Acknowledgments

We thank all of those people who helped make Lite Machines Corporation and the *Model 110*™ helicopter possible, including our good friend Paul Klusman. The *Model 110* Construction Manual and Operator's Guide were developed and computer illustrated by Paul Klusman: engineer, test pilot and helicopter guru. We especially thank Mom and Dad - without their help and constant encouragement we could not have done this.

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PATENT NOTICE

Most aspects of the Lite Machines *Model 110* helicopter including, but not limited to, the main rotor, main rotor blades, tail rotor, tail rotor blades, *Arlton Subrotor*™ stabilizer, *Arlton Gyro*™ stabilizer, swashplate, fuselage structure and configuration, radio installation configuration, landing gear, and drive train are either patented (U.S. 5305968, 5597138, 5609312, 5628620, 5749540, 5836545, 5879131, 5906476; Australia 681287, 686883; Europe 95918276.7-2312, 95932305.6-2312, 96928019.7; France 0605656; Germany 69221307.4; U.K. 0605656), patent pending or patent applied-for in the United States and in other counties. For information concerning patents and licensing, please contact Lite Machines Corporation.

Revision VP8.2 0699

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Introduction

The Lite Machines *Model 110* helicopter is the first mass-produced radio controlled micro helicopter in the world. It is intended as an introductory helicopter for those modelers intrigued by helicopters and helicopter flight, but unable to justify the significant investment in time and money required for traditional helicopter models. The *Model 110* can withstand tip-overs and minor crashes with little or no damage. Many flight skills such as basic hovering, nose-in hovering, low speed maneuvering, forward and backward flight, and pirouettes can be mastered without busting the family budget with a larger, more complex machine.

The *Model 110* utilizes advanced aerodynamics that enable it to fly on 1/10th of a horsepower which is roughly the power consumed by a 75 watt light bulb. In comparison, .30 to .60 size model helicopters use one to two horsepower (10 to 20 times more).

The fixed-pitch main rotor of the *Model 110* helicopter combines *Subrotor* technology and free-flapping, foldable rotor blades in a rugged, high lift rotor system with fewer than half the number of parts found in collective-pitch helicopters. Main rotor lift is controlled by changing the rotational speed of the main rotor rather than varying the pitch of the individual rotor blades (such as with “collective-pitch” type main rotor systems). Fixed-pitch main rotors are substantially simpler than collective-pitch systems and are ideal for beginners. Collective-pitch main rotors allow for advanced aerobatics and engine-off autorotation maneuvers that are typically flown by more experienced pilots.

The tail rotor mechanism of the *Model 110* helicopter incorporates a light-weight *Arlton Gyro* stabilizer which eliminates the need for an expensive electronic gyro and extra capacity receiver batteries. The unique central keel fuselage structure is simple, strong and easy to assemble and repair - a far cry from the fragile construction of many electric helicopters.

Designed on modern computer-aided design (CAD) systems and computer-aided manufacturing (CAM) systems, the structure of the *Model 110* helicopter incorporates eight types of engineering plastics, four aluminum alloys, several high strength steels, aircraft plywood and multiple protective surface coatings.

Although beginners can successfully build and fly their *Model 110*, the process can be made significantly easier with the help of an experienced modeler and instructor pilot. Lite Machines recommends that all beginners join the Academy of Model Aeronautics (AMA). The AMA is a non-profit organization that provides services for modelers. The AMA can help you locate a model aircraft club in your area with an instructor pilot (you can also check with your local hobby shop). Membership benefits include a monthly magazine and liability insurance. Many flying clubs require an AMA modeler’s license to operate a model on their flying field. For information on the AMA call (765) 287-1256, or write to:

Academy of Model Aeronautics
5151 East Memorial Drive
Muncie, IN 47302

Consumer Warranty

IMPORTANT! Before building this *Model 110* helicopter kit, read and fully understand the following warranty, and review the entire Construction Manual and Operator's Guide. By building and/or flying this helicopter you indicate your acceptance of the following warranty terms and conditions, and further agree to build and operate this helicopter in a safe and responsible manner.

If you find any term or condition of the warranty unacceptable, or if you feel that this helicopter is just not suited to you, you may return it to your place of purchase in **NEW** and **UNUSED** condition within thirty (30) days of the date of purchase for a refund of the purchase price less shipping and handling. Partially assembled kits, and kits with opened parts packs or missing parts cannot be returned for a refund. Items such as radios, engines and accessories are warranted separately by their respective manufacturers and are not warranted by Lite Machines.

Warranty:

1. Lite Machines Corporation warrants to the first consumer Purchaser that the *Model 110* helicopter substantially conforms to its published description when used as intended as a hobby product, and will be free from defects in materials and workmanship for a period of 90 days after the date of purchase. Lite Machines will repair or replace (at its option) any defective part, and supply any missing part at no charge to the Purchaser within this period. Lite Machines makes no other warranty, express or implied. This warranty does not apply to parts damaged by improper assembly, modification, abnormal service or handling, or crashes.
2. To take advantage of this warranty the Purchaser must provide proof of purchase, receive a return authorization (RA) number from Lite Machines, and ship any defective part (at Purchaser's expense) to Lite Machines for repair or replacement. Shipments of warranted parts back to Purchaser will be made by common carrier standard service. Over-night, expedited or priority service requested by Purchaser will be at Purchaser's expense.
3. It is the responsibility of the Purchaser to properly assemble, maintain, and operate this helicopter in accordance with manufacture's instructions, AMA (Academy of Model Aeronautics) safety codes, local laws and ordinances, and **COMMON SENSE**. It is also the responsibility of the Purchaser to **ALWAYS WEAR APPROPRIATE EYE AND HEARING PROTECTION** when operating this helicopter, and never to operate this helicopter in any way which might endanger persons or property including the Purchaser. The Purchaser is advised to carry appropriate liability insurance such as that commonly provided to modelers by the Academy of Model Aeronautics.
4. **THIS WARRANTY SPECIFICALLY EXCLUDES THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE.** The selection of this helicopter for a particular application or use (beyond hobby/entertainment) is the sole responsibility of the Purchaser. Any advice supplied by any representative of Lite Machines pertaining to any particular application is given freely as an opinion and is not meant to bind Lite Machines or in any other way modify this warranty. Since Lite Machines has no control over

the assembly or use of this product, and since operation of a helicopter is affected by various conditions such as engine power, local elevation and air temperature, Lite Machines cannot guarantee specific performance figures.

5. Notwithstanding the paragraph above, this warranty is in addition to whatever implied warranties may be granted to the Purchaser by law. To the extent permitted by law, all implied warranties, including the warranties of merchantability and fitness for a particular purpose, are limited to a period of one (1) year from the date of purchase. Some states do not allow limitations on how long an implied warranty lasts, so the above limitation may not apply.

6. This warranty shall be the sole and exclusive remedy available to the Purchaser. Correction of defects, in the manner and for the period of time specified above, shall constitute complete fulfillment of all liabilities and responsibilities of Lite Machines to the Purchaser, and shall constitute full satisfaction of all claims, whether based on contract, negligence, strict liability or otherwise. Lite Machines shall not be liable for any costs or expenses incurred in the replacement of any defective or non-conforming parts, and **IN NO EVENT SHALL LITE MACHINES BE LIABLE FOR INCIDENTAL OR CONSEQUENTIAL DAMAGES, OR ANY DAMAGES DUE TO THE USE OR INABILITY TO USE THIS PRODUCT**. Lite Machines shall not be liable, or in any way responsible, for any damages related to modifications, repairs, attempted repairs, or crashes. **IN NO EVENT SHALL LITE MACHINES' OBLIGATIONS TO THE PURCHASER EXCEED THE ORIGINAL PURCHASE PRICE PAID BY THE PURCHASER TO LITE MACHINES**.

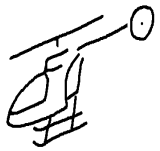
7. Some states do not allow exclusion of incidental or consequential damages, so the above exclusion may not apply. This warranty gives the Purchaser specific legal rights. The Purchaser may also have other rights which vary from state to state.

8. This warranty shall be governed by the laws of the State of Indiana, USA, and any action related to this warranty shall be brought within the jurisdiction and boundaries of the state of Indiana, county of Tippecanoe.

9. No modification or amendment to this warranty will be effective unless reduced to writing and signed by an authorized representative of Lite Machines Corporation.

If you do not understand any aspect of this warranty you may contact Lite Machines for clarification. **IF YOU DO NOT AGREE WITH ANY ASPECT OF THIS WARRANTY, RETURN YOUR UNASSEMBLED HELICOPTER TO YOUR PLACE OF PURCHASE FOR A REFUND.**

Lite Machines believes that information contained within its published materials is accurate as of the date of publication and is not responsible for inadvertent errors or omissions. Lite Machines reserves the right to make changes and improvements in its products without notice.



Model Helicopter Safety

This section contains important safety information regarding proper handling of model-engine fuel and operation of the Lite Machines *Model 110* helicopter.

Fuel Safety

1. Use **ONLY** commercial fuel developed for model engine use. **NEVER USE GASOLINE, DIESEL, OR ANY OTHER FUEL!** These fuels will ruin model engines, and can explode and burn causing injury to **YOU** and **OTHERS.**
2. **DO NOT OPERATE MODEL ENGINES INDOORS!** Hot engine parts and exhaust could ignite carpeting, drapery or furniture. Engine exhaust also contains large amounts of unburned oil that will soil interior furnishings.
3. Never fuel or prime with the glow-plug battery connected to the engine. Sparks from the electrical connection could start a fuel fire.
4. Never fuel, prime, or operate your model while smoking.
5. Store fuel in a cool dry place protected from sunlight and from potential ignition sources (anything burning, or anything that could start a fire if exposed to fuel such as shorting or sparking battery terminals or the furnace in your home).
6. Remove excess fuel from your model with a cloth after refueling or priming. Raw fuel can damage paint and is a potential fire source.
7. Do not store fuel in your model.
8. Fuel is poisonous and can cause death or blindness if swallowed. If swallowed, induce vomiting and call for medical assistance immediately.
9. Fuel is an eye irritant. In case of contact with eyes, flush thoroughly with water.
10. Raw fuel will damage certain types of plastic. Prescription plastic lenses and the clear plastic commonly used on radio transmitter meters will be damaged if exposed to raw fuel (such as droplets sprayed from the engine during starting). Wipe off immediately using spray window cleaner.

IF FIRE SHOULD OCCUR:

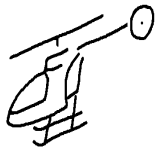
1. Model fuel burns with a nearly **INVISIBLE FLAME, BE VERY CAREFUL!**
2. Use a fire extinguisher, or smother fire with a **CLEAN**, heavy cloth. If fire persists, **GET AWAY!** Better to lose the model than risk severe burns.

Flight Safety

1. **ALWAYS WEAR APPROPRIATE EYE PROTECTION WHEN OPERATING YOUR MODEL.** Fuel droplets, loose parts, and airborne debris ejected from your model could cause serious injury or blindness. Select comfortable, well-fitting eye wear with high-impact resistance such as shop glasses. Prescription glasses made of glass are dangerous because they could shatter if struck sharply.
2. **ALWAYS WEAR APPROPRIATE HEARING PROTECTION WHEN OPERATING YOUR ENGINE.** Many car, airplane and helicopter modelers ignore the sound produced by the engines on their models. High volumes and high frequencies produced by model engines can damage hearing. This damage can be cumulative. Ear-phone and ear-plug style hearing protectors (sold in sporting goods stores in the gun section) are inexpensive and effective at reducing the most damaging and annoying qualities of engine sound. Once your model is started and flying, hearing protection is usually not necessary.
3. **NEVER STAND OR PLACE YOUR EYES OR FACE IN-LINE WITH ROTATING MAIN ROTOR OR TAIL ROTOR BLADES**. Loose parts or debris thrown outward from rotating rotors could cause injury or blindness.
4. **NEVER, EVER FLY NEAR OR OVER PEOPLE**. Always keep your model at a safe distance from yourself and spectators.
5. Use only those model engines designed specifically for the *Model 110* helicopter. Use of more powerful engines (such as racing engines) is potentially dangerous and will void all warranties.
6. Do not use fuel containing more than 35% nitromethane. The added power and heat of high nitro fuels can damage both the engine and your model.
7. Never allow main rotor speed to exceed 2000 RPM (as by operating with blade pitch set too low, or using a high powered engine with high nitro fuel). Rotor parts could separate from the rotor head and cause serious injury or property damage. Very high speeds can also damage the engine.
8. Fly only at approved flying fields or in open areas away from people and property. Do not fly in residential areas.
9. Before turning on your radio, ensure that your radio frequency is not already in use. Flying clubs have organized frequency sharing procedures.
10. Range check your radio prior to the first flight of each day. If your range check is lower than normal, do not fly.
11. Prior to the first flight of each day, check all mechanics for smooth, unobstructed operation. Before the main rotors reach flying speed, gently move all flight controls and confirm proper function. Do not fly if anything is out of the ordinary.
12. Check for hidden damage after crashing, and replace any damaged components.
13. Beginners should have the main rotors tracked, and model adjusted for flight by an experienced modeler.

General Safety

1. Periodically check tightness off all bolts, nuts, set screws and pins. Loose parts could be ejected from your model causing injury, or causing the model to crash.
2. Replace broken or worn components with original parts only. It is important to locate and understand the cause of failure (including pilot error) to prevent recurring problems.
3. Never modify any part of the main rotor or tail rotor systems or drive train. Modifications could lead to part failure.
4. Always replace the main and tail rotor blades in sets if damaged.
5. Do not store your model in direct sunlight. Prolonged exposure to ultraviolet light can weaken some types of plastics.
6. When flying in very cold conditions be aware that metals and plastics (even flexible ones) can become brittle and break or shatter.
7. Keep your model, radio and field equipment clean and in good repair. While cleaning and maintaining your model you can often find and fix potential problems before they occur (such as loose or damaged parts).



Requirements

This section lists the equipment, tools and materials needed to assemble and operate the Lite Machines *Model 110*™ helicopter. Note that a specialized helicopter radio and electronic gyro are not required. Although helicopter radios may be used, they are usually more expensive than airplane radios and do not appreciably improve the flying qualities of the *Model 110* helicopter.

Federal law requires that radio controlled model aircraft use specific radio frequencies. Check with your hobby dealer or local club to find a radio frequency within the appropriate band that is not popular with other fliers in your area (since two aircraft cannot fly on the same frequency simultaneously), and is not subject to local interference (some phone pagers may cause interference).

Radio

1. Standard four (4) channel airplane-style transmitter (Hitec *Focus 4H Micro*, Futaba *Attack*, Airtronics *Vanguard*, JR *F400* etc.. Most radio manufacturers normally supply servo mounting hardware and extra servo control arms.)
2. Four (4) **MICRO** servos (Hitec *HS-80/HS-81*, Futaba *3101*, Airtronics *94501*, JR *341*, etc.)
3. 250 mAh to 600 mAh battery pack, flat style
4. 2-piece Dean's antenna (This short whip-style antenna replaces the long wire antenna on the radio receiver. Long antennas used on airplanes get tangled in the rotor blades of the *Model 110* helicopter.)
5. Servo mounting hardware (if not supplied by radio manufacturer)
6. 3" x 6" x 1/4" latex foam rubber sheet (to protect the receiver from vibration and minimize crash damage)
7. Two small plastic bags (to protect the receiver and battery from dirt and oil)
8. Newspaper rubber bands (to secure radio battery and receiver)

Engine and Fuel

1. Norvel *Vmax-6* helicopter engine (The *Vmax-6* has special cylinder porting and a carburetor venturi sized for easier starting. Do not use super-revving racing engines such as the Norvel *AME*. Racing engines are too powerful and run too fast for the *Model 110* helicopter, and can dangerously over-drive the rotor system. The *Model 110* helicopter is not warranted for use with any engines except for the Norvel *Vmax-6).*
2. Lite Machines *SpiraLite Speed*™ or Norvel *Freedom XL* glowplug

3. Small fuel filter (Do not fly without a fuel filter or pre-filtered fuel. A clogged carburetor jet can cause the engine to stop in flight.)
4. Commercial model engine fuel containing castor oil or a castor/synthetic oil blend and 15% to 25% nitro methane such as Norvel *NVX* or Morgan's *Omega* fuels (Do not use Morgan's *Cool Power* fuel which contains only synthetic lubricant. Some synthetic oils break down at high temperatures, and their use may lead to engine damage. Also, do not use Byron's or Powermaster fuels made for large engines. These fuels have additives that will foul the glow plug on the *Vmax-6*. If you like Byron's fuels, use Byron's *1/2A Blend*. Use lower nitro fuel when flying at elevations near sea level, and higher nitro fuel at high elevations. A pint is enough for about 8 flights.)

Field Equipment

1. Electric starter with reversible rubber starter cone
2. 12 volt battery and charger for electric starter
3. Lite Machines *Lil' Squeezer* fuel system or fuel pump (Do not use a rubber fuel bulb or a syringe with a rubber plunger to transfer fuel because the rubber will contaminate the fuel and foul the glow plug on Norvel engines)
4. DuBro *Kwik-Klip* glow plug starter
5. Paper towels and spray cleaner (Model fuel contains lubricating oil which is exhausted by the engine and coats everything. *Fantastik* all purpose cleaner works well as an oil remover.)

Building Supplies

1. Thin cyanoacrylate (CA) glue, ½ oz. (Fast setting thin CA glue is used for quickly joining wood parts and sometimes finger tips. Use CA glue specially formulated for hobby applications, such as *Instant Jet* by Carl Goldberg Models. Do not use regular Super Glue purchased at a grocery store.)
2. Thick cyanoacrylate (CA) glue, ½ oz. (Slow setting thick CA glue can fill small gaps and form fillets, and allows time to reposition parts after gluing. *Super Jet* medium viscosity by Carl Goldberg Models works well.)
3. CA accelerator (Accelerator hardens CA glues instantly)
4. Liquid thread-lock for securing bolts and set screws (Use only anaerobic thread locking compound such as *Devcon* and *Loctite* brands made for metal screws. *Loctite* "blue" formula works well. Do not use *Loctite* "red" formula because it is almost permanent and makes setscrew removal and adjustment difficult.)
5. Synthetic grease (*Lite Lube Grease* is recommended, 1/4 oz will last for many years)
6. Lube oil with needle oiling tube (*Lite Lube Heavy Oil* is recommended, 14.9 ml will last for many years.)

7. Masking tape
8. X-Acto knife with #11 blades
9. Needle-nose pliers
10. Standard hand pliers
11. Soldering iron and solder (borrow these from a friend if you don't have them)
12. Pencil
13. English ruler (Queen Elizabeth)
14. Paper clip (for radio switch extension)
15. Scissors
16. Newspaper rubber bands (to secure radio receiver and battery)
17. Electric drill and drill bits
18. Hammer (A hammer is required to gently tap pins into some plastic parts. It is also useful when things go hopelessly wrong and instant gratification is desired.)
19. Small phillips screwdrivers (for installing radio components, jeweler's style works best)
20. Small flat-head screwdriver (for adjusting needle valve on engine)
21. Fuel-proof dope or paint (Dope is best for fuel-proofing wood parts because it soaks into wood, dries quickly and is harder than most paints. Buy one large spray can, or one small jar of color and one jar of dope thinner. Dark colors cover wood grain and hide dirt and oil better than light colors.)
22. ½" camel hair paint brush (if necessary for applying dope)
23. Building surface (a 4 foot by 3 foot flat, uncluttered work surface is sufficient)

General Building Guidelines

Assembling a model helicopter can be a lot of fun. As you build your Lite Machines *Model 110* helicopter you will observe the function of each part and subassembly, and develop a feel for mechanical systems in general. It is important to build your own *Model 110* so that you know how to maintain and repair it. For more technical information on how helicopters work, refer to the *How Helicopters Work* section of the Operator's Guide.

Most parts of the *Model 110* are designed to assemble in only one way, so assembly is easy. In some cases, however, parts can be assembled upside-down or backwards. As much as possible, the instructions will warn you about incorrect assembly, so read each assembly instruction entirely and study the drawings before performing each assembly step. When you have completed an assembly step, mark the check-off box by the step number to keep track of your progress.

Review this entire *Model 110* Construction Manual and the *Model 110* Operator's Guide before starting assembly. The beginning of this Construction Manual contains a list of required tools and materials. Follow all building steps carefully, and make no modifications or "improvements". Modifications can reduce performance or lead to part failure. Remember, proper assembly and safe operation of your *Model 110* helicopter are your responsibilities.

Friction and Binding

For the best flight performance, it is important that all mechanical linkages move very freely. The servos in the *Model 110* must actuate several interconnected pushrods, control arms and ball-links to control the main rotor and tail rotor. Even small amounts of friction or binding in the linkages can affect flight performance. Friction and binding often cause problems that are difficult to diagnose, especially for beginners.

Fig. 4-1 shows a simplified linkage system with a servo and several interconnected linkages. Tight ball-links, rubbing pushrods, dragging control arms and jammed parts are all sources of friction and binding. Even if each link produces only a small amount of friction, the total friction produced by a long chain of links can be substantial. This friction can stall the servo, or cause it to perform erratically. Friction and binding can also prevent small servo movements from reaching the main rotor or tail rotor where they are needed for precise control when hovering.

In addition to link friction, molding "flash" (the thin plastic ridge produced by the mold seam-line) sometimes interferes with the operation of moving plastic parts. Molding flash must be removed with sandpaper or a hobby knife.

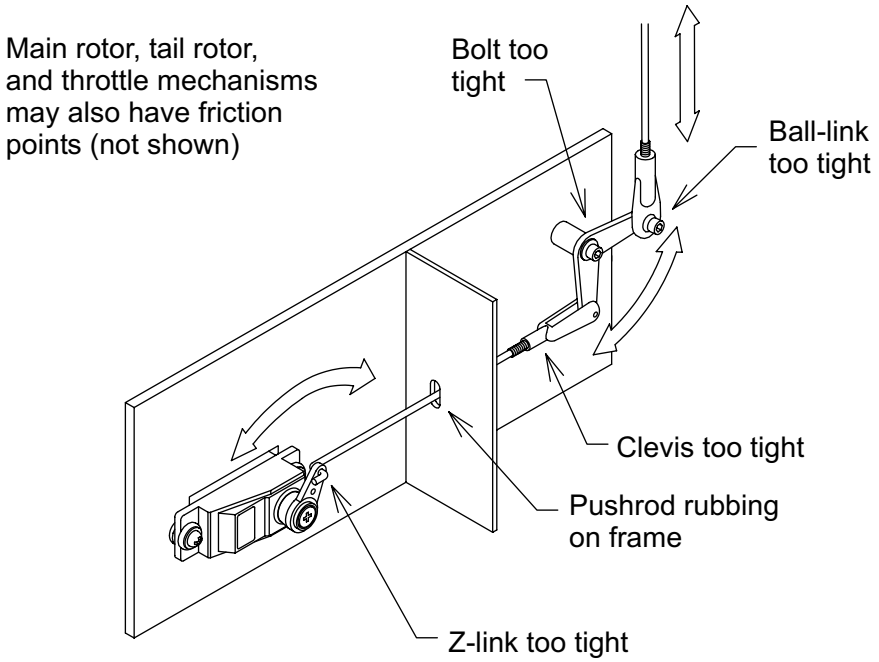


Figure 4-1.

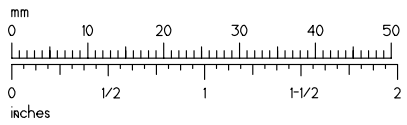
As you assemble moving parts and linkages, make sure that each assembly operates smoothly and without binding. If parts do not operate smoothly, locate the problem and correct it before proceeding to the next assembly step. It is much easier to solve friction and binding problems as you build the *Model 110* than after it is entirely assembled.

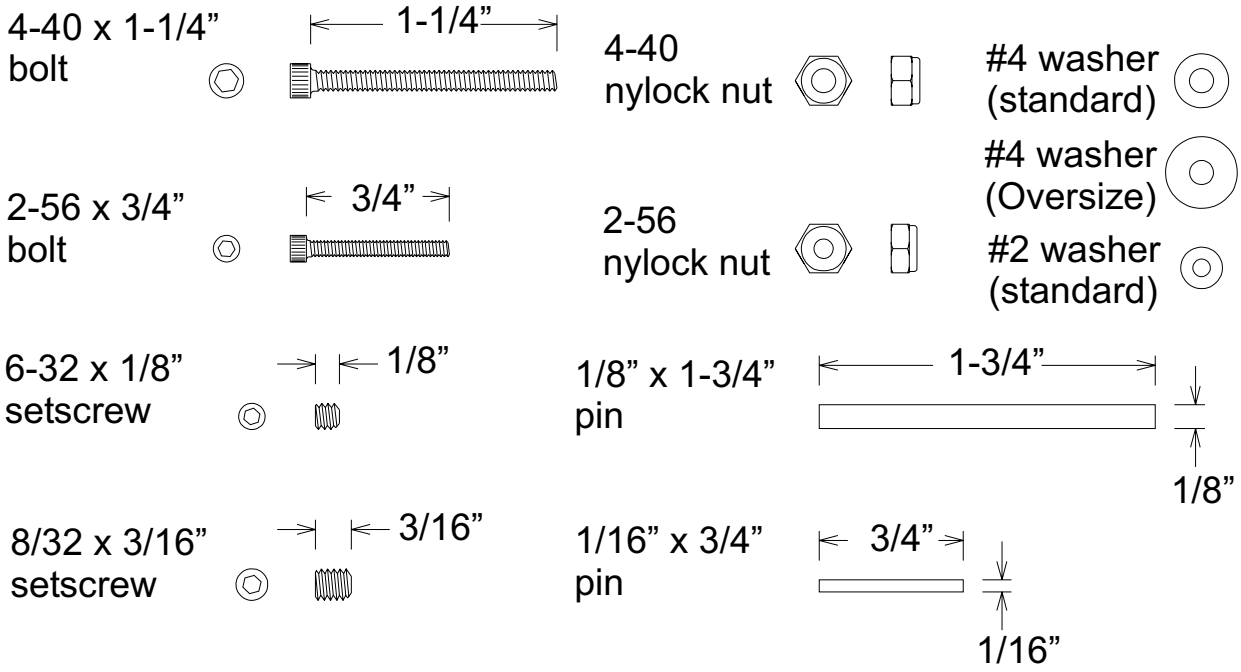
Balance of Rotating Assemblies

Proper balance of rotating assemblies (like the main rotor and tail rotor) is as important as minimizing linkage friction. Out-of-balance components cause vibration that wastes engine power and can lead to bearing and radio problems. Carefully balance all rotating assemblies as described in the instructions.

Fastener Identification

The English system of identifying bolts and screws involves three basic descriptive numbers: bolt size, number of threads per inch, and bolt length. For example, a 4-40 x ½" bolt is a number 4 bolt with 40 threads per inch that is ½ inch long. The same identification system applies to setscrews. Fig. 4-2 shows several examples of nuts, bolts, washers and setscrews at full size. Notice that bolt length does not include the bolt head, while setscrew length refers to the entire setscrew.





Note: All parts shown full size

Figure 4-2.

Nuts of a certain size and thread fit bolts with the same size and thread. For example, 4-40 nuts are used only with 4-40 bolts. Some nuts have a small nylon insert to keep them tight against vibration. These nuts are called nylock nuts. All nuts used on the *Model 110* are nylock nuts. Fig. 4-2 shows both 4-40 and 2-56 nylock nuts.

Several different washer sizes are used on the *Model 110*. For instance, standard number 2 washers are used with 2-56 bolts and nuts, and standard number 4 washers are used with 4-40 bolts and nuts. Oversized number 4 washers are usually used against wood surfaces. A few assemblies require special washers. These washers are labeled in the drawings. See Fig. 4-2 for full size drawings of standard and oversize washers.

Many hardened-and-ground steel dowel pins are used in the *Model 110*. Pins are described in terms of their diameter and length. For example, a 1/16" x ½" pin is 1/16 inch in diameter and ½ inch long. Fig. 4-2 shows several examples of pins.

Crutch

The crutch is the primary structure or backbone of the Model 110 helicopter. All major mechanical assemblies and radio components are fastened to the crutch. It is the only part of the Model 110 that requires fuel-proofing with dope or paint, and is built first to allow time for the dope to dry before attaching other assemblies.

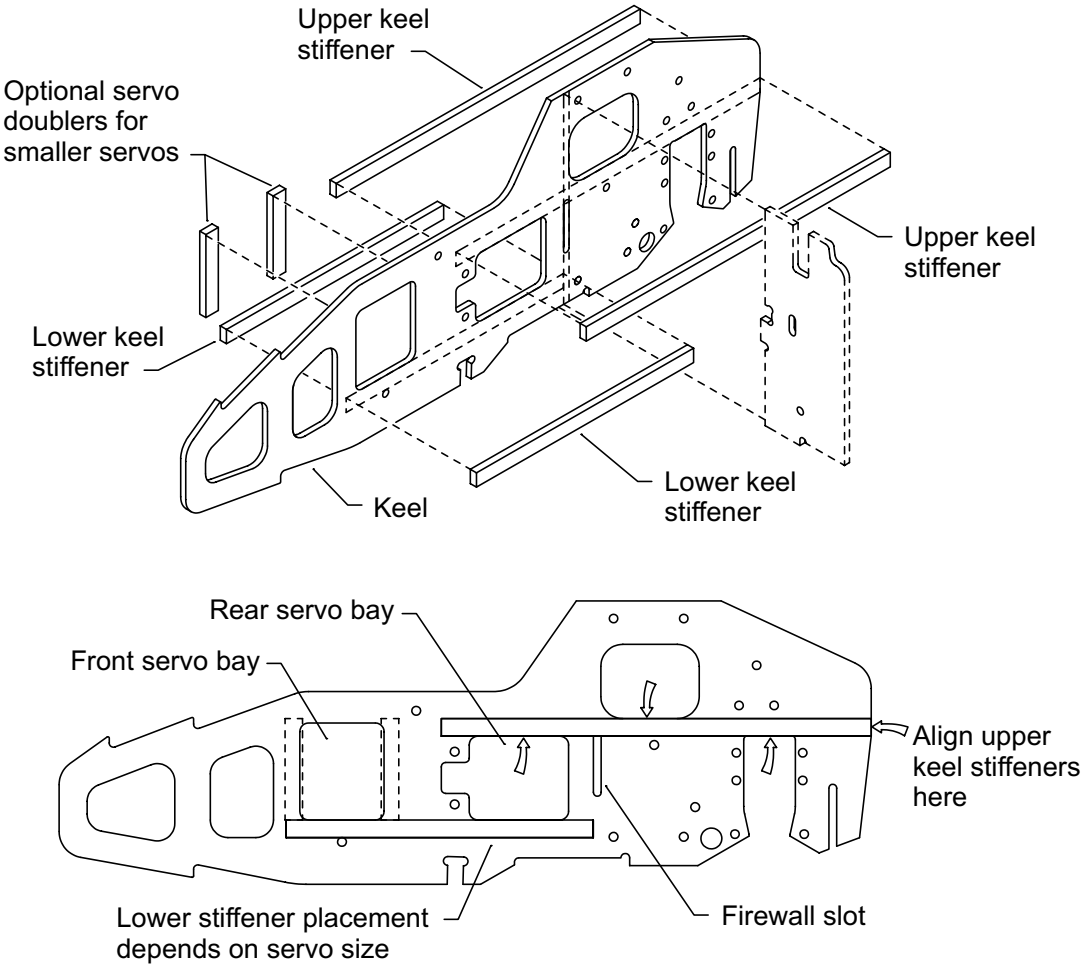


Figure 5-1.

❑ 1. Clear off a 4ft x 3ft (1.2m x 1m) area on a table or bench to use as a building area. Cover your building area with 10 to 15 sheets of newspaper to protect the surface from glue drips and knife cuts. Collect the building supplies listed in the front of this manual and locate the *Tools Bag* supplied in the kit. Keep building supplies and tools nearby as you are building.

❑ 2. Remove all wood parts from their packaging and sand lightly with medium (220 grit) sandpaper (supplied in the *Tools Bag*). Remove any sanding dust with a cloth or several pieces of masking tape (wrap the tape sticky-side-out around two fingers and roll over the wood surfaces).

Note:

Wood parts are assembled with CA glue. To apply thin (instant) CA glue, hold two close-fitting parts together in the exact position desired, and soak the joint with glue. The parts will be bonded almost instantly and cannot be repositioned. The parts may also stick to your fingers. If this happens, don't panic. Gently pry your fingers from the parts, the oil in your skin will eventually cause the glue to peel off (finger-nail polish remover can also soften CA glue). CA glues also produce fumes as they harden. Work in a well ventilated area and avoid holding your head above the glue joint. **CA FUMES WILL STING YOUR EYES AND CAUSE THEM TO WATER JUST AS CUTTING AN ONION WILL.**

❑ 3. Lay the plywood keel flat on your work surface. Align one 6-1/8" (156mm) upper keel stiffener (made of 1/8" x 1/4" spruce stick) on the keel as shown by the curved arrows in Fig. 5-1. Once aligned, tack-glue the ends of the stiffener to the keel with a few drops of thin CA glue. Check the alignment again. If aligned incorrectly, pull the stiffener off and reposition it.

❑ 4. Flip the keel over and repeat the previous step with the other upper keel stiffener.

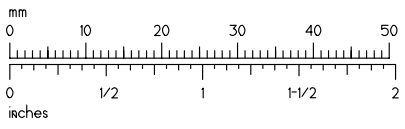
❑ 5. For the next building step locate the 4-1/4" (109mm) lower keel stiffeners (made of 1/8" x 1/4" spruce stick), and a servo to test fit in the rear servo bay. Install rubber grommets (supplied with the servos) into each of the servo mounting arms as shown in Fig. 5-3 (on page 5-4).

Note:

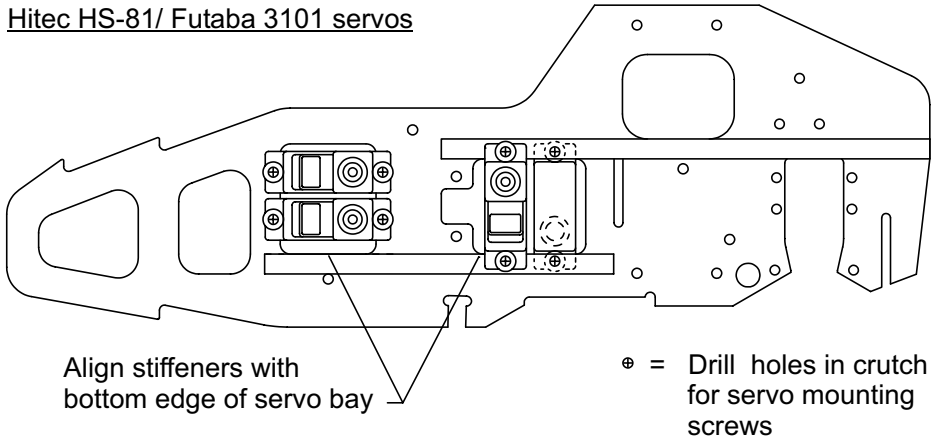
Before gluing the lower keel stiffener to the keel, study Fig. 5-2 and Fig. 5-3. The servo bays are designed to fit Hitec HS-81 micro servos with the upper edges of the lower keel stiffeners are aligned with the lower edges of the servo bays. For smaller servos such as the *JR 341* and *Airtronics 94501*, the lower keel stiffeners must be raised slightly (about 1/16" or 1.5mm) as shown in the bottom half of Fig. 5-2. The upper and lower stiffeners must be far enough apart to allow servos to be inserted into and removed from the rear servo bay. If the stiffeners are too far apart, however, the servo mounting screws will split the wood on the edges of the servo bays and will not hold the servos in place.

❑ 6. Press one firewall half into the keel slot as shown in Fig. 5-1 for use as an end stop. Position the lower keel stiffeners horizontally against the firewall. If you have a Hitec radio system, position the stiffeners vertically against the lower edges of the servo bays and hold them in place with a few pieces of masking tape. If your radio system has smaller servos, place the stiffeners 1/16" (1.5mm) higher.

❑ 7. Insert a servo into the rear servo bay to check the fit (make sure that rubber mounting grommets are installed in the servo mounting flanges). Once you are satisfied that the lower stiffeners are positioned properly, tack-glue them to the keel with a few drops of thin CA and remove the firewall.



❑ 8. Insert and remove the servo again as a final check. If the stiffeners are not positioned properly, break them free, sand them clean, and repeat the previous step. In some cases, it may also be necessary to shave the sharp edges of the stiffeners slightly to prevent the servo wires from chafing against the stiffeners once the servos are mounted.



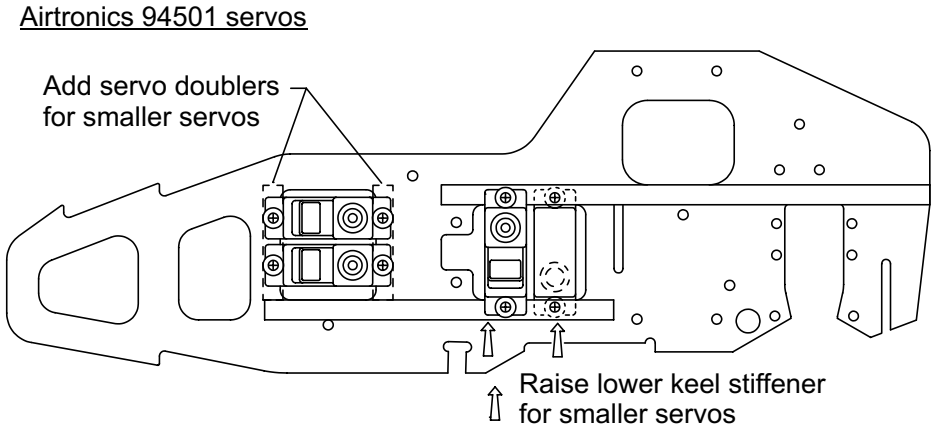


Figure 5-2.

❑ 9. Check the fit of your servos in the front servo bay. Much like the rear servo bay, the front servo bay must be wide enough to accommodate the servos, but small enough to prevent the servo mounting screws from splitting the wood. Hitec HS-81 servos should fit without any further modification. For smaller servos, you may need to add two 1-7/16 " (37mm) servo doublers made of 1/8" x 1/4" spruce as shown in Fig. 5-1 and the bottom half of Fig. 5-2. Position the doublers using a procedure similar to that for locating the lower keel stiffeners. Tape the doublers to the keel, check the servo fit, readjust the doublers and tack-glue the doublers to the keel.

❑ 10. Now that all stiffeners and doublers are positioned correctly, permanently attach each one to the keel by soaking all of the joints touching the keel with thin CA. Thin CA will soak underneath the stiffeners and doublers and form a strong bond. Continue applying thin CA until it no longer soaks into the joints. Watch out for glue drips, and avoid holding your head above the glue while it hardens.

❑ 11. In the following steps you will mark and drill pilot holes for the servo mounting screws. Insert all four servos into the servo bays as shown in Fig. 5-2. The sides of the servo cases should not touch the sides of the servo bays. If they do, vibration may damage the servos over time. Also allow at least 1/8" (3mm) gap between the servos so that they do not vibrate against each other. Insert a sharp pencil through the rubber grommet on each servo mounting arm, and mark the position of each servo mounting screw on the keel.

Hint:

To determine the correct drill size for the pilot holes, drill a practice hole in a piece of scrap keel stiffener material with a small diameter drill bit (about .050" or 1.3mm) and an electric hand drill. The diameter of the drill bit should be about half of the diameter of the servo mounting screws. Carefully screw in a mounting screw into the scrap material. If the test hole is the correct size, it will be difficult to turn the screw into the hole the first time, but the wood will not split. If the hole is too large, the screw will go in easily, but may not grip the wood and will probably pull out. Experiment with different drill bit sizes until you find the right one.

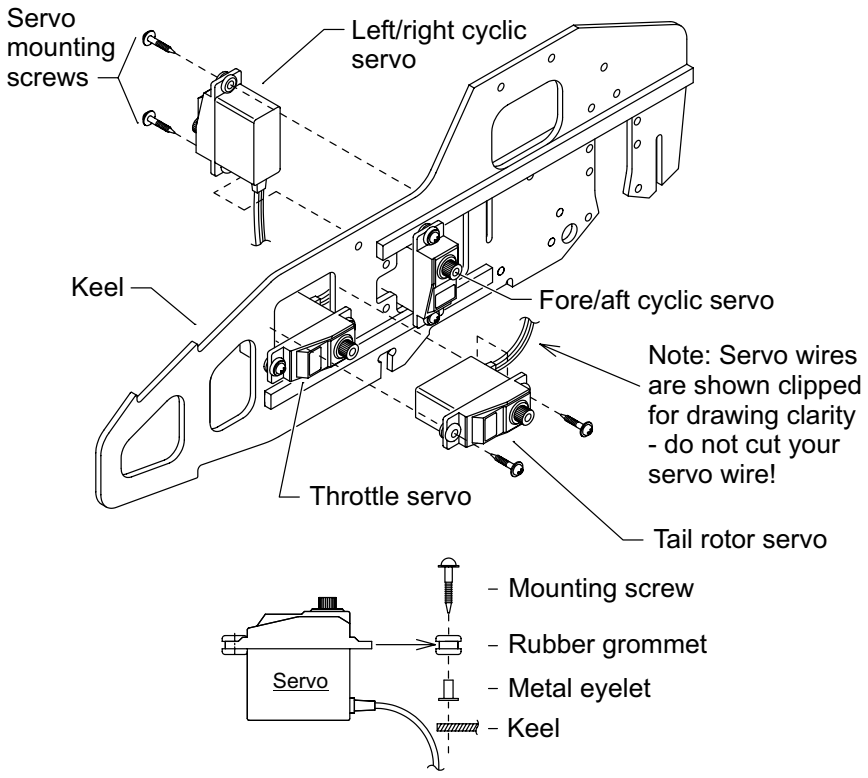
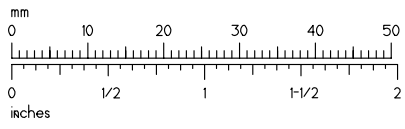


Figure 5-3.



❑ 12. After determining the correct size drill bit, drill all of the pilot holes marked in the previous step. Drill the holes completely through the stiffeners, doublers and keel. Mount the servos to the keel as shown in Fig. 5-3 (note that the left/right cyclic servo is mounted on the opposite side of the keel relative to the other servos) and install all servo mounting screws. If any screws split the wood, remove the servo and apply a drop of thin CA to the split area to repair the hole. Re-drill the repaired hole if necessary.

❑ 13. After you are satisfied that all servos are correctly mounted, remove them from the keel.

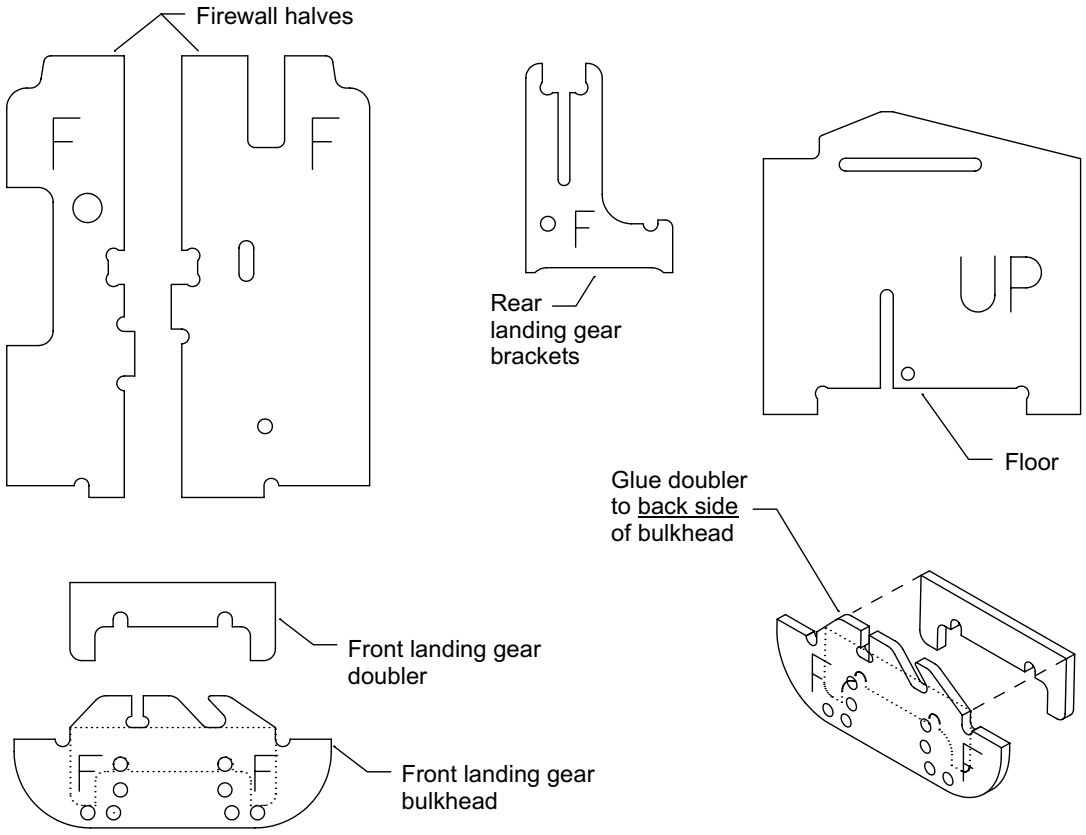


Figure 5-4.

❑ 14. As shown in Fig. 5-4, lay out the remaining plywood crutch parts flat on your work surface. Double check that all pieces are in the same orientation shown in the figure. Lightly mark an "**F**" (for "Front") on the firewall halves, front landing gear bulkhead, and rear landing gear bracket with a pencil. Write "**UP**" on the floor.

❑ 15. Apply thick (slow setting) CA to the front landing gear doubler and place the doubler on the **BACK SIDE** of the front landing gear bulkhead. Make sure the doubler goes on the **BACK SIDE.**

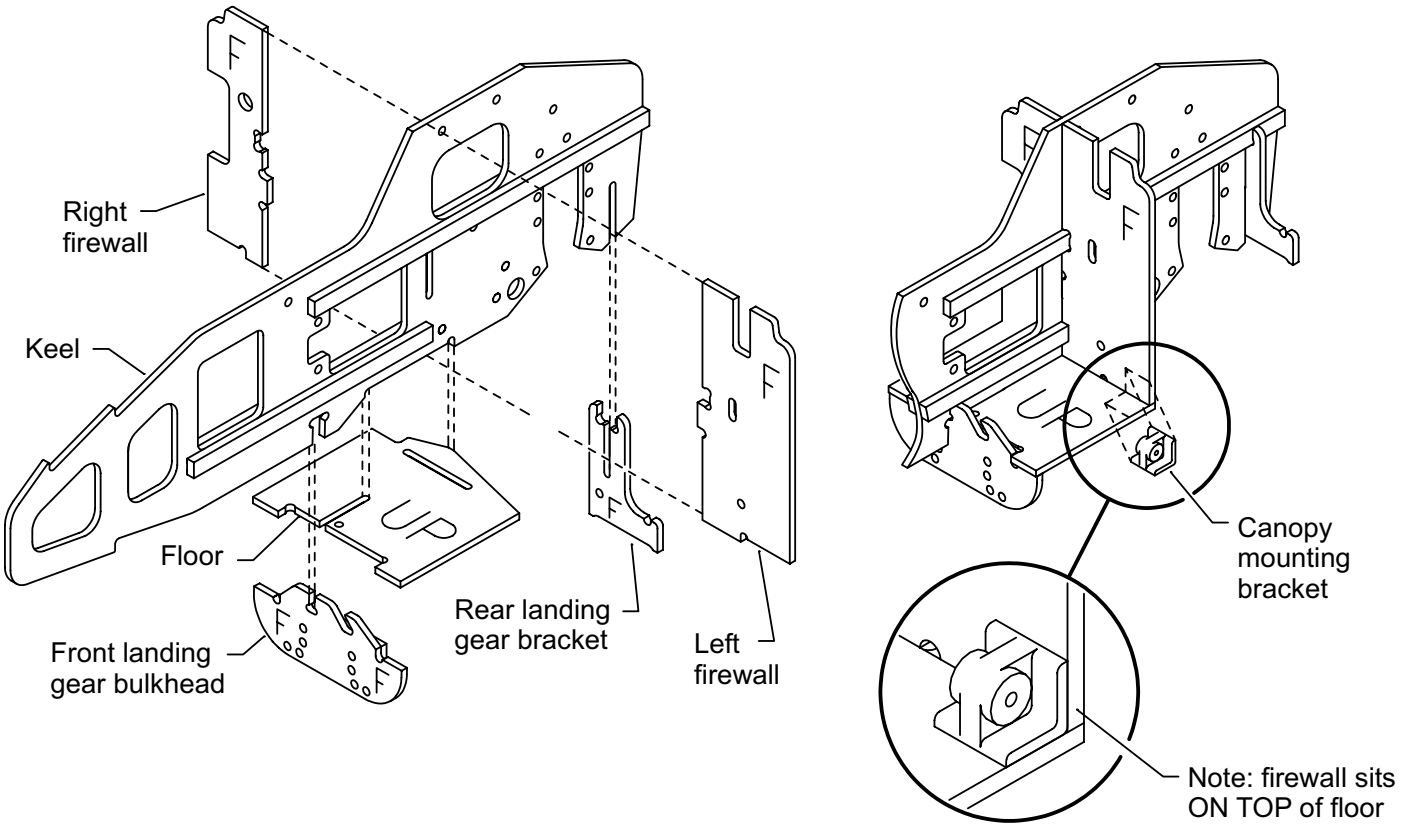
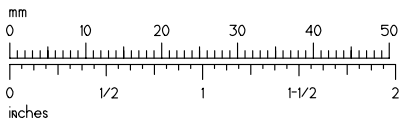


Figure 5-5.

- ❑ 16. In the following steps you will assemble the remaining parts of the crutch and glue them permanently together. To insure that all pieces are properly assembled and aligned, do not glue anything until instructed to do so.
- ❑ 17. Insert the right and left firewall halves into the vertical slot in the keel as shown in Fig. 5-5. Press the floor against the bottom of the keel and over the tabs on the bottom of the firewall halves. Slide the front landing gear bulkhead into the slot in the bottom of the keel and against the front edges of the floor. Make sure the **F**'s on the bulkheads face forward and the **UP** on the floor faces upward.
- ❑ 18. Slide the rear landing gear bracket into the slot at the rear end of the keel. Push the bracket and keel together until the upper end of the bracket is snug against the upper keel stiffeners (the lower edge of the bracket will not be even with the lower edge of the keel). Check from below that the bracket is square (90 degrees) with the keel.
- ❑ 19. Visually check the alignment and fit of all the pieces. Look at the parts from above, below, behind and each side. The firewall and floor should be at right angles (90 degrees) to each other and to the keel. Note that the front landing gear bulkhead actually slants forward at the bottom (by 1.5 degrees) and so will not appear square with the floor.



❑ 20. When convinced that all parts are properly aligned, tack-glue everything together with a single drop of thick CA on each joint (use CA accelerator to harden the CA drops instantly). Check the alignment again. If any part has shifted or is improperly aligned, gently break the appropriate glue joint and reposition the part.

❑ 21. Roughen the flat mounting surfaces of the canopy mounting brackets with coarse (120 grit) sandpaper. Permanently glue the brackets with thick CA at the intersection of the floor and firewall halves as shown in Fig. 5-6. The outer edges of the brackets should be flush with the outer edges of the firewall halves and floor.

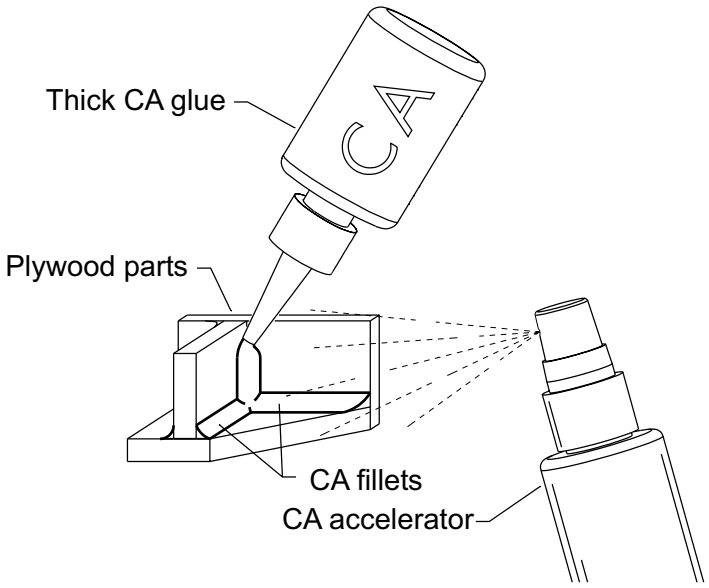


Figure 5-6.

Note:

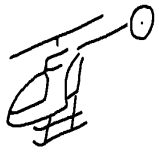
The strength of the crutch depends upon the thickness of the glue joints between the various parts of the crutch. As shown in Fig. 5-6, CA fillets are glue joints made with thick CA that smoothly bridge the gap or angle between two parts, greatly increasing the strength of the joint. For maximum strength, CA fillets should be no less than 1/16" (1.6mm) wide at the base, with 1/8" (3.2mm) being preferred for most joints. Spray or drop a small amount of CA accelerator onto the CA fillet to harden it instantly. **USE CA ACCELERATOR ONLY IN A WELL VENTILATED AREA**.

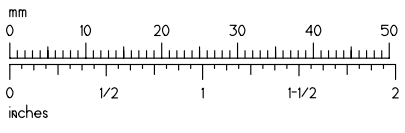
❑ 22. Now that the crutch is assembled, the next step is to reinforce all plywood joints with CA fillets. Work on one joint at a time. Apply thin CA to soak the joint, then apply thick CA along the entire length of the joint to form CA fillet between the parts. Spray a small amount of CA accelerator at the CA fillet from a distance of about 6" (150mm), and the fillet will harden in a few seconds. Be careful not make the fillets behind the left firewall too large or they will interfere later with the main rotor bearing blocks. Also avoid using too much accelerator since it will bubble even thick CA and weaken the joints.

❑ 23. Cover the canopy mounting brackets with masking tape, and apply fuel-proof dope or paint to the entire crutch to seal the wood from engine exhaust oil. Dope is highly recommended because it soaks into the wood and is generally harder than paint.

Hint:

If applying dope with a brush, apply one coat to all wood surfaces on the crutch and allow to dry for a few hours. Sand all surfaces lightly with fine (320 grit) sandpaper to remove any fuzz, and apply a finishing coat to all surfaces. Spray dope is much thinner than brushed-on dope. If using a spray can, apply four to six coats to all surfaces allowing 30 minutes between coats. Sand lightly with fine (320 grit) sandpaper after the second coat. Multiple coats, especially around the back end of the keel and under the floor, are necessary to protect the wood in these areas from fuel and oil. **DO NOT APPLY DOPE OR PAINT INDOORS, AND DO NOT BRING PARTS INDOORS WHILE DRYING. THE VAPORS ARE HARMFUL AND LINGER FOR HOURS. LET THE FINAL COAT DRY OUTDOORS OVERNIGHT**.





Canopy

The canopy is a streamlined plastic shell that protects the radio equipment from oil, dust and debris. On most model helicopters the canopy extends back to the main rotor shaft, but not all the way back to the tail rotor. This is commonly referred to as a pod-and-boom configuration (the pod being the canopy, the boom being the tube which supports the tail rotor). The canopy on the Model 110 helicopter is made of a fuel-resistant plastic that requires no painting. While easily repairable, it is meant to be discarded and replaced when it starts looking ragged after prolonged use and many crashes.

Note:

The canopy halves and reinforcements are removed from the plastic canopy sheet in two steps with a hobby knife. The first step involves scoring the plastic so that the knife blade does not wander on the second cuts. Use a new (sharp) knife blade for best results.

❑ 1. Lightly score the molded cut-lines on the canopy halves, canopy doublers and one seam reinforcement strip with a hobby knife as shown in Fig. 6-1. Do not cut completely through the plastic sheet at this time. Make sure to leave the 1/4" (6mm) edge projection on both sides of the canopy halves (this will be trimmed later with a scissors).

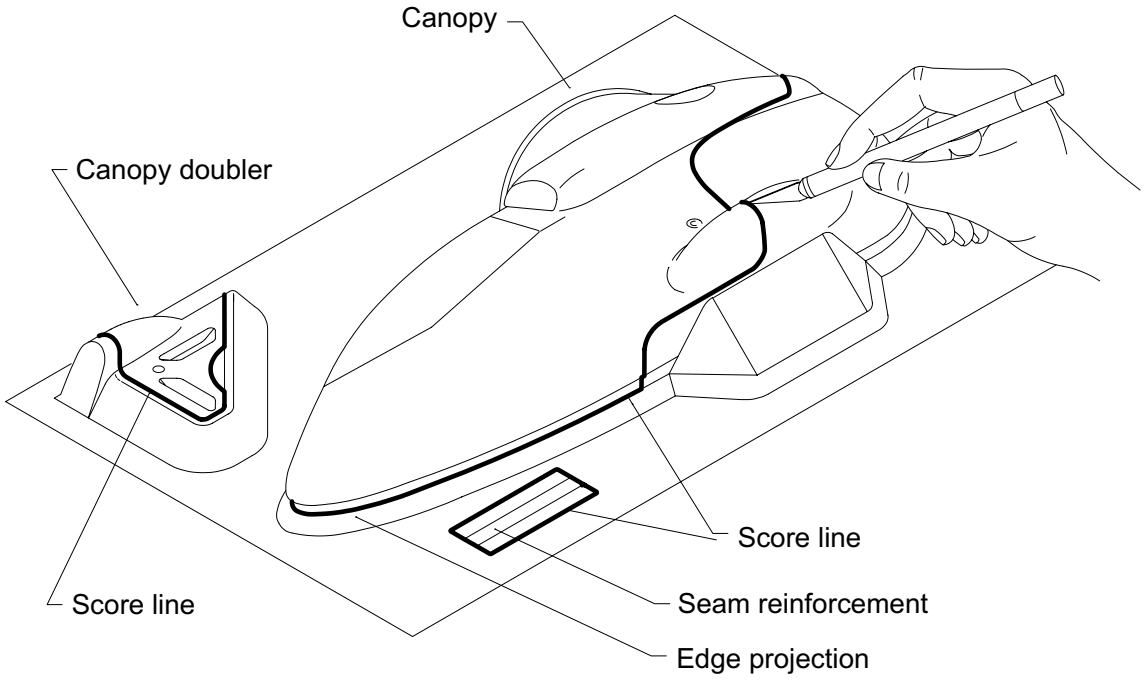


Figure 6-1.

❑ 2. Plunge cut all sharp corners of the canopy halves, canopy doublers and seam reinforcement strip with the tip of a hobby knife to separate the sharp corners from the plastic sheet as shown in Fig. 6-2.

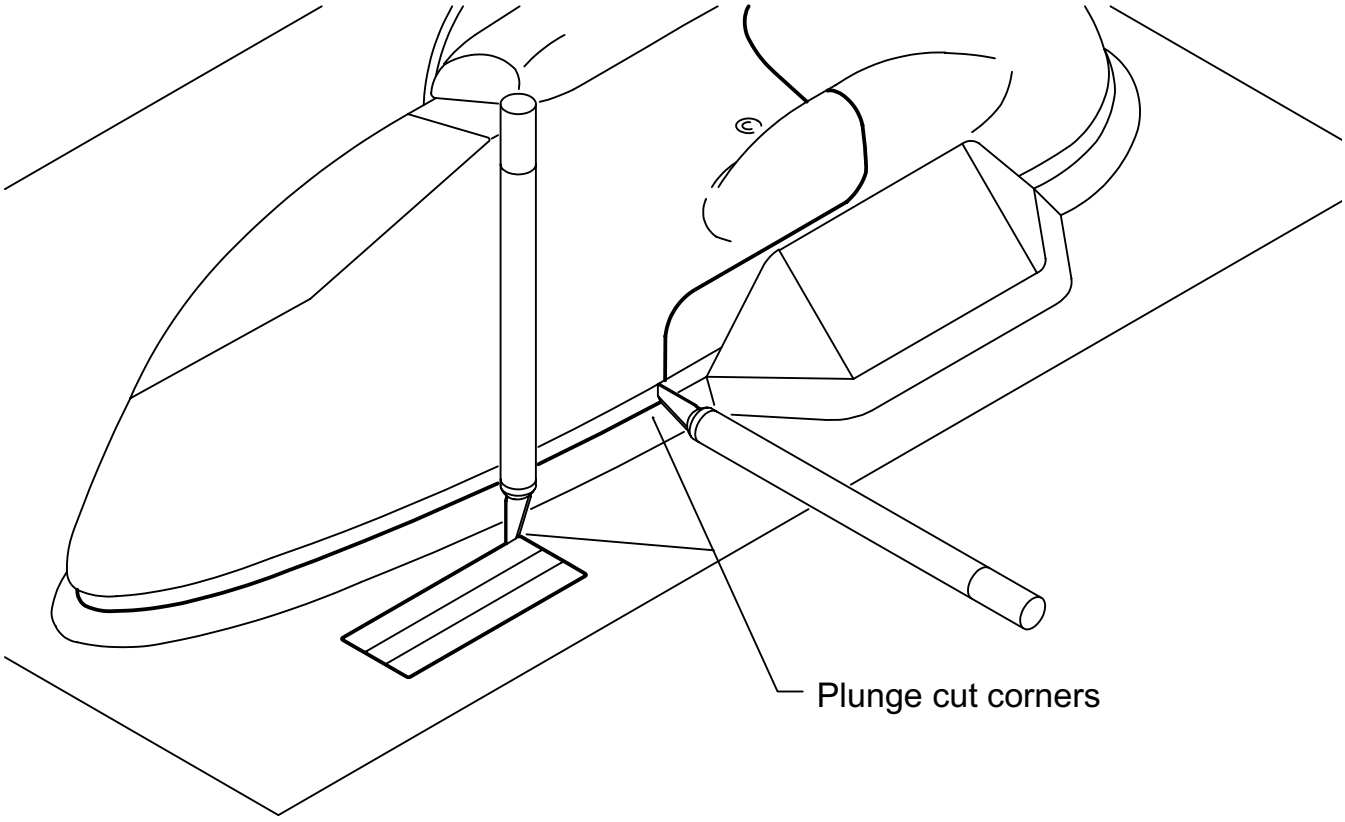
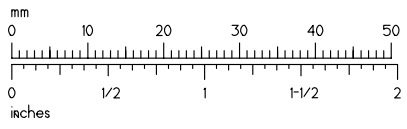


Figure 6-2.

❑ 3. Cut along each of the previously scored cut-lines and remove the canopy halves, canopy doublers and seam reinforcement strip from the plastic canopy sheet. Keep a long piece of scrap plastic for later use.

Hint:

The following steps require trimming the excess plastic from the canopy halves with a scissors. When cutting hard plastic, be careful not to cut with the tips of the scissor blades because they will crack the plastic. For best results cut with the middle of the blades as shown in Fig. 6-3.



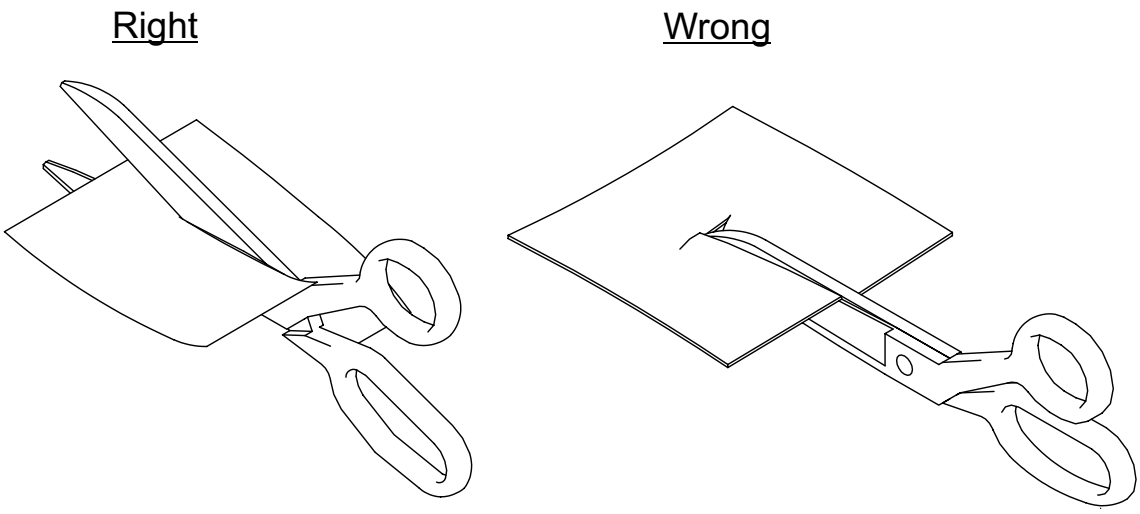


Figure 6-3.

❑ 4. Cut the edge projection off of the left canopy half with a scissors, and sand the inside edge with coarse (120 grit) sandpaper until the inside edge is flat as shown in Fig. 6-4. **DO NOT REMOVE THE EDGE PROJECTION ON THE RIGHT CANOPY HALF**. The right side edge projection fits inside the left canopy half and acts as a glue surface when joining the canopy halves.

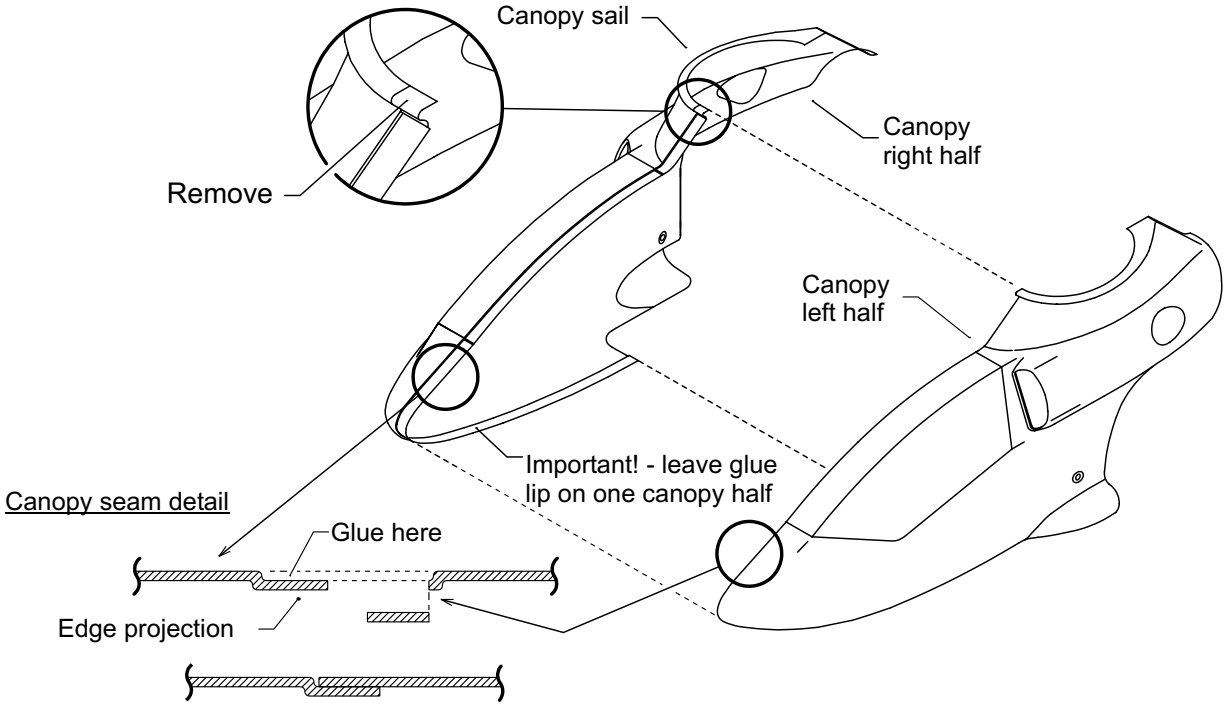


Figure 6-4.

❑ 5. Trim a small portion of the edge projection away from the top of the right canopy half as shown in the upper enlarged view of Fig. 6-4.

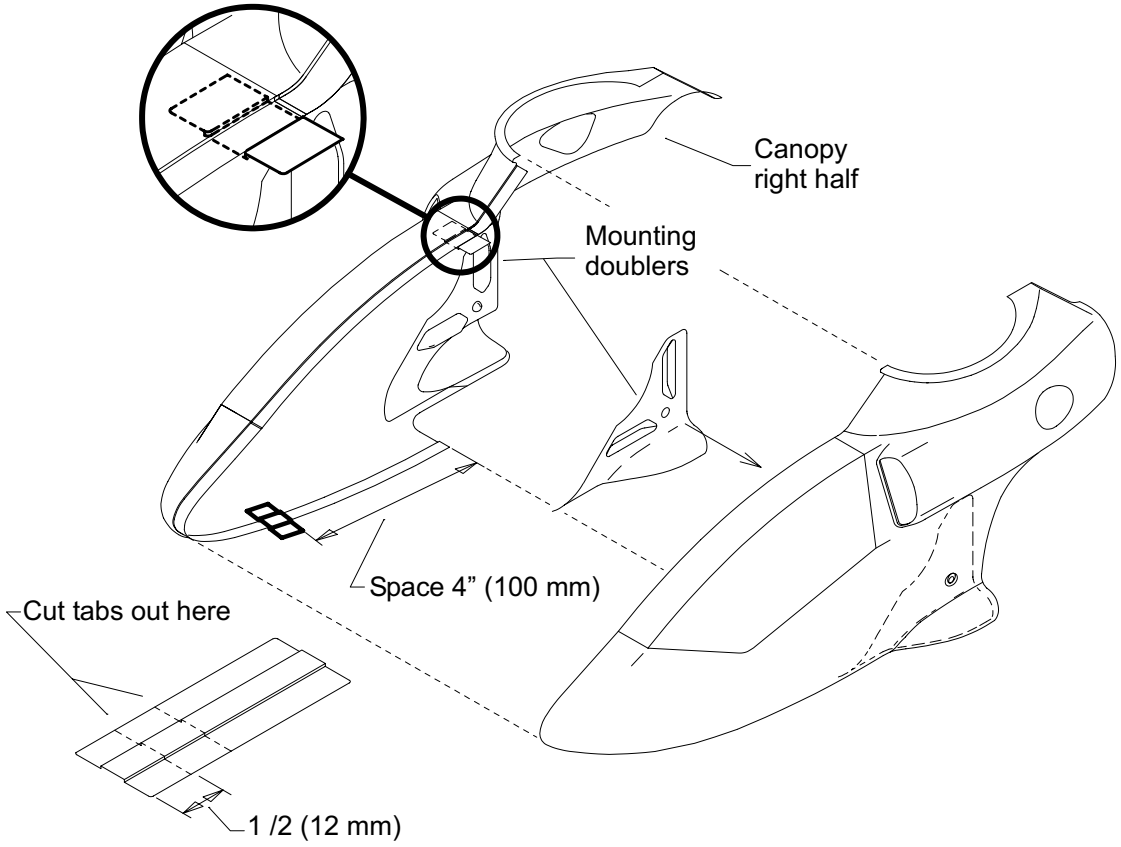


Figure 6-5.

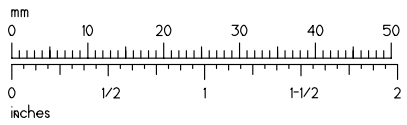
❑ 6. Trial fit both canopy doublers to the inside of the canopy halves as shown in Fig. 6-5, and trace around the doublers with a pencil. Note that the circular indents on the doublers should fit exactly over the circular outdents on the inside of the canopy.

❑ 7. Lightly sand the back of the doublers and canopy halves inside the pencil marks with coarse (120 grit) sandpaper to prepare the surfaces for gluing.

❑ 8. Sand the edge projection (glue strip) on the right canopy half, and the inside edge of the left canopy half with coarse (120 grit) sandpaper to prepare the surfaces for gluing. Also sand the areas that will lie under the seam reinforcements as shown in Fig. 6-5. There is no need to sand seam the area behind the seam reinforcements because this area will not be glued together.

Note:

Use only plastic-compatible CA glue to assemble the canopy. If you are unsure about the compatibility of a particular glue, test it on a piece of scrap plastic. Do not use glue that softens or cracks the plastic.



❑ 9. Hold the right canopy mounting doubler in position on the inside of the right canopy half. When properly aligned, apply thin CA glue around all of the edges of the doubler. Capillary action will pull the glue under the doubler and lock it in place. Hold the doubler and canopy together for about ten seconds while the glue sets. Avoid getting glue on your fingers since the glue will leave permanent fingerprints on the canopy. Repeat the procedure for the left canopy doubler.

❑ 10. Cut two ½" (12mm) pieces from the seam reinforcement strip. Note how the seam reinforcements sit on the inside of the canopy over the top of the seam as shown in Fig. 6-5. Sand the back of the reinforcements with coarse (120 grit) sandpaper to prepare the surfaces for gluing. Glue the reinforcements to the inside of the right canopy half as shown in Fig. 6-5.

❑ 11. Assemble the canopy halves with several pieces of a masking tape. The halves should align very closely. Carefully check the alignment of the window outlines and the fit at the nose. If the halves do not align properly, separate them, trim them with a scissors or sanding block and reassemble them. Repeat this procedure until they fit closely.

❑ 12. Hold the canopy at arm's length and visually check that it is not twisted or distorted. If it is twisted, repeat the previous step.

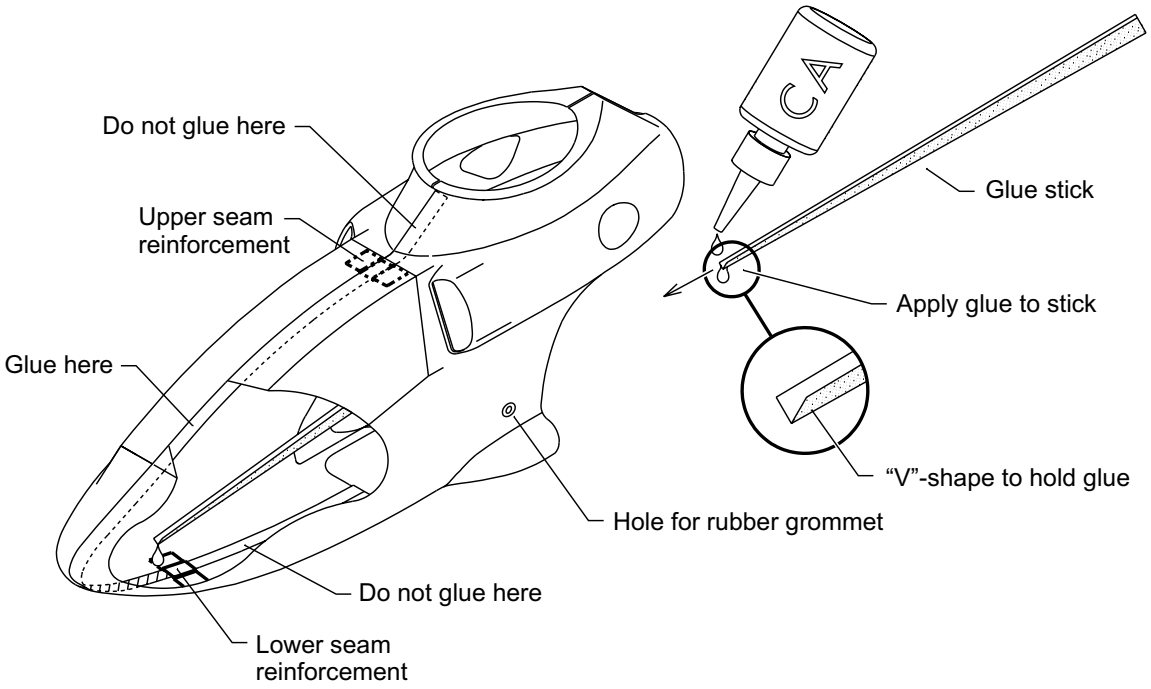


Figure 6-6.

❑ 13. Cut a 12" (30cm) strip of scrap canopy plastic, or a stick, to use as a glue dropper as shown in Fig.6-6.

Note:

The canopy on the *Model 110* is designed to flex open to reduce the possibility of cracking as it is installed around the main shaft. **DO NOT GLUE THE SEAM TOGETHER BEHIND THE UPPER AND LOWER SEAM REINFORCEMENT STRIPS.**

- ❑ 14. Apply a drop of thin CA glue to the end of the glue dropper. Reach the glue dropper down inside the canopy and touch the glue drop to the canopy seam and the seam reinforcement strips. Capillary action will drawn the glue into the seam and lock the canopy halves together. Note that the seam must fit tightly together for the glue to flow properly. Apply glue to the entire seam area in front of the seam reinforcement strips as shown in Fig. 6-6. Be careful not to apply glue near a piece of masking tape because the glue will seep under the tape and mar the canopy surface.
- ❑ 15. Allow the glue to set for about 15 minutes then remove any remaining masking tape. Roll a piece of coarse (120 grit) sandpaper around your finger, and sand all of the exposed edges of the canopy until smooth and even.
- ❑ 16. Carefully cut out the 1/4" (6mm) holes for the canopy mounting grommets with a sharp knife. Cut the holes undersize then enlarge them with a small piece of coarse (120 grit) sandpaper rolled into a tube.

Hint:

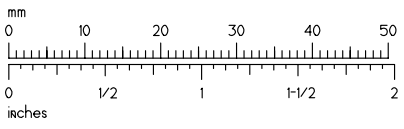
The *Model 110* canopy is designed to be decorated with decals, not paint. But if you choose to paint your canopy, use only fuel-proof paint (Pactra *Formula-U* polyurethane, etc.). Test the paint on a piece of scrap plastic to make sure the paint will not damage the canopy . Use bright colors since they are easier to see in the air. Don't spend too much time with fancy paint schemes since you will probably smash your canopy a couple of times learning how to fly. Your second canopy will last much longer.

- ❑ 17. Cut out the side and top window decals from the canopy decal sheet (see Fig. 6-8) with a scissors. Make sure to cut out the small slits on the top of the side windows.

Hint:

The easiest way to apply decals to the *Model 110* is to first remove a small piece of the paper backing and stick the decal to the desired surface. If the decal is not properly aligned, peel it off and reposition it. Do not remove the remaining paper backing until the decal is properly positioned.

- ❑ 18. Clean the canopy with spray window cleaner to remove any oil and dirt. Peel back 1/4" (6mm) of the paper backing along the bottom of one side window decal, and cut off the paper with a scissors. Carefully line up the bottom of the window decal with the window outline molded into the canopy and stick the decal to the canopy. If the decal is in the wrong place, remove it and try again.
- ❑ 19. Carefully peel back the remaining paper from the window decal and slowly stick the rest of the decal to the canopy. Smooth out any wrinkles as you go along. Repeat with the other side window. Fold the slitted portions of the windows onto the top of the canopy.



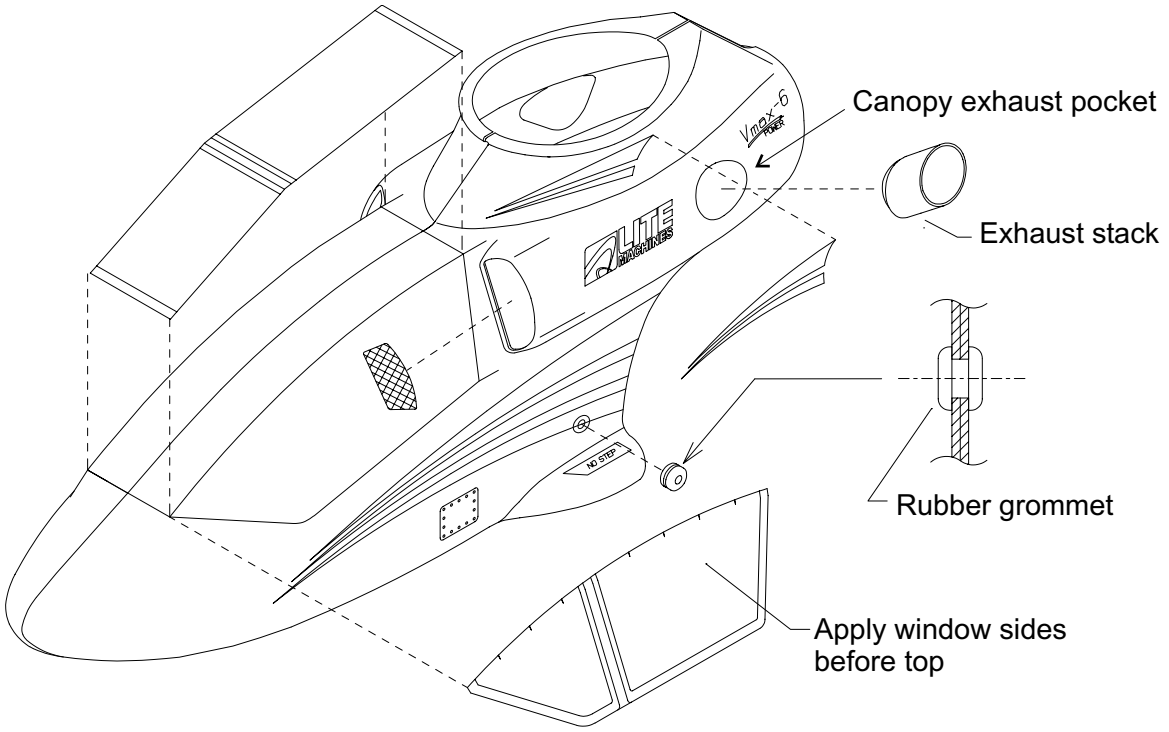
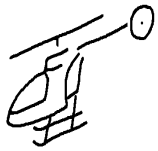


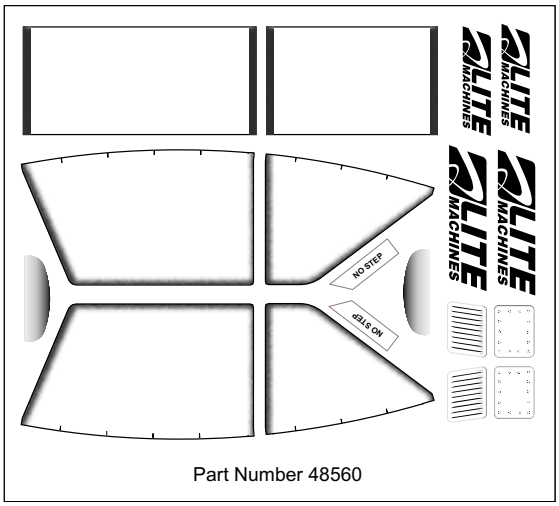
Figure 6-7.

Note:

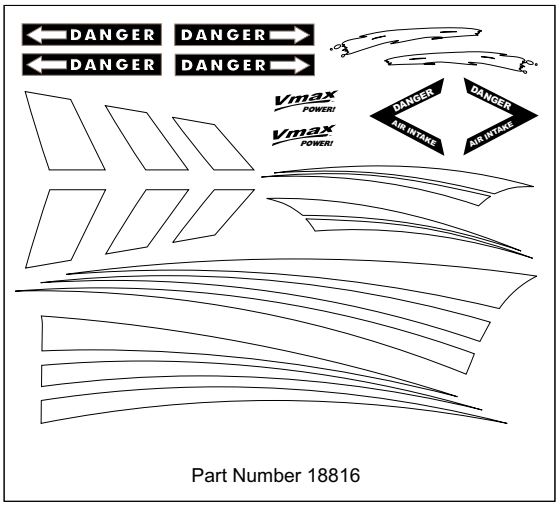
Several optional canopy decal sets are available as shown in Fig. 6-9. You may wish to consider a different decal set for your second canopy.

- ❑ 20. Apply stripe decals as you did the window decals. Follow the color scheme shown in Fig. 6-7 or design your own decal arrangement.
- ❑ 21. Install a rubber grommet in the holes on each side of the canopy. The grommets will be used later to mount the canopy to the crutch.
- ❑ 22. Sand the turbine exhaust pockets on the canopy and the bottom of the plastic turbine exhausts with coarse (120 grit) sandpaper to prepare the surfaces for gluing. Apply a layer of thick CA glue to the inside of the canopy pockets and place the turbine exhausts in the pockets shown in Fig. 6-7.
- ❑ 23. When the glue has set, drill a 1/4" (6mm) hole in the **RIGHT SIDE** turbine exhaust with a drill bit or the tip of a hobby knife. The fuel tank filler tube will eventually extend through this hole to make fueling easier.



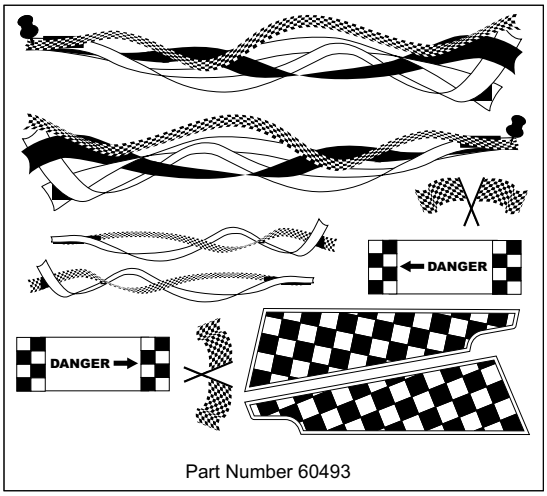


Part Number 48560



Part Number 18816

Figure 6-8



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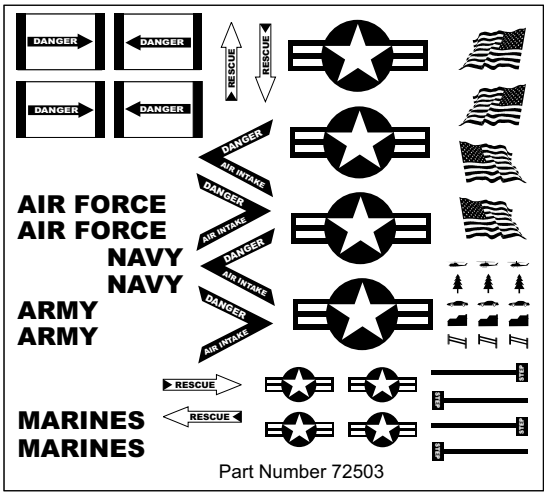

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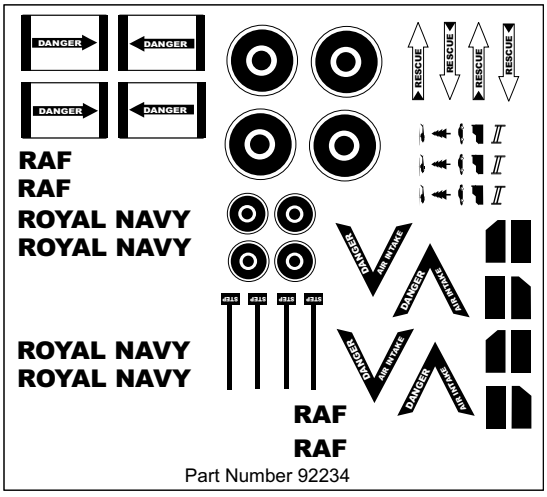
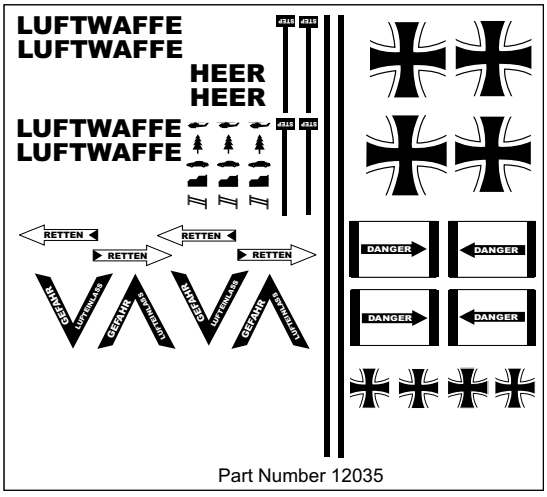
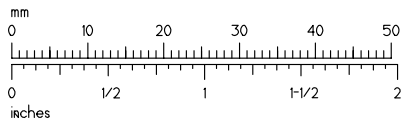


Part Number 92234



Part Number 12035

Figure 6-9



Main Rotor

The main rotor produces the aerodynamic force that lifts your Model 110 helicopter into the air. In flight, the two long main rotor blades act like a large propeller or fan to push air downward. Unlike a propeller, however, the main rotor is designed to move through the air sideways, and incorporates pushrods and linkages to control the pitch of the blades. Most model helicopter main rotors have a flybar at 90 degrees to the main rotor blades that increases stability and controllability of the main rotor. The Model 110 main rotor incorporates an Arlton Subrotor stabilizer that not only increases stability and controllability, but also the efficiency and lifting potential of the main rotor. Many unique features of the Model 110 main rotor (which include the main rotor blades, Arlton Subrotor stabilizer, blade grips, etc.) are patented or patent pending.

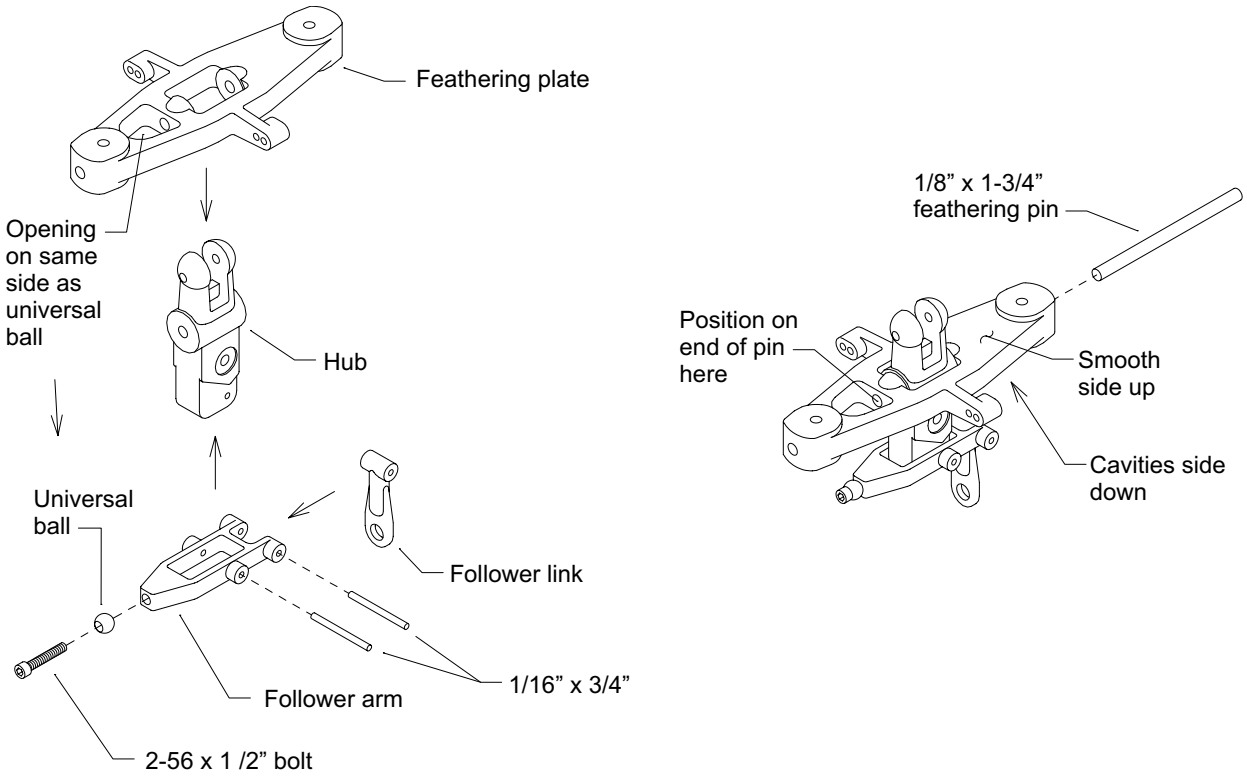


Figure 7-1.

Hint:

When installing a steel pin into a plastic part, hold the plastic part against a hard, solid surface (such as a concrete floor or patio) and tap on the pin with a hammer. Do not hold the part against your kitchen or dining room table, or kitchen counter top. The hard plastic and the end of the pin can damage the table or counter top and cause you long-term grief with the rest of your family.

❑ 1. Attach a metal universal ball to the follower arm using a 2-56 x ½" bolt as shown in Fig. 7-1. Tighten the bolt only until the universal ball is held in place (tightening any further may strip the plastic threads). Attach the follower link to the follower arm with a 1/16" x 3/4" pin. Orient the follower arm and the hub as shown and connect with another 1/16" x 3/4" pin. The pins should extend completely through the plastic parts and equally out of each side. The follower arm and link should move freely.

❑ 2. Slide the rotor hub through the center of the feathering plate. **MAKE SURE THE PUSHROD THROUGH-HOLE IN THE FEATHERING PLATE IS ON THE SAME SIDE AS THE UNIVERSAL BALL ON THE FOLLOWER ARM.** The indentations on the opposite side of the feathering plate should face down (the smooth side faces up). Insert the 1/8" x 1-3/4" feathering pin into the feathering plate. Using a long 4-40 bolt and hammer, gently tap the pin through the hub until it is flush with the inside edge of the pushrod through-hole in the feathering plate. Do not tap the pin further into the through-hole. The feathering plate should rotate about the feathering pin very freely.

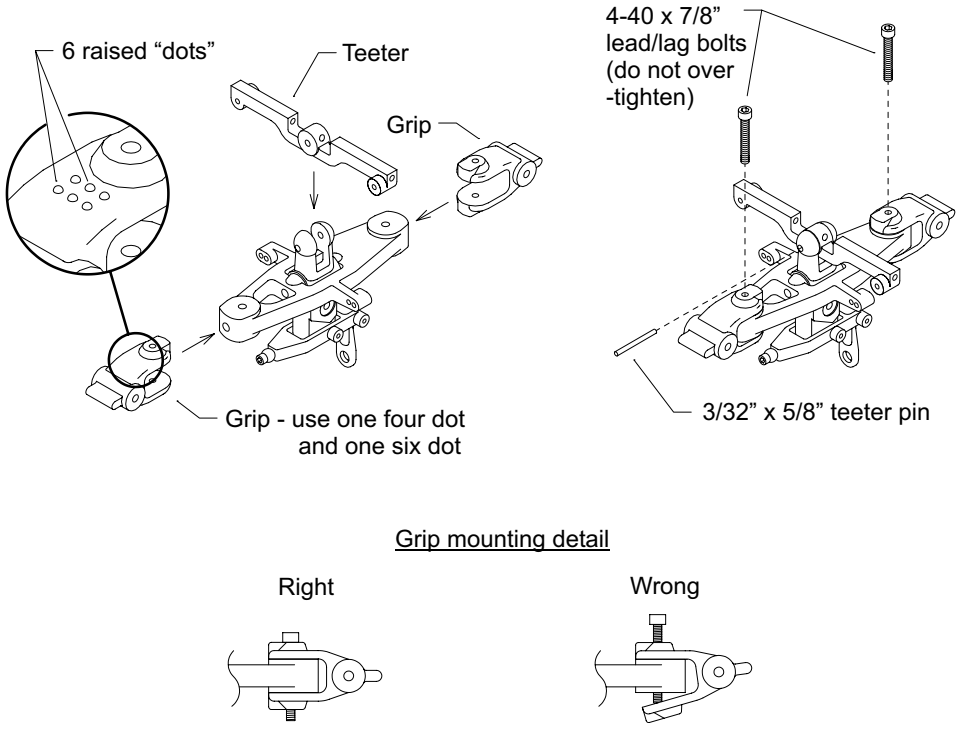
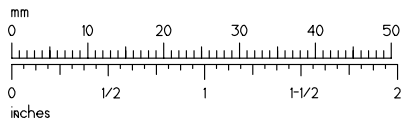


Figure 7-2.

Note:

The *Model 110* helicopter employs interchangeable blade grips to adjust the pitch angle of the main rotor blades. Raised dots on the surface of each blade grip indicate the angle of the grip in degrees. For example, blade grips with four raised dots, called “four-grips”, add four degrees to the blade’s natural pitch angle. Grips with six raised dots, called “six-grips”, add six degrees. When installed on the main rotor, it does not matter if the raised dots face upward or downward. Refer to the *Model 110* Operator’s Guide for information on selecting blade grips for the best flight performance.



❑ 3. Slide a six-grip (having six raised dots) over one end of the feathering plate and a four-grip (having four raised dots) over the other end and secure both grips to the feathering plate with 4-40 x 7/8" lead/lag bolts (these are called lead/lag bolts because the rotor blades swing forward and backward, or lead and lag, on these bolts in flight). Make sure the lead/lag bolts pass completely through the grips as shown in Fig. 7-2. Do not over-tighten the bolts. They will be adjusted later after attaching the rotor blades.

❑ 4. Attach the teeter to the forks on top of the hub with the 3/32" x 5/8" teeter pin. The teeter should move very freely.

Important!

Both the feathering plate and teeter must move very freely. If either binds or drags even slightly your *Model 110* helicopter will not be stable in flight!

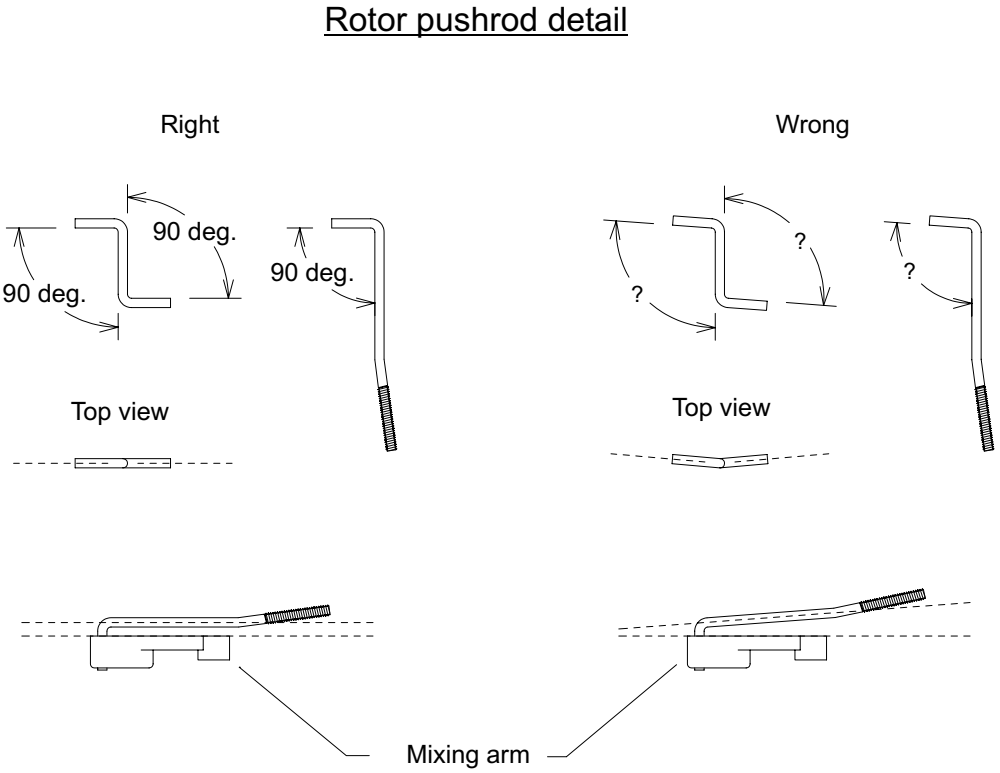


Figure 7-3.

❑ 5. Make sure that the right-angle bends in the two Z-links and mixing-arm/swashplate pushrods measure exactly 90 degrees. Compare the links and pushrods to Fig. 7-3, or insert them into a mixing arm as shown, and bend slightly with a pliers if necessary.

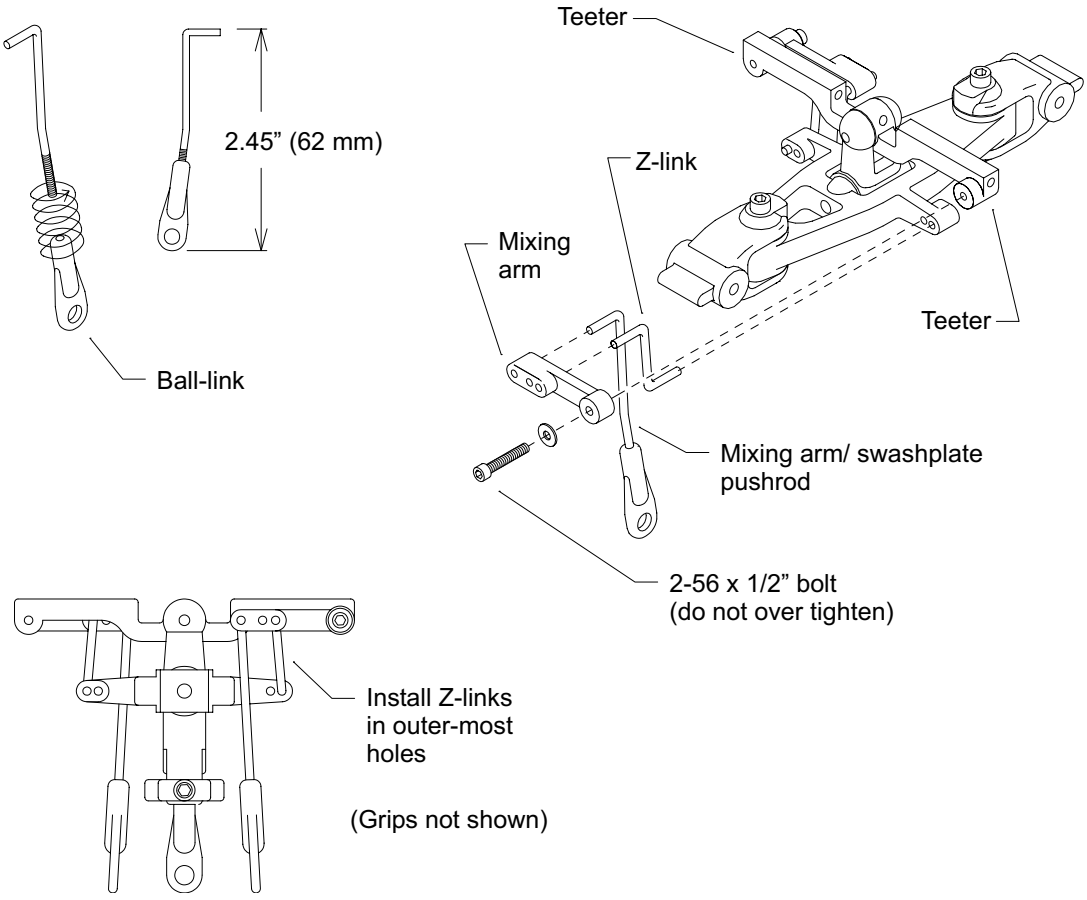
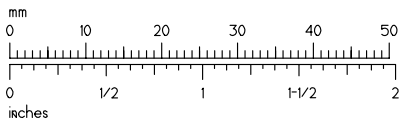


Figure 7-4.

- ❑ 6. Screw a plastic ball-link onto the end of each mixing-arm/swashplate pushrod and adjust to the length shown in Fig. 7-4.
- ❑ 7. Mount the mixing arms, Z-links, and pushrods to the teeter with 2-56 x ½" bolts and washers as shown. Note that two Z-link holes are provided in each mixing arm and feathering plate arm. The two Z-link positions produce different flying characteristics. Place the Z-links in the outer set of holes (away from the center of the rotor head). The outer position produces normal control response, while the inner position is more powerful but less stable. You can move the Z-links to the inner position later if you want to experiment, but do not install a Z-link from an outer hole to an inner hole. This will bind the rotor head.
- ❑ 8. Make sure the 2-56 bolts holding the mixing arms to the teeter are not too tight. The mixing arms must rotate freely against the teeter. A good way to adjust the mixing arms is to slowly tighten the bolts until the mixing arms start to bind, then unscrew the bolts about 1/4 turn until the mixing arms once again move freely.



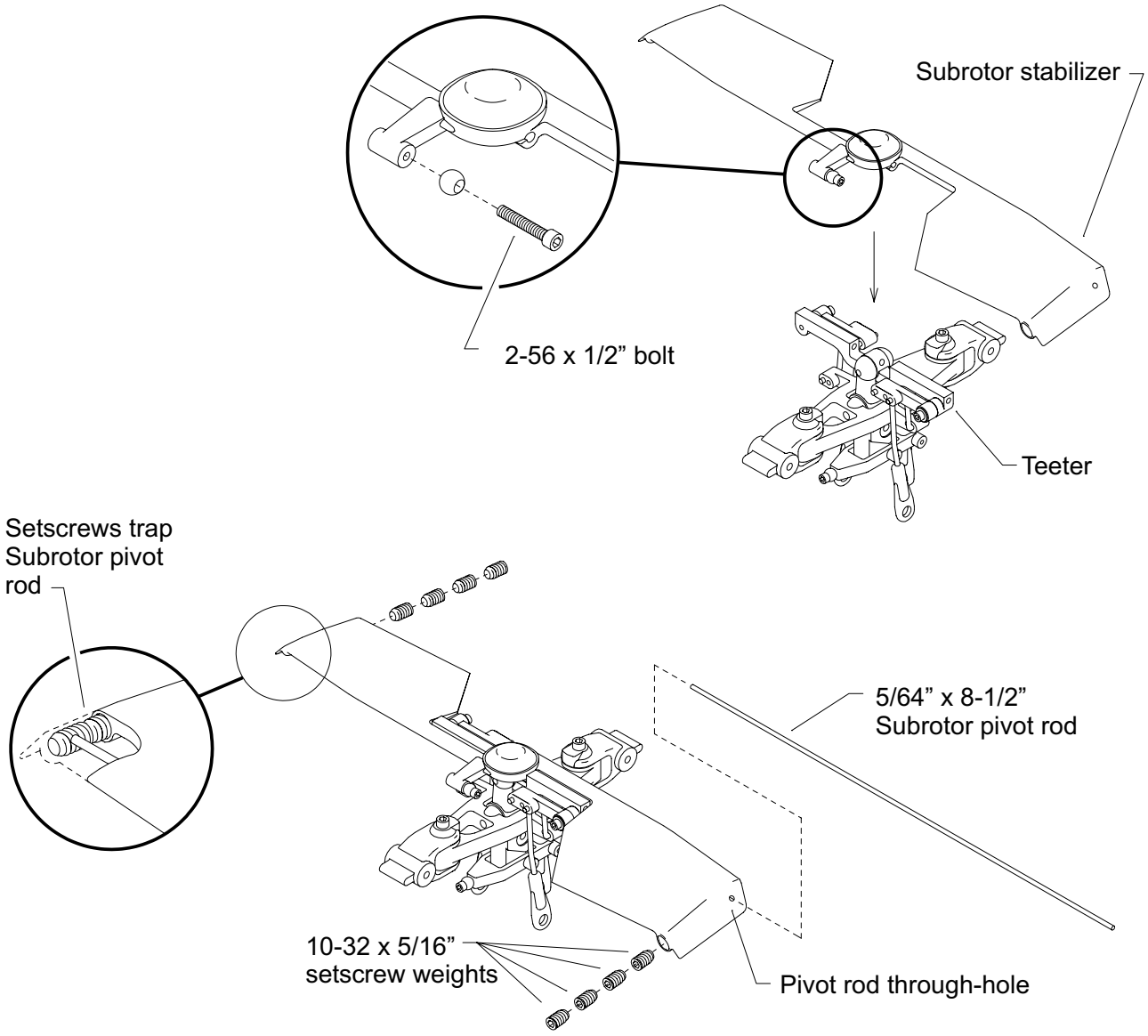


Figure 7-5.

- ❑ 9. Attach a metal universal ball to the *Subrotor* stabilizer using a 2-56 x ½" bolt as shown in Fig. 7-5. Tighten the bolt only until the universal ball is held in place (tightening the bolt further may split the plastic or strip the threads).
- ❑ 10. Screw four 10-32 x 5/16" setscrew weights into **ONE** *Subrotor* blade as shown. Tighten the first setscrew only until the through-hole is blocked (tightening any further may split the plastic). **THE FIRST SETSCREW MUST COMPLETELY BLOCK THE SUBROTOR PIVOT ROD THROUGH-HOLE.**

❑ 11. Mount the *Subrotor* stabilizer to the teeter making sure the universal ball is on the same side as the pushrod through-hole in the feathering plate. Insert the 5/64" x 8-1/2" (2mm x 216mm) *Subrotor* pivot rod into the *Subrotor* blade with the open pivot rod through-hole. Push the pivot rod through the teeter and into the opposite blade. If the pivot rod does not pass through the middle portion of the teeter easily, remove the *Subrotor* stabilizer and enlarge the pivot rod hole in the middle portion of the teeter. To do this, push the pivot rod through the middle portion of the teeter several times so that the sharp edges on the end of the pivot rod scrape out and enlarge the hole. Reassemble the *Subrotor* stabilizer to the teeter.

❑ 12. Screw four 10-32 x 5/16" setscrew weights into the end of the open *Subrotor* blade as shown. Tighten the first setscrew only until the through-hole is blocked (tightening any further may split the plastic). **THE FIRST SETSCREW MUST COMPLETELY BLOCK THE SUBROTOR PIVOT ROD THROUGH-HOLE.**

Warning!

The setscrew weights block off the pivot rod through-hole on both ends of the *Subrotor* stabilizer and trap the pivot rod in the middle. **IF THE SETSCREWS ARE NOT INSTALLED CORRECTLY, THE PIVOT ROD COULD BE THROWN OUT WHEN THE MAIN ROTOR IS TURNING, AND INJURE YOU OR SPECTATORS**.

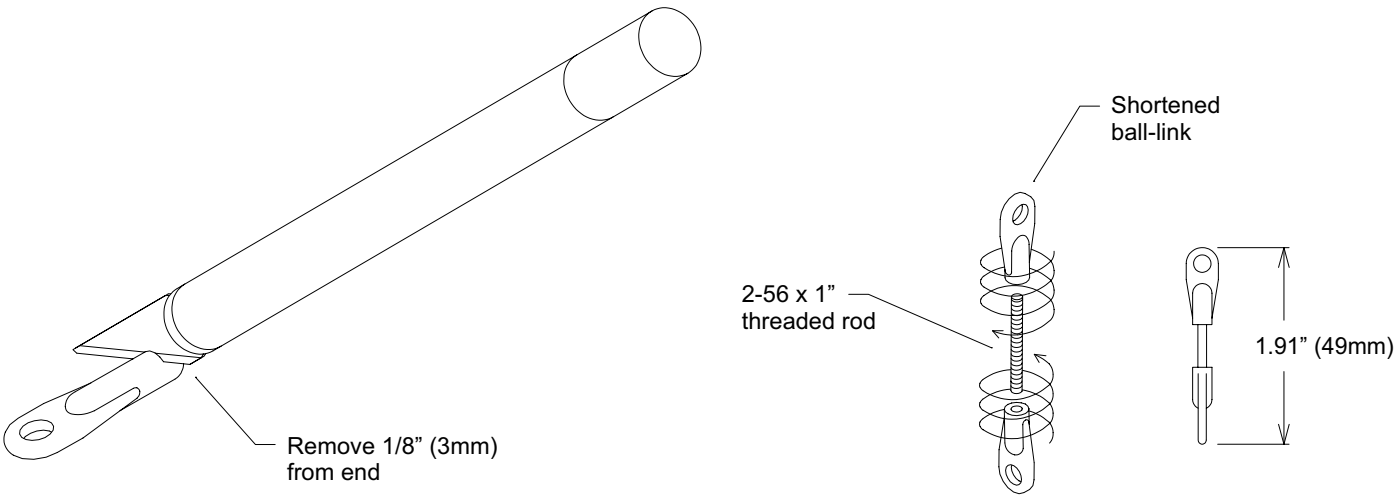
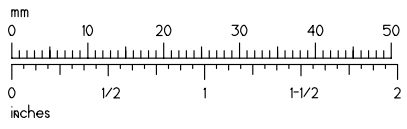


Figure 7-6.

❑ 13. Trim about 1/8" (3mm) off of the ends of two plastic ball-links with a hobby knife. Screw the two ball-links onto the ends of the 2-56 x 1" threaded rod to form the *Subrotor* pushrod. Adjust the length as shown in Fig. 7-6.



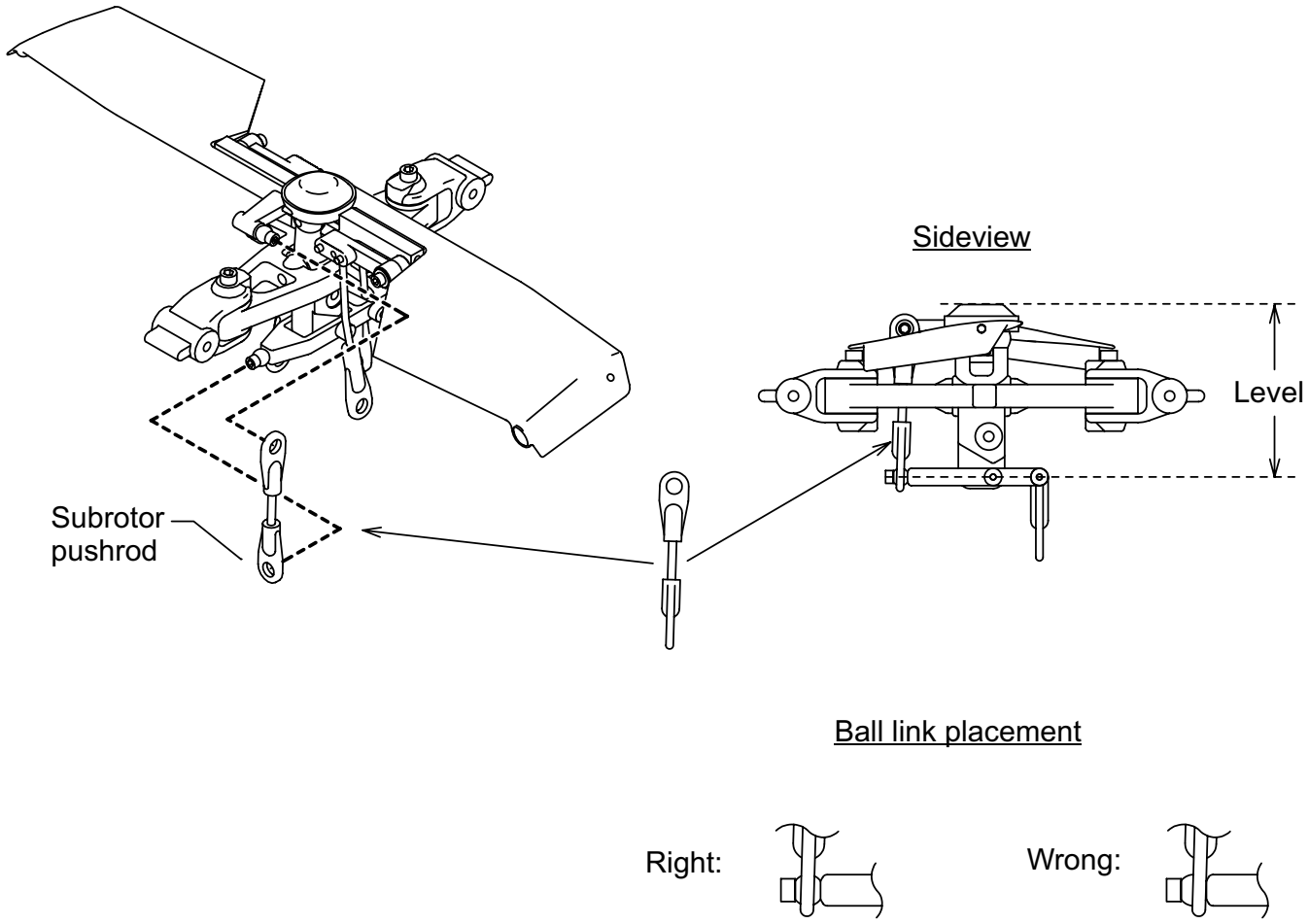


Figure 7-7.

- ❑ 14. Push a rubber grommet (having a 3/16" or 4.7mm) into the large hole in the lower edge of the crutch as shown in Fig. 7-9.
- ❑ 15. Snap the pushrod onto the follower and *Subrotor* universal balls, and check the alignment of the *Subrotor* stabilizer and follower arm. Adjust the length of the pushrod until the *Subrotor* stabilizer is level when the follower arm is level as shown in the side view of Fig. 7-7.
- ❑ 16. Find two 5x11x4mm ball bearings. Although these bearings are oiled during manufacture, the original oil is thin and can evaporate over time. As a precaution, place two 5x11x4mm bearings on a paper towel and apply oil all around the bearing seals. In a few minutes you will see the oil seep into the bearings and wet the paper towel.
- ❑ 17. Push a 5x11x4mm bearing firmly into each bearing block (see Fig. 7-9) until fully seated. It is sometimes easiest to place the bearing on a hard surface and push the bearing block down over the bearing.

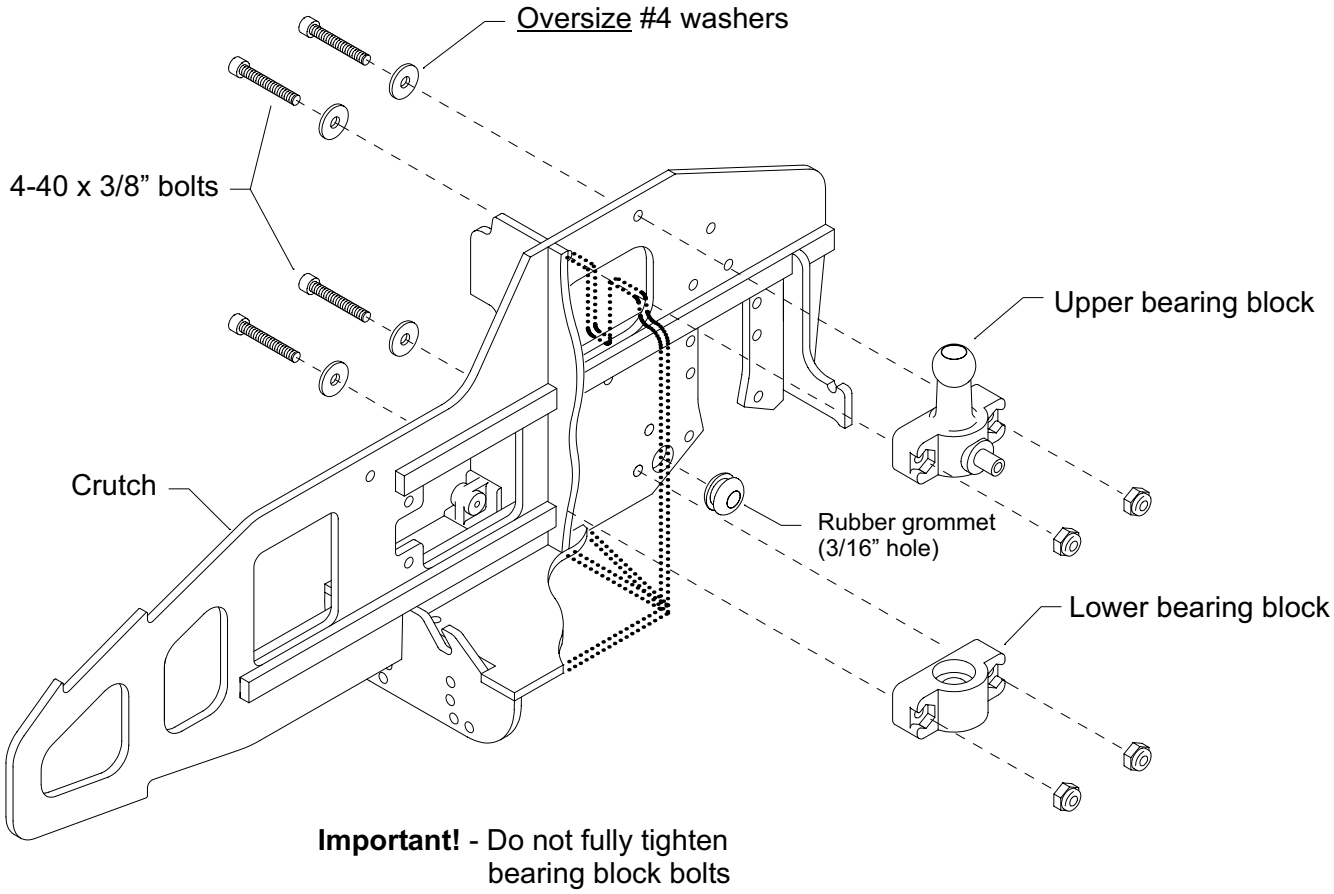


Figure 7-8.

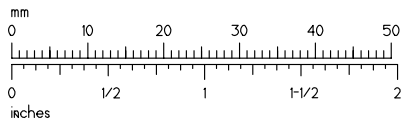
❑ 18. Attach the upper and lower bearing blocks to the crutch with 4-40 x 5/8" bolts, **OVERSIZE** washers (3/8" or 9.5mm outside diameter), and nylock nuts as illustrated in Fig. 7-8. Tighten the bolts just enough to hold the blocks in place; they will be repositioned later.

Note:

In the following steps you will temporarily mount the main shaft to the crutch in order to balance the *Subrotor* stabilizer and main rotor blades. A poorly balanced rotor will shake badly in flight and consume a lot of engine power. Follow the balancing instructions carefully to avoid problems. In later steps you will position the main shaft more accurately and then tighten all of the bolts and setscrews.

Note:

The main rotor shaft on your *Model 110* is made from high-strength spring steel and is designed to flex during crashes. By their nature, spring steel shafts usually are twisted or bowed slightly. Do not be alarmed if your shaft is not perfectly straight. You will find that slight bends in the shaft do not affect flight performance as long as you balance the main rotor blades while they are mounted to the shaft.



❑ 19. Slide the 5/32” x 6-1/2” (4mm x 165mm) main shaft down through the upper bearing block, bearings, bearing collars, crown gear and lower bearing block as illustrated in Fig. 7-9 so that the deep, half-round notch is at the top (and the long, shallow flat is at the bottom). Leave about 1-1/4" (32mm) of the shaft extending above the top of the upper bearing block. The position of the shaft is not important now, and will be set accurately later.

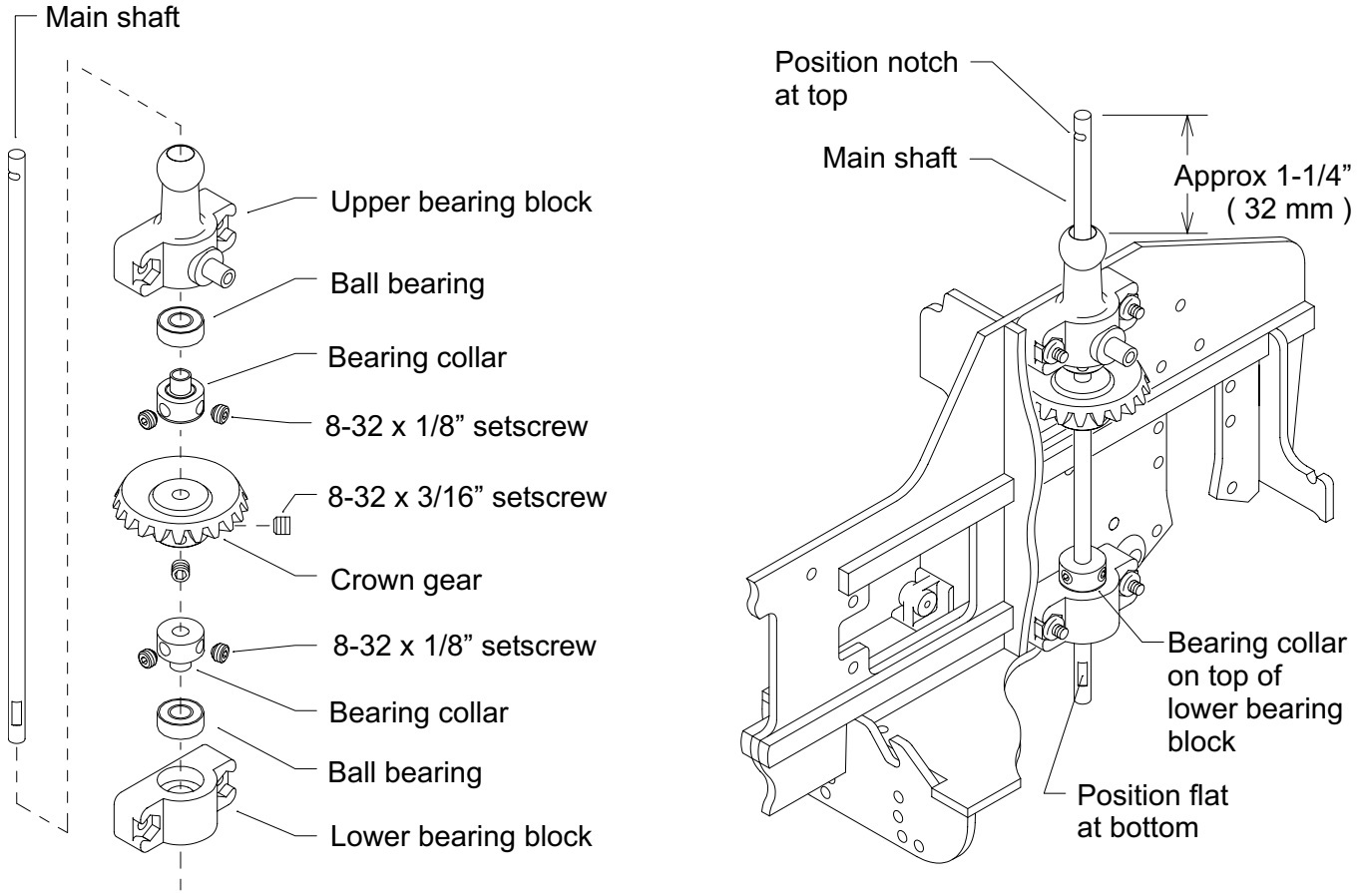


Figure 7-9.

❑ 20. Lightly tighten the setscrews in the upper bearing collar. While pulling the main shaft up against the upper bearing, push the lower bearing collar down as far as it will go against the lower ball bearing, and lightly tighten the setscrews in the lower bearing collar.

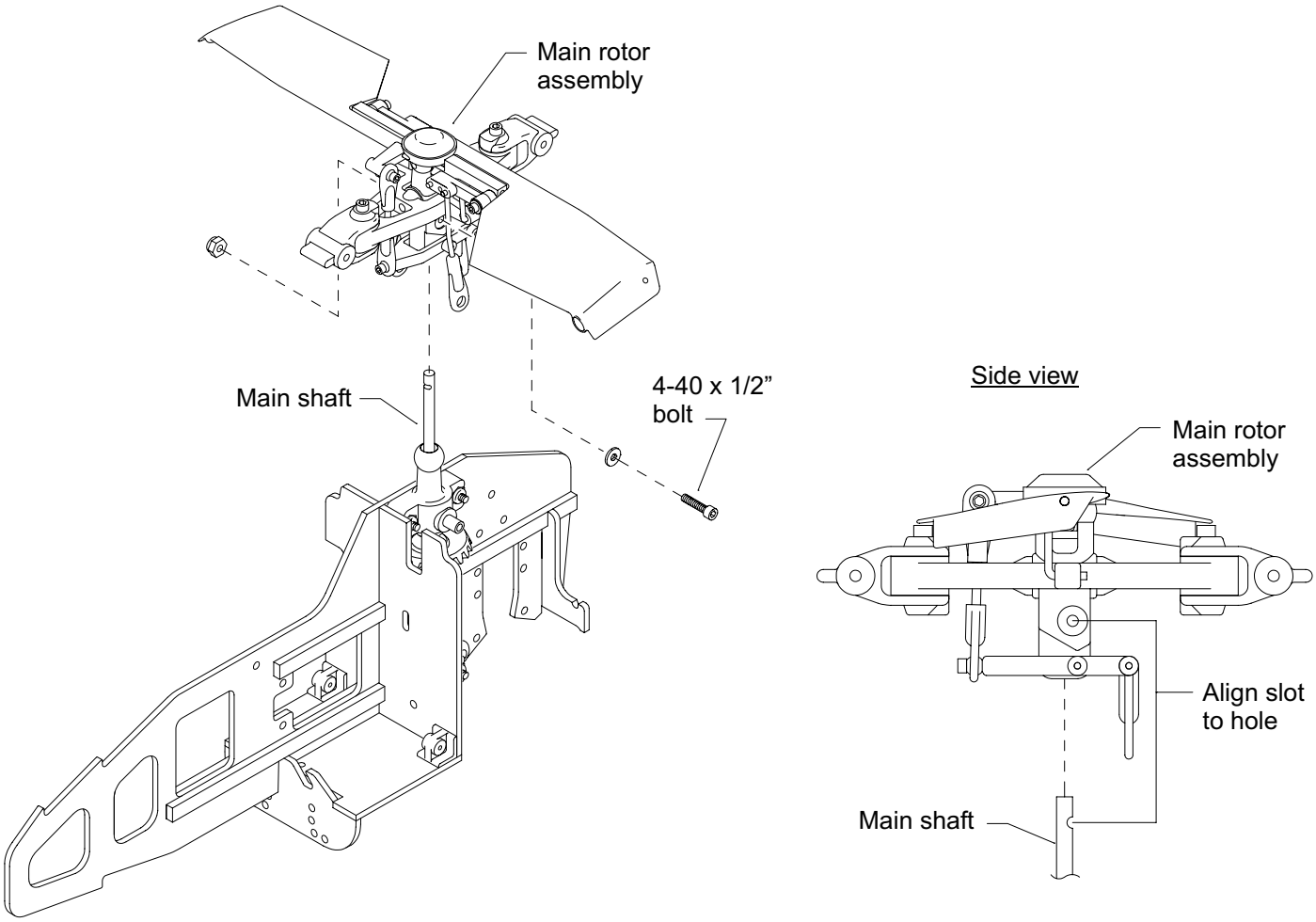
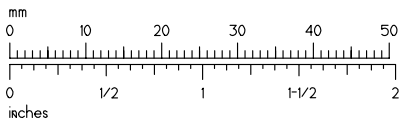


Figure 7-10.

- ❑ 21. Mount the main rotor assembly to the main shaft with a 4-40 x ½" bolt, washer and nylock nut as shown in Fig. 7-10. If the shaft fits too tightly in the main rotor hub, ream the shaft hole in the hub with a 5/32" (4mm) drill bit to remove any interior molding flash. Note that the slot in the main shaft must be correctly oriented to accept the 4-40 bolt.

- ❑ 22. Wash the surface of the *Subrotor* blades with spray glass cleaner to remove any oil or grease (such as finger prints) so that balancing tape will stick.

- ❑ 23. To balance the *Subrotor* stabilizer, support the crutch on two books as in Fig. 7-11 so that the main rotor assembly overhangs the edge of your work surface and can rotate without hitting anything. Add another book on top of the crutch to hold it down. Wrap a piece of masking tape around the two mixing arm pushrods to keep them from flopping around. The heavy blade of the *Subrotor* stabilizer will swing downward.



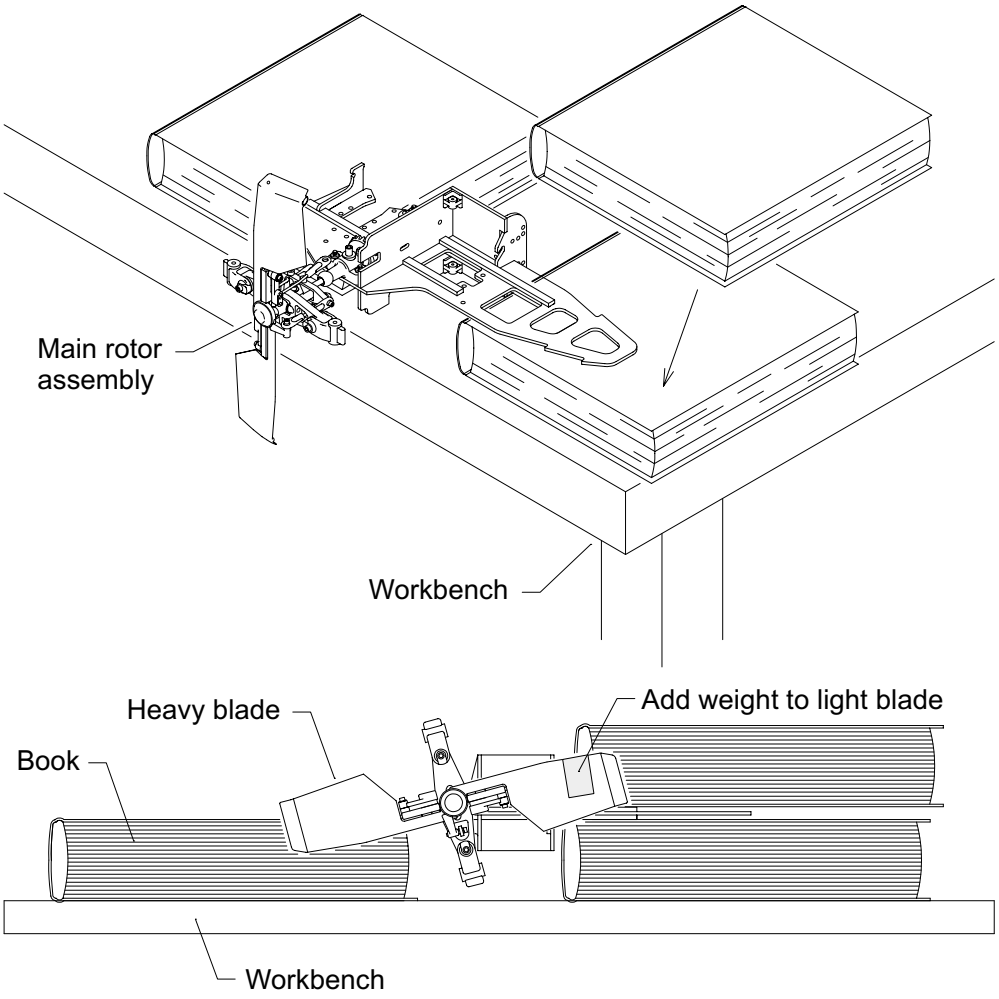


Figure 7-11.

- ❑ 24. Cut out a 1-1/2" x 2" (38mm x 51mm) patch of black stick-on plastic trim material, and wrap it lightly around the leading edge of the high (light) blade as shown in Fig. 7-11. Snip off the ends of the patch until the *Subrotor* stabilizer sits horizontally. This means that both blades are the same weight. Tap the tip of one blade and wait until it stops swinging to check that it is actually balanced. When balanced, press the patch firmly in place.
- ❑ 25. Read and then remove the warning stickers from the main rotor blade. If they do not peel off easily, soak the blades in water for 15 minutes and rub them off.
- ❑ 26. Carefully remove the molding “flash” from the leading edge and tip of each rotor blade with medium (220 grit) sandpaper (“flash” is the thin plastic ridge on plastic parts produced by the mold seam-line). Take care to remove only the flash, and not to change the shape of the leading edge accidentally. Clean the surface of the blades with spray glass cleaner to remove any oil or grease.

❑ 27. If your *Model 110* has dark colored blades, apply a 1" (25mm) stripe of brightly colored (white, yellow or orange) stick-on trim material around each blade near the tip. The stripe makes the blades more visible when rotating at high speed.

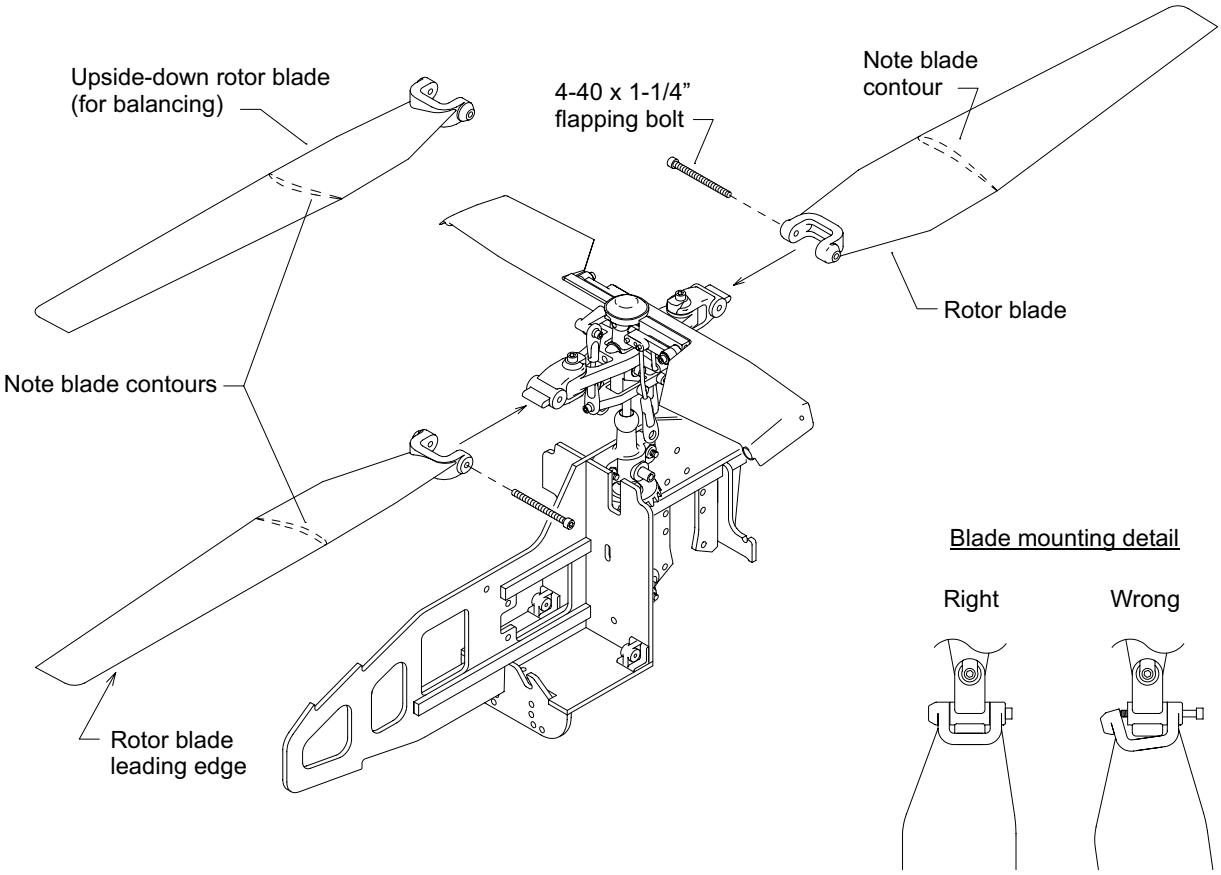
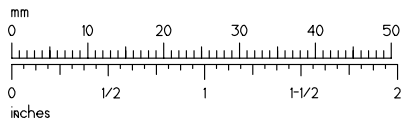


Figure 7-12.

❑ 28. As illustrated by Fig. 7-12, bolt the rotor blades to the blade grips on the main rotor assembly with 4-40 x 1-1/4" flapping bolts (these are called flapping bolts because the rotor blades flap upward and downward on these bolts in flight). **ATTACH ONE BLADE RIGHT SIDE-UP AND ONE UPSIDE-DOWN**. Balancing the rotor is easier when one blade is mounted upside-down. You will reverse the upside-down blade after balancing the rotor.

❑ 29. Tighten the lead/lag and flapping bolts so the blades will stand straight out with the crutch laying on its side. To increase balance sensitivity, angle the blades up slightly as shown in Fig. 7-13.

❑ 30. Wrap a piece of stick-on trim material around the leading edge of the lighter blade and balance the rotor blades as you did the *Subrotor* stabilizer.



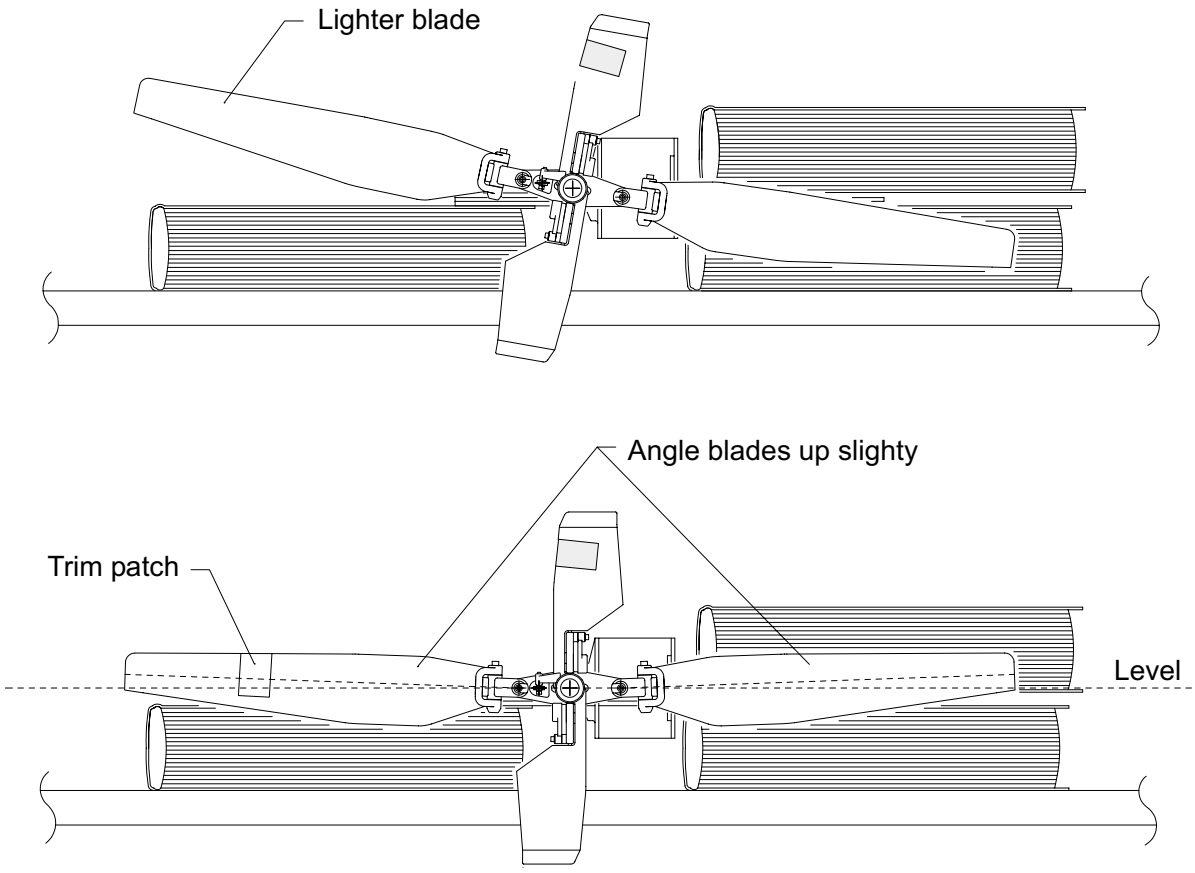


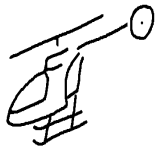
Figure 7-13.

- ❑ 31. Now that the blades are balanced, remove the upside-down blade and bolt it on right side-up (with the cupped surface facing the crutch). Make sure the flapping bolt passes completely through both sides of the rotor blade root as was shown in Fig. 7-12.

- ❑ 32. Loosen the lead/lag and flapping bolts slightly so that the blades are free to swing forward and backward, and flap up and down. A light drag force on the lead/lag bolt will not hurt flight performance, and helps keep the blades from flopping around at low rotor speeds. **IF, HOWEVER, THE BLADES ARE LOCKED RIGIDLY IN PLACE, OR IF THE BLADES DO NOT FLAP UP AND DOWN ABSOLUTELY FREELY, YOUR MODEL 110 HELICOPTER WILL NOT BE STABLE AND WILL BE DIFFICULT TO CONTROL**.

- ❑ 33. With the tip of a hobby knife, lightly mark a small “X” on the blade and blade grip that are on the same side of the rotor hub as the *Subrotor* pushrod. This marks the blade so that you can disassemble and reassemble the main rotor without rebalancing it.

- ❑ 34. Remove the masking tape from around the mixing arm pushrods, and put away the books that supported the crutch. Remove the balanced rotor head from the main shaft, and store it somewhere out of the way.



Swashplate

The swashplate is essentially a large ball bearing assembly surrounding the main rotor shaft below the main rotor. Pilot control commands tilt the lower portion of the swashplate. The upper portion rotates with the main rotor and transmits the pilot commands to the rotating rotor blades. Since the swashplate pitches the main rotor blades up and down in a cycle as they rotate, controls associated with the swashplate are commonly called “cyclic” (pronounced “sigh-click”) controls. The swashplate on the Model 110 helicopter is uniquely simple in design, has double the number of ball bearings found in many other swashplates, and can be easily adjusted for wear.

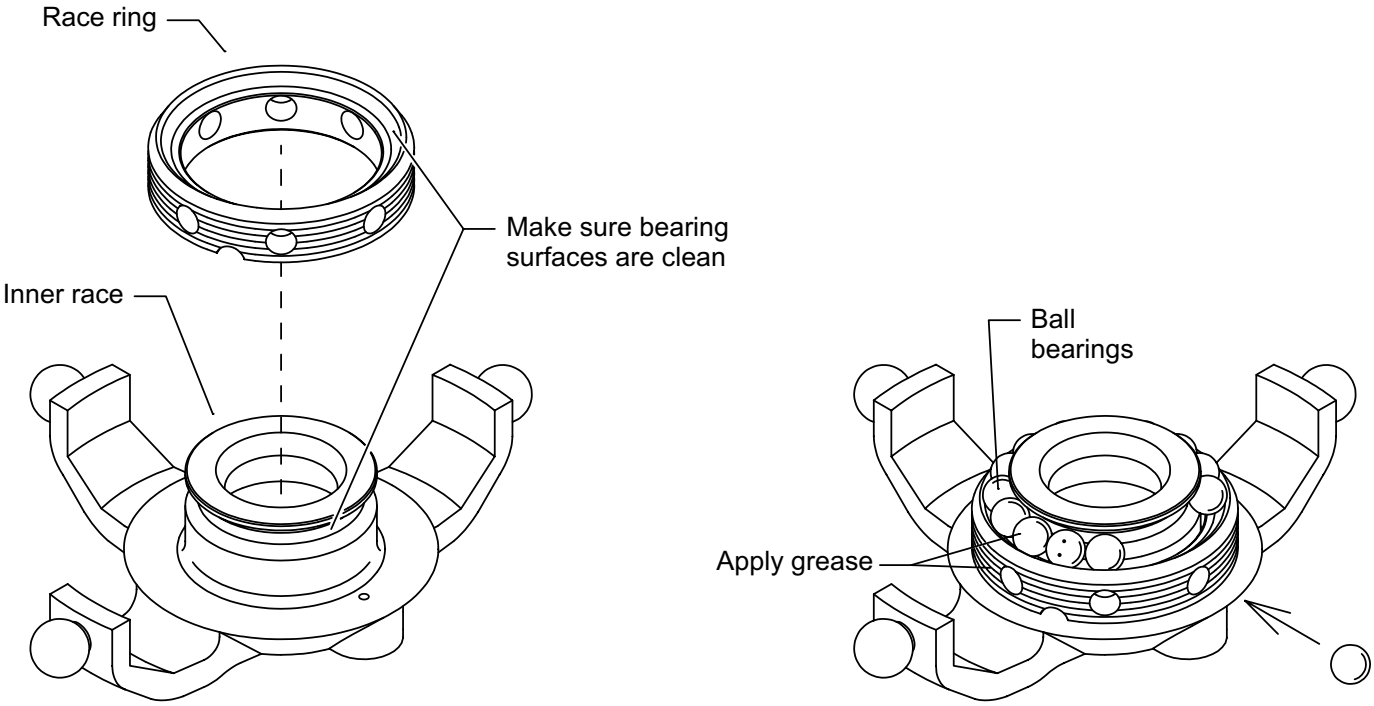


Figure 8-1.

- ❑ 1. Slip the race ring over the inner race with the notched end facing downward as shown in Fig. 8-1. Insert sixteen (16) steel ball bearings into the track formed by the inner race and race ring. The final balls may require a little force to snap into place.
- ❑ 2. Apply enough *Lite Lube* grease (or similar) to the ball bearings to fill the space between the balls.

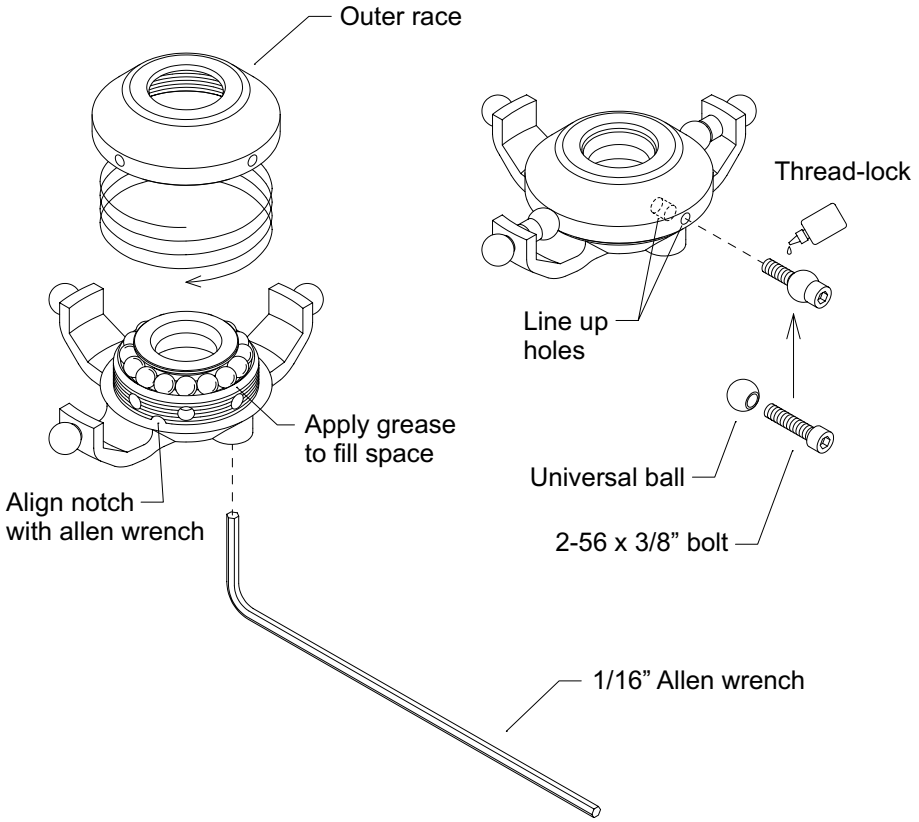


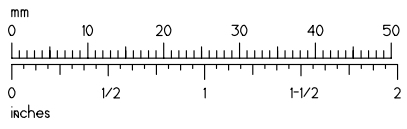
Figure 8-2.

- ❑ 3. Insert one end of a 1/16” hex wrench through the hole in the plastic surrounding the inner race as illustrated by Fig. 8-2. Rotate the race ring until the notch lines up with the end of the wrench . The wrench will prevent the race ring from rotating while you screw on the outer race.

- ❑ 4. Make sure that the inside of the outer race is clean. Screw the outer race clockwise (when viewed from above) onto the race ring until snug. Be careful not to tilt the swashplate assembly while screwing on the outer race. If a ball bearing falls out of the race ring during assembly, it can permanently jam the swashplate.

- ❑ 5. Remove the hex wrench and rotate the outer race and race ring together as a unit. At this point the outer race and race ring are probably screwed together too tightly to allow smooth rotation. Reinsert the wrench clip to hold the race ring, and slowly unscrew the outer race (counter-clockwise) until one of the holes in the outer race lines up with one of the holes in the race ring. This should take less than 1/8th of a turn.

- ❑ 6. Slip a metal universal ball onto a 2-56 x 3/8" bolt, and screw the bolt into one of the holes in the outer race to lock the outer race and race ring together as shown in Fig. 8-2. The bolt should extend through the outer race and into a locking hole in the race ring. Do not accidentally tighten the bolt against the threads on the outside of the race ring. If you do, the race ring will distort and the swashplate will not work properly.



❑ 7. Remove the hex wrench again and spin the swashplate. It should spin very smoothly, **BUT HAVE LITTLE OR NO NOTICEABLE VERTICAL PLAY**. If the races bind or turn roughly, remove the locking bolt, reinsert the wrench and unscrew the races to the next set of locking holes. Replace the bolt and universal ball, and check the motion of the swashplate again. If the swashplate still does not move freely, disassemble and check for dirt or other foreign matter in the grease, and repeat the last two steps.

❑ 8. Once the swashplate spins smoothly, slip metal universal balls onto two more 2-56 x 3/8" bolts, apply threadlock to the bolt threads, and screw the bolts into the swashplate as you did with the first bolt. Remove the first bolt, apply threadlock to the threads and screw it back into the swashplate. Tighten all bolts (but be careful not to strip the threads).

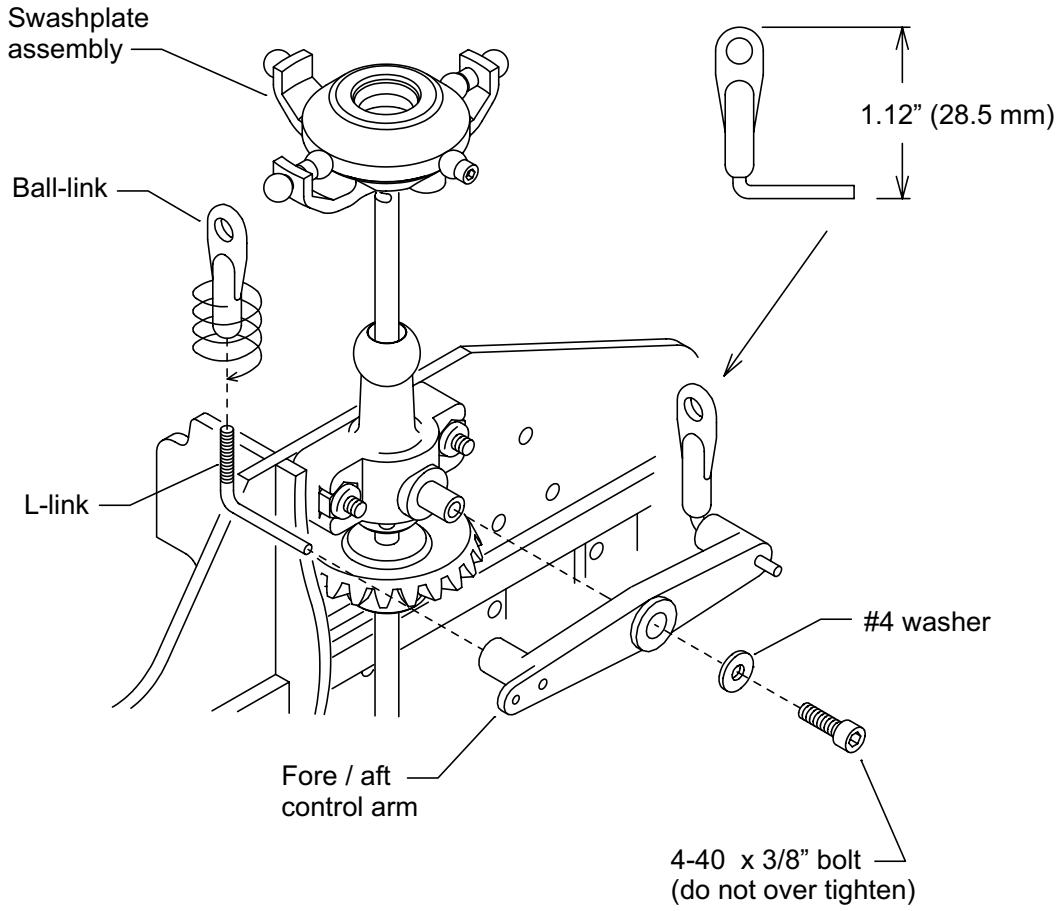


Figure 8-3.

❑ 9. Screw two plastic ball-links onto two threaded L-links, and adjust to the length shown in Fig. 8-3.

❑ 10. Attach the fore/aft control arm to the upper bearing block (which is mounted to the crutch) with a 4-40 x 3/8" bolt and washer. To avoid stripping the hole, push the bolt into the hole while turning it, and do not over-tighten it. The fore/aft control arm should move freely. Insert the free end of each L-link into the control arm as shown.

❑ 11. Place the swashplate on the universal ball on top of the upper bearing block so that the middle swashplate arm is opposite the fore/aft control arm. Snap the ball-links onto the two opposed arms of the swashplate as shown.

❑ 12. Check the tilting motion of the swashplate. It should seat against the plastic universal ball on the upper bearing block, and tilt easily in any direction. If the swashplate does not seat against the universal ball, unsnap the ball-joints, screw them each down ½ turn and reassemble. If, on the other hand, the swashplate is too tight against the universal ball, unsnap the ball-joints, unscrew them each ½ turn and reassemble. Repeat either process until the swashplate rests against the universal ball and moves freely. Note that both L-links must be the same length to prevent the swashplate from binding.

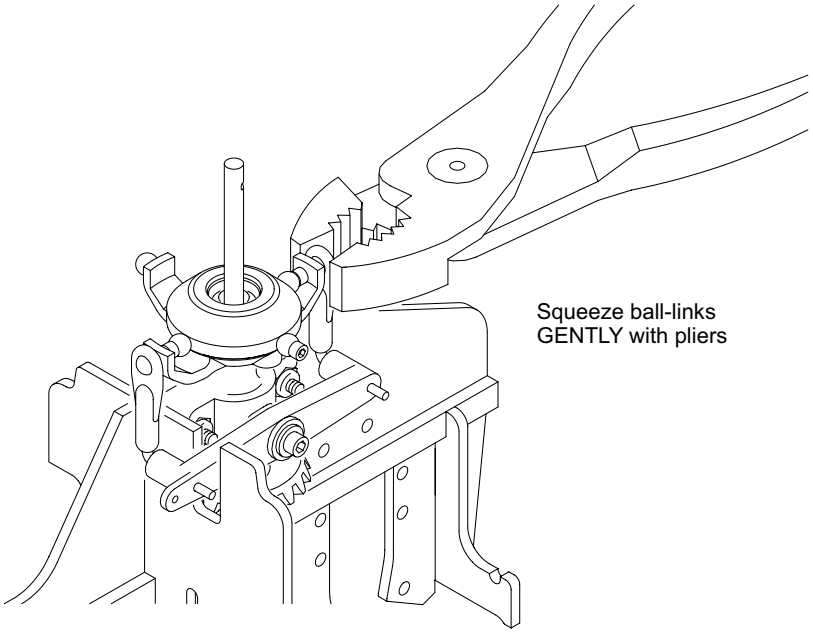
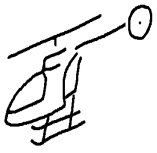
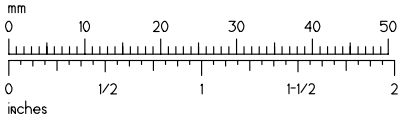


Figure 8-4.

❑ 13. The plastic balls on the swashplate arms may be slightly larger than metal balls. If the ball-joints are too tight, the swashplate may not operate smoothly. To get an idea of the proper fit, snap a spare ball-link onto one of the metal universal balls on the swashplate and move the link around. To loosen a tight ball-link on a plastic ball, gently squeeze the ball-link with a pair of pliers as shown in Fig. 8-4 to deform the ball-link slightly. Be careful, you can easily crush the ball-link if it slips off the ball.





Arlton Gyro Stabilizer

Almost all modern model helicopters require some sort of yaw (tail rotor) stabilization system to make them controllable by the average pilot. Without a yaw stabilizer, the tail of a model helicopter can suddenly swing through 90 or even 180 degrees as a result of changes in engine speed and main rotor torque, or wind gusts and air turbulence. The electronic gyro stabilizers commonly carried on model helicopters are very sensitive, but they are also relatively expensive. The Lite Machines Model 110 helicopter is equipped with a lightweight, mechanical Arlton Gyro™ stabilizer (patented with patents pending) which is built onto the tail rotor linkages and takes the place of traditional electronic systems.

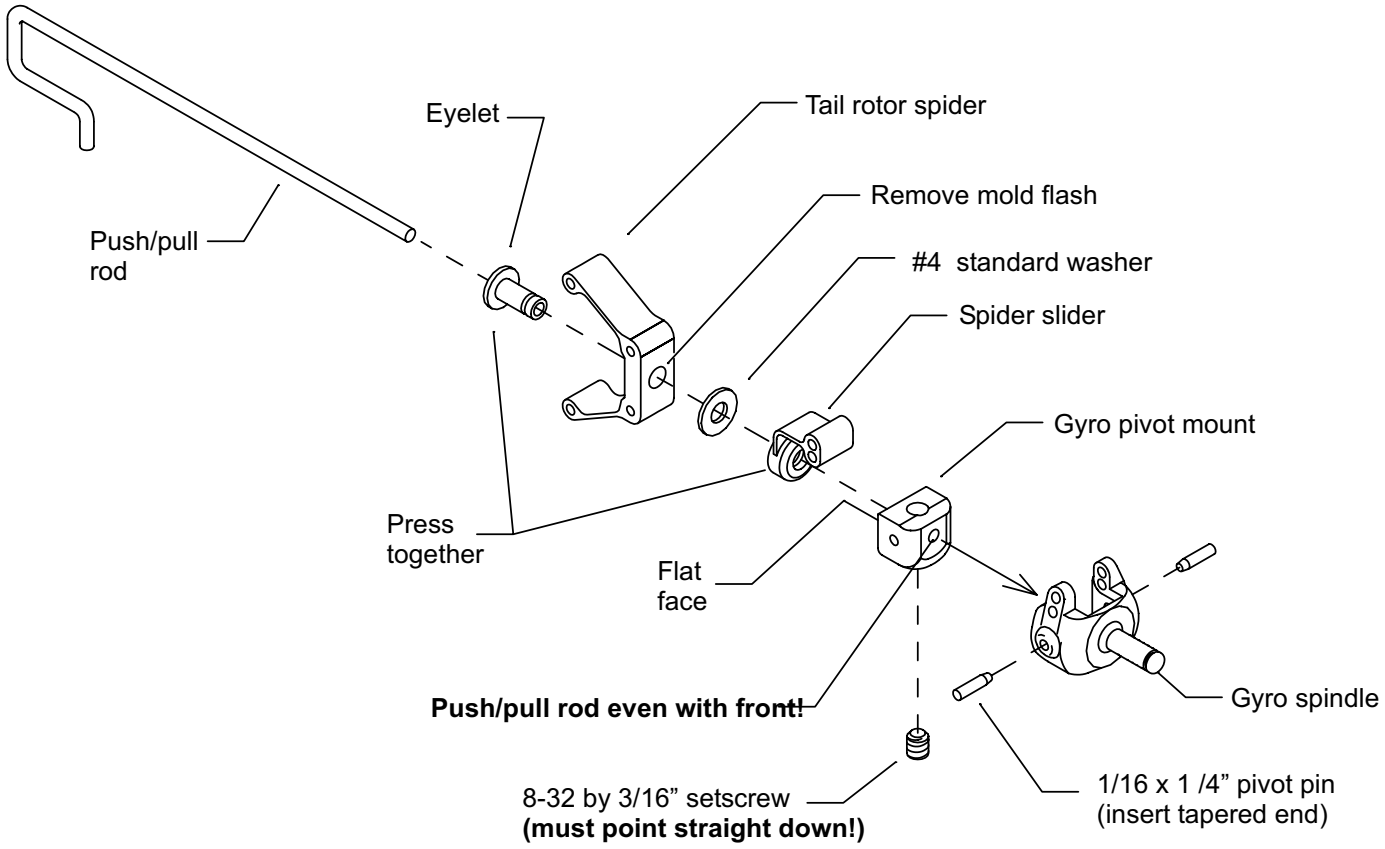


Figure 9-1.

❑ 1. Slide the gyro eyelet through the spider and a standard #4 washer as shown in Fig. 9-1. Washer holes vary in size, so you may have to try several washers before finding one that rotates freely around the eyelet (but don’t use an oversize #4 washer by mistake). Press the eyelet firmly into the spider slider with a pair of pliers.

❑ 2. Carefully study the orientation of the pivot mount and gyro spindle in Fig. 9-1. Note that the setscrew hole in the pivot mount faces down. The pivot mount and gyro spindle should be in this same orientation later when you mount the completed gyro assembly onto the tail rotor or the gyro will not work correctly. Also note that after assembly the straight end of the push/pull rod should not extend past the rounded face of the pivot mount.

❑ 3. Slide the push/pull rod through the spider assembly, and temporarily attach the pivot mount to the end of the push/pull rod with a 8-32 x 3/16" setscrew. Note that the flat face of the pivot mount points toward the bent end of the push/pull rod.

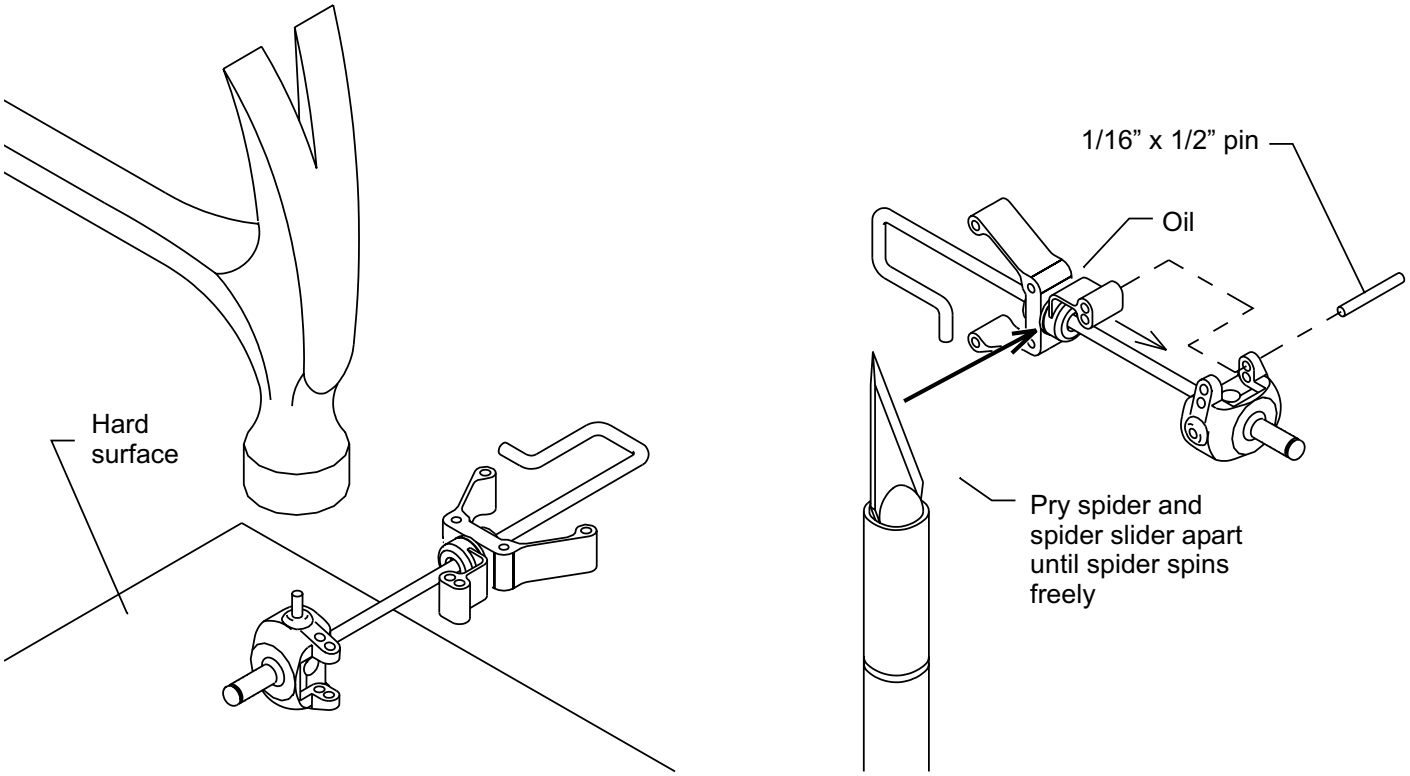
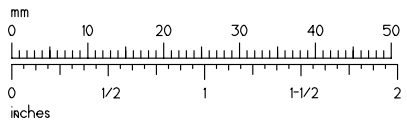


Figure 9-2.

❑ 4. Hold the gyro spindle and pivot mount together against a very hard, solid surface (such as a concrete floor or patio) as shown in Fig. 9-2 in order to install the gyro pivot pins. **NOTE THAT ONCE THE PIVOT PINS HAVE BEEN INSTALLED, IT IS PRACTICALLY IMPOSSIBLE TO DISASSEMBLE THIS PART OF THE GYRO.**

Note:

Steel pins are rounded at one end and tapered on the other. When assembling the gyro spindle to the pivot mount, insert the **TAPERED** end of each pivot pin into the holes in the pivot mount. Note that the pivot mount should be attached to the push/pull rod during assembly, or the pivot pins may block the push/pull rod hole after they are tapped-in with a hammer.



- ❑ 5. While holding the gyro spindle and pivot mount in the correct position, insert one 1/16" x 1/4" pivot pin (tapered end first) through the central side hole in the spindle. **LIGHTLY** tap the pin into the corresponding hole in the pivot mount just enough to keep it from falling out.

- ❑ 6. Turn the gyro spindle assembly over and repeat the last step with the other 1/16" x 1/4" pivot pin. Remember, **DO NOT** hold the parts against your kitchen or dining room table, or kitchen counter top. If you damage a counter top or table you will never hear the end of it.

Warning!

The pivot pins in the gyro assembly are designed to be installed at the same time. **DO NOT ATTEMPT TO HAMMER IN ONE PIN AT A TIME BECAUSE THE POUNDING FORCES WILL DAMAGE THE GYRO SPINDLE.**

- ❑ 7. Double check that the gyro spindle and pivot mount are correctly oriented with respect to each other.

- ❑ 8. Tap the pivot pins into the pivot mount a little further. Check to see if the pins are going in straight, and that the gyro spindle can pivot freely. If a pin is not going in straight and the gyro spindle binds, carefully straighten the pin with a pair of pliers. Keep checking the straightness of the pins while tapping them into the pivot mount until firmly seated. When completely seated, the ends of the pins will be flush with the plastic on the gyro spindle, or they may stick out slightly (1/32" [1mm]).

- ❑ 9. Your *Model 110* has a dual-gain gyro. The gyro spindle has a standard gain (lower pin position) and a high gain (upper pin position). Connect the spider slider to the gyro spindle with a 1/16" x ½" pin in the upper pin (high gain) position. As you tilt the spindle up and down (about 20 degrees each direction) the spider should slide **VERY** freely back and forth along the push/pull rod. If the mechanism jams, check the end of the push/pull rod, it may be hitting the inside of the spindle.

- ❑ 10. Wedge a hobby knife blade between the washer and spider slider, as shown in Fig. 9-2, and carefully pry the slider away from the eyelet slightly until the spider spins freely. There should be no noticeable play between the spider and slider. Apply a drop of oil to each side of the spider.

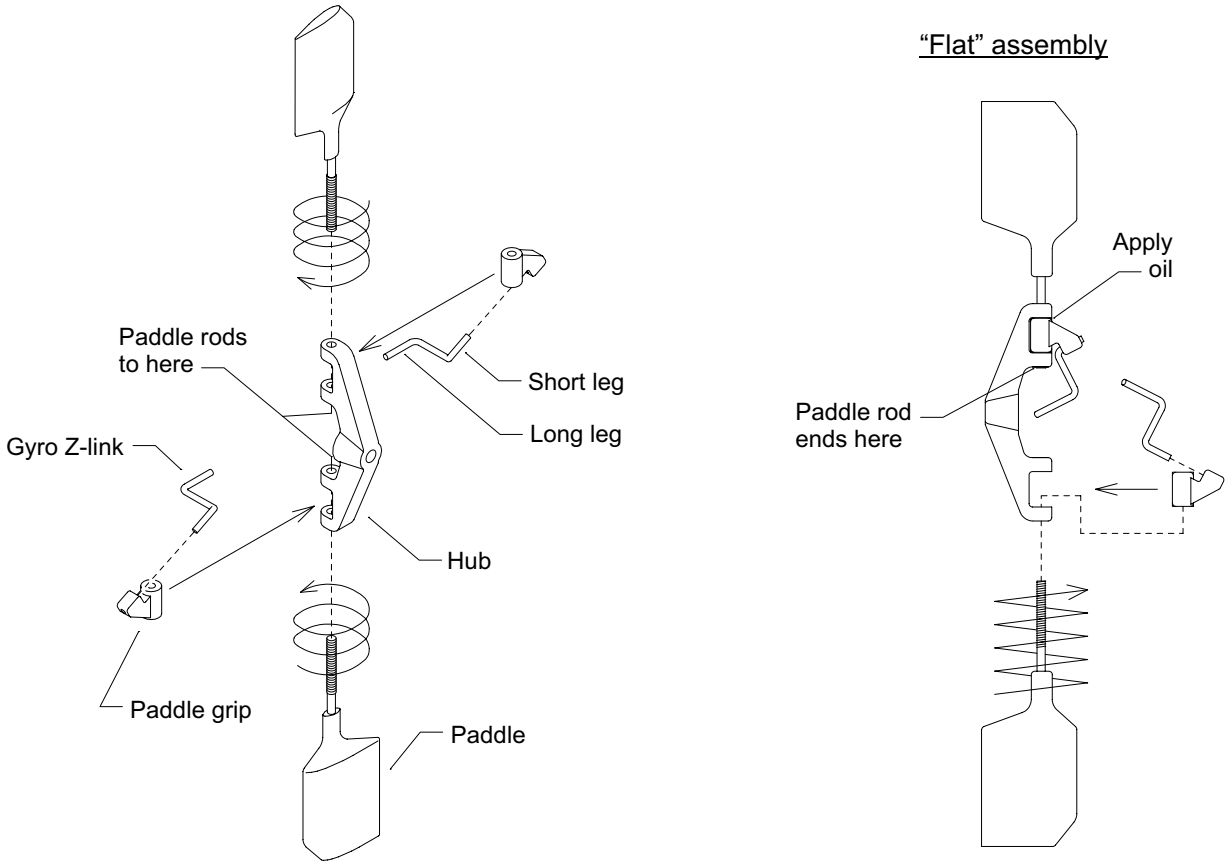
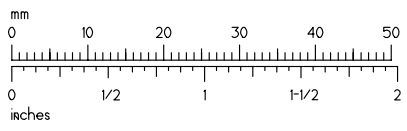


Figure 9-3.

- ❑ 11. Test fit the paddle grips into the gyro hub. Remove all molding flash from the ends of the grips and from the gyro hub where the grips touch the hub. If the grips fit tightly into the hub, shorten the grips very slightly with sandpaper or a hobby knife.
- ❑ 12. The gyro Z-links have one short leg and one long leg. Insert the short leg of each Z-link into a paddle grip as shown in Fig. 9-3. One at a time, insert the threaded rod portions of the gyro paddles into the ends of the gyro hub. Screw the threaded rods completely through the paddle grips until the ends of the rods are flush with the interior of the hub. An easy way to do this is to lay the unassembled components flat on the edge of a table while screwing the paddles in place.

Note:

The threaded rods extending from the gyro paddles are also threaded inside the gyro paddles. When removing a gyro paddle in the future, grip the rod with a pliers (instead of gripping the paddle with your hand) to avoid unscrewing the paddle from the rod.



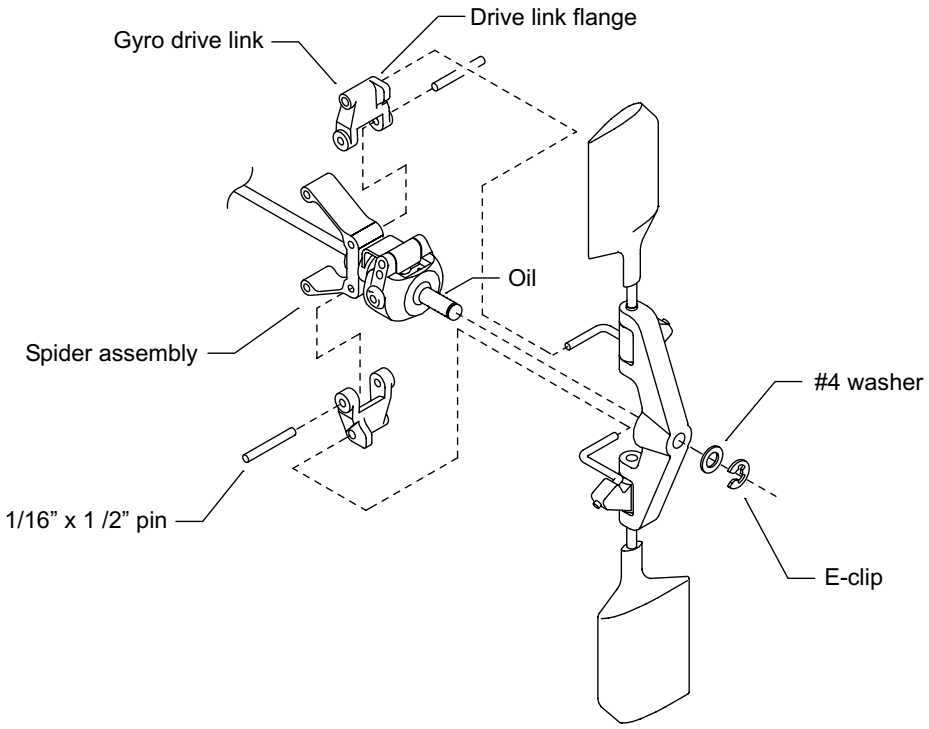
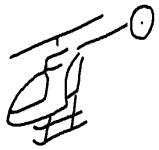


Figure 9-4.

- ❑ 13. Place a drop of oil on the gyro spindle shaft and slide the gyro hub and a standard #4 washer (not an oversize washer) onto the shaft as shown in Fig. 9-4. Press an E-clip firmly into the groove at the end of the shaft to retain the gyro hub and washer.
- ❑ 14. Slide a gyro drive link over the long leg of each Z-link and connect the drive links to the spider with 1/16" x ½" pins. Make sure the drive links are oriented with their flanged side touching the Z-links.
- ❑ 15. Make sure that the gyro paddles can pivot very freely about the gyro pivot pins. Locate the source of any friction or binding and fix it before proceeding.

Note:

The gyro Z-links are designed to pop out of the drive links in a hard crash to reduce the possibility of damage to the tail rotor and drive gears. When reassembling the gyro after a crash, be careful to push the Z-links straight into the drive link holes so that the sharp ends of the Z-links do not cut the inside of the drive link holes and enlarge them.



Tail Boom

The tail boom on the *Model 110* helicopter is an aluminum tube that extends rearward from the body, and terminates in the tail rotor assembly. A wire drive shaft runs down the length of the tail boom, and transmits power from the main rotor shaft to the tail rotor and *Arlton Gyro* stabilizer. The tail rotor incorporates specially designed, high efficiency swept rotor blades (patented) which greatly reduce the mechanical complexity and power consumption of the tail rotor.

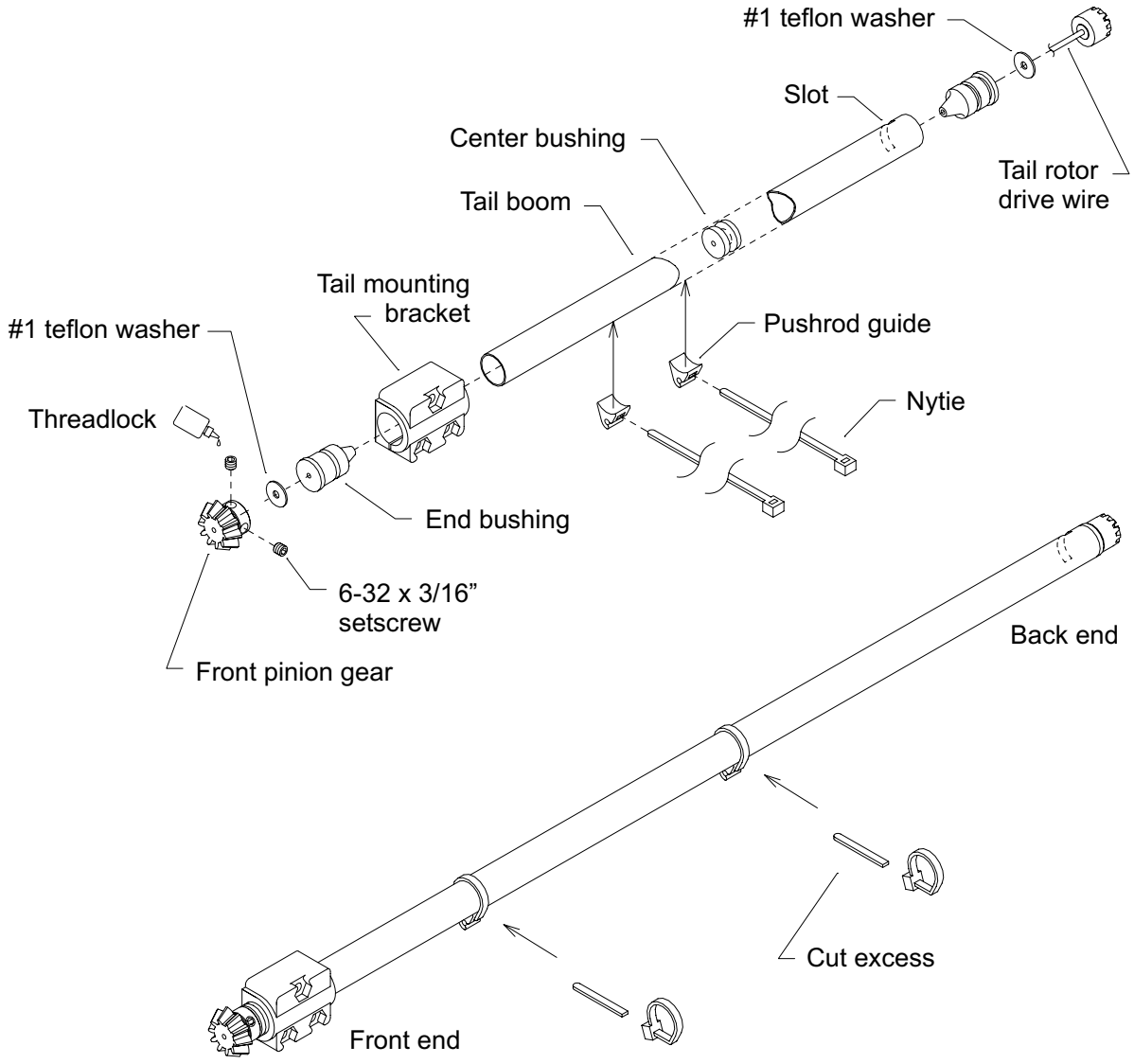


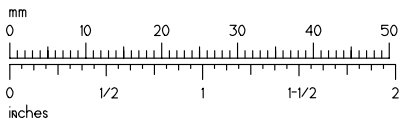
Figure 10-1.

- ❑ 1. In the next steps you will wrap your tail boom with white trim sheet to give it color. Note that the tail boom bracket and tail rotor gearbox fit at each end of the tail boom as shown in Fig. 10-2). Cut two strips of white trim sheet 6.5" x 1-5/8" (165mm x 41mm). Wrap one sheet around the front half of the tail boom leaving 1-3/16" (30mm) of the front end exposed to fit inside the tail boom bracket (note that the front end of the boom is the end without the slot). Wrap the other sheet around the rear half of the tail boom leaving 5/8" (16mm) exposed to fit inside the tail rotor gearbox. As you roll the trim sheets around the boom, the seam should overlap about .25" (6mm) to seal out oil.
- ❑ 2. Locate two plastic end-bushings and a single center-bushing. Apply a drop of oil to the shaft hole in the center bushing, and insert it into the aluminum tail boom (refer to Fig. 10-1). Note that the center bushing is tapered, and will go into the tail boom in only one direction. Push the bushing to the middle of the boom with a long wooden pencil, and insert an end bushing into each end of the boom.
- ❑ 3. Slide the tail boom mounting bracket onto the front end of the boom as shown in Fig. 10-1 with the double bolt holes positioned below the boom.
- ❑ 4. Fill the shaft holes in the two end bushings with oil. Slide a small (#1) teflon washer onto the drive wire, and insert the wire into the rear bushing (located at the notched end of the boom), through the center bushing and out the front bushing.

Note:

The hole in a #1 washer is smaller than the hole in a #2 washer. If a #2 bolt will not pass through a washer, it is probably a #1 washer.

- ❑ 5. Clean the end of the drive wire at the front end of the tail boom with a tissue to remove any oil. Slip a small (#1) teflon washer over the wire, and mount the front pinion gear to the wire with two 6-32 x 3/16" setscrews and threadlock. Leave a small gap between the front pinion gear and washer (about the thickness of a piece of newspaper) to avoid excessive drag and wear. The drive wire should rotate freely inside the bushings.
- ❑ 6. Attach two pushrod guides to the tail boom with short nyties (nylon cable ties) as shown. The exact orientation will be set later when the tail rotor pushrod is attached. After pulling the nyties tight with a pliers, cut the excess off with a knife or scissors.
- ❑ 7. Locate the 7x13x4mm and remaining 5x11x4mm ball bearings, and apply oil as you did before for the main rotor.
- ❑ 8. As shown in Fig. 10-2, slide the tail rotor hub into the 7x13x4mm bearing and over the end of the tail rotor shaft until the end of the hub rests against the plastic bevel gear. Press the hub and gear together while securing the hub to the shaft with 6-32 x 1/8" setscrews and threadlock. Make sure no threadlock gets on the tail rotor shaft inside the tail rotor hub. This will make disassembly difficult later.



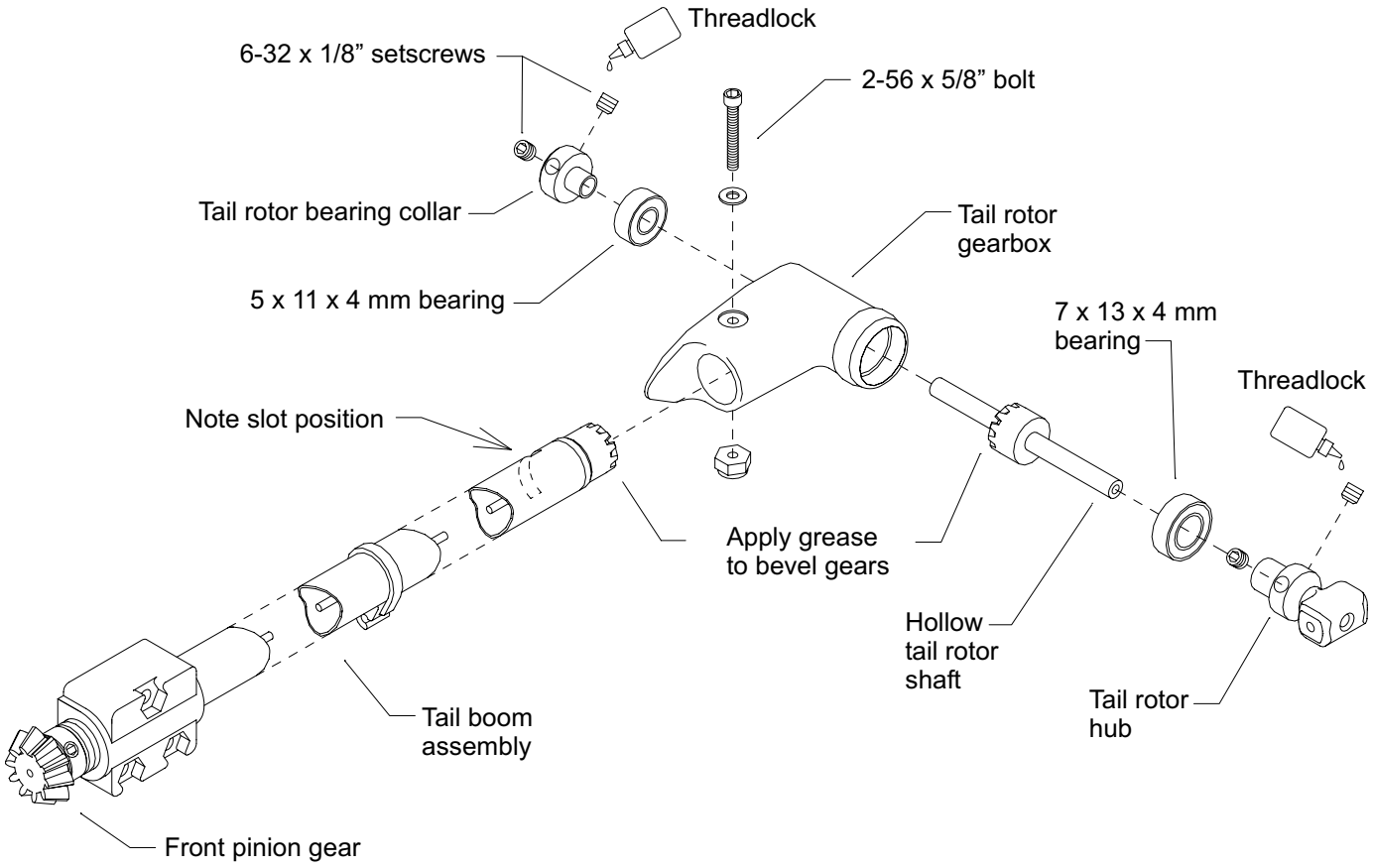


Figure 10-2.

❑ 9. Press a 5x11x4mm bearing and bearing collar into the tail rotor gearbox as shown. Apply *Lite Lube* (or similar) grease to the gear on the shaft, and insert the shaft into the gearbox. **MAKE SURE BOTH BEARINGS ARE COMPLETELY SEATED**.

Note:

Petroleum-based greases and oils (like automotive motor oil) can cause certain plastics to crack or become brittle. Do not use petroleum-based oil or grease on the tail rotor gears because the oil or grease will damage the plastic gearbox over time and cause it to crack.

❑ 10. Secure the tail rotor bearing collar to the shaft with two 6-32 x 1/8" setscrews and threadlock while lightly squeezing the hub and bearing collar together (this insures that the tail rotor shaft and gear are correctly positioned inside the gearbox). Make sure no threadlock gets on the tail rotor shaft inside the bearing collar.

- ❑ 11. Apply *Lite Lube* (or similar) grease to the bevel gear on the back end of the tail boom (remember, don't use petroleum-based grease), and insert the tail boom as far into the gearbox as it will go. This seats the two bevel gears against each other.
- ❑ 12. Look through the bolt hole in the gearbox and rotate the tail boom until the tail boom slot is aligned with the gearbox bolt hole. Install the 2-56 x 5/8" gearbox bolt, washer and nylock nut, but do not tighten the bolt.
- ❑ 13. Turn the pinion gear at the front of the tail boom by hand to check the gear mesh. The bevel gears should bind and turn roughly (this is normal). Simultaneously rotate and pull the tail boom out of the gearbox very slightly (a fraction of an inch) to open the spacing between the bevel gears, and check the mesh again. Repeat the process until the gears run smoothly. Note that the gear mesh should not be too loose or too tight. Tight gears absorb engine power, and loose gears tend to wear out quickly as the teeth skip.
- ❑ 14. Tighten the gearbox bolt to lock the gearbox to the tail tube. When tight, the gearbox nut will dent the tail boom and keep the gearbox from rotating around the tail boom. Check again that the gears rotate smoothly. If not, loosen the gearbox bolt and readjust the gear mesh.

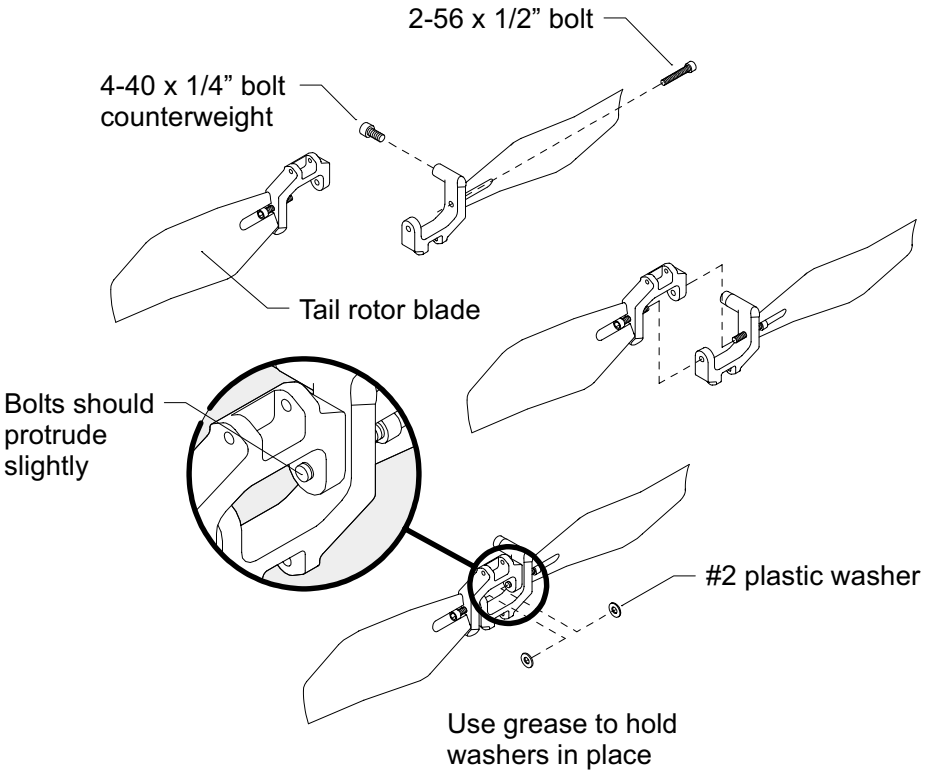
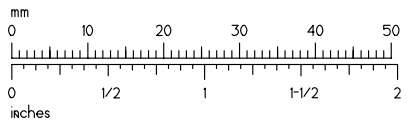


Figure 10-3.

- ❑ 15. Screw a 4-40 x 1/4" bolt counterweight into each tail rotor blade as shown in Fig. 10-3. Do not over tighten the bolts or the plastic will split.



❑ 16. Screw a 2-56 x ½" bolt into the root of each tail rotor blade as shown until about 3/16" (5mm) extends out the opposite side. Interlock the two blades as shown. Place a plastic #2 washer over the end of each bolt using dabs of grease to hold the washers in place.

❑ 17. Slip the interlocked blades over the end of the tail rotor hub, and screw in the 2-56 bolts until the bolt heads are seated against the plastic. You may need to unscrew the 2-56 bolts a few turns first to get the blades to fit onto the hub. Make sure the blades are correctly oriented on the hub and pivot freely.

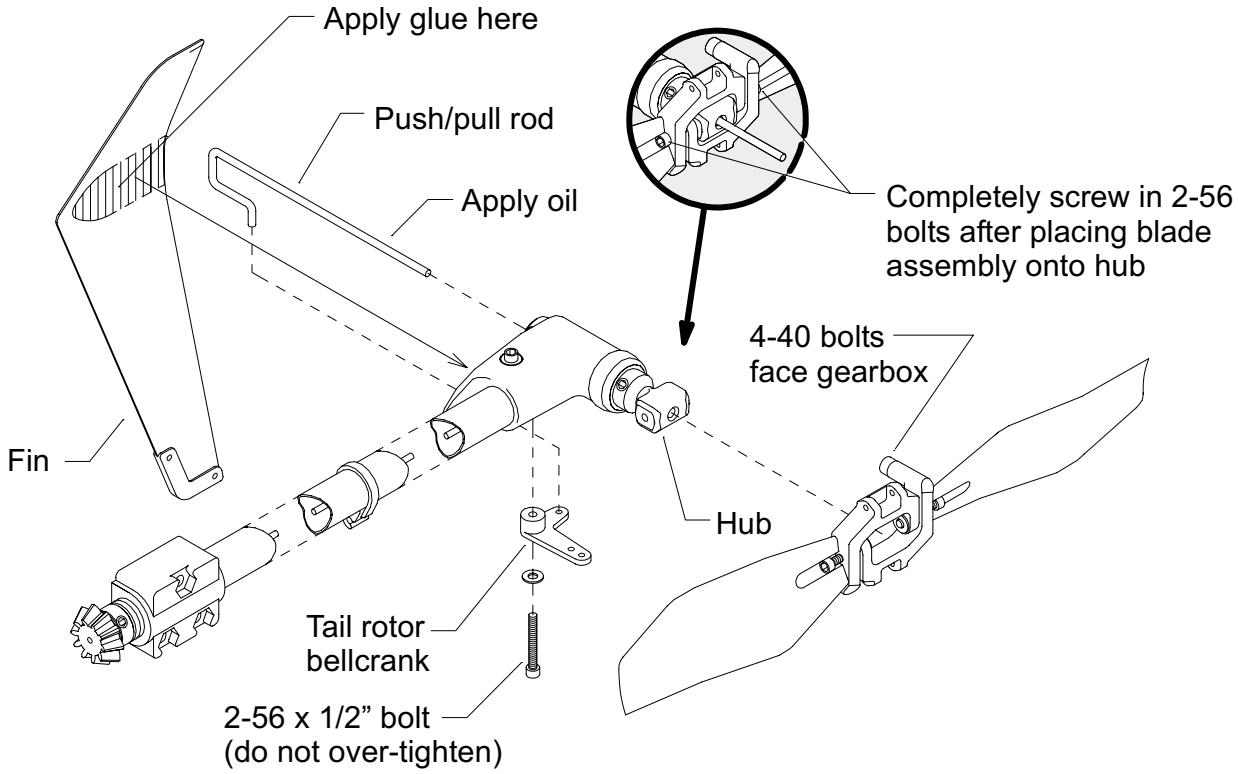


Figure 10-4.

❑ 18. Thoroughly sand the flat side of the gearbox and the corresponding area of the plastic tail fin with coarse (120 grit) sandpaper to completely remove the glossy surface. Apply **THICK** CA to the fin and gearbox, and hold the fin in position against the gearbox for about ten seconds or until the glue starts to set.

Note:

CA accelerator can cause certain plastics to crack or become brittle, so do not use CA accelerator on or near the gearbox or tail fin. Also, do not use thin CA on the tail fin; it will not fill the gap between the fin and gearbox and the fin will break off easily.

❑ 19. Locate the *Arlton Gyro* stabilizer assembly you built previously. Loosen the 6-32 setscrew in the pivot mount, and remove the push/pull rod. Place a few drops of oil on the push/pull rod and slide it through the tail rotor shaft as shown in Fig. 10-4.

❑ 20. Slide the **SHORT** end of the tail rotor bellcrank onto the end of the push/pull rod, and bolt the bellcrank to the bottom of the gearbox with a 2-56 x ½" bolt, washer and threadlock (use only threadlock labeled as “plastic-safe”). Tighten the bolt all the way, then back it off ½ turn or until the bellcrank pivots freely (this is similar to the procedure for adjusting the 2-56 bolts holding the mixing arms onto the rotor head). Make sure the push/pull rod moves freely within the tail rotor shaft when the bellcrank is moved.

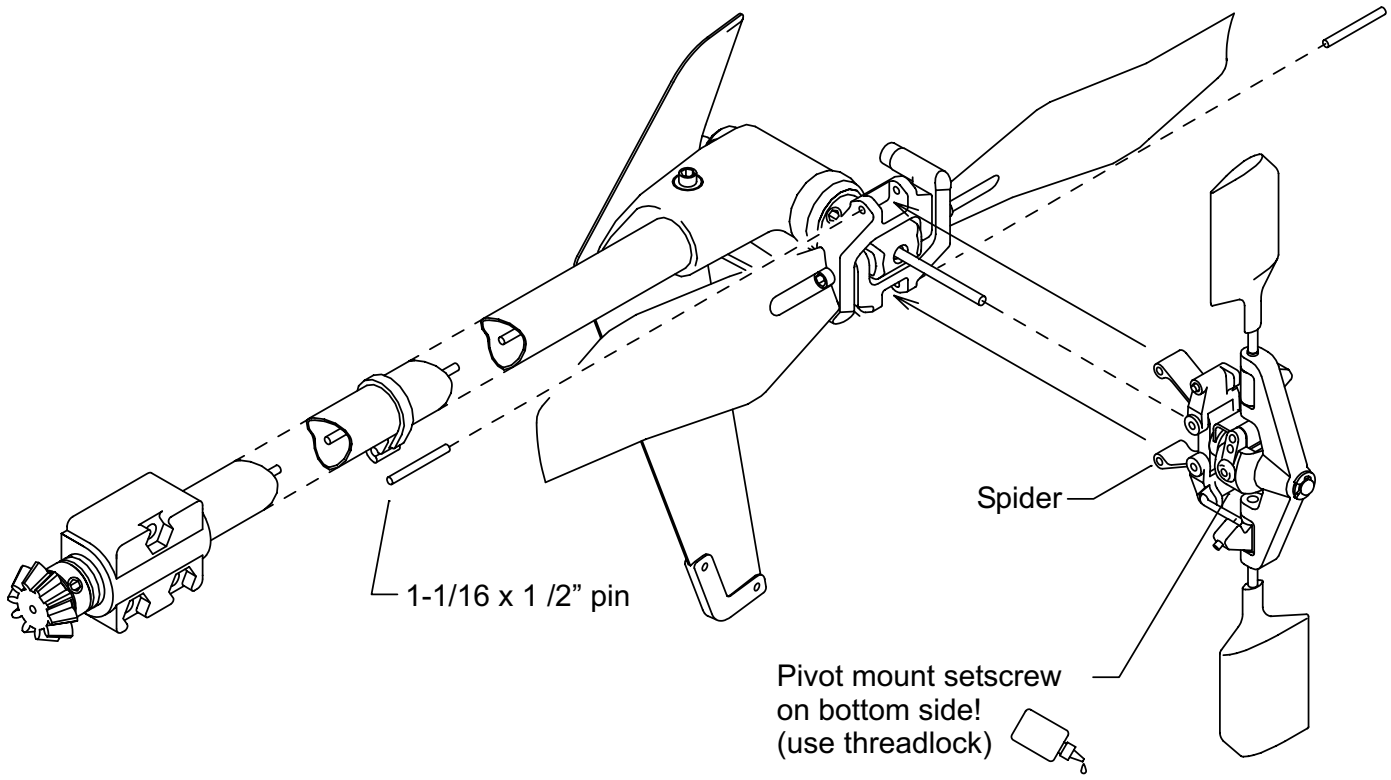
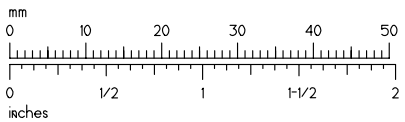


Figure 10-5.

❑ 21. With a tissue, clean any oil from the last 1/4" (6mm) of the push/pull rod extending from the tail rotor shaft. Mount the gyro assembly to the end of the push/pull rod as before using threadlock on the pivot-mount setscrew as shown in Fig. 10-5. **MAKE SURE THE SETSCREW IN THE GYRO PIVOT MOUNT FACES DOWN, OR GYRO SENSING WILL BE REVERSED AND THE GYRO WILL DESTABILIZE THE TAIL**. Also check that the end of the push/pull rod does not extend out from the pivot mount and jam the gyro spindle.

❑ 22. Tilt the gyro back and forth about the pivot pins. It should move very freely. If it does not, locate and eliminate the cause of friction or binding.



Engine

The engine on a helicopter provides the mechanical power necessary to rotate the main rotor and tail rotor. The *Model 110* helicopter uses a special Norvel *Vmax-6* helicopter engine with a heat sink, goop clutch and high-power *SpiraLite* or *Freedom XL* glow plug. Like most model engines, the Vmax-6 runs on model engine fuel containing methanol, castor oil and nitro methane. The unique *Vmax-6* throttle-muffler provides precise throttle control, and traps exhaust gases inside the cylinder which keep the glow plug hot for a more reliable idle. The simple, one-piece goop clutch is automatically lubricated by the castor oil goop naturally dripping out of the engine.

❑ 1. Cut a 3/16" (5mm) piece of fuel tubing for use as a needle valve seal. Unscrew the needle valve from the spraybar, slide the tubing over the end of the spraybar, and carefully screw the needle valve back into the spray bar as shown in Fig. 11-2. Be careful not to over tighten the needle valve and damage the spraybar.

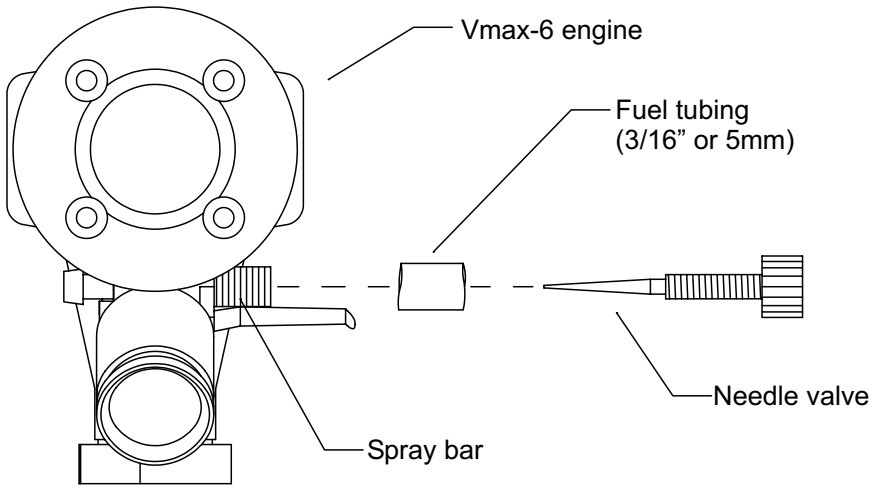


Figure 11-1.

❑ 2. Insert the threaded portion of the clutch shaft through the metal clutch shoes. Make sure the clutch shoes are not upside down - the flat face of the clutch shoes should rest against the engine. Place a drop of threadlock onto the threaded portion of the clutch shaft, and screw the assembly onto the front of the engine. Tighten the shaft with a small wrench (use another wrench on the prop washer to keep the crankshaft from turning).

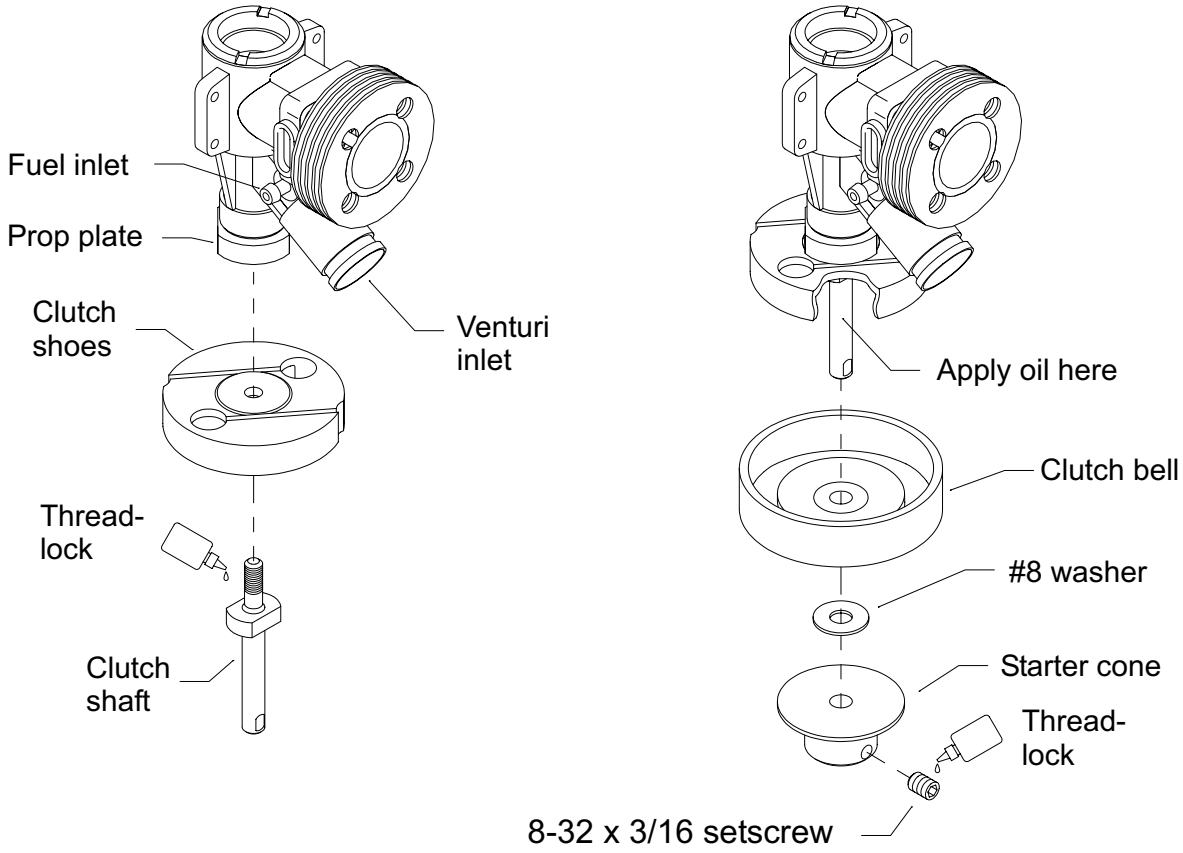
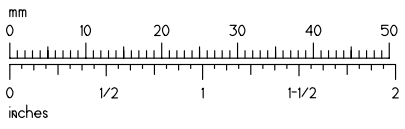


Figure 11-2.

❑ 3. Place a drop of oil on the clutch shaft, and slide the clutch bell and a #8 washer (with a 5/32" or 4mm hole) onto the clutch shaft as shown in Fig. 11-2. Mount the starter cone to the end of the clutch shaft with an 8-32 x 3/16" setscrew and threadlock. Make sure the starter cone setscrew engages the flat on the clutch shaft. When assembled, the clutch bell should spin freely and have a small amount of vertical play (the starter cone should not press the clutch bell against the clutch shoes). Place another drop of oil between the washer and the clutch bell pinion gear.

❑ 4. If you intend to use 15% nitro fuel, place two thin copper glow plug washers into the cylinder as shown in Fig. 11-3. If you intend to use 25% nitro fuel, use four washers. Be careful, they are easily bent or crimped if not fully seated when you tighten the heat sink. Place a *SpiraLite Speed* or *Freedom XL* glow plug on top of the washers, and screw the heat sink into the cylinder. Grip the heat sink with a cloth while tightening it.



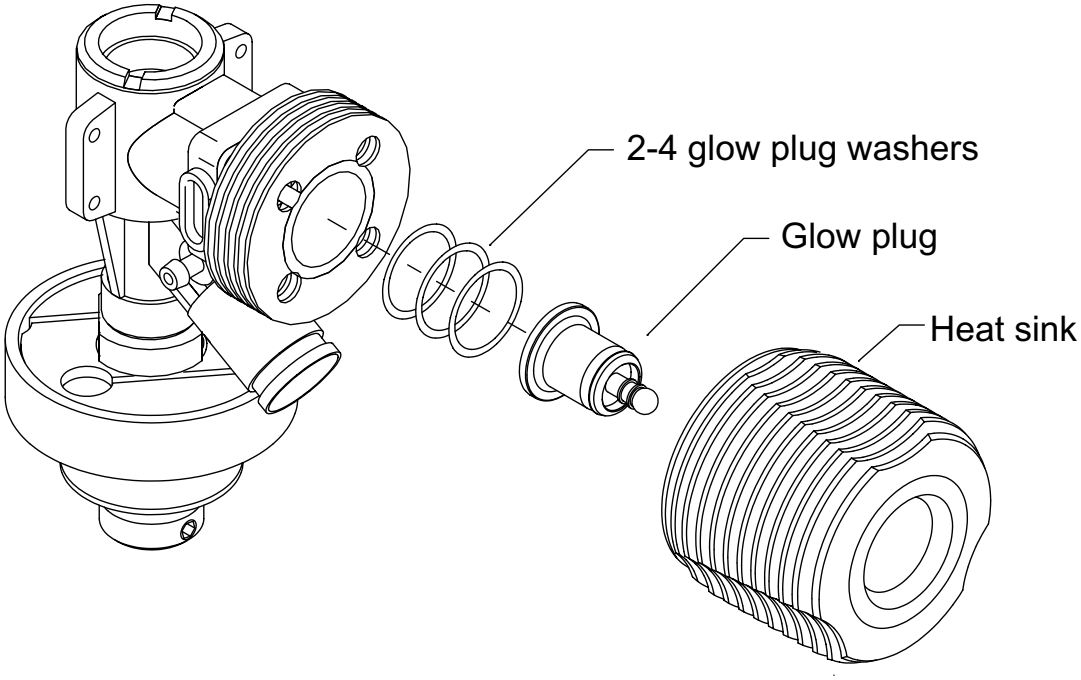


Figure 11-3.

Final Assembly

In this section you will assemble the subassemblies you have already built into something resembling a helicopter. Carefully follow all instructions concerning alignment to insure a smooth running power transmission. Make sure your radio batteries are charged - you will need to use the radio in the next section.

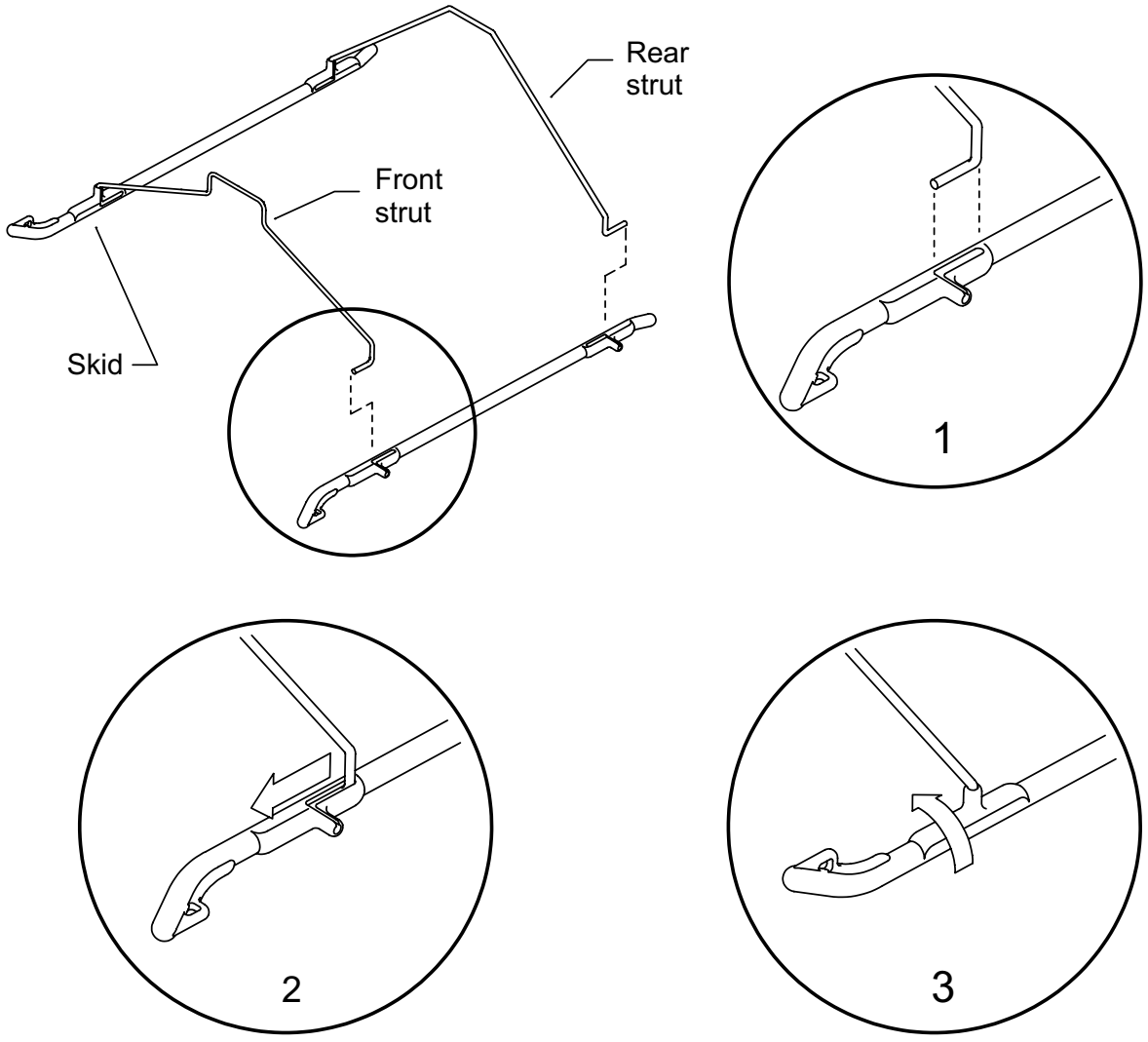


Figure 12-1.

❑ 1. Attach the plastic landing gear skids to the wire landing gear struts as shown. Note that the front and rear struts are different.

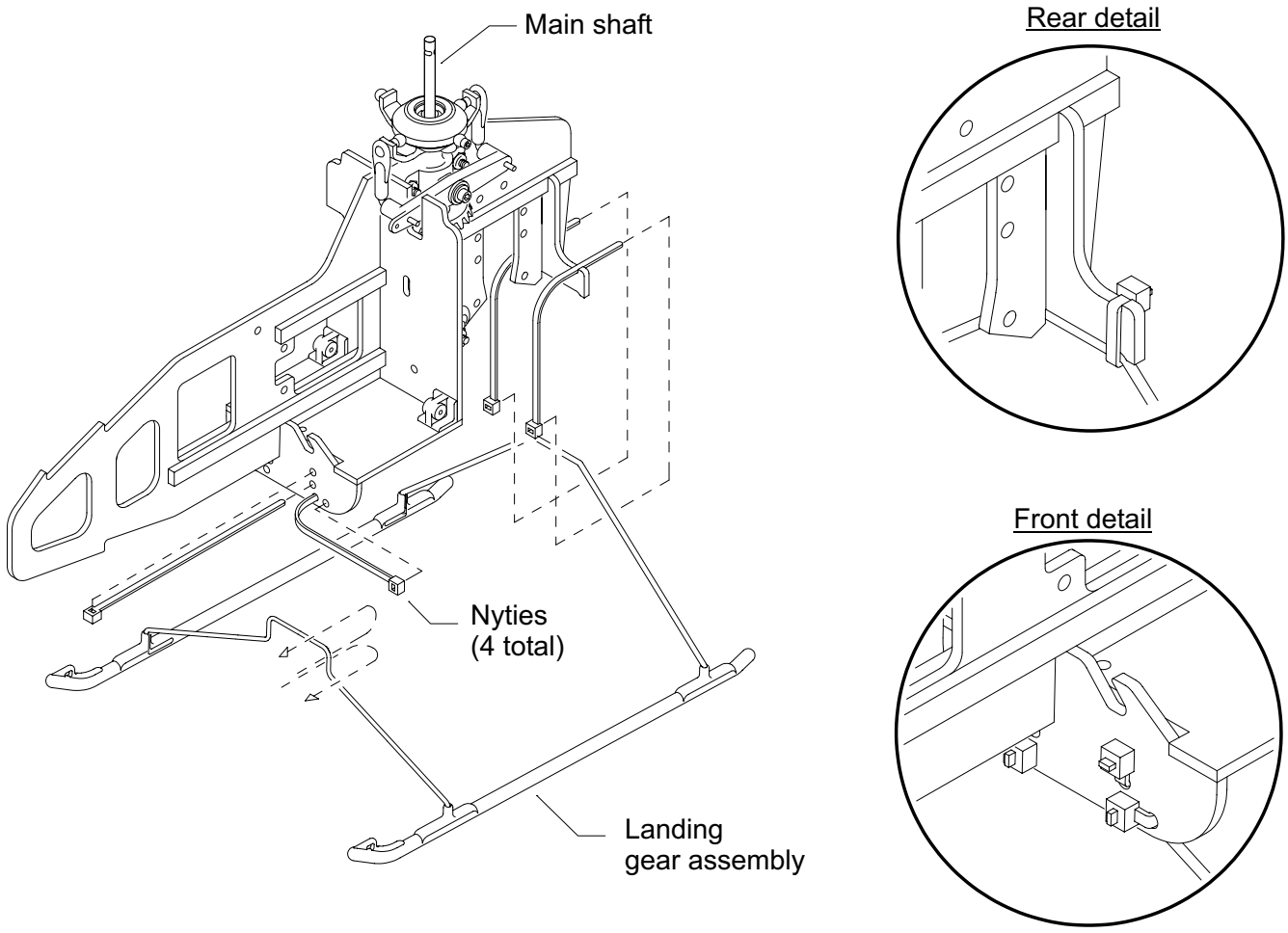
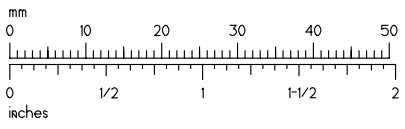


Figure 12-2.

- ❑ 2. Study the orientation of the nyties in Fig. 12-2 before assembling the landing gear and crutch. Attach the landing gear to the crutch with short nyties as shown. Pull the nyties tight with a pair of pliers before clipping the ends. **BE CAREFUL NOT TO POKE YOURSELF WITH THE TOP END OF THE MAIN SHAFT.**

- ❑ 3. Mount the rotor head back onto the top of the main shaft as shown in Fig. 12-3 (review Fig. 7-10 if necessary).

- ❑ 4. Snap the follower link onto the middle of the three swashplate universal balls. Loosen the setscrews in the two bearing collars on the main shaft (see Fig. 7-9 if necessary) in order to adjust the height of the shaft. Move the shaft up or down until the *Subrotor* stabilizer and follower arm are level with the swashplate and fore/aft control arm as shown in Fig. 12-3.



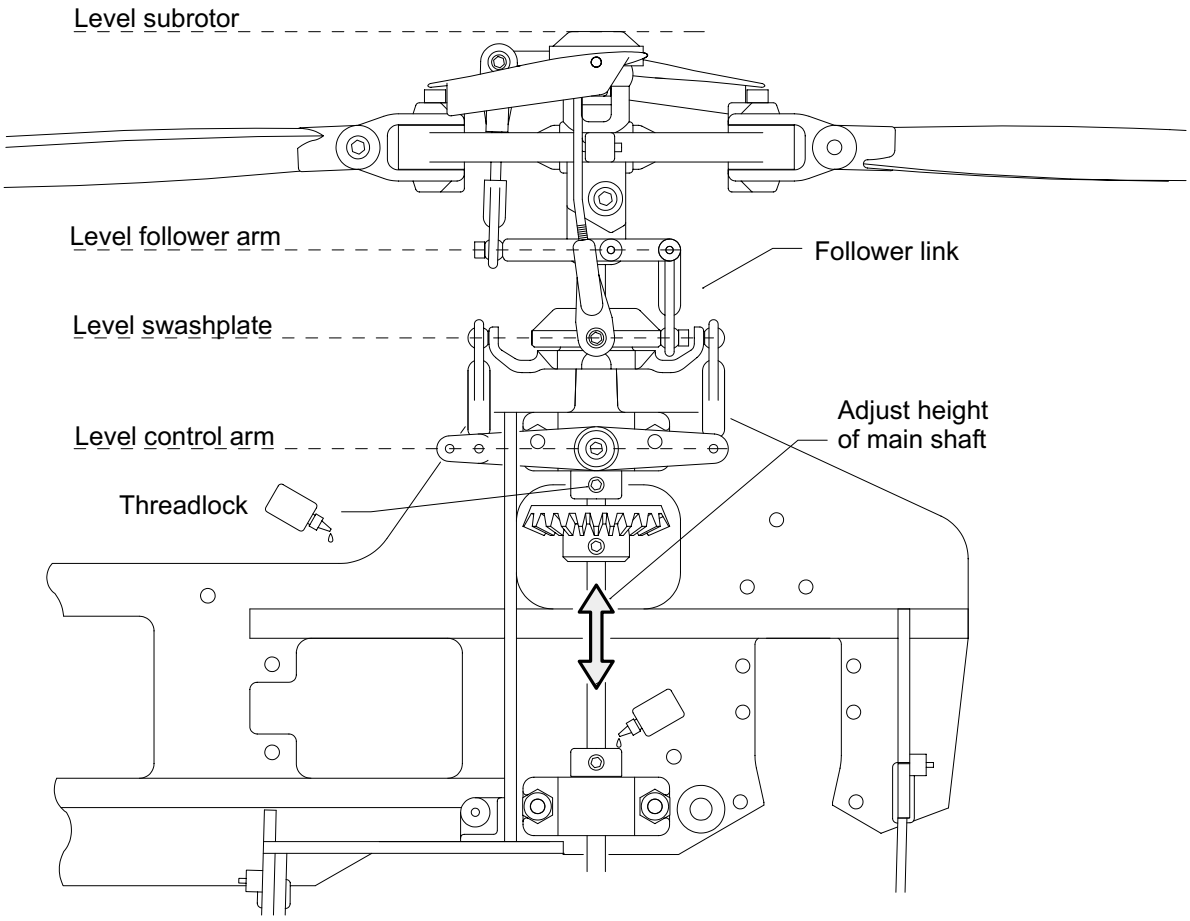


Figure 12-3.

Note:

Certain important setscrews, such as on the main-shaft bearing collars and main gear, need to be very tight (the instructions will mention this in bold type). To make a setscrew very tight, insert the short end of a hex wrench into the setscrew, and grip the long end for extra leverage. These setscrews also require threadlock to insure they will not vibrate loose.

❑ 5. When the shaft is correctly positioned, push the bearing collars firmly against the upper and lower bearings so the shaft cannot move vertically, and secure the setscrews in the bearing collars with threadlock. **MAKE SURE THE COLLAR SETSCREWS ARE VERY TIGHT.**

❑ 6. Snap the mixing arm pushrods onto the two free swashplate universal balls. Adjust the length of the pushrods if necessary to prevent the rotor head from binding (final adjustments will be made later while flying). Make sure the pushrods are of equal length.

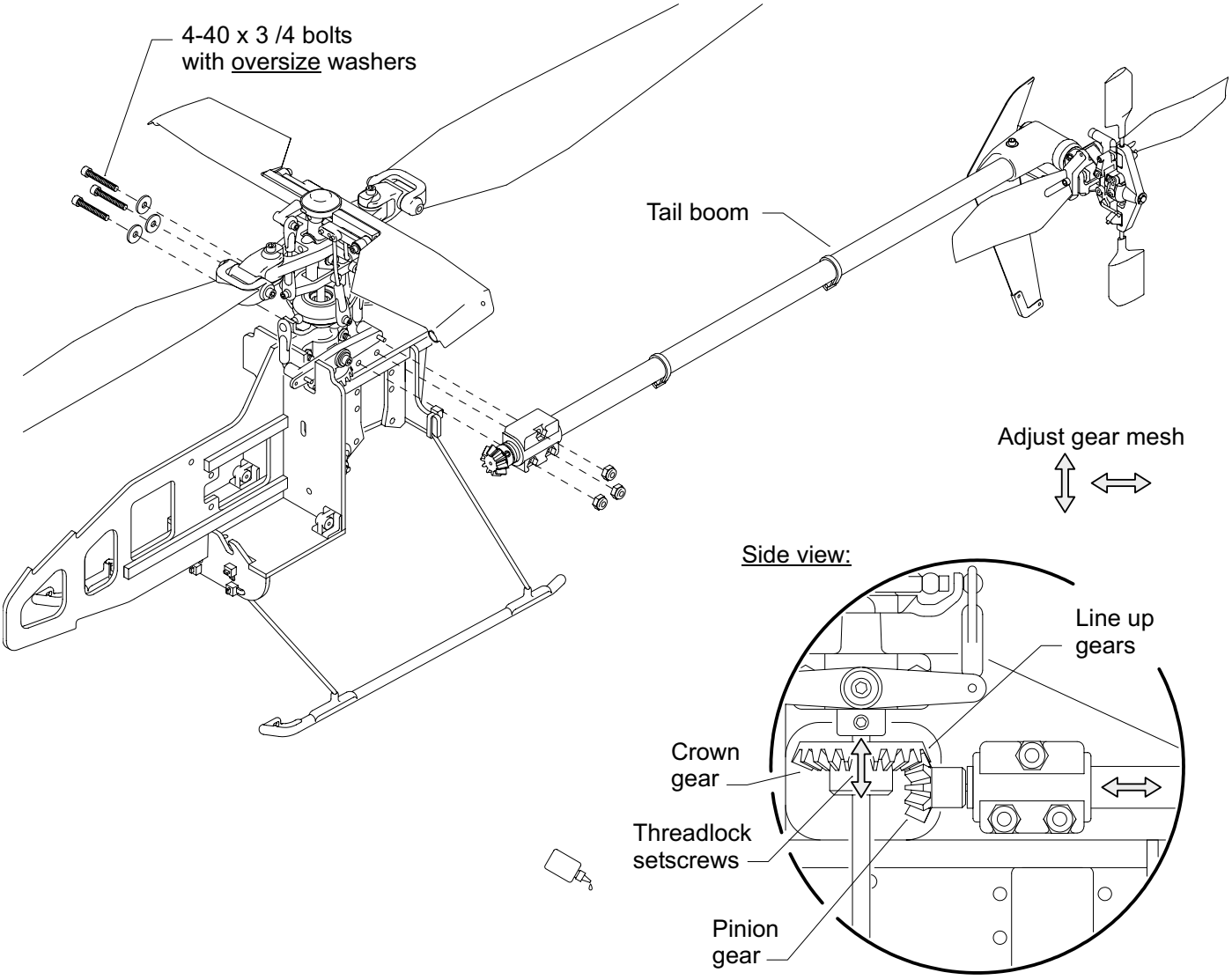
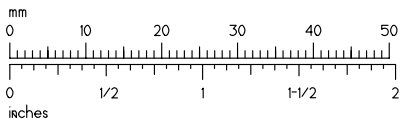


Figure 12-4.

- ❑ 7. Loosely bolt the tail boom assembly to the crutch using three 4-40 x 3/4" bolts, three nylock nuts and **OVERSIZE** washers (3/8" or 9.5mm outside diameter) as shown in Fig. 12-4. Move the crown gear up higher on the main shaft to clear the pinion gear on the tail tube if necessary.

- ❑ 8. Position the tail tube horizontally so that the back of the pinion gear teeth are even with the outer edge of the crown gear. Rotate the tail tube until the tail fin is vertical (and the tail rotor shaft is horizontal). When the tail boom is properly positioned, tighten the three mounting bracket bolts to secure the tail tube to the crutch



❑ 9. To set the crown-gear/pinion-gear mesh, adjust the height of the crown gear in a manner similar to meshing the tail rotor bevel gears. Push the crown gear down onto the pinion gear until the gears bind. Raise the crown gear slightly and tighten one crown gear setscrew. Rotate the main rotor to check the mesh, and repeat the process until the gears run smoothly. Once positioned properly, lock the crown gear to the shaft using threadlock on the setscrews. **MAKE SURE THE CROWN GEAR SETSCREWS ARE VERY TIGHT**.

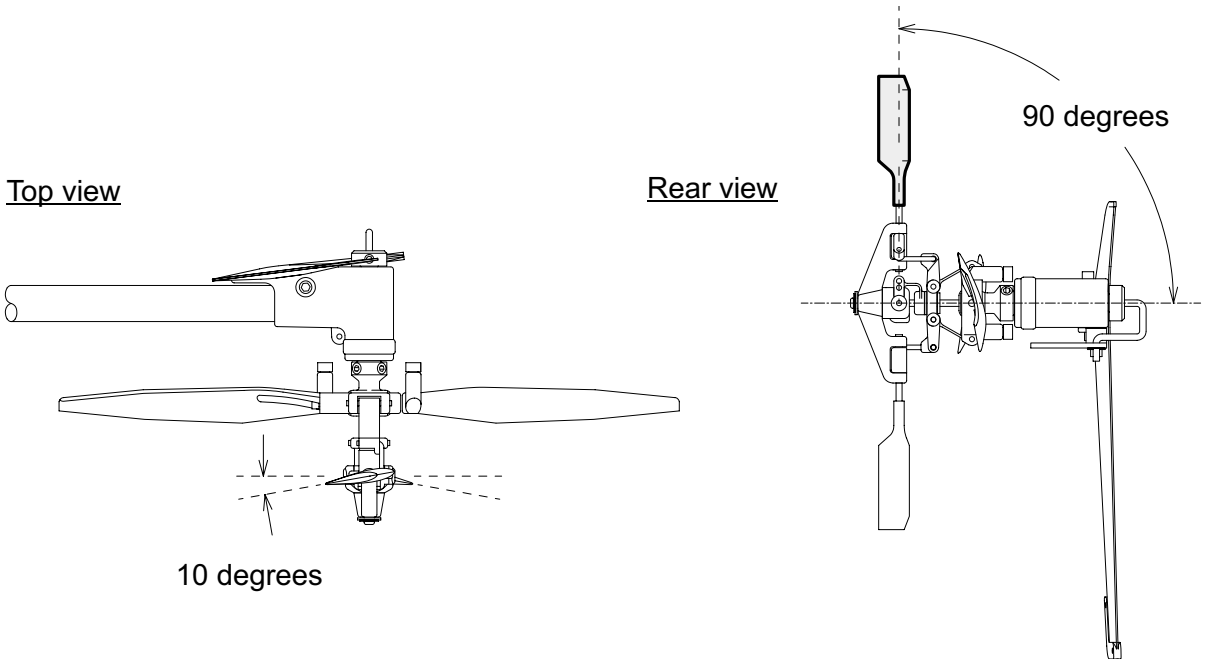


Figure 12-5.

❑ 10. In the following steps you will set the pitch of the tail rotor gyro paddles. First rotate the tail rotor until the gyro paddles are oriented vertically as in Fig. 12-5. Look straight down from above at the end of the top paddle. Notice that the paddle automatically changes pitch as you tilt the gyro back and forth.

❑ 11. While holding the gyro paddles at 90 degrees to the push/pull rod as shown in the rear view of Fig. 12-5, twist the top paddle counter-clockwise in its grip (when viewed from above) so that the paddle forms an angle of about 10 degrees with the tail rotor blades as shown in the top view. **IF THE PADDLES ARE NOT HELD AT 90 DEGREES TO THE PUSH/PULL ROD, THE PADDLE PITCH WILL BE SET INCORRECTLY.**

❑ 12. Rotate the tail rotor 180 degrees and set the pitch of the other paddle as in the previous step. The actual paddle pitch is not critical, but try to pitch the two paddles to the same angle.

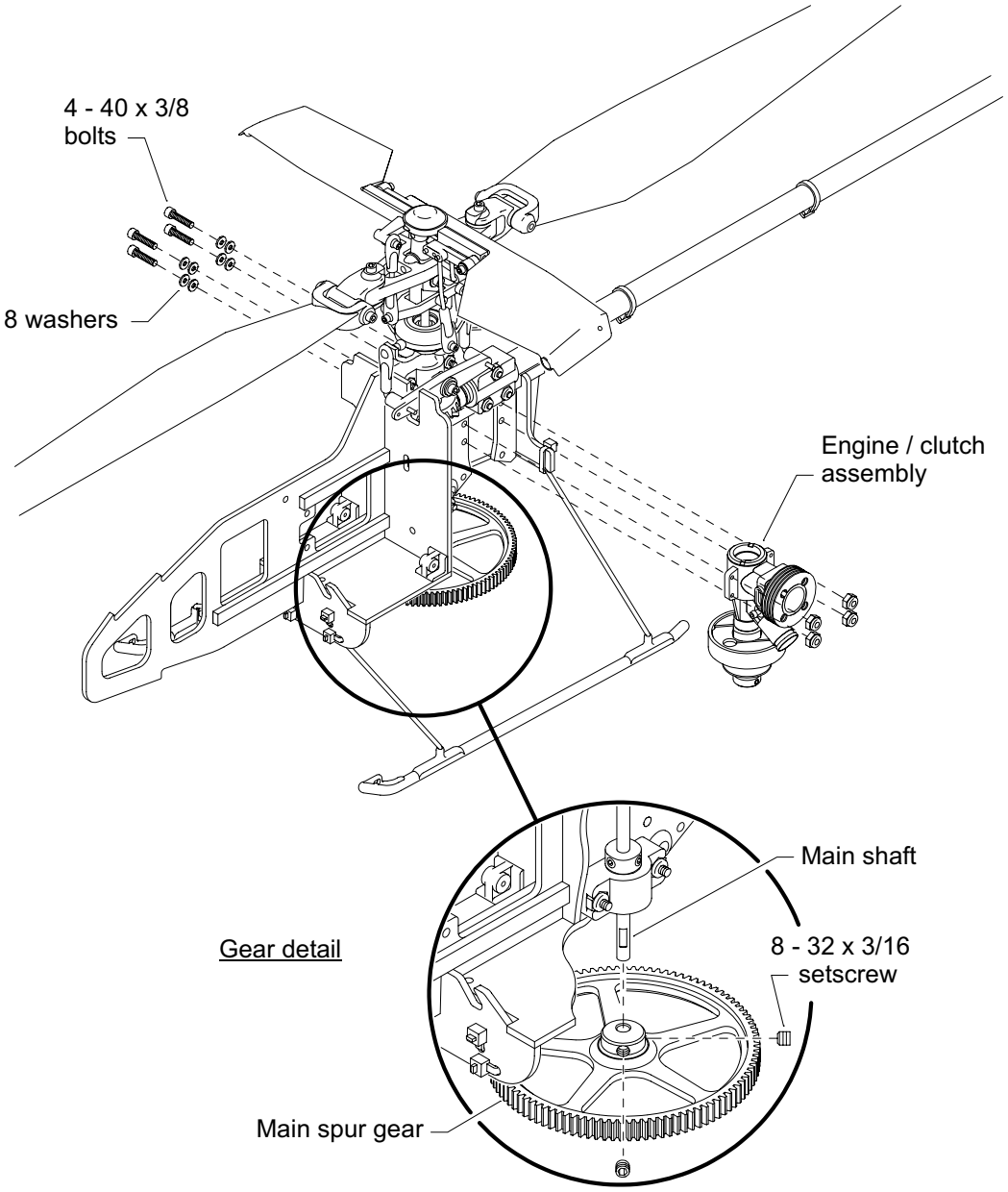
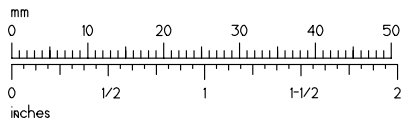


Figure 12-6.

- ❑ 13. Temporarily secure the main gear on the lower end of the main shaft with two 8-32 x 3/16" setscrews as shown in Fig. 12-6. Make sure one of the setscrews is centered on the flat you filed into the shaft. Loosen the two bolts holding the upper and lower bearing blocks to the crutch so they can be shifted slightly to set the main gear mesh.

- ❑ 14. Bolt the engine/clutch assembly to the crutch with four 4-40 x 3/8" bolts, washers and nylock nuts as shown (this may be easier if the heat sink and glow plug are removed). Tighten the bolts until the crutch plywood compresses slightly.



Note:

The engine bolts may loosen over time as the crutch plywood compresses. Remember to check the bolts before your first flight, and every few flights thereafter.

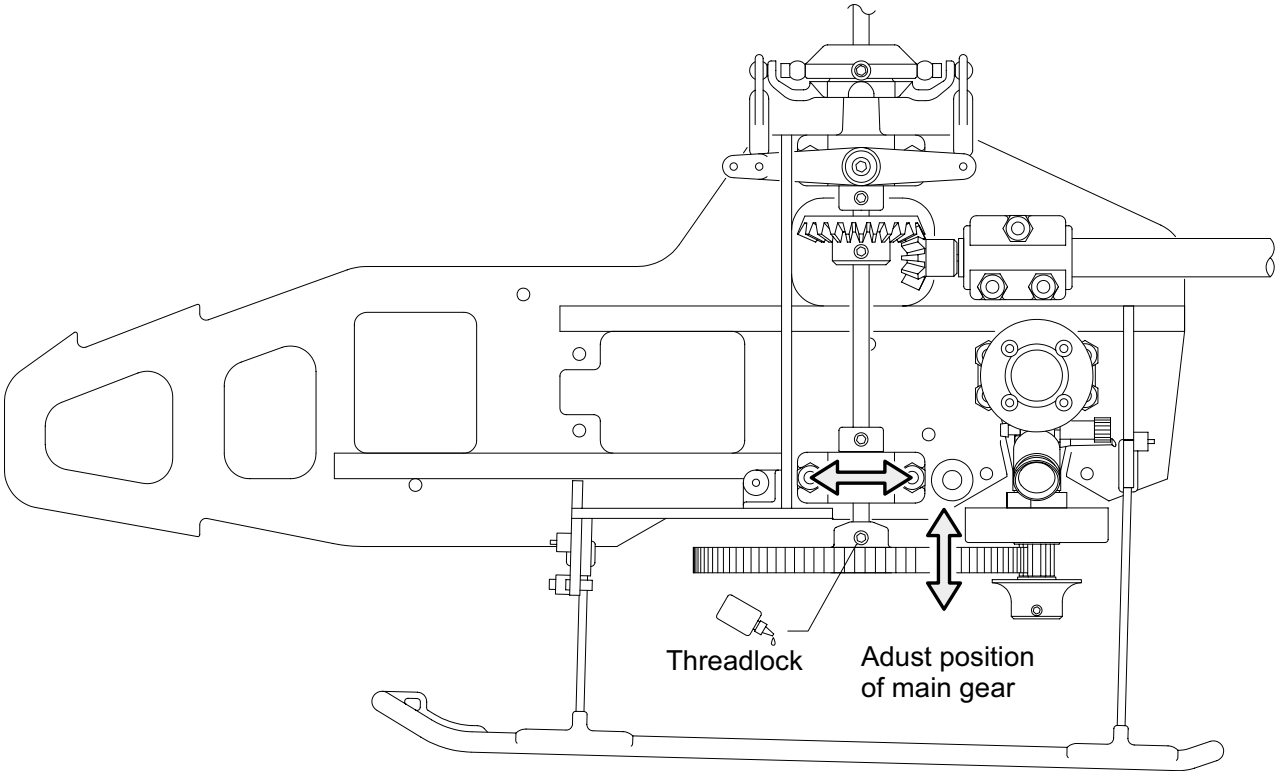


Figure 12-7.

- ❑ 15. Loosen the setscrews on the main gear shown in Fig. 12-7 so that it can slide up and down on the main shaft. Center the main gear vertically on the clutch bell pinion gear so that it does not hit the clutch bell or starter cone washer as it rotates. Note that the main gear may wobble slightly as it turns, so rotate it through a complete revolution to check vertical position. When correctly positioned, lock the main gear to the shaft using threadlock on the setscrews. **MAKE SURE THE MAIN GEAR SETSCREWS ARE VERY TIGHT.**

- ❑ 16. Proper spacing between the clutch pinion and main gear is important for maximum power transfer with minimum drag and gear wear. To set the gear mesh, adjust the horizontal placement of the lower bearing block in a manner similar to meshing the tail rotor bevel gears and crown gear. Push the main gear against the pinion gear until the gears bind. Move the lower bearing block forward slightly, and lightly tighten the bearing block bolts. Rotate the main rotor several complete revolutions to check the mesh, and repeat the process until the gears run smoothly. Once positioned properly, completely tighten all of the upper and lower bearing block bolts. Make sure not to over-tighten the bolts, or the nuts will spin in the bearing block nut recesses.

Hint:

Another way to mesh the main gear is to run a thin strip of newspaper between the gears. With the newspaper in place, force the bottom bearing block all the way toward the engine, and lightly tighten the lower bearing block bolts. Remove the strip of newspaper, and the gear mesh should be close to perfect. When the gears mesh smoothly, completely tighten all of the upper and lower bearing block bolts.

Full size tank filler tube

Figure 12-8

- ❑ 17. Bend the 3/32" (2.4mm) diameter aluminum fuel filler tube with your fingers until it matches the curvature shown at full scale in Fig. 12-8. Insert the filler tube into the top of the fuel tank, and push it into the sump at the bottom of the tank.

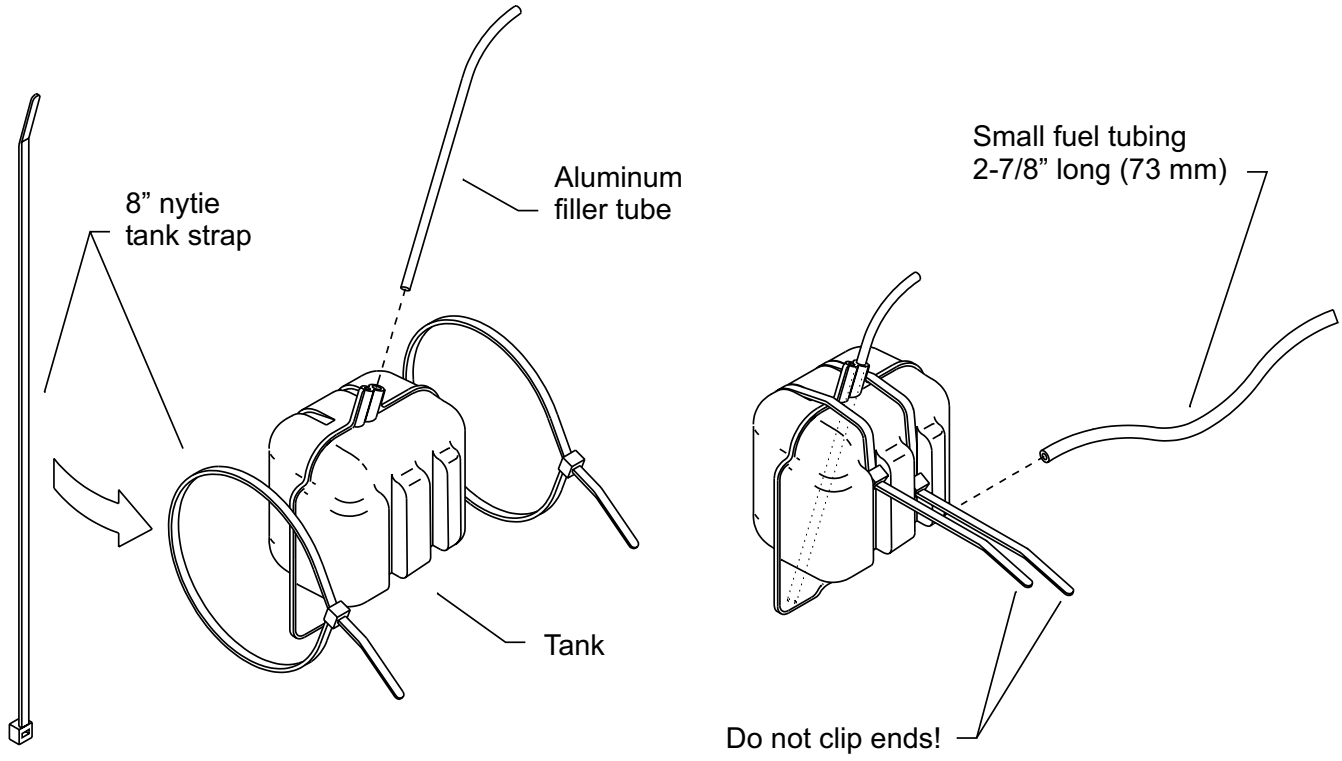
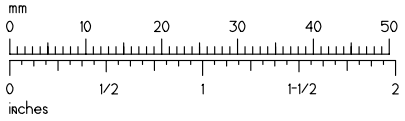


Figure 12-9.



❑ 18. Wrap two long (8" or 200mm) nytie tank straps around the fuel tank and tighten until snug as shown in Fig. 12-9. **DO NOT TRIM THE ENDS OF THE TANK STRAPS**; they will be used later to mount the tank to the crutch.

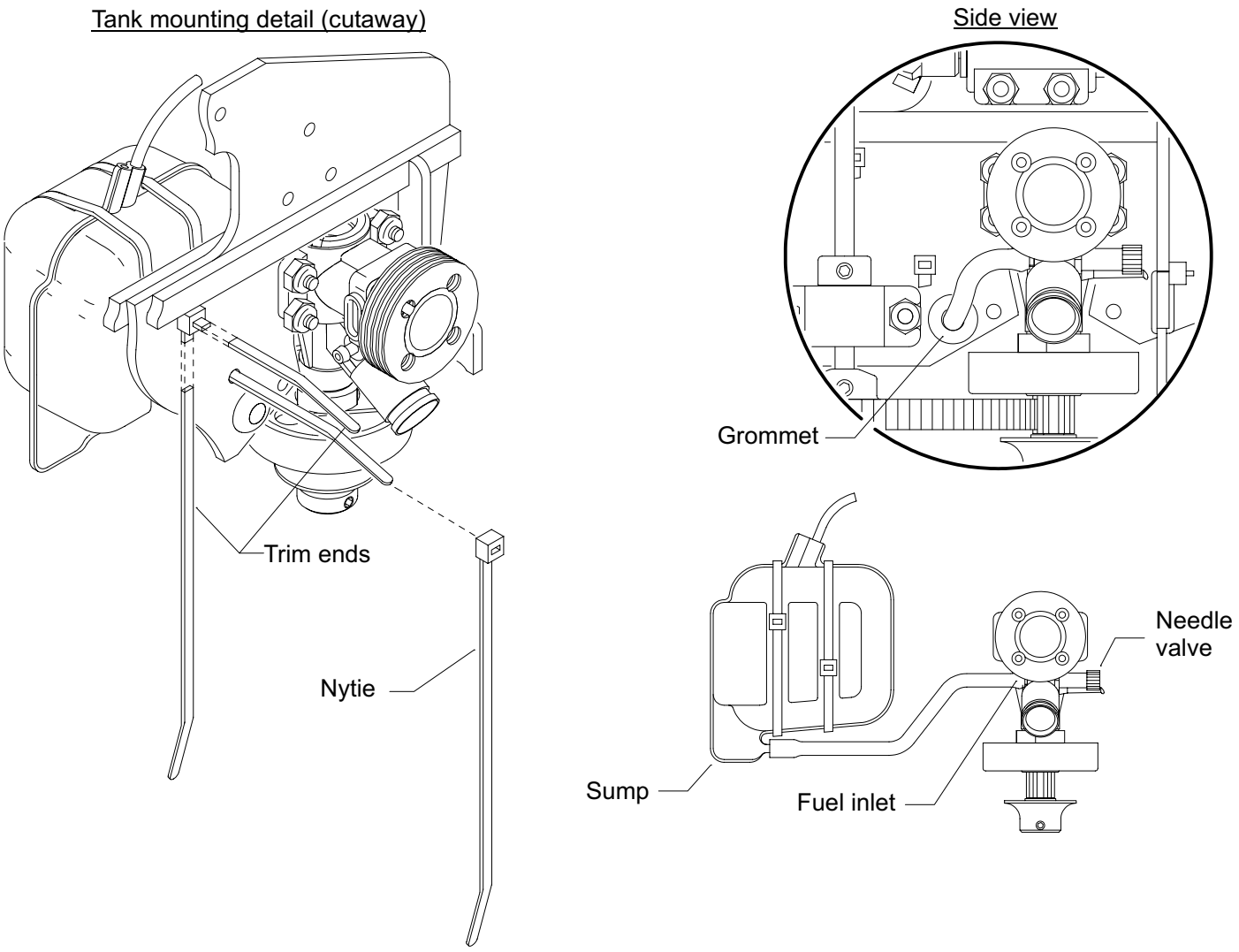
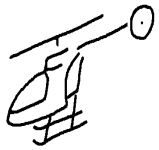
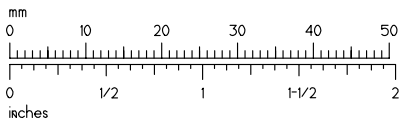


Figure 12-10.

❑ 19. Insert the ends of the two tank straps through the holes in the crutch and through two short nyties as shown in the cut-away view of Fig. 12-10. Pull the tank straps through the nyties until the tank is held firmly against the crutch. Clip the ends of the tank straps and nyties with a hobby knife (this is a little tricky since one of the nyties is behind the main shaft).

- ❑ 20. Attach one end of a 2-7/8" (73mm) length of silicone fuel tubing to the sump on the tank, and the other end to the fuel inlet on the engine. Note that the fuel line passes through the grommet in the crutch (see Fig. 12-10).





Radio Installation

In this section you will install the radio control system. The radio batteries should be charged before starting.

- ❑ 1. Apply a 2" x 2" (51mm x 51mm) piece of 1/8" (3.2mm) self-adhesive black foam tape to the battery side of the crutch as shown in Fig. 13-1 to pad the battery. Trim the excess tape with a scissors or hobby knife. Also pad the lower edge of the crutch opening with black foam tape immediately ahead of the front servo bay as shown. This padding will protect the radio wires that pass through the opening from chafing against the crutch.
- ❑ 2. Mount the four servos to the crutch (review Fig. 5-3 if necessary). Make sure the servos are oriented correctly. The wires on the left/right cyclic servo should point down, while those on the fore/aft cyclic servo should point up. The wires on both the throttle and tail rotor servos should point back toward the fuel tank.
- ❑ 3. If your radio ON/OFF switch lever does not have a side through-hole, drill one near the end of the lever big enough to accept a paper clip wire. Mount the radio ON/OFF switch to the crutch so that ON is **UP** and OFF is **DOWN**. Do not mount the switch with OFF in the up position or the radio might turn off during a hard landing.
- ❑ 4. Install a whip antenna (Dean's brand suggested) to the radio receiver as per the manufacturer's instructions. This usually requires shortening the standard wire antenna and soldering on a connector.
- ❑ 5. Press a rubber grommet (supplied with the whip antenna) into the antenna hole in the firewall, and mount the whip antenna. If using a two piece antenna, insure that the wire whip makes good electrical contact with the antenna base to avoid radio interference problems.
- ❑ 6. Wrap the receiver with 1/4" (6.3mm) latex foam and a few pieces of masking tape. This will protect the receiver from engine vibration and shock during a crash. Slip a thin plastic bag such as a sandwich bag (not shown) over the receiver and foam to protect against any dirt and oil that may get inside the canopy.
- ❑ 7. Mount the receiver and battery to the crutch using two or three newspaper rubber bands as shown in Fig. 13-2.
- ❑ 8. Straighten a paper clip and push it up through the hole in the floor under the ON/OFF switch. Hook the wire through the hole in the switch lever and bend the lower end as shown. Do not bend the wire at the bottom into a hook or L-shape shape; it might snag grass on a hard landing and turn off the radio.
- ❑ 9. Plug the battery into the ON/OFF switch, and plug the switch and servo wires into the receiver according to the radio manufacturer's instructions. If you are using a Hitec Focus 4 radio system, plug right/left cyclic into slot 1, fore/aft cyclic into slot 2, throttle into slot 3, tail rotor into slot 4 and the battery switch into slot B/8. Temporarily install a servo arm onto each servo (the arms do not have to look like the ones in Fig. 13-2).

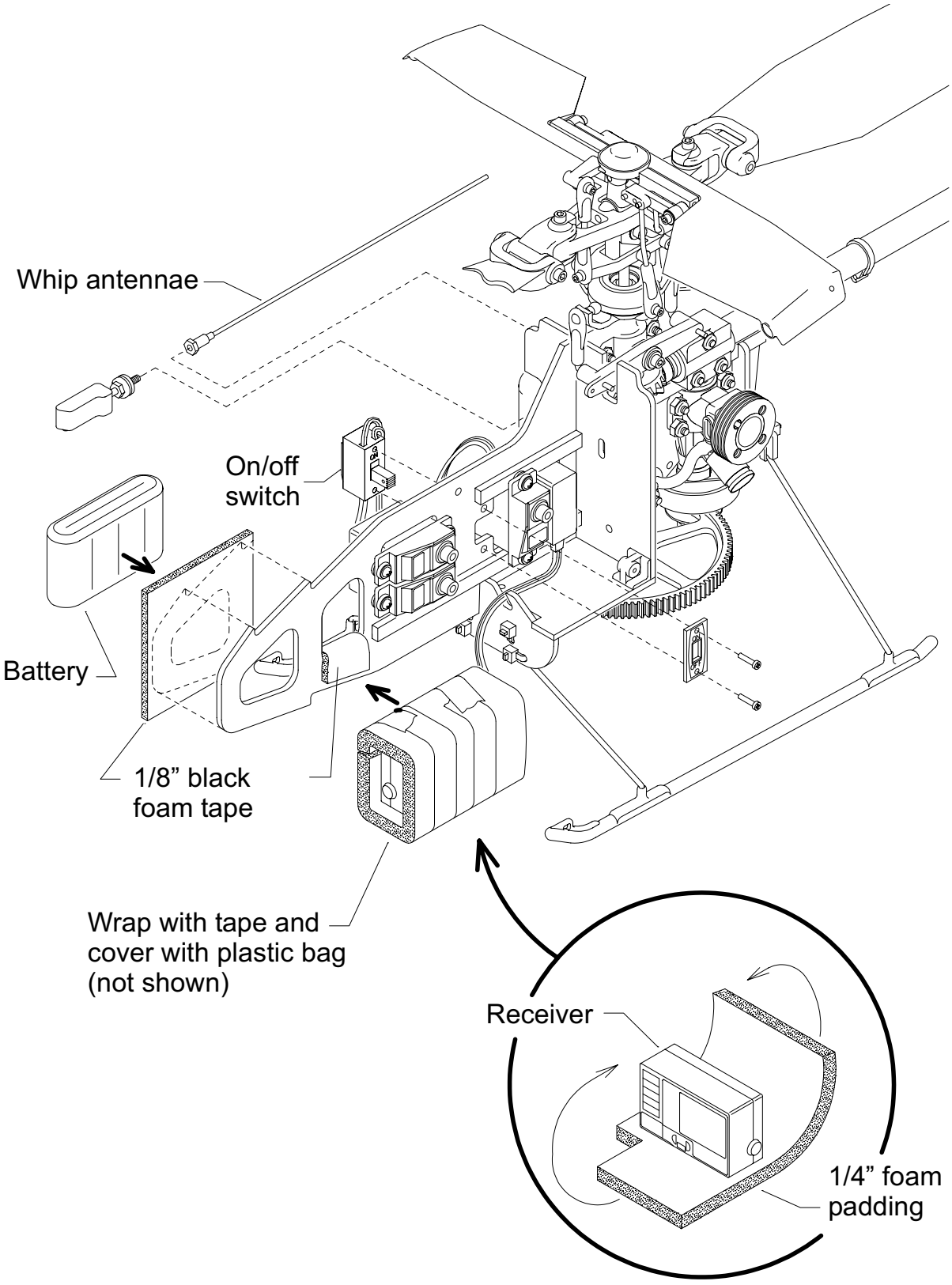
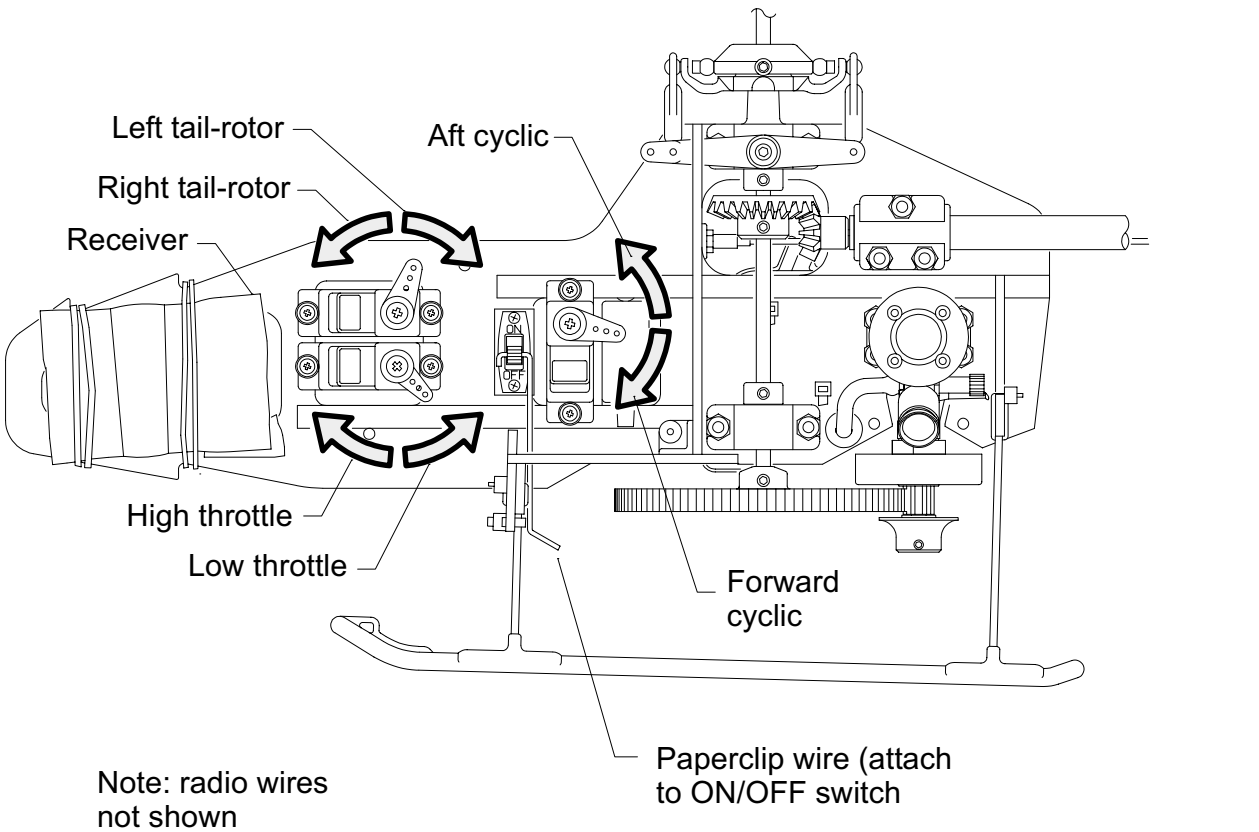

Whip antennae
On/off switch
Battery
1/8” black foam tape
Wrap with tape and cover with plastic bag (not shown)
Receiver
1/4” foam padding

Figure 13-1.


Left tail-rotor
Right tail-rotor
Receiver
Aft cyclic
High throttle
Low throttle
Forward cyclic
Paperclip wire (attach to ON/OFF switch
Note: radio wires not shown

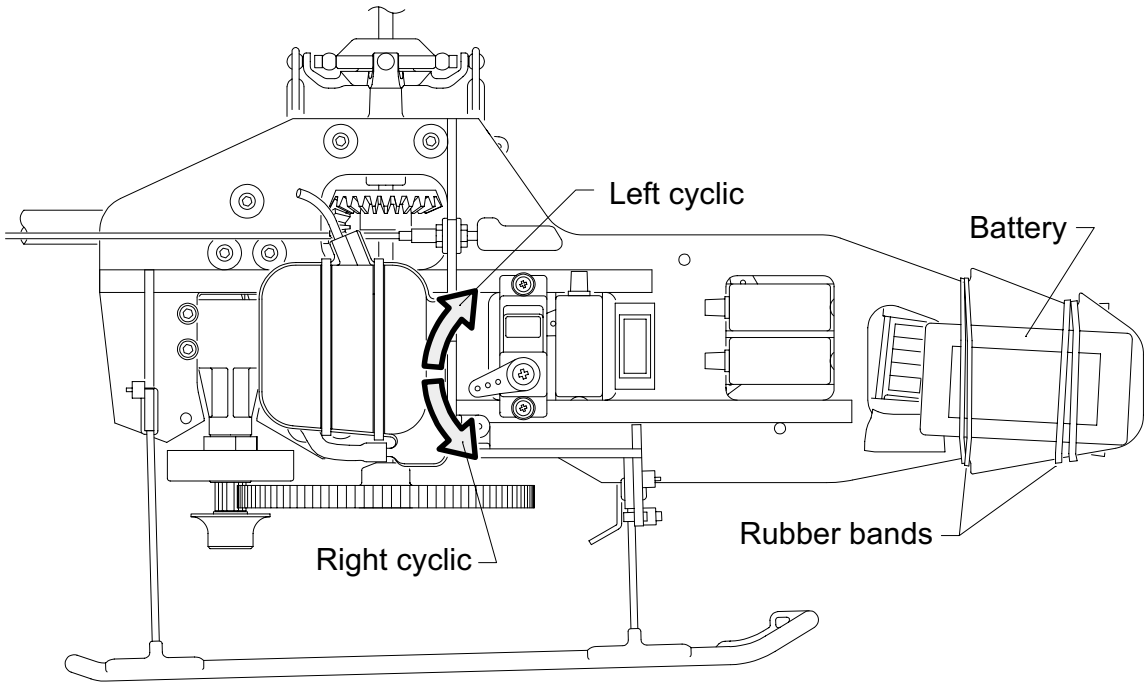

Left cyclic
Battery
Rubber bands
Right cyclic

Figure 13-2.

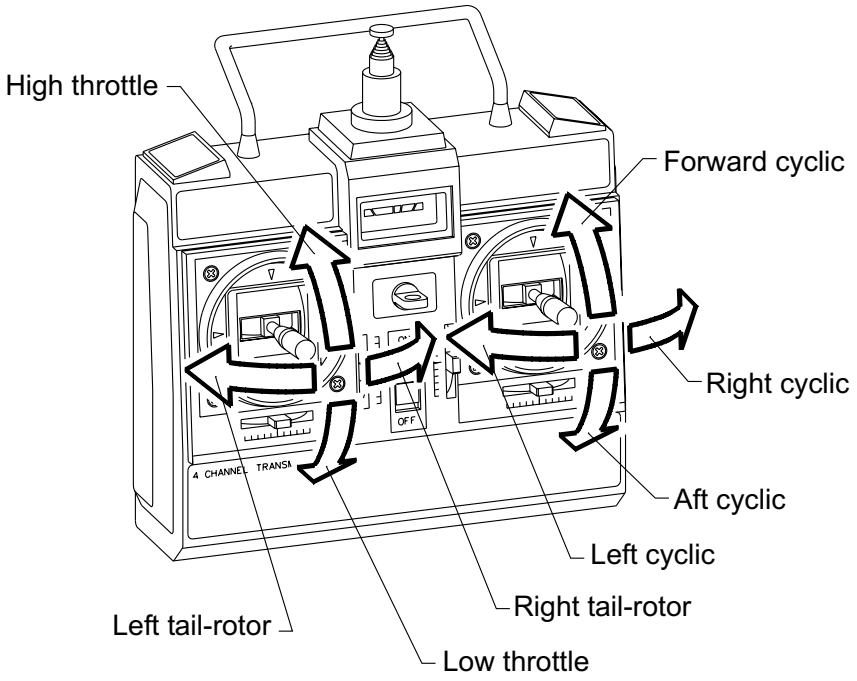
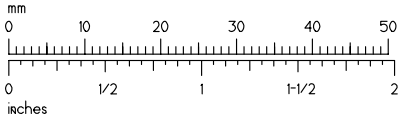


Figure 13-3.

- ❑ 10. Turn on the transmitter and receiver. Plug the servos into the receiver one at a time testing for correct operation (see your radio manual for servo plug assignments).
- ❑ 11. Check that each control on the transmitter moves the correct servo in the correct direction. Moving the throttle stick on the transmitter upward, for instance, should cause the throttle servo arm to rotate clockwise. If any servo rotates opposite to its proper control direction, flip the servo-reversing switch on the transmitter corresponding to that servo. **DOUBLE CHECK THE ROTATION DIRECTION OF EACH SERVO. IT IS PRACTICALLY IMPOSSIBLE TO FLY A HELICOPTER WITH THE CONTROLS REVERSED.**
- ❑ 12. Notice how the four trim levers immediately below and beside the control sticks on the transmitter operate. Each trim lever controls the neutral point of one of the servos.
- ❑ 13. When you finish checking the controls, turn the transmitter and receiver off.



Pushrods and Radio Adjustment

In this section you will install and adjust the servo pushrods and check control throws. Your first flights will be more successful if your *Model 110* helicopter is adjusted correctly, so follow each step closely.

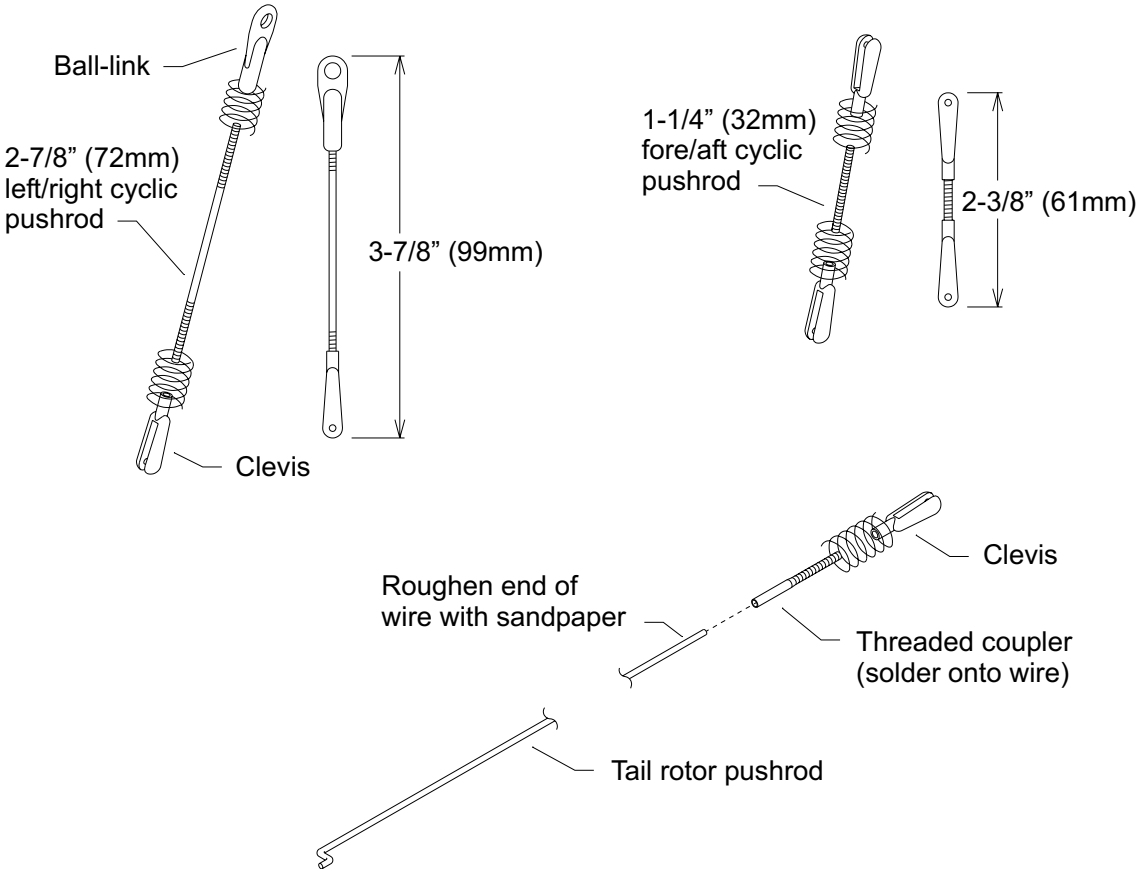


Figure 14-1.

- ❑ 1. Assemble the cyclic pushrods and tail rotor pushrod as shown in Fig. 14-1. Note that the left/right cyclic pushrod has a ball-link on one end and a clevis on the other.
- ❑ 2. Solder the brass threaded coupler to the end of the tail rotor pushrod wire. For a strong solder joint, clean the last 3/8" (10mm) of the wire with coarse (120 grit) sandpaper, and coat the wire with soldering flux. Stuff a 1/4" (6mm) length of solder into the hole in the threaded coupler and hold the coupler with a pair of pliers. Insert the wire into the coupler and heat the coupler with a soldering iron. When the solder melts, push the wire all the way into the coupler and continue heating for five to ten seconds. Shave off any solder drips with a hobby knife when cool (be careful not to cut yourself).

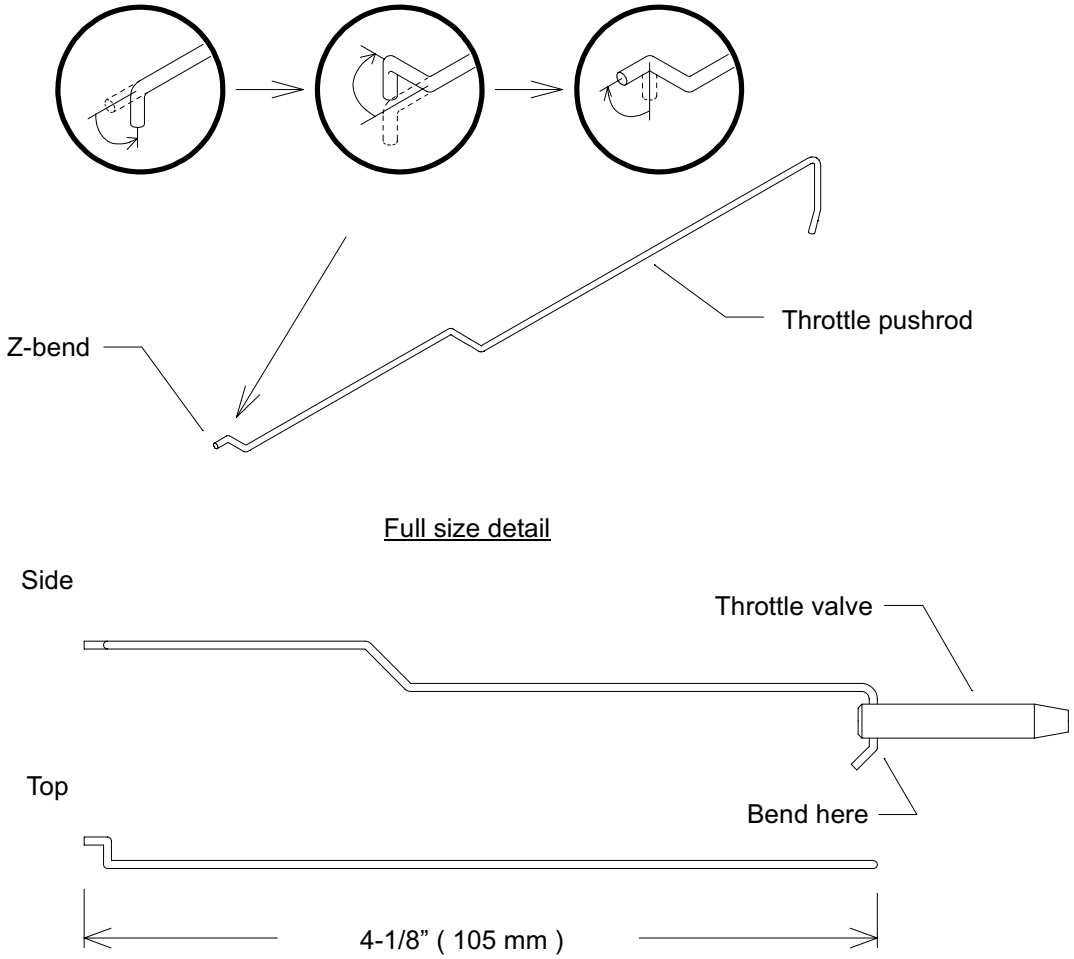
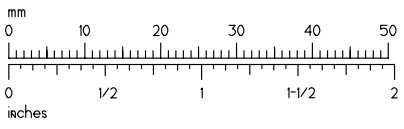


Figure 14-2.

- ❑ 3. Bend the throttle pushrod with a pliers from a 5" (127mm) piece of .043" (1mm) wire as shown at full scale in Fig. 14-. If you accidentally bend the pushrod incorrectly the first time, try again with another piece of wire.
- ❑ 4. Slide the throttle pushrod into the cross-hole in the brass throttle valve. **BEND THE END AS SHOWN SO THAT THE THROTTLE VALVE CANNOT FALL OFF.**
- ❑ 5. In the following steps you will install the pushrods and adjust the servos. To correctly orient the servos for pushrod installation, turn on the transmitter and receiver, move the throttle stick and throttle trim lever to full low position, and all other trims to neutral as shown in Fig. 14-3. Leave the transmitter and receiver on while installing the pushrods.



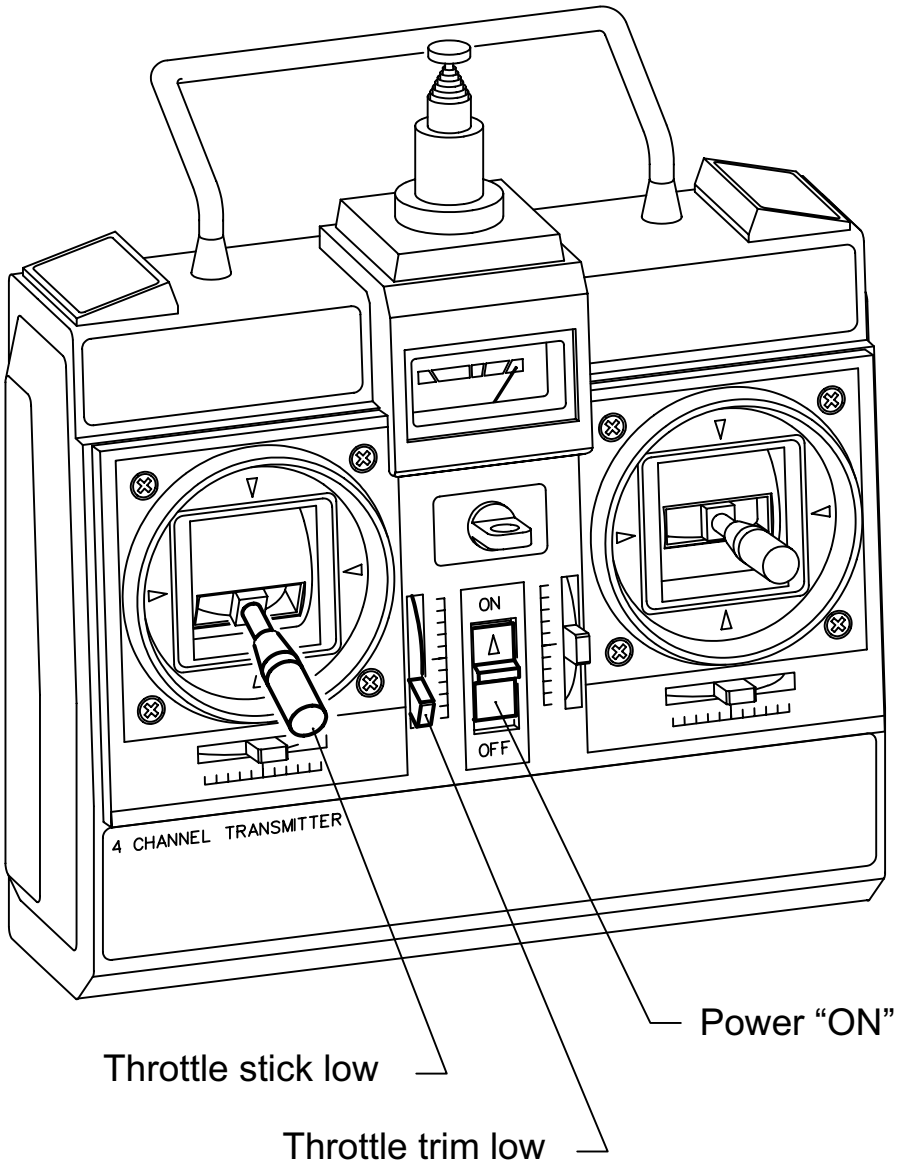

ON
OFF
4 CHANNEL TRANSMITTER
Power “ON”
Throttle stick low
Throttle trim low

Figure 14-3.

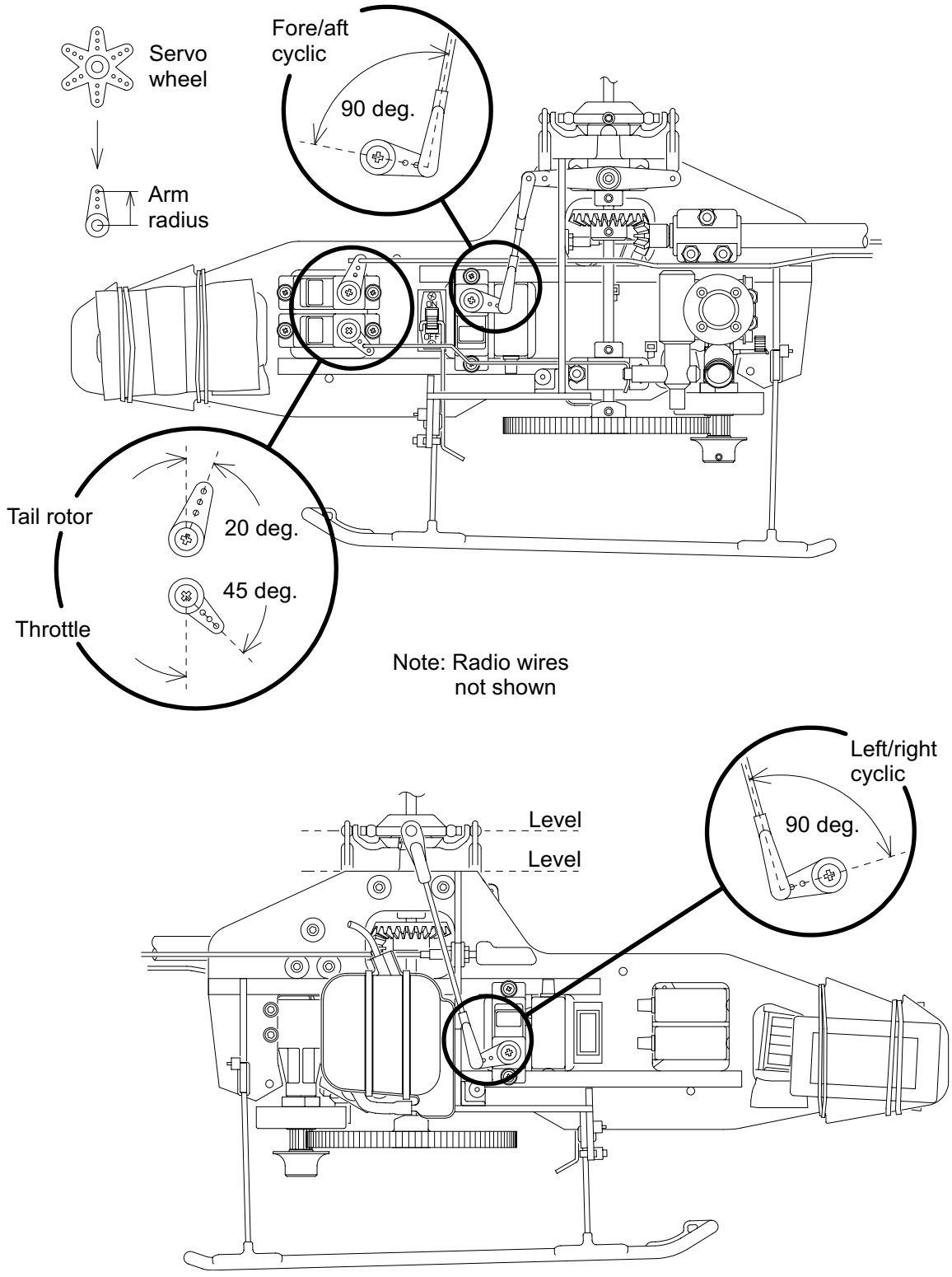

Servo wheel
Arm radius
Fore/aft cyclic
90 deg.
Tail rotor
20 deg.
45 deg.
Throttle
Note: Radio wires not shown
Left/right cyclic
90 deg.
Level
Level

Figure 14-4

Note:

Each servo on the *Model 110* requires a servo wheel having a particular arm radius (the distance from the arm center to one of the arm holes) in order to produce a certain amount of pushrod travel. A large arm radius produces more pushrod travel than a small radius. For each servo, select a servo wheel having arms with holes as close as possible to the radius specified in the text. Place the wheel on the servo output shaft so that one of the arms is angled as in the drawings, then trim off all the other unused arms on the wheel. If you do not have a wheel with holes at the required radius, drill a hole at the desired radius in any wheel you may have.

❑ 6. Find two servo wheels with holes at a radius of .44" to .47” (11mm to 12mm). Fit the wheels to the left/right and fore/aft cyclic servos at the angles shown in Fig. 14-4. Trim all unused arms off the wheels. Secure the servo wheels to the servos with servo wheel screws (with the arms oriented as shown).

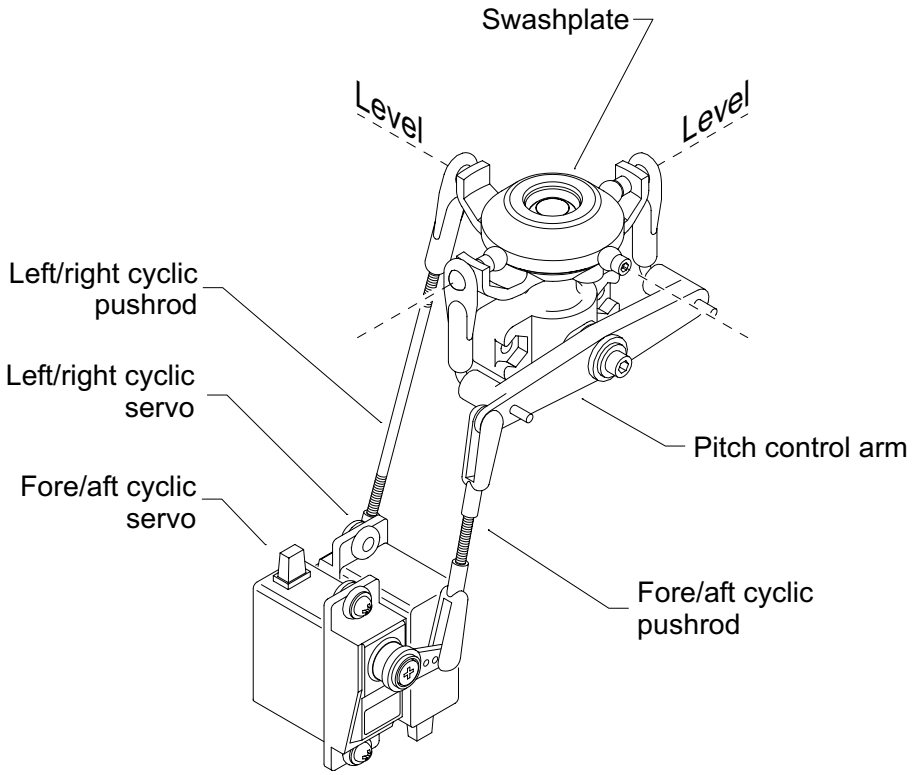


Figure 14-5.

Note:

The angle between a pushrod and a servo arm (measured when the servos are centered) affects pushrod motion. A pushrod that is 90 degrees to a servo arm will travel the same distance in both control directions. A pushrod at an angle other than 90 degrees will travel more in one direction than the other. This effect is called “differential throw”. Differential throw is useful on controls that need to move more in one direction than in the other (such as the tail rotor).

- ❑ 7. Referring to Fig. 14-4 and Fig. 14-5, connect the fore/aft cyclic pushrod to the fore/aft servo (on the .44" or .47" arm-radius hole) and to the fore/aft control arm. Connect the left/right cyclic pushrod to the left/right cyclic servo (on the .44" or .47" hole) and to the unused plastic universal ball on the swashplate. Make sure the plastic clevises on the pushrods snap shut and lock. Note that cyclic (swashplate) control does not require differential throw, so the pushrods should be at 90 degrees to the servo arms as shown.

- ❑ 8. With the cyclic (right) stick and trims on the transmitter centered, adjust the length of the cyclic pushrods so that the swashplate is level with the crutch when viewed both from the front and from the side (the swashplate should also be square with the main shaft). Note that the *Model 110* sits nose-low because the front and rear landing gear struts are of slightly different lengths. Make sure you level the swashplate to the **CRUTCH**, and not to your work surface.

- ❑ 9. The rotor head on the *Model 110* can be adjusted to reduce unwanted linkage and swashplate "slop" (mechanical play). Move the cyclic (right) stick on the transmitter slowly, and observe the motion of the mixing arms on the rotor head. If the cyclic servos move slightly while the mixing arms do not, some linkage slop exists. Lengthen each mixing arm pushrod ½ turn to load the linkages **LIGHTLY** against the swashplate, and check for slop again. Do not lengthen the pushrods too far. Too much pushrod force will bind the swashplate causing premature wear.

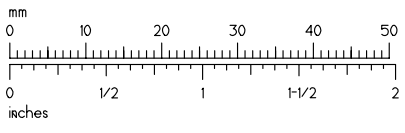
- ❑ 10. To check the motion of the swashplate, stand behind the *Model 110* with the transmitter antenna collapsed and pointing toward the *Model 110*. As you move the cyclic (right) stick on the transmitter forward and backward, the swashplate should tilt forward and backward. Left/right stick motion should tilt the swashplate to the left and right. If either control is reversed, you may have set the servo rotation direction incorrectly earlier. If so, flip the corresponding servo reversing switch on the transmitter.

- ❑ 11. Make sure the cyclic servos are not over-driving the swashplate. Slowly move the cyclic stick and trim levers on the transmitter from neutral to full deflection in every direction (including each 45 degree direction). If the swashplate reaches its mechanical limit before the servos stop moving, the servo motors will stall (you will hear the servos humming). This stalling may burn out the servo electronics if left uncorrected. Reduce the servo throw by adjusting the ATV dials on the transmitter (on Hitec radios) or reduce the servo arm radius on the stalled servo by moving the pushrod inward one hole.

- ❑ 12. Notice how the cyclic trim levers slightly reposition the swashplate. You will use the trim levers to neutralize any control drift later when flying.

- ❑ 13. Select a servo wheel with holes at a radius of .47" to .5" (12mm to 12.5mm) for the tail rotor servo, and trim off all but one arm. Slip the arm over the end of the tail rotor pushrod as shown in detail in Fig. 14-6 . Slide the pushrod back through the hole in the firewall, screw a clevis to the end of the threaded coupler, and connect the clevis to the innermost hole of the tail rotor bellcrank (for the greatest control throw).

- ❑ 14. Snap the pushrod into the guide in the middle of the tail boom, and bend the pushrod as needed to clear the tail boom bracket and engine. Rotate the pushrod guide if necessary to help align the pushrod.



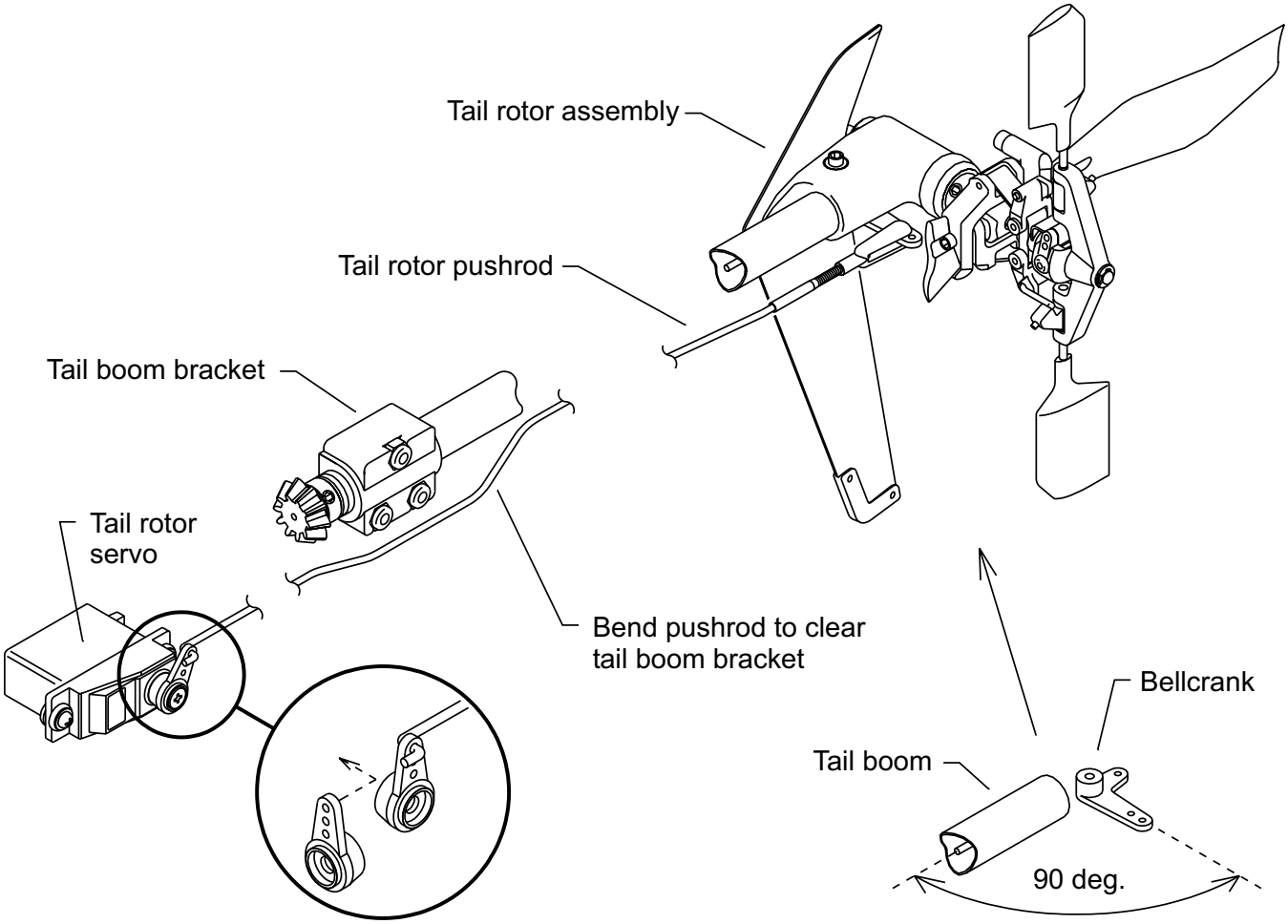


Figure 14-6.

Note:

Metal-to-metal rubbing (such as between the tail rotor pushrod and the nuts and bolts on the tail boom bracket) can create electrical interference that affects the receiver. Make sure the tail rotor pushrod can move back and forth without touching anything metal.

❑ 15. To evenly balance tail rotor control power in right and left turns, more negative blade pitch is required than positive blade pitch. For the proper differential throw, mount the servo wheel to the tail rotor servo at about 20 degrees from vertical as shown in Fig. 14-4 (the angle doesn't have to be exact). Secure the servo wheel with a servo wheel screw.

❑ 16. Adjust the clevis on the tail rotor pushrod until the long arm of the tail rotor bellcrank is square (makes a 90 degree angle) with the tail boom as shown in Fig. 14-6 .

- ❑ 17. Check the maximum control movements (with trim) in each direction as you did for the swashplate. You want as much tail rotor control throw as possible without stalling the servo. If the servo stalls, adjust the transmitter ATV dials (on Hitec radios), reduce the servo arm radius, or move the pushrod clevis to the outer hole on the tail rotor bellcrank (the effects are the same).

- ❑ 18. To double-check tail rotor control direction, move the tail rotor control stick on the transmitter, and watch the tail rotor pushrod. Right and left stick motion should move the pushrod forward and backward respectively. If the tail rotor control is backward, flip the appropriate servo reversing switch on the transmitter

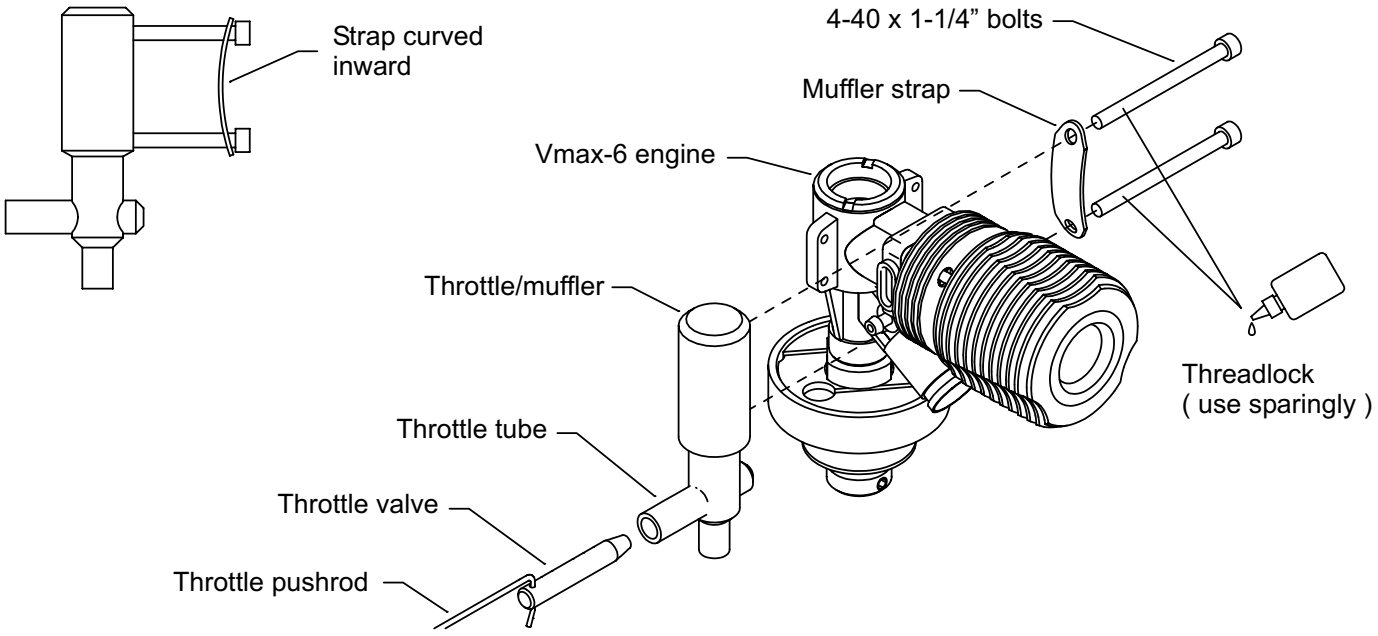
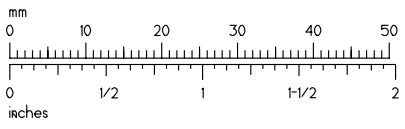


Figure 14-7.

- ❑ 19. The final control to hook up is the throttle (you are almost done!). Select a servo wheel with holes at a radius of .27" to .35” (7mm to 9mm), and trim off all but one arm.

- ❑ 20. Slide the throttle pushrod forward through the throttle hole in the firewall and into the appropriate hole in the servo wheel. Make sure the throttle stick and trim on the transmitter are still in the full low position, and mount the servo wheel arm to the throttle servo at about 45 degrees from vertical as shown in Fig. 14-4.

- ❑ 21. Slide the *Vmax-6* throttle/muffler onto the throttle valve and secure the throttle/muffler to the engine with the muffler strap, 4-40 x 1-1/4" bolts and threadlock as shown in Fig. 14-7. Screw the bolts completely through the muffler chamber and tighten them against the opposite inside wall.



Note:

The flexible *Vmax-6* muffler strap is designed like a leaf spring to hold the throttle/muffler tightly against the exhaust port without distorting the piston cylinder. The strap should curve toward the engine cylinder and flatten out when the muffler bolts are installed. Do not replace the flexible strap with a solid bar or shorten the muffler bolts. You could distort the cylinder and ruin your engine.

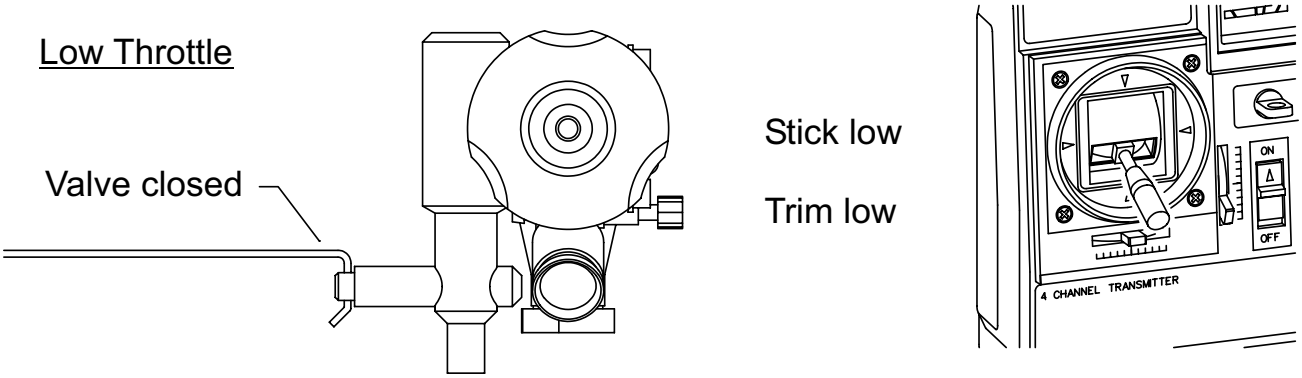


Figure 14-8.

❑ 22. The throttle valve should completely block the muffler exhaust port when the transmitter throttle stick and trim level are in the full low position. Adjust the length of the throttle pushrod by bending or unbending the jog in the middle of the pushrod until the throttle valve closes the exhaust port completely as shown in Fig. 14-8.

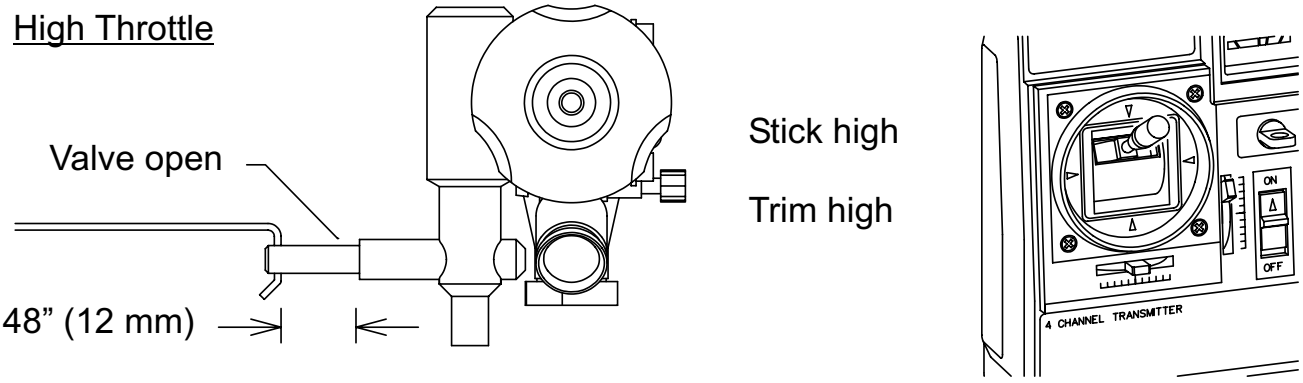


Figure 14-9.

- ❑ 23. Move the throttle stick and trim lever to full high position as illustrated in Fig. 14-9. The throttle valve should move out about .48" (12mm). Adjust the angle of the servo arm, location of the servo arm hole and/or length of the throttle pushrod as necessary to set the throttle valve open and closed positions.

- ❑ 24. All of the controls are now connected. Check each control one last time to insure that everything moves freely, and nothing binds or jams. If you suspect a control is binding, disconnect the pushrod from the servo arm and check the servo and pushrod mechanism separately. If the servo moves much more quickly when disconnected, or if the pushrod is hard to move with your fingers, something is binding. Check for (and fix) tight pivot bolts, tight ball-links, pushrods rubbing on parts of the crutch, etc..

- ❑ 25. Collect the servo and battery wires into a bundle at the lower edge of the keel, and lightly secure the bundle to the keel with a nytie. Route the radio antenna wire along the top edge of the keel away from the servo wires. To avoid radio inteferrence, **DO NOT ROUTE THE ANTENNA WIRE NEXT TO ANY SERVO WIRES**.

- ❑ 26. Make sure all of the servo arms are secured with servo wheel screws, and turn off the receiver and transmitter. Your *Model 110* helicopter should look like Fig. 14-10.

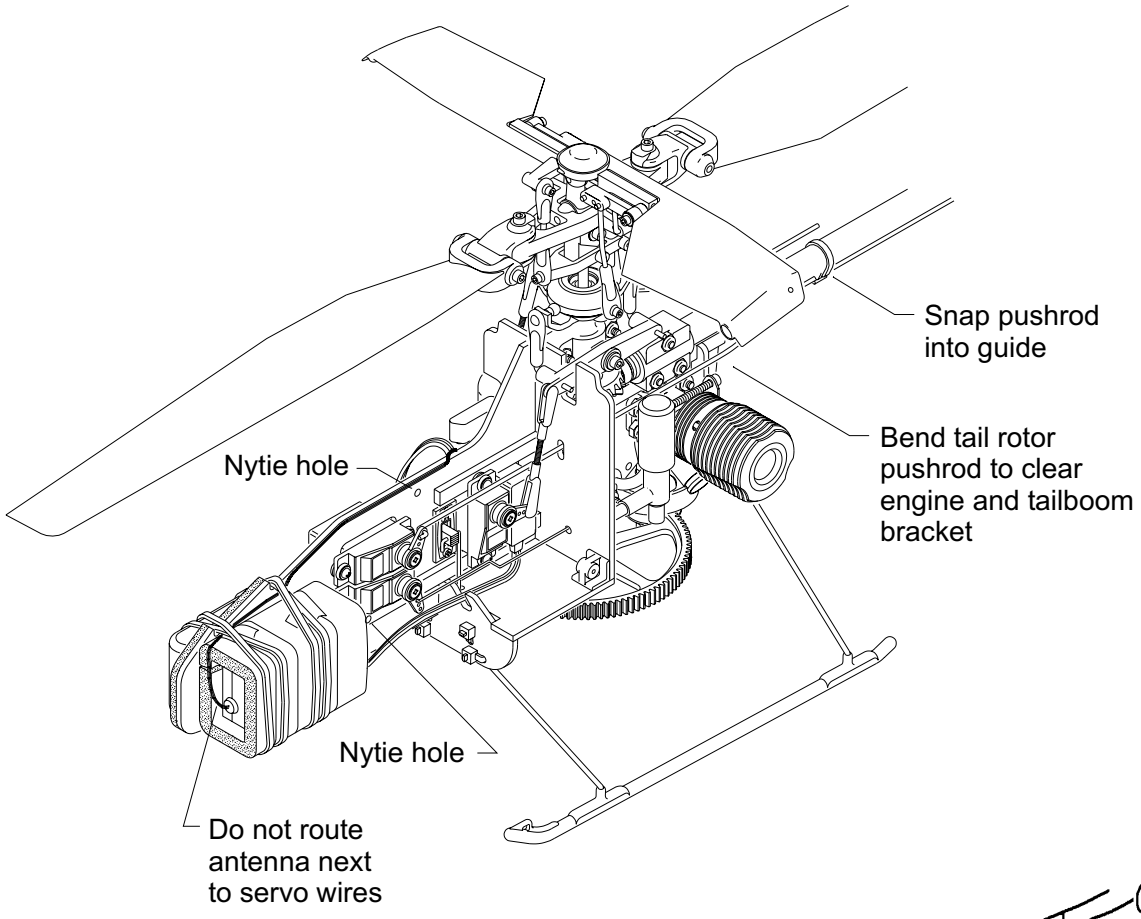


Figure 14-10.

Final Check

In this section you will check your *Model 110* helicopter to insure that it is assembled properly. If you discover a problem, fix it.

- ❑ 1. Tilt the *Arlton Subrotor* stabilizer (on the main rotor) 20 degrees in each direction with your finger tips. The stabilizer must pivot **VERY FREELY** about the teeter pin or your *Model 110* will be unstable in flight.
- ❑ 2. Make sure that the main rotor blades flap up and down **VERY FREELY** about the flapping bolts or your *Model 110* will be unstable in flight. Also check that the lead/lag hinge drags just enough to keep the blades from flopping forward and backward.
- ❑ 3. Tilt the *Arlton Gyro* stabilizer paddles (on the tail rotor) 20 degrees in each direction with your finger tips. The stabilizer should pivot **VERY FREELY** about the gyro pivot pins or your *Model 110* will be unstable in flight.
- ❑ 4. Make sure that the gyro pivot mount setscrew is facing **DOWN** or your *Model 110* will be practically uncontrollable in flight.
- ❑ 5. Spin the main rotor with your finger. The main rotor and tail rotor should spin freely although the clutch bell may drag. The transmission will become much smoother after running for about 5 minutes.
- ❑ 6. Check all electrical connections between the receiver, servos and battery. Make sure that the radio power switch is mounted with **ON** up and **OFF** down (if you smack the ground hard you don't want to turn off the radio).
- ❑ 7. Make sure the engine mounting bolts and muffler strap bolts are tight.
- ❑ 8. Slide the canopy over the crutch until the canopy doublers engage the firewall and floor. Screw a 2-56 x ½" bolt (no washers!) through the rubber grommet in each side of the canopy and into the corresponding canopy mounting bracket on the crutch as shown in Fig. 15-1 (oiling the bolt heads sometimes helps). Tighten each bolt until half of the bolt head is hidden by the grommet and the bolts hold the canopy firmly in place. Rotate the fuel tank filler tube with your finger tip into the right side turbine exhaust.
- ❑ 9. To remove the canopy, rotate the fuel tank filler tube out of the turbine exhaust. Slowly pull outward on the canopy behind the canopy mounting grommets until the grommets slip over the heads of the canopy mounting bolts. **YOU DO NOT NEED TO REMOVE THE BOLTS TO REMOVE THE CANOPY**. If the grommets do not slip over the bolt heads easily, screw the bolts in a little further or oil the bolt heads.
- ❑ 10. To check for proper center-of-gravity, rotate the main rotor until the blades are perpendicular to the tail boom and pick up your *Model 110* by the *Subrotor* stabilizer. The fuselage should hang level (with the tail boom parallel to the ground) or slightly nose-low. If the tail hangs low, your helicopter could become unstable in forward flight. Add weight between the battery and crutch to correct this tail-heavy condition.

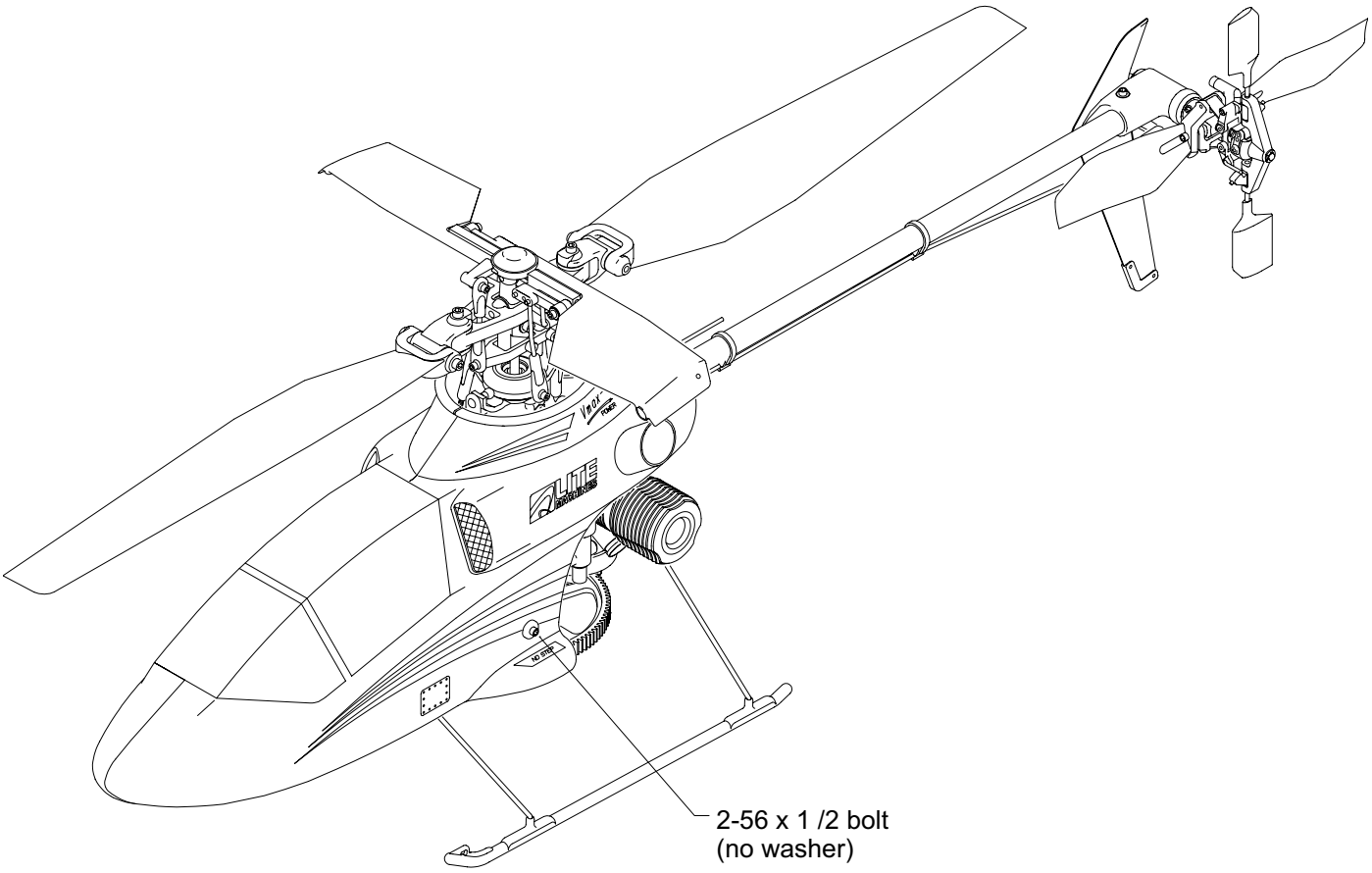


Figure 15-1.

- ❑ 11. Print your name, phone number and address on a card, and slip it under the rubber bands surrounding the battery and receiver so that it can be easily seen in case you ever lose your *Model 110*.
- ❑ 12. Your *Model 110* is done! Take lots of pictures - this is as clean and shiny as it will ever be. Show it to your friends and family, and convince them to buy one.

Hint:

DO NOT THROW AWAY THIS CONSTRUCTION MANUAL. You may wish to refer to it when repairing your *Model 110*.