Three-Dee-Slow-Flyer

M A N U A L

Version February 2020

Jan Henseleit

C A U T I O N! **I M P O R T A N T!**

Please read this manual before opening any bags!

Index

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.

Three-Dee - Slow-Flyer

With the **TDSF** I tried to find out how much you can reduce the weight of a 700-class helicopter without sacrificing stability and flight characteristics. With a take-off weight of only about 2400g (including 570g battery), it is thus lighter than some helicopters of the 500 class. The term "**S**low-**F**lyer" is intended to show parallels to the extremely light wing models of this sector.

The complete mechanic with canopy weighs just under 1100g without the other components.

Despite the extremely light and compact design it is a full reliable and robust helicopter, which can be flown without restrictions and achieves amazing maneuverability and aeronautical precision.

The goal was to create a helicopter, which achieves with extremely small and light drive components, and just a 5s battery almost the same performance as machines with the same size, conventional motors and 5kg. A maximum speed of 1500 rpm at the rotor head due to the minimum rotor disc load is sufficient to fly all 3D maneuvers easily.

For example, we also offer special 710mm rotor blades with a blade weight of only 135g / blade, which results in a tremendous agility with nevertheless very stable flight behavior. Again, I wanted to go new ways.

Of course, even normal rotor blades can be used.

The helicopter did not use anything that was not absolutely necessary. Also no one way bearing is provided with this machine, because training auto rotations anyway are not necessarily advisable due to the low masses.
For an emergency auto rotation, however, it will work, because the small motor used has only a very little braking torque.

However, I have maintained my **L**inear **D**rive **S**ystem, which has now been optimized so far that it plays no role in terms of weight. I did not want to give up the advantages of control precision over a large pitch range with this machine.

Generally, the machine is designed for midi servos. The motor should be a Mini-Pyro with 5mm shaft or a similar drive. A low voltage ESC with 90A is sufficient. (Recommendation see technical data on the next page).

Logs have shown that the peak currents in 5s operation do not rise above 120A even with a pitch range of **+/- 14°.** But then you have to pull all the stops. The little motor achieves peak power of 2KW, which is more than that of a good running 15cc glow engine. The **TDSF** weighs less than half of a glow version of this size, even with an empty tank. The available power is more than sufficient

The recommended drive set works absolutely in a save range and only gets moderately warm during operation.

The structure is similar to my all-round **F**un helicopter **TDF**, where I've gone new ways to save even more weight. The chassis is a bit narrower and no longer screwed, but tine connected and glued. This results in an extremely torsion-resistant, lightweight and stable construction.

The tail tube is a thin-walled 28mm carbon tube without struts. The swash plate is smaller and the rotor shaft is a shaft made of high-strength aluminum, which tapers downwards from 12 to 10 mm from the upper rotor shaft bearing. The rotor head central piece with blade bearing shaft is only one compact part.

Due to the moderate rotor head speed in combination with the low blade weight, the centrifugal forces are just reaching 150kg and are thus far below the conventional values.

The main gear ratio is **11,33: 1** for small motors with approx. 1000kv in **5s** operation.

The tail rotor ratio is set at **1: 6,7** so high that the helicopter has a very good and crisp tail rotor effect in its optimum operating range between 1000rpm and 1500rpm, which is in no way inferior to conventional machines.

Again, I use my since 10 years proven canopy of the **TDR**, where I have come up with something special to underline the extremely low weight of the model.

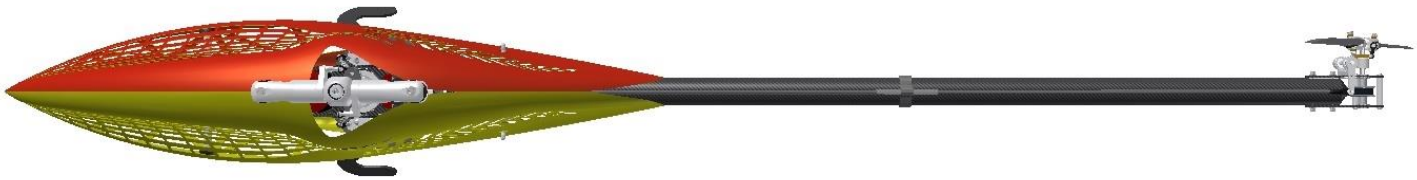
After lamination, I machine the canopy on a CNC machine in a rather complex operation. The window is stylized with small rectangular cutouts and in the back area I have indicated the contour of a bird feather. In the lower area, triangles are milled in order to achieve a filigree, helicopter-fitting design.

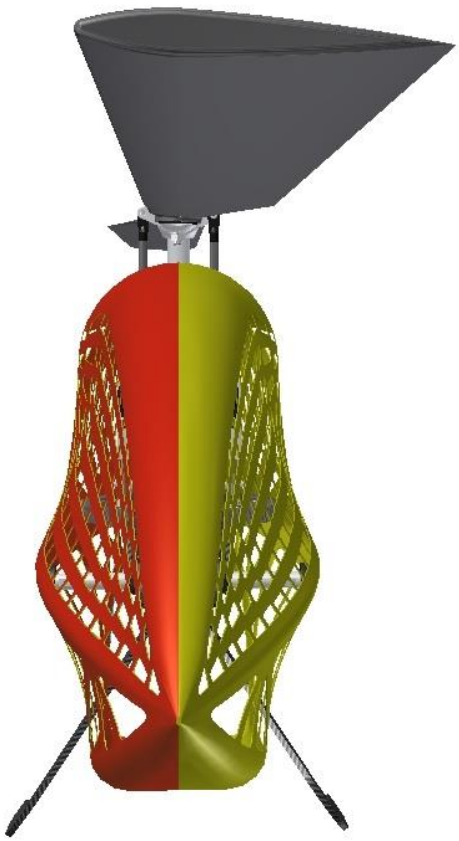
Sticking on design foils is unnecessary and the canopy is only 120g despite the size. Optimal cooling is always guaranteed.

Also lateral air resistance decreases and it is possible to consider the mechanic without removing the canopy. Only on flights in the rain, you should fall back on a conventional **TDF** or **TDR** canopy.

Technical data and recommendations:

TDSlowFly - mechanic (including canopy)	approx. 1100g
Length (canopy to tail)	1400mm
Height	340mm
Skid width	190mm
Rotor diameter with 710mm blades	1556mm
Recommended main blades	Spezial blades 710mm – 135g/blade (270g) (available from us)
Recommended tail blades	X-Blades 106mm (12g)
Recommended midi-servos	MKS-servo set for 500 class helicopter (complete 155g)
Recommended motor	KONTRONIK MINIPYRO with long 5mm shaft (200g)
Recommended ESC	KONTRONIK KOLIBRI 90 LV (100g)
Recommended flybarless-system	V-Stabi Neo (18g)
Recommended battery	5S-battery with about 4400mAh / 30C (570g)
Total weight of all components	about **2425g** ready for flight





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 step, 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.**

At the beginning of each assembly step you will find a part list with pictures, order number and name as well as the number of pieces you need. Normal screws and connecting parts have different (grey) part numbers. These numbers are also found under connection parts in our web shop. The numbers of these parts are shown in the pictures – as well the dimensions - e.g. M3x10. The picture shows, which type of screw has to be used. Caution! The length of screws is the length of the shaft until the screw head. Only with countersunk head screws the length is the total length including the head.

The parts are packaged in separate plastic bags. Each plastic bag is labeled with the number of the assembly step. Bulky or long parts are packaged separately. Complex assembly groups with a great number of small parts are separated into several smaller bags.

Please open only the needed bag when required, as it is easily possible to loose the overview. You can identify the needed bag by looking on the part list of the actual chapter. By means of the part number it's easy to identify the corresponding assembly group for later spare part orders. The first number after zero is figure the parts group.

All parts of the tail gear starts by 09 for instance. Sometimes parts have letters behind the 4 digit order number like a/b/c/d/R/L. This letters show that the parts correspond and belong to one group or only have little differences.

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 drawings and 3D animations in the manual show a right-hand rotation. Left-hand rotation on this helicopter is theoretically possible, but would need some modified parts. Right-rotation helicopters are mainly used worldwide. The differences to left rotation are minimized due to the excellent flybarless systems.

Some 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 **L**octite (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 to much **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.

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.

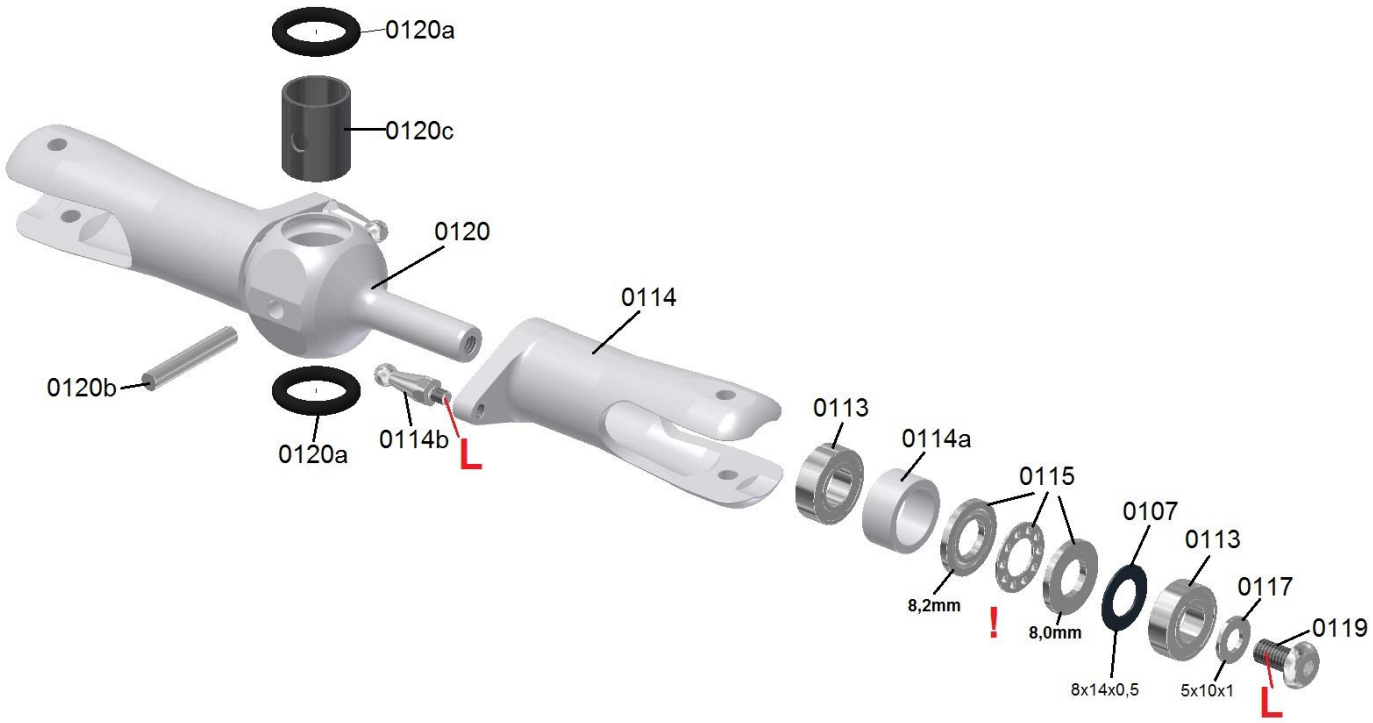
Now I wish you a lot of fun assembling the helicopter!

Chapter – 1 **R o t o r h e a d**

(Assembly step 1)

	0107	spacer washer 8x14x0,5 (SW081405)	2
	0113	radial bearing 8x16x5	4
	0114	blade holder	2
	0114a	distance bush	2
	0114b	threaded ball stud M3x4 / 12 long	2
	0115	axial bearing 8x16x5	2
	0117	spacer washer 5x10x1 (SW051010)	2
	0119	lens head screw M5x10 - 12.9	2
	0120	center hub	1
	0120a	O-ring 12x3	2
	0120b	bearing pin 4x26	1
	0120c	bush 12x13,9x17	1

The rotor head has already been pre-assembled by us ready for installation. To understand the structure and for subsequent repairs, you will still find a description on the next page.
Explanations on the function and assembly of the rotor head on the rotor shaft can be found in a later chapter.



First, the blade grips will be equipped with the respective bearings.

Attention! To avoid mistakes is very important to follow a certain procedure.
First, the two inner bearings 0113, which face towards the center piece, have to be pressed into the respective blade grip. It makes sense to warm the blade grip with a heat gun. (to do this, the individual bearings have to be inserted transversely into the side of the blade grip and to be swiveled in the area of the undercut before they are then pushed inwards).

Now insert the spacer bushing 0114a and then the thrust bearing 0115. To do this, grease the ball cage well before (smear grease in the hollow side of the sheet metal cage).

Pay attention to the correct order which can be seen on the drawing. Make sure the rings do not turn 180 degrees when sliding into the blade handle hole so it is prevented that the groove points towards the ball cage. For safety reasons, you can insert a slightly thinner pin into the bearing ring hole and push it into the blade grip to prevent rotation.

Attention! Slide first the ring with 8.2mm inner diameter ring, then the hollow side ball cage first and last the ring with 8mm inner diameter into the blade grip. Then insert the washer 0107 (8x14x0,5) and finally the second radial bearing 0113.

Attach the two ball ends 0114b to the blade grip arms (use **L**octite).
Attention! When tightening the ball ends do not use a fork wrench, but use a 5.5mm socket wrench to avoid damaging the external hex of the ball ends.
Slide the two blade grips onto the rotor hub 0120. The two 8mm thick stub axles should first be greased with ductile grease.
If the pre-assembled blade grip cannot be slided upon, although the bearings fit easily on the feathering spindle, it is often due to the moved washer 0107 in the blade grip, which then no longer sits centrally and prevents further movement. In this case, take a pin and center the washer again so that it aligns with the other ball bearing holes in the blade grip.

Secure the blade grips with washer 0117 and screws 0119 (use **L**octite). Therefore, turn from both sides with an Allen wrench the two screws 0119 until they touch the stop of the washers and then tighten them tightly.

Note! The blade grips can be pushed back and forth after assembly at least 0.5mm in the axial direction. This is intended to rule out a distortion of the bearings even with different tolerances. For operation, it does not matter because the blade grips will be pulled out when flying to the stop and then an equal distance from the hub center is guaranteed.

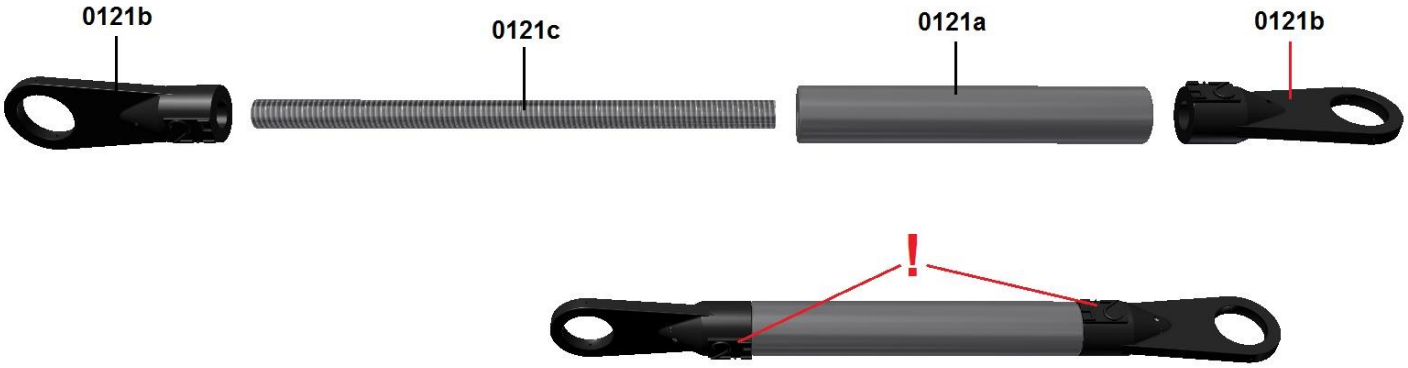
Attention! The lens head screw 0119 has a high strength and may only be replaced with an original spare part, as there is a risk of breakage when using a conventional screw.

Finally, the first one of the two O-rings 0120a will be inserted into the circumferential groove of the hub hole. Subsequently, the stop bushing 0120c is inserted so that its transverse hole is aligned with the transverse hole of the hub. Thereafter, the second O-ring will be placed. Both rings have to be greased with a bit of ductile fat.

The bearing pin 0120b, as well as the associated grub screw M4x8, is required later to mount the rotor head on the main rotor shaft.

Push rod for blade control

	0121a	spacer 35mm	2
	0121b	ball link 15mm	4
	0121c	stud bolt M2,5 x 50	2



Mount the rod as shown in the picture above. Position the ball link in line to prevent damage.

Attention! Screw both ball links 0121b as far as it touches the spacer bush 0121a. Then rotate backward until the lettering „2,5“ is in 90° position to each other as shown on the picture.

Do not try to screw the ball links further if they are touching to the bush, as the thread may be damaged and fixation is not longer guaranteed.

If the positioning is unfavorable, so that you would need to turn the ball link a full turn back to achieve the mounting as in the picture, you can also align the lettering so that it looks in the opposite direction. It only needs more force to press the ball link onto the threaded ball stud than, but has no negative effect on the function. It is only important that the ball links are positioned 90 ° to each other.

Blade bolts

	0138a	blade bolt M4x30 - 10.9	2
	0138b	spacer for rotor blade 4x20x1	4
	NS04	nyloc nut - M4	2
	WS04	washer M4 small	2

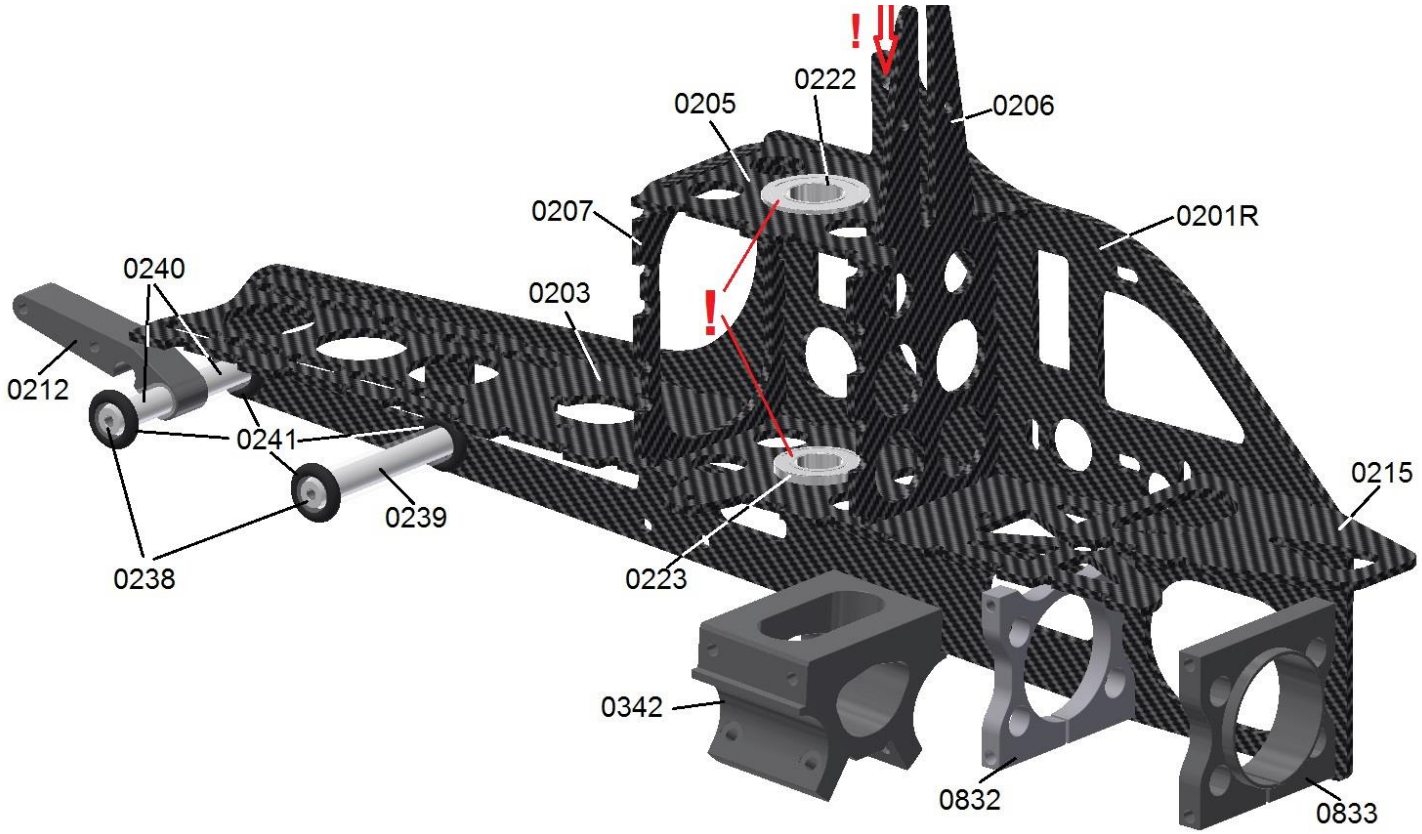
The blade bolts 0138a and spacers 0138b are needed later to attach the main rotor blades. Please always use the plastic spacers on blades with 12mm shank.
Aluminum spacers, which are often included with the blades immediately leave deep scuffing marks in the aluminum blade holders.
Under the screw head and the nyloc nut one of the M4-washers must be placed on each side.

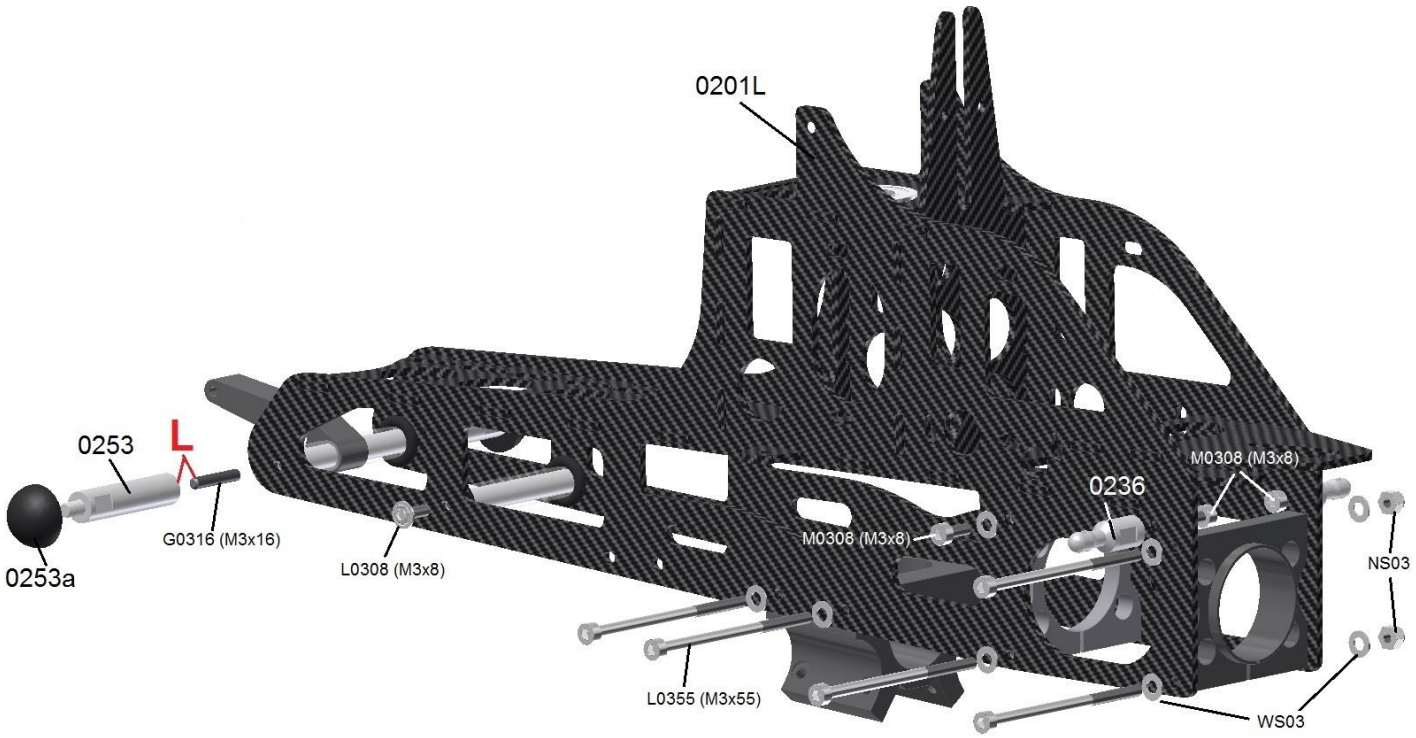
Chapter – 2 **C h a s s i s**

(Assembly step 2)

	0201R	chassis plate right	1
	0201L	chassis plate left	1
	0203	bottom plate	1
	0205	upper plate	1
	0206	vertical stiffening plate - aft	1
	0207	vertical stiffening plate - front	1
	0212	battery lock lever	1
	0215	RC-plate	1
	0222	upper flange bearing 12x21x5	1
	0223	lower flange bearing 10x19x5	1
	0236	canopy mount	2
	0236a	securing pin	2
	0238	spacer 6x44	2
	0239	silicon tube 44mm long	1
	0240	silicon tube 17mm long	2
	0241	O-ring 7x3	4
	0253	canopy mounting bolt - front	2
	0253a	rubber end cap	2
	0305	rubber grommet for canopy	2
	0342	skid support	1
	0832	tail boom support - front	1
	0833	tail boom support - aft	1
	G0316	grub screw M3x16	2
	L0308	lens head screw M3x8	2
	M0308	hex socket screw M3x8	4
	M0355	hex socket screw M3x55	5
	NS03	nyloc nut M3	5
	WS03	washer M3 small	12

Attention! Be sure to read the text next page to install the chassis.





The chassis of the **TDSF** is plugged together and only glued to the individual latches within the chassis with a few drops of superglue. In order to avoid mistakes when plugging together and to check whether everything fits, we have already assembled the individual plates and provisionally fixed them at a few points.
Attention! In any case, all latches of all plates, which are stuck in the corresponding slots of their counterparts, must be glued within the chassis with a few drops of superglue.
For this purpose, the kit includes a can of low-viscosity superglue and an extension needle. Please attach the needle strongly to the plastic tip of the can so that it does not slip off when gluing. To open the bottle, simply turn the lid so that the small lock pin opens at the top. Hold the can between the middle and index fingers and press below against the ground with your thumb. Glue the chassis in one go without a long break, otherwise the metal needle gets clogged. The normal nozzle of the box can be closed by turning the lid.

Please proceed exactly as follows!
All panels are glued together with superglue, only in those areas where the latches are stuck in a slot. Due to the capillary effect, the adhesive penetrates into the slots, without later showing unsightly marks on the outside. The adhesive is not supplied from the outside of the slots, but only from the latch side, where the plates touch each other. The gluing is always done on both sides of the plate latches. First, test the necessary amount in one place to get a feel for it. When gluing, pull the needle along the length of the respective latch in the corner joint.
If there is too much glue, there is a risk that it will pass outwards and continue along the surface.

Attention! In any case, all panels must always be put together before gluing is started to ensure the correct alignment of the chassis. If you first glue only one side, a correct alignment is not guaranteed.
In some cases skill is required in order to approach the needle on both sides with all the points to be glued.

Also the plate connections of the vertical stiffening plates 0206 u. 0207 with the base plate 0203 or the dome plate 0205 must be made at this point to the entire slot width of 30 mm there. The plates must be plugged together so far that the latches look out minimally on the opposite side and no gap between the actual end faces and the counter plate is formed.

Important note: In case of buying later chassis plates to completely mount a chassis itself, the following things must be observed. The side plates are not the same, but at the top of the protruding latch (see red arrow, upper picture - page 11) they have a countersink, which must necessarily point inwards. So there is a left (0201L) and a right (0201R) side plate.

Furthermore, the base plate 0203 and the dome plate 0205 must be inserted so that the collar of the flange 0223 of the bottom plate pointing down, where later the gear sits and the collar of the flanged plate 0222 of the dome plate pointing up to the rotor head. If installed incorrectly they would otherwise slip out of their fits in the carbon plates during flight operation!

The bearings have been glued into the fits with **L**octite. If the bearings have to be replaced, it is necessary to place strips or support rings under the underside of the bottom plate or top of the dome plate before knocking out, so that the force is not transmitted to the adhesive. For removing the upper bearing you can place the mechanics, e.g. on the swashplate gauge and then use a long pin to knock out the bearing in a circular shape from the bottom.
After gluing the plates, the glue should be allowed to dry for one hour before mounting all the remaining connectors, such as skid holders, tail boom flanges, silicone rubber crossbeams.

Please take a close look at the pictures to assemble everything correctly. For the two tail boom flanges, the clamping slots must point downwards. The plastic flange sits at the rear.

The M3x16 stud bolts are screwed with **L**octite all the way into the front canopy holder 0253. The opposite side, which is screwed into the cross bolt 0238, will not be wetted with **L**octite.

Make sure that the battery lock lever 0212 is mounted correctly with the recess facing downwards.

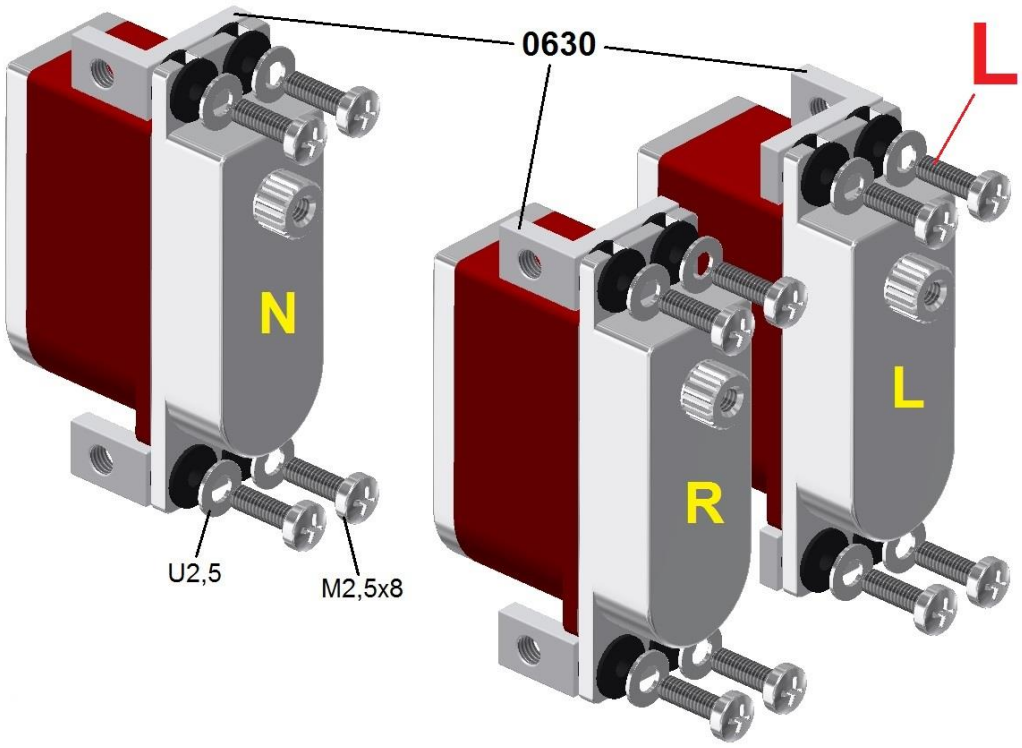
The 0236 rear canopy holders are each fastened to the chassis plates with an Allen screw M3x8.
It is best to turn the rear holders into a position that shows the hole for the securing pin in the longitudinal direction of the mechanics.

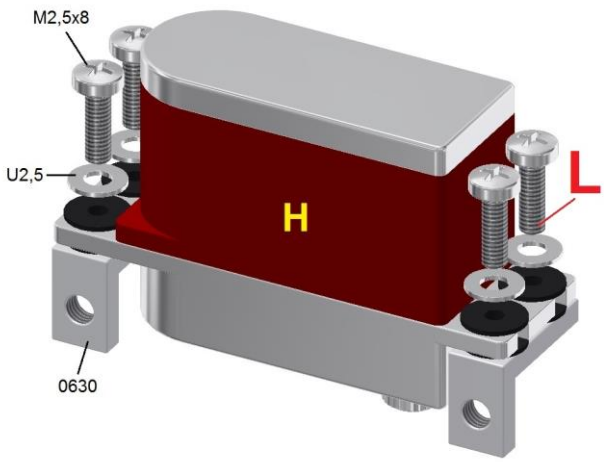
Chapter – 3 **Servos and linear drive**

(Assembly step 3)

Servo preparation

	0630	servo mounting bracket	8
	0640	servo gear 24 teeht	3
	P2508	phillips screw M2,5x8	16
	WL25	washer M2,5	16
	L0306	lens head screw M3x6	8





For the TDSF generally only midi size servos with a maximum case width of 15mm are foreseen. Normal standard servos do not fit into the narrow mechanics.

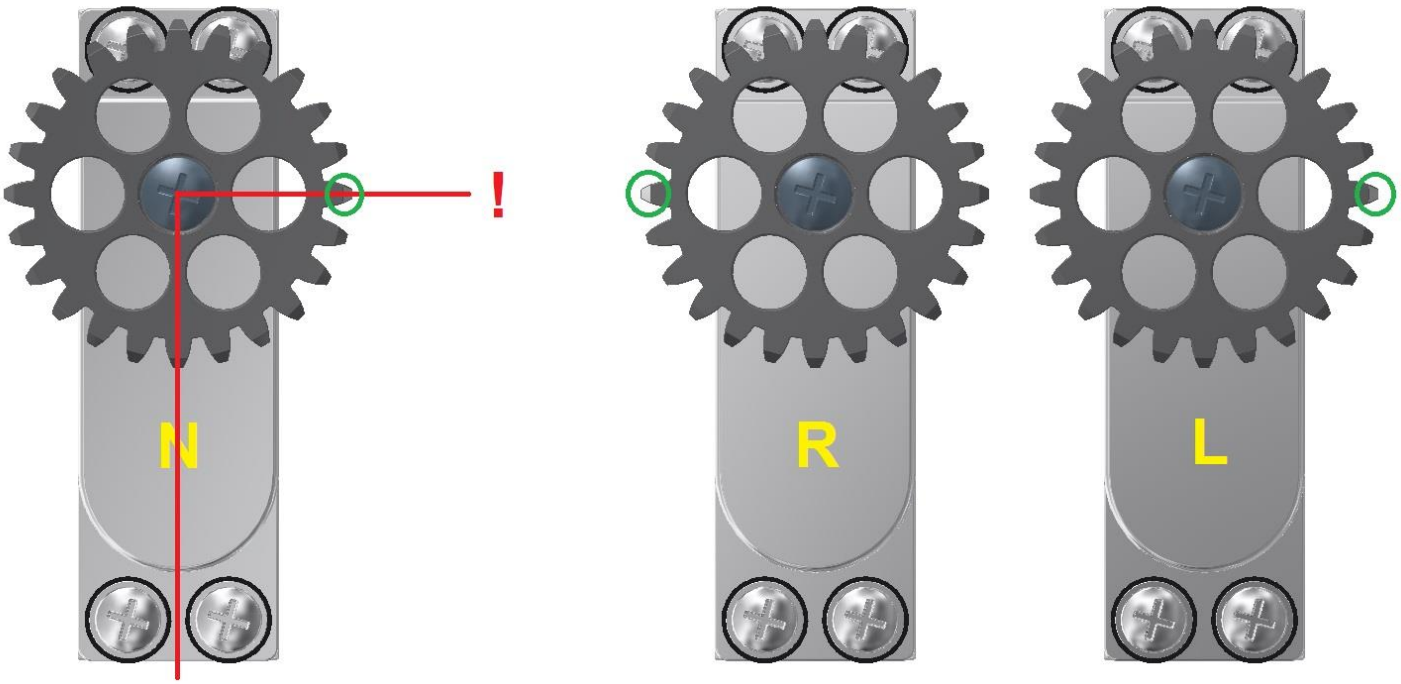
I strongly recommend using the recommended MKS-Servoset. These servos are light, very powerful and fast and they fit perfectly to this helicopter. They have been extensively tested in hundreds of flights and have proven themselves.

When mounting the 0630 servo brackets, be sure to use the proper orientation for the corresponding servo and mount the M3 threaded hole on the front of the bracket to the correct side, as shown in the drawings.

The swashplate servos are positioned on the drawings (page 13) in the same way as they are later placed in the mechanics when looking at the mechanics from the right front (N = pitch servo / L = roll servo left / R = roll servo right).

The tail servo (H) is later mounted upside down in the mechanics. The servo brackets are fixed here on top of the mounting flanges of the servo.
The M2,5x8 Phillips screws are inserted directly through the rubber grommets with a washer. By evenly tightening the M2.5x16 mounting screws, the rubbers can be squeezed together until the servos sit tightly on their blocks.

Assembly of the servo gears



Now mount a servo gear 0640 on each swash plate servo.

To reach an optimum adjustment from mechanical point of view, you should follow the described procedure exactly. So much the better you work here the less corrections you have to do by electronics. In the ideal case you can keep all values in you FBL system without adjustment of the trims and can use your system perfectly.
This can be realized especially with the **L**inear-**D**rive-**S**ystem (**LDS**)

Only servos with a Futaba compatible 25 tooth involute gearing can be used, which is standard at nearly all servos nowadays.

On one side the toothing is manufactured in a way to ensure a very tight fit on the shaft of the servo. You need a high force to press it on. Therefore I recommend to press and to remove the servo gear on an old servo. Then the final mounting on the servos will be a little bit easier.

Attention! The servo gears 0640 should be mounted with one tooth exactly oriented perpendicular to the side wall of the servo.

As with 24 the number of teeth is even the teeth on the opposite side is also oriented perpendicular to the side wall of the servo. Also in the servo longitudinal axis a tooth is exactly aligned. The position of the hole-circle doesn't matter.

As the shaft of the servo have 25 teeth and the servo gear have 24 teeth a very fine adjustment is possible to get the optimum position. This is much easier as in case of a normal servo lever, where often an exact alignment is not possible.

Proceed as following:

Connect the respective swash plate servo directly to the receiver without a FBL-system. Take the channel for aileron or elevator (not ESC or collective)

All trims on the transmitter of the used channel have to stand on center position. Switch on the receiver. The servo will move to neutral position. Keep the system switched on, so the servo shaft cannot be tilted during mounting of the servo gear.

You can also use a servo tester to bring the servo to neutral position.

Place the servo gear onto the servo shaft tentatively and check the position exactly from above. Press the servo gear just slightly on the servo shaft so it just fixed a little bit to check the alignment.

By repositioning the servo gear by one tooth you can find the optimal position in which one tooth is exactly perpendicular to the housing. You can choose the right direction for the repositioning by checking the tendency if it getting better or worse.

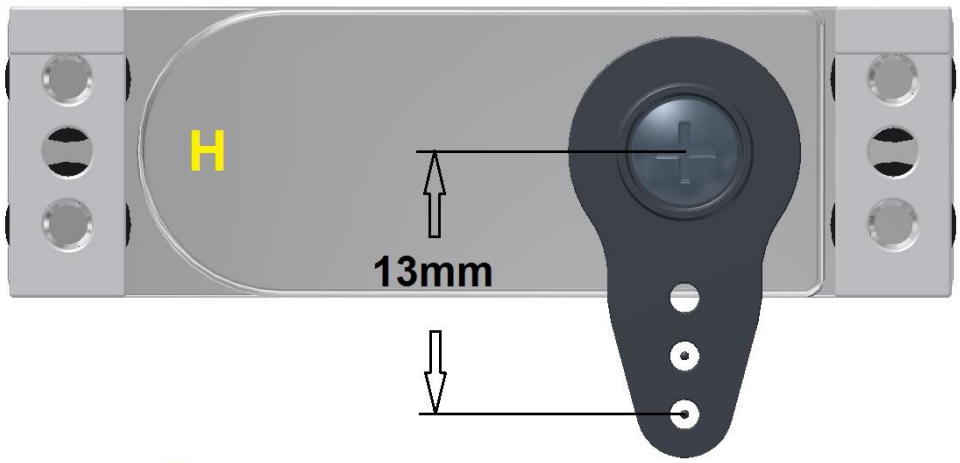
To support the adjusting you can also compare the distances of the two teeth which are closed to the servo side wall. This is easier to check with your eyes.

Prerequisite is a straight fitting servo gear and that you look exactly from above. After finding the optimum position, the servo gear will be pressed completely onto the servo shaft and fixed with the servo lever screw. (use **L**octite).

Mark the respective tooth which lying mostly to the outside (**green circle**) with a water resistant marker to see the position during installing the servo. You have to align this tooth with the middle tooth of the gear rack later.

Proceed like this with all of the three swash plate servos.

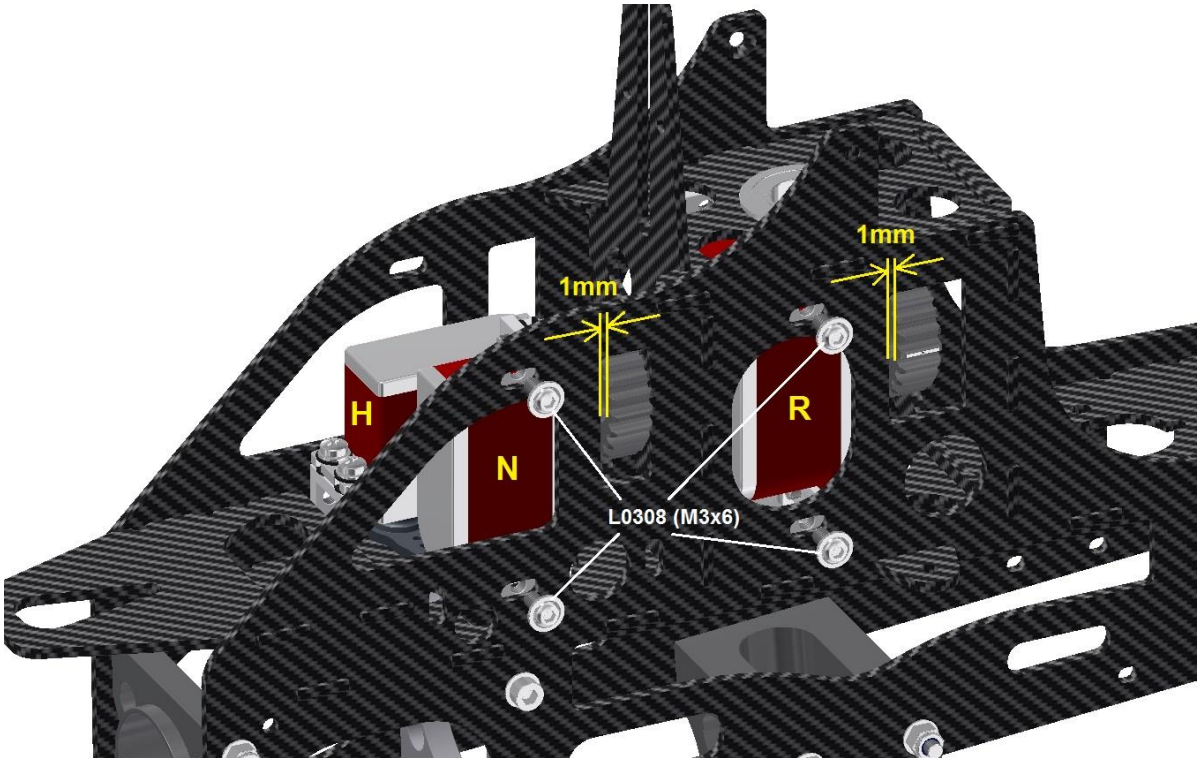
Tail servo lever

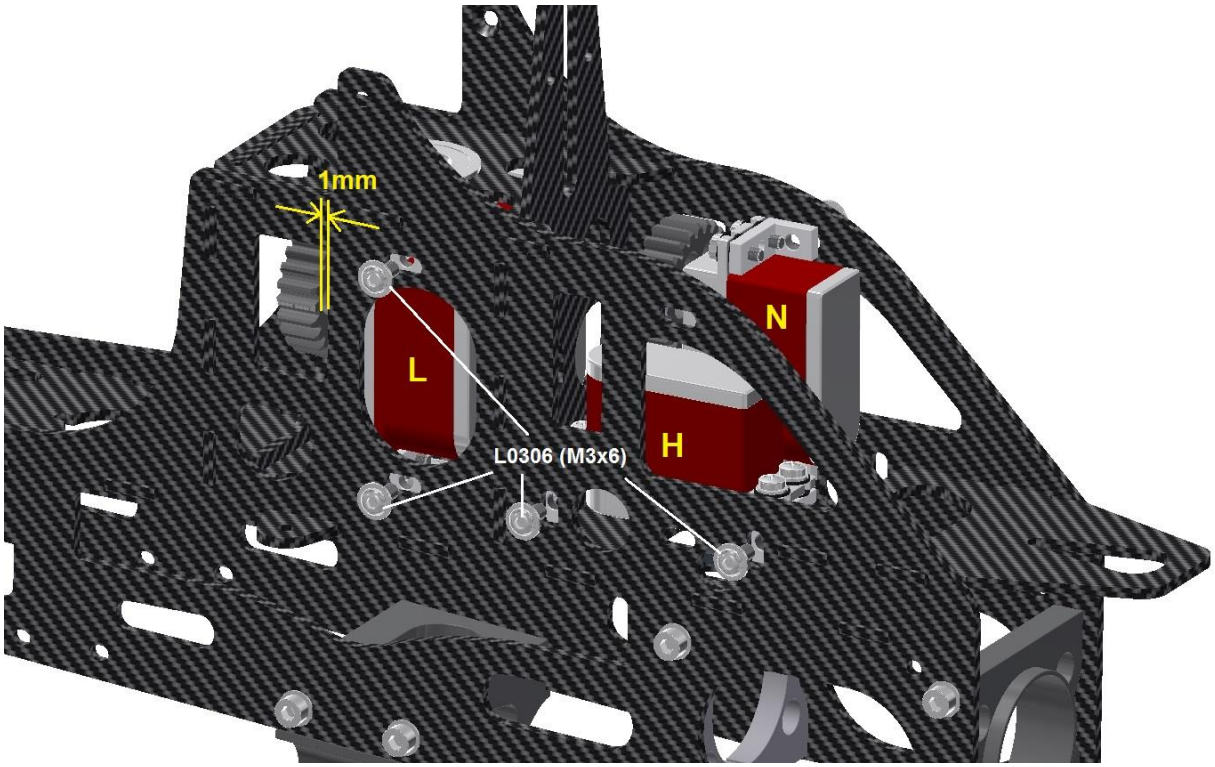


At the tail servo a standard servo lever (see drawing) is mounted, which has a bore on a radius of approx. 13mm.

For servos that have a high pulse rate that is not provided by the normal receiver output, the servo should be connected to the flybarless system to reset to zero in setup mode and then align the lever at right angles to the housing.

Servo mount inside the chassis:

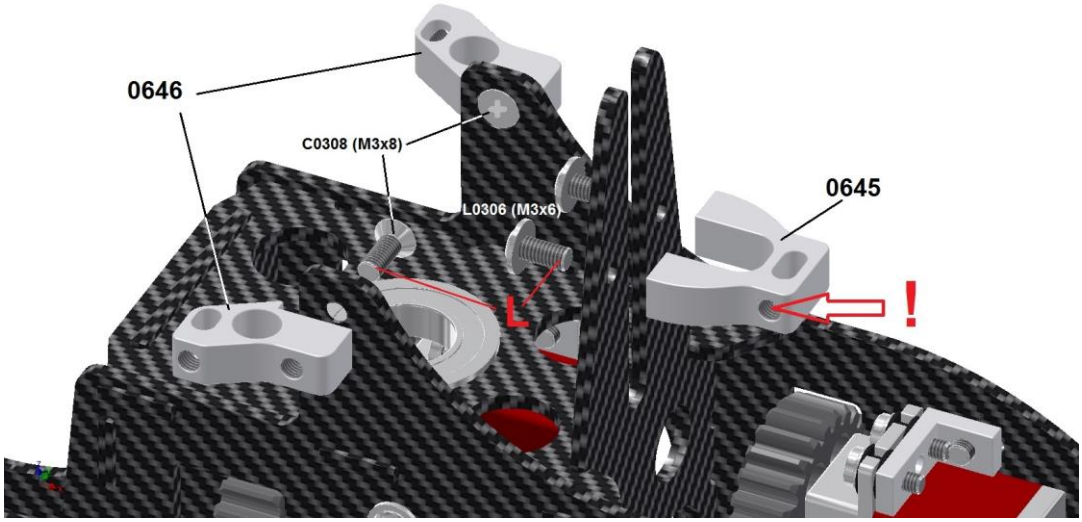




The servos are mounted in the chassis using M3x6 pan head screws as per drawing (use **L**octite).
Attention! The two aileron servos are inserted from the front through the cutout of the front vertical stiffener frame into the mechanics. This is only possible without mounted rotor shaft. This means when removing the servos, in each case the rotor shaft must first be pulled upwards, since the range of motion is otherwise too narrow. Also the engine must be removed.
The elevator and tail servo are easy to insert into the mechanics from behind. The tail servo must be inserted so that the output shaft is positioned closer towards the rear. The screws will initially not be tightened because the exact height positioning follows in a later stage.
The three swashplate servos are positioned in their slots so that the gear bottom side is 1mm from the rear edge of each cutout in the chassis.
You can use a gauge with 1mm thickness to set the distance.
Attention! Ensure that the swashplate servos are positioned vertically and do not sit diagonally so that the teeth engage optimally in the gear rack later on.

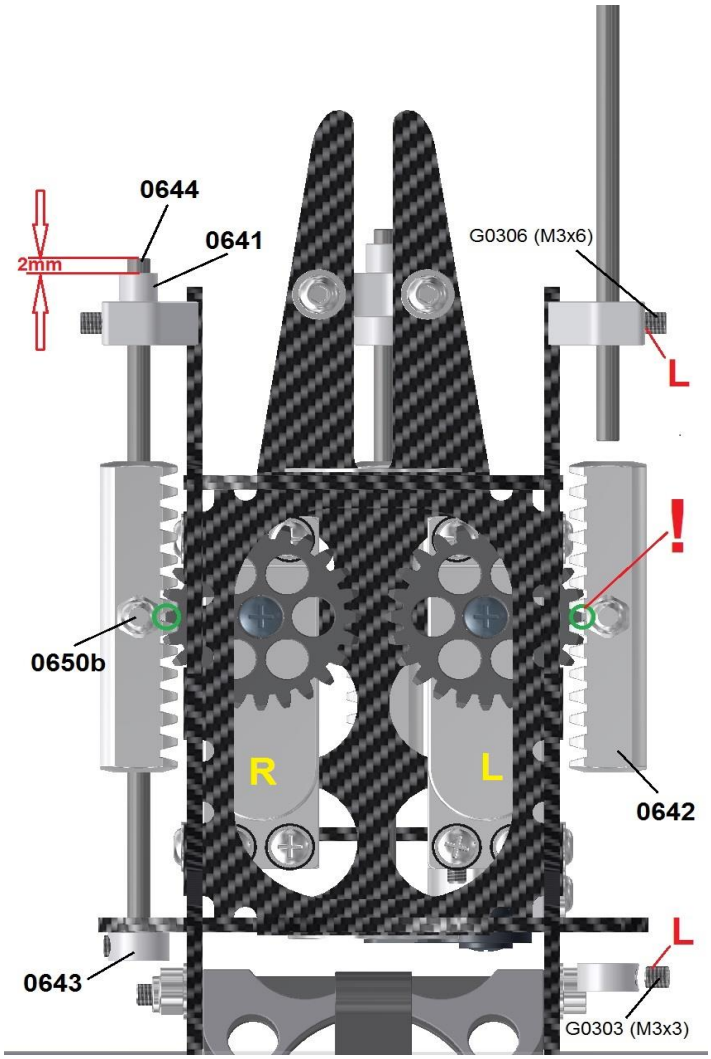
Assembly of the tooth racks

	0645	support for pitch toothed rack guide rod	1
	0646	support for aileron toothed rack guide rods	2
	C0308	countersunk screw M3x8	2
	L0306	lens head screw M3x6	2



The two rack guide axle holders 0646 for the aileron servos are already mounted by us, because it is a little difficult to tighten the screw after gluing the chassis. May be they have to be aligned a little bit later.
Attention! The rack guide shaft holder 0645 for the pitch servo must be mounted so that the side tap hole (red arrow) looks to the left as shown in the picture.

	0641	glue shell	3
	0642	toothed rack	3
	0643	collar	3
	0644	toothed rack guiding rod 3x97	3
	0650b	threaded ball link M3x4 / 4 long	3
	G0303	grub screw M3x3	3
	G0306	grub screw M3x6	3



The picture top left shows the chassis from the front view.
Attention! Screw in the threaded ball link 0650b carefully into the tooth racks 0642 for not over torqueing the threads in the plastic material.
Therefore the tooth racks will be delivered with installed ball link. Additionally they are secured with special superglue for plastic material.
Please do not loosen or tighten them again.

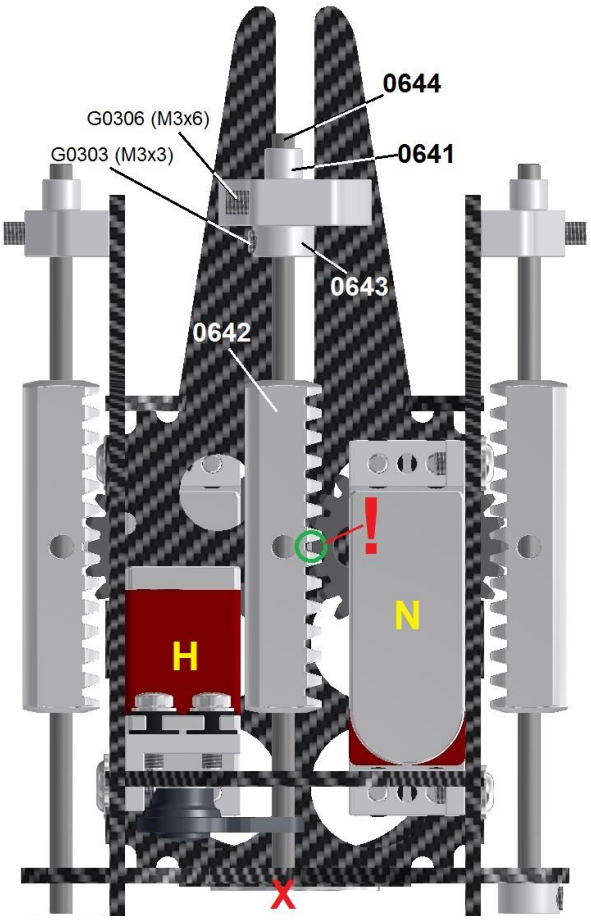
Glue shells 0641 are also already glued to the end face of guide shaft 0644 at a distance of 2 mm.

Now position the gear racks 0642 with their middle tooth gap (green circle) so that it engages in the tooth of the respective swashplate servo marked with the filament pen and then push the axis 0644 through the slot of the upper holder 0646 from above through the gear rod and thread it into the hole in the chassis bottom plate.
Then, from below, the adjusting ring 0643 is pushed on and the axle will be secured with the M3x3 set screw G0303 (use **L**octite).

Finally, the M3x6 grub screw G0306 is screwed into the 0646 holder with a bit of **L**octite and tightened until the guide shaft made of spring steel slightly presses the gear rod against the servo gear.

The rack should have no play when trying to rotate it about the longitudinal axis of the spring steel axis.

A slight lateral pressure on the gear has no negative effects.



The picture on the bottom left shows the mechanics seen from behind.

Proceed in the same way as with the aileron servos, except that here the adjusting ring 0643 for securing the axle 0644 does not sit below the base plate (there would be a very bad access). He therefore sits directly under the rack guide axle holder 0645.

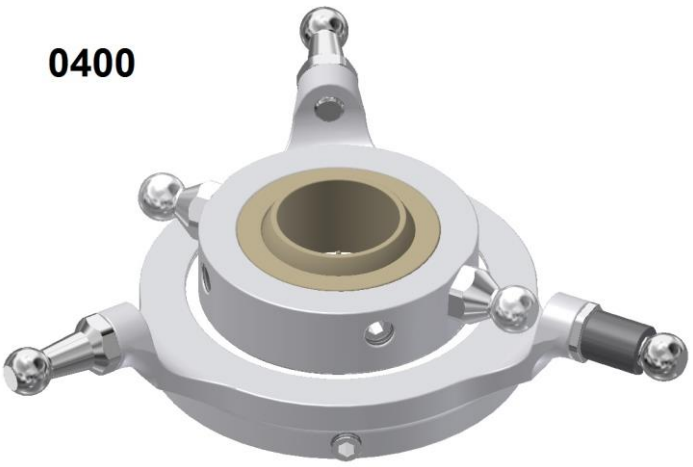
Make sure that you mount the gear rack with the ball pin pointing forward in the direction of flight!

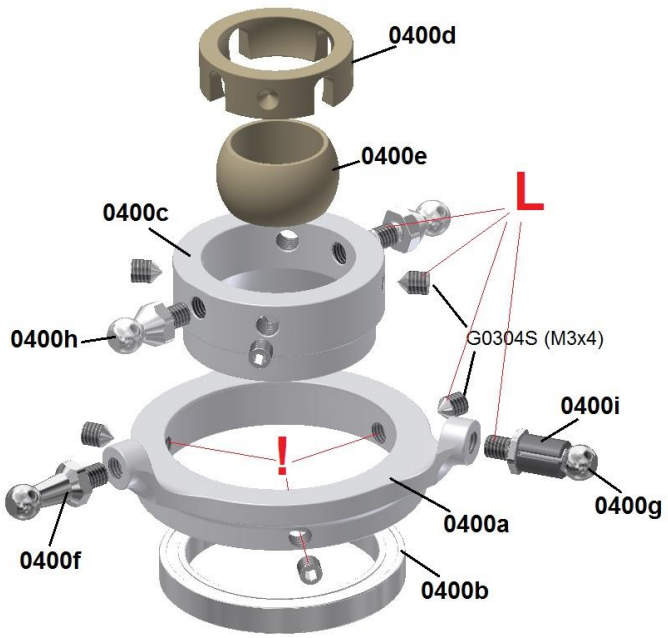
There is no hole at the bottom of the plate but an elongated hole (red **X**), because axis is not exactly centered in the mechanics.
When tightening the upper grub screw G0306 the axle will be presses in the opposite direction all the way to the left as far as the end of the elongated hole.
After mounting, grease both the guide and the teeth of the gear rack with Dry Fluid Gear included with the kit.

Chapter – 4 **Main shaft unit** (Assembly step 4)

Swash plate

	0400a	swash plate outer ring	1
	0400b	bearing 25x32x4	1
	0400c	swash plate inner ring	1
	0400d	ball shell	1
	0400e	ball	1
	0400f	threaded ball stud M3x4 / 9mm	2
	0400g	threaded ball stud M3x4 - 9mm (special shape)	1
	0400h	threaded ball stud M3x4 / 6mm	2
	G0304S	grub screw with tip M3x4	7





The swash plate will generally be delivered finally assembled. In case of a damage the swashplate can be disassembled partly.
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.

Due to the compact design of the swash plate, the bearing 0400b is permanently attached to the inner ring 0400c. This means, when replacing the bearing, the inner ring must also be replaced. In order to get the unit out of the swashplate outer ring 0400a, unscrew the grub screws G0304 (M3x4 with tip) and remove the threaded ball studs 0400h.

Secure the bearing in the outer ring with the three pointed grub screws M3x4, which press each under the edge of the bearing. Push the bearing upwards against the shoulder.

With these three grub screws, you can also eliminate a possibly resulting bearing play by evenly sensitive tightening. As a result, the outer bearing ring is pushed inwards by a few hundredths every 120 °, so that the balls are somewhat under tension.

Attention! The set screws may be tightened as far as possible so that the bearing can still rotate smoothly, without moving anywhere sluggishly.

The ball shell 0400d is held in the inner ring by four grub screws as well. These sit in the corresponding 90 ° subsidence and thus fixing the shell. The slots are there to allow the ball shell to spread open when inserting the ball 0400e.

Also an existing radial play between the ball and the cage can be eliminated by sensitively tightening the grub screws.

Attention! Here you have to be extremely careful, because the plastic shell can deform so easily that the ball can stuck in the shell or even stuck to the rotor shaft.

A slight axial play of the ball has no influence on the control precision. The ball must not jam under any circumstances.

Grease the outside of the ball 0400e and the inside of the shell 0400d with the enclosed Dry Fluid Gear (shake well before use) before pushing the ball into the shell from below.

The threaded ball studs 0400f and 0400g on the outer ring and 0400h on the inner ring must also be secured with **L**octite.

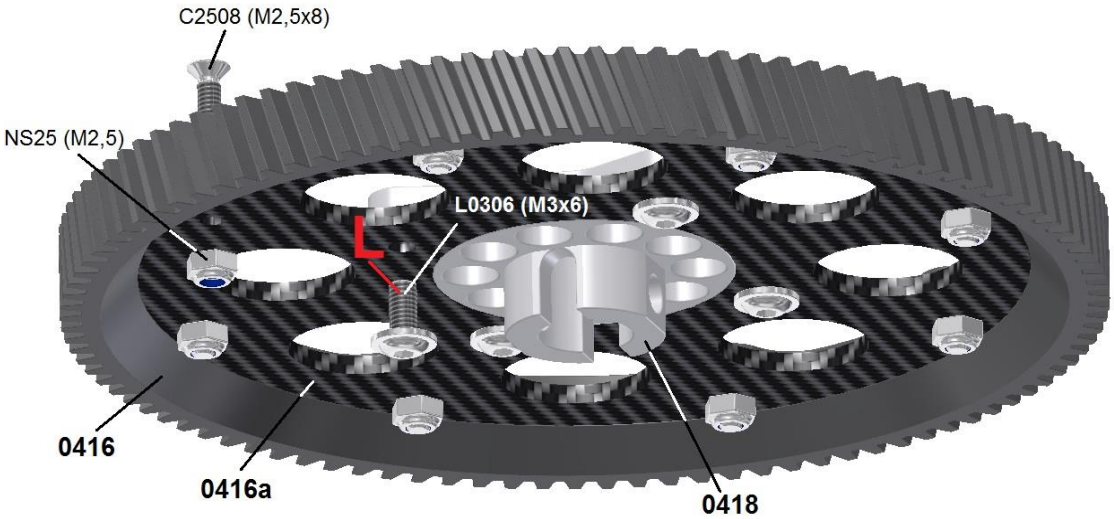
Attention! When tightening, do not use a fork wrench but use a 5.5mm socket wrench to avoid damaging the external hex of the ball ends.

Attention! The ball stud 0400g has a slimmer shape and is intended to be used later for the connection of the rear pitch servo. The sliding sleeve 0400i made of plastic has a slot so that it can be pressed onto the cylindrical shaft of the ball stud.

It will guide the swashplate in the 5mm wide slot of the rear vertical stiffener and serves as a swash plate lock.

Main gear

	0416	main gear	1
	0416a	carbon spoke	1
	0418	main gear flange	1
	0419	hex socket screw M4x20 / 10.9	1
	C2508	counter sunk screw M2,5x8	8
	NS25	nyloc nut M2,5	8
	L0306	lens head screw M3x6	4
	NS04	nyloc nut M4	1



The main gearwheel has already been pre-assembled by us to check if it runs smoothly.

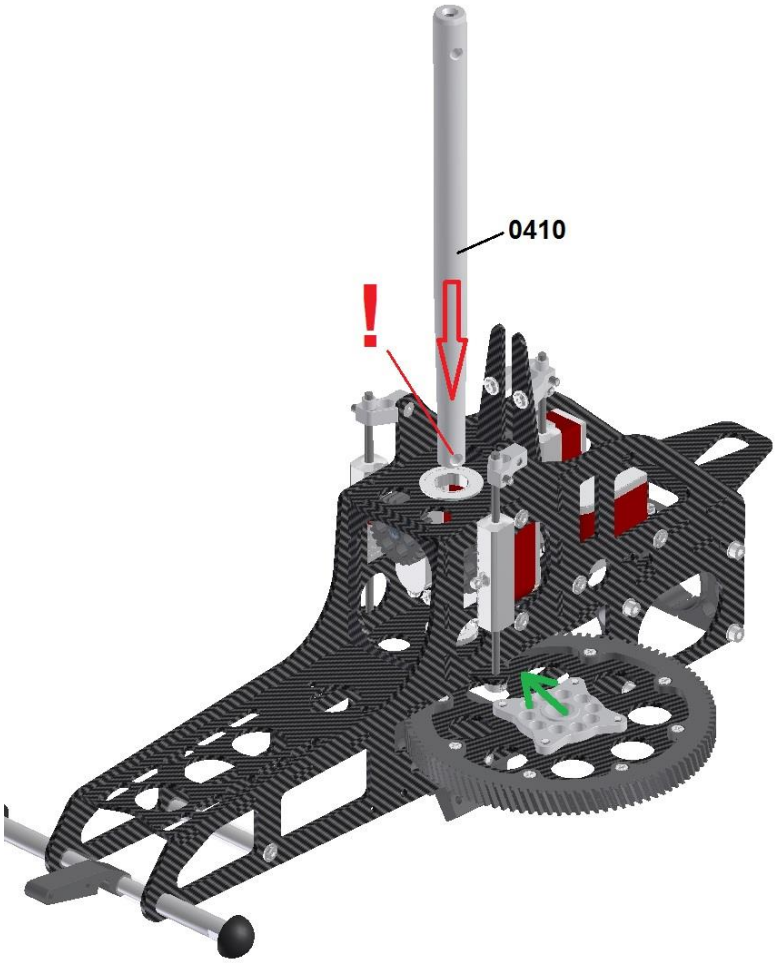
Nevertheless, here you will find a description if a replacement of parts will be necessary.

To prevent the increase of the diameter of the main gear by heating even in case of hardest flying style, a special design measure was taken. The main gear ring 0416 is manufactured with a 0,5mm smaller diameter as it should be. The inner carbon spoke 0416a will not fit inside the gear in cold condition.
For mounting the main gear ring has to be heated in an oven up to 60-70°C (140°-158°F). The gear ring will expand so the carbon spoke can be inserted and positioned easily.

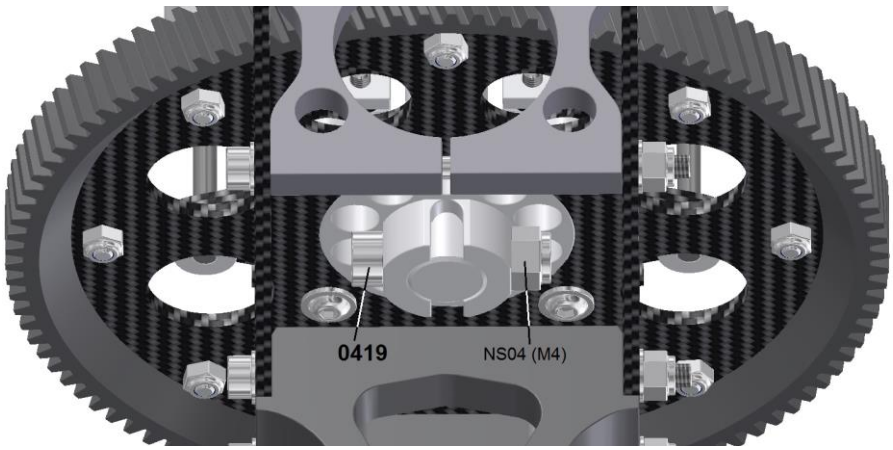
Put in two of the M2,5x8 counter sunk screws C2508 at opposite sides through the holes of the carbon spoke and the gear ring, so that the holes will stay aligned also after cooling down.
Press the carbon spoke down to the ground of the 2mm step of the gear ring. During cooling down the gear ring is shrinking on the carbon spoke and will be fixed with screws after that. All screws will be put from above to the holes and fixed with the M2,5 nyloc nuts NS25 from below.

Now the nominal diameter of the gear is reached. Even under highest loading during flight the diameter will not increase. It just could increase when the temperature of the gear will exceed 60°C (140°F) in operation.
Slide the complete gear on the gear flange 0418. In case of a too tight diameter you can grind the hole in the carbon spoke carefully until fitting without play.
Tighten the four M3x6 lens head screws well (use **L**octite).

Mounting the main gear into the chassis



The gearwheel is pushed into the mechanics from the side until the hole of the flange aligns with the lower main rotor shaft bearing (green arrow).
Then the rotor shaft 0410 will be pushed from above through the two bearings (red arrow).
Attention! The rotor shaft tapers from 12mm to 10mm in the lower third and must be guided through the bearings in the correct direction. The upper side can be recognized by the M4 threaded hole on the front side.
Note: The rotor shaft is made of high-strength aluminum and not anodized. Therefore, make sure that it does not get stuck when it is pushed into the bearings. For aluminum, there is a greater risk of fretting than with a steel shaft. Therefore, grease the shaft a little bit with viscous grease. Do not force the shaft into the bearings if it gets stuck somewhere, but please contact us.

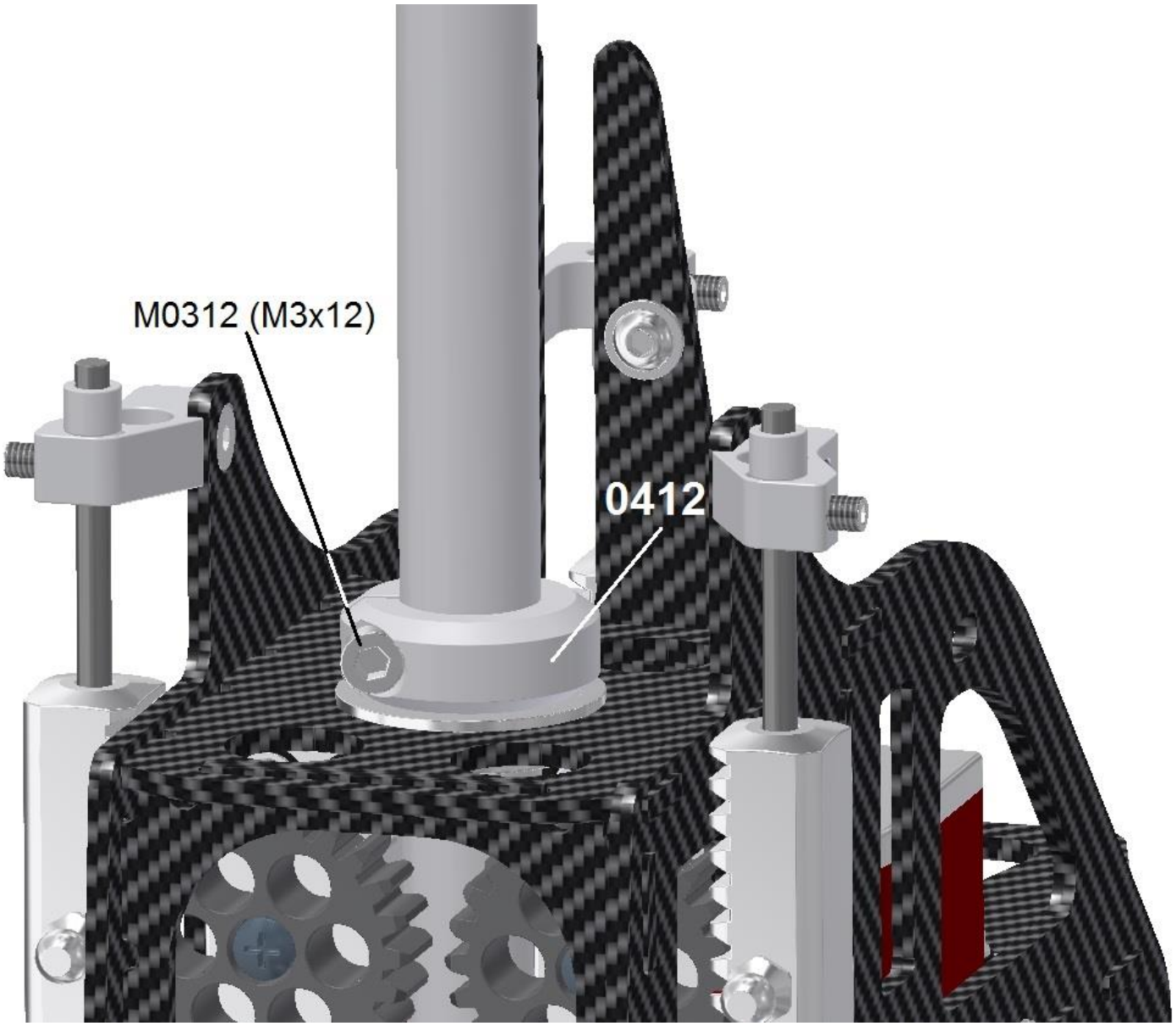


The flange is screwed to the rotor shaft with the M4x20 hex socket screw 0419 and an M4 stop nut.
Tighten the screw very well so that forces are transmitted to the shaft by clamping the flange and no shear forces are applied to the screw.

Attention!
When you pull the main rotor shaft up to the stop and turn it, it may happen that the M3x6 lens head screws, which look out about 0.5mm from the flange 0418 at the top, can slightly scratch the edges of the chassis plate cutout.
If this is only slightly the case, you can leave it that way as the touch points will loop away on their first flight.
Otherwise file off the area of the edge of the chassis minimally.

Axiale fixation of the rotor shaft

	0412	clamping ring	1
	M0312	hex socket screw M3x12	1



Mount the clamping ring 0412 on the rotor shaft.

Attention! Pull up the rotor shaft, so that the gear wheel flange presses against the bottom rotor bearing in the bottom plate.

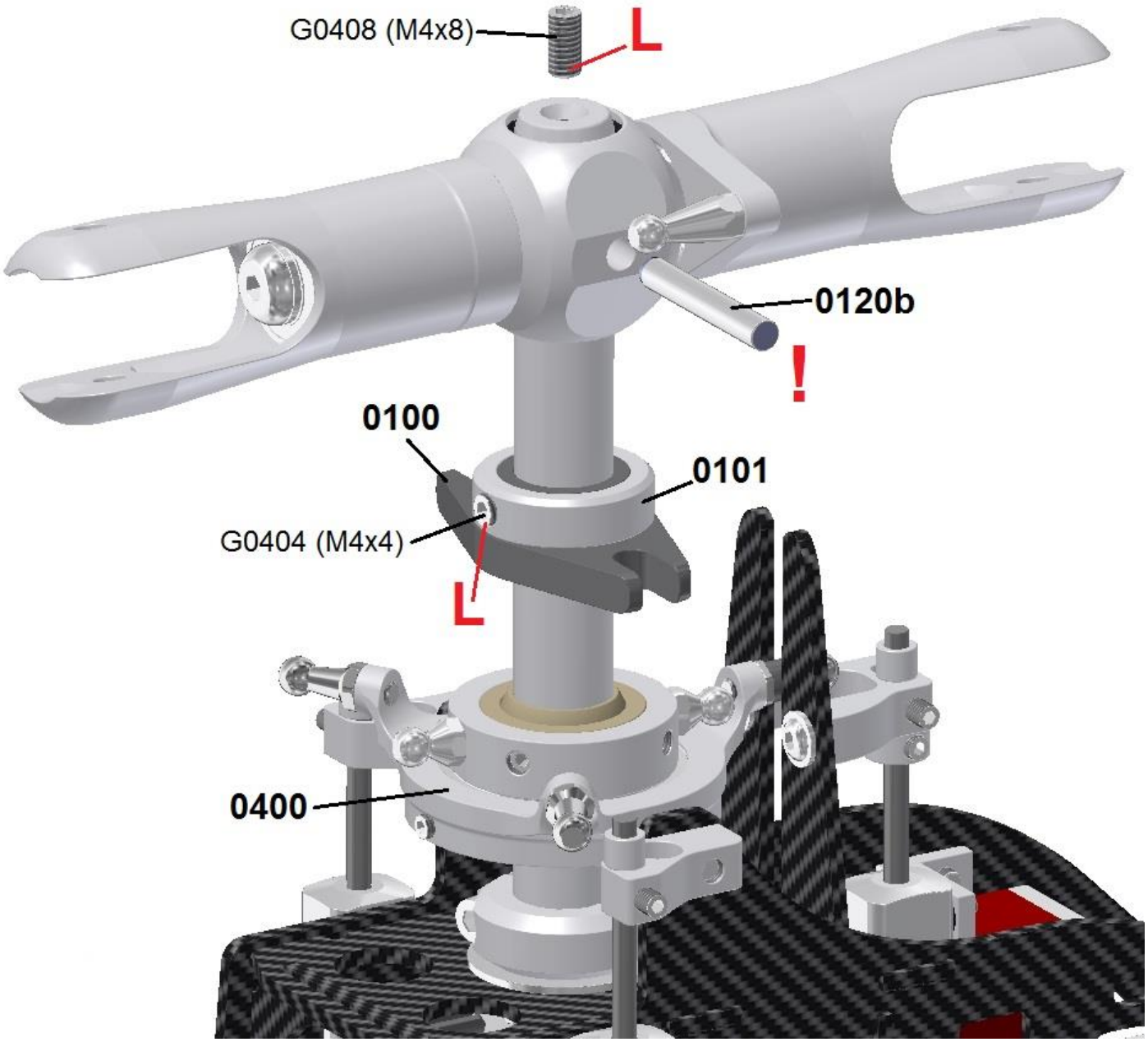
Slide the clamping ring all the way down to the upper rotor shaft bearing and tighten the M3x12 hex socket screw M0312 firmly (in the clamping ring area the rotor shaft should be free of grease).

No Loctite needs to be used here as the ring jam the screw when tightened so that it does not come loose.

The rotor shaft should now no longer have axial play, but still let it rotate smoothly.

Swash plate, linkage rod guide and rotor head

	0100	linkage rod guide	1
	0101	fixing ring	1
	G0404	grub screw M4x4	2
	G0408	grub screw M4x8	1



Slide the swashplate 0400 onto the rotor shaft so that the special ball stud with the sliding sleeve fits into the slot of the rear vertical stiffener plate.

The linkage rod guide 0100 with its fixing ring 0101 is initially pushed only on the rotor shaft. In this area, the rotor shaft should be free of grease (don´t tighten yet).

Now mount the rotor head (please read the entire text first).

Lubricate the rotor shaft in the upper area a little with ductile grease, without applying it into the cross hole.

Attention! Before sliding, make sure that the plastic bush between the O-rings of the rotor hub is aligned so that the transverse hole is aligned with the hub holes and then push the hub perpendicular to the rotor shaft, without twisting it.

When attaching, make sure that the hub hole is at the same angle as the rotor shaft hole.

When turning the rotor head, the bushing in the hub will not rotate on the rotor shaft, so that you will get an incorrect alignment.
The longitudinal axes of the transverse bores would no longer match and so the pin 0120b could no longer be mounted. Minimal differences are not problematic because they can still be corrected when you press in the pin.

To avoid twisting the bushing when sliding on the head, you can also provisionally push the pin into the hub so far that it just prevents the bush from twisting, but does not stand in the 12mm hole for the rotor shaft.

Note: The pin has two different faces. One side is only slightly rounded, while the other side has a slightly stronger chamfer for better insertion of the pin.

For provisionally locking the thin-walled socket, take the side without chamfer.

If the rotor head has the correct position for the rotor shaft after being slid in both the height and in the pin bore longitudinal axis, the pin is pulled out again and then inserted into the hole with its side on which the chamfer is.

Apply some pressure but no force and push the pin only so far into the hub that he still looks out about 4 to 5mm from the hub.

Then wetting the out-looking end of the pin with Dry Fluid Gear and add a few drops into the hub hole on the opposite side.

Finally, the M4x8 Made G0408 is screwed from above into the threaded hole of the rotor shaft and tightened well, so that the pin is fixed in the rotor shaft and does not slip out laterally.

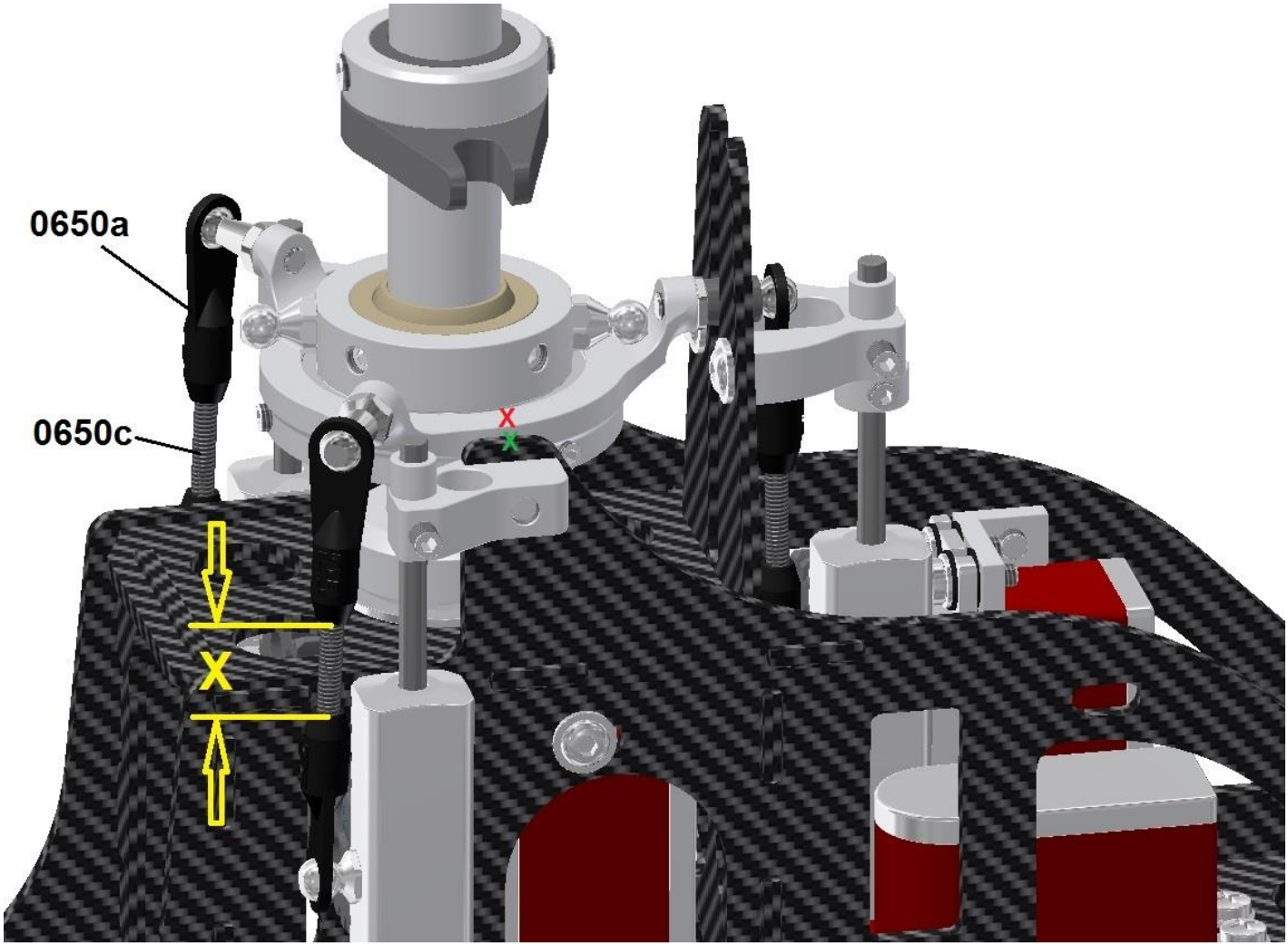
Attention! Never apply **L**octite into the threaded hole itself. If you do so it would push through when screwing in the grub screw, and flow completely and almost inextricably into the transverse bore of the rotor shaft. If it comes out that badly, the pin even can stick to the hub bore, so that it can no longer swing freely.

After the installation, you will notice that the rotor head cannot or just hardly noticeable be swiveled. This is normal because the new O-rings and also the bush must first set properly during the first flights. After a few flights, you will notice that the rotor head allows a muted but easy swinging motion and is not so stiff anymore.

You will find further information in the chapter "Fly-In".

Linkage tooth rack - swash plate

	0650a	ball link 19mm	6
	0650c	stud bolt M2,5x33	3

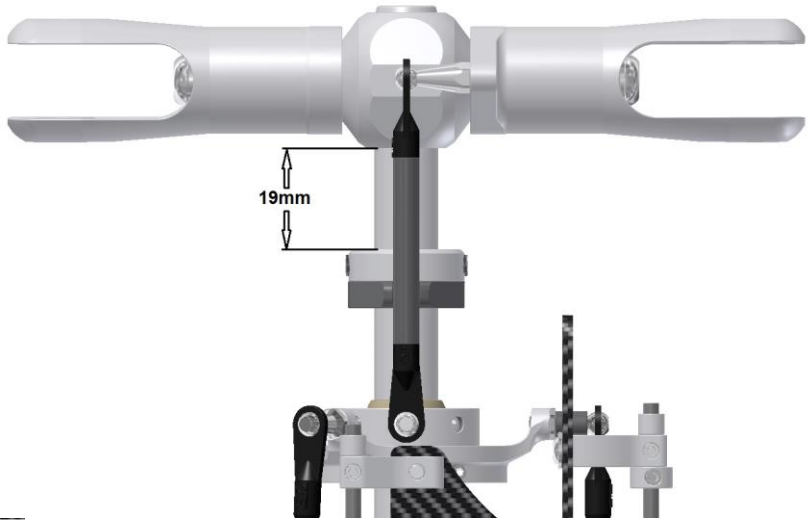


The three control rods between the gear racks and the swashplate has to be pre-assembled so that the distance (**yellow X**) is the same.

For the recommended MKS midi servos, the distance is about **10.5mm** measured between the end faces of the ball links. When using other servos, the distance must be about 2 to 3mm larger, since the position of the servo output shaft is correspondingly lower.

Look at the mechanics from the side and adjust the gear rods in height, that the mean tooth gap of the rack coincide with the marked tooth of the servo gears in servo neutral position. Adjust now the control rod length so that the upper surface of the swashplate outer ring (red X) is at a height with the top of the chassis side plate (green X)
Make sure that the ball joints 0650a are screwed onto the threaded rods 0650c so that the lettering "2.5" is at right angles to the ball links used and points outwards if possible.
For the elevator control this means that the ball links, viewed from the lettering, are rotated by 180 ° with respect to each other.
In the two roll servo racks they are rotated 30° respectively 60° to each other, each for left and right in different directions. See what fits best in accordance with the dimension "X". If a linkage does not fit, you can also accept that the lettering is rotated by 180° and is pressed upside down on the ball stud. This is only a bit more difficult, but does not change the function.

Linkage swash plate - blade grip arms



The control rods 0121a / b / c already prepared in "Chapter 1" are attached to the ball ends.

To do this, first mount the upper ball joint on the blade grip arm, then swivel it laterally into the linkage rod guide 0100 and press it against the ball stud of the swash plate.

When removing the control rods, reverse the procedure, i. e. first hang out at the swash plate, then swing out of the fork and unhook at the blade grip.

Now move the fork 0100 axially on the rotor shaft so that there is a distance of approx. 19 mm between the upper side of the mounting ring and the hub underside of the rotor head and turn it into a position in which the two connecting rods are nicely parallel to the rotor shaft (see picture on the top right).

Finally tighten the two M4 grub screws of the clamping ring step by step (use **L**octite).

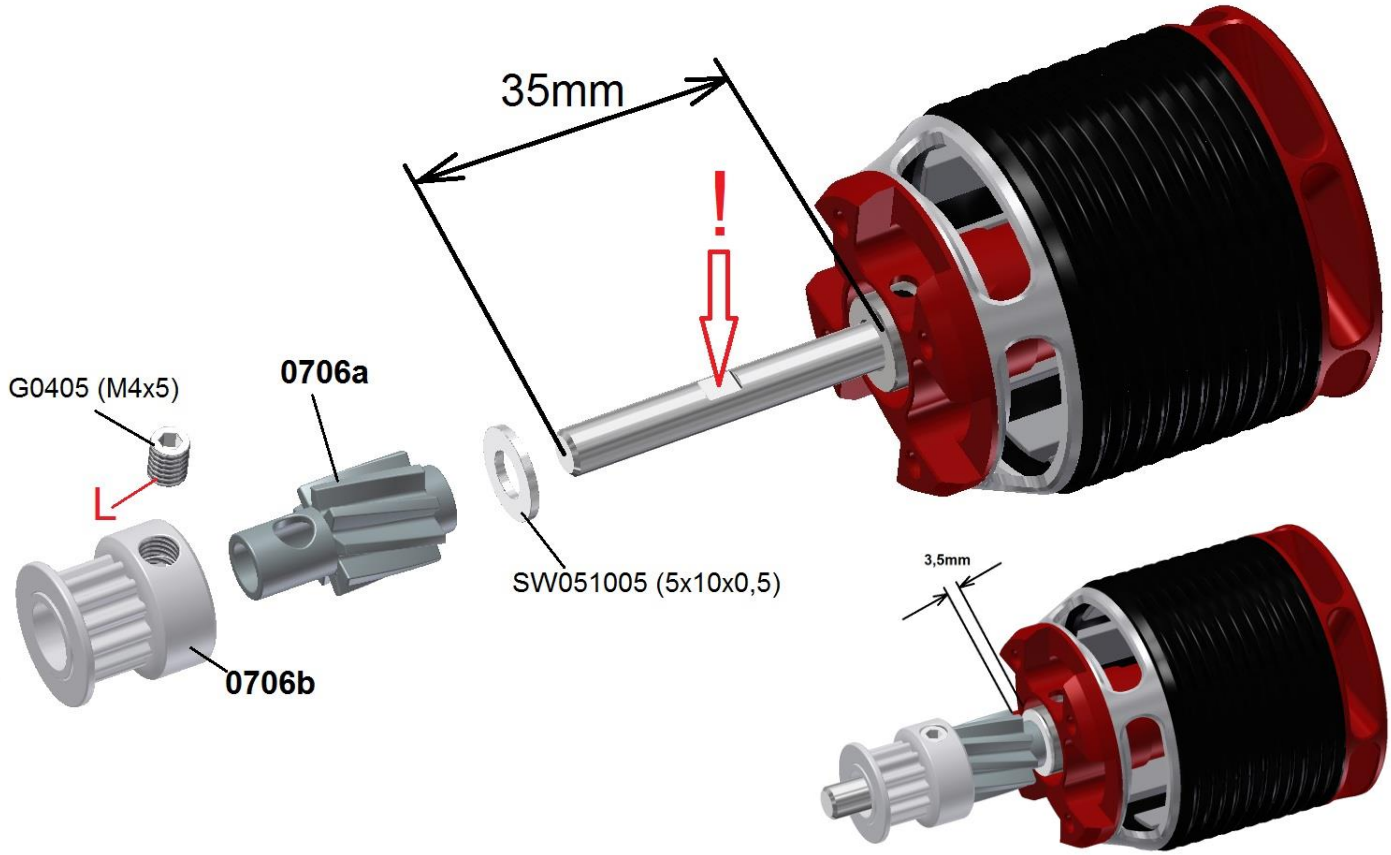
Attention! The grub screws do not press directly on the rotor shaft, but on the shoulder ring of the plastic fork, as they would otherwise leave marks on the shaft.

Therefore, it is important to tighten on the M4x4 grub screws so that they press a bit into the plastic and thereby pass on the pressure on the rotor shaft. Since plastic sets itself at the beginning a little bit over time, it makes sense to retighten the grub screws after a short time.

After the first flights, check whether the linkage rod guide has twisted.

Chapter – 5 **M o t o r u n i t** (Assembly step 5)

	0706a	pinion 9 teeth	1
	0706b	belt pulley 13 teeth	1
	SW051005	spacer washer 5x10x0,5	1
	G0405	grub screw M4x5	1
	L0306	lens head screw M3x6	3



The motor must have a 5mm diameter shaft with a minimum length of 35mm measured from the motor bearing flange. Also a small approximately 0.4mm deep flattening in the middle with a width of 4 to 5mm is needed. In the case that only a shaft with a flattening over the entire length is present, this can also be used. It is important that there is a flattening in the area of the grub screw after sliding the pinion on the shaft.

The toothed belt pulley 0706b has already been pressed onto the pinion 0706a with some Loctite. In case of disassembly, the unit must be heated slightly.

If you have purchased the recommended " **Spezial Pyro-400 / 1000KV** " from us, you can assemble the parts as shown in the picture above. First, push the 5x10x0.5 washer SW051005 up to the adjusting ring of the motor and then push the pinion with the toothed belt pulley up to the stop.

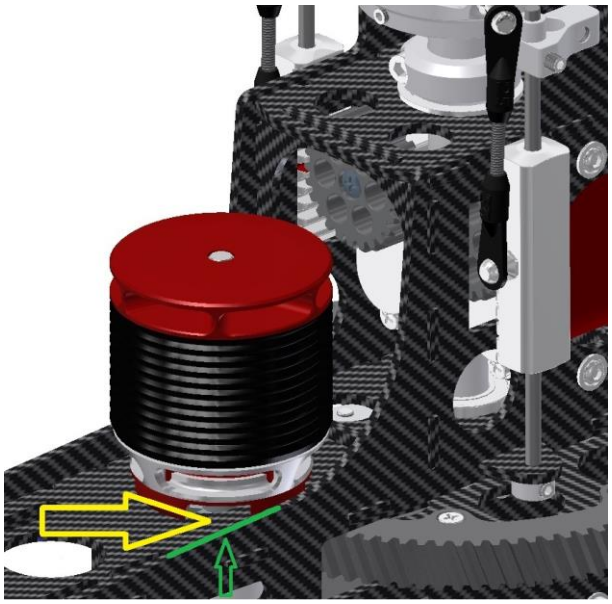
Make sure that the M4 tapped hole matches the flattening of the shaft and tighten the M4x5 grub screw G0405 well (use Loctite).

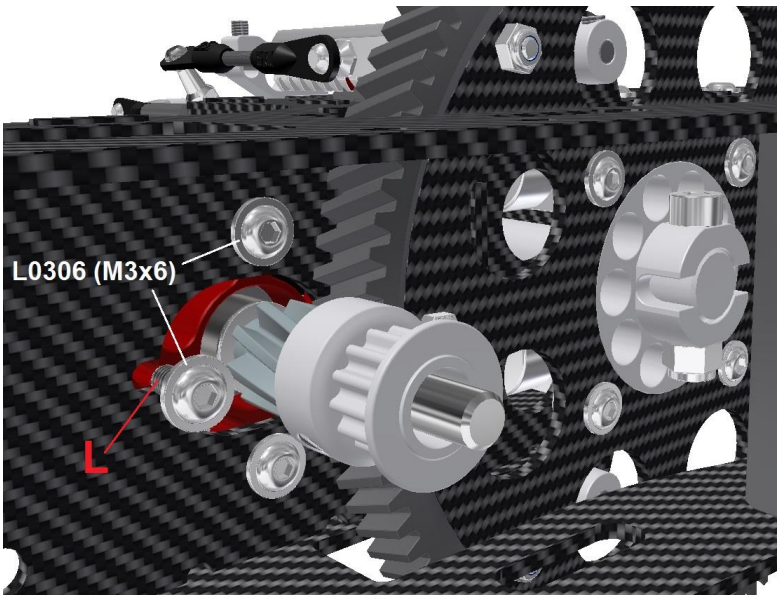
Again, please ensure that there does not get any Loctite in the hole, but only on the thread of the grub screw. Grease the motor shaft a little before so that it is not corroding.

Using the engine " **XNova Lightning 3220-950KV** " also recommended by us the shim is omitted because this engine has an adjusting ring on the shaft sitting in front of the ball bearing, which has approximately the same thickness.

If any other motor is used, it should be ensured that after installing the pinion, the distance between the motor flange and the top of the pinion teeth should be approximately 3.5mm.

Motor installation and adjustment of tooth backlash





The bottom plate of the chassis has an elongated cut out, so that the motor can be easily inserted completed with the pinion.

The three mounting holes are designed as slots, so that the motor can be moved slightly to adjust the gear play. The front hole is open to the rear, but this is irrelevant for the strength.

Insert the motor so that the cables come out of the housing at a 45 ° angle to the left front.

The **yellow arrow** in the picture on the top left shows the area.

Screw the three M3x6 lens head screws L0306 into the motor flange with a small amount of **L**octite, so that the motor rests on the mount, but still can be moved in the longitudinal direction.

On the upper edge of the left chassis plate, which is marked by a green line, in the area where the cables are exiting the motor, a slotted silicone hose will be attached as cable protection (green arrow).

Carefully push the motor towards the main gear until the teeth of the pinion are in the ground and then retract the motor approx. by 0.2mm. First tighten the front mounting screw slightly and carefully turn the main gear.

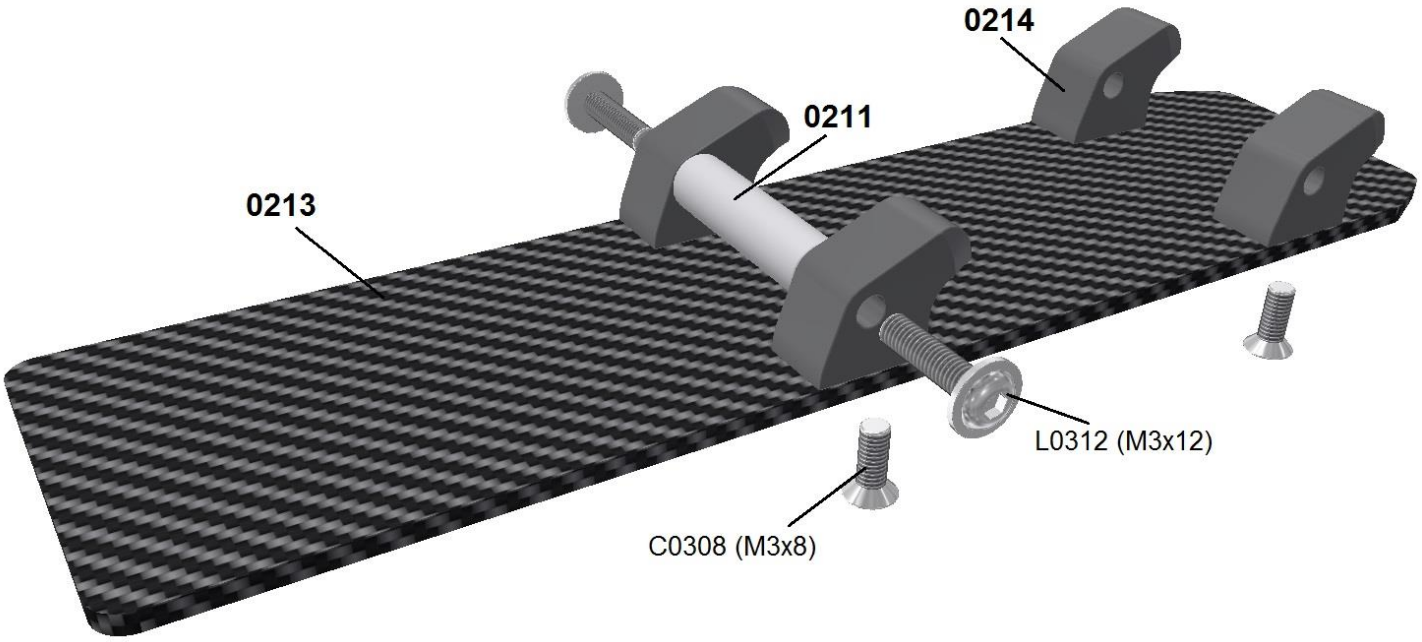
Since there are always small tolerances in the concentricity with the large diameter, it must be ensured that even at the narrowest point there is still a minimal clearance between the tooth flanks of the pinion and the toothed wheel and that it does not jam anywhere.

Carefully pull on the other two screws gradually and check again and again whether it is stucking somewhere.

If you hold the main gear and turn the motor bell back and forth, you can realize if you can still move a minimum. Finally, the screws are tightened well.

Chapter – 6 **B a t t e r y t r a y** (Assembly step 6)

	0214	mounting hook	4
	0213	battery plate	1
	0211	locking bolt	1
	L0312	lens head screw M3x12	2
	C0308	counter sunk screw M3x8	4



Fix the hooks 0214 with M3x8 counter sunk screws C0308 to the plate 0213.
Between the two front hooks the locking bolt 0211 will be mounted. To align all hooks in parallel you can use the locking bolt during the fixation of each pair of hooks.
Just screw it without **L**octite with the M3x12 lens head screws L0312 between the rear pair of hooks when you fix them to the plate. Tighten the M3x8 counter sunk screws C0308 tight to fix the hooks properly and prevent them from twisting.

Loosen the bolt again and proceed in the same way with the front pair of hooks. At the front hooks the bolt remains mounted. At this position the M3x12 lens head screws will secured with **L**octite.

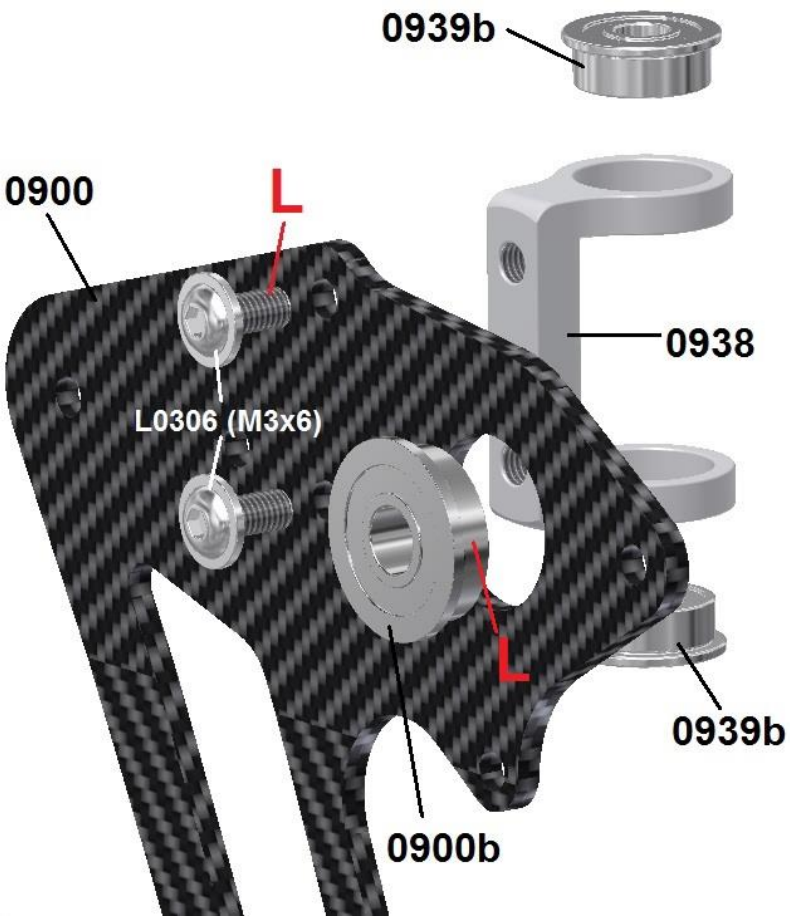
Later, the flight battery is attached to the plate so that the center of gravity is at the right position. I recommend to use transparent glass fiber reinforced tape instead of the usual Velcro tapes. This saves weight and gives more stability.

If batteries are used, which have a width greater than 42mm it may be, that you still have to use a 2mm thick pad (for example foam rubber) between the battery and the plate so that the battery does not hit the lower edges of the chassis side plates.

Chapter – 7 **T a i l g e a r** (Assembly step 7)

P r e p a r a t i o n o f t a i l g e a r h o u s i n g r i g h t

	0900	vertical stabilizer	2
	0900b	flanged bearing 5x13x4	2
	0938	bell crank support	1
	0939b	flanged bearing 4x10x4	2
	L0308	lens head screw M3x8	2



In the picture left you can see the preparation of the vertical fin plate which will be mounted later on the right side.

The plate is also used as a bearing seat for the tail shaft bearing 0900b, which is already mounted by us by using **L**octite.

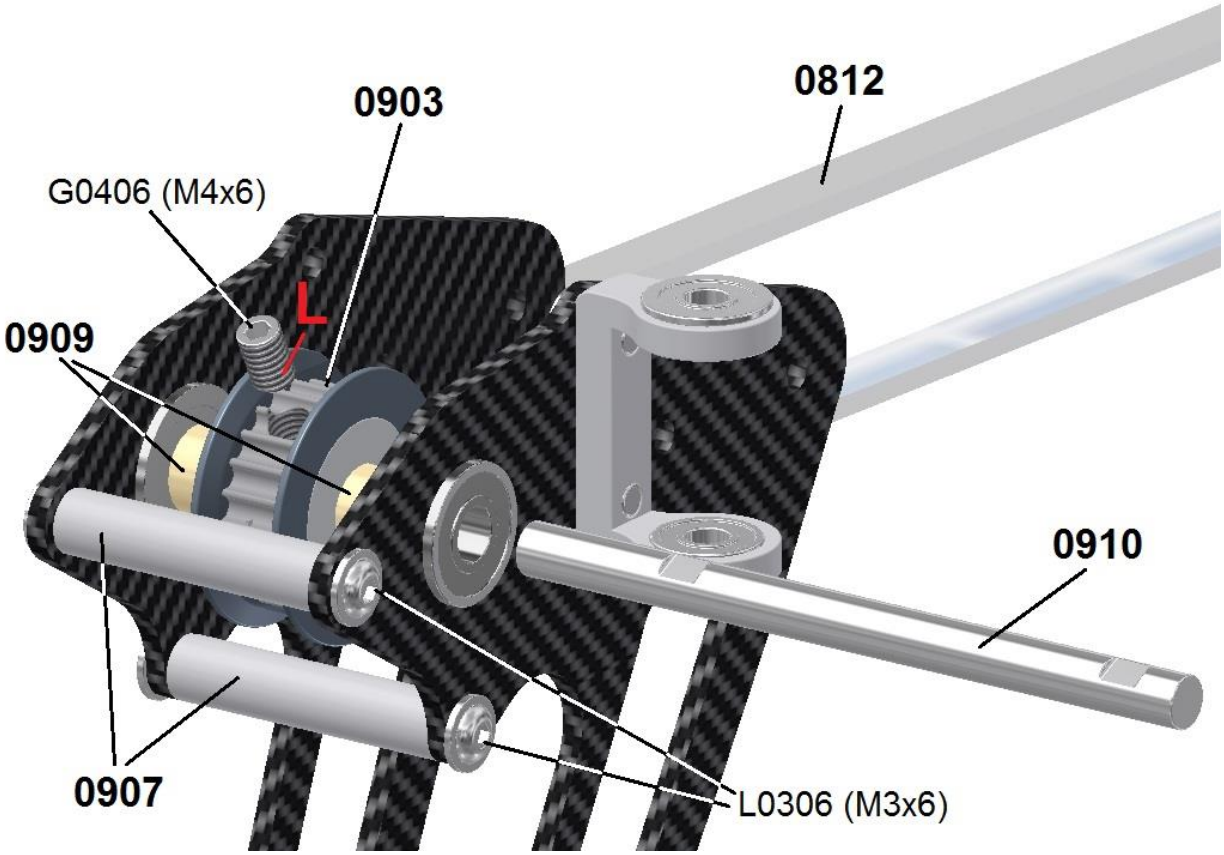
Attention! Take care the collar of the bearing is positioned at the inner side of the tail fin. This secures the bearing from moving. The bearing is looking about 1mm outside the outer surface of the fin plate.

Screw the bell crank support 0938 according to the drawing with two M3x8 lens head screws L0306 to the vertical fin plate 0900.

When mounting or dismounting the bearings 0939b take care not to bend the two flanges with the bearing seats.

Assembly of both plates

	0812	toothed belt	1
	0903	tooth belt pulley 22teeth	1
	0907	spacer 6x28	1
	0909	spacer 5x8x8,25	2
	0910	tail shaft 5x70	1
	L0306	lens head screw M3x6	4
	G0406	grub screw M4x6	1



The plates are assembled according to the drawing above.

The tail rotor shaft 0910 is inserted from the right side of the tail plate with the side first, where the flattening for the M4x6 grub screw G0406 has a greater distance from the shaft end face.

To the left and right of the pulley, the spacers 0909 are inserted. Align the M4 bore of the pulley with the flattening. The shaft should then terminate flush with the bearing of the left tailstock.

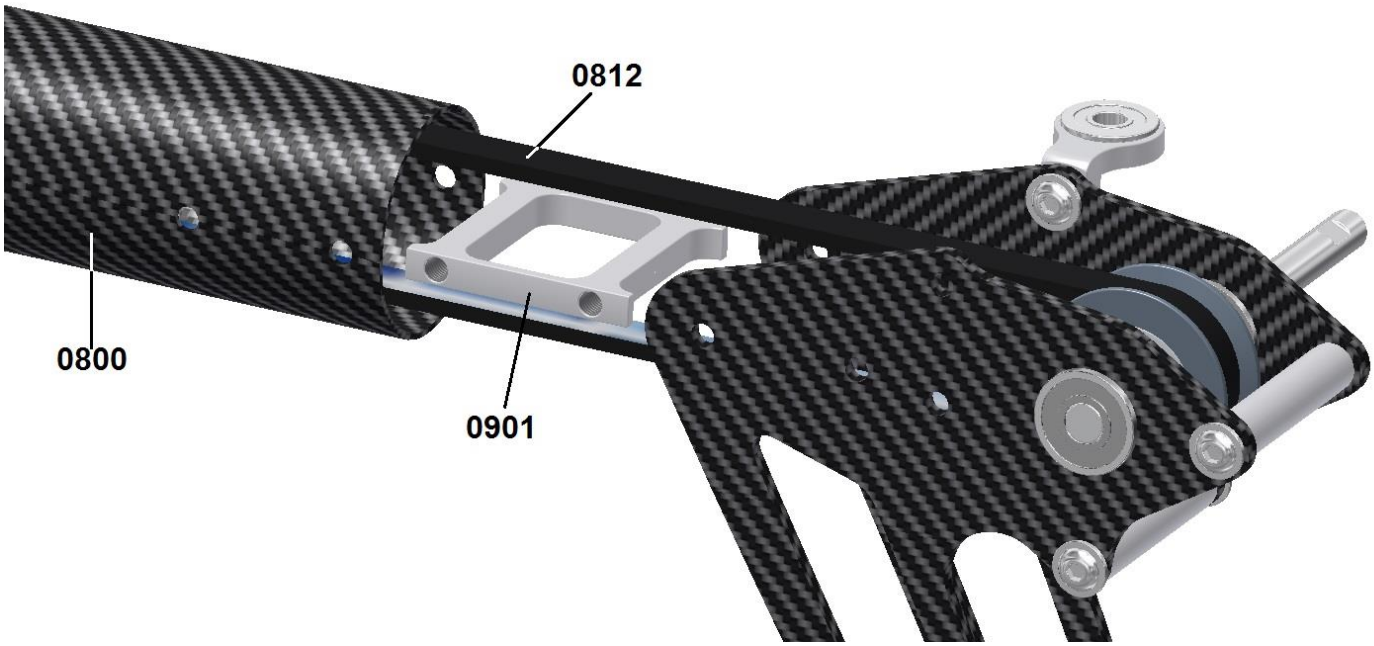
Before mounting the two 28mm long spacers 0907, do not forget to place the toothed belt 0812 over the pulley 0903.

Secure the M4x6 grub screw G0406 with **L**octite, but not too tight. If you tighten it too much, there is a risk that the tail shaft slightly bend under the tension which will cause vibrations.

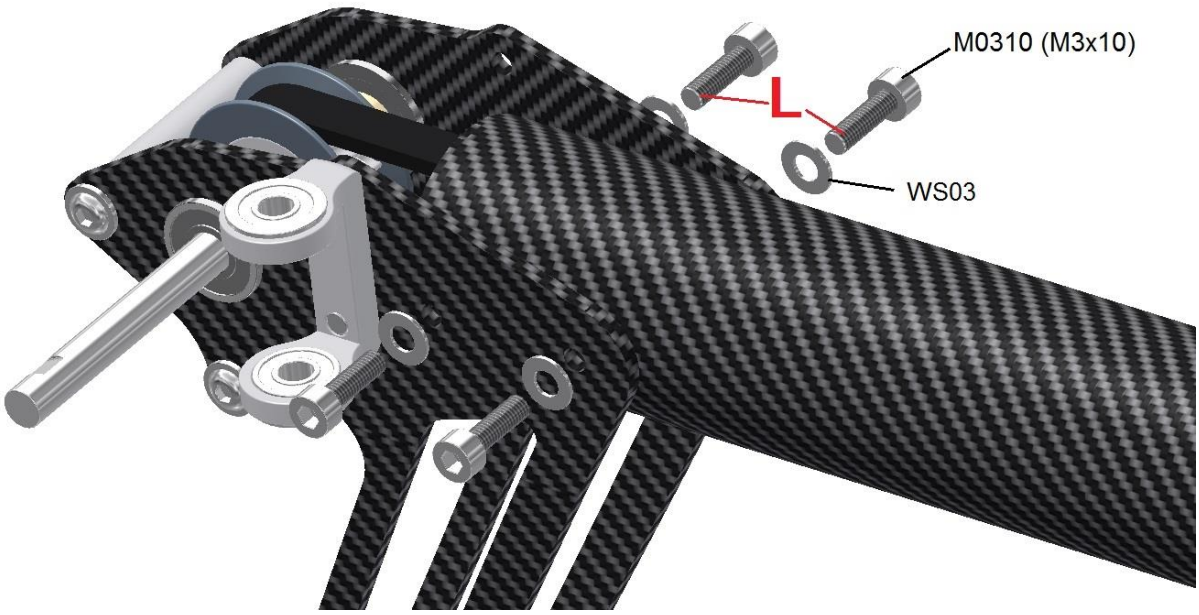
The four M3x6 lens head screws L0306 are also secured with a little **L**octite.

Mounting of the vertical fin plates to the tail boom

	0800	boom 25 x 880	1
	0901	fixation insert	1
	M0310	hex socket screw M3x10	4
	WS03	washer M3	4



Pull the tail belt 0812 through the tail boom 0800 by using a long wire hook or a cord. Position the fixation insert 0901 between the two strings of the belt and position it in the tail boom aligning the threated holes with the holes of the tail boom.



The unit will be screwed with four M4x10 screws M0310 and four washers WS03 to the end of the tail boom. Secure the screws with Loctite and tighten them well stepwise and alternating.

Connecting the tips of the vertical fin

0900L	tip protection left	1

0900R	tip protection right	1

M0308	hex socket screw M3x8	1

N03	nut M3 - flat	1

Press the ends of the two vertical fin plates together and screw them with the two plastic caps 0900L and 0900R.

The fittings act as protection of the tips and as protection from sinking into soft ground.

One cap has a round counter bore for the M3x8 screw and the other one a hexagonal one for the nut.

Do not use Loctite for this connection as you cannot fix the nut properly for loosening.

Securing is not needed as the tensioning of the two vertical fin plates act as a feathering ring and clamp the screw.

The double fin has the advantage compared to conventional fins of a high stability (also with slim plates) and is not breaking even during hard landings.

There will be no resonances at the whole RPM range and they participates to the vibration reduction in the helicopter.

Tail pitch slider

0915a	tail pitch rod	2

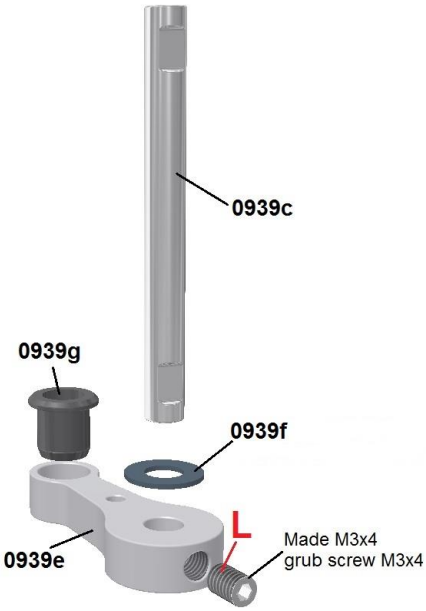
0915b	pin for tail pitch rod	2

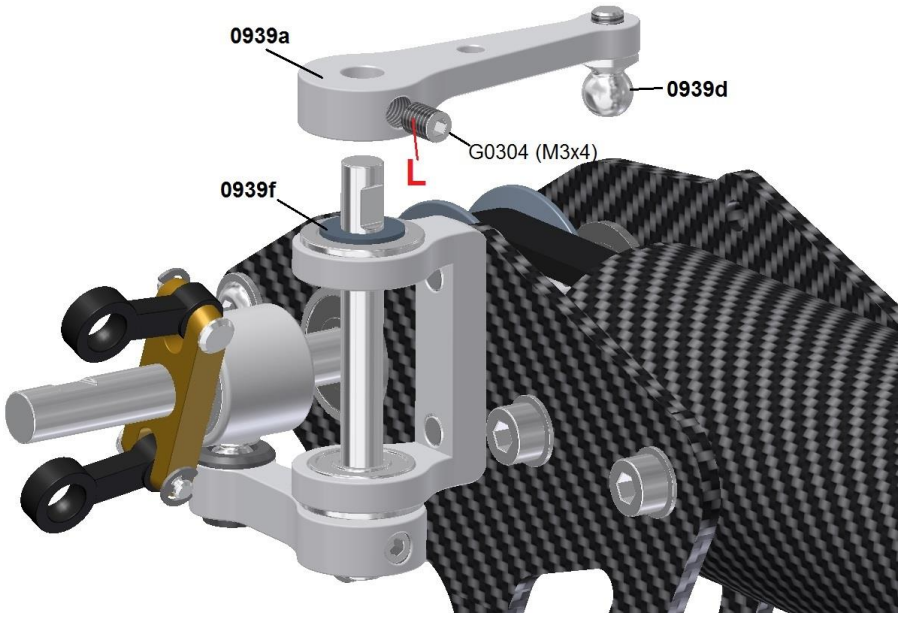
0915c	c-clip	2
0916	tail pitch slider complete	1

The sleeve of the pitch slider is chamfered with both bearings. Therefore, this unit is only available complete, under the part order no. 0916. The tail pitch rod 0915a, as well as the pins 0915b and the C-clips 0915c, are individually available. In case of a crash, usually only the tail pitch rod may break.

Bell crank

0939a	Upper bell crank	1
0939c	shaft 4x40	1
0939d	threaded ball link M3x4 / 4 long	1
0939e	lower bell crank	1
0939f	spacer washer 4x8x0,5 (SW040805)	2
0939g	bush for ball link	1
G0304	grub screw M3x4	2

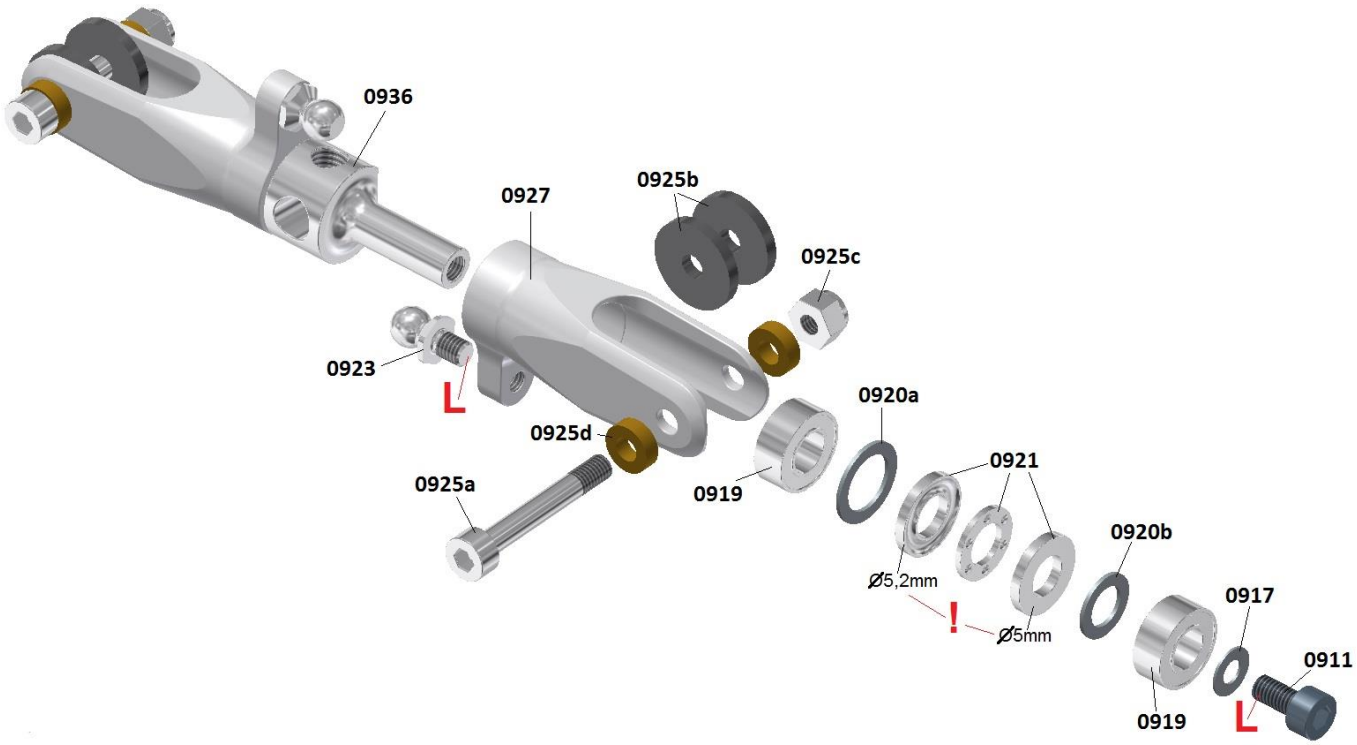




(left picture above) The bushing 0939g will be pressed from above into the lower bell crank 0939e. The shaft 0939c will also be slide into the hole from above and fixed at the flat surface area with a M3x4 grub screw. The shaft should look outside the bell crank by about 1,5mm to the bottom.
As shown in the right picture slide the shaft from the lower side into the bell crank support. Put in a 4x8x0,5mm spacer washer 0939f between bearing and bell crank.
Attention! First slide the pitch slider onto the tail shaft to be able to insert the ball link of the tail pitch slider into the bushing (grease bushing with Dry Fluid Gear). Slide on the second spacer washer 0939f and the upper bell crank 0939a from above with the hole for the grub screw facing forward. Press the two bell cranks together softly when tightening the upper grub screw to prevent axial play. Previously screw the ball link 0939d with some **L**octite to the bottom of the upper bell crank.

Tail center hub with tail blade holders

	0911	hex socket screw M3x6 - 10.9	2
	0917	spacer washer 3x6x1 (SW030610)	2
	0919	radial bearing 5x10x4	4
	0920a	spacer washer 7x10x0.5 (SW071005)	2
	0920b	spacer washer 5x8x0.5 (SW050805)	2
	0921	axial bearing 5x10x4	2
	0923	threaded ball link M3x4 / 4long	2
	0925a	hex socket screw shanked M3x21	2
	0925b	tail blade spacer	4
	NS03	nyloc nut M3	2
	0925d	compensation weight 3x6x2	4
	0927	blade holder	2
	0936	center hub	1
	G0404	grub screw M4x4	1



The assemblies of the tail blade grips are done in the following procedure:

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.

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.

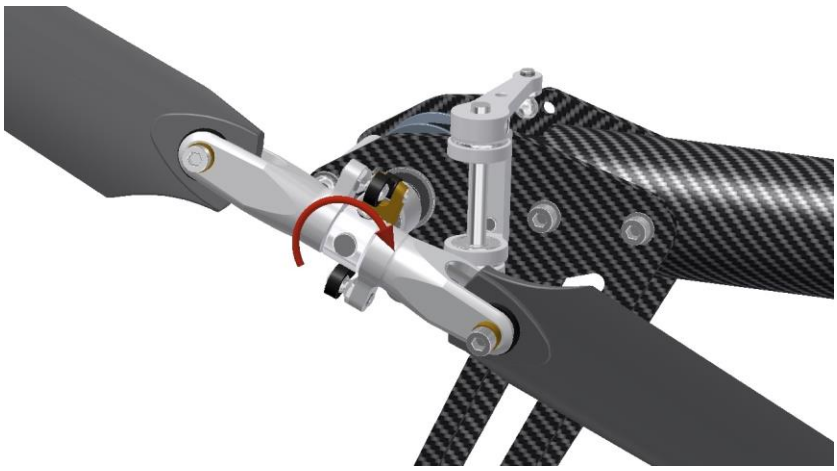
Fasten the link ball 0923 to the blade holders with **L**octite and assemble the tail blades later so that the link balls are positioned forward into the direction of rotation.

Assembly of the tail center hub at the tail rotor shaft

Attention! The complete hub 0936 is attached to the tail shaft in such a manner that the recessed surface points to the gear box. Secure the grub screw M4x4 with **L**octite. Avoid spilling any **L**octite into the bore, otherwise the hub will glue to the shaft.

While you are fastening the grub screw, pull the tail rotor hub 0936 in a position, in one line with the recessed flat surface of the shaft.

In case the tail pitch slider does not slide smoothly on the tail shaft, this is most often due to the pitch rod 0915a, which is still dragging on the ball links. In such case, use a pair of flat pliers to carefully squeeze the assembled arms a little from the outside. This will help them to adapt better to the ball links. Apply DRY FLUID to the shaft and the ball links (shake before use).



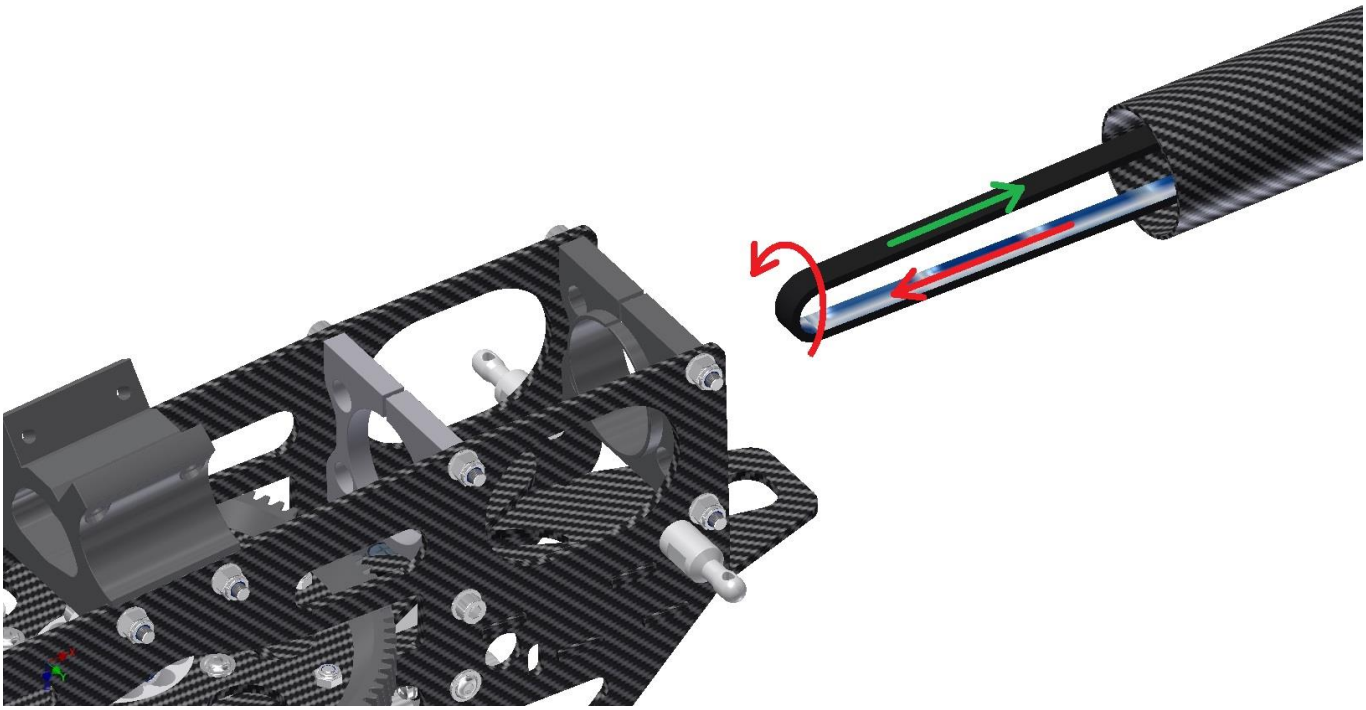
Attention! Keep in mind that the tail blades of the **TSDF** rotate in the opposite direction to most of the other existing model helicopters. If you observe the tail blades from the right side respective to the forward flight direction, they rotate clockwise. I have done this with all my helicopters ever since the beginning.

This is important to know, considering the pulling direction of the belt. The upper belt stream is the loaded side (working stream), while the lower belt stream is the relaxed side (empty stream).

Another advantage of this arrangement is that the grass cut off from the tail rotor flies mostly backwards and not always the whole tail boom turns green.

Chapter – 8 **Tail boom, motor shaft support bearing, skids** (Assembly step 8)

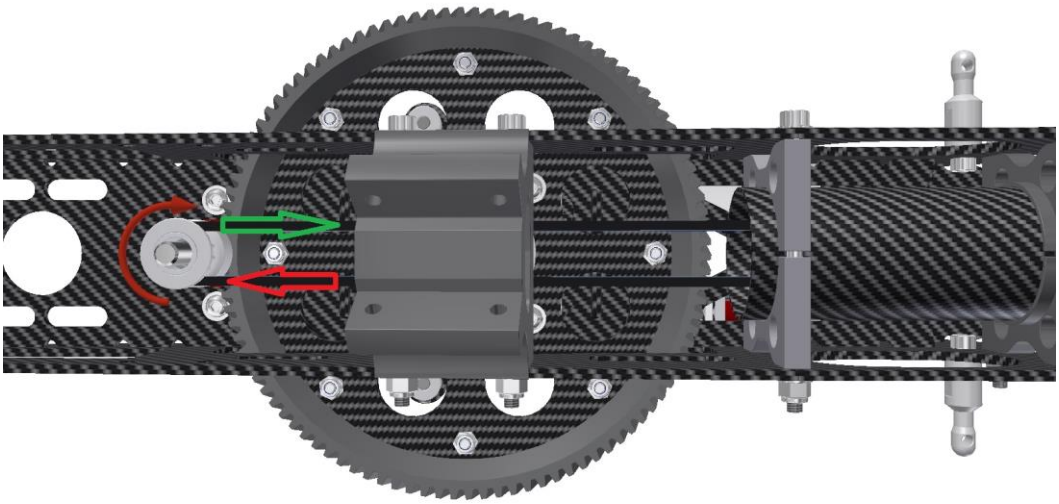
Assembly of the tail boom at the chassis



Turn the core mechanic and tail boom upside down then pull the belt toward the front out of the tail boom and align it in such a manner, that it runs straight without being twisted.

The imprinted arrows signify the moving directions of the belt strands. The red arrow signifies the working strand of the belt and the green arrow signifies the relaxed strand. If you pull the belt into the direction of the red arrow, the tail blades must rotate in the correct direction (clockwise at the front view on top of the tail rotor).

Look from the front to the tail boom. Twist the belt 90° to the left (counterclockwise) (see circular red arrow) until the loop is in a horizontal position and no more vertical as shown in the picture.



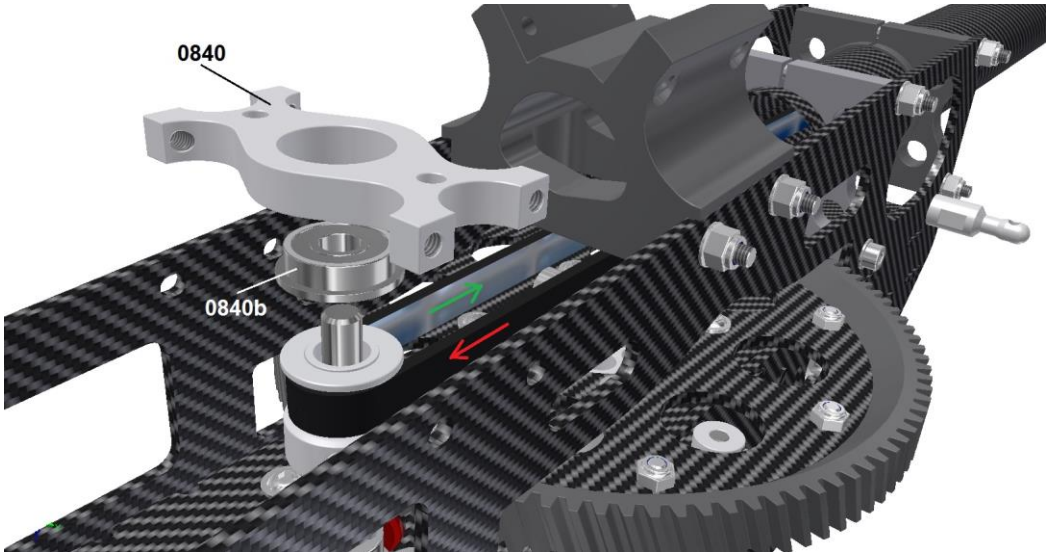
Guide the belt through the two clamping flanges without twisting further. At the same time slide also the tail boom into the two clamping flanges. In the picture the red arrow signifies the working strand of the belt and the green arrow signifies the relaxed strand. Push the boom forward until it almost touches the large gear so you can put the belt over the small pulley.

If you look from the bottom to the pinion it will turn clockwise in operation (see circular red arrow).

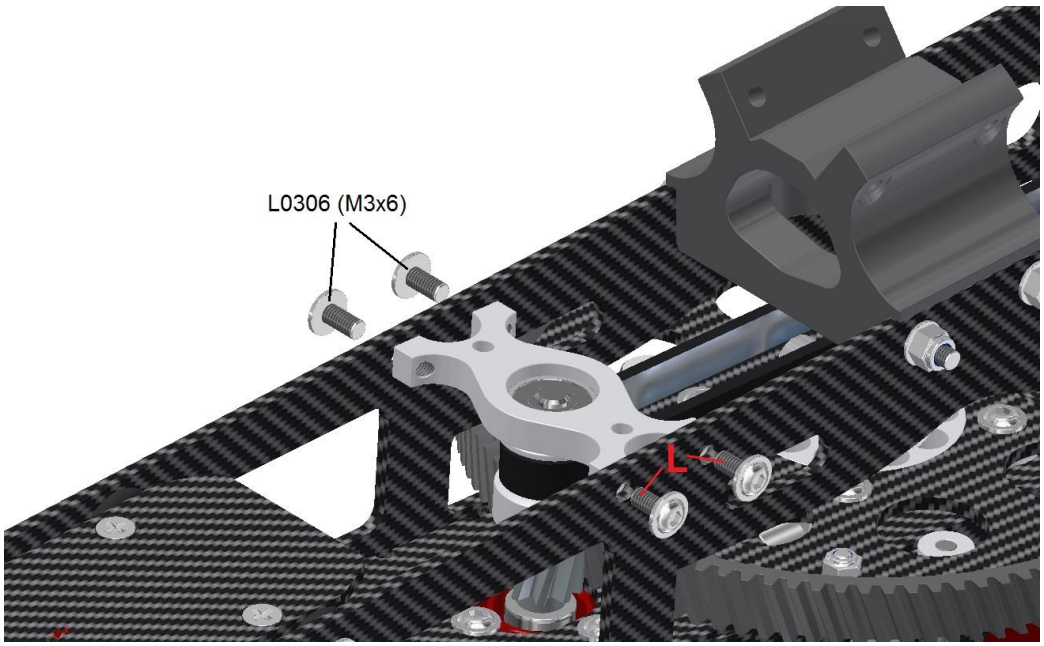
Attention! The tail boom is not yet pulled back so that the belt is still loosely over the pulley and produces no radial tension on the motor shaft.

Assembly of the support bearing for the motor shaft

	0840	support bearing plate	1
	0840b	flange bearing 5x13x4	1
	L0306	lens head screw M3x6	4



The flange bearing 0840b is pressed into support bearing plate 0840 as shown in the picture above. Then the bearing plate is slid onto the motor shaft from below until the lateral M3 threaded holes with the oblong holes in the chassis are at the same height without jamming the plate.
Through the slots, the plate can be attached adapted to the respective motor position. The aim is to screw the plate without jamming or any tension only aligned through the motor shaft and the two chassis plates.
Attention! therefore, it is also important that the belt does not exert any lateral pressure on the pulley. Otherwise, the engine would be tilted in the direction of the main gear, so that the set backlash would no longer be correct.



Finally, the four M3x6 lens head screws L0306 are alternately screwed stepwise with some **L**octite and tightened well.

Adjustment of the belt tension and boom attachment

After mounting the support bearing of the motor shaft, the tail belt can now be tensioned and the tail boom clamped.

First, only the lower clamping screw of the rear boom support made of plastic is tightened enough that the tail boom can still turn and move.

Then turn the helicopter on its back again and take the boom seam as a guide to the orientation of the tail boom about the longitudinal axis. The seam is brought into line with the cocking slot of the tail boom holder.

Now the tail belt is pretensioned and the tail boom clamped.

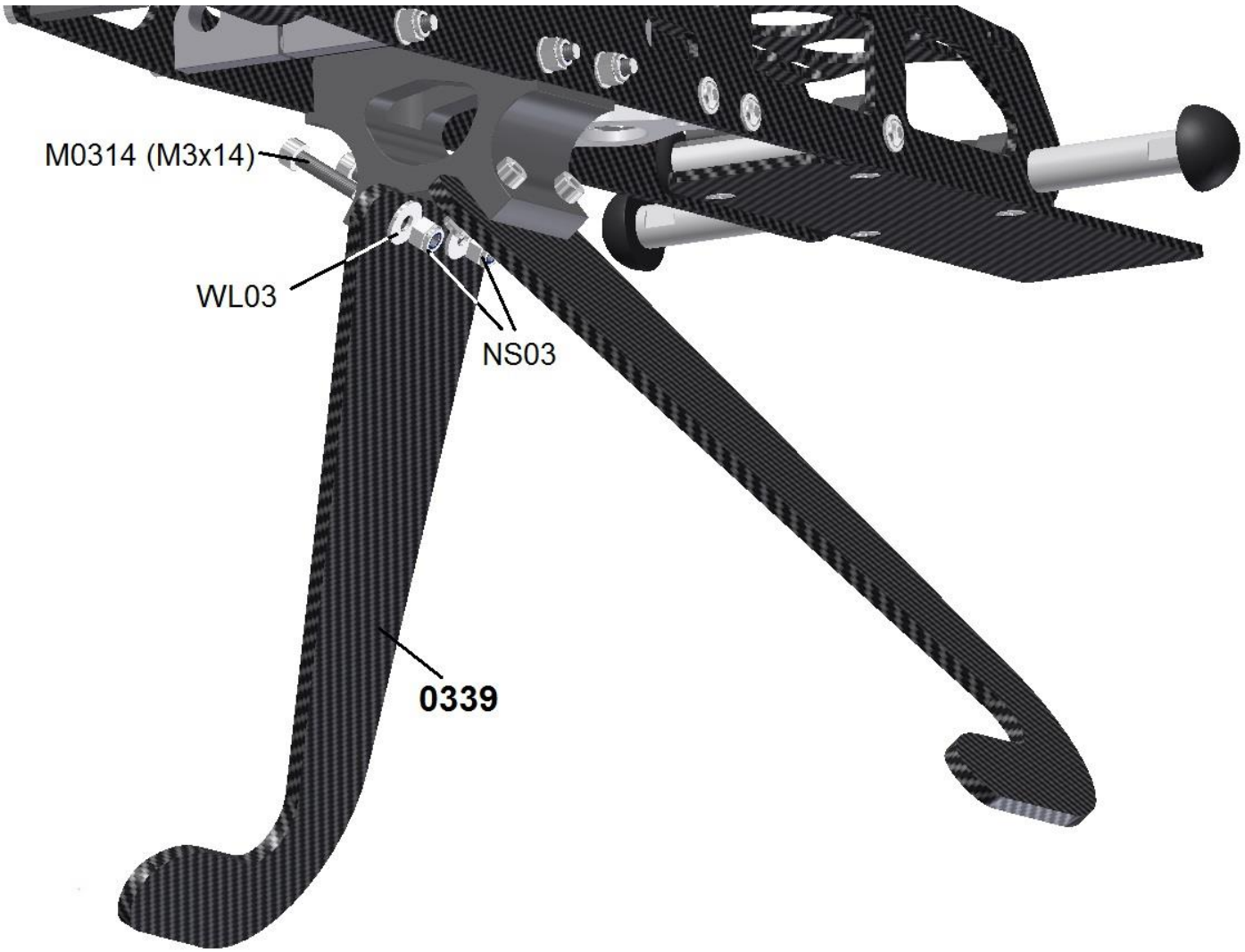
This works best when you grab the tail boom by hand and with your thumb press against the rear tail tube flange at the same time so that the tail boom pushes backwards and tightens the belt.

In general, the tail belt tension is not critical. If it is too tight, it costs performance and if it is too loose, one hears the belt constantly beat against the inner wall of the tail boom during flight. It just should not be so loose that the belt constantly skips under load, which is recognized by a loud snarling noise.

Once the correct position has been found, the stop nuts are tightly tightened by the two lower M3x55 hex socket screws of the two boom clamping flanges. The upper screws should already be tightened before.

Skids

0339	skid	2
M0314	hex socket screw M3x14	4
WL03	washer M3 big	4
NS03	nyloc nut M3	4



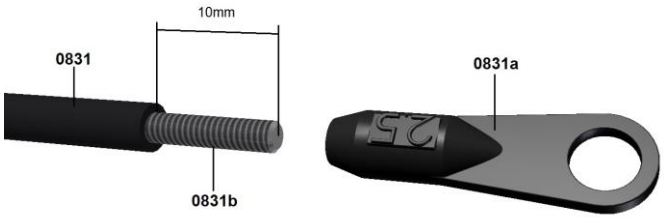
The 3mm thick CFK-skid plates 0339 are mounted on the skid holder as shown in the picture above.

Note: The skid plates are sized for the helicopter so that they have enough stability to absorb even strong and rough impacts. The helicopter has a very stable footing on the ground on the two support skids and the rear double tail, which acts as the third leg.

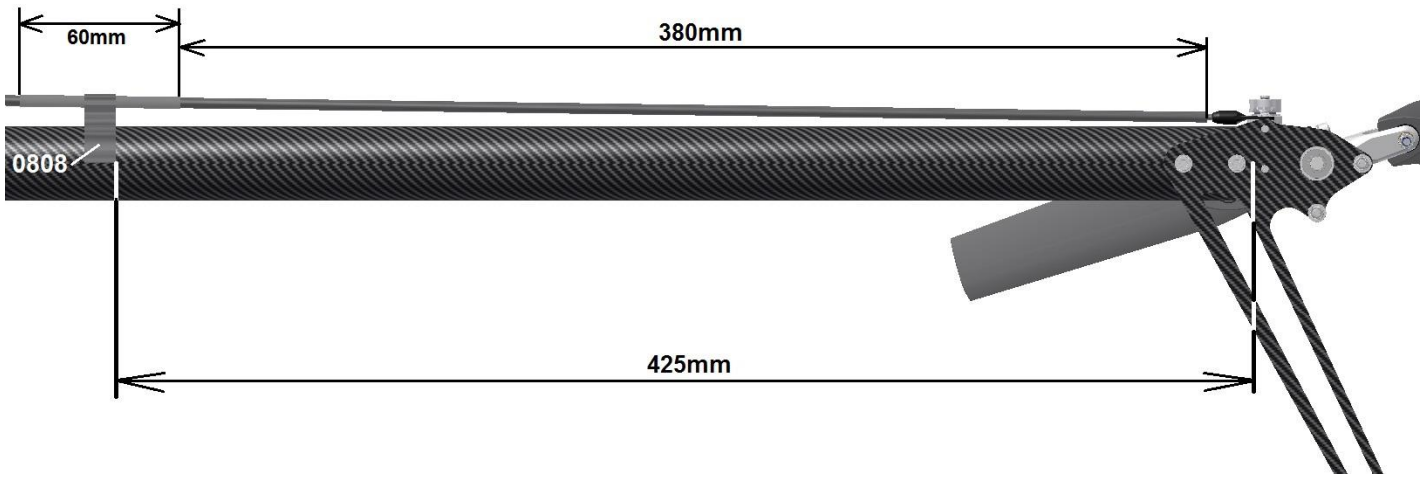
Therefore, I strongly advise against carrying out any experiment with other skids as the vibration behavior of different materials, strength and geometries has a great influence on possible ground resonances.

Tail rotor push rod

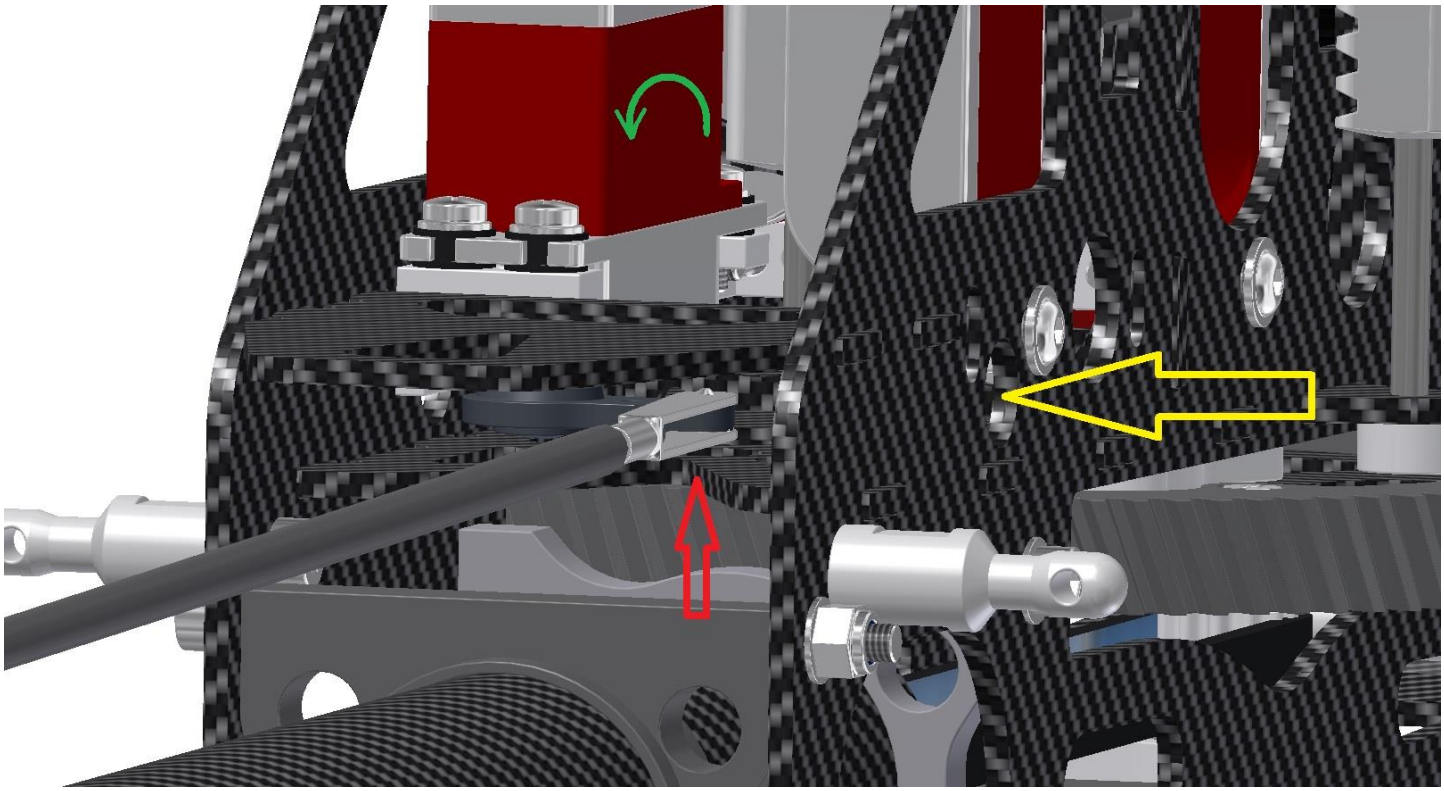
0831	carbon tail push rod 4x 825mm	1
0831a	ball link 19mm	1
0831b	stud bolt M2,5 x 25	2
0831c	shrinking tube 60mm	1
0831d	clevis	1
0808	push rod guide	1



Glue the thread rods 0831b with thin superglue into both sides of the push rod 0831. 10 to 12mm of the thread should protrude on each side.
Note: When screwing up the ball link 0831a the first time on the thread rods you need a high force. To ease this you can tighten and untighten them once on the thread rods before gluing. You can hold the thread rod with a plier in the area which will be glued into the push rod later on. After the glue is dry screw just the ball link 0831a on the push rod.
The clevis 0831d will be screwed on later, after the push rod has been pushed through the push rod guide 0808.



Before fitting the push rod, the approx. 60mm long shrink tube 0831c must be shrunk onto the push rod.
In the picture above, you can see the distance of 380mm from the end of the carbon push rod 0831 to the front of the shrink tube.
The shrink tube should be lubricated on the outside with a little grease so that it slides well in the push rod guide later.
The push rod guide 0808 is glued with thin double-sided adhesive tape (carpet adhesive tape) at a distance of 425mm from the tail boom end to the front of the guide, centrally on the tail pipe. Again, you can take the middle seam as a guide to align.
Spread the legs of the guide slightly apart when placing them on the tail boom, to prevent one of the two sides from sticking before the top of the half-round recess rests in the center.
The push rod is pushed from behind through the guide and then the clevis has to be screwed on the front.
Ball link and clevis should first be turned on the threaded bolt so far, that in each case a gap of about 2mm between push rod and the joint remains.



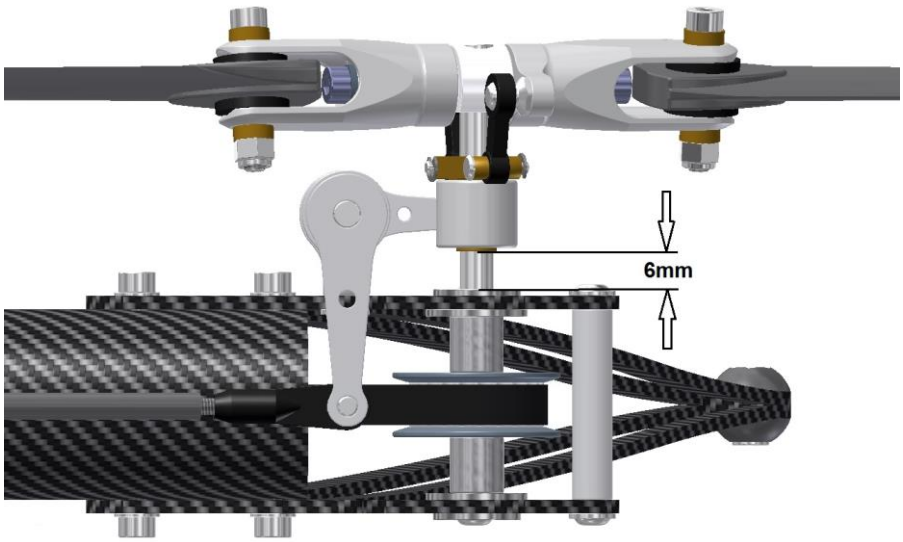
Now hang in the clevis into the lever of the tail servo with a distance of approx. 13mm to the servo shaft axis. The chassis side plate has a hole (**yellow arrow**) on the side, through which you can insert a screwdriver to carefully spread the fork head.

To do this, turn the clevis to a position where the small transverse pin is fixed at the top and releases itself from the underside of the metal leg when it is spread open. There is enough space at the top, while at the bottom you would bump against the bottom plate of the chassis.

Attention! The clevis should be slightly above the bottom plate after hooking into the servo lever, but not scratch it (red arrow).

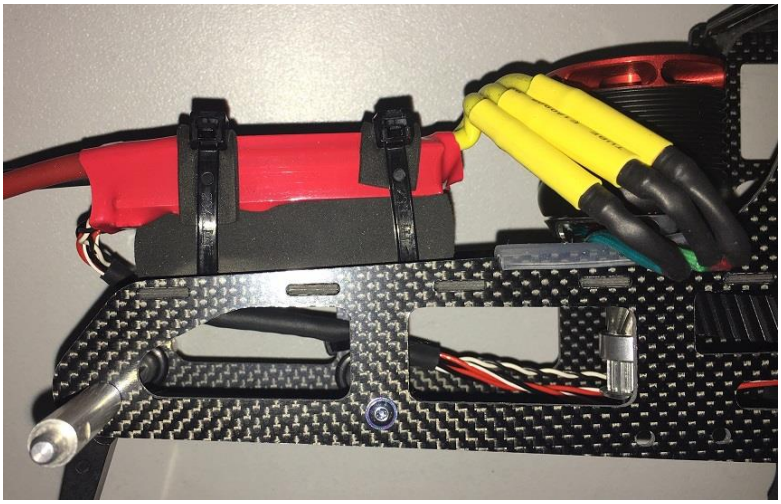
Now align the complete servo on the chassis wall so that it has a slightly oblique angle, which corresponds to the oblique course of the push rod. This means that the servo should be turned a little bit (green arrow) before the two M3x6 lens head screws of the servo brackets on the outside of the chassis are finally tightened. Thus you get a straight force introduction into the push rod respectively on the small pin of the clevis.

Finally, the push rod is mounted at the rear of the tail gear and adjusted so that when standing at right angles to the servo housing servo lever, the control bridge has a distance of about 6mm to the end face of the ball bearing. Thus, the blade grips in neutral position already have a small angle of attack acting against the torque of the main rotor (see picture below).



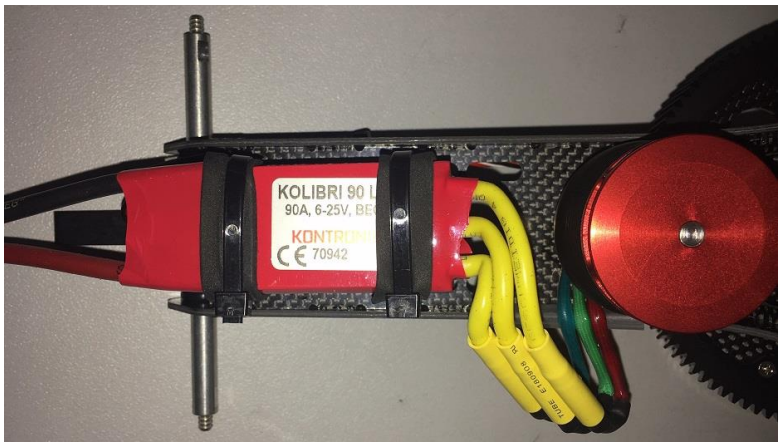
Chapter – 9 **Installation of the remaining RC- components**

Mount of the ESC



Unfortunately the Kolibri-controller is only smooth on the upper side, where the cooling plate is mounted under the shrink tube.
In order to protect the electronic components of the lower side, which protrude very jagged, I recommend fixing the controller with tie wraps as far as possible to the front area of the bottom plate with using a 20mm thick foam rubber backing.

Slots for the tie wraps are milled in the bottom plate. Position the cables to the motor in an arc, as seen in the pictures on the left. Shorten them accordingly to have the shortest possible cable routing.
The two connection cables to the battery can also be kept relatively short.



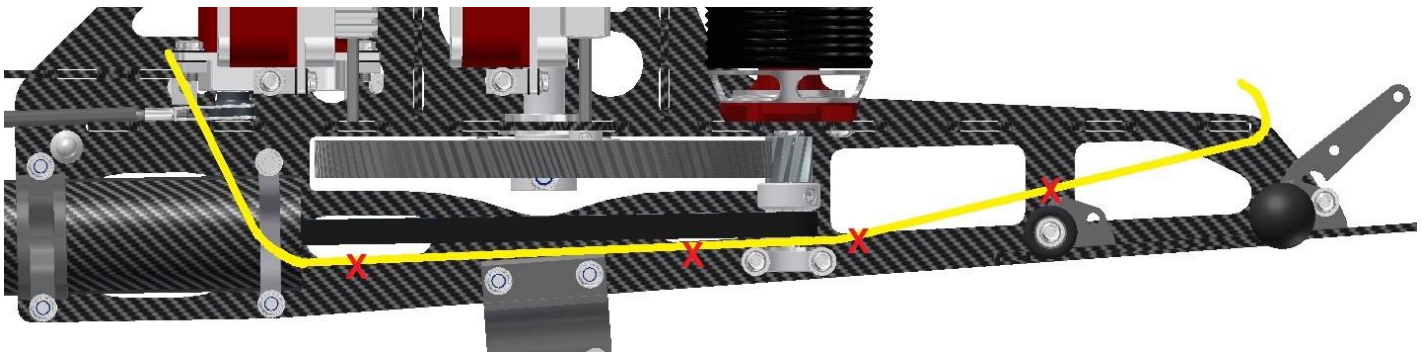
The two cables (master and slave) and the telemetry data cable are routed on the right side inside the mechanics (see third picture on the left).

The cables must be bent downwards relatively closely direct behind the controller outlet and then routed backwards at an angle and then above the support bearing plate and the skid holder.

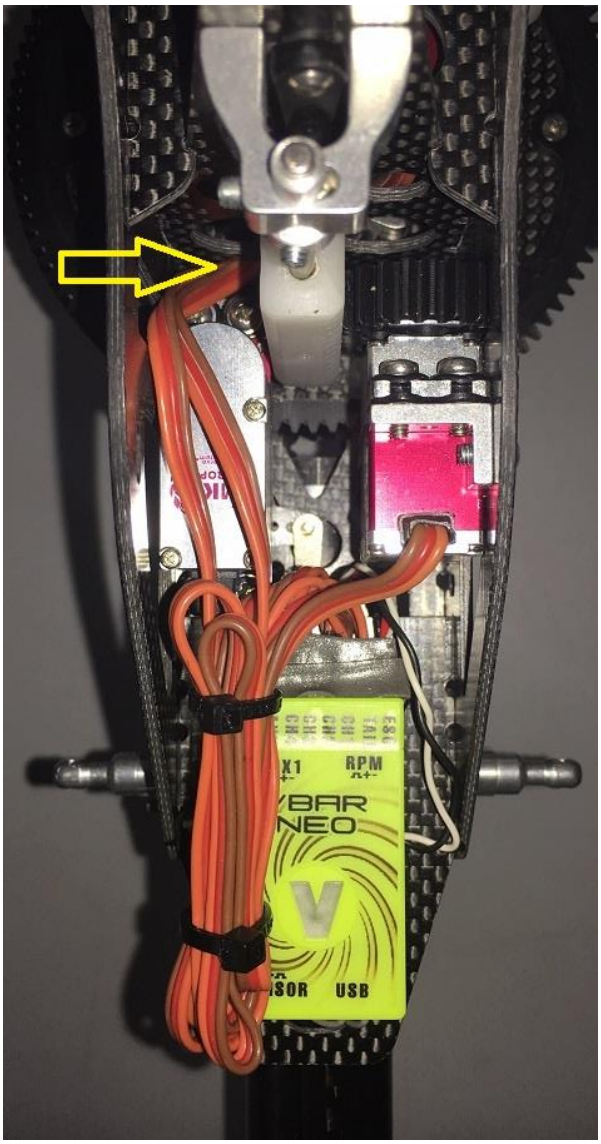
There they are then passed through the lateral cut out of the front tail boom mount 0832 and then inserted directly obliquely up through one of the bottom plate cut outs and connected to the flybarless system.

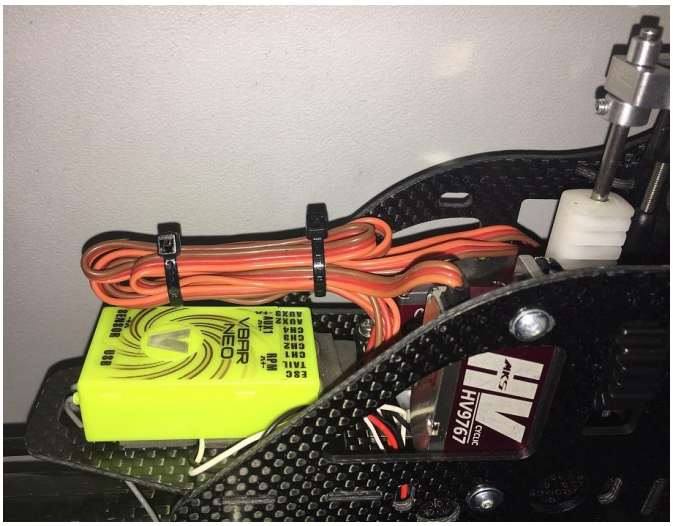
A recommended cable routing line (yellow) can be seen in the bottom picture, with the right chassis plate removed for better visibility.

At points where a (red X) is drawn, a tie wrap is attached for fixation of the cable to the inner side of the right chassis plate.



Flybarless system and receiver





To use a flybarless system with integrated receiver as shown in the pictures above is ideal, but also the installation of a separate receiver is not a problem.
I recommend sticking the stabilizer system generally on the provided carbon plate.
Position your system in the middle of the plate so that there is enough space to guide the antennas down through the plate cut out.
When using a receiver, this is best simply glued with dobble tape onto the tail servo. Receiver cable connections should point to the rear, so that you have a good access to the plugs.

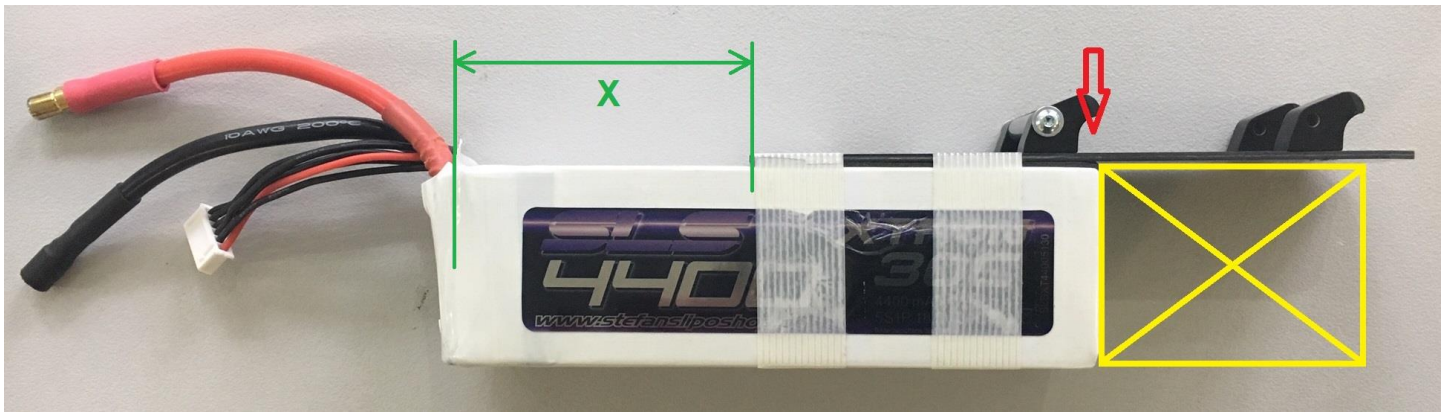
The cables of the two aileron servos (**yellow arrow** - left picture) are routed on the left side through the bottom hole of the rear vertical stiffener to the rear, to avoid that they get into the gear rack. The excessing cable length of the servos can be neatly folded into loops and tied together with tie wraps.

The picture at the bottom right shows a possible antenna routing through tubes or silicone tubes downwards. Since the canopy is made of fiberglass and not carbon, the receiving conditions are not critical as long as the antenna ends are far enough away from the chassis.
The hoses can be attached to the rear tail boom flange with tie wraps.

A buffer or backup battery is not absolutely necessary for the **TDSF**, since both the motor current load of the ESC and the BEC currents of the servos are so low that no problems with failures are to be expected here. The flight battery is also loaded only extremely moderately. All components hardly get warm during operation.

We have never had a power failure of the RC system in our entire test phase.

Flight batterie



The picture above shows examples for the fixation of a 5S - battery to the respective battery trays.

The batteries can be connected with Velcro fasteners. I suggest this only when you have several batteries and just one battery tray.

In general I suggest to fix each battery used to an own battery tray to have a quick exchange. Also the CG is always the same than.

It makes sense to stick the batteries not with Velcro, but with double-sided adhesive tape to the plate and then attach additionally with glass fiber reinforced tape. This saves weight and especially space, because the tape is not so thick.

Evaluate the position by fixing the battery provisionally with a Velcro to the battery tray and hook in the tray in the mechanics. Put on the canopy and lift the helicopter. Turn the blade grips without blades perpendicular to the mechanics.

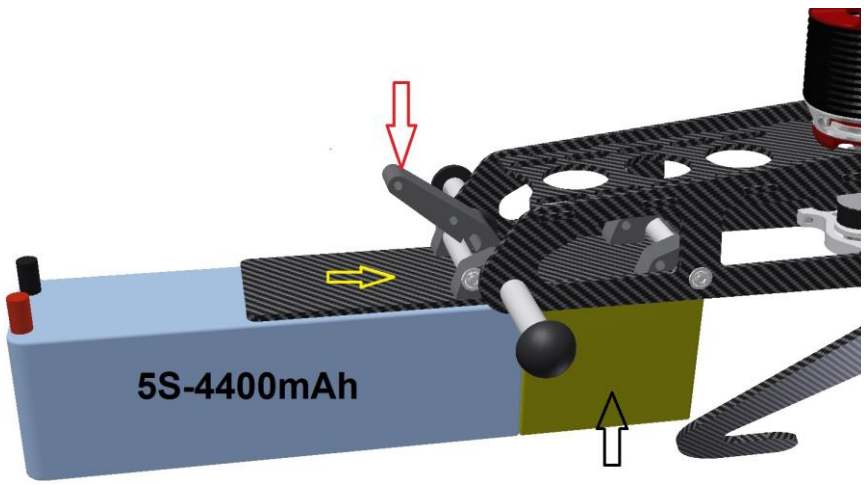
Lift the helicopter with a finger under each blade grip. The mechanic should not tilt to the front or the rear but hanging in the same position as standing on the table with slight nose down.

By shifting the battery you can adjust the correct CG. In the example shown above the 5S battery has a weight of 570g and the dimension „**X**“ around which the battery protrudes forward, is approx. 65mm.

A battery should not weigh below 550g because you will not get a correct CG without the battery touching the canopy.

Attention! The fact that the batteries usually end below the front suspension point (red arrow), the plate bends in flight up and down, because there is not enough rigidity. Therefore, I recommend to cut a block of hard foam, which has the cross-sectional dimension of the battery and is made in length so that it extends to just behind the second hook **(see yellow rectangle)**.

Push this block right up to the battery and stick it to the battery itself and to the plate. Again, this should be done with double-sided tape and also use the reinforced tape. The whole weighs almost nothing and brings a tremendous rigidity in the entire battery suspension.



To lock the battery holder, push it with its hooks onto the silicone rubbers of the distance bolts (**yellow arrow**).
The side **O**-rings center the retaining plate in the middle.
The locking lever is pressed down (red arrow) until it audibly engages in the locking bolt of the battery plate.
The best way is to support the battery with your fingers at the bottom and press the lever down with your thumb.
Attention! Never forget to lock the battery before flying, otherwise it inevitably falls down into the hood.

The **black arrow** shows the recommended rigid foam block for stiffening the battery plate unit.

Chapter – 10 Final works at the canopy and the boom

The canopy is similar in shape to that of the old TDR or TDF, so they can still be used.

The new special TDSF canopy is very elaborately completely provided with cutouts. The window is made up of small rectangles and a feather stylized at the back is a symbol of the lightness of the helicopter.

At the lower side is a triangular structure is milled. This also underlines visually the lightness of the model.

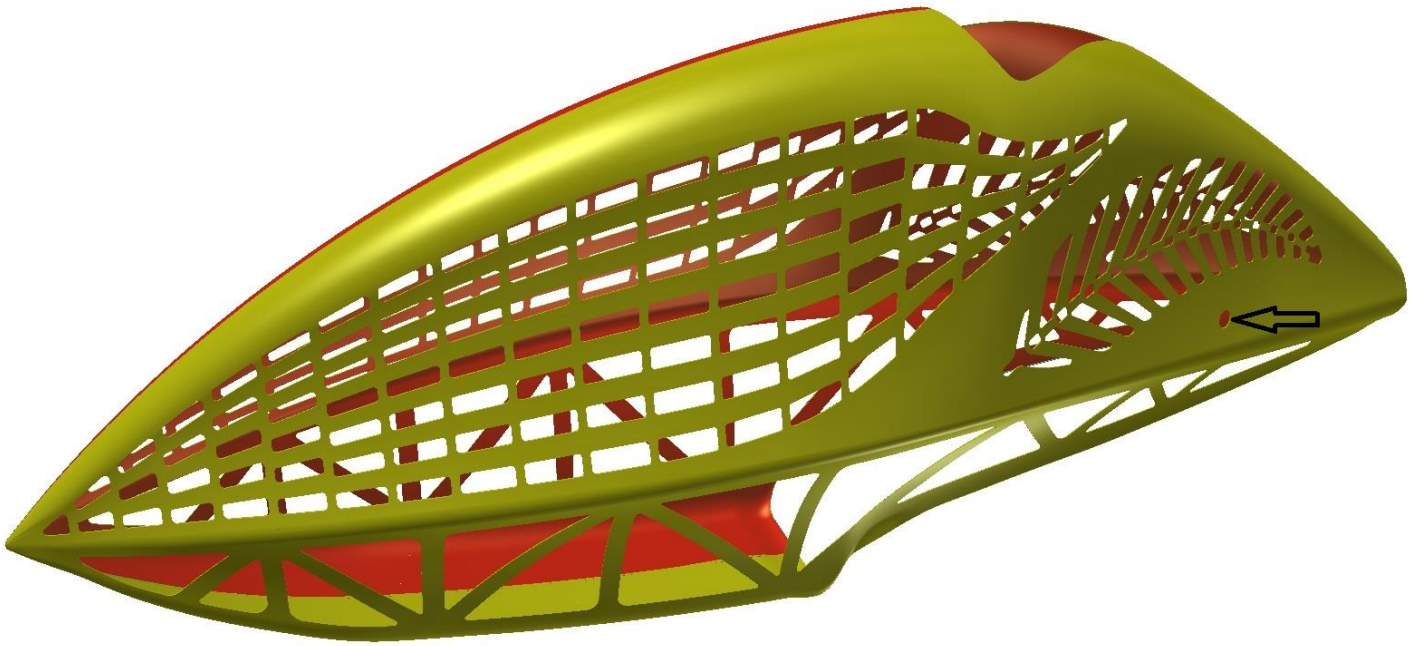
Attention! The cutouts are very time consuming in the production. On the inside of the canopy, small glass fibers remain at the milling edges.

These can be very easily removed with a small round file (needle file / ideal is a small round diamond file). Insert the file from the outside through the respective cut out slightly obliquely against the inner edges. Pull the side of the file while immersing.

Although every single hole is finished very fast, it takes about 20 minutes to cut the glass fibers due to the high number of holes. This is not a big issue for everyone. If I wanted to do that by myself, I would be busy with the number of canopies for a long time 😉

In the end, however, it is still much faster for everyone than gluing the canopy with decals.

At the rear, the two rubber grommets 0305 are inserted into the 8mm holes (**black arrow**).



Note: The canopy is not as damageable as it looks because it is very flexible due to the many cutouts.

Just make sure that you do not get stuck in one of the cutouts when mounting or removing.

Also make sure that the canopy sits correctly on the canopy holders after mounting.

The flight behavior with this canopy is differently than with the closed one. In the forward flight, of course, it brakes much stronger, as here creates a totally turbulent air flow.

That's why the **TDSF** is not that fast, but the nice thing is that it flies very constantly. E.g. in the down passages of a loop the **TDSF** does not speed up as normally, but reaches higher speeds in lateral flight movements, so that it is e.g. predestined for pirouetting loops or similar figures.

The fact that there are no large suction forces acting on the air-flowed canopy, you need not necessarily secure it with the pins at the rear. In any case, during our test flights, no canopy has ever come off the rear canopy mounts.

Attention! Do not fly with the milled canopy in the rain, as there is no water protection of the electronics.

Tail boom decail

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 300mm length and 15mm height.

There is a transparent cover sheeting on the letters and the circumcircle 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).

Keep a distance of about 10mm between the push rod guide and the sticker.

Note: Apply the sticker in dry condition without water and dishwasher fluid. Therefor you have to take care to have the right position when starting to apply the sticker. Lay down the helicopter on the side to be able to look exactly from the top on the area.

Take the stripe with both hands from the left and right side after removing the wax sheet. Then close up to the tail boom. Look exactly perpendicular on the helicopter lying on the side and take care the foil is positioned in the center and parallel on the tail boom. 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.

Repeat the complete procedure on the other side of the tail boom. In contrary to the diagram, the text label does not propagate from the front to the rear, but rather the other way around. Finally press the letters carefully on the tail boom.

Chapter – 11 **Settings**

Pitch

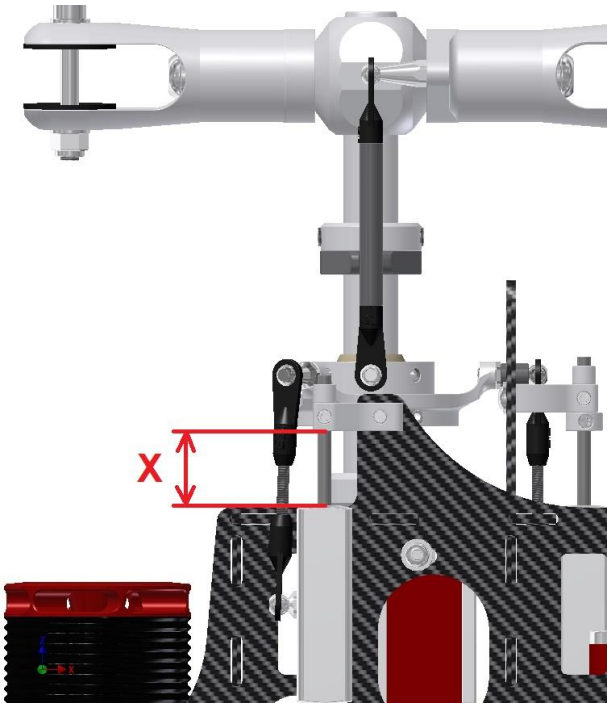
Starting from the basic setting of the swash plate in the neutral position (on page 26), in which the blade holders are 0 °, the desired pitch maxium and minimum values are first set. Follow the instructions of your FBL system.

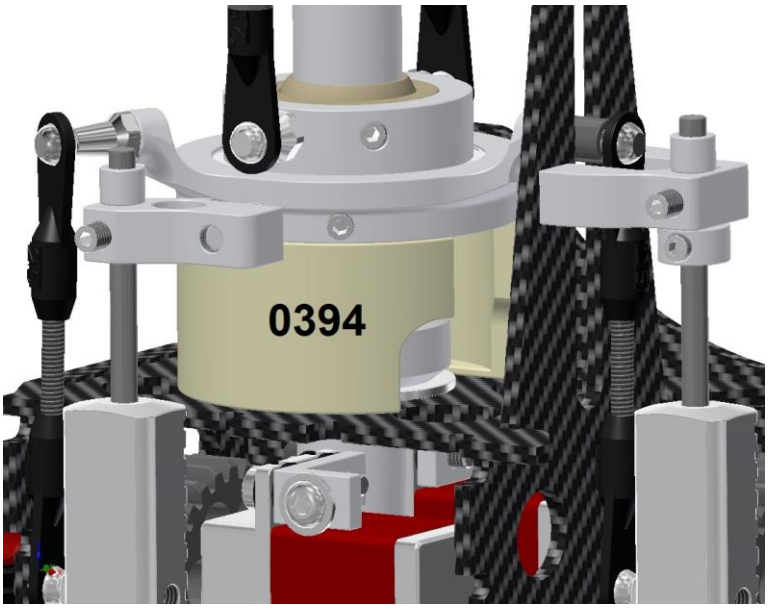
The kit also comes with a swash plate gauge 0394 with a height of 19mm, which is pushed between the upper bearing plate and swash plate (picture below right) to make the swash plate fine adjustment.

In general, this is not different with the **LDS** (**L**inear **D**rive **S**ystem) as with conventional swash plate control. I am not going so far into the full benefits and background of the system I have already introduced in the TDR-II, since a lot of articles have already been published. If you would like to have more detailed background information, you can also download the TDR-II manual and look there again, but the setting values described there can not be transferred to the **TDSF**, since the link geometry is somewhat different.

Due to the smaller lever arm of the toothed servo wheel, the servo forces do not have to be so high, and the high pitch angles will be achived by a greater servo way. Due to the linearity over the entire range, the adjustment of the desired pitch angle is very easy because you can simply measure the distance of the rack to the rack holder at 0 ° (**red X** - picture left below) and then adjust the difference in mm to get the desired Pitch value. A blade gauge is no longer necessary for measuring the maximum values.

1mm stroke of the rack corresponds to a blade angle of 3 °.





Gear rack stroke in mm	Pitchangle in degrees
0,5	1,5
1	3,0
1,5	4,5
2	6,0
2,5	7,5
3	9,0
3,5	10,5
4	12,0
4,5	13,5
5	15,0

For fine tuning of the swashplate servo neutral position you can use the swashplate gauge 0394 (see picture above). For better visibility, the left chassis plate is not drawn.

In the table (left picture), the corresponding pitch angles for adjusting the collective pitch are shown in steps of 0,5 mm. The values are of course also in the other direction for the negative pitch range, which is set just the same.

I recommend to set the maximum and minimum pitch values in the **yellow range** depending on the individual needs and the setup used.

More than 15 ° pitch are not recommended, because collective response will be to violently especially at higher rpm.

Under 13,5 ° pitch are also not recommendable, since here at particularly low speeds the climb performance is relatively moderate.

Next comes the point of the cyclic settings. The manufacturer of your FLB- system usually specifies a reference angle for the cyclic basic setting so that the system knows where. Often the value is between 6 ° and 8 °.

For this purpose, the swash plate should be at 0 ° position and then the menu point should be worked through according to the manufacturer's specification. Either the swash plate automatically moves to a cyclic position, which must then be measured and, if necessary, corrected until the predetermined reference value is reached, or it is necessary to move this value out of the horizontal position of the swash plate itself.

Also hereby you can measure directly on the rack how far it has to move in order to reach the desired reference value of the manufacturer.

That one cyclic servo rod moves downwards and the other upwards does not matter. As a result, only the swash plate remains at its predetermined height.
However, you can not take the table values for this because, in the case of cyclic moves, the swash plate does not slide up and down parallel to the rotor shaft, but makes a pivoting movement about its center point.
As a result, the difference between the different link ball positions between the inner ring and the outer ring results in a requirement.
That means the cyclic deflection on the blade grip is smaller than a collective one with the same tooth rack stroke.

Just calculate with the following values: 1mm toothed rack stroke is approx. 1.8 ° cyclic blade adjustment.
Now you only need to divide the required value by the degree and get the stroke to be set.
Example: 8 ° is required (so the tooth rack stroke would be 8 °**/** 1.8 ° = 4,5mm stroke).

For the measurement, give a pure aileron cyclic input without a elevator or collective pitch, then the one aileron servo rod moves downwards by 4,5mm and at the same time the other aileron servo rod moves 4,5mm upwards.
At its height, the swash plate remains unchanged in its position.

Finally, you usually have to program the cyclic maximum values and limit them by a software cyclic-ring.
The FBL- system ensures that when the cyclic input of aileron and elevator cames at the same time, the deflection does not become too great since both values add up. With this function, the swash plate always maintains the same maximum angle, no matter which direction you swing it.
This prevents mechanical boundary transitions.
In any case, activate this function, if this is not already the case automatically. Set your cyclic maximum values in the swash plate neutral position so that the reciprocating stroke does not exceed 9mm at the same time with a combined cyclic full aileron and elevator input.
However, close to the maximum collective pitch values, these values are then no longer achieved, but this does not matter.
After setting up in the operating mode, move the swash plate to the maximum values of all conceivable combined vertices to see if it mechanically jammed anywhere.
At the same time, carefully turn the rotor head from the top to the right (clockwise) to check whether there is any tension on the linkage in any position.

Of course, you can also make the whole setup with a classic pitch gauge, taking care that the helicopter is standing stable and that the blades are really at 0 ° when the swashplate is at the neutral position.
This must be done in any case at the latest now, if everything else is set so far anyway.
It is precisely with such a stiff system, that the tracking differences have a particularly negative effect on the flight performance.
Place the **TDSF** on a flat, non-slip support and install the main rotor blades.
Align the blades as accurately as possible and place the rotor head in a position along the helicopter so that one blade is above the tail tube. Then calibrate your pitch gauge on a reference surface on the helicopter, which is at right angles to the rotor plane, e.g. the engine cover.
The gauge should be placed as accurately as possible along the helicopter lateral axis, before setting it to zero. Turn the display screen towards the helicopter tip, because you can then also carry out the measurement on this side, namely on the rotor blade, which looks to the front.
Then attach the balance to the rotor blade and adjust the value of the linkage to zero. To do this, always pull off the linkage at the swash plate to adjust it.
Again, you do not need to try long, but can calculate. The M2.5 thread of the link rod has a pitch of 0.45mm. This means that the smallest possible adjustment, namely a half turn of the ball joint, causes a change of 0.225 mm. This corresponds to a difference of approx. 0.7 degrees.
In the worst case, this will reach 0.35 ° to your desired destination, which is quite sufficient. Try to get this on the other blade as well. However, your new value should correspond to the already set blade and not the previous desired value, since the absolute dimension is not decisive, but the equality of both blades is important.
To set the zero pitch, do not use this questionable method, where the rotor blades are turned through 90 ° in the blade holders so that the tips are positioned as indicators.
This can perhaps be done with a helicopter of the 450 size, with the blades much shorter and lighter, but not with a machine of the 700size class. The leverage forces acting on the swash plate are poison for the linkages, the ball joints and the servos.
Also, this type of measurement is not correct.

Tail

The setting of the neutral position has already been described on page 43, so that only the maximum deflections have to be limited. To do this, move the control stick to the maximum level, and adjust the percentages so that the control sleeve with the brass inner part touches the ball bearing in the right-hand side tail fin when the control stick is fully right.
When the control stick is fully extended to the left side, the brass part of the control sleeve should just touching the flattened surface of the tail rotor hub 0936.

Finally, check once again whether all servo deflections, both the swash plate and the tail rotor are moving the right way around and also control if the sensors work in the correct direction.
The swash plate always has to tilt in the opposite direction on all sides, into which you move the helicopter.
The tail rotor control bridge must move towards the gearbox housing when you rotate the fuselage to the left (counter-clockwise) as viewed from the top of the helicopter (rotor shaft axis).

ESC

I recommend to program 3 different roto rpm, the percentage values on the controller being between 50% and 85%.
Depending on the setup and individual preferences used, revs of 1000 rpm to 1500 rpm are recommended.
I myself use the following values: Idle Up1=1000 U/min, Idle Up2=1250 U/min, Idle Up3=1450 U/min.

Higher revs make no sense with the light **TDSF**, since here no flying advantage is achieved, but only unnecessary energy is wasted. The system is only loud and restless, and any midi servos that may be used will then reach their performance limits under unfavorable circumstances.
The tail rotor performance is also high enough at moderate speeds due to the high gear ratio of the belt drive.
Attention! the maximum permissible rotor speed for the **TDSF** is 1600 rpm.

Now two parameters should be adjusted. Once, the BEC voltage for the recommended HV servos should be set to 8V, and you may need to change the rotation direction of the motor when the motor is running in the wrong way.
Place the helicopter without rotor blades on the table so that it is stable and free. Switch off the engine on the transmitter and connect the flight battery. Switch the throttle to Idle Up1 for a second and look that the motor rotates correctly.

Note: When looking at the helicopter from above, the engine rotates to the left (counterclockwise) and the rotor to the right (clockwise).

Rotor blades

The main rotor blades should have a length of about 690mm to 715mm with a weight of 135g to 200g.
Also blades which are swinging to much forward during flight are not favorable, especially for small Midi-Servos.
I recommend our special ultra-light blades with a length of 710mm and a weight of only about 135g.
These blades make the helicopter even more light-footed and agile at low speeds than it already is.

As a tail rotor blade length, the X-Blades with 105mm length have proven themselves. Longer blades make no sense with the high tail rotor ratio.

Chapter – 12 First flight

Before flying, you should put the helicopter on the table again and look at it calmly from all sides. In the head once again everything go through.

- All screws have been tightened, even those which have been solved in the later construction phase.
- If all cables are securely routed, neatly inserted and secured if necessary.
- Operate all control inputs correctly and also control the sensors in the correct direction.
- If the rear blades are mounted correctly (please keep in mind that they are rotating differently with the **TDSF** than with most other helicopters).
- Are all linkages attached.

Take DRY FLUID GEAR and lubricate the main gear, if this has not already been done. It is best to apply the small toothbrush with the small enclosed brush. The pinion is then automatically greased by the pinion. Also grease the rack, if not already done.
Mount the cannopy and check whether the linkage of the swashplate touch it anywhere.

Look for a calm and dry day for the first flight. It makes no sense to fly a new model with hurry under adverse weather conditions just to get a little earlier in the air and then lose days after repairing the model.

There are also risks with a first flight. Always be on the safe side and ensure that there is sufficient safety clearance between you and the model.
Also, many curious people who are too close to the action are not exactly conducive for the own nerves.
Make a final Servo test, if everything goes right.

Attention! In any case, place the helicopter on a non-slippery surface such as grass. Even rough, dry concrete is a necessity, but grass is the best for the first flights. Dangerous are places with hard slippery subsoils or even ice.
This can lead to extreme ground resonances when the rotor is running up due to the slipping of the skids so that the helicopter will tip over.
Also make sure that the lower speed (idle up 1) is not set too low (controller should not be less than 50%), so that the blades can be aligned by the centrifugal forces.
Do not overtighten the blade screws, because just before the flight, when the blades are not aligned, the blades can shake very strong if they cannot orient themselves as early as possible by the centrifugal forces.
I always tighten the screws so that the blades are just clamped so tightly that they do not fold by their own weight while holding the helicopter in knife edge position. If you shake the helicopter a bit, they should do so.

Start the engine and run it up to Idle Up 1.
Get familiarize with the helicopter. If Idle Up 1 is a bit restless and does not yet run smoothly, briefly switch to the next higher speed and then down again, so that the blades align correctly.

Now you probably have to adjust your tail gain to the individual flight conditions and speeds.
Keep in mind that the hovering sensitivity can be set higher than in the fast forward flight.
You may be able to make a final adjustment a little later if you are familiar with the helicopter that you can fly it more spaciously and quickly.

Do not be astonished if the tail is swinging slightly during the first several flights while hovering and is not quite calm yet. This is because the new belt is still very stiff and does not really run smoothly. This will change soon and will improve from flight to flight.

It is also possible that the helicopter shakes a bit on the first flights when speeds of less than 1100 rpm are applied to the head. This is because the damping has not yet set and therefore is a bit too hard. Nothing can happen, it just looks a bit ugly. Just increase the rpm a little and fly the machine a few flights, then it will become better itself.

If the belt makes a loud whistle or chirping noises during the run-in process, you can also brush the teeth with Dry Fluid Gear. After that he usually runs quiet and soft.

If the belt regularly rings under load in the tailpipe, the belt tension can be increased slightly, by pretensioned the tail boom even a little stronger.

Note: Because of the lack of freewheeling and low weight, the autorotation characteristics of the **TDSF** are not as good as with conventional helicopters. Especially if then the ultra-light blades are mounted, you should not just use the helicopter as a trainer for autorotation training. For emergency autorotation in the event of a motor failure, it is always enough to land the helicopter in a controlled manner.

Finally, I still wish you many nice and relaxed flights with the **TDSF** with a very extraordinary flight experience.

For me it has become my favourite helicopter, which inspires me again and again.

To have so much joy with such a small drive and inexpensive equipment, as well as little effort, amazed me even after many hundreds of flights.

The fun factor with the **TDFS** is inversely proportional to the weight 😉

The maintenance or repair of the machine proves to be quite easy, because everything is very clear and easy to reach.

Please contact me by e-mail if there are any questions that I have not dealt with here in the manual.

From time to time, check for a more up-to-date version of the downloadable manual, as it incorporates the latest insights.

Jan Henseleit