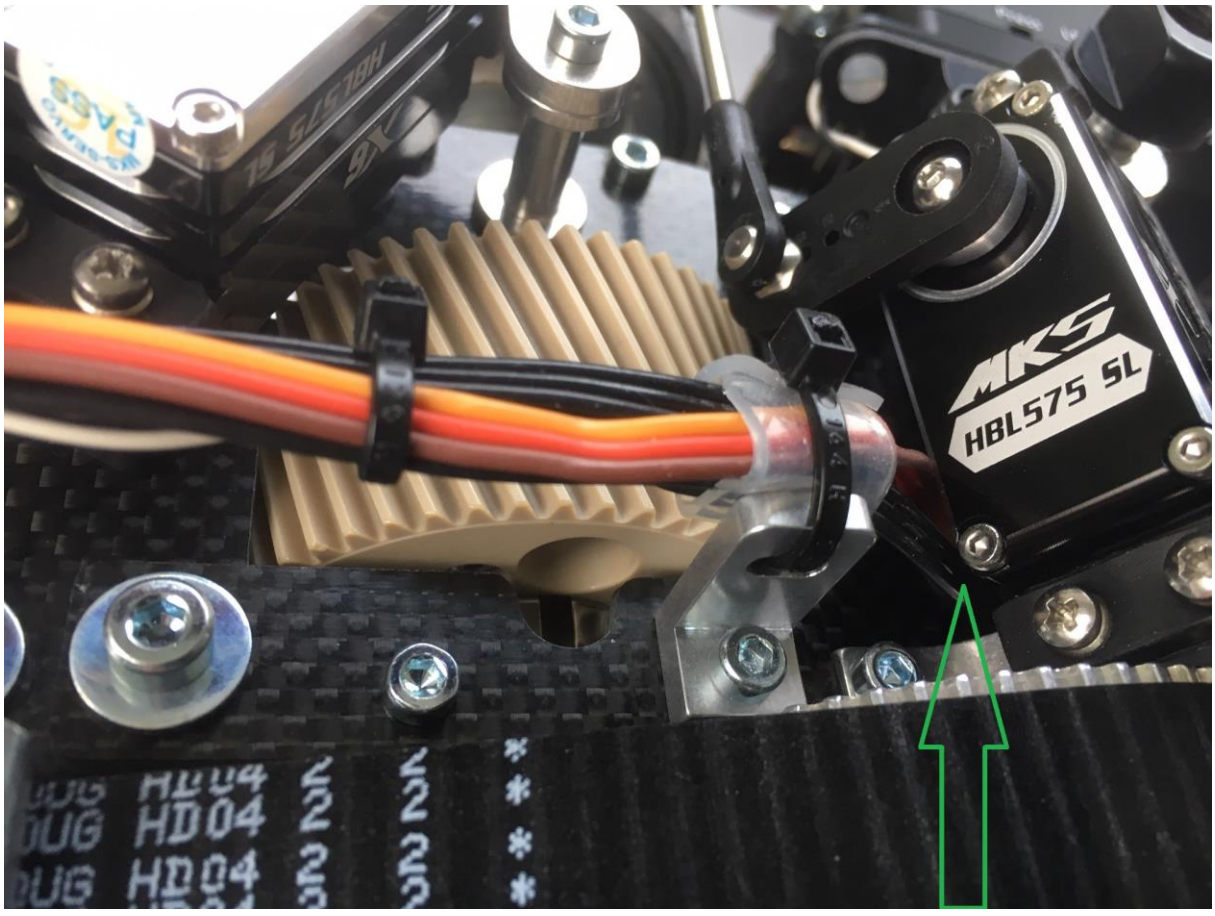
The tail servo cable is glued to the chassis with double-sided adhesive tape (**yellow arrow**). To do this, allow the tape to protrude slightly below the underside of the chassis so that the cable is protected against chafing at the kink point. It then unites just behind the engine with the rest of the wiring harness.
Carefully tighten the tie wraps, which are directly touching the cables, so that they do not cut into the insulation.

Here are the recommendations of the input assignment when using the VBAR NEO

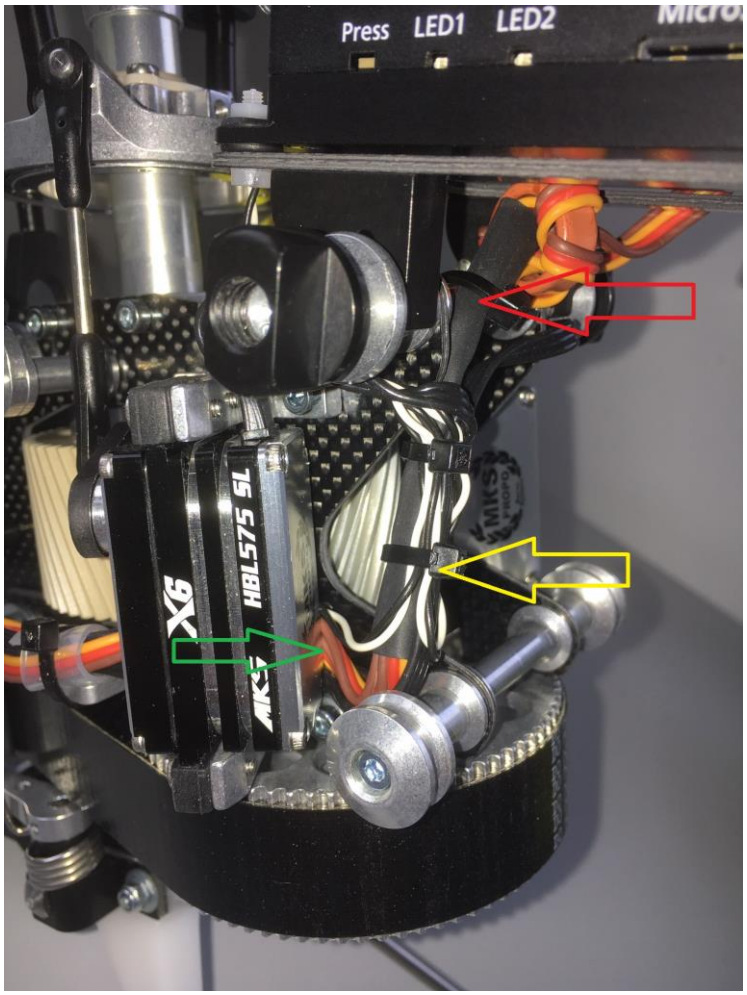
Elevator servo = CH1	Left aileron servo= CH2	Right aileron servo= CH3	Tail servo = TAIL
ESC Mastercable = ESC	ESC Slavecable = CH4	Cable for the backup battery = AUX2	



Attachment to the cable bracket (**yellow arrow**)



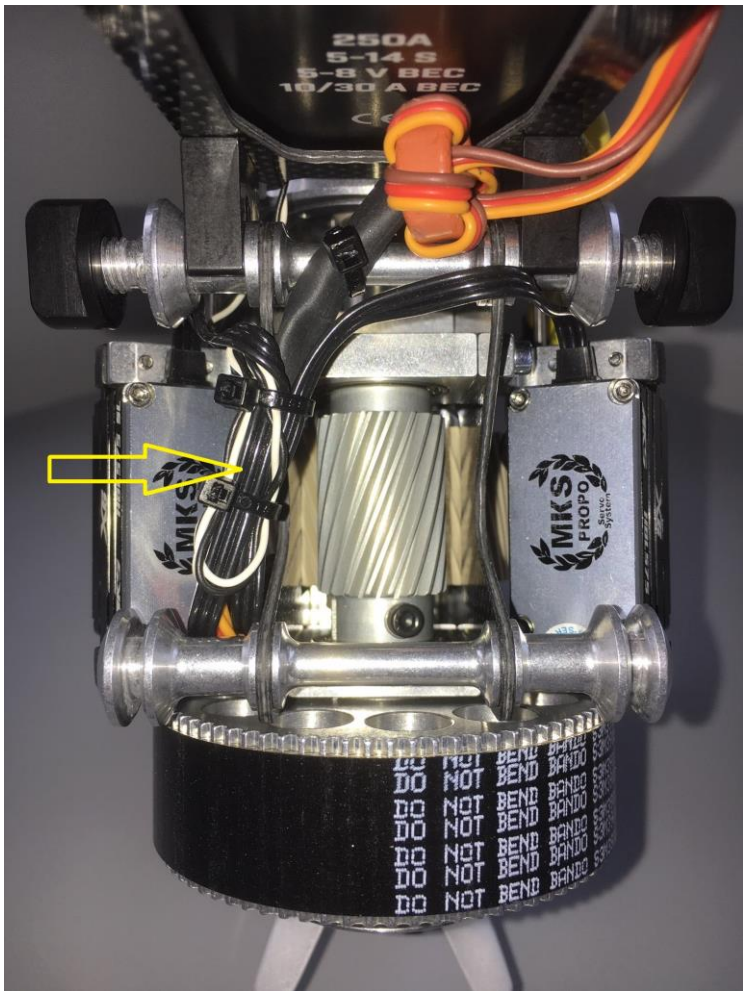
Routing of the cables between the servo and the right chassis plate (green arrow).



(green arrow)
Here the cables are routed between chassis side plate and servo housing from back to front.

(Red arrow) Just behind the ring core, only the two heat-shrinkable BEC cables are fixed to the cross-bolt. The cable from the left aileron servo is bundled separately with the other cables.

(**yellow arrow** - picture above and below) The cables are bundled here and routed in loops, if necessary.



Attention! The ring core should be as close as possible to the bottom of the ESC so that there is enough space later for the flight battery.

Also make sure that all cables are placed <u>in any case</u> in such a way that they will not stand in the way when hanging up the battery tray and will not chaff somewhere in between.

<u>Very Important:</u>

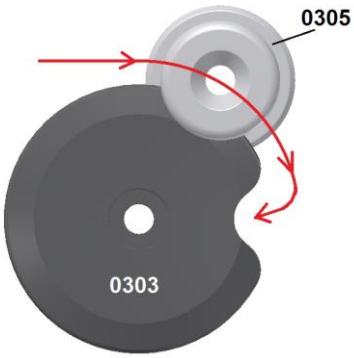
Attention! Finally secure the servo connectors in the VBAR NEO plugs by apply a small bead of silicone or hot glue all over the top of all connectors directly at the housing front.
Otherwise, it is very likely that they are released by vibrations in the air.

Assembly step – 18 Final steps - Decor

18.1 Canopy fixation

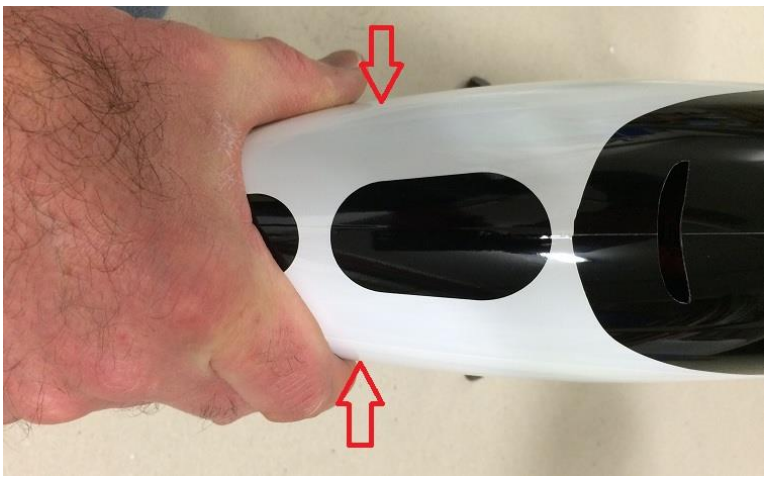
Note: In the following assembly section some pictures from the TDR-II manual are used, because the canopy of the TDR-II-Trainer differs from the TDS-canopy just by the cut out in the rear lower area which it is not closed. Otherwise, they are identically. Respective pictures of the TDS canopy are inserted where necessary.

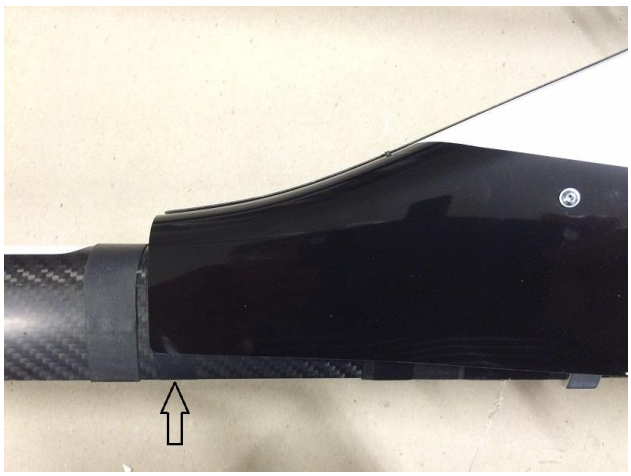
Before starting with the design, the canopy should be adapted on the mechanic. The CFK-canopy is manufactured of high-quality production but they are handmade, so some tolerances may occur.
The holes for the M3x8 lense screws to attach the canopy mount 0305 from the inside are already prepared (see picture below).



The canopy mounts 0305 are designed as a conical thread role and slide during the mounting of the canopy on the upper edge of the canopy bold support 0303. By lifting the tip of the canopy, the tail of the canopy is tilting downward and the fixations are locked in the circular reliefs (see red arrows).

The procedure will be explained now in detail. If you know how to do it, the fixation of the canopy will be quick and non-problematic.





First, mount a battery tray to the mechanic, as it is also the front fixation for the canopy.

Attention! While positioning the canopy the rotor should always be turned perpendicular to the mechanic so the control rods are facing forward and backward. Otherwise, you have to spread the canopy extremely wide when positioning.

Take the canopy with both hands at the tail and spread them slightly. Place the canopy relatively low on the front side and place it high above the mechanics on the rear side so the upper top edge of the canopy is sliding above the tappet over the rotor mast.

Push the canopy backward until it is touching the three silicone points of the battery tray. Turn the canopy in this position back and forth so it is properly placed and centered.

At the rear, the canopy is positioned slightly above the tail boom. At the position of the black arrow, two layers of duct tape should be wrapped around the tail boom to prevent it from scratches (for this, do not use the mounted rubber—they are too thick).

From this position, press against the nose of the canopy to bend the tongues a little bit backward. The canopy should be pushed back about 3 to 5mm. Press the canopy with the thumb and the trigger finger from the outside. In this moment, the rear sides of the canopy move a little bit together and touch on both sides of the tail boom. If you now lift the nose of the canopy, the tail is tilting downward and the two canopy mounts 0305 are locking in the circular reliefs of the canopy bold supports 0303 (see picture in the middle of the page top).

Check the correct fixation by moving both canopy sides a little bit up and downward to see if the fixations are correctly locked. The two lower sides are normally slightly spread. They will be pressed together by the safety rubber band.

The safety rubber band 0307 is absolutely necessary despite the canopy nipple, so that the canopy cannot jump off under any circumstances. It not only ensures that the canopy is secured, but it also presses it evenly to the tail boom and prevents the wind from pushing the canopy ends apart by suction effects in high-speed flight. Two more rubbers are drawn as a reserve further forward on the tail boom, so you do not have to remove the tail every time, if one breaks.

The slipping over of the rubber band needs to be practiced, but this you should know from other areas of your life. ☺

It works best if you start to fold the rubber up at the side of the tail boom where the fit is loose. You can slip your finger up under the rubber there. Lift it until you can pull your finger completely below the rubber.
Pull the finger toward the lower edge of the tail boom and stretch it so far to allow the rubber band to be pulled diagonally to the front at the lower side over the canopy. Move the finger below the rubber band to the upper side and pull it there over the canopy. Position the rubber band 3mm, overlapping the end of the canopy. You will get a nice watertight end.

Attention! Check during the first mounting of the canopy if the control rods collide with the front edge of the swash plate notch. Even with the swash plate taking the most unfavorable position with the control rods showing forward, an additional 3 to 5mm of space should remain to prevent a collision when mounting the canopy.
You may possibly have to rework and adjust the canopy there. By using a round emery band with emery cloth or a half rounded file, this will work properly.
Turn the rotor head with the mounted canopy and check in all positions that there is sufficient space to the control rod and the fork tappet.

Finally, secure the canopy mount 0305 with thin CA glue. A few drops in the gap around the seating area will work. Because of the capillary action, the glue will flow under the mount.

18.2 Application of the canopy decales

The foils must not be applied dry to the canopy because they will stick immediately and cannot be repositioned.

The process will only work if you apply water (with some dishwashing liquid) on the foil and on the canopy itself. Because of the slightly greasy water film, the foil can be moved on the canopy surface for a limited time

You should start smooth the foil with soapy water first on one side and sweep out the water so the foil is better affixed. Start to sweep out the water and folds from there with a soft rag. The position has to be correct from the beginning because as it will become fixed and cannot be moved to the correct position. In this case, pull of the foil completely.

If you did not do this action before, download a video about the application of the foils to the canopy of our first TDR. The procedure for applying the foil is shown in this video. The process is in principle the same for the TDR-II, only the shape of the foil is different and the window consists of four parts instead of three. Because of the shape of the canopy, a single center piece is not possible.

What the comet of the old TDR was are now the aerobatic stripes, which are now separated into three pieces. With some patience, anyone who does not have two left hands can do this job. Anyone who makes some effort will get a canopy that looks similar to a lacquered one, and you have the satisfaction of doing it on your own. Even if have trouble with the first one, the second one will be a lot easier and you do not have to be afraid to lose an expensive painted canopy.

Clean the canopy completely with a sponge with soapy water to remove dirt, grease, abrasive dust, or crumbs.

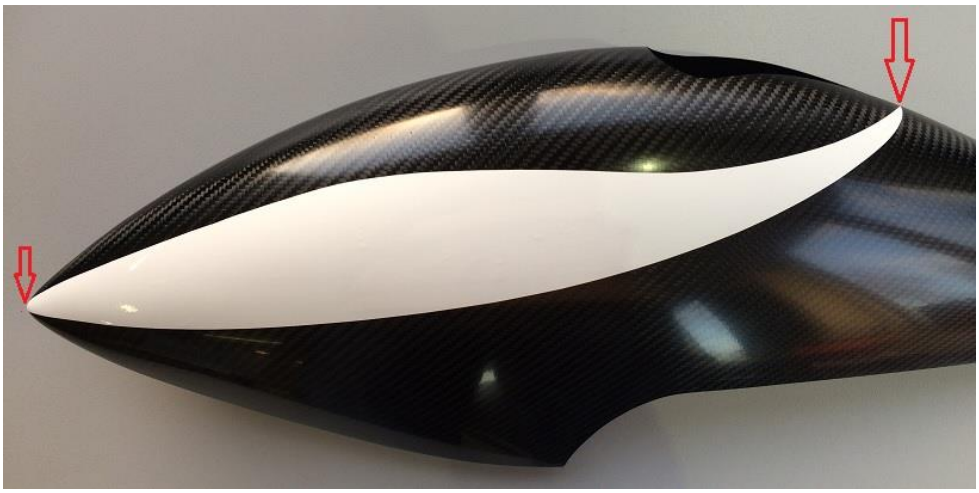
Fill a flat bowl with lukewarm water and add some dishwashing liquid. Always pull just the foil from the waxed paper you want to apply. Don't put the foil together with the waxed paper into the water because the waxed layer will separate from the paper and stick to the bonding surface of the foil and the foil cannot be used anymore. Pull the foil from one corner and pull it directly into the water with the adherent side so that sections of the adherent side do not come in contact and stick together. Pull the foil out of the water and hold it over the bowl so surplus water can flow down.

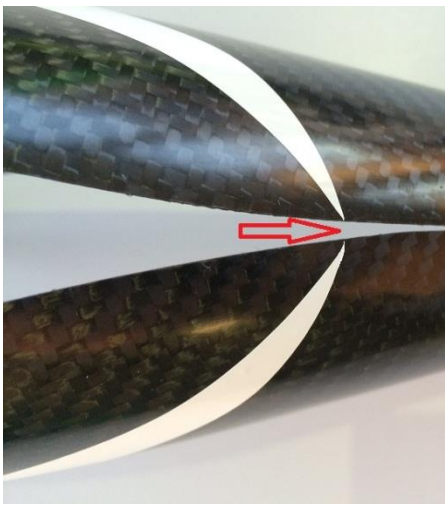
The area on the canopy that will be bonded should also be rubbed a little bit with a wet sponge.

When pulling of an edge of the foil, take care not to damage the waxed paper so that it sticks to the foil. This might happen is the plotter knife cuts too deep into the paper. Take, for example, a carpet knife and lift the foil carefully at another position with the blade.

With this knife, you can trim later on the overlapping parts of the foil. Wait until the foil dries a little bit before cutting. Squeeze out the water from the middle to the sides. Small air bubbles cannot always be avoided. But don't worry; they will disappear in the next days on their own.

Im Nachfolgenden sehen Sie die Vorgehensweise der Folienbeklebung am Beispiel einer TDR-II Haube.





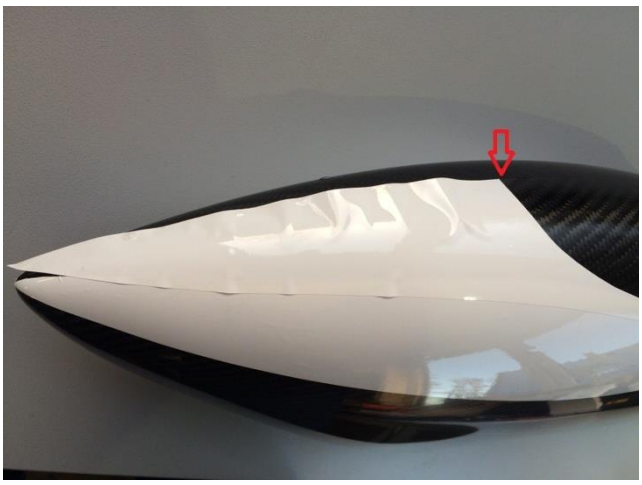
Place the wet (soapy water) lower window side part on the canopy without distorting.

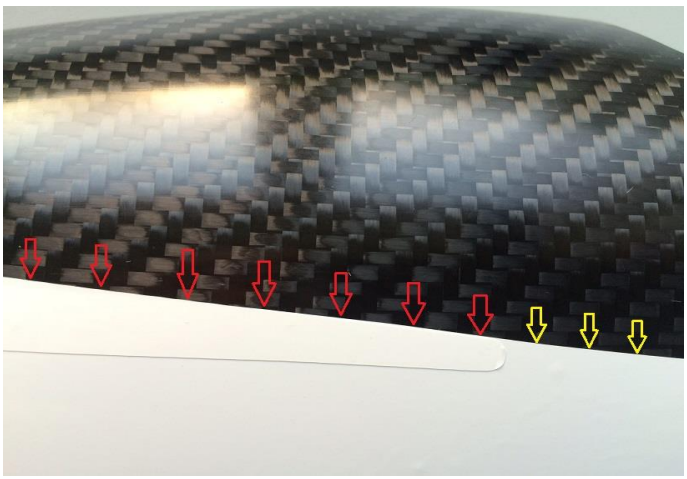
Add more soapy water if the foil cannot be moved. The target is to position the foil without tension with the rear tip at the upper edge and with the front tip at the horizontal middle of the canopy tip. In longitudinal direction, the foil can overlap the center line so that the two tips are overlapping.

Start to smooth the foil carefully in the rear area without shifting it. Squeeze out the water with a soft rag carefully.

Continue slowly toward the tip without shifting the foil position. Start in the large middle area and then squeeze out the water to the top and the bottom.

Check continuously to see if the tip is in the right position and squeeze out folds carefully. If there are folds in the border area, lift the foil at the front, pull it slightly while squeezing from the back to the front. The foils with normal colors are better expandable—fluorescent colors are stiffer.



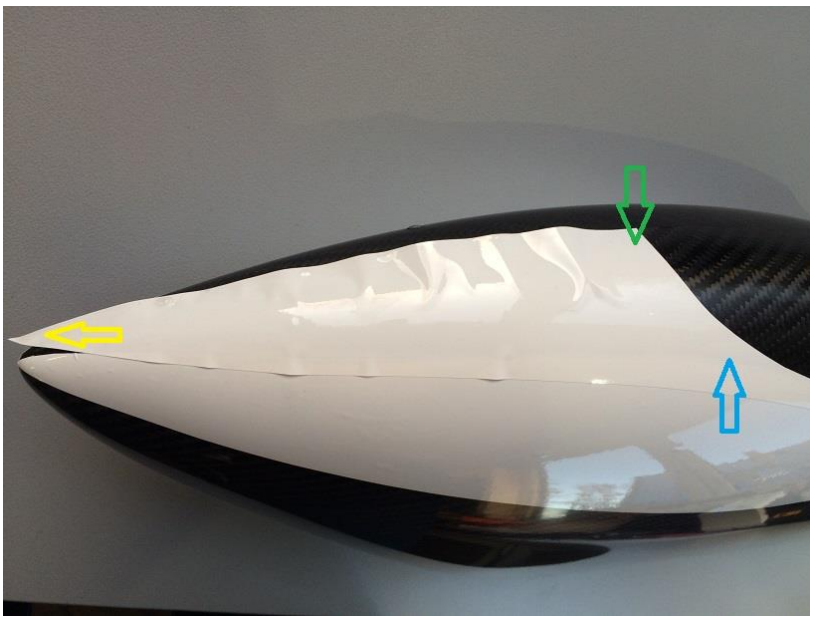


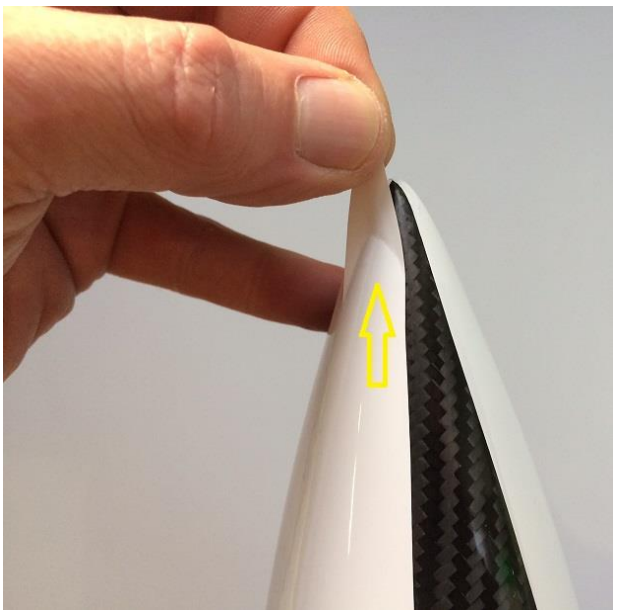
The application of the two upper window foils is the challenging part of the work. They have to be applied on a surface that is curved in both axes. There the foils tend to build folds easily.

Start with positioning the foil at the upper tip (red arrow – left picture) at or slightly above the middle line of the canopy, and ending at the tip of the canopy.

The conical ending tip with the radius at the end should be positioned on the already stuck lower window foil in a way that the upper edge (red arrows – right picture) is initially loose at the upper edge of the lower foil (yellow arrows). The lines are then diverged slowly.

The target is a transition where the complete upper line of the window is a harmonic curve without kinks or interruptions.

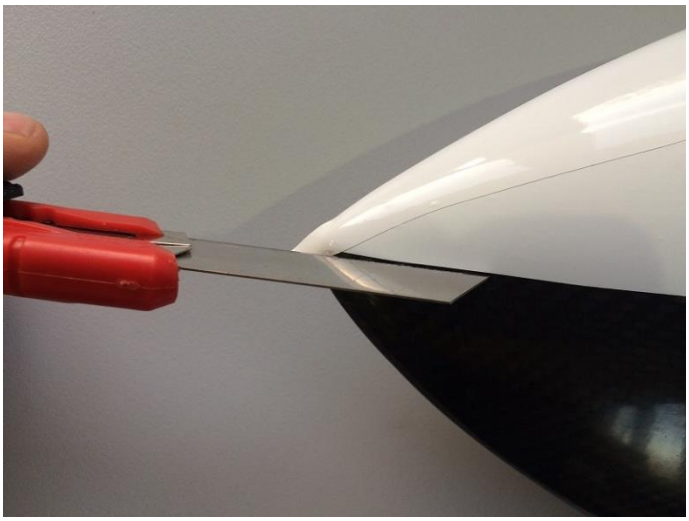


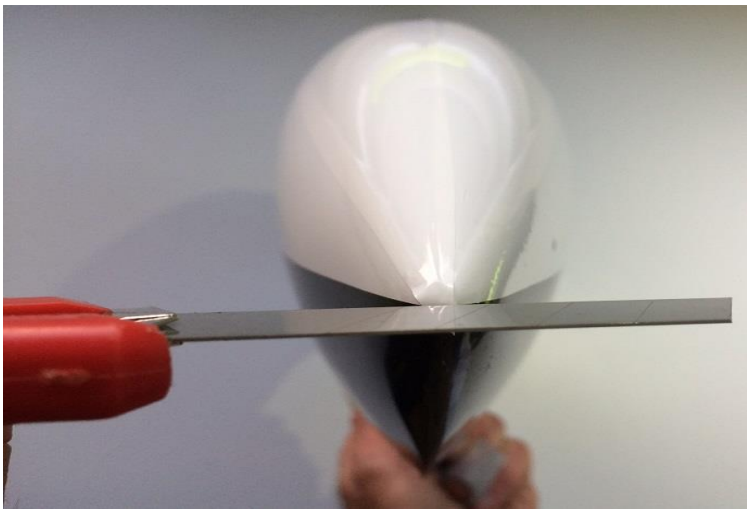


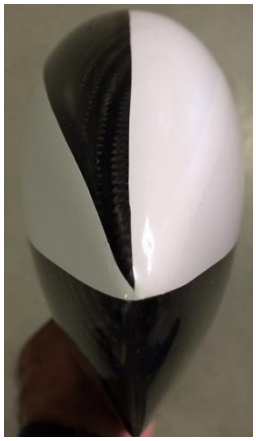
Sweep the foil first in the area of the green and the blue arrow and in-between and make sure it is properly tight. The long rear tip can be carefully stuck and loosely overlapping on the other foil.

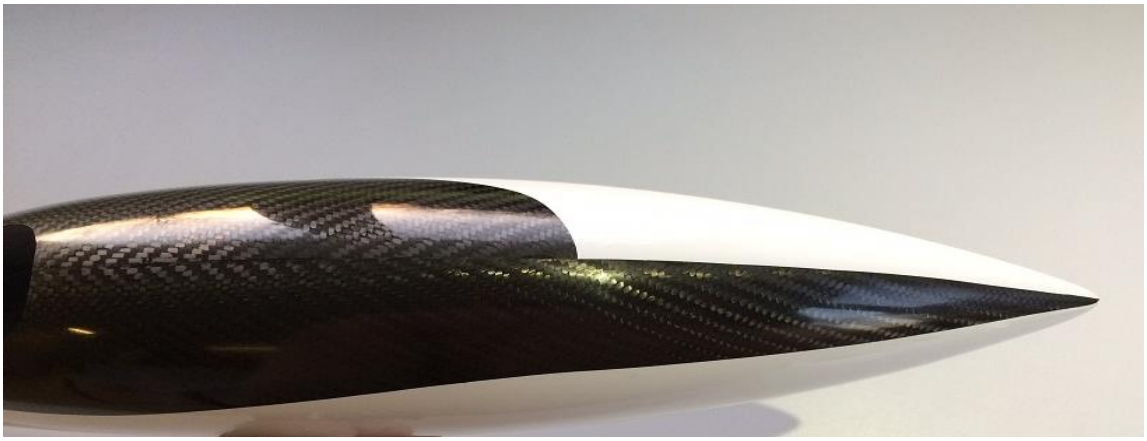
Start to work with the rag to the front, while lifting the foil at the front a little bit and pulling it. Take the tip indirectly as shown in the left picture (yellow arrow), but a little bit more rearward, because you may have to pull strongly to stretch the foil; otherwise, you might stretch the thin tip.

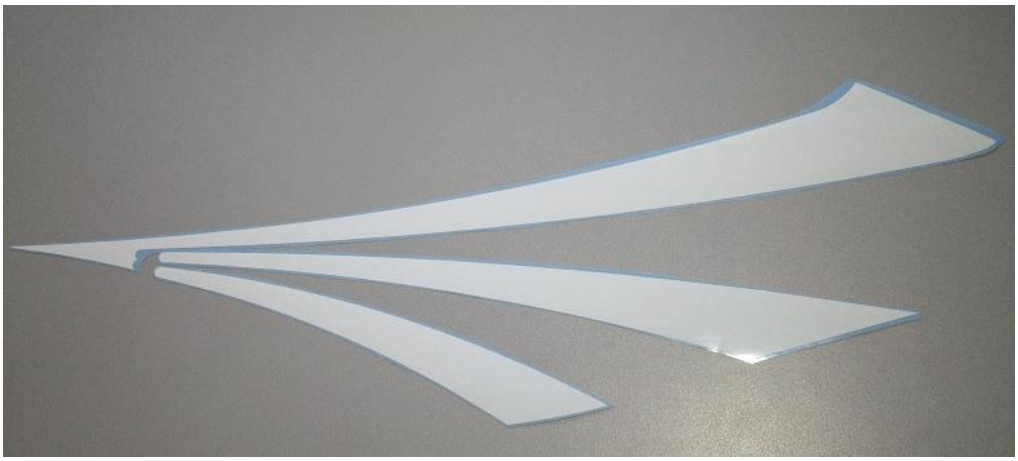
Sweep to the front while pulling at the tip so that the folds become smooth on their own. Take care of the shape of the upper edge of the window. The edge has to be along the center line or slightly above. It doesn't matter if the foil is overlapping a little bit at the front after this procedure. This overlap will be cut later on with a knife (see pictures below).





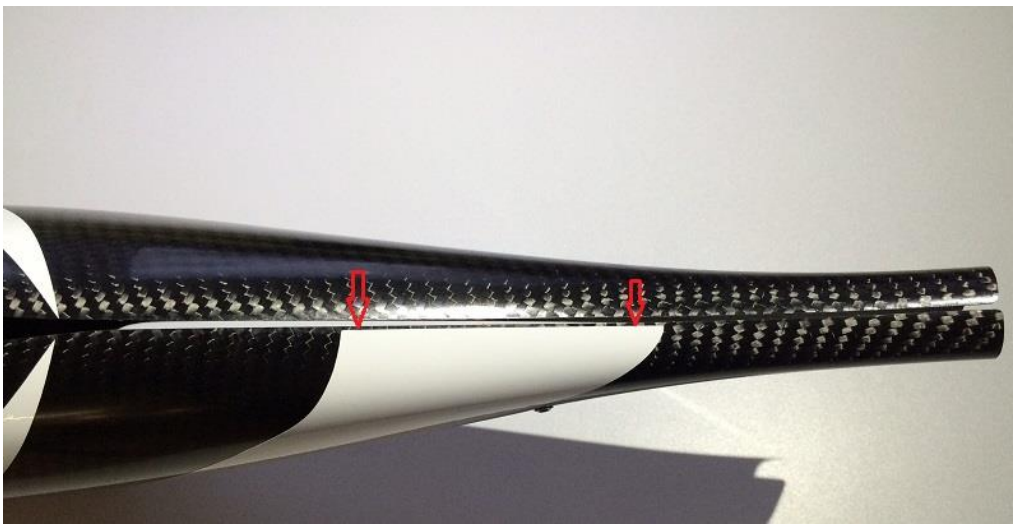






In the left picture, you see the positioning of the aerobatic stripes (in this case, for the left side of the canopy).

The upper stripe is designed with a tip with two reliefs where the two lower strips will be placed. The angle can be varied a little bit. The tips are not filigree, which eases the application.



Start with the upper stripe and place it parallel with the rear edge and flush to the upper edge of the canopy. At the same time, the tip should have a small gap below the window. It is ok when 1-2mm in front of the tip and above the center line is overlapping the tip on the other side.

It is important to lay down the foil with enough soapy water so it can be adjusted with less stress according to the references at the front and the back.

With this way there will be a nice flowing curve from the window, starting at the front with a small gap keep a nice flow as seen in picture.

If you pull strongly somewhere and the foil is sticking to another place on the canopy, there will not be a nice flowing line

With some visual adjustment, you can succeed.

(see also picture of the TDS canopy next page below).

In the middle strip, the front point is obtained by itself (see **yellow arrow** on the left).

The rear point results from the rear edge of the strip, which is to be brought into conformity with the lower edge of the canopy (see **yellow arrow** picture below).

If the edges are not congruent, allow the foil to protrude slightly at the lower edge of the canopy.

The excess film is then later, only when the film is slightly dried, cut with a utility knife.

The same procedure is followed with the lower foil strip (see white arrow below).

The picture below shows the side view of the original **TDS** - canopy with neon yellow stickers.

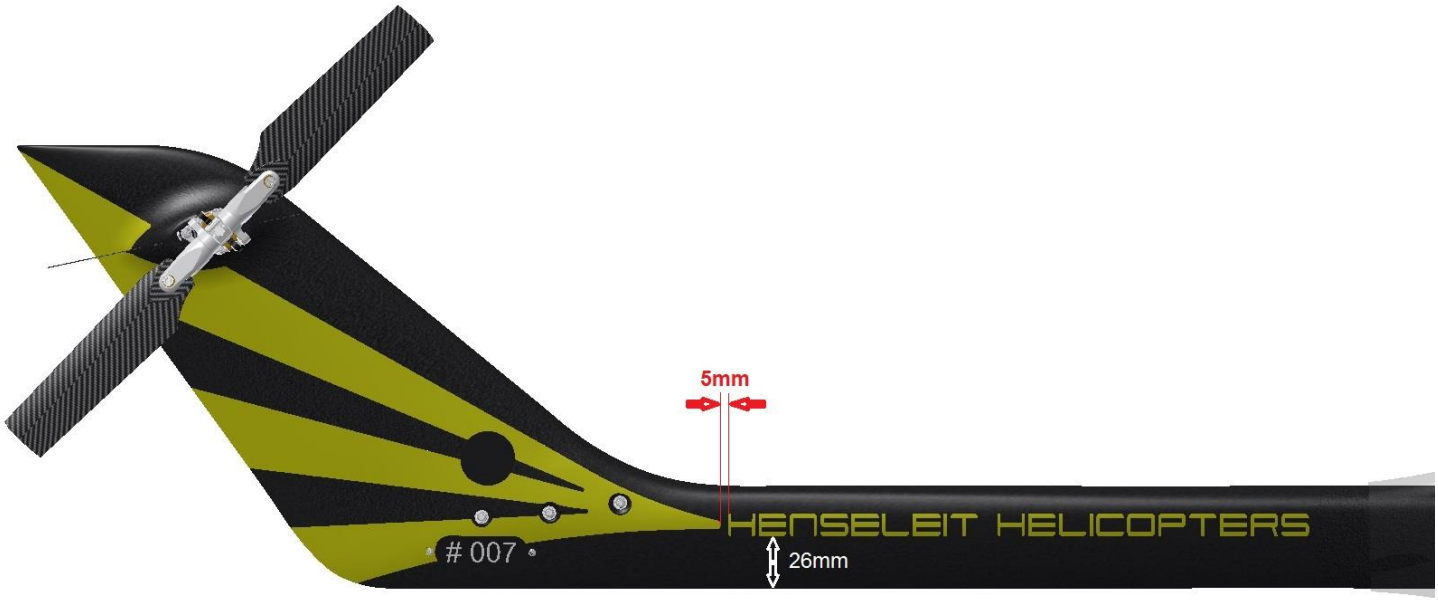
The white, **yellow** and green arrows respectively indicate the edge position of the foil strips in accordance with the canopy edge.

The red arrow shows the hole where the landing gear is later inserted. Here, the foil must be cut out with a small sharp knife in a circle along the edge of the hole. The best way to see the position of the hole is to press the foil there with a finger after it has dried.

The blue arrow shows the location where the mounting screw of the canopy nipple is located. It is also best to press this point vigorously with the thumb several times after the canopy has dried, so that the foil lies as tightly as possible around the screw. Another option is to cut the film around the head of the screw, but it usually does not look that clean.

Attention! Do not cut a small hole in the foil to attach the screw later. As a result, the foil will twist under the screw head and will pull wrinkles when tightening the screw.

18.3 Tail boom decor



Start with the decor of the tail fin:

On the decal sheet for the tail boom there are the left and the right vertical stabilizer foils. The upper tip, which is attached above the dividing line from the edge bow, is already separated.
The right side can be distinguished well by the cutouts for the maintenance cover from the left side.
The positioning of the foils can be handled relatively well, since there are enough orientation points as the holes and trailing edges, which should coincide with the corresponding locations on the tail boom.
Small foil overhangs on the rear of the rudder can be later adjusted with a carpet knife. These foils must also be applied, as described for the canopy, with water and detergent, so that they can be moved and positioned as necessary.
Especially with the vertical tail fin decors, make sure that you pull the foil directly from the paper into the water bowl so that the three stripes do not stick together outside of the water. To do this, roughly cut out the outlines so that only the right and left bows are held one at a time in each hand.
The top two tips are attached separately so they fit well.

Horizontal fin decor:

If you also want to glue the horizontal fin with foil for better visibility in flight, you will find two corresponding triangles for top and bottom on the decal sheet.
Stick these so that the circumferential edges have a distance of approx. 0,5 mm to the outer edge of the tail plane.

Tail boom lettering:

Attention! The lettering must begin relatively close (about 5mm) in front of the vertical tail end decor, or end on the opposite side (see picture last page above).

If the lettering is placed further forward, the other end would disappear under the canopy mounting rubber or under the canopy itself.

Place a horizontal mark 25mm (1mm lower than the lower lettering length) from the lower edge of the tail boom, on both sides of the tail boom.

The label has a length of 290mm. You have two marks for your orientation. The text label is affixed dry without any soap or water. It must fit promptly. Any free-handed attempts bear the risk of irregularities.

Both of the marks are needed for precise application. On such length, any slight irregularities are permanently eye-catching and will look miserable.

Enclosed with your kit is the text label in your desired color. It is not recognizable, however; it is rolled up together with two stripes of 290mm length and 15mm height.

There is a transparent cover sheeting on the letters and the circumjacent foil has not been removed because very often the filigree letters do not retain well on the wax sheet upon removing the foil around the letters.

It is better to remove the complete sticker from the wax paper together with the transparent cover sheet.

In order for you to identify the front and back side, I have marked the beginning of the text with a black marker line (at the location of the **H** from HENSELEIT HELICOPTERS).

Take the stripe with both hands from the left and right side after removing the wax sheet. Then close up to both of the horizontal markings with the bottom of the text label.

Also pay attention to the distance of about 5mm from the tip of the tail fin. Carefully set the label onto the tail boom and sweep it on. Then remove the transparent rip-off foil.

Now start to remove the needless foil around the text label from the tail boom, at the other end (where the S is located of HENSELEIT HELICOPTERS).

Release one corner with your finger nails to get a grasp on the foil and carefully remove it. Observe how the foil separates from the letters. Should any of them lift off, push them down with a sharp object.

Usually this works well because the letters stick to the tail boom far better than to the wax sheet. If the letters tend to lift off easily, give it another stronger sweep across the complete sheet.

At the end, you need to remove sheet remains from the closed parts of the letters O, P and R. Preferably, you would remove the remains with a needle, by pricking it into the remains and lifting them away.

The same has to be done on the other side, whereby the lettering does not run from back to front, as in the picture, but vice versa. The end of the lettering "**S**" must have a distance of about 5mm from the top of the tail fin decor. Finally, press on the letters well.

Assembly step – 19 Battery fixation

Two single battery packs (see technical data for dimensions) are needed for the TDR-II. The packs have to be connected in series.

Use two 7s packs between 4000 and 5000mAh capacity or alternatively I recommend a 6S pack on top and a 4S pack on the lower side for the 10S FAI version (see pictures on next page). The batteries are individually attached above and below to the battery tray separately with Velcro straps.

The Velcro straps will be pulled through the elongated holes below the battery and with the fastener at the top and center of the battery. The fasteners of the top and the bottom battery should not face to the same side.

For the 10S-FAI version I recommend for weight reasons to use reinforced adhesive tape instead of the 4 Velcro straps to attach the batteries to the holder. Additionally, secure the batteries with double-sided adhesive tape to the battery tray bottom plate.

Attention! Always test first if the battery tray can be easily attached to the mechanics without colliding the batteries at the back and also if the canopy can be mounted well.

Mount the batteries with the cable to the front. The routing of the cables to the connectors of the ESC is easier and can be clearly arranged. The corners of the battery where the cables exit are rounded, giving more clearance to the canopy. The sharp edges of the rear side do not disturb at the back.

Note: According to the length of the battery, the position might change. Because of their length, most of the larger batteries with 5000mAh have to be placed as far backward as possible.
If they are too far to the front, the three tongues of the front canopy support cannot move backward. This hinders the locking of the rear canopy fixation.

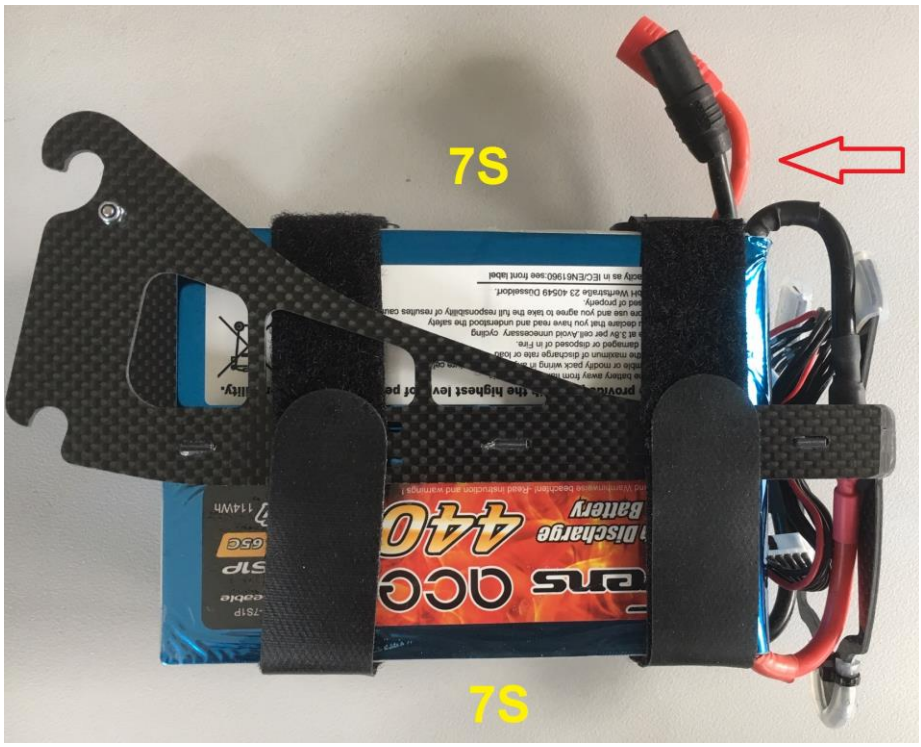
The CG plays no role for the positioning. As long as both batteries together are weighing more than 1,4kg, the CG is in the green area. Additionally a desired nose-heaviness is generated in high-speed flight aerodynamically by the small tail plane.

Even up to 1,9kg battery weight, the helicopter flies well, even with light nose-heaviness. A light nose-heaviness generally cause no problems, but tail-heaviness can create stability problems during fast flights.
The pitch-up tendency of the helicopter is rising with tail-heaviness, while the tendency will be reduced with nose-heaviness.
A plus and a minus cable has to be connected in front of the canopy support. Try to keep the cables as short as possible to prevent additional cable loops, which hinder the positioning of the canopy (see pictures on the next side). It is up to you if you use connectors or directly solder the cables.

Attention! Do not mix up the plus and minus poles of the ESC. This would destroy the ESC completely.

Look also pictures at the next pages

14S – Battery pack



View from the right


View from the top

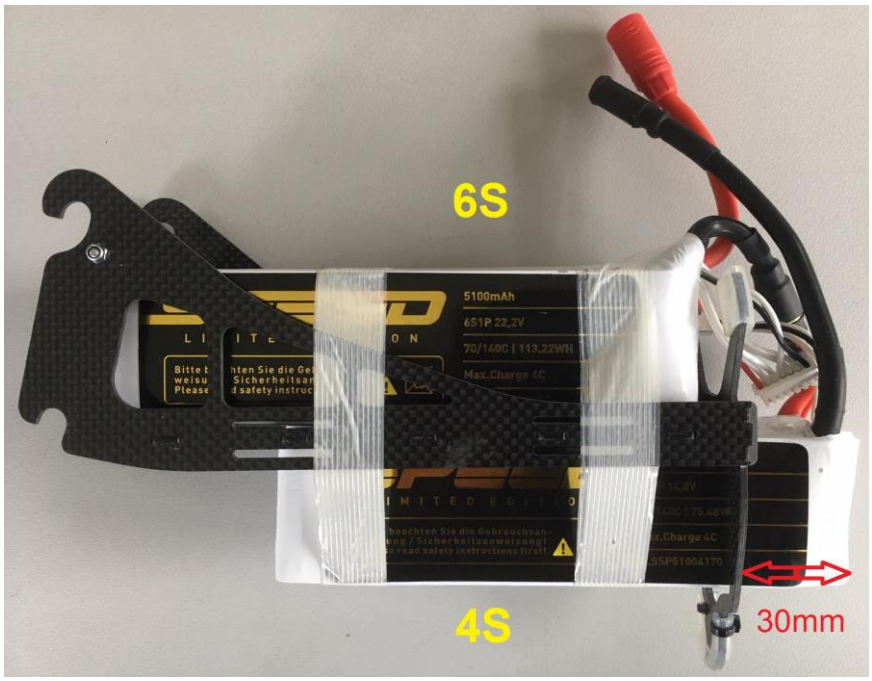

View from the front

Depending on how long the batteries are, it makes sense, due to the sufficient weight of the packs, to push them back so far that there is sufficient space left at the front canopy frame.

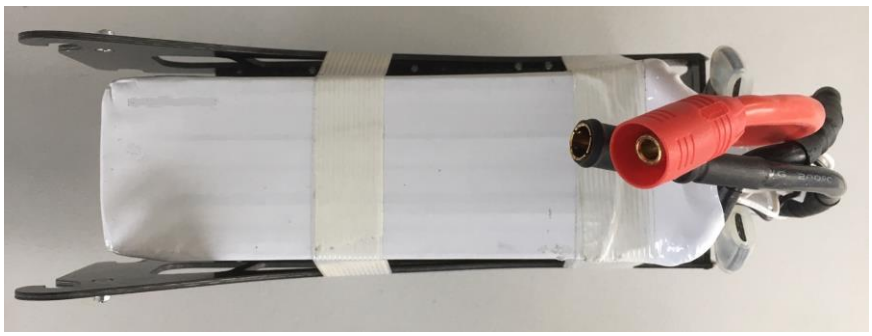
Before attaching the battery, attach the battery holder to the mechanic and make sure that the battery does not touch the chassis at the rear.

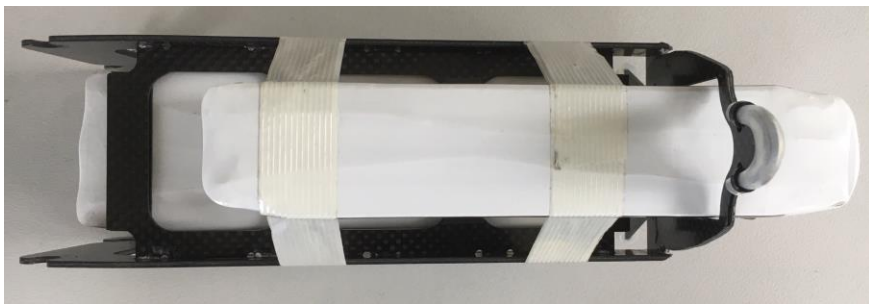
Attention! If possible, pull the rear Velcro strip of the upper battery from the outside of the slot through the large window on top of the inside of the battery compartment (picture top left), otherwise the two side plates will be pulled together when tightening the Velcro strip and will not fit well on the suspension bolts.

10S – Battery pack for the FAI-version



View from the right


View from the top


View from the bottom


View from the front

For pilots with ambitions to fly with FAI - compliant speed competitions, I currently recommend the "**SPEED batteries**" from **SLS**, divided into a **6S** pack at the top and a **4S** pack at the bottom, which fits edgewise through the lower recess of the canopy holder.

Push the 4S battery approx. 30mm forward out of the frame.

These 5100mAh batteries weigh 1400g and have an unbeatable voltage of 3.6V per cell at currents above 300A.

For weight reasons, I recommend to tape the batteries with double-sided adhesive tape to the battery holder bottom plate and to fix and secure them with glass fiber reinforced tape.

Chapter – 20 Basic adjustments

20.1 Swash plate

In this chapter, all the basic adjustments are described beginning with swash plate servo – pitch angle, tail servo – tail rotor controls, ESC basic setup, etc.

I do not claim to be universally valid, since different methods of stabilization can result from the different stabilization systems.
I would just like to make proposals here and point out the specific features of the **TDS**, which deviates from conventional rotor blade settings with a 0 ° pitch in neutral stick position. This proves as useful for a pure speed setup.

Attention! It has to be noted that the swash plate movement for collective pitch is reversed compared to common helicopters, since the blade grips are linked at the rear seen in the direction of rotation of the main rotor. This means, for positive pitch, the swash plate has to move down. The reason for this is a better lever geometry during speed flight. An explanation for this can be found on page 13 (green text above).

Switch on your transmitter and the receiver. Use a receiver battery or the buffer battery for the moment and not the flight battery.

Run through the basic setup of the flybarless system until all servos are running in the same direction. This means that when collective input is given, the swash plate should go down (positive pitch) and up (negative pitch). Also check the cyclic functions. The swash plate should tilt in the same directions as you move the cyclic stick on your transmitter.

Keep the collective control stick approximately at the center and move the cyclic controls just slightly to prevent chaffing with the mechanical stops when the displacements are too big.

Attention! The elevator levers have a flat area or respectively a nose, which will strike the underside or rear edge of the upper bearing plate of the chassis. Make sure that this point is not exceeded at maximum collective pitch (swash plate at the bottom) and simultaneous elevator control to the rear, as well as at minimum collective pitch (swash plate at the top) and simultaneous elevator control to the front.

After a while, you will come to the point where you need to adjust the center position of the swash plate (zero degree pitch). The real position at the blade grip is not of interest at this time—only the position of the swash plate is of interest. Place the swash plate gauge under the swash plate. Move the swash plate downward until the stick is in center position or it is touching the gauge. On some systems, the swash plate travels to the center position without moving the collective stick when you come to the menu point. Check this first without the gauge to be sure the swash plate is not moving downward too far. In this case, the swash plate will be pressed with full power to the gauge and load the servos and control rods more than necessary. The ideal position will be reached when the swash plate is lying all around on the gauge.

According to the accuracy of the pre-adjustments during servo fixation and the neutral impulse of the flybarless system, the positions should nearly fit.

If the difference to the ideal position is not too big, you can use the trim function to adjust the swash plate to the gauge. The swash plate has to constantly touch the gauge all around and the gauge can only be moved over a slight resistance.

If the difference is larger, you can adjust the aileron servos by the length of the control rods, but not by more than +/- 1mm.

If the adjustment of the elevator-servo is completely out of range, you need to reinstall it again and place the hexagon to another position (see page 35 and 36).

The correct adjustment of the swash plate position at center stick position is the important for all of the following. As has already been said, the position of the blade grip is not important at the moment.

The next point in the setup of your FBL system are usually the setting of the maximum or minimum collective pitch value.
The control geometry of the **TDS** was designed in a way that when the stick is centered (swash plate is on the gauge), you get a blade angle preset of **+ 5 °**.
So you can manage a maximum total stroke of about **+/-12 ° (+/-6mm** disc hub) without angular distortion. This gives you about **-7 °** to **+17 °** collective pitch range, which is ideal for the speed flights and also for an emergency autorotation. It still allows sensitive pitch management at the high rotor speeds.

Attention! I would like to point out that it makes no sense to drive a total stroke of more than **+/-12 °**. This is already at the borderline with the maximum **17 °** achieved with max positive collective pitch and is not suitable for untrained pilots. With the **10S-FAI setup**, I generally recommend a positive maximum value of **16 °** pitch.
The machine is also not designed by its control geometry for a larger overall pitch range. Otherwise there will be mechanical collisions of the control levers.

Notes for the speed setup: I recommend you try this setup a few times in any case. The difference with the conventional procedure is that the helicopter is already hovering when the collective stick is at centered position and you have to place the stick below the middle position in order to get 0 ° collective pitch on the blades.

By the way, in the nineties before the the 3D flight style came up, all helicopters were adjusted like this. The 0 ° setting for collective stick center position only makes sense if you want to fly upside down as well as normal. However, since this is not provided for in the **TDS** anyway, this 3D setting only brings disadvantages for speed flights.

Experience shows that it only takes a few flights to get used to it, because you generally do not control the hovering altitude according to stick position, but you can see whether the helicopter is rising or sinking and, accordingly, automatically adapt the stick position.

If you realize after a few flights that you can't get used to that at all, you shouldn't change the basic mechanical setting, but only adjusted the collective pitch curve on the transmitter so that you have 0 ° with stick center position.

The disadvantage is then, as with a conventional setup, that you will get a range of 17 ° and not of 12 ° from the center position of the stick to the maximum, and thus a sensitive collective pitch management in the area important for speed flight is hardly possible.

If someone wants to operate the helicopter absolutely conventionally like a normal fuselage helicopter without speed blades, but with symmetrical rotor blades just in a comfortable way and with rpm´s not above 2200 U/min, there is still the possibility of elongating the control rods between the swash plate and the blade grip arm by about 2.5mm (5 revolutions). As a result, the blade grips at swash plate center position are neutral at 0 ° blade angle. The blade grip arms then stand up a bit upwards, but this does not matter.

If the symmetrical collective pitch range of +/-12 ° is not enough, you can enlarge the range by placing the ball bolt of the blade grip arm into the inner hole.

If the cyclic range is also not enough for you, you can turn out the ball bolts at the inner ring of the swash plate and attach them to the second hole, which are shifted by 90 °. This position increases the lever by 2mm, which also increases the cyclic range a bit. You can also mount two additional ball bolts there to be able to change.

Next are the cyclic adjustments. Most of the time the flybarless system manufacturer gives a reference angle for the basic cyclic adjustment needed for the system parameters. Often this value is between 6° and 8°.

The swash plate should be at stick middle position to perform this setup point according to the manufacturer's manual. Either the swash plate automatically tilts and has to be adjusted to the required value or the requested value has to be adjusted manually.

Finally, you have to adjust the cyclic maximum values, which will be limited by a software "cyclic ring." This means the flybarless system limits the tilt angle when elevator and aileron input is given at the same time. Because of this function, the maximum tilt angle of the swash plate is the same independently on the tilt direction. Therefore, exceeding the maximum mechanical values is prohibited.

So in any case, activate this feature if it is not automatically the case.

The maximum possible limit is as described further ahead due to the mechanical stops on the elevator lever, when maximum collective pitch (swash plate at the bottom) and simultaneous elevator control to the rear, as well as at minimum collective pitch (swash plate at the top) and simultaneous elevator control to the front is given.

After setting all electronic servo ranges, please check whether both rotor blades have the same angle when the swash plate is resting on the swash plate gauge.

Especially with such stiff system as **TDS**, track differences are negatively influencing the flight stability.

Put the **TDS** on a flat, non-slippery surface and mount the rotor blades. Put the gauge beneath the swash plate.

Align the blades as much as possible and orientate the rotor lengthwise to the helicopter. One blade should be above the tail boom. Calibrate the pitch angle gauge on a reference plane for the helicopter perpendicular to the rotor plane, such as the motor top.

Place the gauge exactly perpendicular to the helicopter longitudinal axis before setting it to zero. Position the display to the front and use the front rotor blade for the measures.

Attach the gauge to the rotor blade or place it on the blade grip. Since the control rods are completely screwed together at this state, the control rod of the rotor blade, which has a larger pitch angle in a positive direction, must be removed from the inner ring of the swash plate and the ball link has to be turned out a bit.

There is no need for long trials you can easily calculate the lengthening. The M3 thread of the control rod has a gradient of 0.5mm. This means that the smallest possible adjustment, namely half a rotation of the ball joint, causes a change of the length of 0.25mm. This corresponds to a difference of about 0.5 degrees.

In the worst case, this brings you max 0.25° difference between the rotor blades, which is quite good enough.

Please do not squeeze the ball ends from the outside even if they are a little stiff. Because of the high forces, they adapt quickly. Use a little bit of dry fluid; with the capillary effect, it will get into the small gap.

Check a second time by setting the gauge again to zero and measuring both blades again.

It is important that the swash plate is lying exactly on the gauge as we noticed before that 0.25mm results in a large pitch angle. The accuracy of your work is useless if the swash plate is blurred when the ball link is pressed.

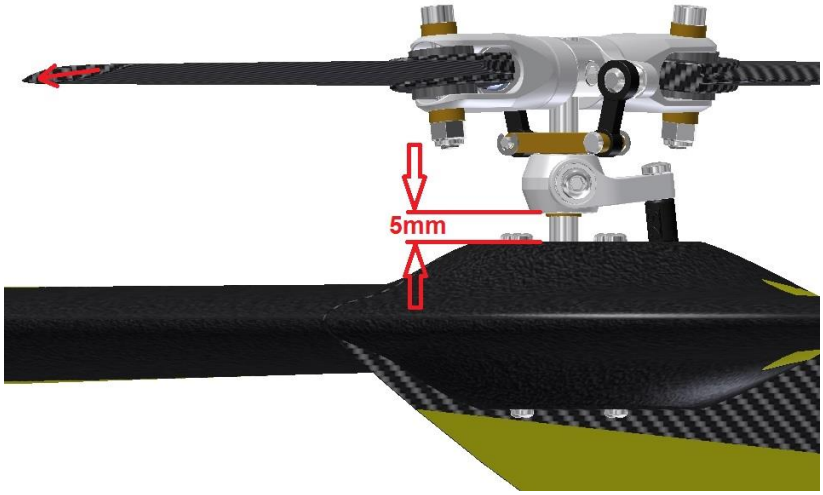
You can also switch on the system and move the swash plate downward until it is lying on the gauge and the servos are slightly growling.

Do not use the dubious method of tilting the rotor blades by 90° so that the blade tips are close together as an indicator. You can do this with a 450-class helicopter, but not at a machine of the 700 size class. The lever forces on the swash plate are horrible for the rods, the ball links, and the servos—besides, this method is not correct.

Switch on your system and move all inputs to the maximum to be sure there are no collisions where control rods or something else at the rotor are chaffing mechanically or hindering the movement.

Turn the rotor (best without blades) carefully at a maximum and minimum collective combined with maximum cyclic and check to make sure everything moves freely. Be aware that at 2200 rpm, this happens 36 times a second!

20.2 Tail rotor



The tail rotor adjustment is quite simple. There are menu items in your Flybarless setup for that, too.

If you have driven the servo to the center-position by the setup menu, you can correct the tail control rod length at the front of the fork head of the tail servo lever.

Set the control rod length so that at center position, there is a distance of about 5mm between the front of the control bridge and the front surface of the tail fin area.

Then adjust the maximum servo angles to both sides so that servo just starts growling because of mechanical stop.

In the case of a tail rotor input to the right, the control sleeve has to move to the left towards the tail.

Finally, check once again whether all servo deflections, both of the swashplate and of the tail rotor, are done in the correct direction.

Attention! The tail rotor sensitivity values must be set very low for high RPM and high speeds so that the tail does not resonate during fast flight. Better to start with values a little bit too low. Nothing can happen, as the tail fin has a stabilizing effect on its own.

The different sensors must counteract in the following directions when moving the helicopter:

The swash plate must tilt on all sides always, in the opposite direction, in which you tilt the fuselage. At the tail rotor, the control bridge must move towards the rear gearbox when you turn the fuselage from above around the yaw axis (rotor shaft axis) to the left (counterclockwise).

20.3 ESC – S e t u p

Here I can only give a few hints for the recommended KOSMIK controller. For other brands, please follow the manufacturer's instructions.
Remove the rotor blades before programming the controller. So nothing can happen if the engine accidentally starts.

I start with the basic programming of the ESC (Mode 4) for the helicopter. Proceed according to the manual. Switch the transmitter and the receiver on to start. You need an adjustment of the throttle channel of 0% to 100% to be able to program the ESC. Since you have to program different throttle curves for each flight state, you can do it right now.

Depending on the setup, you should set the following recommended speeds:
The percentages of the individual speeds depend on the engine or battery used and can be very different individually.

Autorotation engine off

Idle Up 1	approx. 1600 rpm	to start and land	(centrifugal lock is released)
Idle Up 2	approx. 2100 rpm	to fly around normal	(centrifugal lock is locked)
Idle Up 3	approx. 2600 rpm	for speed passes	(centrifugal lock is locked)

It is ideal if the controller has a value between 80% and 90% for the 2500 to 2600 rpm with Idle Up 3 during operation.

Set the Idle Up 3 to 100% for programming of the ESC at first. To activate the 100% throttle curve, switch the transmitter to Idle Up 3. Switch on autorotation, which has priority over the others and gives a 0% signal. Now you can start the programming sequence of the ESC. Connect a flight battery and press the button at the side of the KOSMIK housing.

A sequence of beeps will start. Afterward, the ESC beeps one time, then two times, etc. After the ESC beeps four times, switch off the autorotation switch so the 100% signal is given from the Idle Up 3 curve. After the final beep, you can unplug the battery. Now the basic setup is finalized.

Now you can reduce the Idle Up 3 value to 80%.

Two parameters have to be adjusted. The current of the BEC should be adjusted to 8.0 volts if you are using high-voltage servos, and the direction of the motor has to be corrected in case running the wrong direction.

Put the helicopter on a table standing stable and free. Switch motor to off at the transmitter and connect the flight battery. Switch to Idle Up 1 and switch off the autorotation. If the rotor head starts turning clockwise from above, the motor runs in the right direction and the adjustment is correct

See the KOSMIK manual for adjusting the BEC current and the motor direction.

Finally check to see if the ESC fits underneath the canopy. Depending on the battery type that is used, it will be placed more or less tilted under the canopy. The battery height may not exceed 50mm; otherwise, the KOSMIK will not have enough space.

Mount the canopy to check it. The battery tray with battery has to be installed. If you look through the ventilation slot, you can see the ESC. Use a wooden pole (or something similar that does not scratch the surfaces) to lift the front of the ESC toward the canopy to check the play. Remove the canopy and line up the front edge of the carbon ESC tray with a stripe of cellular rubber (stick to the lower side of the plate). The rubber then lays on the battery so that the ESC is just supported toward the canopy by the silicone tubes mounted on the ESC or has just a little play.

Attention! If you want to fly without the canopy, you will have to fix the ESC with a rubber band. There are slots at the side frames of the battery support for that.

On our website you will find my personal VBAR NEO 10S setup for the TDS with my recommended 10S components as an image file with the appropriate settings.
Of course you may have to make an individual adjustment to your needs or other motors or ESC.
For 14S, the ESC- values must be adjusted to get the recommended rotor head rpm´s.

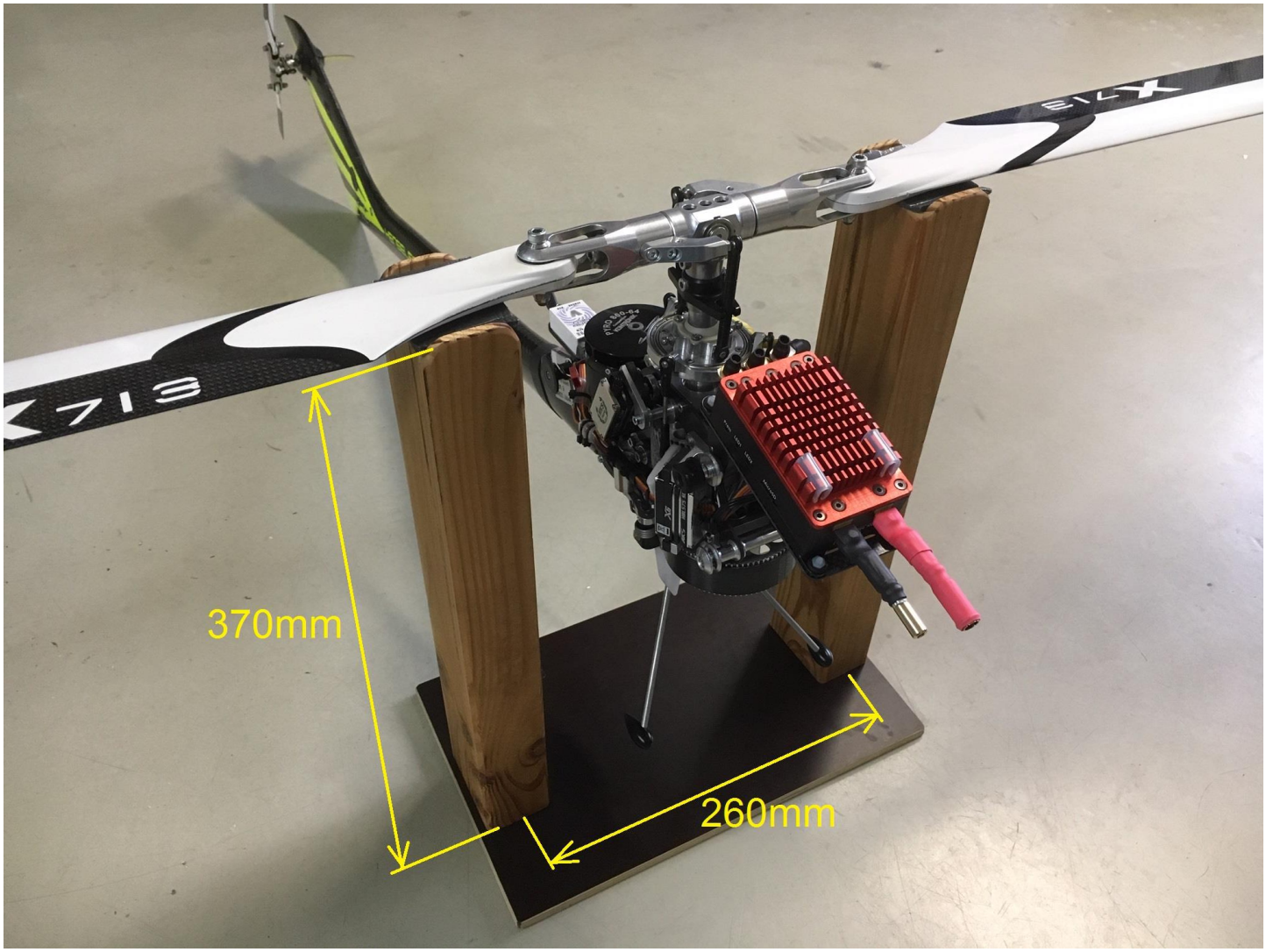
Chapter – 21 Handling and maiden flight

I strongly recommend that you build a small assembly stand before flying in order to be able to hang up the helicopter at the blade roots outside in the flying field.

The reason is that the canopy can only be mounted with pulled out landing gear legs. You can also put the helicopter on the back, but that doesn't get it well, as huge lever forces act on the rotor blades, which put too much pressure on the control rods of the servos.

The stand can be easily built from a board which is about 10mm thickness with an edge length of 300mm x 200mm and two 370mm long roof slats with a cross-section of about 40mm x 60mm (see picture).

It is advantageous to work out the slats at the top and stick on foam rubber or an anti-slip mat.



The procedure before take-off is that you first place the helicopter on the ground without canopy on its legs and attach the battery to the mechanics, as well as to turn on the transmitter.

Then plug in the support battery to start the receiver power supply. Wait until the flybarless system has booted and then connect the flight battery to the ESC.

Adjust the collective stick slightly below the center position so that the blades have about 0 ° pitch and place the helicopter, as seen above in the picture on the stand.

Now you can remove the landing gear legs by twisting them slightly and pulling them down at the same time. Place the legs at the bottom of the board and slide the canopy on the mechanics as described in the canopy chapter. Make sure it sits correctly at the back, so the canopy bolts are locked. Secure the canopy with the rubber and plug the landing gear legs into the holder through the dedicated holes in the canopy.

Attention! By turning slightly and at the same time pressing them hard, the locking bar pushes forward, so that the landing gear legs can be pushed in for about another 12mm.

Twist the landing gear legs back and forth a bit until you feel a snap of the clinch. Never forget that, because a landing without or with only one landing gear leg is very unpleasant.

Put the helicopter on a table and have thoroughly check it again before starting the maiden flight

- Did you tighten all the screws, including the one you had to loosen in a later building phase?

- Are all cables routed safely? Are all connectors carefully plugged in and secured if necessary?

- Are all control inputs in the right direction and do the sensors react in the right way?

- Are the tail blades mounted in the correct direction (taking into account that they have to be mounted in the opposite direction than on most of the other helicopters)?

- Are all control rods mounted?

Grease the gears with DRY FLUID GEAR if this hasn't happened yet. The best way to access the gear is on the right chassis side. The teeth of the intermediate belt pulley or the main belt can also be easily greased with DRY FLUID GEAR. As a result, the teeth of the tooth belt slide much smoother into the tooth gaps and there are no squeaking noises.

The same is valid for the tail belt. Apply some DRY FLUID GEAR on the teeth as you slowly rotate at the rotor's head against the rotor direction.

Remove the main rotor blades and let the helicopter run only with the mounted tail rotor blades on the table. To do this, hang out the control rod at the tail servo, so that the tail rotor remains in a neutral position.

Attention! There is a risk of **injury** in the event of carelessness, but with this test run you can check very nicely whether there are any vibration problems on the engine or the tail rotor. These are usually the two critical points of a helicopter that can lead to massive problems or even total failures later in flight.

Look for a large free area with a non-slippery surface and see that there is nothing loose lying around. Place the transmitter in front of you in such a way that with one hand you can hold the helicopter, and with the other hand you can quickly turn off the engine switch. Ideally, find an assistant to operate the transmitter on your command.

Start with the lowest RPM and feel with your hand placed behind the mechanics on the tail boom how strong the vibrations are. Don't get near the tail rotor or the rotor head either.

Switch to the second rotor speed when the first one has felt good. When passing through the speed band, there are always points where you can feel stronger and then weaker vibrations again. However, if the vibrations become stronger all the time as the speed increases, something is wrong. If the second speed also feels good, switch briefly to the highest speed, but keep it only short as the engine runs without load.

If you have connected a telemetry system, you can also check immediately whether the desired rotor speeds are adjusted and, if necessary, adjust the respective ESC channel percentages.

At the end, switch to the lowest rotor speed again and move the swash plate into your two collective pitch end positions. Give a maximum cyclical input around in all directions and hear if there are exceptional noises arising because there are mechanical collisions somewhere. This is the best way to perform a safe test. Later on during the flight you cannot hear and see anything until the helicopter will be inevitably disassembled.

Note: Today, vibration analysis is often read out because many flybarless systems offer this possibility. Please don't let the display values drive you crazy, but rely on your feeling.

When a system creates unacceptable vibrations, you will hear and feel this. There is no helicopter that runs vibration-free. The stiffer and lighter a mechanic is and the higher the engine power and mass of the rotating parts are, the higher the vibration level can be.

Keep in mind that we have a peak power of up to 15KW (20hp) in a machine that is just weighing 5kg. A modern Formula 1 car with approximately 1000hp is likely to weigh only about 250kg to have the same performance weight ratio 😉.

Dangerous for electronic components are usually the high-frequency vibrations, such as those from a poorly designed engine or also from poorly weighed tail blades.

The low frequency vibrations, which occur in flights especially with strong cyclical inputs, can hardly be avoided. Thus, there can often be high vibration loads in flight, but these usually have no negative effects on the electronic components.

When testing the helicopter without main rotor blades on the table, simply watch how the swash plate behaves. If it stands quietly on its position, there is nothing to worry about. However, if it is constantly starting to shrug and makes uncontrolled movements, the vibration load is too high, or there is another disturbance.

Place the canopy and check the clearance of the control rods and the fork of the swash plate fork device.

Use the recommended main and tail blades.

Look for a nice, windless, dry day for the maiden flight. It doesn't make sense to maiden a new model under adverse weather conditions just to come into the air a little bit earlier. There are enough risks during a maiden flight. Always be on the safe side and take care to have enough safety distance between you and the model.

A lot of curious people are not beneficial for your nerves, either.

Make a final servo check at the flying field and check to make sure everything is running properly. Take time when mounting the canopy. As described before, turn the rotor crosswise to the mechanics and take care that the canopy is hooked correctly at the rear and the rubber tube is correctly placed.

Attention! I urge and recommend that you do a radio-range test, especially when using the carbon canopy. Look to the manual of your radio. The carbon canopy shields the electromagnetic waves, so it is very important that the antennas are out far enough.

Do not perform flights without the canopy—the visibility is very bad.

Attention! Place the helicopter on a non-slippery surface such as grass. Places with a hard or slippery surface or even ice are dangerous. Because of the slipping of the skids, ground resonance might occur and the helicopter could tip over. Bumps or holes in the ground can also be dangerous with the filigree landing gear legs.

Get a large enough heavy rubber mats if you don't have a suitable terrain available. This is the drawback when dealing with a high-bred racing machine, but no one would come up with the idea of driving a Formula 1 car over a beet acre 😉

Take care that the lower rpm (Idle Up 1) is not adjusted too low (ESC input not below 50%) and the run-up time is adjusted to a maximum of 12 seconds.

Resonance may appear at low rpm because of the high stiffness and the close distance of the CG to the rotor head. That's why I developed this special rotor head.

Please read again the-"explanation of centrifugal force-controlled feathering shaft damping for the TDS" on page 14 and 15.

It is important that the rotor does not endless run in the range of less than 1000RPM when starting, and that the blades are adjusted to about 0 °. In the case of the **TDS**, the collective pitch stick must be below the middle position.

Most transmitters have small markings on the side of the collective pitch stick. It is best if you assemble a pitch gauge to determine this point and drive the rotor blades to 0° pitch angle.

Remember this stick position or make a small mark on the transmitter if none exists.

Never forget to take out the swash plate gauge before flight!

Some transmitters, such as the VBar Control touch, also offer the possibility to trigger a short acoustic or vibration alarm in any freely selectable stick position, so that you immediately notice without looking at when you have reached the point where the blades are at 0° pitch angle.

Before landing, be sure to switch the rotor speed to the lower level of about 1600RPM and give a short strong elevator input just before you land, to make sure that the cones have detached and the feathering shaft have the desired freedom of movement.

Turn off the engine after landing and emediately drive the blades back to 0 °.

Normally, the rotor runs out of softly thanks to the seesaw decoupling.

Should you realize that the helicopter suddenly gets very restless, a brave stick input to minimum collective pitch helps to quickly slow down the rotor and keep the helicopter on the ground at the same time.

Tighten the blade bolts, but not too hard, so the centrifugal force can align the blades easily, especially during run up when the blades are not yet aligned and shaking may occur. I tighten the bolts just enough so that the blades are not folding because of their own weight when I am holding the helicopter with the rotor mast horizontally. If you shake the helicopter, the blades should fold.

The first flight:

Start the engine and let it run up to Idle Up 1. Take off and see if any weird things happen.

Attention! Even on grass floor, it usually happens that the fuselage turns to the left by a few degrees due to the jerky torque when the engine is switched on (tail boom moves to the right). This is because the downforce of the tail boom to the ground is not large enough to provide sufficient grip. The two small landing gear legs also do not have the stabilizing properties of a conventional skid landing gear. So don't get afraid when that happens, more than about 30 ° the fuselage usually doesn't twist 😉

For this reason avoid slick hard floor surface as a starting place. If you're flying in summer on a flying field with extremely short grass and hard ground, you can also cut a piece of silicone hose and attach it at the back of the bottom of the tail fin to get more slip resistance.

In extremely unfavorable floor conditions, you can also pull matching silicone hoses over the middle part of the drop-shaped profiles at the bottom of the landing gear legs to achieve the necessary slip resistance.

Attention! Avoid a hard touch down, even if there is a need for a hurry landing. Above all, the helicopter is no longer allowed to make horizontal movements when touching down. Fly emergency autorotations with a slight forward speed to keep the tail straight and flair the machine by continuously pulling the elevator stick just before putting it on ground to take out the forward speed as much as possible. It doesn't matter if you pull the tail over the floor first. It will touch the ground first in any case.

Don't be surprised of the somewhat delayed and sluggish control reactions if you take off with 1600RPM. This is due to the unlocked dampening of the feathering shaft. With stronger cyclical control inputs, you can hear a slight snattering, which is because of the cones haven't yet wandered outward and still have play.

It's best if you transition into a forward flight so that the machine is stabilized by the airstream and then switch to the medium speed of 2100 RPM (Idle Up2). At this moment, rotor head damping also becomes stiff.

When switching the rotor speed, the tail generally makes a slight pivot, as the tail rotor power does not have a compensation capacity that is familiar to 3D helicopters due to the small tail blades and the low tail rotor speed. Therefore, it is best to make changes to higher RPM when flying forward, as the side fin already has a strong stabilizing effect.

Attention! Under all circumstances, avoid letting the helicopter climb vertically from the hovering flight at full collective pitch at low rotor speed and then in addition switch to the next higher rotor speed. This hard and sudden torque increase would completely overwhelm the tail rotor. The stabilization system then gives full tail blade angle against the torque, which leads with certainty in a complete stall at the tail rotor blades, so that the helicopter will start to fly unintended left pirouettes.

But it is not difficult to avoid such situations if you simply fly the machine smoothly.

Should such a situation occur unexpectedly, reduce abruptly the collective pitch angle of the main rotor blades to take out the torque. Normally, the tail rotor then immediately gets grip again.

The worst case would be if this happens close to the ground, so if the pitch is abruptly removed you risk touching the ground.

In such a case, despite rotating fuselage, launch a gentle inclination until you reach a height of 10 to 20 meters. Then you are able to reduce the collective pitch, so the rotation stops again.

You will have to adjust the tail sensitivity at the different flight states respectively at the different rpms. Consider that the sensitivity can be adjusted at a higher value for hovering than for quick forward flight. This means you can make a final adjustment after you are familiar with the helicopter and able to fly it at a distance and fast.

Don’t be surprised if the tail is oscillating a little bit during the first 10 flights. The reason is that the tail belt is stiff at the beginning and not running smoothly. This will change soon and will improve flight by flight.

Get used to the appearance during flight and start to increase the distance slowly. Because of the slim canopy, the orientation detection is more difficult in larger distances than with normal helicopters. Additionally, the helicopter wants to speed up. In a short time, it is far away, even if not intended by the pilot. Be careful if you pull up the machine with constant collective position after a fast fly-by. The machine converts speed to height very well and is quickly out of sight, especially during poor visibility because of bad weather conditions. It happened several times to me and the helicopter went into the clouds. This is an extremely uncomfortable feeling. You can prevent this by reducing the collective to 0° or by flying a steep turn slightly pulled up instead of shooting upward vertically.

I want to mention that, because of the excellent aerodynamics, the **TDS** will become very fast after a small dive, even at low rpm. This is nice on one side, but on the other side, there is a high tendency of the helicopter to pitch up.

To get a high stability at high speed, you also need a high rpm on the rotor head.

The retreating blade does not have enough lift in this case and the helicopter is pitching up. This will get worse the more collective you give. Reduce the collective at fast approaches with low rpm; otherwise, you can be surprised.

Fortunately, there are more and more flybarless systems with a so-called pitch-up compensation. The system, recognized based on the swash plate control with critical states, will be reached and reduces the collective on its own, so the helicopter flies straight and does not pitch up. Don't be surprised if the helicopter does not climb anymore in horizontal flight with full collective and starts to nod. This is a sign of a reduced collective by the system, so nothing should happen.

At the beginning start to fly with the second rotor speed for a few times until you become a little bit familiar with the characteristics of the machine. With the third rotor speed, the machine becomes a projectile and you have to check for a good flight path in your available flight area beforehand.
Also keep in mind that at the highest rotor speed and with high pitch values, the battery capacity lasts for less than 2 minutes. Be sure to preheat the batteries. Cold batteries are not good at all with these currents! Especially the high-performance batteries are very sensitive when used cold.

Do not fly for a longer period with the maximum possible collective pitch value, as all components will completely overheat. In addition, the speed drops and the flight stability decreases rapidly. You can achieve the best flight results with a very sensitive and coordinated collective pitch management by running the machine and not trying to tie it through the measuring track by force.
Use the energy economically by a gentle turn from a higher altitude by first letting the machine speed up at lower collective pitch angle and gradually push more and more collective pitch when the machine is approaching the horizontal trajectory at the beginning of the measurement track. Latest from this point on, the elevator stick should only be moved extremely gently in order to avoid a sudden pitch up of the machine. Do not pull up the machine abruptly when you reach the end of the measuring track, but first slowly reduce the collective pitch value, then pull up the machine extremely soft.
If you fly the U-turn to the counter-approach through half a roll in the ascent flight with a subsequent round decent (as usual with speed flying), you must remember that in the recommended **TDS** setup the 0 ° pitch is slightly below the stick center position. Otherwise, the roll doesn't get completely straight.

Attention! After a flight, you'll need to give both the ESC and the motor plenty of time to cool down before you start for the next flight. Otherwise you won't enjoy the components for a long time.
Always keep in mind that the **TDS** is an extremely compact, lightweight and last-purpose high-performance machine that needs to be treated accordingly.
Fly the machine in a forward-looking and smooth style and keep in mind that it has a high potential for danger due to its performance and speed.
Never trust 100% on the technique. As we move around the border area here, small carelessness can have fatal consequences. If anything fails at speeds above 300km/h, it can cause the machine to tear into a thousand pieces.
That is why faithful maintenance is essential. As a matter of principle, don't fly if there is anything of concern.

Also note the hints in the next chapter.

Chapter – 22 Maintenance and care

Overall, the helicopter is very robust despite the lightweight construction and the necessary maintenance is kept within limits.
Check in the early days, whether somewhere loosen connections or show any particular signs of wear.
Slight abrasion on the not yet run-in gears is normal.
The rear belt also takes a certain amount of time to break in and become soft.
Grease the gears and all sliding joints regularly.
The pinion of the intermediate shaft is made of high-strength aluminum for weight reasons. It is anodized to have the surface as hard as possible. This layer has limited lifetime and wears off at some point.

Since aluminum does not have good gliding properties, such as bronze or brass, it should therefore be regularly lubricated with Dry Fluid Gear and replaced if wear is getting too high.

Check all cables and connections.

Also look for chafing at the cables from controller to engine and, if necessary, attach protection to these places.

Attention! Due to the electrically conductive carbon canopy, there is an extreme hazard for short-circuit with fatal consequences when in getting in contact with bare, uninsulated cables.

Attention! Check from time to time to see if the rear gearbox is still fixed properly at the top of the tail fin. This was glued by us with two-component epoxy resin between the two tail fin walls and additionally secured with the lower four M2x5 Phillips screws. These screws cannot be loosened, as they are also glued in. The bonding is highly loaded due to vibrations and temperature fluctuations, so that in adverse circumstances the bonding could get unglued.

You can notice this, by pushing the tail rotor shaft slightly up or down. After about 50 flights you should unscrew the tip of the fin with the horizontal stabilizer (the top four M2x5 Phillips screws) in order to be able to look at the top of the fin for control. This allows you to control the bonding area better and control if the upper deflection (especially the hole for the fork head) is worn out.

Also after an emergency autorotation, where the helicopter flips over, the tail rotor should be checked. The advantage of the non-turning tail rotor is also that it does not get caught up in the high grass during emergency landings with a standing engine. So it makes sense to look for high grass or a grain field when making an emergency landing at large distance. Normally much less happens than with an uncontrollable landing on a ploughed field.

Check after hard emergency landings if the bonding seam of the tail boom is still ok. In particular, the lower seam can burst up lengthwise at extreme impact loads. By twisting the tail, you can see immediately if the seam has debonded, as then the original torsion stiffness is no longer given. If only the seam has debonded, you can easily repair it by yourself with thin-liquid superglue. Glue the edge down with tape beforehand and let the superglue run from the front into the tail tube.

Attention! To do this, remove the tail boom from the chassis before and remove the long control rod for the tail rotor control (see also p.60 in the manual). Otherwise, there is a risk that the superglue will glue the control rod to the guide piece, which is located at the bottom of the tail boom. Also, be sure to use only so much superglue that nothing runs into the drilling of the guide brackets. If the seam of the tail boom is debonded behind the guide bracket, it makes sense to apply the superglue from the rear lower maintenance opening. The related cover should be removed for the extension of the thrust bar anyway.

For the care, I recommend the following:

All aluminum parts are left natural. They are polished and not anodized. This has the advantage of being able to maintain the bearing fits exactly. You can also readily polish the parts in case of a crash when scratches are formed. With colored anodized coating, scratches are always very unpleasant, as they catch the eye immediately.

If you have parts that are sometimes no longer beautiful in appearance after a while, you can send them to me so that I can run them through the tumbling grinding machine. After that, they usually look as good as new if the scratches are not too deep.

The drawback with not anodizing parts is the higher susceptibility to corrosion. Specifically, the high-strength aluminum tends to stain when it is handled with wet hands. A simple protection and preservation of value is to polish parts frequently when they are touched from time to time. Metal polish is available in most hardware stores (in the auto parts section). They will then shine like new again and the polish will provide some corrosion protection.

If the machine overturns on the ground, causing the linkage to break off, it is essential to check whether the hexagon of the pitch servo has twisted on the servo shaft. One sees this well at a wrong swashplate position after switching on the radio. In this case, the hexagon should generally be replaced as the plastic teeth are damaged and cannot be guaranteed to withstand the stresses of the flight.

Please do not hesitate to contact me by e-mail if any questions arise.

Jan Henseleit