GMP

COMPETITOR

- Range of -

RC HELICOPTERS

ASSEMBLY

Instruction Manual

GMP

THE WORLD'S FINEST RC HELICOPTERS
AVAILABLE AT YOUR LOCAL HOBBY STORE NATIONWIDE

GORHAM MODEL PRODUCTS

QUALITY, PERFORMANCE & SERVICE

INTRODUCTION

The "Competitor" R/C helicopter line has been designed and developed to provide the modeler with the most aerobatic R/C helicopter possible. This without any sacrifice of stability and reliability. To obtain all these features in one model has required more than 12 months of intensive flight testing by Gorham Model Products personnel and also by many top United States modelers. The final design and manufacture has been a joint effort with the Hirobo company who also supply many of GMP's scale helicopters. The result is a model helicopter which provides the ultimate in aerobatic capability while preserving a wide flexibility in the choice of engines and radios that can be used. A very high quality of construction is also built in with the result that your GMP "Competitor" will last for a long time.

'CUSTOM' MODEL

There are two versions of the "Competitor". The first is the "Custom" which is intended as a transition machine for the modeler who has already learned to hover and fly the simpler helicopters and now wishes to move out into full aerobatic performance without incurring too much initial cost. The budget priced "Custom" has identical construction features to its big brother, the "Professional" model, except for the following:

a) The main rotor head is a simpler design with a positive coning angle so as to offer a little more stability and a lower cost for the initial purchase.

b) Some of the bearing surfaces are precision bronze bushes instead of ball bearings. Even so, the 'Custom' has more ball bearings and precision parts than other comparably priced aerobatic helicopters. It is fully aerobatic, can perform all the FAI and AMA contest maneuvers, and has full collective pitch and a 'Bell-Hiller' mix control system.

In all other respects, however, the "Custom" has all the features, quality and performance of the "Professional" model. It can also be upgraded to the "Professional" model standard. The "Custom" can be flown with any engine size between 0.40 and 0.60.

"PROFESSIONAL" MODEL

The "Professional Competitor" has been designed to offer every feature that the serious competition flyer could require to enable him to enter and win National and International R/C helicopter aerobatic competitions. It is capable of all FAI and AMA maneuvers. In addition, it has a superior design of autorotation clutch and many other features which will be described in a later section of this manual.

In the case of both "Competitor" models no corners have been cut to lower costs at the expense of quality and you can be assured that you have the finest value the industry has to offer when you buy and fly either of the GMP "Competitors"

Both the "Custom" and the "Professional" can be obtained with the uniquely designed autorotation clutch, if desired. Note that either of the 'Competitor' machines, when fitted with this advanced design of autorotation clutch, can be autorotated - engine off - by an average RC helicopter flier.

TECHNICAL FEATURES

Performance

The GMP "Competitor" range was nearly one year in its testing program. During this time many control system ratios and mechanical items were changed or adjusted in order to achieve a very important feature - "balanced control". This means that the "Competitor" should 'feel' right to experienced flyers and possess that important but sometimes intangible quality that all R/C helicopters should have: "it feels very 'natural' to fly".

The response of the "Competitor" is fast but very well damped. In addition, the helicopter has plenty of control "power" so that when a maneuver is commenced it can be completed without running out of control power. The "Competitor" also will not surprise you with any unusual flight characteristics. In full size aircraft design a "Cooper" rating is used by pilots to rate the handling quality of a new full size machine for the designers and engineers. If the same rating system was applied to the "Competitor" it would be awarded a very high "Cooper" rating. This means it will be liked and appreciated by the expert flyer and will be much more easily handled by the beginner transitioning into aerobatic flight.

Control System Quality

Because the quality of the controls of any flying machine will dictate the final performance, particular emphasis has been placed on the control system of the "Competitor". You will find many more ball and thrust bearings in the "Competitor" than in other similar R/C helicopters. The purpose of this is to provide a very "tight" control system so that all inputs from the transmitter will be immediately and fully available at the control surfaces themselves. This is a prerequisite to fine quality performance in any flying machine, but especially in an R/C model helicopter.

Collective Pitch and Bell/Hiller Mixing

The "Competitor" range is fitted with full collective pitch on both main and tail rotor blade systems and, in addition, has a Bell/Hiller mix provided to blend control "power" with control smoothness.

There are basically two methods of achieving collective pitch on an R/C model helicopter. One method is to change the pitch of the main blades "collectively" by fitting a rod up the side or center of the main shaft and, while the rotor blades are rotating, change the vertical position of the rod. This, in turn, results in a "collective" pitch change of the main blades through pitch angle mixing arms. This system is used on the Schluter and Kalt helicopters. Most full size 'choppers use the method of moving the whole swashplate up and down to achieve collective pitch as do the "Horizon" and Hirobo R/C model helicopters. Both these methods have their advantages and disadvantages. The method selected for the "Competitor" was the moving swashplate just like its full-size brothers. One advantage of the "Competitor" method which is not immediately obvious is that the collective pitch 'range' is sufficient to cover inverted flight needs without any modification to the standard kit. For inverted flight the swashplate must move in one direction throughout a full range for upright flight, but from the zero position through an equal negative amount for inverted flight. Consequently a total range equivalent to somewhere near 16 degrees of main blade pitch change is required. Both of the "Competitor" control systems easily achieve this requirement.

"Competitor's" Unique Thrust Bearings

The GMP "Competitor" is the first competition helicopter available in the United States to use 'thrust' bearings in main and tail blade systems. The very high centrifugal forces that exist on the bearings of both main and tail blades of R/C helicopters have in the past been taken on one standard ball bearing. The standard ball bearing is designed primarily for radial loads and is not optimum for use where high end thrusts are incurred. The "Competitor" main rotor blades utilize a triple bearing system with a heavy duty thrust bearing in each blade holder, together with two fine quality ball bearings. In addition, all three bearings are adjusted by a double locking system which insures fast and low friction rotation during flight without any lost motion. Again a prerequisite to accurate and advanced aerobatic flight.

Power Plant Versatility

Although the GMP "Competitors" have been designed to be rugged, they utilise advanced and light construction techniques so they will fly with engines ranging through a 40 to 61 cu.in. Both the 'Custom' and the "Professional" model give excellent results with a 50 Schneurle or P.D.P. engine but can also be flown with the 45 or 60 size. A good 45 cu.in. Schneurle engine will fly the "Custom" well and is, in fact, perhaps preferable for the beginner who is just transitioning into his first aerobatic helicopter. Don't forget that you can change the engine size of your GMP "Competitor" at any time.

If you intend to fly at high altitudes, however, remember that the power of your engine will decrease by about 3% - 4% every 1000 feet of pressure altitude above sea level. Also, 5000 feet actual altitude can become equal to 7000 - 8000 feet on a hot day. So, if you live at 5000 feet altitude, assume that you will need an engine which gives about 25% more power than would be required at sea level. Fortunately the 'Competitor' is a very efficient helicopter and its flight performance at 5000 feet will not only be adequate but will be excellent with a good 50/61 Schneurle or P.D.P. engine.

Radio Control Installation

(Later on in this instruction manual we will provide you with detailed information on how to fit your radio in the "Competitor" and set it up so that it will give you the best flight characteristics.)

The GMP "Competitor" is designed for either a 4 or 5 servo installation. With the larger collective pitch helicopters it is an advantage to use 5 servos since the high forces experienced in moving the collective pitch in the helicopter are best handled by a dedicated servo, leaving another one to operate the throttle. This is by no means necessary and, provided the servos are good enough, the "Competitor", like any other helicopter of its type, can certainly be flown well with 4 servos. Any of the inexpensive 4 channel radios available today will usually work well. Sometimes, in fact, the simplest and least expensive radios work best in an R/C helicopter. When using one of the new helicopter radios, however, 5 servos are necessary if the full advantages and the features of the radios are to be used.

With an advanced aerobatic helicopter such as the "Competitor" it is very important to have "tight" controls and, if you intend to participate in serious competition flying, your servos should have ball bearing outputs if possible. In addition, we have found from experience that the feedback potentiometer of the servo gives superior reliability when fitted with a carbon button wiper, sometimes known as a "Giezendanner" wiper. Many of the radios available today are fitted with this type of feed-back pot. This does not imply, in any way, that other servos will not work satisfactorily in "Competitor". This is just to provide you with a target of what we believe are the best characteristics to aim for in your radio installation on "Competitor". A simple 4 channel radio (bearing in mind the servo requirement) is perfectly adequate for both models. However, the "Competitor" is designed for electronic mixing if 'tail rotor' mixing is desired. It certainly provides easier handling if we have this automatic tail rotor compensation for throttle/collective movements (although some experts wouldn't agree and prefer to fly without). There are now many radios available on the market which have this tail rotor mix available as a standard feature and several more models are soon to be released. Some of these fall into the very inexpensive range and, again providing the servos are adequate, and the stick gimbal assemblies are 'tight', these will be good radios to use with your GMP "Competitor".

If you decide to use a radio which does not have electronic mixing (throttle to rudder) then an inexpensive mechanical mix lever mechanism is available for your 'Competitor' to provide this mix.

So bear in mind that any radio that you have available can be used but do consider upgrading to good ball bearing servos is you wish to obtain the very best overall performance from your machine. Also make your "Competitor" installation a 5 servo one if you want the minimum of wear on your servo system. A simple "Y" connector, available from most radio manufacturers, can enable you to use a dual servo installation with a 4 channel radio.

Rotor Blades and Autorotation

The rotor blades of the "Competitor" have an advanced and modern semi-symetrical section and are generally heavier than most other 60 model rotor blades available today. This factor helps in ensuring "Competitor's" superior autorotation capability. In fact, many flyers have reported the ease with which the "Competitor" can be landed after an engine failure compared with other R/C helicopters fitted with so called "autorotation". The GMP "Competitor" autorotation gear is fitted with three precision needle bearings, rather than the single one used in some other 40 and 60 powered R/C helicopters. Consequently, the life and reliability of this unit is very much higher than others with single bearings. The main plastic drive gear itself is of a very sturdy construction and the tail drive gear track provides a very wide contact area because the tail drive steel pinion is an advanced design spiral hypoid bevel gear. This means less likelihood of damage to the main drive gear track. Should the gear be damaged, however, a replacement plastic part is readily available at a very low cost.

Starting System

The standard starting system of the "Competitor" is the top cone start now demanded by discriminating American modelers. It is not an extra cost accessory. This means extra expense in the design and manufacturing costs of the helicopter but the inclusion of this feature greatly eases the starting process and eliminates any problems which sometimes arise when starting with a starting belt.

Clutch Design

The clutch is a classic one-piece design, superior and reliable. This unit is many times more expensive to manufacture than other plastic and two-piece metal clutches available today but it gives smoother engagement and drive performance and it virtually lasts "forever".

Engine Installation

The engine of the "Competitor" faces to the rear to permit quick glow plug changes. It is also mounted in the frames in such a way that it can be dropped out through the bottom of the helicopter without the usual problems of disassembling the cooling system of the helicopter. The headaches usually associated with 'engine change' or removal to service are virtually eliminated with the GMP "Competitor".

Quality Hardware

The "Competitor" uses metric nuts and bolts as do all GMP models. These are selected by nearly all the world's designers as being superior for small mechanisms, and so are rapidly becoming a world standard. The metric hardware is lighter, since it has smaller bolt heads and nuts, and its use enables the whole helicopter design to be lighter and more compact. The threads are finer and, hence, the bolt provides more tensile strength for a given diameter. 90% of the world's R/C helicopters now use metric hardware. The GMP "Competitor's" metric system is a world standard one and is interchangeable with the GMP "Cricket" and Japanese and European R/C helicopters.

Low Aerodynamic Drag

The canopy of the "Competitor" has been designed to give very low aerodynamic drag because of its shape and small frontal profile. It is also made from a plastic thicker than most helicopters to help alleviate the vibration cracks which many times occur in canopies. The canopy attaches at three points and is insulated from vibration by rubber grommets.

Stabilizer "Paddle" Design

The stabilizer paddles of the "Competitor" have been designed in a unique way so that you can see how far you have screwed them on the bar. This eliminates the annoying problem of finding that you've stripped the thread in the plastic just as you're going out to fly (or while you are flying!). The GMP paddles are also 'universal' in that they may be used without modification on any helicopter with a flybar diameter of 1/8" - 5/32" (3mm to 4mm).

BUILDING

The "Competitor" can be built relatively fast, certainly by the expert builder. For the modeler who has not built this type of helicopter before we strongly recommend fully reading the building instructions one time at least before commencing construction. It is extremely important that all of the requirements of the designer are met in terms of adjustments of the controls and assembly of the mechanical items.

Any small mistakes in a sophisticated helicopter like "Competitor" will show up much more in flight performance and reliabilty than with the simpler helicopter such as "Cricket", etc. So do be sure that you go through the building sequence slowly and by stages and only after you have read the full instructions at least once. The tools that you will need include:

- o a pair of scissors
- o a small screwdriver
- o the allen keys provided in the kit
- o a 7/32 nut driver (which can be purchased from your radio component store)
- o a pair of pliers
- o a suitable socket wrench to tighten the engine nut of the engine you select

You will also need a small tube of 'Loctite', a small tube or bottle of any of the popular "10 second" Cyanoacrylate glues, some sandpaper, paint, masking and striping tape and a tube of clear silicone sealer and some epoxy glue.

Most of the construction of "Competitor" does not require any filing or fitting and so does not necessitate a work bench. However, do be sure to cover your work surface with thick paper or cloth material since the metal parts of "Competitor" can scratch polished table surfaces.

One important factor in building an R/C helicopter, which cannot be stressed enough, is that all nuts (other than 'lock' nuts) and threaded devices should be assembled using BLUE 'Loctite' or equivalent, so as to make separation of these components by vibration very improbable. It is also important to note that there is a version of 'LocTite' used for assembling bearings which is usually a red color. This 'LocTite' will give a permanent assembly and, hence, you will find it difficult (if not impossible) to take your helicopter apart again so please don't use the red variety on parts which you wish to disassemble later. If you cannot locate a supply of 'Loctite' try your local auto parts store, hobby store or contact us direct. Please also note that 'Loctite' must be used sparingly - a very small amount should be applied to the threads to be secured. It works better this way.

In addition to 'Loctite', one of the many varieties of Cyanoacrylate (instant) glue can be used for assembling your canopy and securing some items. A tube of clear silicone is also extremely useful in the assembly of the helicopter. Wherever these items ('Loctite', "Cyanoacrylate" or Silicone) are required, the text will be marked appropriately. To help in your selection of the hardware we have provided, for your convenience, a metric scale and illustrations of the various types of nuts and bolts used in the kit. Great care is taken in filling the bags with the correct quantity of parts and mistakes are rare. However, if you do find a shortage in the nuts and bolts or anything else in your kit, don't hesitate to tell your dealer. He will be glad to help you as fast as he can.

Don't forget to build under a good light. Build slowly and please, please, read all the instructions very carefully. They have been written with a lot of care to try and cover every point. Even so your comments on how we can improve our instructions are always welcome. We will continue to upgrade and try to make the "Competitor" instructions the finest available in the industry. Good luck in your building.

BUILDING AND ASSEMBLY INSTRUCTIONS

Before commencing assembly of your Competitor, open the Hardware bag (nuts and screws, etc.) and put the contents in a plastic bowl, tub or similar container. All of the hardware needed for building your helicopter is in this bag. Be careful to select the right screws, nuts, etc., that each step calls for. Read the manual and look at the sketches. Refer to hardware information chart and metric scale on page 35.

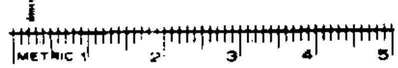
STEP 1 Transverse Lever Assembly - see Figure 1

From bag #5, take the following:

2 #482 Pitch Levers
1 #479 Pitch Shaft "A"
1 #480 Pitch Shaft "B"

From the hardware dish, take the following:

2 #211 5mm balls
4 #241 2mm nuts
2 #270 2.6mm x 8mm skt. hd. screws*
2 #269 2mm x 12mm skt. hd. screws
2 #276 3mm flat washers



* These are a special screw size used in this assembly only. Make sure that you select the right ones.

A. Fasten Pitch Shafts #479 and #480 on to Pitch Levers #482 (both pitch levers are the same) using skt. hd. screw #270 and washers #277. USE LOCKTITE.

B. Fasten Pitch Levers #482 together using skt. hd. screws #269 through 5mm ball #211 and two nuts #241. USE LOCKTITE.

C. Set Transverse Lever assembly and the remainder of bag #5 aside at this time.

NOTE: IT IS IMPORTANT TO TORQUE ALL NUTS AND SCREWS WELL IN THIS ASSEMBLY.

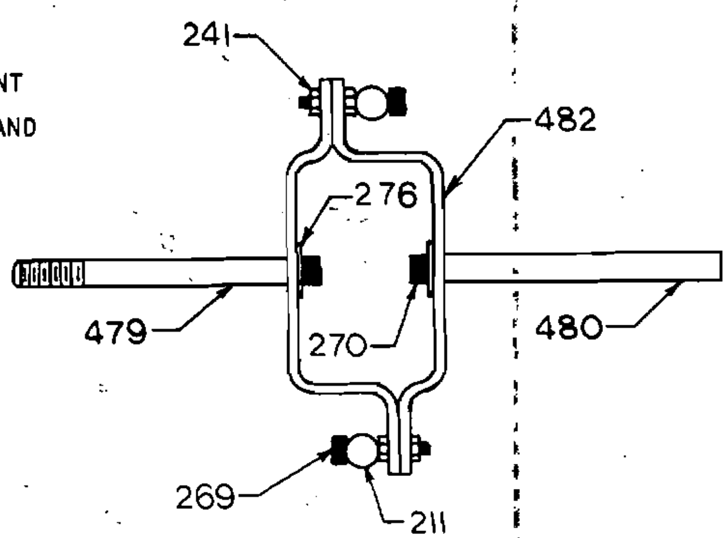


Figure 1
TRANSVERSE LEVER ASSEMBLY

STEP 2 ENGINE ASSEMBLY - see Figure 2

You will need an engine of your choice to proceed with this step. The GMP Competitor Custom and Pro models will fly with any good 0.40, 0.45 0.50 or 0.61 Schneurle or P.D.P. engine. The Competitor Custom model comes with 0.40/0.50 engine mounts and the Professional model comes with 0.60/0.61 engine mounts. If the mounts that come with your Custom or Pro are not correct for the engine of your choice please return them to your dealer, to Heli-Center East, P.O. Box 1205, Hermitage, PA 16148; or to Heli-Center West, 23961 Craftsman Road, Calabasas, CA 91302, for exchange. Enclose $2.00 for handling.

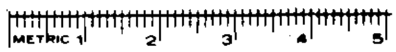
With a new, non-ringed engine, it is advisable to have at least half an hour of bench running. This will help you to familiarize yourself with the carburettor settings.

From Bag #3, remove the following:

1	#429	Tapered Collet	1	#428	Fan
1	#430	Flywheel	1	#441	Clutch Assembly
1	#431	Engine Block	2	#433	Engine Block Cross Pieces
1	#438	Clutch Bell Assembly	1	#432	Engine Block

From the hardware dish, take the following:

2	#235	3mm x 12mm skt. hd. screws
4	#239	4mm x 15mm skt. hd. screws



A. Remove prop nut and washer from your engine.

B. Remove 'prop' drive backplate washer and tapered drive collet from engine. Please proceed cautiously so not to damage engine. Seek advice if in doubt.

C. Install Tapered Collet #429A from kit on engine. The tapered collet in the kit MUST be used since it is matched exactly to Competitor's cooling fan hub.

This collet will fit on all OS Max engines. Some engines, such as Webra and HP, may need a spacer behind the collet to properly locate the cooling fan onto the engine shaft. Other engines, such as the HB, with a smaller output shaft than the OS, use Tapered Collet #429B.

Contact your dealer or Heli-Center East or Heli-Center West if you are unable to make or find the proper spacer or need advice.

D. Place Fan #428 on engine shaft, locating it firmly onto the Tapered Collet #429. Make sure that there is no grit, oil or grease between the mating surfaces.

E. Place Flywheel #430 on engine shaft.

F. Fasten assembly securely with the engine nut. Nut must be very tight so that a slippage does not occur if the engine 'backfires'. However, do NOT use Locktite because it will make removal, if required later, extremely difficult. One method used to ensure a well tightened nut is for one person to hold the cooling fan by wrapping a heavy cloth or towel around it and using both hands to grip the fan. The other person then 'torques' up the nut as tightly as possible. Do not try to hold the fan unit in a vice - it will almost certainly damage or break it.

G. Fasten Clutch Assembly #441 to flywheel using skt. hd. screws #235. Be sure when it is tightened down that it is straight and runs true. If it does not, repeat Steps 'E' and 'F' and try again. USE LOCKTITE.

H. Install Engine Cross Pieces #433 (2) between Engine Blocks #431 and #432 and fasten to engine using 4 skt. hd. screws #439. For shorter engines like the OS the position on the blocks should give maximum height to the engine when mounted in the helicopter. With longer engines like the HB 0.61, the blocks can be reversed to accommodate the extra length and mount the engine lower within the frames.

K. Place the Clutch Bell Assembly #438 on the clutch shaft. Check that the clutch bell spins freely.

L. At closed throttle, position carburettor throttle arm on engine as shown. Check that the carburettor barrel completely closes off the air to the engine at low throttle position. If it does not, adjust the mechanical set screw stop until the barrel can (just) be completely closed by rotation of the throttle arm. This adjustment is particularly important in an RC model helicopter so that the engine can be stopped remotely. Set engine assembly aside.

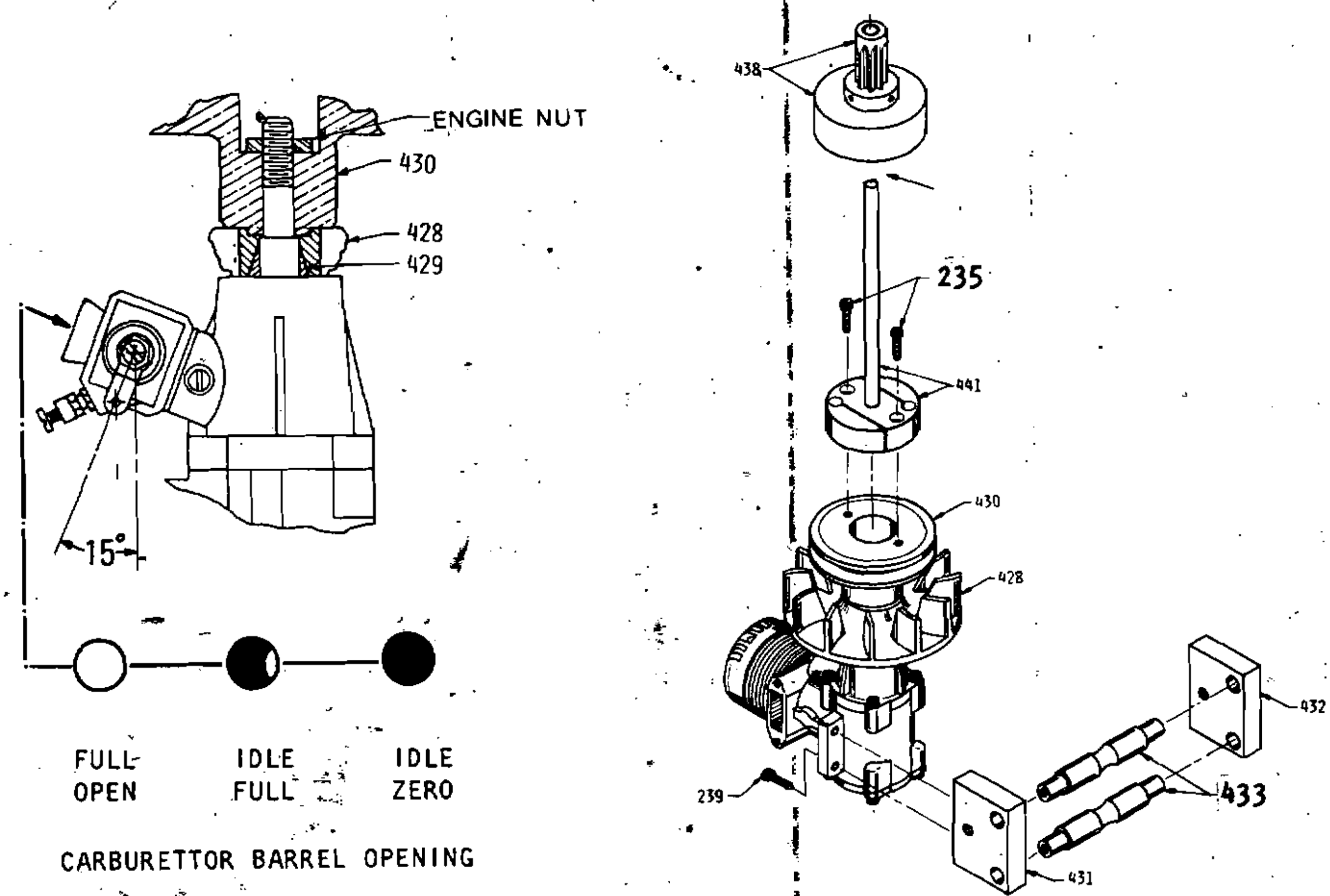


Figure 2
ENGINE ASSEMBLY

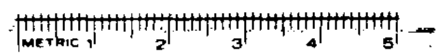
STEP 3 MAIN FRAME ASSEMBLY- see Figure 3

From the kit box, take the following:

1	#406	Right Side Frame
1	#407	Left Side Frame

From Bag #2, take the following:

1	#410	Front Frame Plate
2	#411	Servo Mount Stay
1	#408	Front Stay Right
1	#409	Front Stay Left



From the hardware dish, take the following:

14	#231	3mm x 10mm skt. hd. screws
14	#243	3mm locking nuts

A. Remove about 3/32" of material from the ends of each Front Stays #408 and #409 - see Figure 3. This will ensure clearance of the engine mounting blocks if they need to be mounted lower than the top edge of the front stays.

B. Fasten Front Right Stay #408 to Right Side Frame #406 using two skt. hd. screws #231 and two locking nuts #243. Check that everything is square. Tighten securely. See figure 3.

C. Repeat (A) using Front Stay #409 and Left Side Frame #407.

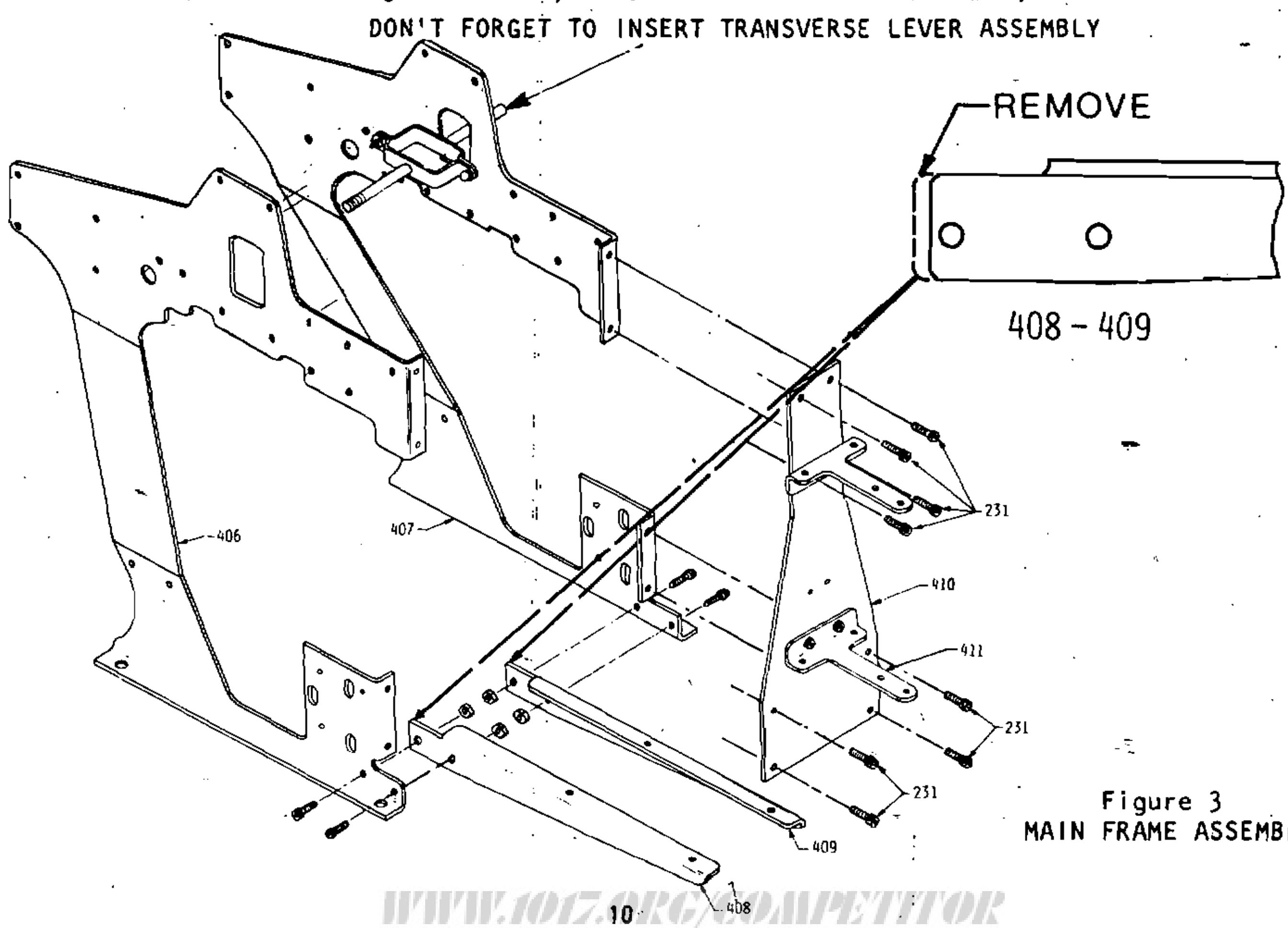


Figure 3
MAIN FRAME ASSEMBLY

D. Fasten Front Frame Plate #410 and Top Servo Mount Stay #411 to left and right frame assemblies using eight skt. hd. screws #231 and eight locking nuts #243. Assemble, but do not fully tighten nuts at this stage. See Figure 3.

E. Place Transverse Lever Assembly from STEP 1 between side frames, arms extending through rectangular holes in upper part of side frames. Threaded pitch shaft should be on the right (starboard) side of the helicopter. See [redacted] screws and nuts while holding main frames together as much as possible and checking, on a flat surface, that the whole assembly is square.

G. Fasten Lower Servo Mount Stay #411 to Front Plate #410 as shown in Figure 3.

STEP 4 COOLING SYSTEM 4 1/2 Needle

The following is needed from the kit box:

1 #557 Cooling Shroud

From Bag #8, remove the following:

1 #569 7/16 x 3/4 x 1 1/2 inch Wood Block

From the hardware dish, take the following:

2 #267 2.7x8mm wood screws

A. Trim the Cooling Shroud #557 to the mold lines on the inside of the shroud. Scissors or a 'hot' knife will do the job.

B. Open up the round hole in shroud to 50mm (2.0") dia. Make sure the hole is cut so as to leave an equal amount of 'lip' around its edge.

C. Place shroud over engine on work bench and check for clearances. Make holes for glow plug, needle valve, throttle control rod and exhaust. When the shroud is finally located there should be a clearance of about one millimeter from the top of the fan to the underside of the fan shroud. A bigger gap than this will reduce the cooling efficiency of the fan.

D. Wood Block #569 is used as the front mount of the cooling shroud and must first be shaped to fit the curvature of the shroud. See Figure 4.

E. Before fastening this block to the shroud, it should be painted or fuel-proofed. Fuel-proof paint, resin, or glue can be used. Fasten block to shroud with epoxy or cyanoacrylate glue. Top edge of block should be flush with upper edge of shroud and centered on front of shroud.

F. From inside of shroud, drive two wood screws #267 through shroud into wood blocks. Screws should be set about 25mm apart. It will help to drill 1/16" dia. pilot holes through shroud and block so that the screws go in without the chance of splitting the wood. See Figure 4.

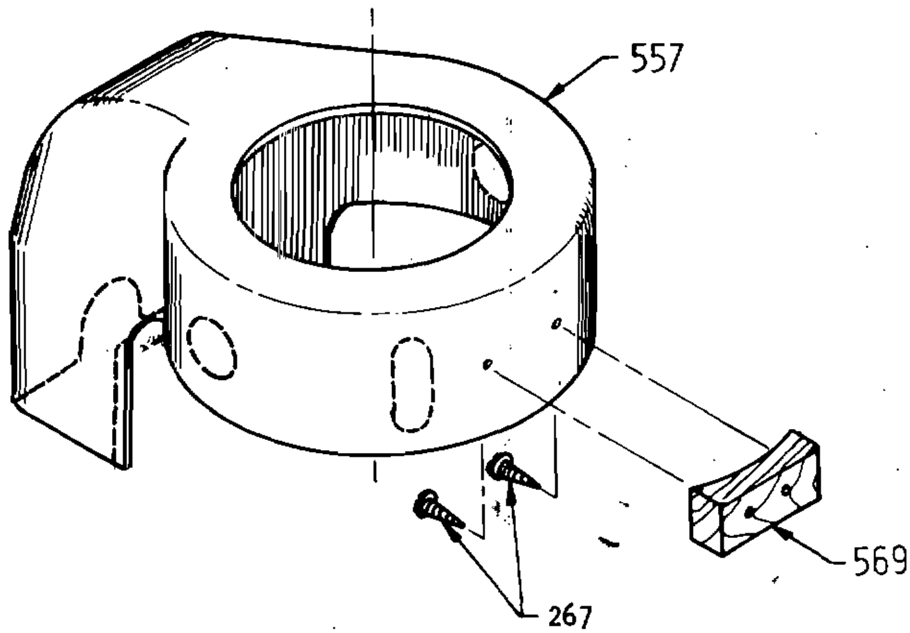


Figure 4
COOLING SHROUD DETAIL

FULL SIZE
TEMPLATE

STEP 5 ENGINE AND MAIN DRIVE INSTALLATION - see Figure 5

From Bag #3, take the following:

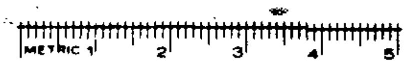
2	#424	Bearing Block and Bearing
1	#427	10 x 15 x 3.5mm Collar
1	#415	Main Shaft
1	#416	Main Gear Assembly

From Bag #6, take the following:

1	#413	Steel Main Shaft Collar

From hardware dish, take the following:

6	#274	4 x 10mm skt. hd. screws
6	#278	4mm flat washers
8	#231	3 x 10mm skt. hd. screws
1	#233	3 x 25mm skt. hd. screw
2	#252	4 x 4mm set screws
1	#243	3mm lock nut
8	#276	3mm flat washers



A. Place engine assembly in frame with shroud properly in place over the front section of the engine.

B. Fasten engine assembly between frames using six 4 x 10mm skt. hd. screws #274 and six heavy 4mm flat washers #278. FINGER TIGHTEN ONLY.

C. Before installing Bearing Block Assemblies #424, lubricate bearings with good grade of light bearing grease or a 140 weight oil.

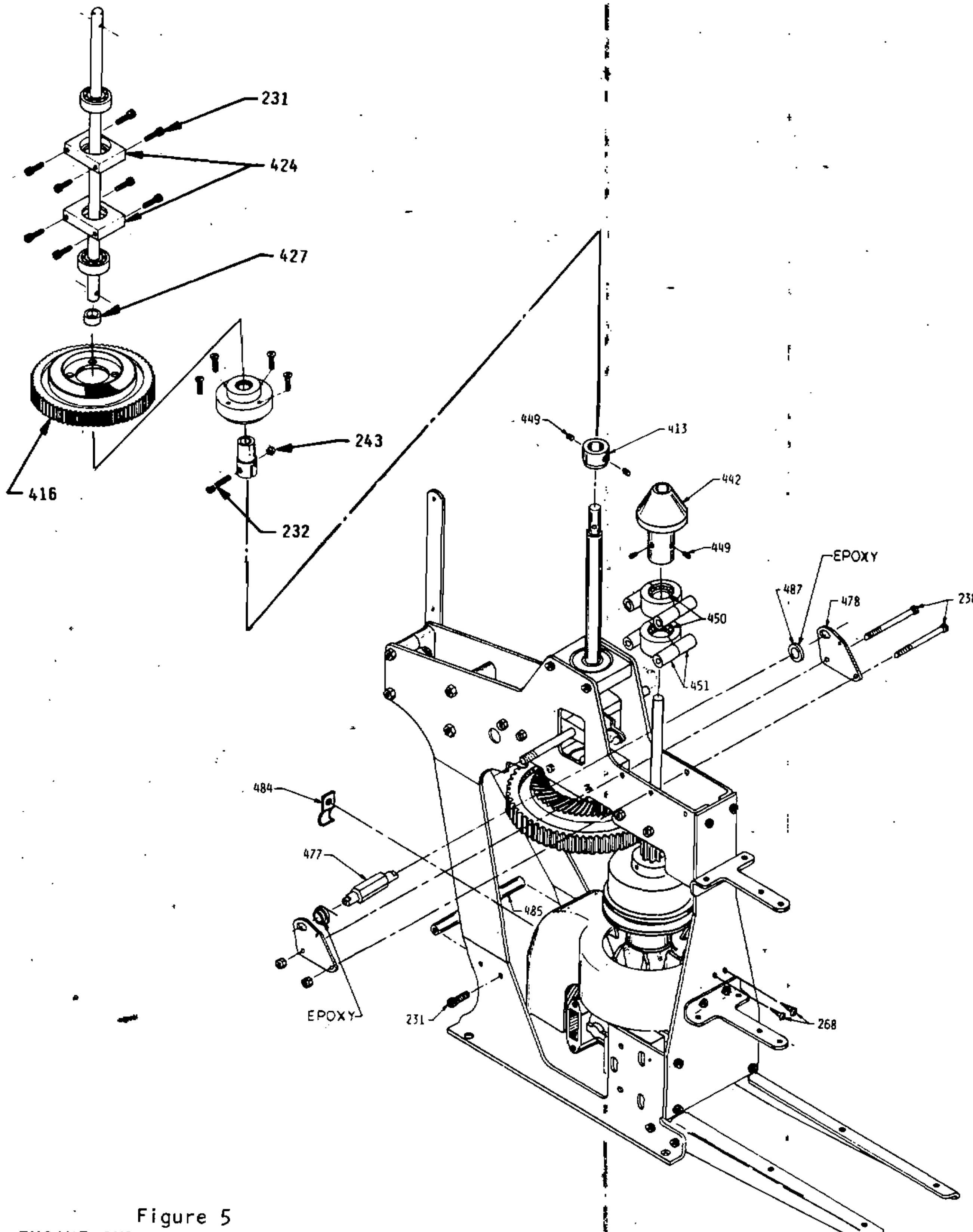


Figure 5
ENGINE AND DRIVE INSTALLATION

D. Fasten top Main Shaft Bearing Block #424 between frames in uppermost holes with open side of bearing up, using four 3 x 10mm skt. hd. screws #231, with a 3mm washer under each screw head. DO NOT TIGHTEN.

E. Fasten bottom Main Shaft Bearing Block #424 between frames in lower holes with open side of bearing down, using four 3 x 10mm skt. hd. screws #231 with a 3mm washer under each screw head. DO NOT TIGHTEN.

F. Slip Main Shaft #415 down through bearing blocks and center of transverse lever to insure proper alignment of bearings. Some oil on shaft may help. Tighten all eight screws securely. USE LOCKTITE.

G. Raise the main shaft far enough to allow the fitting of the Brass Collar #427, followed by the Main Gear #416S, (or #416 if Autorotation Gear)on to the lower end of the main shaft. Collar should be on top of the gear.

H. Fasten gear assembly to main shaft with 3 x 25mm skt. hd. screw #233 and a 3mm lock nut #243. Tighten firmly but don't over torque. (Note: when autorotation gear is used the 3x25mm screws should be replaced by the 3x16mm screws provided in the autorotation assembly package.)

J. Place Main Shaft Collar #413 on main shaft and secure with two 4 x 4mm skt. hd. set screws #252 while pulling up on main shaft and pushing down on the collar. USE LOCKTITE. There should be zero up and down play on the main shaft after this step.

STEP 5A ENGINE AND MAIN DRIVE INSTALLATION - continued - see Figure 5

From Bag #3, take the following:

1 #442 Starting Cone

From Bag #4, take the following:

2 #450 Bearings
4 #451 Plastic Bearing Holders

From Bag #5, take the following:

1 #477 Collective Lever Shaft
2 #478 Collective Lever Plate
1 #485 Frame Pillar
2 #487 Plain Bearing ('Custom' Model)
or 2 #487B Ball Bearing ('Pro' Model)

From Bag #9, take the following:

1 #484 Metal Clip

From the hardware dish, take the following:

2 #231 3 x 10mm skt. hd. screws

2	#237	3 x 35mm skt. hd. screws
2	#238	3 x 40mm skt. hd. screws
4	#243	3mm lock nuts
2	#268	3 x 14mm wood screws
2	#287	3 x 3mm set screws
1	#267	2.7x8mm wood screw
4	#276	3mm flat washers

A. Fit each of the Bearings #450 between two plastic Bearing Holders #451.

B. Lubricate bearings with a good grade of light bearing grease or a 140 weight oil.

C. Place both bearing assemblies, with raised portion up, on clutch shaft. See drawing.

D. Fasten lower bearing assembly in place between the main frames with two 3 x 35mm skt. hd. screws #237 and two 3mm lock nuts #243. Fit one 3mm flat washer #276 under each screw head and under each 3mm lock nut.

E. Using epoxy glue (preferably 30 minute type), glue the two Bearings #487 , or #478B, into the holes on the Collective Lever Plates #478. One plate should have a bearing flange on the left side and one should have bearing flange on the right side. Make sure there is no grease or oil on the surfaces to be glued. See drawing. Do not wait for glue to dry but do Step 'F' immediately so that the bearings will set-up in line with the collective lever shaft.

F. Using two 3 x 40mm skt. hd. screws #238, secure one Collective Plate #478 outside the main frame with the bearing flange facing inwards. Then fit Collective Lever Shaft #477 before mounting the other collective plate on the outside of the other main frame, also with the flange facing inwards. Fit the two 3mm lock nuts #243. TIGHTEN TEMPORARILY UNTIL GLUE SETS.

G. Before tightening clutch shaft bearing assemblies, adjust gear mesh by placing a piece of typing paper between gears then tighten all four bearing block screws and all six motor mount screws securely. Remove paper by turning gears. Gears should mesh and rotate smoothly. If there is any eccentricity then the notepaper check should be repeated with the gear meshing at their tightest point.

H. Check that Collective Lever Shaft #477 rotates freely. If not, adjust Plates #478 until it does. Lubricate bearings with a light oil.

J. Mount front of cooling shroud (wood block end) to front frame plate with two 3 x 14mm wood screws #268. See Figure 5. The under surface of the shroud top should clear the fan top surface by about one millimeter and the 50mm cutout hole should be located symetrically around the engine shaft. These adjustments will ensure good cooling efficiency.

K. Fasten Pillar #485 between frames with two 3 x 10mm skt. hd. screws #231. It may be necessary to drill a new 1/8" dia. holes in each side frame so that the pillar can be located fore and aft correctly, touching the shroud. USE LOCKTITE.

L. Secure the cooling shroud to the pillar using the Metal Clip #484 and a 2.7x8mm wood screw #267. Make a small hole (1/16" diameter) in the rear of the plastic shroud so that the #267 screw can be easily driven in. Do not overtorque. USE SILICONE.

M. Mount Starting Cone #442 on clutch shaft and secure with two 3 x 3mm skt. hd. set screws #287. Starting cone should just rest on top of bearing. Tighten well. USE LOCKTITE.

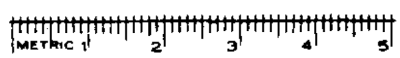
STEP 6 COLLECTIVE MECHANISM ASSEMBLY - see Figure 6.

From Bag #5, take the following:

1	#471	Collective Pitch Lever A
1	#472	Collective Pitch Lever B
2	#486	6mm Plain Bearing ('Custom' Model)
or 2	#486B	Ball Bearing ('Pro' Model)
2	#481	Brass Pitch Collars
1	#483	Aluminum Spacer
1	#476	Plastic Roll Lever
1	#475	Pitch Torque Lever

From the hardware dish, take the following:

2	#231	3 x 10mm skt. hd. screws
2	#276	3mm flat washers
1	#278	4 x 8 x 0.5mm flat washer
1	#275	4mm Lock nut
4	#211	5mm balls
4	#247	2 x 10mm pan hd. screws
4	#241	2mm nuts
2	#288	4 x 6mm set screws
4	#262	2mm flat washers



A. Epoxy one Bearing #486, or #486B, into each Collective Pitch Lever 'A' & 'B' #471 and #472. Bearing must be on inside towards frame. See sketch. Do not forget to thoroughly degrease and clean surfaces of bearing and lever so that the epoxy will hold properly.

B. Place Brass Pitch Collars #481 onto each Transverse Pitch Shaft #479 and #480. Make sure that small shoulders of collars face outwards.

C. Fit Collective Pitch Lever B (short) #472 on to the left transverse pitch shaft, and Collective Pitch Lever A (long) #471 on to the right transverse pitch shaft. Note that the curve or set of the long lever must be upwards, not downward (see exploded view). Fasten front of both collective pitch levers to Collective Lever Shaft #477 using two 3 x 10mm skt. hd. screws #231 and two 3mm flat washers #276. USE LOCKTITE.

D. On the right side, place the Aluminum Spacer #483 onto the Transverse Pitch Shaft #479.

E. Take the plastic Roll Lever #476 (figure 6A) and remove (cut) the section which contains the second and third holes from long leg (lever will now have only one hole on this leg). Place plastic roll lever on collective transverse shaft followed by the 4mm flat washer #278 and 4mm lock nut #275. Tighten nut so that roll lever can move freely, but with very little end play.

F. Remove the lower hole and surrounding material from end of Pitch Torque Lever #475 (see Figure 6B).

G. On left side, fasten Pitch Lever #475 to pitch shaft with two 4 x 6mm skt. hd. set screws. Pitch lever must be perpendicular to transverse mechanism. USE LOCKTITE.

H. Fasten the four 5mm balls #211 using 2 x 10mm pan head screws #247, 2mm nuts #241 and 2mm flat washers #262 in the following locations (see Figure 6 for details): USE LOCKTITE.

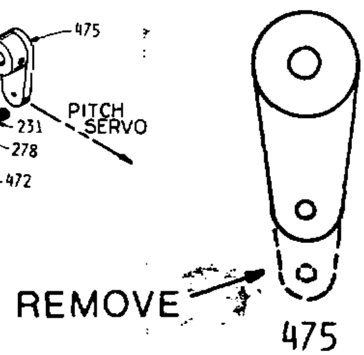


Figure 6B
MODIFIED PITCH LEVER

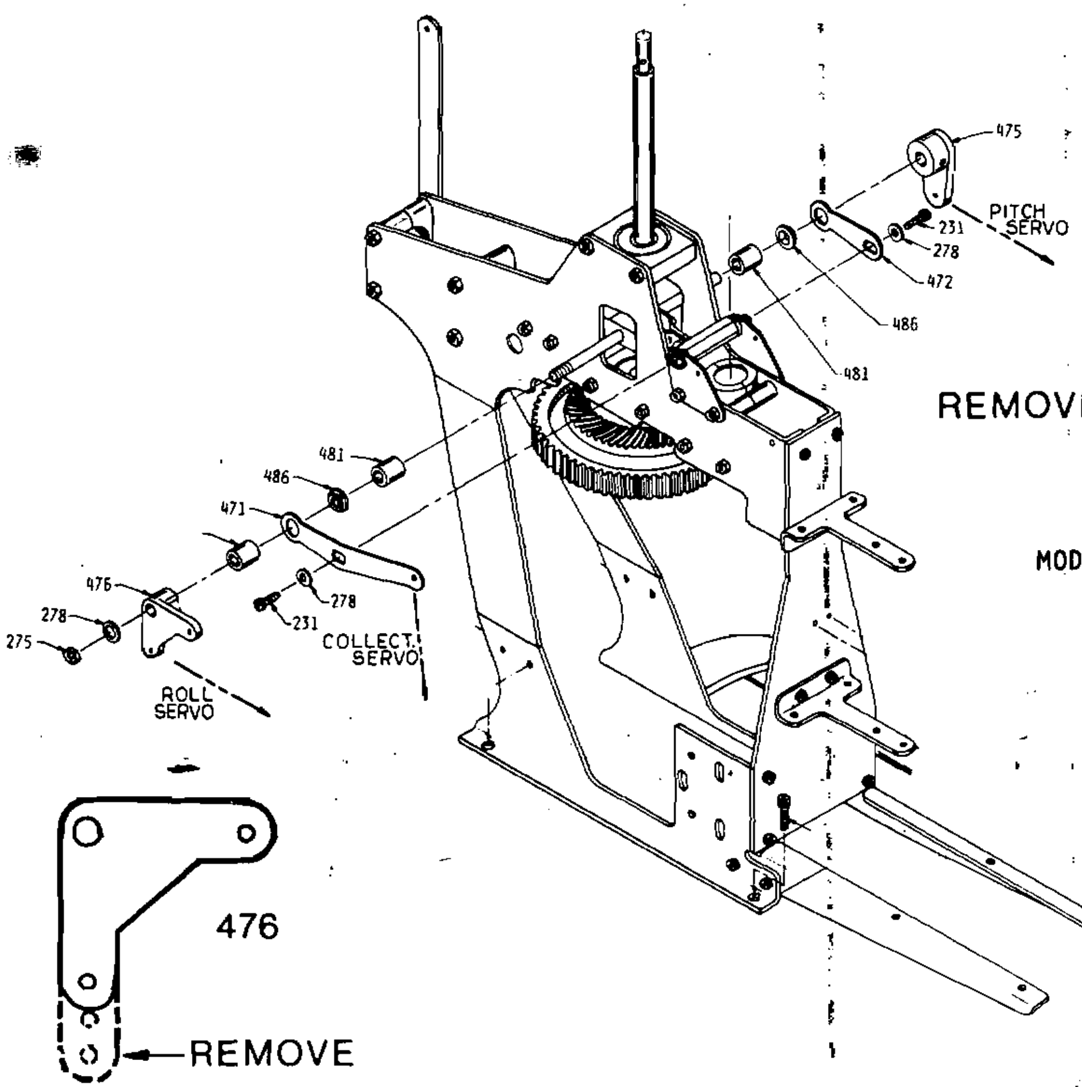


Figure 6A
MODIFIED ROLL LEVER

Figure 6
COLLECTIVE AND CYCLIC CONTROL MECHANISM ASSEMBLY

2 balls on plastic Roll Lever #476 in the outermost holes
1 ball on Pitch Torque Lever #475
1 ball on Collective Lever #471

The balls on the roll lever should both face outwards - away from the raised hub.

The ball on the pitch torque lever should face outwards - away from the hub.

The ball on the collective lever should face outwards.

STEP 7 TAIL GEAR DRIVE ASSEMBLY - see Figure 7

From Bag #4, take the following:

4	#455	Tail Boom Mounts
1	#444	Tail Gear Drive Assembly
2	#452	Bearing Holders

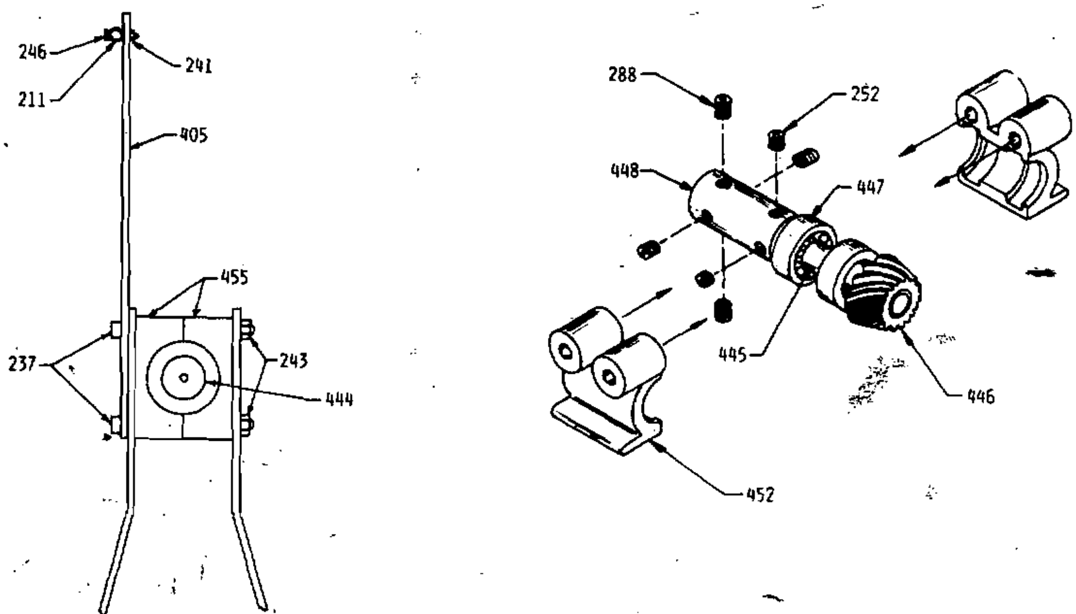
From Bag #2, take the following:

1	#405	Radius Arm Stay

From the Hardware dish, take the following:

6	#237	3 x 35mm skt. hd. screws
6	#243	3mm lock nuts
4	#276	3mm flat washers

A. Install plastic Tail Boom Mounts #454 between side frames using four 3 x 35mm skt. hd. screws #237 and four 3mm lock nut #243. Radius Arm Stay #405 must be retained on the left side of the helicopter by these same screws. DO NOT TIGHTEN.



REAR VIEW OF SIDE FRAMES

Figure 7
TAIL GEAR DRIVE ASSEMBLY

B. Mount Tail Gear Drive Assembly #444 between two plastic Bearing Holders #452.

C. Fasten the whole unit in position between side frames with two 3 x 35mm skt. hd. screws #237 and two 3mm lock nuts #243. Fit one 3mm flat washer #276 under each screw head and under each 3mm lock nut. Set gear mesh as close as possible without binding. Also check, by viewing from the rear through the Tail Boom Mounts #455 that the tail drive gear coupler is centered in the tail tube. Tighten nuts securely but do not overtorque.

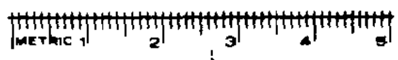
STEP 8 LANDING GEAR ASSEMBLY - see Figure 8

From Bag #1, take all contents:

2	#401	Skids
2	#402	Struts
4	#403	Skid Clamps

From the hardware dish, take the following:

4	#239	4 x 15mm skt. hd. screws
4	#275	4mm lock nuts
8	#265	3 x 12mm pan hd. screws
8	#243	3mm lock nuts



A. Fasten Landing Struts #402 to side frames using four 4 x 15mm skt. hd. screws and four 4mm lock nuts #275. Tighten securely.

B. Slide two skid clamps #403 over each skid #401.

C. Fasten skids to struts with eight 3 x 12mm pan hd. screws #265 and eight 3mm lock nuts #243. Rear of skids should extend 2 inches from the rear edge of the rear skid clamp.

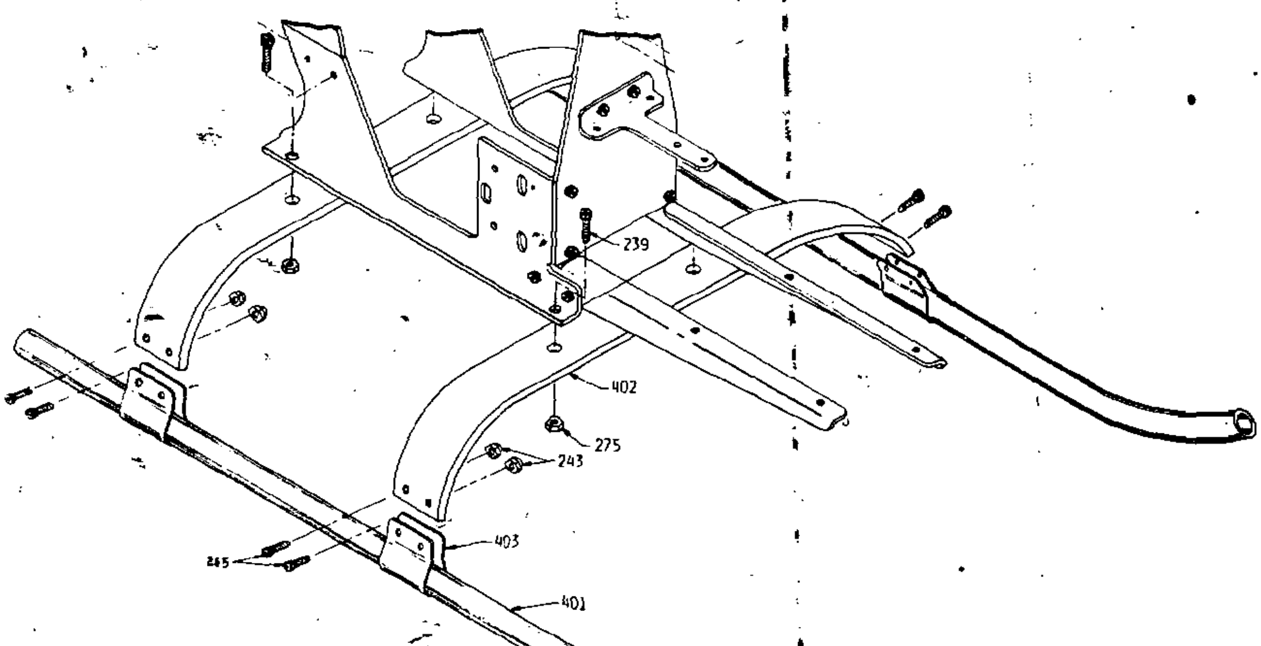


FIGURE 8
LANDING GEAR ASSEMBLY

STEP 9 SWASHPLATE ASSEMBLY - see Figure 9

From Bag #6, take the following:

1	#508	Swashplate Boot
1	#509	Mast Lock
1	#510	Pivot Arm
1	#511	Control Arm
2	#512	Radius Arms
2	#513	Brass Collars
1	#515	Swashplate Assembly
2	#566	2 x 11.8 Needle Pins

From the hardware dish, take the following:

9	#211	5mm balls
1	#241	2mm nut
1	#242	3mm nut
2	#245	2 x 6mm pan head screws
9	#246	2 x 8mm pan head screws
1	#249	2 x 16mm pan head screws
1	#250	3 x 10mm pan head screws
4	#262	2mm flat washers

A. Fasten eight 5mm balls #211 to Swashplate #515 using eight 2 x 8 pan head screws #246. USE LOCKTITE but be sure that it is applied very carefully and thoroughly since these balls are subject to high and continuous vibrational forces.

B. Lube swashplate assembly from the underside with a small amount of light oil.

C. Place Rubber Boot #508 on upper swashplate. Secure with silicone.

D. Place Mast Lock #509 inside Pivot Arm #510. Insert Brass Collars #513 into Pivot Arm #510. Fasten with 2 x 16mm pan head screw #249 and 2mm nut #241. Fit one 2mm flat washer #262 under each screw head and nut. USE LOCTITE.

E. Spread legs of Control Arm #511 and place over Pivot Arm #510. Fasten with two 2 x 6mm pan head screws #245 and 2mm flat washers #262.

F. Attach two Radius Arms #512 to Pivot Arm #510 and Control Arm #511 as shown in drawing using two Needle Pins #566. Needle pins are pressed in and need no further fixing if fitted properly. Check that the whole assembly can move freely.

G. Attach a 5mm Steel Ball #211 to Control Arm #511 using a 2 x 8mm pan head screw #246.

H. Attach radius arms on washout control assembly to the "outermost" balls on upper swashplate ring.

J. Slide whole assembly over main shaft and fasten with a 3 x 10mm pan head screw #250 and 3mm nut #242. USE LOCKTITE.

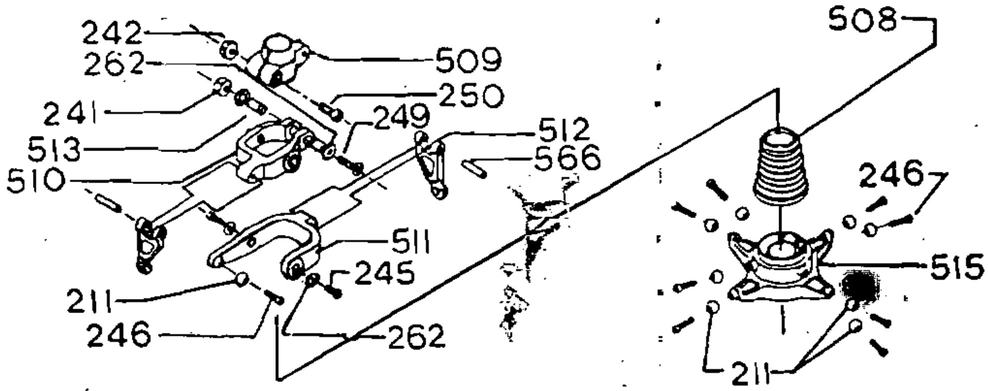


Figure 9
SWASHPLATE AND WASHOUT CONTROL ASSEMBLY

STEP 10 COVERING AND BALANCING OF MAIN ROTOR BLADES - see Figure 10

From the box take the following:

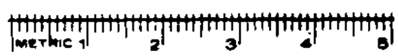
Main Rotor Blades and Covering

From Bag #7 take the following:

2	#531	Plastic Blade Ends
1		Yoke/Blade Holder Unit (factory assembled)

From the hardware dish, take the following:

2	#234	3 x 20mm skt. hd. screws
2	#240	4 x 30mm skt. hd. screws
2	#243	3mm lock nuts
2	#275	4mm lock nuts



A. The rotor blades provided in the Competitior kits are a standard large size, and must be cut to length depending on engine used.

For 0.40 - 0.45 engines, each blade length should be 21 inches. This will result in a total rotor span of 48".

For 0.50 - 0.61 engines, each blade length should be 24 inches. This will result in a total rotor span of 54".

Cut the blades squarely using a razor saw or small hand or power saw and sand the tip smooth. Do not make a mistake and cut the end with the holes in it. Make sure that both blades are <u>exactly</u> the same length.

B. Lightly sand the leading edge of the blades to remove any sharp edges.

C. Reinforce root end of main rotor blades (ends with holes). First sand the top and bottom surfaces where the plastic blade ends are fitted but remove only enough wood to make up for the increase in thickness added by the reinforcing material. If you do not do this the blade end can finish up too thick to fit properly into the plastic blade ends, thus overstressing them. One method to reinforce the blade ends is to take some light weight 3/4 oz. fiberglass cloth and wrap one layer around the first 3 inches of the blade, top and bottom. Attach the cloth to the blades by saturating it with instant or cyanoacrylate glue. When dry trim and sand the reinforced end. You must use very thin cloth or the plastic blade ends to be fitted in the next step will be overstressed when fitted onto the blades.

D. Fasten plastic Blade Ends #531 onto blades with 30 minute epoxy glue and secure with one 3 x 20mm skt. hd. screw #243 and a 3mm lock nut #243. Make sure that both holes in the blade end are aligned with the appropriate holes in the rotor blade before the glue sets.

E. Covering the blades: The blades should be covered with the vinyl film provided in the kit or you can go down to your hobby shop or hardware store and choose the color and texture of your choice. Please, however, do cover the blades because this adds considerably to the 'along the grain' strength. It is recommended that you do not operate the helicopter without blade covering. Before applying the vinyl it is advisable to lightly spray fuel proof paint on the first three or four inches of the blades at the blade holder end and the outer tip of blade to keep fuel from soaking into the wood. To cover the blades, strip the paper backing from the vinyl covering and hold one blade up with your finger and thumb in front of you, with the trailing edge to the right and the plastic hub blade end at the bottom. Now, with the sticky part of the covering facing away from you, overlap the trailing edge of the blade facing you by about 1/2 inch, attaching it at the top or end of the blade first and then carefully let the blade covering stick to the trailing edge underneath until you have the full length fully covered with 1/2 inch of covering. Smooth down carefully with the fingers and then you can take the blade horizontally in your hand and fold the covering over the top surface of the blade, making sure there is a sharp crease at the trailing edge. If handled gently and carefully, covering a blade is very easy. It can be made difficult if the covering is pulled hard in some places and not in others. So be very careful to just gently smooth the covering over the blade rather than pulling it too tightly.

After the top surface is covered, the covering can be wrapped around the leading edge carefully and pulled underneath the blade again until it overlaps the first 1/2 inch seam that we made at the very beginning. Smooth out all wrinkles and bubbles before pressing the covering down hard.

F. Mount both blades to the factory assembled yoke/blade holder unit using 4 x 30mm skt. hd. screws #240 and 4mm lock nuts #275.

G. To balance head, first make sure blades are parallel to head. Place a suitable round axle through either large set of holes in the head and suspend in a HI-Point balancer or other suitable balancer. A round tube or pencil and two straight edges of metal or ply will also do the job. (See Figure 10.)

H. Cut some 1 inch wide by 5 inch long pieces of colored vinyl film or Monokote Trim and wrap the outer end of the lightest blade at the tip. Repeat again if necessary until blades are balanced. Set head and blade assembly aside.

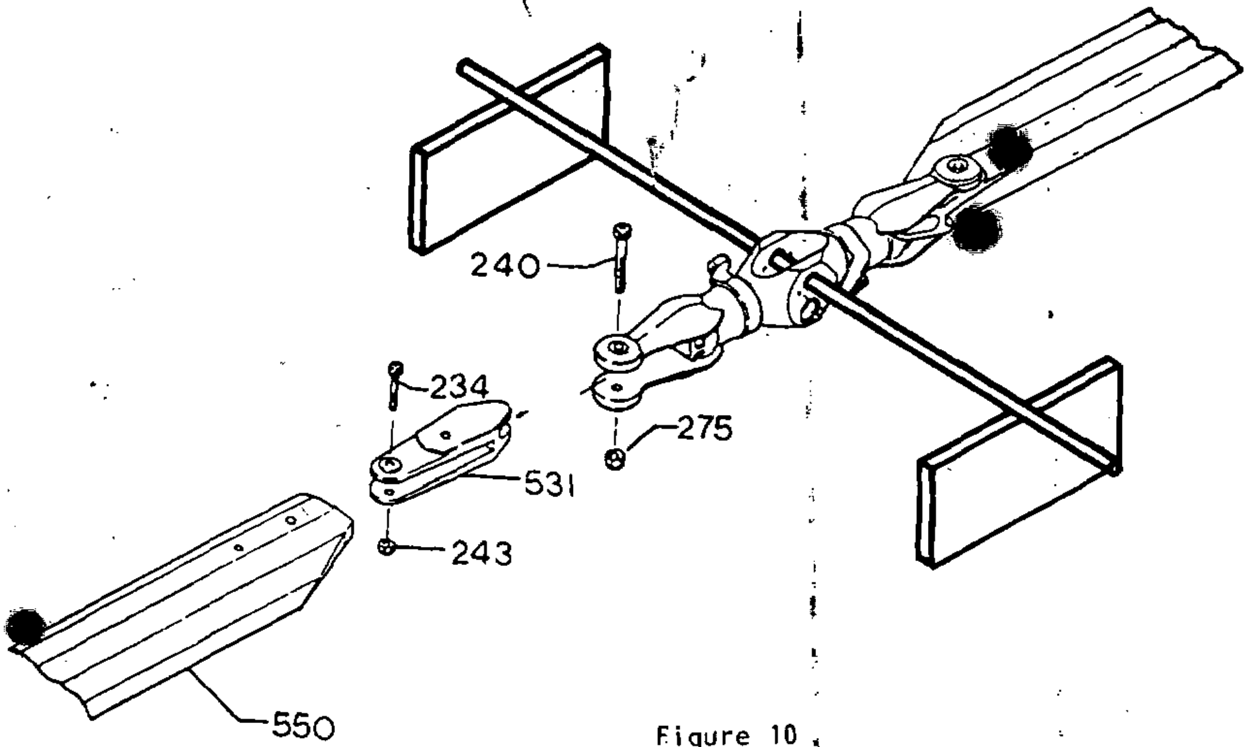


Figure 10
BALANCING MAIN BLADE ASSEMBLY

STEP 11 ROTOR HEAD ASSEMBLY - see Exploded View

From Bag #7, take the following:

1		Rotor Head Assembly (factory assembled)			
1	#530	Rotor Hub	2	#566	2x11.8mm Needle Pins
1	#533	Seesaw Pivot Arm	2	#535	Mixing Arm Holders
2	#532	Flybar Paddles	2	#534	Seesaw Bearing Holders
1	#567	3x15.8mm Needle Pin	2	#538	Plastic Dust Caps
2	#541	NeedleBearing	2	#548	Flanged Ball Bearings
1	#543	Damper Rubber	1	#565	4x29.8mm Needle Bearing
2	#549	Pivot Bolts	1	#539	Yoke Damper Collar (A)
2	#536	MixingArms	1	#540	YokeDamperCollar (B) (threaded)
2	#542	Flybars	2	#537	Gimbal Shaft Bushing ('Custom' Model)
1	#520	Seesaw	or 2	#537B	Ball Bearing ('Pro' Model)

From the hardware dish, take the following:

1	#211	5mm balls	1	#236	3x26mm skt. hd. screw
4	#241	2mm nuts	2	#278	4mm flat washer
1	#252	4x4mm set screw	1	#246	2x8mm pan hd. screw
5	#288	4x6mm set screw	4	#245	2x6mm pan hd. screw
2	#275	4mm lock nut	4	#248	2x14mm pan hd. screw

Note: As you proceed through these steps make sure that all parts move freely but without any excessive play.

A. Remove grease or oil from the two Gimbal Shaft Bearings #537, or #537B Ball Bearings, and the top two holes of machined Rotor Hub #530. Glue the bearings, flanges to the inside, into the holes using a slow setting epoxy. (DON'T STOP - GO TO NEXT STEP BEFORE EPOXY SETS.)

B. Slide the 3[illegible] Needle Pin #567 through bushings with Seesaw Pivot Arm #533 in place while epoxy is curing.

C. Secure the needle pin in place with 4 x 4mm set screw #252 in top of seesaw pivot arm. USE LOCKTITE.

D. Take Damper Rubber #543 and slice off 1mm (no more!) from one end.

E. Lubricate rubber and insert into large hole in Rotor Hub #530. (Note: use Vaseline or any vegetable based grease for this step but don't overlook it since an unlubricated rubber bush <u>can</u> lead to severe vibrations in your helicopter.)

F. Place one flanged Ball Bearing #548 onto each threaded stub of Seesaw Pivot Arm #533, flanges facing in.

G. Thread onto the same seesaw pivot arm threads two plastic Mixing Arm Holders #535, tighten against bearings and position them both to be parallel to rotor hub and in line with each other (see exploded view of rotor head).

H. Fit two Mixing Arms #536 into the plastic Mixing Arm Holders #535 using the two 2 x 11.8mm needle pins #566.

J. Carefully coat the outside rims of the two Ball Bearings #548 with a <u>small</u> amount of SILICONE.

K. Place rotor head assembly into cradles of Seesaw #520 and secure with Seesaw Bearing Holders #534 and four 2 x 14 pan head screws and four 2mm nuts #241. The bearing holders will be on the underside and the seesaw on top - see exploded view of rotor head. USE LOCKTITE.

L. Fasten a 5mm Ball #211 to side of seesaw with a 2 x 8mm pan head screw #246. USE LOCKTITE.

M. Press two Needle Bearings #541 into Rotor Head Yoke #522 until just flush with inside surface of yoke. They must <u>not</u> project beyond the inside surface.

N. Place rotor hub assembly into yoke, and slide a 4 x 29.8mm needle pin #565 through bearing and hub, placing a 4mm flat washer #278 on either side of hub as the pin goes through to space it equally between the yoke (see exploded view of rotor head).

O. Secure needle pin with 4 x 6mm set screw #288 through side of rotor hub. Do not overlook this step. USE LOCKTITE.

P. Lubricate Needle Bearings #541 with a heavy weight oil or light grease. Place two plastic Dust Caps #538 over needle bearings. Fasten with four 2 x 6mm pan head screws #245. USE LOCKTITE.

Q. Place Yoke Damper Collars #539 and #540 into Yoke #522. Secure with 3 x 26mm skt. hd. screw #236. One of the Damper Collars, #540, is threaded and will act as a nut. USE LOCTITE.

R. Screw two Pivot Bolts #549 onto Blade Holder #549 as per drawing. Make sure that they are torqued down firmly but remember that the blade holders are made of aluminum so be careful not to 'strip' the threads in the blade holder. USE RED LOCKTITE. Be sure to rotate the blade holders so that each pivot bolt faces the direction of rotation of the head - see Exploded View. Install the two Flybars #542 into Seesaw #520. The end with the short threads goes into the seesaw. Secure with 4mm lock nut #27[illegible] from inside of seesaw. Nut must be threaded all the way on. Pull both flybars out so that nut rests firmly against the seesaw and then secure with four 4 x 6mm set screws #288. USE LOCKTITE.

S. Screw Flybar Paddles #532 onto flybars until the flybar screw threads just protrude into the square opening in the paddles. Flybar paddles have carefully tapered unthreaded holes that will allow them to tap themselves as they are threaded on. They should be set so as to be parallel to the seesaw and with the leading edge facing the direction of rotation (clockwise when viewed from the top).

T. Balance the flybar by removing the main rotor blades temporarily. (Note which side each blade comes from so that it can be replaced on the same side.) Now adjust the position of the paddles until the flybar assembly is equal weight on each side. If you prefer you can fit one wheel collar on each flybar and slide these collars in or out to achieve a good balance of the flybar unit. Replace the main rotor blades. Torque the 4mm nuts so that the blades will be "friction tight" and will not 'flop' around when the helicopter is tilted slightly.

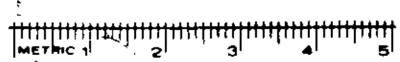
STEP 12 TAIL ROTOR GEAR BOX ASSEMBLY - see Exploded View

From Bag #4 take the following:

1	#163CP	Tail Rotor Assembly	1	#462	Tail Rotor Hub
1	#167CP	Tail Rotor Pitch Plate	1	#453	Tail Gearbox Mount
2	#456	Tail Rotor Pitch Hinge	2	#457	Thrust Bearing Set
2	#458	Flanged Ball Bearings	2	#459	Ball Bearings
2	#463	Tail Pitch Plate Collar	2	#461	2x8.8m Needle Pin
1	#163N	7x7mm Brass Collar	1	#460	3x5mm Brass Collar
2	#243S	3mm lock nuts			

Note: The two 3mm lock nuts in this bag are a special length so that they fit the inside of the plastic blade holders without fouling. If you use any other type of lock nut you may have to relieve the inside of the blade holders a little but be very careful so as not to reduce their strength.

From the hardware dish take the following:



2 #211 5mm balls 6 #241 2mm nuts

6	#247	2x10mm pan hd. screws	2	#277	3mm flat washers
2	#251	3x5mm set screws	2	#570	ball links
2	#287	3x3mm set screws			

A. Grip the Tail Rotor Assembly #163CP in a vice or pliers by the Tail Drive Coupler #448, which is already attached.

B. Insert Brass Collar #163N over the threaded end of the gearbox output shaft. Make sure there is no grease or oil on the shaft or on the threaded hole in the Tail Rotor Hub #426.

C. Thread Tail Rotor Hub #462 onto gearbox output shaft. Threads are left handed. That is, you tighten up by twisting in an anti-clockwise direction. Tighten securely. USE LOCTITE.

D. Assemble tail rotor blade bearings onto each of the threaded studs of the tail rotor hub in the following sequence:

Thrust Bearing Washer (groove out)	
Thrust Bearing	#457
Thrust Bearing Washer (groove in)	
3x7mm Special Flat Washer	#277
Ball Bearing	#459
3mm Lock Nut	#243S (see note above)

E. Lubricate the bearings with light grease or 140 weight oil.

F. Fasten plastic Blade Holders #164CP around bearing assemblies using four 2x10mm pan head screws #247 and four 2mm nuts #241. NOTE: each pair will include one holder with ball link holder projection. USE LOCKTITE on the 2mm nuts - not on the plastic. Check that the blade holders rotate freely without any binding after tightening screws.

G. Attach two 5mm Balls #211 to blade holder assemblies with two 2 x 10mm pan head screws #247 and two 2mm nuts #241. USE LOCKTITE.

H. Place two flanged Ball Bearings #458 into Pitch Plate #167CP, one from each side.

J. Press 3 x 5mm Brass Collar #460 through bearings.

K. Pin two Pitch Hinges #456 into ends of Pitch Plate #167CP using two 2 x 8.8mm needle pins #461.

L. Thread two Ball Links #570 all the way onto Pitch Hinges #456.

M. Thread two 3 x 3mm set screws #278 into two Pitch Plate Collars #463.

N. Place one Pitch Plate Collar #463 onto Pitch Rod #161, then fit the pitch plate assembly onto the pitch rod and hold it in place with second pitch plate collar. Make sure that the two collars trap the pitch plate assembly so that there is no end play. Tighten set screws. USE LOCTITE.

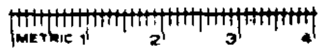
O. Snap ball links on pitch plate assembly onto the 5mm balls on the blade holders. Balls must be on the leading edge as unit rotates in clockwise direction, viewed from the blade side.

P. Fasten Tail Gearbox Mount #453 to gearbox assembly with two 3 x 5mm set screws #251. Webs on mount should be horizontal. USE LOCKTITE.

STEP 13 COVERING AND BALANCING THE TAIL ROTOR BLADES

Take the Tail Rotor Blades from the kit box.

From the hardware dish, take the following:



2 #243 3mm lock nuts
2 #232 3x16mm skt. hd. screws

A. Cut both tail blades to the following lengths, as you did for the main rotor blades in Step 10A:

40 - 45 engine: 4 1/8" (10" dia.)
50 - 61 engine: 4 5/8" (11" dia.)

B. Proceed with sanding, painting and covering the tail rotor blades the same as you did in STEP 10 for the main rotor blades. It is not necessary to cover the roots with fiberglass cloth but a light soaking with cyanoacrylate glue around the hub hole and the tips will help to extend the life of the blades.

C. Cover the blades with vinyl film or Monocote trim. As with the main blades do not use them uncovered.

D. To balance the tail rotor blades use a hi-point balancer or use a metal rod which is a stiff push fit through the mounting holes and check the balance by resting the ends of this rod on two thin edges just as you did with the main rotor blades. Adjustment can be made by adding more covering to the lighter blade or by drilling 1/16" dia. holes in the end of the heavier blade.

E. Mount the blades on the tail rotor assembly so that when the blades turn clockwise (viewed from the left hand side of the model) the leading, or rounded, edge rotates ahead and the surface towards you is the rounded one.

STEP 14 TAIL BOOM ASSEMBLY - see Figure 11

From the wood parts bag #8 take the following:

3 Wood Disks

From the box take the following:

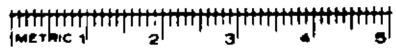
✓1 #554 1/8 inch Tail Drive Tube (brass)
✓1 #553 Tail Drive Wire
✓1 #552 Tail Boom

From Bag #4 take the following:

1 #454 Tail Gearbox Clamp - "hose clamp"

From the hardware dish take the following:

8 #288 4x6 set screw



A. Drill a 1/8 inch hole in the center of the three wood disks from Bag #8 of plywood parts. Check that each disk will fit easily, but not loosely, into the tail tube; if not, sand the diameter down a little.

B. Cut the 1/8 inch brass tube #554 to proper length. This length is determined by the length of the tail boom which is, in turn, determined by the engine size. See chart below:

Engine Size	Tail Boom	Brass Tube
0.40 to 0.45 Engine	25.5"	20.75"
0.50 to 0.61 Engine	28.5"	23.75"

C. Slide the three wood disks over brass tube, placing one in the center and the other two approximately 5 inches from each end. Cement in place using a 5 minute epoxy or use cyanoacrylate glue and baking soda to create a filet.

D. When the glue is dry, put some silicone on the outside of the disks and slide brass tube assembly into the tail boom. Center it in the tail boom and let the silicone dry. Epoxy may be used in place of silicone or you may just drop a small amount of cyanoacrylate glue down the tube and onto the disk edges after the assembly is in place.

E. Insert tail boom between tail boom mounts, in frame of helicopter, so that front of boom protrudes about 1/16" in front of front tail boom mount.

F. Install 1/16" Tail Drive Wire #553 into Gearbox Coupler #165 on tail rotor assembly, and fasten with four 4x6mm set screws #288. So as not to bend wire when tightening set screws, use the following sequence: turn in one set screw until it contacts wire. Turn in opposite set screw securely. Tighten first set screw securely. Tighten both sets of screws this way. USE LOCKTITE.

G. Slide Tail Boom Clamp #454 over tail boom

H. Insert tail drive wire with tail rotor box attached through tail boom tube and into front drive coupler. Check wire for proper length and cut if necessary. Remove wire and lubricate with light grease or medium weight oil before final insertion.

J. Re-insert the tail drive wire and fasten front of wire into front drive coupler. Tighten securely using same technique as sub step (F). USE LOCKTITE.

K. With a twisting motion, pull the tail boom rearward just a little to relieve any compression of the tail gearbox input shaft due to the fitting of the

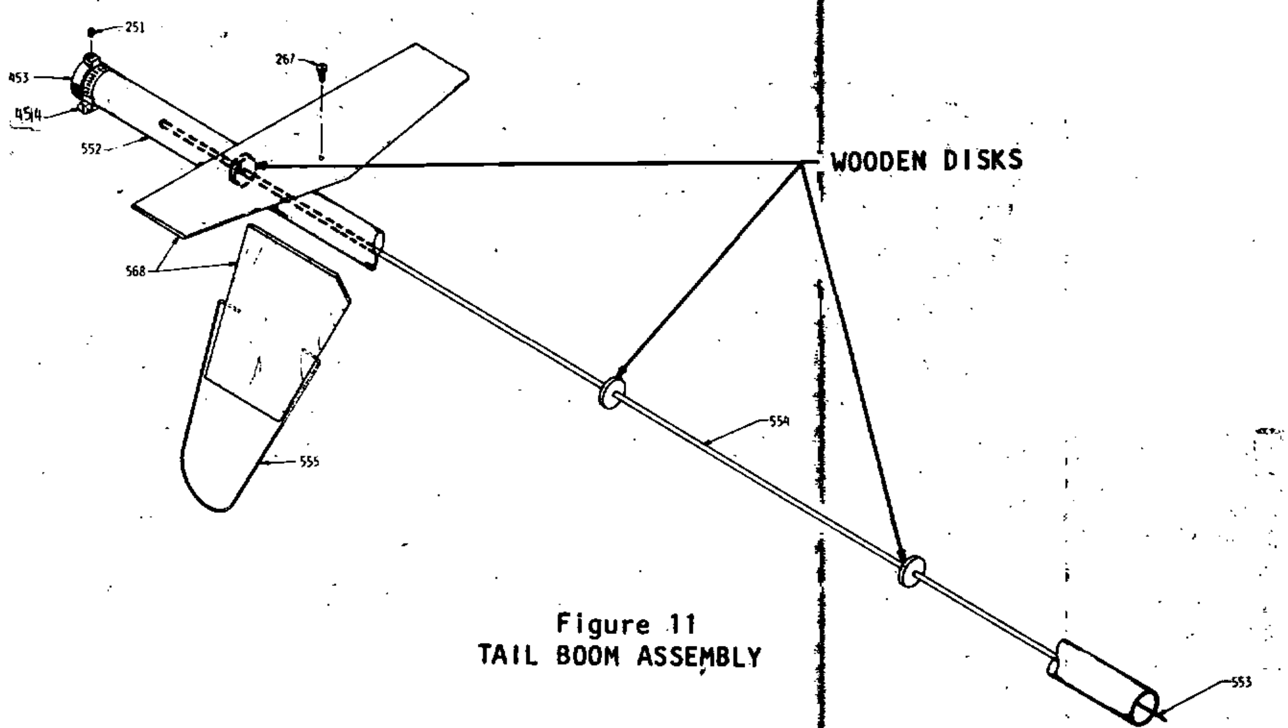


Figure 11
TAIL BOOM ASSEMBLY

tail drive wire. Then position the gearbox horizontally and pointed to the left side of the helicopter.

L. Tighten the four nuts and socket head screws that go through side frames and tail boom mounts.

M. Tighten well the screw of the tail boom clamp to secure the tail gearbox in place.

STEP 15 TAIL FIN ASSEMBLY - see Figure 11A

From the wood parts bag #8 take the following:

1 Horizontal Fin
1 Vertical Fin

From the box take the following:

1 #555 12 inch Tail Skid Wire

From the hardware dish take the following:

1 #267 2.7 x 8mm wood screw

A. Drill a 1/16 inch hole into leading and trailing edge of the vertical fin. Cut away the leading and trailing edge of fin from the holes to bottom of the fin as shown in Figure 11. Bend 1/16 x 12 inch wire #555 to proper shape and epoxy in place. See figure 11.

B. Measure in 4 inches from right side on bottom of horizontal fin and make a line perpendicular to the trailing edge. Epoxy the vertical fin to the horizontal fin on this line.

C. When epoxy is dry, sand and paint or cover with Monokote trim or other plastic covering.

D. Fit the fin assembly onto the tail boom so that trailing edge of horizontal fin is 6 inches from end of tail boom tube. Use a generous amount of silicone so that filets are formed as shown in Figure 12.

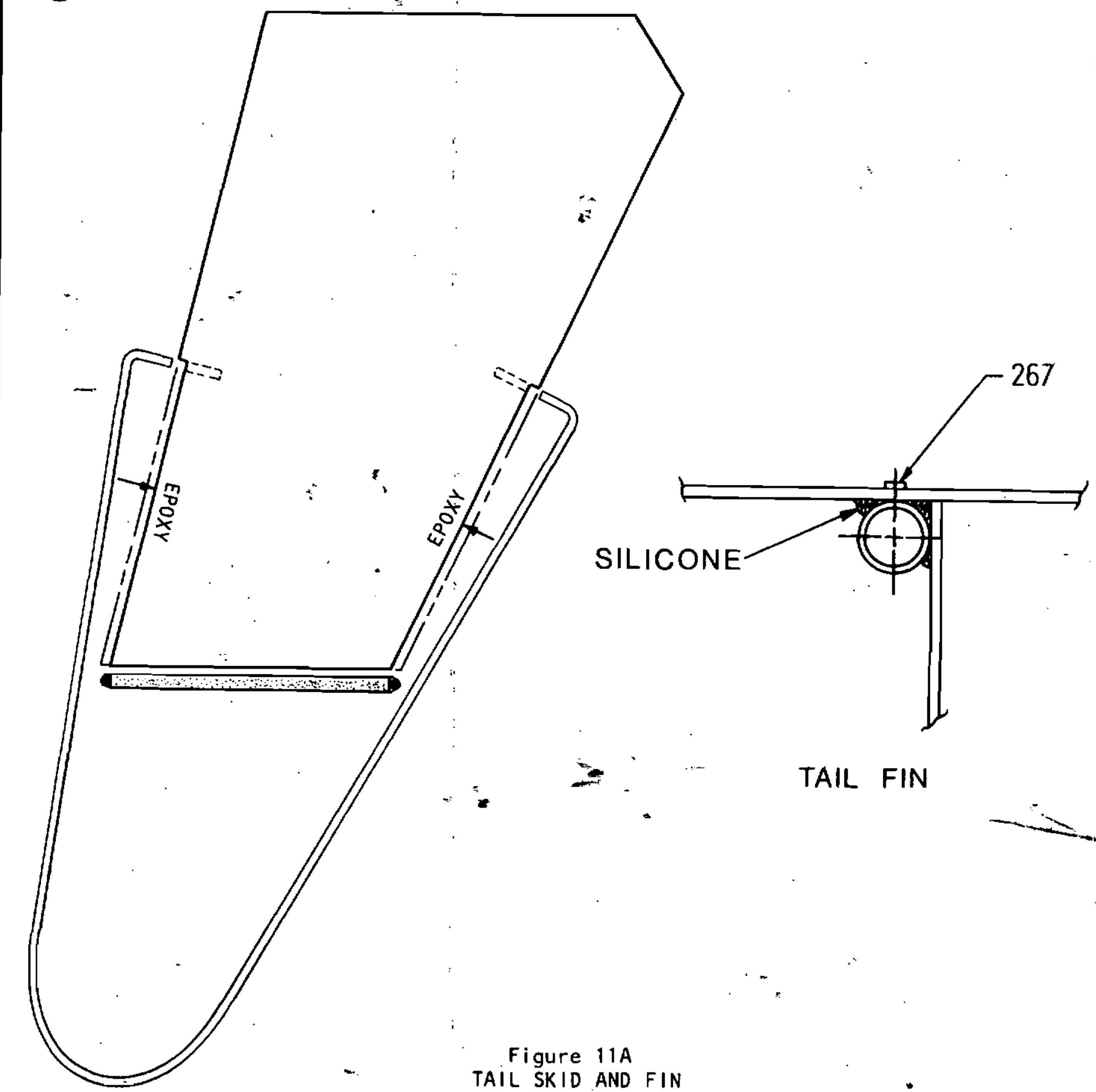


Figure 11A
TAIL SKID AND FIN

E. When silicone has set you can then drill a 1/16" hole through the fin <u>and</u> the tail tube and finally secure the whole assembly to the tail boom with a 2.7 x 8mm wood screw #267. See Figure 12. Note: some fliers prefer to omit the screws so that the whole assembly breaks loose in the event of a crash - you choose.

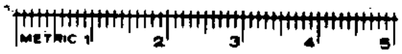
STEP 16 SERVO TRAY ASSEMBLY - see Figure 15

From Bag #8 take the following:

All contents

From the Hardware dish take the following:

4	#268	3 x 14mm wood screw
4	#250	3 x 10mm pan hd. screw
4	#243	3mm lock nut



A. Laminate two horizontal servo trays (3 holes) together with epoxy or white glue. Do the same to the vertical servo trays (1 hole).

B. The precut holes will allow the mounting of most standard servos. Check that your servos will fit these holes. If necessary enlarge or alter them to fit.

C. Cut the vertical servo tray to be 3 1/8 inches long. (See exploded view.)

D. Glue the vertical tray perpendicular to the horizontal tray centered between the two rear servo holes and flush with rear edge. Use epoxy. Let dry.

E. Fit servo tray assembly between servo mount stays on helicopter frame. Notch rear edge of horizontal tray to clear bolt on upper stay.

F. Fasten servo tray assembly to servo mount stays using four 3 x 14mm wood screws #268. Be sure unit is straight in vertical and horizontal planes. It is advisable to drill 1/16" dia. pilot holes to avoid splitting the wood.

G. Glue upper canopy mounts (1/2 x 3/8 x 1 1/4 inch wood blocks) to rear corners on top of horizontal servo tray. Be sure that the overall outside width (tip to tip) is 4 1/8 inches.

H. Glue the two servo mount spacers to the vertical servo tray on the right side next to the servo openings. This is done to elevate these servos.

J. Shorten two servo mount spacers to 3/4 inch long and glue them to the horizontal servo tray at the ends of the <u>front</u> servo hole cutout. This is done to raise the front servo so the control rod will be above the level of the two other servos fitted to this tray.

K. Fit the 8 1/4 x 2 7/8 x 1/8 inch plywood floor to the front stays on the helicopter and drill four 1/8 inch holes to match the mounting holes in the horizontal aluminum stays. Drill 1/4" dia. access hole as shown in Figure 12.

L. Cement the lower canopy mounting block under this floor at its front edge and about 1/4" off center sideways (either way).

M. Remove servo trays and floor and paint or fuel proof. We use Pactra black color spray dope.

N. Remount servo tray assembly and mount plywood floor using four 3 x 10mm pan hd. screws #250 and four 3mm lock nuts #243.

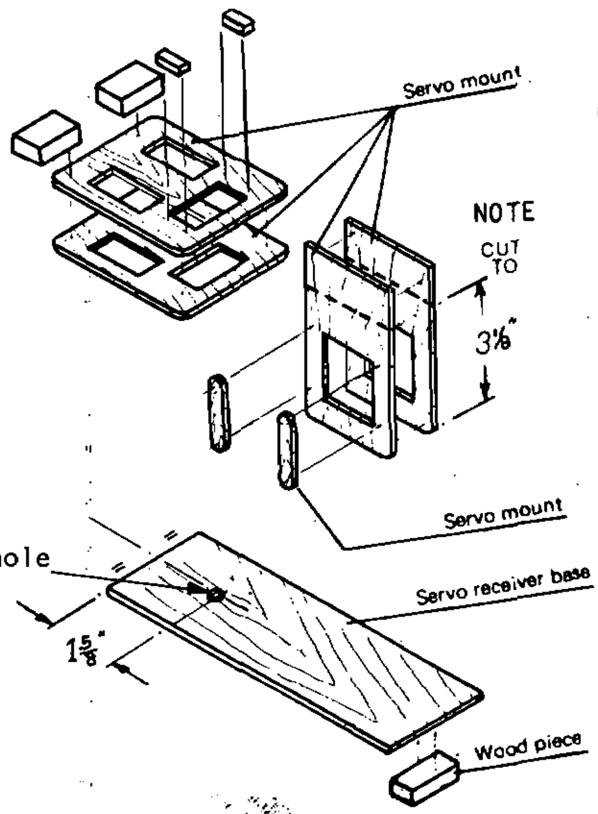


Figure 12
RADIO TRAY ASSEMBLY

STEP 17 CANOPY INSTALLATION

From the box take the following:

1 pr #560 Canopy

From the hardware dish take the following:

3		rubber grommets
3	#268	3 x 14mm wood screws
3	#276	3mm flat washers

A. Cut out canopy halves leaving 3/8 inch edge on the outside of canopy and 3/16 inch flange on back. Scissors work best.

B. Clamp canopy halves squarely together using clamps or clothes pins. Spring clamps work best. Cement halves together with a cyanoacrylate glue. Allow to dry thoroughly.

C. Trim the canopy outside edge to 1/8 inch.

D. Drill or cut 1/4 inch holes in the center of the mounting depressions on each side of the canopy.

E. Position the canopy on your helicopter and drill pilot holes (about 1/16" dia.) in ends of upper canopy wood mounts.

F. Insert rubber grommets into the 1/4" holes in the canopy and fasten canopy to the side mounts with two 3 x 14mm wood screws #268 and two 3mm flat washers #276.

G. Hinge the front of the canopy upwards until it contacts the lower mounting block on bottom of the plywood floor. Visually check to be sure canopy is straight.

H. Mark and drill a 1/16" inch hole through the canopy and into the wood block. Lower the canopy and increase the 1/16" hole to 1/4" dia. Insert a rubber grommet and secure the canopy to the underfloor wood block with one 3 x 14mm wood screw #268 and one 3mm flat washer #276.

J. Remove canopy from helicopter and remove grommets.

K. Mask and paint canopy as desired. Polyurathane or epoxy paints work best. Be sure to degrease the canopy thoroughly before painting. You can wash it in warm soapy water, rinse and dry. If a tinted window is wanted, soak in 'Rit' or other hot water dye before masking and painting.

L. Replace the three rubber grommets.

STEP 18 FUEL TANK ASSEMBLY - see Figure 13

Take the Fuel Tank from the kit box.

Also, from your local hobby shop, obtain 1 foot of medium size fuel tubing.

A. Remove contents of fuel tank.

B. Lay tank on its side on wood floor with cap facing the rear left side.

C. Inset two aluminum tubes into cap. The long one is for the vent and should be bent so that it touches the top inside of tank when cap is in place. To the short tube on the inside of cap connect a 3 inch piece of the silicon fuel line. Connect the clunk to other end. Make sure that the clunk falls onto the floor of the tank by its own weight. If it does not, you need to use a more pliable fuel tubing.

D. Insert cap and tubes into tank.

E. Fit the tank under the vertical servo tray.

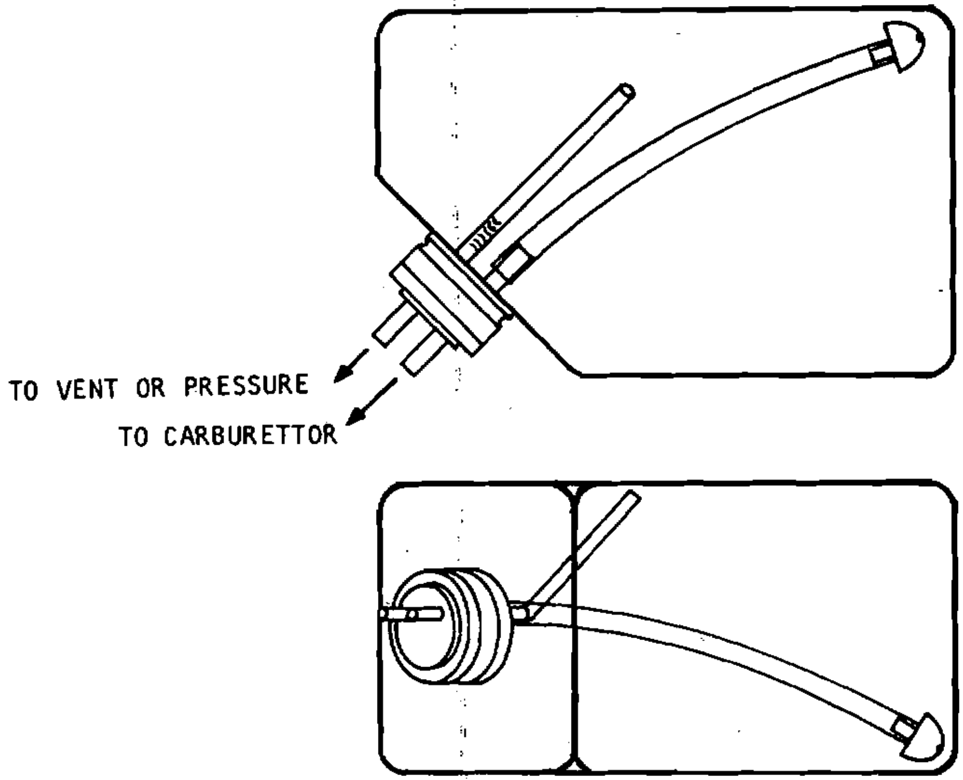


Figure 13
FUEL TANK #559

STEP 19 MUFFLER

Install a muffler of your choice. Our favorite is the MAC's Heliball, available at your local hobby store. It provides a quiet exhaust with minimum loss of power. However, tuned pipes can be used, too, and GMP also stocks a special quiet muffler which works well. Use silicone between the muffler and engine and also on the muffler mounting screws.

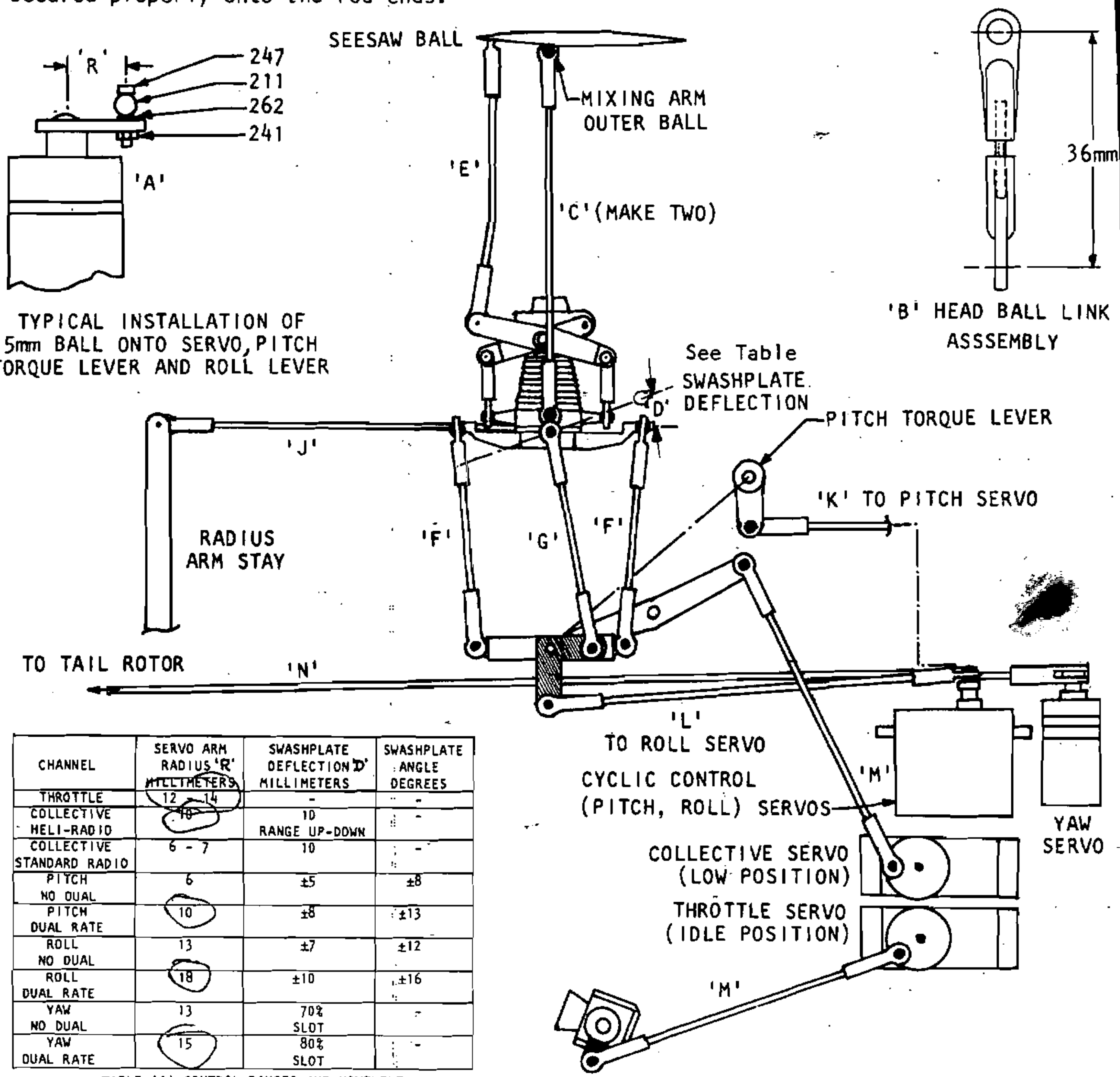
Hardware information chart

Description	Qty/Kit	GMP#
3x10mm Skt Hd Screw	26	231
3x12mm Skt Hd Screw	2	235
3x16mm Skt Hd Screw	2	232
3x20mm Skt Hd Screw	3	234
3x25mm Skt Hd Screw	1	233
3x26mm Skt Hd Screw	1	236
3x35mm Skt Hd Screw	8	237
3x40mm Skt Hd Screw	2	238
4x15mm Skt Hd Screw	8	239
4x30mm Skt Hd Screw	2	240
2x6mm Pan Hd Screw	6	245
2x8mm Pan Hd Screw	10	246
2x10mm Pan Hd Screw	14	247
2x14mm Pan Hd Screw	4	248
2x16mm Pan Hd Screw	1	249
3x10mm Pan Hd Screw	5	250
3x12mm Pan Hd Screw	8	265
2.7x8mm Wood Screw	4	267
3x14mm Wood Screw	9	268
2x12mm Skt Hd Screw	2	269
2.6x8mm Skt Hd Screw	2	270
4x10mm Skt Hd Screw	6	274
2mm Nut	23	241
3mm Nut	1	242
3mm Lk Nut	43	243
3mm Lk Nut	2	243S
4mm Lk Nut	9	275
3mm Flt Washer	23	276
2mm Flt Washer	12	262
3x7mm Flt Washer	2	277
4x8x0.5mm Flt Washer	9	278
3x3mm Set Screw	4	287
3x5mm Set Screw	2	251
4x4mm Set Screw	3	252
4x6mm Set Screw	15	288

METRIC CHECK SCALE IN MILLIMETERS

CONTROLS INSTALLATION AND SET-UP - see Figure 14

We will install and hook-up every control arrangement and servo separately. The push rod lengths will be given - then the overall length with ball links or clevises (measured from center to center of the balls or clevis pins) will be given in parenthesis like this: 2x110mm (120mm). The control rods from servos to controls may vary in length because of variations in individual servo sizes and may need to be varied from the suggested dimensions given. Cut equal amounts from each end of the control rod and deburr the ends thoroughly or your ball link or clevis may not be secured properly onto the rod ends.



CHANNEL	SERVO ARM RADIUS 'R' MILLIMETERS	SWASHPLATE DEFLECTION 'D' MILLIMETERS	SWASHPLATE ANGLE DEGREES
THROTTLE	12 - 14	-	-
COLLECTIVE HELI-RADIO	10	10 RANGE UP-DOWN	-
COLLECTIVE STANDARD RADIO	6 - 7	10	-
PITCH NO DUAL	6	±5	±8
PITCH DUAL RATE	10	±8	±13
ROLL NO DUAL	13	±7	±12
ROLL DUAL RATE	18	±10	±16
YAW NO DUAL	13	70% SLOT	-
YAW DUAL RATE	15	80% SLOT	-

TABLE 'A' CONTROL RANGES AND MOVEMENTS

Figure 14
CONTROL RODS INSTALLATION

Bag #9 contains all of the links, clevises and ball links needed for the control system. Take out the following parts:

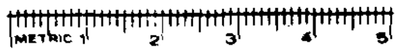
30	#570	Ball Links
2	#571	2x16mm Control Rod
3	#574	2x55mm Control Rod
1	#219	2x70mm Control Rod
2	#229	2x90mm Control Rod
2	#576	2x100mm Control Rod
1	#577	2x110mm Control Rod
2	#578	2x120m Control Rod
5	#211	5mm Balls
2	#579	Control Rod End
2	#581	Clevis
1	#580	Metal Clip

From the kit box, take the following:

1	#556	Control Wire
1	#558	Control Wire Tube

From the hardware dish, take the following:

1	#231	3 x 10mm skt. hd. screw
1	#234	3 x 20mm skt. hd. screw
2	#243	3mm lock nut



Note: See Figure 14 for each individual control rod connection. Each rod is marked with a letter corresponding to the appropriate steps below. For example, step 'B' will refer to the installation of control rod marked 'B'.

First, fit the rotor head assembly to the top of the main shaft and secure it with the 3x20mm skt. hd. screw #234 and the 3mm lock nut #243. Tighten well. Now carry out the following steps.

A. Fit a 5mm ball onto each of the output arms of the pitch (elevator), roll (aileron) and throttle and collective servo (if used). If only one servo is used for throttle (collective) then two 5mm balls will be fitted to a servo <u>wheel</u> as shown in Figure 16. Table 'A' in Figure 14 suggests the radius at which the ball should be fitted onto each servo arm and illustrates a typical installation for your guidance.

Use of the radius dimensions given will result in approximately the correct amount of swashplate cyclic and collective movements. However, this in turn depends upon a servo rotation of plus or minus 45 degrees. If this rotation angle varies, then the radius dimension may have to be varied to suit. Note that we have suggested a shorter radius if your radio does not have dual rate available in pitch and roll.

The swashplate deflections shown in the table will provide a good aerobatic capability for the average flier and are intended as a starting point. However, each flier may feel more comfortable, and give a better performance, with a higher or lower ratio than those recommended. In this event the servo arm length may be changed to suit.

B. Cut about 3mm from the ends of four heavy duty ball links as shown in Figure 14. Take the two 2x16mm (36mm) threaded rods. Screw one of these ball joints onto the end of each of the two threaded rods. Make sure that the rod enters each ball joint equally to a depth of at least 6mm. The distance between the centers of the two balls, if fitted to the ball links, should be 36mm as an initial adjustment. The ball joint ends should be rotated to be at right angles to each other. These two units are fitted between the inside balls of the blade mixing arms and the pivot bolts of the main blade arms. Since these ball links are subject to high flight loads, please make them up very carefully.

C. Take the two 2x100mm (112mm) threaded rods and fit a ball joint at each end, again with the thread entering the ball joint at least 6mm. Both of these rods must always be the same length between the ball joint holes and when any adjustment is made to these particular links it must be made equally. The lower end of each rod is fitted to the 'closest in' 5mm ball on the swashplate upper level and the upper end to the outside ball of the mixing arm in the rotor head.

D. Rotate the washout mast lock on the main mast until the slit in the Plastic Mast Lock #509 is directly underneath the 5mm ball fitted onto the outside of the flybar seesaw. The distance between the top of the washout mast lock and the underside of the rotor hub should be set initially to about 10mm. This distance may need to be readjusted during final set-up. Tighten the bolt in the washout mast lock to secure the unit to the main mast.

E. Take a 2x70mm (88mm) rod and fit it with two ball joints in the same fashion as the others. Feed this control rod through the slot in the rotor head so that one ball joint can be clipped to the side ball of the seesaw and the other ball joint to the top ball of the washout unit. You will have to bend this rod slightly so that it does not interfere with the sides of the rotor yoke, whatever angle the rotor yoke is tilted to. Look at the photos and exploded views to see how this link is fitted. The final length of this rod is adjusted to ensure that the paddles are parallel with the swashplate at all times.

F. Make up two 2x55mm (72mm) control rods with a ball link at each end. These rods are connected between the fore and aft balls of the lower part of the swashplate to the two balls on the rocker arm assembly of the the pitch control lever (inside the main frames).

G. Make up one 2x55mm (72mm) control rod with a ball link at each end. Connect this rod between the ball on the right hand side of the swashplate and the shorter horizontal arm of the aileron "L" lever (situated on the right hand side of the model).

H. Take a 5mm ball and fit it, by means of a 2x10mm screw and a 2mm nut, to the hole in the top of the radius arm stay. The ball should face outwards to the left hand side of the model. USE LOCKTITE.

J. Make up one 2x110mm (133mm) control rod and fit it with a ball joint at each end. This control rod is fitted between the ball on the top of the radius arm stay and the ball on the left hand side of the swashplate.

K. Make up two 2x120mm control rods fitted with a ball link on each end. Connect one rod between the pitch (elevator) servo and the Cyclic Pitch Lever #475 on the left hand side of the model. This rod should be adjusted so that the transverse lever is horizontal when the servo is in its neutral position.

L. Connect the second 2x120mm control rod between the Roll Lever #476 and the roll (aileron) servo. The length of the rod should be adjusted so that the Roll Lever vertical arm is vertical when the servo is in its neutral position.

M. Make up two 2x90mm (110mm) control rods fitted with a ball link at each end. Use one of these to connect the collective pitch servo arm to the end of the collective main lever. Keep this control a straight run. Trim upper servo mount if necessary. Connect the engine throttle lever to the throttle servo with the other rod(see Figures 14 and 16 which show the arrangement of these two rods).

N. Make up the tail rotor control rod from the 38" Control Wire #556 provided in the kit. Solder two Threaded Couplings #579 onto each end of the wire after sliding Tail Rotor Control Tube #558 onto the wire. Please note that these joints must be made very carefully so that a failure due to vibration or loads between servo and control is extremely unlikely. For this reason a good silver solder should be used and both parts thoroughly cleaned prior to soldering. If you have any doubt about your ability to make a good soldered joint in this step, please consult an experienced friend or your local hobby store for advice. Attach a nylon clevis to each end of the threaded couplings. The total length of the finished control rod should initially be 39 5/8", measured from clevis pin to clevis pin. Fasten the tube to the left side of your model by means of Clip #580 secured into an unused hole in the side frame using the 3x10mm socket head bolt #231 and a 3mm locking nut #243. To ensure rigidity of control use either cable ties or vinyl tape every 5" or 6" to hold the assembly to the tail boom.

Now that we have connected all the control rods we will now start the initial set-up of our tail rotor controls.

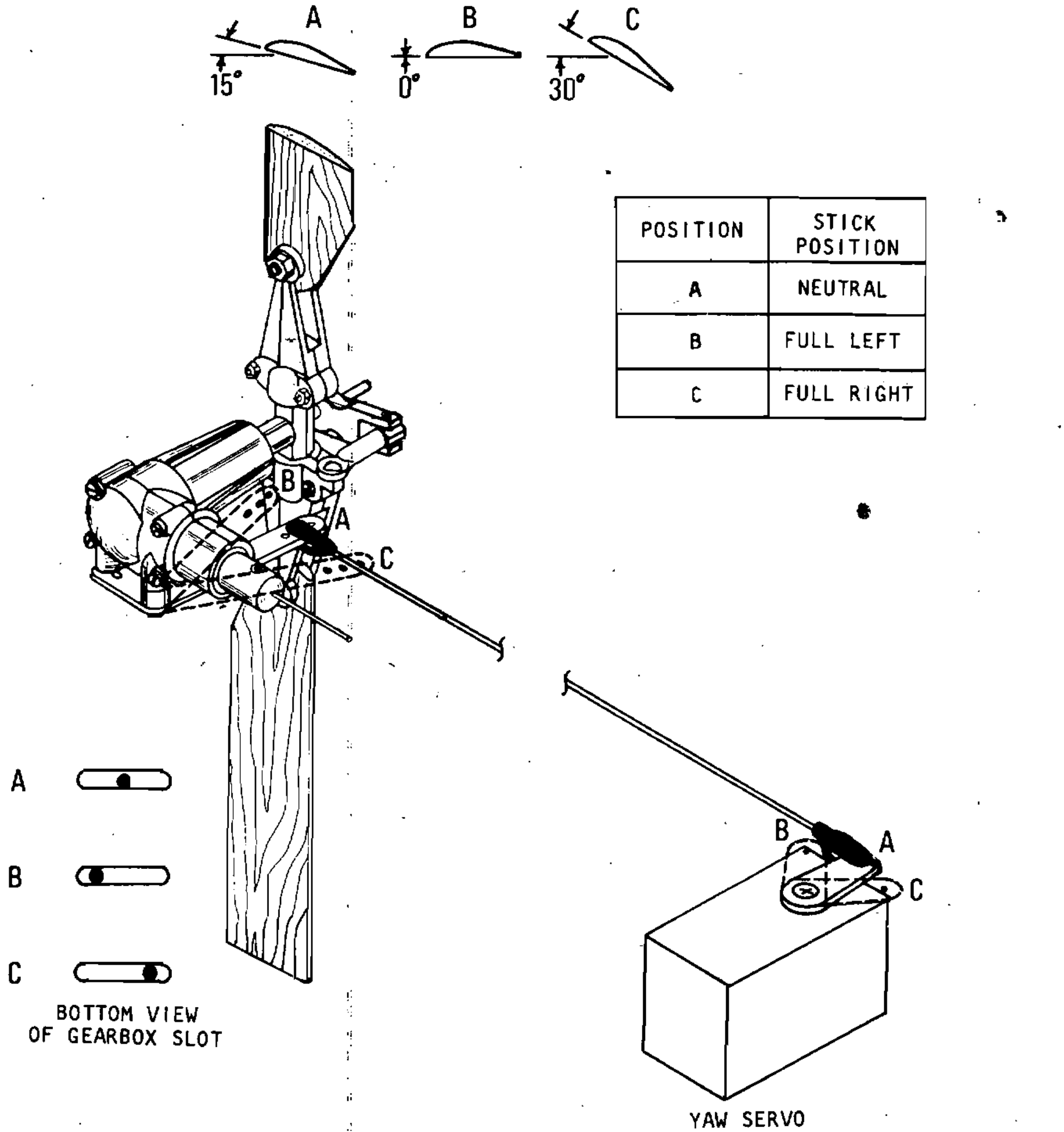
Tail Rotor Control Set-up - see Figure 15

The following text illustrates and describes how to set up your tail rotor controls. Remember that there will always be a mechanical limit on the total travel or movement on the tail control and it is the center of this maximum movement which you should take as a datum when you center the control adjustments. So here are the steps which should be made in sequence:

A. Set the rudder servo arm at neutral position and, at this setting, the control rod from the rudder servo to the tail control lever should be adjusted in LENGTH until the PIN in the gearbox SLOT is CENTERED (see position 'A' in Figure 15).

B. NOW, DON'T TOUCH (A) again and do the following: adjust the LENGTH of the rudder SERVO ARM (the distance from the pivot to the point where the tail wire is fixed) so that, with full left to right rudder stick movement (including the additional movement added by the trim lever also), the pin moves NEARLY (say 80%) the full amount of the movement that the slot will permit (see positions 'B' and 'C' in Figure 15).

C. NOW, DON'T TOUCH the adjustmensts made in (A) or (B) again. Set the collars which postion the pitch control plate on the pitch control wire so that, with FULL LEFT stick on the transmitter, the flat surface of the tail blades are approximately parallel to the line of flight (see position 'B' in Figure 15).



POSITION	STICK POSITION
A	NEUTRAL
B	FULL LEFT
C	FULL RIGHT

Figure 15
TAIL ROTOR CONTROL SET-UP

D. NOW, when the rudder stick is NEUTRALIZED, the blades will look like position 'A' in Figure 15 and, when the rudder stick is full RIGHT, the blades will look like position 'C' in Figure 15.

Note: The above is an initial set-up and the adjustments may need to be varied during flight set-up. Maintaining a central setting of the pin in the slot should always be observed, however, so that you may always have full control available to you.

Final Bench Set-up

Now that your 'Competitor' has been completed and most of the major adjustments have been made, it is time to finalize and refine some of these adjustments before starting the engine and commencing your trimming and flying.

A. Collective Pitch and Throttle

If you refer to the servo set-up for collective pitch, it will illustrate the fundamental relationship of movements required in a collective pitch helicopter. The movement of the pitch angle of the blades themselves should be from approximately 1 1/2 degrees negative to about 7 or 8 degrees positive while the throttle moves from idle to full. At throttle stop position, or trim zero, the blades will be at about 2 1/2 degrees negative angle. Some experts will prefer different settings but this is a good starting point for the "not-so-expert" flyer.

Now it is very easy, in a collective pitch helicopter, to overload the engine with the wrong settings or, sometimes even worse, to have the engine screaming at high collective settings. The way to counter this is to set the throttle of the engine so that it opens 'slowly' at first and progressively faster as the throttle is advanced. Collective should move 'quickly' at first and then at a slower speed towards the end of the rotation of the servo. The engine throttle lever should be set up as shown in Figure 2 and the servo arm should move from an almost horizontal position down to 90 degrees when the throttle is fully opened, thus increasing the amount of motion of the throttle per servo degree as the throttle is advanced.

The collective pitch servo moves from just less than the 90 degree position to a position where the rod is almost in line with the servo arm, thus 'reducing' the amount of movement towards the end of travel.

Playing around with these ratios can give you exactly the amount of engine power that you require for each setting of collective pitch. This factor is a very important one if you are to enjoy the advantages of flying a collective pitch helicopter. Don't worry if you have problems with this at first - it is quite complex and you may need to seek help in setting up this part of the system. Even the 'experts' have trouble with this one and some would set-up their helicopters quite differently from the method described above. However, try the above for 'starters' unless you have an 'expert' friend to help you do it.

With collective throttle set to full up/open position, the mixing arms on the rotor head should be just above level (see Figure 16).

Check that the swashplate is level and that the pitch and roll channels are 'zeroed', including the trims. Now, if you have a pitch gauge, check that the rotor blade angle is 7 - 8 degrees positive.

Set collective/throttle transmitter stick to low position. Set trim to high. Your blade angle setting should now be minus 1 to minus 2 degrees. Half stick should be 3 1/2 degrees to 4 1/2 degrees positive.

With the settings described, your machine should hover at approximately 1500 rpm (head speed) and at full throttle in forward flight the head speed will increase to about 1650.

B. Cyclic Controls Set-up

Make sure that the paddles are set in line with each other, looking end-on. Also check, by looking end on at the paddles, that they are both parallel to the swashplate.

When the swashplate is at right angles to the main shaft, the paddles should be at the same angle. If the swashplate is tilted forward or backwards when the flybar and the paddles are lined up across the helicopter, then they should, in turn, follow the angle of the swashplate movements.

The same applies for a sideways tilt of the swashplate when the flybar and paddles are lined up fore and aft of the helicopter. The swashplate should be level in pitch (at 90 degrees to the main shaft) but tilted 1 or 2 degrees to the right in roll when the transmitter pitch and roll controls are centered (main lever and trim lever).

C. Carburettor Setting

Check the carburettor settings. With a fully open throttle lever on the transmitter, the carburettor barrel should be wide open. At zero throttle lever, but full throttle trim, the throttle barrel should be open just a small amount (about 1/16"). Finally, you should be able to close that small opening to zero by moving the throttle trim to zero. The 'mixing' of throttle and collective pitch settings is shown in Figure 16 and has been described in 'A' above.

D. C. G. Setting

The C.G. should be set to lie between being coincident with the main shaft and 3/8" ahead of it. A forward C.G. will permit better aerobatics and a C.G. on the main shaft will lead to improved hovering. There are several ways of checking the CG. The best way to check CG is to straddle the helicopter with your hands, put your forefingers underneath the main drive gear edges, exactly opposite each other, on the outside of the helicopter. Position the fingers so that they are in line with the main shaft, and then lift the helicopter. You can then, by moving your fingers forward or back, accurately locate the center of gravity. Adjustment of the center of gravity can easily be made by adding a small amount of lead to the nose of the helicopter. You can glue it in the nose of the canopy or on to the front edge of the lower servo tray. Before you add weight, however, make sure that your battery is located as far forward as you can get it.

E. Linkages

All the linkages which move the controls must be free and it is recommended that you check once again by disconnecting the links from each servo, in turn, and move the control rods backwards and forwards with your fingers to make sure that there are no restrictions or friction in the run. Of course a new helicopter will always possess more friction initially but should rapidly decrease after the first few tanks of gas have been used.

It is extremely important to successful helicopter flying to have a very smooth but positive connection between the servo and the flight controls of the helicopter. Any impediment for friction here can easily make the helicopter fly badly, even to the point of being unstable. So please check the smoothness of your control runs and also that there is no 'free play' in the controls. The slightest movement of the transmitter stick should result in movement of the paddles, the swashplate, the tail rotor blades or the throttle barrel of the engine.

FINALLY, CHECK THAT ALL NUTS AND SCREWS HAVE BEEN PROPERLY TIGHTENED.

Now you can commence your first flight testing to fine tune the settings, 'track' the rotor blades and refine the collective pitch settings to suit your engine.

The "Competitor" is extremely stable in the hover and very predictable in forward flight. In fact it is almost identical to a pattern plane in forward flight. So, if you don't achieve these characteristics at first, work on the setting up of the controls until you do because a well set up "Competitor" is a real joy to hover, maneuver close or fly at high speed and do aerobatics. Any further questions on setting up, see your local dealer, your local fliers, or call the factory direct. We will be glad to help you at any time.

The 'Competitior' series of R/C helicopters is intended for the modeler who has had some experience in building and can (or has) at least hovered an R/C helicopter. However, in the event that a 'first timer' has purchased this kit, a set of flying instructions appropriate to his experience is included here. The accomplished flyer will already possess this expertise and he will rapidly explore the capabilities of 'Competitor' in aerobatic flight.

FLYING INSTRUCTIONS

Trimming and Flying

Try and find a quiet spot, certainly away from pets and children, and a smooth surface such as concrete or asphalt. Have somebody with you when you are testing a helicopter in case there is an accident and you need immediate assistance.

Now, follow the engine manufacturer's instructions to set the idle and the top end carburettor adjustments of your engine. With a new, non-ringed engine, it is advsable to have at least half an hour of bench running. This will also help you to familiarize yourself with the carburettor settings of your engine.

Use a fuel with about 12% nitro in it and, if you wish to ensure a slow 'break in', use some Castor oil in your fuel. Start the engine and, with the transmitter idle trim at full, the engine should run at a 'fast idle'. The clutch will engage at around 1,500 RPM. It cannot be stressed too highly that when starting the engine, and until you are actually ready to hover the helicopter, the rotor head should be held firmly in one hand. If you watch any expert flying his machine, you'll see that he does this and it is simply to cover the possible cases of the engine being started at full throttle by accident, or your radio not being switch on, or somebody else's radio interferring with yours, or a link is missing from your helicopter, etc., etc. Any one of a number of things could cause the engine to start at high speed and, if you are not holding the rotor head firmly, then the helicpter, at best, could start off violently and hurt you or anybody near. At the worst, it could take-off, out of control, and unless you were able to regain control quickly, you would lose your helicopter and possibly hazard other people's property or even life. So please observe the 'Golden Rule' for all good helicopter flyers -- HOLD THE ROTOR HEAD FIRMLY WITH YOUR HAND ALL THE WHILE THE HELICOPTER IS NOT ACTUALLY IN POSITION FOR FLYING! AND, AS SOON AS THE HELICOPTER HAS LANDED AND THE BLADES HAVE COME TO REST, HOLD THE HEAD AGAIN FIRMLY BEFORE YOU DO YOUR SHUTTING-DOWN OF THE ENGINE! AND NEVER AIR-TAXI OUT FROM THE PITS OR NEAR PEOPLE OR PROPERTY!

So now on to the first phase of learning to fly.

There certainly are some flyers who are so well coordinated that they can hover a helicopter successfully after a very few attempts. These people fall in the same category, we believe, as those fixed wing flyers who can take-off, fly around and land fixed-wing planes with little or no effort and in a very short time. This section of the 'Competitor' manual, however, is intended for the 'average modeler' who eventually has a heck of a lot of fun flying model aircraft, but takes a little time (and effort) to achieve this result. So, unless you possess more than average coordination, or you have a lot of money and time, we offer the following method of simplifing the process and learning to fly with little or no damage to your machine and your ego.

Now, learning just one function at a time is really impractical unless a training rig to 'tether' the helicpter is used. Learning the functions two at a time, however, is quite easy and many people have learned (with no damage to the helicopter) in this way.

So why not try the one hand (two function) at a time method?

One pre-requisite to learning, in any event, is to have a well trimmed helicopter. Even an experienced flyer, if the helicopter is not trimmed, can find it difficult to maintain a stable hover, and you will normally find that the experienced flyer will land the machine again, several times, after very short experimental lift-offs, if necessary, to get the trim right. So, before you learn to hover, it is extremely important to seek the help of an expert or a reasonably accomplished flyer, if one is available in your vicinity, to hover your helicopter for you and to make sure that it is properly and accurately trimmed. The helicopter blade angle setting in pitch (main and tail) must be correct. The 'tracking' of the blades must be right and the helicopter drive elements and engine must be running smoothly and well. If all of these things are not correct, then don't continue. Once the helicopter is in trim and running smoothly then, and only then, should you commence your learning to hover. If the drive elements are not operating properly, re-check all the clearances and settings. If the blades are 'out of track' and you do not have any expert help available, then you should proceed as follows:

First we must stress that you should not, repeat not, track your main blades by holding your helicopter by the tail boom while lifting it into the air. This is an extremely dangerous practice and is strongly discouraged by GMP.

However, tracking the blades is certainly a difficult procedure for the beginner since it requires the actual hovering of the helicopter for a short period in order to be able to observe which blade is higher than the other. We will, however, describe this procedure for you and, even if you cannot observe the blades yourself, you should try to lift the helicopter to a hover just for a second or two while a friend or somebody else kneels down, at a safe distance of course, and observes the 'tracking'.

'Tracking' is a measure of the lift of each of the blades, which should be equal. If the lift of one blade is greater than the other, then the tracking is wrong and there will be vibration and a loss of control. The tip of one blade must be marked with a piece of colored vinyl or monocote during the building phase and the idea behind this will become apparent now. If you look at the edge of the blades while they are running and the helicopter is just lifting off the ground, you will notice that if the blades are tracking you will see only one blade at the tip, but if they are not tracking you will be able to clearly see one blade higher than the other. Because the blades are marked individually you should then be able to judge which of the blades is the higher. Now, to correct this tracking, you must change the pitch of one of the blades.

Before we do, however, we should also note one other factor and that is that the main blade speed of 'Competitor' should be around 1,500 RPM at lift-off with a throttle setting of about half. If the speed is higher than this, then in order to adjust the tracking, we should increase the blade pitch angle that is lower of the two. If "Competitor's" blade speed is lower than 1,500 RPM, then we should lower the pitch of the blade which was higher. This means that by adjusting the pitch of one of the main blades we can make one blade run higher than the other, or by adjusting both together we can lower the rotor speed of the helicopter.

Because 'Competitor' has "collective" pitch you may also change the rotor speed by increasing or decreasing the collective pitch setting after 'tracking' the blades as described above.

Finally, please note that your high end throttle adjustment (needle valve) should be set so that the engine is on the verge of running rich (occasional four-cycling or "burbling") until the helicopter has lifted off. Even in the hover your engine should still "burble" occasionally.

If you find that you need much more tail blade pitch angle than has been suggested in the instructions and the helicopter's nose is always trying to turn to the left, then you are probably running with too much pitch on the main blades. If, however, you find the helicopter blades are running very fast and the nose always appears to be wanting to go to the right, then you are probably running with too little pitch on the main blades at lift-off. You will soon become accustomed to being able to adjust both the speed of the main rotor blades and the tracking of the blades by adjusting one of them.

Place the helicopter on a smooth and level surface and start the engine. Stand back and to one side, about 6-10 feet away from the machine. The reason for this is that you will now have the best view of the fore-and-aft and side-to-side movements of the helicopter if you are looking at it from 45 degrees. For instance, if you stand directly behind the helicopter, then the fore-and-aft movements are harder to detect. The secret of accurate hovering is to make control inputs at the instant that the helicopter starts to move and maximum anticipation is helped by the best and earliest visual information.

Now, take a deep breath and try to relax. Run up the engine with the throttle lever until the helicopter is 'light on its skids', so that it apparently weighs perhaps only a pound or less instead of its normal weight. Under these conditions it is then quite easy, by using the transmitter tail control lever, to move the nose of the helicopter to the right and to the left, back to the center again, to the left, to the right, back to the center again. All the while you are doing this you will make small adjustments in throttle in order to keep that one pound of weight constant.

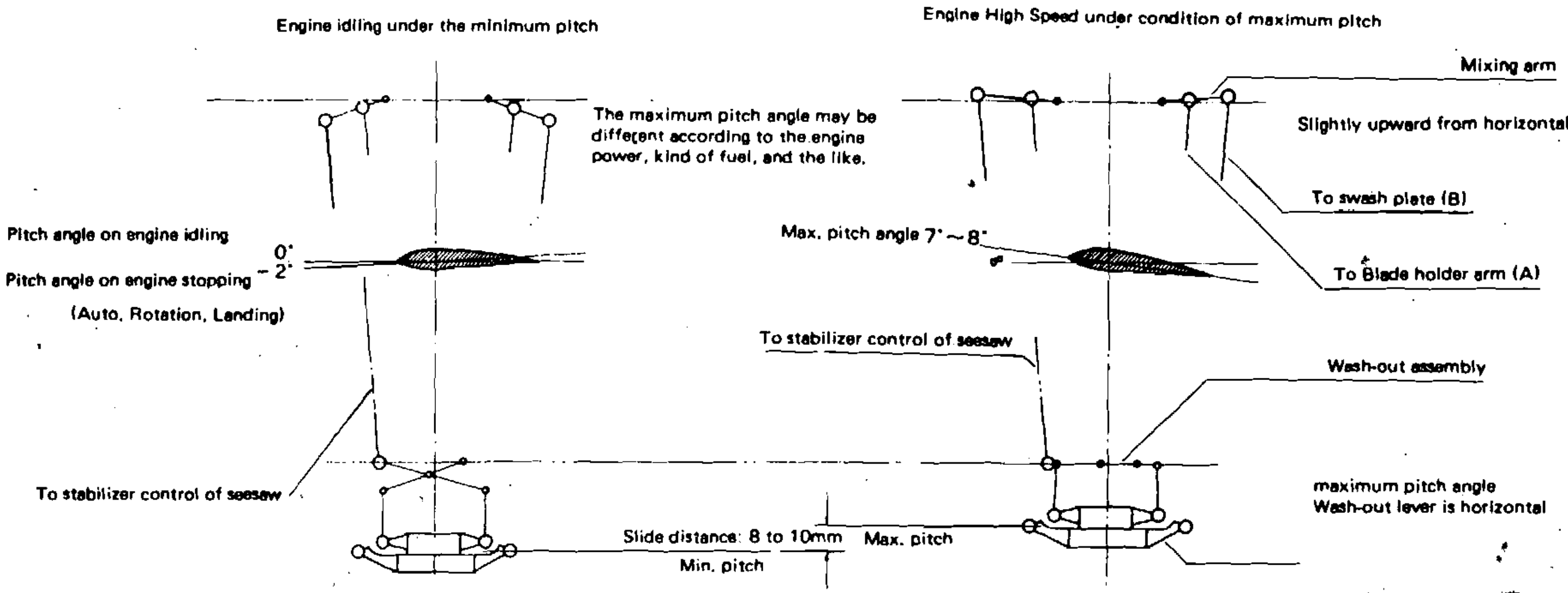
Soon your reflexes will learn how to coordinate the sideways movements of your left hand with the movements of the helicopter rotating to the left and to the right and the up and down movement of the left hand to vary the 'lift' of the helicopter. Do not make any right hand or cyclic movements when practicing this exercise.

It's hard to say how long you should keep up this practice, but certainly you should continue until you can do it without feeling strained during and after each session. When your left hand has been trained to keep the tail straight and the altitude constant, you can now commence to learn coordination of the helicopter's lateral movements with your movement of the right hand stick. So now the next step is to open the throttle so that the helicopter rises in a positive manner to a position between 3 and 5 feet off the ground. It's hard to believe this when you first begin to learn, but if a hovering helicopter is well trimmed and adjusted, there really is plenty of time to maintain, or to correct, the helicopter's movements sideways, backwards and forwards.

An analogy which reflects this argument and that beginners seem to understand is that you can regard the helicopter as a large balloon floating a few feet off the ground. The balloon can wander around as a result of small gusts of wind from different directions. We can keep the balloon stationary in front of us by 'patting' it at the right place and at the right time. If it moves away from us and we pat it towards us it <u>may</u> need another pat to stop it coming and position it where we want it. Except, of course, it will drift off again after a short while and we will have a continuous task of providing the right control inputs to keep the balloon stationary in front of us.

Once you have learned to fly the helicopter, then the 'pulsing' will blend into smooth, but still very small control commands. However, at the early stages, remember to think of the helicopter as a balloon which, let's say, is drifting towards you. You 'pulse' the stick towards it, you pat it back. As it starts to drift back, you'll need a small input in the opposite direction to pat it and stop its motion so that it settles in the spot that you want it. Don't forget that <u>you</u> can start a helicopter moving in one direction with the force produced by the <u>right</u> hand stick, but you will probably, unless you have given exactly the right force at the right time, have to give an opposite force in order to slow it down and to settle it in the position required. Please remember that the foregoing applies only when the helicopter is well designed and, most importantly, well trimmed.

So try these hovering techniques and see if it doesn't help to speed up and ease up the learning process. Make each 'flight' only a few seconds and then land. Each successful 'flight', however short, will place you higher up the learning curve. We have seen people learn by this method and be hovering confidently for five to ten seconds at a time in less than a single morning. So don't give up - <u>you can</u> fly an R/C helicopter if you really want to. Good luck with your hovering sessions.



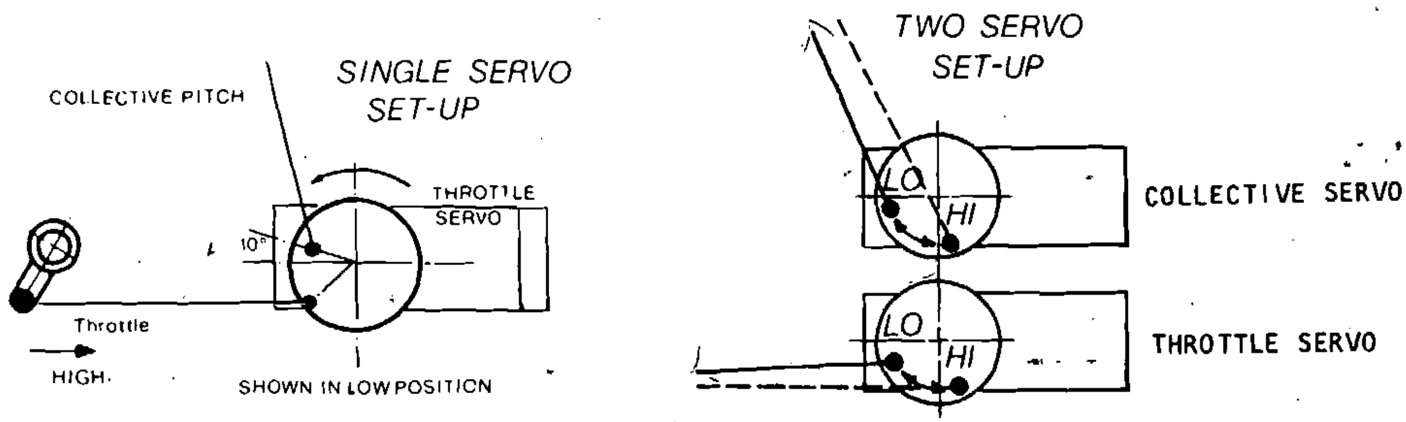
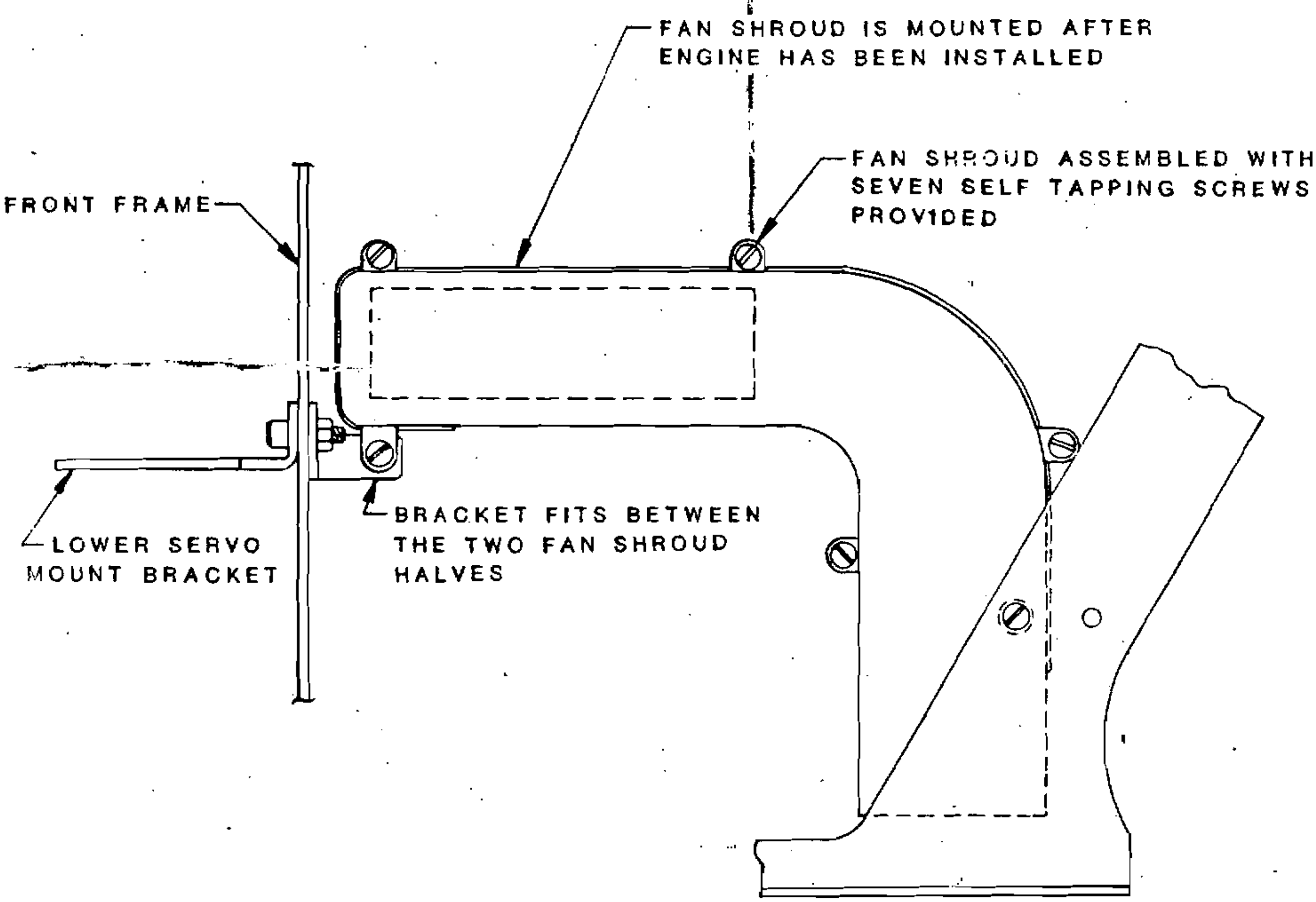
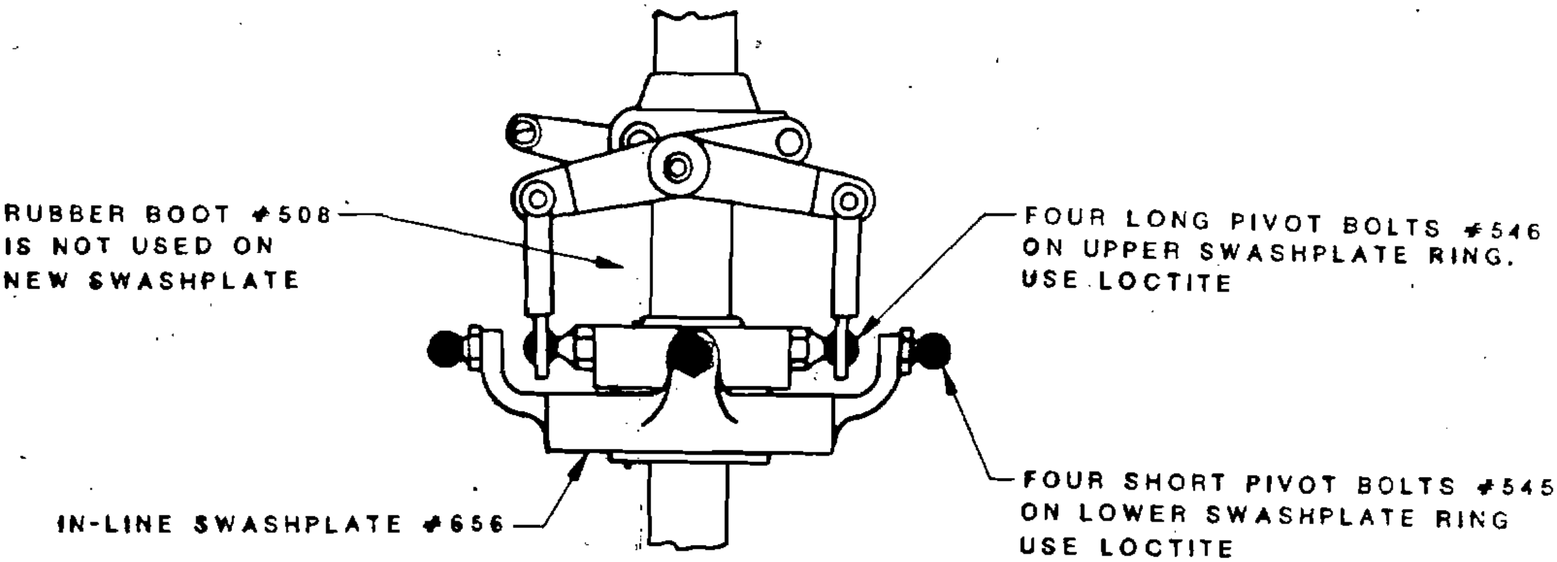


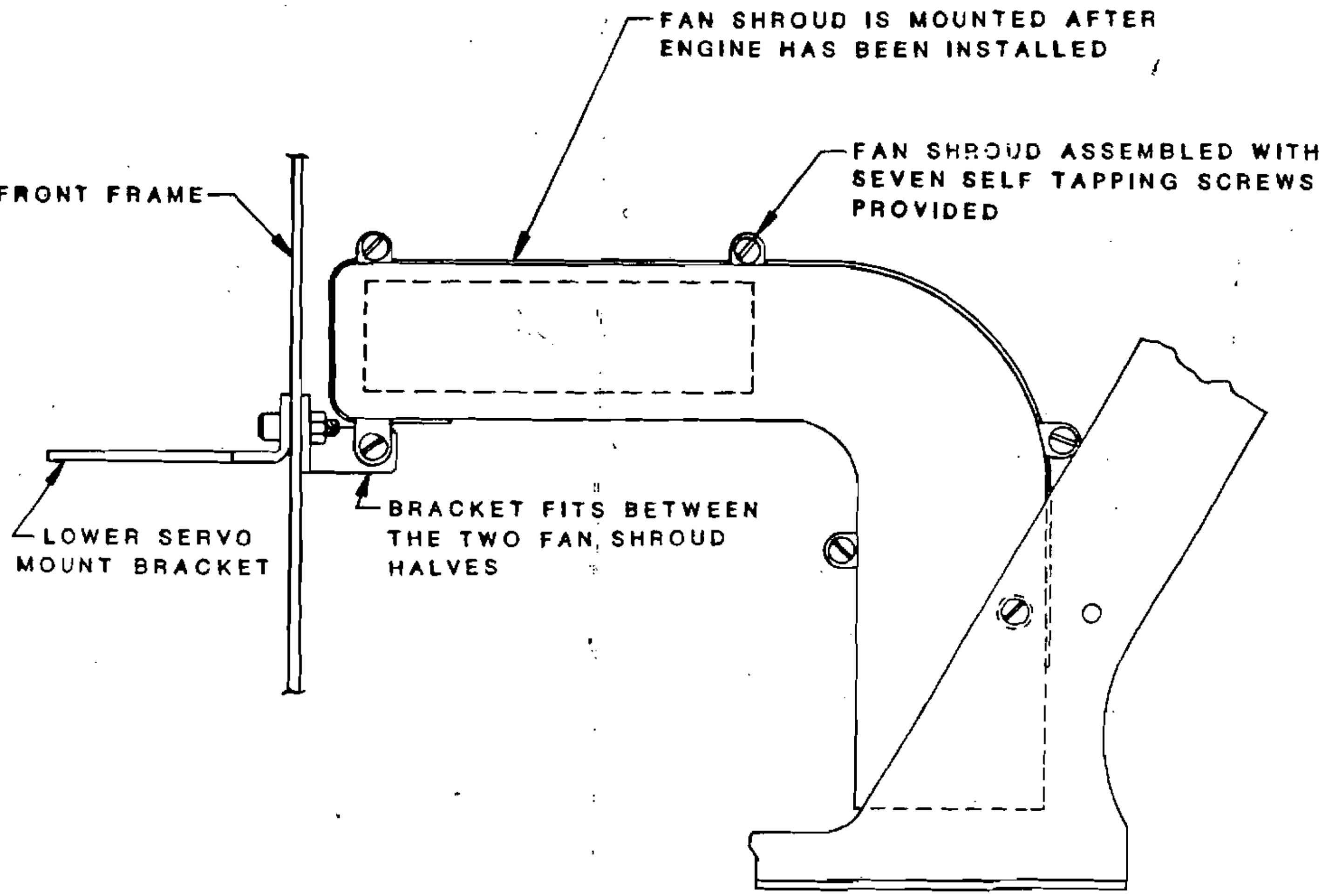
Figure 16 COLLECTIVE PITCH AND THROTTLE SET-UP



COMPETITOR INSTRUCTIONS FOR MOUNTING NEW SPLIT FAN SHROUD



INSTRUCTIONS FOR NEW IN-LINE SWASHPLATE



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