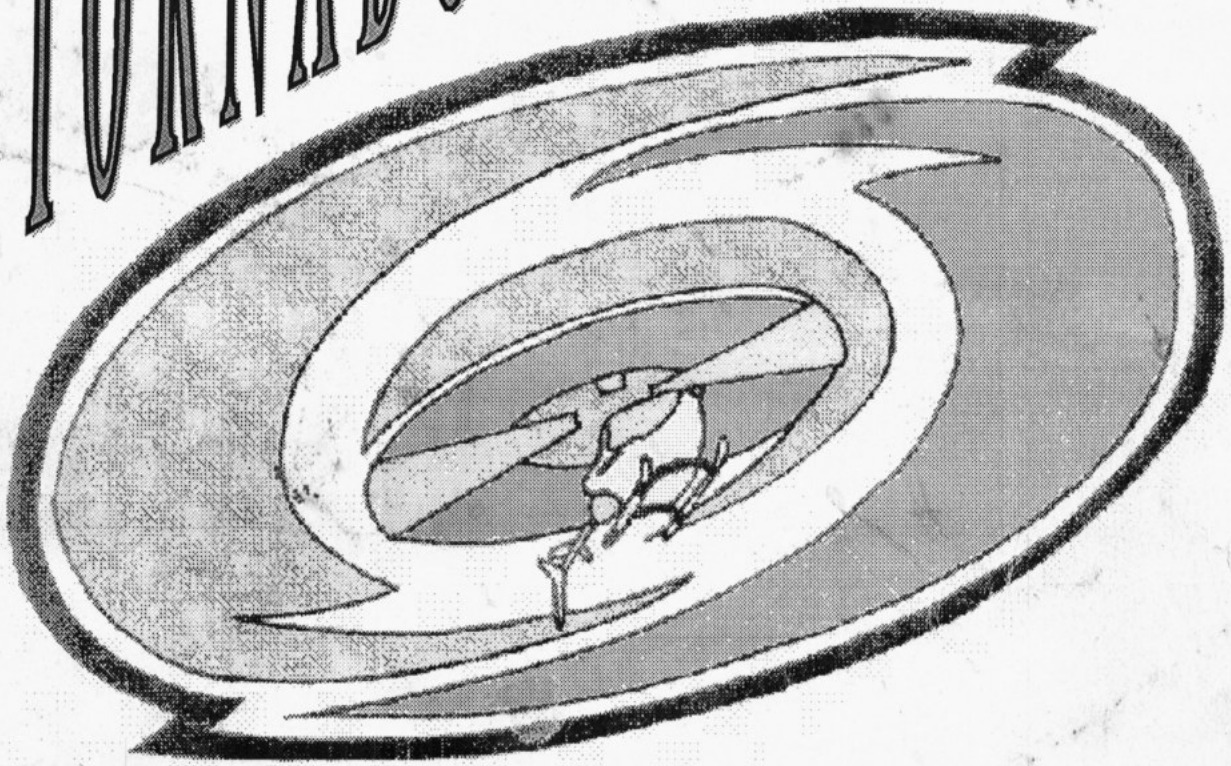


TORNADO II



Tornado II

Instruction Manual

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Before You Begin ...

Read this chapter carefully and ensure the instructions are clear before starting assembly. If any step is unclear, you can get answers by calling the support phone number at the beginning of this manual, or e-mail your question to the following address: fendley@tds.net

This radio controlled model is not a toy! A RC heli of this size can quickly reach speeds of over eighty miles an hour, and an inexperienced pilot can destroy the heli, and perhaps injure himself or others, in a fraction of a second.

First-time builders should seek advice from other modelers in their area. If you need assistance in finding help, let us know, and we will be glad to point you in the right direction.

How to Use This Manual

ICON KEY	
Ω	Warnings
T	Apply threadlock
Γ	Apply grease
E	Apply 2-part epoxy

This "icon key" designates actions that must be taken during the assembly of a particular step. For threadlock to work properly, both surfaces must be clean and dry. Use a threadlocking compound such as Loctite® 272 (blue) or 290 (green). Apply a *small* amount to the bolt and then install the bolt using a moderate amount of torque. Use of a hardened set of allen wrenches is highly encouraged to avoid "rounding" of the wrench or bolt.

Tools Required

While it is true that a poorly built airplane will fly, and in some cases can be trimmed for hands-off flight, a poorly built helicopter will not even hover, and is dangerous to those nearby. Please follow these instructions closely, ensure you understand the next step before proceeding, and get help if you don't understand a step.

Hex Wrenches – You will need 1.5mm, 2mm, 2.5mm, and 3mm Hex (allen) wrenches.

Phillips Screw Drivers - #0 and #1 sizes, ensure that the tips are not rounded!

Nut Driver – 5.5 mm for 3 mm nuts.

Additional Components Required

Engine - .60 in³ (10-cc) two stroke helicopter engine is required.

Radio – A helicopter radio, with a minimum of five channels is required. A mid-range computer radio, such as the JR® XP8103 or the Futaba® 8UHF/P is recommended.

Gyro – A gyro for tail rotor stabilization is required.

Main Rotor Blades – 660 mm or 680 mm in length, with a 14-mm chord.

Tail Rotor Blades – 95 to 105 mm in length with a 5-mm chord.

Warnings

Read all warnings in this instruction manual before attempting to fly this model helicopter. Seek an experienced model helicopter pilot in your area to assist you with this kit building project. It is assumed that the purchaser of this kit has some basic knowledge of radio controlled helicopters. If you need additional assistance in building or flying this model helicopter, please call us at (334) 702-1738.

Warranty Policy

Any part returned with a defective claim would be considered for replacement after assessment of the part in question has been conducted. The customer is responsible for all shipping costs if the product is not defective. Under no circumstance will a product be replaced before it is returned for evaluation to Precision Helicopters, Inc. Under no circumstance will a product be replaced that has been installed or flown on the helicopter. Warranty information must be on file! Precision Helicopters, Inc. does not warranty any equipment installed in the helicopter (i.e. engines, radios, gyros, main or tail blades).

Return Policy

The purchaser of this helicopter kit has 3 days to return this kit if not completely satisfied. The kit must be returned in the purchased state (all bags unopened and in re-saleable condition).

Warranty Sheet

(This warranty information must be received within 10 days of the purchase of this kit.) Please return to the address below.

Precision Helicopters, Inc. has carefully examined the contents of this kit to ensure that high quality is maintained at all times. If you feel you have received a part that is defective (before flying this helicopter), send the part in question to:

Precision Helicopters, Inc.

112 Belton Drive

Dothan Al, 36305

Precision Helicopters, Inc.'s only responsibility regarding this kit is to replace any defective part that is determined to be defective prior to the helicopter's initial flight. The purchaser of this kit assumes all liability regarding its use.

Safety: Initial all blanks

___ I understand and accept the risks of flying radio controlled model helicopters. These are some of the risks associated with flying radio-controlled helicopters:

___ Potential for property damage and bystander injury

___ Potential for personal injury (even death), people have been severely injured or killed from operating radio controlled model aircraft.

___ This model aircraft has the ability to go from 0 to 30 miles per hour in any direction without warning (i.e. radio failure, component failure, pilot error). The model helicopter will severely damage any object it meets.

___ When a model helicopter crashed, it can eject damaged parts at high speeds in any direction. **ALWAYS WEAR EYE PROTECTION!**

___ I understand and agree to completely inspect the model helicopter before each flight to ensure there is no damage, loose bolts, blade problems, ball links, or radio/gyro problems.

___ I understand and agree that I should wear ANZI Z41 polycarbonate lens (or equivalent eye protection) when building or flying this model helicopter. Hearing protection is recommended.

___ I agree to operate this model helicopter in accordance with the Academy of Model Aeronautics safety codes.

___ I understand that Precision model Helicopters, Inc. has no control how this product is used, and can not be held liable for any damage resulting from the use of this product. This includes the exclusion of implied warranty of merchantability and/or fitness for a particular purpose. **FLY AND ASSEMBLE THIS PRODUCT AT YOUR RISK.**

DATE: _____

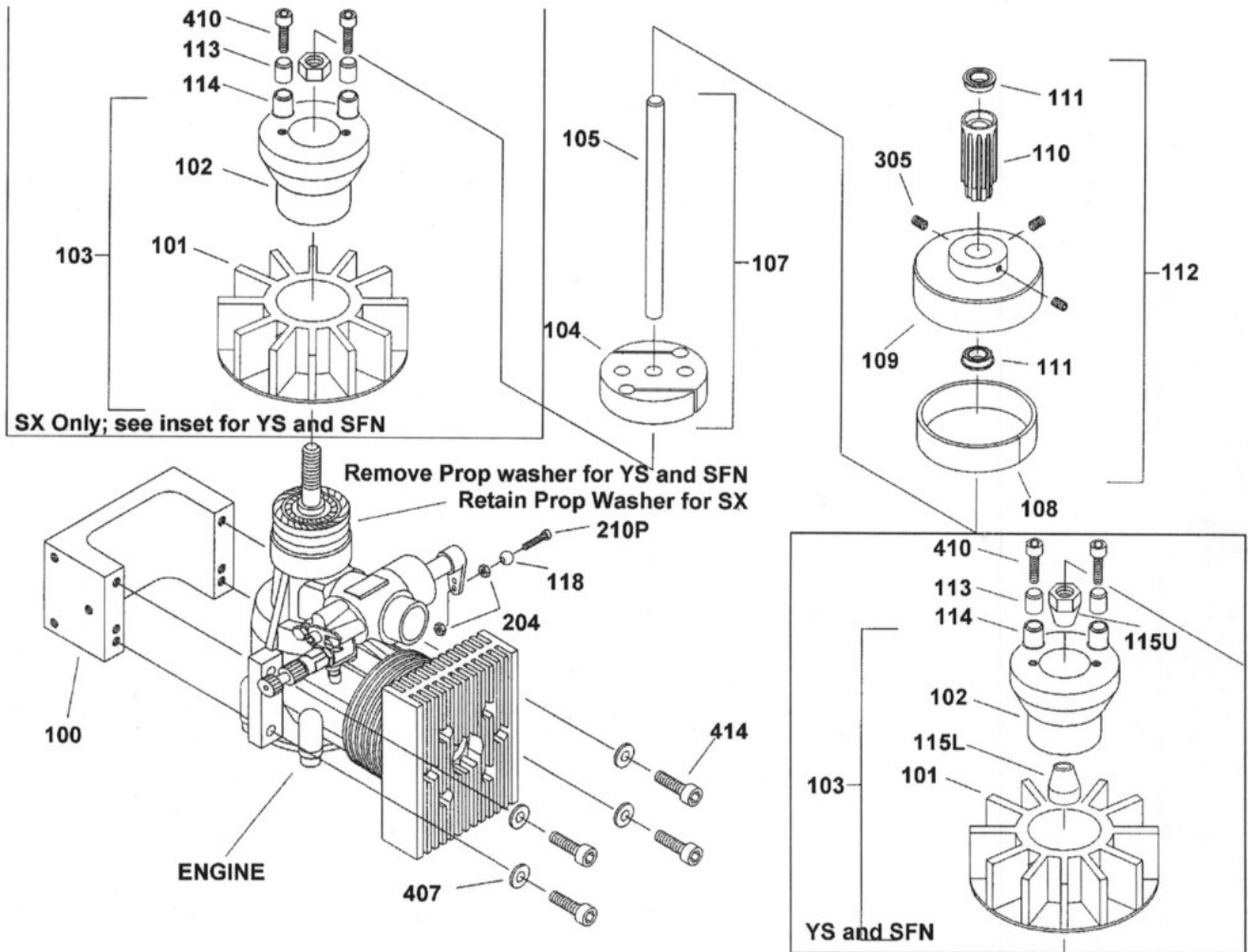
Name: _____

Address: _____

City/State: _____

Telephone: (____) _____

Engine Fan and Clutch Assembly



BAG 1 Contents		
PARTS QUANTITY	PART NUMBER	DESCRIPTION
1	100	Engine Mount
1	101	Cooling Fan
1	102	Cooling Fan Hub (SX,YS,SFN) YS and SFN require collets 115L and 115U
1	107	Self-Aligning Clutch / Start Shaft Assembly (pre-assembled) contains 104 , 105 , 2 x113 , 2 x 114
	104	Clutch Base
	105	Start Shaft
	113	Steel Inserts
	114	Delrin Cups
1	112	Clutch Bell Assembly (pre-assembled) contains 108 , 109 , 110 , 2 x 111 , 3 x 305
	108	Clutch Liner
	109	Clutch Bell
	110	Pinion Gear
BEARINGS QUANTITY	PART NUMBER	DESCRIPTION
	111	Clutch Bell Bearings
HARDWARE QUANTITY	PART NUMBER	DESCRIPTION
1	118	5 mm Control Ball
2	204	2 mm Hex Nut
1	210P	2 x 10 mm Pan Head Screw
	305	3 x 5 mm Hex Set Screw
4	407	4 mm Flat Washer
6	414	4 x 14 mm 12.9 Steel Bolts

- 1-1. Mount the engine to the engine mount (100) using 4 x 4mm bolts (414) and 4 x 4mm washers (407) T.
- 1-2. (SFN and YS only) Remove the engine thrust washer from the engine and install the spacer (if supplied), and the lower fan collet (115L SFN/YS). Make sure the collet is firmly seated on the spacer.
- 1-3. (SFN and YS only) Place the cooling fan (103 SFN/YS) on to the lower collet (115L SFN/YS) and secure with the upper collet / nut assembly (115U SFN/YS) T. (SX) Place the cooling fan (103 SX) on to the engine thrust washer and secure with the engine nut supplied with the engine T. To prevent the engine crankshaft from turning while tightening the collet / nut assembly, remove the engine backplate and use a wooden dowel against the crankshaft. Do not pry against the connecting rod, and make sure there are no wooden fragments in the engine prior to replacing the engine backplate.
- 1-4. Install the delrin bushings (114) and metal bushings (113) on to the fan hub (102 ALL) using two 4mm bolts (410) T.
- 1-5. Wrap the clutch (104) with two layers of black electrical tape, and set aside.

- 1-6. The clutch bell assembly (112) comes preassembled with the 10-tooth pinion (110) and bearings (111) installed. All that remains is to install the clutch lining (108). Begin by roughening the inside of the clutch bell (109) with 220 grit sandpaper. Cut the clutch lining (108) to the proper length such that there is no overlap when installed. Mix a small amount of two part metal epoxy (such as JB Weld®) and apply a thin layer to the inside surface of the clutch bell (109). Place the clutch liner (108) into the clutch bell (109) such that the liner (108) fits tightly against the sides of the clutch bell (109).
- 1-7. Take the clutch (104) with the electrical tape from step 5, and slide the clutch bell assembly (112) down over the clutch (104) and electrical tape. The electrical tape serves two purposes – 1st, the tape increases the outside diameter of the clutch (104) so that the clutch (104) presses the lining (108) tightly against the clutch bell (109), - 2nd, the tape prevents any excess epoxy from sticking to the clutch (104). Set the clutch assembly aside.

BAG 2 Contents (Continued)		
PARTS QUANTITY	PART NUMBER	DESCRIPTION
1	224B	Damper Cap (Unthreaded)
1	225	Rubber Dampener
1	226	Special Lock Nut
1	227	Feathering Axle
2	228	O-ring for Axle
2	230	Special Stainless Steel Washer
2	232	Main Blade Grip
2	233	Main Blade Bolt (Special)
2	234	Blade Grip (Pitch) Control Arm Hardware
2	235	Blade Grip (Pitch) Control Arm
2	237	Flybar paddles
1	238	See Saw
1	239	Flybar
2	243	Flybar Control Arm
2	244	Stainless Steel Special Washer
2	246	Conical Standoff
2	248	See Saw Mixing Arms
1	249	Special (Jesus) Bolt
1	250	Rotor Center Hub
2	252	Main Blade Spacer
BEARINGS QUANTITY	PART NUMBER	DESCRIPTION
4	229	Feathering Axle Bearing
2	231	Feathering Axle Thrust Bearing
2	241	See Saw Flybar Bearing
2	245	See Saw Pivot Bearing
4	247	See Saw Mixing Arm Bearing
HARDWARE QUANTITY	PART NUMBER	DESCRIPTION
4	118	5 mm Control Ball
4	119	5 mm Ball Links
8	204	2 mm Hex Nut
4	206P	2 x 6 mm Pan Head Screw
4	210P	2 x 10 mm Pan Head Screw
1	225	2 x 25 mm (12.9) Steel Bolts
1	301	3 mm Lock Nut
2	306	3 x 6 mm (12.9) Steel Bolts
2	404	4 x 4 mm Hex Set Screw
2	406	4 x 6 mm Hex Set Screw
2	407	4 mm Flat Washer
4	307	3 mm Flat Washer
2	414	4 x 14 mm (12.9) Steel Bolts
3	430	4 x 30 mm (12.9) Steel Bolts
2	900	Pitch Control Rod (16 mm)

2-1. Slide the main rotor shaft block (250) through the center of the main rotor head block (220) until the top of the shaft block (250) is flush with the top of the head block (220). Slide the pivot pin (221) through

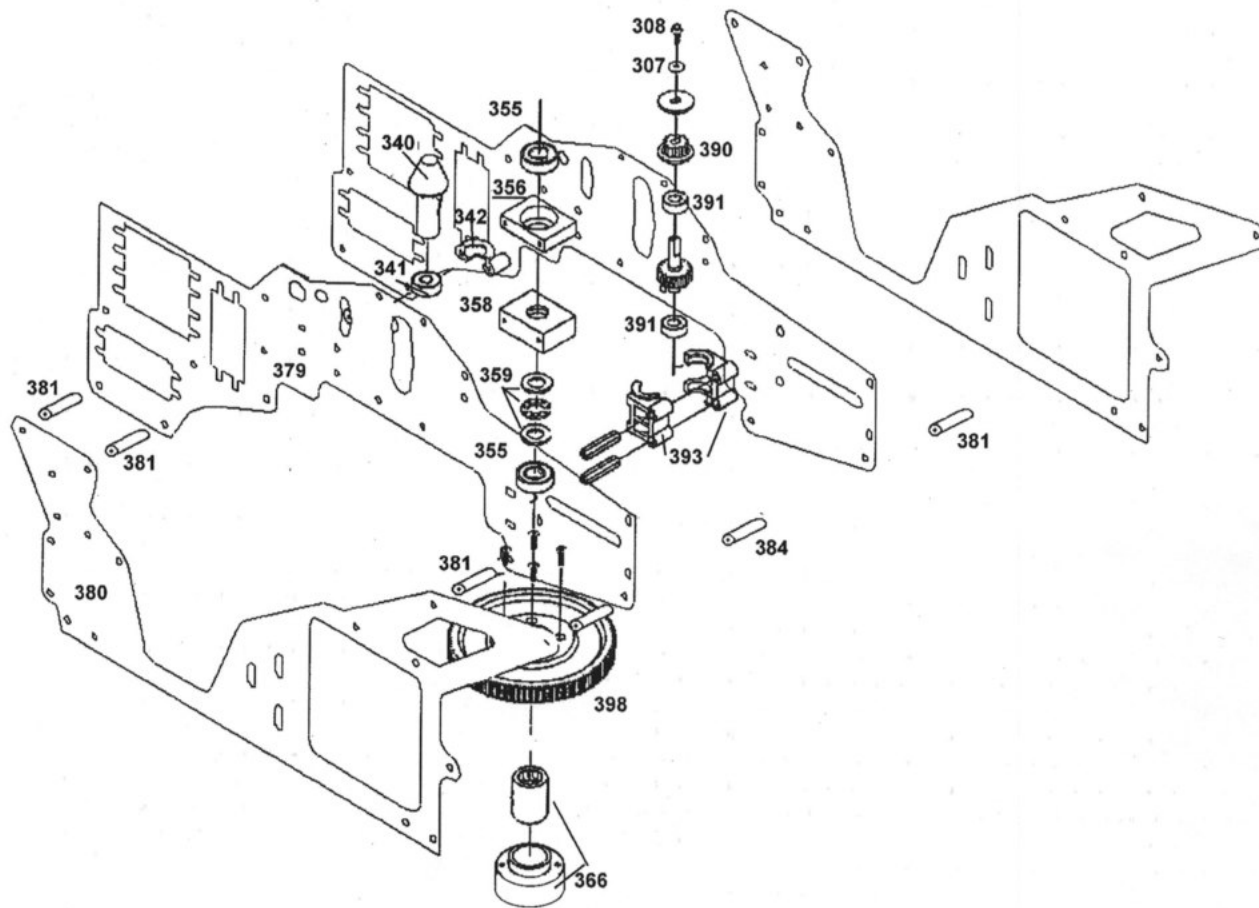
the head block (220). Slide two washers (222) onto the rotor head pin (221), one on each side of the head block (220). Secure the rotor head pin caps (223) to the rotor head block (220) with two (206P) screws on each side T.

- 2-2. The rotor head dampening (225) is installed into the prebuilt head block assembly (220, 221, 222, 223, 206P). The dampener (225) is cut to a proper length for rigid rotor head dampening. If you prefer a softer rotor head dampening, shorten the length of the dampener (225) 2mm at a time until the desired firmness is achieved. Lubricate the dampener (225) with a light oil or synthetic grease before installation. Place a dampener cap (224a – threaded, and 224b – not threaded) on both sides of the rotor head. Insert the 4mm x 30mm-bolt (430) through the non-threaded dampener cap (224b), past the dampener (225), and into the threaded dampener cap (224a). Install a 4mm-locknut (401) and tighten securely.
- 2-3. Center the spindle shaft (227) into the head block (220). Since the spindle shaft (227) is 115.6mm long, and the head block (220) is 42.8mm thick, 36.4mm (1.435”) should stick out from each end.
- 2-4. Install two 4mm setscrews (406) T in the bottom of the head block (220) to retain the spindle (227).
- 2-5. Place a rubber o-ring (228) onto each side of the spindle shaft (227).
- 2-6. Slide an 8x16x6mm blade grip bearing (229) onto each side of the spindle shaft (227).
- 2-7. Slide a bearing spacer (252) onto each side of the spindle (227). The bearing spacer (252) must be oriented such that the side of the spacer with opposing 3mm holes is closest to the inside of the head assembly. Refer to the diagram for clarification.
- 2-8. Slide an 8x16x6mm blade grip bearing (229) onto each side of the spindle shaft (227).
- 2-9. Install a 10x16x0.2mm washer (230) onto each side of the spindle shaft (227).
- 2-10. Install the thrust washer assembly (231) onto each side of the spindle shaft (227). The two races of the thrust washer assembly appear identical, but one has a larger inside diameter (6.2mm) than the other (6.0mm). The one with the larger inside diameter (6.2mm) must be installed first, followed by the caged bearings, and finally by the race with the smaller inside diameter (6.0).
- 2-11. Retain the thrust washer assembly with a 4mm-bolt (414) and 4mm-washer (407) T. Repeat for the other side.
- 2-12. Place a blade grip (232) over the bearing / bearing spacer assembly, lining up the side that has a single 3mm hole. Retain the blade grip (232) on the bearing spacer (252) with a 3mm-bolt (306B) T. Repeat for the other side.
- 2-13. Install the blade grip arm (235) onto the blade grip (232) with two 3mm bolts (310) and two 3mm washers (307) T. Ensure that the blade grip arm (235) trails the blade grip (232); that is when viewing the rotor head from above, the rotor head turns clockwise. The blade grip arm (235) should follow the blade grip (232). Repeat for the other grip.
- 2-14. Slide the seesaw assembly (240) on to the main rotor shaft block (250) such that the large 9mm holes in the seesaw assembly (240) are directly over the 3mm threaded holes in the main rotor shaft block (250).

Place a small 3mm washer (244) directly centered on the 3mm threaded hole in the main rotor shaft block (250) and a seesaw bearing (245) in to the 9 mm hole in the seesaw assembly. Secure the bearing (245) and washer (244) to the main rotor shaft block (250) with a 3mm bolt (310FH) T. Repeat on the other side. Be sure to keep the threadlock out of the bearing, otherwise you may cause the bearing to seize. When this step is complete, the seesaw (240) should pivot freely on the main rotor shaft block (250).

- 2-15. Place a mixing arm bearing (247) in to the 9mm hole on either side of one of the mixing arms (248). Place a 3mm bolt (310FH) through both bearings such that when you look at the head of the bolt, the short side of the mixing arm (248) is to your right. Place the brass spacer (246) onto the 3mm bolt (310FH) so that the tapered portion of the spacer (246) is touching the bearing (247). Place two 3mm washers (307) onto the 3mm bolt (310FH). Screw this entire assembly onto the seesaw (240) T, ensuring that the short portion of the mixing arm remains to the right. Repeat for the other side.
- 2-16. Mount a control ball (118) onto a 2mm bolt (210P). Thread the 2mm bolt into the outer holes in the mixing arms (247) so that the control ball (118) is on the inner side of the mixing arm (247). Each mixing arm (247) should have two control balls (118) on it. Lock the 2mm bolts (210P) into place with threadlock T and a 2mm nut (204). Set the rotor head aside.
- 2-17. Place the flybar bearings (241) into the 9mm holes on either side of the seesaw assembly (240). Pass the flybar (239) through both bearings (241) such that an equal amount of flybar (239) protrudes from either side of the seesaw assembly (240). Slide a 4mm flat washer (222) on to each side of the flybar (239) followed by a 4mm brass spacer (242). Slide a flybar control arm (243) on to each side of the flybar (239), orienting to arm as shown on the diagram. Retain the flybar control arm (243) on to the flybar (239) with a 3mm-setscrew (404). Ensure that both flybar control arms (243) are parallel to each other.
- 2-18. Install the flybar paddles (237) on to the flybar (239). Count the number of revolutions so that each paddle (237) is inserted an equal amount. The paddles (237) must be parallel to each other, and to the flybar control arms (243).
- 2-19. Shorten four of the ball links (119) by 3mm. Install two ball links (119) on to the 3x14mm-threaded rod (236). Adjust the ball links (119) so that the overall length of the rod and ball link assembly (2x119, 236) is 42mm. Install this pitch control rod (2x119, 236) from the ball on the short end of the seesaw mixing arm (248) to the ball on the end of the blade pivot arm (235). Repeat for the other side.

Main Frame Assembly



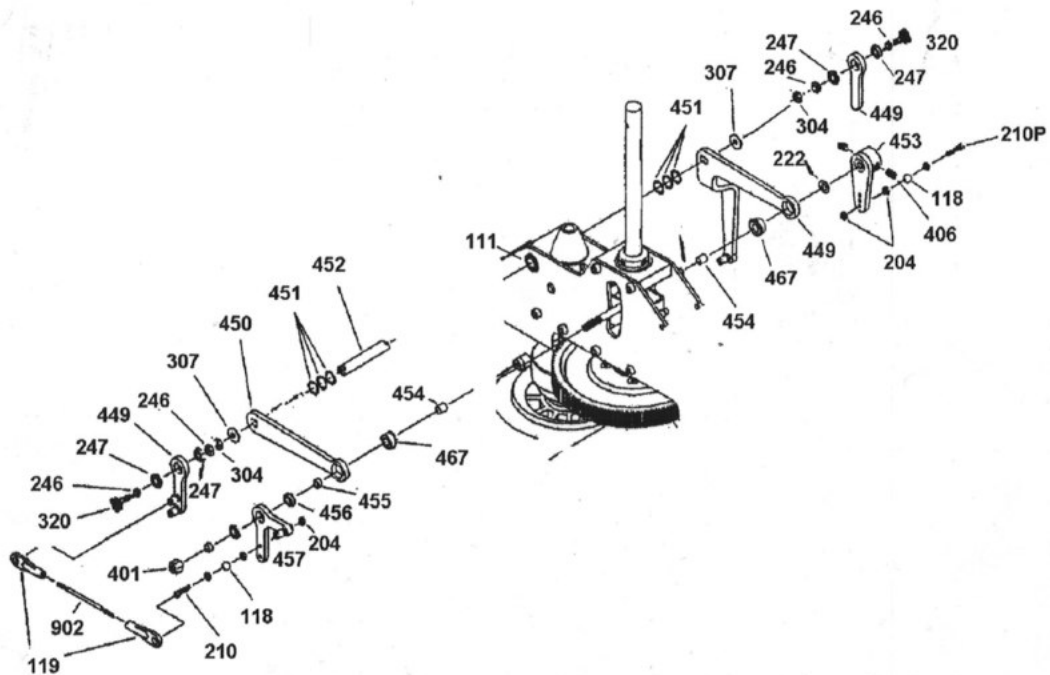
BAG 3 Contents		
PARTS QUANTITY	PART NUMBER	DESCRIPTION
1	340	Start Cone
1	342	Start Shaft Bearing Block
2	343L	Canopy Mount (Large)
1	343S	Canopy Mount (Small)
1	347	Radio Floor
1	353	Mast Lock
1	354	Main Shaft

BAG 3 Contents (continued)		
PARTS QUANTITY	PART NUMBER	DESCRIPTION
1	356	Main Shaft Upper Bearing Block (bearing 355 installed)
1	358	Main Shaft Thrust Bearing Block (bearings 355 , 359 installed)
1	362	Gyro Tray
1	366	Auto Hub Unit (Bearings Installed)
2	373	Transverse Lever Post
2	374	Transverse Lever
1	375	Rear Fan Shroud Mount (G-10, 25 mm)
2	376	Side Fan Shroud Mount (G-10, 36 mm)
2	379	Upper G-10 Frame (II,3D)
2	380	Lower G-10 Frame (II,3D)
8	381	Main Frame Standoffs (16.5 mm)
1	382	Rear Frame Brace (G-10)
1	383	Switch Plate (G-10)
4	384	Main Frame Standoffs (26 mm, threaded)
1	385	Lower Mast Collet
1	386	Lower Mast Collet Bolt
1	390	Front Drive Pulley
1	392	Front Drive Transmission Gear
1	393	Front Drive Transmission Gear Case
2	394	Hexagon Brass Standoffs
4	396	Servo Tray Spacers
1	398	Main Gear (machined delrin, 93 tooth)
BEARINGS QUANTITY	PART NUMBER	DESCRIPTION
2	341	Start Shaft Bearing
2	355	Main Shaft Bearing
1	359	Main Shaft Thrust Bearing
2	391	Front Transmission Bearing
HARDWARE QUANTITY	PART NUMBER	DESCRIPTION
2	118	5 mm Control Ball
8	204	2 mm Hex Nut
2	212	2 x 12 mm Bolt
2	250	2.5 mm Flat Washer
2	268	2.6 x 8 mm Bolt
23	301	3 mm Lock Nut
1	307	Flat Washer
5	308	3 x 8 mm Bolt
8	310	3 x 10 mm Bolt
4	310F	3 x 10 mm Flat Head Bolt
5	314	3 x 14 mm Bolt
8	330	3 x 30 mm Bolt
10	335	3 x 35 mm Bolt
2	340	3 x 40 mm Bolt
2	404	4 mm Hex Set Screw
6	407	4 mm Flat Washer
8	410	4 x 10 mm Bolt

- 3-1. Insert the upper main shaft bearing (355) into the upper main shaft bearing block (356).
- 3-2. Insert the main shaft thrust bearing assembly (359) and lower main shaft bearing (355) into the lower main shaft bearing block (358).
- 3-3. Assemble the upper main frames (379) using the assembled upper bearing block (356) and assembled lower bearing block (358) using 3x25mm bolts (325) and 3mm locknuts (301). The upper bearing block (356) must be oriented so that the bearing is facing up, and the lower bearing block (358) must have the bearing facing down. Do not fully tighten these bolts, some amount of play must still exist between the side frames, and will be removed later.
- 3-4. Attach the lower side frames (380) to the upper side frames (379) using 16 mm aluminum standoffs (381) between the upper (379) and lower (380) side frames and 26 mm aluminum standoffs (384) between the upper side frames (380), and retained by 3x25mm bolts (325) into the threaded 26mm aluminum standoffs (384). As in step 3-3, do not fully tighten the 3mm bolts.
- 3-5. Place the starter shaft bearing (341) between the two starter shaft bearing blocks (342), and place between the upper side frames (379) as shown in the diagram above. Retain the starter shaft bearing assembly in place by passing two 3x25mm bolts (325) through the left upper side frame (379), through the starter shaft bearing blocks (342), through the right upper side frame (379), and retained by two 3mm locknuts (301). As in step 3-3, do not fully tighten the 3mm bolts.
- 3-6. Place a tail rotor drive gear bearing (391) on the top and bottom shaft of the tail rotor drive gear (392). Place this entire gear and bearing assembly (2x391, 392) into the tail rotor front transmission (393). Slide two 6-sided aluminum standoffs (394) into the tail rotor front transmission (393). Slide the transmission into place between the two upper side frames, as shown in the above diagram. Retain the tail rotor front transmission using four 3x25mm bolts (325). As in step 3-3, do not fully tighten the 3mm bolts.
- 3-7. Assemble the elevator control ring (377) by attaching the elevator pivot rods (373) to the control ring half (374) with a 3mm bolt (268) and 3mm washer (250). Bolt the two halves together using a 2mm bolt (212) through a 5mm ball (118), a 2mm nut (204), both elevator halves (374), and secured with two 2mm nuts (204). Place the elevator control ring into place, as shown above.
- 3-8. Bolt the main gear (398) to the autorotation hub (367) using four 3mm counterset screws (310FH)T.
- 3-9. Slide the main shaft (354) through the upper main bearing block (356) and lower main bearing block (358). Insert the main shaft (354) through the brass spacer (454), the autorotation hub (367), lower mast collet (385). Bolt the lower mast collet bolt (386) through the lower mast collet (385) and the 3mm hole in the main shaft (354).
- 3-10. Slide the 10mm main shaft retainer (353) on to the top of the main shaft (354) until it contacts the bearing (355) in the upper main bearing block (356). Insert the 3mm setscrews (404) into the main shaft retainer (353) but do not tighten. Raise the main gear (368) and autorotation hub (367) assembly until it is in contact with the lower main bearing block (358). Slide down the main shaft retainer (353) until it is snug against the upper bearing block (356). Tighten the 3mm setscrews (404). The main shaft should turn freely.

- 3-11. Place the frame assembly on to a flat surface (a thick piece of glass is ideal) and ensure the bottom edges of the lower side frames are flat against the surface. Tighten all 3mm bolts and locknuts, except those retaining the starter shaft bearing assembly (341+342) and tail rotor front transmission (391+392+391+393+394).
- 3-12. Place the tail belt drive gear (390) on to the output shaft of the tail rotor drive gear (392) and retain with a 3mm bolt (308) and washer (307)T.
- 3-13. Attach the engine assembly by inserting the starter shaft (protruding from the clutch bell and pinion gear) through the starter shaft bearing and bearing block (342 + 342). Slide the entire engine assembly upwards until the pinion (110) is in contact with the bearing (341). The six holes in the engine mount (100) should line up with the six small slots in the lower side frames (380). Insert a 4x14mm (414) bolt and 4mm flat washer (407) into each hole, but do not fully tighten the bolts. Cut a small piece of typing paper into a strip 10mm wide and 50mm long. Place this piece of paper between the pinion gear (110) and the main gear (368) by rotating the main gear (368) and feeding the strip of paper where the two gears mesh. Stop when half of the paper has been inserted. Adjust the tension of the pinion gear (110) until it is tight against the main gear (368) and tighten the six 4mm bolts (414). Remove the piece of paper.
- 3-14. Cut another piece of typing paper as you did for step 3-13, and repeat this process for the tail rotor front transmission. When you are done, ensure both pieces of paper are removed. Turn the main gear. The main gear should turn smoothly, without excess gear lash between the pinion gear (110), main gear (368), and tail rotor drive gear (392).
- 3-15. Place the cooling fan shroud (459) loosely over the engine / fan / clutch assembly and assemble with the included 2mm shroud screws (458).
- 3-16. Install the gyro mounting plate (362) with four 3x10mm bolts (310) and four 3mm locknuts (301).
- 3-17. Install the front and rear bottom frame braces (384) to the lower side frames (380) with eight 3x10mm bolts (310) and locknuts (301).

Control System Assembly



BAG 4 Contents

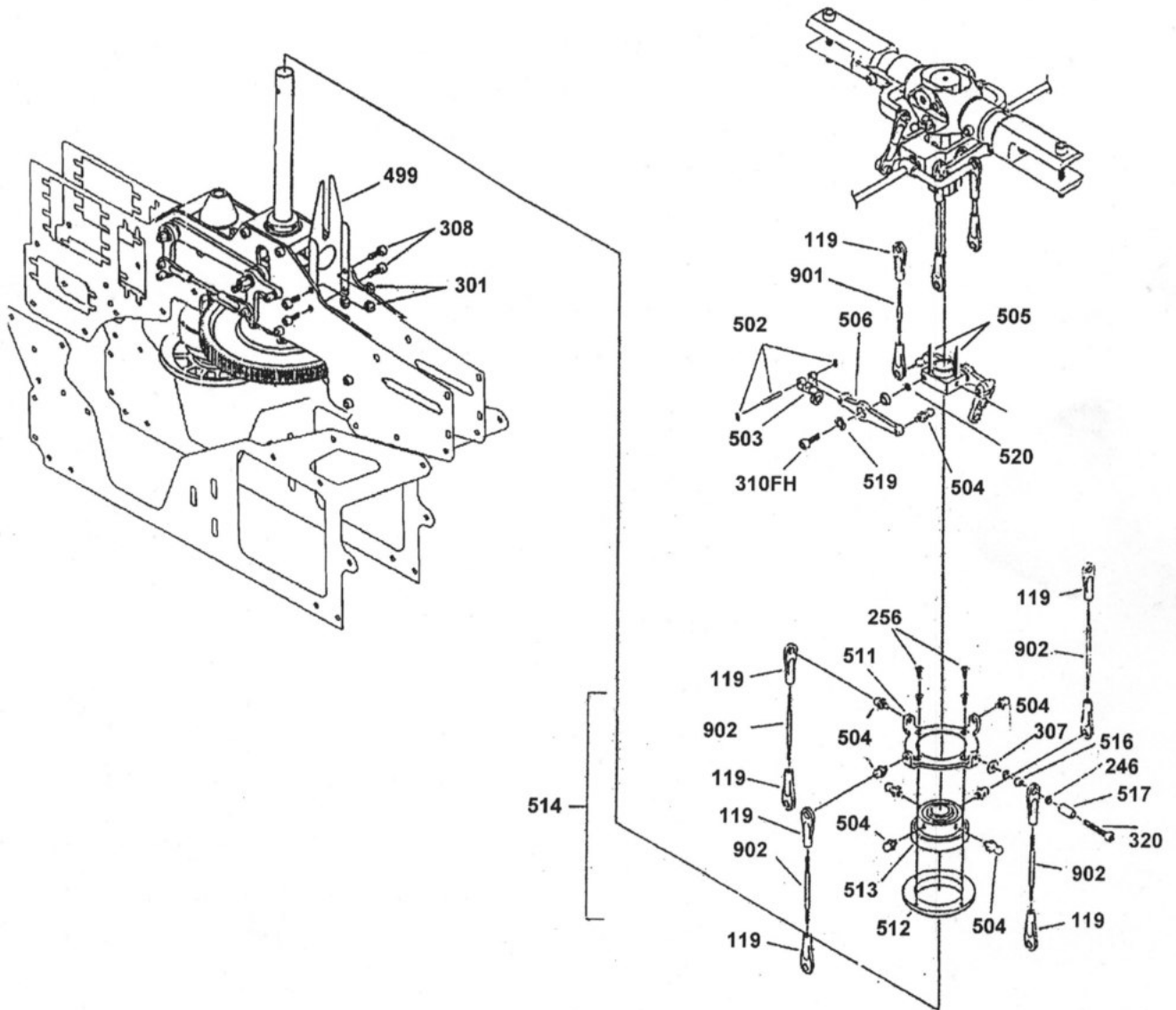
PARTS QUANTITY	PART NUMBER	DESCRIPTION
3	222	Special Washer
4	246	Conical Standoff
2	449	"I" Lever
1	450	Collective Lever Set
6	451	"I" Lever Shims
1	452	"I" Lever Post
1	453	Elevator Control Arm

BAG 4 Contents (continued)		
PARTS QUANTITY	PART NUMBER	DESCRIPTION
2	454	Medium Spacer
2	455	Short Spacers
1	457	Aileron Bell Crank
6	458	Fan Shroud Screws
1	459	Fan Shroud
2	464	Landing Gear Strut
2	465	Landing Gear Skids
1	469	Main Frame Piller
BEARINGS QUANTITY	PART NUMBER	DESCRIPTION
2	111	Main Frame Bearings
4	247	"I" Lever Bearing
2	456	Aileron Bellcrank Bearing
2	467	Collective Unit Bearing
HARDWARE QUANTITY	PART NUMBER	DESCRIPTION
8	118	5 mm Control Ball
4	119	Ball Link
16	204	2 mm Hex Nut
8	210P	2 x 10 mm Pan Head Screw
4	301	3 mm Lock Nut
2	305	3 x 5 mm Hex Set Screw
6	307	Flat Washer
2	310	3 x 10 mm Bolt
6	320	3 x 20 mm Bolt
2	406	4 x 6 mm Hex Set Screw
2	902	2 mm Control Rod (45 mm in length)

- 4-1. Insert the two bearings (111) into the side frames just in front of where the start cone will be placed. The flange of the bearing will remain to the outside of the frame.
- 4-2. Install the "I" lever post (452) into the center of the two bearings (111). The flanged portion of the "I" lever post (452) should protrude equally on both sides of the bearing.
- 4-3. Install two of the shims (451) on both sides of the "I" lever post (452). Up to three shims (451) may be used on either side of the "I" lever post (452) to reduce any free play or lateral movement of the collective unit.
- 4-4. Building the "I" lever (449) assembly from the outside in appears to be the most efficient way. Take a 3 x 20 mm bolt (320), slide the brass conical spacer (246) on to the hub of the bolt, followed by the "I" lever bearing (247), the "I" lever (449), the second "I" lever bearing (247), the conical spacer (246), and finally the 3 mm hex nut (304) and 3 mm flat washer (307). Repeat this process for the other side.
- 4-5. Install a 4.5 mm i.d. washer (222) on both of the posts of the transverse lever assemblies, followed by the medium brass spacer (454) on both sides of the transverse lever assembly posts.

- 4-6. Install bearing (467) on to the collective control system as shown in the diagram, followed by the short brass spacer (455), followed by the flanged bearing (456), aileron bell crank (457), second flanged bearing (456), second short brass spacer (455), and finish with the 4 mm lock nut (401). Tighten only enough to ensure smooth operation.
- 4-7. Install the elevator control arm (453) next, the special 4.5 mm i.d. washer (222) the elevator control arm (453). The elevator control arm (453) will need to be tightened once the swashplate is installed to ensure that the elevator control arm is 90 degrees to the level swashplate.
- 4-8. The two control rods (902) and two ball links (119) will be installed on both the right and left sides of the helicopter. The left control rod (902) attachment will be from the top hole of the "I" lever (449) to the vertical arm of the aileron bellcrank (457). The right control rod (902) and two ball links (119) will attach from the top of the "I" lever (449) to the center hole of the elevator control arm (453). Adjust the control rod lengths so that the "I" levers (449) and the elevator control arm (453) are parallel to each other, and the "I" levers (449) and the vertical arm of the aileron bellcrank (457) are parallel to each other.
- 4-9. Install the main brace (469) using two 3 x 10 mm bolts (310).
- 4-10. Install the landing gear by sliding the skids (465) through the landing gear struts (464), using four 3 x 5 mm hex set screws to lock the skids (465) into place. If the skids (465) are difficult to slide into the landing gear struts (464), apply hot water to the landing gear struts (464) to allow the skids (465) to pass freely. Measure and drill 3 mm clearance holes in the landing gear struts (464) to accommodate main frame mounting holes. Secure the landing gear struts (464) using four 3 x 20 mm bolts (320), four 3 mm flat washers (307) and four 3 mm locknuts (301).

Washout and Swashplate Assembly



BAG 5 Contents		
PARTS QUANTITY	PART NUMBER	DESCRIPTION
4	246	Conical Standoffs
1	499	Anti-Rotation Bracket
2	502	Radius Pins and Clips
2	503	Radius Links
1	505	Washout Base with Pins (508) Installed
1	507	Washout Pin Slider
1	515	Swashplate (consist of 511, 512, 513, and bearing 515)
1	516	5 mm Control Ball with 3 mm hole
1	517	Plastic Rider for Anti-Rotation Unit
BEARINGS QUANTITY	PART NUMBER	DESCRIPTION
4	247	Washout Mixing Arm Bearing
	515	Swashplate Bearing
HARDWARE QUANTITY	PART NUMBER	DESCRIPTION
20	119	Ball Link
5	301	3 mm Lock Nut
2	305	3 x 5 mm Hex Set Screw
1	307	Flat Washer
4	308	3 x 8 mm Bolt
1	320	3 x 20 mm Bolt
1	325	3 x 25 mm Bolt (Jesus Bolt)
8	504	Medium Control Balls
2	901	2 mm Control Rod (30 mm in length)
7	902	2 mm Control Rod (45 mm in length)

- 5-1. Install the anti-rotation bracket (499) using four 3 x 8 mm bolts (308) and four 3 mm locknuts (301).
- 5-2. The swashplate (514) and washout assembly (509) are pre-assembled. Slide the swashplate (514) on to the 10 mm main shaft (354) followed by the washout assembly (509). The washout assembly radius links (503) will snap on to two of the inner swashplate control balls (504). The washout pin slider (507) is installed on to the main shaft (354) next. Use two 3 x 5 mm hex set screws (305) to tighten the washout pin slider (507). Adjust the pin slider (507) flush with the bottom of the rotor head center hub (250) after the main rotor is installed. *Note: the washout pin slider (507) may need to have the small holes enlarged to accommodate the smooth feel you desire.* Attach the balanced rotor to the main shaft (354) using a 3 x 25 mm bolt (325) (12.9 hardness only) and a 3 mm locknut (301). *Note: Do not substitute and hardware in this kit. The hardware provided in this kit is 12.9 grade hardened steel. If you use cheaper hardware (i.e. 8.8 grade hardware), the potential for failure is great if used in high stress locations (such as the Jesus bolt).*
- 5-3. The control rods from the aileron bellcrank (457) to the "I" lever (449) and the elevator control arm (453) to the "I" lever were installed in chapter 4. These rods should have an assembled length (end to end) of 76 mm.

- 5-4. The control rod (901) from the washout mixing arm (506) to the flybar control arm (243) with ball links installed (119) should have a total length of 56 mm end to end.
- 5-5. The two control rods (902) that connect the transverse lever assembly (374) to the fore – aft position of the swashplate (514) should have a total length of 66 mm end to end.
- 5-6. The two control rods (902) that connect the see saw mixing arms (248) to the center balls of the swashplate (514) should have a total length of 78 mm end to end.
- 5-7. The single control rod (902) that connects the left side of the swashplate (514) to the aileron bellcrank (457) should have a total length of 70 mm end to end.
- 5-8. The single control rod (902) that connects the throttle servo to the throttle of your engine will vary in length depending on the brand of engine used. Adjust the end to end measurement in order to obtain full throttle barrel movement.
- 5-9. The single control rod (900) that connects the collective pitch lever (450) to the collective servo should have a total length of 51 mm end to end.
- 5-10. The tail rotor control rod (605) will be adjusted with ball links (119) installed to an approximate length of 27.74 inches. This length may vary slightly depending on the servo used.
- 5-11. The anti-rotation assembly is installed last using a 3 x 20 mm bolt (320), a plastic sleeve (517), a conical standoff (246), a control ball (516), a second conical standoff (246), and finally a 3 mm washer (307). Locktite this assembly into place, after cleaning the receiving hole in the swashplate (514) with alcohol. Do not overtighten this assembly, or the plastic sleeve (517) will distort and prevent the swashplate (514) from rising and falling freely.

If you have an assembly question during this setup, call us (Precision Helicopters, Inc (334) 702-1738) or e-mail to fendley@tds.net

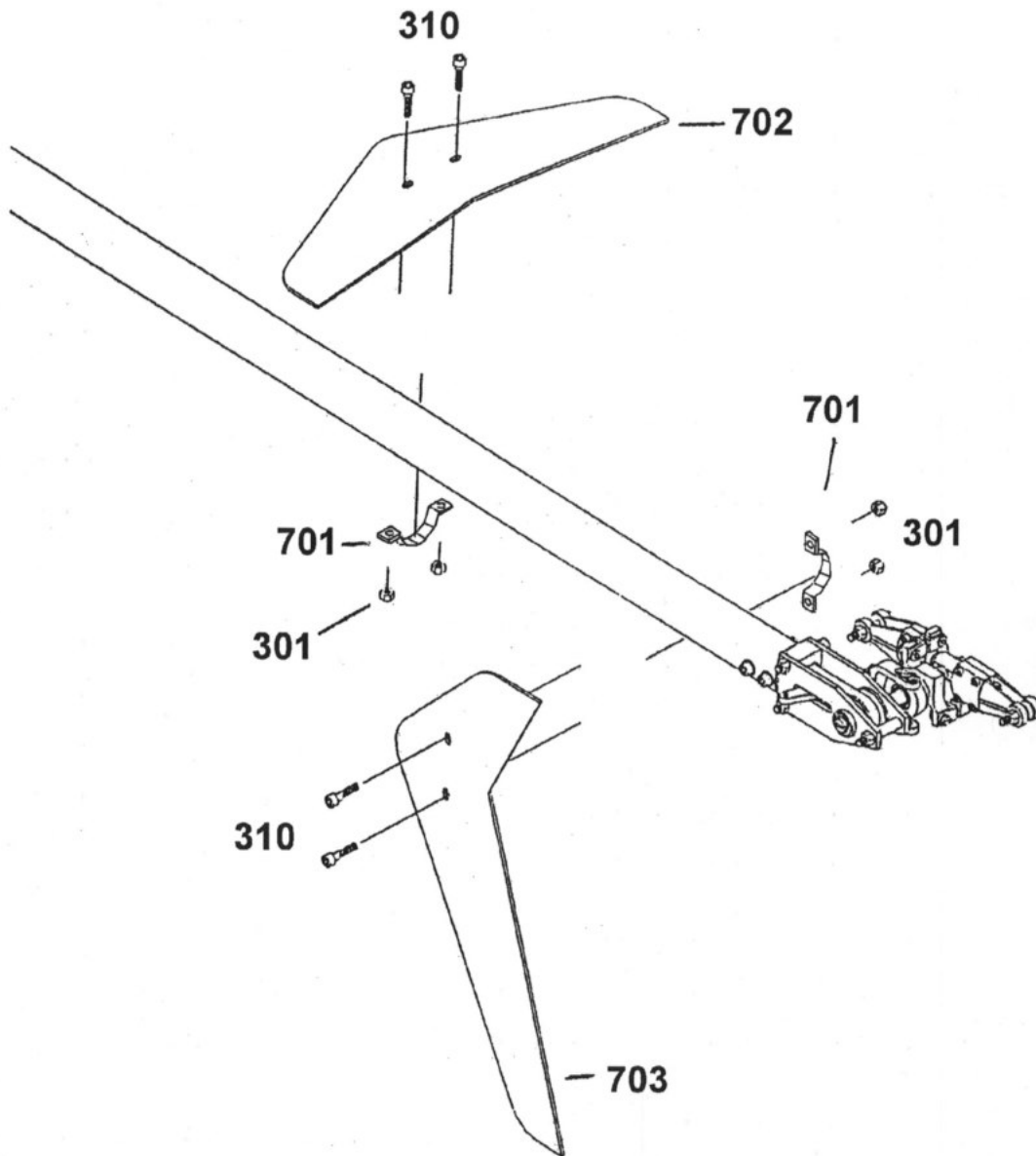
BAG 6 Contents (continued)		
PARTS QUANTITY	PART NUMBER	DESCRIPTION
2	622	Tail Rotor Drive Side Plate
1	623	High Strength Tail Rotor Belt (kevlar reinforced)
1	624	Spacer
1	625	Tail Output Shaft
1	626	Tail Rotor Aluminum Pulley
1	627	Tail Rotor Control Arm Mount
1	628	Tail Rotor Pitch Control Arm
1	629	Spacer
6	630	Special Bolt
2	631	Double End "U" Link
1	632	Tail Rotor Washout Assembly
1	633	CNC Steel Tail Rotor Hub
4	637	Tail Blade Grip Set (2 male / 2 female)
BEARINGS QUANTITY	PART NUMBER	DESCRIPTION
2	634	Tail Rotor Inner Bearing
2	636	Tail Thrust Bearing
2	638	Tail Rotor Outer Bearing
2	639	Tail Rotor Side Plate Bearing
HARDWARE QUANTITY	PART NUMBER	DESCRIPTION
10	204	2 mm Hex Nut
4	207	2 mm Flat Washer
8	210P	2 x 10 mm Pan Head Screw
1	212P	2 x 12 mm Pan Head Screw
1	250	2.5 mm Flat Washer
1	268	2.6 x 8 mm Bolt
5	301	3 mm Lock Nut
2	303	3 x 3 mm Hex Set Screw
4	306	3 x 6 mm Bolt
6	307	3 mm Flat Washer
4	307AL	3 mm Aluminum Flat Washer
2	320	3 x 20 mm Bolt
3	325	3 x 25 mm Bolt (Jesus Bolt)

- 6-1. Attach the tail rotor drive mount (621) to the tailboom (620) using four 3 x 6 mm bolts (306) and four 3 mm washers (307). Use a metal coat hanger that has been straightened with a small hook on the end to pull the nylon drive belt (623) through the tailboom (620) until an equal amount of the belt (623) protrudes from either end of the tailboom (620).
- 6-2. Attach two tail rotor side plates (622) with tail rotor side plate bearings (639) installed to the tail rotor drive mount (620) by passing two 3 x 25 mm bolts (325) through the tail rotor control arm mount (627), through one of the tail rotor side plates (622), through the tail rotor drive mount (620), into the second tail rotor side plate, and secure with two 3 mm locknuts (301). Place the aluminum tail rotor pulley (626) between the tail rotor side plates (622), making sure the pulley (626) engages the drive belt (623) and pass the tail rotor output shaft (626) through the side plate bearings (639) and pulley (626).

Lock the pulley (626) on to the tail rotor output shaft (626) with two 3 x 3 mm hex set screws (303). Pass a third 3 x 35 mm bolt (325) through one of the tail rotor side plates (622), through the 3 mm spacer (624), and on through the other tail rotor side plate (622), securing with a 3 mm locknut (301).

- 6-3. Attach the pitch control arm (628) with a 2 x 12 mm pan head screw (212), two 2 mm washers (207), the 2 mm spacer (629), and finish with the 2 mm nut (204). Tighten only enough to provide *smooth operation*.
- 6-4. Attach the tail rotor washout base (632) to the pitch control arm (628) using two special screws (630) and two 2 mm washers (207). Tighten only enough to provide *smooth operation*.
- 6-5. Assemble the tail rotor grips. Slide the bearings on to the tail rotor hub (633) in the following order: tail rotor inner bearing (634), tail rotor thrust bearing (636), tail rotor outer bearing (638), 3 mm washer (307) and 3 mm locknut (301). Surround the bearing assemble with the two halves of the tail rotor blade grip (637) (use on male and one female half) and secure using four 2 x 10 mm pan head screws (210P). Attach a tail rotor blade (not included) to the grip (637) with a 3 x 20 mm bolt (320) and 3 mm locknut (301). Repeat this process to build the other blade grip.
- 6-6. Screw the balanced tail rotor assembly (with blades) onto the tail output shaft (625). Attach the two control arms (631) to the tail rotor blade grips (637) and washout base (632) using four special screws (630). Tighten only enough to provide *smooth operation*. The proper orientation of the tail rotor blade is when the main rotor head is turning clockwise results in the tail rotor turning counterclockwise when viewed from the right side of the helicopter. The tail rotor blade should be positioned so that the leading edge is turning into the main rotor disk while turning counterclockwise.
- 6-7. Attach four boom mounts (701) to both side frames using four 3 x 35 mm bolts (335) and four 3 mm locknuts (301), do not fully tighten yet. View through the tail boom by pointing the forward portion of the tail boom at a light source. Ensure that the belt (623) is not twisted. Rotate the belt 90 degrees to the right and maintain that position as you slide the boom (620) through the two tail boom mounting brackets (602) and slide the belt (623) over the tail rotor drive gear (390). Pull aft on the tail boom (620) to increase the tension on the belt (623). The proper tension for the belt (623) is reached when the belt will not quite reach the centerline when pushed to the center. Make sure the tail rotor output shaft (625) is perpendicular to the main shaft (354). Tighten the 3 x 25 mm bolts (325) passing through the tail boom mounting brackets (602) until the tail boom (620) is secure.

Tail Boom Attachment



BAG 7 Contents		
PARTS QUANTITY	PART NUMBER	DESCRIPTION
1	700	Fuel Tank
2	701	Hexagonal Fin Clamp
1	702	Horizontal Fin (G-10)
1	703	Vertical Fin (G-10)
1	704	Pickup set for Fuel Tank
HARDWARE QUANTITY	PART NUMBER	DESCRIPTION
4	301	3 mm Lock Nut
4	310	3 x 10 mm Bolt

- 7-1. The fuel tank enclosed has a removal cap. Inside the fuel tank you will find the necessary hardware to completely assemble your fuel tank.
- 7-2. Make sure you install your engine and muffler before installing the fuel tank. If you are using a Hattori style muffler, the fuel tank can only protrude a small amount on the other side of the main frames.
- 7-3. The Tornado II fuel tank is designed to be retained on the helicopter by placing the fuel pressurization and fuel pickup mounting holes on the top of the fuel tank outside of the frames. Once these fitting are installed, the fuel tank will be prevented from moving right and left.
- 7-4. Assemble the two boom braces (603) to both main frames using two 3 x 12 mm bolts (312) and two 3 mm locknuts (301).
- 7-5. Install the horizontal fin (702) using the hexagonal clamp (701), two 3 x 10 mm bolts (310), and two 3 mm locknuts (301).
- 7-6. Install the vertical fin (703) using the hexagonal clamp (701), two 3 x 10 mm bolts (310), and two 3 mm locknuts (301). Clamp vertically!

Servo Installation

BAG 8 Contents		
PARTS QUANTITY	PART NUMBER	DESCRIPTION
3	801	Canopy Grommets
1	802	Canopy Thumbscrew
1	803	Lexan Canopy
1	804	Complete Instruction Manual
HARDWARE QUANTITY	PART NUMBER	DESCRIPTION
20	2512	2.5 x 12 mm screws
20	2512W	2.5 mm Flat Washer
20	2513	2.5 mm Hex Nut

- 8-1. Install your servos with the supplied 2.5 x 12 mm bolts (2512), 2.5 mm washers (2512W), and 2.5 mm hex nuts (2513). Locktite all hex nuts, because vibration will cause them to loosen. Install your servos as shown in the supplemental diagrams.
- 8-2. Assemble the canopy by trimming the edge of the two canopy halves, leaving about 3/8" flange around the edges to be joined.
- 8-3. Wash both halves of the canopy with soap and water before proceeding with gluing the canopy halves together. Clamp the canopy halves together using clothes pins or paper clips.
- 8-4. Cement the halves of the canopy together using one of the following glues: Clear silicone (RTV), Zap-A-Dap-A-Goo, slow epoxy, or slow CA glue.
- 8-5. Once the canopy has dried, trial fit the canopy on the helicopter. Make two 4 mm clearance holes over the two side canopy mounts and one 3 mm clearance hole for the bottom of the canopy.
- 8-6. Once you have determined the correct position to make the canopy nose straight and level, trim any excess canopy material that could cause interference with the control system.
- 8-7. Install the three canopy grommets into the clearance holes in the canopy. Additional material may need to be removed in order to install the grommets.
- 8-8. Once you have completed this procedure, clean and paint the outside of the canopy with your choice of model fuel proof paint.

Final Assembly

- 9-1. Seek out an experienced helicopter pilot in your local area to assist you with the pitch curve and throttle curve radio set-ups for your particular skill level. If you are just starting the new hobby of model helicopters, we recommend that you purchase helicopter manuals such as Ray's Complete Helicopter Manual by Ray Hostetler.
- 9-2. **Warning:** The Tornado II rotor head design allows you to apply positive or negative pitch in either direction. By flipping the see saw mechanism you can run the pitch control arms on the leading edges of the blades.
- 9-3. We recommend flying only high quality carbon main rotor blades or high quality fiberglass rotor blades. Assemble any rotor blades strictly according to the manufacturer's recommendation.
- 9-4. Contact the Academy of Model Aeronautics at 1-800-435-9262 for insurance information and for flying clubs near you.

