X-Cell Ion-X Instruction Manual

Miniature Aircraft USA P/N # 1024 and 1024-2

R/C HELICOPTER SAFETY

A radio-controlled model helicopter is a technically complex device that must be built and operated with care. It is also a fascinating and challenging part of the R/C Sport, the mastery of which is very rewarding.

A model helicopter must be built exactly in accordance with the building instructions. The kit manufacturer has spent much time and effort refining his product to make it reliable in operation and easy to build. The essentially bolt-together construction can proceed quite rapidly, giving the builder a strong sense of accomplishment that encourages hasty progress from one construction phase to the next, so that the completed model can be more quickly seen and enjoyed. It is essential to recognize and guard against this tendency. Follow building instructions exactly. Use only original parts **B** even single screws **B** and consider no alterations. Vibration and stress levels are high and all fasteners and attachments must be secure for safety in operation.

Note that this is the first use of the word SAFETY in these comments. Previously the kit manufacturer=s efforts to ensure RELIABLE operation were mentioned. That is ALL that he can do. Safe operation is the responsibility of the builder/flyer and starts with careful construction and continues with selection and installation of reliable radio equipment, motor, and speed control, and the proper use of batteries and chargers.

The need for safety is nowhere greater than at the flying field. A number of guidelines for safe flight have been developed by experienced flyers and are set down here. It is urged that they be read, understood and followed.

GUIDELINES FOR SAFE R/C HELICOPTER FLIGHT

Fly only at approved flying fields and obey field regulations.
Follow frequency control procedures. Interference can be dangerous to all.
Know your radio. Check all transmitter functions before each flight.
Be aware that rotating blades are very dangerous and can cause serious injury. Never plug the main batteries in until on the flight line ready to fly...never in the pits.
Never fly near or above spectators or other modelers.
If a beginner, get help trimming the model first, and flight training later.
Don=t Atrack@ the main blades while holding the tail boom. This is a temptation to builders who cannot hover yet and is very dangerous.
Follow all recommended maintenance procedures for model, radio, and motor.

WARNING

This helicopter is not a toy, but a complex flying machine that must be assembled with care by a responsible individual. Failure to exert care in assembly, or radio or accessory installation, may result in a model incapable of safe flight or ground operation. Rotating components are an ever-present danger and source of injury to operators and spectators. Since the manufacturer and his agents have no control over the proper assembly and operation of his products, no responsibility or liability can be assumed for their use.

X-CELL LIMITED WARRANTY

The warranty covers defects in material or workmanship or missing components to the original purchaser for 30 days from the date of purchase. Miniature Aircraft, USA will replace or repair, at our discretion, the defective or missing component. Defective components must be returned to us prior to replacement.

Any part, which has been improperly installed, abused, crash damaged or altered by unauthorized agencies is not covered. Under no circumstances will the buyer be entitled to consequential or incidental damages. The components used in this kit are made from special materials designed for special applications and design strengths. We recommend that all replacement parts be original parts manufactured by Miniature Aircraft, USA, to ensure proper and safe operation of your model. Any part used which was manufactured by any firm other than Miniature Aircraft USA, VOIDS all warranties of this product by Miniature Aircraft, USA.

WARRANTY PROCEDURES

Mail all **warranty information within 15 days** of original purchase date. If service is required, send the component in question (if not missing) together with a **photocopy** of your **bill of sale** and an **accurate description of the problem and part**. Ship components fully insured and prepaid. Miniature Aircraft, USA is not responsible for any shipping damages. We will, at our discretion, notify you of any costs involved, or ship it COD. **You are required to pay all postage, shipping and insurance charges**.

X-CELL FURY ION-X WARRANTY REGISTRATION

Please print or type, filling in the information listed below and mail immediately

Model No: _____ Serial No: _____ Price Paid: _____
Owners Name: _____ Age: _____
Address: _____ Phone_____
City: _____ State:_____ Zip:_____
Purchased From: _____
Dealer's Address: _____
_____
Comments:_____

MINIATURE AIRCRAFT USA
31713 Long Acres Drive
Sorrento FL 32776

Phone (352) 383-3201
FAX (352) 383-3204

X-CELL Ion-X

INTRODUCTION

These instructions apply to Ion-X Series Kits #1024

Congratulations! You have purchased a quick assembling, high quality helicopter kit ideally suited for beginner through expert pilots. Please pay particular attention to each assembly step.

SYSTEM REQUIREMENTS

A minimum five-channel Ahelicopter@ type radio with electronic swash plate mixing capability (known as C.C.P.M.) and three high quality servos (Adigital@ type preferred due to their superior centering and equality).

A yaw rate gyro (basic or heading lock type) with a matched servo, to stabilize and assist in tail rotor control. Select the unit best suited to your choice of radio and budget B be aware that even a beginner will appreciate the improved function of a top quality gyro, so choose wisely.

Section XI of this manual will describe some of the choices that are available.

THE KIT PACKAGE

The kit includes detailed drawings showing all parts, part numbers, fastener information and complete radio installation data. Metric hardware is used throughout with correct tensile strength and heat treatment required for each position.

Each assembly step requires that only its corresponding parts bag be utilized, avoiding confusion between similar appearing parts and fasteners for subsequent steps.

Also included is a bag of spare hardware, Allen wrenches (hex keys) and certain other special tools to assist in assembly.

TOOLS AND/OR MATERIALS REQUIRED

The following tools and materials are suggested to assist in building the kit:

Screwdrivers - small straight and Phillips
Plier's B small regular, needle nose and forceps
Hand drill with drill bits
Open end wrenches B 5.5mm (7/32@), 7.0mm (9/32@) and 8.0mm (5/16@)
Dremel tool with sanding drum and carbide disc
Tape
Metric ruler
Small hammer
Vinyl two-sided tape B 1/8@ thick (M.A./USA p/n #3869)
Slow and fast Cyano-acrylate adhesive (CA)
Heat gun
High Quality Synthetic Grease (M.A./USA p/n #4707)
Light oil (Teflon type M.A./USA p/n #4801)
Canopy finishing materials (described elsewhere)
180-220 grit Awet-or-dry@ sandpaper
AC@ clip pliers (both expanding and contracting types)

The following are optional tools:

Ball link installation tool (M.A./USA p/n #0529)
5.0mm nut driver (M.A./USA p/n #2957-1)
5.5mm nut driver (M.A./USA p/n #2957-2)
7.0mm nut driver (M.A./USA p/n #2957-4)
Flybar lock (M.A./USA p/n #0506)
Flybar alignment kit (Expert models) (M.A./USA p/n #0510-1)
Swashplate Alignment Tool (M.A./USA p/n #0513)
Pitch gauge (M.A./USA p/n #0526)
Custom hardened hex tools **B** 1.5mm (M.A./USA p/n #2985-1), 2.0mm (M.A./USA p/n #2985-2), 2.5mm (M.A./USA p/n #2985-3), 3.0mm, (M.A./USA p/n #2985-5)
Infrared thermometer
Voltmeter

The following items are required or useful in the operation of any R/C helicopter:

Batteries to power the electric motor
A charger that is appropriate for the battery type being used
Various selections of quality tools as used in the kit assembling steps.
Frequency flag displaying your radio frequency and color code (included in radio)
Academy of Model Aeronautics (A.M.A.) membership (those individuals not residing in the U.S.A. should join the modeling organization for their country). Membership in the Academy of Model Aeronautics allows you to fly at registered flying sites and events and provides liability insurance. Information is available by calling 1-800-435-9262 or by visiting the A.M.A website at www.modelaircraft.org.

ASSEMBLY INSTRUCTIONS

Please take the time to review all instructions and drawings before building the kit. Each step will list bags, tools and parts required to proceed.

Any position calling for the installation of steel threaded hardware into non-locking threads will refer to the addition of Blue Loctite thread locker (included). Any position using steel hardware into plastic will refer to the addition of slow Cyanoacrylate glue (CA) (not included) as a thread locker. Always clean the threads with alcohol and use the locking material sparingly.

For individuals wishing to know, the following maximum torque values apply to metal-to-metal positions on the model:

Bolt Size	NCM (Metric)	Inch/Pounds (U.S.)
M3	40.0	3.5
M4	70.0	6.2

This information is provided only for interest and in no way indicates that a torque wrench is needed to successfully build the model.

When installing hardware into plastic, be aware that a) threads are forming so hold the item straight while tightening and b) you must stop tightening as soon as the flange or head contacts the plastic surface.

Frequently, the text will refer to items known as APEM@ nuts. These are M2.5 and M3.0 threaded steel inserts that are factory installed in both side frames and various frame channels used in the kit. They are non-locking and require the use of Blue Loctite on any related bolts or screws. Do not attempt to remove them and avoid over-tightening hardware into them. They are quite secure with only minimal tightening and use of Blue Loctite.

ASSEMBLY SEQUENCE SUMMARY

Section: Subassembly:

I. BUILDING THE ROTOR HEAD

Bags Required: #1A, #1B, #1C, #1D and Bag #9A

Tools or materials required:

Small Phillips screwdriver
Small hammer
Solvent (thinner or alcohol)
Loctite B Blue and Green
Slow Cyanoacrylate glue (CA)
M1.5, 2.5 and 4.0 Allen tools
AQ-Tip@ cotton swabs or tissue
Needle nose pliers or forceps
A few inches of masking tape
3/8@ or similar socket with an O.D. of 14.0 B16.0mm
Grease

Step 1: Building the Flybar Support Tube Assembly

Parts Required:

Qty	Part Number	Part Description	Found in Bag
1	#0065	M3x12 Socket Head Bolts	1A
2	#0067	M3x14 Socket Head Bolts	1A
2	#0113	M3x10.5 Threaded Double Ball	1A
2	#0299	M4x10x4 Ball Bearings	1A
1	#0509	Head Button	1A
2	#0597-1	M3.0x4.7x3.2 Brass Spacer	1A
1	#0844-A	Assembled Head Block	1A

Refer to Drawing #1A

Select two #0299 ball bearings and the #0844-A head block assembly. Press a bearing into each end of the #0840-25 flybar tube as shown. The bearing will be flush with the edge when fully inserted.

Select two #0113 threaded doubled balls and two #0597-1 brass spacers. Install a spacer on each threaded ball and apply Blue Loctite to the exposed threads. Install one prepared threaded ball into each Aflat@ adjacent to the ball bearing bearings at each end of flybar support tube as shown in the drawing. Tighten with light torque.

Select two #0067 bolts and temporarily thread each into holes provided near the base of the head block. Note that even though the holes are threaded full depth, the bolts install from the side closest to the slot at each corner. Do not tighten until Section IX , Step 2E.

Select one #0065 bolt and the #0509 head button. Use a small piece of 180 to 200 grit sand paper to lightly roughen the 6.0mm diameter protrusion at the base of the head button. You are simply removing the Agloss@ from the plastic. Insert the bolt from the top end and screw inward 2 to 3 turns. Apply slow CA glue to the Aroughened@ surface and insert into the hole provided at the top of the head block. While holding it and the head block firmly together, tighten the bolt until the top of its head is about 1.0mm below the top surface of the head button. Set aside to dry.

Step 2: Building and Installing the Bell Hiller Mixers

Parts Required:

Qty	Part Number	Part Description	Found in Bag
2	#0017	M3 Hex Nuts	1B
2	#0093	M3x18 Special Pivot Bolts	1B
2	#0109	M3x8 Threaded ball	1B
2	#0113	M3x10.5 Threaded Balls	1B
4	#0159	M3x7x3 Ball Bearings	1B
2	#0334-1	Bell Mixers	1B

2	#0597-1	Brass Spacer	1B
2	#120-18	Main Blade Mount (for M5 blade bolt)	1B

Refer to Drawing #1B

Select two #0109 threaded balls, two #0113 threaded balls and two #0334-1 bell mixers. Install one #0109 and one #0113 threaded ball into the end hole in each bell mixer, using the previously mentioned precaution.

Select four #0159 ball bearings and two #0597-1 brass spacers. Press one #0159 into each bell mixer, followed by one #0597-1 spacer in the center. Press the remaining bearing into the opposite side of the bell mixer, capturing the brass spacer in-between the bearings. Each will protrude approximately 0.5mm when fully inserted.

Select two #120-18 main blade mounts. Examine the arm protruding from each. Two holes for bell mixer installation are provided. The Anormal@ position is the hole closest to the radius end of the arm (farthest from the blade gripping end). We suggest that this is the best position.

Examine the previously assembled bell mixers. In the area where the bearings are installed, note that one side is flat and one side has a 1.5mm Astep@ or Ashoulder@ surrounding the bearing. The Astepped@ side will face away from the pitch arm.

Select two #0093 special pivot bolts and two #0017 M3 hex nuts. Note the correct orientation of the bell mixer bearings and thread into the outer pitch arm hole on the main blade mount. As with the threaded balls into plastic, screw the pivot bolt and bell mixer straight into the pitch arm, tightening it until some friction is felt when you rotate the mixer. Unscrew the pivot bolt about 1/4 turn and check for free rotation of the mixer (without any end-play), then install one #0017 M3 hex nut as a locking device on the exposed pivot bolt threads opposite the pitch arm. Repeat the process for the remaining blade mount.

Step 3: Installing the Main Axle and Blade Mounts

Parts Required:

Qty	Part Number	Part Description	Found in Bag
2	#0023	M5 Lock Nuts	1C
2	#0082-1	M5x45 Special Blade Bolts	1C
2	#0086-1	M5x16 Flanged Socket Head Bolts	1C
1	#0316	M8x15 Silicone Tubing	1C
4	#0319	M8x16x5 Ball Bearings	1C
2	#0324	M10.6x15.8x0.9 Thrust Bearing Spacer Rings	1C
2	#0329	M8.1x13.0x.25 Shim Washer	1C
4	#0331	M8.1x13.0x0.5 Shim Washers	1C
2	#0332	M8.1x13.0x1.0 Shim Washers	1C
2	#0840-12	Large Thrust Bearings (3 pieces)	1C

4	#0844-2	Dampener O-rings	1C
2	#0848-2	M8 Retaining Rings	1C
1	#0848-9	AC@ Clip Tool	1C
1	#120-5	Main Blade Axle	1C
2	#120-7	M5x15 Safety Washers	1C

Refer to Drawing #1C

NOTE: SPECIAL TOOL REQUIRED External type retaining pliers for small external type AC@ rings.

Select the #120-5 main blade axle. Clean the outer surface and internal threads with solvent. Dry thoroughly.

Select both #120-18 main blade mounts from Step 2C and four #0319 ball bearings from Bag 1C. Each blade mount must have two bearings pressed fully into position to function properly. You will need to select a socket with O.D. of 14.0 to 16.0mm to use as a pressing tool to install the outer bearing. Additionally, the #0324 thrust bearing spacer ring will be utilized as a tool to concentrate any pressing force only on the outer ring of each bearing. Begin by inserting a #0319 bearing into the Ablade@ or Aforked@ end of the main blade mount. It will freely slide to within 5.0mm of its final position. To press the remaining distance, set one #0324 spacer ring atop the bearing followed by the socket. Stand the main blade holder upright so that the remaining flat surface for the second bearing (not the protruding pitch arm) is firmly against a wooden block or table edge. Using a small hammer, drive the socket, spacer ring, and #0319 bearing deeper into the blade holder. When the bearing is fully in position the Ahollow@ sound of driving the bearing into position will change and a measurement from the bearing to the radius tip of the blade holder will be approximately 47.0mm.

Installation of the remaining bearing is similar but often requiring much less force due to less surrounding plastic. Position the bearing above the bearing cavity and press firmly by hand. In most cases it will snap into position. Confirm this or set it deeper by laying the #0324 spacer ring (as utilized previously) on a wooden block or table edge, position the blade mount and bearing atop it (with protruding pitch arm out of contact with table or block) and tap atop the opposite radius end or the blade mount with a small hammer. As stated, much less force is required to press this bearing in place. When fully inserted there will be 0.25mm exposed above the plastic surface. Repeat the procedure for the remaining blade mount.

Select the #120-5 blade axle from step 3A, and one M8 retaining ring #0848-2. Using the proper tool, open the ring only enough to allow it to slide over the axle and into position within one of the grooves provided. **IMPORTANT:** be sure it is fully seated within the groove all the way around. Rotate it if necessary to confirm it=s Aseated@ position.

Next, slide one #0331 shim ring (M8.1x13.0x0.5) onto the axle up against the retaining ring #0848-2. Follow with one of the assembled blade mounts #122-18 from step AB@. Insert one #0324 spacer ring (M10.6x15.8x0.9) into the open end of the #0319 bearing within the blade mount.

Special note: Each thrust bearing assembly will contain one outer ring that has a smaller I.D. hole than the other outside ring. Identify this feature with both thrust bearings before proceeding. This can be easily done by sliding each outer ring onto the head axle. Test each

outer race on the axle to determine which has the larger I.D. Install the larger I.D. bearing race with the grooved side away from the #0324 spacer ring previously installed in step AE@. Apply grease to the groove. Next, slide the ball/cage into position, using more grease. Slide the remaining small I.D. bearing race into position with the groove facing the ball/cage.

Use a tooth pick to apply a little Blue Loctite inside the threads at the end of the axle. Select one #120-7 M5x15 safety washer and one #0086-1 M5x16 socket bolt. Install the washer on the bolt, put a socket tool in the bolt socket and insert this assembly into the open end of the blade mount, in the axle. Tighten only finger tight at this time. Note: A small amount of end play in the mount is normal.

Going to the opposite side of the head axle, slide one #0332 shim washer (M8.1x13.0x1.0) up against the previously installed AC@ ring on the opposite side of the assembled blade mount. Select two #0844-2 O-rings and install onto the axle up against the #0332 washer. **Note:** If a stiffer dampening is desired an additional #0331 shim or a #0329 shim (provided) may be added. Flight-testing will be necessary depending on your selection of main blades. In most cases we do suggest the use of a #0329 thin shim and a #0332 thick shim on each side.

Mark the head axle at its centerline. Wrap a small piece of tape over the unassembled end of the head axle to cover any sharp edges. Select the dampening sleeve #0316 and cut it approximately 15.0mm long (keep the rest for spares). Slide the 15.0mm piece onto a pair of needle nose pliers or forceps. Spread its diameter by expanding the pliers so that it can be slid over the end of the axle and onward to the center. Using forceps as a tool to slide the expanding dampener all the way to the center is best. When center is reached, the forceps are easily slid out by holding the dampener stationary. The addition of this silicone tube is a small enhancement to the flight characteristics of the rotor head and in no way is considered either critical or safety related. The rotor head can be used with or without the silicone tube.

Apply a little grease to the outside of the #0316 silicone tubing. Slide the partially assembled axle unit into the main rotor head block #0844 pushing it entirely in until the two rubber O-rings seat fully. From the opposite side install two more #0844-2 rubber O-rings, seating them fully into the head block. Next slide the optional #0329 shim washer (thin) or #0331 medium shim, if chosen, followed by one #0332 shim washer (thick). Secure in place with one M8 retaining ring #0848-2 (AC@ ring), again using the proper AC@ ring pliers. Expand it as little as possible and slide it onto the axle fully into position within the groove provided. Select the special tool #0848-9 and slide it over the axle up against the AC@ ring. Tighten down using one #0086-1 M5x16 flanged socket bolt and one #120-7 safety washer until the AC@ ring is pushed into position within the groove in the axle. Usually a Asnap@ sound will confirm proper fit. Remove the #0086-1 bolt and special tool. Double check by rotating the AC@ ring if necessary. It is important that the AC@ ring is correctly installed within the groove.

Follow steps B thru F to install the blade mount and components on the remaining side of the axle.

Using the appropriate M4 Allen wrenches, moderately and simultaneously tighten each #0086-1 M5x16 flanged socket bolt. Check now to see if each pivots freely. If they do not, the most likely causes are bearings not fully seated in the blade mounts or the thrust bearing(s) and/or spacer washers are incorrectly installed.

Note: The head of each #0086-1 bolt may be tapped while holding the main blade grip. In most cases this will seat the bearing allowing the blade grip to rotate freely.

Recheck each step if necessary. Note, if there is difficulty in removing the blade mount and thrust bearing, the cause is over tightening of the axle bolt(s) causing the previously discussed

Aflare@ on the axle end. To facilitate safe removal in this situation, you can either purchase the #0532 Blade Mount Puller or insert the M5 bolt half way, firmly holding only the blade mount (in mid air) and hit the M5 bolt head with a hammer and wooden block. The O.D. of the end of the axle must then be lightly filed to remove the Aflare@. If difficulty persists, contact M.A./U.S.A. or your local sales representative for assistance.

Select two #0082-1 M5x45 special blade pivot bolts and two #0023 M5 lock nuts. Temporarily install these in each blade mount as shown.

Step 4: Installing the Flybar and Control Arms

Parts Required:

Qty	Part Number	Part Description	Found in Bag
2	#0053	M4x5 Socket Set Screws	1D
2	#0307	Flybar Control Arms	1D
1	#0566-1	Flybar	9A
2	#0840-7	M4 flat Washers	1D

Refer to Drawing #1D

Select two #0307 flybar control arms and two #0053 socket set screws. If work is going to proceed uninterrupted at this time, then you may choose to apply Loctite to each set screw and install them loosely in the control arms, if not, then Loctite must be added later.

Select the flybar and insert it into the flybar yoke bearings on the rotor head block. Visually center the flybar. Select one #0840-7 spacer washer and one #0307 control arm. Slide the spacer followed by the arm onto the flybar, up to the bearing. Repeat for the other side. Lightly tighten each control arm set screw to assist in the next step. Carefully measure each exposed flybar end and adjust the assembly until the lengths are equal and no free play exists in and out of the head block. When the measurements are equal, it is time to align and tighten the #0307 control arms. Two choices are possible. If you intend to operate the model as a beginner (with minimal cyclic and collective travel) then you may simply align each control arm so they are level with each other and tighten the set screws firmly. If you intend to utilize full available cyclic and collective travel for 3-D type flight, then it is suggested that each control arm have a downward angle of 10 degrees (or 5.0mm below a level, straight centerline measured at each ball end on the control arms). Approximate measurements are acceptable. When complete, be sure each set screw is firmly tightened with blue Loctite.

Step 5: Installation of the Flybar Paddles

Parts Required:

Qty	Part Number	Part Description	Found in Bag
2	#0871-5	Sport Paddles	1E

Refer to Drawing #1D

Measure 22.0mm inward from each flybar end and mark with tape. The flybar is self-threading into each paddle and the goal is to have each paddle level to the other and the flybar control arms. **Note:** if your chosen option was to angle the flybar arms downward then the visual line for alignment will be a horizontal line drawn through and connecting each ball on each #0307 control arm. A useful tool for aligning the paddles is the #0510-1 paddle gauge kit. Slow CA glue or epoxy is used as a paddle-locking device, allowing sufficient cure time to simplify aligning the component.

Install each #0871-5 paddle as indicated and remove the marking tape. If all steps were accurately performed then it should be evident that by holding the head vertical and releasing the flybar the paddles will appear balanced. If not, then a small piece of vinyl tape can be applied to the light paddle. It is also possible to fine-tune the balance by lightly sanding the tip of the heavy paddle.

II. BUILDING THE LEFT MAIN FRAME

Bags Required: #2A, #2B, #3D

Tools or Materials Required:
M2.5 Allen Tool
M5.5 (7/32@) flat wrench
Slow CA Adhesive (glue)

Installing the Left Frame Components

Parts Required:

Qty	Part Number	Part Description	Found in Bag
1	#0019	M3 Locknuts	2B
1	#0063	M3x10 Socket Head Bolt	2B
2	#0032	M2.9x9.5 Phillips Self Tapping Screws	2B
1	#0053-5	M3x16 Socket Set Screw	2B
7	#0060-1	M3x6 Socket Head Bolt	2B
4	#0061	M3x8 Socket Head Bolt	2B
5	#0089-1	M3x8 Hex Head Bolt	2B
1	#0169	Bellcrank Pivot Stud (black)	2B
1	#0874-1	Swashplate Anti-Rotation	2B
6	#115-20	M5x20 Spacers	2B
1	#120-12	Upper Main Shaft Block	2B
1	#120-8	Lower Main Shaft Block	2B
1	#124-10	Vertical Rear Channel (216.0mm) w/Bearing	2A
1	#124-12	Vertical Front Channel (132.5mm)	2A

1	#124-13	Front Canopy Stand-offs	2B
1	#124-14	Rear Canopy Stand-off	2B
1	#124-15	Left Main Frame	2A
1	#124-17	Doubler Plate	2B
2	#124-87	Front Battery Plate Spacers	2B
2	#124-88	Rear Battery Plate Spacers	2B

Refer to Drawings #2A

Select the left main frame #124-15, one #124-10 vertical rear channel and one #0060-1 M3 x 6 socket head bolt. Position the frame and channel as shown and install the M3 x 6 bolt into the upper PEM in the channel using blue Loctite.

Select two rear battery mount spacers #124-88 and two #0089-1 M3x8 hex bolts. Using blue Loctite, install the hex side of each spacer on the outside of the left main frame (opposite the channel).

Note: Each spacer has one end that is milled at a 4° angle. This must face outward. The hex side always mounts against the main frame. The low side of each angle is identified by a small milled dimple. This must face towards the front of the frame.

Tighten all the channel bolts securely.

Select one #0169 bellcrank pivot stud and one #115-20 frame spacer. Note the position of the pivot stud outside the frame. Using Loctite, install the pivot stud with the frame spacer on the inside and tighten securely

As per the drawing, install four #115-20 frame spacers using four #0060-1 M3x6 socket head bolts. Tighten using blue Loctite.

Select the #0874-1 swashplate guide and two #0032 M2.9x9.5 Phillips self-tapping screws. Note the location and install the guide using slow CA adhesive on each screw. Check that the guide is mounted vertically.

Install the #120-12 upper main shaft bearing block (hump side upward) using two #0061 M3x8 socket head bolts and blue Loctite. Do not fully tighten at this time.

Install the #120-8 lower main shaft bearing block as shown using one #0060-1 M3x6 socket head bolt and two #0061 M3x8 socket head bolts. Use blue Loctite. Do not fully tighten at this time.

Remove the #0866-15 main shaft from bag 3D. Slide it down through the bearing block and securely tighten the bolts in both blocks.

Select one #124-12 front channel, one #124-17 doubler plate, one #0060-1 M3x6 socket head bolt, one #0019 M3 Locknut, and one #0063 M3x10 socket head bolt. Note the position of each component on the left frame. The channel mounts with the open side facing forward. Install the #0061 bolt through the doubler plate, through the upper frame hole and into the channel. Secure using one #0019 M3 locknut. Install one #0060-1 socket head bolt into the doubler as shown. Temporarily tighten the bolts while aligning the plate and channel with the frame. Loctite will be added to the bolt later. Install two #124-87 front battery mount spacers

and two #0089-1 M3x8 hex bolts. Observe the same method as in step B. Use blue Loctite and tighten securely.

Install one #124-14 rear canopy stand off using one #0089-1 M3x8 hex head bolt. Refer to the drawing for location. Tighten securely using blue Loctite.

The #124-15 front canopy stand off requires a #0053-5 M3x16 socket set screw be installed into the standoff using red or green Loctite. Let dry completely before installing on the side frame. Once dry, install through the frame, using blue Loctite, into one #115-20 frame spacer. Tighten securely.

III. INSTALLING THE MAIN SHAFT, MAIN GEAR AND FRONT TAIL DRIVE

Bags Required: #3A, #3B, #3C, #3D

Tools or Materials Required:

M1.5, 2.0 and 2.5 Allen tools
M5.5 flat wrench
Tri Flow #4801 or similar Teflon oil
(Optional) feeler gauge

Step 1: Installing the Front Tail Rotor Drive Gear and Shaft

Parts Required:

Qty	Part Number	Part Description	Found in Bag
3	#0051	M3x3 Socket Set Screws	3A
1	#0232	15 Tooth Bevel Gear	3A
1	#0237	M5 Retaining Collar	3A
1	#120-9	Front Transmission Shaft	3A

Refer to Drawing #3A

Select one #120-9 front transmission shaft, one #0237 retaining collar and one #0232 (15 tooth) bevel gear. Examine the drawing and note the orientation of these parts. Insert the #120-9 front transmission shaft from the rear of the main frame through the bearing housed in the #124-10 vertical rear channel. With 25-30mm exposed in front of the bearing, slide the #0237 retaining collar followed by the #0232 bevel gear onto the shaft.

Select one #0051 M3x3 socket set screw, apply blue Loctite and partially thread into the #0237 retaining collar. Use a toothpick to apply a small amount of Red or Green Loctite inside the bearing within #120-8. Push the shaft forward into the #120-8 front transmission bearing block. Apply forward pressure on the white Delrin portion of the #120-9 transmission shaft while pressing rearward on the #0237 retaining collar Tighten the #0051 M3x3 socket set screw within the collar. Check to see that no end play exists in the shaft. If there is end play, then reposition the collar to ensure no end play.

Select two #0051 M3x3 set screws. Note the #120-9 front transmission shaft has a flat for a

set screw securing the #0232 bevel gear. Apply blue Loctite to one #0051 M3x3 set screw and install it into the gear, tightening enough to be certain it has engaged the flat and the gear can be moved for final positioning. Final gear position can be determined after the main gear is installed, observing the rule that the bevel gear be centered within the main gear. Check this for a full rotation of the main gear. Which ever method is utilized, always remember to install the remaining #0051 M3x3 socket set screw with Loctite and double check the contact of the first set screw within the flat provided.

Step 2: Assemble the Constant Drive Autorotation Upper Section

Parts Required:

Qty	Part Number	Part Description	Found in Bag
8	#0088-1	M3x5 flat head screws	3B
1	#0866-5	70-Tooth Upper Bevel Gear	3B
1	#0866-6	Upper gear mounting base w/main shaft sleeve	3B

Refer to Drawing #3B

Select eight #0088-1 M3x5 flat head screws and prepare each with blue Loctite. Select the #0866-5 Bevel Gear and #0866-6 mounting base. Press the mounting base downward into the upper surface of the bevel gear, aligning the holes as you proceed. From the underside, install the eight #0088-1 M5x3 flat head screws, tightening them a little at a time in a Astar@ pattern. Tighten all with light torque.

Step 3: Install the Outer Main Gear onto the Autorotation Hub

Parts Required:

Qty	Part Number	Part Description	Found in Bag
4	#0088	M3x8 Flat Socket Head Bolts	3C
1	#0865-90	90T Outer Main Gear	3C
2	#0866-10	M14.0-20.0x0.2 Shim Rings	3C
1	#0866-11	M14 Teflon O-rings	3C
1	#0866-4	Lower Housing w/ Sprag Bearing	3C

Refer to drawing #3C

Select four #0088 bolts and prepare with Blue Loctite. Select the outer main gear (p/n appropriate to your kit's gear ratio) and note the four countersunk holes on the upper surface. Only the countersunk holes will be utilized. Press the gear atop the upper housing, align the countersunk holes, install the four bolts and tighten with light torque.

Select one #0866-10 shim ring and apply a little grease to each side. Set this ring atop the Oilite bushing (visible at the top of the upper housing, protruding through the main gear).

Select another #0866-10 shim ring, apply grease and slide upward to meet the gear mount. Select one #0866-11 Teflon O-ring and install it next to the shim ring. Set the main gear/sprag housing assembly upright on the table. Insert the upper gear/sleeve assembly downward into the sprag clutch. When it makes contact, rotate the upper assembly slightly clockwise while lightly pressing downward. When it drops inward about 5.0mm (easily noticed as you rotate and push downward) lift the combined parts off the table. Hold them inverted at about a 45 degree angle and apply a liberal amount of Tri-flow oil to that portion of the sprag clutch that is visible just inside the lower Oilite bushing in the lower hub. Rotate the unit as you apply more oil. The unit will hold about 7-8cc's (1/4 ounce) of oil. When oiling is completed, press the upper gear fully into the lower gear and wipe away any excess oil.

Note: never force the main shaft sleeve into the sprag clutch. If it does not insert easily while rotating, look from beneath the sprag to be sure that the cogs look uniformly positioned. They are only retained by an outer spring and it is possible to dislocate one during insertion. If necessary, remove the sprag clutch from the housing and it will return to its proper configuration.

Step 4: Installing the Main Shaft and Main Gear/Autorotation Assembly

Parts Required:

Qty	Part Number	Part Description	Found in Bag
1	#0057	M4x4 Socket Head Set Screw	3D
2	#0059-1	M2.5x6 Socket Head Bolts	3D
1	#0840-6	M3x20 Dowel Pin	3D
1	#0866-10	M14.0x20.0x0.2 Shim Ring	3D
1	#0866-11	M14 Teflon O-ring	3D
1	#0866-12	Retaining Collar (black)	3D
1	#0866-13	M14.0x20.20x0.1 Shim Ring	3D
1	#0866-15	Main Shaft	3D
2	#0875	Split Type Mainshaft Collars	3D

Refer to drawings #3D

Select the #0866-15 main shaft. Apply a little light oil to a cloth and briskly wipe-down the shaft. This will remove the protective coating. It is suggested that a trial fit of the main shaft be performed prior to assembling the main shaft components. It may be necessary to loosen the upper block for alignment, re-tighten with the main shaft in place. Insert the main shaft into the upper main shaft bearing block at the top of the mainframe. Slide it through so that 20-30mm is exposed below the bearing block.

Select two #0875 Asplit@ type main shaft collars. Examine the collars. One end of each collar has a flat surface with a .30mm raised step near the bore. This end is always to face a ball bearing. Using these criteria, slide two split collars onto the main shaft exposed below the upper bearing block. The upper collar should have it=s flat surface (with step) facing up to the underside of the upper bearing block and the lower collar should Aface@ the bearing in the

lower block. Slide the main shaft further downward into and through the lower bearing block until about 6.0 **B** 7.0mm is exposed below.

Select the previously assembled autorotation, the #0840-6 dowel pin, the #0866-10 shim ring, the #0866-11 Teflon O-ring, and the #0866-12 collar. It should now be determined which (or both) shim rings (#0866-10 and/or #0866-13) are required. Invert the autorotation assembly and note the Oilite bushing exposed at the base of the housing. A shim ring should ***always*** be placed ***next*** to this bushing. As a trial, install the #0866-13 M14.0x20x0.1 shim ring followed by the Teflon O-ring and the black retaining collar. Temporarily insert the #0840-6 dowel pin through the collar (large I.D. hole) and into the autorotation sleeve. Rotate the outer main gear against the inner and check smooth rotation. Move the gear up and down between the upper gear and the remaining collar. The desired situation is to have the gear rotate freely but have very little up/down play. If it is too loose, substitute shim ring #0866-10 for the #0866-13. If there is no free play and the rotation is with very light friction, it can remain as is since the Teflon O-rings will break-in quickly. It should be noted that there is no operational problem or risk even if the unit develops as much as 0.5mm of free play (at your option the O-rings could be replaced or a shim added). When the correct shim(s) has been determined, remove the dowel pin, the retaining collar, the O-rings, and the shim(s). Apply a little grease to each side of the shim(s) and reinstall all items except the dowel pin.

Slide the autorotation unit into position and slide the main shaft downward. Align the holes within the #0866-12 retaining collar, the sleeve on #0866-6 and the lower main shaft hole. **Note:** that the #0866-12 retaining collar has one large hole and one small hole. The large hole is for insertion of the #0840-6 M3x20 dowel pin and the subsequent #0057 M4x4 socket set screw. The small hole is for removal of the pin using a 1.5mm Allen tool or similar device. Insert the #0840-6 dowel pin as shown in drawings. The pin should easily slide in far enough to allow installation of the set screw. If not, then there are two possible causes and various steps to cure the problem:

> The pin may not insert fully due to an obstruction within the collar. Remove the collar and trial fit the pin. Look for any metal debris lodged in the Asmall hole@ side of the collar. If any exist, use a 1.5mm tool to push the debris out.
>
> The pin may not insert fully due to misalignment of the holes in the related parts. The main shaft hole is suspect here. The easiest solution is to run a ***sharp*** 0.120" (3.0-3.1mm or #31) Drill bit into the assembled retaining collar, sleeve and main shaft. This will deburr any offending hole and will not harm anything. The drill will stop automatically as it reaches the small hole on the opposite side of the collar and is too small to harm the M4 threads at the inlet.

Reinstall the pin followed by the #0057 M4x4 set screw with a very small amount of blue Loctite (on the set screw only).

Note: The sprag bearing should be cleaned and re-lubricated periodically (approximately every 50-75 fights).

The main shaft must now be adjusted and secured at the lower bearing block. Select one #0059-1 M2.5x6 socket head bolt, apply a little blue Loctite and insert an M2 Allen tool. Rotate the lower main shaft split collar (#0875-1) for access to the threaded hole and install the bolt, leaving it loose and the tool in place. Slide the #0232 bevel gear untill it is very slightly forward from center within the gear teeth on the upper delrin gear #0866-5. Lightly tighten one of the set screws in the gear. Lightly pull upward on the mainshaft while pressing downward on the split collar. Tighten the bolt in the lower collar. Select the remaining #0059-

1 m2.5X6 socket head bolt and temporarily install it in the upper split collar, move the unit up to the upper bearing block and lightly tighten. The gear mesh will likely feel notchy when rotated. The adjustment is easily done by slightly moving the #0232 gear rearward until a smooth feel is achieved with minimal backlash in the gears. Be sure that both set screws have blue Loctite and one is contacting the flat of the #120-9 shaft.

IV. INSTALLING THE SECONDARY GEAR DRIVE AND RIGHT MAIN FRAME

Bags Required: #4A, #4B, #4C, #4D, #4E, #4F

Tools or Materials Required:
M1.5, M2.0 and 2.5 Allen Tools
M5.5 and M7.0 (5/32" and 7/32") Flat Wrenches
Small Phillips Screwdriver
Slow CA Adhesive

Step 1: Installing the Secondary Gear Drive

Bags Required: #4B

Parts Required:

Qty	Part Number	Part Description	Found in Bag
4	#0003	M3 Washer	4B
4	#0063	M3 x 10 Socket Head Bolt	4B
1	#124-28	Secondary Gear Drive (pre-assembled)	4B

Refer to Drawing #4A.

Install the #124-28 gear drive onto the inside of the left main frame using four #0063 M3 x 10 socket head bolts and four #0003 M3 washers using blue Loctite. Slide a piece of notebook paper between the main gear and the secondary steel gear. Remove the previously installed #0060-1 bolt in the #124-17 doubler plate and add blue Loctite. Re-install and tighten securely. Also securely tighten the #0063 bolt and locknut in the plate and channel. Tighten the four #0063 bolts in a cross-pattern. Remove the paper strip from between the two gears. The gears should rotate freely with a slight backlash between the gears.

Step 2: Installing the Elevator Bellcranks

Bags Required: #4A, 4C

Parts Required:

Qty	Part Number	Part Description	Found in Bag
2	#0003	M3 Washer	4C
1	#0019-1	M3 Locknut - low profile	4C

1	#0089-1	M3 x 8 Hex Head Bolt	4C
1	#0099	M3 x 30 Phillips Bolt	4C
1	#0105	M3 x 4.5 Threaded Ball	4C
1	#0113	M3 x 10.5 Double Threaded Ball	4C
1	#0597-1	M3 x 3.19 x 4.75 Brass Spacer	4C
1	#0597-2	M3 x 3.42 x 4.75 Brass Spacer	4C
2	#106-02	M3 x 7 x 3 Flanged Bearing	4C
1	#122-28	Brass Sleeve .187" x .125" x .079"	4C
1	#124-14	Rear Canopy Standoff	4C
1	#124-20	Elevator Bellcrank	4C
1	#124-22	Brass Sleeve .187" x .124" x .302"	4C
1	#124-36	Right Main Frame	4A

Refer to Drawing #4B.

Study the drawing for proper orientation of the assembly of the elevator bellcrank #124-20. Install one #0105 threaded ball, one #0113 threaded ball, and one #122-28 brass spacer. Use slow CA adhesive on the threaded end of each.

Press one #106-02 flanged bearing into the hole in the bellcrank. Follow with one #124-22 brass sleeve in the bearing cavity opposite the #106-02 bearing. Capture the brass sleeve inside the bellcrank by pressing one #106-02 flanged bearing into the bellcrank.

As shown in the drawing, insert one #0099 M3 x 30 phillips bolt and one #0003 M3 washer into the appropriate hole for the elevator bellcrank on the left main frame #124-15. On the inside of the left frame, slide one #0597-1 brass spacer, followed by the #124-20 elevator bellcrank assembly, and one #0597-2 brass spacer.

Install one #124-14 rear canopy standoff and one #0089-1 M3 x 8 hex bolt onto the right main frame

Note: The canopy standoff must be on the outside of the right frame. Use blue Loctite and tighten securely.

Position the #124-36 Right Main Frame onto the #0099 Phillips Bolt in the Elevator Bellcrank assembly. Lightly secure in place with one #0003 M3 Washer and #0019-1 M3 Low Profile Locknut.

Step 3: Installing the Right Main Frame Hardware

Bags Required: #4D

Parts Required:

Qty	Part Number	Part Description	Found in Bag

4	#0003	M3 Washer	4D
1	#0019	M3 Locknut	4D
2	#0032	M2.9 x 9.5 Phillips Screw	4D
1	#0053-5	M3 x 16 Socket Set Screw	4D
7	#0060-1	M3 x 6 Socket Head Bolt	4D
4	#0061	M3 x 8 Socket Head Bolt	4D
5	#0063	M3 x 6 Socket Head Bolt	4D
4	#0089-1	M3 x 8 Hex Bolts	4D
1	#0169	Bellcrank Pivot Stud	4D
1	#124-13	Front Canopy Standoff	4D
1	#124-17	Doubler Plate	4D
2	#124-87	Front Battery Plate Spacer	4D
2	#124-88	Rear Battery Plate Spacer	4D

Refer to Drawing #4C

Note: Use blue Loctite on all hardware except the #0019 M3 locknuts and corresponding socket head bolts. **Do Not** fully tighten until all components have been installed.

Install one #0169 bellcrank pivot stud into the #115-20 frame spacer opposite the #0169 bellcrank pivot stud in the left main frame.

Install two #0061 M3 x 6 socket head bolts into the #120-12 upper shaft bearing block.

Install one #0060-1 M3 x 6 socket head bolt and two #0061 M3 x 8 socket head bolts onto the #120-8 mainshaft tail rotor drive bearing block.

Install one #0060-1 M3 x6 socket head bolt into the top hole in the rear channel using blue Loctite.

Install the two #124-88 and two #124-87 battery spacers onto the right main frame opposite the spacers previously installed on the left frame (observe the same alignment procedure as defined in step II) using four #0089-1 M3 x 8 hex bolts.

As in step II, assemble and install the #0053-5 socket set screw and the #124-13 canopy standoff using red and blue Loctite.

Install four #0060-1 M3 x 6 socket head bolts into the four #115-20 spacers.

Install the #124-17 doubler plate using five #0063 M3 x 10 socket head bolts, four #0003 M3 washers, and one #0060-1 M3 x 6 socket head bolt. Refer to the drawing for location of each.

Install two #0032 M2.9 x 9.5 phillips screws into the swashplate guide #0874. Use slow CA adhesive.

First tighten all installed components except the doubler plate. Next securely tighten the doubler plate hardware. Re-check the gear mesh.

Step 4: Mounting the Gyro Plates and Landing Gear Supports

Bags Required: #4E

Parts Required:

Qty	Part Number	Part Description	Found in Bag
4	#0019	M3 Locknut	4E
2	#0060-1	M3 x 6 Socket Head Bolts	4E
4	#0065	M3 x 12 Socket Head Bolts	4E
1	#0595-1	Gyro Bracket (A)	4E
1	#0595-2	Gyro Bracket (B)	4E
1	#115-20	Spacer	4E
2	#115-40	Landing Gear Brackets	4E

Refer to Drawing #4D .

Select one #115-20 M3 spacer, two #0060-1 M3 x 6 socket head bolts, one #0595-1 type (A) gyro bracket and one #0595-2 type (B) gyro bracket. Install the brackets as shown, making sure they are securely tightened and aligned to form a uniform flat top surface.

Mount the #115-40 landing gear brackets to the bottom side of the front and rear vertical channels using four #0065 M3 x 12 socket head bolts and four #0019 M3 locknuts. Set the mechanics on a flat surface in a vertical position. Apply light pressure downward on the frames and tighten the brackets securely.

Step 5: Install the Aileron Bellcranks

Bags Required: #4F

Parts Required:

Qty	Part Number	Part Description	Found in Bag
2	#0051	M3 x 3 Socket Set Screws	4F
4	#0105	M3 x 4.5 Threaded Balls	4F
4	#0159	M3 x 7 x 3 Ball Bearings	4F
2	#0167	Bellcranks	4F
2	#0171	Retaining Collars	4F

Refer to drawing #4E

Refer to the drawing for orientation of the threaded balls in each bellcrank. Using slow CA

adhesive, install two #0105 Threaded Balls into each bellcrank.

Select two #0051 M3x3 socket set screws, two #0171 retaining collars and the previously assembled bellcranks. Note the previously installed #0169 bellcrank pivot studs previously installed near the main shaft in each main frame. Slide a bellcrank into each #0169 pivot stud (flat side away from each frame) followed by one #0171 retaining collar. Apply Loctite to each #0051 M3x3 socket set screw and install in each collar, adjusting each so that the bellcrank pivots freely without and end play. The set screws only require moderate tightening torque. **Do Not Over tighten!**

Step 6: Final Mainshaft Adjustment

This step involves the #0875-1 upper split main shaft collar and #0059-1 M2.5x6 socket head bolt (previously temporarily installed in Section III). Place a small drop of blue Loctite on a scrap plastic bag. Rotate the main shaft until the bolt in the upper collar is visible through the upper frame "window". Insert a finger through the opposite frame "window" and secure the collar. Use an M2.0 allen tool to remove the bolt, dip into the Loctite, and re-install into the collar. While holding the collar with the tool, apply light downward pressure on the main shaft, upward pressure on the collar, and tighten the bolt using moderate torque. The main shaft should rotate freely and have no vertical free-play. Re-check the gear mesh driving the tail.

V. INSTALLING THE LANDING GEAR

Bags Required: #5A, #5B

Tools or Materials Required:
- M2.0, 2.5 Allen tools
- M5.5 open end wrench or socket
- Slow Cyanoacrylate Adhesive (CA)
- Drill and Drill bit (3/32 & .135")

Step 1: Install Lower Plate and Landing Gear

Bags Required: #5A, #5B

Parts Required:

Qty	Part Number	Part Description	Found in Bag
6	#0003	M3 Washer	5B
4	#0019	M3 Locknut	5B
4	#0058-1	M4 x 6 Socket Set Screw	5B
2	#0073	M3 x 20 Socket Head Bolt	5B
2	#0077	M3 x 30 Socket Head Bolt	5B
2	#0872-2	Tail Boom Support Ends	5B

1	#124-24	Graphite Lower Plate	5A
2	#3933	Landing Gear Struts - White	5A
2	#3937	Landing Gear Skids	5A
4	#3937-1	Landing Gear Skid Caps - White	5B

Refer to Drawing #5A

Select two #0003 M3 washers, two #0019 M3 locknuts, two #0073 M3 x 20 socket head bolts, one #124-24 lower plate, and one #3933 white landing gear strut. As per the drawing, install these parts to the front #115-40 landing gear bracket. Do not fully tighten at this time.

Select the two #0872-2 tail boom support ends and examine each, noting that the plastic ball protrudes further out on one side. This side will face down. Select two #0077 M3 x 30 socket head bolts and two #0003 M3 washers. Install a washer onto each bolt and press them completely into the shorter ball side of each boom support end. Install this assembly through the top side of the #115-40 landing gear bracket, the #124-24 lower plate, and one #3933 white landing gear strut. Retain in place using two #0003 M3 washers and two #0019 M3 locknuts. Tighten all four until very little movement of the struts is possible. Do not fully tighten.

Select two #3937 landing gear skids and four #3937-1 landing gear skid caps. Install a skid cap into each end of each skid by applying a small amount of slow CA adhesive inside the skid and pressing the cap fully into place. It may be necessary to tap them into place with a small hammer.

Examine the top of each strut in the area where the skid is inserted. Each will have a 8.0mm diameter raised ”boss” for the following procedure. Select an electric drill with a 2.35mm (3/32”) drill bit. Holding the drill vertical directly over the molded 8.0mm diameter “boss” of the strut, drill downward into the boss. Select another drill bit measuring 3.43 mm (.135”) and enlarge each hole. Thread one #0058-1 M4.x 6 socket set screw approximately half way into the drilled hole. Repeat the procedure for the remaining three positions.

Select each skid and apply a piece of masking tape just ahead (near the curved end) of a measured mark made 245.0mm (9.6”) from the rear end of the skid (measured from the end of the skid, not the cap)

With the model sitting atop a flat surface, slide each “marked” skid into each strut so that the front edge of the front strut contacts the measured “tape mark” and each skid appears straight and vertical as viewed from the front “eye level” with the table top. Keep the model secure in this position for the next step.

Tighten all four #0058-1 socket set screws down against the topside of the skids. Each skid should be secured in place.

VI. INSTALLING THE MOTOR UNIT

Special note: If installing your own motor and speed control, refer to drawing #11B for proper wiring diagram.

Bags Required: #6A, #6B, #6C

Tools or materials required:

M2.0 and 2.5 allen tools
Wire cutters
Phillips screwdriver
M5.5 Open end wrench or socket

Step 1: Installing the Motor Assembly

Bags Required: #6A, #6B

Parts Required:

Qty	Part Number	Part Description	Found in Bag
4	#0003	M3 Washer - large	6A
8	#0009	M3 Washer - small	6A
4	#0019	M3 Locknuts	6A
2	#0058	M4 x 5 Socket Set Screw	6A
16	#0061	M3 x 8 Socket Head Bolt	6A
2	#101-60	5.0 x 7.5mm shim	6A
1	#124-31	15 Tooth Pinion Gear with 5mm I.D.	6A
1	#124-40	Rear Channel Motor Mount (2.31")	6A
1	#124-42	Front Channel Motor Mount (1.97")	6A
1	#124-44	Graphite Mounting Plate	6A
1	#124-46	Lower Graphite Mounting Ring	6A
1	#124-48	Rubber Channel - 6"	6A
1	#124-64	Motor with Speed Controller	6B

Refer to Drawing #6A-1, 6A-2 and 6A-3

Slide three #101-60 M5.0 shims followed by one #124-31 -15 tooth pinion gear, completely down onto the motor shaft. Align the set screw hole with the flat on the shaft. Secure in place with two #0058 M4 x 5 socket set screw. Use blue Loctite and tighten firmly.

Select the #124-44 graphite motor plate, one #124-64 motor unit, four #0009 M3 washers (small) and four #0061 M3 x 8 socket head bolts. Mount the #124-44 plate to the topside of the motor unit using the selected hardware. **Note**: the raised portion of the PEM nuts mounted in the graphite plate face upward (away from the motor unit). Tighten securely using blue Loctite.

Mount the front and rear channels (#124-42 and #124-40) into the main frames using four #0009 washers (small) and four #0061 M3 x 8 socket head bolts. Only tighten until the channels will not rotate freely. The flat surface of each channel must face upward.

Install the motor unit in the frames by first feeding the speed controller and wires through the largest hole in the top side of the #124-24 bottom plate. Simultaneously insert the bottom portion of the motor into the same hole while aligning the bottom side of the #124-44 graphite mounting plate atop both motor mount channels. **Note**: the milled half-circle on the end of the

#124-44 plate must point towards the nose of the helicopter.

From the bottom side of each channel, install four #0003 M3 washers (large) and four #0061 M3 x 8 socket head bolts through the slots and into the #124-24 plate. Apply blue Loctite on each bolt before installation. Tighten only until there is no visible play and the motor unit will slide forward or back. Insert a small piece of notebook paper between the two gears. Apply slight pressure forward on the steel gear while simultaneously tightening the four #0061 socket head bolts. Remove the paper and check for smooth rotation with a slight amount of backlash between the gears. Adjust if necessary.

Remove one #0061 socket head bolt installed in Step C. Apply blue Loctite, reinstall and tighten securely. Repeat with each of the remaining 3 bolts. Recheck the gear mesh.

Select four #0019 M3 locknuts, four #0061 M3 x 8 socket head bolts, one #124-48 rubber channel, and one #124-46 lower graphite mounting ring. Install the rubber channel to the inside of the mounting ring. Trim the rubber channel lengths if necessary. Again, feed the speed controller and wires through the assembled lower ring #124-46. Press the rubber/ring on the protruding portion of the motor below the #124-24 graphite lower plate. Secure the ring to the lower plate using four #0019 M3 locknuts and four #0061 M3 x 8 socket head bolts and tighten securely.

Step 2: Mounting the Fan and Speed Controller

Bags Required: #6C

Parts Required:

Qty	Part Number	Part Description	Found in Bag
2	#0032	M2.9 x 9.5 Phillips Screws	6C
1	#124-70	Cooling Fan	6C
1	#4693	8” Tie Wraps	6C
2	#4695	4” Tie Wraps	6C

Refer to Drawing #6B

Mount the #124-70 cooling fan on the #124-24 lower plate using the two holes just behind the rear two bolts that hold the lower ring, using two #0032 M2.9 x 9.5 Phillips self tapping screws. The decal on the center of the fan must face toward the nose of the helicopter. Tighten the screws using slow CA adhesive.

Install two #4693 tie wraps in the slots provided behind the cooling fan. Remove the protective coating on the servo tape mounted on the bottom side of the speed controller. Install the speed controller on top of the lower plate #124-24 just behind the fan. Secure in place with the two tie wraps. Only light pressure from the tie wraps is needed.

Attach the small speed controller wire and the fan wire to the top side of the bottom plate using two #4695 4” nylon tie wraps.

VII. INSTALLING THE SWASHPLATE, WASHOUT UNIT AND ROTOR HEAD ASSEMBLY

Bag Required: #7A, #7B, #7C

Tools or Materials Required:
M1.5 and 2.5 Allen tools
Medium Phillips screwdriver
Small good quality pliers
Small flat screwdriver

Step 1: Assembling the Swashplate

Bags Required: #7A

Parts Required:

Qty	Part Number	Part Description	Found in Bag
1	#0009	M3 Flat Washer (small)	7A
4	#0051	M3x3 Socket Set Screws	7A
1	#0065	M3x12 Socket Head Bolt	7A
3	#0107	M3x6 Threaded Balls	7A
4	#0109	M3x8 Threaded Balls	7A
1	#0159	M3x7 Ball Bearing	7A
1	#0217	Swashplate	7A
1	#0597-3	M3.0x4.75x4.60 Brass Spacer	7A

Refer to Drawing #7A

Select and examine the #0217 swashplate. Note the four M3 threaded holes at each 90-degree position about the base of the lower swashplate ring. Select four #0051 M3x3 socket set screws and prepare each with blue Loctite. These four holes and set screws are for periodically minimizing any free-play that may develop as the swash plate bearing wears (excessive free-play can cause inaccuracies in control inputs). Install each set screw loosely. The adjustment procedure is to rotate the inner swash plate ring within the outer ring and adjust the set screw until a slight irregularity or Anotchy@ feeling occurs, then loosen the set screw just enough to return to a smooth rotation of the inner ring. Repeat the procedure for each set screw. In most cases, this procedure should be done after every 120 flights. This procedure can easily be done on an assembled model by simply disconnecting the related ball links.

Examine the swashplate once again and note the positions for installation of the threaded balls into the inner ring. Four of the six threaded holes (those at each 90 degree position) are utilized. Three threaded holes (at 120 degree intervals) are utilized for three #0107 M3x6 threaded balls in the outer ring. Select four #0109 M3x8 threaded balls and three #0107 M3x6 threaded balls. Prepare each with blue Loctite and install in each position previously indicated.

Slide the swashplate down the main shaft. Rotate it so that one outer control ball is pointed rearward and the remaining two balls are pointed forward at an angle on each side of the mechanics. This orientation will align one empty threaded hole straightforward at the #0874 anti-rotation unit.

Select one #0009 M3 flat washer, one #0065 M3x12 Socket Head Bolt, one #0159 M3x7 ball bearing and one #0597-3 brass spacer. Slide each onto the #0065 socket head bolt beginning with the ball bearing, followed by the brass spacer and the washer. Apply a small amount of blue Loctite to the exposed threads, insert the assembly through the #0874 anti-rotation unit then into the swashplate and tighten. The swashplate should now be free to slide upon the main shaft without rotating.

Step 2: Assembling the Washout Unit

Bags Required: #7B

Parts Required:

Qty	Part Number	Part Description	Found in Bag
1	#0057	M4x4 Socket Set Screw	7B
2	#0097	M3x 22 Special Phillips 12.9 Hard Bolt	7B
2	#0107	M3x6 Threaded Ball	7B
4	#0159	M3x7 Ball Bearings	7B
1	#0219	Plastic Washout Hub	7B
2	#0221	Washout Arm	7B
2	#0597-2	M3x3.4 Brass Spacer	7B
1	#0840-6	M3x20 Dowel Pin	7B
2	#0869	Washout Ball Links	7B
2	#106-07	M2x16 Pivot Pins	7B
5	#106-08	M2 Circlips	7B

Refer to Drawing #7A

Select two #0107 M3x6 threaded balls, two #0597-2 brass spacers, four #0159 M3x7 ball bearings, and two #022 washout arms. Examine the drawing and note the position for the #0107 threaded ball in each arm. Apply a small amount of slow CA glue to the threads and install one in each arm as shown. Press one ball bearing into each arm (noting that when fully inserted, each will protrude approximately 0.75mm) and install one #0597-2 brass spacer in the opposite side of the bearing. Follow with another #0159 bearing, capturing the #0597-2 brass spacer in between the bearings.

Select two #0097 special phillips bolts and one #0219 washout hub. Examine the drawing and note the orientation of each washout arm to the hub. Install each arm onto the hub using a #0097 special phillips bolt. Tighten each unit until a slight drag is felt when rotating each arm, and then loosen the bolts about one quarter turn. Each arm should pivot freely without any end play.

Select two #0869 washout ball links, two #106-07 M2x16 pivot pins, and four #106-08 M2 circlips (a spare is also included).

Note: The #106-08 circlips are most easily installed on the #106-07 pivot pins by the following method: lay the circlip on a flat surface, hold the #0106-07 pivot pin with a pair of pliers, while aligning one end of the pivot pin vertically on top of the circlip. Tap the opposite end of the pivot pin with a small hammer into the circlip. This will start the circlip onto the end of the pivot pin. Drill a hole in a piece of hard wood, slightly larger than the pivot pin. Align the pivot pin/circlip over the hole and slightly tap the pin again. This will drive the pin through the circlip. Repeat on the opposite end of the pivot pin after the #0869 links and #106-05 arms have been joined together. The washout links #0869 should have no end play and pivot freely. If they do not pivot freely, slide an X-acto blade or razor blade around the pin, in between the plastic link and the washout arm. This will remove any plastic burrs.

Slide the assembled wash out unit down onto the main shaft and snap the two #0869 washout links onto any two opposite #0109 threaded balls on the inner ring of the swash plate. The wash out unit should slide freely on the main shaft. If there is drag, slightly polish the main shaft or the inside of the wash out hub #0571-1.

Select the previously assembled rotor head, the #0057 M4x4 socket set screw, and the #0840-6 dowel pin. Slide the rotor head down onto the main shaft and align the cross hole at the upper end of the main shaft with the hole in the head block just below the flybar pivot bearings. **Note:** the larger of the two holes is for dowel insertion and the smaller hole is for pushing the pin back out using a 1.5mm Allen tool. Alignment can be accomplished by holding the rotor head rotating the main gear clockwise and viewing the holes from the side at eye level.

Important Precaution: There have been instances where builders thought they had all the holes aligned but the main shaft was actually fully beneath the head block holes. To avoid this, it is helpful to confirm the alignment by simply inserting a 2.0 or 2.5mm Allen tool in place of the dowel pin and lifting the model by the rotor head. It pays to be cautious.

If the dowel pin will not fully insert through the main shaft with moderate pressure, rotate the head 180 degrees upon the main shaft and repeat. The dowel pin is always to be installed with the Achamfered end@ first. Once the dowel pin is properly fitted, secure it with the #0057 M4x4 set screw and a small amount of blue Loctite. Apply blue Loctite sparingly and only to the set screw to avoid contacting the dowel pin and making later servicing more difficult. Next, tighten the previously installed #0067 M3x14 socket head bolts clamping the base of the head block about the main shaft.

Step 3: Install the Lower Swashplate Control Rods

Bags Required: #7C

Parts Required:

Qty	Part Number	Part Description	Found in Bag
6	#0133	Ball Links	7C

3	#0369	M2 x 35 Threaded Rod	7C

Refer to Drawing #7B

Assemble the three rods and ball links to the following dimensions and install as noted: the dimensions should indicate the amount of exposed rod between the two links.

- Two Rod Assemblies - distance 19.5mm
  Attach to the rearward side balls on the swashplate and the side-mounted bellcranks.

- One Rod Assembly - distance 15.0 mm
  Attach to the front ball on the swashplate and the front bellcrank mounted in between the frames.

VIII. BUILDING THE TAIL ROTOR ASSEMBLY

Bags Required: #8A, #8B, and #8C

Tools or Materials Required:

M1.5 Allen tool
M7.0 (9/32@-5/16@) socket
Small hammer
Small Phillips and straight screwdrivers
Grease
Retaining Ring Pliers
Green Loctite
Blue Loctite

Special Note: If you choose to use graphite tail rotor blades, it is recommended that they not exceed a length of 95mm.

Step 1: Assembling the Tail Rotor Hub and Blade Holders

Bags Required: #8A

Parts Required:

Qty	Part Number	Part Description	Found in Bag
2	#0019	M3 Locknuts	8A
2	#0021	M4 Locknut	8A
2	#0097	M3 x 22 Special 12.9 Hard Phillips Pivot Bolts	8A
2	#0446-4	M4 x 0.003" Shim Washer	8A
2	#0457	Thrust Bearing (3 pieces)	8A
2	#0873-1	Tail Blade Mounts	8A
2	#115-66	Plastic Tail Rotor Blades - 95mm	8A

2	#120-39	M5 x 4 x 10 Ball Bearings	8A
1	#122-65	Steel Tail Rotor Hub	8A

Refer to Drawings #8A-1 and #8A-2

Select two #120-39 M5x4x10 ball bearings and two #0873-1 tail blade mounts. Press one bearing into each tail blade mount towards the control arm side. The bearing should be even with the outer surface of the blade mount.

Select two #0457 thrust bearings. Each is made up of a ball complement (spaced by a brass retainer) and two outer grooved rings. This assembly will only function when arranged properly within the blade mount. Examine each outer grooved ring and determine which one has the larger inside diameter (a simple test is to slide each onto the #122-65 steel tail rotor hub and select the one that fits loosely). This ring will be the first part of the thrust bearing installed in the tail rotor blade mounts. Using a socket or wood dowel that will fit inside the blade mount, install the larger I.D. thrust-bearing ring (grooved side facing out) into the #0873-1 tail rotor blade mounts. Use light pressure until fully seated. Repeat with the other thrust bearing and blade mount. Next, apply grease to the cupped side of the ball brass retainer ring and the grooved side of the outer grooved ring (the small I.D. race).

IMPORTANT:
Thoroughly remove any excess grease from the center I.D hole in the ball race and the outer grooved ring. This is to ensure that no grease smears onto the threads on the #122-65 tail rotor hub. With the forked end of the tail rotor blade grips facing upward, install the brass ball retainer race (cupped side facing down) followed by the outer grooved ring (grooved side facing down) on top of the previously installed inner grooved thrust bearing ring. Again, look for any grease residue in the I.D. openings.

Select the #122-65 steel tail rotor hub, one #0873-1 tail rotor blade mount, the remaining #0457 thrust bearing components, one #0446-4 M4 shim washer, one #0021 M4 locknut and a 7.0mm socket or nut driver. While holding the tail hub in a vertical position, slide one of the #0873-1 tail rotor blade mount assemblies onto the T/R hub, followed by one #0446-4 0.003" shim. Using a small screwdriver or toothpick, apply green Loctite to the threaded portion of the #0021 M4 Locknut. Install the locknut using a thin walled 7mm socket wrench onto the threaded portion of the tail rotor hub. Select any tool that will insert into the hub center hole to stop rotation. Tighten the #0021 M4 locknut until a slight amount of tension is felt on the tail rotor blade grip while rotating. Slightly back off the M4 locknut until the tail rotor blade grip rotates freely with little or no play. Repeat the process for the opposite tail rotor blade mount. Adjust the end play to match the first mount installed.

NOTE: The opportunity exists, at this time, to balance the hub assembly. If a very thin coat of grease was applied to the thrust bearings, then balancing can be done at this time. If, however, you used more grease than suggested, we recommend waiting until one flight is complete since the excess grease will no longer be a factor in the balance procedure. Balancing the assembly is not mandatory, ***but highly recommended***.

The following will describe the process. If a balancer is not available, select the #0541-8 tail rotor output shaft from the bag #10C. Obtain a large glass with a smooth top rim of at least 90.0mm (3.5@) in diameter. Use the shaft as a pivot point by inserting it into the hub and sliding the hub to the center. The shaft will then sit atop the glass allowing the hub assembly to pivot freely. The proper balance method is called a Afour-point@ balance. Two steps are involved. Always orientate the blade mounts with the threaded control arms in opposite directions (as in flight). First, rotate the unit atop the glass so that the tips of each blade mount

point at six and twelve o=clock positions. Releasing them at this position should result in the assembly remaining vertical. Second, rotate the assembly until at three and nine o=clock positions. If the assembly will not remain at the three/nine o=clock position then you can select a shim or washer and install it under the pivot bolt in the blade mount to secure the tail blade, it may be necessary to trim the washer to adjust the weight. Select two #0019 locknuts, two #0097 bolts and two #115-66 tail rotor blades. Install each blade orientated as shown in drawing #10A, noting that each leading edge corresponds to a pitch arm control ball on each blade mount. Temporally tighten each blade so that they will not pivot easily during handling. Rotate each blade so that the trailing edges can be simultaneously pressed against a straight edge (table top) while pulling out firmly. This will approximate flying position. Set the assembly (with shaft #0541-8 still temporally installed) atop two glasses on a level table top (or suitable blade balancer) and observe which (if any) blade appears heavier. Balance can be achieved easily by either adding a small piece of tape to the lighter blade tip or trimming a little plastic from the Aheavy@ blade tip. Loosen each blade pivot bolt until the blades will pivot freely (but not by their own weight alone). Remove the #0541-8 shaft.

Step 2: Assembling the Pitch Slider

Bags Required: #8B

Parts Required:

Qty	Part Number	Part Description	Found in Bag
2	#0015	M2 Hex Nut	8B
2	#0049	M2 x 10 Socket Head Bolt	8B
1	#0101	M2 x 5 Threaded Ball	8B
1	#0435	Tail Rotor Pitch Slider (brass)	8B
1	#0437	Plastic Pitch Ring	8B
2	#0439	Ball Bearings	8B
2	#0443	M6 Retaining Ring	8B
2	#0859-16	Pitch Links w/Bearings	8B
1	#120-14	Tail Rotor Pitch Yoke	8B

Refer to Drawing #8B

Select one #0101 M2x5 threaded ball and one #0437 plastic pitch ring. Install the threaded ball into the plastic pitch ring; use a small amount of slow CA glue. Do not over tighten. Select two #0439 ball bearings. Place each on a clean surface, “ball” side up and add grease. Press one into each side of the #0437 pitch ring so that the “ball” sides face inward.

Select the #0435 tail rotor pitch slider. Examine the previously prepared #0437 plastic pitch ring. The “boss” which supports the #0101 threaded ball has one side that is rounded. This rounded side will face the flange at the end of the #0435 tail rotor pitch slider. Slide the #0437 plastic pitch ring fully up to the flange of the tail rotor pitch slider.

Select the #120-14 tail rotor pitch yoke. Examine the drawing and note that the angled parts face away from the plastic pitch ring. Slide the tail rotor pitch yoke onto the tail rotor pitch slider up to the previously installed plastic pitch ring.

Select two #0443 M6 Retaining Rings. It is Acupped@, and this Acupped@ side will face away from the pitch yoke. Stand the pitch slider/ring/yoke assembly upright on the flange. Position the #0443 Retaining Ring over the exposed end of the pitch slider. Use a small hammer and a 7.0mm (9/32@-5/16@) socket to cautiously tap the retaining ring downward to meet the pitch yoke assembly. The desired situation is that the components on the pitch slider have no end play and the pitch ring freely rotates with no binding of the ball bearings. If you go too far with the retainer, place a small piece of hardwood or plastic across the exposed end of the brass pitch slider, support the pitch yoke near the ends and tap the wood very lightly with a small hammer or tool handle. The retaining ring should move enough to relieve the bearings. Be very careful not to distort the pitch slider at the end. Orient the second retaining ring such that the prongs fall in between the first ring. Apply a small amount of slow CA glue in the Acupped@ area of the retaining ring to lock it in place.

Examine the pitch yoke #120-14 noting that one side of each arm has a molded cavity, which accepts a M2 Hex Nut. Press one #0015 M2 hex nut into each arm. The opposite side of each arm will be used for mounting the #0859-16 pitch links. Mount each pivot by inserting one #0049 m2x10 socket head bolt through the flange side of one of the bearings in the pivot then through the pitch yoke arm #120-14 as described use a slight amount of blue Loctite inside the threads of the M2 hex nuts. Tighten securely. NOTE: When properly assembled, each pitch link plate will be Acaptured@ between the bearing flange and the mounting surface. This is important as a security if any bearing would fail. The same is true for the later connection to each tail blade grip.

Step 3: Assembling the Tail Rotor Gear Box

Bags Required: #8C

Materials and Tools Required:

M1.5 and 2.5 Allen (Hex) tools
AInside type@ Retaining ring pliers
Green, Blue and Red Loctite
Suitable grease with thin nozzle or Aspring type@ applicator (M.A. USA p/n #4707 recommended)
Small Phillips screwdriver

Parts Required:

Qty	Part Number	Part Description	Found in Bag
1	#0001	M2 Flat Washer	8C
1	#0015	M2 Hex Nut	8C
1	#0043	M2 x 10 Slotted Machine Screw	8C
2	#0049	M2 x 10 Socket Head Bolts	8C
7	#0051	M3 x 3 Socket Set Screws	8C
2	#0056	M3 x 5 “dog point” Socket Set Screws	8C
1	#0061	M3 x 8 Socket Head Bolt	8C
1	#0093	M3 x 18 Special Phillips 12.9 Hard Pivot Bolt	8C

2	#0159	M3 x 7 Ball Bearing	8C
1	#0361	M2 Control Ball	8C
4	#0425	M5 x 13 Ball Bearings	8C
1	#0426	.005" Gear Shim	8C
2	#0427-1	Bevel Gear Set	8C
1	#0431	M5 Circlip	8C
1	#0432	M5.0 x 7.0 x 3.15 Brass Spacer	8C
1	#0445	Tail Rotor Bellcrank	8C
1	#0541-8	Tail Rotor Output Shaft	8C
1	#0597-3	M3 x 4.6 Brass Spacer	8C
1	#0800-7	Tail Rotor Input Shaft w/Female Universal Joint	8C
1	#0861-5	CNC Machined Tail Rotor Gear Box Housing	8C
1	#0861-7	13mm Stepped Spacer	8C
1	#0861-8	Output Shaft Retaining "C" Ring	8C
1	#120-16	Bellcrank Support Arm	8C

Refer to Drawings #8C-1 and #8C-2

NOTE: The longevity of the shafts and gears within the tail rotor gearbox can be greatly enhanced by Amounting@ each with red or green Apermanent type@ Loctite. Each part should be cleaned with alcohol at the contact area. Follow directions provided by Loctite. Removal will require a modeler's heat gun. We recommend that 3-D and/or experienced pilots consider this option.

Some assembly positions will **require red or green** (both are permanent type) Loctite. Please do so, as this is a critical procedure required for proper tail rotor function.

WARNING: FAILURE TO ACCURATELY FOLLOW THESE INSTRUCTIONS COULD RESULT IN LOSS OF TAIL ROTOR CONTROL.

Clean the following parts with thinner to remove any oil prior to assembly with Red or Green Loctite:

#0427-1	Bevel Gear	
#0541-8	Tail Rotor Output Shaft	(shaft portion contacting Bevel Gear)
#0432	M5.0x7.0x3.15 Brass Spacer	
#0800-7	Tail Rotor Input Shaft	(shaft portion contacting Bevel Gear)
#0425	Ball Bearing	(inner diameter only)

Select the #0861-7 13mm stepped spacer from the parts bag. (Note: At your option, you may choose to Amount@ each bearing on the input shaft with green or red Loctite. It is optional at this position and mandatory elsewhere in the assembly procedure). Slide a #0425 ball bearing, the #0861-7 stepped spacer, another #0425 ball bearing, and the #0427-1 bevel gear onto the #0800-7 tail rotor input shaft. Press all parts firmly against the delrin end piece. Prepare two #0051 M3x3 socket set screws with blue Loctite and install them into the gear, making certain that one squarely contacts the Aflat@ on the shaft. Tighten each with moderate torque. There should be no end play in the assembly.

Select one #0425 ball bearing, the #0431 M5 circlip, and the #0541-8 tail rotor output shaft. Snap the circlip into place on the shaft. Apply a little **green** or **red** Loctite to the short end of the shaft and slide a bearing up against the clip. Allow the Loctite to cure for a few moments before proceeding. The following procedure will describe the steps for establishing the correct gear position and ultimately applying the required **green** or **red** Loctite to the outermost ball bearing. Prepare one #0051 socket set screw with blue Loctite. Install it into the #0427-1 bevel gear. Slide the gear onto the shaft so that the set screw is located over the "flat" provided on the shaft and lightly tighten the set screw, only enough to allow the gear to move along the "flat" on the shaft. Slide the #0432 brass spacer and the remaining #0425 ball bearing next to the bevel gear. Slide the shaft assembly (longer end first) into the housing and install the #0861-8 M13 retaining ring (using the proper tool). Rotate the shaft so that a 1.5mm allen tool can be inserted thru the M3 threaded hole at the rear of the housing and into the set screw of the bevel gear. Firmly press the long end of the output shaft towards the #0861-8 retaining ring while using the 1.5 allen tool to firmly press the bevel gear in the opposite direction along the shaft. Tighten the set screw against the "flat" of the shaft while applying this pressure. Check to see that there is no free-play in the shaft assembly. If there is, repeat the process.

NOTE: A simple test can be performed at this time to determine whether or not to use the #0426 0.005@ gear shim. Select the previously assembled input shaft. Slide it into the tail rotor housing. Apply a slight amount of inward pressure and rotate the shaft, noting the feel of the two gears meshing. Now remove the input assembly and the previously installed output shaft. Loosen the set screws in the gear on the #0541-8 output shaft. Add one #0426 gear shim to the output shaft assembly as per the drawing. Re-install and adjust the output assembly as previously done. Once again press in the input shaft assembly. Compare the gear mesh to the mesh with the shim removed. Choose the smoother of the two possibilities. Remove the input assembly. Check to see that there is no free-play in the output shaft assembly. Once again remove the retaining ring and slide the shaft assembly out of the housing. Remove the outer bearing and spacer. Clean the inside of each with alcohol as well as the output shaft. Apply **green** and **red** Loctite to the corresponding area of the output shaft and reinstall the spacer and bearing firmly against the bevel gear. Recheck the tightness of the set screws. Always keep one set screw tight while adding red or green Loctite to the opposite screw. Reinstall the output shaft assembly into the gear housing. At your discretion, the O.D. of the #0425 bearings may be installed with green Loctite inside the gear case. If you Loctite it in place, the disassembly procedure will be more difficult, but the life of the unit will be extended.

Select the previously assembled input shaft. Slide it into the tail rotor housing. **NOTE:** There are two M3 threaded holes at 180 degrees apart on the housing inlet. Install one M3x3 set screw very lightly to provide a little friction against the input shaft spacer #0861-7. Set the desired gear mesh and tighten the set screw. Install the remaining set screw and tighten. NOTE: If repeated installation of the set screw creates burrs on the spacer (which can limit the fine tuning adjustment of the gear mesh), simply rotate the sleeve so that the set screw faces a fresh surface.

Grease is applied through the large diameter hole in the rear of the housing. Use a suitable size syringe (MA USA p/n #4707 or #4709 is recommended). The bell crank support arm will later conceal this access hole. **DO NOT ATTEMPT TO FILL THE CASE WITH GREASE** since it serves no purpose. Simply concentrate the grease application toward the gears and rotate the input shafts to get coverage. The applicator is helpful and avoids getting grease in the threaded area (which would have to be removed to enable the Loctite to work properly). The bell crank support #120-16 installs by keying it into the groove in the back of the Tail Rotor Housing #0861-5, and it is secured with one M3 Socket Head Bolt #0061. Use blue Loctite.

Select one #0597-3 brass spacer, two #0159 M3x7 ball bearings, and one #0445 tail rotor bellcrank. Press one bearing into one side of the bellcrank. Insert one #0597-3 brass spacer in the opposite side followed by another #0159 ball bearing. Each will protrude approx. 0.75 mm when fully inserted. Select one #0001 M2 flat washer, one #0015 M2 Hex Nut, one #0043 M2x10 slotted screw, and one #0361 M2 control ball. Examine the drawing and note which side of the bellcrank is the top and note that there are three control ball mounting holes to select from. This kit will utilize the center hole. Insert the #0043 M2x10 slotted screw into the #0361 M2 control ball, followed by one #0001 flat washer. From the bottom of the bellcrank, insert the slotted screw/control ball/washer assembly into the center hole of the bellcrank. From the top of the bellcrank, assemble one #0015 M2 hex nut onto the slotted screw, using Blue Loctite. Select the previously assembled pitch slider from Step 2 and one #0093 M3x18 special phillips pivot bolt. Slide the pitch slider assembly onto the output shaft with its control ball pointing downward. Press this control ball into the hole provided in the top of the tail rotor bellcrank and position the bearings of the bellcrank directly under the mounting hole in the #120-16 bellcrank support. Select one M3x18 special phillips bolt and insert it through the bearings in the bellcrank from the bottom side of the bellcrank and thread into the #120-16 bellcrank support. Adjust the tightness of this bolt until the bellcrank has no vertical free-play yet pivots smoothly. From the opposite side of the #0093 bolt, install one #0051 M3x3 socket set screw into the #120-16 bellcrank support. Tighten up against the end of the pivot bolt. Use blue Loctite. This acts as a safety, locking the #0093 special phillips bolt into position.

Select the previously assembled tail rotor hub assembly. Examine the drawing and note the orientation of the hub, blade mounts and the gearbox. For further clarity, hold the hub assembly and view it as though you were looking directly at the 5.0mm diameter through hole. Position the blade mount pointing at three and nine o=clock positions. The correct view should show the blade holder to your left (nine o=clock position) as having it's control arm above, the blade mount to your right (three o=clock position) as having its control arm below. **Note:** for future reference, considering the view you now see, the tail rotor blade for the Aleft blade mount@ would have its leading edge pointing upward and the tail rotor blade for the Aright blade mount@ would be pointing its leading edge downward. Slide the hub assembly onto the output shaft; aligning the M3 threaded holes in the hub with the M2 countersunk holes in the shaft. Select two #0056 M3x5 Adog-point@ Socket Set Screws. The term Adog-point@ refers to the 2.0mm diameter protrusion at the end. This will directly engage the 2.0mm diameter holes in the output shaft. Prepare each with Blue Loctite and install into the hub and through to the holes in the output shaft. Tighten each simultaneously a little at a time until fully tight. Note: recheck the tightness periodically with the previously mentioned method in mind.

Connect the two pitch pivots #0859-16 to the hole in the arm of the T/R blade mounts using two M2x10 Socket Head Bolts #0049. Use blue Loctite on the tip of the bolt, taking care not to let any get into the bearings. **Tighten securely.**

IX. BUILDING THE TAIL BOOM ASSEMBLY, BOOM SUPPORTS, AND INSTALLATION ONTO THE MAIN MECHANICS

Bags required: #9A, #9B, #9C, #9D, #9E

Tools or materials required:

M1.5 and 2.5 Allen tools
M5.5 (7/32@) flat wrench
Small pliers
Small straight blade and Phillips screw drivers
Hand drill with 1.30mm (.055@) drill bit

Heat gun
AJ-B Weld@ epoxy or similar slow cure epoxy, slow Cyanoacrylate glue (CA), and silicone glue
Small piece of 180-220 grit sandpaper
Light oil or Vaseline petroleum jelly.

Step 1: Installing the Rudder Servo Mount

Bags required: #9B

Parts Required:

Qty	Part Number	Part Description	Found in Bag
4	#0019	M3 Locknut	9B
1	#0060-1	M3 x 6 Socket Head Bolt	9B
4	#0077	M3 x 30 Socket Head Bolt	9B
2	#0186	Front Tail Boom Clamp Halves	9B
1	#120-35	Graphite Rudder Servo Plate	9B

Refer to Drawing #9A

As per the drawing, slide the #0186 tail boom clamp halves into position between the main frames, note that the rib on the inside of each half is installed towards the nose of the helicopter. Using four #0077 M3 x 30 socket head bolts attach the #120-35 graphite rudder servo plate to the outside of the right main frame. Secure the lower side of the rudder plate using one #0060-1 M3 x 6 socket head bolt. Tighten using blue Loctite. Install four #0019 M3 Locknuts on the threaded portion of each #0077 socket head bolt protruding from the left frame. Do not fully tighten at this time.

Step 2: Building the Tail Boom

Bags required: #9A, #9C

Parts Required:

Qty	Part Number	Part Description	Found in Bag
1	#0006	M2.5 Serrated Lockwasher	9C
2	#0015	M2 Hex Nuts	9C
1	#0019	M3 Hex Locknut	9C
1	#0020	M2.5 Hex Locknut	9C
1	#0024	M2.2 x 4.5 Phillips Self Tapping Screw	9C
2	#0027	M2.2 x 9.5 Phillips Self Tapping Screw	9C
5	#0032	M2.9 x 9.5 Phillips Self Tapping Screw	9C

1	#0039	M2.5 x 10 Phillips Machine Screw	9C
1	#0043	M2 x 10 Slotted Machine Screw	9C
1	#0044	M2 x 12 Slotted Machine Screw	9C
1	#0063	M3 x 10 Socket Head Bolts	9C
1	#0477	Push Rod Guide Support	9C
1	#0587-14	Graphite Tail Boom Ultra 33@	9A
1	#0683	Tail Rotor Gearbox Clamp	9C
2	#0800-5	O-rings	9C
1	#0867-15	Torque Tube Assembly	9A
1	#0868-5	Push Rod Guide	9C
1	#0870-1	Horizontal Fin Mount	9C
1	#120-33	Plastic Boom Mount	9C
1	#124-84	Vertical Fin	9A
1	#124-85	Horizontal Fin	9A

Refer to Drawings #9B-1, 9B-2 and 9B-3

Select the #0867-15 torque tube assembly. The ball bearing at the center is surrounded by a plastic housing that requires the addition of two O-rings #0800-5. Select and install these O-rings. Apply a light coat of oil or Vaseline lubricant and slide the assembly into the tail boom: #0587-14.

Slide the #0870-1 horizontal fin mount on the rear of the tail boom, positioning it 254.0mm (10.0") from the end.

Select one #0006 M2.5 "toothed" lock washer, two #0015 M2 hex nuts, one #0043 M2 x 10 slotted machine screw, one #0477 pushrod guide support and one #0868-5 pushrod guide. Wrap the #0477 support around the boom as shown and install one #0043 screw from above along with a #0015 nut from beneath. Tighten only enough to allow adjustment and slide the support to a position approximately 603.0 mm (23.75") from the front edge of the tail boom.

Insert the #0044 M2 x 12 slotted screw into the small slot in the #0868-5 push rod guide and slide the #0006 M2.5 serrated lockwasher onto the opposite side. Secure this assembly to the horizontal hole within the #0477 pushrod guide support using one #0015 M2 hex nut with blue Loctite. Tighten only moderately so that adjustment may be made later.

Select one #0019 M3 hex locknut, one #0063 M3 x 10 socket head bolt, three # 0032 M2.9 x 9.5 phillips tapping screws, the #0683 tail rotor gearbox clamp, and the previously assembled tail rotor gearbox. Examine the #0683 clamp and note that the rear is the side with three horizontal holes. Slide the clamp onto the rear of the tail boom until even with the end (orientated so the slot within the clamp is centered over the notch in the tail boom). Apply a small amount of grease to the torque tube drive end. Press the gearbox into the boom, fully engaging its molded "key" into the tail boom notch. Align the clamp with the gearbox housing and install three #0032 tapping screws with a small amount of slow CA adhesive on each. Do not over tighten. Confirm that the gearbox is fully inserted into the tail boom by tapping on its rear-flanged surface with plastic tool handle or wooden block. Tighten the clamp about the tail boom by installing one #0063 bolt and #0019 locknut into the hole provided. Do not

tighten so much as to distort the clamp.

Examine the upper surface of the gearbox clamp and note a small hole at the center. This hole must now be duplicated in the tail boom and gearbox (partially). Using a 1.30mm (0.055") drill bit, drill straight downward through the hole and the tail boom. Use light force so that if is easy to stop drilling as soon as the resistance stops. Select the #0024 M2.2 x 4.5 phillips tapping screw and install it into the drilled hole. This particular length screw will protrude partially into the gearbox housing but not contact its input shaft (do not make any substitutions). As an extra precaution it is advisable that the #0683 clamp be glued to the tail boom by wicking a light bead of thin CA glue around the front edge of the clamp where it meets the tail boom. Let dry naturally without accelerator.

Select two #0027 M2.2 x 9.5 phillips self-tapping screws, two #0032 M2.9 x 9.5 phillips self-tapping screws, one #124-85 horizontal fin. Install the horizontal fin atop the #0870-1 fin mount with two #0027 screws. Install the vertical fin onto the #0683 gearbox clamp using two #0032 screws.

Slide one #120-33 plastic boom mount on the front side of the tail boom approximately 107mm (4.25") from the front edge. Refer to the drawing for proper orientation. Install one #0039 M2.5 x 10 phillips bolt and one #0020 M2.5 locknut into the top hole in the #120-33 boom mount. Do not tighten at this time.

Apply a small amount of grease to the tube drive end. Install the tail boom into the #0186 clamps. Hold the main gear while rotating the tail rotor hub and apply pressure forward on the tail boom assembly. After less than one rotation, the tail boom assembly should move further forward (verify that the torque tube universal joints are properly engaged). Push the tail boom as far forward as possible. DO NOT PULL BACK ON THE TAILBOOM. THE STOP MOLDED IN THE BOOM CLAMP IS DESIGNED TO ALLOW FREE-PLAY IN THE TORQUE TUBE. Lightly tighten all four mounting bolts. View the model straight from the rear and rotate the boom as needed to ensure that the gearbox output shaft appears perpendicular to the mainshaft. Apply slight pressure forward on the tail boom while tightening all four boom clamp bolts.

Step 2: Installing the Tail Boom Supports

Bags required: #9A, #9D

Parts Required:

Qty	Part Number	Part Description	Found in Bag
4	#0003	M3 Flat Washers (large)	9D
1	#0019	M3 Locknut	9D
4	#0048	M3.5x25 Socket Set Screw	9D
1	#0065	M3x12 Socket Head Bolt	9D
2	#0093	M3x18 Phillips Bolt	9D
2	#0872-2	Molded Boom Support Ends	9D

2	#0872-5	Graphite Tubes 25@	9A

Refer to Drawings #9C

Select four #0048 M3.5x25 socket set screws and two #0872-5 graphite tubes. Clean each set screw thoroughly with alcohol or lacquer thinner. Use a cotton swab (Q-tip) to clean inside each end of each carbon tube. Roll a small piece of 180 - 220 grit sandpaper into a small tube and use it to roughen the inside surface at each end of each tube.

Select two #0872-2 molded boom support ends. Each has a 5.75 mm diameter hole in the end followed by a 3.0 mm diameter hole set approximately 10.0 mm deeper. Install one #0048 set screw from Step A into each 3.0 mm hole so that approximately 7.5 - 8.5 mm is exposed past the end of the molded boom support end. This also applies to the two #0872-2 support ends previously installed on the rear landing gear mount.

Examine the “ball end” of the #0872-2 molded boom support end. The factory-installed ball has a molded “boss” of approximately 6.3 mm diameter on either side of the ball. One side protrudes 1.0 mm while the other is 1.5 mm. The 1.5 mm thick side should always face the mounting surface to which the tail boom brace will be fastened. This is of particular importance at the front mounting positions.

Select the #0872-5 graphite tubes and the two remaining prepared molded boom support ends from step (A). Note the 1.5mm hole on each brace end. During proper assembling, a small amount of glue will exit this hole.

Graphite tubes can be bonded with “J-B Weld” epoxy (or similar slow curing epoxy) or slow CA glue. The epoxy allows much more time for the assembly steps while the slow CA glue will allow only a minimum working time. Be prepared to move fast if CA type glue is used.

Apply a liberal amount of your chosen adhesive to the threads exposed on the brace end and inside the graphite tube end. Insert one tube into one brace end until it stops (about 9.5 - 10.0 mm) and secure it from moving while the glue sets. Repeat for the remaining brace.

Select two #0003 M3 flat washers, two #0093 M3x18 special phillips bolts, and the two prepared graphite tubes (from the previous step). It is suggested that both braces be aligned and fitted prior to final gluing. Install one washer on one #0093 bolt and insert into one brace end. With the graphite tube pointing forward, temporarily thread the bolt and brace into one of the molded holes on either side of the horizontal fin mount. Repeat the process for the remaining brace on the opposite side of the fin mount.

Align the brace ends attached to the main frames with both graphite tubes and slide the horizontal fin mount forward until the graphite tubes insert into the holes in the front brace ends. Check to see that everything sits naturally without any binding.

Select one #0019 M3 hex locknut, two #0003 M3 washers and one #0065 M3x12 socket head bolt. Install these into the bottom “clamping” portion of the #0870-1 horizontal fin mount. Level the fin and tighten the bolt.

Remove both side bolts that secure the rear of each brace to the horizontal fin mount. Stand the model vertically on its radio tray (easiest in the corner of a room or between your knees while in a seated position). For each brace/graphite tube, prepare the open end of the tube and the threaded part of the brace end on the main mechanics with the glue of your choice. Insert the tube fully into the end and align the rear with the horizontal fin mount and reinstall the

#0093 phillips bolt. Repeat the procedure for the opposite side and keep the model vertical until the glue dries. This procedure assures that the tail boom and braces sit straight and without any pre-load induced from their own weight.

Step 3: Installing the Graphite Tail Rotor Push Rod

Bags required: #9A, #9E

Parts Required:

Qty	Part Number	Part Description	Found in Bag
2	#0133-1	Special Ball Link	9E
1	#0868-15	Graphite Pushrod @	9A
1	#0868-4	Heat shrinkable Teflon tubes	9E
2	#0868-6	M3x40 Threaded Stud	9E

Refer to Drawing #9D

Select two #0868-6 threaded studs. Clean each with alcohol or lacquer thinner. Each stud is to be installed into the graphite tube to a depth of 23.0mm. Select the #0868-15 graphite pushrod. Prepare each stud by applying J-B Weld epoxy (or similar slow drying epoxy) and insert each into the tube to the correct depth. Set aside to dry or apply mild heat from a hair dryer.

Select one # 0133-1 special ball link and one #0868-4 teflon shrink tubes. Slide the teflon tube onto the graphite tube (final positions to be determined later) and thread the ball link onto one threaded stud of the graphite tube, concealing about 7.0 mm of the threads. From behind the tail rotor gearbox, slide the graphite pushrod assembly (leading with the threaded end which has no ball link installed) through the previously installed push rod guide. Select the remaining #0133-1 Special ball link and thread it onto the pushrod to a depth of about 7.0 mm. Connect one link to the rear bellcrank.

X. INSTALLING THE RADIO SYSTEM AND PUSHRODS

Bags required: #10A, #10B, #10C, #10D

Tools or materials required:
- Small Phillips screwdriver
- 1.5mm Allen tool
- Small pliers or forceps
- 4 large heavy-duty servo wheels or arms
  - (J.R. Super Servo Horn set - purchased separately)
  - (Futaba - 45.0 mm diameter wheel - standard with servos)
- Thick two-sided foam tape
- Slow Cyanoacrylate glue (CA) or epoxy

Step 1: Installing the Radio System

Bags required: #10A

Parts Required:

Qty	Part Number	Part Description	Found in Bag
8	#0038	M2.5x10 Phillips machine screws	10A
4	#0039	M2.5 x 12 Phillips Screw	10A
4	#0039-2	M2.5 x 14 Phillips Screws	10A
5	#0389	Wire Retainers (small)	10A
5	#0390	Wire Retainers (large)	10A
2	#0560-1	Servo Spacer	10A
16	#0560-8	M2.5 Flat Washers	10A
1	#115-30	Velcro (red) - 18”	10A
1	#115-95	Rubber Channel - ½”	10A
1	#120-34	Rudder Servo Block	10A

Refer to Drawing #10A-1, 10A-2, 10A-3 and 10A-4

All servos, except the rudder and elevator servo, mount using #0038 M2.5x10 Phillips machine screws and #0560-8 M2.5 flat washers into threaded steel inserts (factory installed) in the side frames. The rudder servo uses #0039-2 M2 x 14 Phillips bolts. The elevator servo uses #0039 M2 x 12 Phillips bolts and two #0560-1 servo spacers. All servos mount to the outside surface of the side frames with the exception of the uppermost front servo, which mounts to the inside of the right main frame utilizing two #0560-1 spacers. Each should be installed with Blue Loctite. The bolt spacing for each servo has been selected to allow the installation of all popular servos with minor deflection of the servo=s rubber grommets and bushings. For example, 4000 series J.R. servos will show the bushings (within the grommets) slightly shifted away from servo case, 8000 series J.R. servos will be similar but less and 9000 series Futaba servos will show the bushing shifted slightly inward towards the case. When installing the rudder servo, use one #120-34 servo blocks as shown. Securely tighten the bolt and nut previously installed on the top of the #120-33 boom mount.

The following table will indicate the Servo Number, Frame Position, Receiver Connection, and Model Connection:

Servo Number	Frame Position/Spline Direction	Receiver Connection	Model Connection
1	Front/Top - Left Frame - Spline Rearward	Elevator	Front Bellcrank
2	Front/Second from Top - Right Frame - Spline Rearward	Pitch	Right Bellcrank
3	Rear/Top - Left Frame - Spline Forward	Aileron	Left Bellcrank
4	Boom Rudder Mount - Spline Forward	Rudder	Tail Rotor

Servo Location and Installation

Examine the drawings and be sure to mount each servo in the correct front/rear orientation.

Do not install any servo arms at this time.

As added protection for the servo wires, cut two small pieces of the #115-95 rubber channel approx. .250" (1/4") in length and glue these in the cut out wire relief area of the #2 servo (right frame) and the #3 servo (left frame).

Select your battery pack (flat type/1500mah or greater preferred). Apply two strips of thick foam tape that will match the left frame in the lowest opening in the right main frame. The battery will be attached to the inside of the left main frame. Fasten the battery so that it is evenly spaced in the right frame opening. Install the Velcro (red) around the battery so that it is held firmly.

Repeat the same procedure with the receiver, again matching the thick foam tape with the left main frame inside the upper opening in the right main frame. If you have chosen a gyro unit with an amplifier box, do not apply the Velcro to the receiver at this time.

Install the switch into the #124-24 bottom plate with the switch facing downward. Take care to center the switch so there can be no contact in either the on or off position with the graphite.

Install the gyro onto the gyro plates following the manufacturers instructions. If your gyro unit includes an amplifier/control box, mount this using thick two sided foam tape onto the outside of the left main frame as shown. Secure the amplifier and receiver using Velcro (red) as shown.

It may be necessary to use servo lead extensions on both the rudder and aileron servos. The fan wire plug may be plugged into any remaining auxiliary channel on the receiver. Make all necessary servo, gyro and switch connections in an orderly manner, routing wires to avoid contact with frame edges and moving parts. Use the #0389 (single servo wire) and #0390 (two servo wires and/or gyro wires) wire retainers to secure the wiring. These items will press onto the head of any M3 socket head bolt. Refer to the drawings for suggested wire routing. Small pieces of two-sided Velcro (red) make excellent wire ties (retainers).

The antenna wire routing is important! Do not bundle the antenna lead wire with itself or other wires. Keep the wire away from the electronics and motor unit. If using a full-length antenna, use a piece of tubing small enough to route the antenna through. This may be secured to the landing gear struts near the skids, allowing the antenna to point rearward. If using a whip antenna, attach the base of the antenna to the outside of the left frame (opposite the battery) pointing forward.

Step 2: Basic Radio Programming

Preliminary adjustments must be made to the radio before installing servo arms (wheels) and push rods. Typical settings are listed for popular radios.

J.R. X 8310/ PCM 10 Series

Select swash type function 65.
Select 120 C.C.P.M. function.
Retain all Adefault@ C.C.P.M. settings of 60%.
Set aileron, elevator and pitch ATV at 100%.

Futaba 9 CH / 9 ZH

Select SR3 swash type in Amodel@ menu.
Retain Adefault@ settings at 60% for aileron, elevator and pitch.
Set aileron, elevator and pitch ATV at 100%.

NOTE: Do not adjust ATV for any trimming or set up changes.
Use only AFR or SWH menus for trimming adjustments.

Step 3: Installing Servo Arms (Wheels) and Pushrods

Bags required: #10B

Parts Required:

Qty	Part Number	Part Description	Found in Bag
4	#0015	M2 Hex Nut	10B
4	#0103	M2 x 5 Threaded Ball	10B
6	#0133	Ball Links (long)	10B
1	#0337	M2 x 27 Threaded Rod	10B
2	#0367	M2 x 60 Threaded Rod	10B

Refer to Drawings #10B

NOTE: Servos #1 through #3 require large servo output positions (Refer to your gyro instructions for what size wheel to use on Servo #4). For J.R. servos, use the heavy-duty J.R. Super Servo arms (available as an option from J.R. in a package of five) in the outer hole (20.0 mm from the center screw). For Futaba servos, use the large 45.0 mm diameter wheel (included with all Futaba servos) in the outer hole (19.50 mm from the center screw). We do not recommend the use of after-market metal servo arms.

All servos must be in the Aneutral@ position before proceeding. For purposes of simplicity, the described procedure will assume a '3D aerobatic type' setup. If you are a beginner, the amount of negative pitch that you will not be using can be eliminated electronically within your radio=s pitch curve prior to flight.

Servos #1, #2, and #3 are set at neutral positions by placing the throttle stick at the center of it=s travel. Servo #4 is set at neutral as per the instructions provided with your gyro.

Always maintain a minimum of 5.0 mm of push rod threads within a ball link.

Servo #1

Select the #0337 push rod and two #0133 ball links. Install each ball link and adjust to the preliminary length of 7.0mm (measured as the amount of push rod exposed between the ball links).

Select the appropriate servo arm (wheel), neutralize the servo and temporarily press the arm onto the servo spline so that the output hole is exactly above and on a vertical line with the hole for the arm retaining screw. Test the position until the criteria is satisfied, note the position and

remove the arm. Install the #0103 control ball from the backside of the servo arm (so it will ultimately face the left side frame) and secure from the outside with Loctite and one #0015 M2 hex nut. Install the arm. Snap the prepared push rod in place connecting the servo to the front swash plate bell crank.

Servo #2

Select one #0367 pushrod and two #0133 ball links. Install each ball link and adjust to the preliminary length of 44.0 mm.

As with Servo #1, the arm for Servo #2 must be the correct size and positioned with the output hole beneath and on a vertical centerline with the arm retaining screw hole (servo in Aneutral@). Contrary to Servo #1, Servo #2 utilizes the control ball to the **outside** of the servo wheel (away from the right frame). Select and install one #0015 hex nut and one #0103 control ball with Blue Loctite. Snap the prepared pushrod in place connecting the servo to the right cyclic bellcrank.

Servo #3

Select one #0367 pushrod and two #0133 ball links. Install each ball link and adjust to the preliminary length of 44.0 mm.

As with Servo #2, the arm for Servo #3 must be the correct size. Servo #3 requires the control ball be on the centerline directly above the arm retaining screw. As with servo #2, this servo will utilize the control ball on the **outside** of the servo wheel and away from the left frame. Select and install one #0015 hex nut and one #0103 control ball with blue Loctite. Snap the prepared pushrod in place connecting the servo to the left cyclic bellcrank.

Servo #4

Again refer to your gyro instructions for the recommended arm length. Servo #4 requires the control ball be on the centerline directly above the arm retaining screw. Select and install one #0015 M2 Hex nut and one #0103 control ball as indicated.

Attach the front of the tail rotor pushrod to the rudder servo. Adjust the pushrod length until the rear bellcrank at the T/R case is parallel to rear of the case when the servo arm is vertical.

Manually operate the pushrod and make preliminary adjustments to the guide so that it operates freely and approximately centered within the guide.

Tighten the #0868-5 guide and #0477 support. Slide the Teflon tube into position within the guide so that the complete operation of the pushrod does not surpass the length of the Teflon tube. Mark the position and disconnect both ball links so that the pushrod and Teflon tubes can be moved away from the guide. Use a heat gun to shrink the Teflon tube and re-install the pushrod in its proper location.

Step 4: Installing the Rotor Head Push Rods

Bags required: #10C

Parts Required:

Qty	Part Number	Part Description	Found in Bag
8	#0133	Ball Links (long)	10C
4	#0135	Ball Links (short)	10C
2	#0313	M2x10 Pushrods	10C
2	#0335	M2x75.0 Pushrods	10C
2	#0337	M2x27 Pushrods	10C

Refer to Drawing #10B

Select four #0133 ball links and two #0337 pushrods. Install two ball links on each pushrod, adjusting each to a length of 11.5 mm (exposed pushrod between each link). Snap each prepared pushrod in place connecting each #0307 flybar control arm to each #0109 control ball of the #0221 washout arms.

Select four #0133 ball links and two #0335 pushrods. Install two ball links on each pushrod, adjusting each to a preliminary length of 61.0 mm (exposed pushrod between each link) and orientate each link perpendicular to the other. Snap one prepared pushrod in place connecting the shorter ball of the #0334-1 bell mixer with one or two remaining #0109 control balls of the inner swashplate ring. Repeat the process for the opposite side. More information will be provided later in this text regarding the bell mixer ratio choices available on this model.

Select four #0135 ball links (short type) and two #0313 pushrods. Install two ball links on each pushrod, adjusting each perpendicular to the other and with a gap of 0.0 mm. Snap one prepared pushrod in place connecting the remaining outer ball (in position nearest the blade holder) of the #0334-1 bell mixer with the #0133 installed in the flybar yoke. Repeat the process for the opposite side of the rotor head.

XI. MOUNTING THE BATTERIES

Bags required: #11A

Tools or materials required:
2.5mm Allen tool

Parts Required:

Qty	Part Number	Part Description	Found in Bag
10	#0064	M3 x 8 Button Head Socket Bolts	11A
1	#115-30	Velcro - Two Sided - Red (40”/1016mm)	11A
1	#124-86	Front Battery Plate Spacer	11A
2	#124-89	Graphite Battery Tray	11A
1	#124-90	Velcro - Stick Back - Male - (215mm)	11A

1	#124-92	Velcro - Stick Back - Female - (215mm)	11A

Refer to Drawing #11A-1, 11A-2 and 11A-3

Select the #124-90 male sticky back Velcro, cut into the lengths shown and attach to each battery mount as per the drawing. The #124-92 female Velcro will be attached to each battery later when the final balance is achieved.

Install the #115-30 Velcro into the battery mounts as per the drawing. Various slots are provided for various battery widths.

Attach each #124-89 battery plate to the pre-assembled studs on the outside of each main frame using four #0064 M3 x 8 button head socket bolts on each side. Install the #124-87 front spacer in between the battery mounts using two #0064 bolts. Apply blue Loctite and tighten securely

XII. ADJUSTING THE C.G.

Refer to drawing #11A-3 and 11B

Before the main battery packs are fit to the model, it is neccessary that step XIII be completed. The reason for this is that the main batteries are used to set the fore and aft C.G. of the model. Cut and attach the female velcro onto the previously attached male velcro. Do not remove the protective backing. The main batteries may be attached via the velcro straps. Mount the finished canopy. Check the C.G. of the model by lifting it by the flybar. The model should be slightly nose heavy. Simultaneously move both batteries until the desired C.G. is achieved. Remove the canopy and mark the position of each battery pack. Remove each pack and remove the backing from the velcro. Press each battery pack back into position thus bonding the velcro to the battery. If using your own battery packs, refer to drawing #11B for proper wiring diagram.

XIII. PREPARING THE CANOPY

Bag required: 12A

Tools or materials required:

Slow Cyanoacrylate glue (CA)
(Optional) Painting materials (See text supplied with the decal sheet)

NOTE: Refer to the *Suggested locations for decals@* sheet. Drill holes and cut out areas as shown. Painting can be done before or after the following steps but trial fitting is suggested.

Step 1: Installing Mounting Hardware and Fitting the Canopy

Parts Required:

Qty	Part Number	Part Description	Found in Bag
4	#0053-5	M3x16 Set Screw	12A
4	#106-22	Rubber Grommets (large)	12A
4	#122-99	Canopy Retaining Knobs	12A

1	#124-98	Canopy	Box
1	#124-99	Decal Sheet	Box

Refer to drawing #12

NOTE: Before gluing any of the grommets into position, finish step "B" first.

A) Select four #106-22 rubber grommets and the canopy. Drill one 1/8th@ (0.125") hole in the center of each mounting cavity in the canopy sides. Slide the canopy in position on the model. Using any size 3mm screws, attach the canopy to the model. Observe whether any of the holes need to be repositioned. Do so until all four screws easily mount without distorting the canopy. Open each hole to a dimension of approximately 0.260" - 0.265" (6.60mm - 6.73mm) using an AH@ drill bit.

B) Insert a grommet into each hole. Assemble each canopy knob using one #0053-5 M3x16 socket set screw. Tighten securely using red or green Loctite. Trial fit the canopy using the assembled retaining knobs. Adjust if necessary. Once you are satisfied with the fit, go to the inside and secure the perimeter of each grommet to the canopy with CA glue.

Step 2: Canopy Finishing Suggestions

At your option, the canopy can be used in the Awhite@ form provided or painted to your choice. If overall painting is chosen, these instructions assume you have the necessary experience and materials therefore only the steps required to finish the canopy in Awhite@ are described below. **Note:** If you are changing the color, be aware that the decals are best applied only over white or very light colors.

NOTE: Refer to Table "Finishing Methods and Procedures". After choosing your finishing methods, please consider the following list of optional materials:

3M Scotch-brite pad or fine steel wool and :@ masking tape
Strong detergent
Masking paper or newspaper
Alcohol or paint prep solvent (such as Dupont #3919 prep-sol)
ATack@ cloth

Paint selection - Automotive polyurethanes are best but modeler=s epoxy or urethane can also be used. Always apply a light coat first, allowing 15-30 minutes set-up time, before final gloss coat.

Painting:	**Clear coat method**	**Non-clear coat method**
Finish choice	Longer completion time, high gloss	Quicker completion time, shorter decal life
Characteristics:	Best decal protection, slightly increased weight	Lightest weight.
Procedures:		
Step 1	Wash thoroughly with warm water and detergent.	Wipe with alcohol or paint prep solution.

Note: The canopy can be left as is or further smoothed. If you wish a smoother finish, apply 3/4" tape (in two layers) on both sides of the seam and sand with 400 grit wet-or-dry paper.If overall painting is chosen, imperfections in the seam can be filled with glazing putty or similar material.

Step 2	Scuff entire canopy with Scotch-brite abrasive pad or fine steel wool and re-wash.	Mask area surrounding window.
Step 3	Mask area surrounding window.	Spray window area with color of choice.
Step 4	Spray window area with color of choice.	Remove masking
Step 5	Remove masking	See step 6 below

Decal Application

	Dry method	**Wet method**
Characteristics:	Quicker but only one opportunity to position decals.	Slower but decals can be re-positioned.

Procedure continuation

Step 6	Carefully cut decals from sheet using a clean modelling knife or scissors, study decal application sheet for suggested positioning.	
Step 7	Apply decals and firmly burnish using the backing paper and finger pressure.	Apply window cleaner to canopy and remove excess with a soft rubber squeegee.
Step 8	Wipe the canopy with a tack cloth and apply clear coat of choice by first applying a very light "tack" coat. Allow this coat to dry 15 30 minutes and follow with a wet coat. Allow to dry, the canopy is now completed.	Allow to dry, the canopy is now completed.

XIV. ROTOR BLADE SELECTION

It is recommended that a blade length of 680mm to 700mm be used. A good quality rotor blade is suggested. Miniature Aircraft USA offers a variety of high quality rotor blades suitable for the Fury Ion-X.

XV. SPECIAL PRECAUTION

THE PROCEDURES OUTLINED IN SECTION XV SHOULD NEVER BE PERFORMED WITH THE MOTOR BATTERIES INSTALLED OR CONNECTED! FAILURE TO FOLLOW THIS COULD RESULT IN SERIOUS BODILY AND/OR MATERIAL DAMAGE!!!

Note - If a BEC is being used, always use an alternative battery source for the receiver to perform section XV.

XV. FINAL MECHANICAL AND ELECTRONIC SET-UP

NOTE: The following procedures will be described using a pitch gauge, fly bar lock and paddle gauges. The use of these items is highly recommended since without them an accurate set-up is very difficult. Refer to the beginning of the manual for the correct order numbers.

Install the rotor blades, noting that the leading edge of each corresponds to a bell mixer on each side of the rotor head (clockwise rotation). The pivot bolts must be tightened the correct amount. This is best described by indicating what is too loose and too tight. If the model is leaned to one side and the blades swing together by their own weight, the bolts are too loose. If a fly bar paddle is held in one hand, a blade tip on the other and an effort is made to fold the blade, the result should not deflect the fly bar more than 25.0mm (1.0@). These are approximate values.

Install a flybar lock onto the rotor head. Install a pitch gauge onto one rotor blade.

Set all transmitter trim levers and servos/bell cranks at neutral as described in Section X, Step 2. The swash plate can now be adjusted to a level position (perpendicular to the main shaft and parallel to the main gear/frames) by adjusting the rods below it. This procedure can be assisted by the use of swashplate leveling tool #0513. A straightedge or bubble level placed across the top surface of the swash plate outer ring may also be used. The final confirmation is done at the rotor blade. Read the pitch at the blade (the exact value in degrees does not matter at this stage). The pitch reading should not change as you rotate the head, checking it at each 90 degree position (starting directly over the tail boom for example). Miniature Aircraft USA offers an excellent tool for leveling the swash plate, order #0513.

NOTE: Adjustments should be split at opposite sides (half turn longer on the left side, half turn shorter on the right side, for example).

Adjust the rods (#0337) from the washout to the flybar control arms until the wash out arms are level. Remember the flybar control arms will not be level due to the 10° offset.

Adjust the rods (#0335) from the swash plate to the bell mixers until the bell mixers are level with the flybar.

The fly bar paddles must now be aligned with the swash plate. This can be confirmed by visually comparing the paddles to the swash plate from the side view. Some pitch gauges will adapt to the paddles or you can use the X-Cell paddle gauges #0510-1. The fly bar lock can be removed for this step if tilting the fly bar helps your view. Adjust each paddle until they are level and parallel to each other.

The collective pitch range can now be adjusted. It is suggested that the "3-D" settings be used initially by everyone (as a set-up guide) then modified electronically to suit individual needs (such as beginners or intermediate pilots). All "3-D" settings should only be set utilizing an "idle-up" function within the radio. If you are a novice, this idle-up function can be deactivated later (prior to flight). As a novice or expert, you will benefit by having the desired "zero" or "neutral" mechanical set-up that results from using the 3-D settings as a starting point.

Initial Pitch Settings

Desired Flying Style/Type	Collective low stick position	Collective half stick position	Collective full stick position
Basic flying and hovering (normal mode)	-2 degrees	+5 degrees	+8 degrees
Mild aerobatics/autos (Idle-up 1)	-6 degrees	+4 degrees	+10 degrees
3-D flying (idle-up 2)	-10 degrees	0 degrees	+10 degrees

Activate a circuit (idle-up(2)) for 3-D settings and move the collective/throttle stick to exactly half stick. Adjust the #0335 pushrod (from the swashplate to the bell mixer) so that the blade reads exactly zero degrees pitch. Repeat for the remaining blade. Move the stick to full and low positions, reading the pitch at each. If previous steps were followed accurately, the range above and below zero should be the same. Any fine-tuning can be done in the "swash type" (SWH) or AFR menus (do not re-adjust ATV for this). Novice and intermediate pilots can turn this idle-up function off and set their desired pitch settings within the normal or idle-up(1) pitch curve circuits.

Cyclic pitch can now be set. With the fly bar lock and pitch gauge in place, position the rotor head so that one blade is directly over the tail boom. Move the collective/throttle stick until exactly zero degrees pitch is shown on the blade. Do not move the stick again. Apply full right and full left Aaileron,@ reading the pitch at each. The result should be ±7 to 7.5 degrees. Adjust SR3 mode (CCPM Swashplate mode) or AFR as needed. Rotate the rotor head so that the flybar is directly over the tail boom and repeat the process for Aelevator.@

Dual rates for aileron, elevator, and/or rudder can be set at 60% if desired. These can be fine tuned at anytime.

Throttle Curve Setup:

1) Normal Mode: Set the normal curve so that a gradual taper from low stick to ¼ stick is achieved. The final ¾ of the throttle stick movement should be a flat line. This flat line ideally should be above 80%. This will set the hover point of the helicopter. It is highly recommended to not go below a throttle setting of 80%. The danger is in heating of the speed controller. There may be a point where the controller gets excessively warm and may thermal off……or worse, depending on the controller you could cause permanent damage. Some controllers are known to have caused radio interference if allowed to heat up. Caution is advised if proceeding in this direction.

2) Idle Up 1: This curve should be a very shallow "v" or "u" type curve with the end points at 100% and its center point set at a starting point no lower than 75%. The points at the ¼ and ¾ position should always be set at 80% or above. Keep the curve uniform. The 75% center position may be fine tuned to control over speeding during aerobatic maneuvers.

3) Idle Up 2: This curve may be a copy of the Idle Up 1 curve or you may desire a higher blade speed at the 0° point on the stick. The ¼ and ¾ points may be increased above the idle-up 1 position. The center point should again be adjusted to maintain a constant blade speed.

4) Throttle Hold: This should be set as a flat line straight across at the 0° position. This will

maintain a motor shut-off command.

5) Flat Lines: The use of flat lines has been used by some pilots with good success. This technique simply uses a normal curve as described above and then just flat lines set at whatever percentage you desire for Idle 1 and 2. Remember to keep the lines above 80%.

Note: If you want to run a slower head speed than you get at 80% for your non-hovering flying, you need to change gear ratios or battery cell counts. It is imperative that you always have the throttle set above 80% whenever you are doing anything more than just hovering or gentle flying around.

XVII. FINAL INSPECTION

Recheck overall for loose fasteners, interfering components, or incorrect radio installation. Operate all radio controls making certain that none are reversed.

Be certain the gyro functions in the correct direction.

XVIII. PRE-FLIGHT INFORMATION

At home:

1) Be sure you have all necessary equipment to operate and service the model
2) Be sure all batteries are fully charged.

At the flying site:

3) Observe any flying site rules.
4) Check the frequency board or nearby pilots to clear your frequency.
5) Range check your radio as per the manufacturer's instructions.
6) Pre-check all controls.
7) Obtain assistance from more experienced pilots of possible.
8) Never leave the transmitter in a position that would allow it to be handled or upset while tending to your model
9) Check your battery status whenever possible. Do not take any unnecessary risks. Always turn off all components between flights.

XIX. PRE-FLIGHT ADJUSTMENTS

1) Remove the main rotor and tail rotor blades

2) Be sure all batteries are completely charged (For Lithium Polymer batteries, refer to section XXX)

3) Mount the main batteries on the model

4) Turn on the transmitter

5) For Futaba radio systems, verify that your throttle channel is reversed.

6) Turn on the receiver and wait for the gyro to neutralize.

7) Plug in the main batteries as detailed in the drawings. Do this carefully and purposefully so that you only make an electrical connection once at each plug connection.

8) Listen for a single tone from the speed controller. This tone will repeat itself 4 times.

9) Advance the throttle stick to the halfway position. The motor will begin to turn. Verify that the motor is turning in the correct direction (main rotor head will turn clockwise). If for some reason it is incorrect, any two of the three wires that connect the speed controller to the motor will need to

be reversed and re-soldered. This is an unlikely scenario, but easily remedied.

10) Shut down the motor, unplug the batteries and turn off the radio equipment.

11) Re-Install the main and tail rotor blades. Choose a suitable flying area free from obstruction for the steps that follow.

12) Before flying, double check the direction of each control, tail rotor and gyro direction. This should be done with only the receiver battery connected, not the main motor batteries. This will eliminate the risk of injury from the main rotor system.

XIX. FIRST-FLIGHT ADJUSTMENTS

1) Repeat steps 4,6,7,8,9 from Section XVIII

2) Slowly move the throttle stick to the halfway point. The motor should begin to spool up slowly until it reaches full speed, at which point speed changes will happen instantaneously. If the motor does not ramp up slowly, you need to shut down and reprogram the speed controller so that the "soft start" function is enabled. Consult the speed controller's manual on how to perform this function. It is important that you do not start and stop the motor repeatedly. This can cause excessive current flow in the speed control which can destroy it. Always bring the throttle stick up to the halfway point and wait for the motor to come up to speed. Alternately, once you have the curves setup, you can go right into an idle up from a dead stop and the model will gently spool up to that speed.

3) Once the motor has reached full speed, you can bring the model into a hover. At this time, the following functions should be checked and adjusted.

   a. **Tail Rotor Trimming**: Adjust the tail rotor trim as per your gyro instructions. When properly adjusted the model should not rotate right or left without any command inputs.
   b. **Swash Plate Trimming**: When the helicopter drifts to the left or the right, adjust aileron transmitter trimmer until stabilized. Re-center trimmer and adjust lower swash plate aileron rods until stabilized again. Repeat same process for fore and aft (elevator) control.
   c. **Main Rotor ADynamic Blade Tracking**: The tracking of the main rotor blades may be checked just prior to lift-off. Be sure to maintain a safe distance from your machine. The adjustments can be made by changing the length of the hiller rod (#0335) on each side of the head. A piece of colored tape may be applied to one blade during balancing or tracking in order to visually determine which blade is high or low.

      Tracking Procedure:

      -Low blade speed >> Lower the high blade
      -High blade speed >> Raise the low blade
      -If blades are out of track **2@** or more >> Re-check original pitch settings

   d. **Collective Pitch Trimming:** Adjust the height and low side of the normal pitch curve until the model has the collective response that you want in a hover.

4) Before proceeding into forward flight, switch into either idle up 1 or idle up 2 mode and verify that a higher rotor speed is attained. Always perform any forward flights in Idle up 1 or 2, never in Normal mode. It is important to keep all maneuvering done at high throttle percentages.

5) After about 5 minutes of flying time, land the model in normal mode and shut the motor down (or simply auto down using throttle hold). Check the temperature of the motor, batteries and speed controller. The motor should be less than 180°, speed controller less than 120°, and the batteries less than 150°. This may be easily checked using an infrared thermometer or similar device. As long as the temperatures stay below these limits and the battery voltage stays within limits, continue flying. Continue to check these temperatures and voltages every few minutes during the flight. If any of these components gets above the listed limit, discontinue flying until everything cools off. Continue this procedure for the first few flights until you get familiar with your models thermal characteristics in relationship to your flying style. Once you have learned these, set up timers in your radio to tell you when to cool the system down or recharge.

NOTE: Performing auto-rotations is a good way to dissipate heat from the system. Be careful of "bailouts". If you switch power back onto the motor before it stops turning, it will come on with full power and could cause a number of problems. Conversely, if the motor has stopped, there will be a long time period for the motor to spool up again, which may also cause problems. Make it a point to fully complete your auto-rotations.

6) The adjustments for forward flight, pitch and trim settings may now be fine tuned. Adjust the high pitch setting so that the model will fly at full stick without loading or over speeding. Remember that unlike a liquid powered heli, which will load up and quit if pushed too hard, an electric heli will continue to pull until something gives. For this reason increase your collective and cyclics a little at a time until you get them where you like the response you get without excessive bogging of the motor.

XXI. Proper use and care of Lithium Polymer batteries

1) The Lithium Polymer batteries sold by Miniature Aircraft USA should be considered fully charged at 4.2V/cell and fully discharged at 3V/cell. This works out to 42 volts charged and 30 volts discharged for a complete set of two of our 5S packs in series. It is **VITALLY** important that these limits are not exceeded. Batteries that are over charged may burst into flames and batteries that are over discharged will swell and be rendered useless.

2) You **must** use only a high quality battery charger capable of charging Lithium Polymer batteries. Such units are available from Schultze, Orbit, Astroflight and others and can be had for as little as $120. Make absolutely certain that you understand how to use your charger and set it up properly every time you use it. The use of the following guidelines will help get you started:

A) Never charge at a rate higher than the capacity of the battery (1C), a rate less than the capacity of the battery is even better and will promote long battery life.

B) Always remove the battery from the model and place into a "fire safe" area for charging. Concrete floors, fireplaces and firesafes are all good choices.

C) Never leave a charging battery unattended...check it often.

D) For long term storage, discharge the battery to approximately 1/2 of it's maximum voltage (18 volts for a 5S pack) and place into a cool place.

E) Charge your batteries one pack at a time, not in pairs as you use them on the heli. This will help to keep the packs voltage balanced.

3) At 1C, a battery will usually take about 1.5 hours to charge. However, at the 1 hour mark the battery will have roughly 90% of it's maximum charge. It is perfectly acceptable to remove the battery from the charger and fly it at this point as Lithium polymer batteries do not exhibit the memory effect that nickel chemistry batteries do. Do this ONLY if you are NOT trying to fully discharge the batteries. Also, you should make it a point to fully charge your batteries every 4 or 5 flights regardless just to get the two packs re-leveled.

4) Lithium polymer batteries do not possess the self discharging characteristics of nickel chemistry batteries. This means that you can charge your batteries days or even weeks before going to the flying field without the need to re-peak the packs when you get there.

5) Make it a goal to NOT fully discharge your batteries. This will keep you away from the critical lower voltage and promote long battery life.

6) Voltage leveling of the two packs to each other is extremely important. You should get in the habit of regularly taking voltage readings of the two packs with a good quality voltmeter (at least 0.01 volts resolution). The voltage of each pack should be within 20.99 and 21.1 volts fully charged. If the voltage difference between each pack should never be more than 0.01volts. If it is, you can top off the lower pack with your charger. The most likely culprits of this charge differential will be the use of multiple chargers and wiring/connector differences. Just remember to check the voltages of each pack often and keep them balanced.

7) Always check the voltage of your packs after discharge and never recharge a battery that may have been damaged due to over dis-charging.

Use the following procedure to determine how long you should fly on a charge

1) Charge each of your packs up individually on the same charger.
2) Go fly for 5 minutes. Fly the way you want, but be aware of excessive motor bogging and try to avoid it.
3) Land, remove the batteries and let them cool off.
4) Recharge each pack and make a note of how many mAHr's go back in, most good chargers will give this data.
5) Choose the lower of the two numbers.
6) Divide that number into the capacity of the pack (currently either 7600 or 5700).
7) Multiply that number times the 5 minutes.
8) Multiply that number by 0.8.
9) This is the final flight time in minutes that you can fly, the way you like, from a full charge, and not have any problems.
10) Remember, you still need to watch temps, so land every so often to check those.

We wish you good luck and many happy hours of flying!
If you have any further questions, feel free to call us.

MINIATURE AIRCRAFT USA
31713 Long Acres Drive
Sorrento, Fl 32776

PHONE (352) 383-3201
FAX (352) 383-3204

WEB SITE: www.miniatureaircraftusa.com
Email: minair@earthlink.net

Ion-X Instruction Manual