

# ***THE MOSQUITO XE***

## ***HELICOPTER***

### **FABRICATION AND ASSEMBLY MANUAL**

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# *MOSQUITO*

## *ULTRALIGHT HELICOPTER*

### FABRICATION AND ASSEMBLY MANUAL

#### THINGS TO KNOW BEFORE YOU START

- Read each section through completely to be sure you understand what you are doing before you start the work.
- Numbers in brackets eg. (24-01) refer to part numbers. The first two digits of the part number refers to the drawing on which it is located.
- All dimensions are in inches unless otherwise noted.
- Fully dimensioned parts in the drawings are for fabrication by the builder from the materials provided. Many of these parts are already precut and pilot drilled requiring finishing by the builder. All non-dimensioned parts and sub assemblies are provided complete and are provided in the drawings to assist in identifying the parts.
- All cutting and drilling must be finished by smoothing with a deburring tool, files and/or sandpaper/Scotchbrite to ensure that there are absolutely no nicks in the material. This is especially true around rivet holes and in the crotches at the end of support angles.
- Any vice used for holding parts must be soft jawed to prevent marking the part. There must be no nicks or scratches left on the parts.
- The best and fastest way to cut aluminum is with a standard wood cutting chop saw and table saw. The saws should have carbide tipped blades with a high tooth count. Aluminum cutting blades are readily available and make the best cut. Spray a little WD-40 on the cut line before cutting to get a smoother cut and prevent clogging the saw blade. After cutting the edges must be smoothed with a file and sandpaper until no nicks or scratches remain.
- To mark hole locations set the caliper to the distance from the center of the hole to the edge of the part. Scribe a small light line on the part at the correct distance in from each edge using the edge as a guide to form a small “X”. Punch mark the center and drill.
- All laser cut, preformed parts have rough edges which must be filed/sanded smooth prior to final installation. Final sanding should leave no nicks in the material and should be done along the axis of the parts, not across it. Most of these parts have small pilot holes which must be drilled to size after bending when bending is required.
- Where referred to in the instructions or drawings, the left side of the helicopter is the left when sitting in the seat and facing forward.

- All bolts and nuts must have a washer underneath them unless otherwise noted. On bolts threaded into aluminum parts a lock washer must be added between the head and the plain washer unless otherwise noted. A washer is not required under the bolt head or nut if it is fastening a spacer, the ball of a rod end or a bearing race. All bolts threaded into aluminum must have a drop of threadlocker placed on the end of the bolt before final installation.
- Where it is difficult to hold a nut in place because of a confined space such as inside the tail boom or mast, put electrical tape over the end of a box end wrench and push the nut into the box end and then use the wrench to hold the nut in place.
- To “reverse thread” nylon locknuts onto rod ends and threaded rods, first thread the locknut onto the threads the proper way about 1/2”. Remove the nut and place it in a box end wrench. Thread the nut back on with the nylon end first pushing with your thumb on the nut and holding the nut straight with the box end while turning.
- Teflon lined rod ends are often excessively tight when received. To loosen the ball find a correct size socket from a socket set such that when placed on the housing around the ball, it will just clear the ball. The socket should rest on the metal liner inside the outer housing but not be touching the ball. Place the assembly in a soft jawed vice so that one jaw is pushing on a flat on the ball and the other is pushing on the socket. Tighten the vice, loosen and check the ball tightness. You should be able to rotate the ball with your fingers with a little effort. Redo if needed until the correct tightness is achieved.
- The bend reference line referred to in the drawings and manual is to assist in positioning the 3/8 bending mandrel. The mandrel is made in the tools section from a 3/4 x 3/4 aluminum square bar which then has one corner rounded off to a 3/8” radius. Draw the reference line on the part. Place the mandrel on the side of the line with the “X” on the drawings. Place the part and mandrel in a vice with the section to be curved sticking out of the vice. The reference line should be level with the top of the mandrel. Use your hands on long parts or a hammer against a block of wood on small parts to gradually bend the part. Refer to drawing 60 for a drawing of how to place the mandrel.
- Never drill holes in a part that is to be bent before bending the part. Mark and punch mark the holes, bend the part and then drill out the holes. On precut parts, bend the part and then drill out the small pilot holes.
- When cutting parts out of plate that require bending, always cut the part so that the bend will be perpendicular or nearly perpendicular to the direction of the “grain” of the plate. The “grain” is the fine lines left by the mill roller on the plate.
- When pressing shafts into bearings use retaining compound provided to ensure a solid bond. Report any loose or excessively tight fits to the factory.
- Dimension “X” referred to in the drawings and manual is the dimension from the front of the seat to the rear wall of the fuselage. It is incorporated to account for the different weight of different pilots and is determined from the following chart:

Weight +/- 10lbs	130	150	170	190	210	230
Dimension "X"	23.5	21.5	20.5	19.25	18.25	17.5

For pilots less than 160 lb the battery should be mounted in the battery compartment between the instrument panel and the front of the body. For pilots 160 lb to 220 lb the battery should be mounted behind the seat bulkhead to the left of the seat. For pilots over 220 lb and over the battery should be mounted on the rear landing gear support to the left of the engine.

- If you have any questions call (403) 669-3101 or email [mosquito@innovatortech.ca](mailto:mosquito@innovatortech.ca)

# I ASSEMBLY

## A. TOOLS

The following tools are required to assemble the Mosquito XE:

- a) Band saw with wood cutting or steel cutting blade
- b) Standard wood cutting table saw with carbide tipped or special aluminum cutting blade
- c) Drill Press
- d) Face or Belt Sander
- e) Hand Drill
- f) Digital Level
- g) Files
- h) Punch
- i) Hammer
- j) Deburring Tool
- k) 3", 5", 8" clamps
- l) 3/16" capacity riveter
- m) Press
- n) Tap and die set
- o) Soldering iron
- p) Welder (for exhaust system)
- q) 18" long 5/16" drill bit

## B. FUSELAGE PREPARATION

### 1. Uncrating

- a) After receiving the fuselage kit carefully uncrate it by removing the screw panels from the unbonded joints.
- b) Take care not to drop any panels during removal which may scratch the windshield or damage the fiberglass.
- c) Remove the screws holding the fuselage to the palette and place the fuselage on a soft surface (cardboard or carpet).

### 2. Bodywork and Paint

- a) Bodywork and painting can be done at any time during assembly. The builder should keep in mind that the more assembly that is done the more disassembly will be required for painting. Conversely, the earlier the painting is done the greater that chance that the paint will be scratched during assembly.
- b) Scratches in the fuselage can be filled with normal body filler putty available from your local body shop store.

### 3. Landing Gear

- a) If the landing gear will be used for float operation, the steel skid T fitting (which connect the skids to the landing gear bows) should be galvanized or zinc or nickel coated for use in water. If the gear is only to be used on land the T fitting can be primed and painted.
- b) Lay out the landing gear skids in a level area of flooring. Slide fittings onto the end of the rear landing gear bow. Place the assembly onto the skids in the position it be under the helicopter fuselage. The rear end of the fittings should be 7" in front of the rear end of the skids. Clamp in place.
- c) Repeat the above procedure for the front bow. Clamp the assembly to the skid so that the bows are tilted toward each other. Measure the distance between the fittings along each skid. The distance should be the same and should be approximately 45".
- d) Place the helicopter fuselage on the bows in the position it will be when fully assembled. The back of the rear bow should be flush with the rear of the gear mount shelf at the rear of the helicopter fuselage.
- e) Install the rear clamps in place around the rear bow with the back of the clamp (with four predrilled holes in it) on the vertical end of the shelf and the front of the clamp under the fuselage. The edge of each clamp should be flush with the outside edge of the shelf. Place the curved shims provided between the top of the bow and underside of the fuselage centered inside the clamp.
- f) Use a 3/16" drill to drill out the pilot holes in the clamps and through the fuselage underneath. Use the 3/16 x 3/8" stainless steel blind rivets provided to rivet the clamps in place. Reach in through the hole inside the fuselage into the inside of the shelf area and place 3/16" washers over the rivets before setting them.
- g) Place the front bow clamps onto the front bow with the shims between the bow and fuselage. While supporting the fuselage, move the front bow and T fittings so that the holes on the forward section of the clamp are approximately 1/2" in front of the seat bulkhead (the seat bulkhead is the reinforcing section of fiberglass that runs laterally across and below the front of the seat). When lined up the front T fittings should remain at equal distances apart from the rear fittings along the skids.
- h) Drill up through the pilot hole in the front of the clamp with an 1/8" bit and check to see the above alignment. If it is off by more than 1/4" in either direction relocate the bow to suit. Once correctly located drill through the remaining holes and rivet in the same manner as the rear bow with reinforcing washers placed over the rivets. Do not place a rivet in the inside hole on the rear side of the clamp. This hole will be used for the reinforcement cable.
- i) Drill and install four 3/16 x 3/8" stainless steel rivets into the corner of each T fitting 3/8" in from each edge into the skid. Install a fifth rivet directly between the two outside rivets on each fitting.

- j) Drill and install two 3/16 x 3/8" stainless steel rivets into the front of the top of the T fitting. One should be 3/8" from the top and the second should be 2.5 " from the top. Repeat the installation at 120 degrees away from the front measured around the outside of each T fitting for a total of four rivets in the top of each T fitting.
- k) Check to see that the skids are parallel and properly centered along the centerline of the fuselage. Drill through the predrilled hole in the center of each clamp with a 1/4" bit directly through the center of each bow and install the AN4-22A bolts provided into each clamp.
- l) Place a mark on the outside of each landing gear bow leg 3" above the top of the T fitting. Drill a hole directly through the center of the legs at this point from the outside in. Insert eye bolts into the front and rear landing bow legs from the inside out.
- m) Bolt forked cable end fittings onto each of the eye bolts using AN3-5A bolts. Add an eye'd cable fitting to the underside of the eye bolt on each side of the rear bow. Bolt eye'd cable fittings to the inside rear hole of the front bow clamps using AN3-5A bolts and a washer inside the fuselage.
- n) Measure the distance between the ends of the forked cable end fittings on the front bows and the distance between the fittings on the rear bows. Measure the distance between the eye'd cable end fittings on the rear bows and the eye'd cable end fittings attached to the front bow clamp on the same side. Add 2.0" to each measurement to account for the depth of the fitting hole and cut cable sections to these lengths. Use a cable swaging tool to securely lock the cable ends into the fittings. Reinstall the finished cables and check that they are tight.

#### 4. Motor Mounts

- a) Measure up from the intersection of the landing gear shelf and the vertical torque box 6 1/4" and place a mark. Place a second mark 8" above the first mark.
- b) Install a motor mount so that the lower edge of the mount is on the lower mark and clamp in place. Drill out the holes through the mount into the torque box with a 3/16" bit.
- c) Remove the mount and install a second mount on the opposite side of the torque box and repeat the drill out procedure.
- d) Install both lower mounts in place with the rivets provided complete with washers on the inside.
- e) Repeat the procedure for both upper mounts.

## 5. Tank Fill Caps

- a) Use a hole saw to drill 2" holes in the top of the tank in the recessed areas on either side of the torque box. .
- b) Line the underside of the fill cap flange with epoxy glue and fix in place on a drilled hole.
- c) Use the self tapping screws provided to secure the fill flange in place. Install screws before the glue cures. Repeat with the second fill cap on the opposite side.

## 6. Tank Vent

- a) Drill a hole 23" above the web of the upper bulkhead inside the torque box (bulkhead used for upper engine mounts) in center back of torque box using a 17/32" drill bit. Smooth and deburr the hole.
- b) Coat the tube section of a fuel bushing (V-40) with silicone glue and insert into the hole.
- c) Cut a 48" section of tube from the 1/4" fuel line provided and insert a fuel elbow (V-41) into one end. Coat the fuel elbow barb with silicone glue and insert into the fuel bushing in the tank.
- d) Use a dremel tool with a ball type cutter to cut 3/8" holes through the engine mount bulkheads in the torque tube in the right rear corner of both bulkheads. Drill a 3/8" hole through the bottom of the fuselage next to the right seat support (I beam section that runs front-rear under the seat) under the holes in the engine bulkhead.
- e) Thread the tubing through these holes and out the bottom of the fuselage. Cut off any excess so that approximately 3" hangs below the fuselage.

## 7. Fuel Gauge

- a) Drill a 17/32" hole in the rear fuselage panel 6" in from the left side of the fuselage and 1" up from the rear panel brace (curved reinforcing I beam that runs horizontally across the back panel). Smooth and deburr the hole.
- b) Drill a second hole 14" directly above the first. Smooth and deburr. Insert fuel bushings and elbows using silicone glue as was done with the tank vent.
- c) Cut a section of fuel tubing to fit between the elbows and mount. Use tie wraps to secure tubing in place.

## 8. Windshield

- a) If the windshield has been removed replace it on the fuselage and looking through the windshield use a marker to outline the trimming edge of the windshield 1/8" inside the windshield recess ledge in the fuselage.
- b) Remove the windshield and use a small hand grinder to trim the windshield to the line.
- c) Use 1/8" clecos in the predrilled holes to install the windshield in place. Use a 1/8" plexiglas drill bit to drill the remaining windshield holes. Holes are to be drilled 1/2" in from the edge of the windshield and at 2" spacings around the perimeter.
- d) Remove the windshield and redrill the rivet holes out to 9/64 using a plexiglas drill bit.
- e) Cut out the fiberglass from the windshield area leaving a 1" lip for the windshield to mount on. Smooth the edges.
- f) Reinstall the windshield using clecos in the same location as was done originally.
- g) Begin riveting with 1/8" aluminum rivets provided starting at the top of the windshield. Stagger back and forth from side to side progressing down the windshield on both sides from the top. DO NOT start at one place and work around the perimeter.
- h) Observe the rivet holes as you progress down the windshield. If they do not line up as you progress, redrill prior to inserting the rivet to prevent stressing the windshield.

## C. TAIL BOOM

### 1. Tail Rotor Cable Guide

- a) Use a marker to lay out the tail rotor cable exit slot from the bottom of the tail boom near the end. Place a mark 8" forward from the rear end of the tail boom on the bottom center of the boom. Place another mark 6" forward of the first mark.
- b) Draw lines between these marks at approximately 3/8" on either side of the bottom center of the boom to form a 3/4" wide slot. Use a dremel tool to cut out the slot inside the above lines.
- c) Place a mark 7" forward of the rear end of the tail boom. Use a clamp or straps to temporarily hold the cable guide in place over the slot with the rear edge of the guide on the 7" mark and with the guide centered on the bottom of the boom.
- d) Drill out 8 evenly spaced 3/16 holes on either side of the guide. Set guide aside for later installation with the tail rotor cable.

### 2. Tail Rotor Drive Shaft

- a) Cut the tail rotor drive shaft to 113" long to within 1/32" and deburr the ends.
- b) Place retaining compound (V-18) on a tail rotor drive shaft plug (24-05) and install into one end of the tail rotor drive shaft (24-04) until the plug is flush with the end of the shaft.
- c) Place retaining compound (V-18) inside the non-keyed end of one of the drive couplings (24-08) and slide it onto the end of the shaft in which you just installed the plug. Be sure

- it has fully bottomed on the end of the shaft. Use a drill press to drill through the coupling hole straight into the center of the shaft about half way through it. Turn the shaft over and drill through the opposite side until the holes meet and continue out the other side. Place two washers under the head and retaining compound (V-18) on the shank of an AN3-15A bolt and install into the hole with a single washer under the nut. (TB-1)
- d) Press a tail rotor drive shaft steady bearing (B-02) into its bearing housing (24-09) and secure with three 6-32 x 3/4 socket head cap screws. Press a tail rotor shaft bearing mount (24-03) into the bearing. Place a steady bearing O-ring (V-25) onto the housing. Repeat for the other two steady bearing assemblies.
  - e) Place pencil marks at 27.375, 56.875" and 86.375" from the outside end of the coupling along the drive shaft. Slide a bearing assembly onto the shaft with the rivet hole end of the bearing mount first. Place the edge of the mount on the line closest to the coupling.
  - f) The mount should be snug on the shaft. If it can wiggle cut a small 1.5 x 6" inch section of .001" shim stock (V-08) provided and wrap around the shaft in a slight helix next to the line and try to slide the mount over it by rotating it as it moves forward. If it can still wiggle cut a longer section of shim stock. If it can't go over the shim cut a smaller piece and try again until you achieve a snug fit.
  - g) With the edge of the mount on the line, drill through the holes in the mount with a 5/32" drill and rivet with 5/32"x 1/8 grip rivet. Repeat for the remaining two housings, each on its respective line.
  - h) Repeat steps (a) and (b) for the coupling at the opposite end of the shaft (TB-2).
  - i) Lay the tail boom on a soft surface with the top of the boom on the floor. Prior to beginning insertion of the drive shaft, drill out the gear box mount holes in the front and rear ends of the tail boom to 1/4".
  - j) Tie a section of rag material to the end of a 10 ft long bar and insert into the end of the tail boom and up through each of the bearing housing bulkheads to ensure they are clean and free of fiberglass debris.
  - k) Place a layer of grease on each of the bearing housing o-rings to ensure they will slide into place correctly.
  - l) Place the drive shaft into the tail boom from the tail end. The riveted ends of the steady bearing mounts should be on the rear side of the bearings. Slide the shaft in past each of the bearing housings. If a housing gets caught on a bulkhead during insertion shake the shaft a little to recenter the housing in the bulkhead hole and continue.
  - m) The shaft is fully inserted when the couplings are evenly spaced (within 1/16") inside each end of the boom. This dimension should be within 1/16" of 1.5".

### 3. Splitter Gear Box

- a) Cut a 1" long key from the 3/16" long keystack provided and smooth the ends.
- b) Insert the key into the tail rotor drive shaft coupling at the front end of the tail boom.

- c) Grease the inside of the coupling and insert the splitter gear box into the end of the tail boom. The fill plug in the box should be towards the bottom of the boom when the boom is in its final position.
- d) Place a lock washer, plain washer and Loctite on four 1/4-28 x 3/4" long bolts and tighten in place in the gear box mount holes.

#### 4. Tail Boom Installation

- a) Install the tail boom in place on the fuel tank flange using the six preinstalled mount bolts provided. The splitter gear box mount hole should be at the top of the boom.
- b) Drill out the remainder of the pilot holes to 3/16". Place a washer on the head of twelve AN3-6A bolts and line the surface of the washer with JB weld or a similar good quality epoxy glue.
- c) Insert the bolts into each of the holes and fasten in place with a washer and nut. Tighten only until a slight resistance is felt and allow the glue to fully cure. Finish tightening the nuts

#### D. ROTOR SHAFT

- a) Slide one of the rotor shaft end plugs (50-05) over the push tube (50-01) with the larger diameter of the plug toward the "Y" end of the push tube. The push rod holes in the plug must be oriented at 90 deg from the slot in the push tube. The fit should be a smooth slide fit with no slack between the plug and tube. If the plug fits too tight you will need to file each side of the plug hole evenly until the fit is correct.
- b) Insert the tube into the rotor shaft assembly (A-03). Place the lower plug over the push tube at the bottom of the shaft in the same orientation as the upper plug. Repeat the filing procedure to get the right fit if required.
- c) Insert the smaller diameter section of both plugs into the ends of the rotor shaft. Rotate the tube and plugs until the slot in the tube aligns with the hole in the pivot block at the top. Look through the rotor pin hole and rotate the tube as required to ensure the tube will not interfere with rotor pin.
- d) Pull the push tube out of the lower end plug and drill through the four holes in the end of the rotor shaft into the plug using a 3/32" bit taking care not to move the plug and not to damage the threads in the holes. Using the threadlocker, install 1/2" long 6-32 socket head cap screws into the shaft and plug.
- e) Slide the push tube back through the lower hole to ensure the upper plug is still oriented correctly. Slide the tube back out of the upper end plug and repeat the procedure on the upper plug using 3/8" long 6-32 screws.
- f) Recheck the fit of the push tube. It should slide smoothly through the plugs but should have no slack. File the plugs slightly if required to achieve this fit.
- g) With the push tube in place, place the rotor pin (25-05) in the teeter block. Press the pin through the block, rotor shaft and push tube. (RS-1)

- h) Bolt a female rod end (B-17) to the rod end mount (49-07) using a 1/4 x 2 bolt with threadlocker on the threads and shank and a lock washer and plain washer under the head. The flats of the rod end should fit down into the slot in the mount.
- i) Place a restraint liner (49-06) onto a flex restraint (49-08) so that the bottom and edges of restraint are flush with the restraint liner as shown in the drawings.
- j) Drill through the restraint into the liner with a 5/32" bit. Counter sink the hole in the liner with a 1/4 bit as shown in the drawings. Attach the liner to the restraint with two 3/4" long 6-32 flat head screws placed in the countersunk liner. The head of the screw should be flush with the liner. Repeat for the second restraint and liner.
- k) Bolt the two restraint assemblies and rod end mount to the bottom of the push rod using AN3-15A bolts as shown in the drawings.
- l) Reverse thread a locknut on the longer threaded end of each of the 1/4" push rods (49-02) until there is 7/8" of threads protruding below the nut. Place a spacer (47-15) on the rod and install female rod ends (B-17) on each rod. Tighten the rod ends up to each spacer.
- m) Slide the push rods into the slots in the plug at the bottom of the rotor shaft up through the top of the shaft. The rods should slide easily through the slots. If they are tight remove the rods and file the slots slightly until the rods slide smoothly with no drag. Reverse thread nuts at the top of the rods until 9/16" of threads protrude above each nut. Install a 1/4" rod end (B-17) on each rod down to the nut but do not tighten.
- n) Before continuing with the rotor shaft the swash plate must be assembled. Press bearing (B-18) into the swash plate (49-04). Press the second bearing in place behind the first. Press the swivel (49-09) into the bearings in the swash plate taking care to properly support the bearing races and not damage the tangs on the swivel.
- o) Bolt four 8-32x3/4 cap screws and two 10-32x3/4 cap screws in place in the bottom of the swash plate and swivel respectively using threadlocker and plain and lock washers on each.
- p) Place a spacer (47-12) on an AN4-24A bolt with no washer. Slide the bolt into one of the rod ends on the end of one of the push rods at the bottom of the shaft assembly. Place a second spacer (47-12) on the bolt on the other side of the rod end. Set the swivel in place as shown in the drawings and push the bolt through one side of the swivel. Use needle nose pliers to insert the next spacer and push the bolt through the spacer and push tube rod end. Continue this process until the bolt is through the opposite rod end. Add a final spacer and tighten the nut in place with no washer.
- q) Press a B-19 bearing into each of the butterfly levers (50-04). Put the levers together with the bearings contacting each other. Place a spacer (47-16) on each side of the lever bearings and slide into place in the "Y" portion of the push tube and over the rod ends as shown in the drawings. Slide an AN4-20A bolt through the push tube and bearings but do not thread on a nut.
- r) Place an AN4-11A bolt through the bottom of the butterfly lever (50-04) and through each of the upper rod ends as shown in the drawings. If the bolt will not slide through both rod ends remove the butterfly lever and turn one of the rod ends on or off the rod as required until the holes line up. (RS-2)
- s) At the same time check to see that the swash plate and butterfly lever are parallel. Check this by placing the swash plate perpendicular to the push tube and checking if the butterfly lever is also perpendicular. This can be done visually or using a square.

- t) If the holes line up but the swash plate and lever are not parallel, back off one rod end 1/2 turn and the other on 1/2 turn until they are parallel. When the alignment is correct insert the bolts and tighten with all metal lock nuts. Fasten a nut on the butterfly lever pivot bolt.
- u) Check to see that the movement of the assembly is smooth and not too tight. If it is too tight the assembly may not be correctly aligned or the rod ends themselves may be too tight. Loosen the bolts and retighten and check again. If it is still tight turn one of the rod ends on or off.
- v) Insert the rotor shaft assembly into the mast tube on top of the mast fin until the top of the bearing housing is flush with the top of the mast tube. Place a shim under the large sprocket flange to hold the assembly 1/16" above the top of the mast tube.
- w) With a 5/16" bit, drill through one of the rotor mount pilot holes on the side of the mast fin into the bearing housing. Drill through the bearing housing into the plastic between the housing and the rotor shaft. Take care not to strike the rotor shaft inside the housing.
- x) Place a 5/16" bolt into the first hole to hold the rotor bearing housing in place while drilling the other holes. Drill out the other 5 holes in the front and side of the mast fin.
- y) Use a 5/16" x 18" long bit to drill through the rear of the rotor mount fin through to the bearing housing.
- z) Remove the rotor shaft assembly. Drill out each of the holes in the housing to 33/64". Counter bore each hole with a 5/8" drill bit or a counter bore tool down 1/16" so that the flange on the nutsert (V-28) will be flush with or below the housing surface.
- aa) Shake any free shavings out of the inside of the housing out through the holes. Insert the 5/16" nutserts and using the nutsert tool (V-29) tighten to 20 ftlbs. Make sure the nutsert tool presses against the nutsert and not the housing while installing. It may be necessary to bevel the outer edge of the nose of the nutsert tool down to ensure this is the case.
- bb) After installing all seven nutserts thread a 5/16-NF tap through each to reduce the torque required when installing the bolts. Check to see that the nutserts do not protrude above the surface of the housing. If they do use a file to make them flush.

## E. MAIN ROTOR CONTROL

- 1. Main Mast Assembly
  - a) Cut the control tubes (50-02) to proper length. Slide a 1/4" control tube end (47-10) into the end of one of the control tubes until the ends are flush. Drill through the holes in the tube into the tube end and place three 5/32 x 1/8 rivets around the circumference of tube at 1/4" axial spacings as shown on the drawings. Press firmly on the riveter while setting the rivet to be sure the head sets up against the tube. Repeat at the other end of the tube. Repeat this procedure for the other two control tubes.
  - b) Reverse thread a 1/4" nut on the 3" threaded rod (49-03) with 3/4" of thread protruding. Repeat for the opposite end of the threaded rod with 5/8" of thread protruding. Thread the 3/4" end into the control tube up to the nut and tighten. Thread a female rod end (B-17) on the 5/8" end up to the nut. Repeat for the opposite end of of the control tube. Check to see that the rod ends at each end of the control tube are at right angles to each other and tighten.

- c) Check the overall length of assembly from the top of one rod end to the other. This distance should be 40.125" to within 1/32". Modify as required. Repeat the procedure for the other control tubes. (MC-1, MC-2)
- d) Use three 1/4 x 1" flat head cap screws to bolt the control tube assemblies onto the sides of the swash plate. (MC-3, MC-4)
- e) Press bearing B-19 into the tube side of the roll lever (49-10). Place an AN960-416 washer (1/16" thick) in the small space between the bearings and proceed to push a second B-19 bearing into the bearing cavity on the opposite side. Use a screwdriver or other pointed device to line up the washers with the bearing bores.
- f) Place a 1/4" spacer (47-15) onto a male 1/4" rod end (B-16) and insert the rod end into the bearings. Place a small amount of thread locker onto the end of the threads and tighten an all metal locknut on the rod end. Use a punch to indent the rod end threads protruding from the nut to lock the nut in place. The rod end should rotate easily in the bearings.
- g) Reverse thread two 1/4" nuts onto two male rod ends (B-16) with 5/8" of thread protruding. Insert an AN4-17A bolt into one rod end. Place one of the pitch levers (48-06) onto the bolt as shown in the drawings followed by a washer. Slide the bolt through the roll lever rod end just installed above, a second washer, the second pitch lever and the second rod end as shown in assembly drawing A-3. Line the two pitch levers up and lightly tighten a nut on the bolt.
- h) Insert a female 1/4" rod end (B-17) with washers on either side between the top holes of the pitch levers. Place an AN4-10A bolt through the lever hole and rod end and tighten a nut on the bolt.
- i) Reverse thread two 10-32 nuts onto two 1/4" male rod ends (B-16) with 5/8" of thread protruding. Install the rod ends into the rod end mount plate (48-03) as shown in the assembly drawing. Install the plate onto the two 1/4" rod ends connected to the roll lever. Tighten on nuts and ensure all rod ends are parallel so that there is no rubbing on the levers.
- j) Place the rear control tube rod end with washers on either side between the lower holes on the pitch lever and bolt in place with an AN4-10A bolt. Now tighten the AN4-17A bolt installed above attaching the pitch lever to the roll lever rod ends.
- k) Place a modified cap screw (50-07) through the lower left control tube rod end. Slide a spacer (47-12) over the screw and insert into the left side of the roll lever. Place a washer and tighten a 1/4" all metal locknut onto the screw. Repeat for the right control tube. (MC-5, MC-6)
- l) Check the rotor shaft and control assembly by placing it on its side with a support under the lower end of the control tubes so that they are parallel to the floor. The roll control tubes should be resting on the block with the pitch tube above them. (MC-7, MC-8)
- m) Position the roll lever (49-10) so that it is in "neutral" position ie perpendicular to the control tubes. Position the pitch lever (48-05) so that the lower section is perpendicular to the control tubes ie. the bottom of the lever is vertical.
- n) With the lower controls in the "neutral" position outlined above check the swash plate. It should be in the neutral position (parallel with the drive sprocket) as well. If it is not turn the upper control tube rod ends up or down as required to bring them into alignment.

- o) Check the play in the control tubes. They should be free to rotate on their axis to the full extent permitted by the rod end at one end ie. rotation should not be limited in one direction by the rod end at one end and in the other direction by the rod end at the other thereby limiting the overall rotational freedom of the tube. This is very important.
- p) Finally, check again that the butterfly lever (50-04) is in the neutral position when the lower controls and swash plate are in the neutral position. Once the controls are properly aligned as outlined above and all nuts are tightened, remove the upper control tube cap screws in the swash plate one at a time, place a drop of threadlocker on the end threads while still in the rod ends and reinstall. When tightened in place, place a small dab of white paint on the top (12:00 position) of each lateral control cap screw head to monitor position.
- q) Flip the control tubes over and resupport parallel to the floor with the pitch tube now below the roll control tubes.
- r) Slide the front cyclic torque tube end (47-06) into the torque tube (47-04) and use a drill press to drill out the holes from each side. Install an AN3-11A bolt in the 3/16" hole.
- s) Press bearings (B-22) into the joystick mounts. Install the mounts on either side of the torque tube through the 1/4" hole using an AN4-14A bolt. Clamp the joystick between the mounts as shown in the drawings and rivet with 3/16 x 1/4" rivets.
- t) Apply some retaining compound (V-18) to the rear torque tube end plug (47-08) and slide it into the rear of the torque tube. Push in until it is 7/16" inside the end of the tube.
- u) Slide the rear of the torque tube into the roll lever (49-10). If the fit is not tight, wrap .001" shim stock around the tube as required to give a tight fit. Be sure the tube is properly bottomed in the lever.
- v) Set up a temporary support to support the cyclic stick above the control tubes and align the cyclic stick so that it is parallel with the control tubes while all components of the control system are in the neutral position.
- w) When the joystick and control system are all in the neutral position, recheck that the torque tube is fully bottomed in the roll lever and clamp the sides of the roll lever to the tube. Drill through the hole in the top of the lever, through the torque tube and approximately 3/4 of the way through the tube end inside. Drill up through the hole in the bottom of the lever until it meets the hole from above. Remove the clamp on the roll lever and remove the cyclic torque tube from the roll lever.

## 2. Collective Assembly

- a) Drill two 9/64" holes 7/8" to the rear of the intersection of the torque tube and the rear landing gear shelf. Holes should be 2" on either side of the fuselage centerline so that they are 4" apart within 1/32".
- b) Fabricate the collective slave lever (48-02) and collective torque tube (48-01) as per the drawings. Rivet together using 3/16 x 1/4 grip rivets with the collective lever gussets (48-05). Rivet the throttle advance lever (48-09) to the back of the torque tube.
- c) Insert a cable sleeve adjuster (V-35) into the inner slot hole in the collective throttle advance lever (48-09) on the collective angle bracket. Tighten the adjuster in place 1/2

of the slot length from the top on the lever and at the midpoint of the threads on the fitting.

- d) Fabricate the collective lever brackets (49-11) and use them to attach the collective angle bracket (48-04) to the collective torque tube as shown in the drawings. Remove the bolts connecting the angle bracket to the torque tube and set the angle bracket aside.
- e) Use a 1/4-28 x 5" bolt to assemble two rod ends (B-16) and the collective slave lever spacers (48-08) to the collective slave lever as shown in the drawings.
- f) Assemble the rod end mount plate (48-03) to the slave lever using 3/16 male rod ends (B-14) as shown in the drawings.
- g) Remove the roll lever and pitch lever assembly from the lower end of the control tube rod ends on the rotor head assembly. Attach the assembly to the collective slave lever using an AN3-30A bolt and the rod end mount plate spacers (48-07).
- h) Use a dremel tool to cut a hole in the left seat support 3 1/2" in diameter. The hole should be centered vertically between the top and bottom of the support and 2" forward of the landing gear shelf bulkhead (laterally mounted section of fiberglass with hole in the center mounted at front of landing gear shelf)
- i) Place large fender washers over the B-16 rod ends at the end of the collective slave lever assembly and insert the collective torque tube through the hole in the seat support. Insert the rod ends through the two holes made in the landing gear shelf and install fender washers and nuts on the outside of the fuselage.
- j) Cut six 3" lengths of foam tubing wrap (V-11). Insert them into the holes through the motor mount bulk heads in the torque tube using silicone glue to hold them in place.
- k) Carefully slide the entire rotor assembly in the tube. It may be easier to lay the fuselage on its side with a support under the top of the mast fin while doing this. Line up the control tubes with the foam lined holes in the motor mount bulkheads as you go. Slide the bearing housing into the correct position and install AN5-14A bolts in each of the side holes with beveled washers underneath. Install AN5-13A in each of the front holes and an AN5-27A in the rear hole. Do not tighten bolts yet in case changes to the collective assembly are required.
- l) Reconnect the control tube rod ends to the collective lever assembly. It may be necessary to drill two small holes on either side of the torque box on the fuselage through which an allen key can be inserted to hold the roll control tube rod end cap screws while tightening.
- m) Install the collective lever angle bracket by bolting in place. Install the collective lever on top of the angle bracket as shown in the drawings.
- n) Fabricate the antirotation plate (46-06). Line the sides of the slot with edge lining (V-48). Install into the upper hole of the fuselage torque box with the top of the slot 1" above the top of the 4" diameter hole and centered in the hole. Mark the bolt holes in the torque box by clamping the plate to the outside of the torque box and drilling through the holes in the plate into the torque box.
- o) Bolt the plate in place inside the torque box using 10-32 x 3/4 socket head cap screws to hold the bottom of the plate and 10-32 x 1 bolts to hold the top of the plate with spacers (46-05) between the plate and the torque box.

- p) Place the spacer (49-05) over the antirotation screw (50-06) and insert into the front threaded hole on the swash plate. Turn in lightly until the screw bottoms in the hole. Measure the distance from the spacer to the swash plate, remove the screw and grind this amount plus 1/16" off the screw. Reinstall the spacer and screw and check to see that the spacer is tight up against the swash plate.
- q) Check to see that the screw does not hit anything or come out of the slot in all possible positions of the cyclic or collective lever. Remove, loctite and replace the screw. Place a small white mark on top of the screw as was done with the others.

### 3. Cyclic Assembly

- a) Reverse thread a 1/4" nut onto a rod end (B-16) with 3/4" of threads protruding. Use a 1/4" x 1-1/4" bolt to attach the rod end to the front end of the cyclic control torque tube assembled earlier. Remember to use some threadlocker on the bolt threads.
- b) Cut an oval hole in the seat bulkhead on the centerline of the fuselage directly above the keel box. The hole should be 2 1/2" wide and 4" tall with the bottom at the top of the keel box surface. Smooth the edges.
- c) Insert the roll tube into the hole and into the roll lever and bolt in place. Double check that the butterfly lever is horizontal across the top when the cyclic stick is vertical. If this is not the case the roll control tube rod ends will have to be disconnected from the roll lever and adjusted up or down until it is. Each turn in on one rod end must be accompanied by a turn out on the other.
- d) Mark the location on the centerline of the keel box at which the rod end at the front of the roll tube will be located. Drill a 1/4" hole in the keel and install the rod end with a fender washer on either side of the fiberglass.
- e) Slide the pitch push tube end (47-07) into the end of the pitch push tube (47-05) and rivet in the same fashion as with the previous control tubes. Reverse thread a 1/4" nut onto a male rod end (B-16) with 3/4" of thread protruding. Install the rod end into the pitch push tube end.
- f) Reverse thread a 1/4" nut onto each end of a threaded rod (49-03) with 3/4" of thread protruding. Thread into the rear pitch push tube end (47-09). Insert the tube end into the rear of the pitch push tube and drill through the holes into the tube end from each side. Install AN3-11A bolts through both holes. Thread the pitch tube assembly into the pitch rod end above the roll lever inside the main mast until the nut touches the rod end.
- g) Tilt the joystick forward as far as possible. Slide an AN4-14A bolt into one side of the joystick mount and place a spacer (47-14) on the bolt. Place the front rod end on the pitch tube assembly on the bolt. Use a pair of needle nose pliers to insert a second spacer on the other side of the rod end inside of the joystick mount and slide the bolt through. A clamp placed at the base of the joystick tube between the mounts will flare the mounts apart to aid in installing the spacers if required. Add a washer and nut and tighten.
- h) Place the joystick in the vertical position. Turn the rotor shaft so that the butterfly lever is in the longitudinal (fore-aft) position. The lever (and swash plate) should be in the neutral (horizontal) position. If this is not the case undo the two bolts at the back of the pitch push tube and remove the plug from the tube by pushing the joystick forward and the plug rearward. Turn the plug in or out on the threaded rod as required to correct the alignment. Reassemble and recheck. (MC-10)

- i) When the alignment is correct tighten the nuts on the threaded rod so that rod end housings are in line with each other. The two bolts at the back of the pitch tube should be horizontal when the rod end housings at either end of the pitch tube are vertical.

#### F. SEAT

- a) Prior to installing the seat install the seat belt by drilling two 5/16" holes into the seat supports at 2" below the top flange and 2" forward from the rear wall of the fuselage in each support.
- b) Use fender washers and an AN5-5A bolt to fasten each side of the seat belt to the seat supports.
- c) Measure the distance across the top of the centerline of the seat supports. Subtract 3/4" from this distance and divide in two. Layout this dimension on the bottom of the seat on each side of the seat centerline. Place a mark at this dimension at 4" from the front of the seat and 10" from the front of the seat. Drill through with a 3/16" bit at these four marks. Countersink the top of the set for a 10-32 flat head cap screw.
- d) Place the seat on the supports with the front edge of the seat at dimension X (see page 6) from the back wall of the fuselage. Clamp the seat in place and drill through the holes in the seat and into the seat supports below.
- e) Cut a 2" x 8" x approximately 3/4" block of wood to fill the gap between the front hole in the seat to the the seat support so that the front lip of the seat is just resting on the seat support.
- f) Use four 10-32 x 1" flat head cap screws to fasten the seat to the seat supports.

#### G. FOOT PEDALS

- a) Reverse thread nuts onto four 1/4" rod ends (B-16) with 3/4" protruding. Drill two 1/4" holes in each fiberglass foot pedal 1/2" up from the bottom of the pedal and 3/8" in from the back. Use AN4-7A bolts to attach the rod ends (B-16) to the foot pedals (46-01).
- b) Fabricate the pedal control plates (46-04) and install onto the inside of each pedal using 3/16" x 1/8" rivets. Plate should be 1" up from bottom of pedal and flush with the back of the pedal with the bolt holes facing rearward.
- c) Install the foot pedal pivot (46-01) as far forward as it can go on the keel box up against the keel box flange. Drill out the six 3/16" holes and install six 3/16 x 1/8" grip rivets.
- d) Press the pedal pivot bearing (B-21) into the pedal bellcrank (46-02) and use AN3-5A bolts to hold in place. Fasten in place on the pivot using a 3/8" nut.
- e) Reverse thread nuts onto four 1/4" rod ends (B-16) with 5/8" of threads showing. Install rod ends on each end of the linkage rods (46-03) and install onto the bellcrank with AN4-11A bolts and to the pedal control plates with AN4-10A bolts.

## H. ENGINE

### 1. Mount Engine

- a) Remove the engine from the box. Check engine for completeness and condition as outlined in the vendor instructions.
- b) Drill out the holes in the engine mount plate to 3/4" (outer) and 10mm (inner) as shown in the drawings. Install the engine mounts onto the engine using the 10 x 30 mm bolts provided with threadlocker applied to the bolts. The 3/4" outer holes in the mounts should be above the 10mm inner holes when the engine is in its vertical position. Isolator holes should be deburred and smoothed with scotchbrite.
- c) Using water (not oil) as a lubricant slide a male vibration isolator half (V-06) into the mount plate from the underside of the engine toward the top (cylinder side) of the engine. Place an engine mount spacer (11-09) followed by the female half of the isolator on the protruding portion of the male section.
- d) Block the engine up under the tail boom next to the engine mounts so that it is level with the engine mount bolts. Slide the helicopter frame back until the bolts have slid through the rubber bushings. Place an engine mount washer (11-10) on each bolt and fasten. Remove the supporting blocks.
- e) Flare the ends of the copper elbows (V-12) provided out 1/16" in four locations around the circumference using a pair of pliers or vice grip.
- f) Cut a section of 1 1/2" ID hose provided to 1 1/4" long. Insert the copper fitting into the carburetor mount on the engine with the upper fitting pointed toward the rear and the lower fitting pointed toward the front. Use hose clamps to tighten in place.
- g) Slide the hose over the copper fittings and the carburetors into the hose. Use hose clamps to secure each connection.
- h) Mount the start button to the seat bulkhead under the collective lever and the master switch on the bulkhead under the seat next to it where it will not be accidentally switched during flight.
- i) Mount the battery directly behind the bulkhead on the left side of the seat using two 1/4 x 5" bolts and a 1/2" x 6" long aluminum strap across the top of the battery. Drill holes in the end of the strap and through the floor of the fuselage and run the bolts through the strap, alongside the battery and through the floor with fender washers under the floor. Wrap the strap with electrical tape to prevent shorting the battery if the battery shifts.
- j) Mount the regulator and CDI units on the rear wall of the fuselage on the left side where they can be reached by the wiring harness.
- k) Wire the engine as per the engine manufacturers instructions using the wiring harness provided. Wire the master switch as per the schematic provided.
- l) Use the heavy gauge black wire to run wire from the positive battery post to the starter button and from the button to the starter terminal. Run a separate ground wire from the engine case back to the negative battery terminal.
- m) Use the looms provided to enclose the wiring for protective covering and aesthetic enhancement.

### 2. Throttle Cable

- a) Drill a 13/64" hole in the back of the landing gear shelf through the box clamp in line with the cable adjuster (V-35) on the throttle advance lever inside the fuselage. The hole should line up so that a cable pulled straight between the holes and the adjuster will pass directly through the flanged hole in the shelf bulkhead between them. A second cable which can be used for the governor mounted 1/2" to the outside of this cable should also be able to pass through the hole in the bulkhead without interference.
- b) Place epoxy glue on a cable adjuster and thread into the hole.
- c) Slide the throttle assembly (V-31) over the collective lever and orient the housing cable connection to point down. Insert a cable adjuster (V-35) into the housing to approx. the midpoint of the threads and tighten the locknut. The cable exit from the throttle should be located just behind the seat bulkhead
- d) Cut two sections of throttle cable sleeve, each 26" long. Cut one section of throttle cable to 60" long.
- e) Slide the cable through the adjuster in the landing gear shelf and through the adjuster in the advance lever.
- f) Slide a ferrule (V-34) onto the cable followed by a length of sleeve and another ferrule.
- g) Slide the cable into the throttle housing cable adjuster followed by the cable stop (V-38) and a cable fitting (V-36) on the end of the cable. Flatten the end of the cable with a pair of pliers and slide the fitting back to 1/8" from the end of the cable and solder at this location.
- h) Test the solder connection by placing the cable loosely in a vice grip so that the fitting butts up against the edge of the vice grip. While wearing a pair of gloves, grip the other end of the cable. Without pinching or kinking the cable pull on the cable with a minimum of 80lbs of force to ensure the fitting is soldered properly.
- i) Place a ferrule over the cable extending from the landing gear shelf followed by the second section of throttle cable sleeve.
- j) Remove the dual cable end of the cable splitter (V-37) and insert the cable into the single cable end so that the sleeve bottoms into the hole.
- k) Ensure the throttle is twisted to the full "off" position. Ensure sleeves are properly bottomed in each of the adjusters and splitter and pull on the cable to ensure it is tight throughout. Place a mark with a felt pen on the cable level with the end of the splitter housing from which the cable is protruding.
- l) Remove the cable from the splitter. Cut the cable at the mark. Slide a fitting onto the end of the cable and repeat the flattening and soldering procedure above. Repeat the 80 lb pull test as above.
- m) Reassemble all throttle components including the cables into the carburetors. Adjust the cable adjusters so that the carburetor slides open at precisely the same time and so that they start to open when the collective lever is raised approximately 3" at the front with the twist grip in the full off position.

### 3. Primary Reduction

- a) Press bearings (B-00) into the bearing mounts (23-04). Use AN3-7A bolts to fasten the bearings in place. Bolts heads should be on the outside (non stepped side) of the mounts for the lower mount and be on the inside (stepped side) for the upper mount.
- b) Place a small amount of retaining compound (V-18) on the bearing mount step at the shorter end of the #2 sprocket shaft (A-00) and press the lower bearing mount (23-04) onto the shaft with the step side of the mount facing towards the sprocket.
- c) Use a 1/2" drill bit to counter bore the 3/8" hole in the top of each reduction housing (23-01/23-02) down approximately 1/16". Install 1/4-28 nutserts (V-28) into the 3/8" holes in the top of each reduction housing. Ensure the tops of the nutserts are flush with the top of the housing or slightly below.
- d) Place the primary reduction drive belt (V-22) on the sprocket and using AN4-10A bolts mount the reduction housings (23-01, 23-02) to the lower bearing mount. The bolt heads should be on the outside of the reduction unit.
- e) Place a small amount of retaining compound (V-18) on the bearing step of the shaft for the upper bearing and press the second bearing mount on the shaft with the step side of the mount facing toward the sprocket. Use AN4-5A bolts with a drop of threadlocker to fasten the mount in place to the reduction. The sprocket should turn freely.
- f) Install the reduction mount (24-01) onto the top of the engine using the 8mm flat head cap screws provided. Place a small amount of threadlocker on each screw before inserting. The beveled end of the mount should be next to the mast.
- g) Install the centrifugal clutch on the crankshaft with the 1/2 x 3 bolt. Apply a small few drops of threadlocker to the threads at end of the bolt. Remove the starter and insert a large screwdriver protected with a heavy cloth into the teeth of the ring gear to hold the crankshaft in place while tightening. Tighten to 70 ftlb.
- h) Place the reduction assembly on the reduction mount with the belt over the clutch and thread in the 3/8" x 1" reduction mount bolts. Each bolt should have two AN960-616 (1/16" thick) washers, and a lock washer under the head.
- i) Push the reduction rearward to tighten the belt as much as possible with your hand. Tighten the bolts to the point where they are snug but will still allow the reduction to move if pried with a screwdriver.
- j) Place a screwdriver in each of the slots next to the rear mounting bolts and pry evenly against the bolt heads until the belt will move 1/4" when pushed with a 5 lb force between the sprockets. Tighten the bolts to 40 ftlbs. Do not over tighten the belt!

#### 4. Exhaust System

- a) Cut the can of the exhaust from the inlet elbow as close to the can and as evenly as possible. Rotate the can down to the position shown in the drawings and reweld in this position.
- b) Fabricate the exhaust supports (11-01, 11-02) from the plate provided. Bend the exhaust support approx 10 degrees just above the enlarged area as shown in the assembly drawing.
- c) Install the exhaust support plates (11-02) on the second and third bolts up from the bottom centerline of the tail boom flange as shown in the drawings. Attach the exhaust supports (11-01) to the support plates using AN4-5A bolts.

- d) Fabricate and form the exhaust support bracket (11-04) as shown in the drawings. Cut four 2" x 2" squares of muffler wrap and cut 3/8" holes in the center of each.
- e) Use JB Weld to glue the exhaust mount spacer (11-09) to the exhaust support. Before the glue is able to cure, stack the fender washer, exhaust support bracket (11-04), muffler wrap, reduction heat shield (11-03), baffle mount, snubber washer (11-10) onto each exhaust support and fasten with the AN6-22A bolts supplied.
- f) Mount the exhaust on the exhaust manifold using the springs provided with the engine. The exhaust should rest across the exhaust support brackets. Adjust the brackets to make the exhaust as square to the engine as possible. Weld the brackets in place.
- g) Inject silicon gasket glue into each of the exhaust mount springs along their full length. This will greatly increase the life of the springs.
- h) Fabricate and form the heat shield (11-06) as shown in the drawings. Place the heat shield on the exhaust with a 3/16" shim underneath. With the shield centered on top of the exhaust and centered under that tail boom, drill through the holes in the shield and into the exhaust can.
- i) Stack six AN960L-10 washers on a 3/16 x 3/8 grip rivet in each hole and rivet the heat shield in place.

## 5. Fuel System

- a) Install the fuel pump onto the back of the cabin to the left side of the torque box just above the landing gear shelf. The voltage regulator and two CDI units will be mounted above the fuel pump.
- b) Cut fuel line (V-43) to run from the tanks valves to a tee fitting (V-44) mounted on the left side of the torque box. All connections are to be fastened with fuel line hose clamps (V-15).
- c) Cut a short 2" section of line to connect the fuel filter (V-49) to the underside of the tee fitting. Run the hose from here down to the fuel pump and from there to a point midway between the carburetors. Install a second tee into the line between the carburetors and run tubing to each of the carburetors inlets.
- d) Run fuel hose from the pulse line connection on the engine between the carb inlet and crank shaft to the pulse line port on the face of the fuel pump. Place a hose clamp on each connection in the fuel and pulse line systems.

## I. DRIVE SYSTEM

### 1. Gear Box Mounts

- a) Cut and bevel two 1-1/8" long keys from the 3/16" keystone (V-26) and bevel the edges. Insert the keys on the top and bottom of the splitter gear box (A-01) and install the 20 mm bore coupling flanges (23-07) so that they are flush with the ends of the shaft.
- b) Cut a 1" long key and install into the tail rotor gear box (A-02) keyway. Install the tail rotor gear box into the rear end of the tail boom with the tail rotor shaft pointing to the left.

- c) Thread in 1/4 x 3/4" bolts to the top and bottom holes. Insert 1/4 x 3/4" bolts through the tail rotor guard braces (12-01) and thread into the side holes.
- d) Use epoxy glue to glue the tail rotor guard (12-02) into the socket in the cable guide and reinforce with two 3/16 x 3/8" rivets on each side.
- e) Place a mark at the point where the guard braces intersect the guard and drill through the guard. Use an AN4-13A bolt to attach the braces to the guard.

## 2. Secondary Reduction

- a) Use the sprocket flanges installed on sprocket #3 as a guide to drill and tap 10-32 holes in the sprocket. Install the sprocket flanges (25-06) on sprocket #3 (25-04) using 10-32 x 3/4 flat head cap screws. The heads of the screws should be flush with the top of the flange. Use threadlocker on each of the screws.
- b) Install the bearing retainer (25-10) onto the bottom of the housing using AN3-11A bolts. Do not use a washer under the head of the bolt, only the nut. Do not tighten yet. Press the sprocket bearing (B-03) into the housing. Finish tightening the bolts turning the nut and not the head. Install the second bearing (B-03) in the upper housing (25-01).
- c) Coat two of the dowel pins (25-11) with retaining compound and press into the lower bearing housing until seated.
- d) Insert the lower bearing housing up into the hole in the bottom of the mast fin and into its final position. Slide it fully forward and note the location at which the tightening stud to be inserted into the back of the bearing housing will enter the mast fin bulkhead. Drill a 9/64 hole in this location. It may be necessary to file back the top of the mast fin to be flush with the bulkhead just above the hole to permit the washer to sit on a flat surface.
- e) Cut a 2" section from the 1/4-28 threaded rod provided. Put threadlocker on the stud and thread into the lower bearing housing. Reverse thread a nut onto the stud.
- f) Place a standard 1/4" washer over the stud and insert the bearing housing up into the hole in the bottom of the mast fin with the stud in the hole drilled previously. Place regular washers and reduction mount washers (11-11) over AN4-10A bolts and secure the bearing housing in place. The front two washers will need to be notched slightly to accommodate the eventual installation of the spacer blocks (25-03).
- g) Press the spacer blocks (25-03) onto the dowel pins in the lower bearing housing and line up the bolt holes.
- h) Press the upper bearing housing onto the short end of sprocket #3. Slide the long end of the sprocket into the lower housing bearing. Place a 2" sleeve over the protruding sprocket shaft and use an 8" clamp to press the sprocket in place. Press until light contact is made with the spacer blocks.
- i) Coat the remaining two dowel pins (25-11) with retaining compound and insert into the dowel pin holes in the upper bearing housing until flush.
- j) Bolt the spacer blocks in place using 1/4 x 5" bolts. Spin the sprocket to be sure all components are in alignment and the bearings rotate smoothly.
- k) Place the cog belts (V-23) around the sprockets. Tighten the nut of the threaded rod to tension the belts slightly. Rotate the rotor shaft a few times to allow the belts to align.

Continue tightening until the belts deflect approx. 3/8" with a 10 lb force between the sprockets. Finish tightening the mounting bolts. Do not over tighten the belts!

- l) Check belt alignment by placing the digital level across top of the side of sprocket #4 from front to back. Record the level reading and then place the level across the top of the upper bearing housing (25-01). The upper bearing housing should be at the same level or tilted back 0.1 degree.
- m) If the assembly is not within spec cut small "U" shape shims from .005" shim material. The shims should be approx .75" wide by 1" long and the slot of the U should be approx. .25" wide and .5" deep. Insert the shims around the mount bolts between the lower bearing housing and the mast fin where required to level the sprocket bearing assembly. A .005" shim under both bolts at one end of the housing will change the level approx .06 degrees.

### 3. Drive Shafts

- a) Prior to installing drive shafts, check the alignment of the drive train. Use a section of straight edge of sufficient length to permit it to be held along the shafts of the secondary drive sprocket and the upper gear box sprocket. They should be parallel and aligned to within 1/8" radial offset. If correction is required, remove the splitter gear box and slot the mount holes in the tail boom as required to bring to within the required limit.
- b) Check alignment between the gear box and primary reduction drive shaft in a similar manner. They should be parallel and within a 1/16" radial offset. If adjustment is required, shim the engine spacers as required to correctly locate the primary reduction shaft.
- c) Cut a 1-1/8" long key from the 3/16" keystack and insert into the keyway. Slide the 3/4" bore coupling (23-06) onto the primary reduction shaft until the top of the shaft is flush with the top of the coupling.
- d) Place a thin curved washer from the flex pack package (V-24) on each of the coupling holes on the primary reduction with the curved side facing up. Place a flex pack on top of the washer followed by curved washers with the curved face facing downward. Install bolts, flat washers and locknuts and tighten until snug but not tight.
- e) Place a second set of curved washers on the open holes in the flex pack with the curved side facing down. Place the lower drive shaft (24-06) on the washers. Insert bolts through the holes and add a set of curved washers on the bolts with the curved side facing up. Install nuts and washers on the bolts and tighten until snug but not tight.
- f) Repeat this procedure for the upper flex pack and for the upper drive shaft. The flex pack always has the curved side of the washer next to it.
- g) Check to see that all the flex packs are flat. If they are being axially pulled out of their relaxed state slide the couplings on the splitter gear box up or down until they are flat. Tighten the flex pack bolts and loctite and tighten the set screws on all couplings.

## J. MAIN ROTOR

## 1. Rotor Head Assembly

- a) Rotor head assembly must be done on a clean surface such as a clean piece of cloth. Be sure all parts and bearing surfaces are clean and free of contaminants prior to assembly.
- b) Remove the inner race (B-06B) from the feather needle bearing assembly (B-06A/B). Place a thin film of retaining compound on the inside of the inner race and press into position on the spindle until it is fully seated.
- c) Use a sharp screw driver to pry out one of the lip seals from the side of the feather needle bearing (B-06A). Be careful not to damage the bearing while removing the seal.
- d) Be sure the bearing is completely clean with no contaminants. Place the over the race with the side containing the remaining seal installed first ie. the sealed side should face the inside of the hub.
- e) Place the retention ring (32-03) on top of the feather needle bearing.
- f) Press the angular contact ball bearing (B-07) in to place on the spindle. The thick end of the outer race should face toward the center of the hub and the thin end of the outer race should face toward the blade. It is very important that the bearing face the right direction. Be certain no contaminants enter any of the bearings during the installation procedure. Repeat with a second angular contact ball bearing (B-07).
- g) Cut the end of the large 3/4 x 5" bolt off to shorten the bolt to 4 3/8" long. Dress the threads at the end to ensure proper engagement with the retention nut. Coat the shank with a film of retaining compound (V-18) and the threads with a film of silicone glue. Place the thin machine washer over the bolt and insert the bolt into the spindle bore.
- h) Thread the retention nut (32-04) on the bolt threads Tighten the bolt to 100 ft lb.
- i) Wrap the bearing assembly in packing tape to seal the bearings during the drilling of the retention nut cotter pin hole. Make sure no metal fragments will be able to enter any of the bearings during drilling.
- j) Place a punch mark 1/8" in from the end of the retention nut and drill straight through the nut and bolt with a 3/32" bit. Install the 3/32" cotter pin (V-66) and set in place. Thoroughly clean the assembly to remove all metal fragments before removing the tape.
- k) Make sure the inside of the bearing cavity is clean. Place 2 small segments of 1/8" plate between the needle bearing (B-06A) and the face of the spindle to support the bearings while pressing the grip in place.
- l) Slide the grip over the spindle/bearing assembly. Line up the holes in the grip with the holes in the retention ring as accurately as possible. The retention ring will be difficult to move after it is pressed into the grip. Press into place until the base of the grip touches the plates.
- m) Use a punch through the 5/16" holes around the circumference of the grip to move the retention ring inside to line up the holes in the ring with the holes in the grip. Do not push against the threads in the hole, use the unthreaded portion (outer 3/16") of the holes in the retention ring to press against.
- n) Cut and shape the pitch horns from the 1/4" aluminum plate provided. Pilot drill the 5/16 mount holes with 1/8" holes prior to bending. Bend the pitch horns using any 3" diameter cylindrical object as a mandrel. After bending drill out the pilot holes with a 5/16" bit.

- o) Cut 1/4" off the end of each of the AN5 bolts provided for the rotor head (twelve AN5-7A, two AN5-10A, four AN5-11A. Bevel the ends and clean up the threads.
- p) Place a small amount of threadlocker on the threads of the AN5-7A bolts and install one AN936-A516 lock washer and one AN960-516 heavy washer on each bolt, place silicone gasket glue on the bolt shank and thread into each hole not used by the pitch horn or pitch horn reinforcement. Note that there is a top and a bottom to the grip. The small 1/4-28 grease nipple hole is on the bottom half of the grip.
- q) Install the pitch horn on the grip with AN5-11A bolts complete with washers, loctite and silicone glue as above.
- r) Form the pitch horn reinforcement from the 1/8" plate provided and install on the grip with an AN5-10A bolt, loctite, silicone and washers. Drill through the reinforcement into the pitch horn as shown in the drawings and install an AN3-6A bolt.
- s) After the silicone glue has cured install the grease nipple into the 1/4-28 hole. Stand the grip on end with the spindle at the top and use a grease gun to grease the grip until grease comes out of the needle bearing seal all the way around the grip. The grip will need to be regreased after the first run up of the helicopter.
- t) Repeat the assembly for the opposite grip.

## 2. Mounting

- a) Press the teeter bearings (B-05A) into the hub plates (32-05) so that they are flush with the plate on one side. Place a film of retaining compound on the teeter pins on the rotor shaft and install the teeter bearing races (B-05B) onto the pins using the teeter pin nut to fully seat the races against the teeter block. Remove the nuts.
- b) Install the hub plates onto the teeter pins with the protruding bearing facing out. Place the teeter thrust spacer (32-07) over the protruding needle bearing. Place a .062" teeter thrust washer (B-09A) over the thrust spacer followed by a teeter bearing (B-09C), a .032 teeter thrust washer (B-09B) and a second .062" washer (B-09A). Place a 7/16" USS washer over the bearing pack followed by the teeter nut. Do not tighten the nut until after balancing. Repeat for the opposite hub plate.
- c) Cut 3/8" off the end of each of the four 7/16 x 5 1/2 bolts supplied and dress the ends. Install the grip assembly between the hub plates as shown in the drawings and fasten in place with the 7/16" bolts. Tighten to 40 ftlb. The head of the bolts should be on the same side as the pitch horn. Complete the assembly of the opposite grip and install in a similar manner.
- d) Cut 1/2" off the ends of the four 7/16 x 3" bolts supplied and dress the ends. Install the blades into the grip slots and fasten in place with the 7/16" bolts. Lightly tighten the bolts.
- e) Use a 1/4-28 die to fully thread the eight 1/4-28 x 1 1/2 bolts up to the head. Reverse thread 1/4-28 nuts onto each of the bolts and insert into the lead lag adjustment holes on the grips. Use a grease gun to grease the grips until a small amount of grease extrudes from the needle bearing.
- f) Use a caliper to place a mark 1/4" from the inside end of the blade on the leading edge of the blade. Hold the pretentioner (34-06) over the leading edge as shown in the drawing with the groove on the leading edge and the mark on the blade showing through the

middle of the center hole on the pretentioner. The face of the pretentioner should be vertical.

- g) Using a 1/4" drill bit drill through the center hole down approx 1/8" into the leading edge of the blade. Remove the pretentioner and use a 7/32" bit to drill 1" straight into the blade. Do not drill further than 1". Tap the hole with a 1/4-28 tap.
- h) Install the pretentioner using the blade using a 1/4 x 1 bolt complete with locktite and lock washer.
- i) Reverse thread a nut on a 5/16 x 1 bolt and install into the pretentioner. Do not tighten at this point.
- j) Assemble the pitch links (50-03) by reverse threading nuts on 4 rod ends (B-16) with 3/4" protruding and threading into the pitch links.
- k) Bolt the pitch links into place in the butterfly levers using AN4-11A bolts. Do not bolt the links to the pitch horns until after balancing.

### 3. Balancing

- a) Tighten the outer blade bolt to 40 ftlb. Tighten the inner blade bolt to 10 ftlb. Screw in the lead-lag screws until they contact the blade bolt. Once all are in contact, tighten each screw an additional 1/8 turn. Loosen the outer blade bolt 1/2 turn.
- b) Use the digital level held along the chord line of the end of the blade to set the blade to 0 degree pitch.
- c) Lay a 4 ft or longer straight edge along the side of the hub plate and use a digital caliper to measure the distance from the straight edge to the leading edge of the blade directly in outboard of the pretentioner. Measure the distance from the straight edge to the leading edge of the blade at the end of the straight edge. Both of these measurements should be the same after completing the lead/lag adjustment.
- d) Adjust the lead lag screws by backing off both the upper and lower screw on one side the same amount (start with 1/6 turn each or one flat) and then turning in both screws on the other side in until tight. Make adjustments and recheck with the caliper until both measurements are the same within +/- .003".
- e) Tighten the 5/16 bolt on the pretentioner against the grip to 4 ftlb. Recheck the lead lag measurements and adjust as required. Repeat for the opposite blade.
- f) Ensure the teeter pin nuts are loose and that there is nothing else that will inhibit teeter movement of the rotor. There should be no air movement in the room.
- g) Place the digital level on top of the flat on top of the hub plate so that it is centered on the plate. If the level itself does not have a smooth flat bottom or is made of plastic, a small section of angle or flat bar may need to be placed under the level.
- h) Wait until the blades stop moving and check the reading of the level. If the blades are disturbed slightly they should return to this same reading. If this is not the case something is resisting the blade movement and the balancing will not be correct.
- i) If the level does not indicate a 0.0 degree reading then the blades will need to be balanced.

- j) Remove the screws holding the tip cap in the heavy blade and grind a small amount from the inside of the cap between the threaded holes. Set the cap on top of the end of the blade and recheck the level. Remove additional material as required to balance the blades. When the rotor is level, loctite the tip cap screws and reinsert. Remove the screws from the opposite cap and loctite as well.
- k) Once the blades are balanced, tighten the teeter pin nuts and cotter pin in place.
- l) Fasten the pitch links to the pitch horns using AN4-11A bolts and the pitch horn spacer (32-06). Ensure there is full rotational play in the pitch links after tightening the rod end lock nuts similar to what was done with the control tubes in the controls section.
- m) Line the edge of the teeter bearing caps (33-02) with silicone glue and place over the teeter pin nut with the grease nipple hole facing down. Secure in place using 8-32x1/2" cap screws. Install a straight grease nipple (V-65). After the glue has cured slowly grease the bearing until a small amount of grease extrudes from the opposite side of the teeter bearing.

## K. TAIL ROTOR

- 1. Control Assembly
  - a) Press the tail rotor control bearing (B-13) into its housing (51-04) so that it is flush. Use AN3-6A bolts to hold the bearing in place.
  - b) Press the control bearing mount (51-05) through the bearing with the large diameter of the mount on the same side as the nuts. Press the actuator (51-07) onto the section of the bearing mount protruding through the bearing. Drill through the 3/16 holes and deburr the holes inside the bearing mount.
  - c) Reverse thread nuts onto two 3/16" rod ends with 5/8" protruding and insert into the control bearing housing. The rod end housings should be parallel and facing each other as shown in the drawings.
  - d) Remove the two bolts installed on the forward tail boom side of the tail rotor gear box next to the tail rotor shaft. Insert 1/4-28 x 1 1/2" bolts through the lever mount (51-02) and the spacers (51-10) and after adding some threadlocker reinstall in the gear box. There should be a washer and a lock washer on each bolt.
  - e) Reverse thread two nuts on two 1/4" rod ends with 5/8" of threads protruding. Mount on the lever mount with the housings parallel and facing each other but do not tighten.
  - f) Place a drop of threadlocker on a 10-32 x 1 cap screw. Insert through the tail rotor control lever (51-01) and thread into the slave lever (51-06). Place the lever assembly on the rod ends. Bolt in place with an AN4-17A bolt on top and an AN4-12A bolt on the bottom. Tighten the rod end nuts and ensure that the lever can swing freely.
  - g) Reverse thread nuts on two 1/4" rod ends with 5/8" of thread protruding. Place threadlocker on the threads and thread into the end of the slave lever with the housings parallel and facing each other.
  - h) Slide the control bearing assembly onto the tail rotor shaft. Insert the linkage (51-03) between the rod ends on the slave lever and on the control bearing housing (51-04). If

required, bend the linkage plate slightly until it slides easily between the rod ends with no slack. Fasten in place with AN4-7A bolts on the pivot and AN3-6A bolts on the housing.

- i) Slide the control bearing assembly back until the keyway in the tail rotor shaft is exposed. Insert the key (51-08) with the rounded side facing up. Slide the assembly back over the key and line up with the holes in the actuator. Grind one 10-32 x 1/2 cap screw to .400" long. Add threadlocker and to this screw and to a 1/2" screw and thread into the key.
- j) Check the motion of the control. It should be smooth and easy to actuate with the control lever. If this is not the case check all rod ends for correct alignment and check the keyway by loosening the bolts to see if it is binding. File the edges of the key as required to eliminate binding.
- k) Fabricate the front tail rotor cable bracket (11-05). Install the bracket on the left edge of the top of the keel box 7.5" behind the rod end holes for the pedal in the floor below measuring straight back. Rivet the bracket in place using 3/16 x 1/8" grip rivets. Use a stick with a small piece of tape on the end to place reinforcing washers on the back side of the rivets prior to setting.
- l) Drill a 1/2" cable routing hole in the seat bulkhead just above the keel box surface to the lower left side of the cyclic control hole cut earlier. Cut a second hole in the rear wall of the fuselage approx. 7" below the bottom of the fuel tank and 1" to the left of the torque box. Hole will be 1/2" wide and approximately 1" tall.
- m) Cut a third hole in the lower tank cone 1" behind the rear tank bulkhead and 4" to the left of center. Hole should be approx 1/2" wide and 1 1/2" long.
- n) Route the cable through the cable guide and up to the front of the tail boom and through the three holes just drilled.
- o) Install the cable onto the brackets by pulling the rubber on the swivel joint forward and turning the nut off the threads. Slide the sleeve portion of the cable fitting through the slot in the cable brackets and slide into place in the bracket hole. Tighten the nut at the midpoint of the threads and slide the rubber back into place.
- p) Reverse thread a nut on each cable end with 5/8" of thread protruding and thread on female rod ends.
- q) Attach the rod end to the left foot pedal control plate upper hole with an AN3-13A bolt and a spacer (46-07) between the rod end and the lever. Attach the rod end to the tail rotor control lever with an AN3-7A bolt.

## 2. Blade Assembly

- a) Ensure the inside of the blades are clean and free of any small particles. Obtain the section of 1-1/2" thick blue styrofoam (V-03) and press one side up against the tip of the blade so the tip makes an impression in the foam. Use a sharp utility knife to cut the shape of the hollow portion of the blade tip out. Test the insert in the blade to be sure of a good fit. Trim as required to make a snug but not an excessively tight fit.
- b) Use Bulldog premium glue (V-07) to glue the inside of the first inch of the blade tip and spread on the bonding surfaces of the foam as well.

- c) Insert into the blade until approx. 1/8" is left protruding from the tip. Repeat process for the root of the blade, both on the leading and trailing sides of the pivot until the blade is sealed. Repeat for the second blade.
  - d) Clean up all excess glue using a mild solvent if required (without letting it touch the foam). After the glue has cured overnight use a sharp utility knife to trim the foam flush with the end of each blade using the end of the blade as a guide for the knife to produce a clean finished look.
3. Rotor Assembly
- a) Rotor assembly must be done on a clean surface.
  - b) Press the tail rotor pivot bearings (B-10) into the sides of the tail rotor hub.
  - c) Press the 7/8" diameter tail rotor hub seal (V-62) into the tail rotor hub end cap (33-06) with the steel side of the seal in first.
  - d) Attach the blade pitch horns to the blades and fasten using AN3-11A bolts.
  - e) Place silicone glue on the blade pivot in the location of the seal spacer (33-08) and slide the spacer on to the blade pivot. Place the tail rotor hub end cap (33-06) on the seal spacer with the seal facing toward the hub.
  - f) Press the outer feather bearing (B-11) on to the pivot. Do not press against the end of the tail rotor, press against the tops of the pitch horns.
  - g) Slide the pivot spacer (33-12) onto the pivot. Press the needle bearing inner race (B-05B) onto the pivot. Place a thin washer (AN960L-616) on the pivot follow by a 3/8 castle nut (AN310-6). Install a cotter pin (V-19) through the hole in the pivot to fix the nut. Repeat for the second blade.
  - h) Press the needle bearing (B-05A) into the tail rotor hub (33-05). There is a 1 degree taper in the bearing holes and also on the end faces of the tail rotor hub. Place two small 1/32" thick washers under the inner edge of the tail rotor hub to make the bore straight with the press while pressing the bearing in place.
  - i) Slide the tail rotor housing spacer (33-07) into the tail rotor hub on top of the needle bearing.
  - j) Place silicone on the end of the tail rotor hub and press the tail rotor hub onto the blade assembly while supporting the blade assembly with the end caps.
  - k) Place thread locker (V-17) onto the threads of 10-32 x 1" socket head cap screws and fasten the hub end cap into place. Repeat for the opposite blade.
  - l) Install grease fittings into the 1/4-28 grease holes and grease the tail rotor hub.
4. Balancing.
- a) Obtain a short (approx 18") section of 1/4" rod. Insert the rod into the vice so that it is horizontal with approximately 1 foot of rod pointing out to one side.
  - b) Place the tail rotor on the rod with the rod inserted through the teeter bearings. You may need to reposition the rod tilting it up slightly to account for the bend in the rod under the

weight of the rotor. The assembly should be level with the blades positioned horizontally and facing opposite directions as they will be when mounted on the helicopter.

- c) Release the rotor. If it does not move, lightly tap the balancing rod with a small metal object to reduce any friction effects. If there is little or no movement the rotor is balanced. If it tilts, place two 3/16" washers next to the outer most pitch horn mounting bolt on the lighter blade. Set the rotor level and recheck. Add/remove washers to the lighter blade until it no longer moves.
- d) Add the washers to the outer bolt. If a longer bolt is needed remove one washer to account for the heavier bolt and install the longer bolt and remaining washers. Recheck the balance and make further adjustments if required.

## 5. Mounting

- a) Place a small amount of grease on the tail rotor teeter spacers (33-11) and place on the teeter bearings inside the rotor hub. The grease will help to hold the spacers in place while installing the rotor.
- b) Rotate the tail rotor shaft so the rotor mount hole is horizontal and slide the rotor hub over the shaft. Place a hub spacer (33-11) on the AN5-20A teeter bolt and insert through the bearings and shaft. Install a nut with no washers on the bolt and tighten.
- c) Reverse thread two nuts on 3/16" rod ends (B-14) with 1/2" of threads protruding. Thread the male rod ends into two female rod ends (B-15).
- d) Place threadlocker on two 10-32 x 1-1/4 cap screws and install the female rod ends onto actuator (51-07) with a spacer (51-11) between the rod ends and the actuator. Repeat for the male rod ends mounting onto the pitch horns with spacers installed under the rod ends.
- e) Check the travel of the pedals relative to the travel of the tail rotor control bearing. A comfortable range of foot travel should send the control bearing from one stop to the other. Make adjustments to the cable bulkhead nuts as required.

## L. INSTRUMENT PANEL

- a) Prior to installing the instrument panel in the front of the fuselage mark the location that the tail rotor control cable will route through the lower panel by measuring up from the keel surface and in from the keel edge and transferring to the lower instrument panel. Drill a 1/2" hole at this location.
- b) Disconnect the front cable rod end from the pedal and the cable from the bracket. Install the panel in place by fibreglassing the underside of the panel to the fuselage with 2 layers of fiberglass all along the upper edge of the panel and by riveting the lower edge of the panel to the keel box.
- c) Cut three 3" holes in the panel in your desired location. Recommended placement is with the rotor/engine tach top center with temperature and air speed gauges below on either side and the Tiny Tach centered directly below.
- d) Cut back the side lugs on the Tiny Tach 1/8" from the face. Use the rectangular dimensions of the housing to cut a hole into the panel in the desired location. Push the

tach into place in the rectangular hole and fasten with 10-32 x 1" cap screws. The face of the Tiny Tach should be flush with the face of the panel.

- e) Mount the pitot tube By bonding in place out the front of the fuselage below the windshield. Tube the back side of the tube to the ASI using 1/4" fuel tubing and the 5/16" hard plastic transition tubing.
- f) Drill 3/16" holes just before the "Y" in each exhaust manifold and use the clamps to mount the EGT senders. Place the CHT senders under the upper spark plug on each cylinder. Route the four wires together on the left side of the main mast and use the short 8 wire jumper to run the wires to the correct terminals on the gauge.
- g) Run the wire from the Tiny Tach next to the gauge wires up to the bottom spark plug wire on the engine. Wrap the red tach wire around the spark plug wire 4 times and tape in place. Use the grounding bolt on the lower left side of the engine to mount the ground wire.
- h) Fabricate the tach sensor mount bracket from 1/8" aluminum plate provided and install onto the front rotor shaft housing mount bolts. Insert the hall effect sensor for the rotor tach through the 7/8" hole and up to 1/4" below the arms of the large rotor shaft sprocket. Use the nuts to fasten in place.
- i) Glue one of each of the small magnets provided to the underside of the arms directly above the sensor as described in the rotor tach directions (make sure they are facing the right direction). Run the wire to the rotor tach. Use the colored wires provided to power the tach from the master switch.
- j) Use the colored wires to splice into the generator wires on the engine (black wires on bottom of engine next to fan cowling). Run the wires to the engine tach.
- k) Be sure all wires and connections are properly soldered and taped. Enclose all wires together in the 3/4" loom (V-10) provided and use tie wraps to secure in place.

M. FLOATS (for float equipped Mosquito XEL's only)

- a) Make a mark on the horizontal centerline of one of the right skid at 2" from the rear end of the skid.
- b) Lay the right uninflated float alongside the skid with the rear tab at the rear end of the float alongside the mark placed above. The inflation opening is at the rear of the float. The right float will have the two side tabs facing toward the center of the helicopter if the float were inflated.
- c) Place a mark on the centerline of the skid at the location of each of the holes in the bottom float tabs. Double check that the marks do not interfere with the T fittings on the skids.
- d) Drill 1/4" holes through the centerline of the skid at each of the marked locations and deburr.

- e) Repeat for the opposite float
- f) Following completion of the helicopter attached the floats by using  $1/4 \times 2-1/2$  std bolts with fender washers to attach each set of tabs to opposite sides of each skid. Inflate the floats to 3 psi. Use a bungee cord or short section of rope through the side tabs to secure the float against the bows.

## II TUNING

### A. MAIN ROTOR STATIC PITCH

- a) Place a small punch mark on the tip of one of the blades in the end of the spar about 1/4" from the leading edge. Place another punch mark on the leading edge of the same blade about 1/4" from the root. This will be designated as blade number one.
- b) Use a bungee cord to strap the cyclic stick back to the center of the front of the seat. Stand directly in front of the front pad and press the digital level to the underside of the flat spar portion of blade. Adjust the pitch link by unfastening the lower pitch link bolt and turning the rod end in or out as required.
- c) Adjust as required to bring the level to 0 degrees +/- 0.1 degree. Each 1/2 turn of one rod end represents approximately 0.2 degrees of pitch. Move the rod ends at both ends of the pitch link in or out approximately the same amount. After refastening ensure the rod ends at each end of the pitch link are in line with each other to permit the link to pivot on its axis the maximum amount possible.
- d) Smoothly swing the blades around so as not to move the cyclic stick and standing in the same spot adjust the number 2 blade until it has the same reading as blade 1. Recheck both blades. Remove the bungee cord.

### B. TAIL ROTOR STATIC PITCH

- a) Rotate the tail rotor until the blades are horizontal. Adjust the foot pedal until the control hits the full right stop (right pedal down). Hold the rotor so that it is perpendicular to the tail rotor shaft. Hold the digital level alongside the center of the tip to the center of the trailing edge of the blade to measure the angle of the blade. Adjust the pitch link until this reads 87 degrees +/- 0.5 degree.
- b) Rotate the rotor 1/2 turn and repeat with the second blade. Adjust the pitch link as required until the second blade has the same reading. Recheck both blades.

### C. MAIN ROTOR BALANCE

- a) Start the engine and proceed through break-in steps as required. When full rpm operation is permitted rotor tuning can continue. If the rotor can be brought up to full speed with minimal vibration engine break-in can be completed. If not, final rotor balancing will need to be completed at lower rpm's until the rotor is adequately balanced for full speed operation.
- b) The following procedure is for tuning without an electronic balancer. If you are able to obtain a balancer you should follow the directions provided with the balancer for the most accurate tuning.
- c) Run the rotor up to full speed of 500 rpm (or a lesser speed if vibration becomes uncomfortable) for the first time and feel the vibration produced by the main rotor. Shut down the engine and wait until the rotor stops. Loosen the outer blade bolt on blade #1 1/2 of a turn.
- d) Back off the locknuts on the adjustment screws two turns each and position so that the flats of the nuts on the sides are vertical. Use the nuts for rotation reference points. Back

off the two front screws “one flat” each ie. turn out each screw 1/6 of a turn (until the next flat is vertical). Turn in the two rear screws until tight (approx. the same amount). This will pivot the blade forward slightly. Retighten the outer blade bolt.

- e) Bring the speed back up to 500 rpm (or the same max rpm achieved previously) and feel the vibration. If it is better or no different than the first attempt repeat the above procedure. If it feels worse turn the screws back to their original position and then another flat beyond that. Recheck the vibration.
- f) Continue with the trial and error method continuing in the direction that reduces vibration until it begins to increase again. When in the area of least vibration move the screws only 1/12 (flat to point) at a time to bring the vibration down as low as possible.
- g) At this point there should be virtually no main rotor vibration left. If there is still vibration it is due to rotor imbalance. Add four standard 1/4” SAE washers to the 2” long cap screw near the root of blade #1 and check the vibration. If it feels better change the number of washers until the vibration is eliminated. If it feels worse move the washers to the other blade and make adjustments as required.
- h) When finished there should be no rotor frequency vibration left. You will always be able to feel a small amount of high frequency engine vibration but there should be no vibration from the main rotor.

#### D. TAIL ROTOR DYNAMIC BALANCE

- a) Tail rotor imbalance will feel like a buzzing feeling in your back. Lower level tail rotor imbalance can be difficult to distinguish from normal engine vibration.
- b) If the tail rotor feels out of balance try adjusting the number of washers on the outer blade fastening bolt (same as used for the static balance) and using trial and error as was done with the main rotor to reduce the imbalance as much as possible.

#### E. DYNAMIC PITCH TRIM

- a) As you are bringing the engine up to approx. 2000 rpm observe the tips of the blades passing in front of the helicopter. If they are pitched correctly they will both follow the same path. If they are out of adjustment the tips will appear to oscillate up and down as each blade passes in its own path.
- b) If they are out of adjustment adjust the pitch link on blade #1 by turning the lower ball joint in 1/2 turn. Recheck the tip paths. If they are closer to being in line then turn the pitch link on blade #2 out 1/2 turn to keep the nominal setting of the blades the same for autorotation purposes. Continue in this manner until both blades are in the same path.
- c) If they are further apart turn the link on blade #1 back out to its original position and out a further 1/2 turn and recheck. Make further adjustments as required to each blade until the blades are in line. The helicopter is now ready for hover trials.
- d) Final pitch adjustments must be made during forward flight. With the helicopter in forward flight at approx. 50 mph notice if there are any “1 per rev” oscillations similar to out of balance vibration. This is caused by pitch trim.

- e) After taking a short flight land the helicopter and adjust the link on blade #1 up 1/2 turn. Take another short flight and check the vibration level. Adjust the link up or down as required until the vibration is minimized.

F. FLY SAFE AND ENJOY YOUR NEW MOSQUITO HELICOPTER!!