C. Mount the gyro motor to the gyro plate #105-84, using two strips of servo tape, one on each side of the gyro motor.

D. Use the two four inch nylon ties #4695 to secure the wire lead coming from the gyro motor to the lower mainframes.

VIII. GAS TANK INSTALLATION

Step 1. **Build the Gas Tank.**

Parts Required:

Special Tool: 3/16" Drill Bit

1	#0648	10 oz. Gas Tank w/Cap	8A
1	#105-100	Gas Line (19 inches)	In Tank
2	#0405	Vent Fitting	In Tank
1	#0401	Gas Clunk	In Tank
1	#0403	Gas Fitting	In Tank
3	#0011	Washers M5x10	In Tank
3	#0013	5mm Hex Nuts	In Tank
2	#0682	8 inch Tie Wraps	8A

Refer to Drawings # 8.

A. Study the drawings and drill the holes for the gas tank fittings #0405 and #0403. Carefully clean all debris from the tank.

B. Mount both the gas vent fitting #0405 and the carburetor return fitting #0405 using two M5x10 washers and two 5mm hex nuts #0013.

C. Cut a piece of gas line 70mm long. Put the gas clunk #0401 on one end the gas fitting #0403 on the other. Install the assembly into the tank using one M5x10 washer #0011 and one 5mm hex nut #0013. Before completely tightening rotate the tank and check how the clunk works. It must fall down and touch each side as that side is facing downward. Rotating the clunk line will change this, either helping or hurting the clunking effect. Tighten the fittings, securely. **NOTE:** The fuel Clunk must not touch the end of the tank when held on end, so as not to cause an obstruction in the fuel draw.

D. Before installing the gas cap, rotate both plastic ends of each side of the rubber plug until none of the holes in the rubber are visible to ensure proper seal. Install rubber cap plug in the gas tank and tighten the center screw securely. **NOTE:** The rubber plug is a special material for gasoline. **Do not use the plug for methanol fuels.**

Step 2. **Mounting the Gas Tank.**

A. Using two strips of servo tape on top of the fuel tank and position the tank under the servo tray and stick in place. Use the two 8 inch tie wraps #0682 to secure the tank. **NOTE:** Use of a gas filter is recommended.

B. Install approximately 7 inches of gas line from the carburetor primer bulb (on the rear side of the carburetor) to the carburetor return fitting. Use 5 inches of gas line for the carburetor intake and the remaining gas line may be used as an over-flow line.

IX. ASSEMBLE THE TAILROTOR TRANSMISSION

Step 1. **Assemble Tailrotor Hub and Blade Holders.**

Parts Required:

2	#0463	Tail Rotor Blades	9A
4	#0019	Hex Locknuts 3mm	9A
2	#0073	M3x20 Socket Head Bolts	9A
2	#0103	M2x5 Threaded Steel Balls (Long Thread)	9A
2	#0299	M4x10 Ball Bearings	9A
2	#0453	Tail Rotor Blade Mounts	9A
2	#0457	T/R Thrust Bearings	9A
4	#0446-3	Special Shims .001	9A
4	#0446-4	Special Shims .003	9A
1	#0446-1	One-Piece Machined 4mm Stud Steel Tail Rotor Hub	9A

Refer to Drawing #9.

NOTE: Remember to clean all steel components before applying Loctite.

A. Take the two tailrotor blade mounts #0453 and thread the M2x5 threaded balls #0103 into the outboard holes, using slow cyano.

B. Press the M4x10 ball bearing #0299 into the blade mounts, on the root end, seating them squarely and fully.

C. Lay out the two thrust bearing assembles #0457. Use two spare 4mm bolts for greasing and assembling the thrust bearings. Each bearing has one race that has a smaller I.D. Place the small I.D. halves on the two bolts with the ball grove facing up. Apply grease all the way around the groove. Next place the ball retainers with the cup sides up onto the balls. Apply grease to the top sides of the bearing race that has a larger I.D.. Place the other halves of the bearings on the bolts completing the assemblies, wipe off any excess grease.

D. Slide the blade holders onto the one piece machined steel T/R hub #0446-1 followed by the thrust bearings. **NOTE:** The large I.D. half of the thrust bearings has to go on the steel hub first, leaving the small I.D. half next to the shims #0446-3 or #0446-4 and the locknut #0019.

E. Thread the #0019 M3 locknuts up onto the steel hub and lightly tighten. Check for end play in the blade holders. **NOTE:** If there is end play in the blade holders it will have **NO** adverse effect on the operation of the tailrotor due to centrifugal force loading the thrust bearing as it was designed to do. However two different sizes of shims are provided if you would like to remove some of the end play. **NOTE:** A small amount of end play must exist so as not to put the bearing in a bind. If shims are used, place an equal amount on each side because it is important to keep the distance equal between the center of the hub and each blade pivot hole.

F. Insert into each blade holder #0453 one tail rotor blade #0463 followed by one M3x20 socket head bolt #0073. The tail rotor pivot bolts #0073 should be facing inward. Secure using one #0019 3mm locknut. Tighten only enough that the tail blade can rotate with slight pressure. **NOTE:** If the tail blade and mount are held horizontally the tail blade will not fall.

NOTE: Re-check drawing for correct tail blade directional orientation for a clockwise rotation.

Repeat entire procedure for the other tail blade.

G. To balance the entire tail rotor assembly the #0429 tail rotor output shaft found in section 9C may be used as a balance bar. Lightly grease the output shaft and slide the #0449 rubber dampener found in section 9D half way over the shaft. Clean the exposed shaft of grease. Slide the assembled tail rotor hub onto the rubber dampener.
NOTE: To accurately balance the tail rotor, the tailrotor blades must extend straight out from the hub and parallel to each other.
Set this entire unit in between two "glass" glasses on a flat surface. If there is an imbalance the heavy blade will hang lower. Add weight in the form of a narrow strip of colored tape or preferable use a small 3mm washer on the blade pivot bolt of the lighter blade, to balance. (If the washer is used trim the washer with a pair of cutters to achieve the proper weight needed.) The tail should remain in any position if balance is correct. Proper blade balance is essential. Remove the output shaft #0429 and rubber dampener #0449.

Step 2. **Assemble Pitch Slider.**

Parts Required:

2	#0041	M2x8 Slotted Cheese Head Machine Screws	9B
1	#0101	M2x5 Thread Steel Ball(Short Thread)	9B
2	#0133	Long Ball Links -- Long	9B
1	#0435	Brass Tail Rotor Control Slider	9B
1	#0437	Plastic Control Slider Ring	9B
2	#0439	M6x10 Ball Bearings	9B
1	#0441	Plastic Pitch Plate - Tail Rotor	9B
1	#0443	Snap on Retainer Pitch Plate	9B

Refer to Drawing #9.

A. Begin by threading the M2x5 short threaded ball #0101 into the side hole of the control ring #0437. Use cyano and thread the ball squarely in place.

B. Place the two #0439 ball bearings (M6x10) on a clean paper with the balls visible. Lightly grease each.

C. Slide one bearing on the #0435 brass control slider. Lightly slide the control ring over the slider, followed by the other bearing, and finally the #0441 pitch plate small end first. Press together until the bearings squarely and completely enter the recesses in the control ring. Do not force.

D. Examine the #0443 pitch plate retainer, noting its four inside spring fingers and cupped shape. It will be pressed on the end of the brass slider to retain this subassembly, but this must be done with great care to ensure that the control ring is neither to tight nor to loose. The control ring bearings are precise and delicate but necessary for a tight play free tail rotor control.

Cut a hole just large enough to go over the end of the brass slider in a small piece of very thin plastic such as the flap from a plastic sandwich bag (Saran Wrap, etc) and place it over the slider against the pitch plate face. Rest the slider vertical against a wood or cardboard surface, pitch plate up, and press the retainer in place, cupped face **UP**. A piece of scrap wood with an appropriate drilled hole in it will be very helpful for this operation. Continue pressing the retainer in place until it seats against the thin plastic shim. Carefully tear and pull the plastic out. This should provide a subassembly in which the control ring is free to rotate smoothly but with negligible end play. Apply slow cyano to retainer clip where it touches the pitch control plate.

E. Screw #0133 ball links to the pitch plate using M2x8 machine screws #0041. Just seat the screws, so that the links can rotate with firm pressure.

Step 3. **Assemble the Gearbox and Bell Crank.**

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 application of heat to break down the glue.

Parts Required:

1	#0800-7 T/R Input Shaft	Bag 9C
4	#0025 Phillips Pan Head Self Tapping Screws M2.2x6.5	9C
4	#0051 M3x3 Socket Set Screws	9C
1	#0421-A T/R Gear Box Housing	9C
1	#0421-B T/R Gear Box Housing	9C
4	#0425 M5x13 Tail Gear Box Ball Bearings	9C
1	#0429 T/R Output Shaft	9C
1	#0431 E-Clip - Output Shaft	9C
1	#0433 Plastic Gear Spacer - Output Shaft	9C
2	#0427 Bevel Gears	9C
1	#0095 Special Bolt Tail Rotor Bellcrank	9C
2	#0159 M3x7 Ball Bearings	9C
1	#0445 T/R Bellcrank	9C
4	#0426 .005" (.12mm) shims	9C

Refer to Drawing #9.

SPECIAL NOTE FOR INSTALLING #0427 OR #0547 TAIL ROTOR GEARS IN ALL X-CELL OR XL-PRO HELICOPTERS.

Four #0426 .005" (.12mm) shims are provided for adjusting the gear mesh. In most cases none will be required, however in some cases 1 or 2 per gear may be necessary to achieve optimal gear mesh.

The set-up procedure is as follows:

1.) Trial fit all components (without shims) and assemble gear box with a couple of the #0025 screws. To be accurate, it is necessary to insert the transmission into the tailboom each time you wish to check gear mesh. This is because the boom will slightly compress the transmission case.

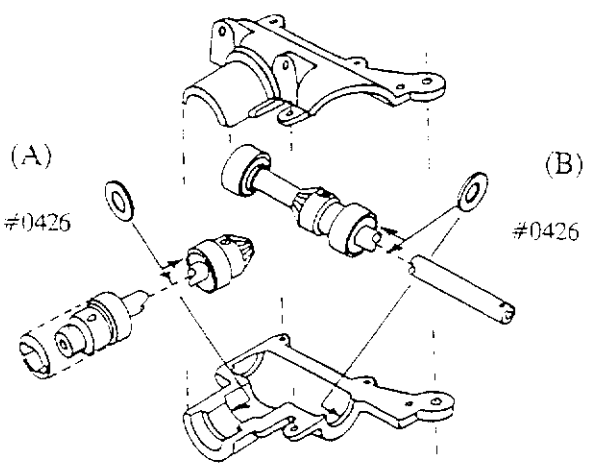
Each shaft assembly should be individually test fitted with each transmission case in place to check for end-play and excessive bearing loads. The former is caused by the gear being set too far from the bearing

or spacer and the later is from too much spacing causing the assembly to "snap" into place in the transmission.

2.) If it is determined that shims are required, trial fit one-at-a-time (never exceeding two in any one location) to optimize gear backlash. The above procedures must be adhered to each time a shim is tested (to avoid end play or bearing pre-load).

By examining the drawing you will see that only two positions are acceptable for shimming. Position (A) is behind the bearing nearest the gear on the input shaft and next to the stepped area of the transmission. Position (B) is outside the bearing on the output shaft but inside the flange of the transmission case.

The most desired gear mesh will be that of minimum backlash, even the point of having slight interference during rotation. This condition will " Break-in" during the first few flights. As with any similar system, we always recommend a through check over after the first 20 - 30 flights to ensure good mesh and change to new grease (to remove any break-in debris).



A. At this time clean the input shaft #0800-7 and the output shaft #0429, the inner race on the four ball bearings #0425 and the two bevel gears.

B. At builders discretion apply a small amount of blue Loctite to input shaft #0800-7 next to the delrin coupler. Slide one of the bearings #0425 all the way up against the delrin. Lay the lower half of the T/R gear box #0421-A on the table and hold the input shaft over the T/R gear box half and apply a small amount of Loctite where the second bearing goes and slide the bearing into position. Apply blue Loctite to the two M3x3 set screws #0051 and start each in to the bevel gear #0427. Place the gear on the shaft and run one of the set screws down and make sure that it is on the flat. Push this assembly down into the lower T/R gearbox half and adjust the gear so that no end play exist but without binding the two bearings. Tighten the two set screws thoroughly and set aside this assembly to cure for a few minutes.

C. Snap the E-clip #0431 into the groove on the T/R output shaft #0429. Apply a small amount of Loctite to the small portion of the shaft beside the E-clip. Slide one of the two remaining bearings #0425 onto the shaft and up against the E-clip.

D. Apply blue Loctite to the two remaining M3x3 set screws and start them onto the bevel gear #0427. Slide this gear onto the shaft teeth first and run one of the set screws down into the flat spot on the shaft. Slide the plastic spacer #0433 on next followed by the remaining ball bearing #0425. Apply Loctite where the bearing will sit. Lay the other T/R gear box half #0421-B on the table and place the output shaft into its perspective position. Once again adjust the gear and tighten so that there is no end play and no binding in the bearings. **Caution:** This is a small gear, do not over tighten.

E. After curing apply a liberal amount of grease to both gears. With the two shafts in there respective positions bring the two T/R gearbox halves together and install the four M2.2x6.5 phillips screws #0025. **NOTE:** Be sure to install the screws from the correct side. Check for binding, if any - sand plastic spacer between output gear and bearing and reposition gear.

F. Slide the T/R pitch slider onto the shaft. (Pre-Assembled in step 2)

G. Press two #0159 ball bearings into the holes in the tail rotor bellcrank #0445, using the special bellcrank bolt #0095 to keep the bearings aligned and in place.

H. Engage the control ring ball in the clip end of the bellcrank assembly #0445 and squarely thread the special bolt #0095 into the gear housing #0421 from the bottom. Tighten the bolt until there is no play or bearing drag.

Step 4. **Install Assembled Tail Rotor Hub.**

Parts Required:

3	#0447-1 Locking Clips (Circlips)	Bag 9D
1	#0447-2 Groove Pivot Pin	9D
1	#0449 Rubber Dampener	9D
2	#0001 Flat Washers 2mm (small)	9D
1	#0053 M3x5 Socket Set Screw	9D

(one #0447-1 has been supplied as a spare)

Refer to Drawing #9.

A. Press the silicone dampening #0449 sleeve onto the output shaft about 10mm in length. Use a 1.5 Allen wrench or a small drill to pierce through the silicone dampener and through the cross hole in the output shaft. Insert the M3x5 socket set screw into the end of the output shaft #0429 and temporarily tighten the M3x5 set screw #0053 against the Allen wrench or drill bit to ensure that no burrs exist in the shaft. Loosen the set screw and remove the allen wrench or drill bit. Check with the drawing to ensure the proper orientation of the delta tail hub before pushing it over the silicone sleeve. Hold the hub with the pin hole lined up with the hole in the output shaft then push the hub into position, a small amount of grease maybe necessary to get the hub to slide over. You may want to slide a smaller object than the pivot pin through the hub and shaft initially to get the hub centered easily.

B. Center the pivot pin #0447-2 in the T/R hub than apply blue Loctite to the M3x5 set screw #0053, in the end of the output shaft and tighten. **NOTE:** Do not over tighten, breakage of the pin could result.

C. Place a M2 washer #0001 on the pivot pin then snap the clip #0447-1 into the groove. Repeat this process for the other end of the pin.

D. Snap the two ball links #0133 onto the balls #0103 on each tail rotor blade mount.

X. BUILDING THE TAIL BOOM

Step 1. **Installing Tube Drive.**

Parts Required:

1	#0556-1	Aluminum Tailboom(31.5" long)	Bag10A
1	#0809-1	Tube Drive Shaft	10A
4	#0057	M4x4 Set Screws	10B
2	#0800-2	Delrin Shaft/Bearing Adapters	10B
2	#0800-3	Torque Tube Ball Bearings	10B
2	#0800-4	Delrin Bearing Supports	10B
4	#0800-5	X-Cell O-Rings	10B
2	#0800-11	Male Universals	10B

Refer to Drawing # 10.

A. Snap (one) inner bearing adapter #0800-2 inside the ball bearing #0800-3. Support the bearing below the inner race and press the delrin adapter in place until it snaps. Place the assembly over an upright outer delrin bearing support #0800-4 (cupped end) with the adapter flange upward. Press until it also snaps in place. Repeat with the other parts. Slide (one) O-ring #0800-5 into the first outside groove of either end of the completed bearing assembly. Pass a second O-ring in the same manner into the second groove. Repeat this process on the remaining bearing assembly. Using a wooden dowel or similar device which will slide inside the tailboom. Press each boom bearing assemblies into the tail boom 10.5" from each end. (**NOTE:** A small amount of dish washing soap and water inside the boom and on the rubber O-Rings will make the assembly slide easier.)

B. Note the design of the steel insert in the graphite shaft #0809-1. The alignment of the male universal #0800-11 is dictated primarily by its fit over the exposed portion of the steel insert. When slid in place, it will automatically stop at the end of the graphite tube. As a secondary point of alignment, the large I.D. bore of the male universal will snugly fit over the O.D. of the graphite shaft. This provides additional support for the ends of the graphite tube which are the most vulnerable to damage. There may be a little fitting necessary to install the male universal. Ideally, the fit should be a light press fit(never force it in any way). If the male part will not fit in this manner, simply lightly sand the last 15.0mm of the graphite tube with a little sandpaper such as 400-600 grit, using a rotating motion between fingers. When the male universal is properly positioned, you will see the center point of each milled flat directly in the center of the set screw holes. Apply Loctite and securely tighten the M4x4 set screws #0057.
NOTE: It is not recommended to apply adhesive to any part of the male universal installation since future service will be impossible.
After one male universal is in place, insert the graphite tube into the tail boom through each

bearing assembly, sliding in far enough to allow installation of the remaining universal joint. Install the other universal #0800-11 in the same way.

Step 2. **Installing Tail Rotor Push Rod Guides, Fin Mounts and Push Rod.**

Parts Required:

1	#0375	T/R Push Rod (700mm)	10A
1	#0556-3	T/R Pushrod Extension	10A
1	#0481	Horizontal Fin	10A
1	#0486	Vertical Fin	10A
5	#0477	T/R Control Rod Guides	10C
1	#0385	T/R Control Rod Coupler	10C
1	#0479	Horizontal Fin Mount	10C
5	#0015	Hex Nuts 2mm	10C
5	#0043	M2x10 Slotted Machine Screws	10C
2	#0025	M2.2x6.5 Phillips Screws	10C
2	#0079	M3x35 Socket Head Bolts	10C
2	#0075	M3X25 Socket Head Bolts	10C
4	#0019	3mm Locknuts	10C
2	#0487	Vertical Fin Clamps	10C
1	#0003	3mm Large Washer	10C
3	#0061	M3x8 Socket Head Bolts	10C
1		Previously Assembled Tail Rotor Gearbox	
1	#0035	M2.2x16 Phillips Screw	10C
1	#0387	Tail Rotor Control Rod Guide	10C
2	#0137	Plastic Clevis	10C

Refer to Drawing # 10.

NOTE: The notched end of the tail boom is the rear (Tail Transmission) side.

A. Slide the #0479 horizontal fin clamp onto the tailboom 9-3/8" from the rear. Loosely mount the four tailrotor control rod guides #0477 by wrapping them around the boom and securing each with an M2x10 machine screw #0043 and a M2 hex nut #0015. Mount one between the horizontal fin clamp #0479 and the "rear" end of the tailboom and mount the other three in front of the horizontal fin clamp.(The screws are long enough to allow the control rod to be snapped in from the sides when needed). Measuring from the notched end of the tailboom, the first control rod guide should be 100mm from the end. The next guide should be 130 millimeters from the first one. The next 3 guides should be 145 millimeters apart.

B. Insert an M3x35 socket head screw #0079 through the top front hole in the vertical fin #0486 and through a vertical fin clamp #0487 and loosely thread on an M3 locknut. Insert an M3x25 screw #0075 through the bottom front hole in the fin and the lower hole in the clamp and add a locknut. Assemble the rear clamp to the remaining holes in the fin in identical fashion, with the exception that one #0003 3mm washer will be inserted in between the slot in the fin clamp #0487. **NOTE:** The #0079 bolt (3x35mm) must go through the M3 washer. **NOTE:** This washer applies to the rear clamp ONLY.

C. Slide the assembled tailrotor gear box into the boom as far as it will go, slide the clamp up against the tailbox and align the three holes. Screw the tailbox to the clamp using the three

M3x8 bolt #0061. Ensure that the tailbox is fully seated in the boom then tighten the vertical fin clamp bolts.

D. Install the two M2.2x6.5 Phillips screws #0025 in the two holes in the top of the horizontal fin #0481 and into the fin mount #0479. A small amount of Goop or silicone glue under the horizontal fin #0481 will help extend the life of the fin.

E. Examine the central rod coupler #0385, noting that it will accept the control rods beyond their threaded portion. The intent is to better support the rods against bending. Use the coupler to join the tail rotor control rod #0375, and the tail rotor control rod extension #0556-3. (Protect the rods with tape or cloth when clamping them to allow the coupler to be screwed on.) Be sure both rods enter the coupler approximately 7mm in depth. Start a clevis #0137 on each end of the push rod. Exact adjustment will be made later.

F. Slide the tailboom into the mechanics holding the tailbox with your right hand and holding the mainshaft with your left. Spin the main shaft back and forth until the tail drive engages, then push the boom in as far as it will go. Mark the boom next to the tailboom support halves #0185 with a piece of tape or put a small scratch on it with an X-acto knife. Slide the boom back about 1.0mm. Standing behind the model, sight the tailbox to the mainshaft. Make sure that the T/R shaft is perpendicular to main shaft. Tighten the four M3x30 bolts #0077 in the tailboom support halves, then recheck alignment. **Option:** Due to the size of some workshops and the aggravation of spinning a model around on the table wondering what you are going to knock over next with the tailboom, you may want to wait until you've finished setting up the main mechanics before installing the tailboom.

G. Bend the tail end of the tail rotor control rod approximately 168 degrees in order to align with the tail rotor bellcrank #0445.

H. Install the tailrotor pushrod and hook up the rear clevis #0137 to the center hole in the bellcrank on the tail box using a small piece of fuel line stretched over the clevis as a safety.

I. Install the front tailrotor pushrod guide #0387 on the upper mainframe using one M2.2x16 Phillips screw #0035.

J. Align all the pushrod guides so that there is no binding throughout the travel of the pushrod.

Step 3. **Installing Twin Boom Supports.**

Parts Required:

2	#0585-6	Graphite Boom Supports	10A
8	#0009	3mm Small Washers	10D
1	#0073	M3x20 Socket Head Bolt	10D
2	#0065	M3x12 Socket Head Bolts	10D
3	#0019	3mm Locknuts	10D
4	#0585-7	Threaded Inserts	10D
4	#0585-8	Female Mounts	10D

Refer to Drawing # 10.

A. Assemble each graphite boom support #0585-6 using four #0585-7 threaded male inserts and four #0585-8 female mounts as follows: Using 80 grit sand paper (or similar) roughen the smooth raised areas next to the threads on each #0585-7 threaded male insert. Clean both the #0585-7 and #0585-8 parts with alcohol or thinner.

Gluing the ends in place is a simple matter and can be done in a number of ways.

METHOD (A) - Apply J.B. Weld epoxy liberally to the threaded male insert #0585-7 (avoiding the threads) and the inside of each tube end. Push each insert in place until only the threads are exposed. Allow to dry overnight. The following day, apply RED Loctite, slow CA, or epoxy to the threads and screw each female mount #0585-8 in place. Note that each mount has a 2-1/4 degree angle milled into it to allow for the width variation from frames to tail clamp as shown in the drawing. Promptly proceed with steps "A" and "B". Obviously, the choice of adhesives will dictate the speed of which you must proceed in this step. Allow assembly to cure fully before operation.

METHOD (B) - If you are in a rush, this is the quickest method. Screw each threaded male insert #0585-7 into a female mount #0585-8. Apply Slo C.A. to the insert and the I.D. of the female mount. Spray a little C.A. Kicker onto the graphite tube (on one end only) and insert it fully into the mount assembly. The other end must be assembled, aligned and installed without Kicker so sufficient time is available. (After installation Kicker can be used if desired). Again, be sure to study the drawing so that parts are not improperly aligned and not useable.

B. Mount each graphite boom support #0585-6 to the inside of the lower frames using two M3x12 bolts #0065, six 3mm small washers #0009 and two 3mm locknuts #0019.

C. Place a 3mm small washer #0009 on the M3x18 bolt #0073. Run the bolt through the left boom support then place a washer on the bolt. Next slide the horizontal fin clamp #0479 on the boom to line it up with the bolt. Use a M2.5 driver or Allen wrench to thread the bolt through the fin mount. Place another washer on the bolt, slide the right boom support onto the and secure with a 3mm locknut. **NOTE:** Before fully tightening make sure that the horizontal fin is square to the main shaft.

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.**

A. Provisions have been made in plastic tray switch plate #0575-8 for the receiver switch and the gain box for the gyro. If you elect to use these positions. Mount the two devices at this time.

B. Plug all your servo leads into the receiver. Do not allow any wires to rub the corners of the graphite frames or any moving part. Route all wires as neatly as possible using small tie wraps to hold in place.

C. Mount the gyro amplifier on the bottom side of the plastic servo tray. Use double sided servo tape to secure in place.

D. Wrap the receiver and battery in foam and mount on the front of the plastic servo tray. Secure with either velcro or tie wraps loosely pulled.

E. If a whip antenna will be used, tests have proven that the best place to mount the antenna base is on the radio plastic tray #0575 sticking straight forward.

F. If you are electing to use a full length antenna, route it out of the canopy then down to the landing gear strut next to the skid and then back up to the tailboom. Again ensure that the wire doesn't rub any corners and is free from moving parts.

SPECIAL NOTE: If using a computer radio, clear all ATV's to 100%. Clear normal throttle and normal pitch curves so that they are linear and throwing to there limits. Clear sub trims, trim memory, stunt trims, or anything that would change servo centering. Check direction of the servos.

In the following steps, be sure to use Loctite on all steel threaded balls #0103, nuts and screws. All measurements given for pushrods are from the inside of the ball links at the connection point with the push-rods. Unless otherwise specified.

Step 2. **Setting up the Tail Rotor Servo.**

A. Activate the electronic tail rotor compensation for "Right" (clockwise) rotor rotation. Check direction of the tail rotor servo by giving a right tail rotor command. The servo arm should move towards the front of the servo tray. With the gyro running move the nose of the helicopter to the left, the servo arm should move towards the front of the tray again.

B. Position the collective stick at half stick. The servo arm should be square to the servo tray.

C. Snap the clevis into one of the holes on the servo arm at least 11mm out on the servo arm.

Step 3. **Install the Elevator Servo Pushrod.**

Parts Required:

1	#0367	Control Rod	11A
1	#0133	Long Plastic Ball Link	11A
1	#0137	Plastic Clevis	11A

Refer to Drawing # 11.

A. Start the clevis #0137 on one end of the M2x60 control rod and the long ball link #0133 on the other end. Adjust to a length of 41mm between the links.

B. Install this pushrod on the #0105 ball of the elevator bellcrank #0157 in the swing arm.

C. With the radio on position a wheel on the elevator servo and drill a hole 12.5mm out on the wheel and straight up from the servo arm retainer screw.

D. Study the drawing of the servo wheel. It must be trimmed so that the clevis has clearance to move to both extremes without hitting the servo wheel.

E. As with the rudder control rod install a piece of fuel line on the clevis as a safety.

Step 4. **Install the Aileron and Collective Pushrods.**

Parts Required:

2	#0371	Threaded Pushrods M2x90	11B
6	#0133	Long Plastic Ball Links	11B
1	#0359	Roll Servo Link Retainer Bar	11B
3	#0361	M2 Steel Balls	11B
6	#0015	2mm Hex Nuts	11B
1	#0101	Threaded Steel Ball M2x5	11B
2	#0045	M2x14 Threaded Machine Screws	11B
1	#0042	M2x10 Threaded Machine Screw	11B
1	#0001	2mm Flat Washer	11B
1	#0369	M2x35 Threaded Pushrod	11B

Refer to Drawings #11.

A. Study the drawing showing the special control arm assembly on the aileron pivoting servo. **NOTE:** that the three control rods running to it have their ball links trapped by the arm assembly and therefore, must be fabricated first.

B. Select the M2x35 control rod #0369, start two plastic ball links #0133 one on each end and adjust so that there is 22mm of rod between the links.

C. Select the two thread pushrods M2x90 (curved) #0371 and thread one #0133 ball link(long) onto each end of both control rods. Thread the links on the curved ends of the rods until the base of the ball link #0133 is 11mm from the center of the bend in the rod #0371. Thread the remaining ball link on until a distance of 69mm is achieved between the base of the links.

D. Snap one M2 steel ball #0361 (drilled version) in the ball links on the bent ends of the two aileron rods #0371.

E. Insert one M2x5 threaded ball #0101 in the center hole of the roll servo link retainer bar #0359 from the bottom and secure it with one hex nut M2 #0015. Use Loctite.

F. Select a double ended servo arm from the radio system hardware, long enough to match the 24mm hole separation on the retainer bar. If necessary, obtain an un-drilled arm or wheel and drill and shape it to suit. Center the servo electronically and mount it exactly parallel with the servo lengthwise.

G. Insert an M2x14 screw in each end hole of the retainer bar, slide an aileron roll bar on each and secure with an M2 hex nut. Snap the collective rod ball link on the center ball and mount the assembly of the three rod to the servo arm. Secure with two M2 hex nuts from underneath the arm. Tighten securely using a small wrench or long-nosed pliers. Use Loctite. Check the configuration against the drawing. (collective rod forward). Snap the ball links onto the #0105 threaded balls on the roll bell cranks #0167.

H. With the radio on center the collective stick. Position wheel on the collective servo. Drill a hole 11mm out and square to the servo. Install the M2 steel ball #0361 on top of the servo arm using a M2x10 threaded machine screw #0042, a 2mm flat washer #0001 and a 2mm hex nut #0051. Use Loctite. Snap the remaining ball link on the collective rod onto this 2mm ball.

I. With the collective stick in the center, the roll servo should be exactly vertical and both aileron bellcranks are square to the frames.

Step 5. **Install the Throttle Pushrod.**

Parts Required:

1	#0679	M2x170 Control Rod	11C
2	#0133	Long Plastic Ball Links	11C
1	#0015	2mm Hex Nut	11C
1	#0042	M2x10 Slotted Machine Screw	11C
1	#0001	2mm Flat Washer	11C
1	#0361	2mm Steel Ball	11C

Refer to Drawings #11.

A. With the throttle stick in the center position, and a servo wheel on the throttle servo. Drill a hole 14mm out and straight down. Mount the 2mm steel ball #0361 to the outside of the wheel using one M2x10 machine screw #0042, a 2mm washer #0001 and a 2mm hex nut #0015. Use Loctite.

B. Start a plastic ball link #0133 on each end of the M2x170 control rod and adjust to a length of 148mm between the ball links. Snap the control rod onto the carburetor arm and the servo arm. Adjust the throttle ATV's for no binding at low or high throttle.

C. Adjust the hover throttle so that the carburetor is 13mm from full open at a hover. This will give a good starting point and about 1450 rpm (Head Speed) in a hover.

Step 6. **Install Rotor head, Flybar and Hiller Control Rods.**

Parts Required:

8	#0133	Ball Links (long)	11D
4	#0135	Ball Links (short)	11D
2	#0313	Threaded Rods M2x10	11D
2	#0335	Threaded Rods M2x75	11D
2	#0337	Threaded Rods M2x27	11D

Refer to Drawing #11.

A. Remove the special head bolt #0091 from the head, slide the head down onto the mainshaft and align the hole on the top side of the main shaft with the hole in the head block. This can be accomplished by holding the rotor head in one hand and spinning the maingear clockwise with the other. Install the special bolt and tighten.

B. At this point check to see how free the washout block slides up and down the guide pins #0297 in the bottom of the head block. If it is stiff, disengage the wash out block and rotate it 180 degrees and try again. Determine which way is best and use pliers to tweak the pins a small amount as needed to one side or the other until the washout block slides up and down the pins with a minimum of drag.

C. Start a long ball link on each of the two flybar control rods #0337 and adjust to 9mm. Snap both control rods to the flybar control arms and washout arms.

D. Start a long #0133 on each end of the Hiller control rods #0335 and adjust to a length of 59mm. These rods go from the bell mixers on the blade holders to the swashplate. Snap both into position.

E. Start a short ball link #0135 on each end of rod #0313 and adjust to a length of 1mm between the ball links. These rods go from the bell mixer to the delta plate on the rotor head.

XII. CANOPY PREPARATION

Step 1. **Mounting Clear Lexan Window.**

Part Required:

1	#106-96	Lexan Window	Box
1	#0504-1	Epoxy Glass Canopy	Box
12	#0024	M2.2x4 Phillips Pan Head Self-Tapping	Bag 12A

Refer to Drawing #12.

NOTE: Because of current trends to apply wild paint job to canopy and fins, the window area was left in the canopy to allow people to express their creative side. However, a clear Lexan window is supplied for those who wish to be able to see in.

A. If you wish to use the Lexan window you must cut the opening in the canopy. Cut just inside the scribe line with a cutting wheel and clean up with a sanding drum, small file or sand paper.

B. Examine the Lexan window and note that there are two scribe lines around it's perimeter. The outer most line is your guide for cutting. Cut about 2mm - outside this line using sharp scissors or a dremel tool and cutting disc (USE EYE PROTECTION).

C. If you wish to screw the window in place, twelve self tapping screws #0025 (M2x6.5) are provided. The location of each screw will be as follows: one mounted on either side of the nose about one inch from the center, one mounted on either side of the top about one inch from the center one centered at the nose, one positioned at each of the three rounded corners, the remaining four screws (one for each side) should be mounted in between the nose and the back two lower mounted screws and between the top two screws an each side. Dividing these areas in half. After determining location of each of the 2.2x4 Phillips self tapping screws #0024, drill a hole at each location using a #56 or .046 bit. Holes should be 3mm from edge of canopy opening. Extra screws are provided if needed.

NOTE: Alternately, Miniature Aircraft USA canopy glue #0502 or epoxy can be substituted for screws. Use coarse sand paper (80 grit) to roughen the surfaces to be glued.

Position window in canopy and starting at the nose, drill the front two holes using the same bit. Start screw and tighten snug. Next, drill the top two holes. Work your way along each side installing screws as you go.

NOTE: Once the canopy is painted and window is permanently installed, apply a drop of Polyzap to the screws on the inside of the canopy.

NOTE: Lexan window may be dyed or tinted using Rit dye with warm water and a little white vinegar.

Step 2. **Mounting Canopy.**

Parts Required:

2	#0003	3mm Large Washers	Bag 12A
2	#0063	M3x10 Cap Head Bolts	Bag 12A
3	#106-97	Rubber Grommets	Bag 12A

Refer to Drawing #12.

A. Drill a 1/8" guide or starter hole in the marked location for the canopy mounts and grommets. Use a grinding stone or a tapered reamer to enlarge the holes to 7.5 - 8mm. It may be necessary to use a small screwdriver to help work the grommets into the canopy. Apply medium cyano to each grommet **inside** the canopy.

B. To install the canopy on the model, slide the canopy into position apply thumb pressure to the grommet on top of the canopy on the standoff, push grommet down until it seats. Hold the canopy on both sides and pull it over the lower standoffs and push grommets all the way on. Place a 3mm large washer on both M3x10 cap head bolts and screw into standoffs.

Step 3. **Installation of Thumb Screw Plastic Caps.**

Parts Required:

2	#106-95	Thumb Screw Plastic Caps	Bag 12A

Refer to Drawing # 12.

NOTE: **Installation of Thumb Screw Plastic Cap for Canopy Retainer Screws:** Suggestion - Use #105-98 stand-off and a block of wood. Thread the M3x10 bolt fully into the #105-98 stand-off and place the plastic cap upside down on a flat surface. Use a block of wood and hammer (or bench vise) to press the bolt head into the plastic cap. **NOTE:** It is a hard press, no glue is needed.

XIII. BUILDING THE ROTOR BLADES

Step 1. **Assembling Blade Mounts.**

Parts Required:

2	3674-1	Pro-Wood Rotor Blades	Wrapped in Box
4	0019	M3 Locknuts	13A
4	0093	M3x15 Phillips Bolts or Socket Head Bolts	13A
2 pair	3674-5	Pro .60 Blade Reinforcements(Top and Bottom)	13A
4	3674-6	Carbon Fiber Inserts	13A
2	3723	Brass Blade Pivots	13A

Refer to Drawing # 13.

A. First identify the top and bottom plastic blade reinforcements #3674-5 marked with a "T" and "B". Thoroughly rough up the surface to be glued using either 36 - 40 grit sand paper or a sharp object.

B. Match the holes in the carbon fiber plates #3674-6 with the blade reinforcements #3674-5. Thoroughly rough up the mating surfaces on each.

C. Press into the larger of the three holes in each blade root-one #3723 brass blade pivot. Center the brass pivot in the holes.

D. Press each top and bottom plastic reinforcement onto the brass pivots on each blade. Line up the two bolt holes in each reinforcement with the two small holes in each blade. Press one #0093 Phillips head bolt threw any of the two holes in each blade. With a pencil or pin trace around the outer perimeters of each plastic reinforcement #3674-5 (Both top and bottom). Remove the bolts #0093 and plastic reinforcements #3674-5.

WARNING: Blade reinforcements must be glued using SLOW CYANO ONLY. **No other glue will work satisfactorily.** Read Section "E" entirely before proceeding.

E. Match each blade reinforcement #3674-5 with it corresponding carbon fiber insert #3674-6. (Refer to section "B"). Insert into the two small holes on each carbon fiber insert two #0093 Phillips head bolts. (**NOTE:** The surface which was not sanded will be on the bolt head side). On the top side of the rotor blade liberally apply slow cyano glue to the inside of the traced area for the blade mount. Press the top plastic reinforcement onto the glued area while lining-up the two bolt holes. Wipe away any excess glue. Immediately apply slow cyano to the insert area for the graphite plate. Press the matching graphite plate into position. Again wiping away any excess glue. Completely thread both of the Phillips head screws into the blade. On the bottom side of the blade repeat the above process using the bottom plastic blade reinforcement with matching carbon fiber insert. Secure by using two #0019 M3 locknuts and by clamping the blade pivot area with vise grips, table vise or a suitable clamping device. Allow to thoroughly dry. Repeat step "E" on matching blade.

Step 2. **Adding Lead Strips.**

Parts Required:

2	3674-8	3/16" x 362mm Round Lead	13B
3	3712	Balsa Blade Caps	13B

Refer to Drawing # 13.

A. Sand each rotor blade with 220 or 320 grit sandpaper until very smooth. (Use of a sanding block and proper attention to thin trailing edges will ensure retention of the correct airfoil. Be certain the trailing edge remains straight during this operation.

B. Cut the lead strips #3674-8 into six lengths, the same length as the long slots along the leading edge of the blades. Cut two shorter pieces of lead for the two shorter slots. Be sure that all like lead strips remain equal in length.

NOTE: Using a sanding block, sand each lead strip on a flat surface by rolling under sanding block. If an exact gram weight is desired, the use of a gram scale will be necessary.

C. Place all the lead strips in their respective slots and weigh the blades on a gram scale or our new blade balancing system #0514. The total weight should be the same. If not, trim the lead in one of the slots until equal weight is achieved.

NOTE: If a gram scale is not available the following guide may be used:

Net blade weight (weight is written or root of blade)	+____ grams
Approximate weight of lead and wood strips installed	+_44__ grams
Approx. Blade covering installed	+_12__ grams
Approximate weight of blade mounts installed	+_15__ grams
Total Flying Weight	=____ grams

D. If less weight is desired, trim one of the lead pieces in each blade until desired weight is achieved.

E. If more weight is desired, you may also add bronze powder #3709 to the blades.

F. Starting at the outer end of the slot, apply a coat of thin cyano around the lead in the slots. Allow to sit for about 30 seconds, then apply cyano accelerator. Repeat this process until near the top. A small gap must be left as to allow room for the balsa strip #3712.

Step 3. **Initial Balance.**

Refer to Drawing # 13.

A. As an initial step in balancing, we will now establish the center of balance point. Using a BIC type pen, dowel, or tube of any type, position the blade lengthwise in front of you on a level surface. Using the pen as a fulcrum at 45 degrees to the leading edge, determine the balancing point, mark the blade accordingly, and repeat at 90 degrees to the previous line. (Hint: Gently rotate the pen right or left until the balance is established, and mark well for future reference, even after sanding). Both blades should balance within 1-2 millimeters of each other. Since they were factory matched and all material added accurately measured, you should have no difficulty. However, if there is an imbalance, the blades may be matched by two possible methods. First, determine which blade you wish to shift and in which direction. For example, if tip weight is to be added, simply rout out a small area at the tip of the blade slot and glue in a small amount of the excess lead strip as needed. Keep in mind that any weight added to the blade being corrected, must also be added to the other blade at the **center of balance point**, thus retaining the original balance of the two blades. The optional bronze #3709 powder may also be used as a balancing aide. See #14.

B. Cut balsa strips #3712 for each slot and trim to fit (i.e. round corners). Press balsa firmly into slots and secure with cyano on all sides. Block sand the raised portion until flush with the blade surface. Coat with a film of cyano and wipe away excess.

C. At your option, seal the wood at the hub and tip areas with either instant cyano or fuel-proof paint. Lightly re-sand blades with 220 or 320 grit sandpaper once again. Carefully remove all dust using a clean towel or a tack rag, wiping several times. At clean blade is a must for proper adhesion of the blade covering material.

Step 4. **Cover Blades.**

Parts Required:

2 3674-7 Blade Covering White (In box)

Refer to Drawing # 13.

A. With the blades now ready for cover, select a clean flat surface and after removing the backing material from a piece of blade covering #3674-7, lay it adhesive side up. Now carefully measure 10mm in from the near edge and mark each end with a ballpoint pen. Holding the blade with the hub in your left hand and the blade tip in your right hand, set the trailing edge down on the mark from the left end of the covering in a position to just clear the base of the hub when it is wrapped into position. Rock gently to adhere the covering to the trailing edge.

At this point, the 10mm section of blade covering will be visible between yourself and the blade trailing edge. Fold the blade toward yourself and apply pressure on the 10mm section of the marked covering. This will establish the bottom of the blades. Lift the blade up with covering clinging to the trailing edge and firmly smooth the short 10mm side onto the underside of the blade with a continuous slide of the finger. Continue rubbing the entire trailing edge as you rotate the blade upright. Do not allow the covering to touch the top blade surface until the trailing edge is firmly bonded with a clean, sharp fold.

Now rotate the blade further and progressively smooth the covering end to end as you go. Continue around the leading edge and back to overlap the starting edge of the covering on the bottom of the blade. Trim excess covering neatly from the blade and smooth the entire surface again. Repeat this process with the other blade. **Note:** A useful technique to allow good control of this sticky material and to prevent it from prematurely adhering to the blades in any area, weight the covering by sticking a piece of wire on what will be the final edge of the covering to be adhered, before starting. This will cause the covering to maintain a continuous roll-away from the blade surface until deliberately pressed down. Repeat entire process with the remaining blade.

Step 5. **Final Balance of Blades and Rotor Head.**

Refer to Drawing # 13.

Equipment Required: **NOTE:** The performance potential of modern R/C helicopters is so great that the use of specialized equipment for proper assembly and set-up is fully justified by the results achieved. This is particularly true of balancing procedures for all rotating parts. Nothing so clearly distinguishes one helicopter from the rest as perfect blade tracking and freedom from vibration. This manual describes only the procedure usable without special equipment which includes balancing the fly bar on its own bearing in the pivot block, and then suspending the head with main blades from the flybar across two straight edges, such as two rectangular blocks of wood. This procedure has been proven very effective and produces a vibration free head. The ultimate in head balance can be achieved by using a good static balancer such as the balancer #0514 sold by Miniature Aircraft USA or its equivalent. Its value lies in its ability to include main blade balance. If you have such a unit, use it following the instructions with it.

A. Support the rotor head assembly from Step 4 above vertically in the same manner. (A vice with soft jaws, etc.) that allows the fly bar to pivot freely around a horizontal position. Adjust the fly bar weight inward slightly on the paddle end that rotates downward. Continue small adjustments until the fly bar will remain level. Tighten all four weight set screws tight using Loctite.

B. Remove the rotor head from the main shaft. Mount the main rotor blades to the head using M4X35 socket head bolt #0082 and M4 lock nuts #0021, temporarily installed in section I. Position the blades straight out from the head and tighten the screws just enough to hold the blades in position.

C. Obtain two wood blocks at least 75mm (3 inches) high with parallel surfaces (2 short sections of good quality 2x4 serve very well) and two single side razor blades. Then, suspend the head and blade assembly between them supported on the fly bar. One main blade will invariably tilt downward.

Note: As described, before rotation of main blade on rotor head may result in a better balance. Cut a partial strip of the red tape provided (the degree of unbalance will give an indication of the width necessary) and apply near the end of the light opposite blade. Just stick a corner of the tape to the blade until the exact amount is determined. When exact balance is achieved (when the blade tips are equal distance from the bench top) apply the tape to the blade starting underneath, as with the regular covering.

D. Re-install the entire balanced rotor head assembly onto the main rotor shaft.

XIV. FINAL MECHANICAL AND ELECTRONIC SET-UP

Step 1. **Setting up the Collective Servo.**

Refer to Drawings # 11.

A. Move the collective stick slowly all the way to the top and check that the collective arm is going as far as possible without putting the elevator bellcrank #0157 in a bind where it sticks through the mainframe and adjust ATV as necessary.

B. Move the collective stick slowly all the way to the bottom and adjust the ATV so that the collective arm goes all the way to the bottom without binding.

C. With the pushrod lengths given you should be able to use 100 to 110% ATV travel on the pitch servo.

D. With the collective stick at the top check that the swashplate is moving all the way to the top without binding. Adjust the four lower swashplate rods #0227 if necessary.

E. Once again check all collective and aileron, servo's, bellcranks, and pushrods at one half throttle stick for vertical and horizontal positioning.

Step 2. **Final Swashplate and Fly-Bar Alignment.**

Refer to Drawing # 11.

NOTE: Miniature Aircraft offers both swashplate and fly-bar alignment tool kits. Order #0510 and #0512.

A. **Swashplate:** A final check for a level swashplate may be achieved with the use of a main rotor pitch gauge (#0526) and a fly-bar lock (#0505). All transmitter stick and servo arms should be in a neutral position. Snap the fly-bar lock into the rotor head. Position the pitch gauge on one main rotor blade and set the pitch reading in the blade. Rotate the main rotor head in all four 90 degree positions. If the swashplate is truly level,the pitch reading will remain the same in all four positions. If incorrect, adjust the rods just below the swashplate until a level swashplate is achieved.

B. **Fly-Bar Paddles:** Now that the swashplate has been leveled, the fly-bar paddles may also be leveled, set your pitch gauge on 0 degrees. position on the paddle and adjust the paddles until they are level(Parallel) with the main rotor head. A straight rod such as a fly-bar may be used on the rotor head top as an aid in aligning the paddles. It is very important that the fly-bar control #0307 and the fly-bar paddles are all parallel to each other. For an excellent aid order #0510. (Fly-Bar alignment tool kit).

Step 3. **Adjusting Pitch Curves**.

Refer to Drawing # 11.

A. If you have selected an FAI type set up, you will probably want to run, depending on blade selection, 5 to 6 degrees of pitch in a hover (one half collective stick position) with about 10 degrees of pitch at full stick position and about 3 degrees of negative at low stick position. For the idle-up(s) you will want around 4.5 to 5 degrees of pitch at hover, 8.5 to 9.5 degrees at full top and 2.5 to 4 degrees of negative at low. For throttle hold, you will need about 5 degrees at hover, 11 or 12 degrees of positive at full and 4 to 5 degrees of negative at the low.

If you are setting up for hot-dogging, normal stick for hovering should be roughly the same as an FAI set-up. The same is true for the first idle up if your radio is equipped with two idle ups. You would use the first idle up for doing normal aerobatics, then the second idle up would be set up with 0 degrees of pitch at half stick, 4 degrees of negative at quarter stick, 4 degrees of positive pitch at three quarter stick and between 8.5 to 9.5 degrees of positive pitch at full and between 8.5 to 9.5 degrees of negative pitch at low. Throttle hold should be similar to the FAI set up, with the exception of maybe having a little more negative pitch at low for quick descents.

Step 4. **Adjusting Swashplate Throw.**

Refer to Drawing # 11.

A. Set the pitch gauge for 0 degrees of pitch. Move the collective stick until pitch gauge lines up with flybar. Set the pitch gauge for -6 degrees and with the main blades running parallel to the tail boom, give full right cyclic and adjust ATV so that the rotor blade has -6 degrees of cyclic pitch change. Repeat this process for the other side using +6 degrees on the pitch gauge. Repeat process for the elevator set up. This is the recommended maximum amount of swashplate travel that should be used.

Step 5. **Adjusting Tailrotor**

Refer to Drawing # 11.

First check servo for proper directional travel. Right tail stick command pulls the pushrod forward. Reverse if necessary. Turn on the ATS mixing function (for right hand rotation) on your transmitter. The 0 point should be at 1/2 throttle stick position. Adjust the low and high point to approximately 25% each. This will provide a good starting point for your first flight. Check for proper compensation direction by increasing the throttle stick. This should result in pulling forward like a right hand command. Re-Check that at 1/2 throttle stick the rudder servo arm has remained in neutral.
With the throttle and rudder stick in their center position adjust the tail rotor control rod until the outer hole in the tail rotor bellcrank #0445 is approximately 1-2mm rearward from the back edge of the tail rotor transmission housing #0421. This should result in approximately 20mm distance between the tail rotor blades when folded together. Check both left and right tail rotor commands at low and high throttle

positions for no binds. Adjust transmitter ATV's if necessary.

Step 6. **Gyro.**

A. Carefully read the gyro instructions provided. Set gyro sensitivity to approximately 40-50%. Turn gyro and radio switches on and check for proper gyro/rudder direction operation. Helicopter nose pulled to the left should result in a right tail rotor command. Reverse gyro if incorrect. When using a gyro, a battery pack with 1000mah minimum is recommended. When switching gyro on and off, observe that rudder servo retains its same centering position. If needed, adjust gyro centering per gyro instructions.

Step 7. **Elevator and Aileron Dual Rates and ATV's.**

Depending on the characteristics of which you desire dual rates should be set for your flying style. A starting point of about 70% on aileron and elevator work well. ATV's should be set for no binding.

XV. FINAL ASSEMBLY AND BALANCE

A. A fuel filter is recommended.

B. Balance: Check the completed helicopter by suspending it from the flybar (with the flybar crosswise) just above a level surface. With an empty fuel tank, it should remain level or tilt forward no more than 6 or 7mm (1/4") as measured over the length of a skid. Adjust battery pack position (or similar system element) to achieve this.

XVI. FINAL ASSEMBLY INSPECTION

A. Recheck entire machine for any loose nuts, bolts, or screws.

B. Re-check plans for proper installation.

C. Inspect radio installation. Check to see that there is no mistake in the operational direction of each servo with no binds.

D. Check all rod connections for proper installation.

E. Check all moving components on helicopter for bind free operation.

F. After completion of the final inspection, we recommend that you familiarize yourself with all stick movements, switches and functions of the radio system as it relates to your helicopter. Practice until you feel comfortably ready for your first flight. Be careful to always ensure that the batteries in your radio system are fully charged before each flying session. We recommend the use of a good battery voltage meter to monitor the voltage level during use.

XVII. NECESSARY FLIGHT ITEMS

A. Obtain item necessary for flight:

1. Unleaded Gasoline (High Test)
2. Oil: Two Cycle Racing Oil - Preferably Synthetic
3. Ample tools for field use
4. Frequency flag displaying your transmitters frequency colors or numbers (Supplied with your radio system)
5. **Always mix the GASOLINE AND OIL in a well ventilates area. (The engine owners manual will explain the gas/oil mixture)**

B. At the flying field:

1. Obey all flying field rules
2. Check the frequency board or any fliers for frequencies in use, before turning on your transmitter.
3. Perform a pre-flight radio range check as per radio specifications.
4. Pre-check all radio functions.
5. Check for possible help from other helicopter pilots.
6. Be sure not to leave radio transmitter on between flights.
7. **WE STRONGLY URGE THE USE OF A FIRE EXTINGUISHER AT THE FLYING SITE. GASOLINE IS FAR MORE VOLATILE THAN METHANOL BASE FUELS. THEREFORE THE LIKELY HOOD OF FIRE IS MUCH GREATER.**
8. Carry gasoline in gasoline approved containers.
9. When transporting gasoline make sure that the container is sealed tightly.
10. Avoid prolonged breathing of gasoline vapors as they can be hazardous to your health.
11. If you smoke, do not smoke on the way to and from the flying field.
12. Do not smoke while fueling, de-fueling or flying a gas powered model.
13. If there are children in the house, do not leave the plug wire attached to the spark plug. If the carburetor has any fuel in it the possibility for personal injury is possible.

XVIII. FIRST FLIGHT ADJUSTMENTS

A. Before flying double check direction of each control; tailrotor compensation direction and gyro direction. The first few flights should be limited to hovering only.

B. **Engine Carburetor Settings:** Refer to the Zenoah Quartz G-23 instruction manual for adjusting carburetor. This manual also provides a trouble shooting chart for defining engine problems.

C. **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 head speed you want to hover at, also ensure that the model is hovering 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.

NOTE: Try to maintain original hovering recommended pitch settings. Flight trim for fine tuning once engine settings have been achieved. Fine tune low pitch settings for aerobatic maneuvers desired. Fine tune high pitch settings to match performance level of engine used.

D. **Tail Rotor Trimming:** Adjust the tail rotor control rod clevises until the tail stabilizes with trimmer in neutral.

E. **Tail Rotor Compensation:** With the model in a trimmed stationary hover adjust the top tailrotor compensation so that the nose of the model stays straight during a slow vertical ascent. Starting at a height of fifteen to twenty feet, descend and watch for the nose of model to change direction or drift to one side or the other. Adjust lower tail comps. to correct this. NOTE: The speed that you ascend and descend should be as slow as a FAI pilot might ascend and descend his heli while performing a top hat maneuver.

F. **Swashplate Trimming:** When the helicopter drifts to the left or the right, adjust lower swashplate aileron rods until stabilized again. Repeat same process for fore and aft (elevator) control.

Gyro:

G. If you are using a dual rate gyro adjust the high rate for hovering as high as it will go without oscillation of the tail. Once you get the model flying in forward flight adjust the gyro on the low rate as high as it will go

without the tailrotor oscillating.

H. **Main Rotor 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 must be applied to one blade during balancing in order to determine which blade is high or low. Tracking procedure:

- Blade speed is low, lower the higher blade
- Blade speed is high, raise the higher blade
- If blades are out an inch or better, re-check original bench pitch settings

I. **Top Pitch:** Adjust the top end pitch on your idle up functions so that the model will fly at full throttle without losing head speed. A model with to much top end pitch tends to be "pitchy" and unstable.

J. **Adjustment of Static Tracking.**

A. Screw in (2) M3x8 socket set screws #0563-2 at the base of the main rotor head block until they just contact the mainshaft. Stand your transmitter antenna (or something else to use as a measure) under the tip of the one blade and rotate the head carefully to make a comparison of the tip height of each blade. Adjust each set screw until moderate pressure exists on the main shaft and each blade tip is at the same height.

First Flight Tip

After hovering the model, land and let blades stop by themselves. Recheck tip height and readjust, if necessary. **IMPORTANT:** Always be sure that the blade pivot bolts are quite snug--offering significant resistance to the lead/lag of the blades. Also, after this procedure, it may be necessary to readjust the tracking slightly.

XIX. STARTING AND STOPPING THE ENGINE

To Start:

A. Always start the engine with the throttle trim up. The throttle or collective stick should be all the way down or closed. Check idle-ups and throttle hold for proper position of switches(off).

B. The air cleaner provided with this engine has a built in choke feature. If the engine is cold or hasn't been run in the last hour or so it may be necessary to turn the choke on.

C. The correct procedure for using the pull starter is as follows: Hold the rotor head with your left hand, place your left foot on the left landing gear skid, between the two landing gear struts and pull the pull starter handle with your right hand. Short quick pulls should be sufficient to start the engine.

D. If the choke is on, pull the starter until the engine fires or attempts to start. Turn the choke off, and pull the starter cord until engine starts.

To Stop:

A. If the throttle servo is set up to completely close the carburetor with the throttle trim down, this will shut the engine off. Forceps can also be used to cut off the gas supply to the carburetor.

B. Forceps should be left on the gas line to prevent leaking and fumes from escaping thus minimizing the chances of a fire.

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

The staff at Miniature Aircraft USA would like to express their appreciation to Tim Schoonard, Wayne Mann and Paul Bittengle for their time and dedication in the creation and final production of the X-Cell Gas Graphite Instruction Manual.

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SPECIAL NOTICE
XL-SERIES HELICOPTERS VERSES DUAL-TAIL USAGE

Subject: A). #0541 and 0541-1 High Performance Dual FAI Tail Rotor System.

B). #1006 XL-PRO and #1007 Optima XL-PRO.

C.) #0547 High Speed Tail Gear .30, .40, .50 and .60 size.

1). If the customer purchases a 0541 & 0541-1 Dual Tail Rotor System for installation on a XL-PRO .60 Graphite FAI Helicopter Kit #1006 or Optima XL-PRO .60 Graphite FAI Kit #1007, the customer is required to purchase (2) #0427 Tail-Rotor Beveled gears for proper operation and installation.

2). If the customer purchased #0547 High Speed Tail Rotor gear kit for X-Cell .30, .40, .50 and .60's and decides to install a #0541 or #0541-1 Dual-Tail Rotor System, the customer is required to re-install the #0427 Tail-Rotor gears supplied with the kit or purchase (2) #0427 replacement parts.

Common Solution to Tracking Problems on X-Cell 50, 60 Series Helicopters

- **Probable Cause** -
  Thrust bearing limited by Loctite contamination.
  Solution - Apply loctite inside axle hole rather than on bolt. Use very small amount and allow at least 1 hour cure prior to use.

- **Probable Cause** -
  Thrust bearing is notchy from a contamination of dirt and or crash. Since thrust bearings cannot be properly checked without operational loads it is best to not reuse them after a crash or extended operation. (Avg. use 1 year)
  Solution - Replace units as per manual.

- **Probable Cause** -
  Thrust bearing installed backwards.
  Solution - Always be sure that the load bearing side be nearest the bearing bolt. In other words, the larger I.D. side goes nearest the head block. Carefully reassemble in correct orientation.

- **Probable Cause** -
  Thrust bearing bound-up on head axle. This inhibits correct thrust bearing operation as blade loads vary.
  Solution - Do not overtighten axle bolts. This will cause the ends or the axle to "Swell" or "Roll" slightly limiting the thrust bearing. This is noticeable when the thrust bearing will not easily slide off the axle. Prior to replacement, the axle should be replaced.

- **Probable Cause** -

  Main axle bent causing intermittent tracking problem as the axle tries to rotate slightly within the head block.

  Solution - Replace axle.

- **Probable Cause** -

  Bell mixers are not uniformly installed. This can be either a mixer reversed on the pivot bolts or rotated so that dissimilar length control balls connect to the hiller rods on each side of the head.

  Solution - Carefully study the instruction manual and the appearance of the mixers on the rotorhead. Each mixer has a "stepped" area surrounding one bearing. This "step" should always face the pitch arm portion of the blade holder also, the short control ball #0109 must always connect to the long hiller rods and not the short flybar yoke rods.

- **Probable Cause** -

  Blade pivot bolts are too loose. Due to slight variations in blade cordwise C.G. and the oscillation state in which the blades function during pitch changes, it is suggested that the pivot bolt be used as a "shock absorber" to hinder exaggerated blade oscillation.

  Solution - Tighten blade pivot bolts until the blades are very snug within the mounts - commonly, this would mean that by holding the blade and the flybar, and pivoting the blade the flybar would deflect at least 2" prior to blade movement. 9 out of 10 modelers set this up far too loosely.

- **Probable Cause** -

  Improperly assembled blade reinforcement causing considerable difference in one hiller rod and the other to achieve tracking.

  Solution - Replace blades and study the assembly procedures carefully prior to assembly.

- **Probable Cause** -

  Blade spanwise C.G. not matched.

  Solution - It is most important that the spanwise C.G. be exactly matched prior to covering and that the blades have the same total weight.

X-CELL GAS FUEL/OIL RECOMMENDATIONS

1. Ratio - 40:1 in Amoco Premium or similar white gas.

   IMPORTANT: - The oil must be the following type to maximize performance and cooling:

   - Petroleum based only.
   - "Ashless" type.
   - 2 cycle air cooled type, not the type used for water cooled engines such as Marine applications.
   - Do not run carburetor excessively rich or plug fouling and/or radio interference may result due to plug carbon build up.

X-CELL GAS TECH TIPS

Subject: X-Cell Gas Spark Plug Tuning.

If, like most, you think spark plugs are a "No-Brainer", your only partially right. Spark plug adjustment and installation is important to peak engine performance in your X-Cell Gas model, so keep the following points in mind:

1) Never assume the new plug is properly gaped - check it yourself - many tools and methods are available to set plug gaps, but the most accurate are the wire type. Always be sure the side electrode is parallel, flat and centered over the center electrode. The gap should be equal and uniform across the two surfaces. It may seem trivial, but it is important and will pay-off in improved operation.

2) If your plug has a removable top cap be sure it is not loose.

3) Plugs with removable seal washers should be tightened with a torque wrench to factory specifications, but most modelers will probably ignore this.. As an alternative, you should insert the plug, turn it to where it is firmly finger-tight and make a 1/4 revolution turn using an appropriately sized socket wrench (to avoid damage to the porcelain).

4) Frequently check the plug for build-up of carbon deposits (varies depending on the oil used, cylinder temperature, and fuel mixture) which can cause poor ignition and radio interference. Plugs are best cleaned with a commercial plug cleaner used by auto parts/repair shops or solvents and a small wire wheel/brush. Always re-check the gap.

5) Always use the correct length plug. If the plug were too short, spark will occur in the shrouded area of the plug hole instead of down in the combustion chamber. The plug could mis-fire, the empty threads collect ignition debris and cause pre-ignition. Too much plug reach will cause pre-ignition because the exposed threads will burn and collect carbon deposits (also possibly damaging the cylinder head threads during plug removal. Of coarse, at the worst, the piston may hit the plug and be destroyed or at least, close the gap.

1. SAFETY PRECAUTIONS

- **This manual describes the engine. For its mounting and control, see the instruction manual for the model airplane, helicopter and boat.**
- **Each engine is designed for use on each model airplane, helicopter and boat. If it is used for any other purpose, we cannot be responsible for its reliability or safety.**
- **Use genuine parts for replacement.**
- **Check the propeller, rotor and screw propeller every time. If it is damaged, replace it with a new one.**
- **If the propeller (or the rotor or the screw propeller) hit something while the engine is in operation, immediately stop the engine and check it.**
- **Start the engine on a flat surface without pebble stones.**
- **Never modify the flywheel.**
- **Check the flywheel. If it is damaged, replace it with a new one.**
- **When mixing the fuel, or operating the engine, carry it out in a well-ventilated place.**

2. MOUNTING G230PU

Make sure that the G230PU is mounted on the aircraft grade plywood with more than 6mm of thickness or a mount of equivalent strength and is firmly fixed with 4 bolts.

[NOTE]

1. Be sure to set flat washers or metal plate on the reverse side of the mount to prevent bolts from sinking into the mount. Before be sure to check for loose bolts.
2. Since the engine is equipped with a float-less carburetor with a diaphragm pump, the direction of cylinder and position of fuel tank can be freely selected .
3. If the rubber joint is placed between the engine and the body for anti-vibration, check if the rubber is too week and select the proper hardness of the rubber, in order to avoid the unexpected vibration under operating engine RPM zone.
   Note carefully that if the engine is vibrated at idling, then the idling RPM is likely to get unstable due to overflow at carburetor by the vibration.
4. Coat the bolts for muffler with anti-looser (e.g., Locktite or equivalent).when assembling.

3. PROPELLER, ROTOR & SCREW PROPELLER

1. Propeller for airplane

The recommended prop sizes are as shown in the table bellow.

Diameter × Pitch (in.)
18 × 6, 16 × 8 - 10

This engine with a standard muffler produces the maximum output when the engine is running at about 10,000rpm. Be sure to use a propeller which makes the engine speed approximately 7,000-9,500rpm while the airplane is flying.

[NOTE]

When mounting the spinner, set a pin on the hub with more than 3mm of diameter, thus preventing slipping.

2. Rotor for helicopter

Adjust the rotor-pitch to obtain 9,000-10,000 rpm of the engine at full throttle operation.

3. Screw Propeller for boat

The exhaust system (e.g., muffler) is not equipped with as standard. When you select the exhaust system for the engine, check how many the engine speed (rpm) is required when the maximum output is generated by using the muffler you select.

And then decide the appropriate the screw propeller that would meet such engine speed (rpm) that the muffler required.

In general, standard size of the screw propeller (Surface prop type) are as follows:

Diameter (mm)	Pitch ratio (mm)
65 - 75	1.9 - 1.4

4. FUEL

Mix. gasoline and 2-stroke oil at a mixing ratio of 25:1-40:1

[NOTE]

1. Be sure to use a gasoline-resistant fuel piping (Do not use any silicon rubber tube).
2. Never use any alcohol fuel or alcohol added fuel, or the rubber part' in the carburetor will be damaged.

5. OPERATION

Hand flip start

Since the G230PU is equipped with the ultra compact C.D.I. type flywheel magneto ignition system, it should be started according to the following procedure;

* The magneto system of G230PU is designed in such a way that when the exhaust port is closed by the piston, that is, when the compression stroke starts (Refer to Fig. 1-A), sparks are never produced on spark plug no matter how fast the propeller may be flipped. Be sure to quickly flip the propeller when the edge of magnet on the rotor is approaching the coil (Fig. 1-B). It means that the propeller should be quickly flipped about 90 degrees in crank angle before the compression is about to start.

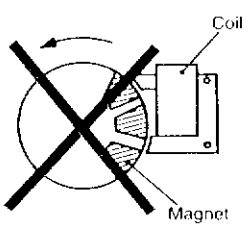


Fig.1-A

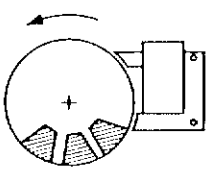


Fig.1-B

How to Start the Engine

1. For Airplane
   a. Fill the fuel tank with the fuel .
   b. Choke the engine and turn the propeller a few times until the fuel appears at the carburetor.
   c. Set the throttle valve at the idle position or at the position

slightly open from the idle position. Quickly flip the propeller in the counterclockwise direction according to the procedure described above. Flip the propeller a few times. Then the engine starts.

2. For Helicopter & Boat
   a. Fill the fuel tank with the fuel.
   b. Push the priming bulb upper the carburetor until fuel appears in the priming bulb.(for Helicopter)
   c. Choke the engine and open the throttle valve approximately 1/3~1/2 of the full open position.
   d. Quickly pull the starter cord when the initial explosion is heard.
   e. When the initial explosion is heard, open the choke, set the throttle valve at the idle position or at the position slightly open from the idle position and quickly pull the starter cord a few more times. Then the engine starts.

[NOTE]

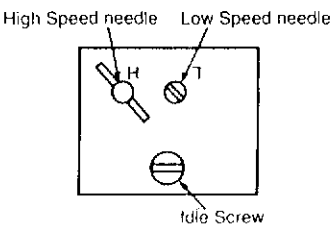
- Be sure to open the choke when the initial explosion is heard.
- When the choke is opened, be sure to close the throttle valve to a position near the idle position before starting the next flipping (If the engine is started while the throttle is wide open, a great thrusting force is produced, which is very dangerous).
- Be sure to wear a thick glove when flipping the propeller. Use all fingers, except thumb, for the flipping operation.

How to Stop the Engine

For stopping the engine, the black lead wire from the coil should be grounded to the engine body, or the throttle valve should be closed completely.

6. CARBURETOR ADJUSTMENT

The carburetor is provided with 3 adjust screws which are set to the best (approximately) positions by our company, but they may need a little adjustment depending on the temperature, atmospheric pressure (altitude), etc. of the area where the engine is used. Start the engine without making any adjustments. Make readjustments only when the engine shows any mal-functioning.



1. Standard opening of each needle as follows;
   Low speed needle : 1⅛ ± ¼
   High speed needle: 1⅜ ± ¼

Idle Screw: Turning this screw clockwise increases the idling R.P.M. Turning it counterclockwise decreases the idling R.P.M

Low speed needle: This is the fuel adjust screw (not the air screw). Turning this needle clockwise makes the mixture gas leaner and turning it counterclockwise makes it richer.

High speed needle: Turning this needle clockwise makes the mixture gas leaner and turning it counterclockwise richer. Set this needle at a position which is 1/4 open from the maximum R.P.M. position while the airplane is on ground.

[NOTE]

1. Do not tighten the High and Low Speed needles too firmly.
2. When the unit has just started and the engine is not warm enough, there may be insufficient acceleration and the engine may be stopped. Be sure to perform idling before operation.

7. ENGINE BREAK-IN

No specific break-in is required. The engine is gradually broken-in as it is used and the output is also increased gradually.

8. SERVICING

The engine can be disassembled or reassembled without any specific difficulties, but be careful of the following matters;

a. For disassembling, the special tools shown in the parts list are required in addition to the general tools. Be sure to use a new gasket when the crankcase and cylinder have been disassembled.

b. Removing rotor

1. Screw in the stopper (P/N 3350-96220) in place of the spark plug. Then turn the rotor counterclockwise until the piston touches the stopper. Take care it can cause damage to the piston or connecting rod if the stopper is not screwed in to the bottom.
2. Loosen and remove the rotor securing nut.
3. Remove the rotor by using the puller (P/N 1490-96101). Do not hit on the crankshaft by a hammer, that can increase the runout of the shaft.

c. Assembling crankcase

1. Apply grease on the oil seal lips and oil on the bearing.
2. Assemble the crankshaft with a new gasket.
3. When both front and rear crankcases are tightened, the portion of gasket protruding on the cylinder mounted surface should be cut off with a knife until the gasket becomes flush with the cylinder mounted surface.

d. Assembling piston

Before assembling the piston, apply the oil on the small end bearing and piston, and set the piston ensuring that the arrow mark on the top of piston is directed toward the direction of exhaust port.

e. Assembling cylinder

1. Coat the oil on the inner surface of cylinder.
2. The piston is provided with a knock pin which stops the piston ring from turning. Set the splitted section of piston ring at the knock pin and assemble the cylinder ensuring not to break the piston ring.

f. Adjusting air gap of coil.

The air gap of coil should be adjusted to 0.3 mm (0.01").

g. Adjusting ignition time.

This engine with the point-less C.D.I. type requires no adjustments of ignition time.

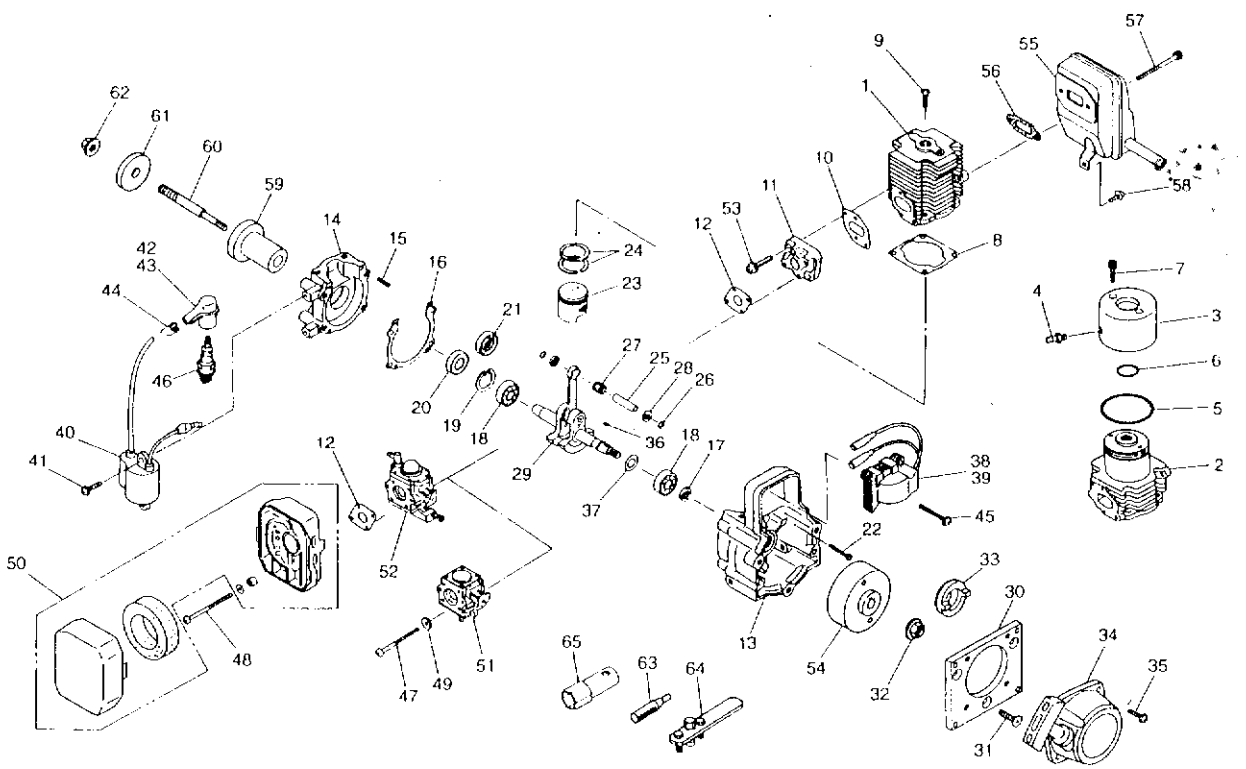
9. SPECIFICATIONS

MODEL	ZENOAH G230PU	ZENOAH G230PUH	ZENOAH G230PUM
PURPOSE	Airplane	Helicopter	Boat
TYPE	Air cooled		Water cooled
DISPLACEMENT	22.5cc		
BORE × STROKE	32mm × 28mm		
COMPRESSION RATIO	7.4 : 1		
MAXIMUM OUTPUT	2.1PS/10500rpm [∗ 1.9PS/10500rpm]		2.2PS/11000rpm
OPERATING ENGINE SPEED	2000~10000rpm	3000~11000rpm	3500~15000rpm
IGNITION SYSTEM	CDI type Flywheel magneto		
CARBURETOR	WALBRO WA197A	WALBRO WA167A	WALBRO WA197A
AIR CLEANER	—	Dry type	—
STARTING	Hand flip	Recoil starter	
FUEL	2-cycle oil pre-mixed gasoline (Mix ratio 25~40:1)		
SPARK PLUG	NGK BMR7A or CHAMPION RCJ6		
DRY WEIGHT	1.42Kg [∗1.58Kg]	1.49Kg [∗1.65Kg]	1.45Kg

[NOTE] [∗ with standard muffler]

Specifications are subject to change without notice.

10. PARTS LIST



[NOTE] The parts indicated " ∗ " in the part number column are supplied as an assembly. No individual part available.

Index No.	Parts No.	Description	Q'ty per unit PU	PUH	PUM
1	1148-12111	CYLINDER	1	1	0
2	1160-12110	CYLINDER	0	0	1
3	1160-12210	JACKET	0	0	1
4	07851-00515	JOINT	0	0	2
5	07000-03038	O RING 3×38	0	0	1
6	1160-12320	O RING 1.5×19.5	0	0	1
7	1160-12330	BOLT M3×8	0	0	2
8	1140-13120	GASKET CYL	1	1	1
9	3310-12281	BOLT M5×20	4	4	4
10	1140-13150	GASKET INSU	1	1	1
11	1148-13161	INSULATOR	1	1	1
12	1148-13131	GASKET CARB	1	2	1
	1155-21101	CRANKCASE COMP	1	1	1
13	∗	CRANKCASE (R)	1	1	1
14	∗	CRANKCASE (F)	1	1	1
15	2629-21130	PIN	3	3	3
16	1140-21140	GASKET CASE	1	1	1
17	2169-21210	SEAL 12×22×7	1	1	1
18	1155-21240	BEARING	2	2	2
19	04065-02812	RING SNAP	1	1	1
20	06034-06001	BEARING	1	1	0
21	1650-21220	SEAL OIL	0	0	1

Index No.	Parts No.	Description	Q'ty per unit PU	PUH	PUM
22	01252-30530	BOLT M5×30	4	4	4
23	5600-41111	PISTON	1	1	1
24	1850-41210	RING PISTON	2	2	2
25	1101-41310	PIN PISTON	1	1	1
26	1260-41320	RING SNAP	2	2	2
27	1140-41330	BEARING	1	1	1
28	1101-41340	WASHER THRUST	2	2	2
29	1155-42000	CRANKSHAFT C	1	1	1
30	1155-74110	PLATE MOUNT	1	1	1
31	0262-10516	SCREW CM5×16	3	3	3
32	1650-43230	NUT	1	0	0
33	1160-75210	PULLEY	0	1	1
34	1861-75100	RECOIL ASSY	0	1	1
35	0263-30414	SCREW M4×14	0	4	4
36	1000-43240	KEY	1	1	1
37	1140-43250	SHIM	0~2	0~2	0~2
38	2629-71210	COIL SO (GRAY)	1	0	0
39	1160-71210	COIL SO (RED)	0	1	1
40	2629-71311	COIL IG	1	1	1
41	0263-30414	SCREW M4×14	2	2	2
42	2629-72210	CAP PLUG (BLACK)	1	0	0
43	2850-72110	CAP PLUG (RED)	0	1	1

Index No.	Parts No.	Description	Q'ty per unit PU	PUH	PUM
44	1400-72121	SPRING	1	1	1
45	0260-30422	SCREW M4×22	2	2	2
46	1148-73120	SPARKPLUG BMR7A	1	1	1
47	0263-30550	SCREW M5×50	2	0	2
48	0263-30555	SCREW M5×55	0	2	0
49	1142-83110	SPACER 5×10×1.6	2	0	2
50	1751-82002	AIRCREANER	0	1	0
51	1145-81002	CARBURETOR 197A	1	0	1
52	1148-81002	CARBURETOR 167A	0	1	0
53	0263-90520	SCREW M5X20	2	2	2
54	1155-71110	ROTOR	1	1	1
55	1148-08010	MUFFLER	1	1	0
56	1140-13140	GASKET MUFF	1	1	0
57	01252-30550	BOLT M5×50	2	2	0
58	0263-30408	SCREW M4×8	1	1	0
59	1152-43260	HUB	1	0	0
60	1152-43281	STUD	1	0	0
61	1152-43290	WASHER HUB	1	0	0
62	3350-53410	NUT	1	0	0
63	3350-96220	STOPPER (OPT)	1	1	1
64	1490-96101	PULLER ASSY (OPT)	1	1	1
65	1110-91320	SOCKET	1	1	1