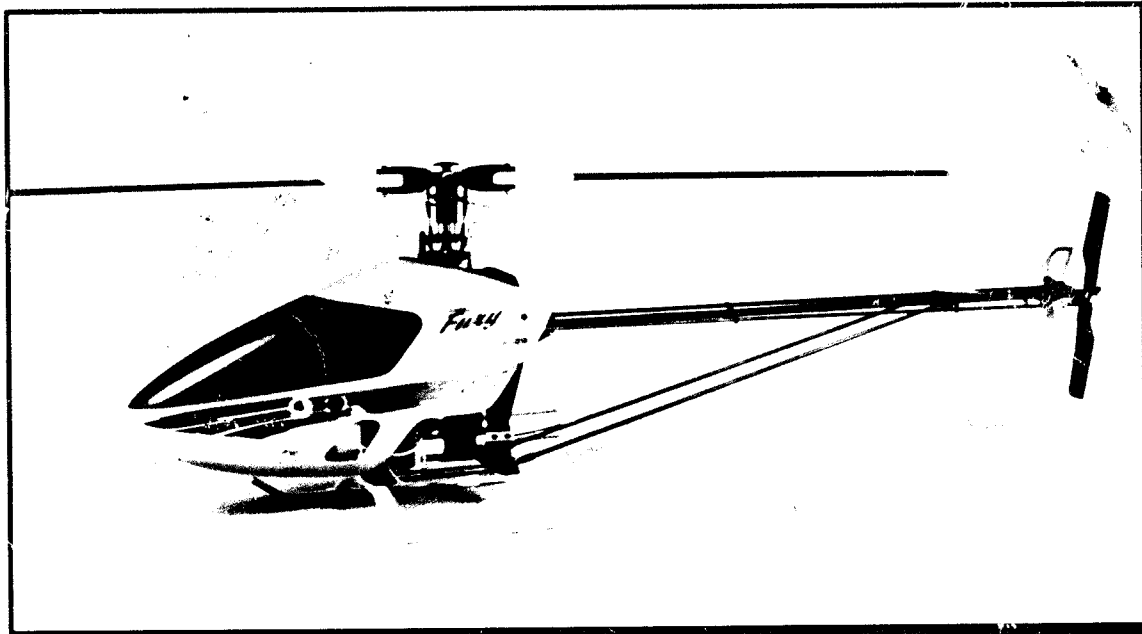


Instruction Manual

Kit # 1020-5 and #1021-5

X-CELL
Fury
Extreme
80-90



Miniature Aircraft USA

3743 Silver Star Road Orlando, Florida 32808

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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, only to ensure proper and safe operation of your model. Any part used which were manufactured by any firm other than Miniature Aircraft, USA VOIDS all warranties of this product by Miniature Aircraft, USA.

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.**

MINIATURE AIRCRAFT USA

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X-CELL FURY “EXTREME”

INTRODUCTION

These instructions apply to Fury Extreme kits #1020 and #1021.

Congratulations! You have purchased a quick assembling, high quality helicopter kit ideally suited for beginners through expert pilots.

Please pay particular attention to each assembly step.

SYSTEM REQUIREMENTS

1. A minimum five channel “helicopter” type radio with electronic swashplate mixing capability (known as C.C.P.M.) and five high quality servos (“digital” type preferred due to their superior centering and equality).
2. A yaw rate gyro (basic or heading lock type) to stabilize and assist in tail rotor control – select the unit best suited to your choice of radio and budget – be aware that even a beginner will appreciate the improved function of a top quality gyro, so choose wisely.
3. Helicopters require special engines not commonly used in airplanes, so choose a quality product made for or known to work properly in a model helicopter. There are a few good choices and the staff at Miniature Aircraft USA will be happy to assist you. Mufflers or tuned pipes are also important choices and are more limited.

Section VII 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 are 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 items are suggested to assist in building the kit:

Screwdrivers - small straight and Phillips
Pliers – small regular, needle nose and forceps
Hand drill with 1.30mm (.052”), 1.50mm (1/16”) and 2.35mm (3/32”) drill
Open end wrenches – 5.5mm (7/32”), 7.0mm (9/32”) and 8.0mm (5/16”)
Dremel tool with sanding drum and carbide disc
Tape
Metric ruler Note: for your convince a ruler is provided on the last page of this manual.
Small hammer
Appropriate “thin wall” socket to fit your engine crankshaft nut
Vinyl two-sided tape – 1/8” thick (M.A./USA #3869)
Glow plug wrench (M.A./USA #2957-7)
Slow and fast cyanolate glue (M.A./USA #4960-1 and #4964-1)
Heat gun
Grease (high quality synthetic M.A./USA #4707)
Light oil (Teflon type M.A./USA #4801)
Canopy finishing materials (described elsewhere)
180-220 grit “wet or dry” sandpaper
“C” clip pliers (both expanding and contracting types)

Silicone glue

The following are optional materials:

- Ball link installation tool (M.A./USA #0529)
- 5.0mm nut driver (M.A./USA #2957-1)
- 5.5mm nut driver (M.A./USA #2957-2)
- 7.0mm nut driver (M.A./USA #2957-4)
- Flybar lock (Expert models) (M.A./USA #0506)
- Flybar alignment kit (expert models) (M.A./USA #0510-1)
- Swashplate Alignment Tool (M.A./USA #0513)
- Pitch gauge (M.A./USA #0526)
- Custom hardened hex tools – 1.5mm (M.A./USA #2984-1), 2.0mm (#2984-2), 2.5mm (#2984-3), 3.0mm (#2984-5)

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

- Glow fuel specifically formulated for helicopter use. Nitromethane content as suggested by the engine manufacturer or your personal preference (10% - 30% is the normal range). M.A./USA technicians can assist you in your selection.
- Fuel pump (we suggest #4331 electric or #4333 manual type pumps).
- 12 volt electric starter (we suggest the Sullivan Hi Torque starter M.A./USA #4687).
- Starter extension adapter for 6.0mm diameter start shaft (we suggest the “Pro-Flex” start system #4684)
- 12 volt battery (6.0 amp minimum).
- 1.5 volt glow battery or driver to ignite the glow plug (we suggest you contact M.A./USA to review available options). The most convenient connection method is using medium to large “alligator” clips.
- Extra glow plugs. Glow plug selection should be of suitable heat range and quality to endure helicopter applications. Avoid “cheap” plugs.
- Tool selection (as used in the kit assembling steps).
- Frequency flag displaying your radio frequency and color code (included in radio)
- 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 website at www.modelaircraft.org.
- Premium grade fuel filter(s).

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 Loctite thread locker (included). Any position using steel hardware into plastic will refer to the addition of slow cyanolate glue (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:

<u>Bolt Size</u>	<u>NCM (Metric)</u>	<u>Inch/Pounds (U.S.)</u>
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 “PEM” 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 Loctite on any related bolts or screws. Do not attempt to remove them and avoid overtightening hardware into them. They are quite secure with only minimal tightening and Loctite.

ASSEMBLY SEQUENCE SUMMARY

- Section I - Building the Rotor head
- II - Building the Left Main Frame
- III - Installing the Main Shaft, Main Gear and Tail Drive
- IV - Building and Installing the Radio Support Assembly
- V - Installing the Right Main Frame, Bellcranks and Gyro Brackets
- VI - Building and Installing the Landing Gear
- VII - Installing the Clutch, Fan and Engine Assembly (Including Guidelines for Engine and Exhaust Selection).
- VIII - Building and Installing the Fuel Tank Assembly
- IX - Installing the Swashplate, Washout Unit and Rotor head Assembly
- X - Building the Tail Rotor Assembly
- XI - Building the Tailboom Assembly, Boom Supports and Installation onto the Main Mechanics
- XII - Installing the Radio System and Pushrods
- XIII - Preparing the Canopy
- XIV - Preparing the Rotorblades
- XV - Final Mechanical and Electronic Set-up
- XVI - Final Assembly and Balance
- XVII - Final Inspection
- XVIII - Pre-Flight Information
- XIX - Starting and Stopping procedures

I. BUILDING THE ROTOR HEAD

Bag(s) Required: 1A – 1D

Tools or materials required:

- Small Phillips screwdriver
- Small hammer
- Solvent (thinner or alcohol)
- Loctite
- Slow cyanolate glue
- M1.5, 2.5 and 4.0 Allen tools
- M5.5 nut driver or flat wrench
- “Q-Tip” cotton swabs or tissue
- 180 to 220 grit sandpaper
- Needle nose pliers or forceps
- A few inches of masking tape
- 3/8” or similar socket with an O.D. of 14.0 –16.0mm
- Grease
- “C” clip pliers

Step 1. Installing the Flybar Support Tube Assembly

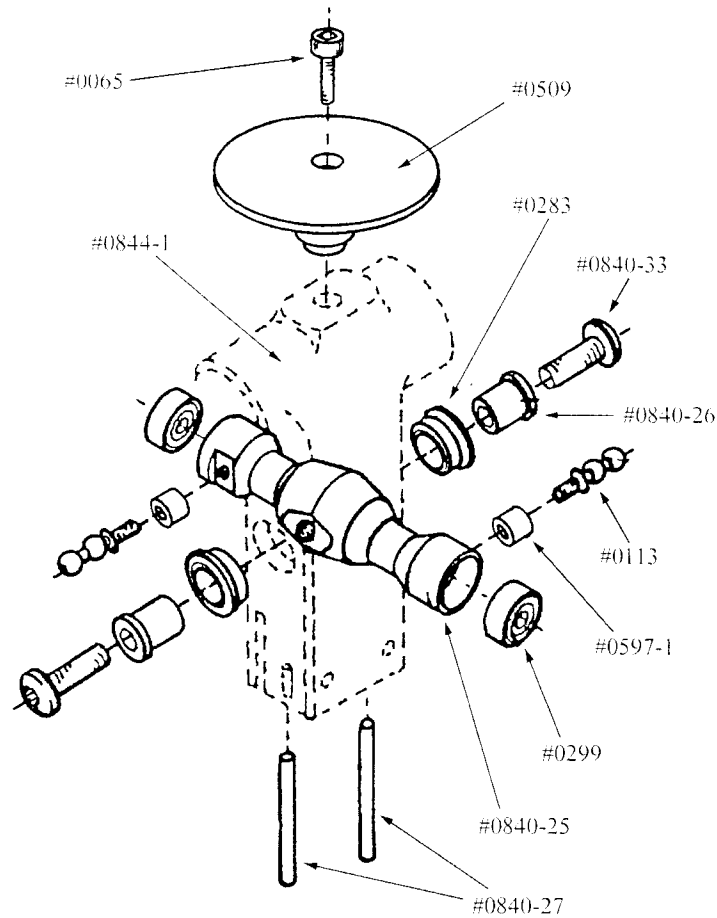
Bag(s) Required: 1A

Parts Required:

			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	#0840-25	Flybar Tube	1A
2	#0840-26	Pivot Bearing Spacers	1A

2	#0840-33	M4x12 Button Head Bolts	1A
1	#0844-1	Aluminum Head Block	1A

Refer to Drawing #1A



Drawing # 1A

- A. Select two #0299 ball bearings and the #0840-25 flybar support tube. Press a bearing into each end as shown. The bearing will be flush with the edge when fully inserted.
- B. Select two #0840-26 pivot bearing adapters, two #0840-33 M4x12 button head bolts and the #0844-1 head block. Examine the head block and note the #0283 ball bearing installed on each side. Insert one #0840-33 bolt into the flanged end of one of #0840-26 pivot adapter. Apply a small amount of Loctite to the exposed threads. Repeat for the remaining bolt and adapter. Examine the #0840-25 flybar support tube from Step 1A. Note the 6.0x6.0mm “flat” (with M3 threaded hole) next to each previously installed bearing. Also note the “flats” at the center of the tube. Slide the tube into the head block, orientating the “flats” as shown. Beginning at one of the #0283 pivot bearings in the head block, insert one of the prepared bolts (with adapter) through the bearing and into the flybar support tube. Tighten with moderate torque. Repeat the process for the opposite side. Check to see that the tube can pivot freely.
- C. Select two #0113 threaded doubled balls and two #0597-1 brass spacers. Install a spacer on each threaded ball and apply Loctite to the exposed threads. Install one prepared threaded ball into each “flat” adjacent to the ball bearing bearings at each end of flybar support tube. As shown in the drawing. Tighten with light torque.
- D. 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.

- E. Select one #0065 bolt and the #0509 head button. Use a small amount piece of 180 – 200 grid sand paper to lightly roughen the 6.0mm diameter protrusion at the base of the head button. You are simply removing the “gloss” from the plastic. Insert the bolt from the top end and screw inward 2 – 3 turns. Apply slow cyanolate to the “roughened” 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 it’s head is about 1.0mm below the top surface of the head button. Set aside to dry.

Step 2. Building and Installing the Bell Mixers

Bag(s) Required: 1B

Parts Required :	Bag #
2 #0017 M3 Hex Nuts	1B
2 #0093 M3x18 Special Pivot Bolts	1B
4 #0113 M3x10.5 threaded balls	1B
4 #0159 M3x7x3 Ball Bearings	1B
2 #0317 Main Blade Mounts	1B
2 #0334-1 Bell Mixers	1B
2 #0597-1 Brass Spacer	1B

Refer to Drawing #1B.

- A. Select four #0113 threaded balls and two #0334-1 bell mixers. Install a threaded ball into each end hole in the bell mixers, using the previously mentioned precaution.
- B. 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.
- C. Select two #0317 main blade mounts. Examine the arm protruding from each. Two holes for bell mixer installation are provided. The “normal” 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, you’ll note that one side is flat and one side has a 1.5mm “step” or “shoulder” surrounding the bearing. This “stepped” side should always face the pitch arm (opposite side from the head of the pivot bolt).

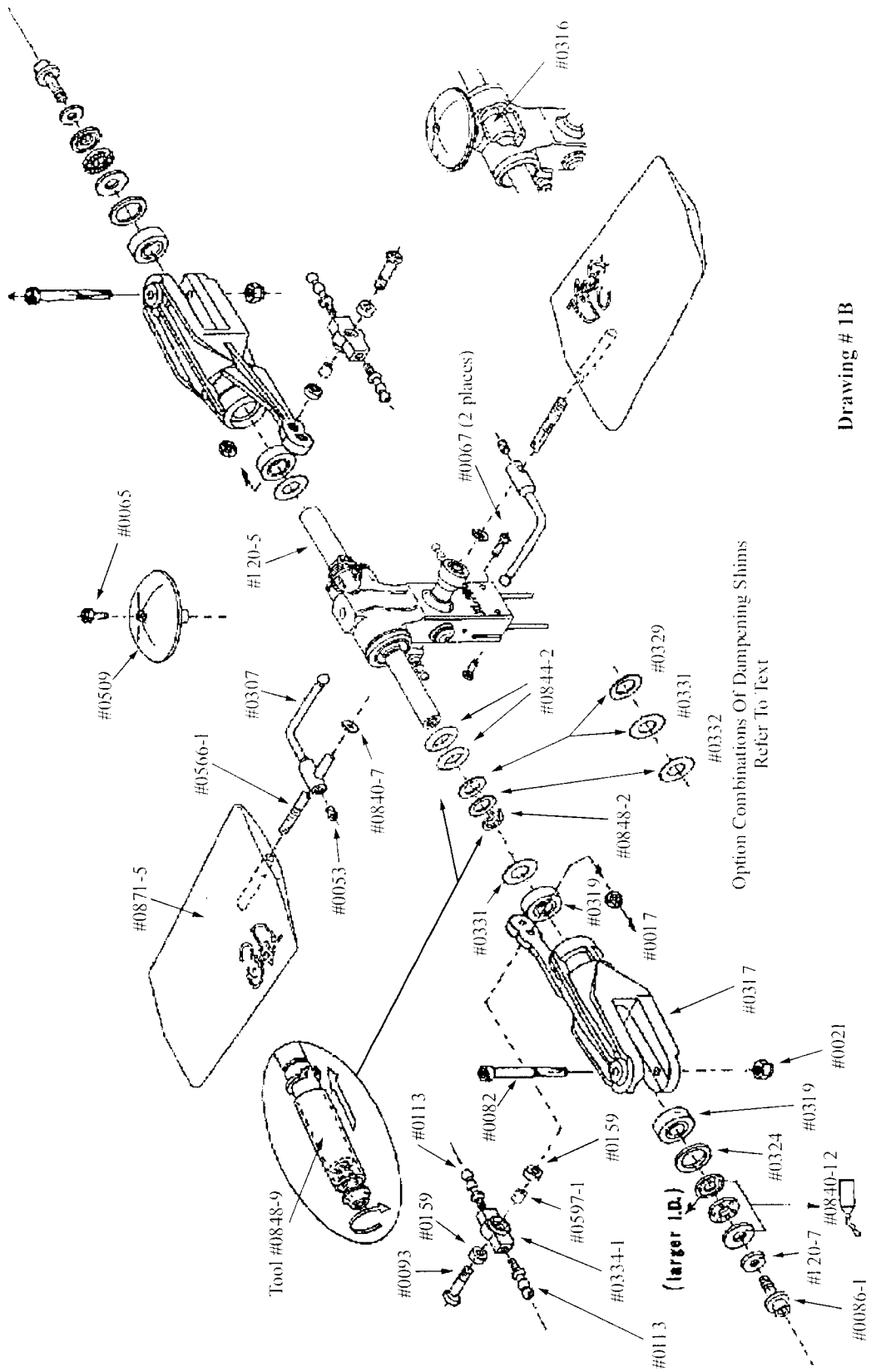
Select two #0093 special pivot bolts and two #0017 M3 hex nuts. Note the correct orientation of the bell mixer bearings and thread into the outer pitch arm hole on the main blade mount. As with the threaded balls into plastic, screw the pivot bolt and bell mixer straight into the pitch arm, tightening 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

Bag(s) Required: 1C

Parts Required:			Bag #
2	#0021	M4 hex nuts	1C
2	#0082	M4x45 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 pcs.)	1C
4	#0844-2	Dampener O-rings	1C
2	#0848-2	M8 Retaining rings	1C
1	#0848-9	"C" Clip tool	1C
1	#120-5	Main Blade Axle	1C
2	#120-7	M5x15safety washers	1C

Refer to Drawing #1B (next page)



Drawing # 1B

Note: SPECIAL TOOL REQUIRED

“External type” retaining pliers for small external type “C” rings.

- A. Select the #120-5 main blade axle. Clean the outer surface and internal threads with solvent. Dry thoroughly.
- B. Select both #0317 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 – 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 “blade” or “forked” end of the main blade mount. It will freely slide to within 5.0mm of it’s final position. To press the remaining distance, set one #0324 spacer ring atop the bearing followed by the previously mentioned 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 “hollow” sound of driving the bearing into position will change and a measurement from the bearing to the radiused tip 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 radiuses 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
- C. 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 “seated” position.
- D. First, 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 #0317 from step “B”. next insert one #0324 spacer ring (M10.6x15.8x0.9) into the open end of the #0319 bearing within the blade mount.
- E. 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 “E”. 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.
- F. Use a tooth pick to apply a little 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 and put a socket tool in the bolt socket and insert this assembly into the open end of the blade mount, into the axle. Tighten only finger tight at this time. Note: A small amount of end play in the mount is normal.
- G. Going to the opposite side of the head axle, slide one #0332 shim washer (M8.1x13.0x1.0) up against the previously installed “C” 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 #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.
- H. Mark the head axle at it’s centerline. Wrap a small piece of tape over the un-assembled end of the head axle to cover any sharp edges. Select the dampening sleeve #0316 and cut it approx. 15.0mm long (keep the rest for spares). Slide the 15.0mm piece onto 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. Note: Observe the orientation of the blade mount pitch arms in relationship to the head block.

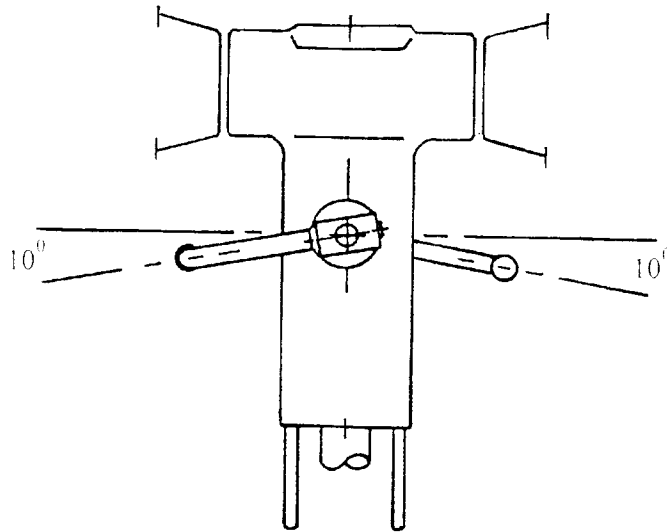
- I. Apply a little grease to the outside of the #0316 silicone tubing. Slide the partially assembled axle unit into the main rotor head block #0844 pushing it entirely in until the two rubber "O" rings seat fully. From the opposite side install two more #0844-2 rubber O-rings, seating them fully into 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 ("C" ring), again using the proper "C" 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 "C" ring. Tighten down using one #0086-1 M5x16 flanged socket bolt and one #120-7 safety washer until the "C" ring is pushed into position within the groove in the axle. Usually a "snap" sound will confirm proper fit. Remove the #0086-1 bolt and special tool. Double check by rotating the "C" ring if necessary. It is important that the "C" ring is correctly installed within the groove.
- J. Follow the same order in steps B thru F install all necessary blade mount and components on the remaining side of the axle.
- K. 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. 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 "flare" 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 one-half way, firmly hold 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 "flare". If difficulty persists, contact M.A./U.S.A. or your local sales representative for assistance.
- L. Select two #0082 m4x45 special blade pivot bolts and two #0021 m4 lock nuts. Temporarily install these in each blade mount as shown..

Step 4. Installing the Flybar and Control Arms

Bag(s) required: 1D, 11A

Parts Required:	Bag #
2 #0053 M4x5 socket set screws	1D
2 #0307 Flybar control arms	1D
2 #0840-7 M4 flat washers	1D
1 #0566-1 Flybar	11A

Refer to Drawing #1C (next page)



Drawing # 1C

- A. 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 freeplay 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 Loctite.

Step 5. Installation of the Flybar Paddles

Bag(s) required: Bag # 1A

Parts Required:

2	#0871-5	Sport Paddles	1A
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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 cyanolite glue or epoxy is used as a paddle-locking device, allowing sufficient cure time to simplify aligning the component. Install each 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

Bag(s) Required: 2A, 2B

Tools or Materials Required:

M2.5 Allen tool

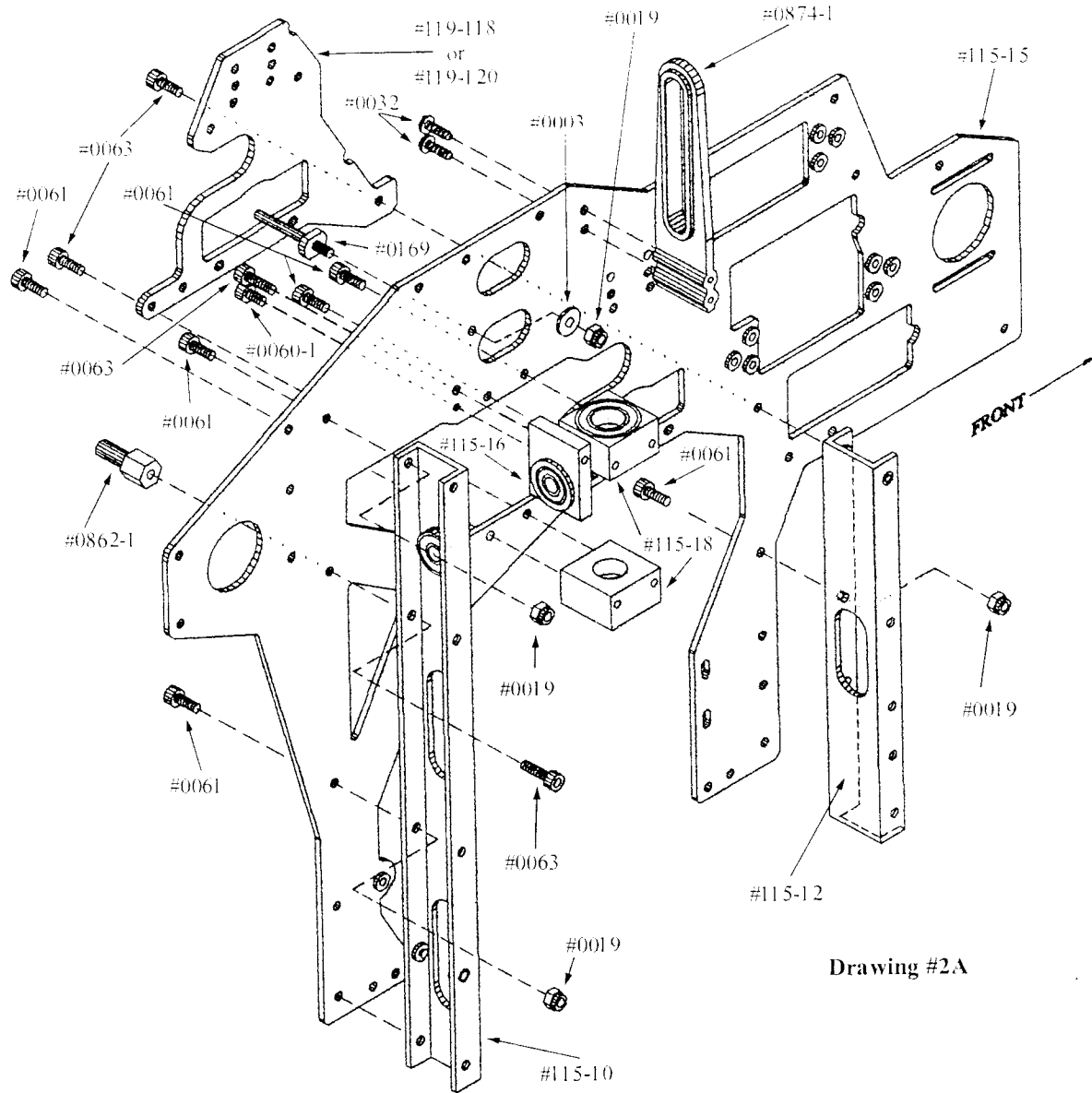
M5.5 (7/32") flat wrench

M7.0 (9/32") flat wrench

Step 1. Installing Vertical Channels and Bellcrank

Parts Required:			Bag #
1	#0003	M3 flat washer	2B
4	#0019	M3 hex lock nuts	2B
2	#0032	M2.9x9.5 Phillips self tapping screws	2B
1	#0060-1	M3x6 socket head bolt	2B
8	#0061	M3x8 socket head bolt	2B
4	#0063	M3x10 socket head bolt	2B
1	#0169	Bellcrank pivot stud (black)	2B
1	#0862-1	Bellcrank stand-off (gold)	2B
1	#0874-1	Swashplate anti-rotation	2B
1	#115-10	Vertical rear channel (216.0mm) w/ bearing	2A
1	#115-12	Vertical front channel (132.5mm)	2A
1	#119-118	8.18 Graphite doubler plate	2A
or	#119-120	8.45 Graphite doubler plate	
1	#115-15	Left main frame	2A
1	#115-16	Front transmission block w/bearing	2B
2	#115-18	Lower main shaft block w/bearing	2B
2	#115-20	M5x20 hex spacers (gold)	2B

Refer to Drawing #2A (next page)

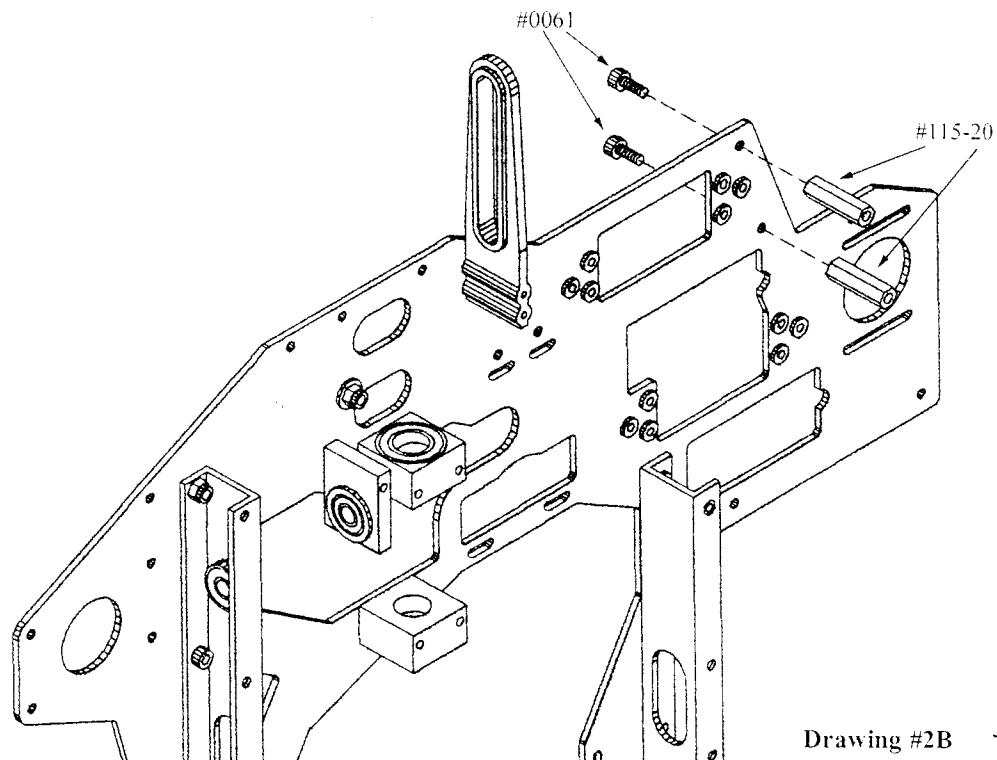


Drawing #2A

- A. Select the left main frame #115-15, one #115-10 vertical rear channel, two #0061 M3x8 socket head bolts and two #0019 M3 hex locknuts. Orientate the frame and vertical channel as shown and install two M3x8 socket head bolts and lock nuts as shown.
- B. Select the #0862-1 gold bellcrank stand-off and one #0063 M3x10 socket head bolt. Apply Loctite and insert the bolt from *inside* the vertical channel through the fourth hole from the bottom. Hold the bolt in place by inserting an M2.5 Allen tool directly through the vertical channel into the socket head. Install the #0862-1 gold bellcrank stand-off from the outside of the left frame onto the exposed bolt. Tighten moderately.
- C. Select one #0169 bellcrank pivot stud (black), one #0003 M3 flat washer and one #0019 M3 lock nut. Note the position for the pivot stud outside the frame. Install the pivot stud with washer and nut on the inside and tighten moderately.

- D. Select the #119-118 (or #119-120) right side secondary clutch plate, one #115-12 vertical front channel, one #0061 M3x8 socket bolt, one #0063 M3x10 socket bolt and one #0019 M3 locknut. Note the orientation and position for the secondary plate and the vertical channel. Install the #0061 bolt through the front lower hole in the secondary plate, through the upper frame hole as shown (fifth hole up from the bottom in the location for the channel shown) and into the pem nut in the upper end of the channel (#115-12). The open side of the channel faces forward. Temporarily / lightly tighten the bolt so the channel can be aligned at the bottom. Align all holes and install one #0061 socket bolt with one #0019 locknut into the hole, fourth up from the bottom. Tighten the bolt and nut securely.
- E. Select the #0874-1 swashplate anti-rotation post and two #0032 M2.9x9.5 Phillips tapping screws. Note the correct location and install the anti-rotation post inside the main frame with the two screws.
- F. Select two #115-18 lower main shaft bearing block, one #0063 M3x10 socket bolt and three #0061 M3x8 socket head bolts. Note the position for the blocks and the orientation (full diameter of the bearing facing up on the upper block, lower block bearing facing downward). Install it using Loctite with the two #0061 bolts in the upper block and one each of #0061 & #0063 in the lower block.
- G. Select one #115-16 front transmission block, one #0063 M3x10 socket head bolt and one #0061-1 M3x6 socket head bolt. Note the position and orientation of the block (bearing side facing rearward and "double threaded hole side" facing the left main frame. Apply Loctite and install one #0063 M3x10 bolt through the frame into the uppermost bearing block threaded hole. Repeat the same steps for the #0060-1 M3x6 bolt into the lower hole. The precision holes and part will assure a correctly aligned block but should you wish to check it, insert one of the following between the main shaft block and front transmission block: a standard hexagonal pencil, a standard "Papermate" pen, any 7.5mm diameter.

Refer to drawing# 2B



Drawing #2B

- H. Select two #115-20 M5x20 hex spacers and two #0061 M3x8 socket head bolts. Note the positions for each and install with Loctite on the inside surface of the left main frame. The #0063 bolt in the front of the secondary plate from section D may be tightened at this time. Use Loctite.

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

Bag(s) Required: 3A, 3B, 3C

Tools or Materials Required:

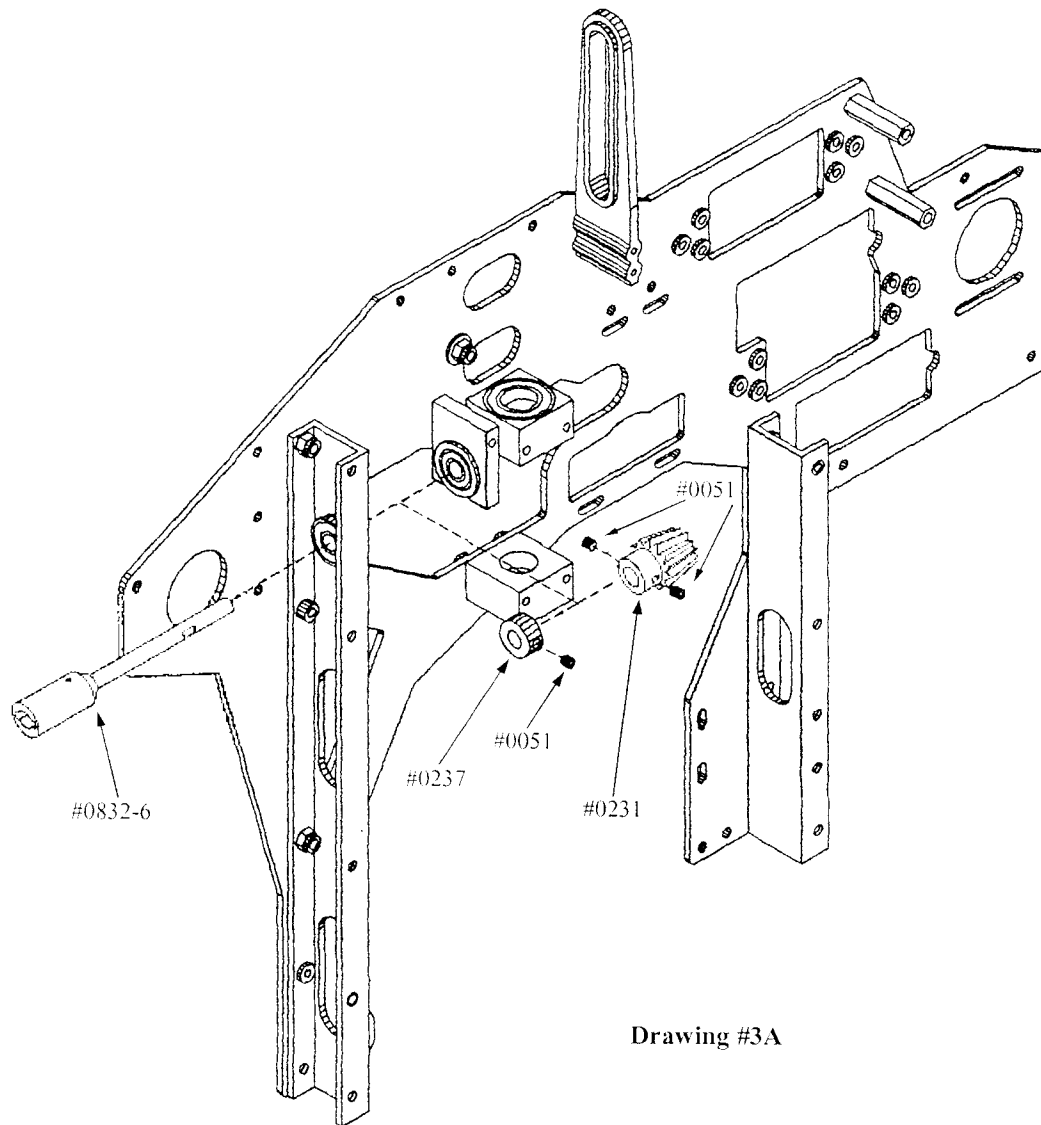
- M1.5, 2.0 and 2.5 Allen tools
- M5.5 flat wrench
- Tri flow #4801 or similar Teflon oil
- (Optional) "feeler" gauge

Step 1. Installing Front Tail Rotor Drive Gear and Shaft

Bag(s) Required: 3A

Parts Required:			Bag #
3	#0051	M3x3 socket set screws	3A
1	#0231	16 tooth bevel gear	3A
1	#0237	M5 retaining collar	3A
1	#0832-6	Front transmission shaft	3A

Refer to Drawing #3A (next page)



Drawing #3A

- A. Select one #0832-6 front transmission shaft, one #0237 retaining collar and one #0231 (16 tooth) bevel gear. Examine the drawing and note the orientation of these parts. Insert the #0832-6 front transmission shaft from the rear of the main frame through the bearing housed in the #115-10 vertical rear channel. With 25-30mm exposed in front of the bearing, slide the #0237 retaining collar followed by the #0231 bevel gear onto the shaft.
- B. Select one #0051 M3x3 socket set screw, apply Loctite and partially thread into the #0237 retaining collar. Use a toothpick to apply a little **RED** Loctite inside the bearing within #115-16. Push the shaft forward into the #115-16 front transmission block and bearing. Apply forward pressure on the white Delrin portion of the #0832-6 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 yes, then reposition the collar.
- C. Select two #0051 M3x3 set screws. Note the #0832-6 front transmission shaft has a “flat” for a set screw securing the #0231 bevel gear. Apply 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 in one or two ways. First, a 1.5mm Allen tool can be positioned between the front end of the gear (tips of the teeth) and the bearing within the

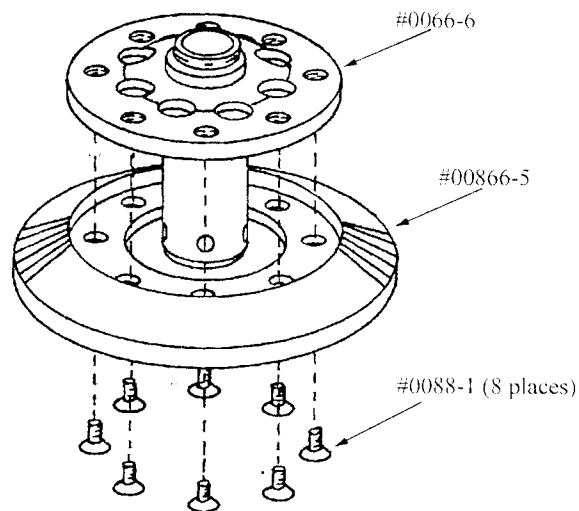
#115-16 front transmission block. Press the gear against the 1.5 tool and tighten the set screw against the flat. Be sure the tool is positioned with its flat surfaces contacting the gear and bearing (a feeler gauge set to 1.45-1.50mm or .057”-.059” may be substituted). Second, you can wait to set final position 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. Whichever 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

Bag(s) Required:

Parts Required:		Bag#	
8	#0088-1	M3x5 flat head screws	3B
1	#0866-5	70T upper bevel gear	3B
1	#0866-6	Upper gear mounting base with mainshaft sleeve	3B

Refer to Drawing #3B



Drawing # 3B

- A. Select eight #0088-1 screws and prepare each with Loctite. Select the bevel gear and 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 flat head screws, tightening them a little at a time in a “star” pattern. Tighten all with light torque.

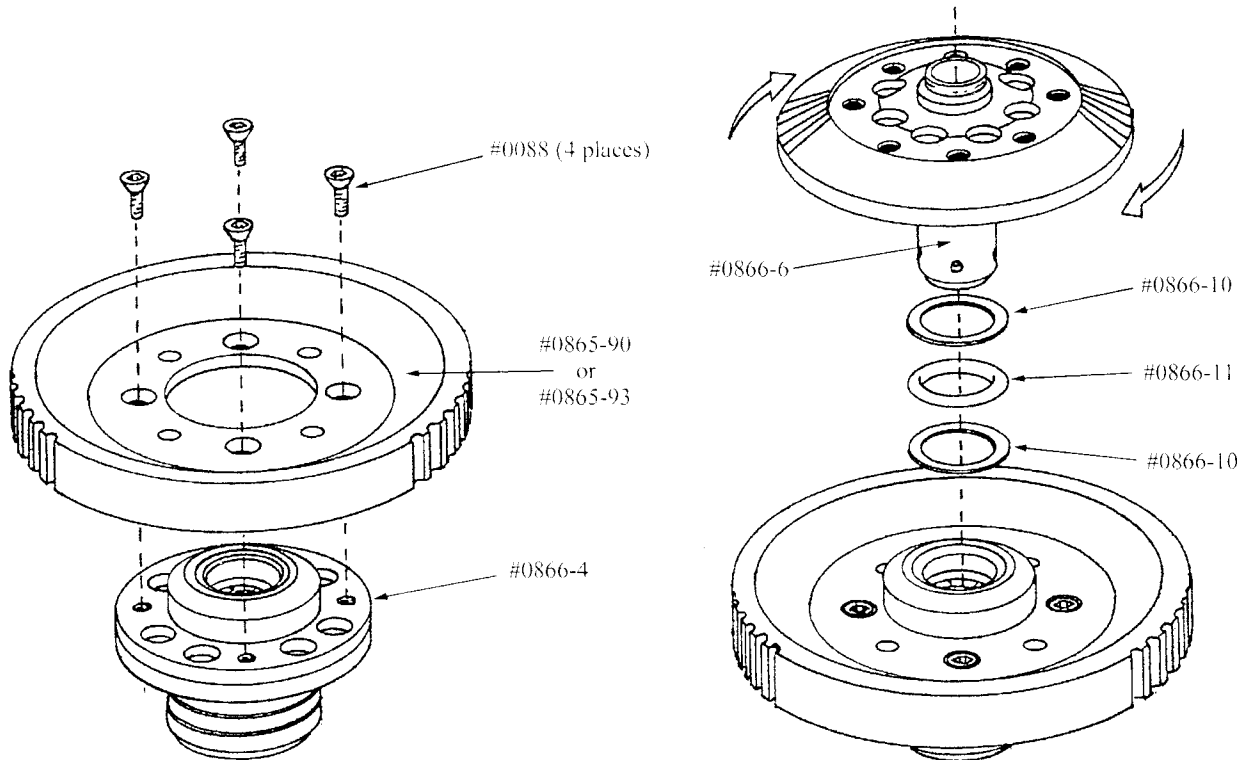
Step 3 Install the Outer Main Gear onto the Autorotation

Parts Required:		Bag#	
4	#0088	M3x8 flat socket head bolts	3C
1	#0865-90	90T Outer main gear (kit #1020)	3C
or 1	#0865-93	93T Outer main gear (kit #1021)	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

115-7

Refer to drawing #3C



Drawing # 3C

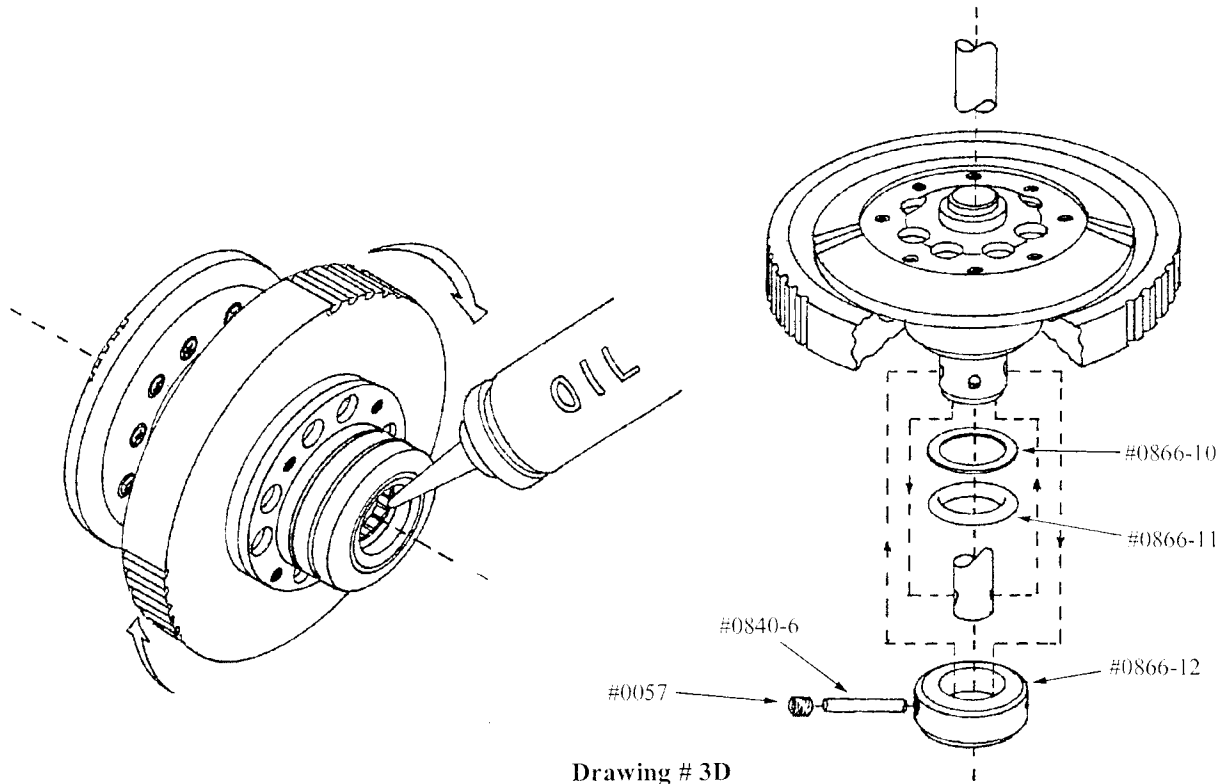
- A. Select four #0088 bolts and prepare with Loctite. Select the outer main gear and note the four countersunk holes on the upper surface. For this application, only the countersunk holes will be utilized. Press the gear atop the upper housing, align the counter-sunk holes, install the four bolts and tighten with light torque.

- A. 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 silver upper housing, protruding through the main gear).

- C. Select another #0866-10 shim ring, apply grease and slide upward to meet the gold 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 degrees 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 (1/4 ounce) of oil. When oiling is completed, press the upper gear fully into the lower gear and wipe away any excess oil.

Refer to drawing 3D



Drawing # 3D

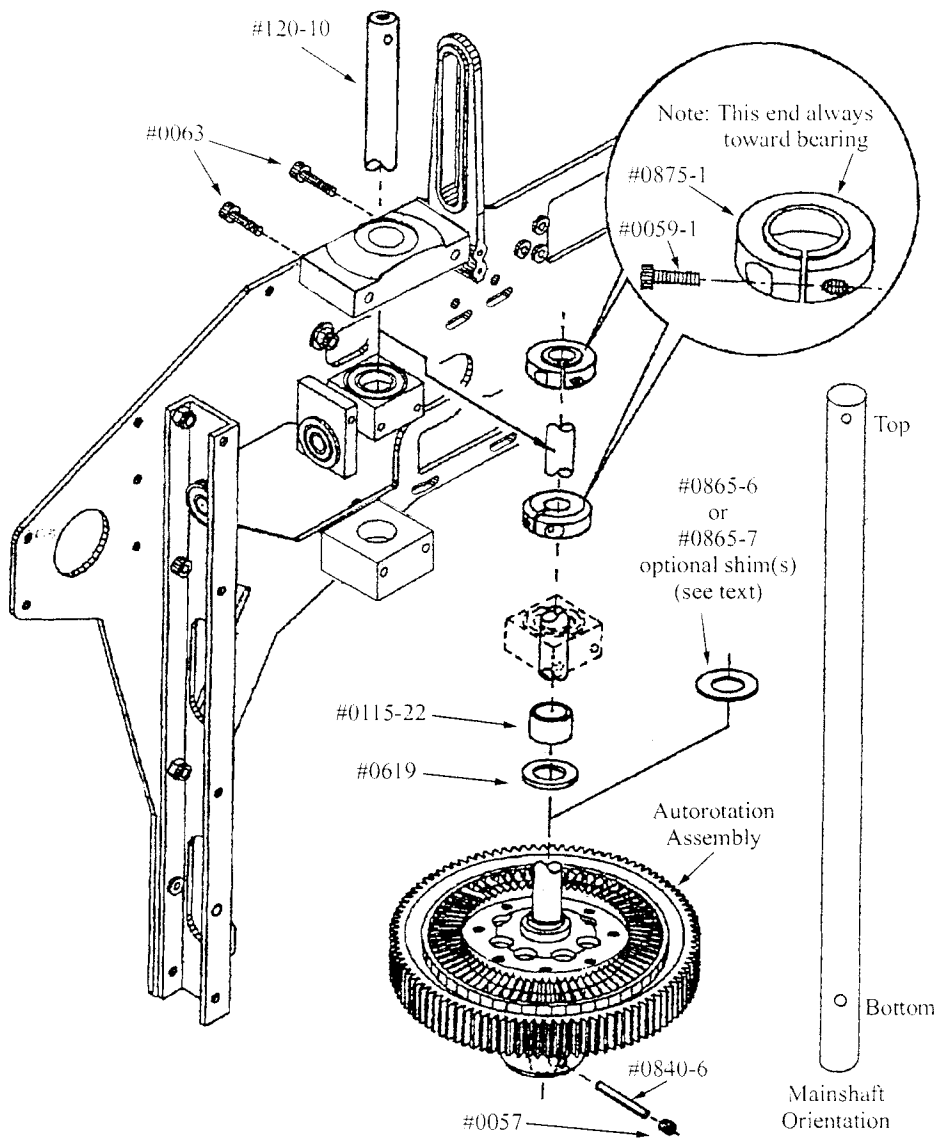
Note: never force the mainshaft sleeve into the sprag clutch. If it does not insert easily while rotating, look from beneath the sprag to be sure that the cogs look uniformly positioned. There are only retained by an outer spring and it is possible to dislocate one during insertion. If necessary, remove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

Step 4 Installing the Mainshaft and Main Gear / Autorotation Assembly

Parts Required:			Bag#
1	#0057	M4x4 socket head set screw	3D
2	#0059-1	M2.5x6 socket head bolts	3D
2	#0063	M3x10 socket head bolts	3D
1	#120-10	Mainshaft	3D
1	#120-12	Main shaft bearing block w/double bearing	3D
1	#0619	M10.1x15.8x0.5 spacer washer	3D
1	#0840-6	M3x20 dowel pin	3D
1	#0865-6	M10.1x15.8x0.1 shim ring	3D

1	#0865-7	M10.1x15.8x0.2 shim ring	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
2	#0875-1	Split type mainshaft collars	3D
1	#115-22	M10.1x11.1x7.8 brass tube	3D

Refer to drawings #3D and 3E



Drawing # 3E

- A. Select the #120-12 mainshaft bearing block and two #0063 M3x10 socket head bolts. Note the position and orientation of the block (bearing facing downward). Install the block using the two #0063 bolts with blue Loctite. Do not fully tighten until the mainshaft has been inserted.
- B. Select the #120-10 mainshaft.
NOTE: The mainshaft must be installed per the drawing.
 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 mainshaft be preformed prior to assembling the mainshaft components. It may be necessary to loosen the lower block for alignment, re-tighten with the mainshaft in place.
 As noted above, insert the correct end of the mainshaft into the upper mainshaft bearing block at the top of the mainframe. Slide it through so that 20-30mm is exposed below the bearing block.
- C. Select two #0875-1 "Split" type mainshaft 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 this criteria, slide two split collars onto the mainshaft 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 "face" the bearing in the lower block. Slide the mainshaft further downward into and through the lower bearing block until about 6.0 – 7.0mm is exposed below.
- D. Note: the following orientation and selection of parts is considered the "normal" parts required. Package 3E will also contain two sizes of special shim rings (#0865-6 and #0865-7) which will only be used to fine-tune an "unusual" fit and would only be utilized *between* the #0619 spacer washer and the autorotation unit. Select the #115-22 brass tube and the #0619 spacer washer. Slide the tube onto the mainshaft and up inside the lower bearing block. Approximately 1.0mm will be exposed below the bearing block. Follow this with the spacer washer. Ideally, both parts will stay on the shaft (since it is laying horizontal on the top of the table) and little or none of the shaft will protrude past the spacer washer.
- E. Select the previously assembled autorotation, the #0840-6 dowel pin, the #0866-10 shim ring, the #0866-11 Teflon o-ring, the #0866-12 collar and the #0866-12 collar and the #0866-13 shim ring. 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 gold housing. A shim ring should *always* be placed *next* to this bushing. As a trial, install the #0866-10 M14.0x20x0.2 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 that the gear rotate freely but have very little up/down play. If is too tight, substitute shim ring #0866-13 for the #0866-10. If it is too loose, add shim ring #0866-13. If there is no freeplay 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 freeplay (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.

NOTE: Concerning step "F" below, it may be necessary to loosen the lower main shaft block #115-18 to allow the main shaft to slide into the bearing easily. Retighten the bolts after the main shaft has been tightened.

- F. Slide the autorotation unit into position and slide the mainshaft 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 3E and 3F. The pin should easily slide in far enough to allow installation of the set screw. If this is not possible then there are two possible causes and various steps to cure the problem:

1- 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 "small hole" side of the collar. If any exist, use a 1.5mm tool to push the debris out.

2- 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 Loctite (on the set screw only).

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

- G. The main shaft must now be adjusted and secured at the middle bearing block. Select one #0059-1 M2.5x6 socket head bolt, apply a little 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. Pull upward on the main shaft while pressing downward on the split collar. Tighten the bolt. Check the gear mesh during a full rotation of the main gear. If the gear mesh is "notchy" and tight throughout the 360 degree rotation (and the tail rotor bevel gear is confirmed to be correctly positioned as per Section III Step 1C) then an adjustment is required. This can be accomplished by either adding a shim ring as per section III step 5D or slight repositioning of the #0231 bevel gear. The shims are the preferred method. If the gear mesh has only one or two small tight spots during a full rotation, nothing is required as they will break-in quickly.
- H. To avoid loss and prepare for final adjustment during a later step, 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.

IV. BUILDING AND INSTALLING THE RADIO SUPPORT ASSEMBLY

Bag(s) Required: 4A, 4B

Tools or Materials Required:
M2.0 and 2.5 Allen tools
M5.5 flat wrench (7/32")

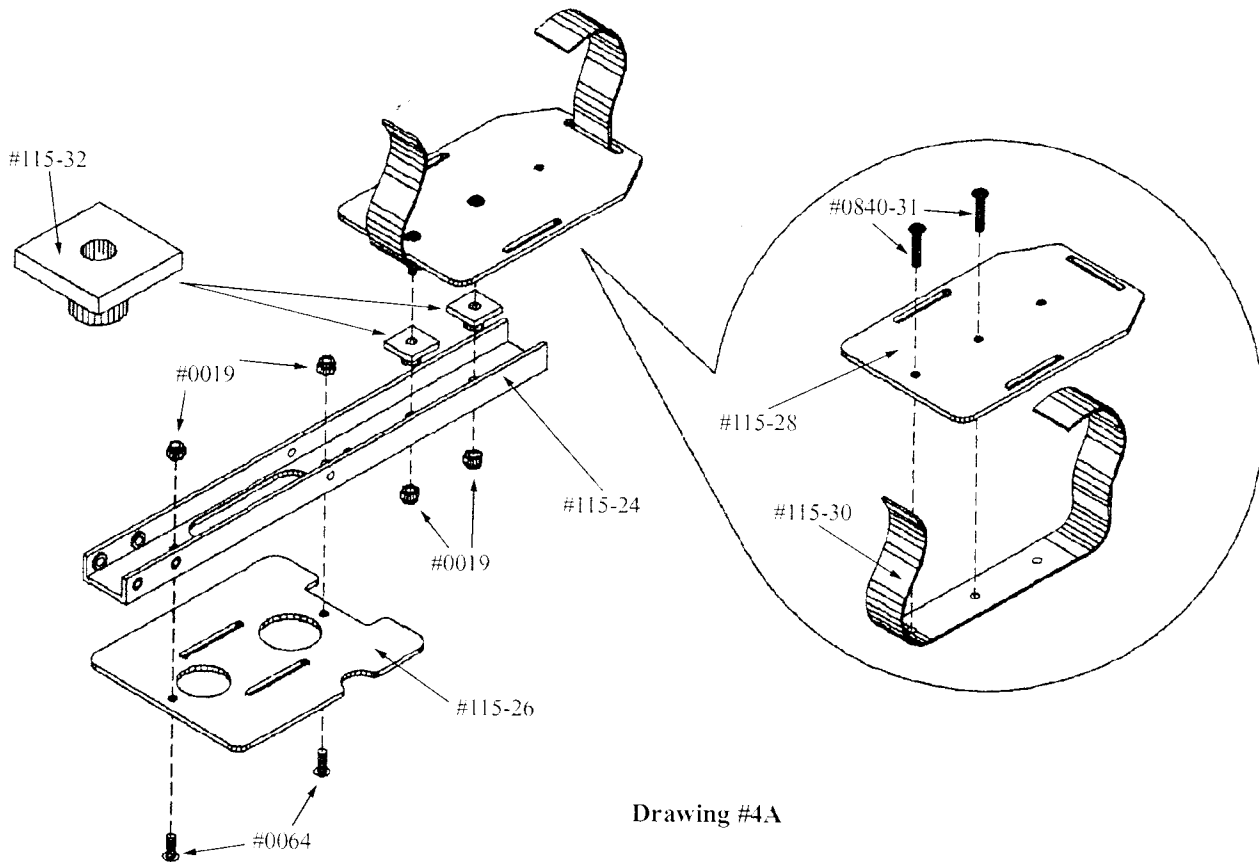
Special Note:

Section XII (Canopy Preparation) will call for the installation of plastic thumb screw caps (#106-95) onto M3x14 socket head bolts (#0067). These items are contained in Bag 13A. They must be pressed firmly together and doing so at this early stage (with the help of a part from the bag/step which you are about to begin) is most helpful. The part to be utilized as a "tool" is the #106-41 canopy stand-off from Bag #4B. A block of hard wood will be required. Select two #0067 bolts and two #106-95 black plastic caps. Thread one #0067 bolt approximately eight full turns into the #106-41 canopy stand-off. Place one

plastic cap on a bench or the floor with the “hexed pocket” side upward. Position the socket head of the bolt (within the #106-41) squarely atop the cap and use a block of hardwood to drive the bolt head into the cap. Repeat the process for the remaining bolt and cap and return the parts to their respective bags for later use.

Parts Required:			Bag #
4	#0019	M3 hex lock nuts	4B
2	#0064	M3x8 buttonhead bolts	4B
1	#0089	M3x10 flat hex head bolt	4B
2	#0840-31	M3x16 button head bolts	4B
1	#106-41	Canopy stand-off	4B
1	#115-24	Horizontal channel	4A
1	#115-26	Tank plate	4A
1	#115-28	Radio/battery plate	4A
1	#115-30	16.0x305.0mm red Velcro	4A
2	#115-32	White plastic spacers	4B

Refer to Drawing #4A, 4B.



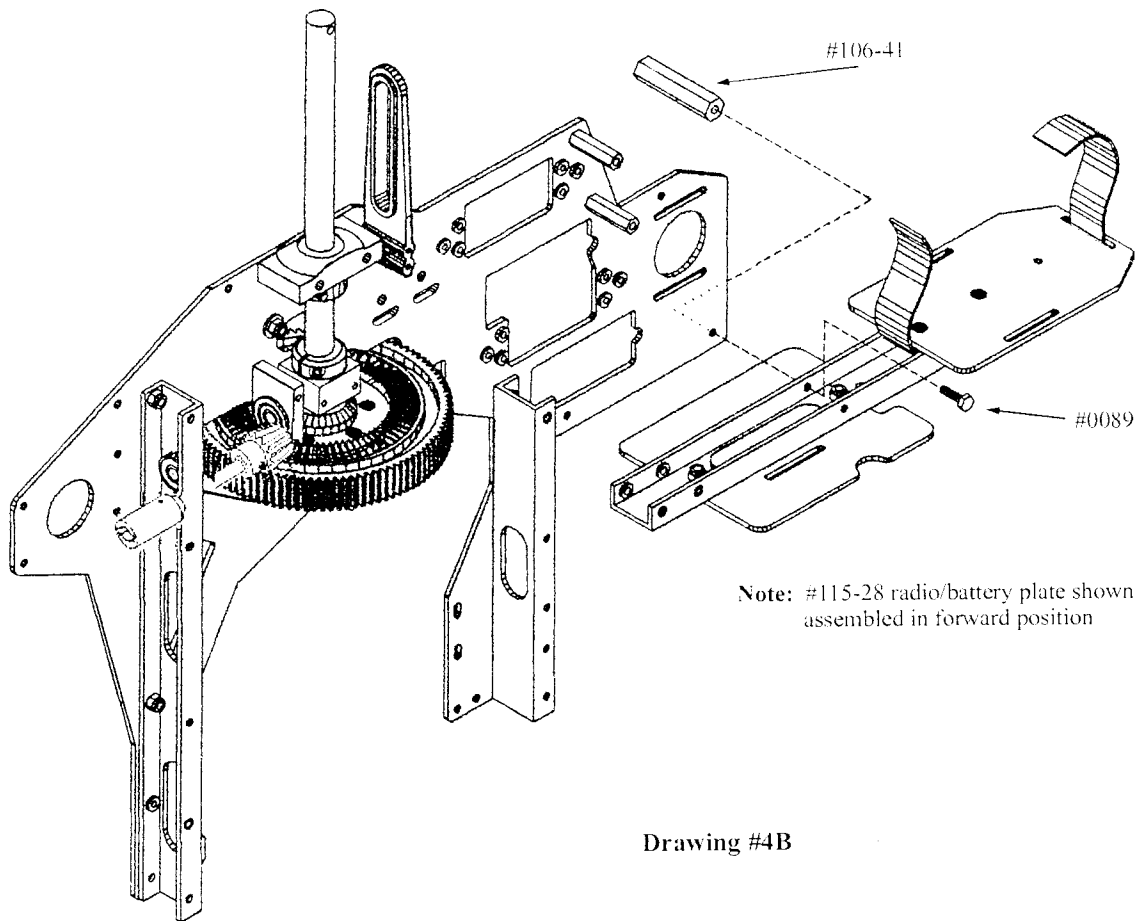
Step 1.

- A. Select the #115-24 horizontal channel. Being a “u-shaped” channel, we’ll consider the bottom to be the flat side. Select the #115-26 tank plate. Two sided adhesive tape has already been applied. This side will be the “bottom” side. Review Drawing #4A to determine what is “front” and “rear” for each part. Select two #0064 M3x8 button head bolts and two #0019 M3 hex lock nuts. The two

bolts should enter the tank plate from the bottom (“two-sided adhesive tape side”) up through the flat side of the #115-24 horizontal channel, followed by two #0019 M3 hex lock nuts from above. Tighten both.

- B. Select the #115-28 radio/battery plate, the #115-30 Velcro strip, two #0840-31 M3x16 button head bolts, two #115-32 plastic spacers and two #0019 M3 hex lock nuts. At this time, it is suggested to make a determination of final battery position for correct model C.G., two positions are possible, on the radio/battery plate. In general, if you’ll be utilizing a battery pack of over 1400 MA and a muffler type exhaust, you can utilize the most rearward position with the widest bolt spacing. If you’re using a tuned-pipe type exhaust system and/or a smaller battery pack, you’ll want to locate the plate in the forward position using the most narrow bolt spacing.

The #115-28 radio/battery plate is reversible so either side can be considered the top. Holding the Velcro strip firmly against the bottom of the radio/battery plate (with the three holes aligned) insert two #0840-31 M3x16 button head bolts from the topside of the plate and through the Velcro strip. Select two #115-32 plastic blocks and slide each onto an exposed bolt. Position this assembly onto the front end of the #115-24 horizontal channel (the side opposite the previously installed tank plate and the open part of the “u-channel” upward). The plastic blocks will sit inside the open side of the channel. Install and tighten, two #0019 M3 hex lock nuts onto the bolts and against the bottom “flat” side of the channel.



- C. Select one #106-41 canopy stand-off and one #0089 M3x10 flat hex head bolt. The sides of the #115-24 horizontal channel each have three holes. Two are with PEM nuts and one, at approximately center, is open. From inside the u-channel, insert one #0089 M3x10 flat hex head bolt so it protrudes out of the “left side” open hole. Examine the left main frame. In the lower front section, the left frame has three holes which correspond to those on the left side of the horizontal

channel. Apply Loctite to the previously inserted #0089 bolt and insert it with the horizontal channel into the furthest forward hole in the main frame. From outside the main frame, install one #106-41 canopy stand-off onto the #0089 bolt. Align the remaining two holes and tighten the bolt into the stand-off using a flat wrench.

V. INSTALLING THE RIGHT MAIN FRAME, BELLCRANKS AND GYRO BRACKETS

Bag(s) Required: 5A, 5B, 5C, 5D, 5E

Tools or Materials Required:

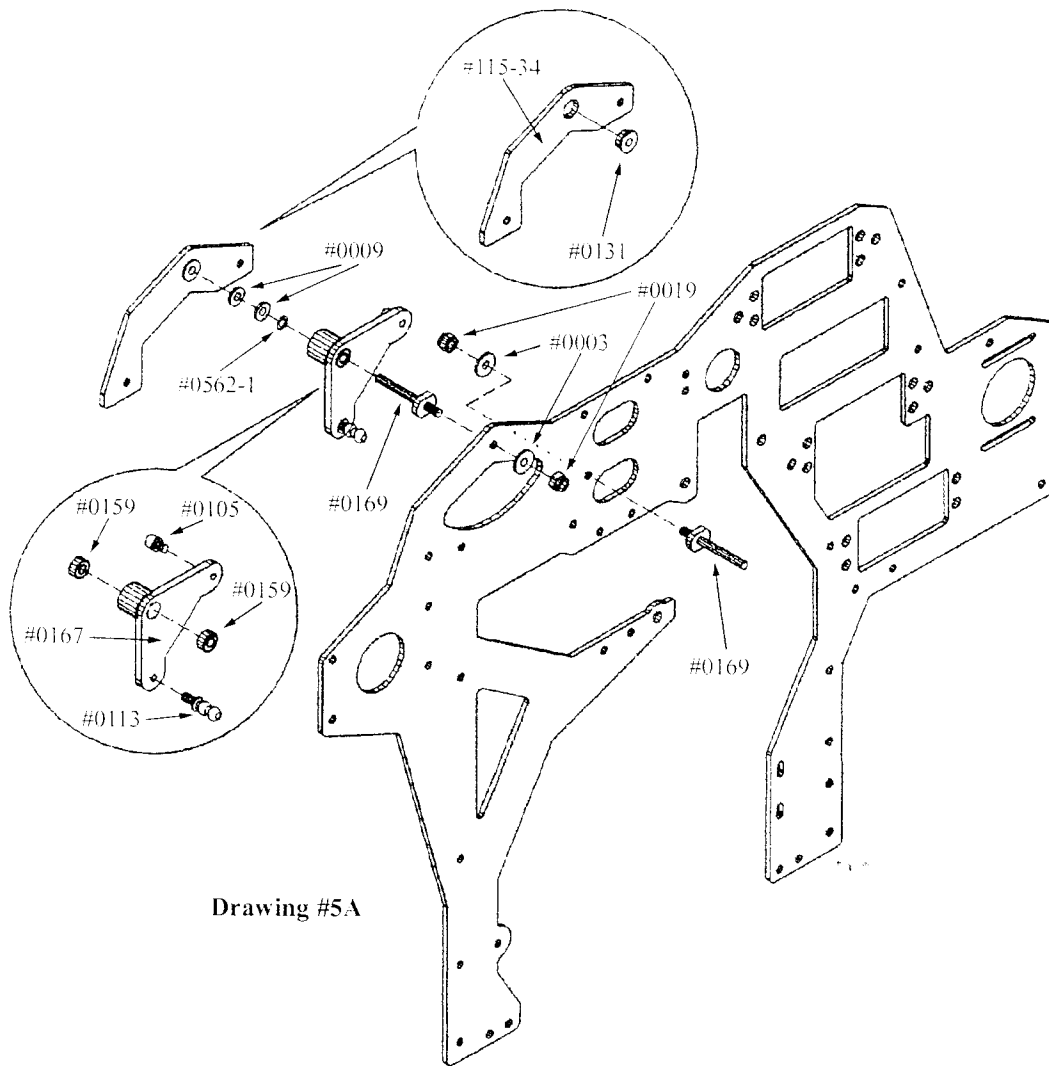
- M1.5, 2.5 Allen tools
- M5.5 and 7.0 (5/32" and 7/32") flat wrenches
- Small Phillips screwdriver
- Slow cyanolate glue (CA)

Step 1. Installing Bellcrank Pivot Studs and the Rear Bellcrank

Bag(s) Required: 5A, 5B,

Parts Required:		Bag #
2 #0003	M3 flat washer (large)	5B
2 #0009	M3 flat washer (small)	5B
2 #0019	M3 hex lock nuts	5B
1 #0105	M3x4.5 threaded ball	5B
1 #0113	M3x10.5 threaded double ball	5B
1 #0131	Plastic flanged bushing	5B
2 #0159	M3x7 ball bearings	5B
1 #0167	Bellcrank	5B
2 #0169	Bellcrank pivot studs	5B
1 #0562-1	M3.2x5.1x0.7 shim ring	5B
1 #115-34	Bellcrank support plate	5B
1 #115-36	Right main frame	5A

Refer to Drawing #5A (next page)



Drawing #5A

- A. Select the #115-36 right main frame, one #0169 bellcrank pivot stud, one #0003 M3 flat washer (large) and one #0019 M3 hex lock nut. Examine the drawing and note the position for the forward bellcrank pivot stud (the “mirror image” position of the previously installed left main frame pivot stud from Section II, Step 1C). Install the pivot stud from the outside of the right main frame followed by one M3 flat washer (large) and one M3 hex lock nut on the inside of the frame. Tighten moderately.
- B. Select the remaining #0169 bellcrank pivot stud, one #0003 M3 flat washer (large) and one #0019 M3 hex lock nut. These parts are for the rear bellcrank. As viewed in Drawing #5, you’ll note that this “rear bellcrank pivot stud installs the same as in the previous step except from the opposite (inner) side of the right main frame. Install the parts as per the previous step.
- C. Select the #0167 bellcrank, two #0159 M3x7 ball bearings, one #0113 M3x10.5 threaded double ball, and one #0105 M3x4.5 threaded ball. Examine the drawing for the orientation of the two sizes of threaded balls and the bellcrank. Hold the bellcrank as in the view and be sure of which position and side gets the #0113 threaded double ball. Insert a 1.5 Allen into the #0113 threaded double ball and apply a little slow cyanolate glue to the threads. Screw this into the correct hole on the flat side of the bellcrank. Remember, you are forming threads as you go into the plastic, so keep firm and straight pressure on the ball as you go. Do not overtighten, stopping when the threaded ball flange contacts the bellcrank. Repeat the process for the #0105 threaded ball that installs from the opposite side of the bellcrank.

Select two #0159 M3x7 ball bearings and insert one into each side of the bellcrank. When fully inserted, each bearing will have 0.75mm remaining exposed outside the bellcrank.

Noting that the flat side of the rear bellcrank must face the inside of the right main frame, slide it into position with the #0113 threaded double ball inside the curved slot provided in the frame. Note, after the model is built, this bellcrank and/or its support plate can easily be removed for service by rotating both 180 degrees.

- D. Select the #115-34 bellcrank support plate and one #0131 plastic flanged bushing. Examine the drawing (holding your part as shown in the view) and determine the correct side to install the bushing into. Press the #0131 plastic flanged bushing into the #115-34 bellcrank support plate until the flange contacts the plate.

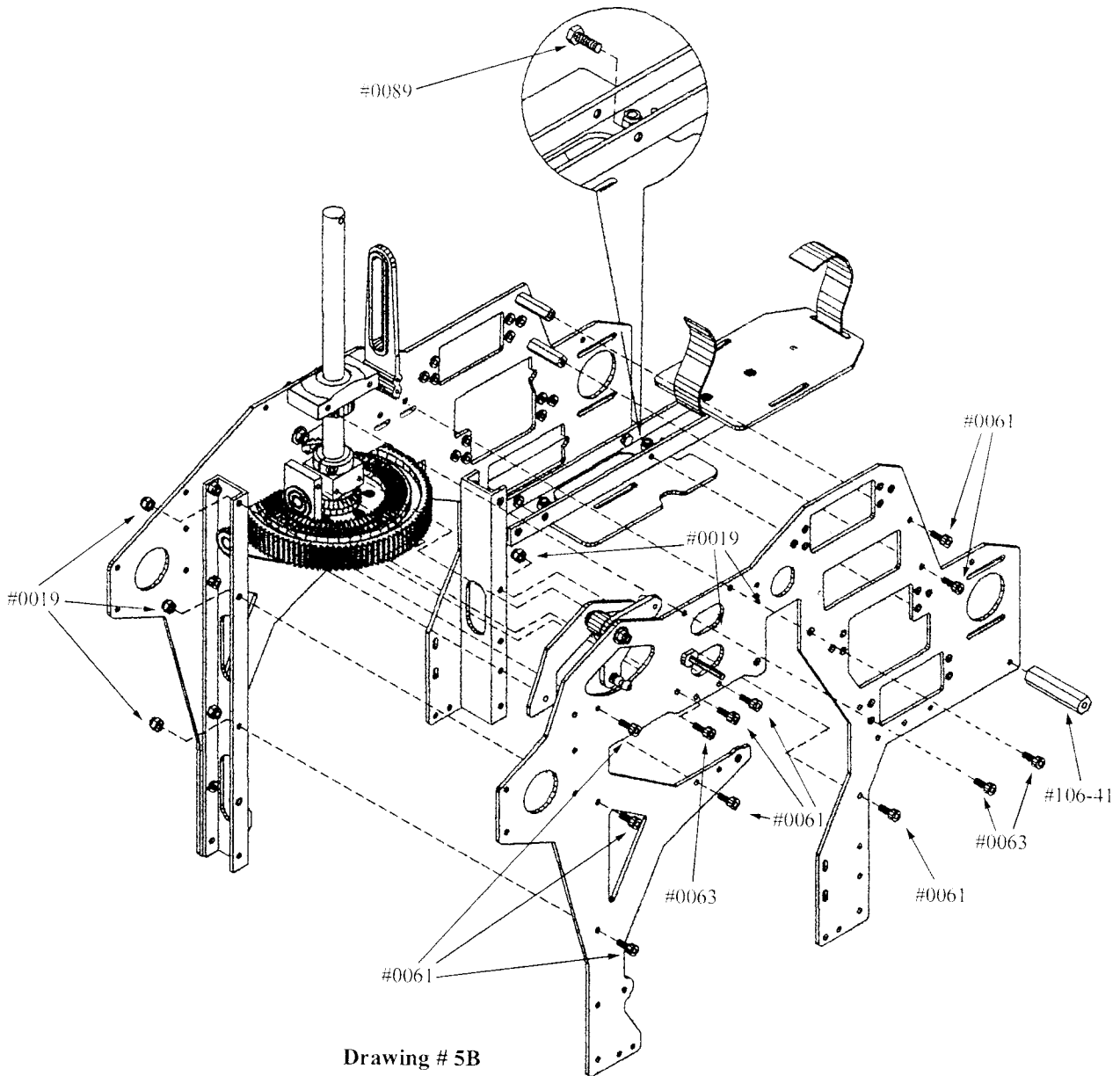
Select one #0562-1 M3 shim, two #0009 M3 flat washers (small) and the previously assembled bellcrank support. Install the following (in order) onto the exposed pivot shaft outside of the rear bellcrank. First, one #0562-1 M3 shim ring, second, two #0009 M3 flat washers (small) and third, the assembled bellcrank support plate (with the flange side of the bushing next to the previously installed items).

Step 2. Installing the Right Main Frame and Front Bellcranks.

Bag(s) Required: 5C

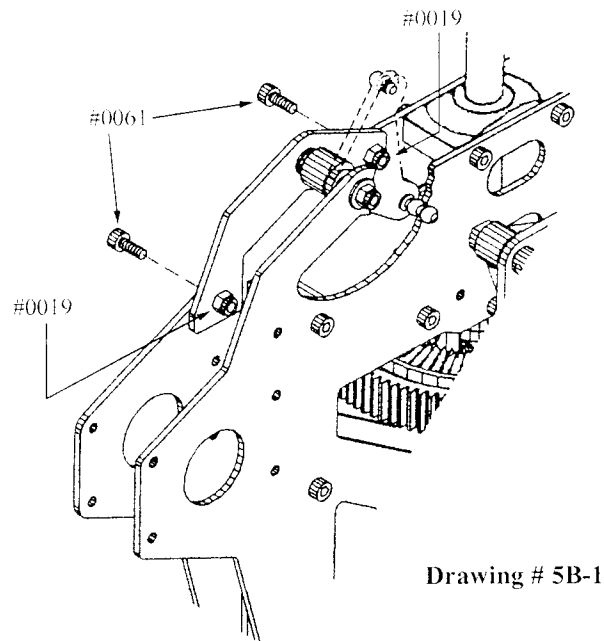
Parts Required:		Bag #
6	#0019 M3 hex lock nuts	5C
2	#0032 M2.9x9.5 Phillips self tapping screws	5C
2	#0051 M3x3 socket set screws	5C
11	#0061 M3x8 socket head bolts	5C
3	#0063 M3x10 socket head bolts	5C
1	#0089 M3x10 flat hex head bolt	5C
4	#0107 M3x6 threaded balls	5C
4	#0159 M3x7 ball bearings	5C
2	#0167 Bellcranks	5C
2	#0171 Retaining collars	5C
1	#106-41 Canopy stand-off	5C

Refer to Drawing #5B (next page)



- A.** Select the previously prepared left and right main frames. Approximately 8.0mm of each upper main shaft bearing block bolt is exposed on the left main frame assembly. Orientate the right main frame properly and slide it onto these two exposed bolts. Be sure that the previously installed rear bellcrank support plate is still just inside the left main frame (between each frame) as you proceed. Select two #0063 M3x10 bolts, (use Loctite) and install loosely on the upper main shaft bearing block bolts.

Refer to Drawing #5B-1



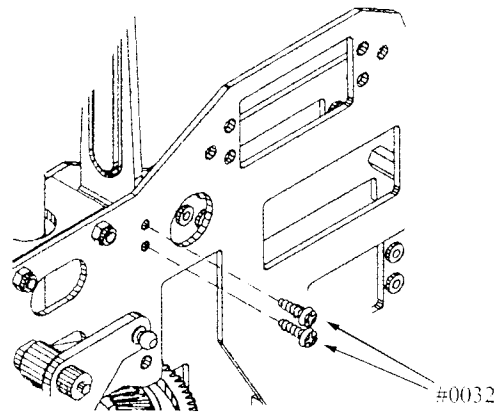
Select eleven #0061 M3x8 socket head bolts and eight #0019 M3 hex lock nuts. Install six #0061 and six #0019 in the following positions exactly opposing the same type hardware previously installed in the left main frame: The upper three holes of the #115-10 rear vertical channel (one will be opposite the rudder bellcrank stand-off bolt), the two holes in the upper rear part of the left main frame corresponding to the #115-34 rear bellcrank support plate (it goes between the main frames), and the fourth hole upward from the bottom in the #115-12 front vertical channel. Apply Loctite to the five remaining #0061 bolts. Install them through the right frame and into the two gold #115-20 hex frame spacers (located at the front of the left main frame), the two threaded holes of the #115-18 middle main shaft bearing blocks and the rear hole only in the lower main shaft bearing block.

Select one #0063 M3x10 socket head bolt, apply Loctite and install through the right main frame and into the #115-16 front transmission block.

Tighten the two previously installed #0063 M3x10 socket bolts at the upper main shaft block #120-12

Select one #0089 M3x10 flat hex head bolt and one #106-41 canopy stand-off, apply Loctite and install in the manner and opposite position as the stand-off in Section IV, Step 1C.

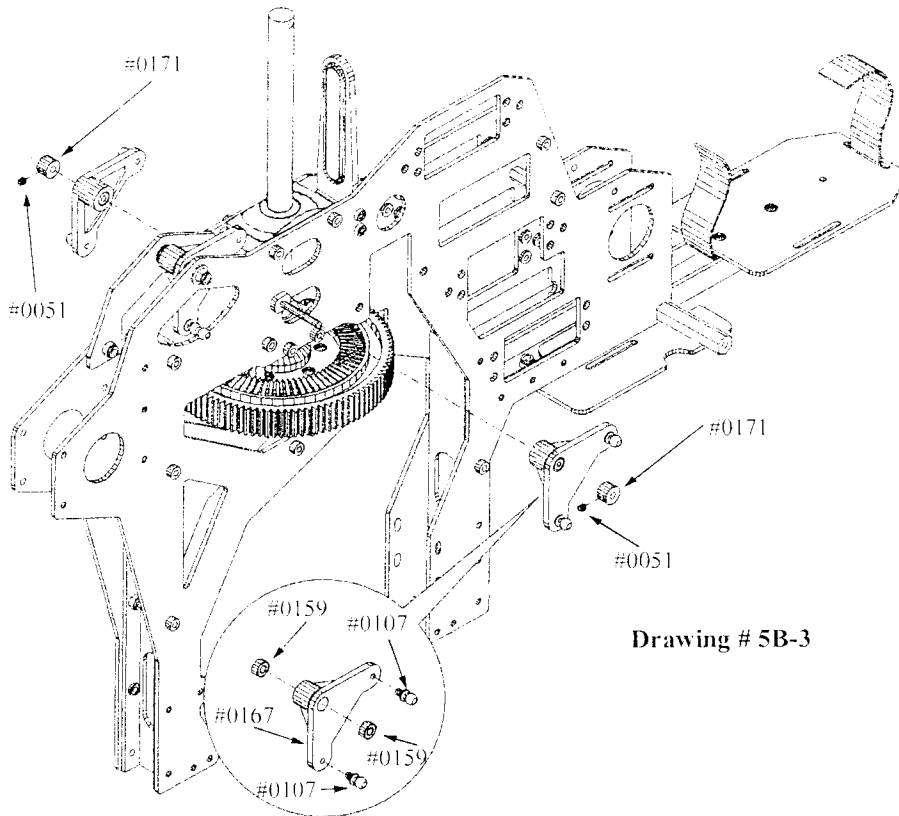
Refer to Drawing #5B-2



Drawing # 5B-2

- B.** Select two #0032 M2.9x9.5 Phillips self-tapping screws and install through the right main frame into the remaining holes in the #0874-1 swashplate anti-rotation.
- C.** Select two #0167 bellcranks and four #0107 M3x6 threaded balls. Apply a very small amount of slow cyanolate glue to the threads of each ball and install two into each bellcrank (on the “flat” side the bellcrank only).
- D.** Select four #0159 M3x7 ball bearings. Press two into each bellcrank as previously done in Section V, Step 1C.

Refer to Drawing #5B-3 (next page)



Drawing # 5B-3

- E. 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 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.

Step 3. Final Main Shaft 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, Step 5H). Place a small drop of 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.

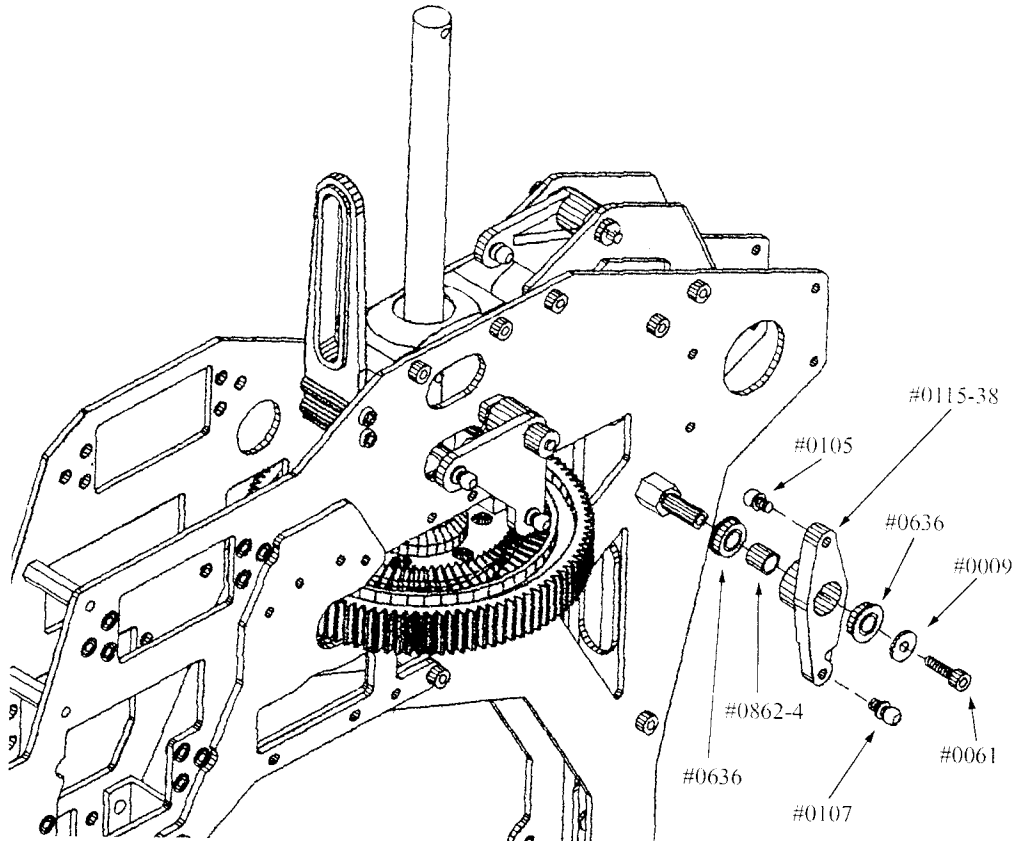
Step 4. Assemble and Install the Rudder Bellcrank.

Bag(s) Required: 5D

Parts Required:			Bag #
1	#0009	M3 flat washer (small)	5D
1	#0061	M3x8 socket head bolt	5D
1	#0105	M3x4.5 threaded ball	5D

1	#0107	M3x6 threaded ball	5D
2	#0636	M5x10x3 flanged bearings	5D
1	#0862-4	Brass spacer ring	5D
1	#115-38	Rudder bellcrank	5D

Refer to Drawing #5C



Drawing # 5C

- A. Select two #0636 flanged ball bearings, one #0862-4 brass spacer ring, and one #115-38 rudder bellcrank. Press one bearing into one side of the bellcrank and reverse, insert from the opposite side one #0862-4 brass spacer followed by the remaining bearing (the brass spacer will limit full insertion of the second bearing by .03-.04mm to prevent bearing damage after installation on the stand-off).
- B. Examine the drawing and note the orientation of the bellcrank on the model and the required threaded balls (flat side facing away from the left main frame, long end downward, longer threaded ball on the long end/flat side and shorter ball on the short end facing the main frame).

Select one #0105 M3x4.5 threaded ball and one #0107 M3x6 threaded ball. Apply a small amount of slow cyanolate their threads and install in the appropriate positions on the bellcrank.

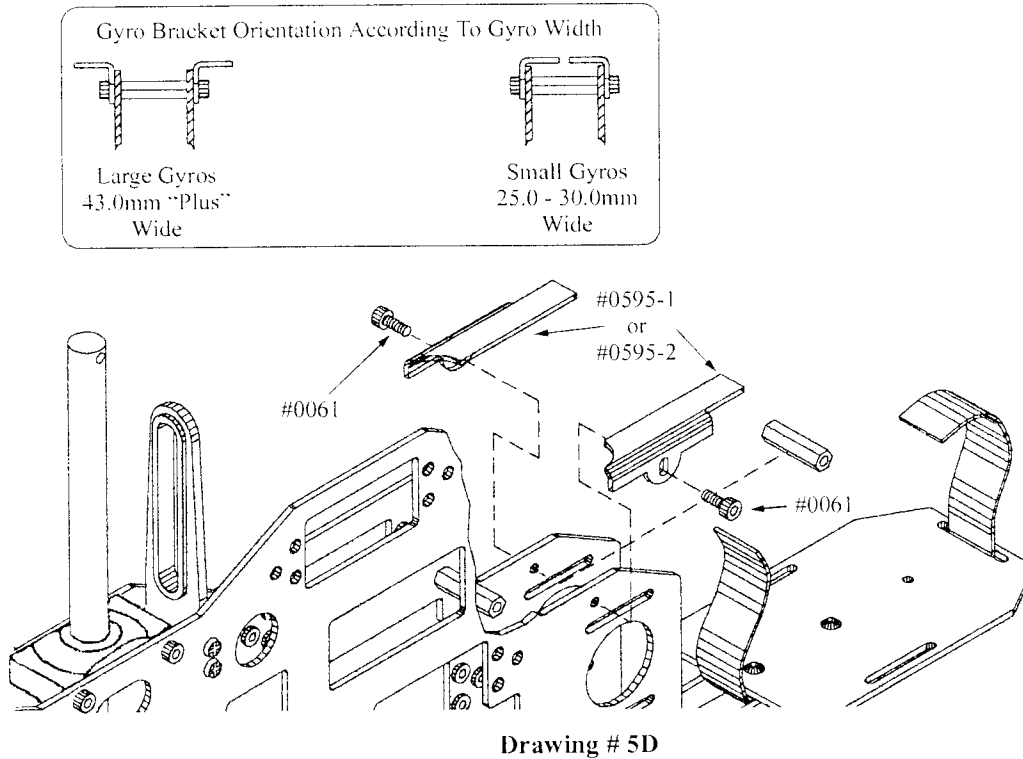
Select one #0009 M3 flat washer (small) and one #0061 M3x8 socket head bolt. Press the bellcrank onto the stand-off previously installed on the rear of the left main frame as shown. Place the #0009 washer onto the #0061 bolt and add a small amount of Loctite to the threads. Install this into the stand-off and tighten with moderate torque. Check for smooth movement of the bellcrank.

Step 5. Install the Gyro Brackets.

Bag(s) Required: 5E

Parts Required:			Bag #
2	#0061	M3x8 socket head bolts	5E
1	#0595-1	Gyro bracket (A)	5E
1	#0595-2	Gyro bracket (B)	5E
1	#115-20	Hex spacer	5E

Refer to Drawing #5D



- A. Examine the drawing and note front/rear orientation of the gyro brackets (always the same) and the three width possibilities corresponding to your choice of gyro. Make the best selection for your gyro sensor.
- B. Select one #115-20 M3 hex spacer, two #0061 M3x8 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 well tightened and aligned to form a uniform flat top surface.

VI. BUILDING AND INSTALLING THE LANDING GEAR

Bag(s) Required: 6A, 6B

Tools or Materials Required:
M2.5 Allen tool
Small Phillips screwdriver
Hand drill with 2.35mm (3/32") drill

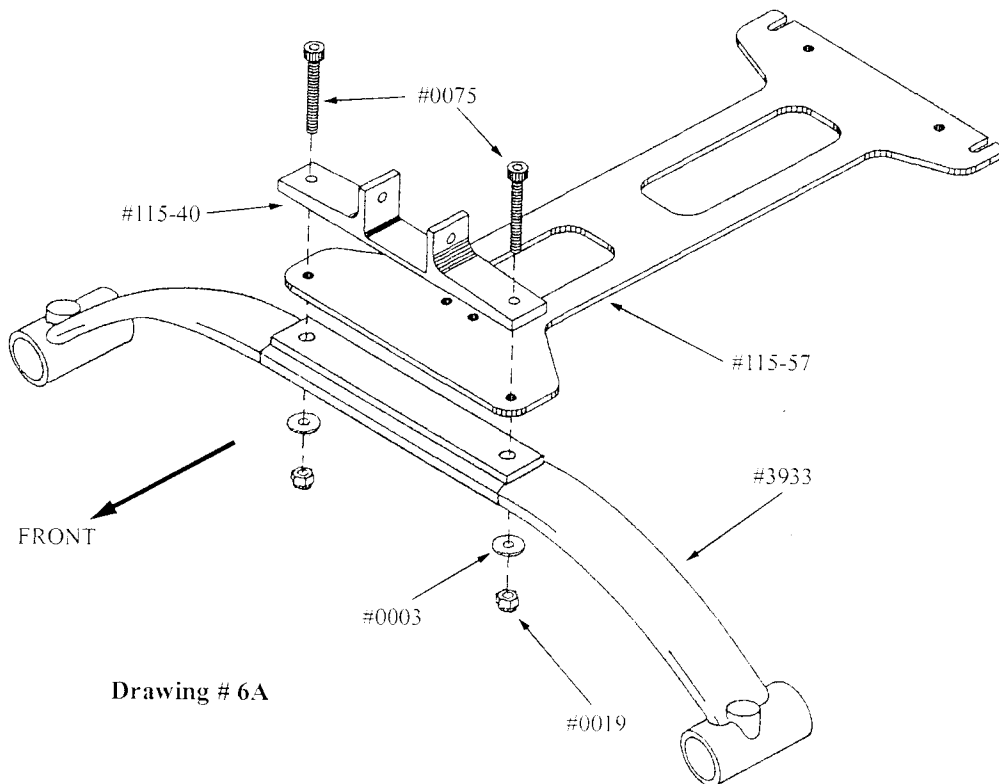
Small hammer
 Slow cyanolate glue
 M5.5 (7/32") wrench
 Tape

Step 1. Installing Landing Gear Braces and Struts

Bag(s) Required: 6A, 6B

Parts Required:			Bag #
4	#0003	M3 flat washers (large)	6B
8	#0019	M3 hex lock nuts	6B
4	#0032	M2.9x9.5 Phillips self-tapping screws	6B
4	#0065	M3x12 socket head bolts	6B
4	#0075	M3x25 socket head bolts	6B
2	#3933	White struts	6A
2	#3937	Aluminum skids	6A
4	#3937-1	Plastic skid caps (white)	6B
2	#115-40	Black aluminum landing gear mount	6B
1	#115-57	Lower frame plate	6A

Refer to Drawing #6A



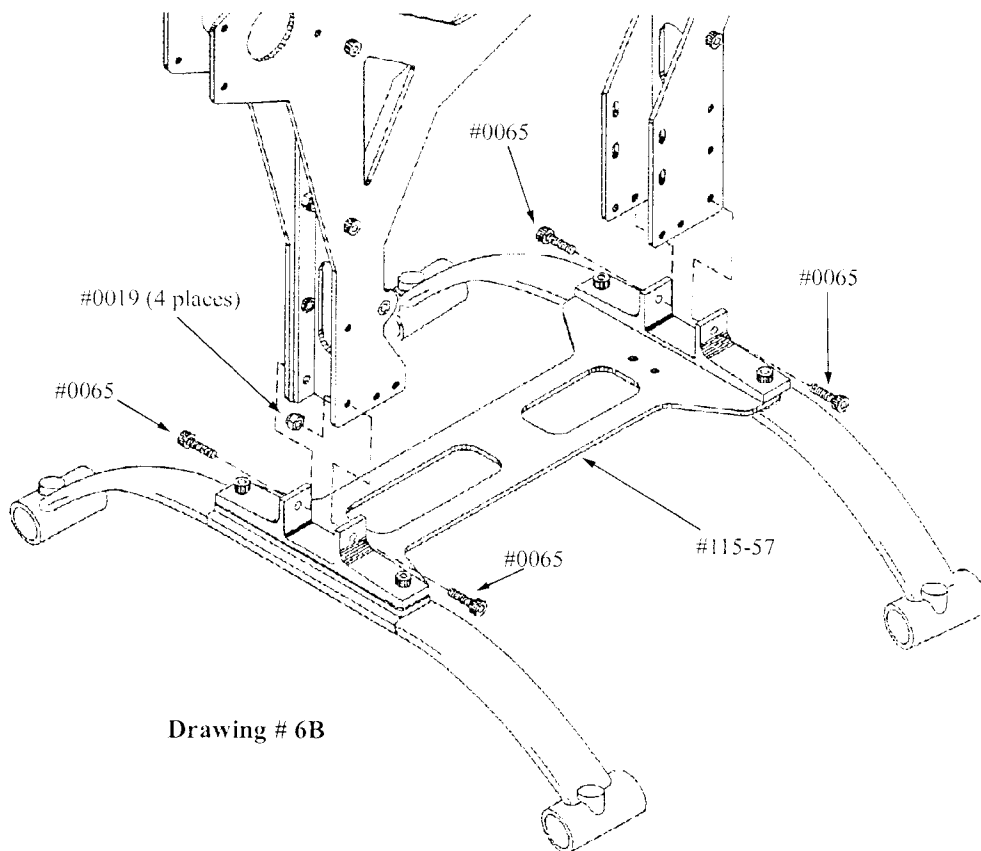
- A. Select four #0003 M3 large flat washers, four #0019 M3 hex lock nuts, four #0075 M3x25 socket head bolts, two #3933 struts one #115-57 lower frame plate and two #115-40 machined landing gear mounts.

NOTE:

Step 1B will discuss the installation of #0075 M3x25 socket head bolts securing the #115-40 mounts and #115-57 plate to the #3933 strut. In the case of the rear strut, these bolts will be initially used only as a building aide and later be replaced by different parts (Section XI, Step 2).

- B. Examine the drawing and note the orientation of parts to be attached to the strut. As noted, install one #115-40 landing gear mount, one #115-57 (the front side) lower plate, two #0003 M3 washers, two #0019 M3 hex lock nuts and two #0075 bolts. Do not fully tighten the bolts to allow alignment later. Repeat the steps for the remaining strut. Use the slots in the rear side of #115-57 lower plate.

Refer to Drawing #6B

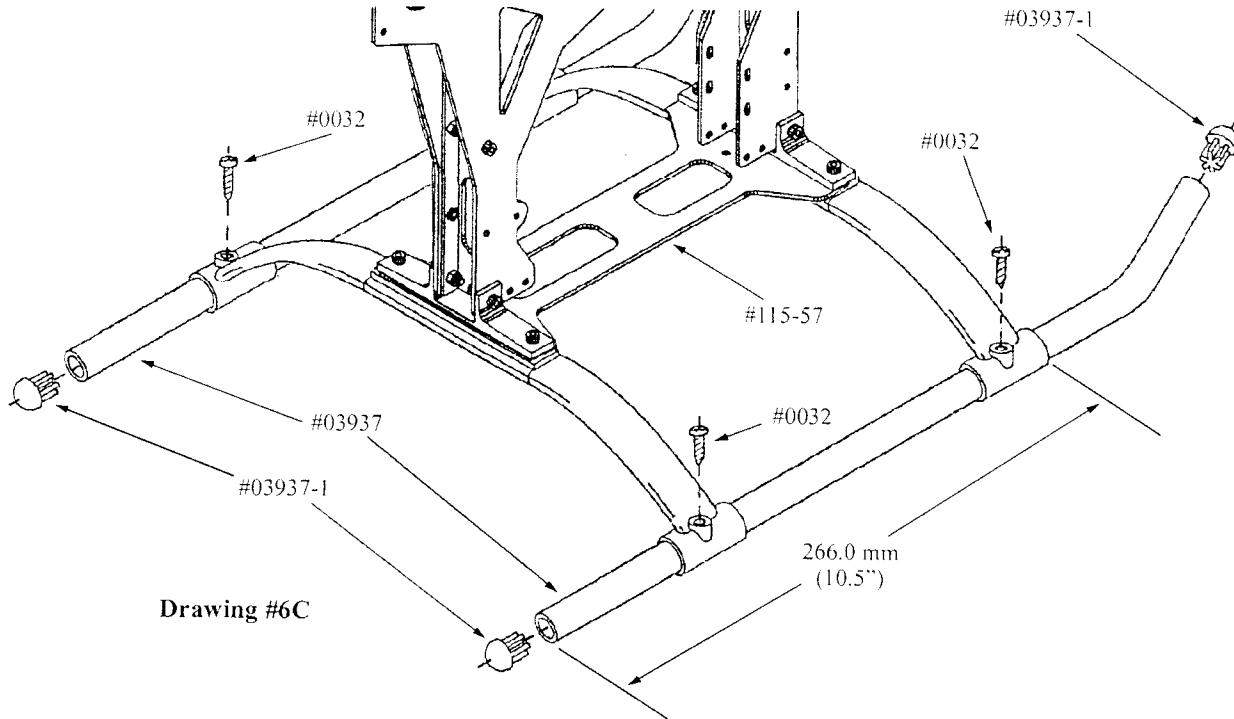


- C. Examine the drawing and note the orientation of the parts as they attach to the main frame assembly. The main frame assembly will slide downward into the channel formed at the top of each #115-40

landing gear mount. Select four #0065 M3x12 socket head bolts and four #0019 M3 hex lock nuts. Install each strut assembly onto the main frame with the lower end of each strut “swept forward” (meaning that, as viewed from the side, the top of the strut appears further rearward on the model than the lower part of the strut where the skid inserts). Leave this hardware slightly loose for alignment. With the bottom of each strut squarely on a flat surface, tighten all eight previously installed bolts. Check to be sure that the #115-57 lower plate remains flat with no bow.

- D. Select two #3937 skids and four #3937-1 skid caps. Install a skid cap into each end of each strut by applying a small amount of slow cyanolate glue inside the strut and pressing the cap fully in place.

Refer to Drawing #6C



- E. Select each skid and apply a piece of tape just ahead (nearer the curved end) of a measured mark 266.0mm (10.5") from the rear end of the skid (measure at the “skid end” 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.

- F. Examine the top of each strut in the area where the skid is inserted. Each will have an 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” and through the upper surface of the skid tubing (with a little attention it is very easy to note that you’ve only drilled through the upper surface of the skid and not also the lower surface. Select one #0032 M2.9x9.5 Phillips self-tapping screw, apply a little slow cyanolate glue and install in the previously drilled hole. Repeat the procedure for the remaining three positions.

VII. INSTALLATION OF THE CLUTCH, FAN AND ENGINE ASSEMBLY (INCLUDING GUIDELINES FOR ENGINE AND EXHAUST SELECTION).

Bag(s) Required: 7A, 7B, 7C, 7D, 7E, 7F

Tools or Materials Required:

M2.5 and 3.0 Allen tools

M5.5 (7/75”) flat wrench

Light oil

“Thin wall” (12 point) socket and ratchet to fit the crankshaft nut of your chosen engine

6.0-7.0mm (1/4”) diameter wooden dowel of minimum – 75mm (3”) length

Small Phillips screw driver

Sharp modeler’s knife or dremel tool with cutting wheel

Cyanolate or silicone glue

Central Guidelines to Assist in Properly Handling the Engine and Fan Hub Assembly:

- Always remove the carburetor to facilitate safe tightening of the crankshaft nut (the only exception being the Yamada .61ST which should, instead, have its crankshaft secured through removal of the crankcase backing plate). Use a wooden dowel or 6.0-8.0mm (1/4”-5/16”) in diameter to secure the crankshaft during the tightening of the crankshaft nut. Additionally, the kit includes a flat plate #0546-21 to be attached (via the included M4x12 bolts) to the top of the fan hub so the fan is not damaged. Never use the fan blades as a device to grip the hub. Never use any device that secures the crankshaft by contacting the top of the piston as this can damage the engine.
- Always use the proper socket to fit the crankshaft nut. NOTE: Most Sixty size engines with larger diameter crankshaft require “thin wall” (12 point) type sockets due to their larger crankshaft hex nuts. Do not use any nut other than that supplied by the engine manufacturer.
- All Fury kits utilize a “dual collet” system to secure the fan hub. In all cases, the engine’s factory installed drive hub (along with any factory Woodruff key, collet or washer) are to be removed and not utilized. It is recommended that a very light coat of oil be applied to each brass collet (supplied with your kit) to improve its fit into the fan hub. Additionally, the fan hub should be rotated about one turn (with light tension from the crankshaft nut) upon the collets to improve the contact.

Guidelines for Engine Selection:

- The following engines are best suited to your kit:
 - O.S. 91H recommended for Kit #1020
 - Y.S. 80H recommended for Kit #1021

NOTE: If desired the Extreme can be flown using a .61 size engine with no problems, however a gear ratio change will be required.

If you wish to consider other choices and have questions, contact Miniature Aircraft USA at MINAIR@AOL.COM for assistance.

Guidelines for Exhaust System and Fuel Selection:

Many choices in exhaust systems are available and their performance is directly related to the choice of fuel. Always use the highest quality "helicopter only" fuel. The nitromethane content is an important factor in choosing an exhaust system.

Exhaust systems can be classified as two types: mufflers (a canister bolted directly to the engine or attached with an O-ring to an adapter) and tuned pipes (identified by a curved tubing manifold, silicone or Teflon coupler; and a tapered or cylindrical "tuned pipe").

Mufflers – generally considered the most "user friendly" systems, requiring little or no maintenance, compatible with all levels of nitromethane and least sensitive to glow plug choices

The following are to be considered in your selection of an exhaust system:

Muffler Systems

Hatori #9914 80/90 two piece muffler (with "O" rings)

Collets and Related Components for Suggested Engines (each listed in order of assembly starting at the engine front bearing):

Engines: O.S. 91H

1	#0331	Washer
1	#0546-6	Base collet
1	#0579-4	Cooling fan/hub
1	#0546-5	Upper collet
1	#0331	Washer
1		Hex nut

Y.S.(Yamada) .80

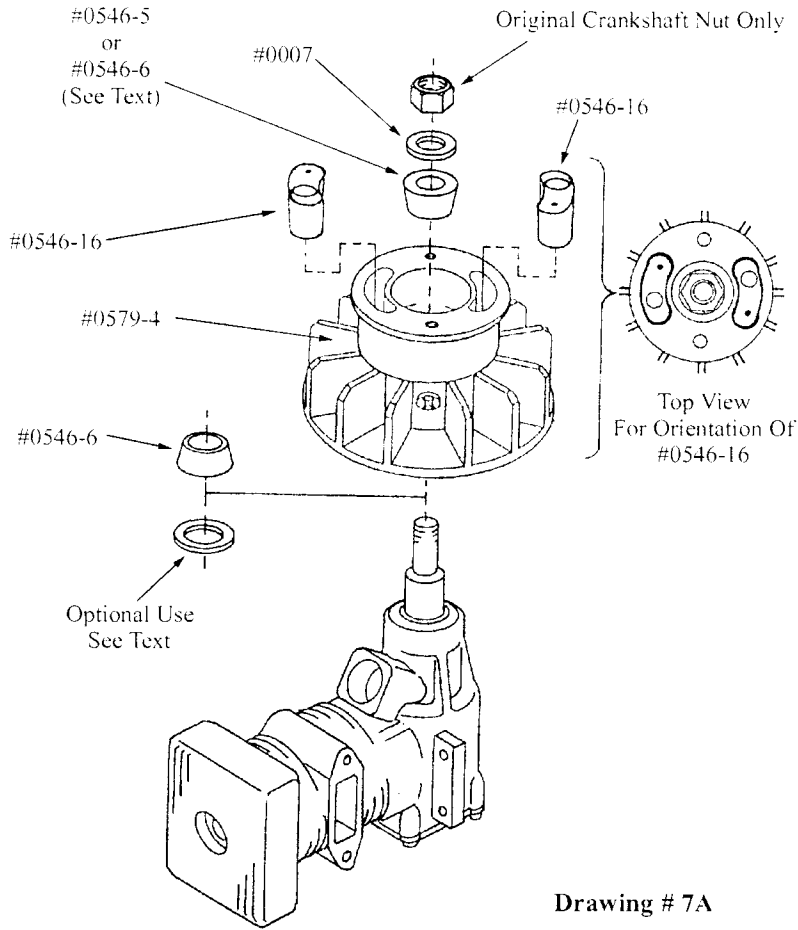
1	#0546-6	Base/upper collet
1	#0579-4	Cooling fan/hub
1	#0546-5	Upper collet
2	#0331	Washer
1		Hex nut

Step 1. Installation of the Fan Hub Assembly On the Engine

Bag(s) Required: 7A, 7C

Parts Required:		Bag #
1	#0007 M6.6x1 2.3 flat washer	7C
2	#0078 M4x12 socket head bolts	7C
1	#0546-6 Base collet (9.5mm I.D.)	7C
2	#0546-16 Molded rubber dampeners	7C
1	#0579-4 Fan/hub assembly	7A
1	#0546-21 Fan tool	7A
2	#0331 M8.0x13.0x0.5 flat washers	7C
1	#0546-5 Collet (8.0mm I.D.)	7C

Refer to Drawing #7A



Drawing # 7A

- A. Following the previous guidelines, select the correct collets and related hardware and install the fan on your engine of choice. Be sure to use Loctite and tighten the hex nut with moderate torque using a ratchet wrench of at least 6.0" in length (typical 3/8" drive ratchet wrench).
- B. At this time, it is wise to make a simple test to check clearance between the clutch driver and the tip of the engine crankshaft. Select the #120-28 clutch/bearing block/driver assembly from bag 7A. Note the Delrin ball (bronze in color) and drive pins protruding from its base. As a test, press this end into the fan hub until flat atop the hub. While this is not as it will ultimately be positioned, it will determine that a proper gap exists between the tip of the crankshaft, the crank nut, and the clutch

driver. If it will not press fully in place, then the crankshaft must be shortened accordingly or you've used the incorrect washer(s) under the crank nut. The problem is rare but still important to consider. If necessary, place the engine/fan assembly into a plastic bag (exposing only the tip of the crankshaft) and use a Dremel tool with carbide disc to remove a little material from the crankshaft tip. NOTE: The #120-28 clutch/bearing block/clutch driver assembly is provided to you temporarily inserted in the #115-43 clutch bell/pinion gear/upper bearing block assembly.

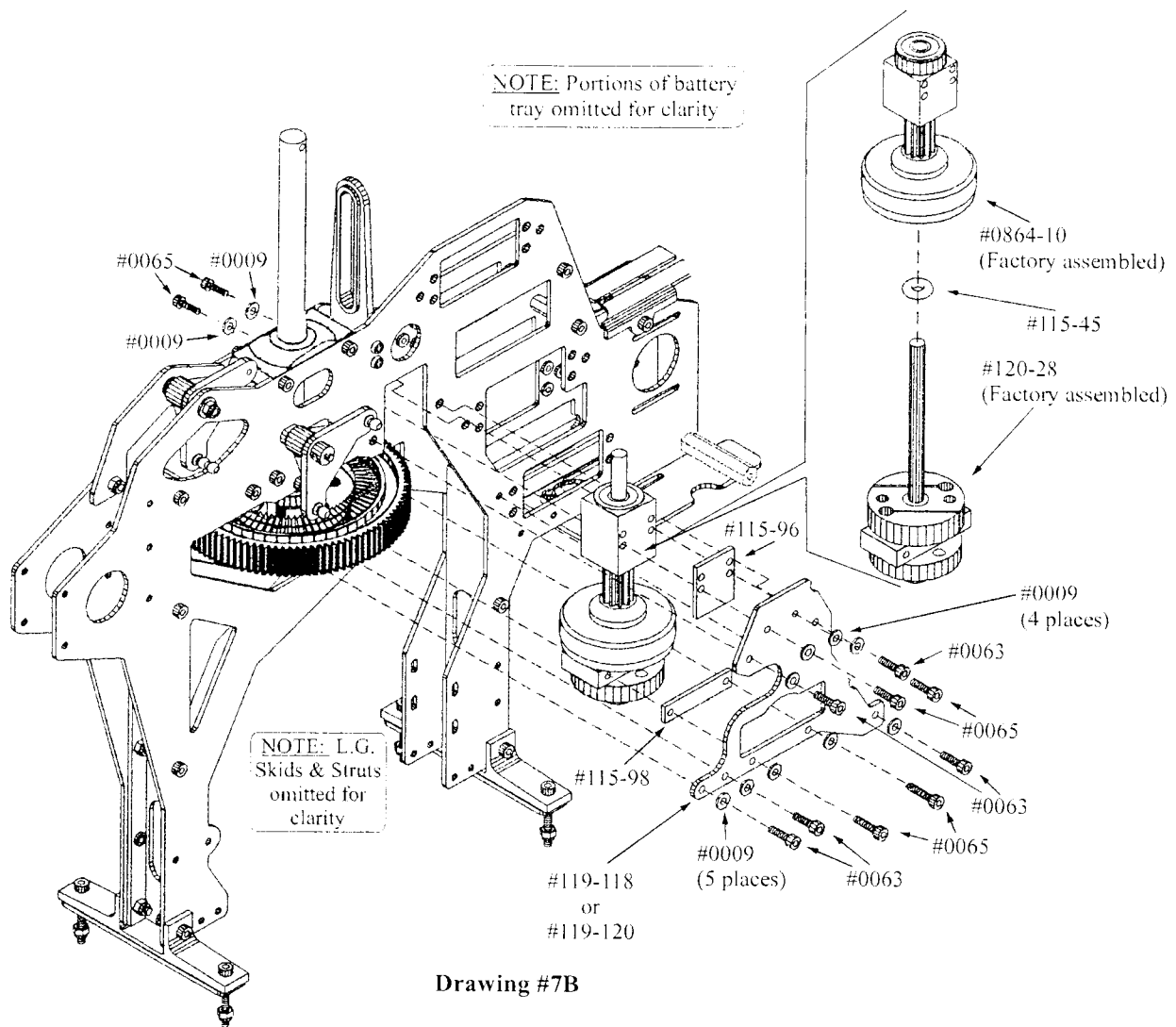
- C. Select two #0546-16 molded rubber dampeners. Examine each, noting that one side will have a 4.5mm hole (sometimes a "through" hole) and a small 2.0mm "dimple." This side will face up, away from the fan hub. Each dampener can be installed dry or with talcum powder using a blunt tool or finger tips to insert fully into the hub. They sit "flush" or within 0.25mm of the top surface of the hub.

Step 2. Installing the Clutch Assembly

Bag(s) Required: 7A, 7B

Parts Required:			Bag #
13	#0009	M3 flat washers (small)	7B
5	#0063	M3x10 socket head bolts	7B
1	#120-28	Clutch/lower bearing block/clutch driver assembly	7A
1	#0864-10	Clutch bell/pinion gear/upper bearing block assembly	7A
1	#115-45	M6 O-ring	7B
1	#115-96	Upper clutch plate spacer	7B
1	#115-98	Lower clutch plate spacer	7B
8	#0065	M 3x12 Socket bolt	7B
1	#119-118	Clutch plate (kit #1020)	7B
OR			
1	#119-120	Clutch plate (kit#1021)	7B

Refer to Drawing #7B. (next page)



- A. Select the #120-28 clutch/lower bearing block/clutch driver assembly, the #0864-10 clutch bell/pinion gear/upper bearing block assembly, the #115-45 M6 O-ring and the #119-118 or #119-120 clutch access plate.

Examine the “clutch area” in the left main frame and note that the area corresponding to the upper clutch bell bearing block (just ahead and below the previously installed #0874-1 swashplate anti-rotation) contains six 3.0mm holes arranged in two horizontal rows. The upper two holes are slightly behind the middle two holes. Examination of the clutch access plate will show similar and corresponding holes. Examine the upper bearing block of the #0864-10 clutch bell assembly and note again, that only the lower two holes will be utilized in this kit.

Once again, examine the left main frame. This time, note the two slots located directly below the rectangular clutch bell opening (45.3mmx15.3mm with a small round notch at the top center). These slots satisfy the needs of all X-Cell Fury kits.

In addition to the previously selected #120-28, #0864-10, 115-45 and 119-118 or #119-120 parts, select thirteen #0009 M3 flat washers (small), five #0063 M3x10 socket head bolts, and eight #0065 M3x12 socket head bolts.

Slide the #115-45 O-ring onto the exposed 6.0mm shaft of the #120-28 clutch/driver assembly followed by the #0864-10 clutch bell assembly. From the right side of the previously assembled main

frames, insert the clutch assembly into position by tilting it and pushing the tip of the start shaft up in between the frames first, followed by the clutch bell going into the rectangular opening and the clutch lower bearing block aligning with the slots provided.

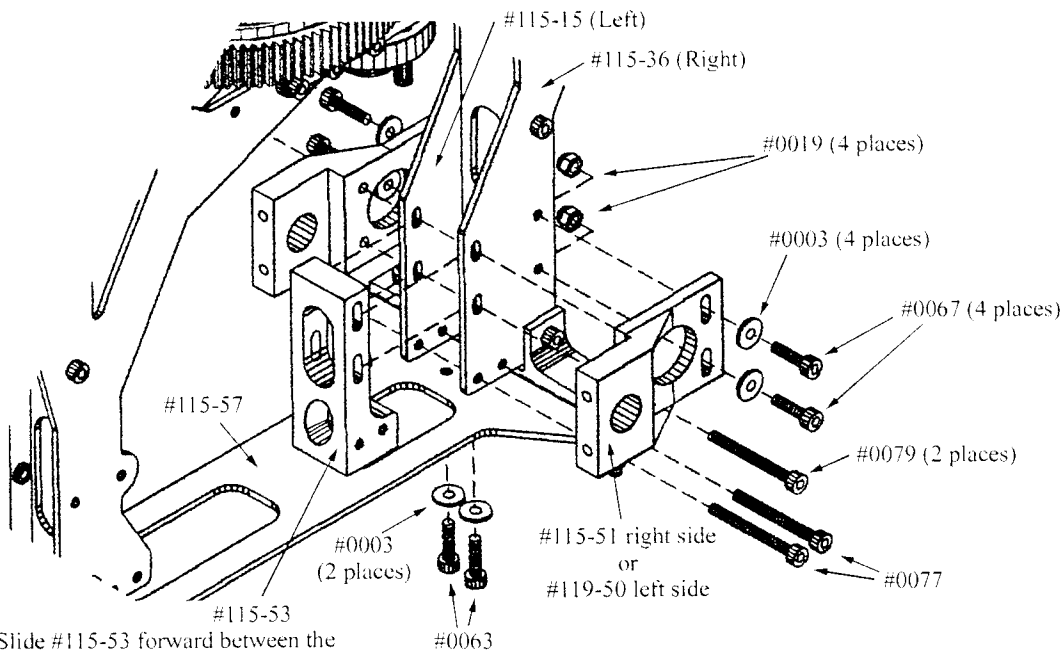
- B. Examine the drawing and note the position of the #0065 bolts through the access plate. Select the #119-118 or #119-120 access plate, one #115-96 upper doubler plate and one #115-98 lower doubler plate. From the right side lay the access plate (and doubler plates) into position on the right main frame. Using Blue Loctite, insert one #0065 M3x12 socket head bolt with washer into each upper and lower bearing block hole position. Uninstall into each bearing block (upper and lower) through the left side frame one #0009 m3 washer and one #0035 m3x12 socket bolt. Use blue Loctite. Do not fully tighten at this time.
- C. Prepare five #0063 M3x10 socket head bolts by installing a #0009 M3 flat washer and a little Loctite. Examine the drawing and note the position for each #0063 bolt around the perimeter of the #119-118 or #119-120 clutch access plate. Tighten all five bolts securely.
- D. Tighten all eight #0065 bolts through the upper and lower clutch bearing blocks with moderate torque. Gear mesh should have minimal free-play and be smooth. The gears will require a few flights to “break-in” so disregard any minor irregularities in the mesh.

Step 3. Installing the Motor Mounts and Engine

Bag(s) Required: 7A, 7D

Parts Required:	Bag #
6 #0003 M3 flat washers (large)	7D
6 #0019 M3 hex lock nuts	7D
2 #0063 M3x10 socket bolt	7D
4 #0067 M3x14 socket head bolts	7D
2 #0077 M3x30 socket bolts	7D
2 #0079 M3x35 socket head bolts	7D
4 #0080 M4x14 socket head bolts	7D
1 #0546-19 Alignment tool	7D
1 #115-53 Inner motor mount block	7A
<i>For kit #1020</i>	
2 #115-47 Motor mount shims	7D
1 #115-50 Left engine mount	7A
1 #115-51 Right engine mount	7A
<i>For Kit #1021</i>	
1 #119-50 Left engine mount	7A
1 #119-51 Right engine mount	7A

Refer to Drawing #7C

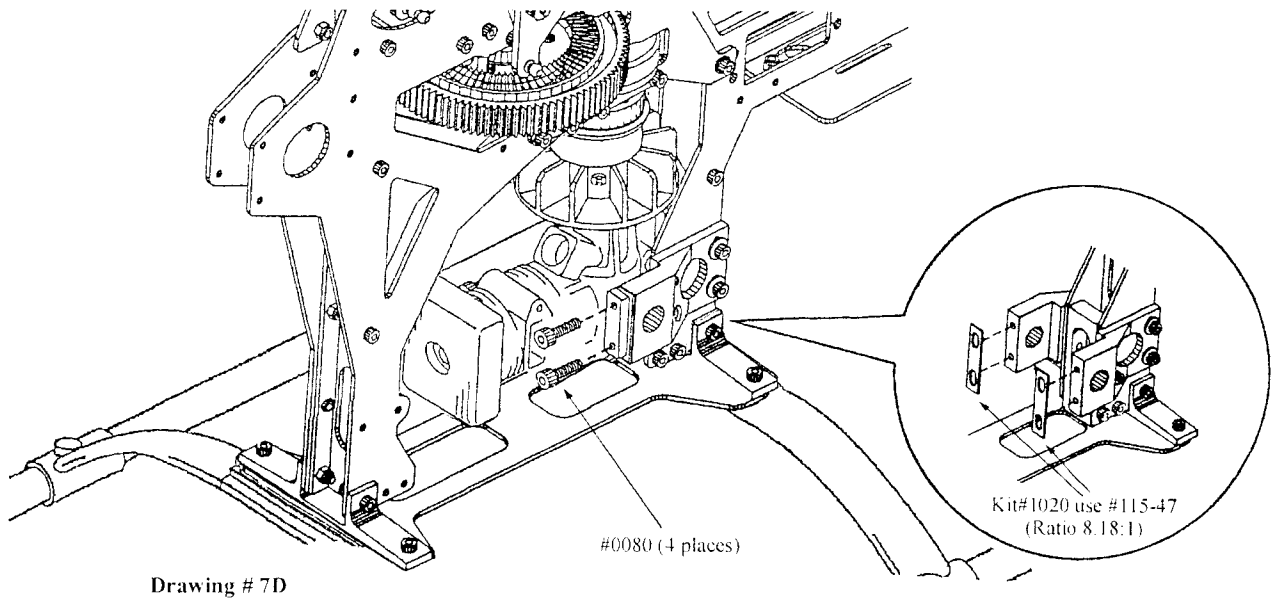


Drawing # 7C

- A. Select four #0003 M3 flat washers (large), four #0019 M3 hex lock nuts and four #0067 M3x14 socket head bolts. Additionally, select one each #115-50 and 115-51 (Kit #1020) or #119-50 and #119-51 and two #115-47 motor mount shims (Kit #1021). Examine the drawing and note two 3.0mm holes (ahead of the vertical slots) passing through each side frame and the #115-12 vertical front channel. Prepare four #0067 M3x14 socket head bolts by installing one #0003 M3 flat washer on each. Loosely install the appropriate motor mount onto each side frame by inserting a bolt and washer at each hole (through the vertical front channel) and adding one #0019 M3 hex lock nut inside, tighten each so that the mounts are secure but can be slid up/down for the next step.

Select two #0079 M3x35 socket head bolts and add a little Loctite. Select one #115-53 inner motor mount. Examine the drawing and note the opposite direction for the installation of each #0079 bolt, and install the block and bolts. Tighten them so that the motor mount can still slide up and down. Using the two lower holes below the motor mounts, install two #0077 m3x30 bolts and two #0019 M3 locknuts on the opposite side. On the underside of the #115-57 lower plate, below the inner motor mount #115-53, install two #0063 M3x10 bolts and two #0003 M3 washers. Use Loctite on the bottom bolts. Tighten all bolts securely (with exception of the two #0079 bolts).

Refer to Drawing #7D



- B.** Select four #0080 M4x14 socket head bolts and the #0549-19 alignment tool. Examine the alignment tool and note the slot next to the half-round cut-out area. The tool is intended to set a gap between the clutch driver and the fan hub, with the slot and cut-out providing clearance around the drive pins and Delrin ball on the clutch driver.

Prepare each engine mounting bolt by adding Loctite. Prepare the engine by making sure the carburetor stop screw is adjusted to allow for a fully closed carburetor (determined by visually observing the closed barrel and the inability to blow air through fuel line connected to the fuel inlet).

The #0546-16 molded dampeners within the fan hub will accept the clutch driver pines in any one of three ways – dry or lubricated with talcum powder or a thin coat of petroleum jelly (Vaseline). Do not lubricate the Delrin ball.

Slide the engine into position, making sure each drive pin is properly in each dampener. Insert one #115-47 motor mount shim under each engine mounting flange (Kit #1020 8.18 ratio only) and install four of the appropriate mounting bolts to secure the engine, leaving the bolts loose enough to allow engine movement. Insert the #0546-19 tool from either side and firmly push the engine/fan assembly against it and the clutch driver. The most convenient method to apply this force is by putting the thumbs of each hand (from each side) atop the clutch bell and the remaining fingers below the fan, then squeezing with both hands until the two components are fully engaged.

The engine should “hang” naturally in alignment with the motor mount as viewed from all sides. Since the “motor mount to frame” bolts are still loose enough to allow adjustment, you should be able to align all components (it may be helpful to lightly tighten the “motor to motor mounts” at this point to clarify the alignment. This procedure is important since a poor alignment will prematurely wear out the clutch bearings, ball and dampeners. Since the clutch ball can act as an “articulated joint”, the important factor is that, even if the engine were at a slight angle, the fan hub and clutch delrin ball be aligned at the point of contact. This “point of contact” is approximately 3.75 to 4.0mm below

the top surface of the fan hub. After alignment, tighten all related bolts with moderate torque. Note, future removal of the engine will not require loosening the motor mounts at the frames so the process will be much simpler.

Step 4 Installing the Fan Shroud and Switch Plate

Bag(s) Required: 7A, 7F

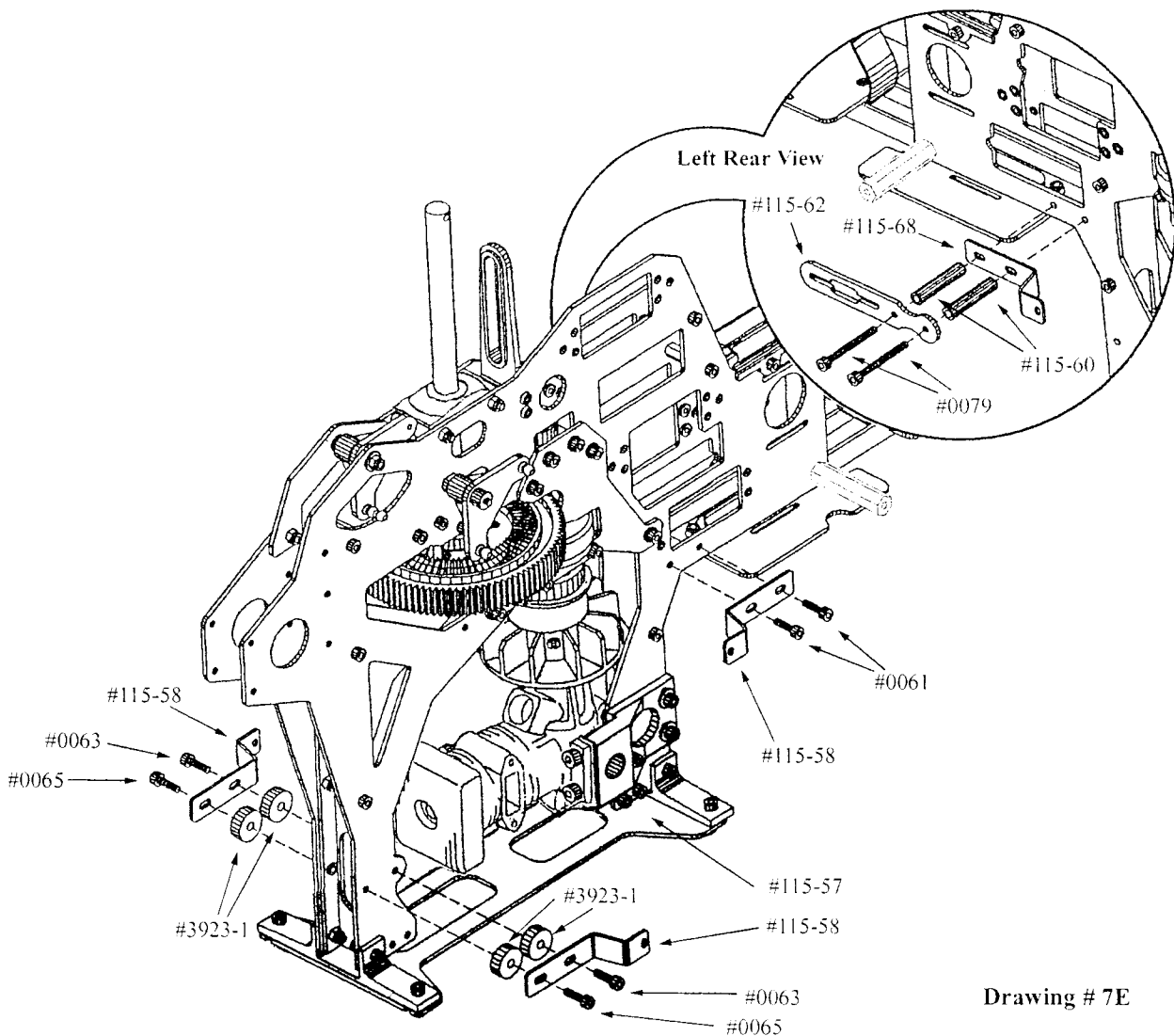
Parts Required:			Bag #
5	#0029	M2.2x13.0 Phillips self-tapping screws	7E
4	#0032	M2.9x9.5 Phillips self-tapping screws	7E
2	#0061	M3x8 socket head bolts	7E
2	#0063	M3x10 socket head bolts	7E
2	#0079	M3x35 socket head bolts	7E
1	#0548-5	Left and right fan shroud	7A
4	#115-58	Fan shroud braces	7E
2	#115-60	M5.75x27.5 carbon tubes	7E
1	#115-62	Switch plate	7E
4	#3923-1	M4.0x14.6x4.9 round plastic spacers (black)	7E
2	#0065	M3x12 socket head bolts	7E

Refer to Drawing #7E, 7F

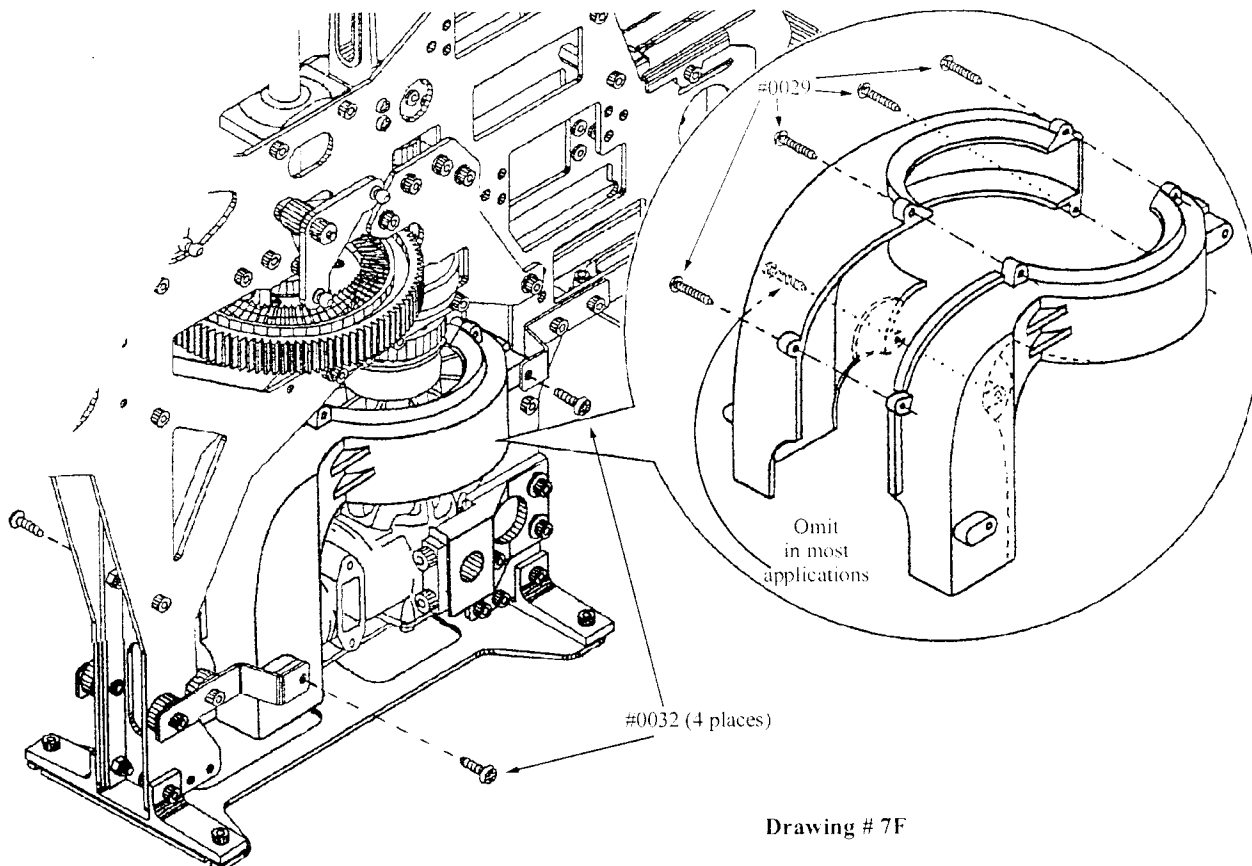
Please note the following before proceeding to install the fan shroud:

- Some additional trimming of the fan shroud may be required depending on your choice of engine. It is assumed you will trial fit the shroud prior to any modification. In general, trimming is for carburetor and/or cylinder head clearance. If your carburetor inlet comes to within 8.8mm of the fan shroud, trimming is suggested. The "trimming" can simply be to add about a 20.0mm diameter hole directly in-line with the carburetor inlet or making a "u" shaped cut-out extending downward into the cylinder head opening at the base of the shroud (the latter will eliminate one #0029 M2.2x13 Phillips screw and the surrounding material – which is not a problem). Trimming can easily be done by using a sharp modeler's knife (scoring the surface deeply and bending the material to break it away) or a dremel tool with cutting wheel or abrasive drum.
- A. Select two #0079 M3x35 socket head bolts, one #115-58 fan shroud brace, two #115-60 carbon tubes and one #115-62 switch plate. Examine the drawing and note the orientation of the switch plate and related parts. Prepare each bolt with Loctite. Insert each bolt through the switch plate followed by a carbon tube and the fan shroud brace. Install this assembly onto the left main frame and into the threaded inserts of the left side of #115-24 horizontal channel. Leave each bolt just loose enough to allow adjustment in the next steps.

- B. Select two #0061 M3x8 socket head bolts and one #115-58 fan shroud brace. Prepare each bolt with Loctite and install (similar to the previous step) in the right main frame opposite the switch plate/fan shroud brace of the left frame. Again, leave the bolts loose enough to allow adjustment.
- C. Select two #0063 M3x10 socket head bolts, the two remaining #115-58 fan shroud braces, and two #3923-1 plastic spacers. Examine the drawing and note that each frame has two holes for attachment of the rear fan shroud braces. For this step, the forward hole (containing a threaded insert) in each frame is utilized. Prepare each #0063 socket head bolt with Loctite and insert first into the fan shroud bracket hole (nearest the bend) and then through one #3923-1 plastic spacer. Install each onto either side of the frame assembly, noting that they should be horizontal and not so tight as to restrict adjustment. Keep in mind that the rear holes will be utilized during later steps so the holes should remain aligned with the frame and vertical channel holes. Select two #3923-1 plastic spacers and two #0065 M3x12 socket head bolts. Prepare each bolt with Loctite. Slide a plastic spacer between the rear fan shroud brace on each side and install a #0065 socket head bolt in each threading into the vertical rear channel. As with the preceding hardware, leave just loose enough to allow adjustment.



Drawing # 7E



- D. Select both halves of the #0548-5 fan shroud and two #0029 M2.2x13 Phillips self-tapping screws. Examine the drawing and slide each half of the shroud in position between the previously installed braces. While loosely sitting within the frames, install the two #0029 screws (one front and one rear, from the left side) to hold the shroud halves together. Take this opportunity to align all the braces and shroud mounting holes visually and check for any clearance issues as described at the beginning of step 5. If needed, the #0032 M2.9x9.5 Phillips self-tapping screws that secure each corner of the shroud to each brace can be utilized to assist in positioning the shroud while checking clearances. When you are satisfied with the fit of the shroud, select and install the remaining three #0029 M2.2x13 Phillips screws and (if not already utilized) the four #0032 M2.2x9.5 Phillips screws as shown in the drawing, leaving any screws into the braces loose for adjustment. Align the shroud using the following criteria: the shroud should have approximately equal clearance above and below the fan and should be centered horizontally around the fan hub/clutch driver assembly. Tighten all brace to frame and the four #0032 shroud to brace screws. Later, should you wish to remove the shroud (all or half) the “brace to frame” bolts need not be loosened again. This greatly simplifies later servicing.

VIII. BUILDING AND INSTALLING THE FUEL TANK ASSEMBLY

Bag(s) Required: 8

Tools or Materials Required:

- Modeling knife or razor blade
- 8.0mm (5/16”) flat wrench

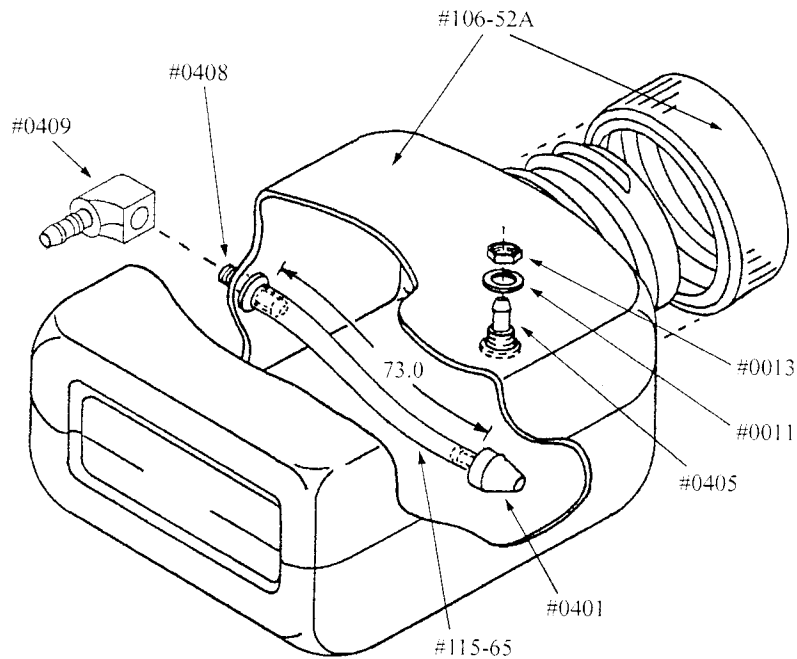
- 2.25mm diameter (.086") drill bit (optional)
- Small pliers or vice grips (optional)
- Forceps (hemostats) (optional)
- Premium grade fuel filter(s) (two in all cases except Y.S..61 ST2 engine)

NOTE: The correct procedure for installing X-Cell fuel tank fittings is as follows: Insert fitting from inside the fuel tank using forceps or fingertips, pull through a snug-fitting hole until the inner flange is flush against the tank inner surface, install the washer and nut finger tight, insert the shank of 2.25mm diameter (.086") drill bit into the fitting's hole (to prevent collapse), lightly grip the nipple with pliers while tightening the nut with an 8.0mm (5/16") flat wrench. When fully tightened, there will be a "circle" of tank material surrounding the fitting flange which will "raise" above the tank surface about 0.5mm. This process assures a good seal.

Step 1. Preparing the Fuel Tank

Parts Required:			Bag #
1	#0011	M5 flat washers	8
1	#0013	M5 hex nut	8
1	#0397	Medium fuel tubing (483.0mm plus)	8
1	#0401	Fuel pick-up "clunk" (brass)	8
1	#0405	Fuel vent fitting (brass)	8
1	#0408	Fuel pick-up fitting	8
1	#0409	90 degree external tank fitting	8
1	#106-52A	Pre-drilled fuel tank with cap	8
1	#115-64	Two-sided Velcro (13.0x330.0mm)	8
1	#115-65	Special fuel pick-up tubing (73.0mm)	8

Refer to Drawing #8A



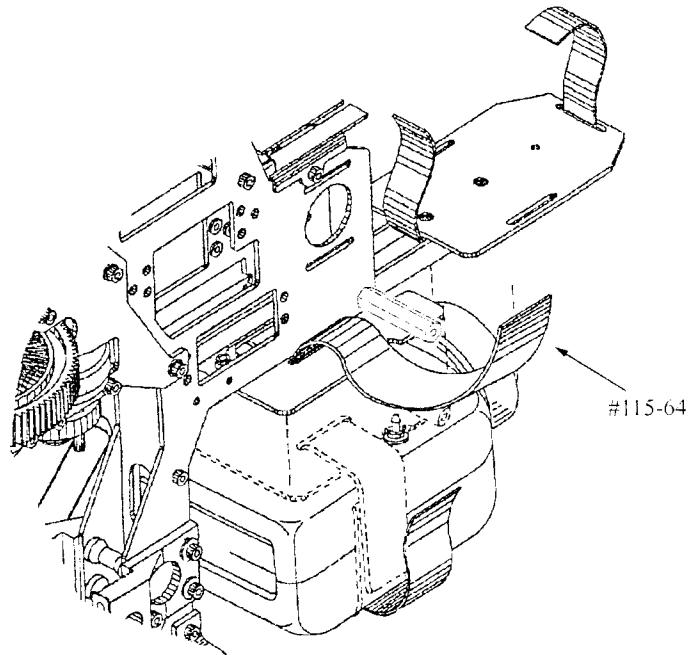
Drawing # 8A

- A. Select one #0401 pick-up "clunk," one #0408 pick-up fitting and one #0405 vent fitting. Examine each, making sure the hole in each is clean and unobstructed. Select the #115-65 special fuel pick-up silicone tubing and press one end fully onto the nipple on the non-threaded end of the #0408 pick-up fitting. Press the tubing until it meets the hex surface. Press the other end fully onto the #0401 pick-up "clunk."

Special Information Regarding Fuel Pick-up Tubing Materials: Radical 3-D type flight demands that the fuel pick-up tubing be very flexible. Your kit includes a special material for this position which eliminates the need for an auxiliary fuel tank. It is not mandatory *but suggested* that you use the special tubing if radical 3-D flight is anticipated. If not, the normal type tubing is acceptable. The general deterioration of the fuel pick-up tubing within the tank (at a much more rapid pace than outside the tank) is caused by two primary factors: exhaust gases recirculated into the tank via the connection of the vent fitting to a fitting on the exhaust system and the presence of nitromethane in the fuel. All engines (except Y.S..ST2 with its own internal pressure system) benefit from the typical "exhaust pressure set-up" to enhance fuel flow so it's faults must be accepted. The nitromethane content (low 5-10% through high 30%) is also beneficial so this too must be accepted as a factor contributing to fuel tank maintenance. In basic terms, you must pay frequent attention to the fuel tank if your goal is to maximize performance and reliability. Should you use any other flexible fuel tubing at the clunk, always maintain the exact length of 73.0mm. Frequency of service should be every six to ten gallons of fuel burned (depending on the variables mentioned).

- B. Insert the prepared fuel pick-up tube, clunk and fitting (from inside the tank) out through the hole supplied in the side of the tank and secure with one #0409 90 degree external tank fitting. Tighten securely resulting in the 90 degree fitting pointing rearward. A 5.0mm hex is provided on the pick-up fitting to aid in tightening. Install the #0405 vent fitting in the top of the tank and secure it with one #0011 washer and one #0013 hex nut.
- C. Thoroughly blow-out the inside of the tank to remove any debris and install the cap. Screw the cap in place with light pressure until it stops and then turn it one-eighth turn further.

Refer to Drawing #8B



Drawing # 8B

- D. The tank position is critical for canopy clearance. Examine the drawing and note the orientation of the tank to the mechanics. Note that a small "notch" is provided on the right side of the #115-26

tank plate – the #0405 vent fitting, installed in the top of the tank, will center directly within this “notch” when the tank is correctly installed following the next procedure.

Select the #115-64 two-sided Velcro strip. Note the slot on the tank plate, just outside the main frame, on each side. Working from the right side of the model, push the end of the Velcro strip downward into the first slot, under the midpoint and the frames and up into the slot on the left side of the model. Adjust the position of the Velcro so that, when pulled taut and straight outward on each side, there is 67.0mm (2 5/8”) of Velcro strip outside the *right* hand edge of the tank plate.

Remove the protective covering from the two-sided tape on the bottom surface of the tank plate. Clean the top surface of the tank with alcohol. Align the tank, as indicated, under the tank plate and press firmly upward. Pull the Velcro strip tightly as you wrap it around the tank (slightly

compressing the tank sides) and overlap itself on the right side of the tank. The grip of the two-sided tape onto the tank will increase within a few hours.

- E. All cuts to fuel line should be made using a sharp modelers knife or razor blade. Select the #0397 fuel tubing. Cut one piece 152.0mm (6.0”). Attach this piece to the fuel pick-up fitting on the left side of the fuel tank. Install a fuel fitting at the other end. Determine the remaining length from fuel fitting to carburetor by holding the fuel filter in-line with the carburetor inlet at a distance from the tank that forms the connecting fuel tubing in a natural arc as it exits the tank fitting. After making the connection to the carburetor, the fuel tubing should sit naturally without sagging more than 25.0mm (1.0”) or creating sharp bends. The canopy has provisions molded in-place to guide the fuel tubing after installation.

Complete the tank installation by connecting the tank vent to the exhaust pressure fitting (excluding Y.S. 80). The final tubing length should not interfere with the main gear nor create any sharp bends. It is highly recommended that you add a fuel filter to the exhaust pressure tube to minimize any debris coming back into the fuel supply. Note: Due to its proximity to exhaust heat and combustion by-products, the exhaust pressure tubing will require periodic replacement similar to the fuel pick-up tubing within the tank.

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

Bag(s) Required: 9A

Tools or Materials Required:

- M1.5 and 2.5 Allen tools
- Medium Phillips screwdriver
- Small good quality pliers
- Small flat screwdriver

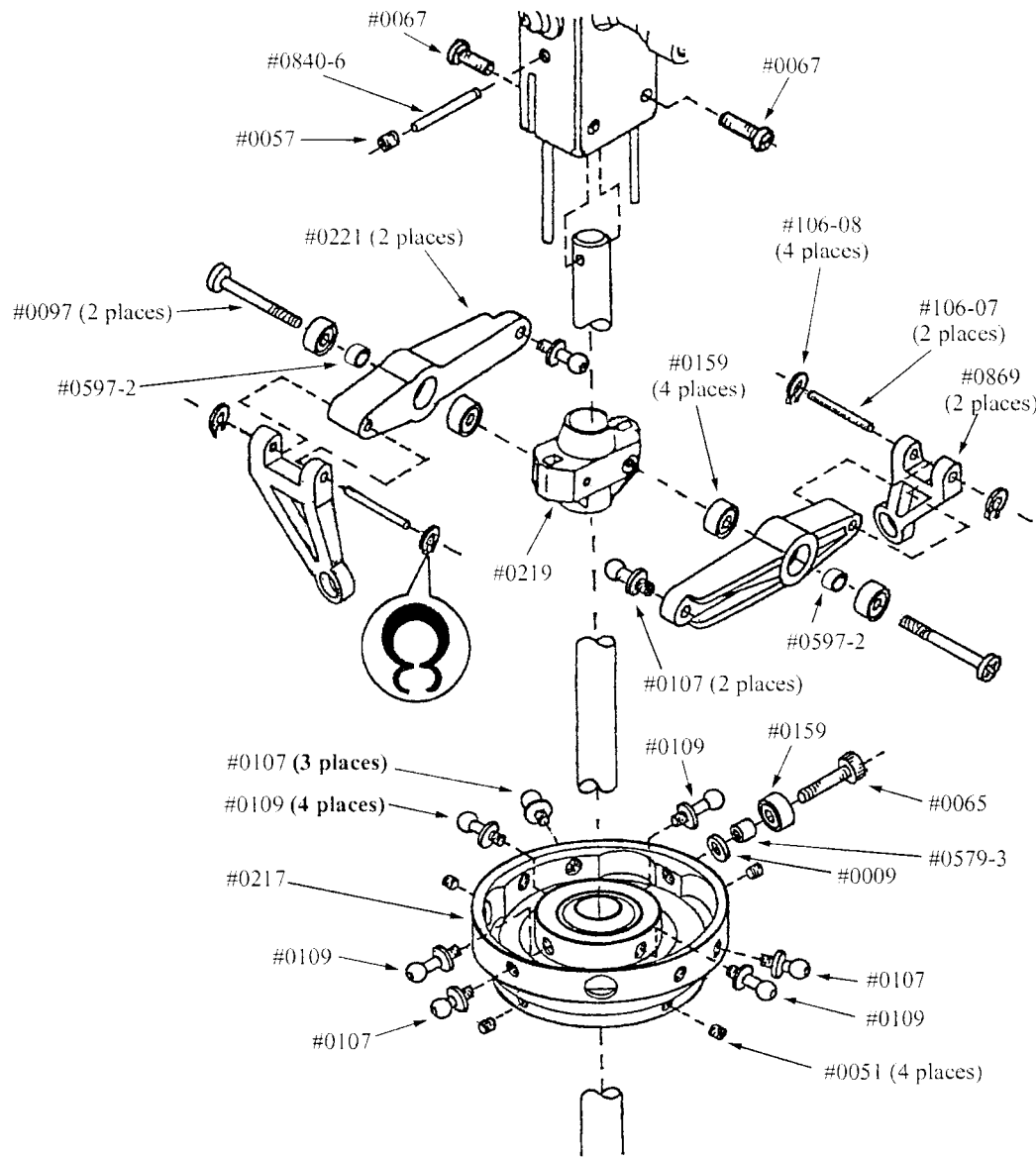
Step 1. Assembling the Swashplate

Bag(s) Required: 9A

Parts Required:			Bag #
1	#0009	M3 flat washer (small)	9A
4	#0051	M3x3 socket set screws	9A
1	#0065	M3x12 socket head bolt	9A
3	#0107	M3x6 threaded balls	9A
4	#0109	M3x8 threaded balls	9A
1	#0159	M3x7 ball bearing	9A
1	#0217	Swashplate (new style only)	9A
1	#0597-3	M3.0x4.75x4.60 brass spacer	9A

- A. Select and examine the #0217 swashplate. Note the four M3 threaded holes at each 90° about the base of the lower swashplate ring. Select four #0051 M3x3 and prepare each with Loctite. These four holes and set screws are for periodically minimizing any free-play that may develop as the swashplate bearing wears (excessive free-play can cause inaccuracies in control inputs). Install each set screw loosely. The adjustment procedure is to rotate the inner swashplate ring within the outer ring and adjust the set screw until a slight irregularity or “notchy” 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 twenty gallons of fuel. This procedure can easily be done on an assembled model by simply disconnecting the related ball links.

Refer to Drawing #9



Drawing # 9

- B. 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° position) are utilized. Access for

these holes is through either 5.0mm diameter access hole in the outer ring. Three threaded holes (one between the two 5.0mm diameter access holes and the remaining two at 120° intervals) are utilized for three #0107 M3x6 threaded control balls in the outer ring. Select four #0109 M3x8 threaded balls and three #0107 N3x6 threaded balls. Prepare each with Loctite, and install in each position previously indicated.

- C. 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 straight forward at the #0874-1 anti-rotation.

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 bolt beginning with the ball bearing, followed by the brass spacer and the washer. Apply a small amount of Loctite to the exposed threads, insert the assembly through the #0874-1 anti-rotation 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

Bag(s) Required: 9B

Parts Required:	Bag #
1 #0057 M4x4 socket set screw	9B
2 #0097 M3x22 special Phillips head 12.9 hard bolts	9B
2 #0107 M3x6 threaded balls	9B
4 #0159 M3x7 ball bearings	9B
1 #0219 Plastic wash-out hub	9B
2 #0221 Washout arms	9B
2 #0597-2 M3x3.4 brass spacers	9B
1 #0840-6 M3x20 dowel pin	9B
2 #0869 Washout ball links	9B
2 #106-07 M2x16 pivot pins	9B
5 #106-08 M2 circlips	9B

Refer to drawing # 9 (preceding page)

- A. Select two #0107 M3x6 threaded balls, two #0597-2 brass spacers, four #0159 M3x7 ball bearings and two #0221 washout arms. Examine the drawing and note the position for the #0107 threaded ball in each arm. Apply a small amount of slow cyanolate glue to the threads and install one in each arm as shown. Press two ball bearings into each arm (noting that when full inserted, each will protrude approximately 0.75mm).
- B. Select two #0097 Phillips bolts and one #0219 wash-out hub. Examine the drawing and note the orientation of each wash-out arm to the hub. Install each arm onto the hub using a #0097 phillips bolt. Tighten each unit until a slight drag is felt when rotating each arm, then loosen the bolts about one quarter turn. Each arm should pivot freely without any end-play.
- C. Select two #0869 washout ball links, two #106-07 pivot pins and four #106-08 circlips (a spare is also included).

The following will describe the correct method of handling the circlips. Each circlip has a rounded "base" with an open end flanked by a curved "prong" at each side. Two tools are useful in handling the circlips. First, small good quality pliers and second, a small flat-blade screwdriver (such as M.A./USA #2960-4 M3 screwdriver). Use the pliers to firmly grip the flat surfaces of the "base" of the circlip, leaving the "prongs" exposed. The screwdriver is to be used as a "wedge." Push it firmly between the prongs, spreading them slightly as they pass along the taper of the screwdriver blade. As soon as they are gripping the screwdriver blade, release the pliers. At this point, the circlip is spread open slightly by its grip on the screwdriver and ready to be slid onto the shaft. The screwdriver is removed after the clip is in position on the shaft. The process is simple and becomes quite easy once you've done it a time or two.

Examine the drawing and note the orientation of each washout ball link and its washout arm. For each washout arm, press a link in place so the holes align. Press one #106-07 pivot pin into each, leaving equal mounts exposed on each side.

As described earlier, prepare each circlip and slide into position on each exposed pivot pin. Place a drop of oil at each pivot point.

D. Slide the assembled washout unit down the main shaft. Examine the swashplate inside circumference. Four areas are "widened" to allow the installation or removal of ball links connecting to the inner swashplate control balls. Using these "widened" areas, position the washout ball links over two of the control balls and snap in place.

E. Select the previously assembled rotorhead, the #0057 M4x4 socket set screw and the #0840-6 dowel pin. Slide the rotorhead down onto the mainshaft and align the cross hole at the upper end of the mainshaft 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 rotorhead, rotating the main gear clockwise and viewing the holes from the side at eye level.

Note: ***Important Precaution*** There have been instances where a builder thought he had all the holes aligned but the mainshaft 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 rotorhead. It pays to be cautious.

If the dowel pin will not fully insert through the mainshaft with moderate pressure, rotate the head 180 degrees upon the mainshaft and repeat. The dowel pin is always to be installed with the "chamfered end" first.

Once the dowel pin is properly fitted, secure it with the #0057 M4x4 set screw and a small amount of Loctite. Apply 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 mainshaft.

X. BUILDING THE TAILROTOR ASSEMBLY

Bag(s) Required: 10A, 10B, 10C

Tools or Materials Required:

- M1.5 Allen tool
- M5.5 socket nut driver
- M7.0 (9/32"-5/16") socket (optional)
- Small hammer
- Small Phillips and straight screwdrivers
- Grease
- Pliers
- Red or green Loctite (optional)

Step 1. Assembling the Tail Rotor Hub and Blade Holders

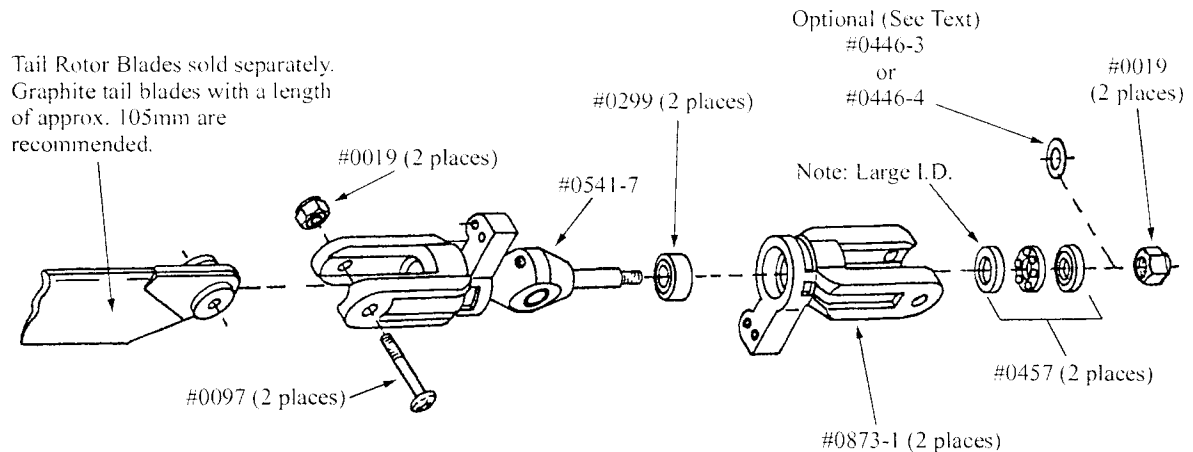
Bag(s) Required: 10A

Parts Required:

Bag #

4	#0019	M3 hex lock nuts	10A
2	#0097	M3x22 special 12.9 hard pivot bolts	10A
2	#0299	M4x10x4 ball bearings	10A
2	#0446-3	Special shims .025mm (.001") thick	10A
2	#0446-4	Special shims .075mm (.003") thick	10A
2	#0457	Tail rotor 3 pc. Thrust bearings	10A
1	#0541-7	Steel tail rotor hub	10A
2	#0873-1	Tail blade mounts	10A

Refer to Drawing #10A.



Drawing # 10A

- A. Select two #0299 M4x10 ball bearings. Press one bearing into each blade mount in the 10.0mm hole nearest the previously installed threaded ball. The bearing should be even with the outer surface of the blade mount.
- B. 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 #0541-7 hub and select the one that fits loosely). This ring will ultimately install nearest the tail rotor hub with the groove facing away from the hub. The smaller inside diameter ring will be mounted outside the ball complement with the groove facing toward the hub. The brass retainer for the ball complement is "cupped." To help retain the grease, the "cupped" side should face the hub.

Prepare the thrust bearings by applying grease to each groove and the "cupped" side of the ball retainer. A small amount on each surface is all that is required. Stack each component as previously indicated and place on a clean surface.

- C. Shims are provided to minimize in/out play in the blade mounts. The shim(s) are used in about 25% of the units assembled. Each blade mount must be test-mounted to determine if any shims are required. While there are various methods of handling the thrust bearings and installing the blade mounts, the following will describe one convenient method. Select the #0541-7 hub, one assembled blade mount, one "prepared" thrust bearing (recalling which side has the larger inside diameter), one #0019 M3 hex lock nut and a 5.5mm socket or nut driver. Slide the blade mount onto one side of the #0541-7 hub. Insert the #0019 M3 hex lock nut into the socket. Set one "prepared" thrust bearing atop the socket and nut (with the larger I.D. pointing away from the nut). While holding this vertical (or at least with thumb and forefinger keeping the thrust bearing in place, slide the hub/blade mount down over and through the thrust bearing and start the nut onto the threads of the hub shaft. Select any tool that will insert into the hub center hole to stop rotation and tighten the M3 nut with light

torque. Repeat the process for the opposite side. Move each blade mount inward and outward on the hub and compare each. The criteria is simply that whatever free play exists should be minimal (approximately no more than the thickness of a piece of note paper) and equal. If the fit is not satisfactory, hold the particular blade mount vertical, remove the nut and insert a shim and reinstall the nut. Do the same for the opposite side as needed. Please note, you may see “side” play in each blade mount. This is a normal condition (due to the use of “grooved race” type thrust bearings) and is non-existent as soon as the tail rotor is in operation. This set-up allows the thrust bearing to function at its best. Do not attempt to shim either blade mount to the extent that zero free play exists as this will cause problems.

- E. 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*.

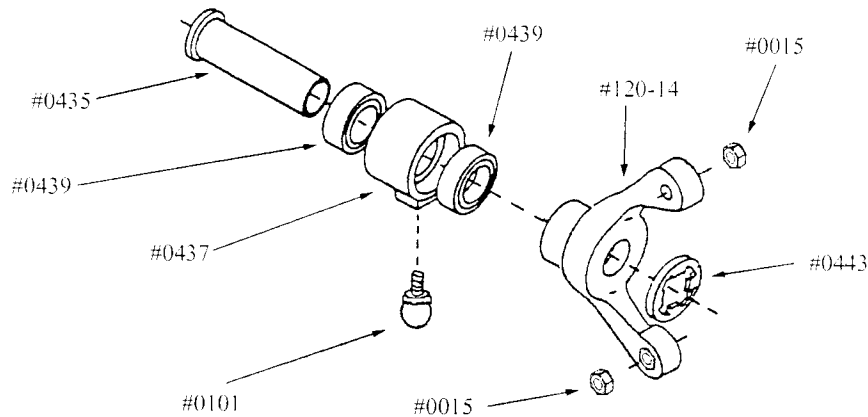
The following will describe the process. If a balancer is not available, select the #0541-8 tail rotor output shaft from the bag #10C. Obtain a large glass with a smooth top rim of at least 90.0mm (3.5”) in diameter. Use the shaft as a pivot point by inserting it into the hub and sliding the hub to the center. The shaft will then sit atop the glass allowing the hub assembly to pivot freely. The proper balance method is called a “four point” balance. Two steps are involved. Always orientate the blade mounts with the threaded control balls 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. If it will not, then examine the amount of excess plastic material that exists next to each threaded control ball. Determine which side appears heavy and use a sharp modelers knife to cut a little plastic away. Usually, a very small amount of plastic must be removed. Second, rotate the assembly until at three and nine o’clock positions. As before, the threaded control balls are opposite each other. If the assembly will not remain at the three/nine o’clock position then you can either add a drop of slow cyanolate to the tip of the light blade mount (just past the blade bolt hole) or select a leftover shim washer from bag 10A and install it with a little cyanolate exactly where the pivot bolt will enter the blade mount to secure the tail blade. Select two #0019 locknuts, two #0097 bolts and two of the appropriate tail 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 “heavy” 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

Bag(s) Required: 10B

Parts Required:	Bag #
2 #0015 M2 hex nut	10B
2 #0049 M2x10 socket bolt	10B
1 #0101 M2x5 threaded ball	10B
1 #0435 Tail rotor pitch slider (brass)	10B
1 #0437 Tail rotor pitch ring (plastic)	10B
2 #0439 M6x10x2.5 ball bearings	10B
1 #0443 M6 retaining ring	10B
2 #0859-16 Pitch links w/bearings	10B
1 #120-14 Tail rotor pitch yoke	10B

Refer to Drawing #10B.



Drawing #10B

- A. Select one #0101 M2x5 threaded ball and one #0437 pitch ring. Install the threaded ball into the pitch ring, use a small amount of slow CA glue. And do not over tighten.
- B. 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.
- C. Select the #0435 pitch slider. Examine the previously prepared #0437 pitch ring. The “boss” which supports the #0101 ball has one side that is rounded. This rounded side will face the flange at the end of the #0435 pitch slider. Slide the #0437 pitch ring fully up to the flange of the pitch slider.
- D. Select the #120-14 pitch yoke. Examine the drawing and note that the angled parts face away from the pitch ring. Slide the pitch yoke onto the pitch slider up to the previously installed pitch ring.
- E. Select the #0443 M6 retaining ring. It is “cupped” and this “cupped” 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 7.0mm (9/32”-5/16”) socket to cautiously tap the retaining ring downward to meet the pitch yoke. 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. Apply a small amount of slow cyanolate glue in the “cupped” area of the retaining ring to lock it in place.
- F. 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 pitch links #0859-16. Mount each pivot by inserting one #0049 m2x10 socket 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 “captured”

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.

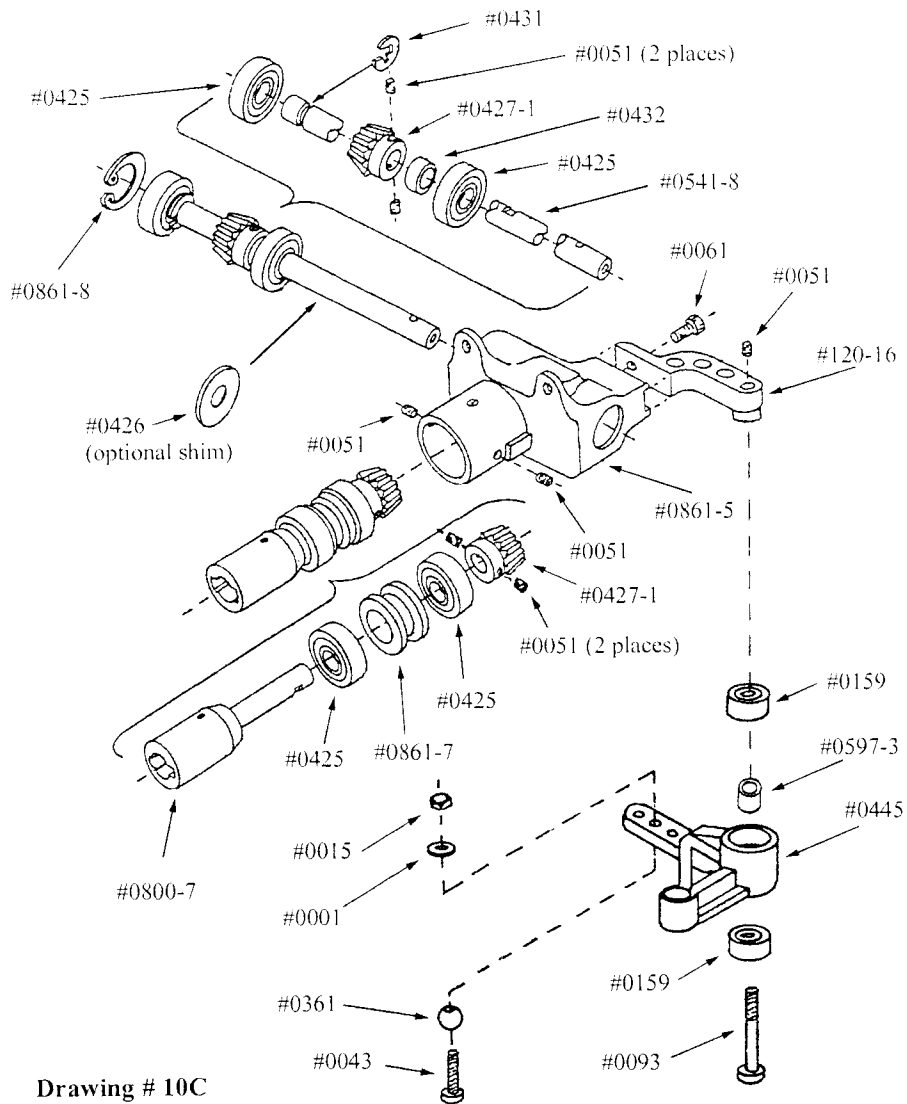
Step 3. Assembling the Tail Rotor Gear Box

Bag(s) Required: 10C, 11A

Parts Required:			Bag #
1	#0001	M2 flat washer	10C
1	#0015	M2 hex nut	10C
1	#0043	M2x10 slotted machine screw	10C
2	#0049	m2x10 socket bolts	10C
7	#0051	M3x3 socket set screws	10C
2	#0056	M3x5 "dog-point" socket set screws	10C
1	#0093	M3x18 special Phillips 12.9 hard pivot bolt	10C
2	#0159	M3x7 ball bearing	10C
1	#0361	M2 control ball	10C
4	#0425	M5x13 ball bearings	10C
2	#0427-1	Bevel gear set	10C
1	#0541-8	Tail rotor output shaft	10C
1	#0431	M5 circlip	10C
1	#0432	M5.0x7.0x3.15 brass spacer	10C
1	#0445	Tail rotor bellcrank	10C
1	#0800-7	Tail rotor input shaft with female universal joint	10C
1	#0587-14	Tail boom "Ultra 33"	11A
1	#0597-3	M3x4.6 brass spacer	10C
1	#0061	M3x8 socket bolt	10C
1	#0426	.005" gear shim	10C
1	#0861-5	C.N.C. T/R gear box housing	10C
1	#0861-7	13mm stepped spacer	10C
1	#0861-8	13mm C-ring	10C
1	#120-16	Fury Extreme bellcrank support	10C

NOTE: The longevity of the shafts and gears within the tail rotor gearbox can be greatly enhanced by "mounting" each with red or green "permanent 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.

Refer to Drawing #10C.



NOTE: Clean the following parts with thinner to remove any oil.

1. This kit also includes a special output shaft gear spacer (#0432). **DO NOT MAKE ANY SUBSTITUTIONS.**
2. 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.

MATERIALS AND TOOLS REQUIRED:

- M1.5 and 2.5 Allen (Hex) tools
- “inside type” Retaining ring pliers
- Green, Blue and Red Loctite

- Suitable grease with thin nozzle or "spring type" applicator (Miniature Aircraft #4707 recommended)
- Small Phillips screwdriver

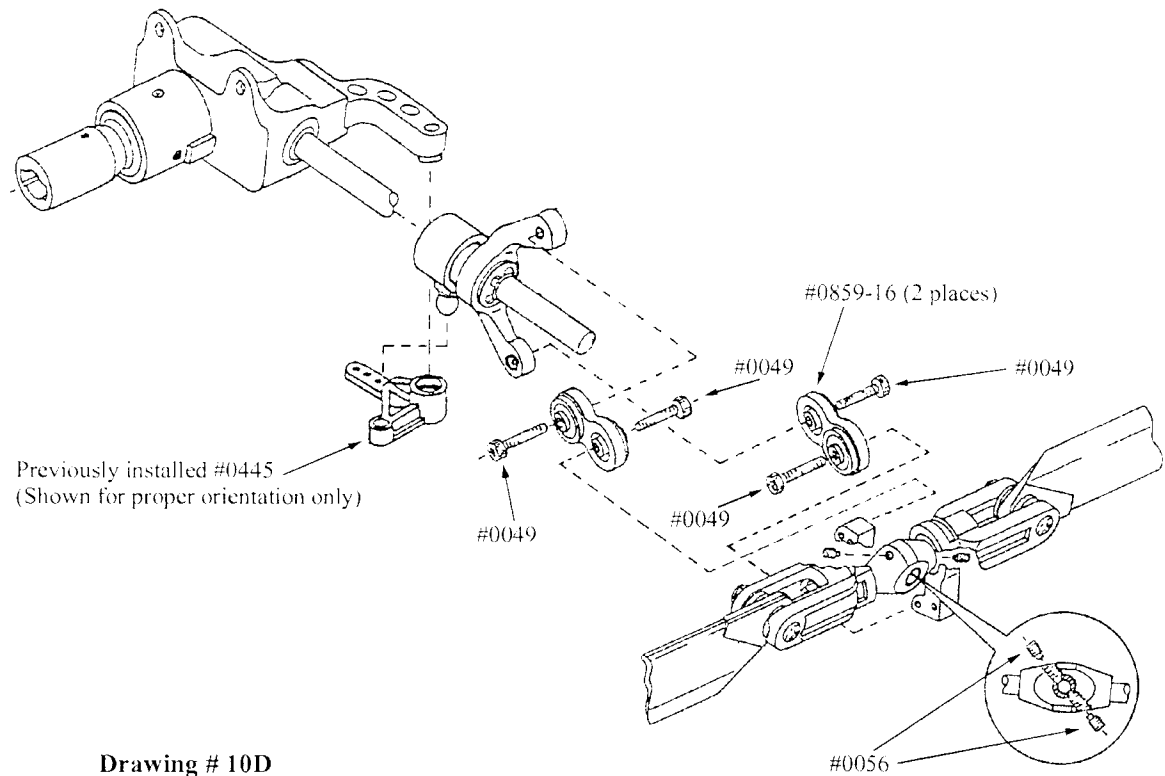
- A. Select the #0861-7 stepped spacer from the parts bag. (Note: At your option, you may choose to "mount" each bearing on the input shaft with green or red Loctite. It is optional at this position and mandatory elsewhere in the assembly procedure). Slide a #0425 bearing, the #0861-7 spacer, another #0425 bearing and the bevel gear onto the #0800-7 input shaft. Press all parts firmly against the Delrin end piece. Prepare two #0051 M3x3 socket set screw with blue Loctite and install them into the gear (making certain that one squarely contacts the "flat" on the shaft). Tighten each with moderate torque. There should be no end play in the assembly.
- B. Select one #0425 bearing and the #0431 "E" clip and the #0541-8 output shaft. Snap the "E" clip 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 to establishing the correct gear position and ultimately applying the required **green** or **red** Loctite to the outermost ball bearing. Prepare one socket set screw with Loctite. Install it into the outer gear #0427-1. Slide the gear onto the shaft so that the set screw is located over the "flat" provided, and lightly tighten the set screw (only enough to allow the gear to move along the "flat"). Slide the #0432 spacer and remaining #0425 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) 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 the bevel gear in the opposite direction along the shaft. Tighten the set screw against the "flat" 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 .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 out put shaft assembly as per the drawing. Reinstall 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 and re-assemble the output shaft. 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. Apply Loctite to **the remaining** socket set screw and install it into the bevel gear. Re-check the tightness of the first set **screw. Always** keep one set screw tight while adding Loctite to the opposite screw. Re-install the output shaft assembly into the gear housing. At your discretion the O.D. of the #0425 bearings may be green Loctited inside the gear case. If you Loctite in place, the disassembly procedure will be more difficult, but the life of the unit will be extended (especially for hard 3D flying).

- C. 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.
- D. Grease is applied through the large diameter hole in the rear of the housing. Use a suitable size syringe (Miniature Aircraft #4707 or #4709 is recommended). This access hole will later be concealed by the bellcrank support arm. **DO NOT ATTEMPT TO FILL THE CASE WITH GREASE** since it serves no purpose. Simply concentrate the grease application towards 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 bellcrank support #120-16 installs by keying it into the groove in the back of the T/R housing #0861-5, it is secured with one M3 socket bolt #0061. Use blue Loctite.

- E. Select one #0597-3 brass spacer, two #0159 m3x7 ball bearings and one #0445 T/R 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 that there are three holes to select from. This kit will utilize the center hole. Insert from the bottom, one M2x10 screw, one M2 control ball and one M2 flat washer, followed from the top, Loctite and one #0015 M2 hex nut. Select the previously assembled pitch slider and one #0093 M3x18 special Phillips pivot bolt. Slide the pitch assembly onto the output shaft with its control ball pointing downward. Press this control ball into the hole provided in the top of the bellcrank, and position the bearings of the bellcrank directly under the mounting hole in the #0861-9 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. Tighten up against the end of the pivot bolt. Use blue Loctite. This acts as a safety, locking the #0093 bolt in position.
- F. 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 its control ball above, the blade mount to your right (three o'clock position) as having its control ball below, and each threaded M3 hole in the hub be at the one and seven o'clock positions. [Note: for future reference, considering the view you now see, the tail rotor blade for the "left (nine o'clock) blade mount" would have its leading edge pointing upward and the tail rotor blade for the "right 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 "dog-point" socket set screws. The term "dog-point" refers to the 2.0mm diameter protrusion at the end. This will directly engage the 2.0mm diameter hole in the output shaft. Prepare each with Loctite and install into the hub and through to 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.
- G. Connect the two pitch pivots #0859-16 to the inward most hole in the arm (the hole in the half circle position on the T/R mount arm) of the T/R blade mounts using two M2x10 socket bolts #0049. Use slow CA glue on the tip of the bolt, taking care not to let any get into the bearings. Tighten securely.

Refer to Drawing #10D (next page)



Drawing # 10D

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

Bag(s) required: 11A - 11D

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

"J-B Weld" epoxy or similar slow cure epoxy, slow cyanolate glue and silicone glue

Small piece of 180 - 22- grit sandpaper

Light oil or Vaseline petroleum jelly.

Step 1. Installing the Tube Drive, Push Rod Guides, and Fins.

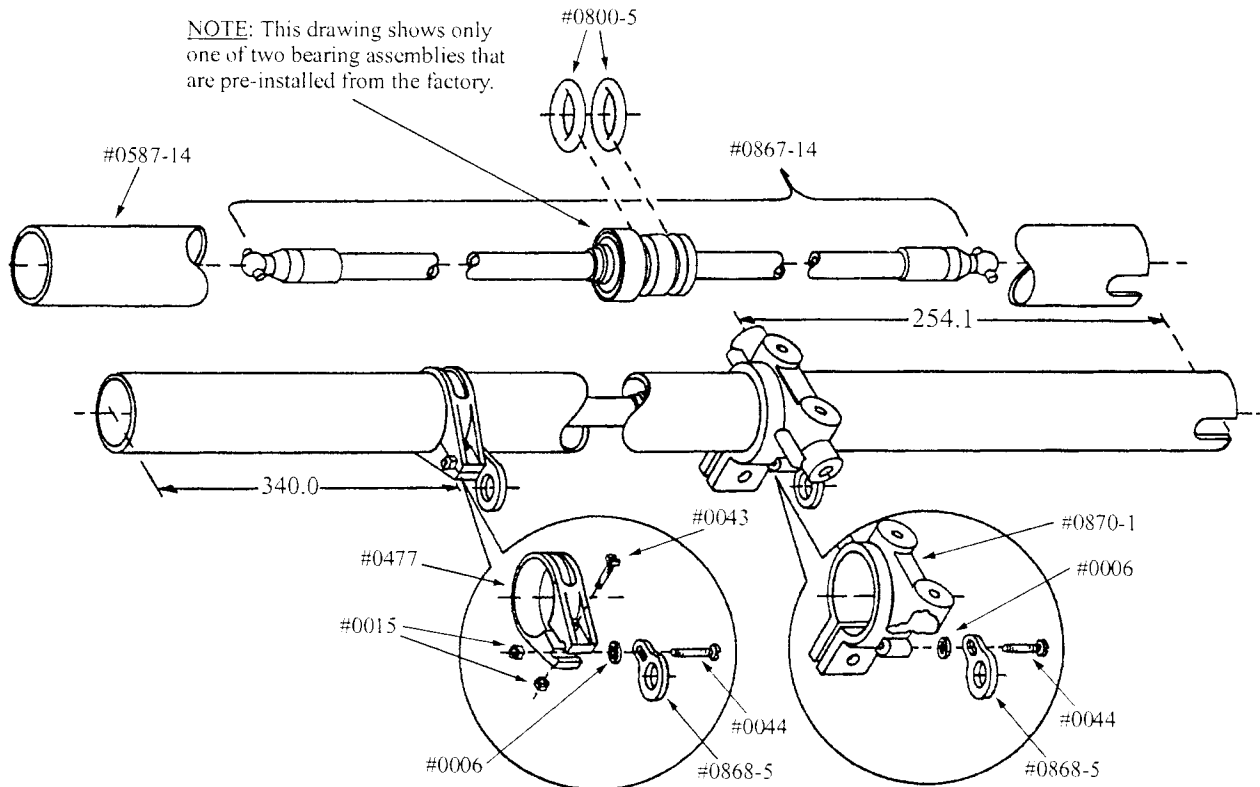
Bag(s) required: 11A, 11B

Parts Required

Bag #

8	#0003	M3 flat washers (large)	11B
2	#0006	M2.5 "toothed" lock washers	11B
2	#0015	M2 hex nuts	11B
3	#0019	M3 hex lock nut	11B
1	#0024	M2.2 x 4.5 Phillips self tapping screw	11B
2	#0027	M2.2 x 9.5 Phillips self tapping screw	11B
5	#0032	M2.9 x 9.5 Phillips self tapping screw	11B
1	#0043	M2 x 10 slotted machine screw	11B
2	#0044	M2 x 12 slotted machine screw	11B
1	#0063	M3 x 10 socket head bolts	11B
4	#0077	M3 x 30 socket head bolts	11B
2	#0113	M3 x 10.5 threaded balls	11B
2	#0186	Front tail boom clamp halves	11B
1	#0477	Pushrod guide support	11B
1	#0589-4	3-D type horizontal fin	11A
1	#0589-5	3-D type vertical fin	11A
1	#0683	Tail rotor gearbox clamp	11B
4	#0800-5	O-rings	11B
2	#0868-5	Pushrod guides	11B
1	#0870-1	Horizontal fin mount	11B
2	#115-20	M5 x 20 hex spacers (gold)	11B
1	#0587-14	Graphite Tail Boom Ultra 33"	11A
1	#0867-14	Torque tube assembly	11A

Refer to Drawing #11A

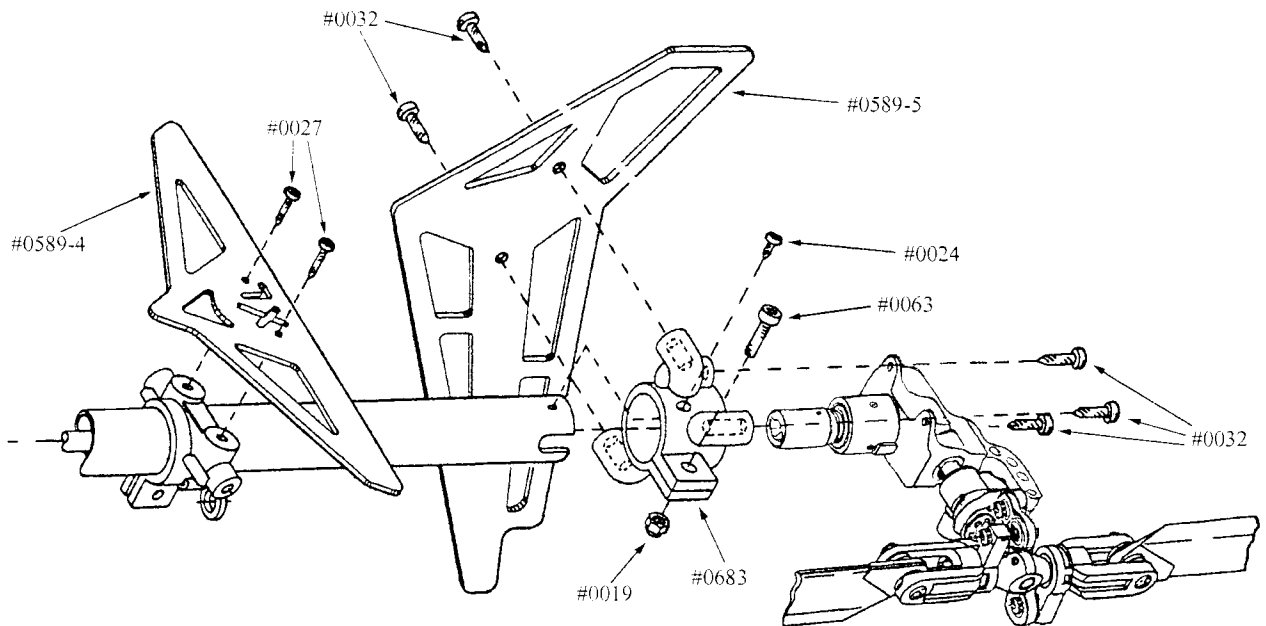


Drawing # 11A

- A. Select the #0867-14 torque tube assembly. The ball bearing at the center is surrounded by a plastic housing which 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.
- B. Select one #0006 M2.5 "toothed" lock washer, one #0044 M2 x 12 slotted machine screw, one #0868-5 pushrod guide and the #0870-1 horizontal fin mount. Examine the drawing and note which side of the horizontal fin mount should be to the left side of the model. The side having the molded "boss" with a 1.5mm diameter hole will be the left and the full diameter of the 1.5mm hole will face the rear. Insert the #0044 screw into the small slot in the #0868-5 guide and slide the #0006 lock washer onto the opposite side. Screw this assembly into the 1.5mm hole at the rear of the fin mount leaving the screw slightly loose to allow adjustment later. Slide the assembled fin mount onto the rear (notched end) of the tail boom, positioning it approximately 254.1mm from the end.
- C. Select one #0006 M2.5 "toothed" lock washer, two #0015 M2 hex nuts, one #0043 M2 x 12 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 340.0mm from the front edge of the tail boom.

As done in step "B", install the remaining #0868-5 guide, #0006 lock washer, #0015 hex nut and #0044 screw into the horizontal hole within the #0477 pushrod guide support.

Refer to Drawing #11B



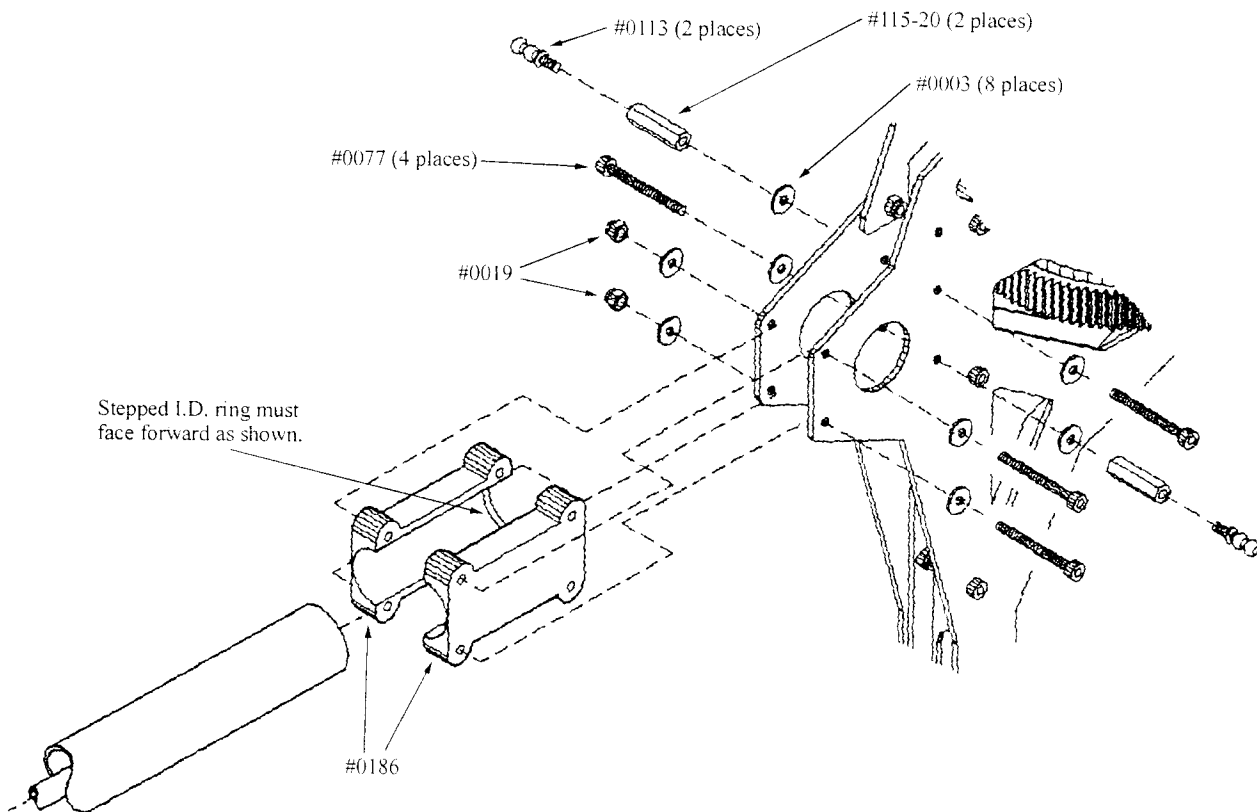
Drawing # 11 B

- D. 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 tailrotor 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 cyanolate glue on each. Do not overtighten. 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.

- E. 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 (.055") drill bit, drill straight downward through the hole and the tail boom. Use light force so that it 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 suggested 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.
- F. Select two #0027 M2.2 x 9.5 Phillips self tapping screws, two #0032 M2.9 x 9.5 Phillips self tapping screws, one #0589-4 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.

Refer to Drawing #11C



Drawing # 11C

- G. Select eight #0003 M3 flat washers, two #0019 M3 hex locknuts, four #0077 M3 x 30 socket head bolts, two #0186 front tail boom clamp halves, and two #115-20 M5 x 20 hex spacers. Examine the drawing and note the hardware securing the front tail boom clamp halves to the main frame. Two of the four bolts are secured with lock nuts while the remaining two bolts thread into hex spacers that will eventually support the rear of the canopy. These two must have Loctite applied on the threads. The position for each hex spacer is important. Viewing the left main frame (directly from the side), note the four holes used for mounting the tail boom. An M3 x 30 bolt and M3 washer will be inserted from this side in each hole except the upper left one. Viewing the right main frame, you will note that only the upper right hole will have a bolt inserted from the right side. In all positions, an M3 washer is always used next to the side frame. Leave all bolts loose.

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 BOOMCLAMP 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 tailboom while tightening all four boom clamp bolts.

- H. Select two #0113 threaded balls. Apply loctite and install one in each previously installed #115-20 hex spacer (from step G).

Step 2. Installing the Tail Boom Supports.

Bag(s) required: 11A, 11C

<u>Parts Required</u>			<u>Bag#</u>
8	#0003	M3 flat washers (large)	11C
1	#0019	M3 hex locknut	11C
4	#0048	M3.5 x 25 socket set screws	11C
1	#0065	M3 x 12 socket head bolt	11C
2	#0093	M3 x 18 special Phillips bolt	11C
4	#0872-2	Molded boom support ends	11C
2	#0079	M3 x 35 socket head bolts	11C
2	#0872-5	Graphite tubes 25"	11A
2	#3923-1	M4.0 x 14.0 x 4.9 round plastic spacers (black)	11C

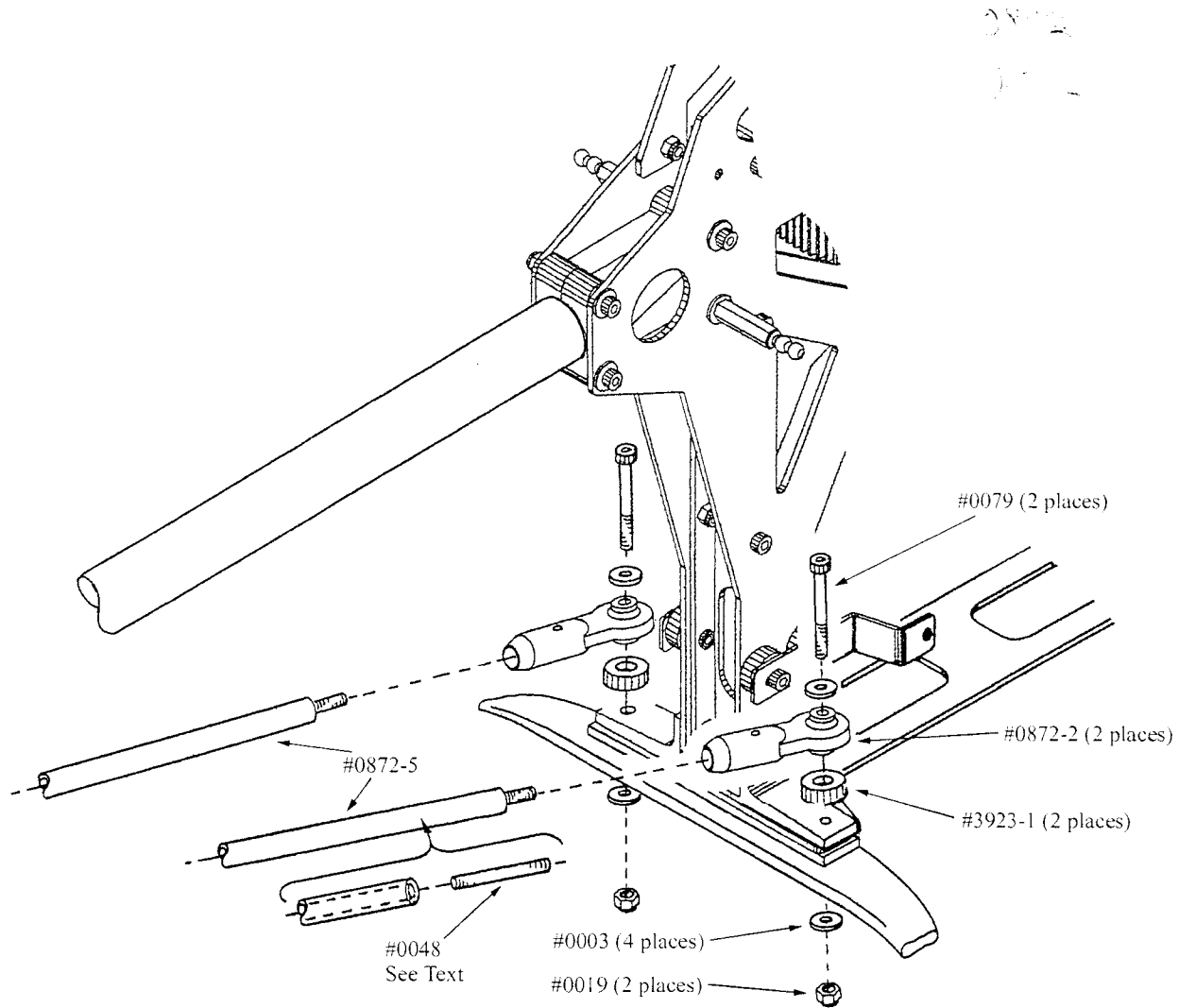
Refer to Drawing #11E and 11F.

- A. Select four #0048 M3.5 x 25 socket set screws and the appropriate graphite tubes for your kit. Clean each set screw and 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 four #0872-2 molded tail 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 part.

Examine the "ball end" of the #0872-2 tail boom support end. The factory installed ball has a molded "boss" or 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.

Refer to Drawing #11D



Drawing #11D

Referring back to section VI step 1B, note the two #0075 M3 x 25 socket head bolts temporarily securing the rear landing gear strut to the landing gear mount. Remove one of these bolts. Select four #0003 M3 flat washers, two #0079 M3 x 35 socket head bolts, two #3923-1 plastic spacers and two of the prepared tail boom brace ends from step (A). Install one washer onto one #0079 bolt and insert into the brace end with the shorter molded "boss" (as discussed in step A) nearest the washer. Slide one #3923-1 spacer onto the opposite side of the brace end and insert

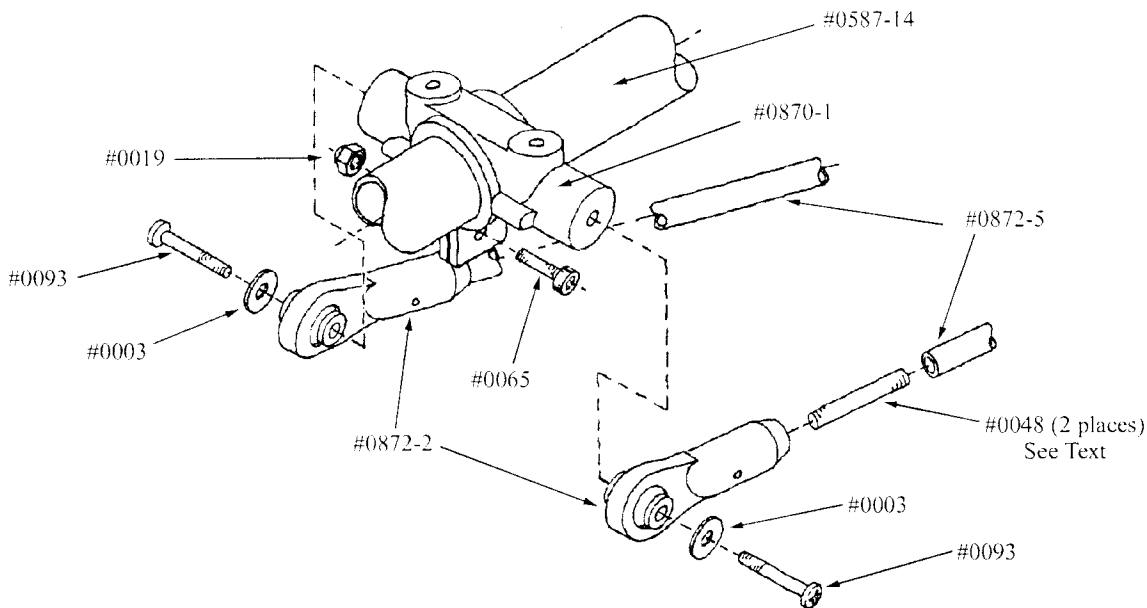
the assembly into the hole within the landing gear previously occupied by a #0075 bolt. Reinstall the washer and lock nut beneath the landing gear strut, remove the remaining #0075 bolt on the opposite side and repeat the above procedure.

- B. Select the #0872-5 and the two remaining prepared brace 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 cyanolate glue. The epoxy allows much more time for the assembly steps while the slow cyanolate glue will allow only a minimum working time. Be prepared if cyanolate 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 up. Repeat for the remaining brace.

Refer to Drawing #11E



Drawing # 11E

- C. Select two #0003 M3 flat washers, two #0093 M3 x 18 special Phillips bolt and the two prepared graphite tubes (from the previous step). It is suggested that both braces best 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 (either at the fan shroud brace or rear strut) 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 and one #0065 M3 x 12 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 you 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

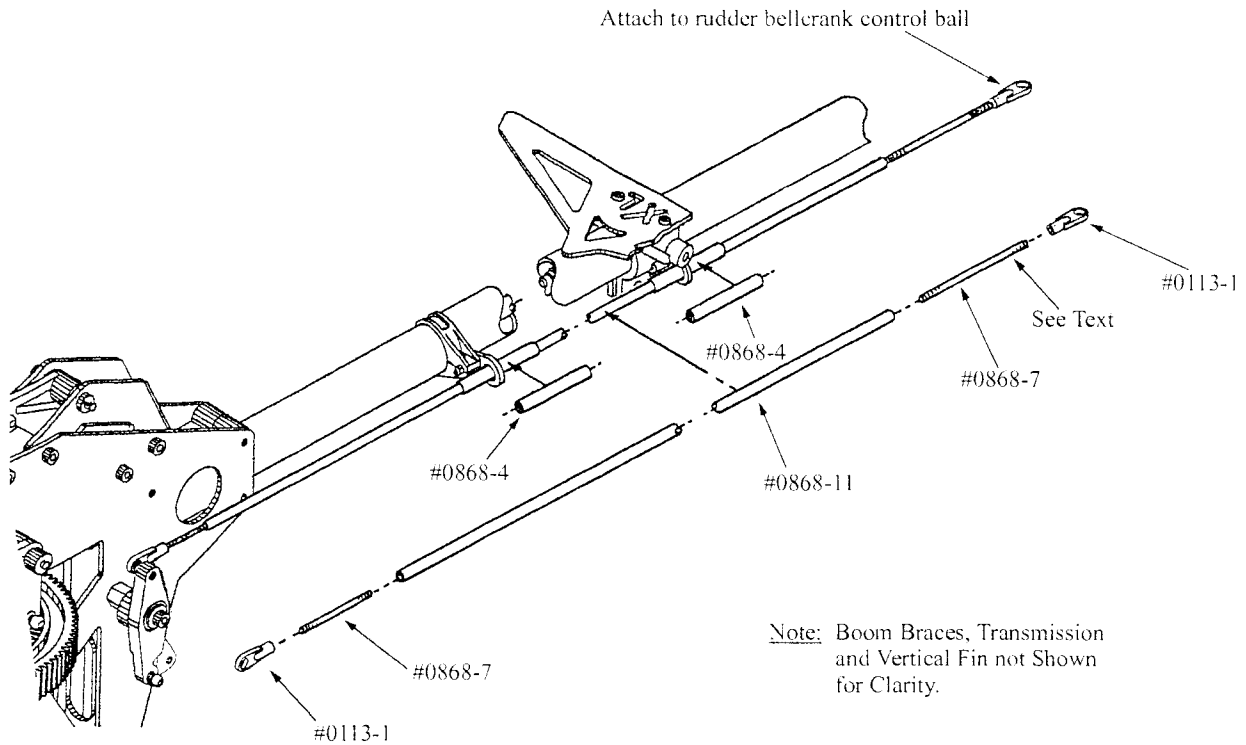
tube fully into the end, align the rear with the horizontal fin mount and reinstall the #0093 Phillips bolt. Repeat the procedure for the opposite side and keep the model vertical until the glue dries. This procedure assures that the tail boom and braces sit straight and without any pre-load induced from their own weight.

Step 3. Installing the Graphite Tail Rotor Pushrod.

Bag(s) required: 11A, 11D

	<u>Parts Required</u>	<u>Bag#</u>
2	#0133-1 Special ball link	11D
2	#0868-4 Heat shrinkable Teflon tubes	11D
2	#0868-7 M3 x 60 threaded stud	11D
1	#086810 Graphite pushrod 31"	11A

Refer to Drawing #11F



Drawing # 11F

- A. Select two #0868-7 threaded studs. Clean each with alcohol or lacquer thinner. Each stud is to be installed into the graphite tube to a depth of 26.0 mm – 26.5mm. Select the #0868-11 graphite tube. 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.

- B.** Select one # 0133-1 special ball link and two #0868-4 Teflon shrink tubes. Slide each Teflon tube onto the graphite tube (final positions to be determined later) and thread the ball link on the longer 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 short threaded end which has no ball link installed) through each previously installed pushrod 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 front belcrank and one to the rear. Temporarily slide each Teflon tube to the ends of the graphite tube so they do not interfere with final adjustment. Adjust each ball link until the front belcrank is vertical and the rear belcrank is parallel with the rear of the T/R transmission case.

Manually operate the pushrod and make preliminary adjustments to each guide so that it operates freely and approximately centered within each guide. If necessary, use two pliers to create up to a 5° angle at the center of the #0868-7 threaded stud (rear of the graphite pushrod).

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

XII. INSTALLING THE RADIO SYSTEM AND PUSHRODS

Bag(s) required: 12A - 12G

Tools or materials required:

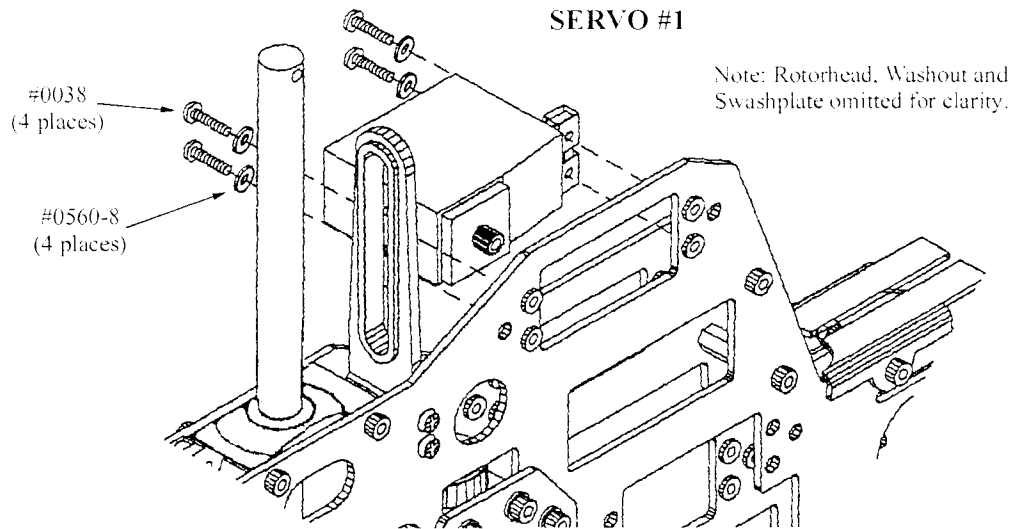
- Small Phillips screw driver
- 1.5mm Allen tool
- small pliers or forceps
- 4 large heavy duty servo wheels or arms
 - (J.R. Super Servo Horn set - purchased separately)
 - (Futaba - 45.0 mm diameter wheel - standard with servos)
- Thick two sided foam tape
- Slow cyanolate glue or epoxy

Step 1. Installing the Radio System.

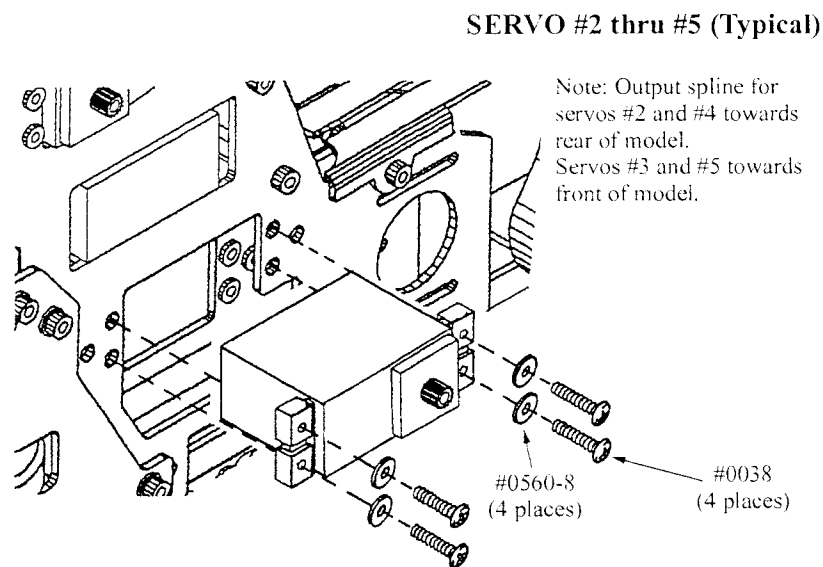
Bag(s) required: 12A

		<u>Parts Required</u>	<u>Bag #</u>
20	#0038	M2.5 x 10 Phillips machine screws	12A
3	#0389	Wire retainers (small)	12A
3	#0390	Wire retainers (large)	12A
20	#0560-8	M2.5 flat washers	12A
2	#115-30A	16.0 x 152.0 mm Velcro (red)	12A
1	#115-30B	16.0 x 305.0 mm Velcro (red)	12A

Refer to Drawing #12A, 12B



Drawing # 12A



Drawing # 12B

- A. All servos mount using #0038 M2.5 x 10 Phillips machine screws and #0560-8 M2.5 flat washers into steel threaded inserts (factory installed) in the side frames. All servos mount to the outside surface of the side frames with the exception of the uppermost servo which mounts to the inside of the right mail frame. Each should be installed with 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.

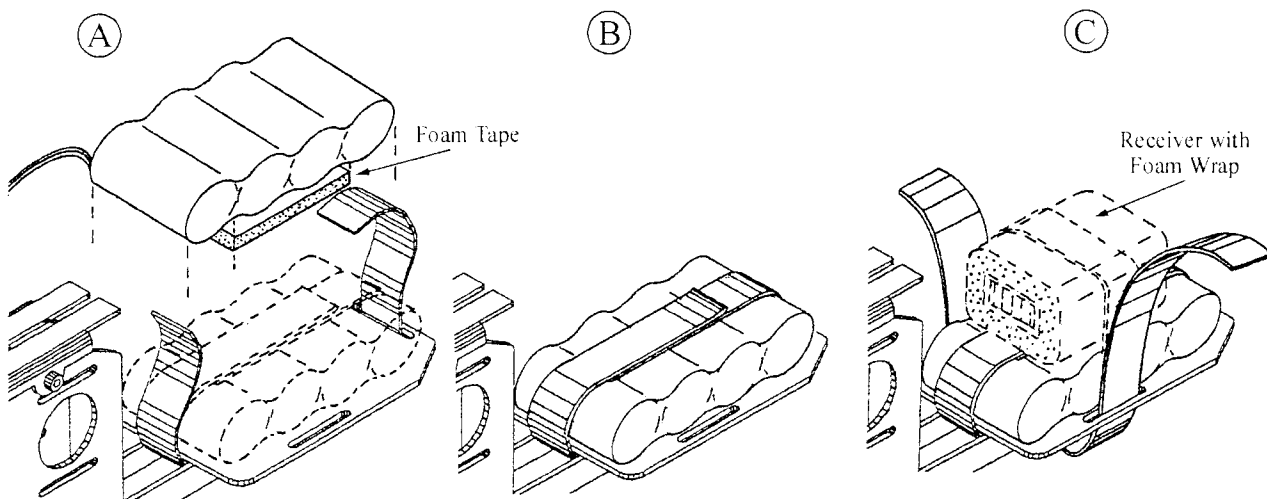
The following chart will indicate the servo number, position, receiver connection and model connection:

<u>Servo</u>	<u>Position</u>	<u>Receiver Connection</u>	<u>Model Connection</u>
#1	Top (right frame)	"Elevator"	Rear Belcrank
#2	Second from Top (left frame)	"Pitch"	Left Front Belcrank
#3	Third from Top (right frame)	"Aileron"	Right Front Belcrank
#4	Fourth from Top (left frame)	"Rudder"	Rudder Belcrank
#5	Fifth from Top (right frame)	"Throttle"	Carburetor

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

Do not install any servo arms at this time.

Refer to Drawing #12C

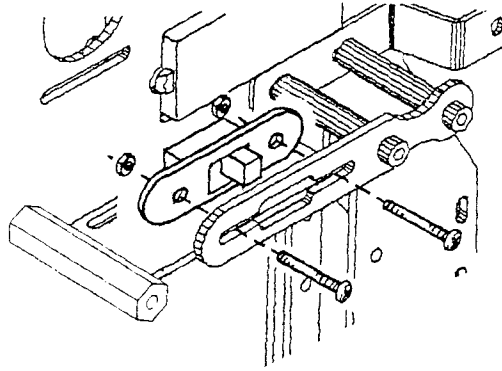


Drawing # 12C

- B.** Select your battery pack (flat type/ 1400 ma or greater preferred). Apply two strips of thick foam tape and fasten the battery squarely on the #115-28 radio/ battery plate (evenly spaced between the Velcro). Wrap the Velcro firmly across the battery.

Wrap your receiver in dense foam. We suggest the M.A./ USA radio installation kit #3051 which includes a foam tube which fits the receiver very nicely. Leave an opening for the servo wiring. Set the prepared receiver atop the battery and secure with the #115-30B Velcro strap (the strap is to be inserted through slots provided in the plate on either side of the battery).

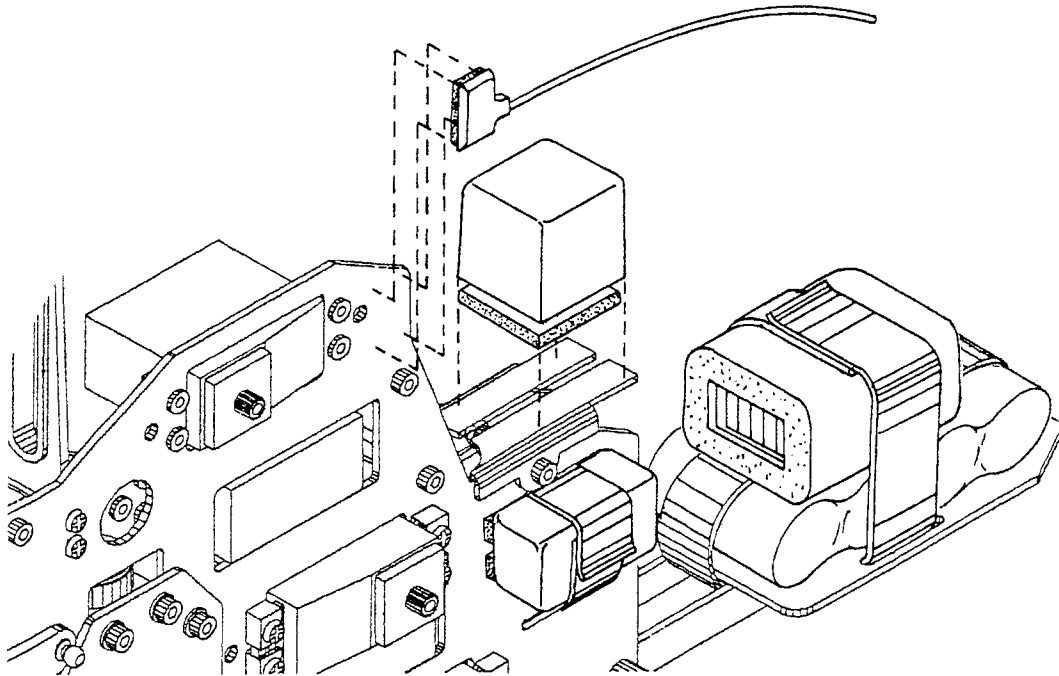
Refer to Drawing #12D.



Drawing # 12D

Install the switch into the #115-62 switch plate, taking care to center the switch so there can be no contact in either the on or off position.

Refer to Drawing #12E



Drawing # 12E

Install the gyro following the manufacturer's instructions. Examination of the left and/or right frame will reveal two horizontal slots on each at the very front. Velcro strips #115-30A are provided to secure any component such as the gyro amplifier or governor to either side frame. Always use thick two sided tape in addition to the Velcro.

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) retainers to secure the wiring. These items will press onto the head of any M3 socket head bolt. The bolts retaining the uppermost #115-20 hex frame spacer are ideal positions to install #0389 for servos #1 and #2. Bolts retaining the gyro mounting brackets are suitable positions for #0390 retainers.

Remote base loaded antennas (such as #4623 for 72 MHz.) are recommended. The “stick-on” types are preferred and provision is provided for mounting this type on the right side frame just in front of servo #1. Do not bundle the antenna lead wire with itself or other wires. Aim the antenna straight forward and curve as needed to clear the canopy inner surface.

Step 2. Basic Radio Programming

Preliminary adjustments must be made to the radio before installing servo arms (wheels) and pushrods. 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 “default” C.C.P.M. settings of 60%.
- Set aileron, elevator and pitch ATV at 100%.

Futaba 8 UMP/ 9Z

- Select SR3 swash type in “model” menu.
- Retain “default” 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

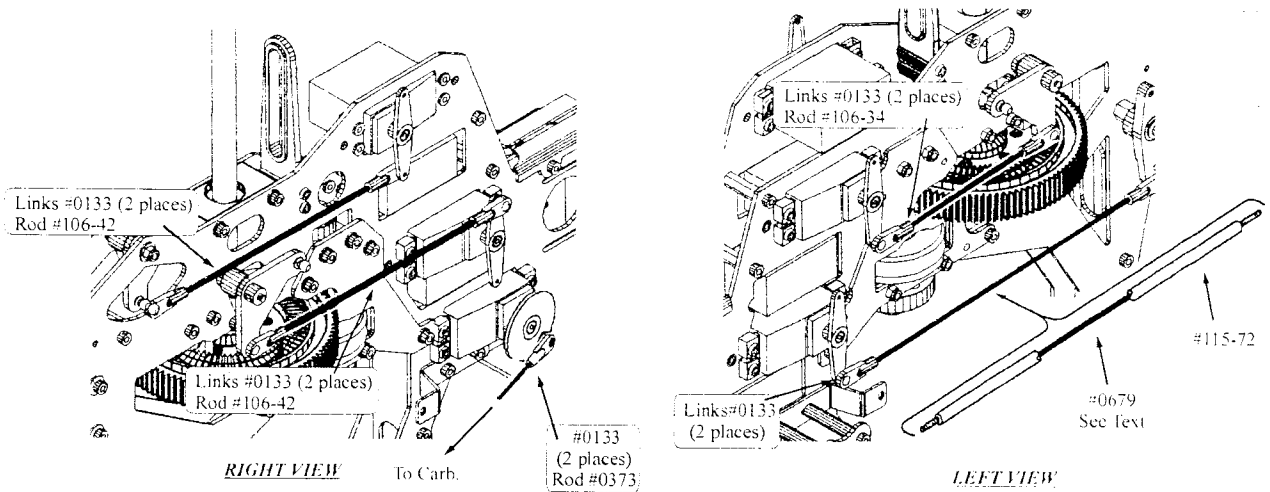
NOTE: Servos 1 - 4 require large servo output positions. For J.R., use the heavy duty J.R. Super Servo arms (available as an option from J.R. in a package of five) in the outer hole (20.0 mm from the center screw). For Futaba, use the large 45.0 mm diameter wheel (included with all Futaba servos) in 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 “neutral” position before proceeding. For purposes of simplicity, the described procedure will assume a “3-D aerobatic type” set up. 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. Servo #5 is set at neutral by adjusting 50% throttle in the throttle curve center point and placing the throttle stick at the center of it’s travel.

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

Refer to Drawing #12F.



Drawing # 12F

Servo #1

<u>Parts Required</u>			<u>Bag #</u>
1	#0015	M2 hex nut	12B
1	#0103	M2 x 5 threaded ball	12B
2	#0133	Ball links (long)	12B
1	#106-42	M2 x 115 push rod	12B

Select the #106-42 pushrod and two #0133 ball links. Install each ball link and adjust to the preliminary length of 103.5 mm (measured as the amount of pushrod 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 beneath and on a vertical centerline 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 right side frame) and secure from the outside with Loctite and one #0015 M2 hex nut. Install the arm, leaving the retaining screw out for Step 6. Snap the prepared pushrod in place connecting the servo to the rear swashplate bellcrank.

Servos #2 and #3

<u>Parts Required</u>			<u>Bag #</u>
2	#0015	M2 hex nuts	12C
2	#0103	M2 x 5 threaded balls	12C
4	#0133	Ball links (long)	12C
1	#106-34	M2 x 87 pushrod	12C
1	#106-42	M2 x 115 pushrod	12C

Select the #106-34 pushrod and two #0133 ball links. Install each ball link and adjust to the preliminary length of 70.5 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 "neutral"). Contrary to servo #1, servo #2 utilizes the control ball to the outside (away from the left frame). Select and install one #0015 hex nut and one #0103 control ball with Loctite. Snap the prepared pushrod in place connecting the servo to the left cyclic bellcrank.

Select the #106-42 pushrod and two #0133 ball links. Install each ball link and adjust to the preliminary length of 102.5 mm.

As with servo #2, the arm for servo #3 must be the correct size. Contrary to servos #1 and #2, servo #3 requires the control ball be on the center line directly above the arm retaining screw. As with servo #2, this servo will utilize the control ball outside the servo arm, and away from the right frame. Select one #0015 M2 hex nut and one #0103 control ball and install in the arm with Loctite. Snap the prepared pushrod in place connecting the servo to the right cyclic belcrank.

Servo #4

		<u>Parts Required</u>	<u>Bag #</u>
			12D
1	#0015	M2 hex nut	12D
1	#0103	M2 x 5 threaded ball	12D
2	#0133	Ball links (long)	12D
1	#0679	M2 x 170 pushrod	12D
1	#115-72	M4 x 150 graphite tube	12D

Select the #0679 pushrod, the #115-72 graphite tube and two #0133 ball links. Install one ball link on one end of the pushrod to a depth of about 7.0 mm. Wipe the pushrod with alcohol and apply slow cyanolate or epoxy about 10.0 mm long at the center of the pushrod. Slide the graphite tube over the pushrod and install the remaining ball link, tightening it fully against the graphite tube. Align each link in the same orientation and wipe away any excess glue.

Servo #4 requires identical orientation, arm length and ball position at neutral as servo #2. Select and install one #0015 M2 hex nut and one #0103 control ball as indicated. Snap the prepared pushrod in place connecting the servo to the rudder belcrank.

Servo #5

		<u>Parts Required</u>	<u>Bag #</u>
2	#0015	M2 hex nut	12E
2	#0103	M2 x 5 threaded ball	12E
2	#0133	Ball links (long)	12E
1	#0373	M2 x 130 pushrod	12E

Select two #0133 ball links and the #0373 pushrod. This pushrod had extended thread surfaces and may be too long for some applications. To determine the correct length, measure the exact distance from the servo #5 (throttle) spline hole to center point of the carburetor barrel. Subtract 18.0 mm from this distance. The result will be the total desired length of the #0373 pushrod. If any material must be cut, do approximately half at each end. Install two ball links and adjust so that holding the prepared pushrod up to the original measuring points (the servo center screw hole and the carburetor barrel center point) will show each directly on center and visible through the hole in each ball link.

Select a servo control arm or wheel which is equal or greater in length from center to output hole as compared to the same measurement on the carburetor control arm. With the servo at "neutral" (50% throttle curve of your transmitter and the throttle stick at the center of it's travel) position the servo arm so that it's output is visually perpendicular to a line connecting the servo spline to carburetor arm mounting bolt centerline. Determine the position of the carburetor barrel at 50% throttle and attach the carburetor arm with the same criteria. Install one #0015 M3 hex nut and #0103 control ball in each arm using Loctite.

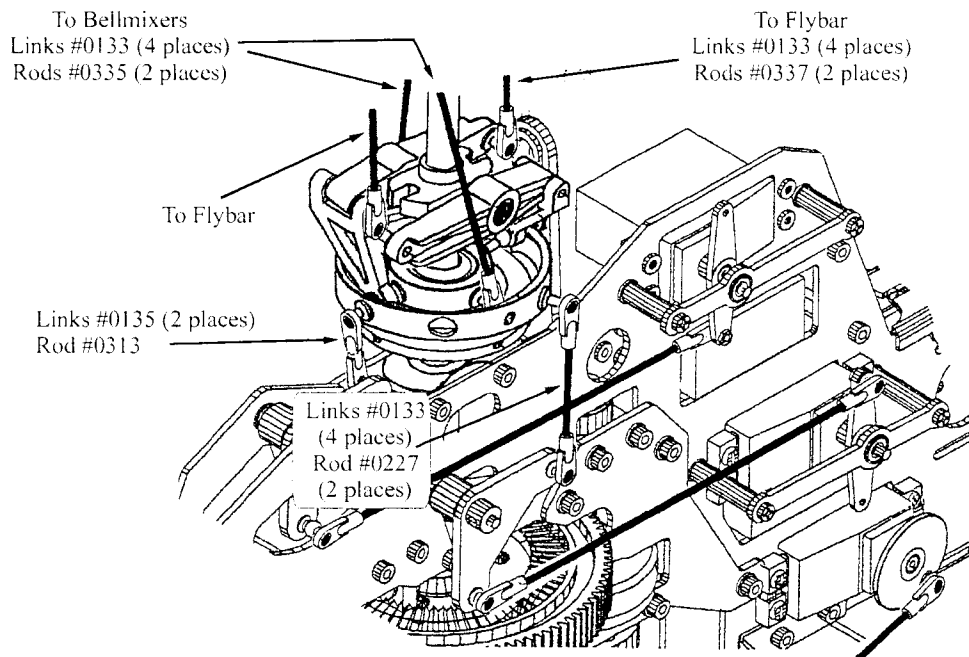
NOTE: Due to variations in carburetor design, make the determination as to if the carburetor control arm ball should be inside or outside the carburetor arm based on which will provide a straighter pushrod orientation when viewed from above.

Snap the prepared pushrod in place connecting the servo to the carburetor.

Step 4. Installing the Swashplate Lower Pushrods

		<u>Parts Required</u>	<u>Bag #</u>
4	#0133	Ball links (long)	12F
2	#0135	Ball links (short)	12F
2	#0227	M2 x 42 pushrods	12F
1	#0313	M2 x 10 pushrods	12F

Refer to Drawing #12G



Drawing # 12G

- A. Select four #0133 ball links and two #0227 pushrods. Install two links on each pushrod, adjusting each until 26.0 mm (if calipers are used make them 25.2mm each) of pushrod is exposed between the links. Snap each prepared pushrod onto a forward facing control ball on the outer swashplate ring and the corresponding bellcrank below. Orientate each ball link on each pushrod so each link is uniformly centering on it's respective control ball.
- B. Select two #0135 ball links and the #0313 M2 x 10 pushrod. Install each ball link, adjusting each until 0.5mm (if using the 25.2mm length on the #0227 rods, adjust this rod until no rod is exposed between the ball links) of pushrod is exposed between them and the links are orientated perpendicular to each other upon the pushrod. Snap the prepared pushrod in place connecting the rear control ball on the outer swashplate ring with the rear bellcrank.

Step 5. Installing the Rotor Head Pushrods

		<u>Parts Required</u>	<u>Bag #</u>
8	#0133	Ball links (long)	12G
4	#0135	Ball links (short)	12G
2	#0313	M2 x 10 pushrods	12G
2	#0335	M2 x 75 pushrods	12G
2	#0337	M2 x 27 pushrods	12G

Refer to drawing #12G.

- A. 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 #0107 control ball of the #0221 washout arms.
- B. 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 outer ball (in position farthest from the blade holder) 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.
- C. 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.
- D.

Step 6. Installing the ball bearing servo output supports.

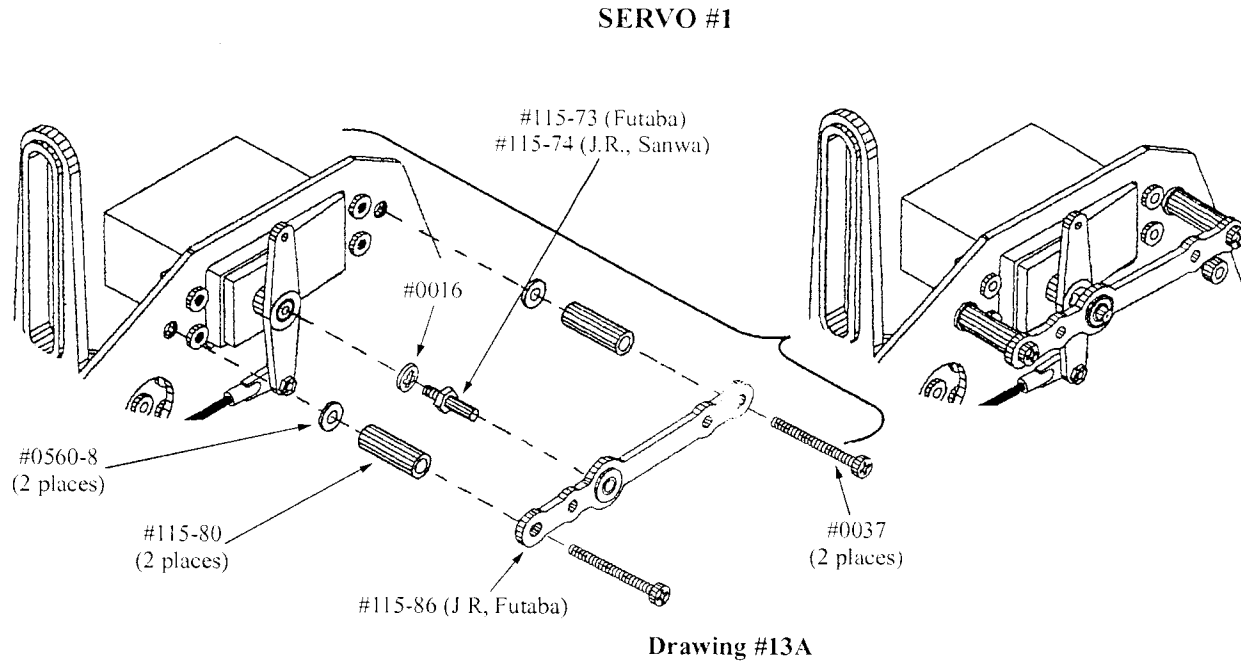
Bag(s) Required: 12H

Important note: Futaba and Hi-Tech servos require an M2.6 threaded fastener/bearing pivot (#115-73) for retaining the servo wheel and J.R./Sanwa require an M3.0 threaded fastener/bearing pivot (#115-74). Do not make any substitutions for the correct parts or a failure could occur.

Parts Required:		Bag#
4 #0016	M3"intenal toothed" lock washers	12H
2 #0037	M2.5x25 Phillips screws	12H
6 #0037-1	M2.5x30 Phillip screws	12H
4 #115-73	M2.6 pivot stud (Futaba , Hi-Tech)	12H
4 #115-74	M3.0 pivot stud (J.R./Sanwa only)	12H
2 #115-80	M2.8x4.5x16.5 spacer tube	12H
6 #115-82	M2.8x4.5x23.0 spacer tube	12H
4 #115-86	Servo output support plates with ball bearings (J.R./Sanwa, Futaba)	12H
8 #0560-8	M2.5 flat washers	12H

Note: for any application utilizing Futaba servos, the appropriate Futaba servo wheel must be modified for clearance as shown in drawing 13C. Position each servos #1 - 4 at neutral and modify each wheel at this time. A Dremel tool with coarse sanding drum is most useful for this procedure. Refer to drawing 13C.

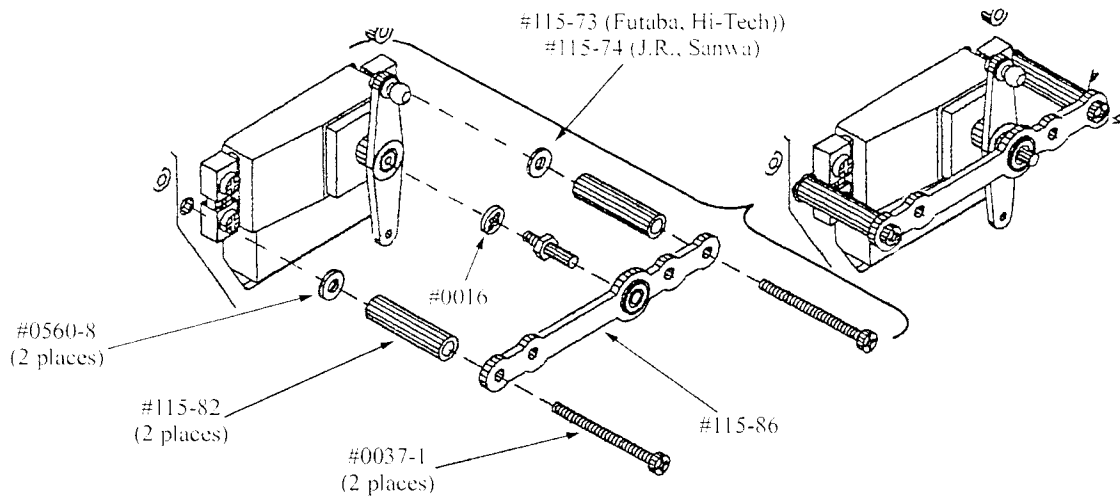
Refer to drawing #13A



- A. Installation on servo #1. Select one appropriate pivot stud (#115-73 for Futaba / Hi-Tech or #115-74 for J.R./Sanwa) and one #0016 lock washer. Remove the factory supplied screw retaining the servo arm (wheel) and install the pivot stud and lock washer in it's place. Select the two #0037 M2.5x25 Phillips screws, the two #115-80 spacer tubes, support plate #115-86 and two #0560-8 M2.5 flat washers. Examine the support plate and note the flanged side of the ball bearing. This flange **must** face the servo arm (wheel). Press the support plate (with ball bearing) onto the pivot stud about one quarter the length of the stud. Each end of the support plate is secured to the right main frame by a #0037 M2.5x25 screw, a #115-80 spacer tube and a #0560-8 M2.5 flat washer. The washer **must** be next to the frame. Install the hardware at each end with Loctite and moderate torque. Note: allow the support plate to "center" itself before simultaneously tightening the screws to avoid inducing a "pre-load" to the servo.

Refer to drawing #13B. (next page)

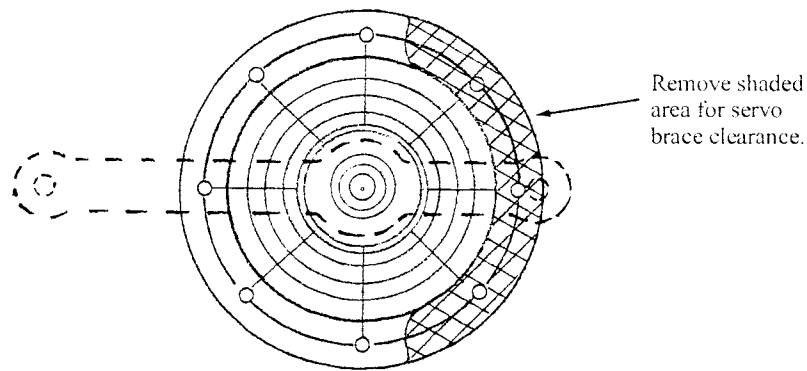
SERVO #2 thru #4 (typical)



Drawing #13B

- B. Installation on servos #2 through #4. The procedure for these servos is the same except that all spacer tubes and corresponding screws are changed. The longer spacer tubes #115-82 and screws #0037-1 are used.

Futaba Servo Wheel Modification



Drawing # 13C

PREPARING THE CANOPY

Bag(s) required: 13A

Tools or materials required:

Slow cyanolate glue

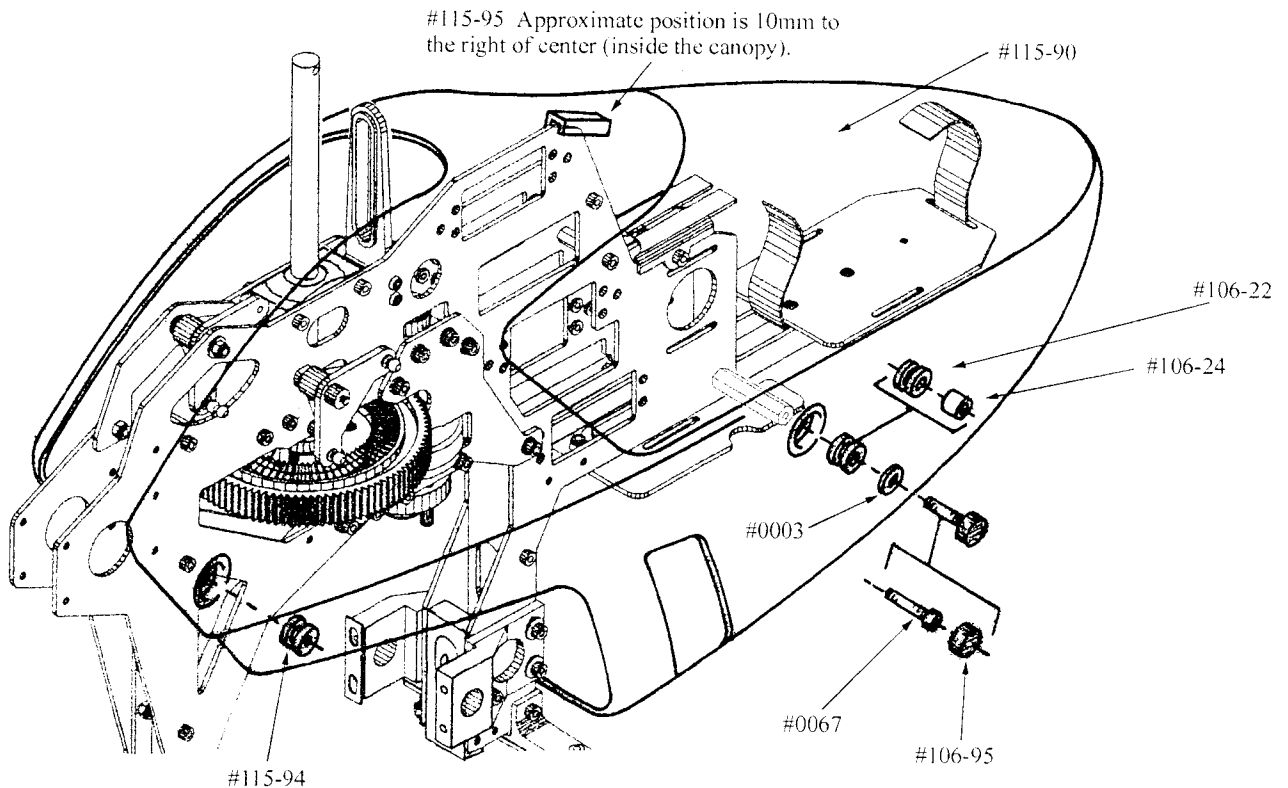
(Optional) Painting materials (See text supplied with the decal sheet)

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

		<u>Parts Required</u>	<u>Bag #</u>
2	#0003	M3 flat washers (large)	13A
2	#0067	M3 x 14 socket head bolts	13A
2	#106-22	Rubber grommets (large)	13A
2	#106-24	M3.0 x 5.0 x 5.3 spacers	13A
2	#106-95	Plastic thumb screw caps (Previously assembled on the #0067 socket head bolts listed above)	13A
1	#115-90	Canopy	Box
2	#115-94	Rubber grommet (small)	13A
1	#115-95	1" Rubber channel	13A

Refer to drawing #14



Drawing # 14

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

- A. Select two #106-22 rubber grommets (large), two #106-24 graphite spacer tubes, and the canopy. These "larger" grommets install in the forward holes in the canopy. Insert one grommet into each hole. Go to the inside and secure the perimeter of each grommet to the canopy with cyanolate glue. The #106-24 graphite spacer tubes must be glued into the center of each grommet. An easy method

is to slide one spacer onto a small screw driver or Allen tool (2.5 mm) until it reaches the handle and stops. Apply a little cyanolate to it's outer surface and use the tool to insert it into the grommet. Repeat the procedure for the remaining side.

Select two #115-94 rubber grommets (small). Install one in each rear canopy hole, securing each on the inside with cyanolate glue.

- B.** *NOTE: Some flyers prefer to glue the channel to frame instead of the inside of the canopy. Either method will work sufficiently.* Examine the drawing, noting the location of the rubber channel #115-95 on the top edge of the right main frame. This channel's purpose is to keep the upper side of the canopy centered in relation to the main shaft and swashplate. A very small amount of silicone glue or goop may be applied to the inside of the channel ends to temporarily keep the channel in position on the upper frame. Trial fit the canopy in to position. Check to see if the grommets in the canopy need to be shifted. Do so at this time. Once satisfied. Apply silicone glue, goop or slow c.a. to the top side of the rubber channel #115-95. Re-install the canopy and hold in position with masking tape or spacers until dry. Glue all grommets as described in step "A".
- C.** The following procedure is used to install the canopy: holding the canopy in the window area with one hand, lightly spread the rear section with the other hand while sliding the canopy rearward over the mechanics (the front of the canopy can remain slightly higher than it's final mounting position during this procedure). Snap each rear grommet onto the stand-offs at the rear. Center the top of the canopy with respect to the swashplate and press downward, engaging the rubber channel (from step "B") onto the right frame and bringing the front grommet downward into alignment with each front stand-off. Install each prepared thumb screw with an M3 flat washer into each front grommet and stand-off. Note, a small mark at the top of the canopy, in line with the right frame, is helpful in aligning the top of the canopy. Also, a little grease on the #0113 threaded balls makes it easier to slide each grommet all the way to the inner ball and extends the life of the grommet.

Step 2. Canopy Finishing Suggestions

At your option, the canopy can be used in the "white" 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 "white" 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.

Choices:	<u>Clear-coat method</u>	<u>Non Clear-coat method</u>
Characteristics:	High gloss, best decal protection, slightly increased weight.	Quick completion, shorter decal life, lightest weight.
<u>Procedures:</u>		
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 detailed. If you wish to smooth it further, apply ¼" masking tape (in two layers thick) on both sides of the seam and sand with 400 grit wet-or-dry paper. If overall pointing is chosen, imperfections in the seam can be filled with glazing putty or similar material.	
Step (2)	Scuff overall with Scotchbrite abrasive pad or fine steel wool. Wipe again with cleaner.	Mask area surrounding the "window", scuff window area with Scotchbrite pad or fine steel wool and wipe again with cleaner.
Step (3)	Mask area surrounding the "window" and spray with color of choice. Remove masking.	Spray window area with color of choice. Remove masking.

(Decal Application)

Choices:	<u>Dry Method</u>	<u>Wet Method</u>
Characteristics:	Quick, only one opportunity to position decals.	Slower, easy repositioning of decals.
<u>Procedures:</u>		
Step (4)	Carefully cut decals from sheet using sharp scissors or a clean modelers knife. Study decal application sheet for suggested positioning,	
Step (5)	Apply decals and firmly burnish to canopy surface using the decal backing paper and firm finger pressure.	Apply window cleaner to canopy, position each decal and remove excess liquid with a soft rubber squeegee. Allow to dry . Canopy is completed.
Step (6)	Wipe the canopy with a tack cloth and apply clear-coat of choice by first applying a very light "tack" coat (allowing it to dry 15-30 min.) followed by a wet coat. Canopy is completed.	

NOTE: After reading the above suggestions and making your choice, please consider the following list of optional materials:

3M Scotchbrite pad or fine steel wool
and ¼" masking tape
Strong detergent
Masking paper or newspaper
Alcohol or paint prep solvent (such as Dupont #3919 prep-sol)
"Tack" cloth

Paint selection - Paint must be chosen to be fuel proof or compatible with fuel proof clear-coat. 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 coats.

XIV. Rotor Blade Selection

It is recommended that a blade length of 690mm to 710mm be used. A good quality rotor blade is suggested. Miniature Aircraft offers a variety of high quality rotor blades suitable for the Fury Extreme.

XV. FINAL MECHANICAL AND ELECTRONIC SET-UP

NOTE: The following procedures will be described using a pitch gauge, flybar 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.

- A. Install the rotorblades, 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 flybar 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 flybar more than 25.0mm (1.0"). These are approximate values.
- A. Install a flybar lock onto the rotor head. Install a pitch gauge onto one rotorblade.
- C. Set all transmitter trim levers and servos/bellcranks at neutral as described in Section XII, Step 2. The swashplate 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 a straight-edge or bubble level placed across the top surface of the swashplate outer ring. The final confirmation is done at the rotorblade. 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° position (starting directly over the tailboom for example).

NOTE: Adjustments should be split at opposite sides (half turn longer on the left side, half turn shorter on the right side, for example). Do not adjust the short rod at the read of the swashplate to exceed 2.0mm of exposed pushrod. If this much is required please repeat Section XII, Step 3.

- D. The flybar paddles must now be aligned with the swashplate. This can be confirmed by visually comparing the paddles to the swashplate from the side view. Some pitch gauges will adapt to the paddles or you can use the X-Cell paddle gauges #0510-1. The flybar lock can be removed for this step if tilting the flybar helps your view. Adjust each pushrod connected to the flybar control arms simultaneously (if one is lengthened, shorten the other the same amount).
- A. 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 de-activated later (prior to flight). As a novice or expert, you will benefit by having the desired “zero” or “neutral” mechanical set-up which results from using the 3-D settings as a starting point.

	<u>Low</u>	<u>Half Stick</u>	<u>Full</u>	<u>RPM</u>
Basic/Hovering	-2° (20%)*	+5 (50%)	+8° (90%)	1500
Mild Aerobatics/ Autorotation [Idle-up ⁽¹⁾]	-4° (60%)	+4° (60%)	+10° to +11° (100%)	1700-1800
3-D [Idle-up ⁽²⁾]	-10° to -11° (100%)	Zero (50%)	+10° to +11° (100%)	1700-1800

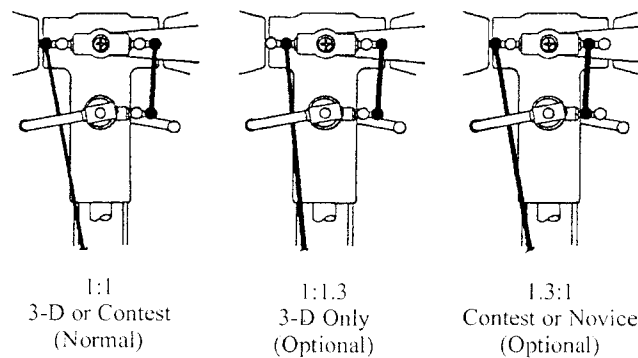
*(Approximately throttle settings)

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 bellmixer) 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 readjust 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.

- B. Cyclic pitch can now be set. With the flybar lock and pitch gauge in place, position the rotor head so that one blade is directly over the tailboom. 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 “aileron,” reading the pitch at each. The result should be ±6 degrees (7 degrees can be used by expert pilots for 3-D). Adjust AFR as needed. Rotate the rotor head so that the flybar is directly over the tailboom and repeat the process for “elevator.”
- C. Dual rates for aileron, elevator, and/or rudder can be set at 60% if desired. These can be fine tuned at anytime.
- D. Set the throttle settings to approximate those shown in the chart.

- E. (Optional). Various aspects of the flight characteristics can be altered to suit your individual needs. Each involves the set-up of the rotor head. The "normal" set-up has been described thus far. Each possible variation is listed below:
- Bell mixer ratios. The bell mixers supplied with your kit have three ratio choices available. The drawing shows the choices and characteristics. Each should only be evaluated after you're very familiar with the characteristics of the "normal" set-up.

Refer to drawing #15



Drawing # 15

Rotor head dampening. The rotor head can be stiffened with the addition of one #0329 spacer on each side next to the #0331. The #0329 shims are available separately at your dealer. Maximum allowable stiffness is determined at hover or during autorotation (in breezy wind conditions). If the rotor is too stiff, an "oscillation" or left/right "rocking" motion will occur. If so, the RPM is not suitable for the chosen stiffness and an adjustment must be made. Slightly increasing the RPM or removing the shim is required.

XVI. FINAL ASSEMBLY AND BALANCE

Part(s) Required:

Exhaust system

- Install the exhaust system as per the manufacturer's instructions. In the case of all popular motors, except the Y.S..61, install a section of fuel tubing from the pressure fitting of the muffler (or manifold) to the fuel tank vent fitting. It is suggested that a fuel filter be installed in this tube to avoid any exhaust system debris from entering the fuel supply. Arrange the tubing (by adjusting its length) so it does not interfere with any moving parts on the model. Also be sure the canopy will not rub an abrasive edge against it. If necessary, a "heat shrink tubing" "protective sleeve" can be added or tie wraps can secure the tubing away from interference.
- Lift the model by the flybar (near the head) and note its balance. With empty fuel tank and canopy installed, the rear of the skids should be slightly higher than the front when supported over a level surface. If needed, adjust the radio/battery from Section IV, Step 1B to suit. Normally with popular components, the model should not require any lead added but some exhaust systems combined with

lightweight battery packs may cause a balance problem. The model will not perform properly if tail heavy.

XVII. FINAL INSPECTION

- A. Recheck overall for loose fasteners, interfering components, or incorrect radio installation. Operate all radio controls making certain that none are reversed and that the throttle can properly close the carburetor. Be certain the gyro functions in the correct direction.

XVIII. PRE-FLIGHT INFORMATION

- A. At home:
 - 1) Be sure you have all necessary equipment to operate or service the model.
 - 2) Be sure all batteries are fully charged.
- B. At the flying site:
 - 1) Observe any flying site rules.
 - 2) Check the frequency board or nearby pilots to clear your frequency.
 - 3) Range check your radio as per the manufacturer's instructions.
 - 4) Pre-check all controls.
 - 5) Obtain assistance from more experienced pilots if possible.
 - 6) Never leave the transmitter in a position that would allow it to be handled or upset while you are starting the model.
 - 7) Check your battery status whenever possible. Most factory shipped batteries can only sustain three "tank-full" flights before needing a re-charge. Do not take any unnecessary risks. Always turn off all components between flights.

XIX. STARTING AND STOPPING PROCEDURES

TO START: Always start the engine by using the transmitter trimmer only (*high* throttle trim, *low* throttle stick). Check idle-ups and throttle hold for proper position of switches (off). Connect the glow plug battery connection selected to the engine glow plug. Connect the starter to the 12v battery and check that it operates in a counter-clockwise rotation, viewing the model from above. Hold the rotor head firmly with one hand. Engage the starter extension of the starter with the shaft or adapter on top of the engine and rotate. When the engine starts remove the starter and glow plug battery.

TO STOP: Set the transmitter throttle stick and trimmer to its lowest setting. If it does not stop but is running slow enough to halt the rotor blades, then do so and remove the fuel line to stall the engine. In this case, re-adjust throttle ATV until engine may be stopped by use of a transmitter trimmer. (After daily use of your model, we recommend the use of an after run oil for engine protection). *Never attempt to stop the blades while they are rotating.*

XX. FIRST FLIGHT ADJUSTMENTS

- A. Before flying double check direction of each control; tail rotor compensation direction and gyro direction. The first few flights should be limited to hovering only.
- B. Engine Carburetor Settings: With the engine running, set the idle adjustments to enable the engine to maintain a rich reliable idle (trying to four cycle) at low throttle, mid to high trim. Set the high speed needle to accelerate, but slightly rich. The motor should transition smoothly from high rpm's to low rpm's during the flight of the helicopter. Short duration vertical climbs to test the top end are the safest method to get the high speed needle valve setting close.

Throttle and Pitch Curve: After the needle valves are adjusted, the model can be trimmed for hover. The throttle curve should be adjusted so that the model is almost to the hover head speed just above quarter stick. This helps the model lift off smoothly and also allows you to do slow vertical descents without the engine dropping out. The throttle curve above half stick should also be adjusted so that slow vertical ascents can be made without the engine speeding up or slowing down. Simultaneously adjust the hover

pitch and hover throttle for the desired hovering RPM at half stick. Next adjust the high and low side of the normal pitch curve until the model has the collective response you want in a hover.

- C. Tail Rotor Trimming: Adjust tail rotor trim as per your gyro instructions.
- D. Tail Rotor Compensation For Torque: (Note: Not require if you own a heading lock gyro). All adjustments are made from hover (at least 15' height) with a "trimmed" tail rotor. When properly adjusted the model should not rotate to the right or left when ascending or descending. See your radio manufacturers instruction manual.
- E. 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.
- F. Main Rotor "Dynamic" 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 rods (#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 1/2" or more re-check original pitch settings.
- G. Setting Top Pitch: Adjust the top pitch on your *idle-up* functions so that the model will fly at full throttle and maintain proper head speed. Too much top end pitch/ too low RPM tends to be "pitchy" and unstable.

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

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