BUILDING INSTRUCTIONS

FOR

System 80

Heli Boy	Order No 715
BELL 222	Order No 709
BO 105	Order No 713

HUBSCHRAUBER Schlüter MODELLBAU

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General Information

"System 8o" consists of a number of modules which can be combined in many ways.
The "Heli-Boy", which is known as "the" model among model helicopters, is the basic element of the system. This fundamental element remains the same for all versions of the System 8o helicopters. The variations are mainly concerned with rotor heads and control components.

Building Instructions

The building instructions for "System 8o" covers all variations in a progressive order. In building the helicopter, please proceed step by step. The non-applicable stages should, of course, be omitted. Each stage is marked accordingly.

A) Basic Heli - Boy

Two-bladed rotor with flap hinges, without collective pitch, so that all control parts, rods, levers, etc. for collective pitch are eliminated.

B) Standard Heli-Boy (Bell 222)

Two-bladed rotor head and collective pitch, aerobatic modification parts and a modification for flybarless flying (so-called rigid rotor).

C) Bolkow BO 1o5

Four-bladed rotor head and collective pitch. (Note that this model may be fitted with any of the previously described rotor heads).

To simplify construction, all bulding components are packed in bags numbered in a sequence corresponding to their appropriate assembly stage. These bags contain all small hardware parts, bolts, washers, nuts, etc., which are required for that particular building stage. It is therefore recommended that you keep to the number sequence given in instruction stage and on the corresponding bag. To avoid confusion, open only the bag required for a particular stage on which you are presently working. Some parts groups have already been preassembled. Only "normal" tools are required for assembly: screwdrivers, pliers and similar items. Special socket head screw wrenches 1.5, 2.5 and 3 mm, as well as socket wrenches 5.5 and 11 mm (for crankshaft nut), 8 mm socket wrench, 22o mm long (for glow plugs) and a tube of heavy duty grease are also provided in the kit. All of these accessories are packed in a seperate bag.

Special devices or a building board are not required for assembly, but it must be recognized that we are handling very high quality and precise mechanics and assembly should therefore be done in dust-free sorroundings. Also please note that all bearings and pivots should be greased before assembly, since it will not be possible to add grease later. This is a very important point, since it will ensure sufficient lubrication from the very beginning and extend the life of the helicopter. Later oiling of bearings from the outside will not be so satisfactory.

Stage 1, basic frame (Bag 1)

Both side plates (147) are fastened together using four U-shaped channels (141) and the bottom support (158) as shown in figure 1. Use a total of 16 M 3 x 8 steel bolts and M 3 nuts. Nuts must be inside. It is important to adjust the side plates so that they are parallel. Tighten immediately.
Nuts without the plastic locking ring must be secured by a drop of Loctite (1341). Note: do not use the red or permanent Loctite, only the type which allows later disassembly.
Skid struts (123) are fastened with re-inforcement channels(156) and two socket head screws M 3 x 15, with lock nuts underneath the body. Fasten skids (124) with clamps(125)to struts (123), using eight M 3 x 1o bolts and nuts. Skids should project about 1o cm at the rear end. Tighten bolts, nuts fitted downwards. If the skids have to be removed often, for easier transportation, fasten the two socket head screws M 3 x 15 with ordinary nuts (not included in kit) and without skid struts to bottom support. The re-inforcements are then redrilled to 6.5 mm dia. The center holes of the skid struts (123) should then be slightly countersunk to 6.5 mm (1/4") dia. (for about 1 mm depth only). Now you can fasten the landing gear in place with lock nuts from the underside. Removal and replacement will be very easy.

Stage 2, pitch and roll lever, (Bag 2)

Fasten three steel ball fittings (434) in the raised bosses of the pitch lever (445) (T-lever) and roll lever (446) (angled lever). Do not tighten too much. As shown in fig. 2 the pitch lever (445) is on the left side and the roll lever (446) is on the right side of the side plates. Assembly order from the outside in is: Steel screw M 3 x 15, washer, bushing (151), pitch lever (445) or roll lever(446), side plate (147) and lock nut M 3 from the inside of the side plates(147). Tighten all nuts well. When assembling moving parts, use the grease provided. They should move easily, but without play.

Stage 3, Main Rotor Shaft, (Bag 3)

In this stage the main rotor shaft with swash plate, bushing and drive wheel are assembled. According to type of main rotor system, there are the following main rotor shafts:

A) Basic Heli Boy (715): The shaft (458) for the rotor without collective pitch is provided with the top end milled down to 7 mm dia.

B) Standard Heli Boy Bell 222 (7o9): For the two-bladed aerobatic rotor, a collective pitch wire (448) is fitted into the slot of the main rotor shaft (45o). Use grease! The short angled end of the wire faces downwards. The bottom end of the main rotor shaft has the hole nearer to the end.

C) Bolkow BO 1o5 (713) For the four-bladed rotor the collective pitch wire (457) is inserted into the small hole in the sleeve (538), with the short angled end from the inside. Both parts are then fitted onto the main rotor shaft (45o) using grease.

Important: The sleeve (538) must move very freely, without snagging, together with the collective pitch wire (457).

Now slide on to the main rotor shaft, from the bottom end with the collective pitch wire (457) in place in the slot in the main shaft:

1. Swash plate driver (444), wide edge downwards
2. Swash plate (453, 454, 412) (assembled), inner ring upwards
3. Swashplate ball (452), ball upwards
4. Spacer (475)
5. Bearing block (152) with ball bearing (456) upwards.
6. Bearing block (152) with ball bearing downwards. See figure 3

Next slide the main rotor shaft and bearing blocks between the side plates (147). Fasten bearing blocks with four M 3 x 3o socket head screws and M 3 lock nuts. Make sure that the support plate (449) is fitted under the M 3 x 3o screw heads on upper left side. Slide gear (148) onto main rotor shaft from below and fasten with the special M 3 x 23 screw and M 3 lock nut. Slide up shaft and adjust axial play from above with swashplate ball and 2 set screws M 3 x 3. These screws should be treated with Loctite before assembly and tightened well. In order to eliminate a possible downward movement of shaft during a very hard landing, an additional support bearing is installed. Fasten the ball bearing(316) to the support bearing block (163) in the following order: Socket head screw M 3 x 15, ball bearing (316), washer 3 mm dia, bearing support block (163), self lock nut M 3. The complete sub-assembly is now fastened underneath the main drive gear (148) with socket head screw M 3 x 35 and self lock nut, between side plates. The ball bearing should almost touch bottom edge of gear (148) with no more than 1/1o mm space between them. See figure 6. Insert three steel ball fittings in the bottom ring of the swashplate. Three control rods (433) are fitted with two ball joints (o58) each. Ball joints should be screwed on until they touch each other. Now connect these three assemblies between the three swash plate balls and the three balls of the pitch and roll levers. Carrier pin (455) is inserted into fourth hole on swash plate ring. This pin moves in the slot of the supporting plate. See figures 4 & 5.

Stage 4, Collective Yoke (Bag 4)

The collective yoke is only required on models with collective pitch (Standard Heli Boy (7o9), Bell 222 (7o9) and BO 1o5 (713). Assembly to the frame is made with a socket head screw M 3 x 35, which also holds the support bearing block described in previous stage. Toggle joint (443 B), ball bearing (316), two bushings (535), and 2 steel screws M 3 x 5 are inserted into fork end of collective yoke (466). Bushings are fitted from the outside of the collective yoke. Parts must move easily (grease well). Eye bolt (447) is fitted through the ball bearing (316) and retained with a self lock nut M 3. Slide collective yoke (466) with two bushings (from inside) onto the side plates. The lower right angled end of the collective pitch lever, which protrudes below the main rotor shaft, is inserted into the eye bolt and then toggle (466) with bushing washers are fastened from outside of the main frame with the M 3 x 35 screw which also holds the support bearing block between the frames. The collective pitch yoke must also move easily, use grease. See figure 7.

Stage 5, Tail rotor Drive (Bag 5)

Slide spur gear (146) 15 teeth, onto tail drive shaft (346). Insert set screw M 3 x 5 through the gear hub into tail rotor shaft hole. Don't forget to use Loctite on all screws which are not self locking. Drive shaft (351) is also secured at the flattened shaft spot by this screw. Fasten set screws tightly. Two ball bearings (352) are slid onto drive shaft and tail rotor shaft, as shown in picture 8 and placed in the bearing blocks (339). This unit is now inserted in frame behind the large gear and fastened with socket head screws M 3 x 3O, using washers and lock nuts on both sides. Do not tighten yet.

Now move bearing blocks (339) with gear (146), so that gear (146) engages fully into upper teeth of large gear with minimum free play. The frame bolts for the baeringblocks may now be tightened. This has to be executed very carefully, to avoid jamming of the plastic halves and distortion of the bearings. Best results are achieved when tightening the crossing screws, until a clear heavy movement of the gear is noticable. - Then loosen screws again until gear runs smoothly.

Tail tube (35o) is inserted into frame from the rear, plain end first. The steel wire shaft is inserted through the tail tube bearings (343) which are inside the tail tube. The tube is now adjusted so that there is a 3 mm gap between the end tube and the plastic bearing shells, and is secured in the frame with four socket head screws M 3 x 3o and self lock nuts. Do not fasten bolts too tight, so that tube is deformed. See figure 8. Assembly of tail tube is not required on the "Bo 1o5", since a flexible drive is used.

Stage 6, tail rotor gearbox, (Bag 6)

Push bevel gear (348, 22 teeth) onto tail rotor shaft (38o) so that drilled side of shaft faces bevel gear. Slide one open ball bearing (352) and one shielded ball bearing (363) onto the shaft. Bevel gear (347, 17 teeth) is fastened with socket screw M 3 x 5 onto tail rotor shaft (346). (Do not tighten screw yet, so that the drive shaft may also be pushed in later.)Ball bearing (352, open) and (363, shielded) are now slid onto shaft. Fit both gear assemblies into tail rotor gearbox (34o). Insert guide bushing (379) according to drawing. (Long shaft (38o) in square part, short shaft (346) in round part.) See figure 9.

Grease gears well, and half fill gearbox with grease before assembly.

The two holes on the gearbox, beneath the bevel gears, are each closed with a screw M 3.5 x 3, so that warm and liquid grease cannot leak out.

As shown in figure 1o, the tail rotor gearbox is now assembled with screws M 3 x 25 and lock nuts, nuts upwards. In open configurations, without fuselage (for example - Heli-Boy) taile skid (353) should be fastened under the fourth gearbox bolt M 3 x 3o, using a washer.
The adjustable clamp (354) is fitted onto the tail tube, then the tail rotor gearbox.
Now tighten the clamp so that screw is on the left side, looking in direction of flight. Important: tail rotor housing should be rotated so that the rotor shaft is horizontal to the ground. From the top, through the hole in the tail gear box, insert a socket wrench 1.5 mm and tighten socket head screw M 3 x 5 on the front gear. By rotating slightly, make sure that the screw end contacts the flat portion of the drive shaft (351). Tighten the screw firmly.
The afore mentioned steps are not required when assembling fuselage kit BO 1o5 (714). Pre-assembled bearing block (341) with controllever (342) and control rod (349), as shown in figure 1o, is inserted from the right side through the hollow shaft (38o). Use grease. With four steel screws M 3 x 8 (1o), fasten to tail rotor housing with the tail fin fitted between the two plastic parts. Do not damage the threads by tightening screws too hard. This applies to the basic Heli-Boy (715) and to the standard Heli-Boy. (7o9 E). Note that bolt lengths vary in these cases.
Now check the entire drive unit, from the front gear down to the rear hollow shaft, ensuring that every part moves smoothly and freely.

Stage 7, Drive Unit (Bag 7)

For this stage the engine to be used must be available. Basically, almost every modern 1o ccm engine with a crankshaft ending of 1/4" dia. (6.35 mm) may be used.
Cooling fan (127) is fitted on to the engine shaft. The spacer ring (15o) may be required between fan wheel and motor hub, enabling fan to rotate freely without touching the carburetor. A 6 mm dia. washer is now slid onto engine shaft and the fan is fastened (using holder, Order No 1344) with fan crankshaft nut. Use the socket wrench included in the kit. The nut should be tightened well, but do not clamp fan wheel in vise, etc.
Clutch (153) which is already fitted with the starting shaft (154) may now be bolted onto the fan wheel with 2 socket screws M 4 x 15. Exact centering is required. Steel washer 6mm dia. is now slid onto the starting shaft (154). Do not forget this.
After assembly of clutch (153) with starter shaft (154) the entire unit must be checked for exact concentricity. In checking, clamp engine in a vise or a similar method, remove glow plug and slowly turn the fan. The end of the clutch shaft should not have any whip, or as little as possible (1/10thmm at the most). If it does not run true, then possibly the fan has been misaligned when fastening crankshaft nut. Remedy: loosen crankshaft nut, rotate fan wheel slightly, retighten nut and check alignement of shaft end again. In some cases this step may have to be repeated several times. When everything runs accurately fit the clutch bell onto the starting shaft, push over clutch. As shown in figure 11, the unit is now inserted between the upper frame sides. Spread frame sides a little, for easier entry of upper bearing casing. From above, put the following parts onto the starter shaft:

1. Washer 6 mm dia.
2. Bearing block (131) with ball bearing (217) downwards,
3. Bearing block (131) with ball bearing (217) upwards.

Now insert bearing blocks between frame parts and fasten with socket screws M 3 x 3o, using washers and M 3 lock nuts. Don't tighten screws yet!

Stage 8, Engine Mount and Fan Housing (Bag 8)

Almost every type of engine has a different flange. Holes in motor supports (143) correspond to an average design, which may have to be corrected in some cases. Use file to enlarge holes according to your engine type. It is important that engine mounts are not distorted when fastening the engine to the frames.
Both engine mounts (143) are fastened to the slots in the side plates with M 3 x 35 socket screws, using washers on both sides and M 3 lock nuts. In doing so, also insert the aluminum block (142) between the side frames, with the same screws. Fasten engine with four socket screws M 3 x 15 and lock nuts M 3, onto engine mounts. Do not tighten screws yet.

Now adjust play between the steel gear and the large gear by moving the entire drive unit. The teeth of small gear must engage fully but level and straight into upper teeth of large gear, with practically no play. As an aid in assembling and adjusting, use a piece of typing

paper about 12 mm wide, and allow this to slip in between the teeth of the small and large gears, This paper should run through the gears without being mashed. All ten nuts of the engine mount and the ball bearing blocks can now be evenly tightened. Do not distort adjustment of the drive elements when tightening. These steps are very important to ensure easy movement of drive unit, and for durability of gears. Then put spinner (149) onto top of starter shaft and secure with two set screws M 3 x 3. (See figures 12 and 13.)

Cut out both halves of fan housing (PVC molded parts) along dotted line and drill the marked points for the four retaining screws. (Hole 3,5 mm dia.) The fan housing may be cut out with a jigsaw or scissors. If cut along dotted line, the top round openings are automatically also cut out. The fan housing is then assembled as shown in figure 14. Please note: figure 14 shows fan housing in black, as it stands out better in the picture, although it is actually made of transparent PVC. This provides better recognition of fan wheel parts, i.e. of the carburetor (viewed through the transparent housing). Before fitting fan housing or before cutting out openings for the engine, it will be best to remove the needle valve and the adjusting lever on the carburetor. Cut fan housing in the connecting area of the engine, so housing reaches engine. Take care that no loss of air occures by unnecessarily cut openings. Also note that left half of fan housing is fitted against inside of the right hand side main frame. Fasten with four M 3 x 10 steel screws with large washers and hexagon nuts. Openings for needle valve and carburetor lever may then be determined through the transparent material and cut out neatly. The needle valve should then be refitted.

Stage 9, Fuel Tank and Fittings

Drill three 6 mm dia. holes in fuel tank (1119) and install fittings as shown in figure 15. Slide onto bent tank fitting (from inside) a 5 cm piece of fuel tubing and fix tank pendant. Make sure that tank pendant rests on tank floor and doesn't get jammed or closed when pendant jumps up. The entire tank is now pushed in from the right and fitted to the rear bottom hole of the side plates, secured with a rubber band. Loop the rubber around tank, lead through chassis hole and fasten to the other side of tank. When inserting tank into frame, also insert the strip of white PVC about 0,5 mm thick, between tank and frame, with a new tank a bit difficult, but ensures that frame does not wear grooves into tank. Then make connections to carburetor, as shown in figure 15. Keep fuel tubing short, if necessary make a cut in cooling fan housing, but make sure that the tubing is not pinched or damaged by the housing.

Stage 10, Tail Rotor, (Bag 10)

The brass spacer tube (359) and tail rotor hub (327) are pushed onto tail rotor hollow shaft (380) and fastened with two socket screws M 3 x 3 (use wrench 1,5 mm) fitted through the lateral tapped holes. Place two ball bearings (316) in the plastic halves of blade mounts (317) (adding washer 369). Fit the blade mounts together and secure with M 2 x 10 screws and nuts. Fasten to each arm of blade mount (317) on the outside a ball joint and secure with M 2 x 10 screws and hexagon nuts. Put a 2 mm washer between the ball and arm! Screw on to the tail rotor hub the assembled blade holders and fasten with M 3 x 8 socket head screws. Use 2,5 mm wrench. Secure tightly. See figure 16.

Push on to protruding control rod wire:

1. Collar (314)
2. Washer 2 mm (important)
3. Control plate (315)
4. Washer 2 mm (Important)
5. Collar (314)

Fasten collars temporarily with 2,6 x 4 mm set screws. Fasten two ball joints to control plate (315) with two M 2 x 1o screws. Note: looking from the left, the tail rotor revolves to the right. The control arms with ball joints are positioned to the rear of the blademounts. Fasten M 3 x 15 screws and M 3 lock nuts to the blade holders temporarily. The tail rotor blades will be installed later.

Stage 11, Main Rotor with Flap Hinges

Basic Heli Boy, without collcective pitch (Order No 715)
or rotor head set, Order No 8o1. (Bag 17)

See figure No 29 and 3o

On the slotted end of the main rotor hub (5oo) fasten two ball races (5o3). Sequence: socket screw M 4 x 1o, ball race (5o3), washer 4 mm dia. Fasten screws tightly. Hub (5oo) with two ball races is now placed in appropriate recesses of the nylon halves (5o2). These halves are secured (from the top) with 4 M 3 x 35 socket screws. In doing so, also clamp parts (533) under the nylon halves. Loosely fasten the M 3 lock nuts. Important: Parts (533) have to be screwed under nylon halves that ball racesof rotor hub are positoned between parts (533). The slotted end of rotor hub (5oo) is located crosswiseto parts (533) Flap hinges (534) are now inserted between parts (533) and secured with M 4 x 3o socket screws and lock nuts. In the remaining openings of plastic halves (5o2) the other two ball races are placed (5o3) and 4 M 3 x 35 screws of nylon halves are tightened.
Stabilizerbar (5o5) is pushed through the free ball races. Fit on one side a 4 mm dia. washer together with collar (559) and M 3 x 3 socket screw. From the other side, fit a 4 mm dia. washer and control arm (5o7) ball to the inside - and secure with M 3 x 3 socket head screw. Thread the plasticcontrol paddles (749) on to ends of stabilizer bar and fix with epoxy or similar glue. Line them up in an exactly parallel position. The thread will cut itself into the paddles. Take cautionnot to overtighten paddles. The stabilizerbar is now moved back and forth until it is balanced exactly. When this position is found, collar (559) and lever (5o7) are secured to the flybar. Lever (5o7) should be positioned exactly parallel with control paddles. Blade holders (517) are temporarily fastened to the flap hinges with M 3 x 15 socket screws and lock nuts. The completed rotor head is fitted onto the main rotor shaft and fastened with a M 3 x 15 socket screw and lock nut. Control rod (528) is fitted with one ball joint without ball (o58) at each end. The short threaded end is screwed all the way in to the ball joint.
Screw in upper ring of swash plate steel ball fitting (434). From this fitting, control rod (528) is routed through the slot of carrier (444) through parts (533), to the ball of control arm (5o7). The end of control rod (528) with the short threaded end is located downwards, so that exposed thread will not be able to act as a saw in the slot of

the carrier (444). Adjust the carrier so that lever is in an exactly vertical position. When the rotor head is tilted, the carrier should not touch any surrounding parts. Length of the rod should be adjusted at top ball joint, so that control arm (5o7) is in a horizontal position, when the swashplate is in a horizontal position.

The use of the plastic control paddles (749) will provide a very good but not too fast control reaction. A beginner will benefit more from stability than a fast control reaction, he may add balancing weights (755) to the flybar.
This has the advantage that weights can be added or taken off on the flying field without having to change any other adjustments. Flight behaviour can easily be adjusted to prevailing weather conditions -

If building the Basic Heli Boy (715) continue now with Stage 14, Servo Carriers.

Stage 12, Two-Blade-Main-Rotor with Collective Pitch (Bag 11)

Bell 222, Order No 7o9 orRotor head only, (8o2)

As shown in figure 17, the already assembled blade shaft holders (555) are loosely fastened between the side plates (551) with two M 3 x 3o socket screws and lock nuts. The control arms are inserted in the slots of the side plates (551).
Two shock absorber rubber sleeves (569) and steel tubes (568) are assembled into the aluminum housing (567). Now fit the complete aluminum housing between the side plates, using two M 3 x 3o screws and lock nuts. Do not tighten.

Fit the black steel bearing (563) longer end first, into the center top hole of the pre-assembled rotor hub. The side plates are loose, so that they can be spread a little. Fit onto the steel bearings and tighten all six screws of the side plates.
Two steel ball fittings (434) are fitted onto the control arms and secured with M 3 nuts. See figure 18.
The aluminum adapter (575) is fitted onto the blade shaft (572) and fastened on the inside hole with a M 3 x 15 socket screw and a M 3 lock nut. Tracking differences might occur through distortion of the adapter - oder No 575 - on the blade bearing shaft - order No 575 - For this reason the inner socket head screwM 3 x 15 with lock nut has to be tightened very well. You even achieve a better result, applying some Loctite - oder No 1341 - on the adapter and slide it on the blade bearing shaft. Protect the needle bearing from Loctite.
The flat blade holders (574) are fastened onto the outer hole with M 4 x 2o socket screws and lock nuts. The blade holders, and with these the rotor blades, can now pivot readily. The remaining six M 3 x 15 socket screws with M 3 lock nuts are temporarily screwed into blade holders, for later blade attachment. Adjustment and rotor blade assembly follow later.

The pre-assembled unit with rotor hub is now slid onto the main rotor shaft. A M 3 x 3o socket screw, with black steel bearing washers (57o) and M 3 lock nut is used to fasten the rotor head to the main shaft. Be sure that the bolt goes through the bearings (563) and the hole at the top of the shaft.

Bag 12

As shown in figure 19, fit three steel ball fittings (434) with M 3 nuts to the mixing lever (561). The mixing lever is then spread a little and snapped onto the hollow steel shaft. Stabilizer bar (564) is

Screw the plastic control paddles (747) on the ends of stabilizer bar and fix with epoxy or similar glue. Line them up in an exactly parallel position. The thread will cut itself into the paddles. Take caution not to overtighten paddles.
The stabilizer bar is now moved back and forth until it is balanced exactly. This has to be executed very carefully since later control response and smooth running of the rotor depend on this procedure. When this position is found, collar (559) and lever (562) are secured to the flybar, using M 3 x 3 socket screws. Stabilizer bar must have slight axial play and must move smoothly in the rotor hub. On tightening control lever (562) take care that lever is exactly parallel to control paddles. On assembly of the control paddles note that rotor has to rotate to the right (viewed from above). Small side of paddles faces to the front (viewed in rotation direction).

To increase stability balancing weights may be fixed onto stabilizer bar. (Order No 755). This has the advantage that weights can be added or taken off on the flying field without having to change any other adjustments. At a maximum two weights are allowed.

Screw one ball joint without ball onto protruding pitchlinkage and press onto middle ball head of the mixing lever. Aline ball joint, so that mixing lever is exactly horizontal, when arm of toggle lever (466) faces vertically downwards. (Both levers in middle position). Provide control rod (573) (8o mm long) with 2 ball joints and press onto ball head of upper swashplate ring, i.e. ball of control lever (562). Control rod (573) has a shorter thread on one end, which should be screwed into the downwards facing ball joint, all the way through.

Length of the rods have to be adjusted, so when stabilizer bar is in middle position exactly horizontal, control lever is also horizontal. Control rod (573) is routed through fork end of carrier (444). Push carrier upward, so pitch linkage is left free in it's lowest position (routed through slot of rotor shaft). Tighten carrier with 2 socket screws M 3 x 3, so control rod (573) can be led upward exactly in the middle of the side plates. Don't overtighten clamping screws on carrier.

Screw together 2 ball joints without ball and linkage (433) (2o mm long) leaving a gap of 4 mm linkage between the pins of the ball joints. Connect with these linkages ball heads on mixing lever, with ball heads on blade levers. Take care, that blade levers have the same distance to the rotor head.

Bag 13

To improve control response, extension set for aerobatic flight may be installed. By direct control of the rotor blades through the swash plate (technically exactly determined) the improved control response is achieved, based on mixing of direct control by the swash plate and indirect control and stabilisation through stabilizer bar. Sequence can be viewed in figure 21.

Remove the two steel ball fittings (434) on the blade pitch levers and screw them into the free tapped holes of upper swash plate ring. Screw the two small mixing levers (566) with the riveted ball heads inside (ball heads to the outside) with one steel bearing (535) and bearing washer (57o) onto the outside of blade lever, using one soc-

566), steel bearing (535), blade lever and nut M 3).
On mounting these parts, care has to be taken that the mixing levers (566) move absolutely smooth, but without play. (Grease)!
Ball joints, originally pressed onto the ball heads of the blade pitch arms, will now be routed straight downwards and pressed onto the riveted ball heads of the short arms of the small mixing levers. (As shown). Provide two linkages (436) (4o mm long) with two ball joints without ball. Connect linkage with the ball heads in upper ring of swash plate and the long arms of the small mixing levers (566). (Two linkages are routed on the same side slanty to the top).

Basic setting: On middle position of pitch linkage (mixing lever on stabilizer bar is exactly horizontal), and middle position of swash plate (exactly horizontal), the small mixing levers (566) on the blade pitch arms must also be exactly horizontal.

If you want to fly without a stabilizer bar, replace it with the short shaft (579). Before doing so, the hollow steel tube for the stabilizer bar is fitted with a ring (578) thus preventing any tilting movement. The mixing levers of Bag 13 must be used with this arrangement. CG corrected rotor blades (889) must be used for proper control characteristics when flying without a flybar. Other control adjustments are not changed. See figure 31.

For all models -continue with Stage 14, Servo-Carriers

Stage 13, Four-Bladed-Rotor (Bag 18)

"Bo 1o5" (713) or Rotor Head Only (8o3)

The blade control levers (519) are fitted with mixing levers (525), 1 collar bearing (535), 1 collar bearing washer (57O) and M 3 x 1o socket screw with lock nut. Balls on mixing levers (525) face to rotor center. Mixing levers must move easily, without play, See figure 32. Fit blocks (575) onto the 4 blade bearing shafts (519). To the side of the blocks, flap hinge parts (582) are fastened with one M 4 x 2o socket screw and one M 3 x 2o and the appropriate nuts. In the remaining outer hole, flap hinge (581) is inserted and fastened with M 4 x 2o socket screws and lock nut. Do not tighten fully. The steeper bevel on the inner front face of flap hinge (581) should face upwards. See figure 33.
On the longer shaft of rotor hub (537) a rotor head crossplate (536) is added, and fastened with four M 3 x 8 socket screws and lock nuts. Insert screws from the top. See figure 34.

One after the other, fit four pre-assembled blade-bearings onto the rotor head crossplate (536). Two M 3 x 3o socket screws are inserted from below, through the crossplate (536) which is already mounted onto the rotor hub, through the blade bearings and the upper crossplate (536). M 3 locknuts are fitted from above. The upper crossplate is pushed onto the rotor hub (537). It is advisable to loosely fasten all four blade bearings first and then tighten the screws one after the other, taking care not to distort the rotor head when tightening.

Important:

The arms of the blade control levers with assembled mixing levers (525) should be in front of the blade bearings, while the blade bea-

The main rotor hub is now placed onto rotorshaft and fastened with a M 3 x 2o socket screw and M 3 lock nut.
The four control rods (433) are each fitted with two ball joints without ball (o58). Length from ball center to ball center should be about 4o mm. Four steel ball fittings (434) are screwed into the collective pitch sleeve (538) on the main rotor shaft and connected by control rods to the ball heads of the mixing levers (525), which face towards the rotor shaft. With the pitch lever in middle position, the mixing levers should also be about in the middle between the rotor cross plates.

The four rods (539) are each fitted with two ball joints without balls (o58). Length from ball center to ball center should be about 92 mm. Four steel ball fittings (434) are screwed into the inner upper ring of swashplate. The swashplate is then connected with the ball heads of the mixing levers, (525), which face away from the rotor hub. One control rod (539) is led through the fork of carrier. The carrier is adjusted so that the levers of the swashplate move exactly vertically. Do not overtighten the two clamping screws of the carrier (444) Viewed in rotation direction, setting for each rotor blade will be approx. 9o° lead.

When the swashplate is horizontal, the mixing levers (525) should be about in the middle between the rotor crossplates. See figures 37 and 38.
The 16 ball joints for the rotor head should move very easily. It is therefore recommended that they are assembled with a small amount of grease. The blade holders (574) are temporarily screwed onto the flap hinge with a M 3 x 2o socket screw and a M 3 lock nut. The remaining twelve M 3 x 15 socket screws and lock nuts will be used later when fitting the rotor blades to the hub.

Stage 14, Servo Carriers (Bag 14)

The rear cabin section (2 mm plywood part) is fastened with two M 3 x 1o screws, washers, and M 3 lock nuts, to the two small channels in the frontof the main frames. See figure 22. The top servo carrier (139) and bottom servo carrier (14o) are inserted in between the main frames from the front. Determine height of servo carriers, according to type of servos used. Now drill 3 mm dia. holes right through the chassis and the servo carriers. Ensure that the long socket wrench for the glow plug can be freely inserted through the lower servo carrier, as shown in figure 22. Upper and lower servo carriers are now fastened with two M 3 x 1o steel screws, washers and lock nuts. Screws with washers are fitted from the inside to the outside. Since the servo carriers are sometimes bent inwards, so they cannot be clamped between the chassis plates. Fitting can be eased by inserting a piece of wood between the carriers to spread them out to equal widths. Then they can be fitted more easily into the chassis, aligned and drilled. In determining the position for receiver and battery, keep the center of gravity position in mind so that later correction with additional weights may be avoided. Center of gravity should be about 5 mm in front of main rotor shaft, when tank is empty and the radio components can be placed to ensure this position. In the upper and lower servo plates (small and large rectangular 2 mm plywood parts) drill and saw the necessary holes and openings for the servos, etc. Before doing

so, and before continuing construction, it is important to read the instructions in the next chapter, Stage 15. The wooden servo plates are then fastened onto top of servo carriers (139) and (14o) with four M 3 x 8 screws each and washers. The plywood side walls (2 mm) are then fitted according to the positions of servo plates. Gluethem against the side plates and in front against the back wall sections. Re-inforce the corners with balsawood pieces 5 x 5 mm. Before installing servos, the wood parts should be painted. The proper arrangement may be seen in figure 23.

Collective Pitch models only

The mixing lever (344) is placed onto the spigot of the lower servo carrier (longer end of lever to the left, looking in flight direction). From above, insert M 3 x 2o screw with washer and tighten. Mixing lever should move easily, but without play.

Stage 15, Control Rods (Bag 15)

Positioning of the servos as well as control rods and mixing levers may be seen in various drawings. These arrangements are typical for most radio control systems. It may, however, be necessary to do minor alterations according to the type of radio used. The arrangement of servos and a typical installation of radi control unit and batteries may be seen in figures 25 and 26.

Positioning of control rods may also be seen in drawings. Please note that rods leading to servos have no threads at one end, because lengths have to be determined according to servos when installing. Rods are shortened accordingly, threaded sleeves are soldered on, and clevises are fitted and assembled to servos. When fastening threaded sleeves, black annodized control rods must be sanded clean, to enable good soldering results. Threaded sleeve may be glued on with a good glue. Absolutely grease-free and sanded rods are required for good joints.

Drawing 24-A shows upper servo plate with the rod connections to the swash plate. This arrangement is usedfor all control systems. Drawing 24-B shows lower servo plate with all rods and mixing levers, for rotor systems with collective pitch.

The trim lever (358) for tail rotor is assembled to the slot of the collective pitch lever (466) in the following order: from chassis side insert M 3 x 15 steel screw with washer into slot of the lever. Then washer, brass bearing tube (151) and trim lever (358), third washer and hexagon M 3 nut are added. The entire sub-assembly is now moved in the slot of collective pitch lever and temporarily fastened at the top of the slot. Lever should move easily, but without play. Exact adjustment will be done later during trial flights.

Control rod (356) (76o mm long) is inserted into guide tube (357), two plastic snap links (o59) are added. Guide tube (357) for control rod to tail rotor is best cushioned with a few pieces of wood about 3 mm thick and then taped to helicopter tail boom with plactic tape. The guide tube willthus not bend in the tail clamp area and will provide smoother control. The snap link at the rear end of rod (356) is hooked into the center of the control lever for the tail rotor. Rod (356) is bent slightly at an angle to make about a 1 cm offset after leaving the tube end, so that the plastic snap link runs directly on-

to the upper arm of the trim lever (358).

BASIC ADJUSTMENT: Collective pitch lever should be in the center position of it's total range of movements - trim lever (358) in a vertical position. Rearmost arm of the tail rotor pitch change lever should be parallel to rear edge of tail rotor housing.

Drawing 24-C is for a rotor head without collective pitch - Basic Heli-Boy (715). This drawing shows the same lower servo plate and the same servo position as drawing 24-B, however, the rods and mixing levers for collective pitch are now eliminated. The throttle servo has a direkt link to the engine carburetor. The tail rotor servo lever connects to lower end of lever (358). From the upper end a second control leads to tail rotor. Lever (358) is fastened to a hole on outer right hand side of the main frame just behind the support bearing block. Follow this order: M 3 x 15 screw from the outside, 3 mm dia. washer, 151 bearing bush, 358 trim lever, main frame, M 3 nut. The lever must move easily.

Stage 16, Rotor blades

Main rotor blades (881) are for rotor with flap hinges, without collective pitch - Basic Heli-Boy (715) and two-bladed rotor with collective pitch (with stabilizer bar!) - Standard Heli-Boy (7o9). The main rotor blades (889) are fitted with a metal leading edge for CG correction and are used for the two-bladed rotor system without a stabilizer bar. Main rotor blades (888) are fitted with a metal leading edge and used for the four-bladed rotor system for the "Boelkow BO 1o5" . Both main rotor blades are already shaped and provided with holes for the blade mounts. Before covering the rotor blades with self-adhesive foil, it is advisable to sand the trailing edge lightly. Paint tips and the area around the mounting screws. Cover the rotor blades with self-adhesive foil which has already been cut to size.

Do not cover area at the blade mount connections.

If you intend to fly the aerobatic version (using the mixing levers of Bag 13) the ends of the blades must be re-inforced with fiber-glass cloth and resin.

This is a must for aerobatic flying. Rotor blades (888 and 889) with metal leading edge are also shaped and finished. The steel shaft for CG correction is glued in front of the cut-off leading edge. This wire is bent at 9o degrees at one end and epoxied in front of the blunt nose edge, so that the right angled end of the wire fits around the blade end in the blade holder area. The length of the short end ist about 4o mm. It is epoxied in place there too. The shaft must be glued onto blade nose along the entire length. Filling the gap between wire and blunt nose edge is unneccessary, because the blades are covered with foil later. As the wire at the same time forms the profile of the blade nose, surplus epoxy glue must be removed by carefully sanding off. The inner ends in the blade holder area must be covered and re-inforced with fiberglass cloth and polyester resin for at least 8o mm length. In doing so, it is absolutely neccessary to also cover the angled-off wire end with fiberglass cloth and resin. Failure to do this could lead to serious injury to the flyer or those in the vicinity of the helicopter. Everyday experience has shown that pre-drilled attachment holes in the blades usually fill up with resin when covering the blades, and that it is difficult to re-drill the holes at their former location. Therefore the blades with metal nose are supplied without holes. The 3 mm dia holes can be made after fiber-glass re-inforcement has dried. The correct position of the holes

Procedure for Covering

Remove pre-cut foil from backing paper and place foil on a smooth and even surface, with self-adhesive side up. Place the rotor blade with top surface up on top of foil: foil must overlap the trailing blade edge by about 1 cm. Press blade on foil in this position and take care that the trailing edge is lined up straight with cut foil. Put the foil carefully around leading edge and press down thoroughly throughout. Try to avoid air bubbles forming under the foil. Fold overlapping foil edge around trailing edge of the blade with as sharp a crease as possible.
At the trailing edge, the foil will overlap the already covered side by about 1 cm. Press foil end down thoroughly to prevent it's peeling off during later use. Fasten main rotor blade to blade mounts with 3 each M 3 x 15 screws (looking down from above, rotor rotates to the right - clockwise). Rotor blades have to be in a straight line with blade mounts, blade pitch lever at zero position has to coincide with zero line of the fully symmetrical rotor blade profile.

Balancing of the Main Rotor Blades

On rotors without collective pitch - Basic Heli Boy (715) - the flap hinge screws are fastened as tightly as needed so that the rotor blades are aligned level, and do not sag down. The stabilizer bar can now be suspended between two supports, so that rotor can balance freely. See figure 4o.
For the two-bladed rotors, with collective pitch - Standard Heli-Boy (7o9) - follow these instructions:

Remove rotor hub with mounted main rotor blades and stabilizer bar from main rotor shaft. Instead of using a screw for rotor head fastening, a 2 mm steel wire is used and the entire rotor head (as shown in figure 27), similar to a see-saw, is suspended between two blocks. For the following adjustments, it is important that main rotor hub stands up vertically from the side plates on rotor head. Even a small inclination of the rotor hub will influence the adjustments.

With the four-bladed-rotor, always balance two opposite blades against each other. Pivot the rotor head with two opposite blade bearings on blocks and balance the other rotor blade pair. It is important that blade bearings are disconnected from levers, etc., and can balance and rotate freely. Flap hinges and pivot screws should be tightened so that rotor blades may just move freely. See figure 41. More weight has to be applied to the lighter weight blade (shown by an upward motion) by adding additional self-adhesive foil along the blade length until counterbalance is achieved. This step is important for a smooth running rotor system and should be done very carefully.

With a four-bladed rotor-head, it should be noted that it is difficult to discern four different colors when adjusting true tracking. It has proven better to use dark pieces of tape about 2 cm wide. Fix a piece of tape onto the tip of the first rotor blade: on the next blade an identical piece, but 2 cm away from the blade tip; third blade, another piece of tape 4 cm from the blade tip; and the fourth blade is fitted with tape 6 cm from blade tip. Consider these pieces of tape when balancing the rotor blades. When checking blade tracking, look closely for tape positions to see which blade does not track. For true tracking of all four blades, there should be one even dark stripe, when looking from the side into the rotating rotor. Further details on balancing, determining rotor blade CG, etc., can be read in my book "Remote Controlled Helicopters" (9956).

Tail Rotor Blades

The plastic tail rotor blades (748) are installed without covering

When installing blades, note that tail rotor rotates clockwise when viewed from the left side of the helicopter.

Stage 17, Finishing and Adjustments

The routing of the control rods are illustrated clearly in drawings 24-A, 24 - B and 24 - C. The size and type of servos employed may cause some variation in positions of the various rods. The following swashplate movement should occur for full servo travel:
A) Swashplate to front - - 1o degrees

" " rear - 1o degrees

" lateral to left - - 1o degrees
" " " right - 1o degrees

These swashplate movements can be retained when using additional controls for aerobatic flying. The model will react much faster, but still remain very stable.

B) Pitch angles of the main rotor blades and tail rotor blades on the Basic Heli-Boy without collective pitch should be:

Main rotor pitch gauge +4 degrees to +5 degrees.

The adjustment is done by simple bending of blade holders. This is a proven method of adjustment. Bending should not be done by holding the rotor blade itself. Use parallel jaw pliers, or grip the blade attachments at their inner ends and bend only very little at a time.

Tail rotor adjustment about + 18 degrees (tail of the helicopter moves to the left). Full movement range should be about plus/minus 15 degrees (from minus 3 degrees to plus 27 degrees).

C) Pitch angles of the main rotor and tail rotor compensation on two-bladed rotor with collective pitch - Standard Heli-Boy/Bell 222 (7o9) should be:

Main Rotor	Tail Rotor Compensation	Throttle Pos. Idle
O degrees	O degrees	idle
+2 degrees	+2 degrees	2o %
+3 degrees	+4 degrees	4o %
+4 degrees	+6 degrees	6o %
+5 degrees	+8 degrees	8o %
+6 degrees	+1o degrees	1oo %

The amount of tail rotor compensation is changed by moving the trim lever (358) in the slot of the collective pitch lever. (Downward for more tail rotor compensation).

Tail Rotor - Direct Control

There should be a movement of 1o degrees to each side in addition to the compensation value.

When adding the extra parts for the aerobatic version (mixed direct control to the main rotor-blades),
the control movements of swash plate (cyclic control for change of flight direction) are retained. They should not be changed. Please note that the helicopter will react faster and more directly in this case, as compared to standard versions. The collective pitch range, however, is reduced by the added aerobatic mixing levers. Accordingly, the control rod from the front mixing lever to the collective pitch lever must be attached in a higher hole. It may also be required to attach this rod farther outwards on the front mixing lever, so that a larger collective control movement is obtained. Note that

tail rotor fitted in the slot of the collective pitch lever by moving it in the slot. When adjusting tail rotor compensation in this way, the mixing lever (358) must also be cut off at the top end to avoid touching the large gear (148).

The final adjustment - mainly with the aerobatic version - is highly dependent on opinion, control habits and requirementsof the individual pilot. Main rotor blades must have an identical coning angle (V-form) when in a stationary condition (static tracking). If necessary, loosen the screws which retain the bearing blocks to the blade axles a little and raise or lower one of the blades, correct V-form. The coning angle is not quite as important as the fact that both blades should have the same angle. It may be advisable to measure the distance from one blade tip to the tail rotor. Then turn blades by 18o degrees and measure the distance of the second blade. Correct as necessary.

D) Main Rotor Adjustment on 4-bladed rotor, Bolkow 1o5 (713)

These adjustments must be carried out with utmost care. It is also absolutely necessary that all levers and rods are of equal length for all four blades. Above all, ensure that arms of blade pitch levers all have the same distance to rotor hub and that mixing levers are all fully symmetrical. Generally this can easily be checked through the openings in the rotor plates.
Assuming that the swash plate is level in all directions, the mixing levers (525) should be centered between the rotor plates. In about the center position of the collective pitch levers (466) - long arm vertically downward - the mixing levers (525) should also be centered between rotor plates. At the rotor blades there should now be a pitch of about plus 5 degrees (blade pitch levers are riveted on to ensure this). Small deviations (about plus or minus 2 degrees) can be adjusted on inner pitch levers. Larger deviations are best corrected at the blade holder by loosening the three screws, turning the blade a little and fastening the screws again. From a center position, all four blades should have a range of plus/minus 5 degrees (from 0 degrees to maximum 1o degree).

The control linkage for the engine should be adjusted so that with a 5 degree pitch of main rotor blades, engine should run at 8o % of maximum speed.

Tail Rotor Compensation should be as follows:

Main Rotor	Tail Rotor
o degrees	about + 6 degrees
+ 2 degrees	about + 7 degrees
+ 4 degrees	about + 8 degrees
+ 6 degrees	about + 9 degrees
+ 8 degrees	about + 1o degrees
+ 1o degrees	about + 11 degrees

(Tail of helicopter moves to the left).

An additional tail rotor movement of plus/minus 1o degrees should be available. These figures are intended as guidelines, as they are highly dependent on engine performance, rotor rpm's and exact adjustments of the four rotor blades. For exact checking and correction of blade pitch, it is advisable to obtain the universal pitch gauge, Order No

Gauge enables measuring of tail rotor angles.

However, you may prepare s simple gauge on your own,(sample can be seen on the picture 28) of 5 mm thick plywood. Take care that the length is 32o mm; only then the degrees are correct. In the drilled holes you may install round wooden sticks. Attach gauge underneath rotor blade, fasten with rubber band. View scale of gauge over stabilizer bar! All mentioned angle of incidences relate always to the stabilizer bar! Bar must be on all measurings exactly horizontal, i.e. in a right angle to the main rotor shaft.

Cabin Construction and Tail Fin- Basic and Standard Heli-Boy (No 715 and 7o9)

The basic mechanical kit can be flown in the open configuration. But you have to consider that the model has no stabilizer and has no tail fin, thus only limited flight performances can be achieved.

The basic mechanics can be fitted with a simple cabin, stabilizerand side fin. The parts are already included in the Basic Heli-Boy kit (715) and the Standard Heli-Boy kit (7o9). For other kits, these parts are available in kit 711, "Training Cabin". By no means, this configuration can be considered as a provivisional arrangement, but has been conceived for very practical reasons. Excellent protections for the radio unit is provided and casing is very aerodynamical. Mechanics is uncoverd, providing easy access at all times. Very effective setting of side fin and stabilizer provide excellent flight performance, in this open configuration.

Building Instructions

Both cabin halves are cut out so that in the center and at the rear wall a 3 to 5 mm wide edge remains. Both halves are joined by PVC glue, so that the large opening (for the rear wall) rests on a level plane. Hold glued parts together with clothes pins, let dry well. See figure 42.

Cabin may be painted as you prefer, but do not use nitrocellulose paints. Then slip cabin (from front) over servo supports, with rear edge over rear wall, which was already included in basic kit. Use a rubber band underneath and fasten crosswise between the plastic dowels at the side. See figure 43.

Fit the fin (figure 45) underneath plastic bearing block (341) at the right side of the helicopter. Note that the control lever (349) can move freely and that the lever (342) does not rub or get jammed. See figure 44.

Fasten the stabilizer to tail tube with the two PVC clamps (two M 3 x 1o screws each with two washers and a M 3 nut). Stabilizer projects to the left and should have 2oo mm clearance from tail rotor shaft to the rear edge of fin. The plastic clamps can then be prevented from rotating on the tail tube by securing with one 2,2 x o,5 in each of the two pre-drilled 1,8 mm holes.

Note: The guide tube for the tail rotor control rod should not be dented or bent. Use spacers under the tube, so that it is absolutely true and straight.

Figure 46 shows the finished Basic Heli-Boy (715).

Figure 47 shows the model with the two-bladed rotor, with collective pitch and training cabin - Standard Heli-Boy (7o9).

Final Information

Starting of the engine will be executed with an electrical starter, fitted onto the starter cone, with a common rubber coupler. Or starting may be executed from the side with a round belt (Schlüter-Order No 732) or alternatively with similar type of belting which can be joined to form an endless loop.

For starters with a broad cone, we recommend extension piece (Schlüter Order No 747). This part will be fitted on the starter thus starter is positioned above the rotor and cannot interfer with linkages.

For the open version practically all known muffler types can be used, normally mounted with the exhaust pipe facing upward.
Specially suited (also for clauseá fuselages) is Schlüter muffler, Order No 937, with clamp (936),fitted to the left fuselage side, and to screw of the U-shaped channel (141) at rear frame (top).
Use an engine manifold (938) with an adapter suited for the engine (933/....). Connection between the manifold and muffler is made by a silicone hose (939). See figure 48.

Variations available

All basic models of the Heli-Boy, as well as "Bell 222" and "Bolkow Bo 1o5" can be modified with the following extension kits:

Training cabin and simplified stabilizer for open configurations Order No 711 (This is already contained in the Basic and Standard "Heli-Boy" kits (715 and 7o9).

PVC extruded fuselage kit "Bell 222" Order No 71o

Fiberglass fuselage kit "Bell 222", Order No 712

Wheel Landing Gear "Bell 222" Order No 779

Fiberglass fuselage kit "Bolkow Bo 1o5" Order No 714

For initial training and for adjustments the "Heli-Trainer", Order No 7o7, is recommended. An adapter for "System 8o", open configuration, Order No 781, is also available.

Questions regarding the correct fuel type, necessary starting equipment and accessories are answeredin my book, which reflects 1o years experience in helicopter flying:

"RC-Helicopter Manual", Order No 9956

Other details on breaking-in of model, training, maintenance and safety are also contained in this book. The book is threfore thoroughly recommended and I wish you lots of success with your

"Schlüter HelicopterSystem 8o"

Eng. Dieter Schlüter

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