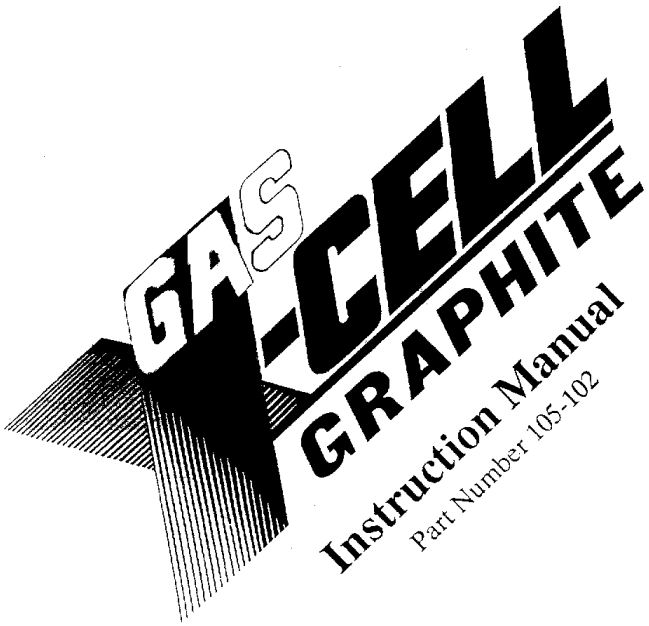


# Instruction Manual

Part Number 105-102

# R/C HELICOPTER SAFETY

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

A model helicopter must be built exactly in accordance with the building instructions. The kit manufacturer has spent much time and effort refining his product to make it reliable in operation and easy to build. The essentially bolt-together construction can proceed quite rapidly, giving the builder a strong sense of accomplishment that encourages too-rapid progress from one construction phase to the next, so that the completed model can be more quickly seen and enjoyed.

It is essential to recognize and guard against this tendency. Follow building instructions exactly. Use only original parts - even single screws - and consider no alterations. Vibration and stress levels are high and all fasteners and attachments must be secure for safety in operation.

Note that this is the first use of the word SAFETY in these comments. Previously the kit manufacturer's efforts to ensure RELIABLE operation were mentioned. That is ALL that he can do. Safe operation is the responsibility of the builder/flyer and starts with careful construction and continues with selection and installation of reliable radio equipment, engine, and fuel system, and the proper use of starters and other support equipment.

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

## GUIDELINES FOR SAFE R/C HELICOPTER FLIGHT

1. Fly only at approved flying fields and obey field regulations.
2. Follow frequency control procedures. Interference can be dangerous to all.
3. Know your radio. Check all transmitter functions before each flight.
4. Be aware that rotating blades are very dangerous and can cause serious injury. Always hold the rotor head while starting the engine and do not release until at the take off point.
5. Never fly near or above spectators or other modelers.
6. If a beginner, get help trimming the model, and flight training later.
7. Don't "track" the main blades while holding the tail boom. This is a temptation to builders who cannot hover yet and is very dangerous.
8. Follow all recommended maintenance procedures for model, radio, and engine.



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*X-CELL*

WARRANTY REGISTRATION

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

Model No:_____ Serial No:_____ Price Paid:_____

Owners Name:_____ Age:_____

Address:_____

City:_____ State:_____ Zip:_____

Purchased From:_____

Dealer's Address:_____

_____

Comments:_____

_____

**NOTE:** In the X-Cell Gas Graphite Manual page 51, Section XVIII, Paragraph B, reference is made to engine carburetor settings. This paragraph refers the builder to review the Zenoah Quartz G-23 Instruction Manual for initial needle settings. It is our recommendation that all settings be done according to the Zenoah Manual except for the high speed setting. We recommend a high speed setting of 1 to 1-1/2 turns counter clockwise.

**NOTE:** If the muffler supplied with you Zenoah Quartz G-23 has a exhaust extension tube greater then 1 inch in length, we highly recommend the excess to be removed.

MINIATURE AIRCRAFT USA
3743 SILVER STAR ROAD
ORLANDO, FLORIDA 32808
U.S.A

## WARNING

This helicopter is not a toy, but a complex flying machine that must be assembled with care by a responsible individual.

Failure to exert care in assembly, or radio or accessory installation, may result in a model incapable of safe flight or ground operation. Rotating components are an ever-present danger and source of injury to operators and spectators.

A word of warning, new laws are in effect concerning transportation on commercial airlines any item containing or utilizing gasoline as a fuel system. Check with your local airlines concerning these matters.

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**
3743 Silver Star Road
Orlando, FL 32808

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FAX (407) 292-4296

# XL-GAS GRAPHITE SERIES HELICOPTER

## INTRODUCTION

*Congratulations!* You have just purchased the highest quality Helicopter kit available and one which will build up in a short time into the finest flying helicopter on the market today!

There -- the conventional introduction has been taken care of!

If you just skimmed through it, that's fine. It was there just to get you up to speed anyway. Be warned, however, that is one of very few paragraphs that you dare skim through in this Construction Manual!!

We won't list all of the features of the helicopter here either. You probably read our brochure before buying the kit and it lists over forty impressive features. If you gave your copy to a friend, there is another in the kit. After you refresh your memory, give this one to another friend.

Briefly, this is a light weight, beautifully performing chopper that is ruggedly built of quality materials embodying state-of-the-art design and engineering. This Construction Manual will attempt to do justice to it. Read on.....

## SYSTEM REQUIREMENTS

*In addition to the kit, you will require:*

### *1. A Helicopter Radio with 5 Servos*

Typically, such a radio provides 5 or more channels to control Fore and Aft Pitch (Elevator); Roll (Aileron); Yaw (Rudder); Throttle; and Collective Pitch (changes pitch of both main blades together to vary lift). Throttle and Collective Pitch servos are controlled together by the normal throttle stick movement. This arrangement not only provides adequate servo power for all functions, but also allows important channel mixing functions to be provided by the transmitter.

In any event, it is recommended that any system used incorporate powerful, precise centering, ball bearing servos in order to realize optimum performance from this very responsive helicopter.

### *2. A Rate Gyro*

Probably the one advance in model helicopter technology that contributes most to easy and enjoyable flight is the insertion of an "angular rate sensitive" gyroscope in the yaw (rudder) servo lead from the receiver. This device senses even minute swings of the helicopters nose (yaw) left or right and makes immediate corrective inputs to the tail rotor servo to counteract these movements. This action is not to be confused with that of an "autopilot" in that it does not keep the helicopter pointed in one direction. The amount of its corrections depends on how sharply the nose begins to swing - a small correction for a small amount, or a larger correction for a larger amount. In other words, the gyro response varies with the angular rate of change, which is why this particular type of gyro is called a "rate" gyro as distinguished from a "position" gyro.

The important effect is to make the helicopter much easier to control, and it is highly recommended that a gyro be used in the X-CELL. Miniature Aircraft, USA has offered rate gyros to modelers since their inception and currently stocks units ideal for all helicopter use.

It is essential to have your Radio and Engine on hand before beginning kit construction because they will be needed fairly early in the building sequence. The Gyro is not important at this time, except that the gyro control switch box is easier to install early.

## CONSTRUCTION

The XL-Gas Graphite has been designed for easy and straight-forward assembly but, like any precision device, considerable care should be taken and work should progress in a methodical and orderly fashion.

Please read these instructions thoroughly, prepare your work place, and get all required tools together before you begin.

## THE KIT PACKAGE

The kit includes detailed drawings showing all parts - with numbers - in proper relation to each other in easy to understand subassemblies. Also included is a detailed pictorial fastener list, radio and servo installation, and set-up data such as exact push rod lengths where possible, and a metric scale for your convenience. Metric hardware is used because its design and quality are superior for use in precise mechanisms.

By taking out just the major parts and the bag of small parts called for in any assembly step, confusion between similar parts and fasteners can be minimized.

Also in the box will be a small bag of spare parts such as nuts and bolts. A package containing Allen wrenches and certain other special tools needed for construction is also included.

## TOOLS REQUIRED

In addition to the tools listed below, it is quite important to have a good place to work. An actual workbench is not needed because no metalworking (filing, etc) is required and just the blades and fiberglass canopy require material removal and sanding operation. Your work table should, however, be protected from marring by the various metal parts used.

Screwdrivers - both slotted and cross-recess (Phillips Head) #00, #1
Long-Nosed Pliers
Tweezers
Hand Drill with appropriate bits
Dremel Power Tool or equivalent
Small Fine File
5.5mm Open End Wrench (can be 7/32")
7mm Open End Wrench (can be 9/32")
Allen Wrenches (supplied in kit)
Appropriate Socket Wrench for your engine shaft nut
Vinyl Two-Sided Servo Tape 1/8" (#3869)
Scissors
Slow Zap (#4917)
Thin Cyanoacrylate Glue (#4881)
Loctite (MA/USA) thread lock liquid (supplied in kit)
(**NOTE:** Use only the material supplied or its EXACT equivalent)
Masking tape, Paint for finishing Canopy, 80 and 220 Grit Sandpaper
Heat Gun (Monokote type)
Grease, Teflon Filled (Order #4709 - 2 oz tube, or #4707 - 1 oz syringe)
Tri-Flow Teflon Oil (Part #4801)
J.B. Weld Epoxy (#4853)

In addition, the following will make assembly easier and prove useful later, in your model toolbox:

Ball Link Application Tool (part #0529)
5.0mm Nut Driver (#4669)
5.5mm Nut Driver (Socket on a Handle) (#4670)
7mm Nut Driver (#4671)
Fly-Bar Alignment Kit (#0510)
Universal Swashplate Lock (#0512)
1.5mm Allen Wrench on a Handle (#4651)
2.0mm Allen Wrench on a Handle (#4653)
2.5mm Allen Wrench on a Handle (#4655)
3mm Allen Wrench on a Handle (#4657)
Ball Link Pliers (Part #0545)
Pitch Gauge (Part #0526)
Flybar Lock (Part #0505)
Tail Rotor Blade Balancer (Part #3750)

These tools can be obtained from your local hobby shop, or ordered directly from Miniature Aircraft, USA.

## ASSEMBLY INSTRUCTIONS

The instructions to follow will build up subassemblies and incorporate them in the helicopter in a logical sequence. The subassemblies will be clearly recognizable on the main drawing as will the parts and fasteners used. Take a few minutes to carefully study the entire drawings before beginning assembly. Note that the drawings include a series of "exploded" views which show the various subassemblies with the individual parts shown unassembled but in relative positions which make obvious the manner in which the parts fit together to create the subassembly.

Each assembly step will begin with an exact list of parts required including locations in the kit box where appropriate. There is essentially no difference in assembly operations. It will be helpful to have a small dish, or box available in which to place the small parts, bolts and nuts for each step for easy access. Any special tools required will be called out in the text.

**NOTE:** Beginning the assembly sequence with the Rotor Head rather the basic Main Frame Structure may seem unusual but allows the use of the engine start/clutch shaft as a very effective alignment tool to facilitate Rotor Head assembly before the shaft itself is assembled.

## ASSEMBLY SEQUENCE

### I. ROTOR HEAD ASSEMBLY

STEP 1. Install The Pivot Block and the Head Button into the Head Block
2. Final Assembly of the Fly-Bar Yoke and Guide Pins
3. Building and Installing the Bell Mixers
4. Assemble and Install the Main Blade Mounts
5. Add the Fly-Bar, Control Arms and Paddles
6. Assembly of Flybar Paddles

## II. BUILDING TOP MAIN FRAME SECTIONS

STEP
1. Assemble Aileron (Roll) Bellcranks to Main Frames
2. Assemble Elevator Servo Graphite Mount
3. Assemble Elevator (Fore and Aft) Swing Arm Unit
4. Assemble Front Tail Drive Transmission
5. Install Antirotation Arm, Lower Mainshaft Bearing Block, Tailboom Support Halves, Front Frame Plate and the Clutch Shaft Bearing Block
6. Mount Lower Frames, Gyro Mounting Plates and the Upper Mainshaft Bearing Block.

## III. ASSEMBLY OF MAIN SHAFT COMPONENTS

STEP
1. Installing the Mainshaft, Autorotation Unit with Maingear
2. Assembling Swashplate
3. Assembling Lower Swashplate Control Rods and Anti-Rotation Arm Pushrod
4. Assembling Wash-Out Unit

## IV. ASSEMBLING ENGINE COMPONENTS

STEP
1. Mounting the Pull Starter
2. Mounting the Flywheel, Fan Shroud and Rear Motor Mount

## V. BUILDING AND INSTALLING THE CLUTCH SYSTEM

STEP
1. Assembling the Clutch to the Clutch Bell
2. Install the Clutch Bell Assembly
3. Installing the Engine, Lower Frame Rails and Gyro Plate

## VI. BUILDING AND INSTALLING THE LANDING GEAR

## VII. RADIO TRAY ASSEMBLE AND SERVO INSTALLATION

STEP
1. Installation of Radio Tray Supports
2. Assemble Plastic Tray and Install Servo's
3. Mount Servo Tray to Mechanics
4. Installing the Elevator Servo and the Gyro Motor Assembly

## VIII. GAS TANK INSTALLATION

STEP
1. Build the Gas Tank
2. Mounting the Gas Tank

## IX. ASSEMBLE THE TAILROTOR TRANSMISSION

STEP
1. Assemble Tailrotor Hub and Blade Holders
2. Assemble Pitch Slider and Bell Crank
3. Assemble the Gear Box
4. Install Assembled Tail Rotor Hub

X. **BUILDING THE TAIL BOOM**

STEP 1. Install Tube Drive
2. Installing Tailrotor Pushrod Guides, Fin Mounts and Push Rod
3. Install Twin Boom Supports

XI. **INSTALLATION OF REMAINING RADIO EQUIPMENT, ASSEMBLING AND INSTALLING PUSHRODS**

STEP 1. Install the Switch for the Receiver, Gyro, Radio Receiver, Battery and the Antenna
2. Setting up the Tailrotor Servo
3. Install the Elevator Servo Pushrod
4. Install the Aileron and Collective Pushrods
5. Install the Throttle Pushrod
6. Install the Rotor Head, Flybar and Hiller Control Rod

XII. **CANOPY PREPARATION**

STEP 1. Mounting Clear Lexan Window
2. Mounting Canopy
3. Installation of Thumb Screw Plastic Caps

XIII. **BUILDING THE ROTOR BLADES**

STEP 1. Assembling the Blade Mounts
2. Adding the Lead Strips
3. Initial Balance
4. Cover Blades
5. Final Balance of Blades and Rotor Head

XIV. **FINAL MECHANICAL AND ELECTRONIC SET-UP**

STEP 1. Setting Up the Collective Servo
2. Final Swashplate and Flybar Alignment
3. Adjusting the Pitch Curves
4. Adjusting Swashplate Throw
5. Adjusting TailRotor
6. Gyro
7. Elevator and Aileron Dual Rates and ATV's

XV. **FINAL ASSEMBLY AND BALANCE**

XVI. **FINAL ASSEMBLY AND INSPECTION**

XVII. **NECESSARY FLIGHT ITEMS**

XVIII. **FIRST FLIGHT ADJUSTMENTS**

XIX. **STARTING AND STOPPING THE ENGINE**

## I. ROTOR HEAD ASSEMBLY

**NOTE:** At the builders discretion the bearings and shaft in this section may be glued together using Loctite (red, green, or blue). If you choose to do this the disassemble process will become very difficult and will require the application of heat to break down the glue.

### Step 1. Install the Pivot Block and the Head Button into the Head Block

Parts Required:

| | | |
|---|---|---|
| 2 | #0033 M3x5 Phillips Machine Screws | Bag 1B |
| 1 | #0289 Head Block | Bag 1A |
| 1 | #0294 Long Pivot Block | Bag 1B |
| 2 | #0301 Pivot Ball Bearings | Bag 1B |
| 2 | #0563-1 Brass Inserts | Bag 1B |
| 2 | #0563-2 M3x8 Socket Set Screws | Bag 1B |

***Refer to Drawings # 1.***

**A.** Clean the I.D. of the pivot ball bearings #0301 and the long pivot block #0294 using a paper towel and some thinner. At builders discretion apply a very small amount of loctite to the shaft on both sides of the pivot block. Slide the bearings all the way on the block, one on each side. (If necessary, tap into place, applying force only to the inner race.)

**B.** Identify the two small holes recessed at the end of the middle bore in the #0289 head block and squarely thread an M3x5 Phillips head screw #0033 into one hole until it seats. Do not over-tighten. Slide the pivot block unit into the middle bore from the other end until it seats against the screw head previously installed. Thread the other M3x5 phillips screw into the remaining hole until it seats and traps the pivot block assembly. Neither screw should be so tight as to bind the bearings. Instead, they should be adjusted equally so that neither end play nor binding exist.

**C.** **Installing Static Tracking Screws**

**Purpose:**

To allow adjustable static tracking of the rotor head due to slight variations in blade height at the tips by eliminating any looseness about the mainshaft due to wear or stretching of the base of the head block.

Special Tools Required:

1 Small Hammer

Examine the head block #0289 closely. On each side (at the base) just above where each #0297 pin is installed, you will notice a hole molded in the plastic.

Select an M3 bolt from the spare parts and screw it 3/4 of a turn into the knurled end of one of the brass inserts (#0563-1). Hold this straight with respect to the hole and use light tapping pressure on the bolt head (with a small hammer) to start the insert into the hole. When you are satisfied that the insert has started into the hole straight, remove the M3 bolt and use the hammer to set it flush with the head. Due to it's slotted construction and knurled edge, the brass insert will "set" itself firmly into the plastic. No Cyano is required. Repeat

the process on the other side.

Again, using an M3 socket-head bolt from your spares, it is now necessary to test the threads. Screw the bolt into the insert slowly. It will have some resistance and possibly squeak a little. This is fine since this process will spread the insert deeper into the sides of the hole. Remove the bolt and repeat on the other insert.

Start each set screw #0563-2 and screw in until it is flush with the surface of the rotor head. Final adjustment will come after the main rotor blades have been mounted.

**Step 2. Final Assembly of the Flybar Yoke and Guide Pins**

Parts Required:

| | | | |
|---|---|---|---|
| 4 | #0063 | M3x10 Socket Head Bolts | Bag 1C |
| 2 | #0115 | M3x10.5 Threaded Balls | Bag 1C |
| 2 | #0292 | Flybar Yoke Halves | Bag 1C |
| 2 | #0296 | Pivot Block Spacers | Bag 1C |
| 2 | #0297 | M2.5x24 Guide Pins | Bag 1C |
| 2 | #0298 | Delrin Bearing Cups | Bag 1C |
| 2 | #0299 | Flybar Bearings (M4x10) | Bag 1C |
| 2 | #0339 | Delta III Plates | Bag 1C |
| 1 | #0509 | Large Head Button | Bag 1C |

***Refer to Drawings # 1.***

**A.** Rotate the pivot block until the cross hole is squarely visible through the side slots in the head block (it may be held in this position using the clutch shaft of the clutch assembly #0267). Slide one #0296 plastic spacer onto each end of the exposed shafts from the pivot block #0294. Holding the pivot block cross hole level within the head block and press one #0292 flybar yoke half (rounded side outward) fully onto each end of the pivot block. Align each flybar yoke half with the "tool" leveling the pivot block. This step is important but not critical since the through hole in the pivot block is only a "clearance hole" for the flybar to pass through.

**B.** Examine each #0298 Delrin bearing cup. Note that one side is made to accept an #0299 (M4x10) bearing with a snap fit. Insert one #0299 bearing into each bearing cup, making sure that it is fully seated. Select both #0339 delta offset plates. The O.D. of each #0298 bearing cup is designed to snap into the delta offset plate. Install one into each plate.

For your convenience, temporarily apply a small piece of tape on each side of the rotor head block and designate one side as the left side and one as the right side. Examine each delta offset plate carefully. You will see that each is symmetrical with the exception of a protruding end with an M3 threaded hole. Holding the rotor head block with the left side facing you, position one delta offset plate up against one end of each flybar yoke half (aligning each un-threaded hole in the plate with each flybar yoke half hole) with the M3 threaded hole offset to your right. Install two M3x10 socket head bolts with a small amount of slow cyano through each delta offset plate and into each flybar yoke half. Be sure that the bearing faces outward. Rotate the head block 180° and repeat the process. This pivot block/delta plate assembly should now pivot freely and the through hole in the pivot block should be in alignment with each M4x10 bearing.

Apply a small amount of Loctite to each #0115 threaded ball and install them from the outside into each delta offset plate. Note that each will slightly scuff against the head of the nearest M3x10 socket head bolt during installation. This will not cause any problem. Be sure each #0115 ball is fully tightened.

C. Drive the two #0297 guide pins into the bottom holes in the head block until they seat solidly. (They will project about 16.0mm when seated.) **NOTE:** The lower 8mm of the pins #0297 may be roughened with 80 grit sandpaper and press in place with epoxy or slow cyano.

**D.** Using either a X-acto knife or 220 grit sandpaper, rough up the top of the head block around the center hole and the bottom portion of the head button #0509 where the two parts will make contact. Apply a small portion of Slow Zap to the head button only! Do not allow any Zap to run down into the head block. Press the head button into the block #0289 and seat fully. Use Kicker to dry the Zap on the outside of the block to keep the glue from running down the block while drying if needed.

**Step 3. Building and Installing the Bell Mixers**

Parts Required:

| | | | |
|---|---|---|---|
| 2 | #0017 | M3 Nuts | Bag 1D |
| 2 | #0093 | Special Bell Mixer Screws (M3x18) | Bag 1D |
| 4 | #0115 | M3x10.5mm Threaded Balls | Bag 1D |
| 4 | #0159 | Ball Bearings for Bell Mixer (M3x7) | Bag 1D |
| 2 | #0317 | Main Blade Mounts | Bag 1A |
| 2 | #0333 | Bell Mixers | Bag 1D |

***Refer to Drawings # 1.***

**NOTE:** This is the first step involving the threading of control link balls into plastic parts and three important requirements must be met. First, the ball thread must be started squarely in the hole. This is assured by first pushing the ball onto the allen wrench (a quality feature of this kit is the series of custom control balls used that have hex sockets in the end), and carefully starting the threaded end into the hole as squarely as possible. This can be determined by alternately viewing the ball and wrench from two aspects 90 degrees apart ("backing up" the thread a small amount before turning in the normal direction will help prepare the plastic hole to accept the screw thread). Second, a small amount of slow cyano acrylate glue must be applied to the thread. Normally this can be done to the remaining threads after the part has been threaded halfway on. Be careful not to get glue on the ball or your fingers -- use a toothpick. Third, the ball must not be threaded in so tightly that the threads created in the plastic are stripped. Each ball has a flange intended to seat against the plastic part, so thread the ball down until this flange just contacts the surface.

A. Thread two long shank threaded balls #0115 into each #0333 bell mixer. Use slow cyano and be sure to thread in squarely without over-tightening.

B. Using a #0093 bell mixer screw to assist in alignment, press a #0159 ball bearing into each side of each #0333 bell mixer. Be sure the bearings are square and properly seated.

C. Examine the #0317 blade mounts. Two holes are provided on each pitch arm for the installation of the bell mixers. For the purpose of this particular model, you will only be using the hole **nearest** the main body of the blade mount. Upon further examination, you will find a small raised area surrounding each hole. Since the outer hole is **not** to be used, it is advised that you remove the small raised area from that

hole. A sharp knife will do this easily. This will provide suitable bearing clearance when the bell mixer is finally installed in the other hole.
With the stepped side facing away from the head of #0093, slide each bell mixer assembly on a #0093 bell mixer screw and thread into the hole nearest the main body of each #0317 blade mount. Using Loctite, thread a #0017 M3 nut on the exposed threads of #0093 screw on the inside of the blade mount arm. Tighten the nut securely against the inside of the control arm. Do not be alarmed if the nut takes on a slanted appearance after light tightening -- its function is solely as **extra** security and is not at all critical (should you wish, the nut may be completely eliminated by putting a small amount of slow cyano or epoxy over the exposed threads - it is your option). Apply slow cyano to the nut against the plastic, as a fillet. Be sure each bell mixer is adjusted to allow for no drag or free play.

**Step 4. Assemble and Install the Main Blade Mounts**

Parts Required:

| | | | |
|---|---|---|---|
| 2 | #0021 | M4 Locknuts | Bag 1E |
| 2 | #0082 | M4X45 Socket Head Bolts | Bag 1E |
| 2 | #0085 | M5x16 Socket Head Bolts | Bag 1E |
| 1 | #0315 | Main Blade Axle | Bag 1E |
| 1 | #0316 | 10mm Fuel Tubing | Bag 1E |
| 4 | #0319 | Ball Bearings | Bag 1E |
| 2 | #0321 | Thrust Bearings | Bag 1E |
| 2 | #0323 | Dampener Rubber O-Rings | Bag 1E |
| 2 | #0325 | Thrust Bearing Spacers | Bag 1E |
| 2 | #0327 | Bearing Retainer Washers | Bag 1E |
| 2 | #0329 | Thin Shim Washers | Bag 1E |

***Refer to Drawings # 1.***

**NOTE:** Prior to beginning this section, be sure to degrease the threads in the #0315 blade axle and bolts #0085 with alcohol or thinner.

A. Using a pair of needle nose pliers or by use of Miniature Aircraft USA special Head Axle Dampener Installation Tool #0522, spread the 10mm piece of fuel tubing #0316 over the #0315 blade axle. Center the fuel tubing on the blade axle and glue in place with slow cyano. **NOTE:** The fuel tubing will be providing the lifting point for the model instead of the #0323 O-rings doing this job. This will allow the O-rings to provide dampening for the model which is what they are designed to do.

B. Select both #0317 main blade mounts from Step #3. Also select two #0319 ball bearings, one #0321 thrust bearing, one #0325 thrust bearing spacer, one #0327 retainer washer, and one #0085 M5x16 socket head bolt from the parts bag. Press a ball bearing into a blade mount cavity on the control arm end. Seat it fully. Press the second ball bearing into the mount from the fork end. Seat it squarely and fully by using a socket or pipe of suitable diameter (the same O.D. as the bearing) to avoid any pressure on the inner race. Check alignment by sliding the #0315 main blade axle through this bearing, through the mount, and through the previously installed bearing. Remove the axle. Repeat this entire process with the second blade mount.

C. Carefully slide a #0323 dampener O-ring about 30mm onto the #0315 main blade axle, taking care not to damage it on the sharp edge of the axle. Insert the long end of the axle into the top hole of the head block until the O-ring seats in its annular cavity. Slide the other O-ring on the

opposite end of the shaft until it seats in its cavity.

D. Select the two #0329 shim washers and slide one on each end of the blade axle. Slide a blade mount on one end of the axle. Refer to drawing #_1_ for proper orientation.

E. Lay the #0321 thrust bearing on a clean surface and separate the two races and the ball ring. Note that one race has a larger inside hole diameter than the other. This point is most important. Determine the larger-holed race by slipping each race onto the end of the axle and choose the looser one. Lay the larger race down, ball groove-up, and place the ball ring on it. Apply a small amount of grease and place the other race on the ball ring (groove down). Set aside until you reach Step G.

F. Slide the #0325 thrust bearing spacer into the fork end of a blade mount up against the ball bearing.

G. Place a #0327 bearing retainer washer on the M5x16 socket head bolt and insert the screw down into the thrust bearing from the top. Apply a small amount of Loctite on the threads inside the main axle. Invert the bolt and thrust bearing assembly and, using one of the Allen wrenches in the kit, thread it into the blade axle through the fork end of the assembled blade mount. Tighten most of the way, and slide the blade mount against this stack to square it up. (The thrust bearing should engage the shouldered part of the axle with the small I.D. race nearest the head of the M5x16 bolt).

H. Repeat steps E, F, and G to install the other main blade mount. Using the two Allen wrenches in the kit, tighten the whole axle assembly firmly. (**IMPORTANT:** DO NOT OVER-TIGHTEN or axle damage may result.) Be sure each blade mount control arm is oriented to the head block as shown in view #1. This is to say that with the right hand rotation of this model, each blade will be commanded by the control arm at its leading edge.

I. Temporarily install the two M4x45 socket head bolts #0082 and two M4 locknuts #0021 into the blade holders.

**Step 5. Add the Flybar, Control Arms and Paddles.**

Parts Required:

| | | |
|---|---|---|
| 1 | #0566-1 Flybar(Inside Tailboom) | Bag 10A |
| 1 | #0019 M3 Locknut | 1F |
| 2 | #0053 M3x5 Set Screws | 1F |
| 1 | #0091 M3x16(12.9) Head Bolt | 1F |
| 2 | #0305 Control Arm Spacers | 1F |
| 2 | #0307 Flybar Control Arms | 1F |

***Refer to Drawings # 1.***

A. Insert the flybar #0566-1 into the bearings provided in the #0339 delta offset plates. Follow with one #0305 spacer and one #0307 control arm on each side. Slide each up to the delta offset plates and then center the flybar. Apply loctite and very lightly tighten the M3x5 socket set screw in each control arm until it just touches the flybar. Shift the flybar until there is no side play between the control arms and the flybar is balanced. Now sight from one side at both control arms, align each level with the other. It is helpful to use a small pair of straight edges on each

control arm to insure that they are each level to the other. Securely tighten each socket set screw in each control arm. **NOTE:** Available through Miniature Aircraft USA is a special Fly-Bar Alignment Kit. Order #0510.

B. Temporarily install the main head bolt #0091 and one M3 locknut #0019 into the remaining hole on both sides of the main rotor head block #0289, just below the Delta offset plates #0339. The locknut, inserts into the hex shaped hole. Only slightly tighten the head bolt #0091, at this time.

**Step 6. Assembly of Flybar Paddles**

| | | | |
|---|---|---|---|
| 2 | #0561-3 | Pro-Paddles Main Section | 1A |
| 10 | #0561-1 | Brass Weight Set Screws | 1G |
| 4 | #0561-2 | Pro-Paddle End Caps | 1G |

***Refer to Drawings #1.***

A. **NOTE:** Before assembling the paddles it will be necessary to choose the over-all paddle weight desired by the number of brass screws used to achieve a desired flying characteristics.

The following characteristic may be expected with the installation of the set screws:

- With no set screws (total weight approximately 14.5 grams) - Crisp response similar to #0311 paddles but without any fore and aft sensitivity in fast flight.
- With one to four set screws (total weight approximately 16.2 - 20.5 grams) - graduating increase in stability yet still fully aerobatic.
- With five set screws (total weight approximately 22.0 grams) - excellent smooth hovering and FAI type aerobatics. NOTE: should you wish, it is possible to use a lead strip capped by one set screw to bring the total weight up to about 40.0 grams. Such choices are made considering flying style and total blade weight.

B. Thread into the front hole on the inner end of each fly-bar paddle #0561-3 the desired number of brass weight set screws #0561-1. Completely install each set screw before installing the next one.

C. The end caps #0561-2 are simple to install. Set each into position (but not fully flush). Apply a little cyano to the joint and press each end of the paddle onto a flat surface to set the caps flush. Wipe the excess glue away with a paper towel (quickly). Use a light spritz of kicker to quick cure.

D. Ideally, each paddle should be threaded onto the flybar covering a minimum of 25.0mm. However, should you desire a shorter disc, they may be further threaded to encompass up to a total of 40.0mm of flybar. Be sure to secure threads with slow cyano or epoxy. Align paddles level to each other and in line with the fly-bar control arms #0307. Check drawings for proper orientation. The use of Miniature Aircraft's Fly-Bar Alignment Kit #0510 is very helpful for this step. Final balance of the fly-bar assembly may be achieved by either adjusting the position of one of the brass set screw weights or by trimming the brass weight with wire cutters.

## II. BUILDING TOP MAIN FRAME SECTIONS

### Step 1. Assemble Aileron Bellcranks to Main Frames

Parts Required:

| | | | |
|---|---|---|---|
| 2 | #105-13 | Graphite Top Main Frame Sides | 2A |
| 2 | #0169 | Aileron Bellcrank Pivot Studs | 2B |
| 2 | #0009 | Flat Steel Washers 3mm (small) | 2B |
| 2 | #0019 | Hex Locknuts 3mm | 2B |
| 2 | #0167 | Aileron Bellcranks | 2B |
| 4 | #0159 | Ball Bearings M3x7 | 2B |
| 2 | #0105 | M3x4.5 Threaded Balls | 2B |
| 2 | #0107 | M3x6 Threaded Balls | 2B |
| 2 | #0051 | M3x3 Socket Set Screws | 2B |
| 2 | #106-25 | Aileron Bellcrank Retainer Collars(gold) | 2B |

***Refer to Drawings # 2.***

A. Build a left and a right top main frame #105-13 by installing on the outer side a bellcrank pivot stud #0169 in each frame with a flat steel washer 3mm small #0009 and a M3 locknut #0019 on the inside of each frame. Tighten securely.

B. Using slow cyano thread a #0107 M3x6 threaded ball and a #0105 M3x4.5 threaded ball into the flat side of the bellcrank #0167. Do the same thing on the other bellcrank only reversing the position of the balls so that the bellcranks are opposite each other.

C. Press all four bearings #0159 into the two bellcranks ensuring that they are square and fully seated.

D. Partially thread the M3x3 set screws #0051 into the two retaining collars #106-25.

E. Hold the left main frame with its stud facing you, and select the bellcrank which will slide on the stud with one arm vertically down containing a short ball, and the other arm pivoting rearward containing a long ball #0107. Place a small amount of Loctite on the set screw threads, partially screw into collar, and retain the bellcrank by sliding the collar on the stud and tighten the set screw. Check to be sure that the bellcrank operates smoothly; if not, slightly back off retaining collar.

F. Mount the other bellcrank and collar to the right main frame in a similar way. Holding the frames together in normal orientation will show that each has a bellcrank that can be held with an arm pointing rearward with a long ball on it.

### Step 2. Assemble Elevator Servo Graphite Mount

Parts Required:

| | | | |
|---|---|---|---|
| 3 | #0586-6 | Elevator Plate Spacers | 2C |
| 3 | #0586-8 | M3x20 Hex Bolts | 2C |
| 3 | #106-22 | Rubber Grommet Isolators | 2C |
| 3 | #106-24 | Dampening Sleeves | 2C |

| | | | |
|---|---|---|---|
| 3 | #0009 | Flat Steel Washers M3 (small) | 2C |
| 6 | #0003 | Flat Washers M3 (Large) | 2C |
| 3 | #0019 | 3mm Locknuts | 2C |
| 1 | #0586-5 | Graphite Elevator Plate | 2C |
| 3 | #0586-7 | M3x15 Hex Bolts | 2C |

***Refer to Drawings # 2.***

A. Install the three rubber grommets #106-22 into the graphite elevator plate. Squeeze grommets together and push in as far as possible. Use a small straight screw driver and work around the grommets, pushing one side all the way through. Center the three dampening sleeves #106-24 in the grommets.

B. Refer to the drawing for proper orientation. Bolt the elevator plate to the inside of the right graphite upper frame plate #105-13 using the following hardware: three #0586-7 M3x15 hex bolts, three #0009 M3 washers (small), six #0003 M3 washers (large), three #0586-6 elevator plate spacers and three #0019 M3 locknuts. Tighten securely.

**Step 3. Assemble Elevator (Fore and Aft Pitch) Swing Arm Unit.**

Parts Required:

| | | | | |
|---|---|---|---|---|
| 2 | #0131 | Plastic Bearing Bushings | Bag# | 2D |
| 1 | #0099 | Special Bolt M3x30 | - | 2D |
| 2 | #0155 | Elevator Swing Arm Halves | | 2D |
| 1 | #0157 | Elevator-Bell Crank | | 2D |
| 1 | #0105 | M3x4.5 Threaded Steel Ball | | 2D |
| 2 | #0113 | M3x10.5 Double Threaded Balls | | 2D |
| 2 | #0159 | Ball Bearings M3x7 | | 2D |
| 2 | #0161 | Pivot Pins Elevator | | 2D |
| 1 | #0019 | 3mm Locknut | | 2D |
| 2 | #0047 | Slotted Cheese Head Machine Screws M2x16 | | 2D |
| 2 | #0015 | Hex Nuts 2mm | | 2D |

***Refer to Drawings #2.***

A. Pick up one Swing Arm Half, #0155, and holding it so that the outside surface of the fork end is against a solid surface, press a Pivot Pin, #0161, into the fork end hole from the inside until its end is flush with the outside surface (bottoms against the supporting surface). Tapping the Pin into place with a mallet or wood block may be necessary. Repeat the process with the other Swing Arm Half.

B. Press a plastic bearing bushing #0131 into the hole at the opposite end of each Swing Arm Half. Do this from the outside. Slide the special bolt #0099 into each #0131 to check that it pivots freely. Slightly open the holes if needed.

C. Select the Elevator Bellcrank #0157 from the parts bag, and the Threaded Ball #0105 (single ball end) from the parts bag. Using the proper size Allen Wrench from the tool bag and following the procedure previously described, glue and screw the ball into the arm of the Bellcrank.

D. Following the above procedure, screw in place and glue the two Double End Balls #0113, again referring to the drawing for position.

E. Select the Ball Bearings #0159 and press them into the remaining holes in the Bellcrank #0157.

F. Assemble the swing arm halves #0155 to the elevator bellcrank #0157 by squarely pushing the pivot pins #0161 into the ball bearing #0159, aligning and pressing the arm halves together. Secure the halves together with two M2x16 slotted bolts #0047 and M2 hex nut #0015, using Loctite.

G. Select the right hand main frame plate #105-13. As per the drawing insert the special bolt #0099 from the left side through the frame plate. Slide the assembled elevator bellcrank assembly onto the special bolt on the inside of the right upper frame side, making sure that the bellcrank arm projects through the aperture in the right side frame with the ball end up. Follow this assembly with the left hand side frame assembly #105-13 and one M3 locknut #0019. Do not fully tighten at this time.

Step 4. **Assemble Front Tail Drive Transmission.**

Parts Required:

| | | | |
|---|---|---|---|
| 3 | #0051 | M3x3 Socket Set Screws | 2E |
| 2 | #0233 | Front Drive Housing Halves | 2E |
| 2 | #0235 | Front Drive Ball Bearings | 2E |
| 1 | #0237 | Front Drive Retainer Collar | 2E |
| 2 | #0241 | Front Drive Housing Guide Sleeves | 2E |
| 1 | #0232 | 15 Tooth front Drive Pinion | 2E |
| 1 | #0800-6 | Front Transmission Output Shaft | 2E |
| 2 | #0077 | M3x30 Socket Head Cap Screws | 2E |
| 4 | #0003 | Flat Washers M3 (large) | 2E |
| 2 | #0019 | Hex Locknuts M3 | 2E |

***Refer to Drawings # 2.***

A. Clean the I.D. of the two bearings #0235 and the front input shaft #0800-6 with thinner to remove any oil.

B. **NOTE:** At the builders discretion the bearings and shaft in this section may be glued together using loctite (red, green or blue). If you choose to do this the disassemble process will become very difficult and will require the application of heat to break down the glue.

Slide one of the bearings #0235 onto the shaft #0800-6 about half way then apply a small amount of Loctite to your finger and rub it around the shaft up next to the shoulder. Slide the bearing up next to the shoulder. Rub a small amount of Loctite where the other bearing is to be located then slide this bearing into position.

C. Lay one of the front drive housing halves #0233 on the table and push the output shaft assembly into this half. Put the other half in place and press the two halves together. Start the front transmission sleeves #0241 into the two holes in the drive housing then turn the unit over on the table with the sleeves against the table and push down on the drive housing until the housing is flush against the table.

D. Apply blue Loctite to one of the M3x3 set screws #0051 and start it in the retainer collar #0237. Slide the collar all the way up against the bearing and tighten the set screw. Ensure that the input shaft is slid completely up against the bearing. Check for binding.

E. Start the remaining two M3x3 set screws #0051 into the front drive pinion #0232 and position the pinion on the shaft and tighten down one set screw in the flat spot nearest the end just enough to keep the gear on the shaft but at the same time allowing it to slide on the shaft. Final adjustment and tightening will come later.

F. Bolt the front tail drive transmission into the upper main side frames using two M3x30 bolts #0077, four M3 large washers #0003 and two M3 locknuts #0019. Do not fully Tighten.

Step 5. **Install Antirotation Arm, Lower Mainshaft Bearing Block, Tailboom Support Halves, Front Frame Plate and the Clutch Shaft Bearing Block**

Parts Required:

| | | |
|---|---|---|
| 1 | Clutch Shaft Bearing Block with Clutch Bell | 2F |
| 4 | #0003 3mm Large Washers | 2G |
| 11 | #0063 M3x10 Socket Head Bolts | 2G |
| 1 | #106-62 Upper Canopy Stand-Off | 2G |
| 2 | #106-72 Frame Plate Corner Blocks | 2G |
| 1 | #0107 M3x6 Threaded Steel Ball | 2G |
| 1 | #0247 Radius Arm Support | 2G |
| 18 | #0009 M3 Small Washers | 2G |
| 2 | #0185 Front Tailboom Support Halves | 2G |
| 8 | #0077 Socket Head Bolts M3x30 | 2G |
| 10 | #0019 M3 Locknuts | 2G |
| 1 | #0182 Mainshaft Bearing Block w/Bearing | 2G |
| 1 | #105-10 Front Frame Plate | 2A |

***Refer to Drawings # 2.***

A. Using two #0063 M3x10 socket head bolts, two 3mm small washers #0009 and two #0019 M3 locknuts bolt into position, one #0247 radius arm support onto the top left main frame. The holes are slotted. Center the radius arm in the slots.

B. Using slow cyano, glue the #0107 M3x6 threaded ball in place in the top hole in the #0247 support.

C. Install the lower bearing block #0182 (bearing side facing up) using two #0077 socket head bolts M3x30, four #0009 flat washers M3 small and two #0019 hex locknuts M3. **Do not fully tighten.**

D. Install the clutch/bell, clutch shaft bearing block assembly using two M3x30 bolts #0077, four M3 large washers #0003 and two M3 locknuts #0019. **Do not fully tighten.**

E. Install the tailboom support halves #0185 using four M3x30 bolts #0077, eight M3 small washers #0009 and four M3 locknuts #0019. **Do not fully tighten.**

F. Install the #106-72 frame plate corner blocks with four M3x10 bolts #0063 and four M3 small washers #0009. **Do not fully tighten.**

G. Mount the #106-62 upper canopy stand-off to the #105-10 front frame plate with one M3x10 bolt.

H. Mount the front frame plate #105-10 to the upper main frame corner blocks #106-72 using four M3x10 bolts #0063. **Do not fully tighten.**

Step 6. **Mount Lower Frames, Gyro Mounting Plates, Upper Mainshaft Bearing Block**

Parts Required:

| | | |
|---|---|---|
| 2 | #105-12 Graphite Lower Main Frame Plates | 2A |
| 4 | #105-14 Socket Head Bolts M3x45 | 2H |
| 17 | #0009 3mm Small Washers | 2H |
| 9 | #0063 Socket Head Bolts M3x10 | 2H |
| 4 | #105-16 Unthreaded Dog-Bone Spacer | 2H |
| 2 | #106-76 "Threaded" Spacers | 2H |
| 2 | #106-72 Frame Plate Corner Blocks | 2H |
| 1 | #0182 Main Shaft Bearing Block w/Bearing | 2H |
| 2 | #0077 Socket Head Bolts M3x30 | 2H |
| 3 | #0019 3mm Locknuts | 2H |
| 1 | #0595-2 Gyro Mounting Plate | 2H |
| 1 | #0203 Main Shaft (Standard) | 2A |

***Refer to Drawings # 2.***

A. Install the corner blocks #106-72 to the inside bottom of the front frame plate #105-10 using four M3x10 bolts #0063 and four 3mm small washers #0009. **Do not fully tighten.**

B. Attach the lower mainframe plates #105-12 to the lower corner blocks #106-72 using four M3x10 bolts #0063 and four 3mm small washers #0009. **Do not fully tighten.**

C. Attach the lower frames to the upper frames at the rear using four M3x45 bolts #105-14, four 3mm small washers #0009, four un-threaded "Gold" spacers #105-16 and two threaded spacers #106-76 "Black" that go between the upper frames. **Do not fully tighten.**

D. Install the upper mainshaft bearing block #0182 with the bearing side facing down using two M3x30 bolts #0077, four 3mm small washers #0009 and two 3mm locknuts #0019. **Do not fully tighten.**

E. Remove the mainshaft #0203 from bag 2A and clean the mainshaft with some type of solvent to remove the oily coating.

F. Temporally slide the main shaft through the mainshaft bearing blocks #0182 as to align them so that we can begin to tighten all the bolts in the frame structure.

G. At this point all bolts going through the upper frames and all bolts holding the front plate and the lower frames to the top frames should be just slightly loose enough as to allow a little movement.

H. Sit the mechanics on a hard flat surface and press down on the top mainframes to ensure that everything is square.

I. Tighten all the bolts in the following sequence; Mainshaft bearing blocks, clutch shaft bearing block, the four M3x45 bolts #105-14 holding the lower frames to the upper frames at the rear

of the mechanics. Next tighten all of the M3x10 bolts #0063, holding the front frame plate #105-10 to the mechanics.

J. Attach the right gyro mounting plate #0595-2 to the inside of the lower main frame #105-12 using one #0063 M3x10 socket head bolt, one #0009 M3 washer and one #0019 M3 locknut. Level the gyro mounting plate and tighten.

K. Remove the mainshaft and the clutch shaft bearing block and set aside for the time being.

L. The rest of the bolts will be tightened at a later time.

## III. ASSEMBLE MAINSHAFT COMPONENTS

Step 1. **Installing the Mainshaft, Autorotation Unit with Maingear.**

Parts Required:

| | | | |
|---|---|---|---|
| 1 | #0203 | Main Shaft (From Bag 2A) | |
| 1 | #0209 | Autorotation Hub with Bearing Assembled | 3A |
| 1 | #0207 | Main Gear 90 Tooth | 3A |
| 2 | #0205 | Main Shaft Retainer Collars | 3B |
| 6 | #0051 | Socket Set Screws M3x3 | 3B |
| 6 | #0069 | Socket Head Bolts | 3B |
| 6 | #0019 | Hex Locknuts 3mm | 3B |
| 1 | #0211 | Plastic Autorotation Hub Spacer | 3B |
| 1 | #0213 | Steel Autorotation Lower Spacer | 3B |
| 1 | #0215 | Retainer Collar | 3B |

***Refer to Drawings # 3.***

**NOTE:** Before installing the mainshaft, clean well to remove any residue.

A. Slide the mainshaft #0203 down through the top bearing block #0182.

B. Next place one of the retainer collars #0205 under the bearing block and slide the mainshaft through this.

C. Next hold the elevator bellcrank #0157 up and slide the mainshaft through this.

D. Place another mainshaft retainer collar #0205 under the elevator bellcrank and slide the mainshaft through this and the lower bearing block #0182.

E. Start two M3x3 socket set screws #0051 into each #0205 retainer collars.

F. Noting that the maingear is two-sided and can be mounted either way, press the gear onto the shorter boss of the autorotation hub, being careful to align the mounting bolt holes. Insert the six M3x16 socket head bolts #0069 from the gear side and secure from the hub side with the six M3 locknuts #0019. Tighten securely. Lightly oil (DO NOT GREASE) the autorotation bearings. (**NOTE**: Tri-Flow Teflon Oil is recommended, order #4801).

G. Place the plastic auto hub spacer #0211 on top of the main gear and auto hub and then slide the autorotation unit up onto the bottom side of the mainshaft. Follow this assembly with one #0213 lower steel autorotation spacer and one #0215 retainer collar. Secure the retainer collar to the main shaft using two #0051 M3x3 set screws. Tighten securely using loctite.

H. Place your middle finger on either hand on the bottom of the mainshaft. Place your thumb on the same hand on top of the bottom mainshaft retainer collar and squeeze together. This will pull the mainshaft all the way up and take the vertical play out of the maingear. Tighten up one of the set screws in the collar and then do two things; Spin the main gear while holding the mainshaft to ensure that it spins freely. Next check for vertical play in the main gear by holding it on both sides with both hands and try to move the gear up and down. The ideal situation is where there is virtually no vertical play but at the same time the gear spins freely. Once you are satisfied tighten both set screws in the retainer collar securely.

I. Apply some blue Loctite to two M3x3 set screws in the upper mainshaft retainer collar #0205. Pull down on the top of the mainshaft with your thumb while pulling up on the upper collar with your middle finger. Tighten both set screws securely.

J. Remove the M3x3 set screws from the front tailrotor pinion gear #0231 and apply Loctite. Re-install screws but do not tighten.

K. Push the transmission down into the main gear so that it is seated. Slide the pinion gear back on the shaft till it rubs the step on the maingear then slide the pinion forward about a half of a millimeter then lightly tighten the set screw against the flat. View the gear mesh from underneath the top mainframe. Rotate the maingear 360 degrees and make sure that the pinion gear does not get up against the back edge of the maingear. There should be some clearance all the way around. Once satisfied tighten both set screws securely.

L. Next adjust the gear mesh between the front transmission and the maingear. You want no play between the gears but no binding or tight spots. If either exists, loosen the mesh slightly. Ensure that the universal joint end of the shaft is pointed straight down the tailboom. To check this find a shaft or drill bit that will fit into the universal joint and check to see if it is centered between the tailboom support halves. Once both of the alignments are done tighten the two M3x30 bolts and re-check alignment. Sometimes it will change slightly when you tighten the bolts.

Step 2. **Assembling Swashplate.**

Parts Required:

| | | | |
|---|---|---|---|
| 1 | #0217 | Aluminum Swashplate (10mm) | Bag 3C |
| 4 | #0051 | M3x3 Set Screws | 3C |
| 3 | #0107 | M3x6 Threaded Steel Balls | 3C |
| 4 | #0109 | M3x8 Threaded Steel Balls | 3C |
| 1 | #0111 | M3x10.5 Thd. Double Ball | 3C |

***Refer to Drawing #3.***

A. Apply a small amount of Loctite to the four M3x3 set screws #0051 and install them into the outer ring of the swashplate. These set screws are for adjusting the play out of the radial bearing. Lightly tighten up two set screws opposite each other and then check to make sure that the bearing doesn't get notchy. Once these two set screws are set the other two can be set in the

same manner.

B. Examine the swashplate #0217 for control ball positioning. Using a small amount of Loctite on each, thread four M3x8 threaded balls #0109 on the inner ring of the swashplate at 90 degrees apart. Using Loctite mount three M3x6 threaded ball #0107 in three of the four holes in the outer ring of the swashplate. In the remaining forth hole thread one #0111 M3x10.5 Double Ball.

C. Slide the swashplate down the main shaft #0203 from the top side.

Step 3. **Assembling Lower Swashplate Control Rods and Anti-Rotation Arm Pushrod.**

Parts Required:

| | | | |
|---|---|---|---|
| 10 | #0133 | Plastic Balls Links Long | Bag 3D |
| 1 | #0249 | M2x42 Control Rod | 3D |
| 4 | #0227 | M2x42 Control Rods | 3D |

***Refer to Drawing #3 and #11.***

A. Complete four control rods #0227 by threading a plastic ball link #0133 on each end. The length of the finished rods is determined by laying control rods with ball links attached over the precise full scale view on the control rod length chart. See drawings. The rods must be identical in length. As a check dimension, the length of metal rod between inner plastic link faces is 22.0mm.

B. Referring to the drawing for control rod placement, snap the ball link on one end of a control rod to the **OUTSIDE** ball on each of the double balls mounted to the elevator bellcrank. Similarly, snap a ball link on the longer of the balls on each roll bellcrank. Holding the four control rods up, snap the four top ball links to the outer swashplate. Be sure the double ball on the swashplate faces to the **LEFT.** The link from the left roll bellcrank should be snapped on the **INNER** ball.

C. Thread the plastic ball links on the M2x42 control rod #0249 to the length that matches the radius arm rod length in the control arm chart. The reference dimension for the length of the rod between the ball links is 23mm. Snap this rod on the radius arm support ball end and onto the outer (only remaining) ball of the double ball on the swashplate.

Step 4. **Assembling Wash-Out Unit.**

Parts Required:

| | | | |
|---|---|---|---|
| 1 | #0219 | Wash-Out Center Hub | Bag 3E |
| 2 | #0097 | Special Bolts M3x22 | 3E |
| 2 | #0109 | M3x8 Threaded Steel Balls | 3E |
| 2 | #0223 | Wash-Out Special Links | 3E |
| 2 | #0221 | Wash-Out Arms | 3E |
| 4 | #0159 | M3x7 Ball Bearings | 3E |
| 2 | #106-07 | Pivot Pins | 3E |
| 5 | #106-08 | Circlips | 3E |

*Refer to Drawing #3.*

**NOTE:** One extra #106-08 circlip is included.

A. Take the two washout control arms #0221 and the two M3x8 Balls #0109 (longer shank) and tread a ball into the hole in the long end of each Arm from the flat side. Use Slow Cyano. Make sure the balls are threaded squarely in place and lightly seated against their flanges.

B. Press Ball Bearings #0159 into both sides of the center holes in both Control Arms.

C. Using two special washout arm bolts #0097, and carefully follow the drawing , screw the arms on the washout center hub #0219. (Suggestion: squarely start the thread of each bolt into its hole in the hub part way first without the arm.) The control ball should face inward. Tighten entire assembly until there is no lateral play and no bearing drag.

D. Using two pivot pins #106-07 assemble the wash-out special link #0223 to each control arm #0221. Their orientation is shown on the drawing. Note that they mount on the short end of the arms, projecting inward. The pins press in place centered in the links. Secure each end of the pins using circlips #106-08. The special links #0223 should have no end play and pivot freely. If they do not pivot freely, carefully apply heat with a heat gun until they operate smoothly.

E. Slide assembled wash-out unit down onto the mainshaft, snap the two #0223 wash-out links onto any two opposite #0109 steel balls on the inner ring of the swashplate.

## IV. ASSEMBLING THE ENGINE COMPONENTS

Step 1. **Mounting the Pull Starter.**

Parts Required:

| | | |
|---|---|---|
| 1 | #105-5 Gas Engine | Box |
| 1 | #105-26 Adapter Plate | 4B |
| 1 | #105-32 Pull Starter | 4B |
| 4 | #105-38 M4x10 Socket Head Bolts | 4C |
| 8 | #105-34 4mm Flat Washers | 4C |
| 4 | #105-36 4mm Lock Washers | 4C |

*Refer to Drawings # 4.*

**NOTE:** We highly suggest removal and balancing of the engine flywheel before assembling the pull starter components. The flywheel may be balanced using a High-Point balancer. Take care not to loose any components, mounted under the flywheel.

A. Remove the gas engine #105-5 from the box.

B. Open bag four and take out the bag containing the pull starter #105-32 and the hardware bag.

C. Mount the pull starter #105-32 using the four M4x10 bolts #105-38, four 4mm flat washers #105-34 and four 4mm lock washers #105-36. **NOTE:** Study the drawing to ensure proper orientation of the pull starter. Four extra #105-34 4mm flat washers have been included to be

used under the 105-38 bolts for bolt and flywheel clearance.

Step 2. **Mounting the Flywheel, the Fan Shroud and the Rear Motor Mount.**

Parts Required:

| | | |
|---|---|---|
| 1 | #105-58 Rear Motor Mount | 4E |
| 1 | #105-56 Fan Shroud Rubber Moulding | 4E |
| 4 | #0031 M2.9x6.5 Phillips Screws | 4E |
| 1 | #105-52 Fan Shroud | 4A |
| 1 | #105-46 Fan Shroud Adapter Plate | 4D |
| 4 | #105-44 M5x8 Flat Head Screws | 4D |
| 1 | #105-48 Fan Hub w/Fan | 4D |
| 1 | #105-42 M6x16 Flat Washer | 4D |
| 1 | #105-40 M6x15 Socket Head Bolt | 4D |
| 4 | #0546-16 Urethane Dampeners | 4D |
| 1 | #0078 M4x14 Socket Head Bolt | 4E |
| 1 | #105-54 M4x10 Flat Washer | 4E |
| 1 | Strip of Plastic | 4A |

***Refer to Drawings # 4.***

A. Mount the fan shroud adapter plate #105-46 to the motor using the four M5x8 screws #105-44. Study the drawings to ensure proper orientation.

B. Wipe the inside of the fan hub #105-48 and the tapered end of the crankshaft to ensure that they are clean. A small amount of Tri-Flo oil may be applied to the crankshaft and collets after cleaning to aid in the alignment process.

C. Mount the fan hub #105-48 to the crankshaft using the M6x15 bolt #105-40 and the M6x16 flat washer #105-42. Apply blue Loctite to the threads of the bolt. Tighten securely. **NOTE:** An Allen wrench for the M6x15 bolt is provided in the engines tool bag.

D. Press the four urethane dampeners #0546-16 into the slots in the top of the flywheel. A pair of pliers and soapy water will make the job easier. Tap in completely using a small rubber hammer.

**NOTE:** Once fully seated if any of the Delrin isolators are sticking up above the top of the flywheel, trim off with a razor blade.

E. Study the drawing, starting at one end and working your way around install the rubber moulding #105-56 around the big hole in the fan shroud #105-52. Use Poly Zap or Flex Zap to secure in place.

F. Cut four 10mm x 10mm squares out of the left over fan shroud material. Use Poly or Flex Zap to glue these over the four holes that will be used for mounting the fan shroud. Use a small hand drill to redrill the holes in the fan shroud.

G. Mount the fan shroud #105-52 to the fan shroud adapter plate #105-46 using four M2.9 x 6.5 Phillips screws #0031.

H. Study the drawing and loosely mount the rear motor mount #105-58 to the top of the cylinder head using a M4x14 bolt #0078 and a M4x10 flat washer #105-54. **NOTE:** The hole in the motor mount is offset and must go towards the top.

## V. BUILDING AND INSTALLING THE CLUTCH SYSTEM

### Step 1. Assembling the Clutch to the Clutch Bell.

Parts Required:

| | | |
|---|---|---|
| | Clutch Shaft Bearing Block, Clutch Bell w/Pinion and Lower Bearing are (Pre-Assembled) from Section II. Step 5. | |
| 1 | #105-76 Clutch with Shaft & Delrin Ball | 5B |
| 1 | #0273 Clutch Bell Spacer | 5C |
| 2 | #0051 M3x3 Set Screws | 5C |
| 1 | #0215 Wheel Collar | 5C |

***Refer to Drawings # 5.***

A. At the builders discretion the clutch shaft may be Loctite to the clutch shaft bearing block bearing. If you choose to do this, all parts to be Loctite, must be cleaned of any oils. This will stop all wear between the shafts and the inner race of the bearing. However this will make disassembly more difficult. **NOTE:** If you decide to do this do not Loctite the bottom clutch bell bearing to the clutch shaft because it only turns when the engine is idling.

B. Next slide the M6x8.5 clutch bell spacer washer #0273 down the clutch shaft. Slide the clutch shaft up through the clutch bell and fully seat the clutch. If you are Loctiting the shaft at this time use your finger to rub a small amount of Red Loctite around the shaft. Next work the clutch shaft in and out about 10mm to get Loctite between the shaft and the bearing. Now fully seat the clutch again and immediately slide the wheel collar #0215 down into position, apply some blue Loctite to the M3x3 set screw #0051 and tighten the wheel collar leaving between a half to one millimeter free play in the clutch bell. Once this distance is set and the wheel collar is tight, lay the assembly aside to dry for about twenty minutes. **NOTE:** Make sure that the wheel collar is against the top bearing while the Loctite is setting up.

### Step 2. Installing the Clutch Bell Assembly.

Parts Required:

Two M3x30 bolts #0077, four M4 flat washers #0003 and two M3 locknuts #0019 previously used while tightening up the frames with the bearing block installed.

***Refer to Drawings # 5.***

A. Slide the clutch bell assembly into position from underneath the upper main frames. Secure the bearing block with two M3x30 bolts, four 3mm large washers #0003 and two 3mm locknuts #0019. **Do not fully tighten.**

B. When aligning the pinion gear to the main gear #0207, two things must line up. First the two gears should have a little play between them throughout the entire rotation of the maingear and the pinion gear must be at 90 degrees to the main gear. The later can best be achieved by using

a small bubble level that is easily obtainable at most hardware stores. Place the level on the outer ring of the maingear and level the mechanics, then place the bubble on the clutch bell. Once these two requirements are met, securely tighten the two M3x30 bolts.

**Step 3. Installing the Engine, Lower Frame Rails and the Gyro Plate.**

Parts Required:

| | | |
|---|---|---|
| 2 | #105-93 Coil Spacers | 5D |
| 2 | #0077 M3x30 Socket Head Bolts | 5D |
| 1 | Engine Coil Assembly (no number assigned) | 5A |
| 1 | #105-88 Lower Frame Rail (Right) | 5A |
| 1 | #105-86 Lower Frame Rail (Left) | 5A |
| 1 | #0546-19 Alignment Tool | 5A |
| 2 | #0087 M4x20 Socket Head Bolts | 5D |
| 2 | #105-90 M4x14 Flat Washers | 5D |
| 9 | #0063 M3x10 Socket Head Bolts | 5D |
| 4 | #0009 3mm Small Washers | 5D |
| 7 | #0019 3mm Locknuts | 5D |
| 1 | #105-84 Gyro Mounting Plate | 5A |
| 5 | #0003 3mm Large Washers | 5D |
| 2 | #105-91 Special Engine Spacers | 5D |
| 1 | #105-89 3mm Star Washer | 5D |
| 1 | #0595-1 Left Rear Gyro Mounting Plate | 5D |

***Refer to Drawings # 5.***

A. Slide the engine up into the frames and engage the Delrin ball and the drive pins on the bottom of the clutch into the Delrin isolators in the top of the flywheel. **Do not fully seat.**

B. Take the alignment tool #0546-19 and slide it between the top of the flywheel and the bottom of the clutch. Notice that it has a notch in the cutout area near the handle portion. This is for clearance for one of the drive pins.

C. Once the tool is in position place your thumbs one on each side of the clutch bell. Put your remaining fingers underneath the fan shroud # 105-52 and pull up on the engine until the clutch is fully seated. Leave the alignment tool for now.

D. Place a M4x4 flat washer on one of the M4x20 bolts #0087. Run the bolt through the left hand lower frame rail #105-86, through the lower frame #105-12, into one special engine space #105-91 and thread the bolt into the motor. **Do not fully tighten.**

E. Run three of the M3x10 bolts #0063 through the lower frame rail holes. Two in the rear holes and one in the front holes. Use 3mm small washers #0009 on the rear bolts on the inside of the frames. Start three 3mm locknuts and run up but do not fully tighten. The front bolt is merely for alignment and will be removed later.

F. Repeat steps D. and E. for the right hand side of the mechanics.

G. The three lower frame rail bolts M3x10 #0063 need to be tightened while holding the frame rails flush with the lower edge of the lower main frames.

H. Holding the engine up against the clutch as previously done, have someone tighten the M4x14 bolts. Recheck to see that the bolts are secure.

I. Mount the rear motor mount to the lower main frame, use three M3x10 bolts #0063 and three 3mm large washers #0003, using Loctite. On the left hand side only use the upper hole in the motor mount. The lower hole will be used to mount the coil assembly. Tighten these three bolts and the M4x14 bolt #0078 holding the rear motor mount #105-58 to the motor. Mount the coil assembly and the left gyro mounting plate #0595-1 using the following: Two #0077 M3x30 socket head bolts, two #0003 M3 large washers, one coil assembly, two #105-93 coil spacers, one #105-89 3mm star washer, one #0595-1 gyro mounting plate and one #0019 M3 locknut. Use Loctite on the lower #0077 bolt in the motor mount. NOTE: The star washer #105-89 mounts in between the lower main frame #105-12 and the gyro mounting plate #0595-1. Connect the coil wires as needed.

J. The engine installation is now complete, the alignment tool #0546-19 can now be removed and the two M3x10 bolts #0063 in the front lower frame rails.

K. The rear gyro mounting brackets #0595 should be roughly level and in line with each other. The bolts holding them should be fairly snug. Next position the rear gyro mounting plate #105-84 between the frames and stick it squarely and securely to the mounting brackets. Using Goop #0502. **NOTE: <u>The plate should not be touching the lower main frames.</u>**

L. Loosen both bracket bolts slightly and use a 12 inch ruler to level the plate so that it is sitting perfectly square to the mainshaft.

## VI. <u>BUILDING AND INSTALLING THE LANDING GEAR</u>

Parts Required:

| | | | |
|---|---|---|---|
| 2 | #3923 | Struts | 6A |
| 2 | #3927 | Skids | 6A |
| 4 | #0075 | M3x25 Socket Head Bolts | 6B |
| 4 | #0003 | 3mm Large Washers | 6B |
| 4 | #0019 | 3mm Locknuts | 6B |
| 2 | #3927-1 | Skid Caps (Front) | 6B |
| 2 | #3927-2 | Skid Caps (Rear) | 6B |
| 4 | #3923-1 | Landing Gear Spacers | 6B |

***Refer to Drawings # 6.***

A. The Tuf-Strut I landing gear struts are not pre-drilled for mounting to the mechanics because they are a universal gear set for various applications. Drill two 3mm or a 1/8" hole at 102mm spacing in each strut.

B. Mount the struts to the lower frame channels using four M3x25 bolts #0075, four landing gear spacers #3923-1, four M3 washers #0003 and four M3 locknuts #0019. **NOTE: <u>The struts should be curving forward towards the front of the model.</u>**

C. Use a heat gun to heat the struts where the skids slide through. Get them hot, it makes it alot easier. **NOTE:** Do one side at a time. The skids should stick out the back side of the rear strut, 70mm.

D. Cyano the end caps into the skids using slow cyano. It may be necessary to heat the end caps to ease installation.

## VII. RADIO TRAY ASSEMBLY AND SERVO INSTALLATION

### Step 1. Installation of Radio Tray Supports.

Parts Required:

| | | |
|---|---|---|
| 1 | #0347 Upper Tray Frame Support | 7B |
| 4 | #0063 M3x10 Socket Head Bolts | 7B |
| 4 | #0065 M3x12 Socket Head Bolts | 7B |
| 1 | #105-94 Lower Radio Tray Support (Left) | 7A |
| 1 | #105-96 Lower Radio Tray Support (Right) | 7A |
| 6 | #0009 3mm Small Washers | 7B |
| 6 | #0019 3mm Locknuts | 7B |
| 2 | #105-98 Lower Canopy Stand Offs | 7B |

***Refer to Drawings # 7.***

A. Mount the upper tray frame support #0347 to the vertical front plate #105-10 using two M3x10 socket head cap screws #0063, two M3 washers #0009 and two locknuts M3 #0019. Only assemble loosely at this time.

B. Mount the lower radio tray supports #105-94 and #105-96 to the lower frame rails #105-88 and #105-86, using four M3x12 bolts #0065, four 3mm small washers #0009 and four 3mm locknuts. **Do not fully tighten.**

C. Mount the lower canopy stand-offs #105-98 to the lower radio tray supports with two M3x10 bolts #0063.

### Step 2. Assemble Plastic Tray and Install Servo's

Parts Required:

| | | |
|---|---|---|
| 6 | #0029 M2.2x13 Phillips Tapping Screws | 7C |
| 15 | #0027 M2.2x9.5 Phillips Tapping Screws | 7C |
| 8 | #0001 Flat Washers 2mm (small) | 7C |
| 2 | #0575-3 Servo Spacer Blocks w/Three Holes | 7C |
| 2 | #0575-1 Servo Screw Doubler Blocks w/Two Holes | 7C |
| 4 | #0035 M2.2x16 Phillips Tapping Screws | 7C |
| 1 | #0575-4 Upper Servo Tray | 7A |
| 1 | #0575-5 Lower Servo Tray | 7A |
| 1 | #0575-6 Main Vertical Support and Throttle Mount | 7A |
| 2 | #0351 Roll Servo Pivots (male) | 7C |
| 2 | #0353 Roll Servo Pivots (female) | 7C |
| 1 | #0575-7 Secondary Vertical Brace "H" | 7A |

| | | |
|---|---|---|
| 1 | #0575-8 Switch Plate | 7A |
| 1 | #105-92 Throttle Servo Spacer (Long) | 7C |
| 2 | #0357 Plastic Pivot Bushings | 7C |
| 1 | #105-93 Throttle Servo Spacer (Short) | 7C |

***Refer to Drawings # 7.***

A. Examine the exploded view showing the placement of plastic parts and servos in the radio tray.

B. **Servo Installation:** The order of assembly of the various parts is not critical; however, experience has shown that it is more convenient to initially fit the servo prior to overall assembly. The reason for this is due to adjustable nature of servo openings. Obviously this tray must accept all popular servo sizes, so the following will outline each servo installation.

**Mount Servo's as Follows:**

1. **Roll (Aileron) Servo:** Note that the aileron (roll) servo is mounted on pivots to allow it to rock fore and aft under control of the collective pitch servo ahead of it. Select the servo to be used for Roll control and install all four rubber grommets. Select a #0351 Roll Servo Pivot from the parts bag and, holding it in place under one end, use a small drill to mark it for proper hole drilling to accept two of the servo mounting screws from your radio hardware. (**NOTE:** Recognize that screwing this servo to the Pivot is just like screwing the servo down to a wood or plastic servo tray in that a small enough drill must be selected to allow your particular screws to thread into the plastic.) Drill the holes and screw the Pivot to the servo. In identical fashion, mount the remaining #0351 Pivot to the other end of the servo. Press two #0357 plastic pivot bushings into the holes in the two #0353 Roll Servo Pivots. Hold the servo in approximate position centered in its clearance hole in the tray and press the bushings of the Pivot Supports into the servo Pivot ends (lightly grease). **NOTE:** The servo should pivot freely. Slightly enlarge pivot bushing holes if needed.

Rotate each #0353 servo pivot into their respective position on the underside of the upper tray #0575-4. Hold the entire servo assembly and the upper tray together. Allow no side play in the servo and center the output spline with the true center of the tray(the rear hole of the screw to the vertical support #0575-6 is true center). Lightly cyano glue the pivot supports #0353. Re-check the servo alignment, good retention end-wise and freedom to pivot. Glue securely. From the top side of the upper tray drill two small holes through the slots provided into the servo pivots #0353. Secure using four #0027 (M2.2x9.5) self-tapping screws and four M2 washers #0001.

2. **Rudder Servo:** Select two plastic spacer blocks #0575-3. Using the original servo hardware, mount the blocks to the servo allowing at least 1.0mm of servo case clearance. Set the assembly into position in the tray. The output position of the servo is to the rear of the tray. Align the center hole on each block #0575-4 install a #0027 M2.2x9.5 Phillips Screw into each center hole. Center the servo within the opening and tighten all four servo screws previously installed. Apply a thin coat of cyano around each block #0575-3.

3. **Collective Servo:** Mount the collective servo with the splined output shaft towards the rear. Secure servo using the four servo screws provided in the radio system and two doubler blocks #0575-1.

4. **Throttle Servo:** Select two Delrin spacer blocks #105-92 and 105-93 (White), using the original servo hardware, mount the blocks to the servo allowing at least 1.0mm of servo case clearance. The taller block #105-92 goes towards the rear of the model. Set the assembly into position in the tray. The output position of the servo is toward the front of the tray. Mount the servo to the tray using four M2.2x13

Phillips screws #0029 and four 2mm washers #0001.

C. **Overall Assembly:** Refer to **View** for overall positioning of all plastic parts. It is best if a thin line of cyano is put on the mating surfaces prior to installation of the screws. Using two #0027 (M2.2x9.5) Phillips self-tapping screws, fasten the vertical tray #0575-6 to the underside of the upper tray #0575-4. Secure the secondary vertical brace #0575-7 ("H" shaped) to the front side of the vertical tray #0575-6 using one #0027 M2.2x9.5) screw. Mount the vertical brace with the screw eyelets pointing forward(towards the helicopter's nose). Position the main lower plate #0575-5 and secure using two #0029 (M2.2x13) Phillips tapping screws through the front two holes in the upper servo plate #0575-4. Use two #0027 (M2.2x9.5) in the center two holes on the bottom side.

**Step 3. Mounting Servo Tray to Mechanics**

Parts Required:

| | | | |
|---|---|---|---|
| Special Tool: | | One 3mm or 1/8" Inch Drill Bit | |
| 14 | #0003 | 3mm Large Washers | 7D |
| 6 | #0065 | M3x12 Socket Head Bolts | 7D |
| 6 | #0019 | 3mm Locknuts | 7D |

***Refer to Drawings # 7.***

A. Mount the radio tray to the upper tray mount #0347 using two M3x12 bolts #0065, two 3mm washers #0003 and two 3mm locknuts #0019. Before tightening the bolts that hold the tray to the bracket or the bolts that hold the bracket to the front frame plate, make sure the tray is held up against the bracket tight and that the tray is level and not leaning left or right.

B. Using a 3mm or 1/8" drill bit and using the holes in the lower servo tray supports #105-94 and #105-96 as a guide drill through the servo tray and install the Mx12 bolts with the 3mm washers #0003 and 3mm locknuts. Once these four bolts are in, tighten these along with the four bolts that hold the tray braces to the lower frames.

**Step 4. Installing the Elevator Servo and the Gyro Motor Assembly**

Parts Required:

| | | | |
|---|---|---|---|
| 4 | #0560-2 | M2.5x16 Phillips Screws | 7E |
| 4 | #0560-8 | 2.5mm Flat Washers | 7E |
| 4 | #0560-4 | 2.5mm Lock Washers | 7E |
| 4 | #0560-3 | 2.5mm Hex Nuts | 7E |
| 2 | #4695 | 4 Inch Nylon Ties | 7E |
| 3 | #0389 | Wire Lead Retainers | 7E |

***Refer to Drawings # 7.***

A. The elevator servo goes into the graphite dampened plate with the output shaft towards the mainshaft. Secure the servo with four M2.5x16 Phillips bolts #0560-2, four 2.5mm flat washers #0560-8, four 2.5mm lock washers #0560-4 and four 2.5mm hex nuts #0560-3.

B. Use the wire lead retainers #0389 to hold the servo wire to the frames.