Ergo

.32-.36 AND .46 ASSEMBLY INSTRUCTIONS

ERGO SPECIFICATIONS

Overall Length	46.5"	**Tail Rotor Diameter**	9.17"
Overall Height	16.38"	**Gear Ratio**	9.78:1:5.18
Main Rotor Diameter	48.5" (.32-.36) 50" (.46 3D)	**Gross Weight**	6.75-7.0 lbs.

JR PROPO

Heli Division

INTRODUCTION

Congratulations on your purchase of the JR Ergo helicopter kit.

This kit has been both engineered and manufactured by JR with help from some of Japan's top R/C helicopter engineers (now employed by JR).

As you may well know, the name JR has for years been synonymous with state-of-the-art, high quality radio control systems known the world over for their exceptional reliability and engineering.

JR now brings this reputation and knowledge into the helicopter market with the development of the Ergo and the organization of the JR heli division. Years in the making, the Ergo's superior quality and exceptional parts fit and finish create a new standard of quality that was previously unavailable.

Before you begin the assembly of your Ergo, we suggest that you first review the entire instruction manual to become familiar with the assembly sequences and parts layout.

WARNING

The radio controlled model helicopter contained in this kit is not a toy, but a sophisticated piece of equipment. This product is not recommended for use by children. Radio controlled models such as this are capable of causing both property damage and/or bodily harm to both the operator/assembler and/or spectator if not properly assembled and operated. Horizon Hobby Distributors assumes no liability for damage that could occur from the assembly and/or use/misuse of this product.

AMA INFORMATION

We strongly encourage all prospective and current R/C aircraft pilots to join the Academy of Model Aeronautics. The AMA is a non-profit organization which provides services to model aircraft pilots. As an AMA member you will receive a monthly magazine entitled *Model Aviation*, as well as a liability insurance plan to cover against possible accident or injury. All AMA charter aircraft clubs require individuals to hold a current AMA sporting license prior to operation of their models. For further information, you can contact the AMA at:

Academy of Model Aeronautics
5151 East Memorial Drive
Muncie, IN 47302
(317) 287-1256

PRE-ASSEMBLY INFORMATION

When first opening your Ergo kit, you will notice that all of the parts are packaged and numbered to coordinate with the assembly step numbers of this instruction manual.

All small hardware (nuts, bolts, washers, etc.) for each step are separated and packaged separately within the main parts bags. When beginning a section, you will need to open only the bag with the corresponding number to the section you are going to start. It is suggested that you place all of the hardware in an open container (e.g., coffee can) during assembly so as not to lose any of the small parts. It may also be helpful to familiarize yourself with the various sizes of screws, bolts, nuts, etc., as illustrated in the appropriate assembly section before you begin assembly. At the end of each assembly, in most cases, there should be no parts remaining.

Great care has been taken in filling the bags with the correct quantity of parts and hardware for each section. However, occasionally mistakes do happen. In the event that you find a parts shortage or are in need of technical assistance, please contact your local JR heli division parts dealer, or contact the Horizon Service Center directly.

Horizon Service Center
4105 Fieldstone Road
Champaign, IL 61821
(217) 355-9511 (9am to 5pm CST)

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ERGO .32-.36 AND ERGO .46 3D FEATURES

Heavy-Duty Aluminum Quad Frame System
Provides excellent rigidity and vibration absorption.

One-Way Hex Start Shaft System
Provides positive starting. Starter shaft utilizes a one-way bearing that allows the shaft to stop after the engine is started.

Wide Spread Tail Output Shaft Bearings
Reduces vibration and improves control response.

Belt-Driven Tail Rotor Design
Provides easy adjustment and low maintenance. Also eliminates the need for optional/expensive tube drive shafts.

Precision Ball Bearings at All Critical Locations
Provide low wear, high precision and reduced maintenance.

Unique Cyclic Mixing Control System
Offers easy adjustment and precise control.

Self-Aligning One-Piece Steel Clutch System
Offers easy installation and adjustment with exceptional reliability.

Pre-Assembled Control Linkages
High quality JR ball links are installed and pre-adjusted to take the guesswork out of assembly while saving building time.

Straight Blade Axle Rotor Head Design
Provides high responsiveness and solid blade tracking.

Low Drag Flybar Paddles
Provide quick yet smooth cyclic response at all flight speeds.

Heavy-Duty Main Blade Grips With 4mm Blade Bolts
Provide a solid and secure mounting surface to easily handle the stresses of radical 3D flight.

Rearward Facing Engine Design
Provides easy access to the glow plug for starting. Engine slips easily through the main frame for trouble-free engine maintenance.

Heavy-Duty Tail Boom Carrier
Provides increased structural rigidity and improved tail rotor precision.

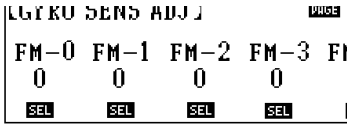
Pre-Finished Main Rotor Blades (.30 Kit)
Provide easy assembly with excellent flight characteristics.

Superior Parts Fit and Finish
Make assembly trouble free and enjoyable.

ITEMS REQUIRED TO COMPLETE THE JR ERGO (not supplied in kit)

1. RADIO SYSTEM REQUIREMENTS (NOT INCLUDED):

6-channel or greater R/C helicopter system with 5 servos, 1000 mAh receiver battery and gyro.



2. ENGINE REQUIREMENTS (NOT INCLUDED):

A .32-.36 R/C Helicopter Engine (Ergo .30) or .46 R/C Helicopter Engine (Ergo .46)

(Webra .33 Heli Engine Shown)

(Thunder Tiger Pro .46 Heli Engine Shown)

A special helicopter type muffler is also required

(JRP960078 Ergo .32-.36 Muffler Shown)

(JRP960079 Ergo .46 Muffler Shown)

3. BUILDING SUPPLIES (NOT INCLUDED):

The following items are needed to complete the assembly of the JR Ergo:

Fuel Filter

Silicone Fuel Tubing

Whip Antenna

Glow Plugs

Double Sided Servo Mounting Tape

Locktite 242 or equivalent

Nylon Wire Ties To Secure Radio Wires

Spiral Tubing

4. TOOLS NEEDED TO ASSEMBLE THE JR ERGO (NOT INCLUDED):

Phillips Screwdirver

Nut Drivers: 5mm, 7mm

Needle Nose Pliers

Scissors

Drill and Drill Bits

Small Hammer

X-Acto Knife

Metric Ruler

Allen Wrenches: 1.5, 2.0, 2.5, 3.0mm

Blade Balancer

5. FIELD EQUIPMENT REQUIRED (NOT INCLUDED):

12 Volt Electric Starter

12 Volt Starting Battery

1.5 Volt Glow Plug Battery

Remote Glow Plug Adaptor

Helicopter Fuel 15% - 30%

Fuel Pump

Hex Starting Shaft

Pitch Gauge

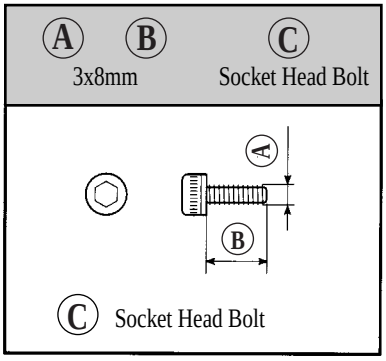
Ball Link Pliers

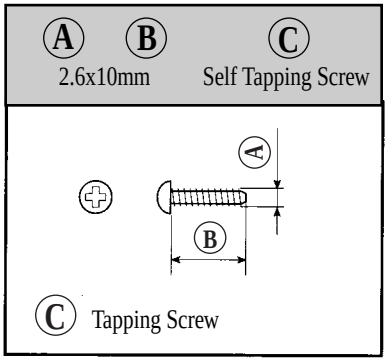
Training Gear (Beginners Only)

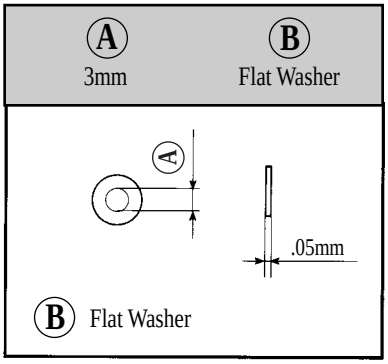
HARDWARE IDENTIFICATION

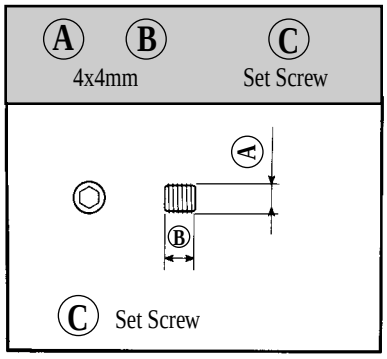
There are many various sizes and shapes of hardware included in this kit. Prior to assembly, please be careful to identify each screw by matching it to the full size screw outlines included in each step.

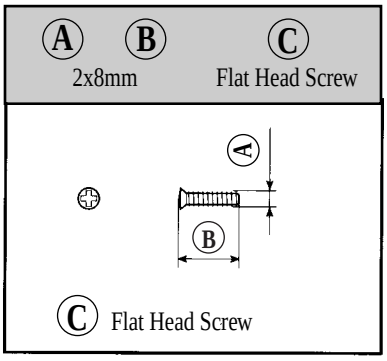
All of the hardware, screws, nuts, etc., contained in the Ergo kit are described in the following A, B, C manner:

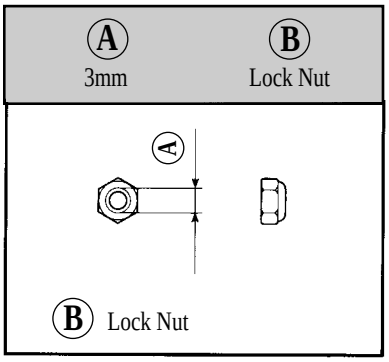


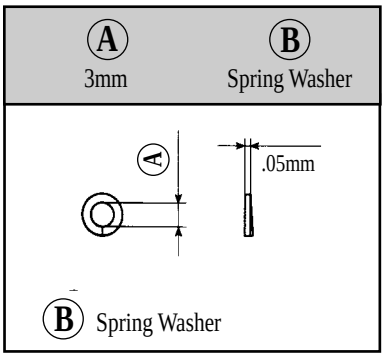


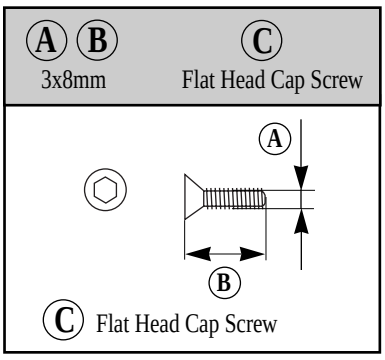


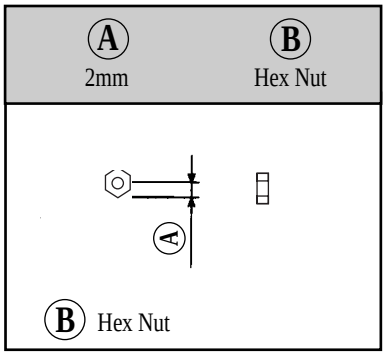










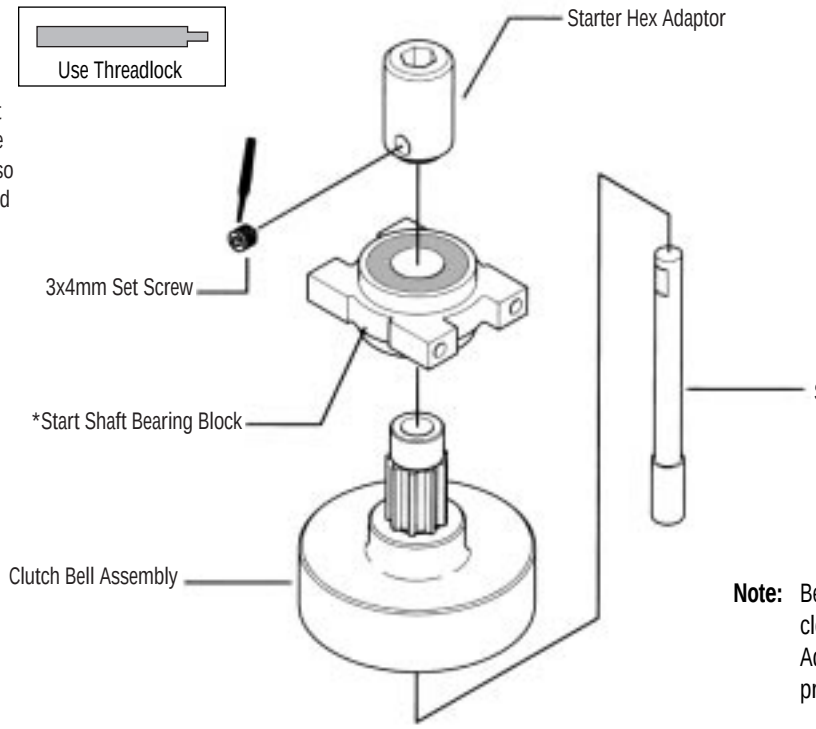


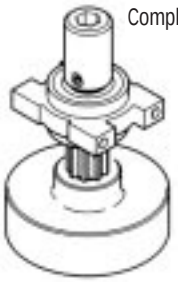
1-1 CLUTCH BELL/START SHAFT ASSEMBLY

.....1 pc
3x4mm Set Screw

* When installing the Start Shaft Bearing Block Assembly, be sure the Bearing Block is positioned so the Bushing faces upward toward the starter hex adaptor, with the bearing toward the Clutchbell Assembly.

Use Threadlock





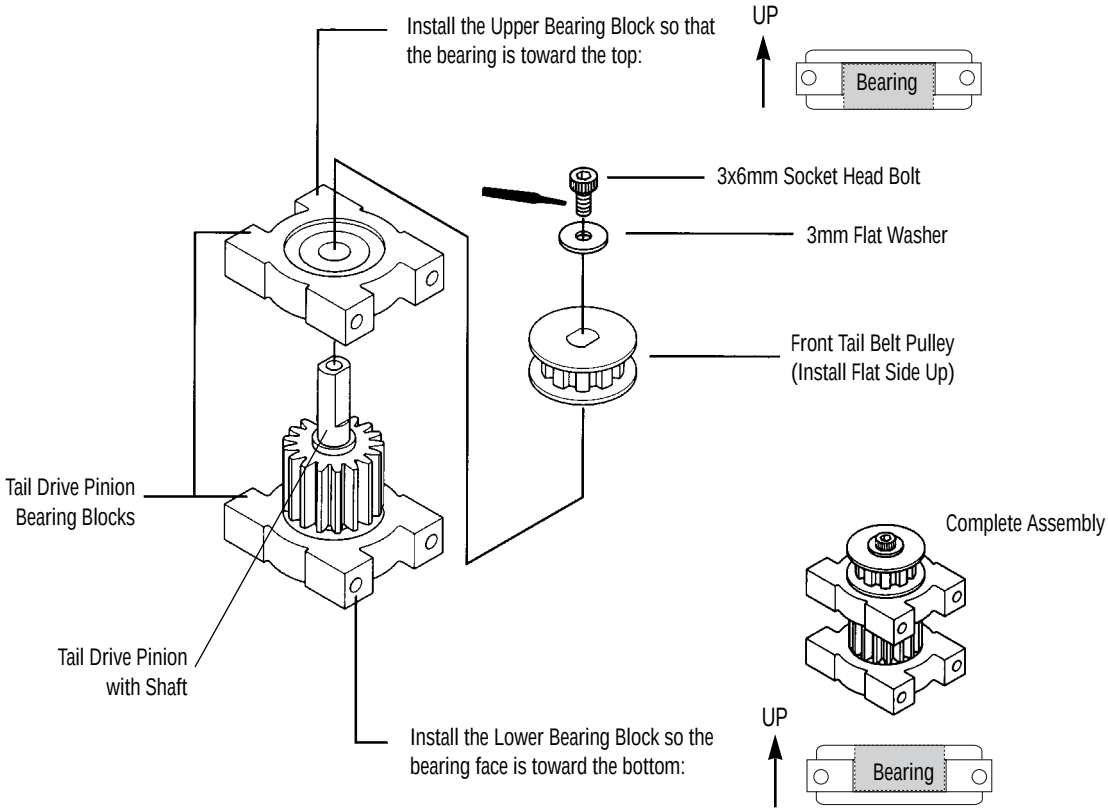
Note: Be sure to allow a slight amount of clearance between the Start Hex Adaptor and the Bearing Block to prevent binding.

1-2 TAIL DRIVE PINION/BEARING BLOCK ASSEMBLY

Use Threadlock

...1 pc
3x6mm Socket Head Bolt

.....1 pc
3mm Flat Washer



1-3 CONTROL BALL INSTALLATION

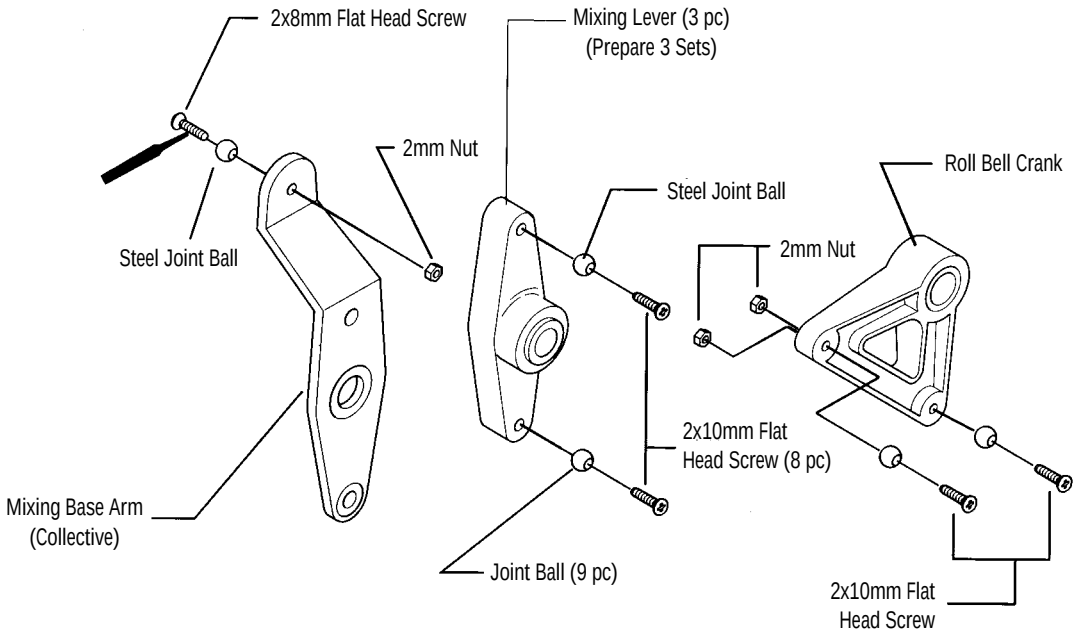
Use Threadlock

.....1 pc
2x8mm Flat Head Screw

.....8 pc
2x10mm Flat Head Screw

.....9 pc
Steel Joint Ball

.....3 pc
2mm Nut



1-4 SERVO MIXING LEVER UNIT ASSEMBLY

.....2 pc
3x8mm Flat Head Screw

.....1 pc
3x8mm Socket Head Bolt

3x28mm Socket Head Bolt ....1 pc

.....5 pc
Nylon Washers

.....1 pc
3mm Flat Washer

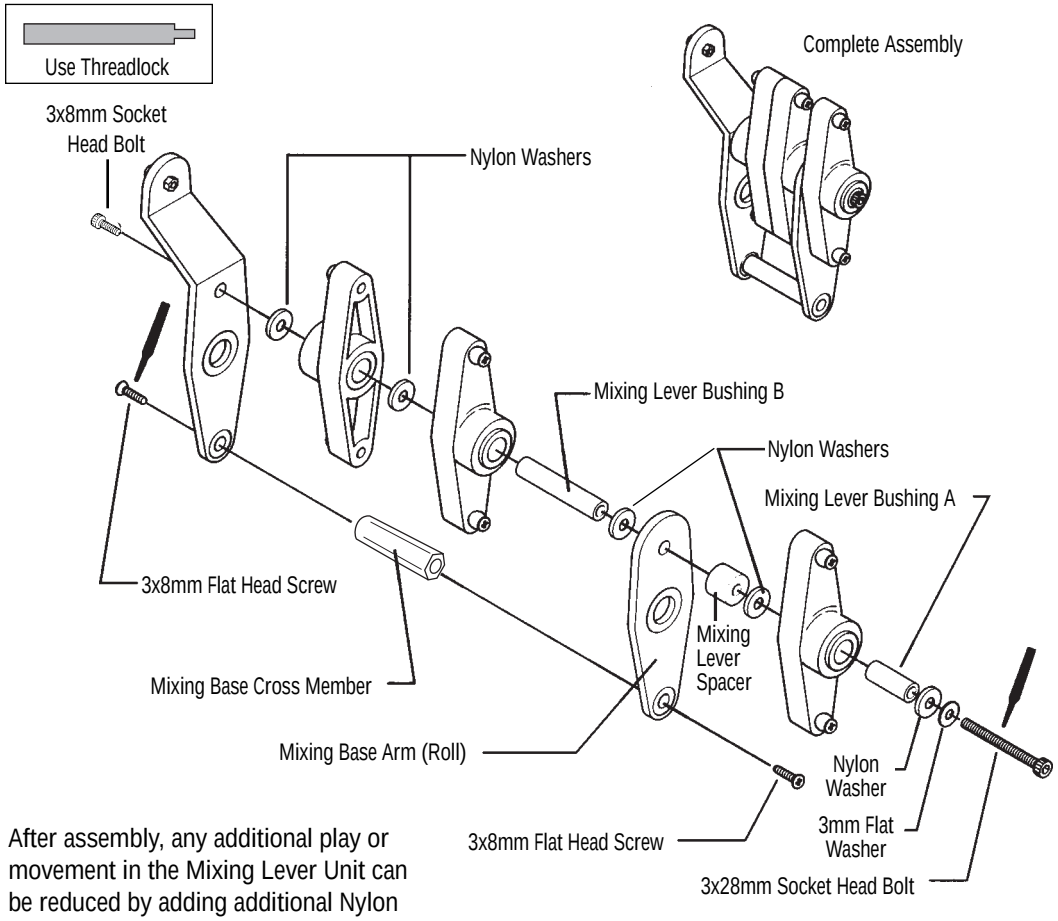
.....1 pc
Mixing Lever Spacer

.....1 pc
Mixing Lever Bushing A

Mixing Lever Bushing B .....1 pc

Mixing Base Cross Member ....1 pc

Use Threadlock



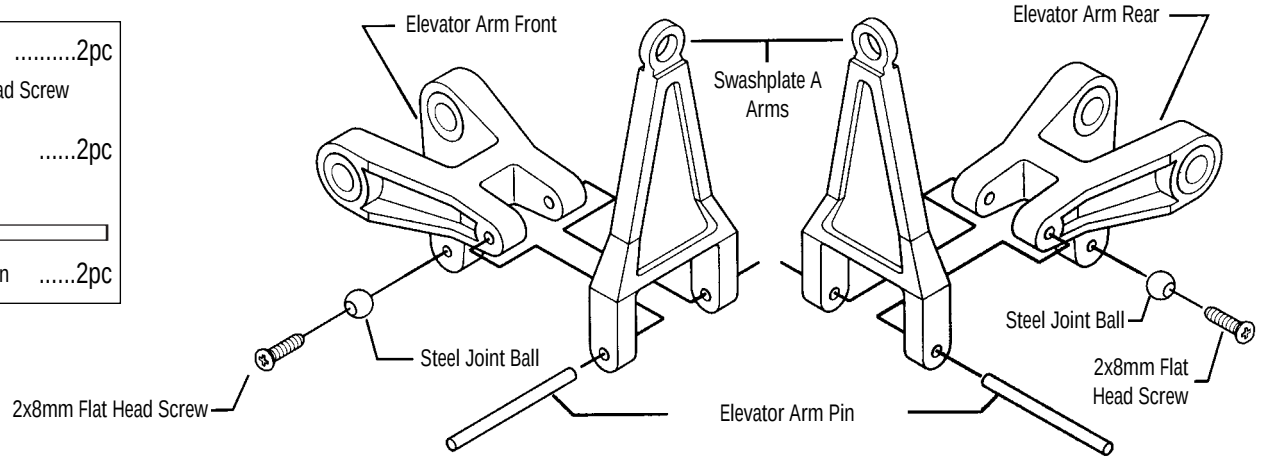
After assembly, any additional play or movement in the Mixing Lever Unit can be reduced by adding additional Nylon Washers as needed.

1-5 ELEVATOR ARM ASSEMBLY

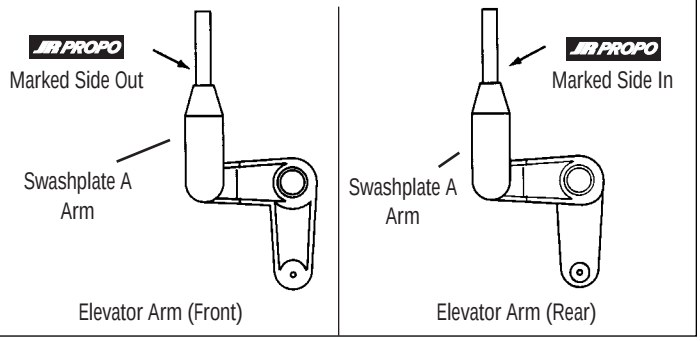
.....2pc
2x8mm Flat Head Screw

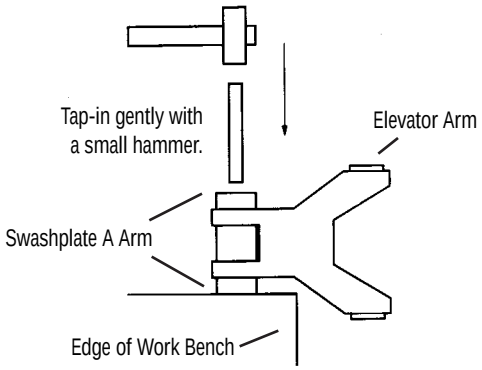
.....2pc
Steel Joint Ball

Elevator Arm Pin 2pc

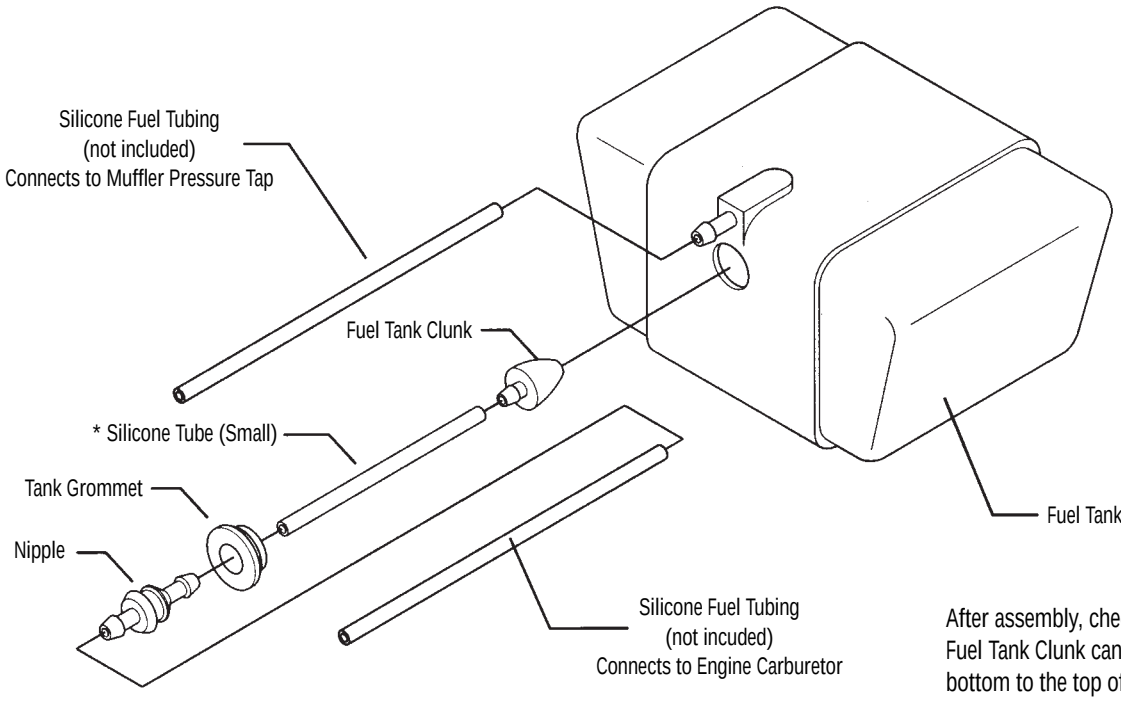


Caution: Be sure to note correct Swashplate A Arm installation direction.





1-6 FUEL TANK ASSEMBLY



* Trim before installation to a length of 58mm

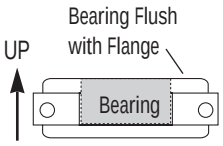
After assembly, check to be sure the Fuel Tank Clunk can move from the bottom to the top of the tank without touching the back wall of the Fuel Tank.

2-1 UPPER MAIN FRAME SECTION ASSEMBLY

Use Threadlock On All Screws

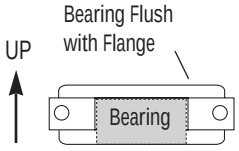
3x8mm Socket Head Bolt	.....21 pc
3x10mm Socket Head Bolt	.....1 pc
3mm Flat Washer	.....11 pc
Body Mounting Standoffs Shaft	.....2 pc
2.6x8mm Self Tapping Screw	.....4 pc

Upper Main Shaft Bearing Block

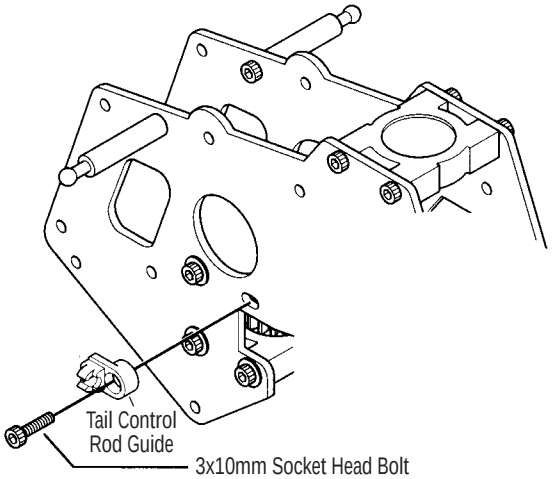


Position so the side of the bearing block that has the bearing flush with the flange is upward.

Lower Main Shaft Bearing Block

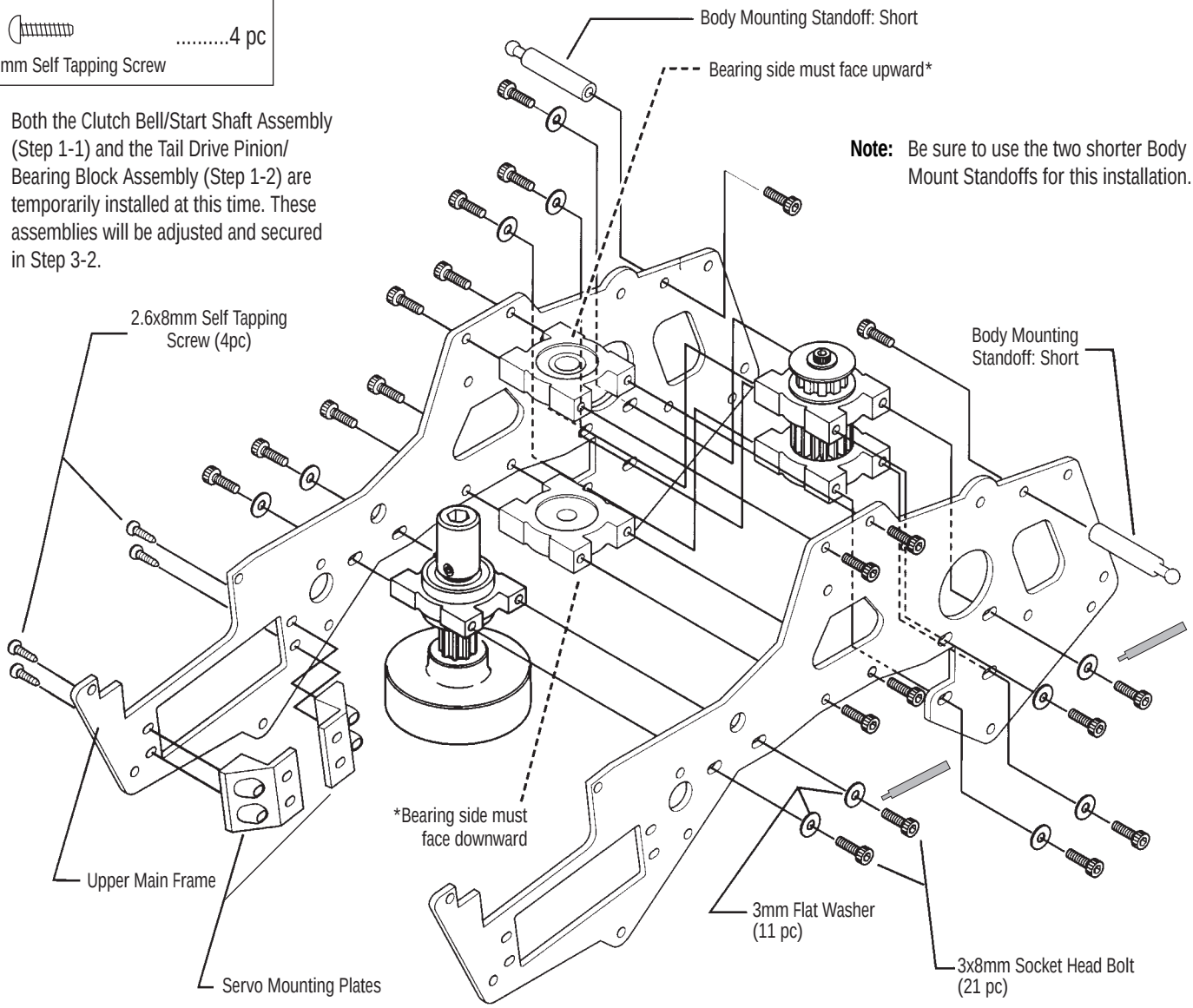


Position so side of the bearing block that has the bearing flush with the flange is downward.



Note: Both the Clutch Bell/Start Shaft Assembly (Step 1-1) and the Tail Drive Pinion/ Bearing Block Assembly (Step 1-2) are temporarily installed at this time. These assemblies will be adjusted and secured in Step 3-2.

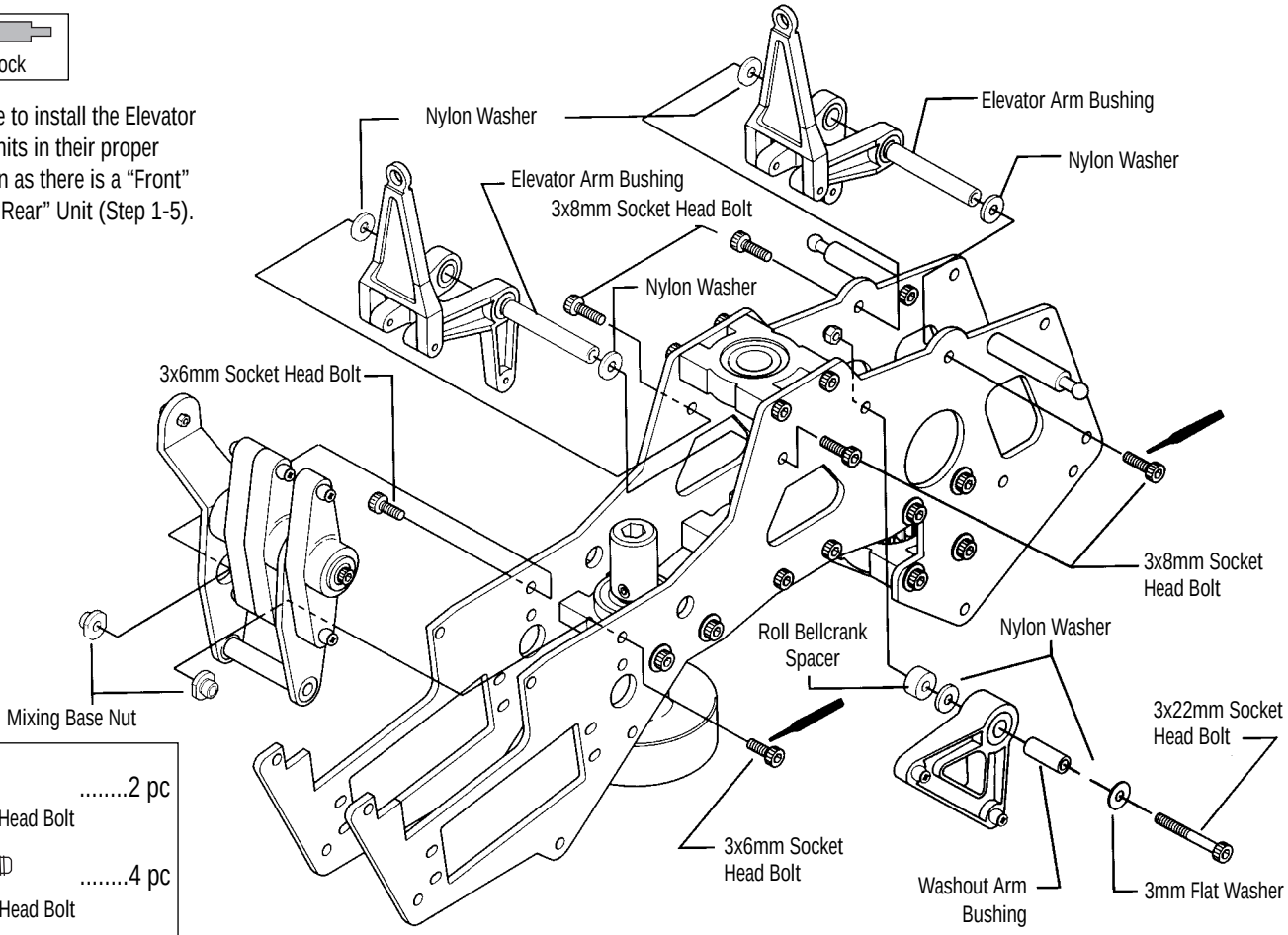
Note: Be sure to use the two shorter Body Mount Standoffs for this installation.



2-2 UPPER MAIN FRAME CONTROL LEVER INSTALLATION

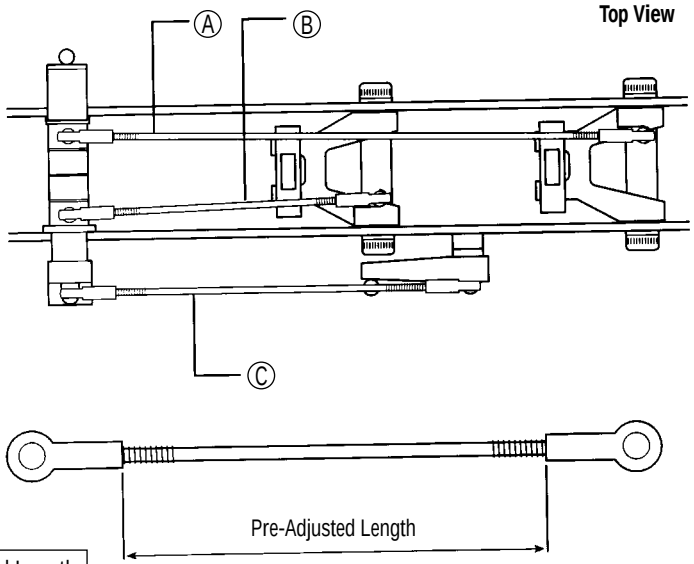
Use Threadlock

Note: Be sure to install the Elevator Arm Units in their proper location as there is a "Front" and a "Rear" Unit (Step 1-5).



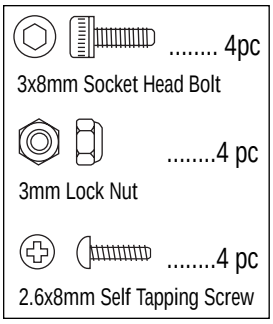
- .....2 pc — 3x6mm Socket Head Bolt
- .....4 pc — 3x8mm Socket Head Bolt
- 3x22mm Socket Head Bolt .....1 pc
- .....1 pc — 3mm Lock Nut
- .....5 pc — Nylon Washers
- .....1 pc — 3mm Flat Washer
- .....1 pc — Roll Bellcrank Spacer
- .....1 pc — Washout Arm Bushing
- Elevator Arm Bushing .....2 pc
- Mixing Base Nut .....2 pc

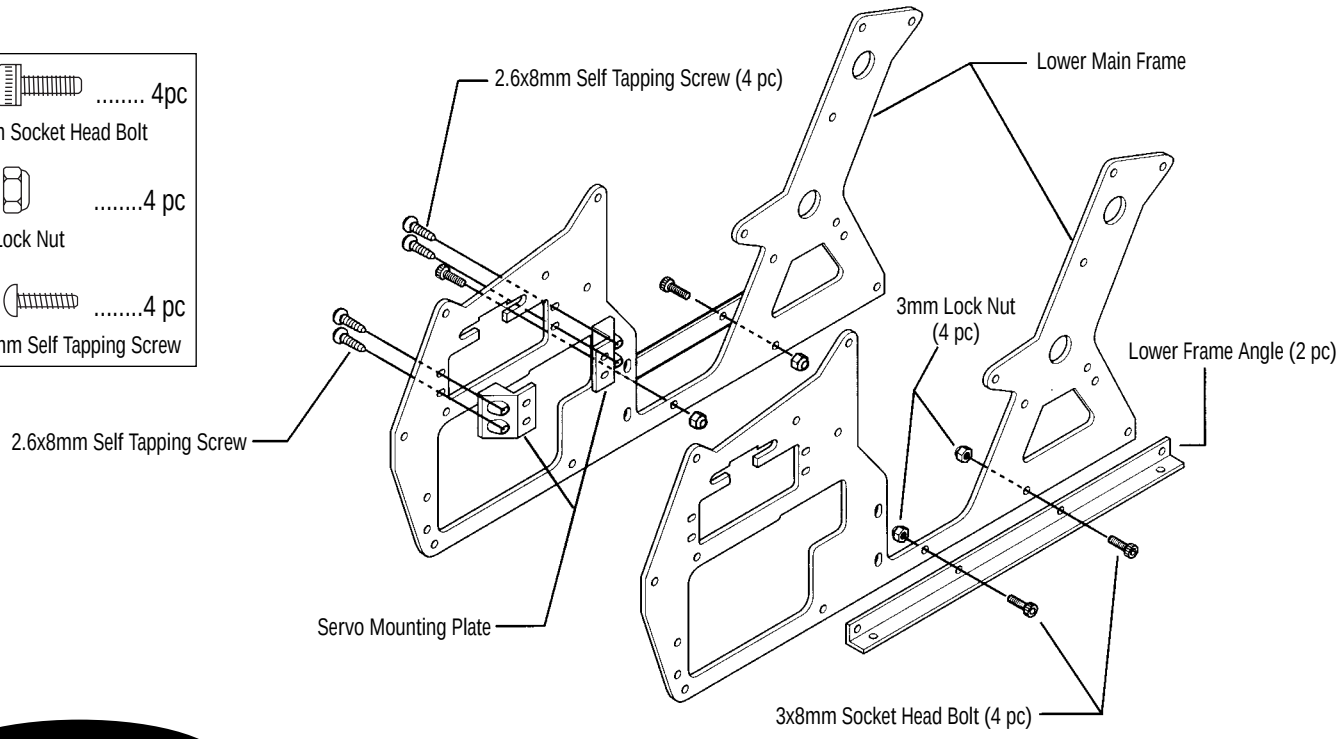
Attach the pre-finished Control Rods to the Mixing Levers/Control Arms as shown:



	Rod Length	Pre-Adjusted Length
Ⓐ	110mm	92mm
Ⓑ	45mm	24mm
Ⓒ	75mm	59mm

2-3 LOWER MAIN FRAME ASSEMBLY

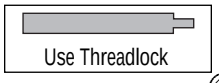


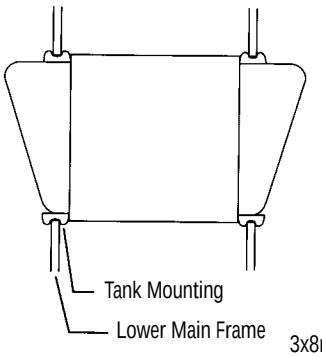


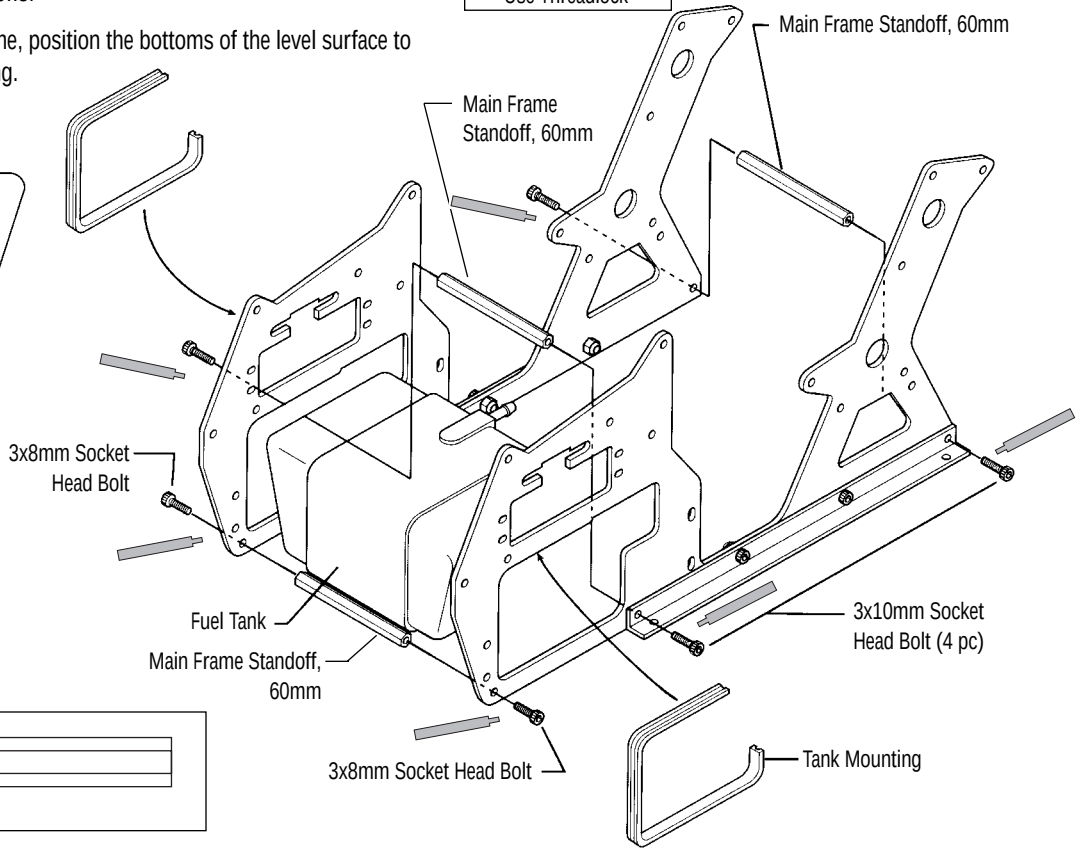
2-4 FUEL TANK INSTALLATION

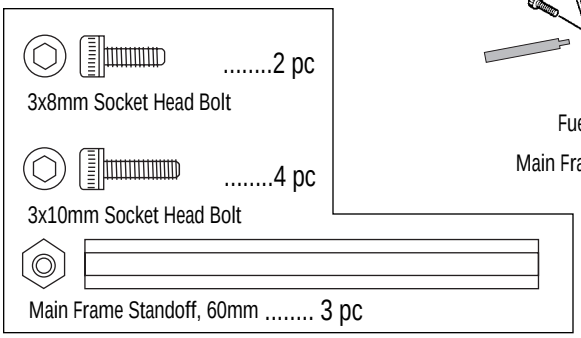
Note: Install the Fuel Tank and Tank Mounting Rubber into the lower frame halves before attaching the Main Frame Standoffs.

When securing Standoffs to frame, position the bottoms of the level surface to prevent twisting during tightening.

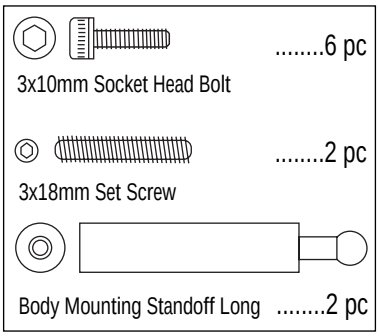


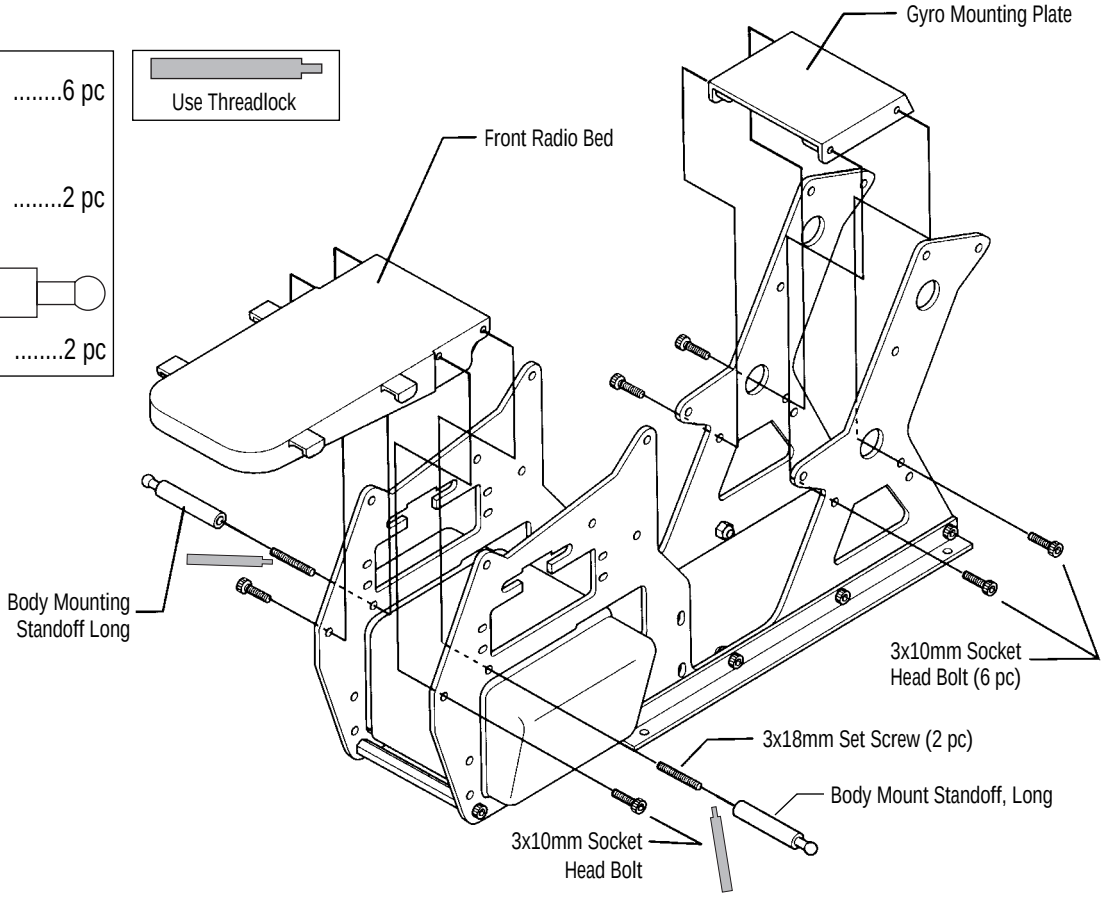




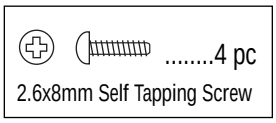


2-5 FRONT RADIO BED/GYRO MOUNTING PLATE INSTALLATION



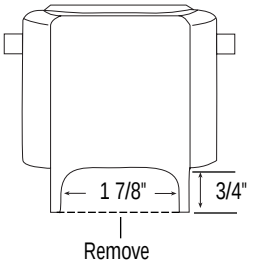


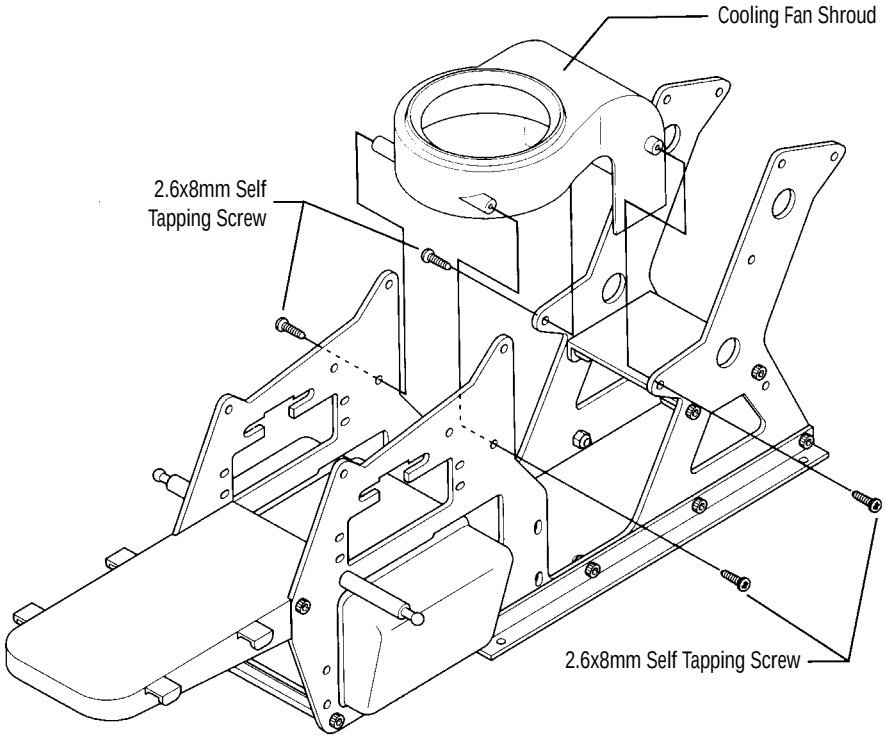
2-6 COOLING FAN SHROUD INSTALLATION



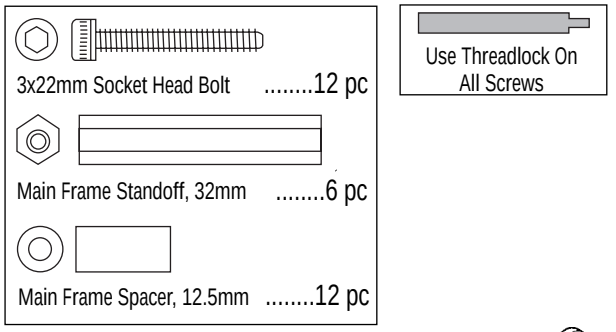
Ergo .46 Fan Shroud Adjustment

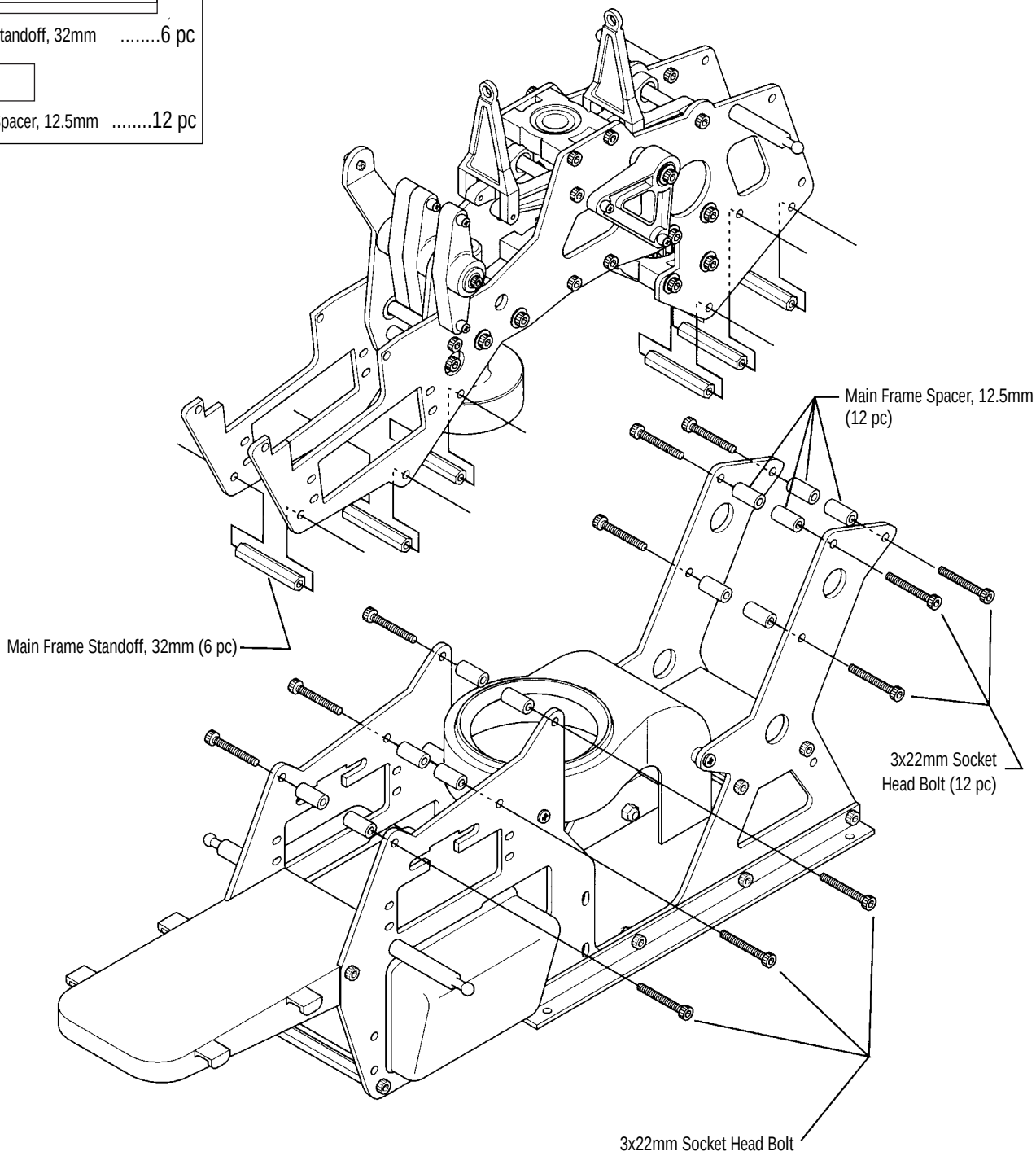
When installing a .46 size engine it will be necessary to trim the bottom portion of the Fan Shroud as shown:





2-7 UPPER/LOWER MAIN FRAME ASSEMBLY ATTACHMENT

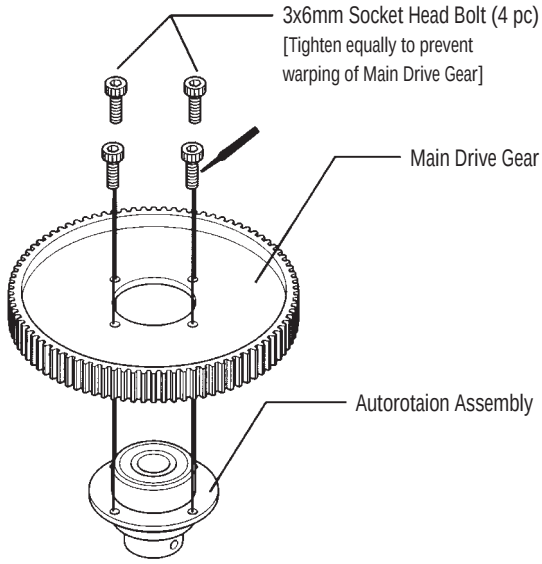




3-1 MAIN DRIVE GEAR/AUTOROTATION ASSEMBLY

Use Threadlock

.....4 pc
3x6mm Socket Head Bolt



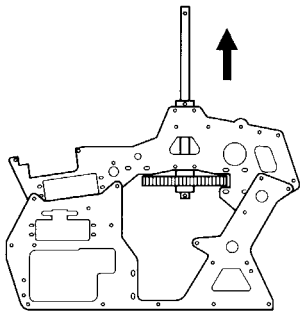
3-2 MAIN DRIVE GEAR/AUTOROTATION ASSEMBLY INSTALLATION

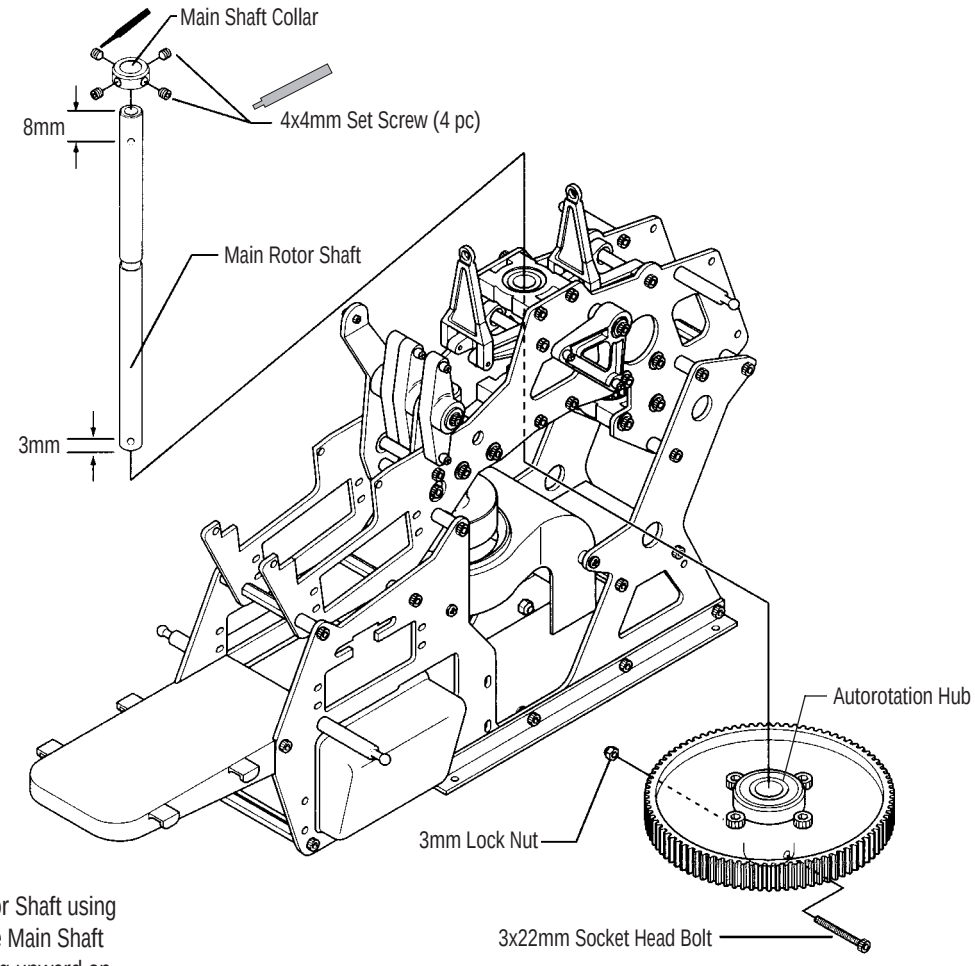
Use Threadlock

.....4 pc
4x4mm Set Screw

3x22mm Socket Head Bolt .....1 pc

.....1 pc
3mm Lock Nut

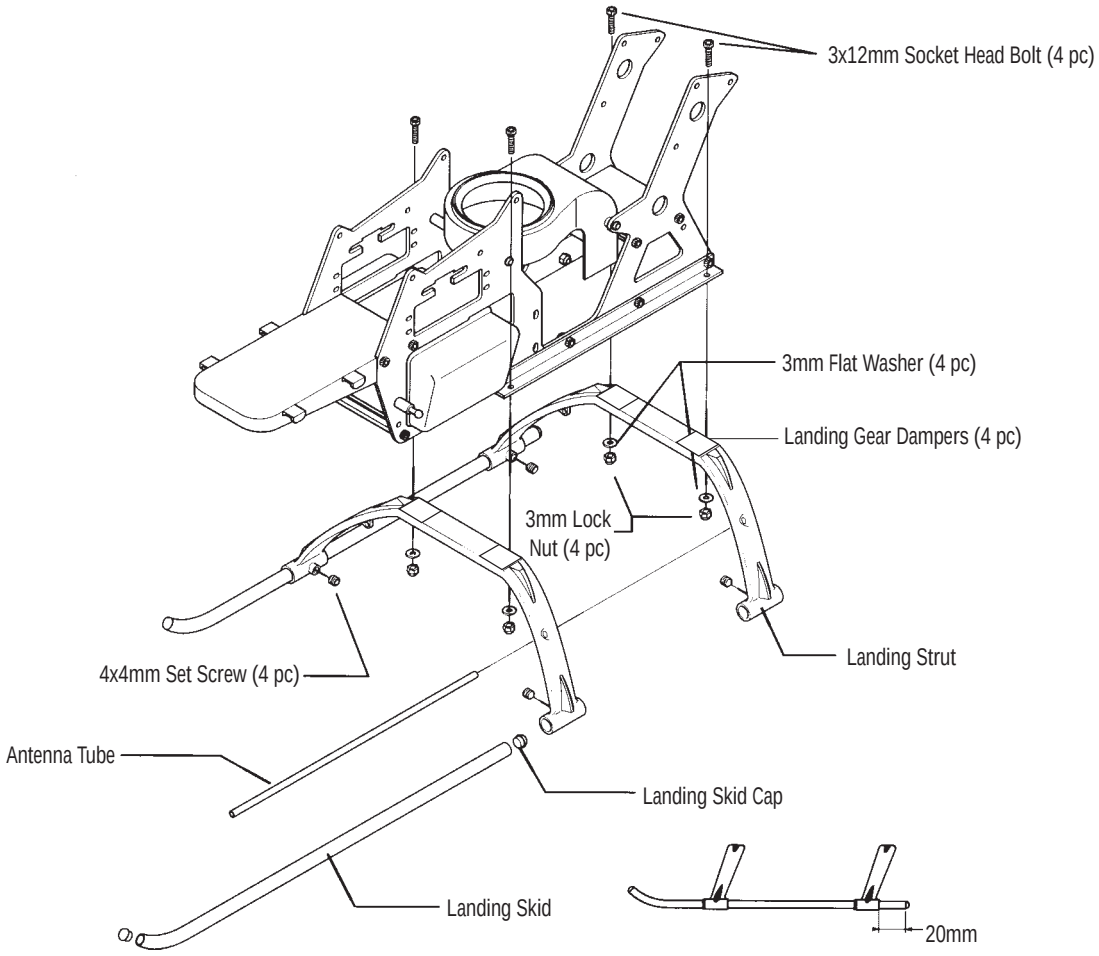




1. Secure the Autorotation Hub to the Main Rotor Shaft using the 3x22mm Socket Head Bolt. Next, slide the Main Shaft Collar onto the Main Rotor Shaft. While pulling upward on the Main Rotor Shaft, secure the Main Shaft Collar to the Main Rotor Shaft using the four 4x4mm Set Screws.
2. Once the Main Shaft Assembly is in place, adjust the gear mesh of the Clutch Bell and Tail Belt Pinion Gears, and secure the bolts left loose from Step 2-1.

3-3 LANDING GEAR ASSEMBLY INSTALLATION

4x4mm Set Screw	.....4 pc
3x12mm Socket Head Bolt	.....4 pc
3mm Flat Washer	.....4 pc
3mm Lock Nut	.....4 pc



3-4 .32-.36 COOLING FAN/HUB INSTALLATION

For proper installation of the fan assembly, it is neccessary for the engine to have the prop drive washer installed.

Note: If you are building the Ergo .46 3D Version, proceed to Step 3-4.1

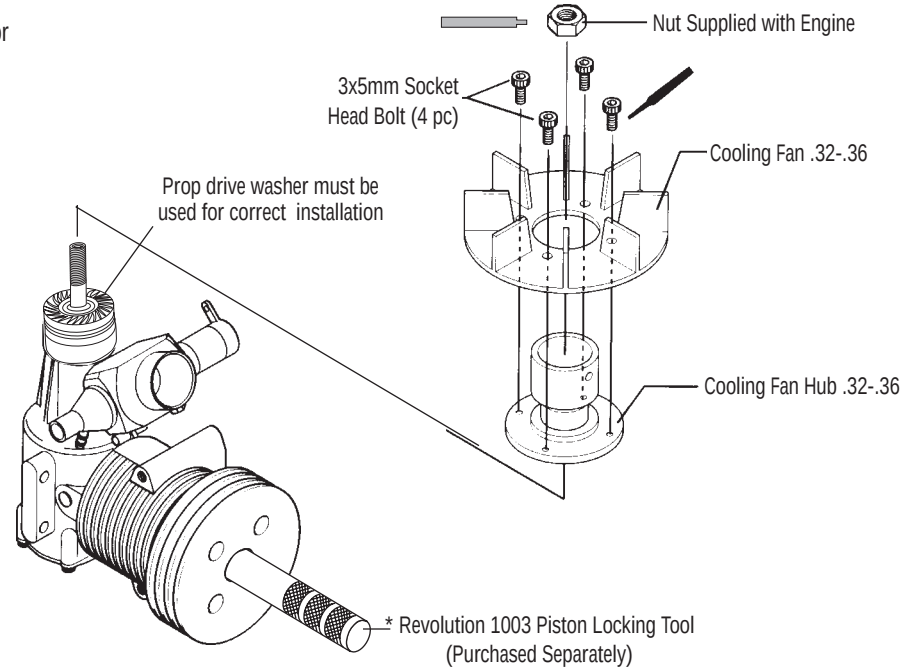
O.S. .32SX-H Installation

For proper installation of this engine, it will be necessary to purchase the O.S. Prop Drive Washer for this engine (Part #23408000).

*It is recommended that a Piston Locking Tool be used to properly secure the Fan Assembly to the engine.

Use Threadlock

3x5mm Socket Head Bolt	.....4 pc



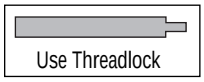
3-4.1 .46 COOLING FAN INSTALLATION

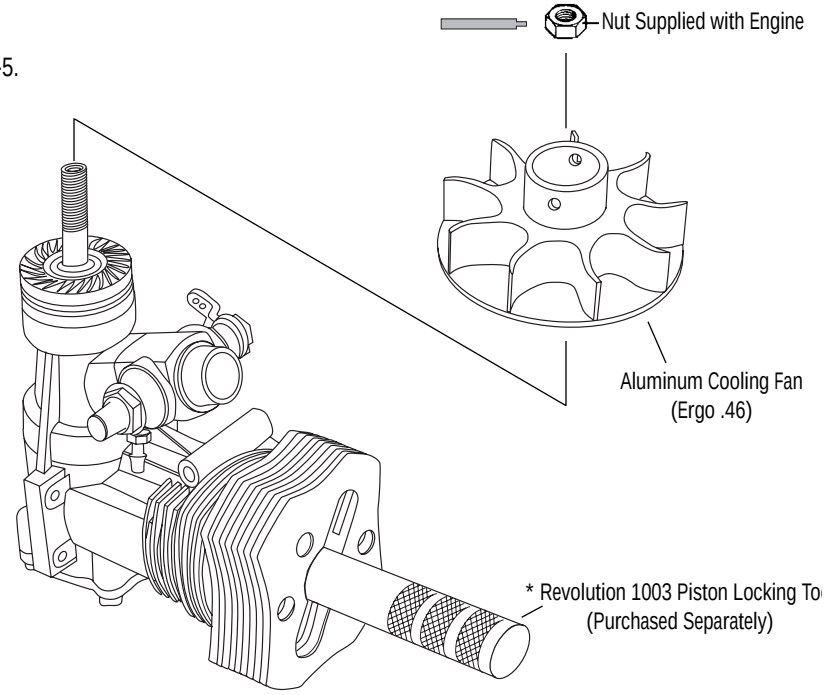
Note: If you are building the Ergo .32-.36 Version, proceed to Step 3-5.

Note: It will not be necessary to use the four 3x5mm Socket Head Bolts included in this screw bag.

Note: It will be necessary to shorten the Crankshaft of the engine to allow clearance. Test fit the Fan Assembly to determine the correct amount to be removed. On the Thunder Tiger Pro .46 Heli Engine, it will be necessary to remove 1/2" from the tip of the Crankshaft.

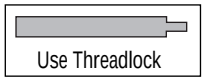
*It is recommended that a Piston Locking Tool be used to properly secure the Cooling Fan Assembly to the engine.

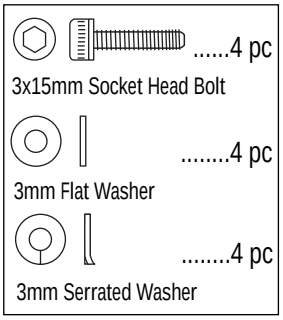


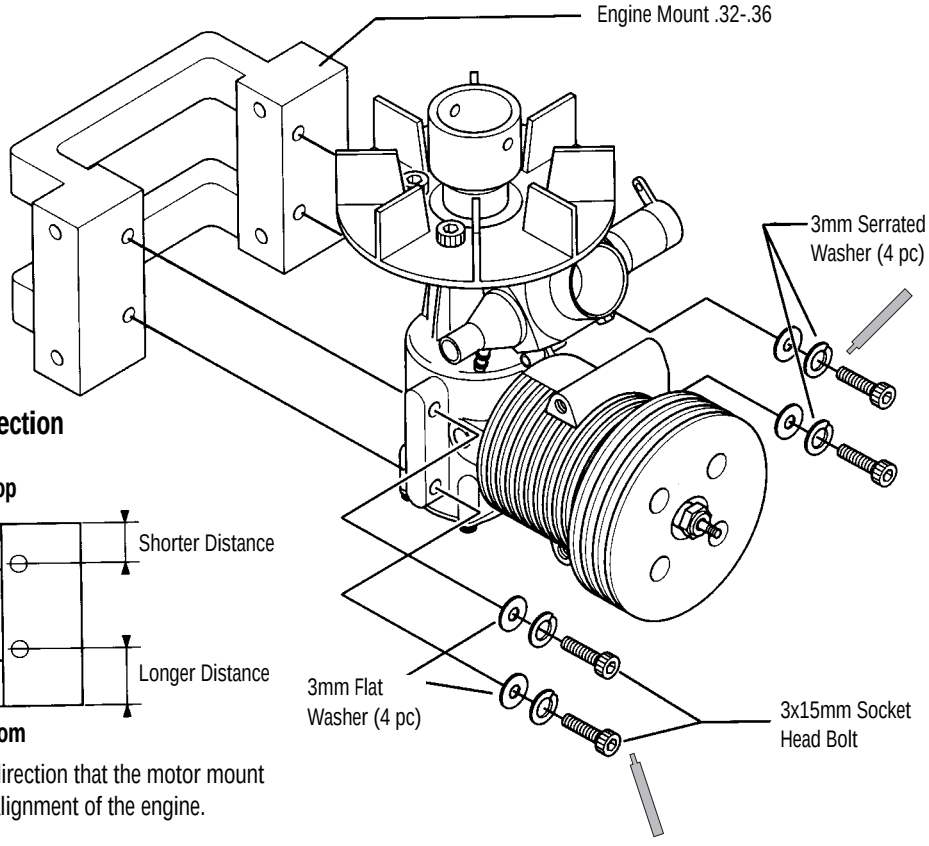


3-5 .32-.36 ENGINE MOUNT ATTACHMENT

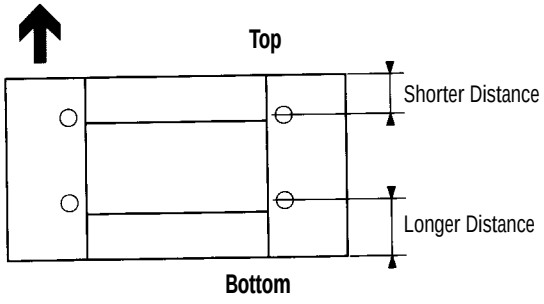
Note: If you are building the Ergo .46 3D Version proceed to Step 3-5.1.







Motor Mount Direction



It is important to note the proper direction that the motor mount is installed to achieve the correct alignment of the engine.

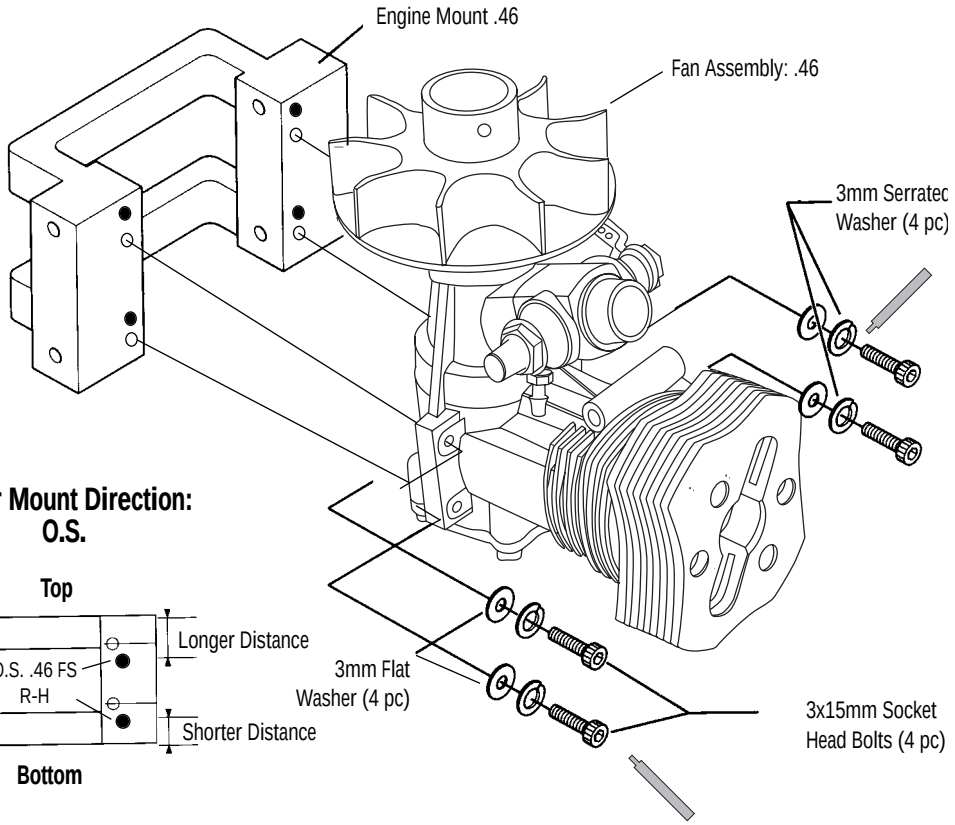
3-5.1 .46 ENGINE MOUNT ATTACHMENT

Use Threadlock

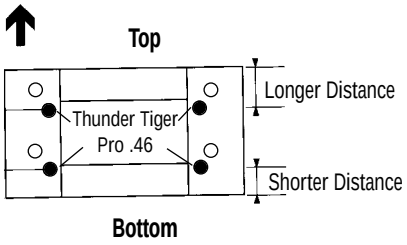
.....4 pc
3x15mm Socket Head Bolt

.....4 pc
3mm Flat Washer

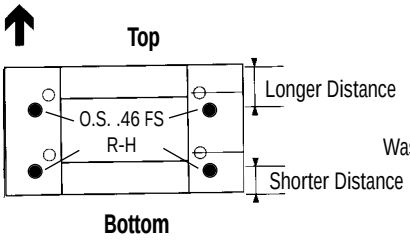
.....4 pc
3mm Serrated Washer



Motor Mount Direction: Thunder Tiger



Motor Mount Direction: O.S.



It is important to note the proper direction that the Motor Mount is installed to achieve the correct alignment of the engine.

3-6 CLUTCH ASSEMBLY ATTACHMENT (ALL)

Use Threadlock

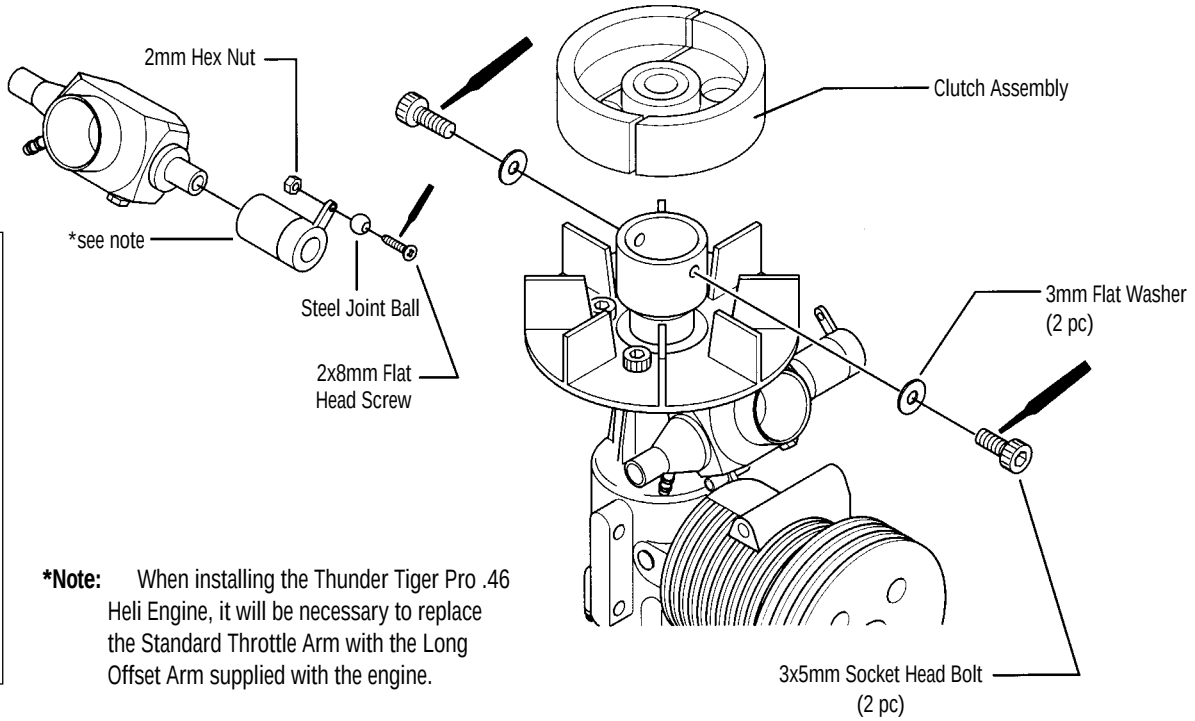
.....1 pc
2x8mm Flat Head Screw

.....2 pc
3x5mm Socket Head Bolt

.....1 pc
2mm Hex Nut

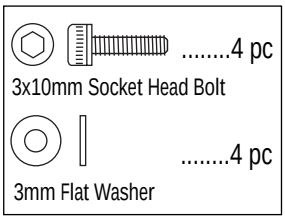
.....2 pc
3mm Flat Washer

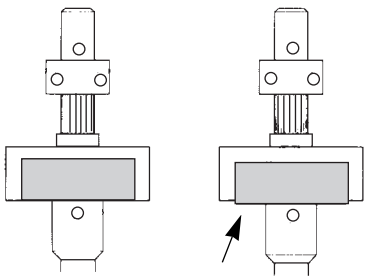
.....1 pc
Steel Joint Ball

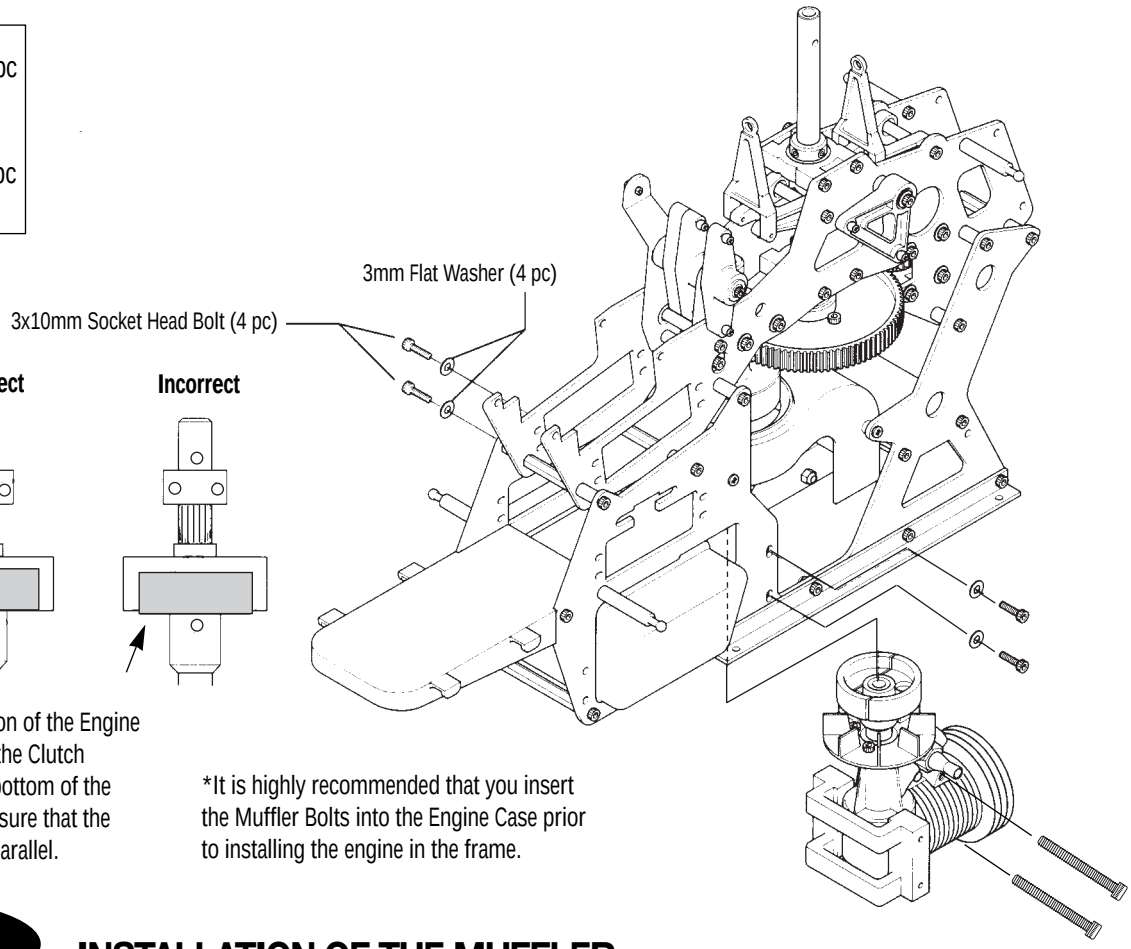


***Note:** When installing the Thunder Tiger Pro .46 Heli Engine, it will be necessary to replace the Standard Throttle Arm with the Long Offset Arm supplied with the engine.

3-7 ENGINE INSTALLATION (ALL)



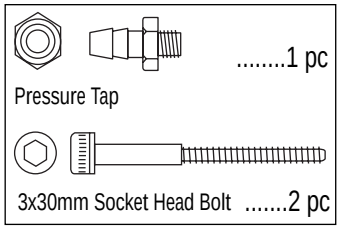


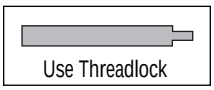


Adjust the height and position of the Engine as shown so the bottom of the Clutch Assembly is flush with the bottom of the Clutch Bell. Also check to insure that the Engine and Clutch Bell are parallel.

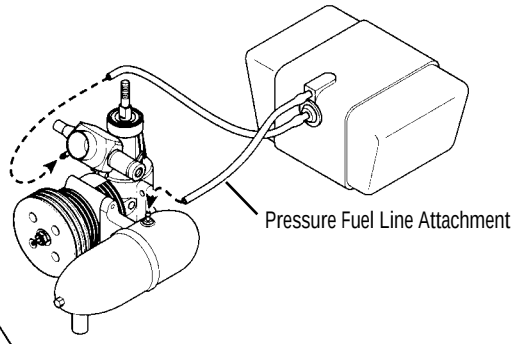
*It is highly recommended that you insert the Muffler Bolts into the Engine Case prior to installing the engine in the frame.

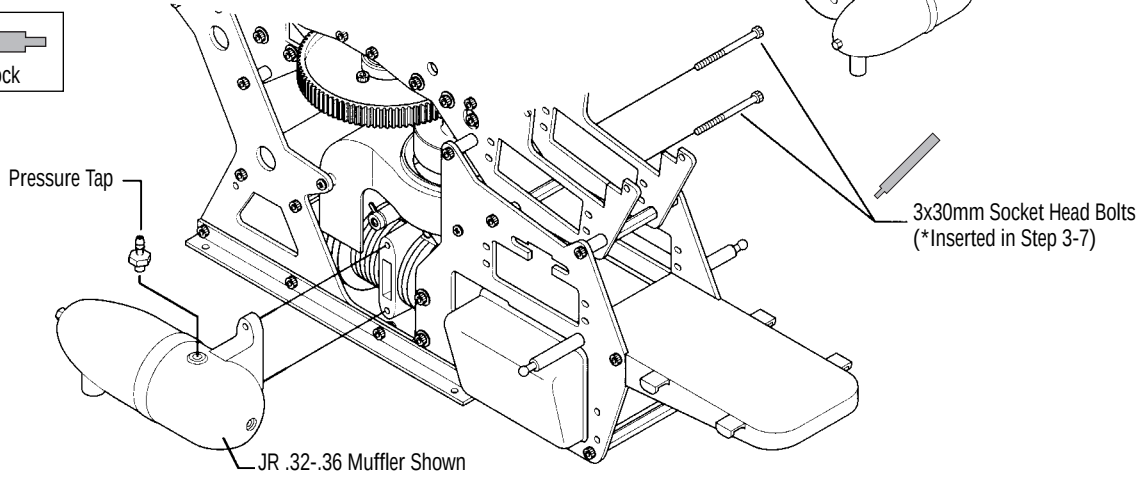
3-8 INSTALLATION OF THE MUFFLER





Note: The installation shown is for a .32-.36 size engine with the JR muffler (JRP960078). Installation of other .32-.36/.46 engine muffler combinations may vary. Please refer to your engine/muffler instructions for proper installation.



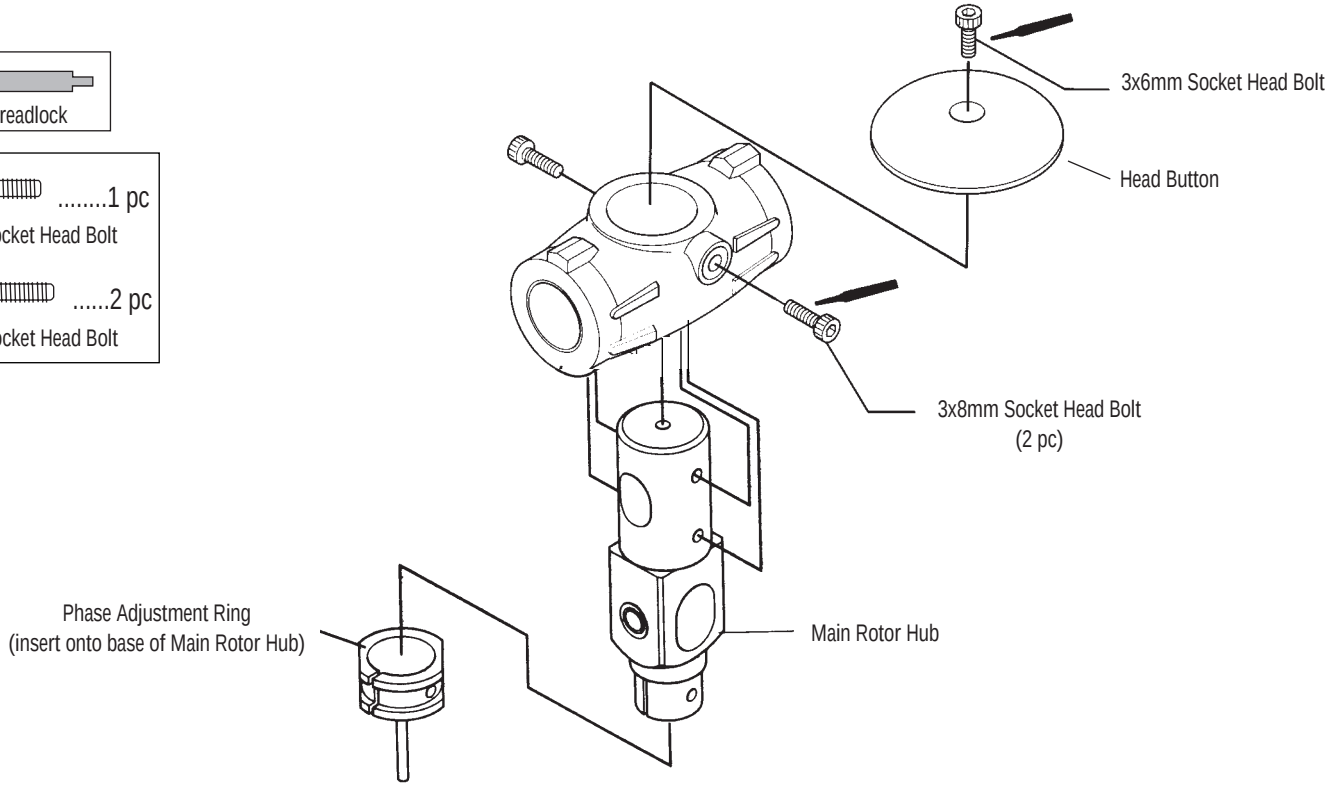


4-1 ROTOR HEAD HUB ASSEMBLY

Use Threadlock

.....1 pc
3x6mm Socket Head Bolt

.....2 pc
3x8mm Socket Head Bolt



4-2 MAIN BLADE HOLDER ASSEMBLY

Two Sets Required

.....4 pc
3x6mm Self Tapping Screw

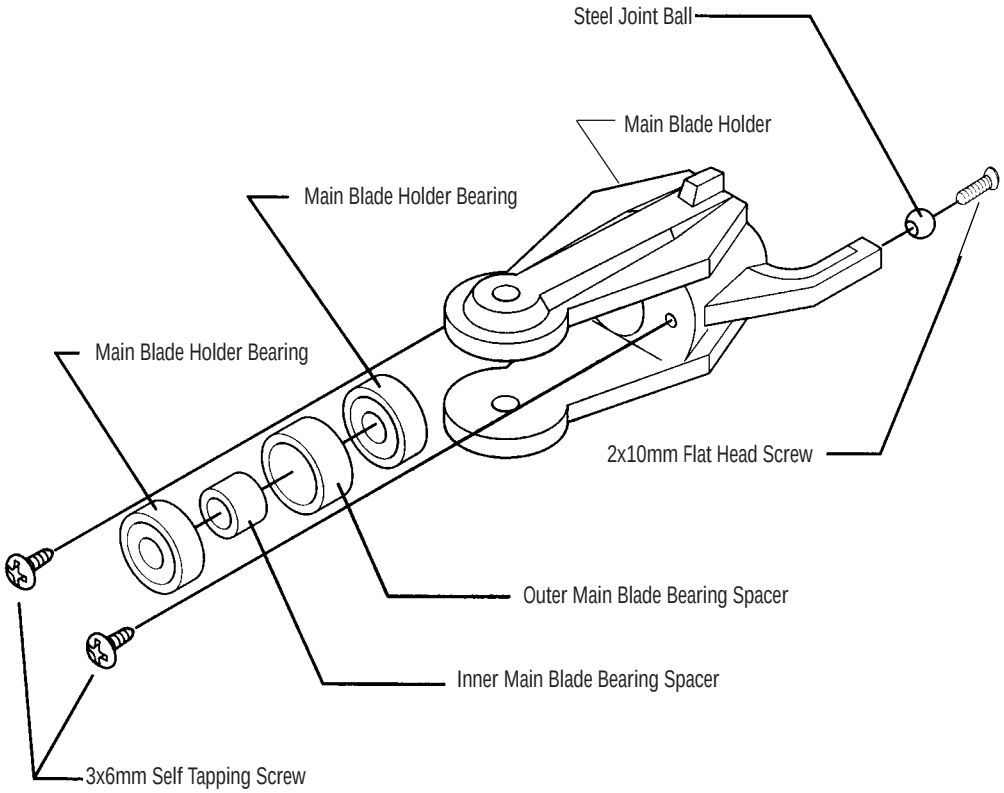
.....2 pc
2x10mm Flat Head Screw

.....2 pc
Steel Joint Ball

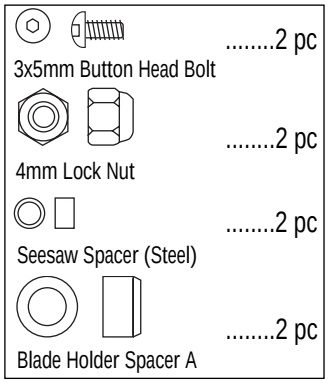
.....4 pc
Main Blade Holder Bearing

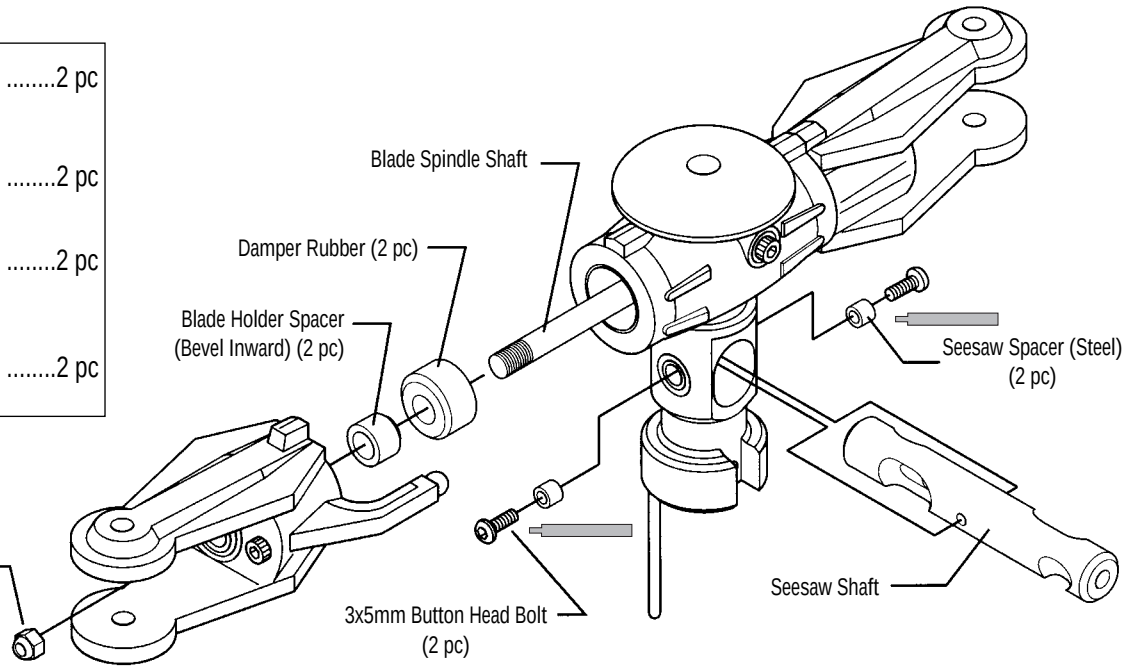
.....2 pc
Outer Main Blade Bearing Spacer

.....2 pc
Inner Main Blade Bearing Spacer

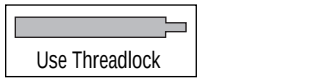


4-3 MAIN BLADE HOLDER/SEESAW ATTACHMENT

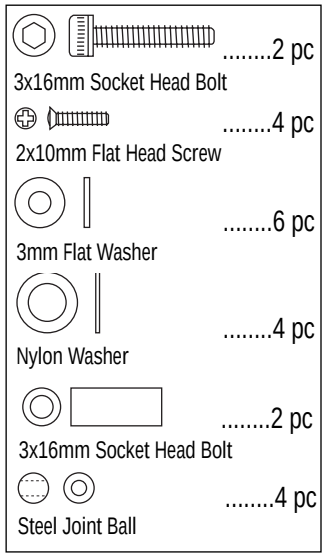


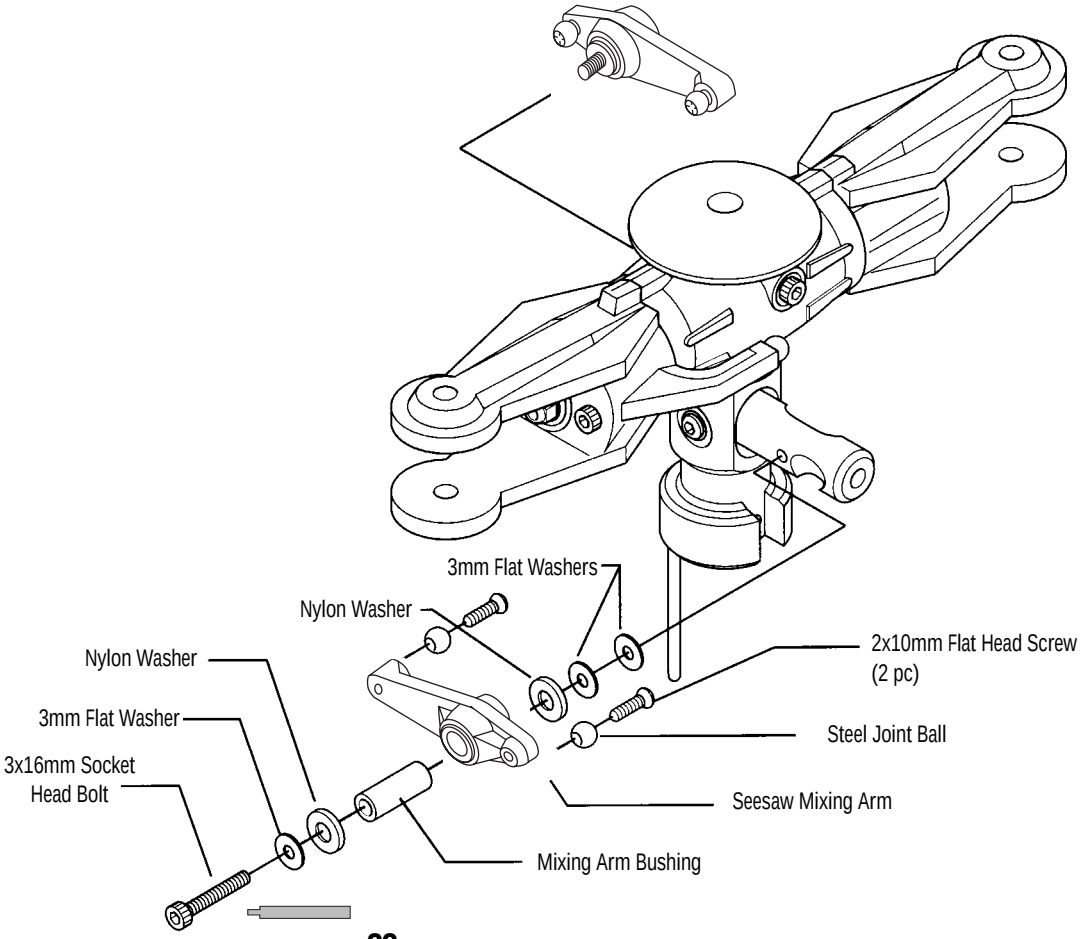


4-4 SEESAW MIXING ARM INSTALLATION

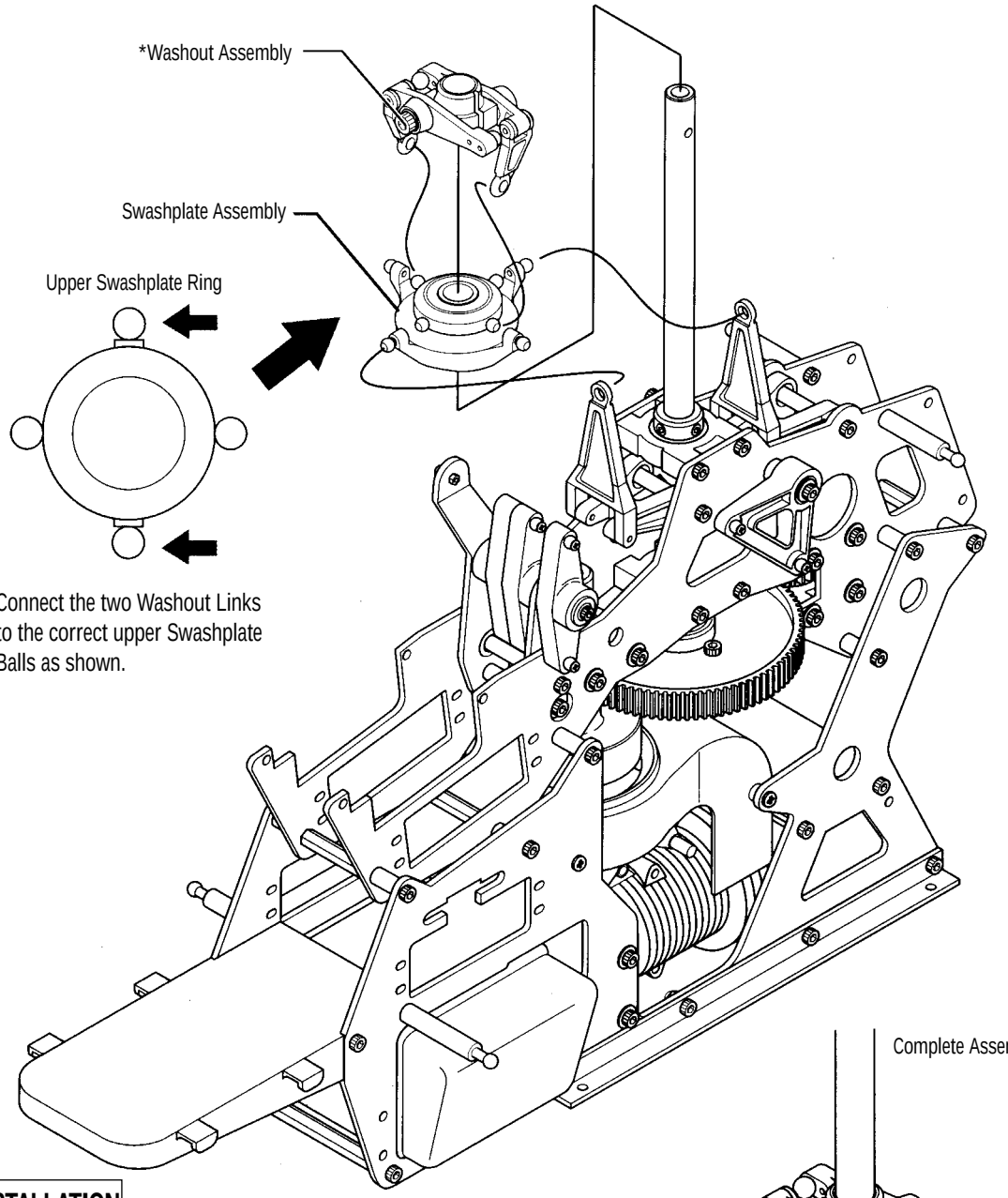


Two Sets Required

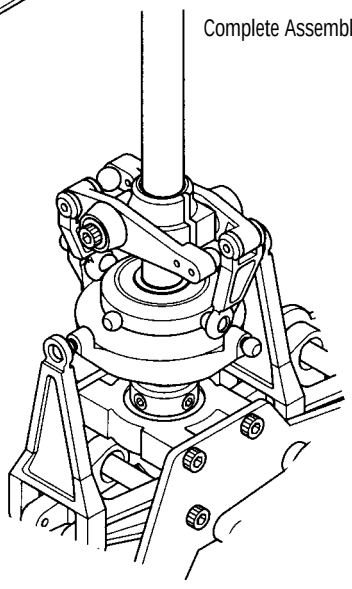




4-5 SWASHPLATE/WASHOUT ASSEMBLY INSTALLATION



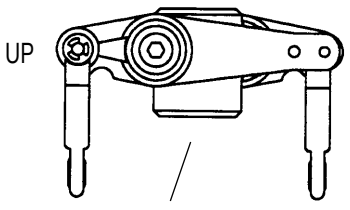
Connect the two Washout Links to the correct upper Swashplate Balls as shown.



***SWASHOUT ASSEMBLY INSTALLATION**

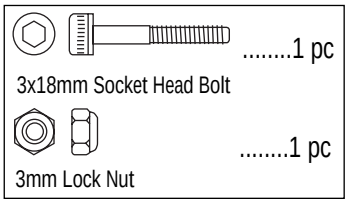
When installing the washout assembly be sure the long flange of the mixing base is positioned downward (toward the swashplate) with the short portion facing upward.

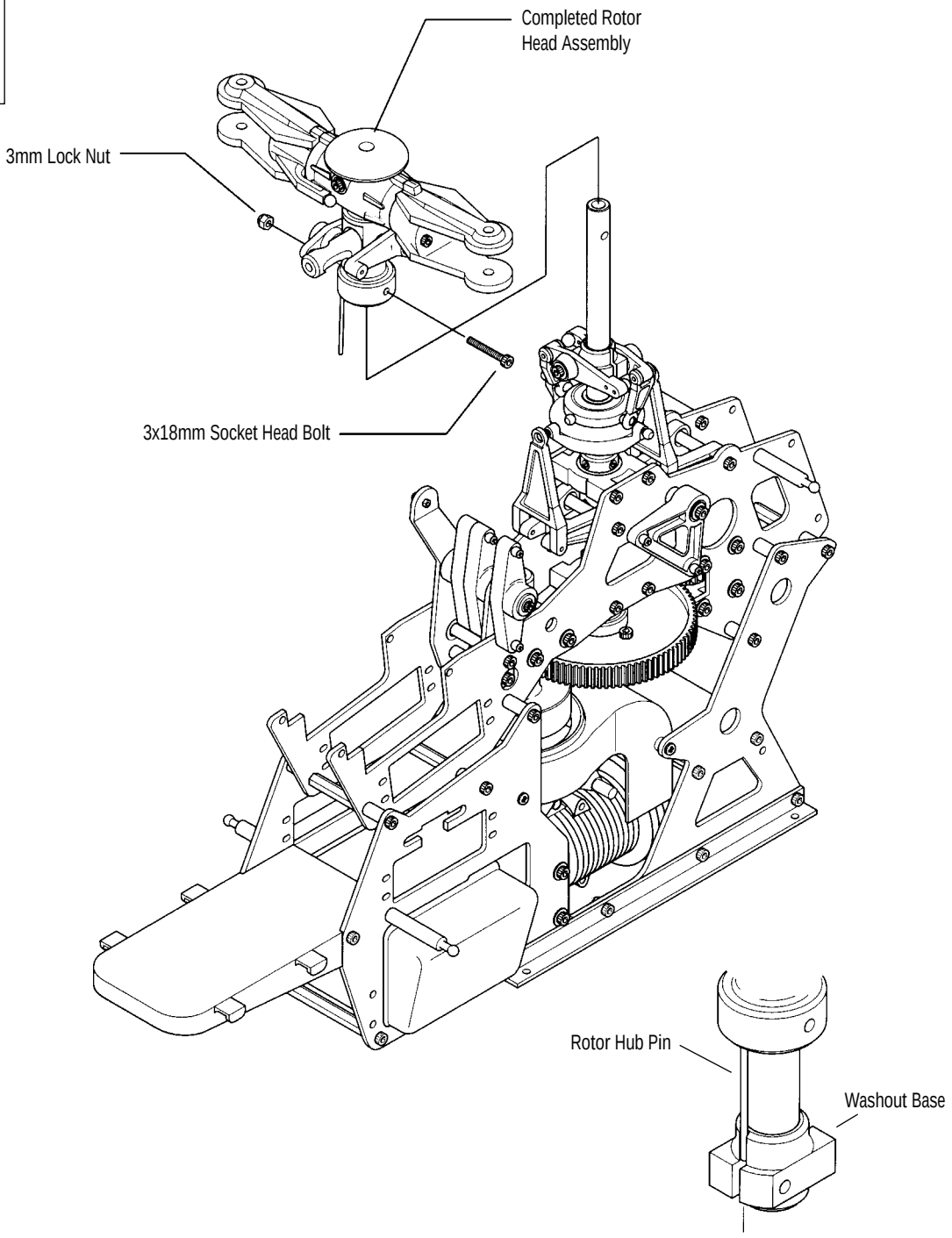
Washout Assembly



Long portion of mixing base flange must face downward.

4-6 ROTOR HEAD INSTALLATION





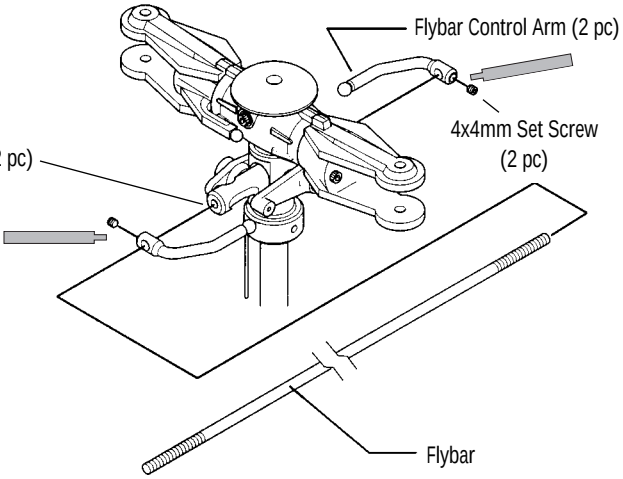
Note: Be sure to engage thePhase Adjusting Ring into the Washout Base Groove before securing the Rotor Head Assembly in place.

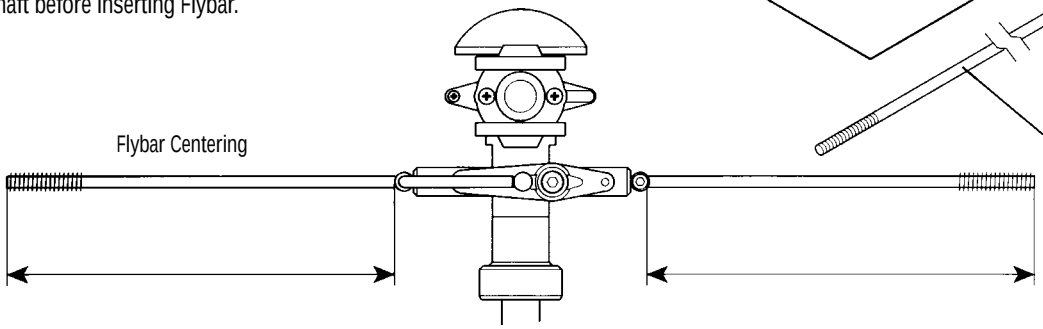
4-7 FLYBAR INSTALLATION

Use Threadlock

.....2 pc
4x4mm Set Screw

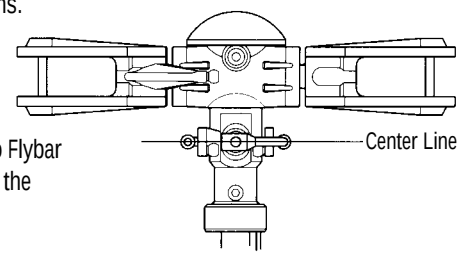
* Be sure to insert Flybar Bushings into the Seesaw Shaft before inserting Flybar.





Note: Center the Flybar in the Seesaw Shaft before securing the two Flybar Control Arms.

Check to insure that the two Flybar Control Arms are parallel to the center line of the Flybar.

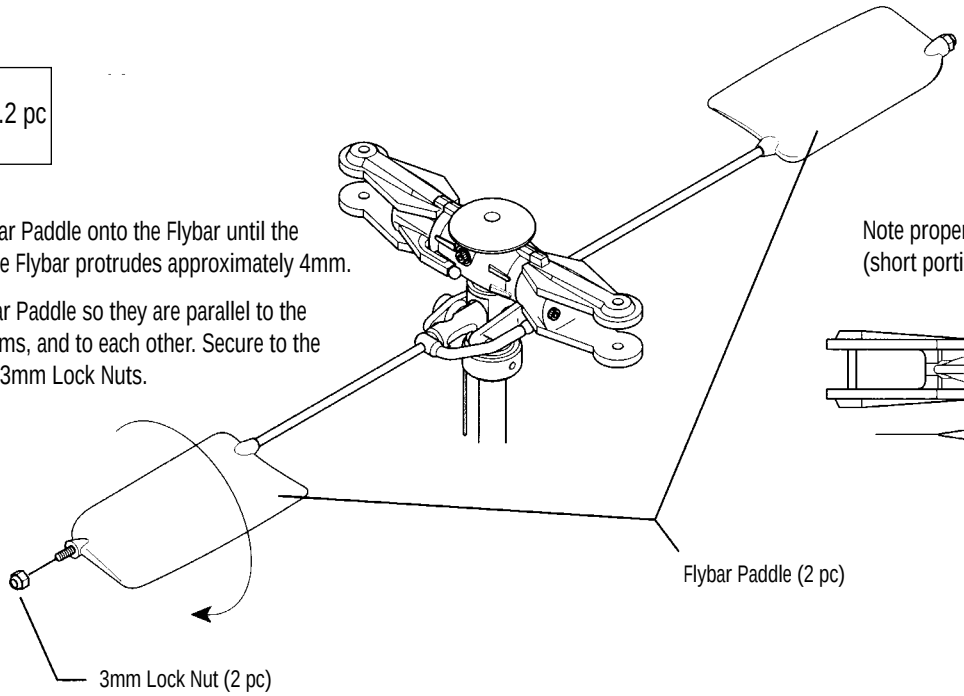


4-8 FLYBAR PADDLE ATTACHMENT

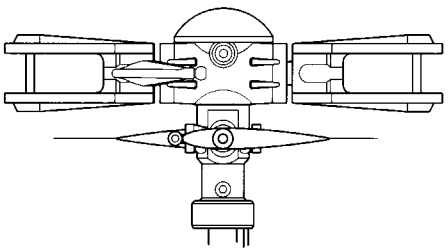
.....2 pc
3mm Lock Nut

Thread each Flybar Paddle onto the Flybar until the threaded tip of the Flybar protrudes approximately 4mm.

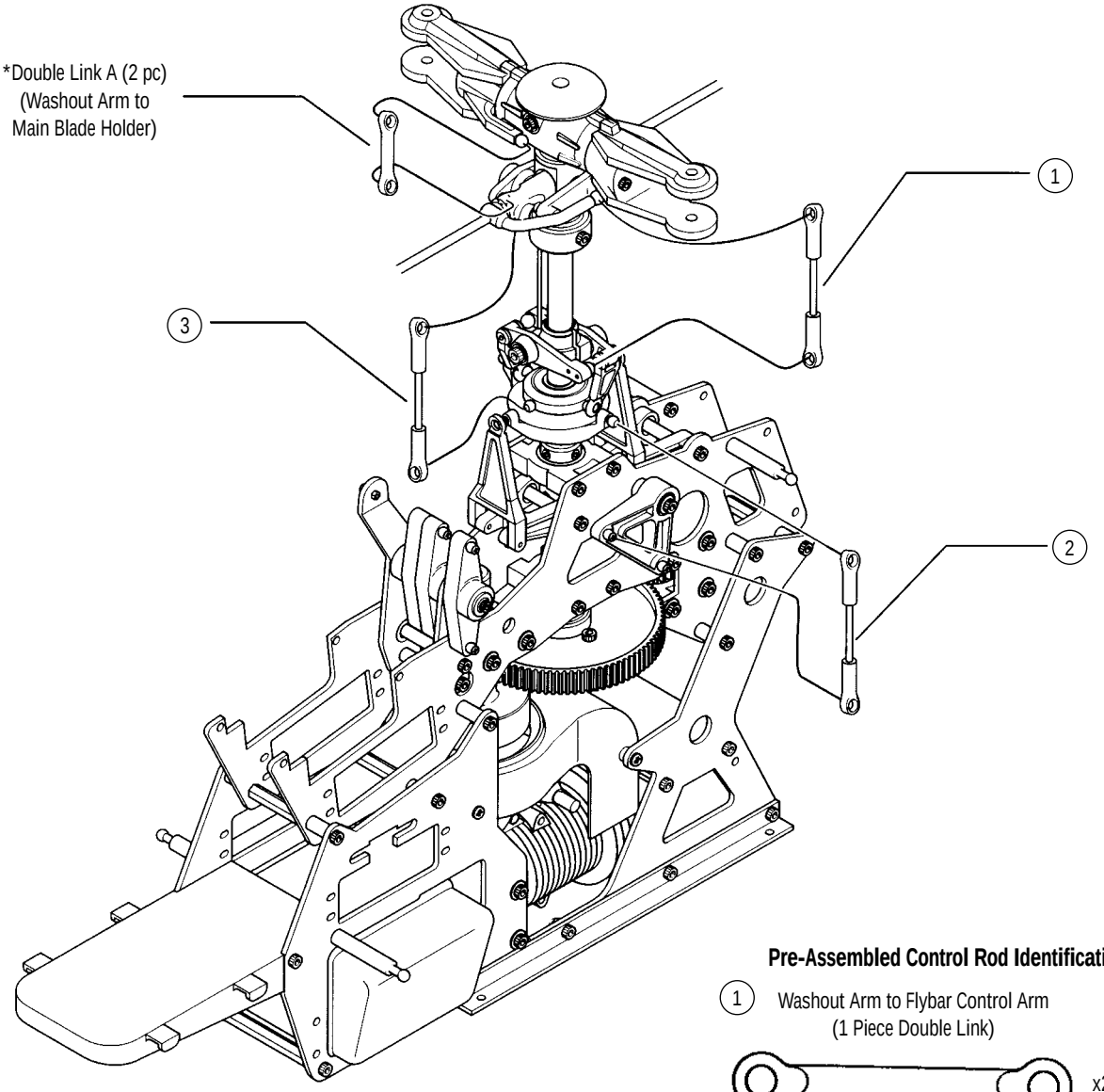
Adjust each Flybar Paddle so they are parallel to the Flybar Control Arms, and to each other. Secure to the Flybar using two 3mm Lock Nuts.



Note proper direction of each Flybar Paddle (short portion forward, clockwise rotation).

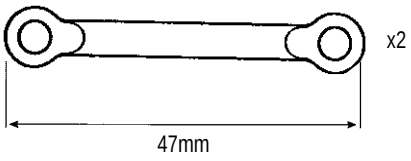


4-9 ROTOR HEAD/SWASHPLATE CONTROL ROD INSTALLATION

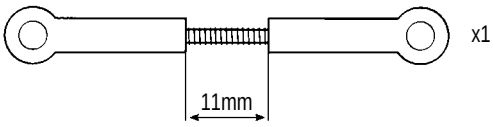


Pre-Assembled Control Rod Identification:

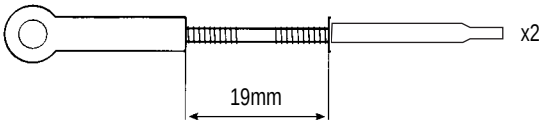
1 Washout Arm to Flybar Control Arm
(1 Piece Double Link)



2 Swashplate to Roll Bellcrank
(2.3mmx30mm Threaded Rod)



3 Swashplate to Washout Arm
(2.3mmx40mm Threaded Rod)



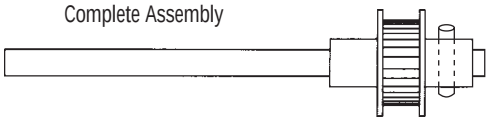
Note: **Ergo .46 3D Kit**

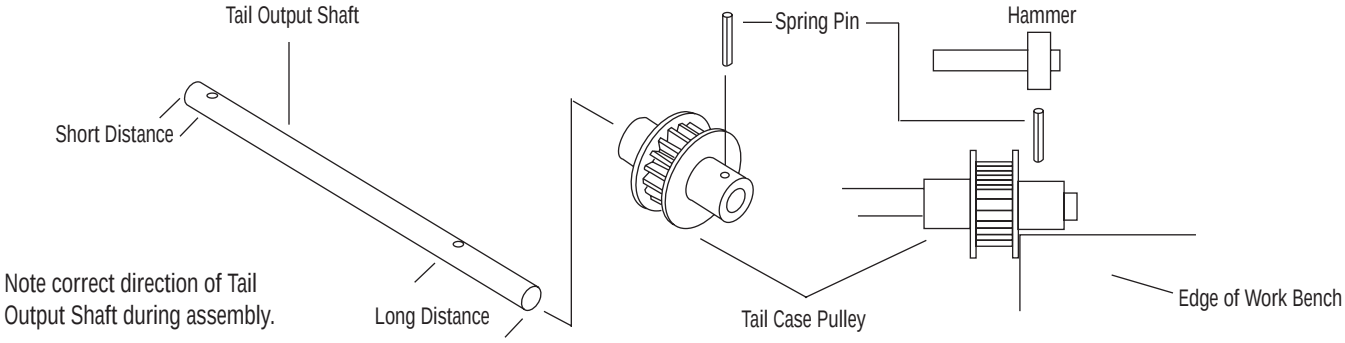
Your Ergo .46 3D Kit includes an additional set of Double Links (B Style #960081). These links are designed to provide proper blade pitch for 3D Flight (+10° thru -10°).

Using the Standard Double Link "A" will provide a Standard Blade Pitch Range (+15 thru -4).

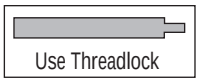
Standard Double Links "A" are recommended for all training and sport flying applications.

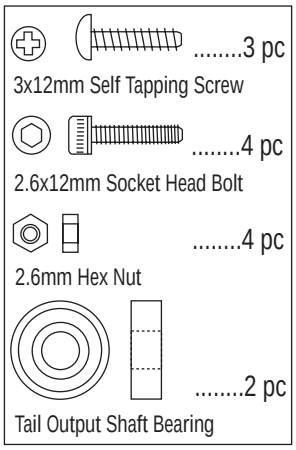
5-1 TAIL OUTPUT SHAFT/PULLEY ASSEMBLY

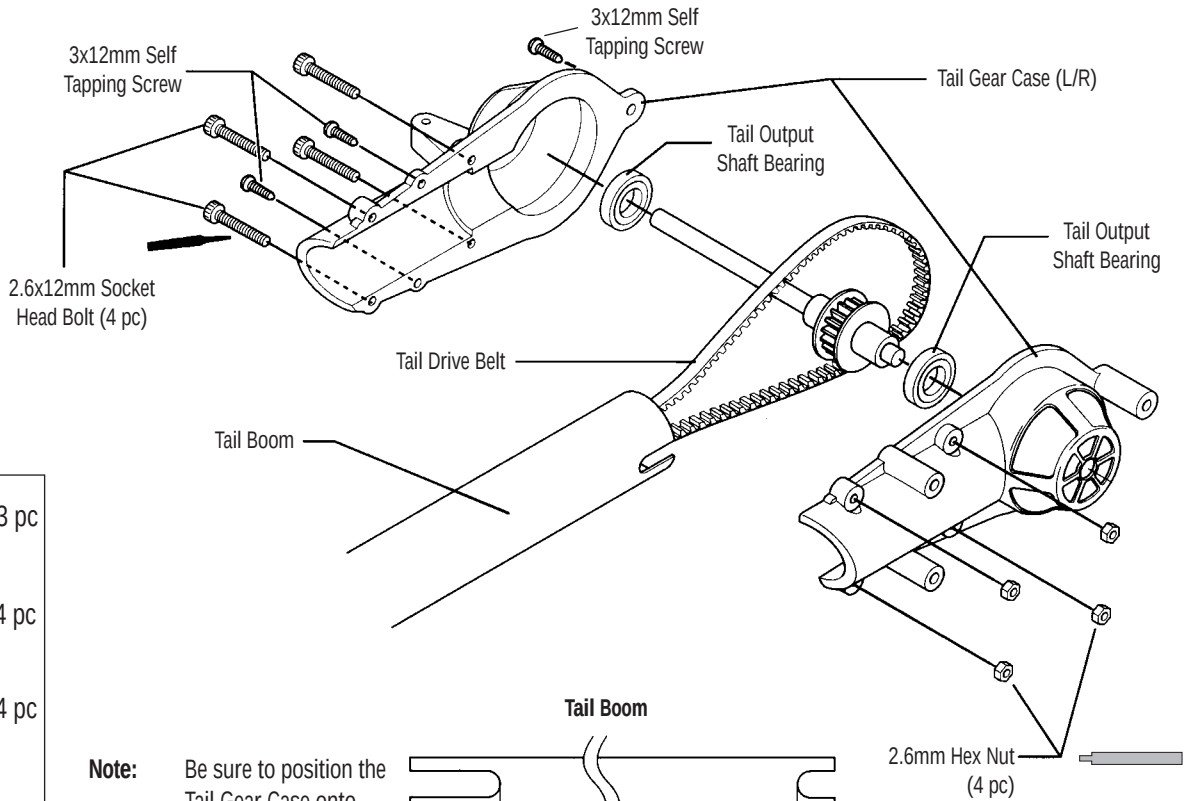




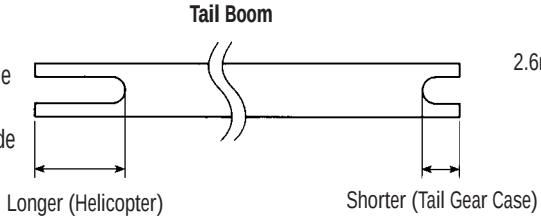
5-2 TAIL GEAR CASE ASSEMBLY



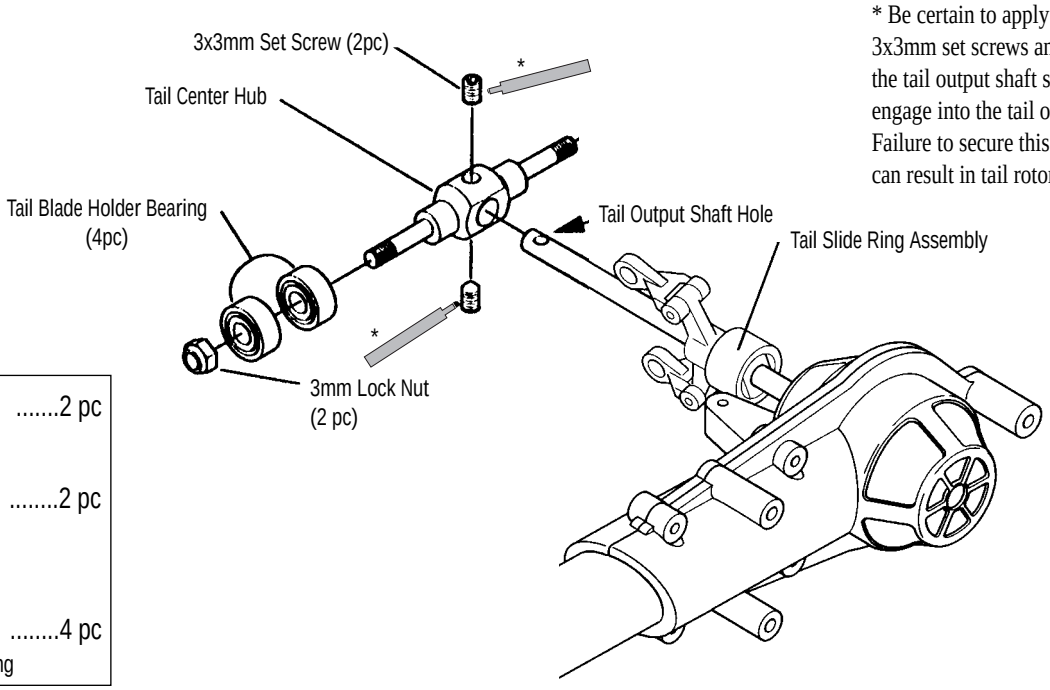




Note: Be sure to position the Tail Gear Case onto the shorter slotted side of the Tail Boom.



5-3 TAIL CENTER HUB ASSEMBLY



* Be certain to apply Locktite to the two 3x3mm set screws and attach securely to the tail output shaft so the set screws engage into the tail output shaft hole. Failure to secure this assembly properly can result in tail rotor failure during flight.

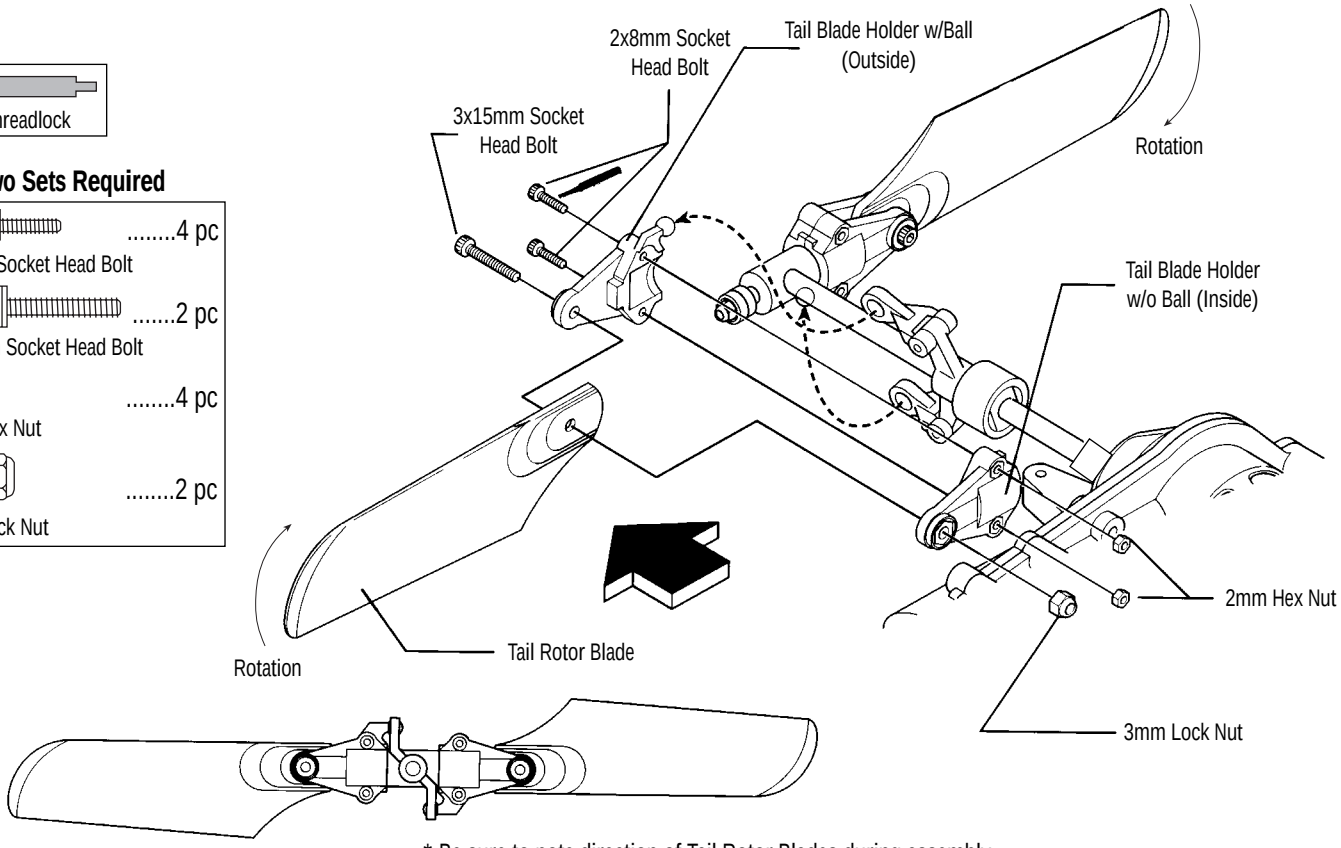
Use Threadlock

.....2 pc
3x3mm Set Screw

.....2 pc
3mm Lock Nut

.....4 pc
Tail Blade Holder Bearing

5-4 TAIL BLADE HOLDER ASSEMBLY



Use Threadlock

Two Sets Required

.....4 pc
2x8mm Socket Head Bolt

.....2 pc
3x15mm Socket Head Bolt

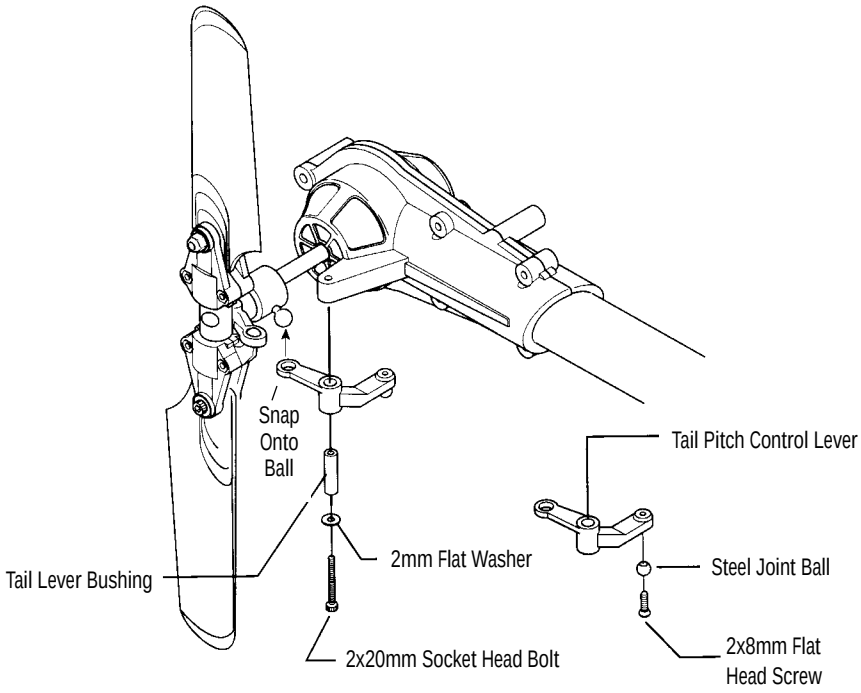
.....4 pc
2mm Hex Nut

.....2 pc
3mm Lock Nut

* Be sure to note direction of Tail Rotor Blades during assembly.

5-5 TAIL PITCH CONTROL LEVER INSTALLATION

2x8 Flat Head Screw	.....1 pc
2x20mm Socket Head Bolt	.....1 pc
2mm Flat Washer	.....1 pc
Steel Joint Ball	.....1 pc
Tail Lever Bushing	.....1 pc

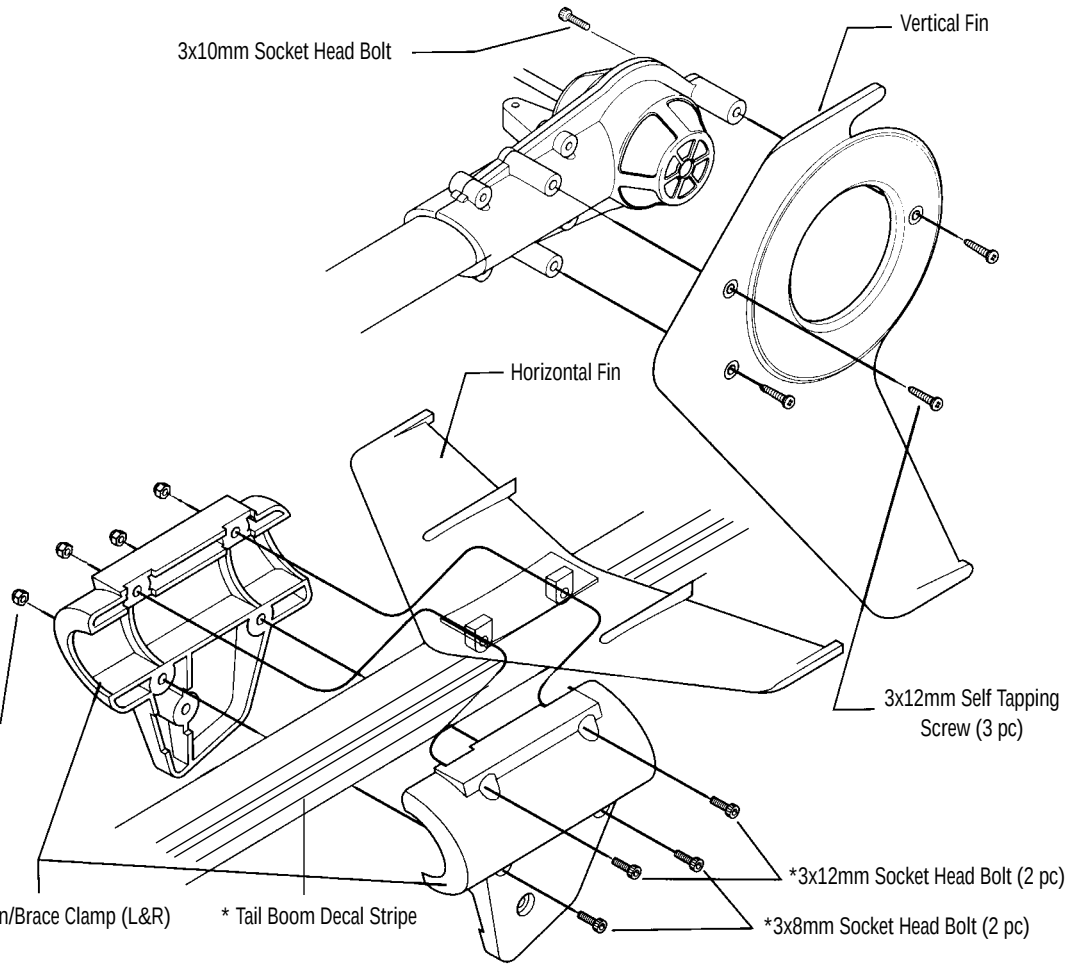


5-6 TAIL FIN ATTACHMENT

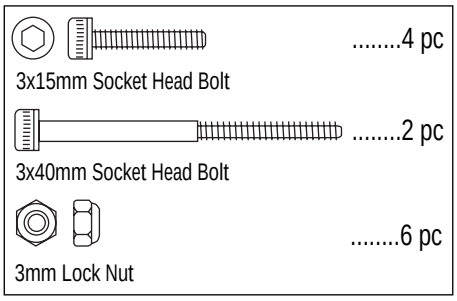
3x8mm Socket Head Bolt	.....2 pc
3x10mm Socket Head Bolt	.....1 pc
3x12mm Socket Head Bolt	.....2 pc
3x12mm Self Tapping Screw	.....3 pc
3mm Lock Nut	.....4 pc

* Do not completly secure these bolts as this assembly will need to be correctly positioned in Step 5-10.

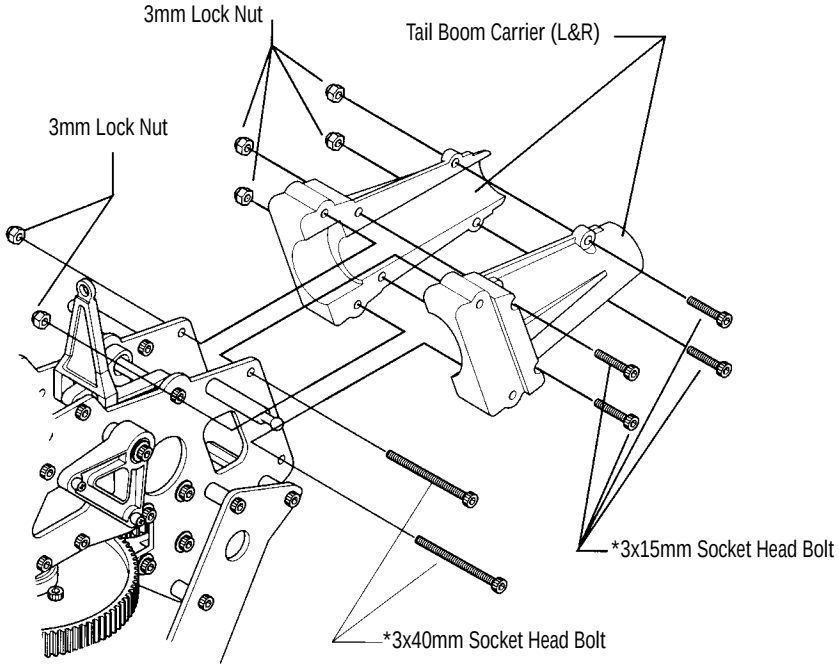
* **Note:** Please attach the Tail Boom Decal Stripe (located on the decal sheet) prior to attaching the horizontal fin/brace clamp.



5-7 TAIL BOOM CARRIER INSTALLATION

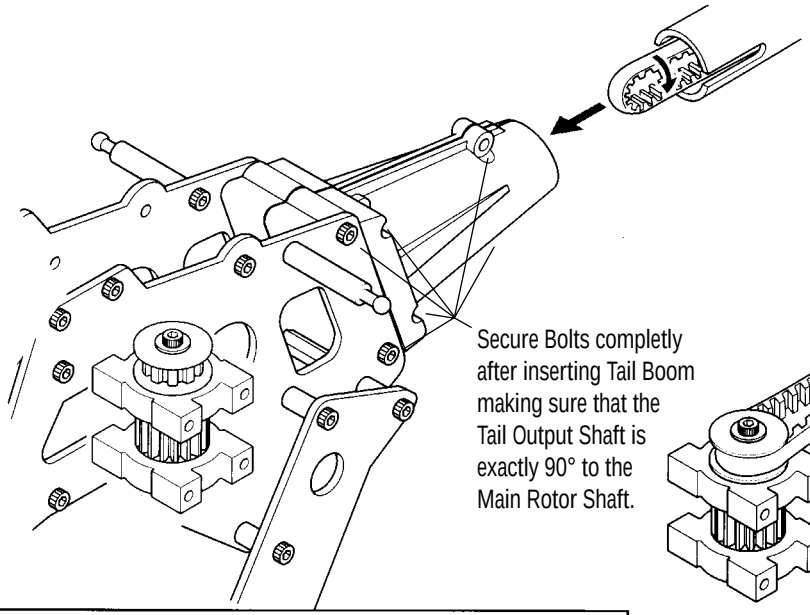


* Do not fully tighten at this time. These bolts will be secured in Step 5-10.



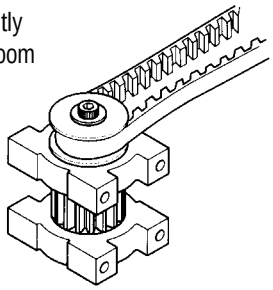
5-8 TAIL BOOM ASSEMBLY INSTALLATION

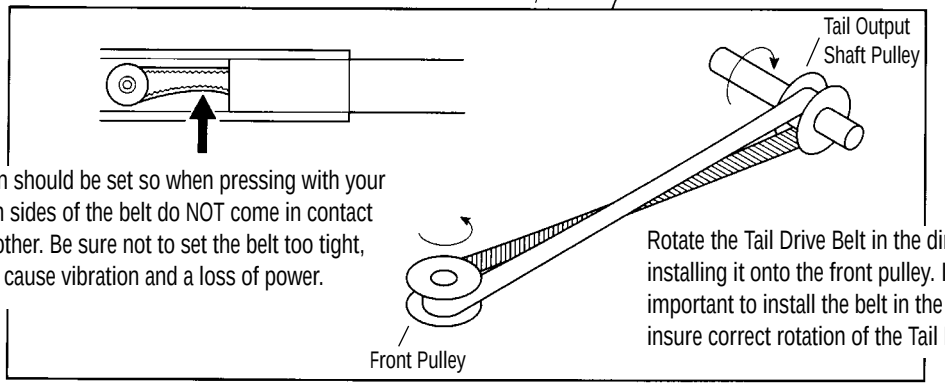
Slide the Tail Boom through the Tail Boom Carrier and engage the Tail Drive Belt over the Front Pulley. Be certain to note the correct rotation (direction shown below. Set the belt tension per the directions below.).



Note: It may be necessary to add one thickness of electrical tape around the end of the Tail Boom to insure positive attachment to the Tail Boom Carrier.

Secure Bolts completly after inserting Tail Boom making sure that the Tail Output Shaft is exactly 90° to the Main Rotor Shaft.

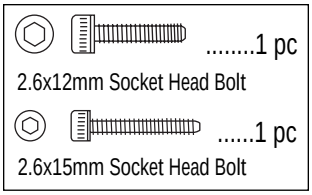


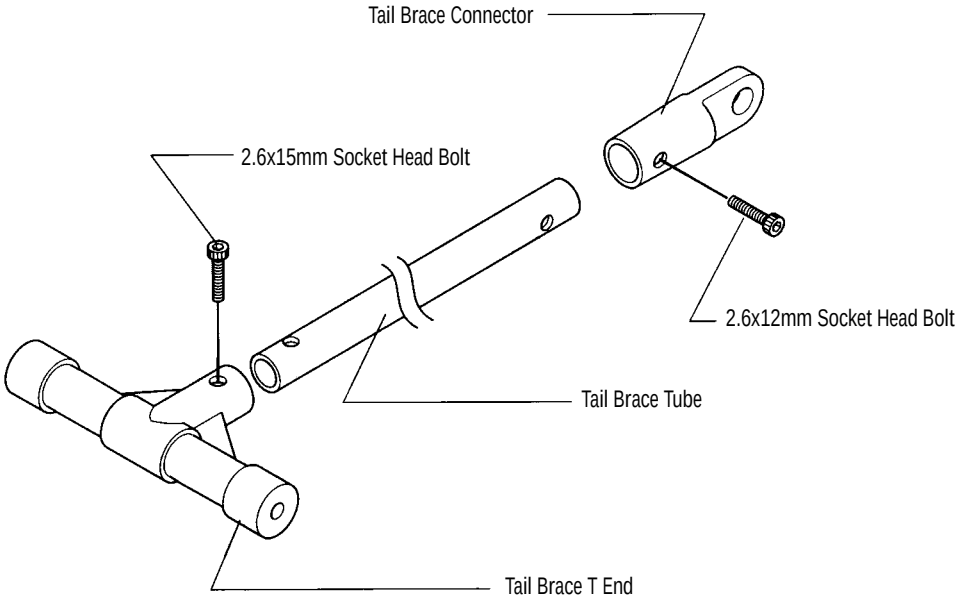


Belt tension should be set so when pressing with your finger, both sides of the belt do NOT come in contact with each other. Be sure not to set the belt too tight, as this can cause vibration and a loss of power.

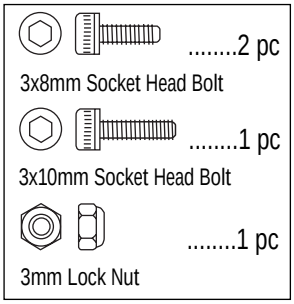
Rotate the Tail Drive Belt in the direction shown before installing it onto the front pulley. It is extremely important to install the belt in the proper direction to insure correct rotation of the Tail Rotor Blades.

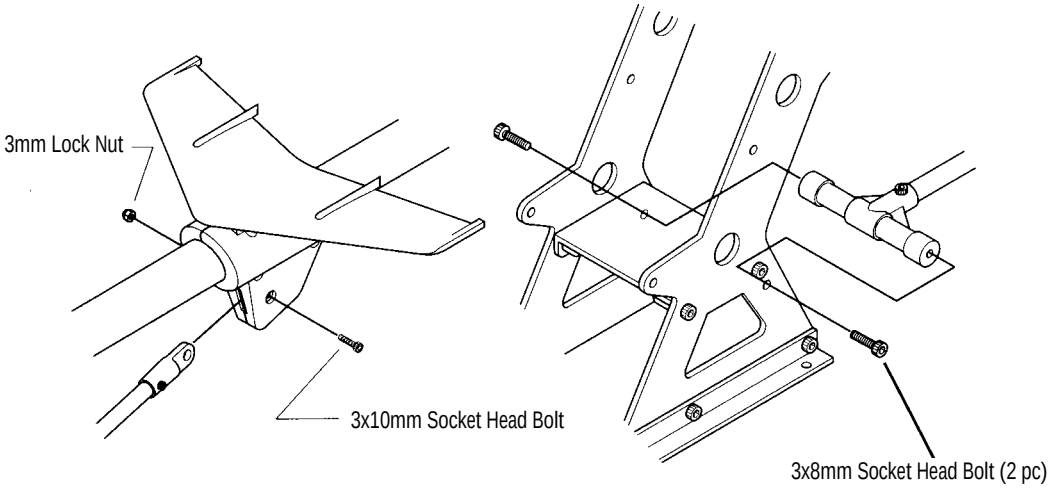
5-9 TAIL BOOM BRACE ASSEMBLY

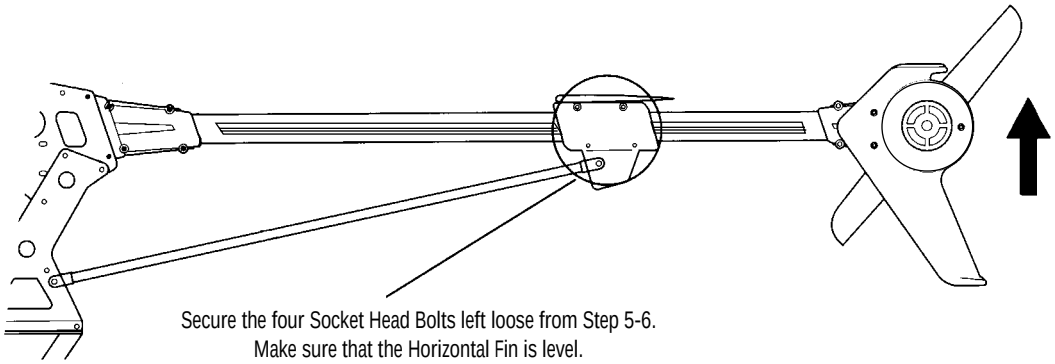




5-10 TAIL BOOM BRACE INSTALLATION

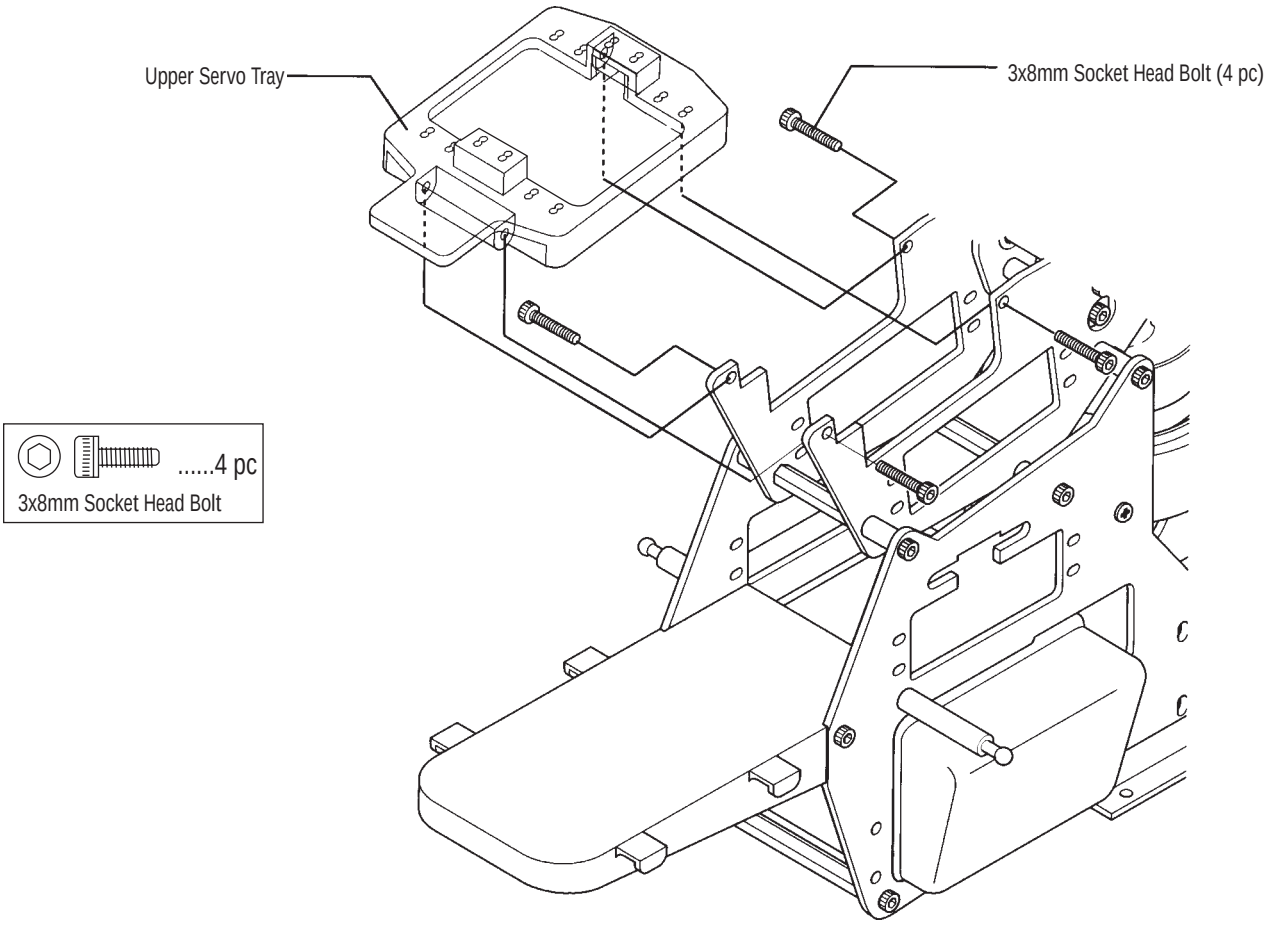






Secure the four Socket Head Bolts left loose from Step 5-6.
Make sure that the Horizontal Fin is level.

6-1 UPPER SERVO TRAY INSTALLATION



RADIO INSTALLATION SUGGESTIONS

Be sure to install four rubber servo grommets and eyelets to each servo prior to installation. When securing the servos to the helicopter, be sure not to over-tighten the mounting screws.

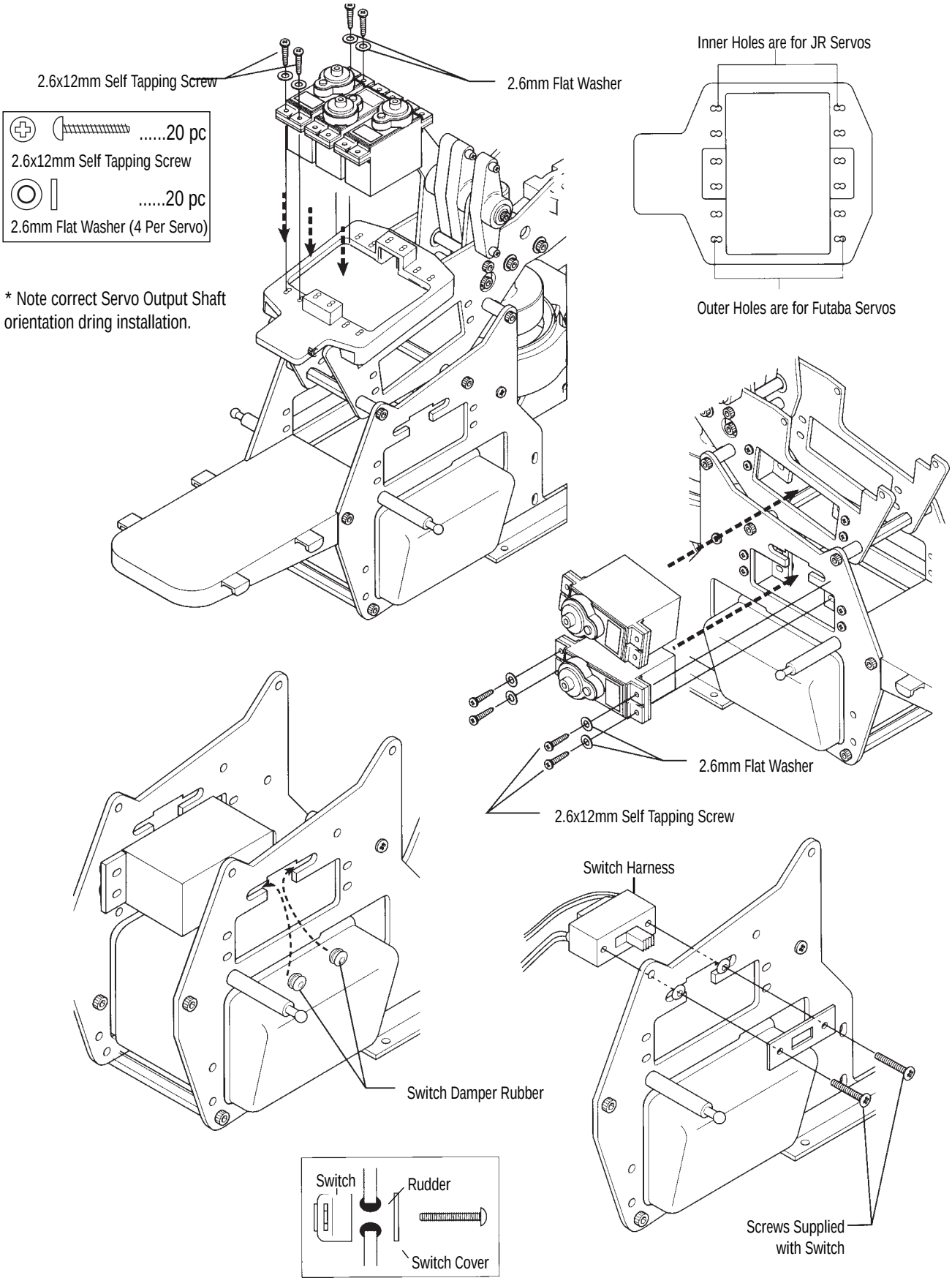
All servo rods contained in this kit have been pre-adjusted to fit JR servos. If you are installing a different brand radio system, please adjust the rod lengths to the correct dimensions as listed in these instructions.

When adjusting control rods, be sure to adjust each universal link the same amount so as not to unthread one link too far.

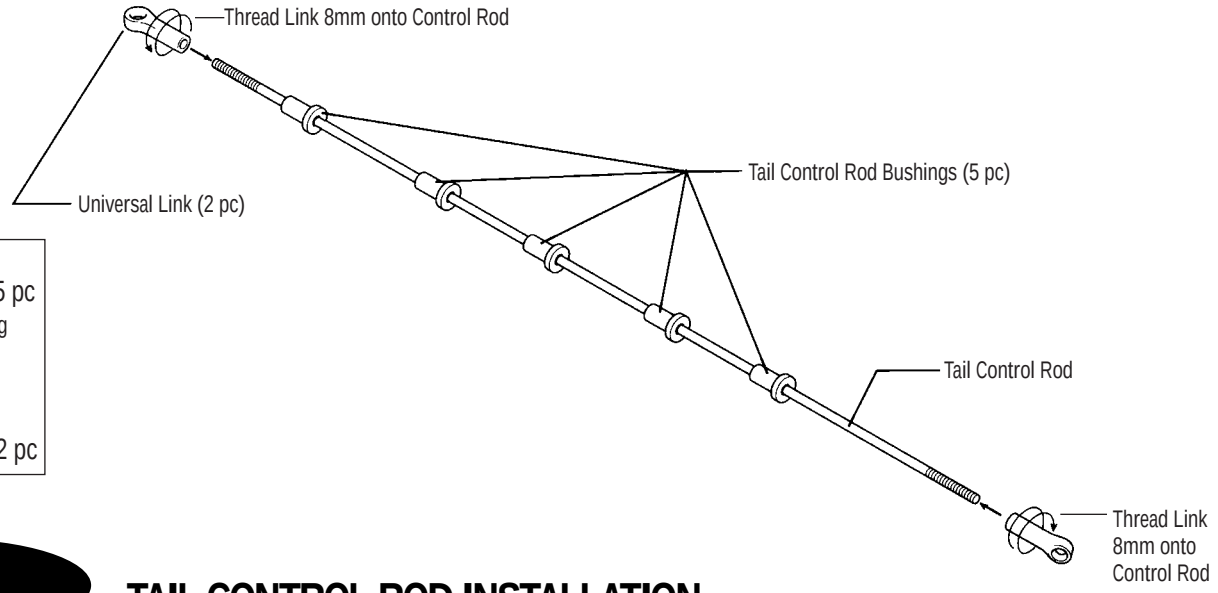
It is suggested that both the receiver and gyro amplifier be isolated from vibration by wrapping them in foam, then securing them to the model using double-sided servo tape.

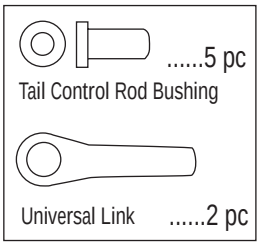
Be sure to keep all servo lead wires, etc., away from all servo arms, rods, and sharp edges of the helicopter's mechanics. Group these wires together after final installation using small nylon wire ties.

6-2 SERVO/SWITCH HARNESS INSTALLATION

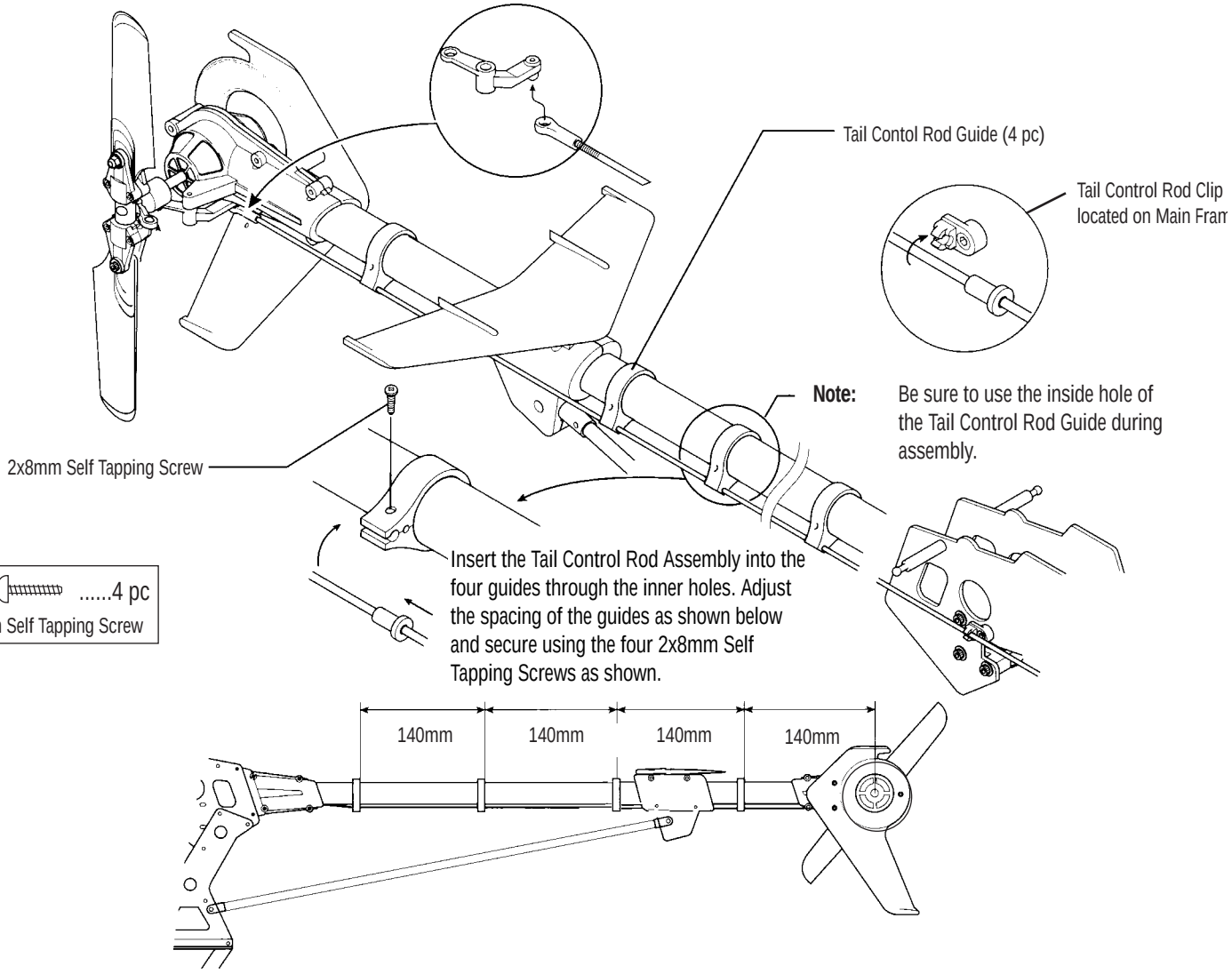


6-3 TAIL CONTROL ROD ASSEMBLY





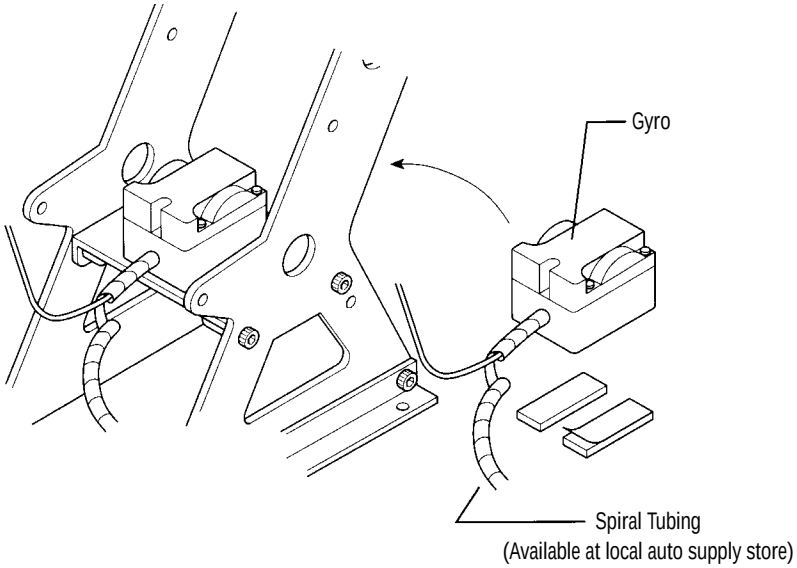
6-4 TAIL CONTROL ROD INSTALLATION



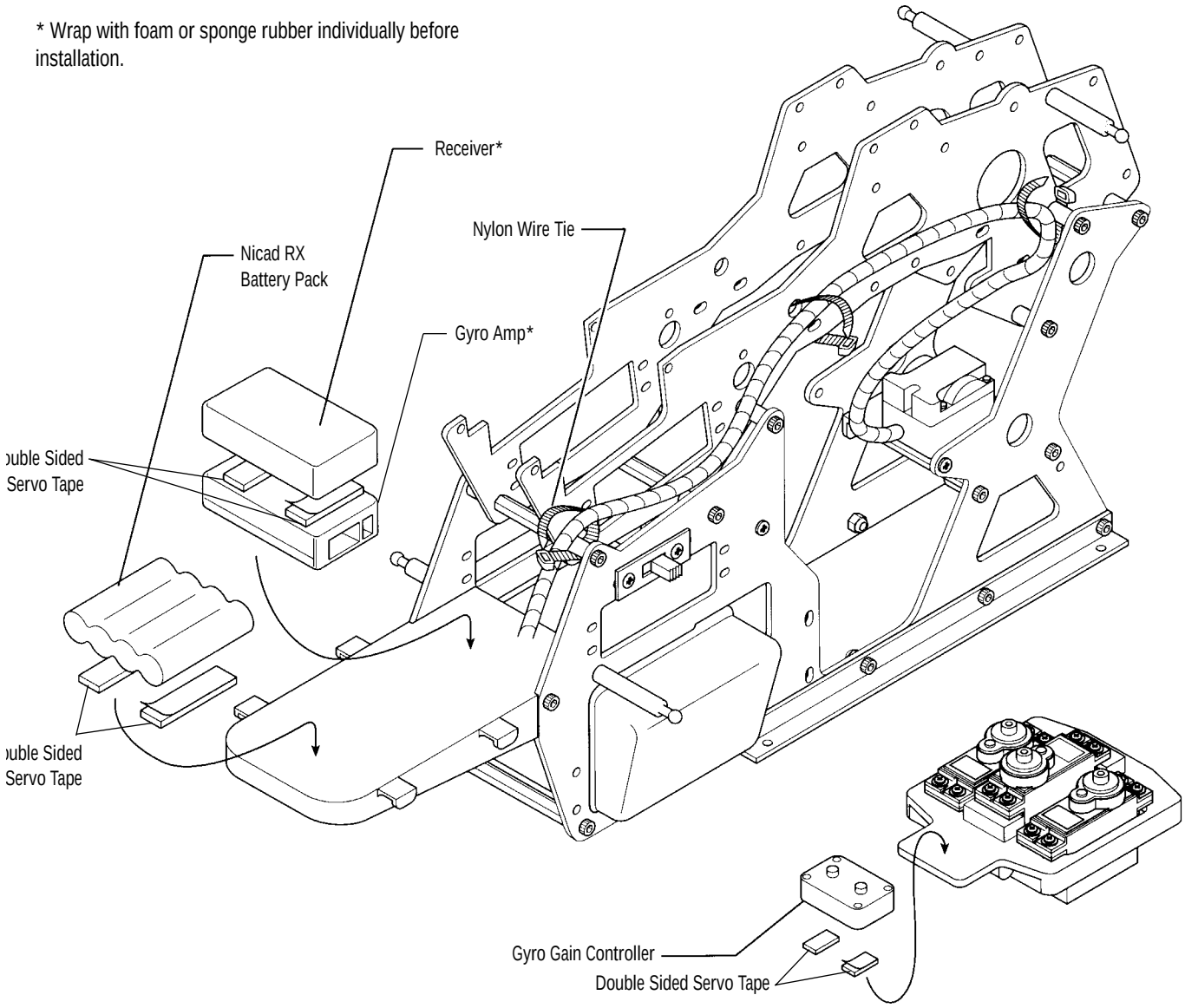
6-5 GYRO/RECEIVER/BATTERY INSTALLATION

Caution: Be certain when installing the Gyro to the Gyro Mounting Plate that it does not come in contact with the frame of the helicopter, and that the surfaces are free from oil, residue, etc. Clean if neccessary to insure proper adhesion.

Note: Nylon Wire Ties, Double Sided Servo Tape, and Spiral Tubing are not included in this kit.



* Wrap with foam or sponge rubber individually before installation.



The following preparations are suggested for use with JR radio systems. However, these procedures are applicable to most other brand radio systems. These suggested adjustments are necessary to insure correct installation and attachment of the control linkages and servo horns.

TRANSMITTER PREPARATION

1. Set all trim levers, trim knobs and switches to the neutral or zero positions.
2. Turn the transmitter power switch to the “on” position.
3. If you are using a computer radio system that has been adjusted previously to another model, reset all functions and input values to the factory preset position.
4. Move the throttle/collective control stick to the center or half stick position. Next slide the throttle trim lever to the full low position.

RECEIVER FLIGHT PACK PREPARATION

1. With the transmitter still on, slide the receiver switch to its “on” position. All servos should move to the neutral, or center, position.
2. Check to insure that all servos operate with the appropriate control stick.
3. Rest the throttle stick to the center position, making sure the throttle trim is still at low.
4. Turn off the receiver switch first, followed by the transmitter.

SERVO HORN INSTALLATION SUGGESTIONS

For proper operation, it is important that the servo horns are positioned on the servos in the “exact” neutral position. Although most computer radio systems offer a sub-trim feature, it is suggested that the servo horns be manipulated on the servos to achieve the “exact” neutral settings.

Since the servo output spline on a JR system has an odd number of teeth (21), it is possible to reposition the servo arm on the servo at 90° intervals to achieve the proper neutral attachment of the servo horn.

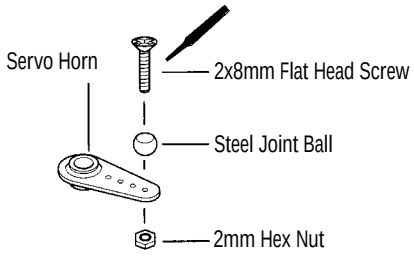
Once the correct arm of the servo horn has been established, it is suggested that the remaining, unused arms be removed from the servo horn as shown in the installation diagrams.

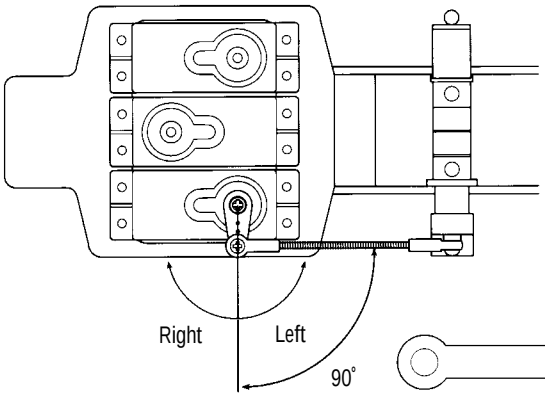
It will also be necessary to enlarge the appropriate hole in the servo horn slightly to allow correct installation of the steel control balls to the servo horn.

7-1 AILERON LINKAGES

..... 1 pc
2x8mm Flat Head Screw
.....1 pc
Steel Joint Ball
.....1 pc
2mm Hex Nut

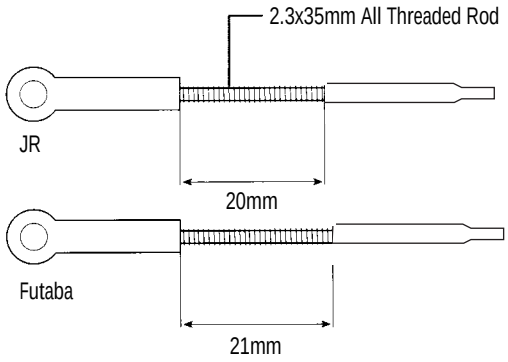
A Special Note To Beginners: It is suggested that the maximum travel limits for aileron, elevator, pitch and rudder controls be reduced to 70%.
Note: Attach the steel joint ball to the correct hole as shown below:



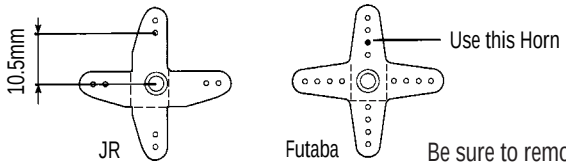


Make sure the Aileron Trim is in the center position before attaching the Servo Arm to the Servo.

Servo Reversing Directions	
JR	Normal
Futaba	Normal



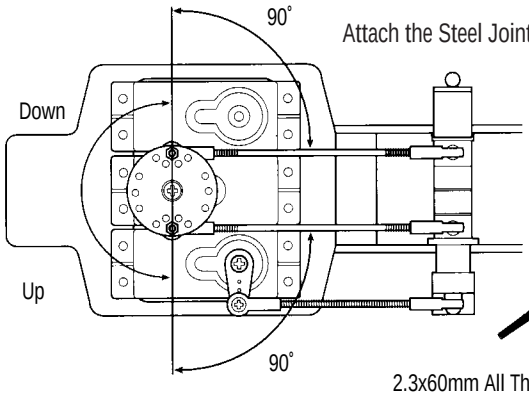
Servo Horn Hole Selection



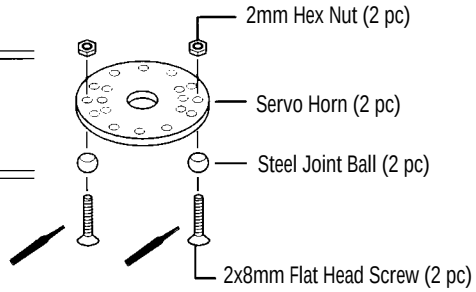
Be sure to remove the excess Servo Horn Arms as shown.
Secure the Servo Horn using the Servo Horn Screw.

7-2 ELEVATOR LINKAGE INSTALLATION

.....2pc
2x8mm Flat Head Screw
.....2pc
Steel Joint Ball
.....2pc
2mm Hex Nut



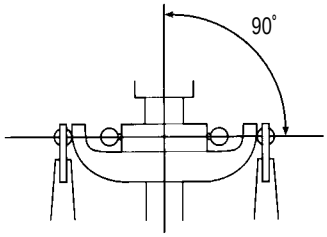
Attach the Steel Joint Ball to the bottom side of the Servo Horn.

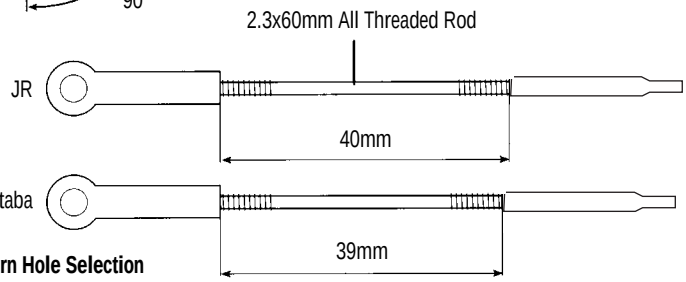


Make sure the Elevator Trim is in the center position before attaching the Servo Arm to the Servo.

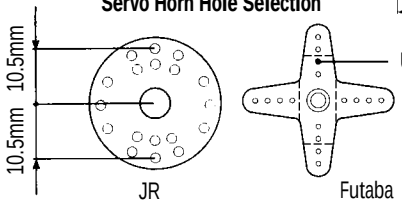
Servo Reversing Directions	
JR	Normal
Futaba	Normal

At this time, check to insure that the Swashplate is at a 90° angle to the Main Rotor Shaft in both fore/aft and right/left directions.





Servo Horn Hole Selection

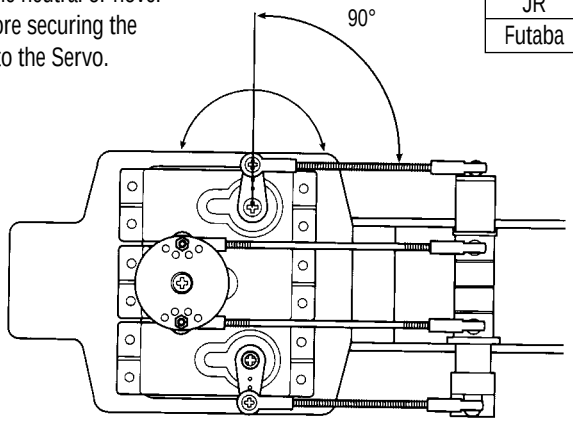


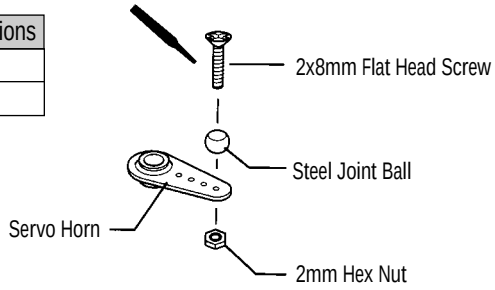
Be sure to remove the excess Servo Horn Arms as shown.
Secure the Servo Horn using the Servo Horn Screw.

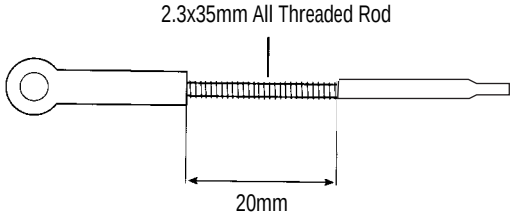
7-3 COLLECTIVE LINKAGE INSTALLATION

Note: Make certain that the Collective Servo is in the neutral or hover position before securing the Servo Horn to the Servo.

Servo Reversing Directions	
JR	Reverse
Futaba	Reverse

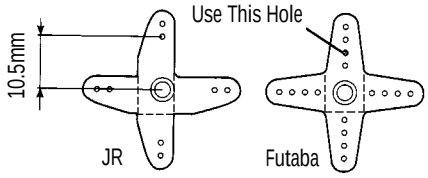


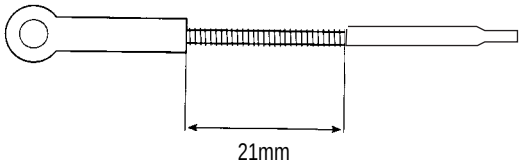




.....1 pc
2x8mm Flat Head Screw
.....1 pc
Steel Joint Ball
.....1 pc
2mm Hex Nut

Servo Horn Hole Selection





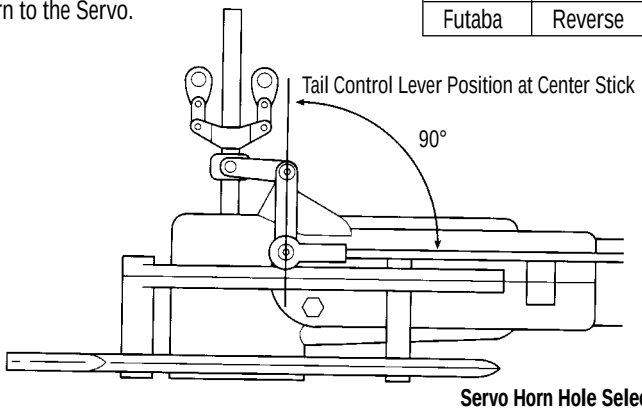
Be sure to remove the excess Servo Horn Arms as shown. Secure the Servo Horn using the Servo Horn Screw.

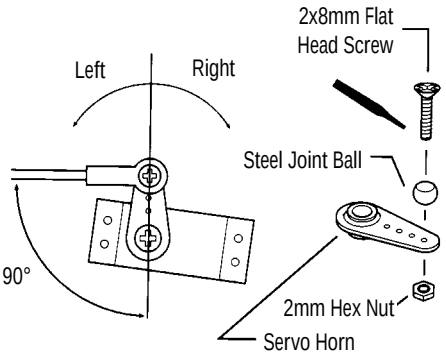
7-4 TAIL CONTROL ROD SERVO CONNECTION

Note: Make certain that the Tail Rotor Servo is in the neutral or hover position before securing the Servo Horn to the Servo.

Servo Reversing Directions	
JR	Reverse
Futaba	Reverse

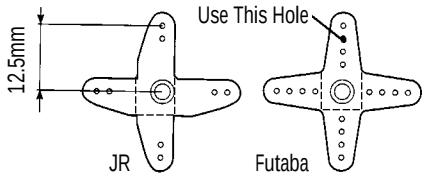
Servo Reversing Directions	
JR	Reverse
Futaba	Normal





.....1 pc
2x8mm Flat Head Screw
.....1 pc
Steel Joint Ball
.....1 pc
2mm Hex Nut

Servo Horn Hole Selection



Be sure to remove the excess Servo Horn Arms as shown. Secure the Servo Horn using the Servo Horn Screw.

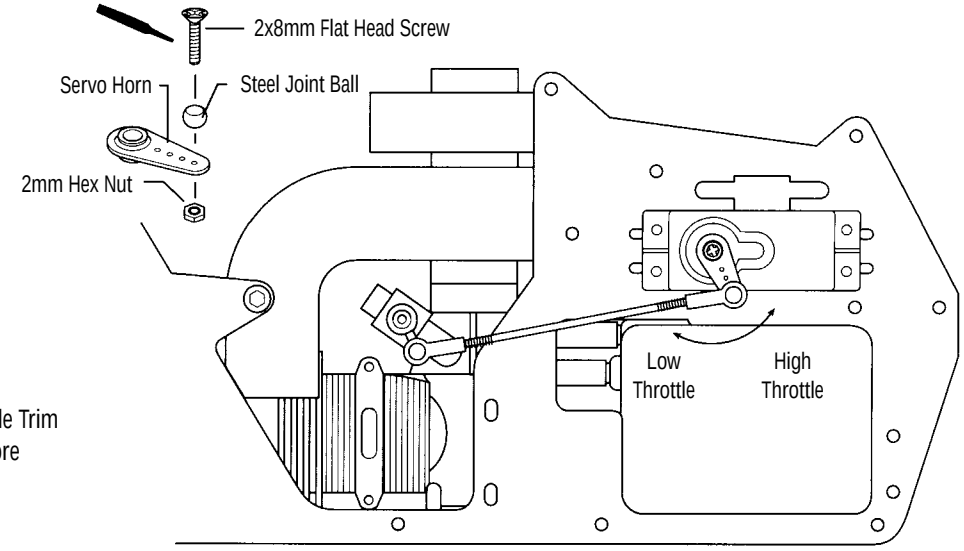
An Important Note: Check to insure the Tail Control Rod can slide through the Tail Control Rod Guides smoothly before connecting it to the Servo. If resistance is felt, rotate the Tail Control Rod Guides slightly until the Control Rod slides smoothly.

7-5 THROTTLE LINKAGE INSTALLATION (ALL)

2x8mm Flat Head Screw	.....1 pc
Steel Joint Ball	.....1 pc
2mm Hex Nut	.....1 pc

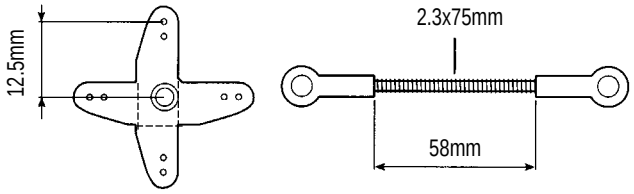
Servo Reversing Directions	
JR	Reverse
Futaba	Reverse

Note: Make sure that the Throttle Trim is in the low position before attaching the Servo Horn.

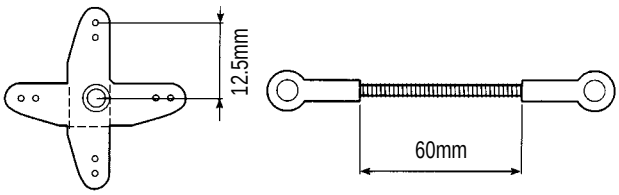


SERVO HORN SELECTION/LINKAGE ADJUSTMENTS

JR System/Webra .33 Engine or Thunder Tiger Pro .46 Heli Engine

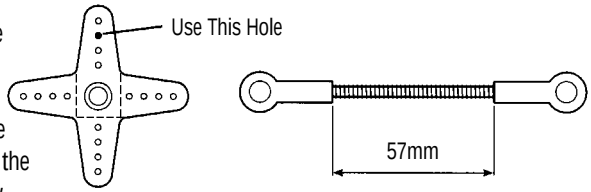


JR System/O.S. .32SX-H Engine

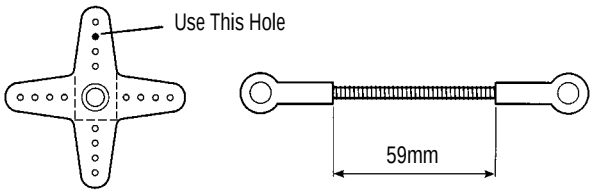


Futaba System/Webra .33 Engine or Thunder Tiger Pro .46 Heli Engine

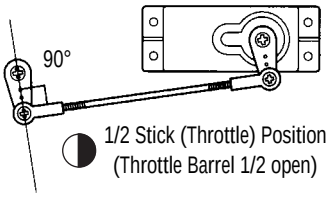
Be sure to remove the excess Servo Horn Arms as shown. Secure the Servo Horn using the Servo Horn Screw.



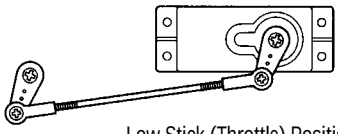
Futaba System/O.S. .32SX-H Engine



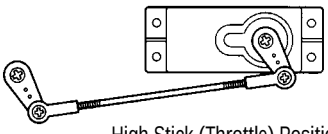
THROTTLE ARM/SERVO HORN POSITIONS



◑ 1/2 Stick (Throttle) Position (Throttle Barrel 1/2 open)



● Low Stick (Throttle) Position (Throttle Barrel Fully Closed)

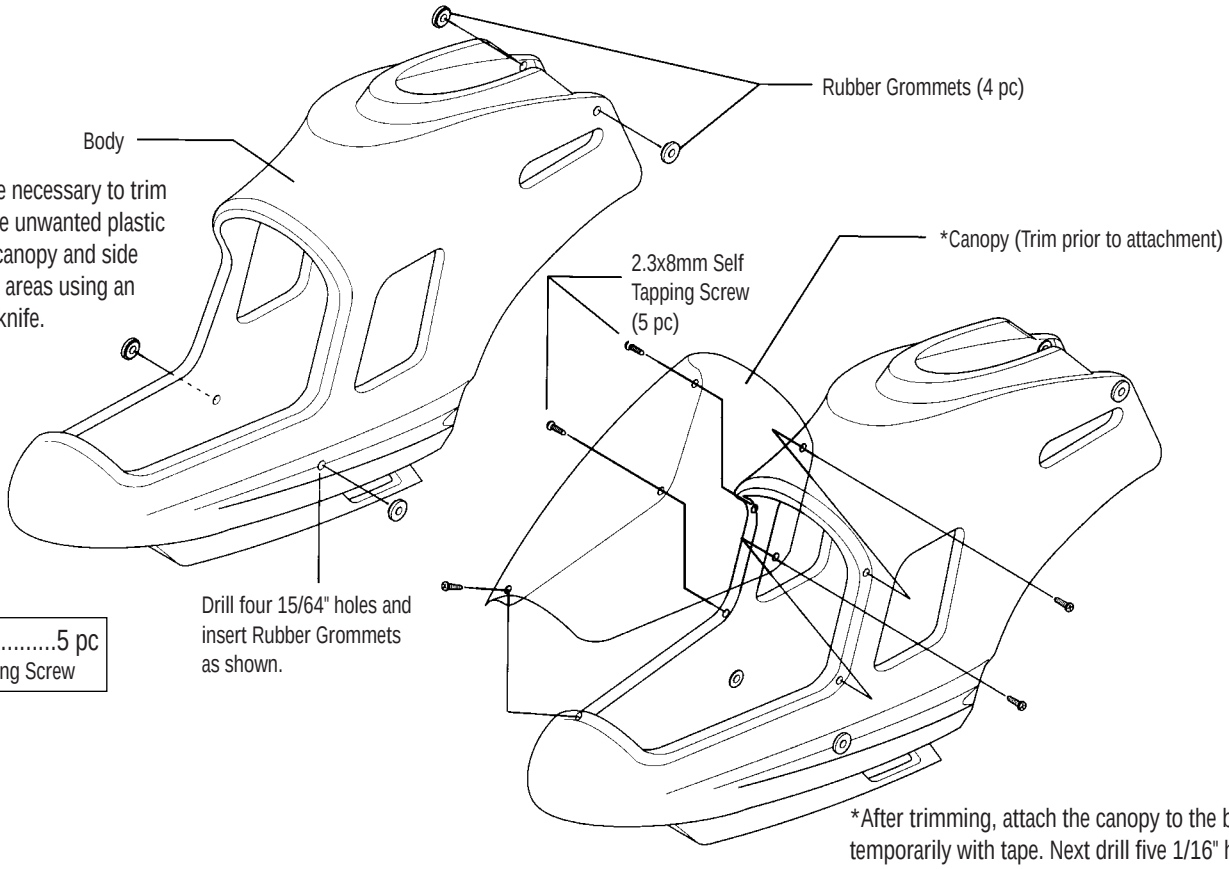


○ High Stick (Throttle) Position (Throttle Barrel Fully Open)

*To avoid differential throttle travel, make certain both the throttle arm and the servo horn are positioned as shown in the above diagrams.

To achieve the correct position of the throttle/servo arm, it may be necessary to re-position the throttle arm on the carburetor. It may also be necessary to adjust the length of the throttle linkage slightly to achieve full open and closed positions of the carburetor.
It is also possible to increase/reduce the travel of the throttle servo through the travel adjust function found in most computer radio systems. If this function is used, make sure the values for the high and low positions remain equal (same value for high/low). If these values are not equal, this will create a differential, or uneven movement of the throttle, making rotor RPM adjustment and fine tuning more difficult.

8-1 BODY ASSEMBLY/CANOPY ATTACHMENT



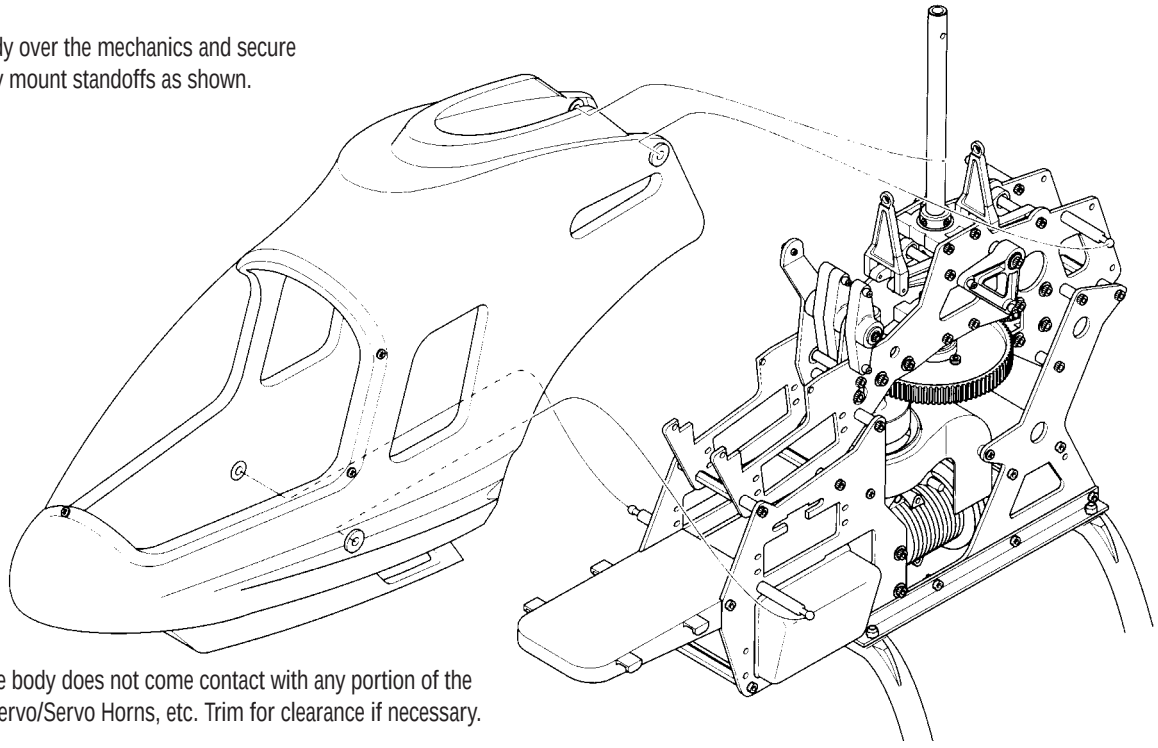
Note: It will be necessary to trim away the unwanted plastic off the canopy and side window areas using an X-Acto knife.

.....5 pc
2.3x8mm Self Tapping Screw

*After trimming, attach the canopy to the body temporarily with tape. Next drill five 1/16" holes through both the canopy and the body and secure using the 2.3x8mm screws provided.

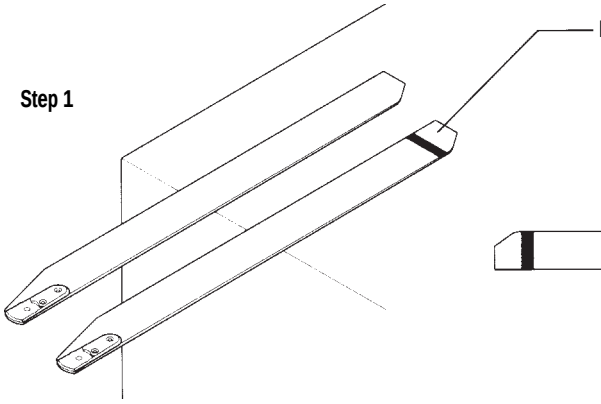
8-2 BODY ATTACHMENT

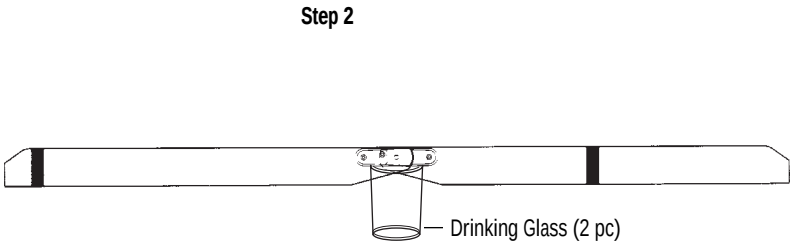
Slide the completed body over the mechanics and secure through the four canopy mount standoffs as shown.



Check to insure that the body does not come contact with any portion of the Main Frame, Muffler, Servo/Servo Horns, etc. Trim for clearance if necessary.

8-3 MAIN ROTOR BLADE BALANCING

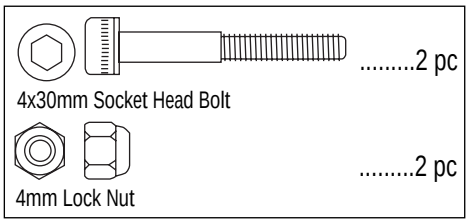


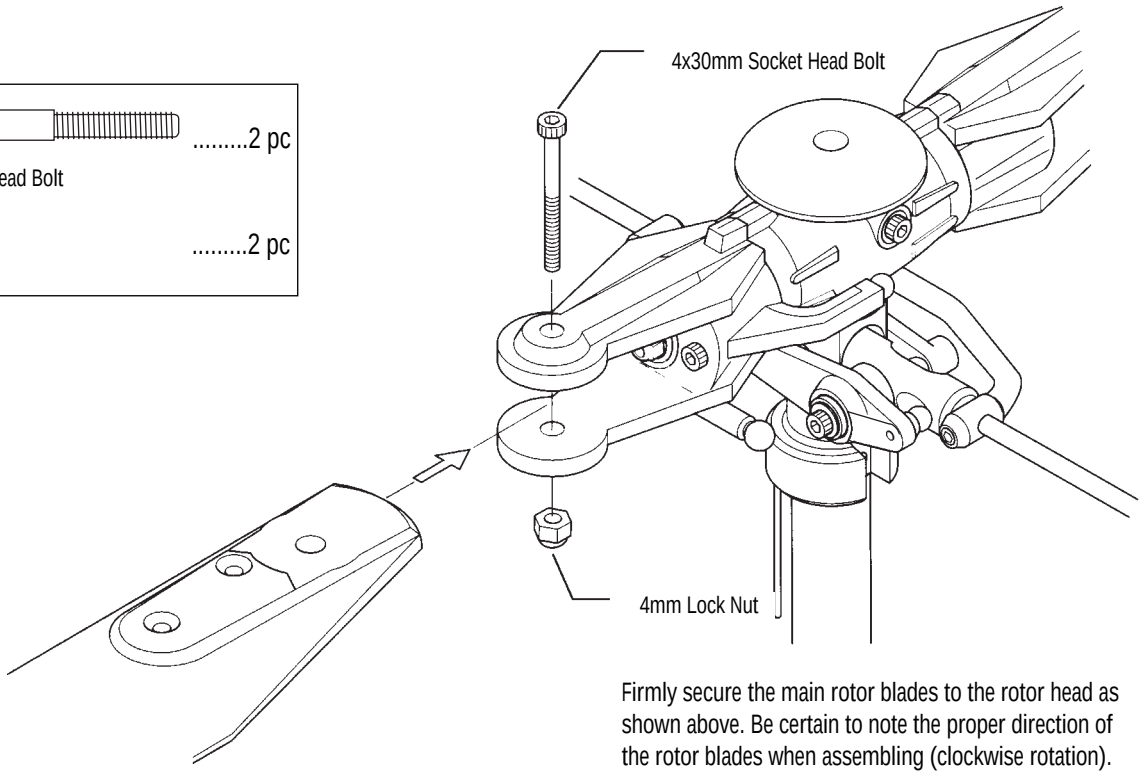


Spanwise C.G. Balancing
Place each rotor blade on a sharp edge of a table as shown and adjust so each rotor blade "teeters" on the edge of the table. If the blades are correctly balanced, they should be at an equal distance to the edge of the table. If they are not, apply tape to the center of the light or short blade until equal distance can be achieved.

Final Static Balancing
To static balance the main rotor blades, it is suggested to either attach each blade to a "seesaw" type blade balancer (RVO1001), or bolt each of the two blades together through the blade mounting holes shown and suspend this unit between two drinking glasses. Add blade tracking tape (from decal sheet) to the tip of the light or high blade until they each become level to the table surface.

8-4 MAIN ROTOR BLADE ATTACHMENT





Firmly secure the main rotor blades to the rotor head as shown above. Be certain to note the proper direction of the rotor blades when assembling (clockwise rotation). Main blades should be tightened so they can pivot when moderate pressure is applied. Do not allow the main blades to swing freely within the main blade holders.

Now that the radio system is completely installed into the helicopter, it is necessary to check and adjust the following:

1. **Servo Direction (Servo Reversing)**
   Check to insure that all servos have been set to the correct direction as shown in the Control Linkage Installation Section (Steps 7-1 to 7-5).

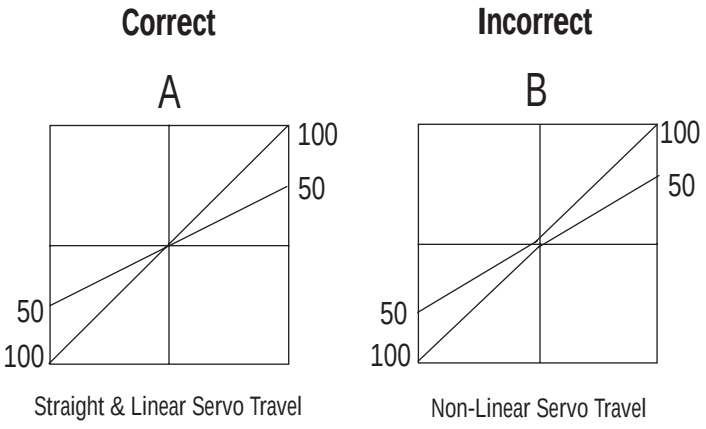
2. **Dual Rates**
   It is suggested that for initial flights, the dual rate function values be set as follows:
   0 Position (low rate) 60%
   1 Position (high rate) 100%

3. **Exponential Settings**
   It is suggested that the exponential rate settings remain in the 0 value position until the initial test flights. After initial flights, adjust the exponential values to achieve the desired control feel.

4. **Sub-Trim Settings**
   It is suggested that the correct neutral settings be achieved without the use of the sub-trim feature. If sub-trim is used for final flight adjustments, it is not suggested that the sub-trim values exceed 10. If the sub-trim values are greater, readjust the control linkages and reset the sub-trims to 0.

5. **Travel Adjustment**
   The travel adjustment feature allows the control surface to be adjusted to achieve maximum travel, or surface deflection. When using this feature, it is extremely important that the high/low, up/down values for each channel be set at an equal value or a differential movement will occur (Diagram B). It is especially important that the throttle and collective pitch travel limits are set to an equal value (Diagram A).

   Please refer to the diagrams below for clarification.



6. **Pitch/Throttle Curve Adjustment**
   It is very important that the throttle and pitch curves are adjusted properly to achieve the best performance from your helicopter. When properly adjusted, the main rotor head RPM should remain consistent throughout all maneuvers and throttle stick positions. A constant RPM will also help to improve the effectiveness and accuracy of the tail rotor and gyro systems.

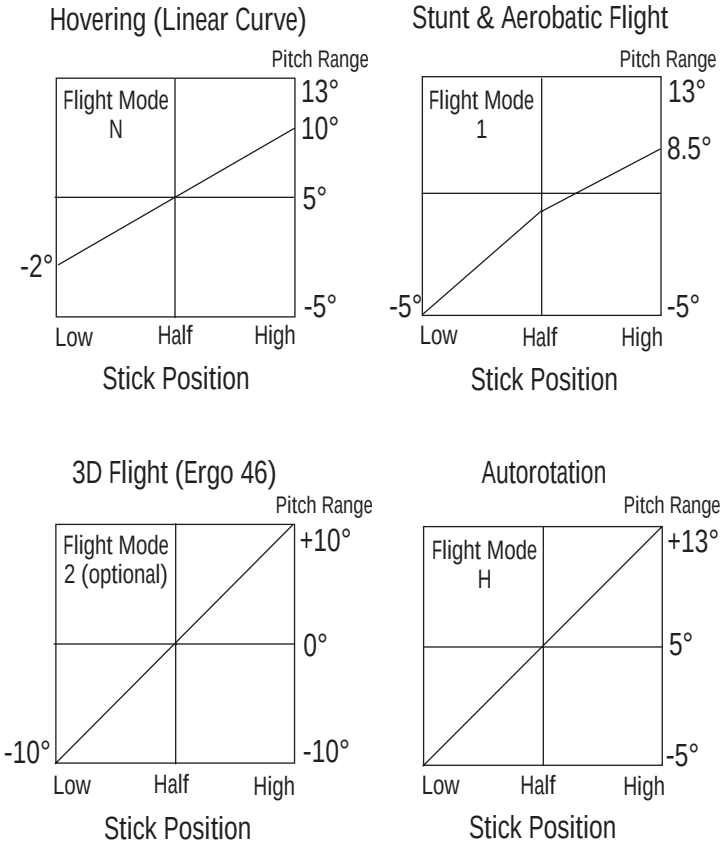
A. Pitch Curve Adjustment
Using a pitch gauge (optional) set the low, mid and high stick pitch settings as shown in the diagram below. Use the travel adjust feature to set the maximum high and low pitch required for all flight modes. This pitch travel can then be reduced by altering the pitch curves as shown below.

Pitch Range Settings

Flight Mode	Application	Low Pitch (Low Stick)	Hovering Pitch (Half Stick)	High Pitch (High Stick)
N	Hovering	-2°	5°	10°
I	Stunt & Aerobatic Flight	-5°	5°	8.5°
*2	3D Flight (Ergo 46)	-10°	0°	10°
H	Auto-Rotation	-5°	5°	13°

Note: * To achieve this pitch range settings with the Ergo, it will be necessary to use the optional "B" style double link set (#960081). (This item is included with the Ergo .46 kit.)

Pitch Curve Settings



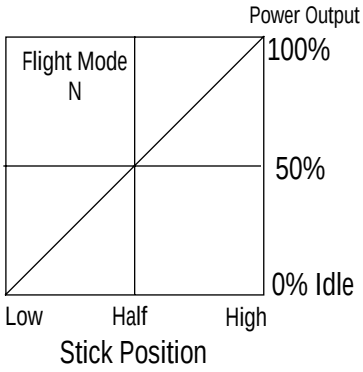
Note: When using the "B" style double link set for 3D flight, the maximum pitch range is altered to +10¯ – ¯10, reducing the + pitch range for autorotations.

B. Throttle Curve Settings

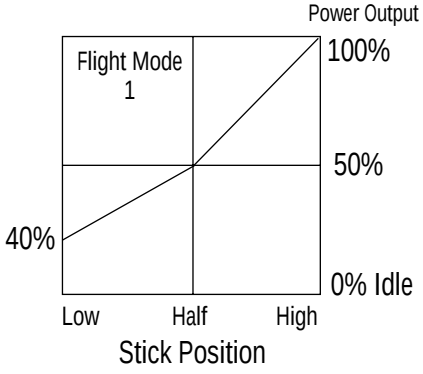
Below are several examples of possible throttle curves during various flight conditions.

Since throttle curves can vary greatly due to engine and muffler combinations, it will be necessary to fine tune and adjust these values during test flights to achieve a constant main rotor RPM.

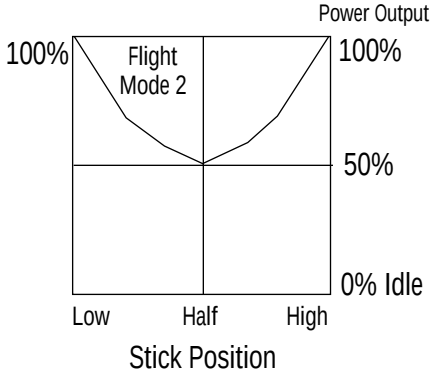
Hovering (Linear Curve)



Stunt & Aerobatic Flight



3D Flight (Optional)



Note: The throttle curve examples shown correspond to the pitch curve examples show in Step 6A.

It will also be necessary to set the correct idle speed of the engine when the throttle hold function is activated.

This idle value is located within the throttle hold function. This will allow the engine to remain at idle when practicing autorotations.

7. **Revolution Mixing**

   It will be necessary to adjust the revolution mixing to properly compensate for the torque of the engine during all flight conditions (except autorotation).

   Since there are many variables that can alter the value of the revolution mixing (engine, blade pitch, fuel, etc.), it will be necessary to fine tune this function during test flights.

   The following values are shown only as a starting point toward achieving proper compensation:

Flight Mode N	**Flight Mode 1**	**Flight Mode 2 (3D)**
Up 35	Up 15	Up 15
Down 30	Down 10	Down 15

8. **Gyro Gain Adjustment**

   It will be necessary to adjust the "gain" or compensation of the gyro to create the correct amount of "holding power" necessary for a solid neutral tail rotor. The intent of the gyro is to compensate for abrupt movements, or wind direction changes, working in conjunction with the revolution mixing function.

For hovering, it is recommended that you start with the gyro gain at approximately 60°, and continue to increase slightly until the tail of the helicopter "hunts", then reduce the value slightly.

This same adjustment will also be necessary to achieve proper forward flight. Generally, the gyro gain for forward flight will be approximately 10% - 20% less than that of the established hover gain due to aerodynamic forces present in forward flight.

If you are using a dual rate gyro, adjust the gain so that you are using "higher" gain setting for hover, and the "lower" gain setting for forward flight.

It will also be necessary to confirm the direction that the gyro compensates when the body of the helicopter is rotated.

To do this, turn the radio system on and suspend the helicopter by the main rotor head. Next, move the rudder stick to the right and watch the direction that the tail rotor servo arm travels. Now while watching the tail rotor servo arm, rotate the body of the helicopter counter clockwise. The servo arm should move in the same direction as when the rudder stick was moved to the left.

If the arm moves in the opposite direction, reverse the gyro and re-test.

XF622 DATA SHEET #1 ERGO .32/.46 (INITIAL SET-UP)

MDL	[1] 2
TYP	AC [HE]
D/R SW	FACTORY PRE-SET

GEAR SW	FACTORY PRE-SET

	THR	AIL	ELE	RUD	GER	PITCH
★REVERSE SW	NORM [REV]	[NORM] REV	[NORM] REV	NORM [REV]	[NORM] REV	NORM [REV]
SUB-TRIM	Adjust so that no trim is required					
TRAVEL ADJUST	Adjust for Full Power	+80%	+80%	+100%	+ %	+150%
(TRV ADJ.)	Adjust for Engine Off	–80%	–80%	–100%	– %	–150%

		L	2	H
THRO CURVE TLN, T2N, THN TLS, T2S	N	0%	50%	100%
	S	40%	50%	
PITCH CURVE PLN, P2N, PHN PLS, P2S, PHS PLH, P2H, PHH	N	-2° Pitch	5° Pitch	10° Pitch
	S	-5° Pitch	5° Pitch	8.5° Pitch
	H	-5° Pitch	5° Pitch	13° Pitch

		AILE	ELEV
DUAL RATE (A1, EL)	POS 0	90%	90%
	POS 1	100%	100%

THRO HOLD HOLD	[ON] OFF	POSITION
		Adjust for Idle

REVO MIX (RV)	+ –	UP (U)	35%
		DOWN (D)	30%
HOLD RUDD OFFSET		(HLD)	±

* Before flying, confirm that all controls function in the proper direction.

XF622 DATA SHEET #2 ERGO .32/.46 (INITIAL SET-UP WITH 3D PITCH/THROTTLE CURVE)

MDL	1 [2]
TYP	AC [HE]
D/R SW	E.A A E. [CF]

GEAR SW	FACTORY PRE-SET

	THR	AIL	ELE	RUD	GER	PITCH
★REVERSE SW	NORM [REV]	[NORM] REV	[NORM] REV	NORM [REV]	[NORM] REV	NORM [REV]
SUB-TRIM	Adjust so that no trim is required					
TRAVEL ADJUST	Adjust for Full Power	+80%	+80%	+100%	+ %	+150%
(TRV ADJ.)	Adjust for Engine Off	–80%	–80%	–100%	– %	–150%

		L	2	H
THRO CURVE TLN, T2N, THN TLS, T2S	N	0%	50%	100%
	**S	100%	50%	
PITCH CURVE PLN, P2N, PHN PLS, P2S, PHS PLH, P2H, PHH	N	-2° Pitch	5° Pitch	10° Pitch
	**S	-10° Pitch	0° Pitch	10° Pitch
	H	-5° Pitch	5° Pitch	13° Pitch

		AILE	ELEV
DUAL RATE (A1, EL)	POS 0	90%	90%
	POS 1	100%	100%

THRO HOLD HOLD	[ON] OFF	POSITION
		Adjust for Idle

REVO MIX (RV)	+ –	UP (U)	35%
		DOWN (D)	35%
HOLD RUDD OFFSET		(HLD)	±

* Before flying, confirm that all controls function in the proper direction.

Note: Flight Mode "S" shown is for 3D type flying **only and is not recommended for use by entry-level pilots.

XP642 DATA SHEET #1
ERGO .32/.46 (INITIAL SET-UP)

Modulation S-PCM • Z-PCM • PPM (FM)

Model Number 1

Model Name E32

*** Note:** Before flying, confirm that all controls function in their proper direction.

CHANNEL	THR (1)	AIL (2)	ELE (3)	RUD (4)	GER (5)	PITCH (6)
* REVERSE SW	NORM • [REV]	[NORM] • REV	[NORM] • REV	NORM • [REV]	[NORM] • REV	NORM • [REV]
SUB-TRIM	Adjust so that no trim is required					
TRAVEL ADJUST (TRV ADJ.)	Adjust for full power	+ 80 %	+ 80 %	+ 100 %	+ 100 %	+ 150 %
	Adjust for engine off	- 80 %	- 80 %	- 100 %	- 100 %	- 150 %
FAIL-SAFE (S-PCM)	Adjust only if S-PCM modulation is selected					

FAIL-SAFE TIME (ZPCM)	Adjust only if Z-PCM modulation is selected
D/R SW	Factory Pre-Sets
GEAR SW	Factory Pre-Sets

		AILE (AI)	ELEV (EL)
DUAL RATE • EXP	POS 0 D/R	90 %	90 %
	POS 0 EXP	20 %	20 %
	POS 1 D/R	100 %	100 %
	POS 1 EXP	20 %	20 %

THRO HOLD (HLD)	[ON] OF	POSITION
		± Adjust for idle

REVO-MIX (RV)	+	UP (U)	35 %
	–	DOWN (D)	35 %
HOLD RUDD OFFSET (OFFSET HLD)			±

		L	2	H
THRO CURVE TLN, T2N, THN,	N	0 %	50 %	100 %
TLS, T2S	S	40 %	50 %	
PITCH CURVE PLN, P2N, PHN,	N	-2° pitch	5° pitch	10° pitch
PLS, P2S, PHS,	S	-5° pitch	5° pitch	8.5° pitch
PLH, P2H, PHH	H	-5° pitch	5° pitch	13° pitch

		CHANNEL MASTER SLAVE	MIX SWITCH	OFFSET	+GAIN	-GAIN
PROG. MIX	A	→	ON • F1 • FO • H			

TRIM OFFSET	Store trim positions after initial test flight

XP642 DATA SHEET #2
ERGO .32/.46 (INITIAL SET-UP WITH 3D PITCH/THROTTLE CURVE)

Modulation S-PCM • Z-PCM • PPM (FM)

Model Number 2

Model Name E46

*** Note:** Before flying, confirm that all controls function in their proper direction.

CHANNEL	THR (1)	AIL (2)	ELE (3)	RUD (4)	GER (5)	PITCH (6)
* REVERSE SW	NORM • [REV]	[NORM] • REV	[NORM] • REV	NORM • [REV]	[NORM] • REV	NORM • [REV]
SUB-TRIM	Adjust so that no trim is required					
TRAVEL ADJUST	Adjust for full power	+ 80 %	+ 80 %	+ 100 %	+ 100 %	+ 150 %
(TRV ADJ.)	Adjust for engine off	- 80 %	- 80 %	- 100 %	- 100 %	- 150 %
FAIL-SAFE (S-PCM)	Adjust only if S-PCM modulation is selected					

FAIL-SAFE TIME (Z-PCM)	Adjust only if Z-PCM modulation is selected
D/R SW	EA • A • E • [CF]
GEAR SW	Factory Pre-Sets

			AILE (AI)	ELEV (EL)
DUAL RATE • EXP	POS 0	D/R	90 %	90 %
		EXP	20 %	20 %
	POS 1	D/R	100 %	100 %
		EXP	20 %	20 %

		POSITION
THRO HOLD (HLD)	[ON] OF	± Adjust for idle

REVO-MIX (RV)	+	UP (U)	30 %
	–	DOWN (D)	30 %
HOLD RUDD OFFSET (OFFSET HLD)			±

		L	2	H
THRO CURVE TLN, T2N, THN,	N	0 %	50 %	100 %
TLS, T2S	** S	100 %	50 %	
PITCH CURVE PLN, P2N, PHN,	N	-2° pitch	5° pitch	10° pitch
PLS, P2S, PHS,	** S	-10° pitch	0° pitch	10° pitch
PLH, P2H, PHH	H	-5° pitch	5° pitch	13° pitch

		CHANNEL MASTER SLAVE	MIX SWITCH	OFFSET	+GAIN	-GAIN
PROG. MIX	A	→	ON • F1 • FO • H			

TRIM OFFSET	Store trim positions after initial test flight

**** Note:** Flight mode "S" (Stunt) shown is for 3D type flying **only** and is not recommended for use by entry level pilots.

XP-783 DATA SHEET
ERGO .32/.46 (INITIAL SET-UP)

MODEL NO. _____

MODEL NAME **ERGO .32/.46**

MODULATION **S-PCM • Z-PCM • PPM**

			AILE	ELEV	RUDD
D/R EXP	0	D/R	90 %	90%	70 %
		EXP	25%	25%	30%
	1	D/R	100%	100%	100%
		EXP	%	%	40%
STUNT TRIM	INH • [ACT]		Adjust as necessary during flight		

AUTO D/R (POS.1)	ST-1	[INH] • ACT
	ST-2	INH • [ACT]

AUX 2 INPUT	D/R • R HOLD

*

		THRO	AILE	ELEV	RUDD	GEAR	PITCH	AUX2
REVERSE SW		NORM [REV]	[NORM] REV	[NORM] REV	NORM [REV]	[NORM] REV	NORM [REV]	NORM REV
SUB-TRIM		Adjust so that no trim is required						
TRAVEL ADJUST		Adjust for Full Power	L 80%	D 80%	L 100%	+ %	H 150%	+ %
		Adjust for Engine Off	R 80%	U 80%	R 100%	– %	L 150%	– %
FAIL-SAFE	S(TYPE)							
	Z(TYPE)	HOLD • 1.0 S • 0.5S • 0.25S						

		L	1	2	3	H
THRO CURVE (TH:)	N	0 %	%	50%	%	100%
	1	40%	%	50%	%	
	*2	100%	%	50%	%	
PITCH CURVE (PI:)	N	-2° Pitch		5° Pitch		10° Pitch
	1	-5° Pitch		5° Pitch		8.5° Pitch
	*2	-10° Pitch		0° Pitch		10° Pitch
	H	-5° Pitch		5° Pitch		13° Pitch

THRO-HOLD (HOLD)	INH • [ACT]	POS: Adjust for Idle
INVERTED (INV.P)	[INH] • ACT	OFFSET: %

REVOLUTION MIX (RV)	NORMAL	UP (U.N.)	35%
		DOWN (D.N.)	30%
	STUNT	UP (U.S.)	15 %
		DOWN (D.S.)	15%
	HOLD RUDD OFFSET		
ACC-MIX			%

		CHANNEL	+ POS	– POS	SW	OFFSET
PROGRAM MIX	MIX A	→	%	%	%	%
	MIX B	→	%	%	%	%

* **Note:** Flight Mode 2 shown is for 3D type flying **only** with 0° pitch at half stick. This is not recommended for use by entry-level pilots.

**Before flying, confirm that all controls function in the proper direction.

PCM10SX DATA SHEET
ERGO .32/.46 (INITIAL SET-UP)

MODEL NO. (84) _____

MODEL NAME (81) ERGO .32/.46

MODULATION (85) SPCM-ZPCM-PPM

**

	THRO	AILE	ELEV	RUDD	GEAR	PITCH	AUX2	AUX3	AUX4	AUX5
REVERSE SW (11)	[R] N	R [N]	R [N]	[R] N	R [N]	[R] N	R N	R N	R N	R N
TRAVEL ADJUST (12)	Adjust for Full Power	L 80%	D 80%	L 100%	+ %	+150%	+ %	+ %	+ %	+ %
	Adjust for Engine Off	R 80%	U 80%	R 100%	– %	–150%	– %	– %	– %	– %
SUB-TRIM (15)	Adjust so that no trim is required									
TRIM RATE (83)	%	%	%	%						

			AILE	ELEV	RUDD
D/R EXP (13)	0	D/R	90%	90%	70%
		EXP	25%	25%	30%
		TYPE	NORM	NORM	NORM
	1	D/R	100%	100%	100%
		EXP	%	%	40%
		TYPE			
	2	D/R	%	%	%
		EXP	%	%	%
		TYPE			
AUTO D/R (23)	ST-1	INH ·[ACT]	[0]· 1 · 2	[0]· 1 · 2	[0]· 1 · 2
	ST-2	INH ·[ACT]	0 ·[1]· 2	0 ·[1]· 2	0 ·[1]· 2
	ST-3	INH · ACT	0 · 1 · 2	0 · 1 · 2	0 · 1 · 2
	ST-4	INH · ACT	0 · 1 · 2	0 · 1 · 2	0 · 1 · 2
	HOLD	INH · ACT	0 · 1 · 2	0 · 1 · 2	0 · 1 · 2
STUNT TRIM (25)	ST-1	INH ·[ACT]	Adjust as necessary during flight.		
	ST-2	INH ·[ACT]			
	ST-3	INH · ACT			
	ST-4	INH · ACT			

THROTTLE HOLD (16)	HOLD SW	INH·	HOLD GEAR
	POS	Adjust for Idle	
	AUTO CUT	INH ·[ACT]	
		POS	

FUNCTION SELECT (16)	FLIGHT EXTRA	[INH]·	GEAR AILE
	GEAR SW	[INH]·	GEAR HOLD
	INVERTED SW	[INH]·	INVT HOLD
	PIT. LEVER LOW	[INH]·	ACT
	PIT. LEVER HI	[INH]·	ACT

4→1 MIX (41)	R	%
	L	%
	MIX SW	INH·ACT

GYRO SENS (44)	INH · AUX 3 · [AUTO]	0	85%						
		1	50%						
		2							
		NR	S1	S2	S3	S4	HD	INV	
		0	1	1					

			CHANNEL MASTER	→ SLAVE	TRIM	SW	OFFSET		+GAIN	–GAIN
PROGRAM MIX (51) - (58)	1	INH · ACT		→	OFF · ON	NR·S1·S2·S3·S4 MX·HD·INV				
	2	INH · ACT		→	OFF · ON	NR·S1·S2·S3·S4 MX·HD·INV				
	3	INH · ACT		→	OFF · ON	NR·S1·S2·S3·S4 MX·HD·INV				
	4	INH · ACT		→	OFF · ON	NR·S1·S2·S3·S4 MX·HD·INV				

							EXP		L	1	2	3	4	5	6	H	
5	INH · ACT		→	OFF · ON	NR·S1·S2·S3·S4 MX·HD·INV	OFF · ON	IN	0							100	
								OUT									
6	INH · ACT		→	OFF · ON	NR·S1·S2·S3·S4 MX·HD·INV	OFF · ON	IN	0							100	
								OUT									
7	INH · ACT		→	OFF · ON	NR·S1·S2·S3·S4 MX·HD·INV	OFF · ON	IN	0							100	
								OUT									
8	INH · ACT		→	OFF · ON	NR·S1·S2·S3·S4 MX·HD·INV	OFF · ON	IN	0							100	
								OUT									

PCM10SX DATA SHEET
ERGO .32/.46 (INITIAL SET-UP) CONTINUED

		EXP		L	1	2	3	4	5	6	H
THRO CURVE (18) TH,TRIM=SLOW HOV.T=CENTER	N	OFF • [ON]	IN	0			50				100
			OUT	0			50% Power				100% Power
			HOV.SEL	——	HOV	HOV	HOV	HOV	HOV	HOV	——
	1	OFF • [ON]	IN	0			50				100
			OUT	40% Power			50% Power				100% Power
	*2	OFF • [ON]	IN	0			50				100
			OUT	100% Power			50% Power				100% Power
	3	OFF • ON	IN	0							100
			OUT								
	4	OFF • ON	IN	0							100
			OUT								
PITCH CURVE (68) P,TRIM=CENTER HOV.P=CENTER	N	OFF • [ON]	IN	0			50				100
			OUT	-2° Pitch			5° Pitch				10° Pitch
			HOV.SEL	——	HOV	HOV	HOV	HOV	HOV	HOV	——
	1	OFF • [ON]	IN	0							100
			OUT	-5° Pitch			5° Pitch				8.5° Pitch
	*2	OFF • [ON]	IN	0							100
			OUT	-10° Pitch			0° Pitch				10° Pitch
	3	OFF • ON	IN	0							100
			OUT								
	4	OFF • ON	IN	0							100
			OUT								
	HOLD	OFF • ON	IN	0							100
			OUT	-5° Pitch			5° Pitch				13° Pitch
	INVT	OFF • ON	IN	0							100
			OUT								

TRIM OFFSET (82)	HV.T	HV.P	LO.P	HI.P	AILE	ELEV	RUDD

ATS REVO-MIX (47)	[RIGHT] • LEFT		
	POS	HOV	6° Pitch
		ZERO	0° Pitch
	NORM	UP	35
		DN	30
		–P	0
	STNT1	+P	15
		–P	15
	STNT2	+P	15
		–P	15
	STNT3	+P	
		–P	
	STNT4	+P	
		–P	
	HOLD RUDD OFS.		

FAIL-SAFE (77)	Z	MODE	HOLD • 1.0s • 0.5s • 0.25s
		MEMORY	
	S	MEMORY	

SWASH TYPE (65)	TYPE		1s • 3s(90°) • 3s(120°)	
	1s	SWASH	+ • —	
		SW	NR • S1 • S2 • S3 • S4 • HD	
	3s	EXP		
		GAIN	AILE	%
			ELEV	%
			PITCH	%

ATS ACC-MIX (48)	VOL	%
	TIME	

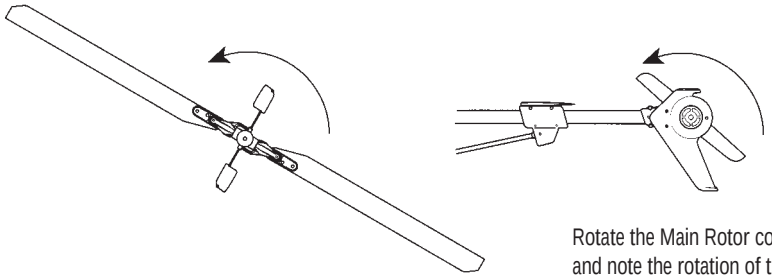
***Note:** Flight Mode 2 shown is for 3D type flying only with 0° pitch at half stick. This is not recommended for use by entry-level pilots.

**Before flying, confirm that all controls function in the proper direction.

Once all assemblies have been completed, please review the following suggestions before attempting initial flights.

- Review the instruction book and confirm that all assembly steps have been completed thoroughly.
- Check to verify that the tail rotor assembly rotates in the correct direction (see the diagram below).
- Check to insure that all servos are operating smoothly and in the correct direction. Also verify that there is no binding in the control rods and that each servo horn is secured with a servo horn mounting screw.
- Verify that the gyro is operational and compensating in the correct direction (detailed in Step 8, page 42).
- Make sure that both the transmitter and receiver have been fully charged (refer to your radio system instructions for proper charging procedures).
- Check to insure that the throttle is working properly and in the correct direction.

Correct Main/Tail Rotor Rotation Direction



Rotate the Main Rotor counter clockwise (backward) and note the rotation of the Tail Rotor.

BLADE TRACKING ADJUSTMENT

Blade "tracking" is an adjustment to the main rotor blade pitch that must be accomplished during the initial test flights.

Although the blade pitch angle in each blade may appear equal, it is still possible for a set of main rotor blades to run "out of track", making adjustment necessary.

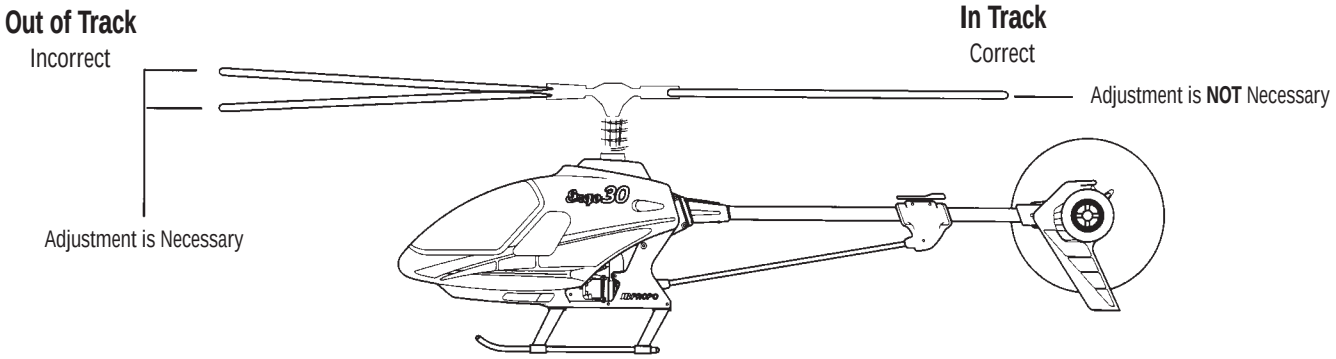
Main rotor blades that are out of track with one another can cause vibration, instability, and a loss of power due to additional drag.

On the initial flight, it will be necessary to increase the blade speed to just before lift-off RPM and view the rotor disc at eye level from a safe distance (approximately 15 to 20 feet).

Note which blade is running low (by colored tracking tape) and increase the pitch of the low blade one turn of the ball link at a time until each blade runs in track (on the same plane).

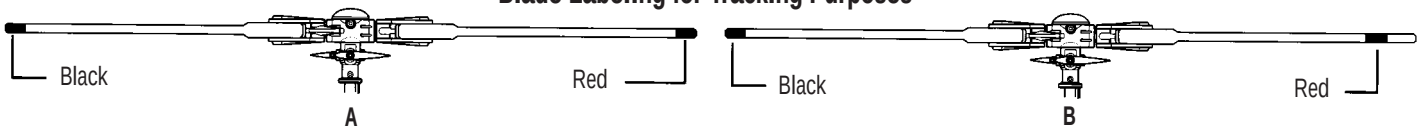
Please refer to the diagrams below to identify the different tracking situations, as well as several methods to mark each rotor blade for tracking identification.

BLADE TRACKING IDENTIFICATION



Caution: Be sure to maintain a safe distance from the helicopter (15 to 20 feet) when tracking main rotor blades.

Blade Labeling for Tracking Purposes



A: Use two different blade tracking tape colors (e.g., black and red) at the tip of each main rotor blade.

B: Use the same color blade tracking tape located at different positions on each rotor blade.

Note: Adding additional blade tracking tape to the rotor blades at this stage will make it necessary to re-static balance the main rotor blades.

Engine

After each day of flying, fully drain the fuel tank. Then, start the engine and let it idle until the engine and the fuel line are completely burned off. It is also suggested that an after-run oil be used to prevent premature engine corrosion.

Tail Rotor Belt

Periodically check the tension on the Tail Drive Belt (as shown in Step 5, page 29) to insure that it has sufficient tension for proper engagement. It is especially important to check this after initial test flights.

Check All Nuts and Bolts

A helicopter is subject to high vibration during flight. It is important to check that all screws, nuts and bolts are properly secured after each day of flying. It is also suggested that you perform a "quick" inspection between each initial test flight for approximately the first 6 to 10 flights.

Check Ball Link Wear

Check to insure that all universal links fit freely but securely to the control balls. If there is excessive play noted, replace the universal link in question.

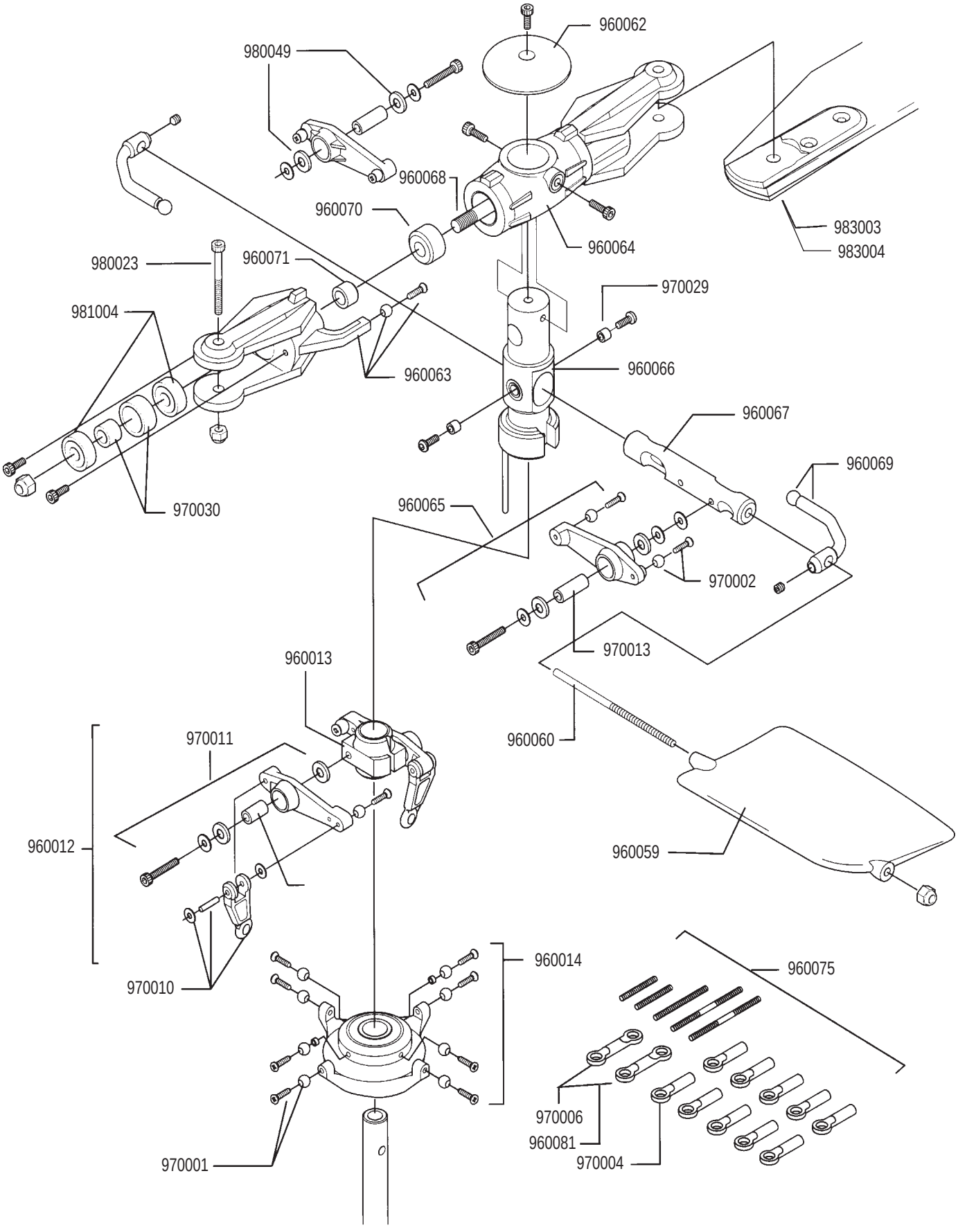
Battery Maintenance

Check to insure that your batteries are properly mounted and charged. The most frequent cause of crashes (aside from pilot error) is battery failure or disconnection. Be certain that your batteries are fully charged and limit your flight time to 3 or 4 flights between charging. If more flight time is required, purchase a reliable quick field charger.

Cleaning

At the end of each flight or flying session, wipe down your helicopter with a clean towel or rag. This is also a good time to inspect all parts for tightness or fatigue. Remember, a clean, well-maintained helicopter will provide you with many hours of trouble-free flight.

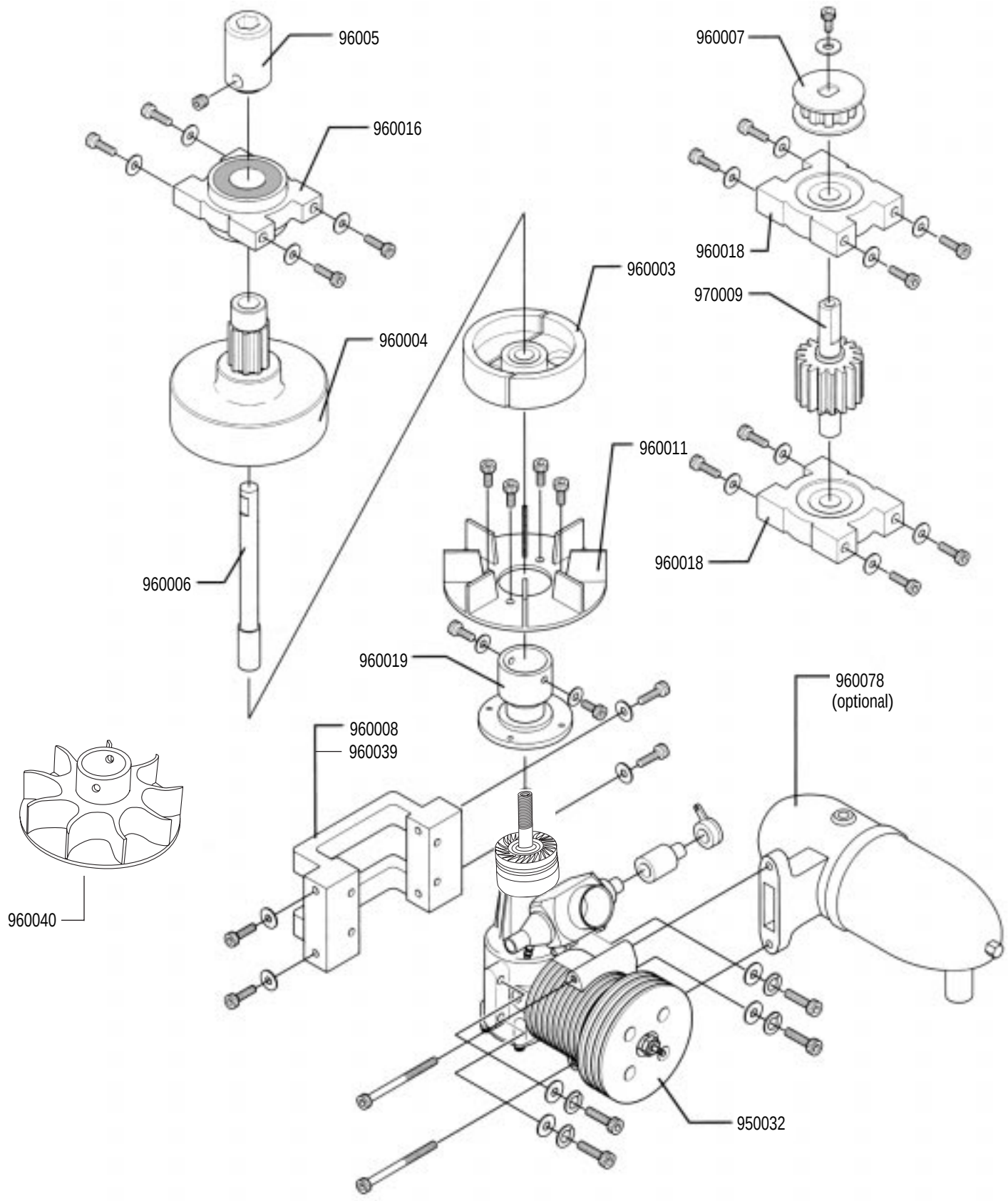
ROTOR HEAD/SWASHPLATE/WASHOUT ASSEMBLY



ROTOR HEAD/SWASHPLATE/WASHOUT ASSEMBLY PARTS LIST

PART #	DESCRIPTION	QUANTITY	COMMENTS /ADDITIONAL CONTENTS
960012	Washout Assembly	1	Complete w/all Components
960013	Washout Base	1	
960014	Swashplate Assembly	1	3 - 2x8mm Flat Head Screws 4 - 2x10mm Flat Head Screws 7 - Steel Joint Balls
960059	Flybar Paddles	2	2 - 3mm Lock Nuts
960060	Flybar	2	
960061	Rotor Head Assembly	1	Complete w/all Components
960062	Head Button	1	1 - 3x6mm Socket Head Bolt
960063	Main Blade Holder	2	2 - 2x10mm Flat Head Screws 2 - Steel Joint Balls
960064	Main Rotor Body	1	2 - 3x8mm Socket Head Bolts
960065	Mixing Arms	2	2 - Mixing Arm Bushings 4 - Nylon Washers 4 - 2x10mm Flat Head Screws 4 - Steel Joint Balls 2 - 3x16mm Socket Head Bolts 6 - 3mm Flat Washers
960066	Main Rotor Hub	1	1 - Washout Pin 1 - Oiless Bushing
960067	Seesaw Shaft	1	2 - Seesaw Collars 2 - 3x5mm Button Head Cap Screws 2 - Flybar Bushings
960068	Blade Spindle Shaft	1	2 - 4mm Lock Nuts
960069	Flybar Control Arm	2	2 - 4mm Set Screws
960070	Blade Damper Rubber	4	
960071	Blade Holder Spacer A	2	
960075	Linkage Set A	1	2 - 2.3x20mm Threaded Rod 1 - 2.3x30mm Threaded Rod 2 - 2.3x40mm Threaded Rod 10 - Universal Ball Links 2 - Double Link A
960081	3D Double Link	4	
970001	Steel Joint Ball w/2x8mm Screw	10	10 - 2x8mm Flat Head Screws
970002	Steel Joint Ball w/2x10mm Screw	10	10 - 2x10mm Flat Head Screws
970004	Universal Ball Links	10	
970006	Double Link	4	
970010	Washout Link	2	2 - Washout Link Pins
970011	Washout Arm	2	2 - Washout Arm Bushings 4 - Nylon Washers 2 - 3x15mm Socket Head Bolts 2 - 3mm Flat Washers
970012	Washout Arm Bushing	2	
970013	Mixing Arm Bushing	2	
970029	Seesaw Spacer Collar	2	
970030	Main Blade Bearing Spacer	2	2 - Inner Bearing Spacers 2 - Outer Bearing Spacers
980023	Main Blade Bolt Set	2	2 - 4mm Lock Nuts
980049	Nylon Washer .5	10	
980051	Nylon Washer 1.3	10	
981004	Main Blade Holder Bearing	2	
983003	Main Rotor Blade (.32-.36)	2	Pre-Covered & Weighted
983004	Main Rotor Blade (.46)	2	

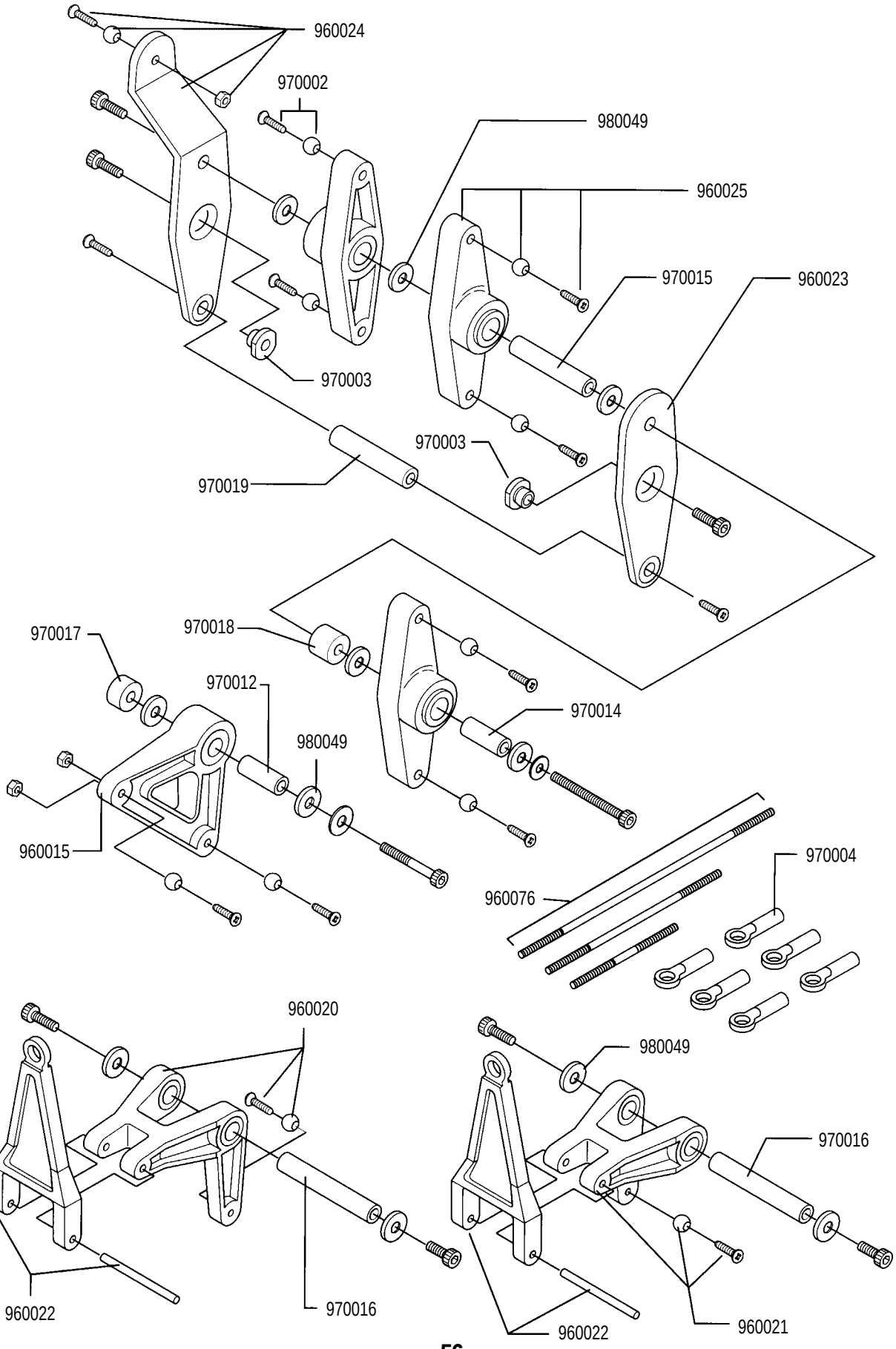
START SHAFT/CLUTCH/ENGINE ASSEMBLY



START SHAFT/CLUTCH/ENGINE ASSEMBLY PARTS LIST

PART #	DESCRIPTION	QUANTITY	COMMENTS /ADDITIONAL CONTENTS
960003	Clutch Assembly	1	Complete w/One-Way Bearing 2 - 3x5mm Socket Head Bolts
960004	Clutch Bell Assembly	1	Complete w/Pinion Gear, Clutch Lining and Oiless Bushing
960005	Starter Hex Adaptor	1	Complete w/One 4x4mm Set Screw
960006	Start Shaft Assembly	1	
960007	Front Tail Belt Pulley	1	Complete w/One 3x6mm Socket Head Bolt
960008	Engine Mount .32-.36	1	Complete w/Four 3x10mm Socket Head Bolts and Four 3mm Flat Washers
960039	Engine Mount .46	1	
960011	Cooling Fan Blades .32-.36	1	Complete w/Four 3x5mm Socket Head Bolts
960016	Start Shaft Bearing Block	1	Complete w/Bearing
960018	Tail Drive Pinion Bearing Block	1	Complete w/Bearing
960019	Fan Hub .32-.36	1	
960040	Aluminum Fan Assembly .46	1	
970009	Tail Drive Pinion w/Shaft	1	Complete w/One 3x6mm Socket Head Bolt and One 3mm Flat Washer
960078	.32-.36 Muffler	1	Complete w/One Pressure Tap

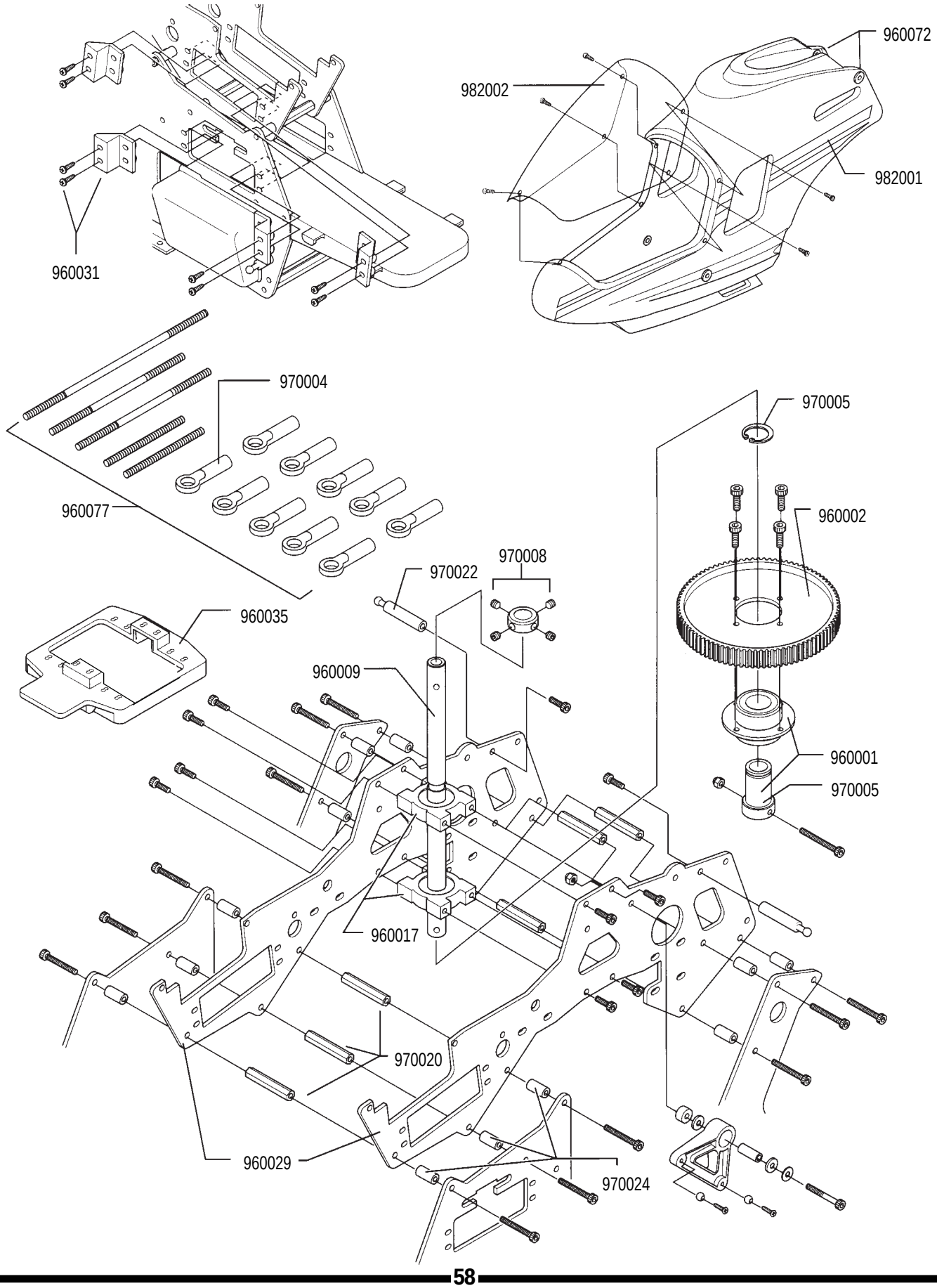
CYCLIC MIXING ARMS/ELEVATOR/AILERON CONTROL ARMS



CYCLIC MIXING ARMS/ELEVATOR/AILERON CONTROL ARMS PARTS LIST

PART #	DESCRIPTION	QUANTITY	COMMENTS /ADDITIONAL CONTENTS
960015	Roll Bellcrank	1	Complete w/Bushing 2 - Steel Joint Balls 2 - 2x8mm Flat Head Screws 2 - 2mm Hex Nuts
960020	Elevator Arm: Front	1	Complete w/Bushing Steel Joint Ball 2x8mm Flat Head Screw
960021	Elevator Arm: Rear	1	Complete w/Bushing Steel Joint Ball 2x8mm Flat Head Screw
960022	Swashplate A Arm	2	Complete w/2 A-Arm Pins
960023	Mixing Base Arm: Roll	1	Complete w/Bushing
960024	Mixing Base Arm: Collective	1	Complete w/Bushing Steel Joint Ball 2x8mm Flat Head Screw 2mm Hex Nut
960025	Mixing Lever: Cyclic	3	Complete w/Bushings 6 - Steel Joint Balls 6 - 2x8mm Flat Head Screws
960076	Linkage Set B	1	1 - 2.3x45mm Threaded Rod 1 - 2.3x75mm Threaded Rod 1 - 2.3x10mm Threaded Rod 6 - Universal Links
970002	Steel Joint Ball w/2x10mm Screw	10	
970003	Mixing Base Nut	2	
970004	Universal Ball Link	10	
970012	Washout Arm Bushing	2	
970014	Mixing Lever Bushing A	2	
970015	Mixing Lever Bushing B	2	
970016	Elevator Arm Bushing	2	
970017	Roll Bellcrank Spacer	2	
970018	Mixing Lever Spacer	2	
970019	Mixing Base Cross Member	1	
980049	Nylon Washer .5mm	10	

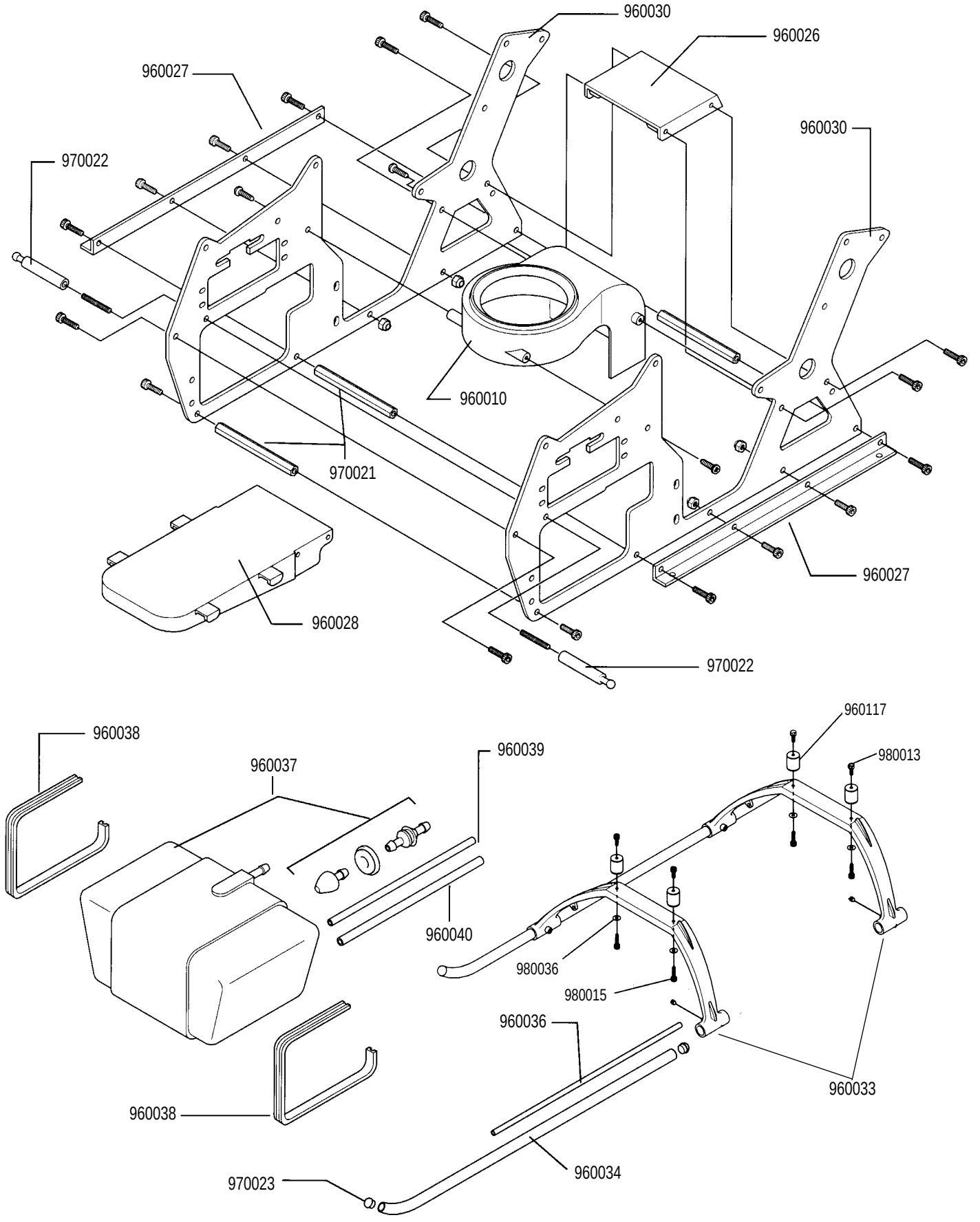
UPPER MAIN FRAME/RADIO TRAY/BODY SET



UPPER MAIN FRAME/RADIO TRAY/BODY SET PARTS LIST

PART #	DESCRIPTION	QUANTITY	COMMENTS /ADDITIONAL CONTENTS
960001	Autorotation Assembly	1	Complete w/Four 3x6mm Socket Head Bolts
960002	Main Drive Gear 88T	1	Complete w/Four 3x6mm Socket Head Bolts
960009	Main Rotor Shaft	1	
960017	Main Shaft Bearing Block	1	Complete w/Bearing
960029	Upper Main Frame	2	
960031	Servo Mounting Plates	4	8 - 2.6x8mm Self Tapping Screws 8 - 2.6x12mm Self Tapping Screws 8 - 2.6mm Flat Washers
960035	Upper Servo Tray	1	4 - 3x8mm Socket Head Bolts 12 - 2.6x12mm Self Tapping Screws 12 - 2.6mm Flat Washers
960072	Rubber Grommet	4	
960077	Linkage Set C	1	2 - 2.3x35mm Threaded Rod 2 - 2.3x60mm Threaded Rod 1 - 2.3x75mm Threaded Rod 10 - Universal Ball Links
970004	Universal Ball Links	10	
970005	Autorotation Shaft Hub Sleeve	1	Complete w/Clip
970008	Main Shaft Collar	1	Complete w/Four 4x4mm Set Screws
970020	Main Frame Standoff: 32mm	2	
970022	Body Mounting Standoff	4	2-3x8mm Socket Head Bolts 2-3x18mm Socket Head Bolts
970024	Main Frame Spacer 12.5mm	6	
982001	Ergo .32/.46 Body Set	1	4 - Rubber Gromments 5 - 2.3x8mm Self Tapping Screws
982002	Ergo .32/.46 Canopy	1	5 - 2.3x8mm Self Tapping Screws
960073	Ergo .32/.46 Decal Set	1	

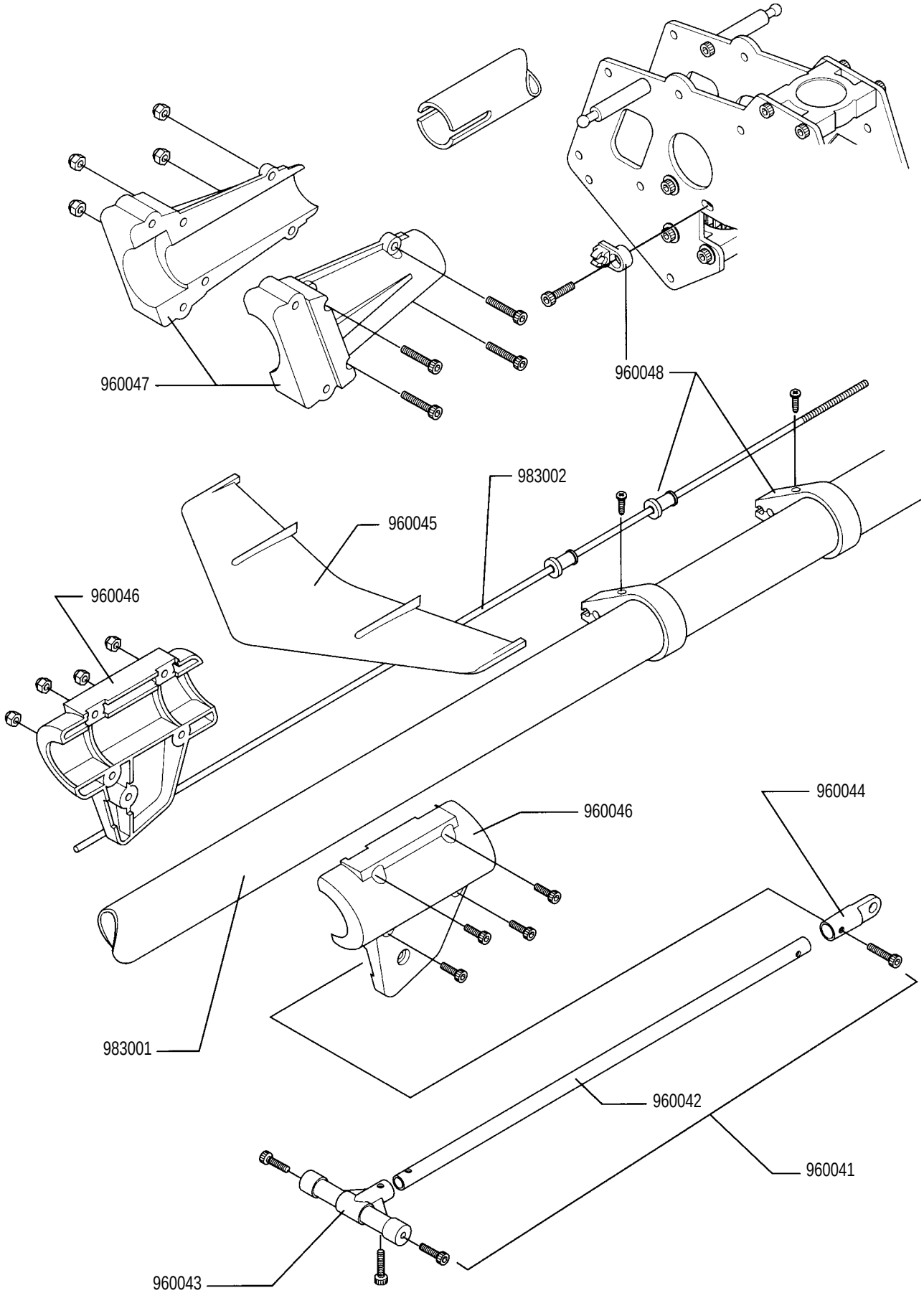
LOWER MAIN FRAME/LANDING GEAR/FUEL TANK



LOWER MAIN FRAME/LANDING GEAR/FUEL TANK PARTS LIST

PART #	DESCRIPTION	QUANTITY	COMMENTS /ADDITIONAL CONTENTS
960010	Cooling Fan Shroud	1	4 - 2.6x8mm Self Tapping Screws
960026	Gyro Mounting Plate	1	4 - 3x10mm Socket Head Bolts
960027	Lower Frame Angles	2	
960028	Front Radio Bed	1	
960030	Lower Main Frame	2	
960032	Landing Gear Set	1	2 - Landing Skids 2 - Landing Struts 4 - Skid Caps 4 - 3x4mm Set Screws 4 - 3x12mm Socket Head Bolts 4 - 3mm Flat Washers 4 - 3mm Lock Nuts
960033	Landing Struts	2	4 - 3x4mm Set Screws
960034	Landing Skids	2	4 - Skid Caps
960036	Antenna Tube	3	
960037	Fuel Tank Set	1	1 - Fuel Stopper 1 - Tank Grommet 2 - Installation Rubbers 1 - Silicone Fuel Tubing 1 - Fuel Clunk
960038	Tank Mounting Rubber	2	
970021	Main Frame Standoff: 60mm	2	
970022	Body Mounting Standoff	4	2 - 3x8mm Socket Head Bolt 2 - 3x18mm Socket Head Bolt
970023	Landing Skid Caps	4	
970025	Switch Damper Rubber	4	
960117	Landing Gear Damper	4	

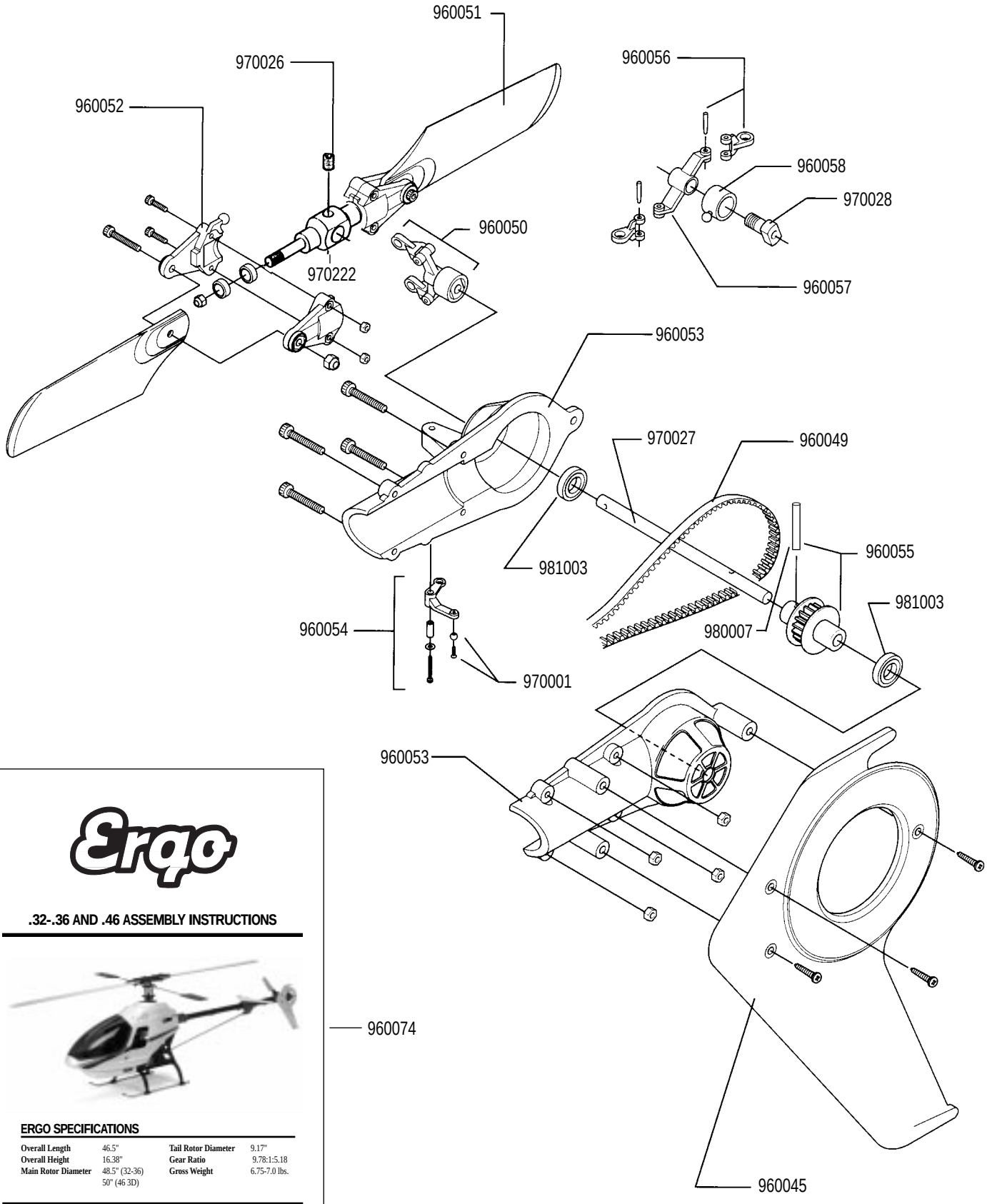
TAIL BOOM/TAIL BRACE/TAIL BOOM CARRIER



TAIL BOOM/TAIL BRACE/TAIL BOOM CARRIER PARTS LIST

PART #	DESCRIPTION	QUANTITY	COMMENTS /ADDITIONAL CONTENTS
960041	Tail Brace Set	1	1 - Tail Brace Tube 1 - Tail Brace Connector 1 - Tail Brace T End 1 - 2.6x12mm Socket Head Bolt 1 - 2.6x15mm Socket Head Bolt
960042	Tail Brace Tube	1	
960043	Tail Brace T End	1	2 - 3x8mm Socket Head Bolt 1 - 2.6x15mm Socket Head Bolt
960044	Tail Brace Connector	1	1 - 2.6x12mm Socket Head Bolt
960045	Tail Fin Set	1	1 - Vertical Fin 1 - Horizontal Fin 3 - 3x12mm Self Tapping Screw 2 - 3x12mm Socket Head Bolts 2 - 3mm Lock Nuts
960046	Horizontal Tail Fin/Brace Clamp	1	2 - 3x8mm Socket Head Bolts 2 - 3x12mm Socket Head Bolts 5 - 3mm Lock Nuts 1 - 3x10mm Socket Head Bolt
960047	Tail Boom Carrier	1	2 - 3x40mm Socket Head Bolts 4 - 3x15mm Socket Head Bolts 6 - 3mm Lock Nuts
960048	Tail Rod Guide Set	4	4 - Tail Rod Guides 5 - Tail Rod Guide Collars 1 - Tail Control Rod Guide 4 - 2x8mm Self Tapping Screws 1 - 3x10mm Socket Head Bolt
983001	Tail Boom	1	
983002	Tail Control Rod	1	

TAIL CASE/TAIL BLADE HOLDERS/TAIL PITCH PLATE



Ergo

.32-.36 AND .46 ASSEMBLY INSTRUCTIONS

ERGO SPECIFICATIONS

Overall Length	46.5"	**Tail Rotor Diameter**	9.17"
Overall Height	16.38"	**Gear Ratio**	9.78:1:5.18
Main Rotor Diameter	48.5" (32-36) 50" (46 3D)	**Gross Weight**	6.75-7.0 lbs.

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TAIL CASE/TAIL BLADE HOLDERS/TAIL PITCH PLATE PARTS LIST

PART #	DESCRIPTION	QUANTITY	COMMENTS /ADDITIONAL CONTENTS
960045	Tail Fin Set	1	1 - Horizntal Fin 1 - Vertical Fin 3 - 3x12mm Self Tapping Screws 2 - 3x12mm Socket Head Bolts 2 - 3mm Lock Nuts
960049	Tail Drive Belt	1	
960050	Tail Slide Ring Assembly	1	Complete w/all Components
960051	Tail Rotor Blades	2	
960052	Tail Blade Holder Set	2	2 - 3x15mm Socket Head Bolts 4 - 2x8mm Socket Head Bolts 2 - 3mm Lock Nuts 4 - 2mm Hex Nuts
960053	Tail Case Set (L&R)	1	4 - 2.6x12mm Socket Head Bolts 4 - 2.6mm Hex Nuts 1 -3x10mm Socket Head Bolt
960054	Tail Pitch Control Lever	1	1 - Lever Bushing 1 - 2x20mm Socket Head Bolt 1 - 2mm Flat Washer 1 - Steel Joint Ball 1 - 2x8mm Flat Head Screw
960055	Tail Case Pulley	1	1 - Pressure Pin
960056	Tail Pitch Link	2	Complete w/2 Link Pins
960057	Tail Pitch Plate	2	
960058	Tail Slide Ring	1	Complete w/Bearing
960074	Ergo .32/.46 Assembly Manual	1	
970001	Steel Joint Ball w/2x8mm Screw	10	10 - 2x8mm Flat Head Screws
970222	Tail Center Hub, 1 Piece	1	
970027	Tail Output Shaft	1	
970028	Tail Slide Ring Sleeve	1	
981003	Tail Output Shaft Bearing	2	

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Revised 3/4/97