Three-Dee

RIGID

Version 2010-2011

M a n u a l

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Jan Henseleit

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

Please read the manual before opening the bags

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Safety Advice

A remote controlled helicopter is not a toy and must be kept out of the hands of children.
Only correctly assembled helicopters, that are maintained regularly, after each flight, can function properly.
<u>Keep a safe distance from the helicopter and always assume that something may go wrong at any time causing it to become uncontrollable.</u>
If repairs have to be carried out only use original parts that you can order directly in my web-shop.
Lack of attention to detail, or mistakes in the helicopter assembly, or assembly of components and a lack of experience in using the radio control can result in the helicopter becoming uncontrolled and dangerous. Due to the enormous kinetic energy in the rotors, there is a risk of fatal injuries or death and damage of any type can occur due to lack of attention.
Therefore do not fly over people, cars or anything else that might be in danger. Safety is very important and is your responsibility, as the manufacturer and the sales agents have no control over the use or maintenance of the Three-Dee RIGID.
The company *Henseleit Metallverarbeitung* and it sales representatives are not liable or responsible for any damage or injuries arising from products out of their supply programme and therefore are not responsible in any way, as proper use or assembly can not be supervised by us.
I strongly recommend that you do not use products that are not documented and specified in my handbook. An up to date spare part price list can be obtained from me or my sales agents. You also will find current information on my website.
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Jan Henseleit

Three-Dee RIGID

The **TDR** was the first 1.6 meter class production helicopter worldwide which was only delivered with a Rigid main rotor for flybarless flying.
In my opinion the flybar will not be used any more in future. Due to the technological progress the rise of the electric helicopter in all sizes cannot be prevented any more either. The advantages prevail concerning nearly all points, so that the further development is more or less predictable.
Because of the apparent demand for flybarless electric helicopters the development of a light system without any compromises was the consequent step to apply new standards and to get a compact model especially being adjusted to the 3 axis stabilisation, which perfectly supports the completely new possibilities.

Concept:
In general it is not possible to re-invent the wheel. Over the years I have presented innovations and tried various possibilities that have also been adapted in other areas. Some day you approach a constructive solution offering all possible physical features.
There are always different possibilities to achieve the aim. However, after some time there is also the danger that only the design is modified not resulting in flight-technical advantages. I am interested in building a system that is determined by a clever assembly of the absolutely necessary components and a minimum number of parts.
In my opinion a straight and clear design is the advantage of this helicopter. For the first time I decided to use a two-stage drive in my helicopters.
Due to the positive experiences using the MP series with the spiral cut gear wheels module 1 concerning the efficiency, robustness and operating noise the different constructive advantages prevail in spite of the small loss caused by the second stage.
In contrast to the predecessor possible savings could be achieved because the production of the smaller gear wheels is less complex and problematic and the one-way drive shaft can be smaller because it is mounted on the intermediate shaft.
In opposite to belt driven systems the efficiency is much higher which save a lot of battery power.
The rigidity of the entire mechanics is increased without using additional stiffening elements. The extremely compact assembly of the transmission unit which is the core of the mechanics results in an optimal assembly of the two tail boom mountings that are located far from each other as well as an optimal support of the main rotor shaft.
The distance between the upper mount plate and the compact main rotor centre hub is smaller than in any other helicopter of this size, so that the bending stress on the hollow 10mm main rotor shaft does not cause any problems.
The complete tail gear drive has got an improvement and in opposite to the TDR-2009 all gears are manufactured with milling machines so that the tolerance is much better than of the injection plastic gears before.
A horizontal stabiliser was not used any more. This part is not really necessary and it interferes with the flight. Besides it increases the weight as well the vibrations and is difficult to transport (it is amazing how much easier it is to place the helicopters without horizontal stabiliser next to each other and turned by 180° in the car).
Thanks to the remarkably slender and futuristic design of the helicopter you do not miss the horizontal stabiliser.

For people who have not much space in their cars it is especially advantageous that the tail boom including the front pinion, the struts and the push rod can be removed from the helicopter within less than a minute.
In order to do so, you only have to detach both struts as well as the push rod in the front area of the mechanics, loosen the two lower attachment screws of the tail boom holder and pull out the tail boom to the back.
The tail boom is automatically fixed at the correct position in the front holder, so that it is always exactly aligned after having been pushed in.
The carbon chassis structure can be divided into the upper and the lower part, whereas the robust upper part includes all components necessary for the flight and the lower part only contains the battery and my obligatory skid plates.
Thus the light mechanics can perfectly be integrated into the fuselages because for this purpose the lower part can be removed completely in order to mount corresponding fastening angles. The advantage of a mechanics consisting of a flyable upper part where only a stable battery support and the skid plates are attached at the lower area is its great flexibility for different individual uses that can be realised later.
All batteries up to dimensions of 60x60x360mm can easily be inserted into the protecting slot of the „Rigid“ from the front as well as from the back.
The spacers are covered with a silicon tube such that the battery is held in a non-slip and safe position by only two Velcro strips.
The entire mechanics is extremely easy to maintain and can be mounted and dismounted quickly.
The gear stages can be assembled and disassembled individually without having to dismount the entire mechanics. It is also possible to assemble and disassemble all servos without dismounting the mechanics.
After adding the recommended equipment inclusive blades the helicopter ready to fly has a weight of about 3,1kg without the drive battery.
Using a 12s accumulator of 3700mAh and 1200g a take-off weight of nearly 4.3kg can be reached, which is an amazing value for an all-metal carbon helicopter with this rigidity, stability and life time.
The futuristic canopy with its distinctively surrounding line as well as its concave recesses guarantees a considerably better visibility due to the increased height. It also underlines the very compact appearance.
The low distance between the upper side of the mechanics and the main rotor results in completely new proportions. Thus the actual rotor is located directly above the canopy, which gives the helicopter a very racy design.
People who know me have experienced that I set a high value on 3D performance as well as on fast speeds since I have built my first helicopter, the old, blue Three Dee. In my opinion there is nothing more elegant and fascinating than a helicopter dashing through the air with high speed and blade noises like a pod racer.
That is the reason why the Rigid canopy was designed a bit more aerodynamically which is shown by the extreme high speed flight qualities, forwards as well as backwards.
The V-Stabi electronic system offers completely new perspectives regarding the high speed flight, which were not possible when using a flybar. So the advantage of an aerodynamic casing is even more considerable.
Try speeding. It is fun, looks elegant and helps to relieve stress and to relax.
During the flight events it is a popular alternative to flying within a small area of 10x10 m which is nowadays quite common. For the „aged ones“ among us who are older than 25 years old it is still good to cope with because it does not require such quick reactions but more sensitiveness and an eye for spacing.
You will also enjoy loopings with a diameter of 150 m or nice slow rolls like being drawn over the entire field on a string.
But be careful, slowly approach spacious flying over longer distances, it has to be learnt!

For many years I have known of the problems that layman have during the quite complicated lacquering process. That is why I developed a high-quality, UV resistant decal set with a window and a comet tail to give the helicopter a typical, distinctive design. It can be attached by every reasonably skilful user.
The result looks like a high-gloss clean lacquering without frayed edges and is much cheaper and quicker to apply than every kind of lacquering.
In general, it was my aim to keep the costs of replacement parts as low as possible, so that the nice helicopter will not only be used on Sundays. That is why I decided to use again my well-proven blackly anodised 25mm aluminium tail boom. In my opinion the still increasing costs for carbon tail booms because their more precious look are not justified and after a crash they can be a considerable cost factor.

When using a flybarless helicopter the flight properties mostly depend on the used stabilisation electronics to emphasise the quality and performance of the mechanics. So I recommend the flybarless V-Stabi system developed by Uli Röhr and distributed by Mikado.

The recommended engine using a Pyro 700–52 (with standard shaft) in connection with the successfully operating Jive controller not requiring any receiver power supply is the optimal configuration for this helicopter at present.
Test flights have shown that this setup in 12s operation allows a speed of approx. 1900 rpm at a pitch of up to 14 degrees, if necessary.
I think that the standard Pyro 700-52 or something similar like the Scorpion 4035-560KV with about 3 to 4kw is strong enough for 98% of the pilots.
There are motors with more power but the difference in maximum speed is so little that it makes no sense in my eyes. I think that stronger motors can be an option for people who only wants to fly fast on a long straight distance. (for records and so on) If you dive down from a higher altitude you will have no difference in speed.
The disadvantages of big motors is a higher weight and a much higher temperature which will stress the plastic gear of the first gear step. So have to be very carefully not to break many gears during flight because of to high temperature.

Also bigger batteries will be necessary which also add up weight and the complete helicopter gets very hot under the canopy which may ends in electronic failure.
A easy way to otimize the TDR with the recommended motor for speeding is to set the ESC to 100% and use 15 teeth pinion with a 12s setup than you will have plenty of power and speed ☺
In this configuration there are some details which you have to observe. You will find some informations about that in chapter **XV “Directions for initial flight”**

In general, this light helicopter also allows an 10s operation with brilliant performance values. Because of the low difference in price between the 10s and 12s batteries the decision which battery to use is problably not too difficult.
Flight attempts have shown that a slightly higher capacity is needed for the same flight time when using 10s batteries. The reason for this is the higher power consumption at a lower voltage. Thus the balance of weight between the 10s and the 12s is compensated.
The advantage of the 12s is that it offers more power during extreme manoeuvres.
Apart from that the use of 10s provides more power than every optimally adjusted glow version.
In connection with the development of the Rigid numerous test flights with a logger data capture were carried through, which persuaded me to refrain from the exaggerated present max rotor speed hype.
Thanks to light models with flybarless main rotors it is not necessary any more to race with a rotor head speed exceeding the limit of 2000. The properties when flying straight on are even fantastic at 1300 rpm at the main rotor. Every flybar head helicopter would pitch up hopelessly at these manoeuvres.
Most of the 3D figures can be flown because of a lower rotor disc load also using a more moderate head speed. So more than 1800 rpm at the main rotor are unnecessary when flying this helicopter.
The logger data show that the efficiency of the blades decreases rapidly with increasing head speed, so that most of the energy is wasted.
For the same flight condition „Hovering at one position“ 570W is required at 1300 rpm at the rotor and at 1850 rpm you already need 1000W. At more than 2100 rpm 1500W are required, i. e. nearly the triple amount, although you do nothing more than hovering.
This result shows clearly that the flight time can be increased considerably, if the rotor does not constantly rotate at full speed. All these results have contributed to and influenced the choice of the speed reduction and the recommended drive of the Rigid.
Only exception to fly with higher rotor rpm is for speed competitions were the flight time is not important (please also look into chapter XV)

Bag	Part-No.	Term	pcs.
(-1-)		**MAIN ROTOR**	
	RI - 0100	FLYBAR LINK GUIDE	2
	RI - 0100a	STUD 2x 20	2
	RI - 0102s	O - RING 16x2.5 hard	4
	RI - 0103	ROTOR BRAKE CAP	1
	RI - 0105b	HEXAGON SOCKET SCREW M3x 8	2
	RI - 0105c	HEXAGON SOCKET SCREW M3x 12	2
	RI - 0107	SPACER WASHER 8x 14x 0,2	2
	RI - 0109-2010	O - RING INNER BUSHER	2
	RI - 0110-2010	FEATHERING SPINDLE tempered	1
	RI - 0111-2010	SPACER WASHER 8x 14x 0,2	2
	RI - 0113	RADIAL BEARING 8x 16x 5	4
	RI - 0114	BLADEHOLDER	2
	RI - 0115	AXIAL BEARING 8x 16x 5	2
	RI - 0116	PITCHARM	2
	RI - 0116a	THREADED LINK BALL M3x4 / 4 long	2
	RI - 0117	SPACER WASHER 5x 10 x 1	2
	RI - 0119	HEXAGON SOCKET SCREW M5x10 -12.9	2
	RI - 0120	CENTRE HUB	1
	RI - 0121a	BRASS BUSHING	2
	RI - 0121b	BALL LINK 15mm long	4
	RI - 0121c	STUD BOLT M2,5x 25	2
	RI - 0136	CENTRE HUB BOLT M4x18	1
	RI - 0136a	NUT - M4 flat	1
	RI - 0138	SHANKED BLADE BOLT	2
	RI - 0138a	NYLOC NUT - M4	2
	RI - 0138b	SPACER FOR ROTORBLADES	4
	RI - 0140a	FEATHERING SPINDLE SEESAW	1
	RI - 0140b	FLANGED BEARING 8x 16x 5	2
	RI - 0140c	COUNTER SUNK SCREW M5x 8	2
	RI - 0140d	GRUB SCREW M4x 4	1
(-2-)		**CHASSIS**	
	RI - 0201	UPPER CARBON SIDE FRAME	2
	RI - 0202	BOTTOM CARBON SIDE FRAME	2
I	RI - 0221	BEARING SUPPORT	1
I	RI - 0222	BEARING SUPPORT	3
I	RI - 0223	RADIAL BEARING 10x 22x 6	4
II	RI - 0232	TAIL BOOM HOLDER FRONT	1
II	RI - 0233	TAIL BOOM HOLDER BACK	1
II	RI - 0236	CANOPY MOUNT	2
II	RI - 0237a	STUD BOLT M3x 72	4
II	RI - 0237b	WASHER M3 large	6
II	RI - 0237c	NYLOC NUT M3	6
III	RI - 0238	STUD 6x 58 / M3	3
III	RI - 0238a	SILICON TUBE (for 0238)	3
III	RI - 0239	STUD 6x 62 / M3	3
III	RI - 0239a	SILICON TUBE (for 0239)	3
IV	RI - 0241	SKID CLAMP	4
IV	RI - 0242	SKID PLATE HOLDER	4
IV	RI - 0243	SKID CAP	2
IV	RI - 0245	STUD 6x 62 / M4	2
IV	RI - 0245a	SILICON TUBE (for 0245)	2
IV	RI - 0245b	UNDER CARRIAGE STUDDING M4 x 20	4
IV	RI - 0246	PHILLIPS SCREW M3x8	4
IV	RI - 0247	WASHER M3 large	8
IV	RI - 0249	NYLOC NUT M3	4
	RI - 0250	SENSOR BOTTOM PLATE	1
V	RI - 0250a	HEXAGON SOCKET SCREW M3x12	2
	RI - 0252	CONTROLLER SUPPORTING PLATE	1
III	RI - 0253	CANOPY MOUNTING BOLT FRONT	2
III	RI - 0253a	RUBBER END CAP	2
III	RI - 0253b	STUD BOLT M3x 16	2
I2 / III6	RI - 0254	DOME HEAD SCREW M3x 8	8
I	RI - 0255	HEXAGON SOCKET SCREW M3x8	14
III	RI - 0256	HEXAGON SOCKET SCREW M3x10	6
I14/III8	RI - 0257	WASHER M3 small	22
III	RI - 0263	NYLOC NUT M3	2
(-3-)		**OTHER PARTS**	
	RI - 0301	GLASS FIBRE CANOPY	1
	RI - 0303	CANOPY DECAL - window	1
	RI - 0304	CANOPY DECAL - tail of a comet	1
	RI - 0305	RUBBER GROMMET	2
	RI - 0306	SAFETY PIN	2
	RI - 0321	CARBON VERTICAL STABILIZER	1
	RI - 0333	TDR DECAL red	1
	RI - 0334	TDR DECAL yellow	opt.
	RI - 0339	SKID PLATE	2
	RI - 0340	SKID	2
	RI - 0350	CABLE TIE	10
	RI - 0355	SILICON EDGE PROTECTION	1
	RI - 0360	VELCRO for battery	2
	RI - 0394a	SWASH PLATE GAUGE 12mm	1
	RI - 0394b	SWASH PLATE GAUGE 6mm	1

Bag	Part-No.	Term	Stk.
(-4-)		**MAIN SHAFT UNIT**	
	RI - 0400	SWASH PLATE	1
	a	THREADED LINK BALL M3x3 / 9 long	3
	b	THREADED LINK BALL M3x4 / 9 long	2
	c	DOME HEAD SCREW M3x 6	3
	d	WASHER M3 small	3
	RI - 0410	ROTOR SHAFT (hollow)	1
	RI - 0412	SPACER BUSH 40mm	1
	RI - 0413	SPACER BUSH 11,5mm	1
	RI - 0414	MAIN SHAFT GEAR FLANGE	1
	RI - 0414a	HEXAGON SOCKET SCREW M4x 18	1
	RI - 0414b	NYLOC NUT M4	1
	RI - 0414c	WASHER M4	1
	RI - 0415	SPACER WASHER 10x 16 x 0,5	1
	RI - 0416-2010	MAIN SHAFT GEAR	1
	RI - 0416a	HEXAGON SOCKET SCREW M3x 12	6
	RI - 0417	SPACER WASHER set (10x16x0,2 / 0,3)	PE
(-5-)		**INTERMEDIATE SHAFT UNIT**	
	RI - 0506	GEAR WHEEL intermediate shaft	1
	RI - 0510	INTERMEDIATE SHAFT	1
	RI - 0515	SPACER WASHER 10x 16x 0,5	4
	RI - 0516	INTERMEDIATE SHAFT PINION	1
	RI - 0517	SPACER WASHER set (10x16x0,2 / 0,3)	PE
	RI - 0518	ONE WAY DRIVE FLANGE assembly	a-c
	RI - 0518a	ONE WAY DRIVE FLANGE	1
	RI - 0518b	ONE WAY DRIVE 10x 14x 12	1
	RI - 0518c	RADIAL BEARING 10x 19x 5	2
	RI - 0524-2010	CROWN GEAR	1
	RI - 0525	HEXAGON SOCKET SCREW M3x 8	12
	RI - 0526	CROWN GEAR FLANGE	1
	RI - 0527	GRUB SCREW M5x 5	2
(-6-)		**LINKAGE & SERVO MOUNT**	
III	RI - 0616	SWASH PLATE ANTI ROTATION GUIDE	1
III	RI - 0616a	HEXAGON SOCKET SCREW M3x12	2
III	RI - 0616b	WASHER M3 small	2
I	RI - 0630a	BALL LINK 15mm long	2
I	RI - 0630b	THREADED ROD M2,5 / 52mm	1
I	RI - 0630c	PLASTIC SPACER BUSH 39mm	1
I	RI - 0630d	BALL LINK / 19,5mm long	4
I	RI - 0630e	THREADED ROD M2,5 / 45mm	2
	RI - 0631	CARBON TAIL PUSH ROD 807mm	1
IV	RI - 0632	BALL LINK / 19,5mm long	1
IV	RI - 0633	STUD BOLT M2,5x 25	2
IV	RI - 0635	SCHRINKAGE TUBE for 0631	3
IV	RI - 0636	CLEVIS M2,5	1
I	RI - 0638	THREADED LINK BALL M2x5 / 3 long	3
I	RI - 0638a	NUT M2	3
II	RI - 0642	SERVO ATTACHMENT PLATE M2,5	4
II	RI - 0643	PHILLIPS SCREW M2,5x 12	16
II	RI - 0643a	WASHER M2,5	16
II	RI - 0645a	FOR & AFT SERVO SUPPORT	2
II	RI - 0645b	SUPPORT FRAMING SQUARE	2
II	RI - 0645c	LENS HEAD SCREW M3x 8	2
II	RI - 0645d	HEXAGON SOCKET SCREW M3x8	2
II	RI - 0645e	WASHER M3 large	2
II	RI - 0646	TAIL SERVO SUPPORT	2
II	RI - 0646a	HEXAGON SOCKET SCREW M3x10	2
II	RI - 0646b	WASHER M3 large	2
(-7-)		**ENGINE MOUNT**	
	RI - 0706	PINION 13 tooth (opt. 14 T / 15 T / 16 T)	1
	RI - 0706a	GRUB SCREW M4x 4 (for 0706)	1
	RI - 0706b	SPACER WASHER 1,0x 6x 12	1
	RI - 0706c	SPACER WASHER 0,5x 6x 12	1
	RI - 0706d	SPACER WASHER 0,3x 6x 12	1
	RI - 0706e	SPACER WASHER 0,2x 6x 12	2
	RI - 0706f	SPACER WASHER 0,5x 8x 14	1
	RI - 0706g	SPACER WASHER 0,5x 10x 16	1
	RI - 0716	MOTOR PLATE	1
	RI - 0716a	HEXAGON SOCKET SCREW M3x 12	4
	RI - 0716b	WASHER BRASS thick	4
	RI - 0717a	HEXAGON SOCKET SCREW M4x 16	3
	RI - 0717b	WASHER M4 small	3
	RI - 0720a	COUNTER BEARING HOLDER	1
	RI - 0720b	RADIAL BEARING 6x 19x 6	1
	RI - 0720c	HEXAGON SOCKET SCREW M4x 30	3

Bag	Part-No.	Term	pcs.
(-8-)		**TAIL BOOM**	
	RI - 0800	BOOM 25x920mm	1
	RI - 0801-2010	SQUARE HEADED COUPLING	2
	RI - 0801a	GRUB SCREW M4x4	2
	RI - 0802	CARBON BOOM SUPPORT 580mm	2
	RI - 0804	ATTACHING BALLS for 0807	2
	RI - 0804a	LENS HEAD SCREW M3x 8	2
	RI - 0805	BOOM SUPPORT END	2
	RI - 0805a	HEXAGON SOCKET SCREW M3x 25	1
	RI - 0805b	NYLOC NUT M3	1
	RI - 0807	BALL LINK 8mm	2
	RI - 0807a	THREADED ROD M3,5x 30	2
	RI - 0808	TAIL PUSH ROD SUPPORT front	1
	RI - 0809	CARBON BOOM SUPPORT CLAMP	1
	RI - 0810-2010	TAIL DRIVE SHAFT 852mm	1
	RI - 0813-2010	DRIVE SHAFT BEARING assembly	a-f
	a	BEARING SUPPORT	2
	b	RADIAL BEARING 10x 15x 4 lose	2
	c	BEARING BUSH	2
	d	COLLET	2
	e	FINE PITCH THREADED NUT M8x1	2
	f	LOCKING WASHER	2
	g	O - RING 16x2.5 hard	2
	RI - 0824-2010	PINION for taildrive	1
	RI - 0824a	GRUB SCREW M4x 4	1
	RI - 0828	BEARING FLANGE assembly	a-d
	a	BEARING FLANGE	1
	b	RADIAL BEARING 8x 16x 5	2
	d	HEXAGON SOCKET SCREW M3x 6	2
	RI - 0830-2010	PINION SHAFT	1
	RI - 0831-2010	CLUTCH	1
	RI - 0831a	CLUTCH INSERT	1
	RI - 0831b	GRUB SCREW M4x 6	1
	RI - 0833	TAIL BOOM DECAL	2
(-9-)		**TAIL GEAR BOX**	
	RI - 0900	TAIL GEAR HOUSING assembly	a-b
I	a	TAIL GEAR HOUSING	1
I	b	FLANGED BEARING 5x 13x 4	4
II	RI - 0902	BEVEL GEAR STEEL	1
II	RI - 0902a	GRUB SCREW M4x 4	1
I	RI - 0903-2010	BEVEL GEAR PLASTIC	1
I	RI - 0904-2010	INPUT SHAFT	1
I	RI - 0904a	LENS HEAD SCREW M4x6	1
I	RI - 0904b	WASHER M4 large / 1,2 thick	1
II	RI - 0907-2010	SPACER BUSH 5x 6,5x 21,7mm	1
II	RI - 0907a	SPACER WASHER 5x 10x 0,2	3
II	RI - 0907b	SPACER WASHER 5x 10x 0,1	1
II	RI - 0910-2010	TAIL OUTPUT SHAFT	1
IV	RI - 0911	HEXAGON SOCKET SCREW M3x6 - 10.9	2
III	RI - 0915a	TAIL PITCH CONNECTING ROD	2
III	RI - 0915b	PIN 2x8mm	2
III	RI - 0916-2010	TAIL PITCH SLIDER assembly	1
IV	RI - 0917	SPACER WASHER 3x 6x 1	2
IV	RI - 0919	RADIAL BEARING 5x 10x 4	4
IV	RI - 0920	SPACER WASHER 5x 8 x 0,5	2
IV	RI - 0921	AXIAL BEARING 5x 10x 4	2
IV	RI - 0924	THREADED LINK BALL M3x 3 / 9mm long	2
IV	RI - 0925	HEXAGON SOCKET SCREW M3x 18	2
IV	RI - 0925b	PLASTIC SPACERS for tail blades	4
IV	RI - 0925c	NYLOC NUT M3	2
IV	RI - 0927-2010	TAIL BLADE HOLDER	2
I	RI - 0931	CLUTCH	1
I	RI - 0931a	CLUTCH INSERT	1
I	RI - 0931b	GRUB SCREW M4x 4	1
IV	RI - 0936	CENTRE HUB	1
IV	RI - 0936a	GRUB SCREW M4x4	1
V	RI - 0937	SPECIAL BUSH for tail gear box fastening	1
V	RI - 0937a	HEXAGON SOCKET SCREW M3x 16	1
V	RI - 0938	BELL CRANK MOUNT	1
V	RI - 0938a	HEXAGON SOCKET SCREW M3x 22	1
	RI - 0939	BELL CRANK assembly	a-i
VI	a	BELL CRANK	1
VI	b	FLANGED BEARING 3x 7x 3	2
VI	c	SPACER	1
VI	d	THREADED LINK BALL M2x4 / 3mm long	1
VI	e	SPACER WASHER 3x 6x 1	2
VI	f	PLASTIC SLEEVE	1
VI	g	NUT M2	1
VI	h	CHEESE HEAD SCREW M2x5	1
VI	i	HEXAGON SOCKET SCREW M3x16	1
V	RI - 0941a	HEXAGON SOCKET SCREW M3x 6	2
V	RI - 0941b	WASHER M3 small	3

Technical Data and Equipment Recommendations:

Production and distribution:	Henseleit Helicopters
Diameter main rotor	up to 1620mm
Main rotor blades	680 - 720mm
Recommended main rotor blades	710mm / approx. 63mm deep/ 185g
Tail rotor blades	up to 110mm carbon blades (recommended 105mm)
Weight ready to fly equipped without drive battery	3.1kg
Take-off weight according to used drive battery	4.0 – 4.9kg
Take-off weight with battery recommended by manufacturer	4.3kg
Length top of canopy to end of tail unit	1420mm
Total height	370mm
Maximum width of skids	200mm
Maximum width of canopy	140mm
Recommended engine	Pyro 700-52 (standard shaft)
Recommended controller	Jive 80+ HV or Jive 120+HV
Recommended speed reduction for 12s operation	12.36 : 1 (13 teeth pinion) or 11,47 : 1 (14 teeth pinion)
Recommended speed reduction for 10s operation	10,04 : 1 (16 teeth pinion) or 10.71 : 1 (15 teeth pinion)
Fixed, unchangeable speed reductions:	
Transmission ratio main rotor to tail rotor	1 : 4,93
Speed reduction intermediate shaft to main rotor	2.55 : 1
Recommended main rotor speed:	1300 - 1900 rpm
V-max (during horizontal straight on flight)	185 km/h
V-max which we have got from a high altitude dive	250 km/h
Recommended RC installation (frequency)	2.4 Ghz
Servos: (high-quality strong and fast digital servos of standard size)	

General information for the assembly

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 get easily stuck and lose track.
It is not sufficient to view only the images, because the text contains important instructions that have to be considered in any case.
The assembly groups are packaged in 9 separate plastic bags. Each plastic bag is labelled with the name of the assembly group. Bulky or long parts are packaged separately. Complex assembly groups with a great number of small parts are separated into several smaller bags. These bags are consequently numbered. Bags containing parts which can be clearly identified and not additionally labelled.
In every stage of the assembly please open only the bags you need. The bag's label consists of two digits separated by a hyphen (e. g. 2 - **I**). This is the bag **I** of the assembly group mechanics chassis (2). The first digit specifies the assembly group and indicates the first digit of the order number of the parts of the assembly group (the order numbers of all parts of the mechanics chassis start with 02..).
The Roman digit following the hyphen (e. g. – **I)** numbers the corresponding bag of the assembly group. The instructions always tell you which bag you have to open at a certain moment. The parts of one bag generally belong together, so that you keep an overview.
Please do not open all bags at once and do not pour them out. In the parts list on page 9 you can find all parts of the helicopter classified according to assembly groups and with their order numbers in ascending order. In the first field you can see the Roman digits, if they are used in certain assembly groups.

Attention! The drawings and 3D animations in the manual show a right-hand rotation MP. If you want to build a left-hand rotation Rigid, you have to turn around the one-way drive shaft (for details see corresponding chapter).
In addition, the rotor head has to be assembled in a mirror-inverted way to the drawing in the manual and the tail rotor has to be turned by 180° and then to be fixed to the tail boom. The blade holders have to be controlled from the correct side.

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!

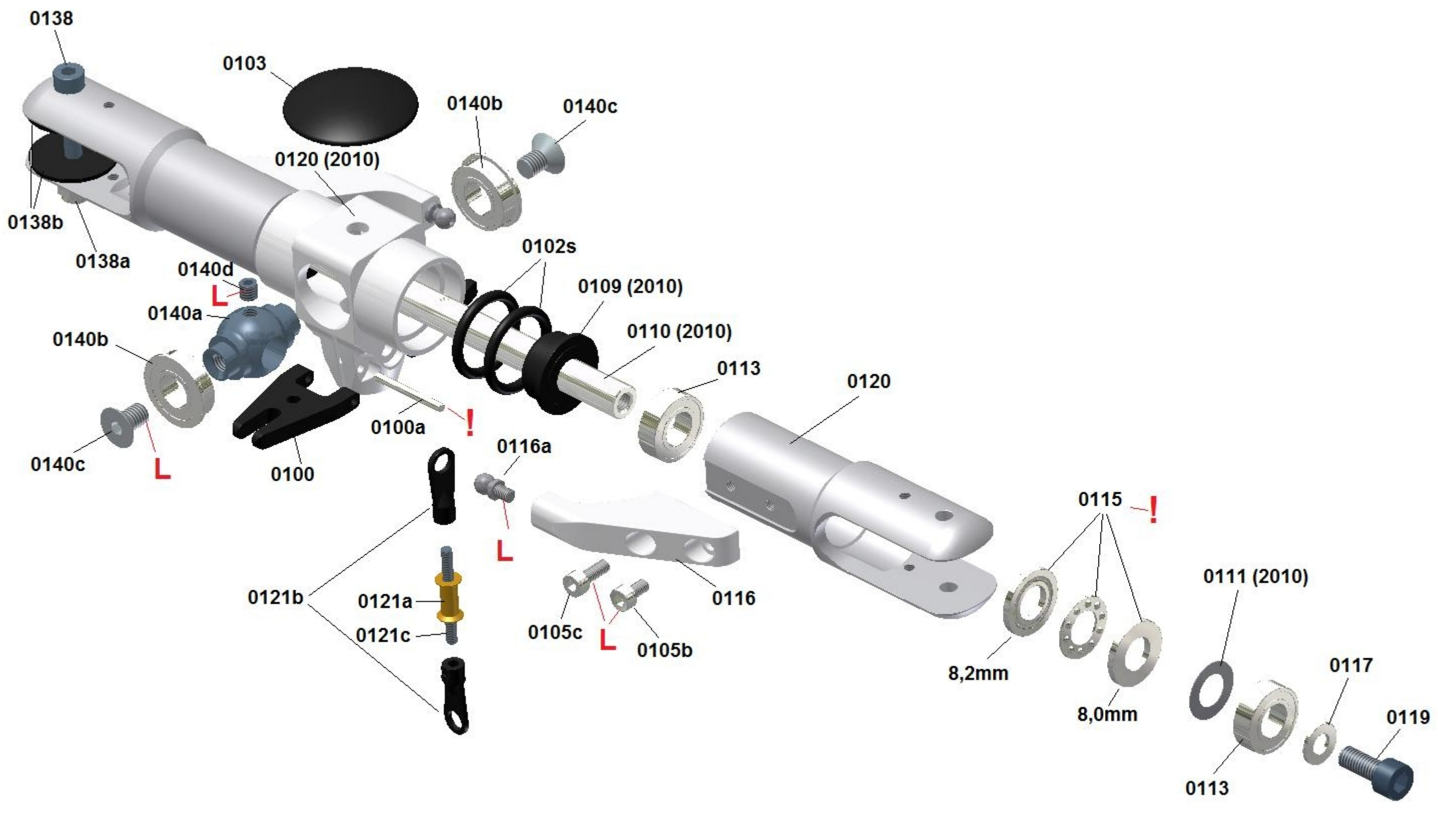
Attention! Screws, which need to be tightened with Loctite are marked with a red "L". Use the blue Loctite "medium strength" or a similar product. Especially with the small grub screws do not use too much Loctite. Otherwise, you may have problems unscrewing the grub screws.
It is not necessary to tighten all screws of the electric Helicopter with Loctite because they do not get loose depending on the kind of stress. Especially the dome head screws can hardly be unscrewed if using Loctite because of their small hexagon.
In general, all grub screws and threaded link balls as well as the screws 0911 of the tail centre hub have to be degreased and tightened with Loctite. The caphead screws allowing to attach the gears to their corresponding flange also have to be tightened with Loctite because the plastics sets after a certain time and the screws may thus become loose.

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

In case that some items do not fit, do not use excessive forces. 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.
Before assembling the parts all edges around the carbon fibre reinforced plastic parts in the carbon fibre reinforced plastic parts bag should be de-burred using a strip of flexible sandpaper to chamfer the sharp edges. It is recommended to de-burr all the parts at once, so you have to wash your hands only once. Please do not let the carbon dust come into contact with other parts of the mechanics or the ball bearing, as it would act like a grinding compound.

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. A small extra bag (Reserve Kleinteile) containing some established replacement screws and ball links has been added to the kit. So 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!



The swash plate driving fork 0100 has already been mounted by us. After having been inserted the stud was tightened in the middle using Loctite where it can be seen through the clamping slot of the centre hub. If the fork breaks during a crash it is recommended to cut one side of the fork using a pair of nippers to remove the the stud 0100a. Then the stud can be removed using nippers by turning it.
Always replace the stud when changing the fork because it has been damaged by the nippers. During re-assembly the fork is positioned first and then the stud is slid through the hole without using Loctite and aligned in the middle. Now a drop of Loctite is applied to the middle of the stud using a needle (at the place where the clamping slot of the centre hub is located). In any case do not apply any Loctite to the stud hole of the centre hub. Otherwise you press the Loctite into the hole of the fork when inserting it and it gets stuck!

The feathering spindle seesaw 0140a has also been pre-mounted by us. For a possible later disassembly first unscrew the two countersink screws 0140c and then remove the feathering spindle. Screw a slightly longer M5 screw from one side in one of the M5 threads of the seesaw. You can push out the seesaw on the side with one of the flange bearings 0140b by slightly hitting on the protruding screw head. The other bearing can be pushed out from inside using a mandrel. This can be facilitated by slightly heating the centre hub.

First attach the blade holders to the corresponding bearings. Attention! To avoid mistakes proceed as described below. First the two inner bearings 0113 showing towards the centre hub are pushed into the corresponding blade holders. It is recommended to heat the blade holder slightly using a hot air gun. Make sure that the bearing rests rectangular and that it does not tilt when assembling it. Now attach the thrust bearing from the fork side. First grease the ball cage thoroughly (add tenacious grease in the hollow side of the sheet cage). Mind the correct order as shown in the drawing. To attach the single rings in the hole, they have to be inserted at the side and crosswisely into the fork and then they have to be tilted in the turned recess. Make sure that the rings do not turn by 180° when sliding into the blade holder hole. The corresponding chamfer must point to the ball cage. It is recommended to insert a thinner stud into the bearing ring hole and to push it into the blade holder to prevent the rings from turning.
First insert the ring having an inner diameter of 8.2mm into the blade holder. Then attach the ball cage with the hollow side turned to the 8.2mm ring and at last add the ring with the inner diameter of 8mm. The spacer washer 0111 (0.2x 8x 14) and then the second radial bearing 0113 are inserted.
Attention! To prevent the second radial bearing from tilting proceed as described below. Provisionally push the feathering spindle 0110 through the already mounted bearing in the blade holder. Slide the remaining bearing in the fork at the side and push it onto the end of the feathering spindle. Tighten one of the black M5 screws loosely in the thread of the feathering spindle and pull the bearing into the hole of the blade holder using the feathering spindle end looking out at the back. It is also recommended to heat the blade holder slightly.
Due to this measure the bearing cannot tilt or jam, because it is aligned to the longitudinal axis of the blade holder by the feathering spindle. Then remove the feathering spindle and assemble the second blade holder in the same way.

At last the blade holder arms 0116 are tightened to the blade holder 0114 using the corresponding screws and Loctite. Before tightening the screws 0105b and 0105c pull the arms in the play of their holes towards the main rotor centre and make sure that they rest properly on the bottom of the blade holder cutout. The threaded link ball 0116a is tightened using Loctite.

Attach the O-rings 0102s with the feathering spindle bushings 0109-2010 to the centre hub. Slightly grease the O-rings. Slide the feathering spindle 0110 into the centre hub. Make sure that the seesaw 0140a is turned such that the grub screw 0140d points to the top (do not yet thighten the grub screw!).

Push the preassembled bladholder onto the feathering spindle.
It can occur that the blade holder pre-mounted to the bearings cannot be slid on completely although the bearing can be moved onto the feathering spindle easily. A shifted spacer washer 0111 that has moved and is not located in the middle prevents it from being moved further. In this case use a stud and centre the washer such that it is aligned to the other holes of the ball bearing in the blade holder.

Secure the blade holders using the washers 0117 and the screws 0119 (Attention! The black screw 0119 has a great rigidity and may only be replaced by an original replacement part. Conventional screws may break. After tightening the screws the blade holders must have centered automatically and they have the same distance to the centre hub. By tilting the seesaw to the stop the blade holders strike the plastic bushing, so that the feathering spindle is better centered in the middle. If there is a remarkable axial play, thin spacer washers can be added between the feathering spindle bushing 0109-2010 and the first bearing 0113. Always use the same size on both sides (in the bag with the O-rings there are two spacer washers 0.2x 8x 14).

Now tighten the grub screw 0140d well from above through the 5mm hole in the centre hub. Use Loctite and slightly cover the grub.
Attention! Avoid adding Loctite to the threaded hole of the seesaw. Otherwise it is pressed by the grub into the passage hole for the feathering spindle, which then gets stuck. Such a stuck feathering spindle can hardly be removed later without destroying other parts.
Attention! Do not yet attach the rotor brake 0103, because the planar supporting area of the main rotor centre hub is needed as supporting area for a measuring bar to adjust the blades (see Chapter XIV – Adjustments).

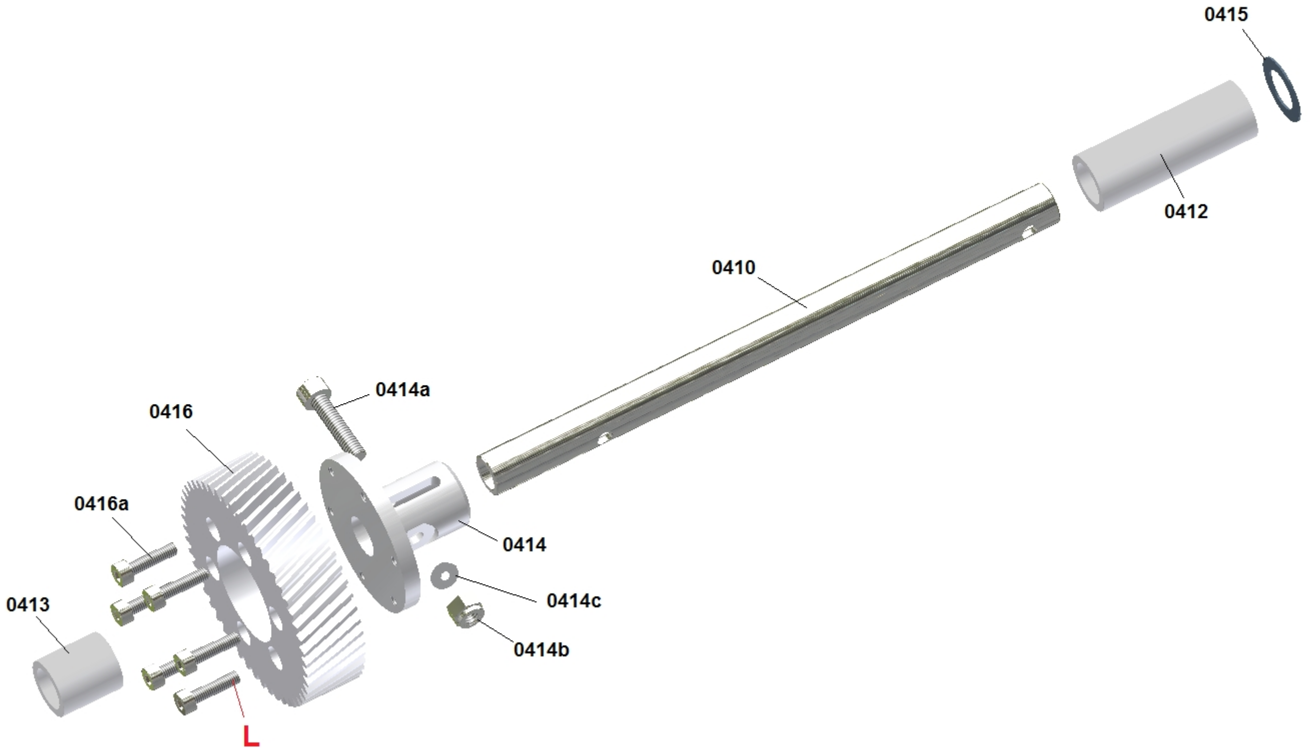
After the assembly you will notice that the blade holders can be tilted up and down to a minimum extend around the centre of rotation of the seesaw within the play of the feathering spindle bushing (The bushings are by two tenth of a mm bigger than the spindle).
With mounted blades and after some flights you can measure about 3-5mm at the blade tips after all parts are set. The rotor can be tilted without problems by this amount. This is intended and the reason for this construction.
Therefore no vibration pulses of the rotor are transmitted to the fuselage during hovering. Hereby resonances are avoided and a smooth hovering during all speeds is assured. During intended cyclic control inputs the feathering spindle tilts against the relatively hard-damped bushings leading to the desired quick reaction of the helicopter.
For pilots who prefer to fly very hard 3D, most of the time with high head speed above 1700 revs there is a option to get a stiffer damping by changing the black spindle bushings 0109-2010 against white bushings 0109 which have no play. Therefore the two inner of the black O-rings 0102s should also be changed against two red O-rings 0102r (please have also a look at the TDR-manual 2009 for more details). In this case sometimes some fuselage resonances have to be accepted when hovering between 1400 and 1700 revs.

After a crash do not try to pull the feathering spindle through the seesaw by using the deformed side. Take the undeformed side.
Check the first visible bearing 0113. The other bearings are usually not affected. Use your finger to turn the inner ring of the bearing and check if it runs smoothly. You can pull this bearing out without having to remove all the other parts from the blade holder. Push the old feathering spindle only into this bearing and pull it out of the blade holder (if necessary heat blade holder) by tilting it sidewisely and luffing it slightly. You can also strike the bearing out from the fork side using a spindle of a thickness of about 6 mm that is positioned diagonally on the inner ring of the bearing. Do not use excessive forces when hitting the blade holders on the new feathering spindle, if the bearings jam. It is recommended to clamp the shaft into a drilling machine and to treat it carefully with a strip of sandpaper.

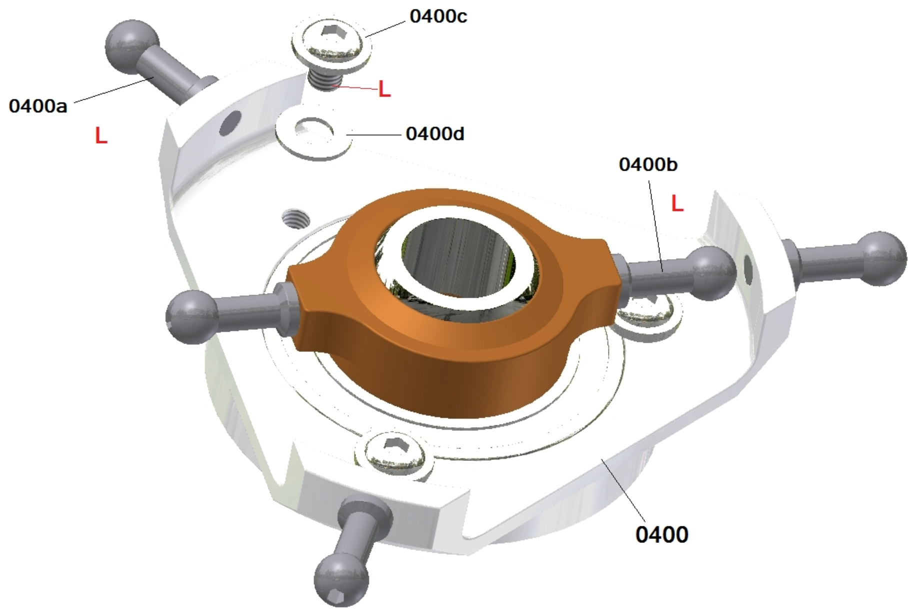
Attention! Do not use any other feathering spindle for the Rigid 2010 than the original feathering spindle RI-0110 (2010) delivered by me. This spindle is inductively surface hardened and was spheroidised on both threaded sides to avoid the danger of hardening cracks in this area with a low diameter. Due to the seesaw bearing the spindle is exposed to higher forces. These are lower when using a conventional bearing with bending points at a greater distance from each other. Therefore a normal soft spindle like the one I have used before will be deformed even at low flight loads. However, this spindle can also be deformed due to certain flight manoeuvres. Avoid extreme pull-out manoeuvres during high air speed, especially in combination with a low head speed. In this case the centrifugal forces are not yet sufficient to take load from the feathering spindle and prevent it from bending.

The connecting rods 0121c are mounted according to the drawing. At first turn the 15mm ball links 0121b to the brass bushing 0121a until they reach the stop. Then turn them, so that they are positioned at an angle of 90° to each other. This can be facilitated by greasing the threaded rod. In the ideal case the imprint 2,5 is positioned, so that it points to the outside during the assembly to the threaded link ball of the blade holder arm and the swashplate (lower forces are then necessary to assemble the link). It will be fine-adjusted later during the adjustment of the blades.

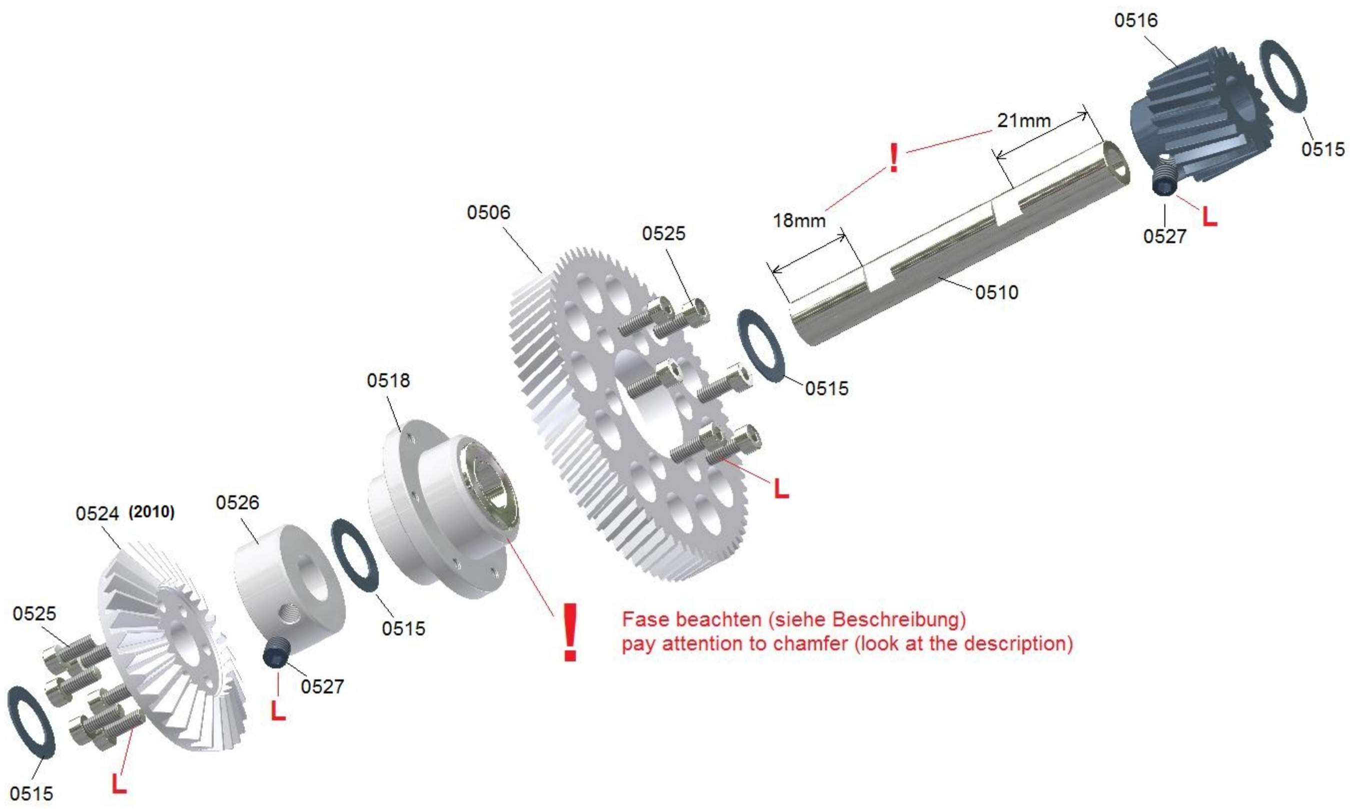
Main shaft unit (Assembly Group 4)



Note that you tighten the screws carefully, evenly, step-by-step and crosswise when mounting the main shaft gear 0416 to the flange 0414 in order to avoid uneven tension to the gear. In this case Loctite has to be used.
Slide the part onto the main shaft according to the drawing and tighten the screw 0414a and the nyloc nut 0414b well (use 90° offset allen wrench and wrench socket to provide sufficient forces). The flange is to stay in position due to the friction and not by shear of the screw!
Do not forget the 0.5mm strong spacer washers on the upper end and put the unit away for the time being.



Tighten the threaded link balls 0400a (with a 3mm long M3 thread) and 0400b (with a 4mm long M3 thread) at the swash plate use Loctite. Also the M3x 6 domehead screws 0400c has to be tighten with Loctite to secure the big ball bearing of the swash plate. Don´t forget to put the 3mm washers 0400d underneath the dome head.



Attention ! At first you have to decide whether you wish to build a right-hand rotation system as drawn in the manual or a left-hand rotation system (looking onto the helicopter from above = right-hand rotation system rotates clockwise / left-hand rotation system rotates anti-clockwise).
It depends on the chosen system which way round you mount the one-way drive flange 0518 to the gear wheel 0506. The almost symmetric flange has a noticeable chamfer on the one side. Put the flange with the chamfered side into the gear hole as described in the drawing to get a right-hand rotation system.
If you wish to build a left-hand rotation system put the other side without the large champfer into the gear hole.
Note that you tighten the screws carefully, evenly, step-by-step and crosswise during assembly, in order to avoid uneven tension to the gear. In this case Loctite has to be used.

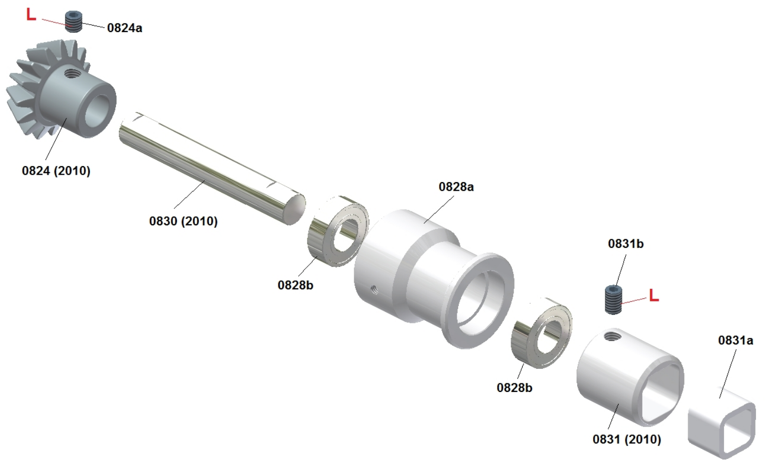
Attention! When attaching the crown gear 0524 to the driving disk 0526 proceed as described below to achieve an optimal rotation. First slide the disk provisionally on the intermediate shaft and tighten it using the grub screw 0527 (do not yet use any Loctite). Make sure that the grub screw jams the flat area of the shaft. Now slide the crown gear 0524 onto the shaft until it reaches the disk and align it according to the attachment threads to tighten it. Tighten it carefully, step-by-step and crosswisely to avoid tension to the crown gear. In this case Loctite has to be used. After having tightened the crown gear to the disk you can loosen the grub to remove the unit from the shaft again.
During this proceeding the crown gear is optimally aligned to the disk. This way it will be positioned at the final assembly. Due to the pressure of the grub screw the disk is not positioned completely centrically and the attachment threads do not allow for an exact position. If the crown gear is mounted after having been fastened as described, it is aligned exactly during the final assembly and runs absolutely smoothly.

Now mount the intermediate shaft pinion 0516 on the intermediate shaft 0510.
Attention ! The distance between the grub screw contact areas and the corresponding end of the shaft is different. The side with the larger distance of 21 mm is mounted to the top in the direction to the pinion (see drawing). The M5x 5 grub screw 0527 of the pinion is tightened well using a small amount of Loctite. Move the pinion on the shaft in the grub screw contact area play such that the shaft looks out at the top of the pinion by 6.5mm before tightening the grub screw using an L-key.
Attention ! Please apply Loctite only on the side of the thread of the grub screw but not to the hole of the pinion. Otherwise the Loctite is pressed through the thread hole on the shaft. This would make a later disassembly extremely difficult!

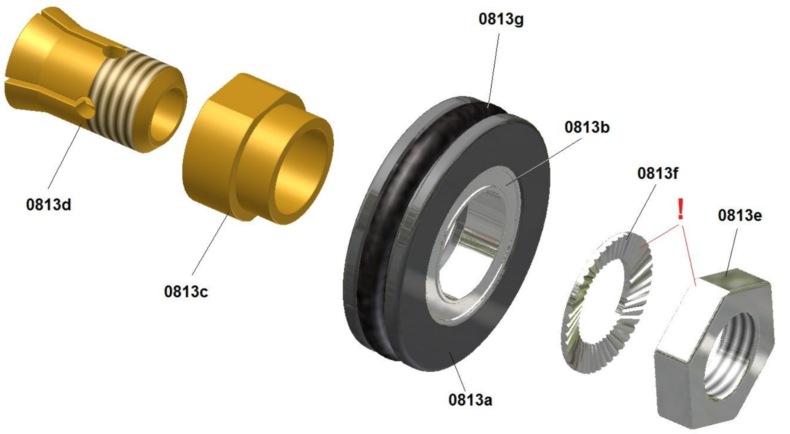
Finally, slide all pre-mounted flanges and the four 0.5mm spacer washers 0515 on the shaft according to the drawing and tighten the M5x 5 grub screw of the driving disk 0526 only loosely without using Loctite, so that the driving disk has not any axial play.
Later during the adjustment of the gear play the position of the driving disk will possibly have to be changed using the corresponding spacer washers. Thus, the grub screw will finally be secured and tightened.

Then put the unit aside.

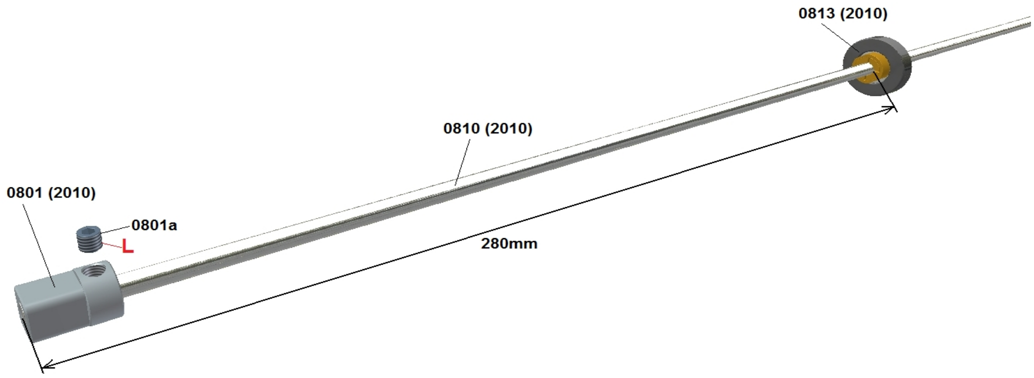
Chapter – IV T a i l b o o m (Assembly Group 8)



The two ball bearings 0828b are pressed into the bearing flange 0828a until they are flush with the flange. The clutch insert 0831a is pressed into the clutch 0831. At first slide the clutch on the shaft 0830 until it reaches the stop and tighten it using the grub screw 0831b (M4x6). Then push the shaft into the bearing support, so that the clutch rests completely on the rear bearing. At last the conic pinion 0824 is slid from the front onto the other side of the shaft until it reaches the stop and tightened using the grub screw 0824a (M4x4), so that the shaft has not got any axial play. Only cover the grub screw with Loctite and avoid covering the threaded hole. If the shaft does not run smoothly after having tightened the grub, loosen the grub again and pull the pinion slightly to the front, so that there is no axial tension applied to the bearings.



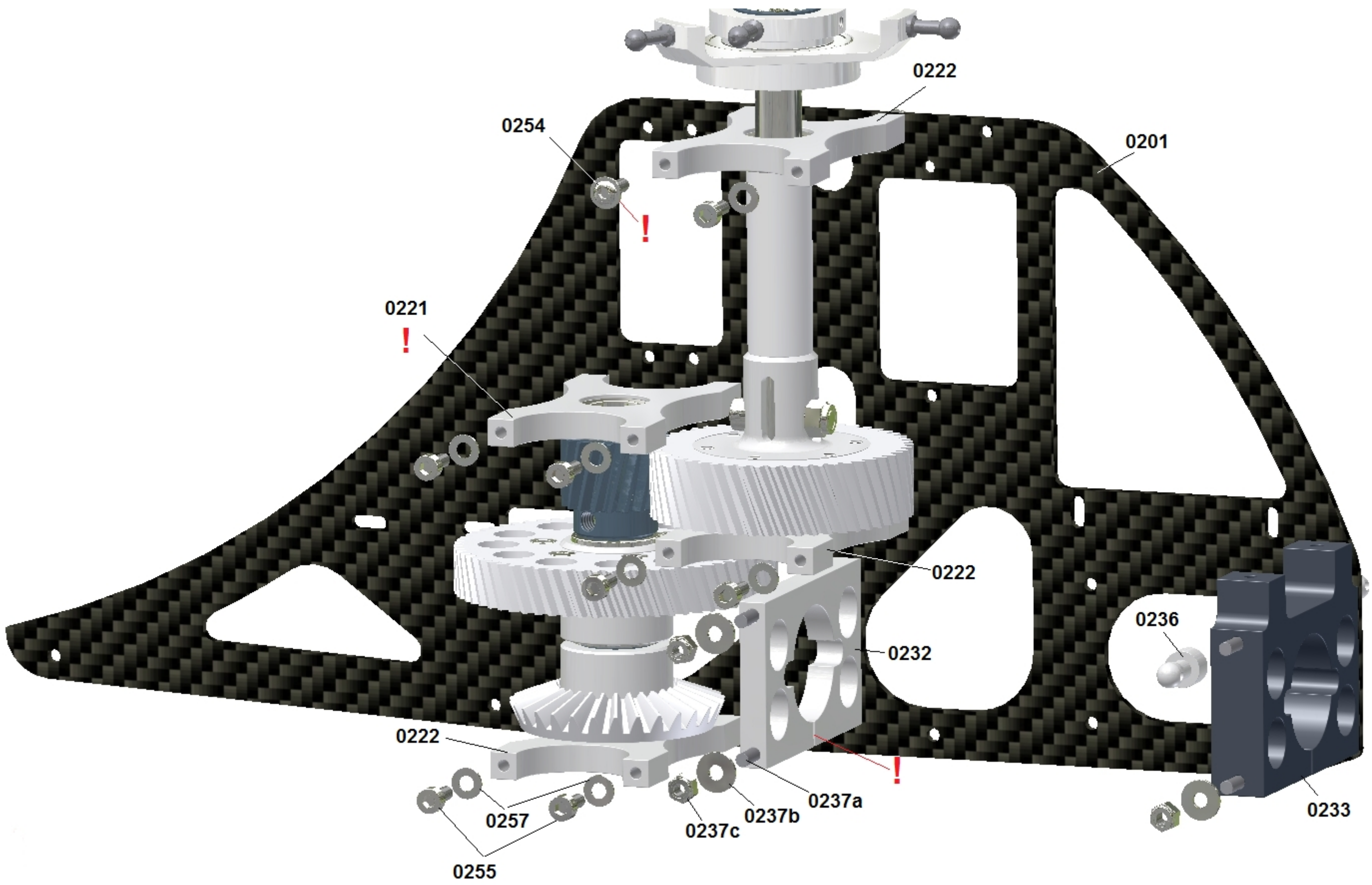
Push the bearing 0813b with the bearing support 0813a onto the bearing bushing 0813c. The collet 0813d is inserted into the bearing bushing.
Attention! Slide the locking washer 0813f onto the collet, so that the bottom of the washer only presses against the inner ring of the bearing. Do not position it the other way round, so that the outside of the washer presses onto the outer bearing ring or the bearing cover (when tightening the nut the bearing would jam). The nut 0813e is only tightened loosely to the first thread pitches of the collet.
Attention! Do <u>not</u> use Loctite. The collet would slip in the bearing bushing during loosening the tight nut. So the nut cannot be removed any more, because you cannot hold the collet.



The bearing 0813 and the square headed coupling 0801 are added to both sides of the drive shaft 0810 as described below. The bearings are attached to the shaft and not jammed in the tail boom any more.

The 5mm drive tube 0810 have a total length of 852mm. Brass pins with a length of about 18 mm are glued to both sides, so that the grub screw 0801a of the square headed coupling 0801 does not press the tube together. At first slide the prepared bearing 0813 from one side on the shaft, so that the clamping slots point towards the outside to the end of the shaft. Thus the unit can be moved more easily. If you did it the other way round, the collet would be pressed into the cone of the bearing bushing and some parts might jam. Position the bearing as shown on the drawing at a distance of about 280 mm from the front side of the drive shaft to the front side of the collet. Now you need a 13mm flat wrench for the nut 0813e and an 11mm flat wrench for the spanner flat of the bearing bushing 0813c.
Attention! Only tighten the nut with your hand (do not use the flat wrenches), so that the nut rests tightly on the circlip (do as much as you can with your hands. Do not use a tool). Then the nut is tightened by 120° using the two flat wrenches. This exactly corresponds to 2 spanner flats (1/3 rotation). If you proceed as described, you will get the exactly correct tightening torque for a secure position of the unit. If you tighten the nut further the thin-walled drive shaft tube may be pressed together or the thin-walled collet 0813d may even break away.
Now attach the square headed coupling 0801 according to the drawing (front edge flush with the tube) and tighten the grub screw 0801a firmly using Loctite. Use the high-quality L-key to apply a sufficiently high force. The grub is to be pressed slightly into the inox steel tube to assure a secure connection that does not slip during operation (do not use any grubs with knife edge seals, because that have not proven their worth).
Proceed the same way with the second bearing and the second square from the other side of the tube. Then put the units aside.

C h a s s i s (Assembly Group 2)



Pre-assembly of the upper part of the chassis

(Bag 2-I) Put the bearing supports 0221/0222 with their bearings 0223 on the already pre-mounted intermediate shaft unit and main shaft unit, such that the bearings looking out of the one side of the support point to the gears !
The bearings of the lower supports point to the top - and the bearings of the upper supports point out to the bottom. At first, tighten the units with the bearing supports loosely on a chassis side-frame plate as shown on the drawing (do not yet tighten the screws).
Attention! one of the plates has got a bigger gap on one side which is marked with a black cross. This plate has to be used as upper support for the intermediate shaft 0510 with the marked side to the front in direction to the motor.
Attention! Use the dome head screws 0254 without the additional washers for the front hole of the upper main rotor shaft frame plate. For all other holes small M3 washers 0257 and M3x 8 caphead screws 0255 are used (for all these screws Loctite is not necessary).

(Bag 2-II) At first one M3 nyloc nut 0237c is tightened using Loctite on only one side of three M3 threaded rods 0237a for the tail boom holders, so that the threaded rod protrudes from the nut by approx. 0.5mm. Later, this nut shall not turn when loosening or tightening the opposite nut to attach the tail boom. Otherwise the threaded rod protrudes unevenly on one side. Now push three of the prepared threaded rods through the corresponding holes from the outside using a large M3 washer (according to drawing). The canopy mount 0236 is added to one side of the fourth threaded rod, which is then moved through the rear upper hole of the chassis without using a washer.

Attention! During the assembly of the tail boom holders note that the clamping slots point down.
Now assemble the second frame plate from the second side. Place the lower edge of the frame plates of the mechanics on an even ground and alternately tighten the screws only slightly at first.

Attention! If the vertical distance of the frame plate holes of the pre-mounted shaft unit is larger than the distance of the chassis side-frame plate holes, the upper 0.5mm spacer washer under the upper frame plate has to be replaced by thinner spacer washers from the enclosed bag with the additional spacer washers.
The lower nuts of the tail boom holders are screwed only loosely on the threaded rod, but not yet tightened!

Adjustment of the axial play of the main rotor shaft

At first, the axial play of the main rotor shaft is removed by adding spacer washers (can be found in the corresponding assembly group bag) between the upper frame plate and the spacer 0412.
In order to do so, push the rotor shaft with the gear completely to the bottom against the bearing of the lower frame plate and measure how far it protrudes from the top of the upper frame plate using a depth gauge of a calliper.

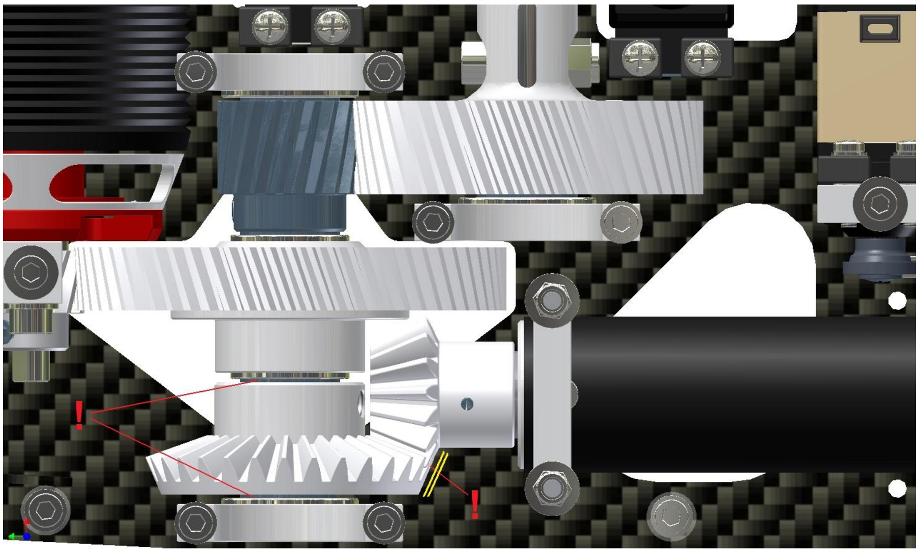
Then pull the shaft in the play against the upper bearing and measure again, how far the shaft protrudes now. The difference of both measurements represents the amount you have to add – in the form of spacer washers – between the upper bearing and the spacer. Only unscrew the upper frame plate once again and pull it to the top and out of the mechanics, to slide the spacer washers onto the rotor shaft. Then re-mount the plate again check for the play again.
A minimum play of one tenth mm has not any negatives effects. Anyway, after some flight hours it can be necessary to check the entire system and to adjust it by adding further spacer washers, if the unit has set.

Adjustment of the axial play and assembly height of the intermediate shaft

For the intermediate shaft proceed in the way as for the rotor shaft. However please note that the steel pinion 0516 is positioned in the same height than the main rotor shaft gear 0416. According to this, you can add spacer washers underneath the upper frame or above the crown gear flange 0526, until it suits well.
If it is necessary to put thinner than the 0,5mm washers above the steel pinion 0516 you have to add the difference between this pinion and the one way bearing flange 0518 so that the position of the gear wheel 0516 is not to high in the gap of the frame to prevent a contact.
Fill up the other gaps between the different flanges with additional washers until there is no axial play any more in the unit.

Attention ! the grub screw of the crown gear flange and the screws of the lower bearing support from the intermediate shaft unit is still not finally tightened yet).
Then place the mechanics again on an even surface and tighten the screws of all frame plates well (excluding the lower frame plate of the intermediate shaft).
Only the upper screw of the two tail boom holders is tightened slightly.

Adjustment of the gear play and the pinion position of the tail drive

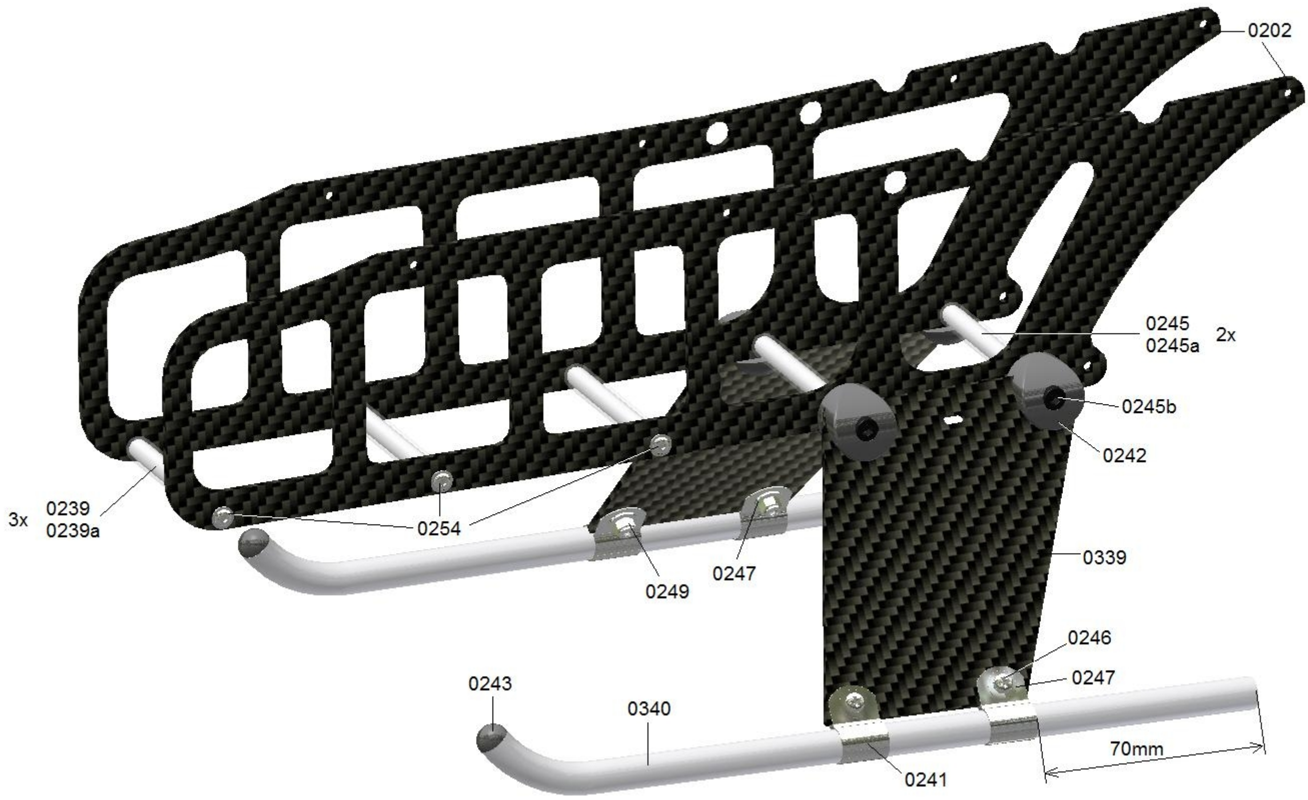


First mount the preassembled bearing flange 0828a (see page 14) with the two M3x6 screws at the front of the boom (short distance from the centre of the hole to the front edge of the boom).
Than adjust the right gear play.
No play, a too small play or the wrong positioning of the pinion in relation to the crown gear (tail boom is pushed in too far or not far enough) can lead to increased noise emissions and to vibrations in the entire drive, which can result in vibrations around the vertical axis or negative influences on the V-Stabi sensors. The entire helicopter will then hover nervously.
Too much play mostly leads to increased operating noises.
Therefore, adjust the gear play and the pinion position diligently (see description).

At first, press the already prepared tail boom through the two tail boom holders, until the pinion is positioned above the crown gear such that the two edges congruently create a parallel line (see yellow lines).
If the tail boom jams in the front aluminium holder, grease it a little and force its slot apart using a screw driver (put it into slot and turn it).
If the tail boom cannot be inserted far enough, because the teeth of both gears already contact, you have to unscrew the lower bearing flange once again and put correspondingly thinner spacer washers below the crown gear to give it a lower position. According to this, you have to compensate for the difference above the crown gear flange the by adding spacer washers, in order to avoid an axial play of the intermediate shaft.
Attention ! You have to try several times. So you have to mount the lower frame plate provisorily to the attachment screws again and again to prevent the intermediate shaft from tilting to one side and from being positioned in an inclined way. The plate can easily be pulled down and removed from the mechanics.
This way you find the correct combination of spacer washers above and below the crown gear flanges with its crown gear until you notice a small play between the teeth edges (you hear a low ticktack when turning at the pinion) when turning the pinion and holding the crown gear.
Always turn the crown gear some teeth further and thus check the play at different positions. There are always certain tolerances and you will notice a smaller or larger play at different positions. It is important that every position has a certain play and that there is not any position without a play. Now you can tighten the screw of the lower frame plate and the grub screw of the crown gear flange. Please ensure that the grub screw is positioned on the flat area of the intermediate shaft.
Attention ! Please apply Loctite only on the side of the thread of the grub screw, but not to the hole of the flanges. Otherwise the Loctite is pressed through the threaded hole on the shaft. This would make a later disassembly extremely difficult!

In order to facilitate the handling during a later assembly, the tail boom can now be pulled out. To find the correct tail boom position it is recommended to wind some fabric tape around the tail boom just behind the rear tail boom holder 0233. It serves as stop mark when re-inserting the tail boom (never mark the boom with a sharp knife or something like that).
If you wish to correct the gear play later during the operation, you can adjust the tail boom axially to the front direction by approx. 0.5 mm at maximum. So you do not always have to use spacer washers. This value should not be exceeded. Otherwise the teeth geometry is not optimally aligned any more.

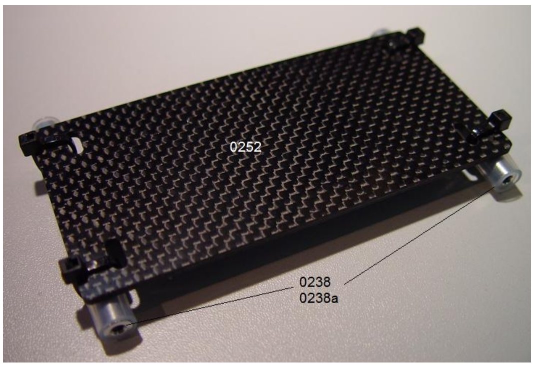
Pre-assembly of the lower part of the chassis



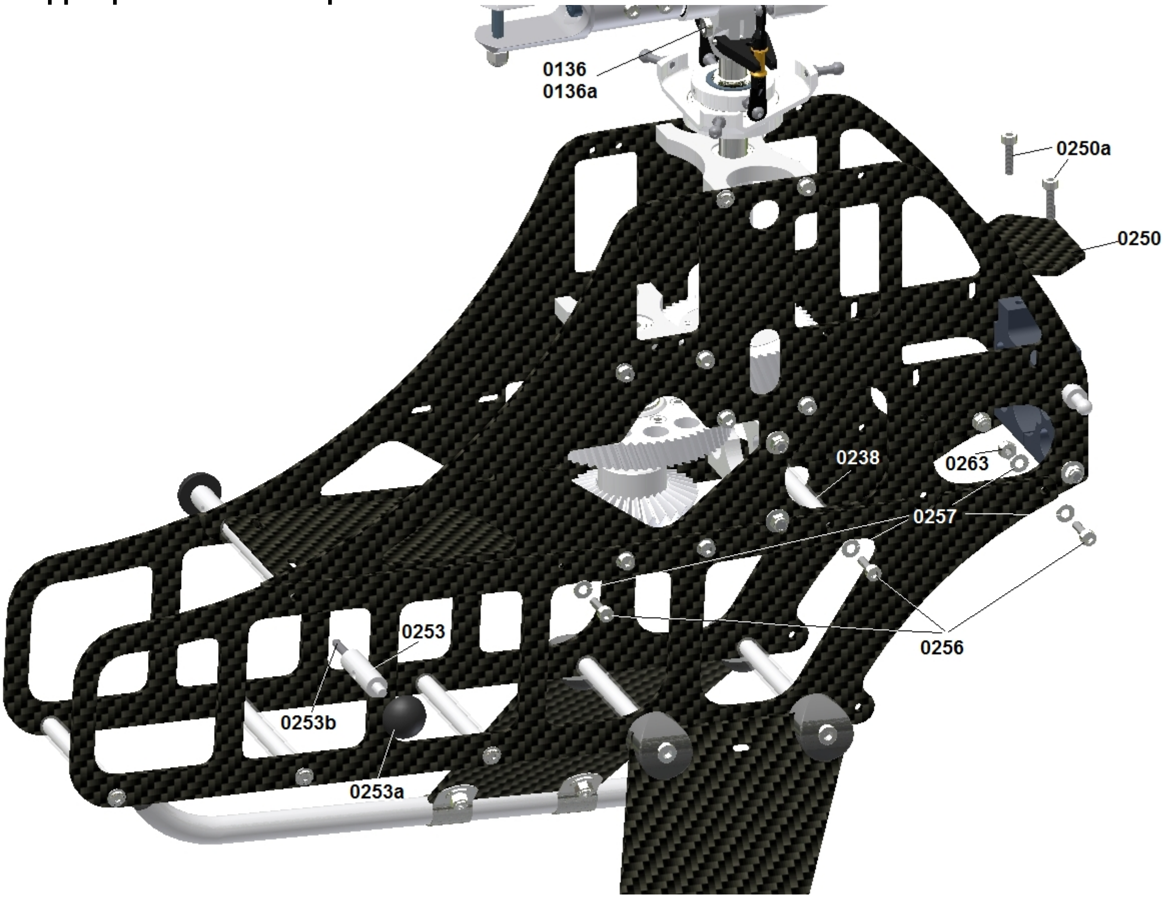
(Bag 2-**III**) Attach the two (lower) frame plates 0202 to each other using the three 62mm studs 0239 covered with the silicon tube 239a. In order to do so, use the lens head screw with a flange 0254 according to the drawing (do not use any Loctite). The other studs and parts of this bags are not yet needed.

(Bag 2-**IV**) Mount the skids 0340 with the skid clamps 0241 as well as the attachment screws 0246 (cross recess M3x8), the large M3 washers 0247, the M3 nyloc nuts 0249 to the skid plates so that the screw heads look to the outside. The skid is to protrude by 70mm from the rear skid clamp. Do not yet tighten the nuts in order to be able to align the skids.
Position the two 62mm studs 0245 (with M4 thread) covered with the silicon tube 0245a between the two chassis frame plates according to the drawing.
Now the plastic holders 0242 are put onto the skid plates and screwed to the studs using the black M4x20 screws 0245b. Align the skids such that the tips are directed vertically to the top and tighten all the screws well.

Mount the controller supporting plate 0252 to two 58mm studs 0238 covered with the silicon tube 0238a (bag 2-**III**) using some cable ties. Please note that the plate is aligned such that is it positioned in the centre and that the closures of the cables ties point to the top but not to the bottom. Otherwise it will hinder the battery from being inserted below the stud.
The cable ties can be found in the bag (Other Parts).



Assembly of the upper part to the lower part of the chassis

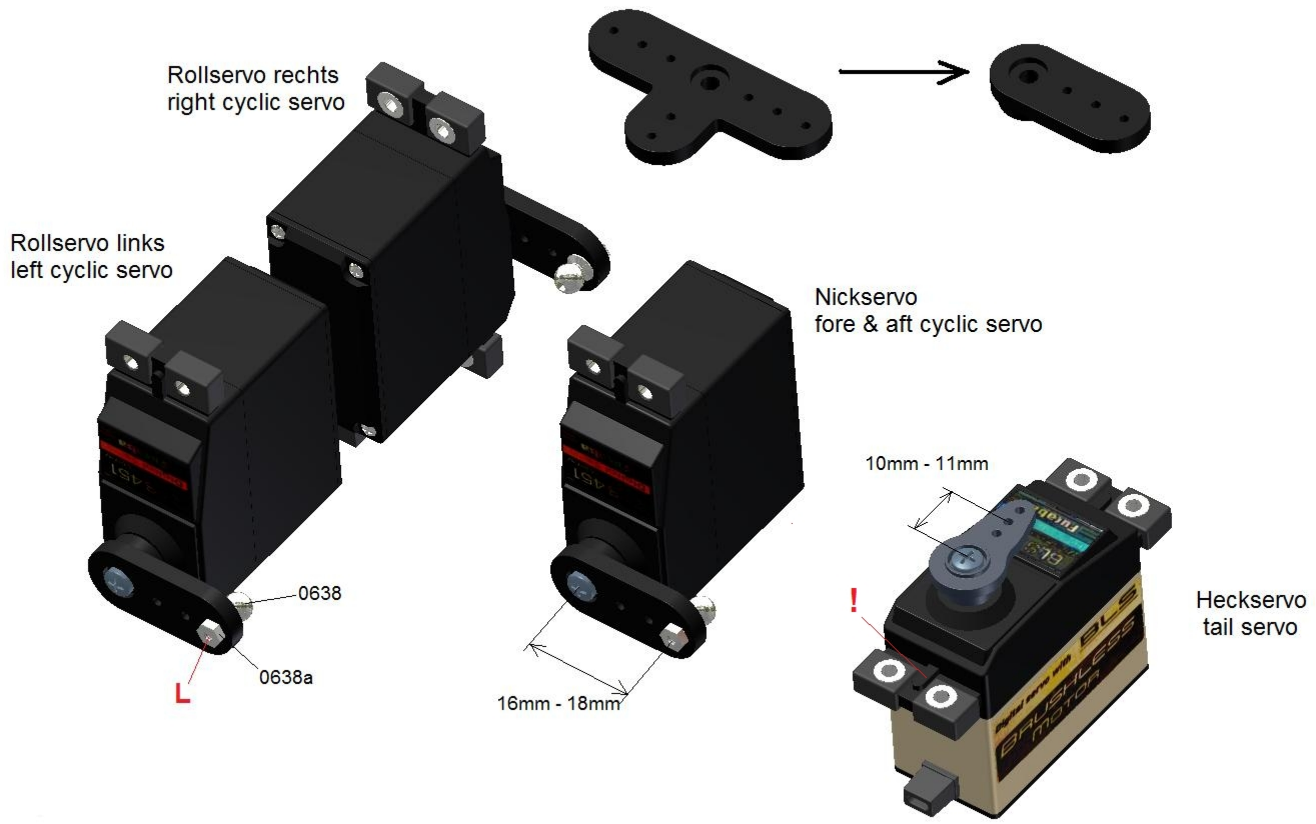


Put the prepared controller supporting plate between the two side-frame plates of the upper part of the chassis according to the drawing. The remaining third stud 0238 is positioned between the free holes just behind the front tail boom holder.
Widen the two side-frame plates of the lower part of the chassis at the top such that it can be slipped over the lower edge of the upper part of the chassis. The plates have to be widened such that the two large holes at the upper edge of the lower part of the chassis can be positioned above the screw heads of the already mounted lower frame plate of the intermediate shaft.
Tighten the upper and the lower part on both sides to the 58mm spacers using the three M3x10 screws 0265. The rear screw is tightened from the inside using a washer 0257 and a M3 nyloc nut 0263 because there is no spacer provided.
The front spacer of the controller supporting plate is tightened using the two front canopy mounting bolts 0235. For that purpose at first screw the M3x 16 stud bolts 0253b into the canopy mounting bolts using Loctite and then attach them to the front spacer of the controller supporting plate. To tighten the canopy mounting bolt you can use a 7mm flat wrenche.
Then the two rubber end caps are attached to the ends of the canopy mounting bolts. These caps fit exactly in the circumferential canopy edge so that they keep their correct position.

(Bag 2-**V**) Assemble the sensor bottom plate 0250 on the rear tail boom holder using the two M3x12 screws. Tighten the screws carefully in order not to destroy the hole in the plastics. Finally, the swash plate can be slid onto the rotor shaft (using some glutinous grease and never thin oil).
The main rotor can be tightened using the M4x 18 shaft screw 0136 and the M4 nut 0136a.

Attention! This has to be tightened well using a 90° offset allen wrench so that the centre hub is clamped on the rotor shaft and the screw is not submitted to shear strain. When the centre hub on the rotor shaft moves during a flight with a loose screw there is the danger that the rotor shaft as well as the centre hub holes are widened. The result is that the centre hub cannot be removed from the rotor shaft any more and in extreme cases the screw of the shaft may shear because of the changing vibrations.

Chapter – VI R C p r e p a r a t i o n (Servos)



At first the metal protective sleeves for the screws are pushed through the damping rubbers of the swash plate servos from below and of the tail rotor servo from above.
Attention! When using the tail rotor servo make sure that a possible stiffening rib on the upper side is flattened such that it does not protrude from the rubber dampings. The reason for this is that this side of the tail rotor servo later is mounted to the attachment blocks.
In addition, it is recommended to shorten the cable of the tail rotor servo which is much too long to a suitable length of 70mm from the servo housing to the end of the plug. In order to do so, cut the Futaba BLS 251 cable at a distance of 30mm to the housing and completely remove the black insulation. Also shorten the cable with the plug such that 30mm protrude from the plug and re-solder the 3 strands (at first cover the single strands with a shrinking tube). Also from the plug the black insulation has to be remove so that the cable is at flexible as possible.
Attention! This procedure is necessary specially when using Mini V-Stabi or something similar if the sensors are includet in one box with the rest of the electronic so that all the cables from the servos and receiver enter this box. If the cables are to stiff or connected with cable ties they will transfere vibrations direct into the box which cause problems later during flight.
Look for further informations in Chapter XI for instance if you want to use a sattelite receiver.
Connect the swash servos directly to a free receiver channel (but not to the carb. or the pitch channel. Switch on the transmitter. Neutralise all trim and sub-trim settings and all programmable mixers should be deactivated so that there is a neutral pulse at the receiver channel and the servo takes its centre position (this is not possible with the tail servo).
The installation has to be switched on when attaching the single servo arms to the multiple teeth shaft of the servo, so that it is positioned at right angles to the housing. Please note the different alignment of the single servos in the image. It is recommended to position the servos according to the drawings and mark them to avoid mistakes during the assembly in the chassis.
If you have chosen the Futaba BLS 451 Servo recommended by me, I strongly recommend to use the enclosed thick 3mm servo arms. These arms are sufficiently stiff and the servo gear remains undamaged during a crash. When using aluminium arms the gear is nearly always defective.
The uneven number of teeth of the multiple teeth unit leads to a slightly different position during the rotation of the servo arm by 180 degrees. That is how you can improve the rectangularity, if it was not optimal at the first positioning.
Try to find a positioning as good as possible and remove the unnecessary arms of the servo arm. Smooth the edges (this works best on a sanding machine) as shown in the drawing above.

(Bag 6-I) Attach the threaded link balls 0638 according to the drawing to the three swash plate servos from the lower side of the arm and secure them on the upper side of the arm using the nuts 0638 (use Loctite).
The distance should be between 16mm and 18mm from the centre of rotation. The Futaba arms have an optimal value of 17.5mm.
For the tail rotor servo you <u>have</u> to use a normal <u>2mm plastic arm</u> with a 1.5mm hole. The reasons for it is that a metal clevis is provided which may never be used with an aluminium or carbon arm, because it is directly mounted into the 1.5mm hole. The optimal mounting point is at 10mm – 11mm from the centre of rotation of the servo. This relatively low distance is necessary because the transmission ratio at the tail drive is 1:1 in contrast to the one of most of the helicopters. Thus at the front servo a smaller way is sufficient.

Assembly of the cyclic servo

(Bag 6-II) At first, use thin double-sided tape to attach the four servo attachment plates 0642 on the inside of the side-frame plates of the chassis such that they are aligned to the holes. This facilitates the servo assembly considerably.
According to the drawing the cyclic servos are pushed from the outside through the cut-outs of the chassis frame plates with the cable pointing to the bottom and screwed using the M2,5x12 cross-head screws 0643 and the washers 0643a.

(Bag 6-I) Mount the ball links 0630d on the two 45mm rods 0630e such that a distance of approx. 27-28mm remains between the front sides. Turn the ball links so that they are positioned at right angles on the ball of the servo and the swash plates and that the writing (2,5) points to the outside. It is difficult to press the ball link on the ball the other way round. The rods are fine-adjusted later.

Assembly of the fore & aft cyclic servo

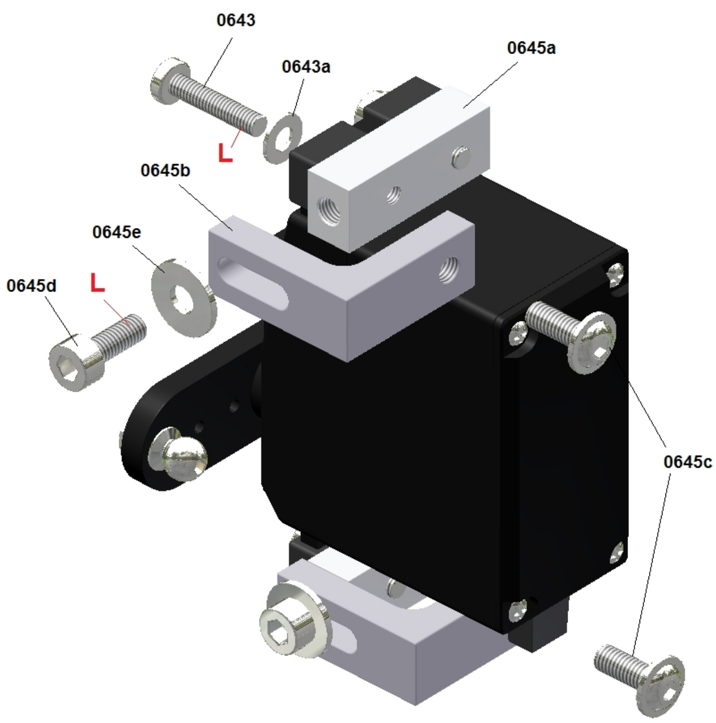
At first attach the two fore & aft cycli servo supports 0645a to the servo according to the drawing using the M2.5x 12 cross-head screws 0643.

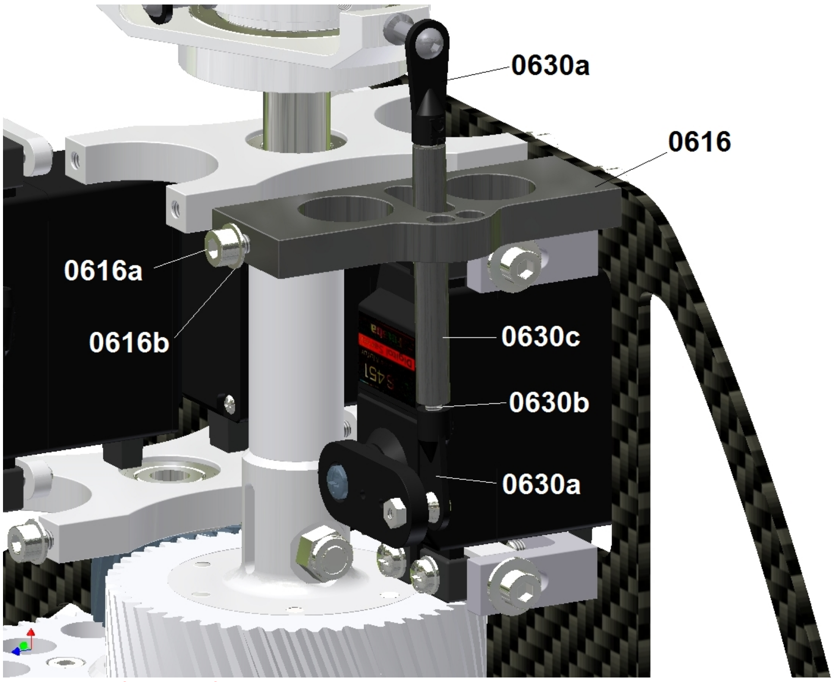
The support framing squares 0645b are at first tightened loosely to the supports.

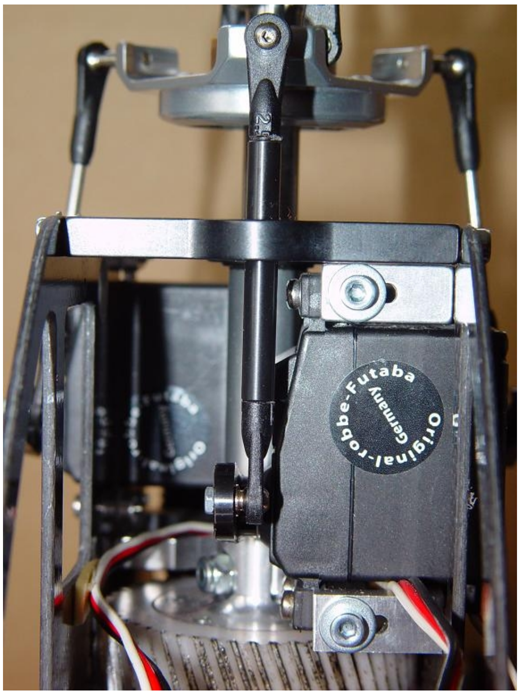
The elongated holes are used later to adjust the servo at the side, so that the threaded link ball of the servo arm is positioned exactly in the centre in the chassis.

It is intended to lead the fore & aft cyclic rod later as vertically as possible through the swash plate anti-rotation guide 0616 (see following page).

Use the two lens head screws 0645c to tighten the angles loosely to the provided holes of the right frame plate of the chassis.







For a better few the left chassis plate is not shown !

The prepared fore & aft cyclic servo is at first tightened provisionally and loosely to the right frame plate of the chassis according to the drawing.

Use a M3x8 lens head screw 0645c to tighten the two support framing squares to the chassis in the centre at the top and at the bottom. Therefore put the lower lens head screw through the chassis hole from outside and position the servo, so that the screw draws the servo to the wall when being screwed in. Avoid to do it the other way round, i.e. the screw head approaches the outer chassis wall. Then the fore & aft cyclic servo cable can be damaged. Bend the servo cable relatively sharply to the top while screwing in the screw. The rubber sleeve of the cable outlet is sufficiently flexible.

Attention! The right cable shown on the right photo is not the fore & aft cyclic servo cable, but it is the cable of the right roll servo. Coming from the front it is led between the fore & aft cyclic servo and the angle to the back. The fore & aft cyclic servo coming from outside is led through a lower chassis cutout back into the chassis (see photos Chapter XI).

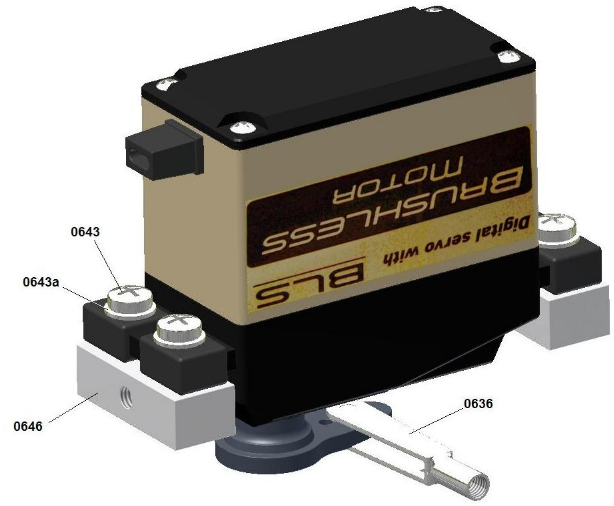
(Bag 6-**III**) Mount the swash plate anti-rotation guide 0616 to the chassis using the M3x12 screws 0616a and the washers 0616b.
The 52mm threaded rod 0630b is pushed through the plastic tube 0630c and the two shortened 15mm ball links 0630a are at first tightened just until before they reach the stop. Turn the ball links to a position so that the writing 2.5mm again points to the outside and assemble the rods according to the drawing. It will be fine-adjusted later.

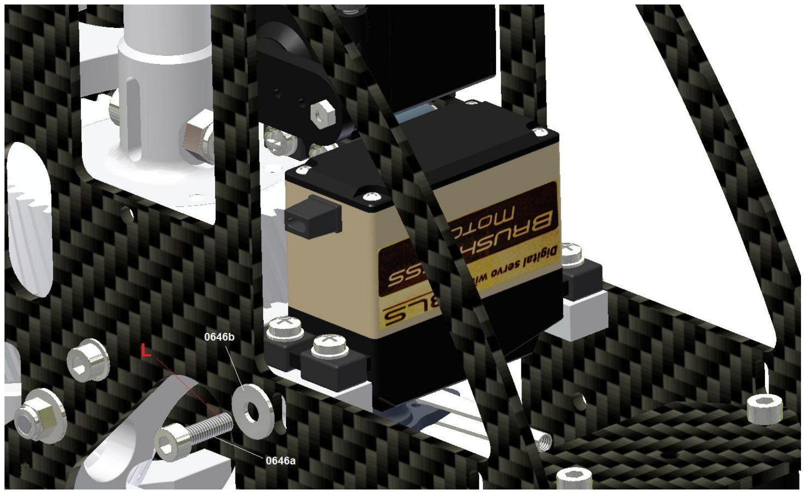
To lead the fore & aft cyclic rod as vertically as possible through the swash plate anti-rotation guide 0616 you have to push the servo into the right position when tightening the screw 0645d.
Have a look that the distance from the servo to the chassis is the same at the top and the bottom so that the servo is not positioned tilted.

Attention! if the fore & aft cyclic rod is not in a vertical line the swash plate will not be aligned correctly in a straigt angle to the longtitude axis of the helicopter which will have a negative influence to the control inputs.

Thighten the screws well after alignment.

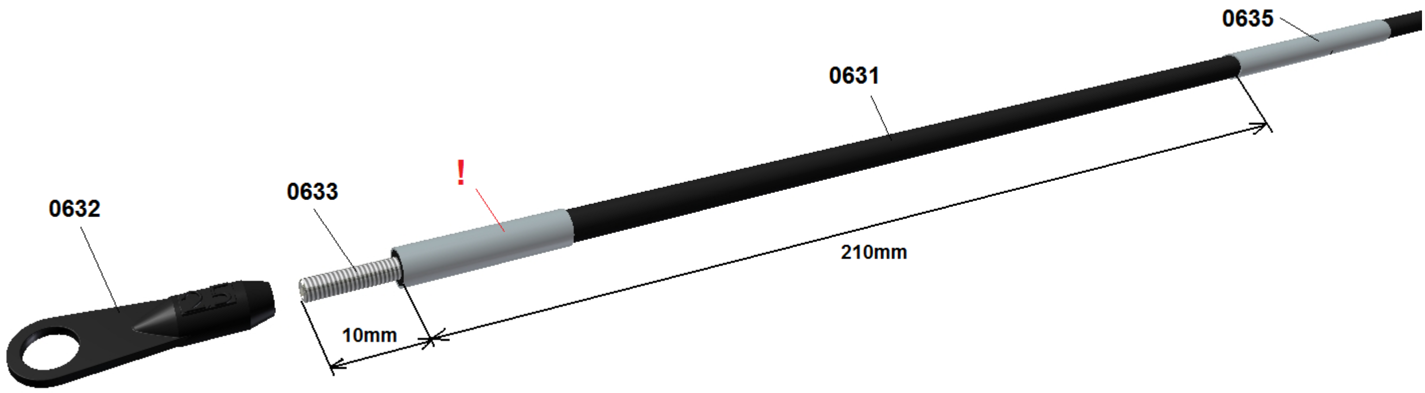
Assembly of the tail servo





Mount the two tail servo supports 0646 to the tail servo (pull the supports to the outside when tightening the screws in the play of the sleeves) using the washers 0643a and the M2.5x12 cross-head screws 0643.
The clevis 0636 can also already be mounted at a distance of approx. 10mm to 11mm from the centre of rotation. The advantage of the clevis is that it can later be reached and opened very easily from the side using a screw-driver to remove the tail boom with the push rod. If there is a ball head at this position, this would not be possible. The safety is not endangered. The forces at the tail servo are relatively weak and during numerous test flights the system has proved its worth.
Push the servo between the frame plates of the chassis as shown in the right image and tighten the supports 0646 in the elongated hole (use Loctite) using the washers 0646b and the M3x10 screws 0646a. Look at the mechanics from behind and mount the servo at a height so that the clevis is positioned in the centre between the sensor support and the rear tail boom holder (a bit more close to the holder). Tighten the two screws well.

Push rod for the tail rotor control



De-grease the threaded rods 0633 and glue them into the carbon push rod 0631 on both sides using superglue.
It should protrude by approx. 10 mm from the push rod.
Make sure that the extending thread may not be covered with glue.

Slide on the three approx. 50mm long shrinking tube 0635 up to the carbon push rod and shrink it such that it is located 210mm before the rear end of the rod and a second one 590mm before the rear end of the rod.
! Cut the third shrinking tube in two equal pieces and shrunk them such that they are located at the ends of the carbon push rod.

The glue has to be dry before attaching the ball link. In order to do so, slightly grease the thread so that the ball link can be turned more easily or at first tighten the link to a different M2.5 threaded rod and then untighten it to widen the holes a bit.
The ball link is tightened such that there is still a gap of approx. 1mm between the link and the carbon push rod.

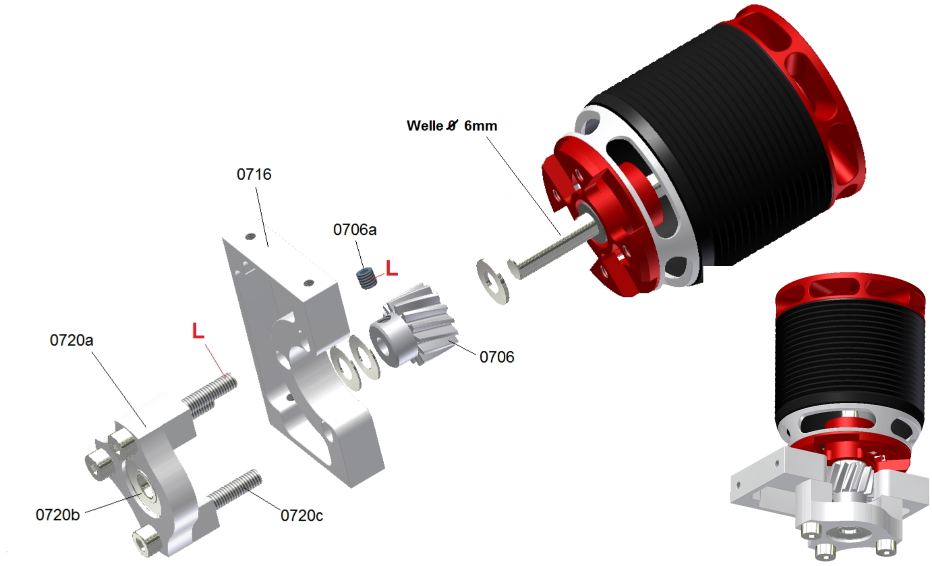
<u>Do not</u> hold on to the carbon push rod with pliers or a similar tool. It is not very resistant to pressure.

The push rod will be assembled later after the tail boom with the tail gear box has been assembled to the mechanics by pushing it through the guiding hole of the strut clamp 0809 and 0808 from behind and screwing it into the clevis 0636 mounted to the tail servo.

The two 50mm shrinking tubes 0635 has to be slightly greased from time to time to prevent the push rod from sticking.

Chapter – VIII Assembly of The Electric Motor

(Assembly Group 7)



The picture above shows the assembly of the recommended Pyro 700-52 motor with standard shaft and M4 attachment holes on a 30mm hole circle. The motor support plate can also be used for different motors with a 25mm hole circle with M3 screws.
For Scorpion motors the counter bearing is not needed and the motor can be attached directly to the plate 0716 using shorter screws. Because of the higher temperature which is generated from Scorpions it is even better not to use the counter bearing because it will generate unnecessary additional heat.

At first solder the 3.5mm or 4mm gold plug to the unshortened motor cables of the motor.

The pinion is manufactured with a countersink in such a way that it can be used for a continuous 6mm shaft (Pyro) and for the Scorpion shaft 8mm to 6mm or 10mm to 6mm as well. Between the pinion and the motor bearing a 0.5mm thick washer has to be used. Different types of 0.5mm thick washers 6mm, 8mm and 10mm are included in the bag (Motor fastening)
Attention! On the Scorpion motor at first the c-clip of the shaft has to be removed. You will not need it anymore because the pinon will keep the shaft in the right position later (look also at the detailed description on the next page).

At first the pinion 0706 has to be mounted provisionally on the shaft using a suitable spacer washer. Tighten the grub screw loosely only (do not use Loctite yet).

The counter bearing support 0720a with the bearing 0720b is tightened through the motor fastening plate to the motor using the three M4x30 screws 0720c (only for the Pyro).
Attention! Make sure that there is no pressure applied to the motor shaft or the pinion when tightening the three attachment screws. This causes tension to the bearings. So make sure that the screws are tightened step-by-step and alternately to avoid tension to the motor shaft on the side (only tighten the screws provisionally without using Loctite).

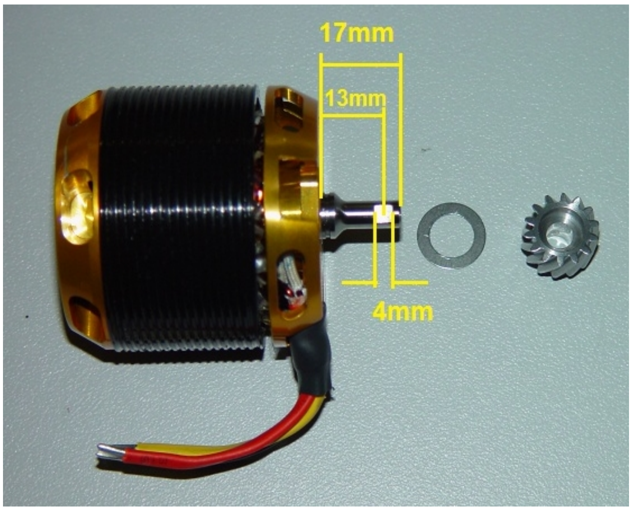
Following the motor frame plate has to be pushed between the chassis frame plates and attached to the provided elongated holes of the chassis frame plates using the M3x12 screws 0716a und the thick brass washers 0716b. Do not yet tighten the screws, so that you can easily move the motor in the elongated holes. Press the plate with the motor vertically down, so that the attachment screws rest on the lower edges of the elongated holes. Hereby the motor is positioned angularly to the chassis. Push it against the gears of the indermediate shaft.

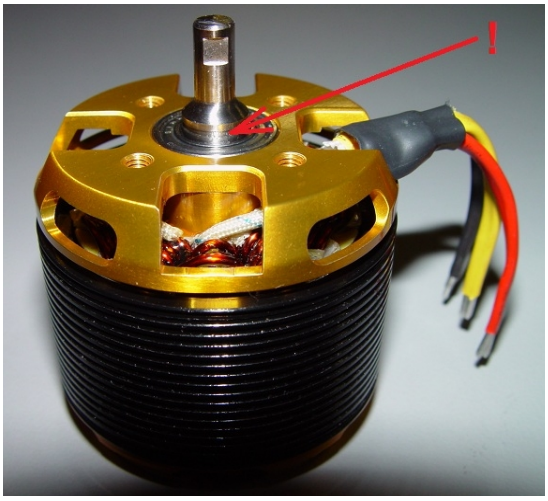
Attention! Watch the gears from the side through the large cutout in the chassis and check if the motor pinion and first step plastic gear are positioned at the same height. Additional washers have to be used between motor bearing and pinion if the bottom side level of the steel pinion 0706 is more than 0.5mm higher then the bottom level of the gear 0506.
Disassemble the entire motor frame plate with the motor again and fill up the gap between the pinion and the counter bearing with different of the enclosed 6mm washers.
Attention! It is very important that a little gap of 0.1 to 0.2mm is left between the counter bearing and the bottom of the pinion so that tere is no axial pressure onto the counter bearing after tightening the three M4 screws.

Finally tighten the three motor mounting screws and the grub screw again (use some Loctite).

Pinion assembly with Scorpion motors

(stepped 8mm and 10mm shaft with circlip)





First, remove the shaft circlip from the groove of the motor shaft (see red arrow in right picture). Then remove any eventually existing spring washers from the shaft.

Be careful, don't pull the motor housing, since it is only after the assembly of the pinion secured again.

Before you continue, wrap the motor with foil or tape to prevent metal chips from entering the interior and sticking to the magnets.

The shaft can now be shortened by an angle grinder to a length of 17mm. Burr the cutting edge.

Form a little surface of about 4 to 5mm width for the grub screw at the appropriate position (see left drawing). The centre of the surface should be about 13mm from the bearing shield.

Since the shaft is hardened, you should use to a small square diamond file or a Dremel rotary tool.

Depending on the type of motor push either a spacer washer 8x14x0.5 or 10x16x0.5 onto the shaft up to the bearing. Then mount the pinion.

Care must be taken that the motor housing is pushed all the way to the bearing shield and the pinion to the spacer washer to prevent axial play of the housing.

The pinions are generally provided with a 10mm countersink and fit also to motors with a 8mm shaft. Reason is to be able to push the pinion as close as possible to the motor bearing shield only with the 0.5mm thick spacer washer between the bearing and the pinion.

After tightening the grub screw (using some Loctite) the pinion will prevent the shaft from moving up.

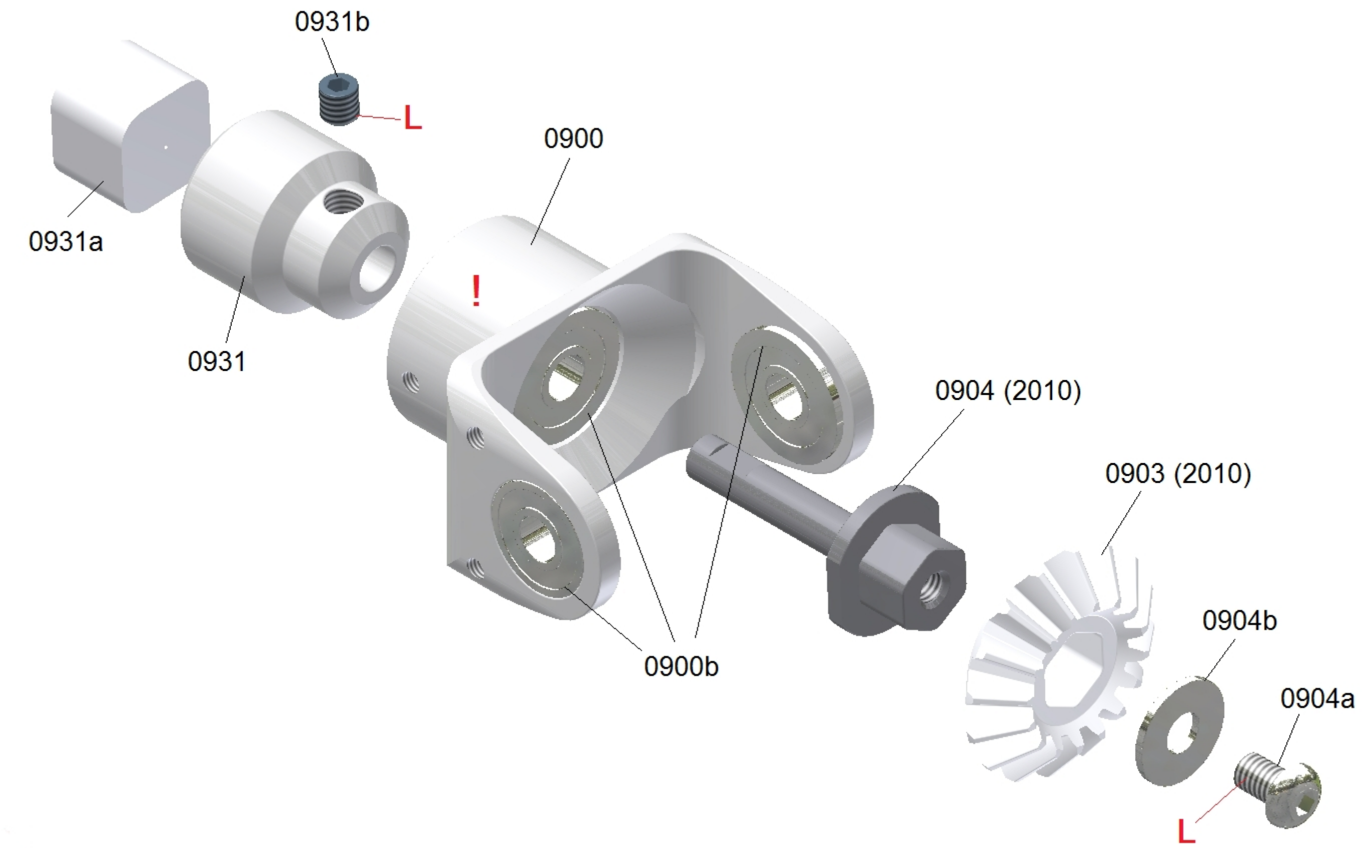
Do not use the counter bearing for the Scorpion because it will generate unnecessary additional heat.

<u>Adjustment of the gear play:</u>

As described above the plate can now be tightened to the chassis (use Loctite). To adjust the gear play push the plate to the back until it reaches the stop. Then pull the plate slightly to the front again, press it down, so that it is positioned at right angles and tighten the attachment screws slightly and step-by-step.

You hear a low ticktack when turning the large gears of the intermediate shaft. Check if the ticktack can be heard at different positions, because it may jam at certain positions due to a minimum strike of the pinion. The plastics of the gear has a large heat expansion property which may lead to a diameter increase by some tenth especially in midsummer during extreme heat and a power-oriented flight style. Therefore it may be necessary to adjust a slightly larger play in summer to have some reserves. The gear does not break due to a too high torque but due to an increasing heat caused by a decreasing play during the operation.
It is also important to grease this gear often with some tenacious multi-purpose grease to minimise friction.

(Bag 9-I)



The bearings 0900b <u>on the side</u> are fixed with a little amount of Loctite from inside the housing 0900a. Parallel pliers or a similar tool can be helpful.

For dismounting the bearings, heat the housing. The bearings can be removed more easily without bending the sensitive housing.

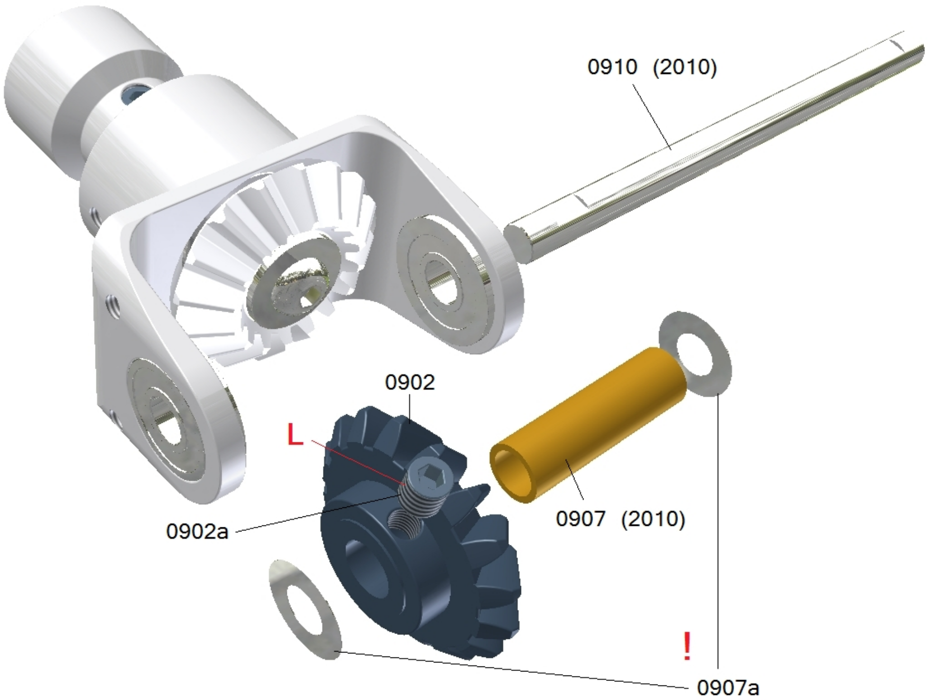
The bearings for the tail input shaft 0904 are pushed into the housing by a mandrel, in order to prevent pressure from being transmitted to the inner rings of the bearing.

Press the plastic bevel gear 0903 onto the stop of the of the tail input shaft hexagon. The attachment screw 0904a has to be tightened firmly and secured using Loctite to hold the bevel gear at the bund of the tail input shaft with the necessary primary tension. Use a 14er flat wrench to hold the bund of the input shaft 0904. The washer 0904b is bent in a saucer-shaped way until it touches the front area of the hexagon of the tail input shaft 0904 in the middle.

Now push the shaft into the bearings of the gear box until it reaches the stop and attach the clutch 0931 from the other side (press in clutch insert 0931a before). The clutch is also pushed against the bearing and attached to the flat area of the shaft using the grub screw 0931b. After that the shaft may not have any axial play in the bearing, but the bearings have to run smoothly. This may occur when pressing the unit strongly together while tightening the grub screw.

Attention ! The gear box flange is covered with a transparent shrinking tube of a wall thickness of 0.1 mm allowing to avoid a direct contact between the aluminium tube and the box. Later when pushing in the box make sure that the shrinking tube does not twist. Otherwise the puncture holes are not aligned to the box holes any more (you can also create new holes using a hot copper-bit).
During the dismounting of the gear the shrinking tube cover may get stuck in the tail boom. Simply remove it from the tail boom and pull it over the tail gear box flange. In case of need the flange can also be wrapped with one or two layers of transparent adhesive tape, if there is not any suitable shrinking tube available.

(Bag 9-**II**)



At first push only the bevel gear 0902 and the spacer 0907 <u>together</u> provisionally between the two bearings of the gear box (do <u>not</u> yet add the spacer washers).

Put the tail output shaft 0910 through the unit. Press the bevel gear against the bearing and now check the play between the two bevel gears.

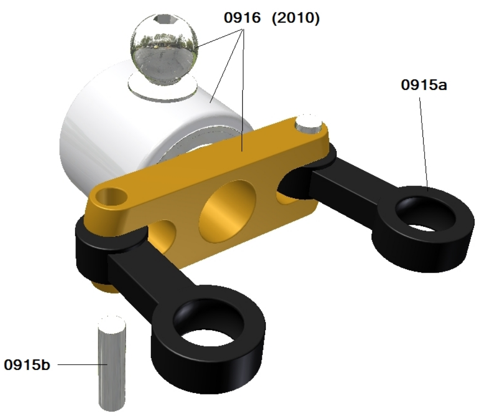
By axially moving the bevel gear 0902 on the tail rotor shaft you can now determine the approximate position where the tail gear has its lowest play and the bevel gears do not jam (it is recommended to leave a small play).

Some spacer washers (Set 0907a) of 0.2 mm and a spacer washer of 0.1 mm marked with black are added to the bag. If necessary, you can install them between the bevel gear and the left flange bearing or between the spacer 0907 and the right bearing or between the bevel gear and the spacer to adjust the gear play. The unit may not have any axial play on the shaft 0910 any more.

Sometimes it is not easy to apply the washers, since you cannot push through the tail rotor shaft.
It is helpful to use a second 5 mm shaft which is sharpened on one side and pushed through the holes before, so that the washers are centred.
It is intended to position the washers such that the tail rotor shaft does not have an axial play and that the gear play is not too large, but not too small after having tightened the grub screw 0902a.

For this purpose turn the tail output shaft. The bevel gears have to run smoothly in every position and must not jam.
Experience shows that the gear wheels are run in after some flights, so that the gear play still increases to a minimum extent.
Now tighten the grub screw using Loctite. Only apply Loctite to the grub screw thread but not to the thread hole.
When tightening the grub screw make sure that it grips the flat area. Pull the tail shaft in the play of the flat area as far as possible to the outside, so that it protrudes from the box as far as possible on the side where the tail rotor is later attached.

(Bag 9-**III**)

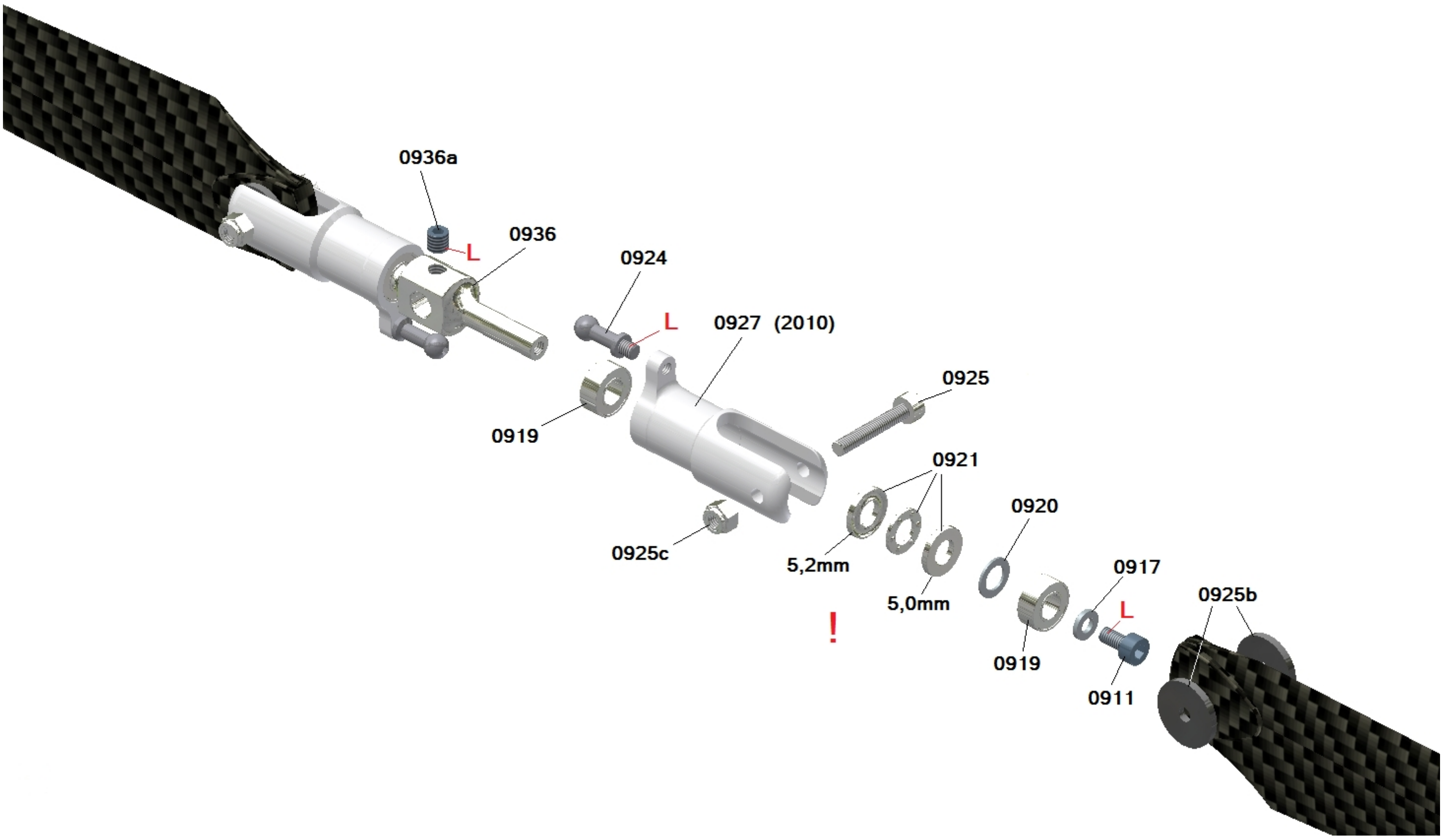


The tail pitch connecting rod 0916 is delivered as a complete unit. The tail pitch connecting rod arms 0915a and the pins 0915b can be ordered as single spare parts, because only the plastic arms usually break during crashes.

The pins are inserted on the side in the hole of the brass connecting rod and are locked into the tighter holes of the plastic arms. They are not tilted in the plastics but in the holes of the connecting rod.

Attention ! Do <u>not</u> use any Loctite.

(Bag 9-IV)



Sequence of assembly steps for tail blade holders:
(If missing the little spacer washers 0920 please have a look into the blade grips)

Grease and insert the three parts of the bearing 0921 in the right order in the blade holder 0927 from outside (first the ring with the larger hole of 5.2mm, then the ball cage, after that the ring with the 5mm hole).
Make sure that the rings do not tilt over by 180 degrees during assembley. The surrounding slot has to point to the ball cage!
Then the spacer washer 0920 (5x 8x 0,5) is mounted. It is followed by a radial bearing 0919. The second radial bearing 0919 is inserted into the blade holder from the inside.
It is recommended to heat the blade holder slightly using a hot air gun if the bearings don´t fit without force.

Attention ! If assembled incorrectly, the blade holders might jam.

The entirely pre-mounted blade holder is now slid onto the centre hub 0936. If the blade holder cannot be slid on until it reaches the radius of the hub, the spacer washer 0920 may have slipped to the side. Use a stud to position it in the middle to try it again.
The entire unit is screwed to the tail centre hub 0936 using the screw 0911 and a spacer washer 0917 (3x 6x 1.0).

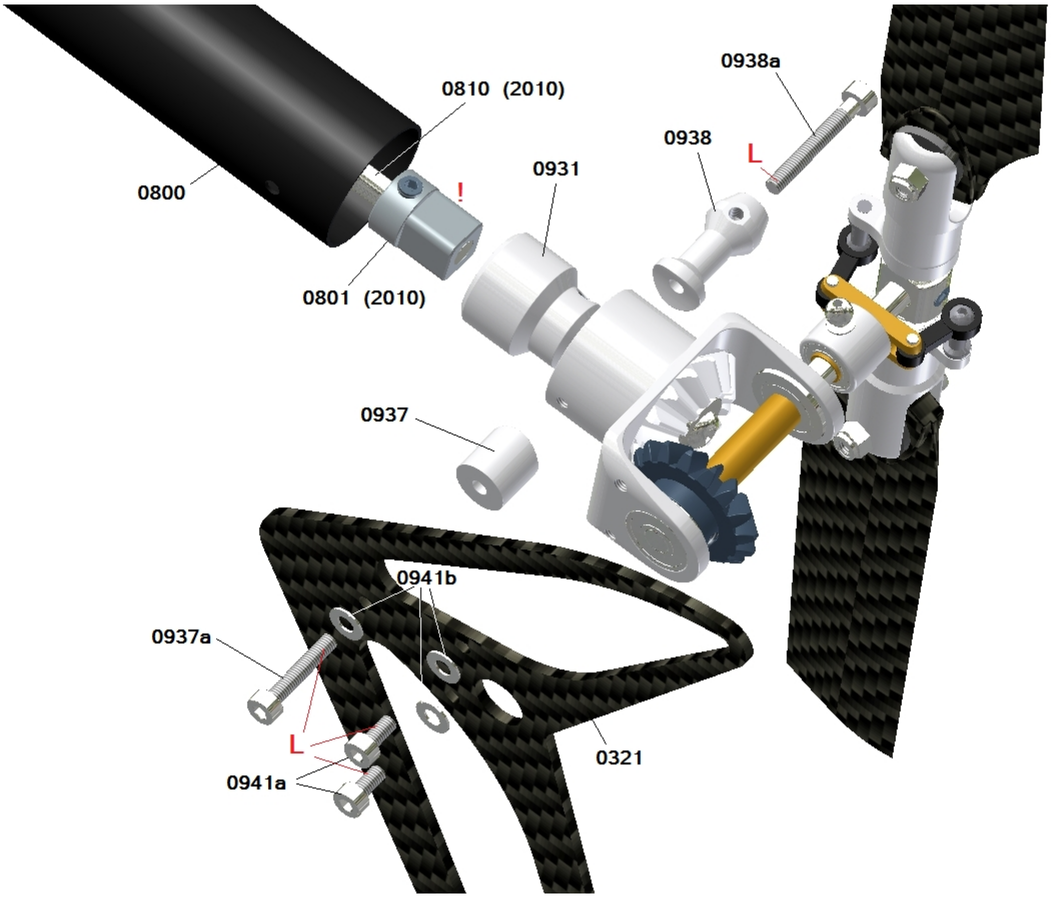
Attention ! Only use the original screw 0911 (M3x6 – 12.9) for fixing the unit to the tail centre hub 0936. Screw it down tightly and secure it with Loctite.
The blade holders can be axially slid to and fro on the centre hub by some tenth to a half millimetres. This is intended and avoids tension to the bearing. In addition there are no disadvantages during practical operation, since the blade holders are torn by the centrifugal forces to the outside against the spacer washer 0917 as far as possible.

For the attachment of the 5 mm thick tail blades the corresponding 1.5mm strong plastic spacers 0925b are enclosed. If possible, do no use any other spacers.
The screws 0925a for tightening the tail blades are only tightened such that they can swing around.

Mount the threaded link ball 0924 at the blade grips use Loctite and turn the blade gripps in such a way that the link ball shows into the direction in which the tail rotor turns.

Attention ! The entire entre hub is mounted to the tail rotor shaft such that the flat area points to the gear box. Secure the grub screw 0936a with Loctite. Do not apply any Loctite to the hole, but only to the grub screw, so that the centre hub does not get stuck on the shaft (also see the image on the next page).
Pull the tail centre hub 0936 in the play of the shaft gap as far as possible to the outside, when tightening the grub screw 0936a.

(Bag 9-V)



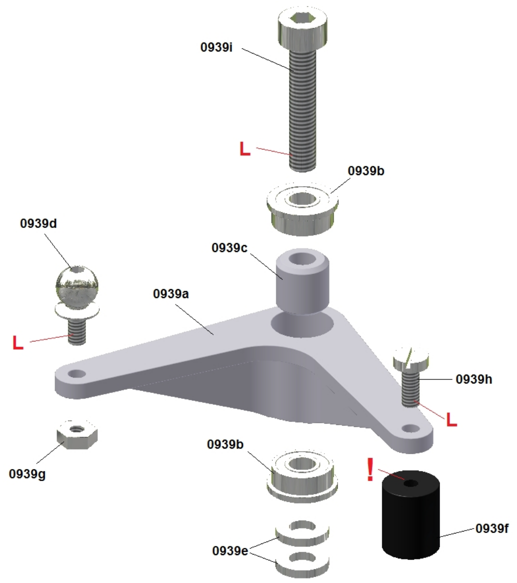
This image shows the assembly of the tail rotor of the right-hand rotation system. When chosing a left-hand rotation system the entire gear box is assembled in a mirror-inverted way and turned by 180°, so that the tail rotor points to the left (according to the flight direction).
Attention ! In both cases the blade holders have to be turned such that the front edge of the blade pointing to the top points into the flight direction. If you look at the tail rotor of a right-hand rotation system from the right side, it rotates clockwisely and if you look at the tail rotor of a left-hand rotation system from the left side, it rotates anti-clockwisely. In any case the blade holder is controlled from the front (according to the rotation direction).

At first attach the vertical stabilizer 0321 to the gear box unit using the two M3x 6 screws 0941a and washers 0941b (use Loctite).
Now you can push the gear box into the tail boom and tighten it. You can only push in the box until the front side of the square headed coupling 0801 reaches the clutch 0931.
Now turn the blade holders of the tail rotors until the square slips into the clutch.
Now you have to make some efforts to push the gear into the tail boom until it reaches the stop. Then it has to be screwed to the two parts 0937 and 0938 as well as the vertical tail (secure all screws with Loctite).
The box is pressed into the tail boom without using excessive forces until the cross-hole of the tail toom is aligned to the threaded holes in the gear box. If it jams, the square has already hit against the stop of the clutch at the back. This means that the drive shaft unit with the two square parts is too long at the ends. In this case pull the unit out of the tail boom once again and check if it is longer than 852mm (if necessary, disassemble a square and slightly shorten the shaft).
While assembling the tail gear the shaft may not have an axial tension, because the compression leads to its deformation during the operation. Its length is usually designed such that it has a play of about 1mm to every side in axial direction, to compensate for different extensions in length.

Make sure that the round areas of the part 0937 properly rest on the boom and that it is not turned out of position when being tightened.

Attention ! Mount the bell crank 0939 (see bag 9-VI) before tightening the screw 0938a (M3x 22).
It may be necessary to turn the bell crank mount 0938 on the boom slightly.
Adjust a correct vertical distance between the plastic sleeve 0939f and the tail pitch slider, so that the bush does not jam against the tail rotor shaft and can be moved smoothly.
Turn the mounting bolt 0938 with the mounted bell crank 0939 into a position in which the bell crank can be moved easily when the threaded link ball of the tail rotor slider is positioned correctly in the plastic sleeve 0939f. Finally tighten the screw 0939a (M3x 22).

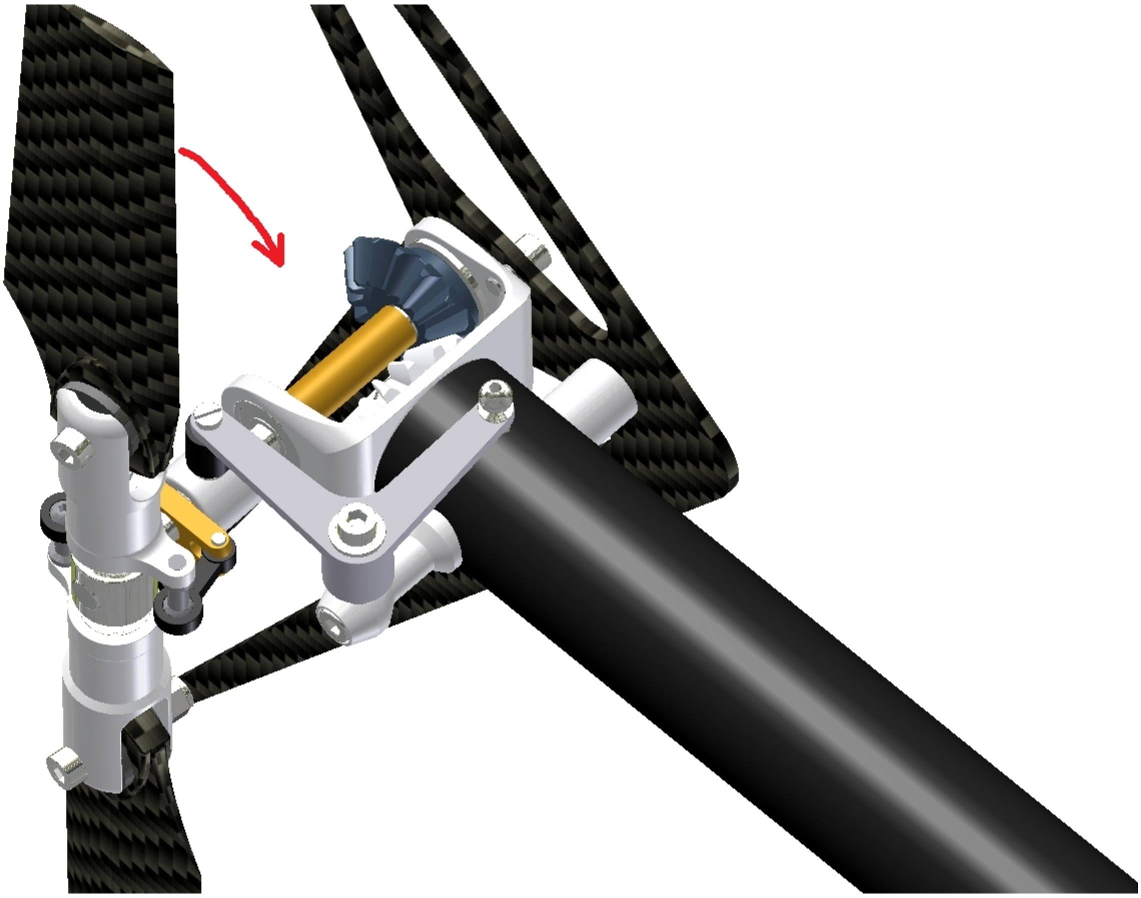
(Bag 9-VI)



The screw 0939h should be screwed down carefully, in order not to damage the hole in the plastic piece.

The screw 0939i (M3x16) has to be tightened to the mounting bolt 0938 carefully. In addition, use plenty of Loctite, as the thread can easily be damaged.
Attention! Do not add any spacer. Only use the spacer 0939e, since there is not enough thread available.
If the extending thread of the threaded link ball 0939d rubs against the boom after the assembly of the bell crank, it has to be shortened and aligned to the front surface of the M2 nut by using a file.

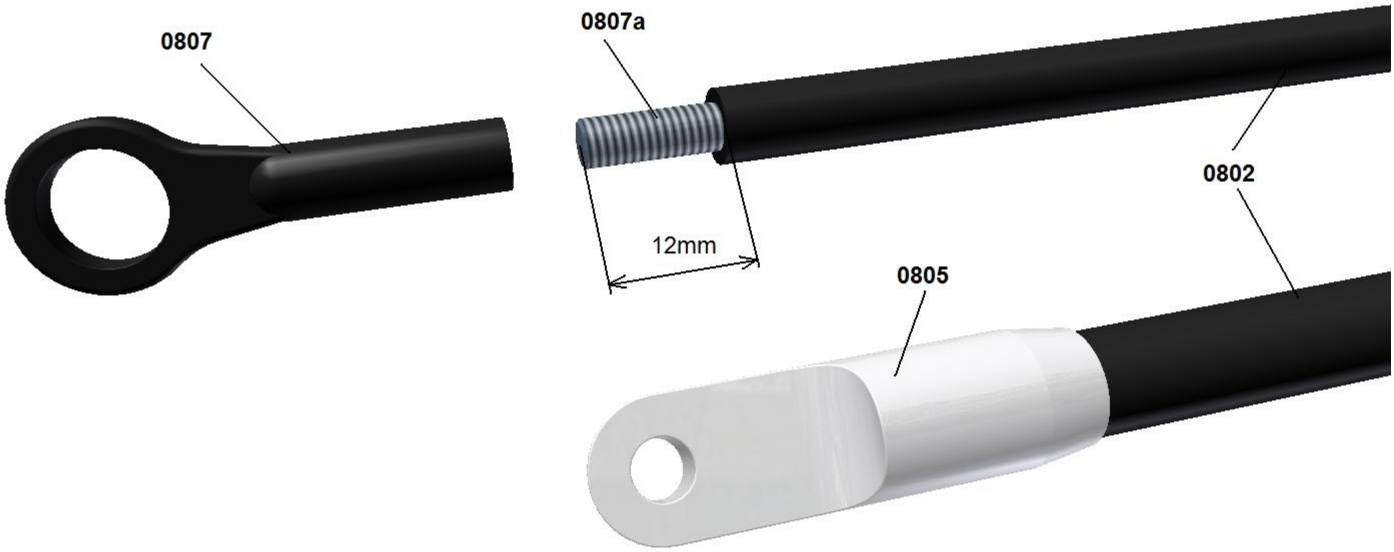
The image shows the assembly of the bell crank for a right-hand rotation system. When chosing a left-hand rotation system the plastic sleeve 0939f and the screw 0939h as well as the threaded link ball 0939d and the nut 0939g have to be attached to the other hole, so that the crank can be mounted in a mirror-inverted way on the other side.



Chapter – X Assembly and struts of the tail boom

(Assembly Group 8)

At first push the tail boom into the clamping flanges of the mechanics as already described on page 16 and adjust the correct position of the pinion to the crown gear. This is easy, if you have wrapped, as recommended, an adhesive tape around the boom at the corresponding place. Tighten the nuts of the two lower threaded rods to locate the tail boom in position.
Attention! Don´t tighten the nut of the bottom thread rod 0237a from the front boom support 0232 to hard because this can damage the bearing 0828b of the bearing flange 0828a because of to much pressure onto the flange.
The strut clamp 0809 with the push rod guide from the tail boom assembly group can be put onto the tail boom before or subsequently. It can be widened far enough without breaking.



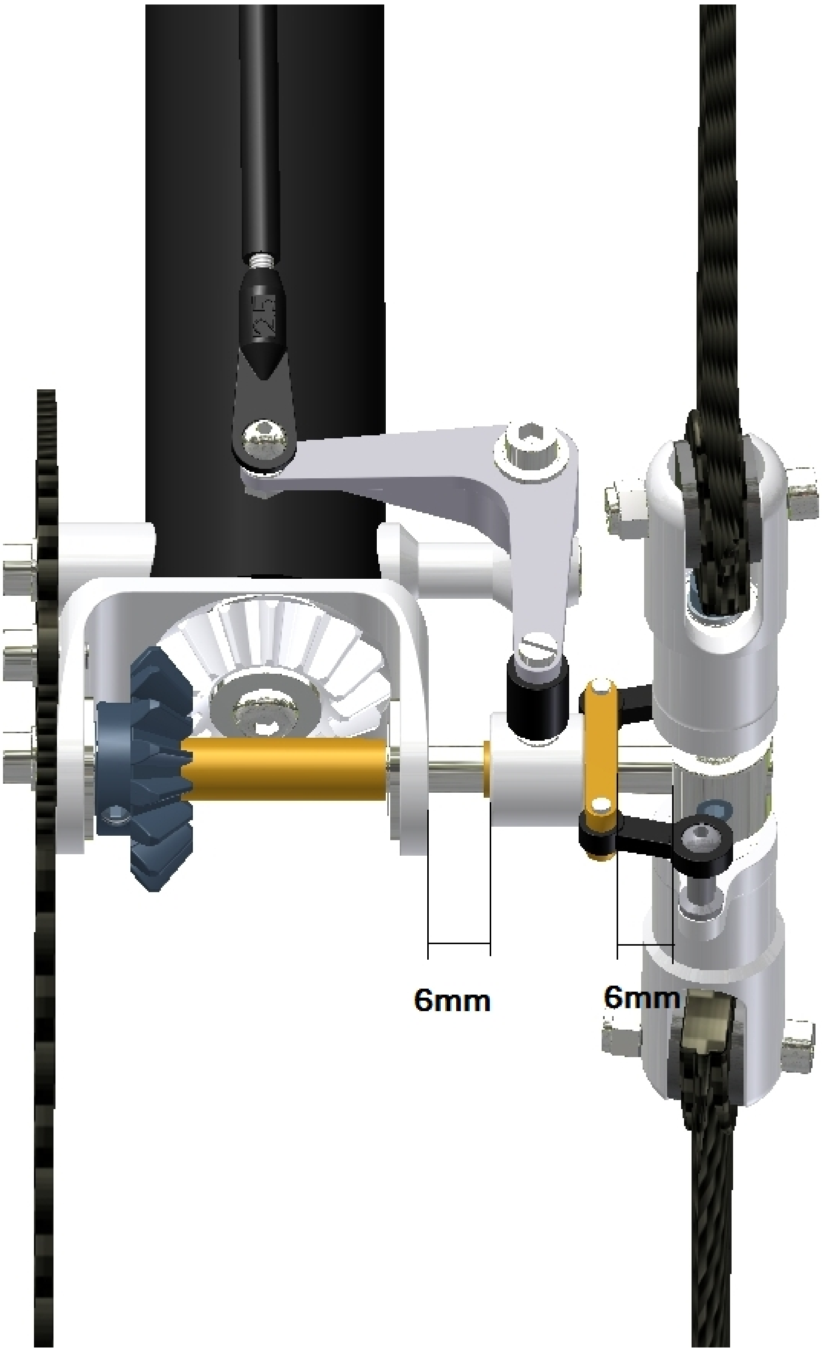
Mount the boom support ends on both sides of the tail struts (see image above). At first, attach the M3.5 threaded rod 0807a on one side using superglue, so that it still protrudes by 12mm (upper drawing). Put the threaded side into the carbon boom which has been sawed off and de-burred only roughly because in this area the thread is mostly damaged.
On the opposite side the boom support end 0805 is glued with superglue (lower drawing). Roughen the first 10mm of the carbon strut using some sandpaper and push the boom support end until it reaches the stop. Only cover the carbon strut thinly and use a larger amount of glue for the hole of the support end. Immediately wipe off leaking superglue.
After the glue has dried the two ball links 0807 are attached up to approx. 1mm before the carbon boom and aligned such that the eye is parallel to the hole of the boom support end 0805.

Attention ! When assembling the attaching balls 0804 you have the possibility to mount them from outside or inside depending on if you wish to remove the battery later from behind or not. It is recommended to mount the balls from inside (unlikely as shown in the drawing), because it is not reasonable to pull the battery out to the back. It is logical that the connecting plugs are located at the front and the canopy can be removed easily to pull out the battery comfortably to the front. If the balls are located inside, the boom support ends look even more elegantly and aerodynamically. In addition, the lens head screw 0804a can be tightened more easily from outside (secure with Loctite). Before tightening the struts loosely at the front of the balls, they should be tightened loosely at the back to the plastic clamp 0809 using the M3x25 screw 0805a and the nut 0805b. At first press only one strut front side on the ball and then hold the second side loosely on the other ball to see if both struts have the same length. Correct the length of the second strut by turning in and out the ball link 0807 until it is suitable and then also press it onto the ball. Look at the helicopter from behind to align the clamp 0809 vertically and tighten the caphead screw until the gap has disappeared.

Now push the already prepared push rod through the upper hole of the clamp 0809 from behind.
The second support 0808 has to be thread also to the push rod. Later it has to be fasten at the boom with thin dobble side adhesive tape exactly in a position were the mounted canopy touch the boom. So it will not only support the push rod but also protect the boom from scratches. Pay attention for the right mounting angle so that the push rod will be positioned in the middle above the boom.

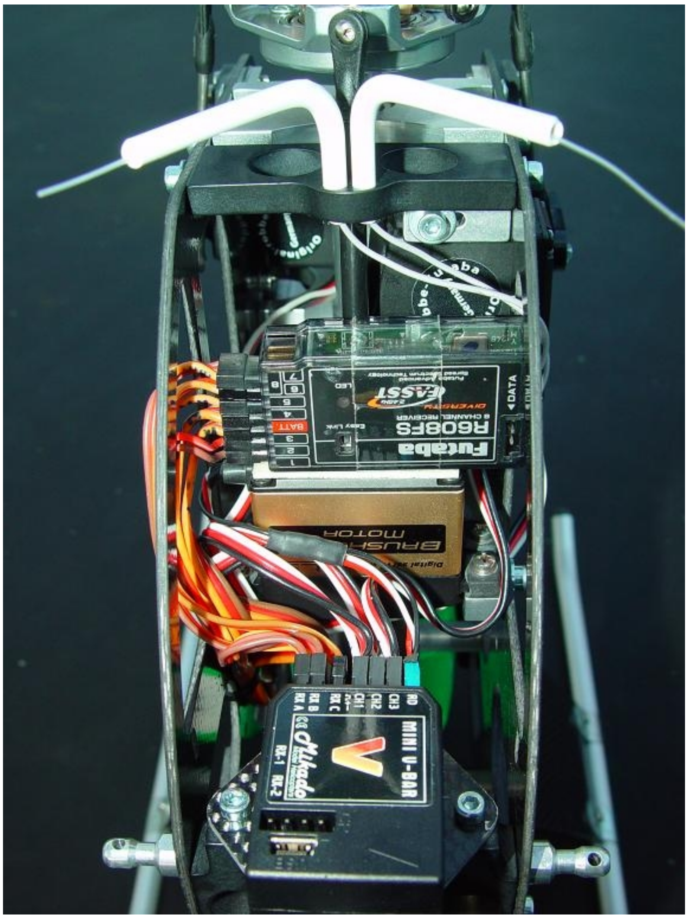
Screw the push rod at the front in the clevis mounted to the tail servo. Adjust the length of the push rod such that there is a distance of approx. 6mm between the tail pitch slider and the gear wall at the neutral position of the servo arm.
If you do so there should be also about 6mm at the other side.

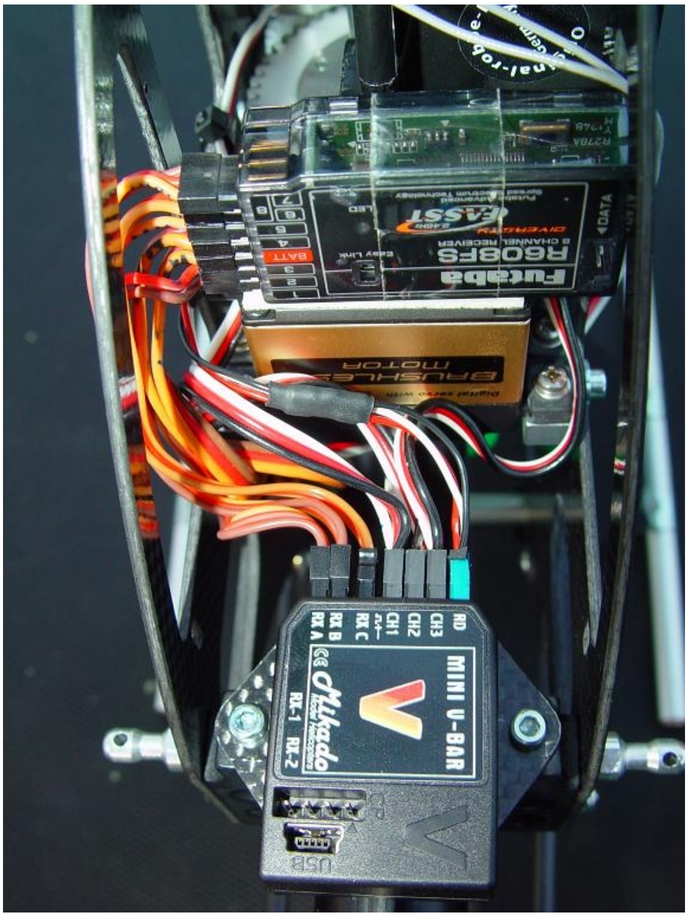
The tail blades should have a little angle against the rotor torque in this position (see picture below).

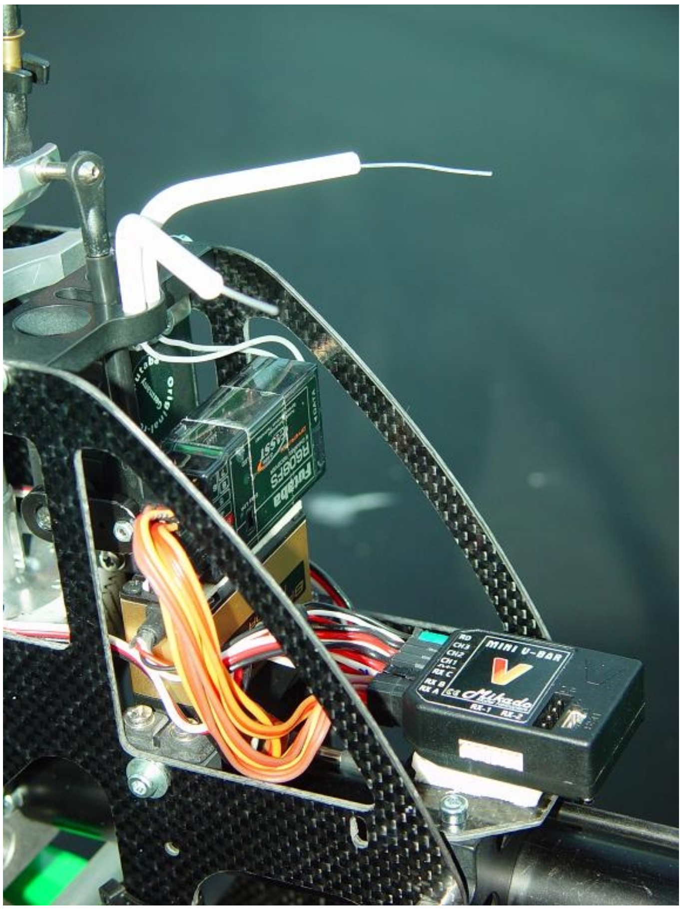


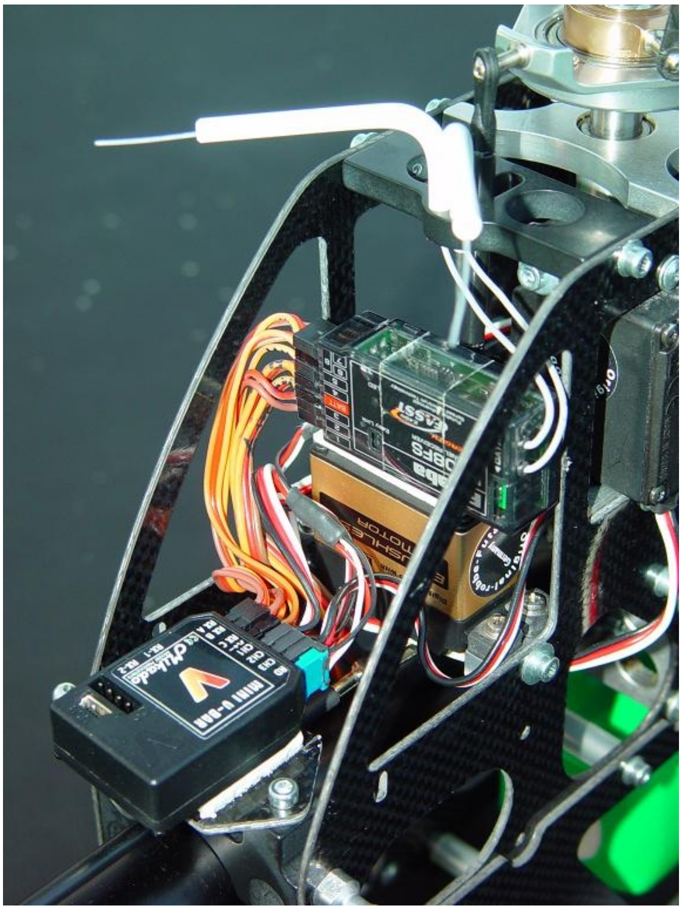
Chapter –XI Assembly of Electronic Parts

(V-Stabi / receiver / controller / batteries)









These images show the reasonable installation of the receiver as well as the 3 axis stabilisation electronics in the example of the Mini V-Stabi.
If you use a different system, proceed correspondingly.
If you use the normal two-part V-Stabi, it is recommended to download the TDR manual 2009. It contains a detailed description for the installation of the system in the same chapter.

Receiver:

The receiver is attached to the bottom of the tail servo in an upright position with the connection plug board pointing to the left. Use double-sided tape for damping purposes and place the housing as far as possible at the right side without touching the chassis. So the plug later has enough space on the left side and you can lay the cables to the back by forming a tight arch, so that they do not protrude too far from the chassis (collision with the canopy).

The assembly looks simple, however in practice it has proved its worth, because you can access the connections in every situation from the left side. For repairing purpose the entire unit consisting of the tail servo and the receiver can simply be pulled out of the chassis from the back by only loosening the two tail servo attachment screws.

The antenna can be led to the top as shown on the image. Use a 4mm plastic tube to form two 90° angles which are inserted from the top in the two holes of the swash plate anti-rotation guide 0616. Turn the angles such that they point by 45° to the left and right side, i.e. they form a 90° angle to achieve optimal receiving conditions. Adjust the height of the tubes, so that they slightly protrude from the upper back edge of the already mounted canopy. So they are located far enough from the rotor. Secure the tubes using some silicone or hot glue.

Satellite Receiver:

You have also the possibility to attach a receiver satellite instead of a conventional receiver.
Attention! Note the following hints for the use with the Mini V-Stabi and the recommended Jive controller with BEC.
For the power supply two cables coming from the Jive must be connected to your RC installation. There is not any problem when using a conventional receiver with a sufficient number of free outputs. The Master cable from the Jive is connected to the throttle channel of your receiver and the slave cable is connected to a free output. This ensures a double power supply.
In contrast to a conventional receiver a satellite receiver often does not offer further free connections to connect an additional power supply. The V-Stabi also offers only one connection for the power supply. So it is recommended to add a fork cable to one of the servo cables, in order to provide an additional power supply via this cable.
The tail servo cable must be shortened anyway. So it is recommended to solder in the additional connecting plug for the second power supply from the Jive controller at this place. It would be even better to solder directly the slave cable leading to the Jive without any plug to the cable (at first find appropriate length).

3 Axis Stabilisation:

The Mini V-Stabi box is attached to the provided basic plate using a layers of double-sided adhesive tape.
Attention! The box must be positioned at right angles in the chassis. Otherwise inexactnesses of the sensor effects will occur during the flight. The cables have to point to the front. Position the box far enough in the rear area of the plate, to gain as much space as possible for laying the cables.

Attention! It is extremely important, that all cables to the receiver or the servos are laid separately, loosely by forming an arch. Do not bind them together using cable ties, because too stiff cables transmit vibrations to the small, light plastic box containing the sensitive sensors. In extreme cases this may lead to a loss of control!

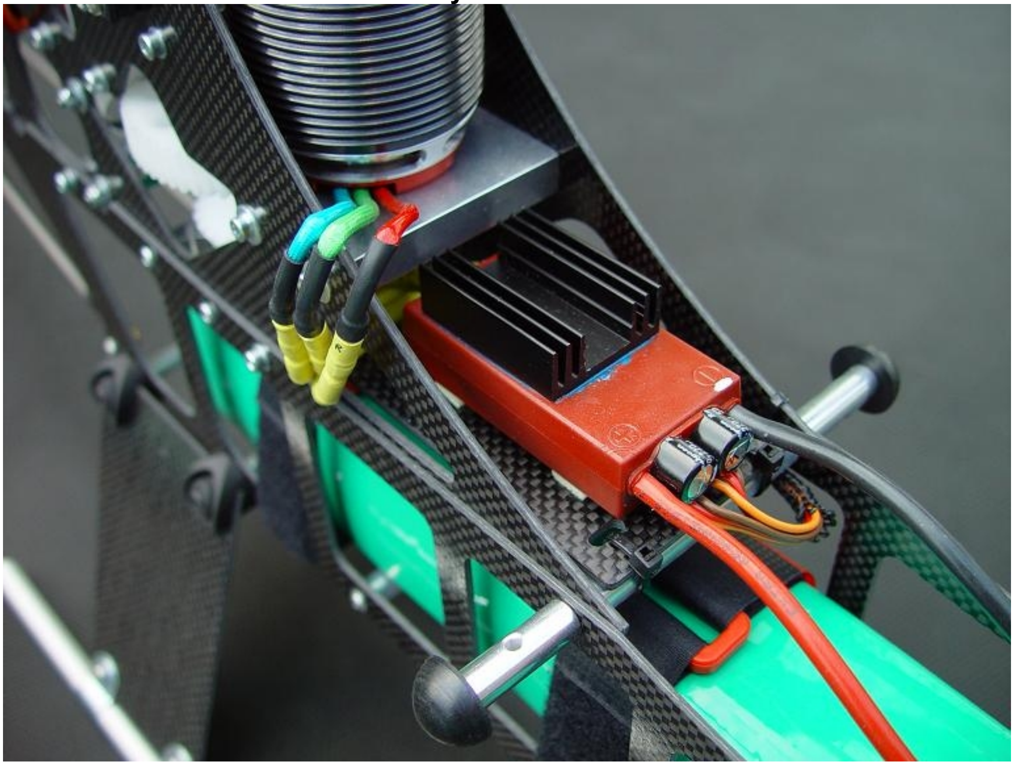
(see also p. 19 – Preparation of the Tail Servo / Shortening of the Servo Cable)

If any problems occur due to vibrations in spite of a thorough cable installation, they are mostly caused by the electric motor. Vibrations of this high frequency have a greater influence than the ones caused by the rotor (unfortunately not all motors are optimally balanced).

If you have this kind of problems, it is recommended to attach the V-Stabi box to the sensor plate using gel pads instead of normal adhesive tape (ensure sufficient adhesive force).
These blue-green pads similar to silicone are available at Align for example. They have very good damping properties especially in the range of high vibration frequencies.

A detailed connection description can be found in the following Chapter XII where the complete programmation of the V-Stabi 3 axis stabilisation is explained.

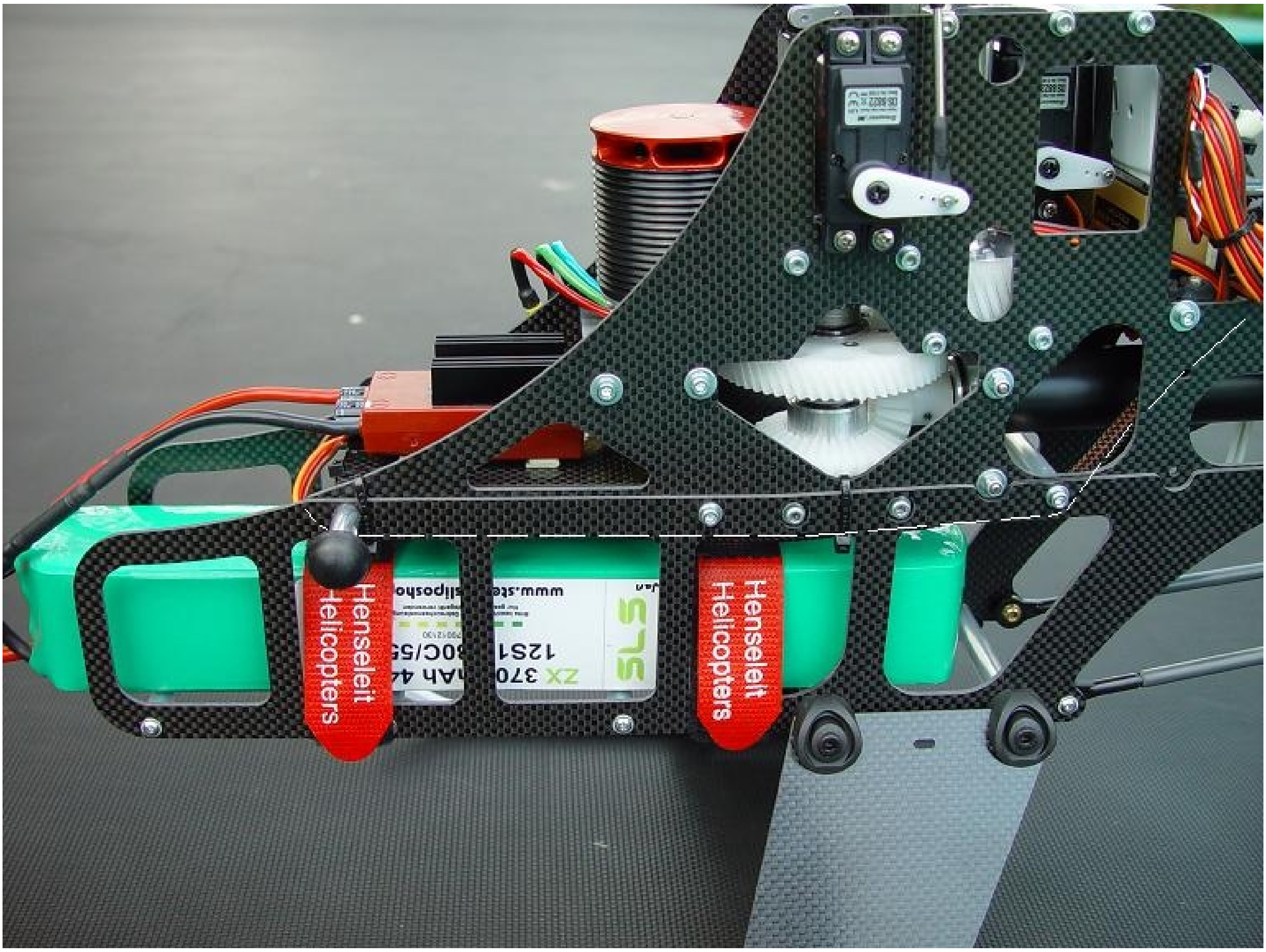
Assembly of the controller



Shorten the yellow cables of the Jive controller to a length of approx. 75mm and solder the 3.5mm gold bushes to the ends. Plus and minus cable remain unchanged. Only 4mm gold plugs are added.
Glue a heat sink on the metal plate of the controller using heat conduction glue. Otherwise the heat conduction is too low. The controller is attached to the centre of the carbon plate using two small strips of double-sided tape, so that the front edges of the two capacitors are aligned to the front edge of the plate.
Only one connecting cable is enclosed to the controller. In any case you need a second one of the same length.
(I am legally bound to point out that the adherence of my following recommendations is at owner`s risk because the manufacturer Kontronik does not give such an advice officially).
As far as my experience goes I have had more than 300 flights without any disturbances within more than one year. Four additional test pilots having had 600 flights until the date of publication of this manual are of the same opinion. According to our experience the toroid in the cable of the 2.4GHz system is not necessary, so you can remove it. Then the length of the cable is sufficient to connect the receiver. When using a normal system the toroid has to remain in the cable and the length of the cable has to be extended correspondingly.
In contrast to the recommendation of using a buffer battery in parallel to the Jive BEC we all fly our helicopters without this additional receiver battery. The Futaba servos have not caused any problems due to the overload of the BEC. However, you should not use any servos which consume even higher currents than this servos. A small buffer battery having a lower capacitiy is not reasonable in the case of a total failure of the BEC, because it is overloaded anyway due to the high currents of the servo in connection with the 3 axis stabilisation.
The advantage of the BEC is that you avoid the unnecessary additional weight of a receiver power supply and that you do not have to worry about the charge condition of a second battery on-board.
In this connection it is important that you take care of your batteries and that you check them from time to time. A disconnected plug due to a bad soldered connection does not only mean in this case „motor down“ but also „receiver down“.
However, as already mentioned this has not happened after nearly 1000 flights in total. Statistically seen you can rely on the safety of the system. There is not any absolute safety when using model helicopters because at any time a servo, the 3 axis stabilisation or a mechanical component may fail.

On the front side of the controller you find two connectors for the master and the slave cable. After having attached the controller you cannot see the plug labelling on the side lying on the bottom. That is the reason why it is reasonable to add a marking to the upper side. The master cable is located on the left side (according to the flight direction). The orange pulse cables of both connections are located on the right side (according to the flight direction).
Also mark the other end of the master cable to find it later after having laid both cables in the chassis.
Now lay both cables together to the back on the left chassis side within the battery slot on the top at the hem of both plates, so that they cannot be seen from outside (see photo on the following page). In this case it is reasonable to use a flexible protective cover protecting the cables. Secure the harness using cable ties.
The cables are led to the top below the last cross-bolt of the mechanics. Connect the additional power supply through the slave cable directly to the free slot of your receiver. Connect the connector of the master cable to the throttle channel of your receiver or to a free channel, depending on if you wish to adjust the speed using already programmed flight conditions with the corresponding throttle curves or using a free slider switch.

The white dashed line shows the way of both cables from the controller to the back



The LiPo battery is pushed into the mechanics from the front and secured using the two Velcro strips. Tighten the Velcro fastener well. Then the battery is pressed onto the silicon supports, has a strong hold and cannot slip during the flight.
The rear Velcro fastener should be positioned directly in front of the skids. Thus it prevents the battery from contacting the inner edge of the canopy´s cutout so that it does not knock during the flight.

Attention! When flying extreme 3D or pirouettes with high angular rates it is recommended to wrap an additonal tape around the front side of the battery. It can be necessary to secure it even more because during fast pirouettes the battery is pulled to the front by enormous centrifugal forces. The battery does not have to be secured at the rear side.

Place the battery in the battery slot such that the two connecting cables are located at the bottom. So you do not have to bend them and can lead them to the top to the controller by forming a nice arch. Shorten the battery cables correspondingly, so that the arch is not too large. Then the balancer connectors are located at the top and are more easily accessible.

To adjust the centre of gravity correctly, the battery is positioned such that the helicopter does not turn away if you take it at the main rotor and hold it in knife flight position. In order to do so, the canopy has to be mounted. Keep the position in mind which can be different depending on the used battery.

Chapter –XII **V-Stabi - Connection And Programmation**

The **TDR** is a truely „rigid“ helicopter, i. e. it cannot be operated by a flybar, is completely flybarless and requires an electronic control system.

My recommendation is the Mini V-Stabi 5… Express distributed by Mikado. Ulrich Röhr was the inventor of the first electronic control system for model helicopters world wide (V-Stabi 1999) and has the greatest experience in this field. Tests have shown that the V-Stabi meets all the demands we made regarding such a system.

The system offers excellent flight properties while hovering as well as during high-speed flights and the hardest 3D flight properties, but most of all the greatest advantages are easy installation and operation.

The suitable „electronic“ setup is decisive. The basic requirements regarding the perfect setup are identical:

- Stable flight characteristics in all situations
- Perfect and precise stopping behaviour during control inputs
- Solid hovering
- No pitching even at high speed
- High and reliable tail holding power

The flight characteristics of an electronically controlled TDR cannot be compared to a mechanical solution, i. e. a flybar, and clearly get ahead of these systems regarding the precision and the stability of the helicopter. In addition, they are offered over a wide range of speed.
A V-Stabi is not an autopilot, in every situation you have to control the helicopter yourself! If you wish to have further information on the effectiveness and the history visit http://www.vstabi.de

When using the V-Stabi the power consumption of the receiver system with four digital servos is increased by 50% compared to a flybar head system. The supply voltage is between 3.5 and 9 Volts. Ensure a safe and sufficient power supply even during the current peaks.
The three servos of the swash plates can reach peaks of up to 15A in the cases of high load.
Use suitable cables (two connections to the receiver are recommended) and make sure that the used power source has a sufficient capacity. Tests have shown that the BEC of a Kontronik Jive 80+HV which is connected via both receiver power supplies is usually sufficient. However depending on the use and on the assembled servos we cannot give any guarantee for the single use of the BEC.

Wiring of the central unit

After the assembly the central unit is connected to the servos and the receiver.
Adjust the transmitter such that only 4 single channels are transmitted (Mode H1, mechanically mixed swash plate – **as you know from the simulator** -).
The mixing of the swash plate is ensured by the central unit, every control function is individually transferred to the central unit (pitch, fore & aft cyclic, cyclic roll, tail).
Make sure that in all flight phases there are not any active mixers in your transmitter. All these tasks are now taken over by the V-Stabi.
Now connect the inputs of the V-Stabi central unit to the outputs of your receiver. In the manual of your transmitter you can see which of the 4 functions pitch, cyclic roll, fore & aft cyclic, and tail is assigned to the single receiver outputs.

Connection plan Mini V-Stabi

V-Stabi	**Servos**
RD	– Tail servo
Ch 3	– CYCLIC servo right
Ch 2	– CYCLIC servo left
Ch 1	– FORE & AFT CYCLIC servo

V-Stabi	**Receiver outputs**	
RXA (cable with the three single plugs)	orange	– tail
	braun	– aileron
	red	– elevator
RXB (standard servo cable)		– Pitch
RXC (standard servo cable)		

Aux – Sensitivity of tail (here you can provide a connection to a free receiver channel allowing to adjust different tail gyro sensitivities depending on the flight condition (generally dependent on the rotor speed) using the transmitter.

Chapter –XIII **Final Tasks** (Canopy etc.)

Now the canopy has to be changed to give the helicopter a trendy design so that it can be recognised well in the air. In general, a light basic colour is reasonable to achieve a better visibility, even if the dark canopy possibly looks more elegant. When choosing a dark canopy, light colours should be used for the window and the remaining design.

Curtis Youngblood - one of his first flights with his new **Rigid** in St. Johann / Austria April 2009

At first, download the small video film (111 MB) from our web-site, in which the attachment of the decal set is described. Everyone can do this work, you only have to have a little patience. After some efforts you will hold a canopy in your hands that nearly looks like being lacquered. In addition, you will have the satisfying feeling of having done it yourself. Even if you have some difficulties at the first time, the second canopy will be perfect. In the case of a crash you do not have to be frightened of losing a cost-extensive and time-consumingly lacquered canopy.

At first watch the video film completely. The playing time of the single steps is not shortened, so that you get a feeling of the needed time. Only the mirror-inverted second side of the canopy has been prepared without having been filmed, in order to decrease the duration of the film. Watch the single sequences a second time just before starting to work. Do not worry, if one of the decal sheets gets damaged. Every single sheet can be delivered in addition.
Please do not try to attach the dry films to the canopy quickly. They can only be attached by covering the attachment side and the canopy using water and washing-up liquid.
Attention! Immediately pull up the decale from the paper whilst dropping it into the water. If the paper gets wet you have only a few seconds for this job otherwise the paper sucks in the water and the surface between the decale and the paper will take of from the paper and will glue onto the decale for ever so that you can´t use it any more.

Use a little trick to slip the canopy over the mechanics. Slightly widen the back of the canopy at the top. While assembling the canopy incline it and position it with the top pointing to the bottom and the back pointing to the top. It is intended to slip the rear upper opening gap of the canopy above the swash plate over the mechanics, in order not to widen it too far. If you turn the rotor until it is located crosswisely to the fuselage, so that the rods are not disturbing, it is even simpler.

It is difficult to slide the rubber sleeves of the canopy onto the canopy mounts when it is cold or they are new. Use a small amount of grease. Push any eyebolts through the cross-holes of the canopy mounts.

To remove the canopy reach into the cut-out from the bottom using your fingers and press against the canopy directly next to the mount from inside. Otherwise you would damage the thin GFK material.

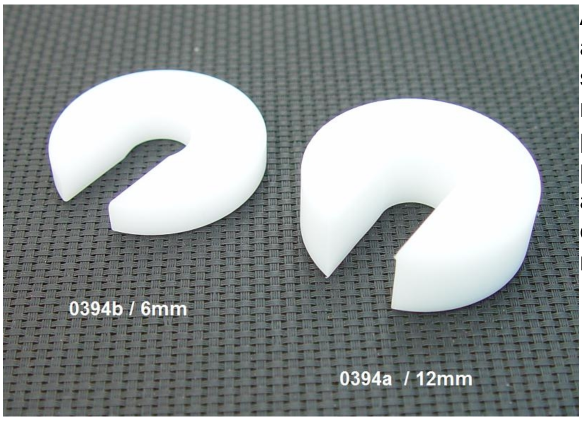
The (www.henseleit-helicopters.de) - decal sheet can be attached to the side of the tail boom directly in front of the strut clamp, so that everyone sees where the Rigid comes from ☺

Attention! If the parts within the canopy are heated too much due to your rough manoeuvres or the summer weather, you can add a triangular cut-out below the canopy in the front area just behind the tip for cooling purposes.
Draw the desired triangle and countersink it using a Dremel. On the top of page 36 you see an image with a corresponding canopy. A relatively large version is shown here. A smaller version is also sufficient (has a lower slowing down effect ☺).

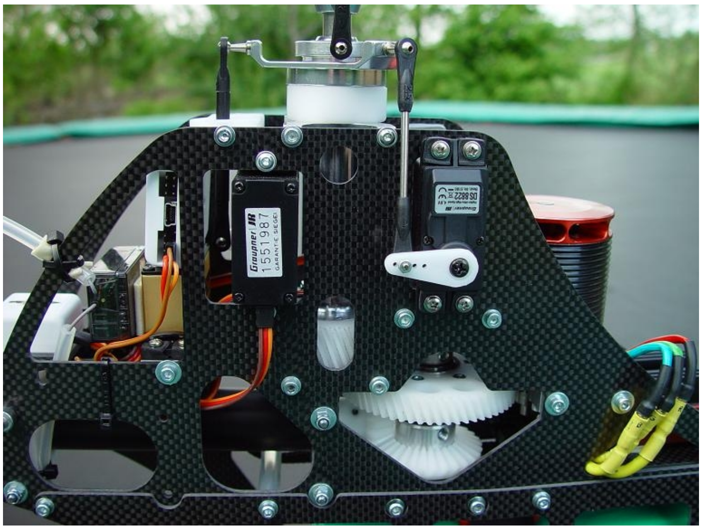
Adjustment of the rotor blades

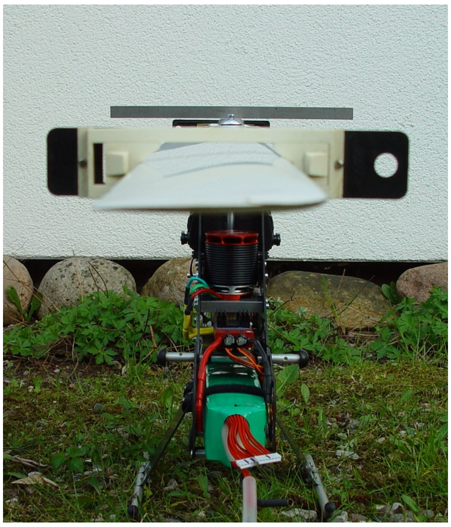
Now mount your rotor blades. Please note the following: If you use the recommended Rigid or Radix blades (length of 710 mm) with a blade root of 12mm you should use the plastic spacers added to the kit in any case but not any aluminium spacers, because they jam in the aluminium of the blade holders and leave ugly traces.

Attention! Irrespectively of which blades you use, it is important that the blades do not have an advance of more than 2mm at the leading edge (to find out, let it hang down vertically from the mounting hole and check if the leading edge hangs straight down or if it is tilted forward at the blade tip). Blades having a larger advance react very aggressively and add a great load to the servos and the mechanics.
You may tighten the blade bolts 0138 so that the blades can still swing around, without much force. They should be tightened just as much as necessary, to not swing down by their own weight, when holding the helicopter with the rotor shaft horizontally. This is very important for the flight characteristic of every helicopter. Too tightly fixed rotor blades produce vibrations and lead to a pronounced pitch-up tendency in high-speed flight.
Some rotor blade manufacturers use longer bushings, which extend above and below the blade root. Reduce the bushes with a file down to the surface of the blade holders tighten the blades with pressure on the root and not on the bushings. Otherwise a sensitive adjustment is impossible. Also, you should grease tightening area of the blades with blade roots of a thickness of 14 mm, which are assembled in the blade holders directly without any additional washers.



At first put the 12mm thick swash plate lock 0394a below the swash plate and push the swash plate to the stop. The main rotor centre hub has a flat surface at the top, were you can put on a flat strip. The strip serves as reference line to align the blades to a pitch of 0° at neutral position of the pitch-stick. You only need two paddle-gauges, but no water level. Push the paddle-gauges to the blade ends and look from the front over both gauges and the rod. Now all three lines have to be aligned. If this is not the case you can correct the connecting rods 0121a/b/c of the main rotor. Attention! A half rotation at one of the ball links can be sufficient.





It may occur that the lengths of the rods have to be adjusted differently to align the blades exactly to 0°. The reason for this are tolerances of the blades or blade holders, that have to be compensated for.
Possibly you already have screwed in the ball link 0121b into the driving bush 0121a until it reaches the stop. However it has to be screwed in further to reach 0°. So let it remain at a positive angle to a certain extent. Align the other blade correspondingly and electronically trim the swash plate in the V-Stabi down to a small extent.
Make sure that the swash plate is not lifted off the lock when aligning the blades. Even a small gap on one side is sufficient to faslify the result completely.
Due to the hard blades used nowadays an adjustment of the blade by track watching while flying is not reasonable, because you do not see anything.
Experience shows, that a helicopter may vibrate in a hover while the track appeared to be perfect. A closer look revealed a pitch-difference of 4° between the two blades. Being very accurate at this stage can spare you the necessity of doing it on the field.

Maximum and minimum pitch:

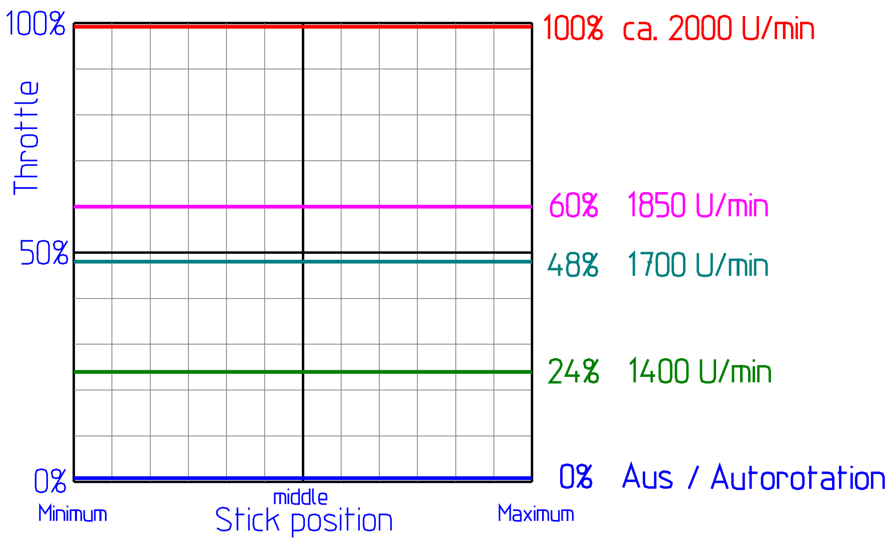
Now adjust the maximum and minimum pitch values using the setup of the 3 axis stabilisation system (chapter XII – p.44).
At first adjust the maximum value by adding the 6 mm lock 0394b to the 12mm lock 0394a and adjusting the way electronically such that the swash plate rests on the 18mm strong support at maximum pitch. The minimum is determined symmetrically to the other side. It can be checked by putting only the 6mm lock under the swash plate.
The adjusted collective way of +/- 6mm according to the dead centre position corresponds to a blade altering angle of approx. +/- 13 degrees. This is a good allround value which does not overload the motor and offers well-balanced flight properties. Extreme pilots can increase the value later to a certain extent, however I consider 15 degrees to be the absolute limit. While hovering you will have great difficulties in keeping the helicopter at a height. It can also result in mechanical problems regarding the rods at a pitch of more than 13 degrees at full cyclic deflections. In every case always make a test and add full cyclic deflection at maximum pitch positions. Then look if the rods or the swash plate collide at a certain position. It is normal that full cyclic deflections in the pitch end positions lead to an uneven movement of the swash plate because due to the large angle differences the servo arms move in extremely different ways. However, this is not problematic because at these pitch values you usually do not add any full cyclic deflections.

Finally clip the rotordisk 0103 into the 5mm hole of the centre hub now .

Adjustment of the throttle curves and the motor:

At first programm your controller in the correct mode according to the instructions of the manufacturer (Mode 4 at the Jive controller). Mode 11 is not working perfect every time. Some times there are some moves arround the yaw axis with this setup.
Attention! If the helicopter had the same starting behaviour as a car or a boat the wrong mode would be fatal.

If the rotor does not rotate when starting the engine, you have to exchange two cables from the controller to the engine.
There are two ways to drive the controller. The Jazz controller works excellently. You provide a RPM via a free channel using a slider switch or via the throttle channel and already programmed values that are retrieved from different flight attitudes. The controller keeps the values constant in spite of different strains. This certainly is only possible as long as the engine is able to maintain the RPM.
If you follow my instructions and standard configurations, the engine can manage 13° pitch with nearly 1850 RPM, i.e. the controller ensures constant RPM up to these values. Therefore it is not reasonable to adjust higher RPM that is reached by the engine at low load but cannot be kept in the case of required performances. This would result in permanent RPM variations and the system becomes nervous.
When using a slider switch for the controller every RPM between about 1300 up to about 2000 RPM can infinitely be adjusted. However, it is difficult to adjust a certain RPM during which the helicopter can be flown particularly well and to immediately combine it with the corresponding gyro sensitivity. My gyro sensitivity is between 95% during speed-flight and 120% during low RPM for hovering. It is obvious, that you can increase the gyro performance with an adjustable sensitivity for lower RPM. At a fixed value the maximum value of the gyro sensitivity is limited by the ascending behaviour during high-speed flight with the highest RPM.
That is why I connected the controller to the throttle channel and programmed 4 different flight conditions + auto-rotation with different throttle curves (in fact, they are straight lines).
Caution! The given values in the table can be used for the set-up with the Pyro 700-52 Motor (13 teeth –pinion) as well as the Kontronik Jive 80+HV controller and a new 12S LiPo Pack.



In the diagram you can find my programmed RPM with the corresponding rates. Five straight lines have been programmed, so that the controller gets a constant input signal independent of the pitch stick position and controls the corresponding RPM itself. Depending on the transmitter the values may differ, but they serve very well as initial values (full throttle RPM 100% is attainable only with 0° pitch and is usually not used during the flight).
Attention! Unfortunately the RPM given by the Jive controller depend to a geat extent on the charge condition or the quality of the battery when being connected. Thus, the adjusted curves when connecting a new, fresh battery do not guarantee that the RPM are still correct after 20 flights with the same battery. With the increasing number of cycles or when using different batteries the RPM vary. So it is reasonable to adjust them from time to time.
For every RPM I have adjusted the gyro sensitivity such that the helicopter flies smoothly during fast forward flights. By means of a slider switch the sensitivity, i.e. the programmed maximum value, can slightly be reduced if necessary. When switching from higher to lower RPM the gyro may get over-controlled for a moment.

Attention! Do not let the engine without blades run at a throttle specification of more than about 30%. If there is not any load due to the rotor the RPM values do not correspond with the values adjusted under load, i. e. the engine runs too high which may result in a damaged mechanics.

Chapter –XV Directions For Initial Flight (RPM, operating limits, recommendations, hints etc.)

Let's get to the point, you're waiting for!
Take your time and wait for good conditions, before you start with the first flights.
Neither spectators nor commentators are helpful for these flights. Always be alert to unforeseen surprises. Carefully check the whole helicopter, including your transmitter at home before leaving for the airfield.
Caution! Perform pre-flight checks (the helicopter moves to the direction the swash plate tilts down to).
Check if the sensor system of the 3 axis stabilisation is adjusted correctly, i. e the swash plate has to run in the opposite direction of its tilt movement (see chapter V-Stabi).
The centre of gravity should be situated at a point, where the complete helicopter, including batteries and canopy, when held with the main rotor shaft horizontally, does not turn away.

Grease all the gears using a small amount of tenacious grease (do not use any thin fluid oil or spray). It is also important that the rotor shaft is greased at the location where the swash plate moves up and down. Use a tenacious grease (e. g. ball bearing grease). This kind of grease produces a caterpillar above and below the ball which pushes the dirt like a joint washer. It can be wiped away from time to time and new grease can be added. When using thin fluid oil or spray at this location micro-fine dust particles may fill the gap which produce grooves and scratches on the main rotor shaft. This may lead to a swash plate jam.

Before the first flight, perform a range-check with retracted antenna (or in test mode with 2.4GHz transmitter).
First, adjust the transmitter clock to 5 minutes, so that you do not accidentally discharge the battery completely at the first time.
Follow the correct sequence when switching the transmitter on and off.

Before the start:
1.) Transmitter **on**
2.) Slider switch to **off** or use auto-rotation switch
3.) Connect power supply – wait until V-Stabi is calibrated
4.) Ruder check
5.) Mount the canopy

After landing:
1.) Slider switch to **off** or use auto-rotation switch
2.) Remove canopy
3.) **Remove** power supply
4.) Switch off transmitter

After this procedure place the helicopter on a grassland as even as possible. When placing it on a plain surface like asphalt or concrete the helicopter may possibly rotate very far around the vertical axis because of the torque impulse when switching on the engine. In addition, there is the danger of a ground resonance.
In these cases use grippy silicon rubbers for the skid tubes.
Basically, position the pitch-stick to neutral (centre) position to a pitch of 0°, align the blades and check if the tail rotor slider switch of the tail rotor is in centre position before you switch on the engine.
Main rotor blades that are not tightened uniformly may also cause problems when swinging away non-uniformly during starting rotor acceleration.
As soon as the rotor has rotated 2 to 3 times the blades stabilise themselves.

Do not worry if the helicopter shakes during the start at approx. 800 RPM because it passes a small resonance field.

You presumabley have to get used to the slightly different control characteristics first, if you have not used a flybarless stabilisation system before. Control it as little as possible, then the system will fly by itself having a good stability. Avoid hectic control impulses. Correct it with small deflections if the helicopter tends to tilt and take off quickly and not too careful. From the moment the helicopter has no contact to the ground any more the stabilisation electronics works perfectly. The adjustment is similar to the one after the introduction of the first heading hold gyro. First you had to get used to them and later you do not want to miss them.

The RPM of approx. 1400 is excellent for energy-saving flights as well as for hovering. Soft 3D as well as quick and silent round-trips are possible without any limits. A nice RPM for relaxing fun-flights.

Approx. 1700 RPM are good for every kind of flight 90% of the pilots fly.

Choosing 1850 RPM give you a wild-ride. This RPM is suitable for flights at high speed as well as hard 3D. However if you use a 3700 battery you should land after 4.5 minutes at maximum.

Depending on your requirements switch between the different RPM to save energy. It is not reasonable to hover at more than 1400 RPM because too much energy will be wasted.

Avoid RPM of more than 1900 because tail boom vibrations lead to vibrations of the aluminium tail boom which can be noticed by a humming noise. For using higher revs it is very important to use well balanced tail blades.

Some hints for high-speed flights. Because of its performance and excellent aerodynamics, the helicopter can be noticeably fast. The V-Stabi allows normal pilots to control these velocities. When using a paddle head the helicopter would pitch up at a speed of up to 200km/h and the smallest fore & aft deflections. The electronic stabilisation allows to keep the helicopter on track, whereas it cannot overcome the laws of physics. At high speed and strong control pulses the helicopter also pitches up even if you use the V-Stabi. The faster you fly the more careful you have to use the fore & aft arm. It is recommended to hold off the downturning helicopter carefully at high speed by flying a soft bow and when it reaches the horizontal position you do not do anything. Then the electronics works perfectly and exactly keeps the helicopter on track.
The maximum flight speed can be reached during an upturn by reducing its pitch angle a bit. Use the acceleration caused when the helicopter falls from the great height to increase its velocitiy and hold it off by a soft bow. During this process increase the pitch continuously. In ideal case the helicopter dashes past you in horizontal position with its fuselage slightly inclined to the front and a pitch of 14 degrees. If you let the helicopter ascend carefully when it can hardly be seen the pitch should be maintained as long as possible. The helicopter should slowly be positioned vertically. So you can use the power and fly breath-taking climb flights into the stratosphere ☺
If you pull up the helicopter uncarefully and reduce the pitch it will result in a poor climb flight ☹

Another advice for high speed flights is to open the ESC generally to 100%. It makes no sense to cut of the tip because for speed flights it is absolute unnecessary to keep a constant head rpm. So the revs will rise during the approach from high altitude with lower pitch value and you will have some kinetic energy stored in the rotor when you pull up the helicopter with a soft curve into a horizontal line. In this moment when you move the stick to maximum pitch the rotor speed will descend and will keep the maximum head speed which the motor can deliver.
If you like to have a special speed set up for competitions you can change the 13 teeth pinion to a 15 teeth pinion in a 12s setup for getting more revs and stability during the approach. With such a configuration we have got a speed of more than 230km/h with the standard Pyro coming down from a high altitude. This shows that you do not need such big monster motors for this kind of speed flying.

Be careful and have a look that the rotor does not get more than 2300 revs and that the blades have not more weight than 200g. The axial bearings 0115 have to be checked more often when flying with high rpms.
Another point is to have a look for the tail rotor when flying with more than 1900 revs on the head. Dangerous boom resonances could occure especially when the tail blades are not very well balanced. You will hear it because of strange drone noises from the boom. Never keep on flying with this resonances because a compete tail rotor failure will be the result soon. Sometimes there is a certain rev were you will get a little more vibrations at the tail and if the revs get higher they will disappear again.

Often it will be also necessary to reduce the tail rotor gain down to less than 50% when you are flying very fast or to use smaller tail blades to prevent the tail from swinging.

Attention! I have to stress out that I can not give any guarantee for such special setups with higher rpm than 2000 as recommended and for setups with motors more than 4KW power because there are too many unknown factors which can cause fatal failures and which are not under my control.

Another strong point of the TDR is the ability for a very long knife flight. This figure which is not very typical for a helicopter can optimally be realised with the TDR because of its high flat canopy producing a sufficient ascending force at a sufficient initial speed.
Fly similarly to the speed flight described above and finish the holding-off bow when the helicopter´s top slightly rises. Then turn the helicopter by exactly 90° so that it reaches the knife flight position (the way round so that the tail rotor presses to the bottom). Pitch should be exactly at 0° and the fuselage should slightly incline to the top, which can still be corrected via the tail rotor. From now on release all pitches so that the helicopter flies on like a bullet.
After some time the flight speed decreases because of the missing propulsion, so that the helicopter starts to lose height. Now you can extend the knife flight a bit by positioning the fuselage with the tail rotor more and more against the direction of the current ☺

For your safety:
Do not under-estimate the danger of the flight object. The low operation sounds also at high RPM can be deceiving. When tapping the full potential, the Rigid is more powerful than any 91 type glow version!
You may be tempted to fly the helicopter in the garden or to do other mischief. But do not do this in any case. The Rigid is not designed for flying indoor. It is a large high performance machine that should be flown on a corresponding terrain.

The drive battery:
Do not use more than 85% of its capacity, i.e. 3.14 Ah at a nominal capacity of for example 3.7 Ah (0.85 x 3.7 = 3.14 Ah).
Attention! When using latest LiPo batterys you do hardly not notice the reduction of the performance because the voltage is very good even at the end. So you do not recognise that the capacity is used. There can be the danger of flying too long. If the RPM decreases considerably you are already below the admissible discharging limit and you risk to destroy the battery. In every case set a timer.

Caution! The power consumption may deviate considerably during different styles of flying. When in doubt, bring the helicopter down earlier. When the battery is discharged to less than 3 Volts the battery could be damaged and not be repaired!
In order not to decrease the service life of a LiPo battery, it is also important to consider and keep the temperature limit of 55°C at the outside.
Therefore, the flight time is not only limited by the capacity, but also by the temperature development of the battery pack depending on the outside temperature. Prefer to reduce your flight time by 1 minute when flying in midsummer at 30° or higher, in order to conserve the battery.
Keep a log and record the flight-time, the outside temperature, the battery temperature after the flight as well as the capacity used, that you can see on your battery re-charger after the recharging process.
This may sound a little bureaucratic, but is very helpful to gain experience. After some flights you will know what to expect of your battery and you will learn its correct usage according to the operating limits.
If you follow the advice, you will have a lot of fun with this new battery technology and numerous nice and problem-free flights.

M a i n t e n a n c e / S p a r e P a r t s

Always leave a palm for air below the rotor ☺

Maintenance advice

It is advisable, especially after the first flights to check the helicopter carefully. Important screws and ball links may have loosened. If such things happen at all, they mostly do in the early flights. Screws, which remain tight over the first three hours, usually remain tight forever. Take a close look to all the components and lubricate the main rotor shaft in the area of the swash plate with thick grease as well as the tail rotor shaft in the area of the tail rotor slider and all gears (do not use any thin fluid oil or spray). Frequently check the condition of the O-rings 0102 for damping the feathering spindle. Old and brittle O-rings may break and fall out of their bushing. Lubricate new rings with Vaseline. Always check the main rotor shaft bearings for possible roughness after a crash. If necessary, replace them.
Caution: Rough bearings may cause strong interferences. Check the parts for being bent after a crash.
Usually, the main rotor 0410 shaft as well as the feathering spindle 0110-2010 has to be checked after crash.

Also check the tail rotor shaft 0910-2010 and the tail centre hub 0936. When removing the tail centre hub from the shaft you can see if the bade holders do a tumbling movement by turning the hub. Unscrew the tail blades, in order to be able to turn the attachment screw 0911 using an Allen wrench.

If the tail boom hums one time below 1900 RPM the tail rotor blades may not be balanced exactly or one of the support bushings of one of the drive shaft bearings may have become loose. So the drive shaft 0810 cannot be guided any more.

For exchanging the feathering spindle 0110-2010 at the main rotor head it is sufficient to unscrew one of the two caphead screws 0119 to pull off the blade holder completely with all its bearings. Do not forgett the grub screw from the seesaw 0140. The second blade holder and the shaft can be removed together from the centre hub. Fix the shaft in the vice to unscrew the second screw as well and to remove the blade holder. Check the first bearing 0113 in the blade holder for rough run. This bearing can be exchanged without having to remove all the other bearings. Simply insert the old shaft, slightly move the bearing to and fro while simultaneously pulling it out. Sometimes it is helpful to warm up the blade grip for that. The other bearings of the blade holders usually remain undamaged.

Maintenance:

In opposite to a glow helicopter which is covered with oil automaticly the aluminium partes of an electric version which are not anodised gets some spots from touching them with perspire fingers. Specially the main rotor and the main blade holders which will be touched often whilst carrying the helicopter has to be protected from time to time with a little oil or some protection fluid for aluminium.

Support

My company is a small scale business. I manage everything, from engineering, testing, documentation, purchasing, manufacturing and presentation to forwarding spare parts, myself. As you can imagine, I am pretty busy over the day. Unfortunately, I never managed to draw more than 24 hours from the day. Since delegating tasks leads to less quality, besides losing a good grip of the basics, I decided not to change my working practises. I always like to give advice on the phone, related to problems, which sometimes turned out not to be caused by my products. I would like to go on with this. With increasing sales and customer base, this becomes a difficult task, as I have to spend more and more time on the phone. Hiring a charming voice for the phone, most probably, would not be helpful except for stating the local time, but not for giving you competent information about helicopters.

Therefore I would like to ask you to do simple spare parts ordering via my **Internet Shop** that can be found on my website.

There are candidates sitting in front of their crashed helicopter and calling me Sunday evening to tell me explicitly what has been damaged. The spare parts list with the order numbers has got lost long ago and so any exact information cannot be given. Such orders by phone can easily take half an hour.

So I ask for your understanding to order spare parts exclusively via the Shop. These orders are dealt with daily and have **top priority**.
It is easier for us to handle clear forms of the same type. You have the advantage of seeing what you will get when viewing the pictures. Besides, you will precisely be informed of the costs and the status of the order.

The number of e-mails, I receive every day, is continuously on the rise. Each individual possibly has enough time to write a long letter and asking many questions. However, it all comes down to me, and I am afraid, I can’t read and answer all these mails in time. Specific problems may require a direct, voice-to-voice-contact, which would possibly be more effective.

Up-to-date information of general interest will be published via the web on my website
www.henseleit-helicopters.de