

PANTERA 50



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WARNING

You are about to embark on a wonderful adventure into the world of remote controlled (R/C) models. However, this helicopter model is not a toy and is not suited for children. A properly assembled and operated remote controlled model helicopter can bring many hours of enjoyment and pleasure, but even if properly assembled and operated, the nature of an R/C system means the radio-link between transmitter and receiver may fail, in which case even competent operators are no longer in control. In addition, due to operator neglect or accident, worn or damaged parts may cause bodily harm and/or death as well as property damage. In addition, the overall mass of the model in motion means contact with non-rotating parts may cause bodily harm and/or death as well as property damage

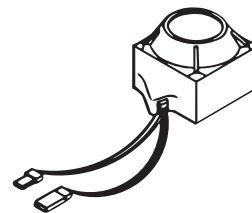
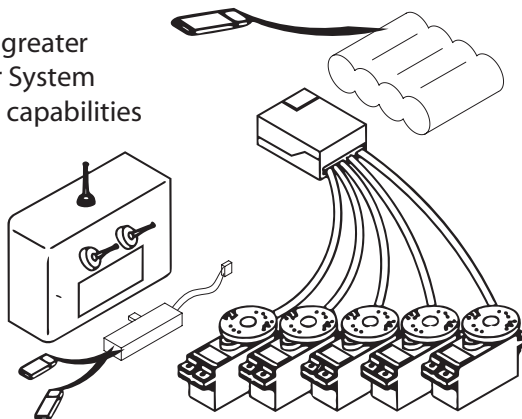
You, and you alone, are responsible for the safe operation of this R/C model helicopter and Audacity Models assumes no liability for harm or damage that could occur from the assembly and/or use/misuse of this product. This manual does not serve as a final and total instruction in the safe and proper assembly and operation of remote controlled model helicopters. Always have personal supervision by a modeler experienced in the safe and proper handling of R/C model helicopters.



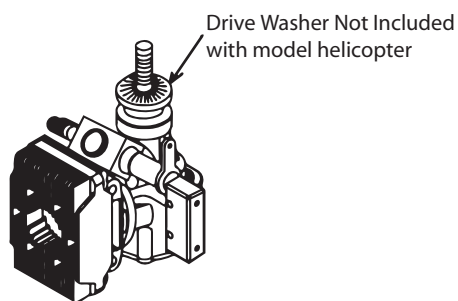
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Items Needed To Complete The Model

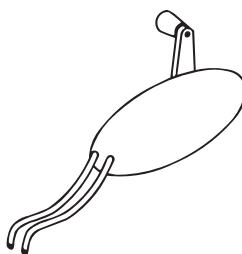
6-channel - or greater
R/C Helicopter System
w/120° CCPM capabilities



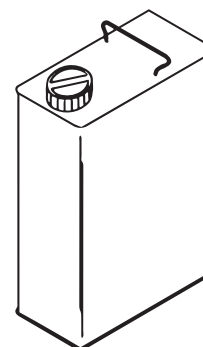
Gyroscope



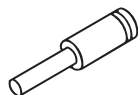
50-class Glo-Fuel Engine



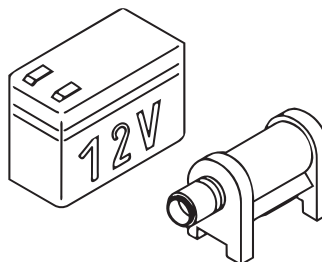
Glo-Fuel Pump



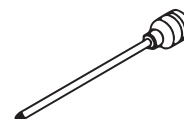
Helicopter Fuel
(15%-30% Nitro)



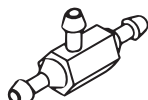
1.2V Ni-Start Battery



12V Gell-Cell Battery
and Electric Starter



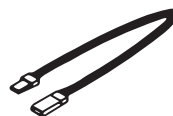
6mm Hex Start Shaft



Fuel Filter
(3-way)



12" Fuel Tubing
(1/8" Silicone)



Servo Extensions
(2 each - 4" Long)



Cyclic/Collective
Servo Control
Horns (x3)





Some Tools Needed For Assembly



Phillips Screw Driver



Nut Drivers (4mm/5.5mm/7mm)



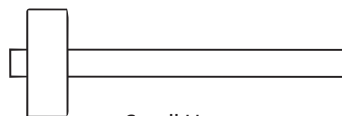
Allen Drivers (1.5mm/2mm/2.5mm/3mm)



Drill Bit 1/16"



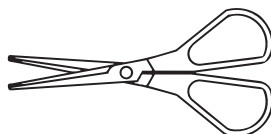
Auger - or - Reamer



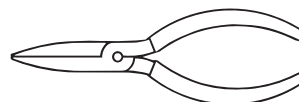
Small Hammer



Wrench (5.5mm/6mm)



Lexan Scissors



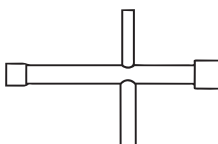
Needle-nose Pliers



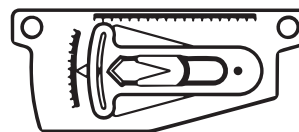
Hobby Knife



Ruler (metric) Greater Than 30cm



4-way Wrench (8-12mm)



Pitch Gauge

Thread Locker Is Used To Keep Assemblies Tight As Vibration May Cause Them To Loosen



Semi-permanent
BLUE Thread Locker

Due to the vibrations caused by operation, nuts, bolts, and set screws may have a tendency to loosen. Repeated tightening is not the solution, instead, the careful application of thread locker is required. Thread locker works something like a glue. There are various types of thread locker, from permanent types which are usually RED in color, to semi-permanent types which are usually BLUE in color. BLUE thread locker is what is recommended. Thread locker is not needed with nylon-lock nuts, nor where metal screws thread into plastic. Finally, be careful to remove all traces of oil or grease by applying a degreaser or acetone to bolts prior to assembly - clean with a paper towel until all traces are gone.

NOTE: Use care when using thread locker near bearing areas as contamination may ruin the bearing and cause it to seize.
Never use thread locker on metal to plastic

Optional Tools and Accessories:

- Dial Indicator
- Ball Link Pliers
- Piston Locking Tool
- Calipers
- 10mm deep-well thin wall socket
- 2 ea. - 5/16" or 8mm 1/4" drive socket
- 2 ea. - 1/4" drive short extensions and 1/4" handles or drives
- one sheet of thin typing paper



Identifying The Model's Hardware

All Audacity Models part numbers begin with AUD (our hobby trade association designator). To make it easy, hardware uses dimensions (dia & length) followed by type. Nuts and washers are identified by their purpose diameter (ID) and type. Thus, it's easy to decode Audacity Models hardware by "reading" the part number. For example, an AUD2615AH is an Audacity Model 2.6mm x 15mm Allen Head bolt. Notice how the diameter is expressed in two digits to allow for an intermediate diameter other than a whole number, i.e. 26 means 2.6 mm diameter while the next two numbers allow for less than 10 mm via leading with a 0, i.e. an 08 = 8mm. Below are the Follow Codes and some further examples to help you get the hang of it.

AUD2008PH



- ① AUD = Audacity Models
- ② 2008 = 2.0mm x 08mm
- ③ PH = Phillips Head

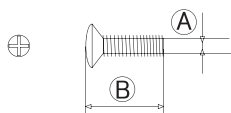
③ Follow Codes

AH = Allen Head Bolt
 SB = Shoulder Bolt
 BH = Button Head Bolt
 PH = Phillips Head Screw
 ST = Self Tapping Screw
 SS = Set Screw

TR = Threaded Rod
 LW = Lock Washer
 FW = Flat Washer
 NL = Nylon Locking Nut
 HN = Hex Nut
 PN = Push Nut

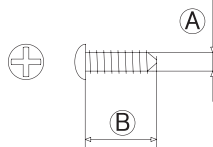
AUD2008PH

M2x8 Phillips Head Screw



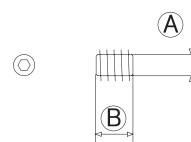
AUD2008ST

M2x8 Self tapping Screw



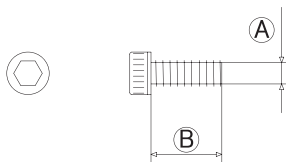
AUD4004SS

M4x4 Set Screw



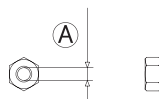
AUD3012AH

M3x12 Allen Head Bolt



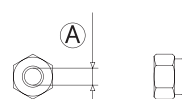
AUD20HN

M2 Hex Nut



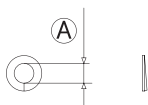
AUD30NL

M3 Nylon Locking Nut



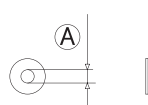
AUD30LW

M3 Lock Washer



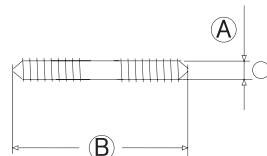
AUD20FW

M2 Flat Washer



AUD2315TR

M2.3x15 Threaded Rod



Before You Begin Assembly

The semi-kit concept and how it saves you time!

As you work your way through the manual you'll discover that many, many of the parts have been pre-assembled for you. Traditionally, model helicopters have been available in two forms. The *kit*, in which you assemble every single component and the Almost-Ready-to-Fly, or ARF model, where it's all done for you. The either-or problem is kits are tedious to build and ARFs leave you not knowing how to make repairs. The audacious solution is the *semi-kit*. By pre-assembling some components for you - building the Pantera 50 is both fun and fast . . . but without the tedium. More importantly, when the inevitable happens, you'll have the knowledge of how to make the repairs! These are some of the components we've pre-assembled for you.



The head has been pre-assembled. This includes everything on the CNC-machined 6061 aluminum head block - like the main rotor blade grips, urethane dampers, thrust and radial bearings, plus spacers, washers, etc. Even the seesaw and the seesaw arms are assembled!



By pre-assembling the clutch bell, the bearing has been accurately pressed into the bottom of the bell. The liner material has been trimmed and epoxied in place. Plus the pinion gear has been threadlocked to the bell and the support bearing has been pressed onto the gear.



CNC-machined of a solid billet of 6061 aircraft aluminum, the fan hub and cooling fan are pre-assembled, (note the lovely airfoil shaped blades). We torqued these bolts evenly so the assembly is smooth running and true - also note the high-end dual-cone mounting system!



The autorotation one-way clutch assembly has been pre-assembled - complete with hardened sleeve, one-way clutch, washers, and snap ring. Then it's been assembled to Main Gear 1 and torqued as well (to avoid distorting the gear.)



The swashplate is replete with tiny balls and screws. And these itty bitty parts can easily slip and bounce onto the floor - never to be seen again! Granted, pre-assembling this unit is a modest time saver for you - but it's done!



By pre-assembling the washout base with the washout arms and links, we've not just saved you time, but we've also ensured these precise small parts are properly assembled. While it's not particularly difficult to do, it's aggravating to deal with, so we do these for you as well.



Pre-assembling the linkage rods is one of those dreary tasks you'll be glad we've done for you. The lengths are spot on to boot. Frankly, this is one of those tedious tasks which leads to Carpal Tunnel Syndrome . . . so trust us when we say your poor wrists will thank us!



The clutch is a deceptively simple pe-assembly. What we've done is to use our press to insert the 6 mm ID one-way clutch within the engine's clutch shoe unit. No big deal really because you can do it easily . . . but only if you have a small press because this is just not one of those jobs created for a hammer!

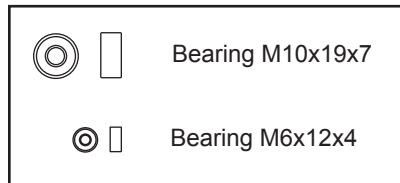


Pre-assembling the spring pin through the aft tail belt pulley and into the tail output shaft is actually pretty easy. All you need is a block of wood and a special tool. The tool, a 2 mm drift, is difficult to come by. While they're available from us - part number PDR0095, \$8.99 - the problem is most folks don't realize they need the tool until after they have the heli. Also, the tail pitch plate uses a left-hand, i.e. a reverse pitch thread so folks get it wrong easily as well. We've even preassembled the pitch links for you!



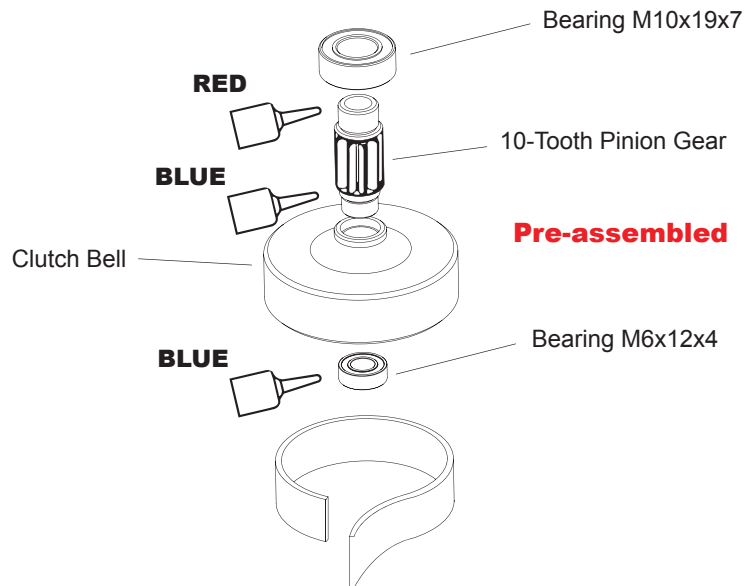
Step 1 – Clutch Bell Assembly

There are two bearings used in this assembly. They are a press fit onto the steel pinion gear as well as into the clutch bell. Since most modelers don't have a press, we have pressed them into place for you. These are the steps; ensure there's no swarf (tiny metal shavings from the machining process) on the parts. Make sure a precise alignment exists between the pinion gear and bearing and between the bearing and the clutch bell itself before operating the press. Also, regardless of which brand of threadlocker you use, take special care to prevent it from entering the bearings!



*** PRO TIP** - we've also had success with an adhesive like **JB Weld®** (24-hour cure, not the JB Kwik®) steel-filled epoxy instead of the RED (permanent) thread locker prior to pressing the upper support bearing onto the pinion gear. But, if you go this route, you must first roughen the inner race of the bearing so that there's a better mechanical bite by the adhesive. We recommend use of a Dremel® tool and a **Roto-Zip® Tile Cut Zip Bit #TC1**. Thoroughly clean everything with acetone before assembly. Then put a thin coat of the epoxy on bearing's inner race (or use RED thread locker) and then a heavier coat on the pinion. Use blue threadlocker for the clutch bell bearing. Lastly, invert the assembly onto a small piece of wax paper (bearing down) to protect the surface of the table and let everything sit overnight to cure.

There will come a day when you want to remove the bearing. At this point it's no good so the judicious application of heat, which would ruin it otherwise, via a plumber's torch, is just what the doctor ordered. Anyway, just heat it up, which will soften the adhesive, and using a rag to grasp it, pull and it'll come right off!



Electrical tape wrapped around the clutch

Installing a Clutch Liner

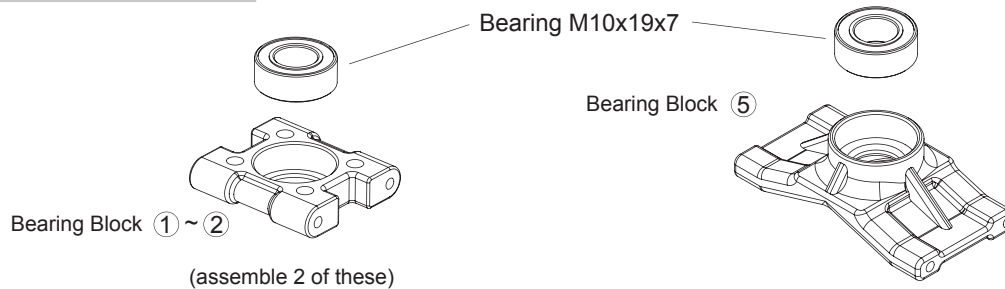
The clutch liner has been preinstalled for you. When you find yourself replacing a liner, these are the steps you'll take. Dry fit the clutch liner because it may be a tad long (not always, sometimes). Don't trim it though unless you really have to because it is easy to trim too much. Next, take the clutch unit and wrap it a couple of times with electrical tape and fit it into the clutch bell so that it's a tight fit against the liner. What you're looking for is the clutch unit wrapped in tape to hold the liner tightly against the wall of the clutch bell. Maybe it takes three or four wraps; this depends on the thickness of your tape and how much you stretched it. Finally, mix up **JB Weld®**, again, the real stuff not the JB Kwik®, and after mixing, smear it lightly (and evenly) on the inside of the aluminum clutch bell, followed by a similar smearing on the clutch liner. Then install the liner into the clutch bell. Wipe off excess adhesive with an alcohol soaked paper towel, then pop in the preprepared clutch unit (prewrapped with the tape) so that it applies even pressure around the circumference of the clutch liner. Set it aside until it cures (the next day). By the way, wear disposable gloves when working with epoxy partly because it can be messy but mostly because epoxy's effect on the human system is cumulative and permanent (so don't waste any of your body's "epoxy-tolerance clock" by getting epoxy on yourself unnecessarily). Finally, epoxy clean up is easily accomplished with denatured alcohol.



Step 2 – Bearing Block Assemblies

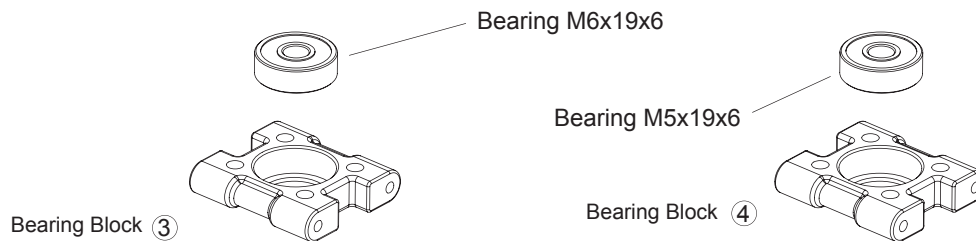
The Pantera 50 has removable bearing blocks, which are a feature of top of the line 90-class models! There are 3 supporting the main shaft and 2 more for the tail pinion gear assembly. Thus, not only do frames last longer than models with bearing seats molded into the side frames, but swapping out a main shaft bearing becomes a simple matter of removing four bolts versus having to split the entire side frame assembly - saving time when you replace bearings!

Main shaft blocks - 3 each



* **NOTE:** Bearing blocks 1,2,3, and 4 are exactly the same. Only which bearing is installed in which block is different.

Tail drive pinion shaft blocks - 2 each

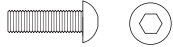


During aggressive 3D flight, the bearings supporting the Pantera's hardened 10 mm tool-steel hollow main shaft (a much harder material than stainless steel, and the same diameter as that found in a 90-class X-Cell) leads a rather tortured existence. Pantera's main shaft bearings are 40% wider than some competing model helicopters use. Also, because the Pantera features 3 main shaft bearings instead of 2, the ensuing flight loads (those transferred to the frame) are greatly reduced resulting in increased service life!

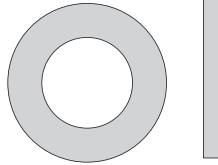


Main shaft bearings compared

Step 3 – Main Gear & One Way Clutch



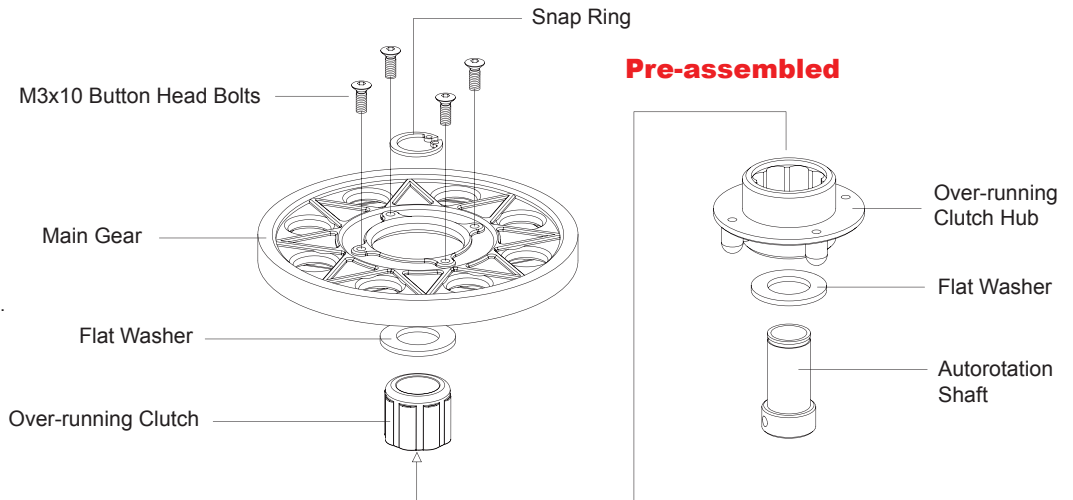
M3x10 Button Head Bolts (x4)



M21x12x2 Flat Washer (x2)

Be careful as you install the button head bolts. The goal is to tighten them evenly, but not so tight you strip the plastic hub.

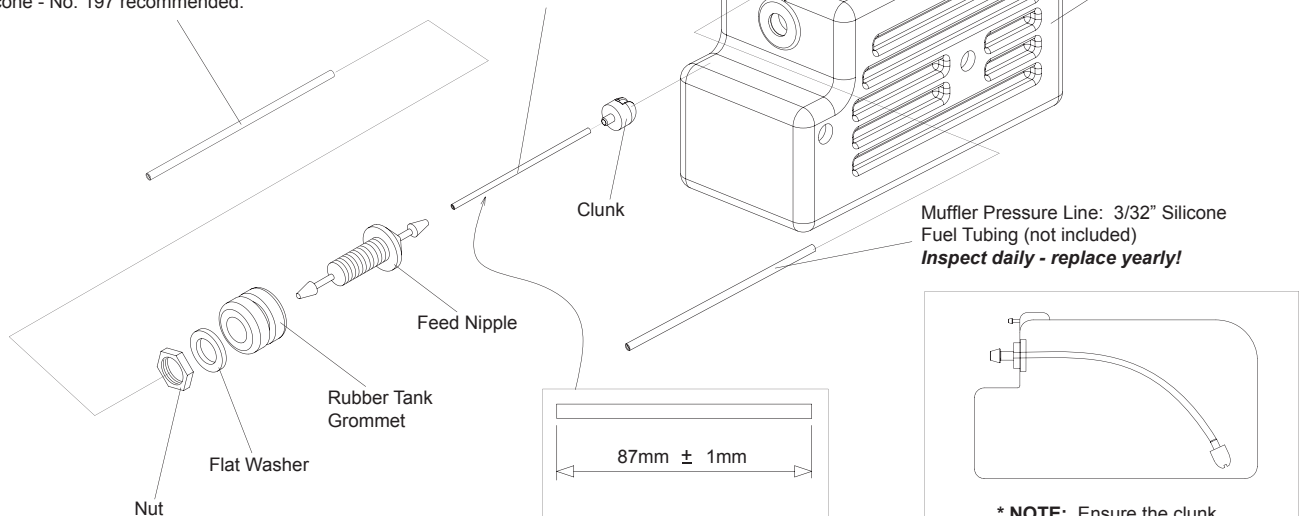
*** PRO TIP** - The autorotation assembly contains a one-way over-running clutch. It's commonly referred to as a one-way bearings amongst modelers. In reality it's a one-way clutch, not a bearing.



Step 4 – Fuel Tank Assembly

*** PRO TIP** - Fuel Feed Line: 3/32" Silicone Fuel Tubing (not included) - Du-Bro® Medium (blue) Silicone - No. 197 recommended.

*** PRO TIP** - Fuel tubing inside the tank is degraded over time due to a compound of the exhaust fumes. When using muffler pressure, after the last flight, fill the tank to the top with fuel and then drain it back out. The exhaust residue will be purged and the flex line will last much longer.
Inspect and replace regularly!



We've been asked why the Pantera 50 fuel tank has ridges molded into the sides. They're present because some engines, notably the YS brand, create quite a bit of pressure. Tanks without the reinforcing ridges swell up and resemble a balloon, and are in danger of bursting!

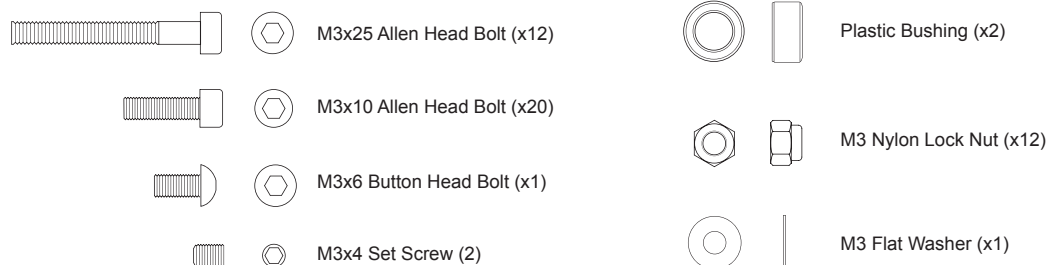
*** NOTE:** Fuel pickup line length is critical, measure carefully!

*** NOTE:** Ensure the clunk swings freely by providing a minimum 1/16" of clearance from the aft fuel tank wall.



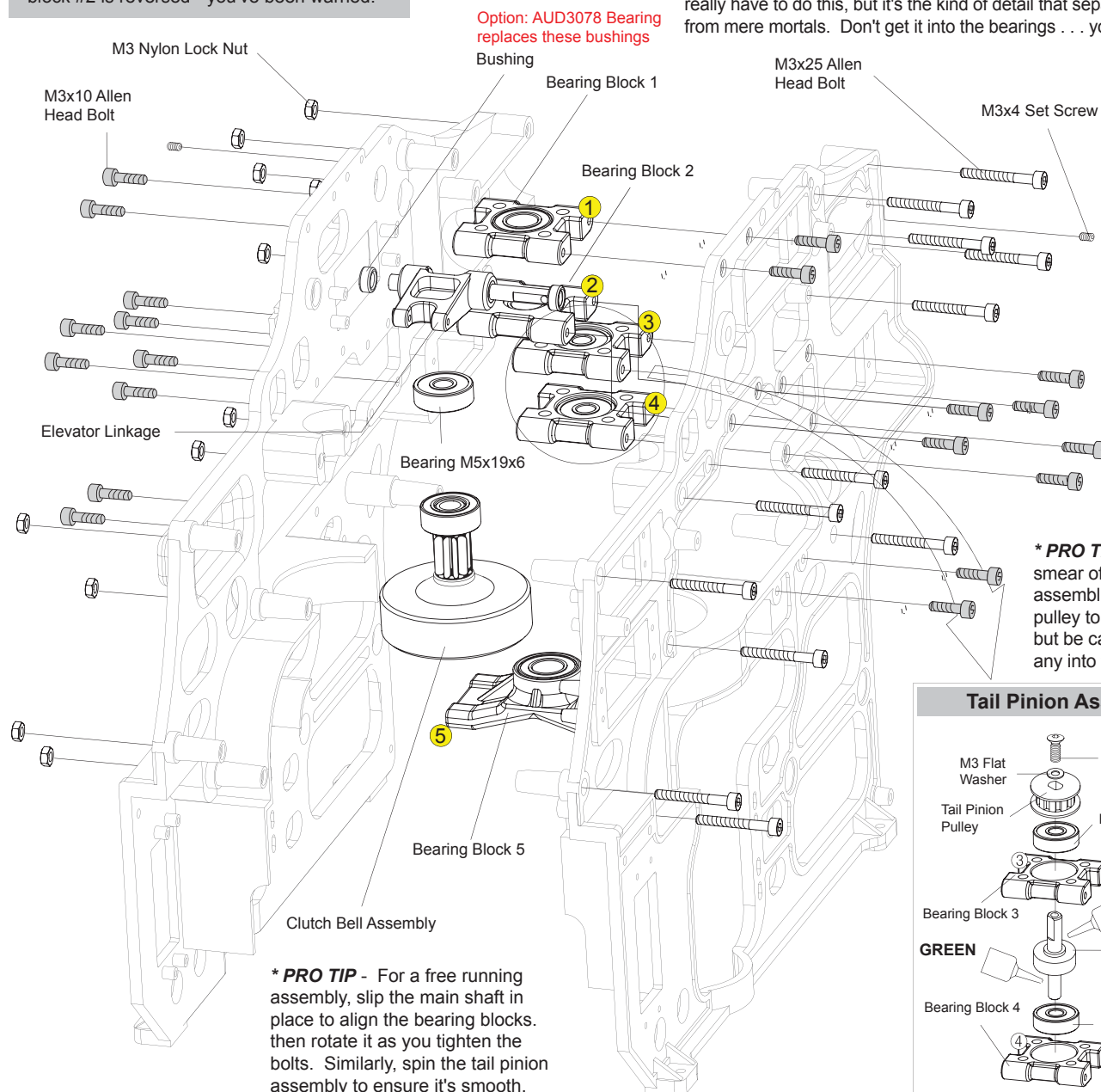
Step 5.1 – Main Frame Assembly

*** NOTE** - The main frame is a complex assembly. Study the two related pages - being careful to install the fuel tank rubber supports and placing the fuel tank into position before completing the joining of the two frame halves.



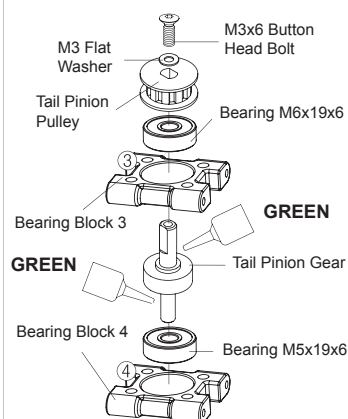
*** NOTE:** Bearing blocks 1,2,3,and 4 are the same. However, the orientation of bearing block #2 is reversed - you've been warned.

*** PRO TIP** - Black CA, which is rubberized and known by the trade name of IC-2000 makes a wonderful adhesive to secure the bearings within the bearing blocks - but wipe the bearing down with acetone first. You don't really have to do this, but it's the kind of detail that separates the pros from mere mortals. Don't get it into the bearings . . . you've been warned!



*** PRO TIP** - Use a light smear of thick CA before assembling the tail pinion pulley to the pinion shaft, but be careful not to get any into the bearing!

Tail Pinion Assembly



Step 5.1 – Detail Photos



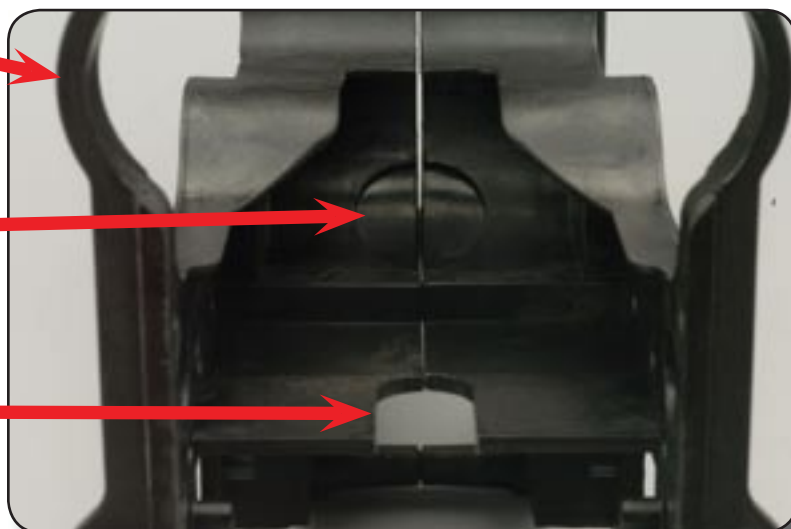
Note how much "meat" there is for the servo screws. We've been known to ditch the servo manufacturer supplied coarse thread screws in favor of optional AUD2015AH (M20x15) Allen Head machine screws because it's easier to snug the servos down to the side frame without deforming the brass eyelets and thereby not crushing the rubber grommets, which are used as isolation dampers. The rubber dampers protect the servos from high frequency vibrations.

It's a small touch, but there are actually two servo mounting boss patterns molded into the side frame at the forward accessory servo mounting position. On the right hand side frame a standard servo for the main needle valve is typically fitted. But on the left side frame, either a standard servo or the large mount of the typical 180° retract servo may be used. The latter servo is typically used for the retractable landing gear of a Bell 222, or even to control the spotlight as used on a law enforcement Hughes 500.

We've opened the side frame up to permit sufficient clearance for the fan assembly. As a result, if you hold your tongue just right you can quickly and easily remove the engine without first dropping either the fan/clutch or landing gear struts. This saves time!

In loosely fitting the sideframes together, it allows you to easily see where the cooling shroud is to be trimmed to permit installation of the air filter snorkel. The material is significantly thinner at this spot in the side frames in order to make the job easier.

Cooling air loss at the slot for the glow plug igniter can be a problem for cooling an engine during really hot summer days and hence, we've kept this slot pretty tight. Fortunately, it's easy enough to open it up, if needs be, to allow you to use one of those large spring loaded glow plug clips - if one of those is what you like, of course.

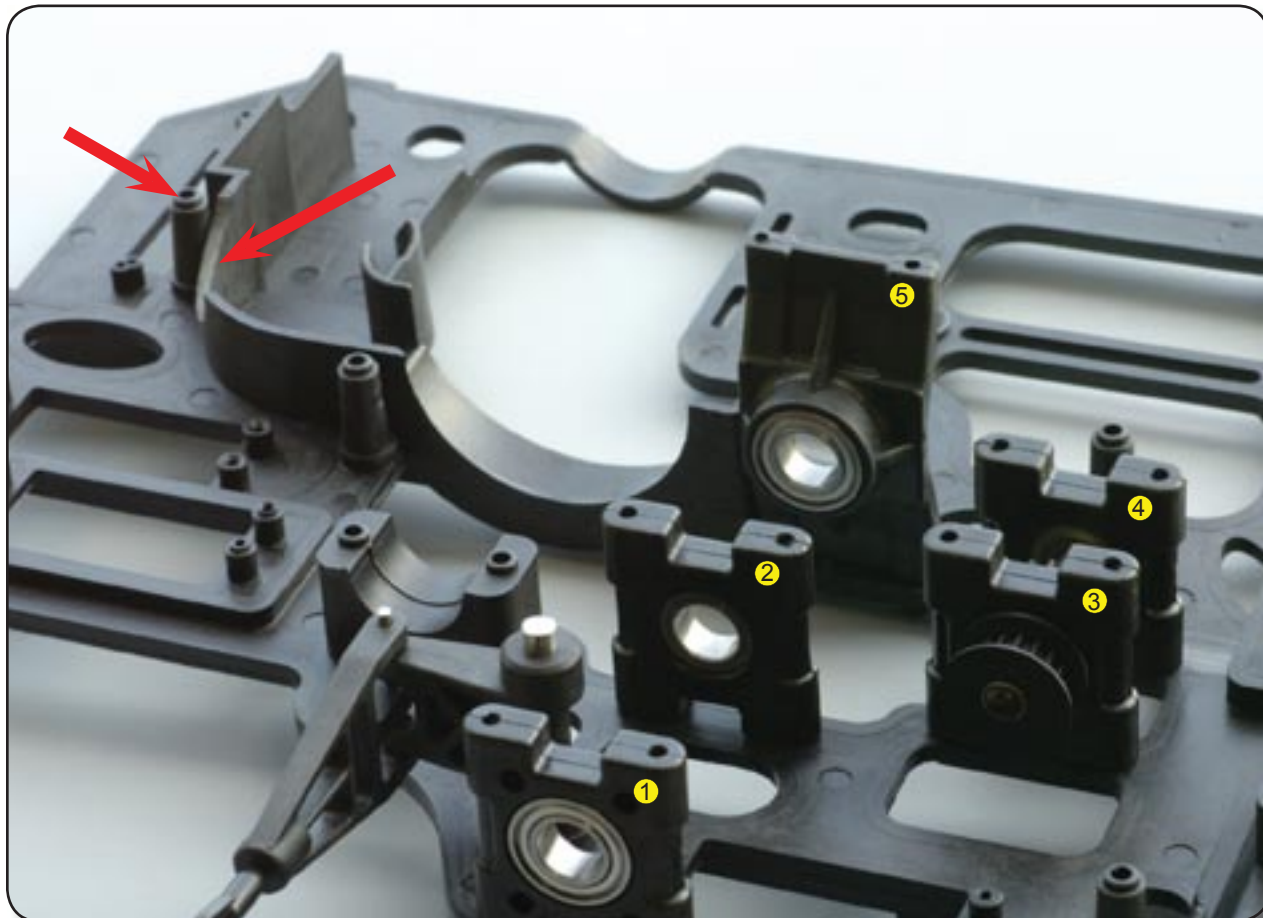


Fitting the supplied air filter assembly (the "snorkel" and air filter) is a matter of just trimming the cooling shroud. Whilst this is a photo of an early candidate for the air filter assembly - we ended up molding it in clear material versus black, and supplying a much larger filter element (for increased preventive maintenance intervals), you can see just how this assembly is attached to the engine. By the way, the 16mm OD of the carb of the OS Max 50SX Hyper shown is the same as that of the 61-91 series of engines with, which we've tested the snorkel without any power loss whatsoever! The reason the system works so well is the short section of the snorkel within the cooling shroud is molded with an efficient aerodynamic teardrop shape. As a result, the temperature rise at the front of the head, caused by the blocking effect of the snorkel, is a mere 10°, which is nothing in the grand scheme of things vs. the 50° rise the aft part of the cylinder head experiences. The real benefit is cooler, more dense air is supplied to the engine (allowing it to make more power) without the dust and abrasive clutch liner dust which wears it out. After run oiling via the snorkel is sweet too!



Step 5.1 – Detail Photos - continued

*** PRO TIP -** Be careful to not cut too far when fitting the snorkel - also, one arrow points at the post, which is usually in danger when you're trimming the side frame - you've been warned! Also, assembling components to one side frame ahead of time makes life easier. After you're satisfied with the alignment of all the components (the trick of using the main and pinion shafts to align the bearing blocks mentioned previously), you may complete the assembly by securing the other frame half in place. By the way, if you're using a header tank, now's the time to bolt it to the right frame half. Also, don't forget the elevator linkage, and if you want to use the optional AUD3078 bearings instead of the bushings, now's the time to fit them as well.



*** NOTE:** It's hard to see the bearing orientation within the blocks in the assembly drawing, but the bearing in block number 2 is inserted from the bottom. The rest of them (blocks 1, 3, 4, and 5) have the bearing inserted from the top (except as noted below).

There's an alternative method of mounting the upper block, for the tail pinion shaft, number 3, which results in creating about 2mm extra clearance between the servo case and the screw head. It's quite simple in that all you do is reverse the top block, number 3, so the bearing installs from the underside (instead of from the top). The downside is the tail belt subsequently runs ever so slightly lower than dead center within the tail boom, which hasn't caused us any grief, but we figured you should know it. Anyway, eyeball the two pictures to the right to see just how much extra clearance we're talking about, to judge if you want to do it this way, or not.

*** PRO TIP -** We use acetone to degrease the main shaft and the tail pinion shaft, as well as the inner race of the bearings, and use threadlocker to secure the inner race to the shafts. The downside is removing the bearings later becomes a pain in the rear, but it's nothing a little application of heat won't resolve. The payoff is a much smoother running model helicopter because the shafts won't ever spin within the inner race! It's a small touch, but it's one, which separates the pros from everyone else.



Conventional mounting - insert both bearings from above



Invert block number 3 - insert bearing from below



Step 5.1 – What can go wrong!



This doesn't look promising does it? During the course of a few flights, the main gear 2 has been riding up against the edge of the main frame. Predictably, the gear is wearing into the main frame. It's time for a little sleuthing to see what we find!



Begin by removing the main shaft as well as the two main gears so that we can see what we have. On the left, the #1 bearing block looks normal. On the right, bearing block #5 is also looking perfectly normal. Other than some gear dust, we're OK.



Herein lies the problem. What's happened is bearing block #2 has been installed upside down. Thus, main gear 2 has been doing its best to lift the bearing out of the block. When you look at the block's reverse side you can how it's been ruined.



Looking at the outer edge of main gear 2 (left) we can clearly see where it's been wearing against the black plastic of the side frame. Look at the picture on the right, however, and you'll see how the gear wore itself a cone shape against the bearing block.



Step 5.1 – What else can go wrong!

Crash #1



Save your box! You'd be amazed how well a totally trashed model will fit right back into it. Frankly, this flight went very, very wrong and these are the sad remains. The servos survived as did the rest of the electronics, a great testament to the strong Panthera side frames!



All is not lost however as it was a great test of the ability of the air filter to save the engine in the model. And by the way, I had just squirted denatured alcohol all over this puppy - she was dripping dirt everywhere - when I realized the great photo op this represented.



Folks, dirt flew everywhere during the chicken dance and none of it made it into the engine! Just peek down the throat of the carb and see just how clean things are. Also, notice how the filter has got dirt all over it - and this is after it's been brushed off to boot.

Crash #2



Here's another example of how the air filter can save your engine. In this crash, the engine freewheeled, i.e. it ran at WOT (wide open throttle) without a load to speak of - yup, the chicken dance again - but the very abrasive clutch liner material didn't get ingested. Whew!



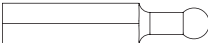



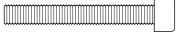







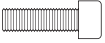













The clutch dust isn't a phenomena of just a Panthera. This will happen to the clutch liner material of any model helicopter as the coefficient of friction between the clutch shoes and the liner is exceeded while the engine is valiantly trying to blow itself up! See it on the fan?



Even inside the fan shroud is coated because this extremely fine, yet highly abrasive dust gets into ever nook and cranny! And if enough gets into your engine it's almost certainly trashed. Hence, the real value of the filter isn't just in day-to-day operations but during a crash.



Step 5.2 – Main Frame Assembly

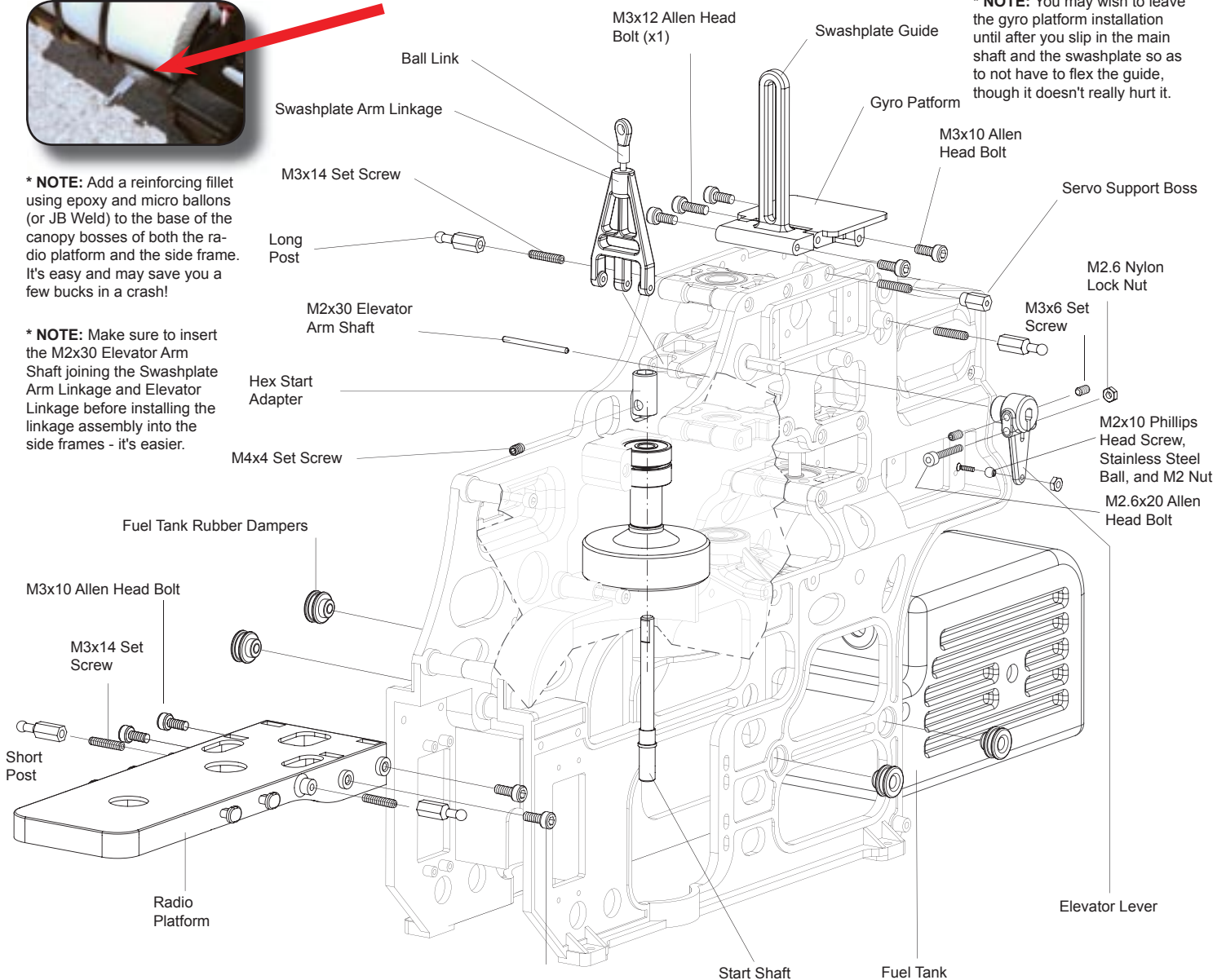
		Canopy Post LONG (x2)			Canopy Post SHORT (x2)
		M2.6x20 Allen Head Bolt (x1)			Servo Support Boss (x1)
		M3x12 Allen Head Bolt (x1)			M2.6 Nylon Lock Nut (x1)
		M3x10 Allen Head Bolt (x8)			M2 Nut (x1)
		M3x14 Set Screw (x5)			M4x4 Set Screw (x1)
		M2x10 Phillips Head Screw (x1)			M3x6 Set Screw (x2)
					Stainless Steel Ball (x1)



*** NOTE:** Add a reinforcing fillet using epoxy and micro balloons (or JB Weld) to the base of the canopy bosses of both the radio platform and the side frame. It's easy and may save you a few bucks in a crash!

*** NOTE:** Make sure to insert the M2x30 Elevator Arm Shaft joining the Swashplate Arm Linkage and Elevator Linkage before installing the linkage assembly into the side frames - it's easier.

*** NOTE:** You may wish to leave the gyro platform installation until after you slip in the main shaft and the swashplate so as to not have to flex the guide, though it doesn't really hurt it.

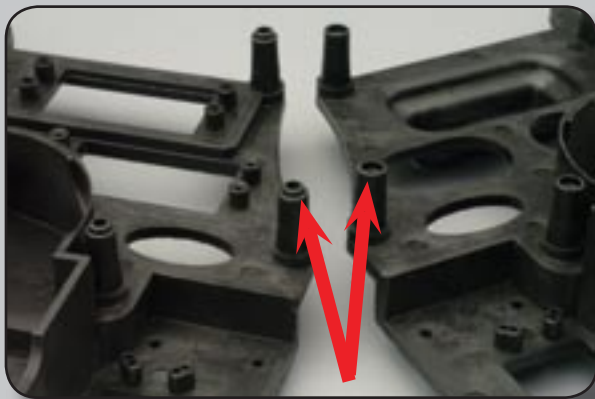


*** PRO TIP:** Mounting the servos now may be easier!

*** Note -** The single M3x12 Socket Head Bolt mounts opposite the aluminum Servo Support Boss

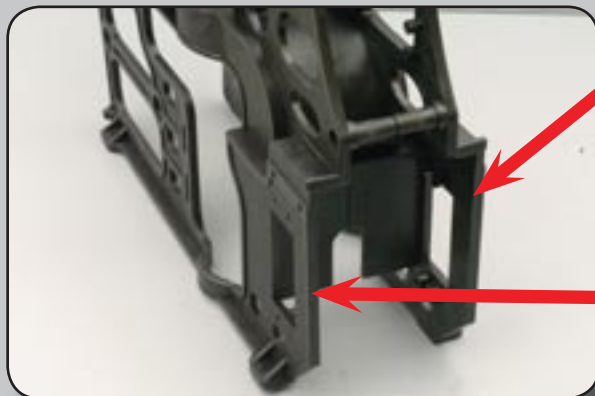
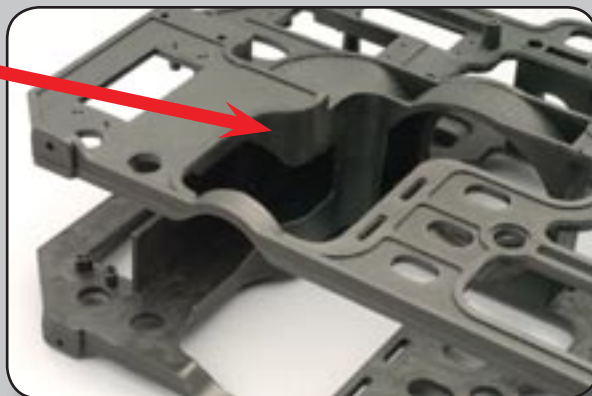


Step 5.2 – Detail Photos



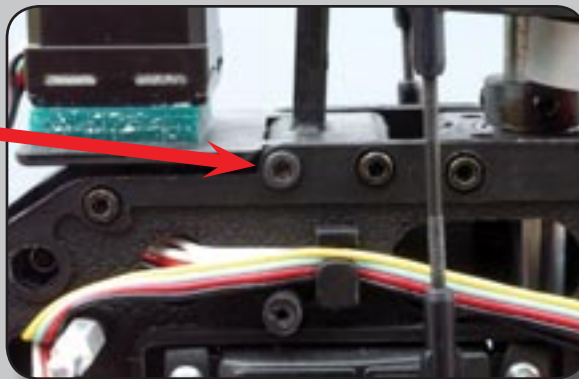
If you look closely at how the two halves of the side frames of the Pantera 50 come together you'll see we've employed a method very similar to that used in fine furniture, which is called tongue and groove. However, the technique has been updated for the injection molded plastic side frames and the resulting male and female guide pins deliver similar results, i.e. tremendous strength in shear. They lock the frame halves together . . . the round peg in the round hole really works! By eliminating relative motion via design, i.e. side-to-side movement between the halves and then using high quality Allen Head bolts to secure them, the Pantera 50 delivers an extremely rigid structure. This is the solid foundation upon which you'll build when performing the most aggressive of the 3D maneuvers like tick-tocks, funnels, and piro-flips!

Unlike competing 50-class models, the cooling fan shroud of the Pantera has been boxed in on the fourth side. Naturally, this is much more efficient than just leaving it open to spill cooling air. No trimming is necessary to fit the OS Max 50SX Hyper, but slight trimming may be necessary to fit big-block engines like an OS Max 61SX, a 70SZ, or even a torque monster like a 91SX. Use the optional AUD0062S Big Block Short Kit (mount and nut) for the 61 and AUD0062L Big Block Long Kit (mount, nut, longer boom and belt, as well as a 7.9:1 Main Gear1) for the 70 or 91. So if you live at high altitude, or are terminally power hungry, we have what you need to make a gonzo powerful 50-class heli. Yes, cooling becomes a more critical, so you'll need to run the mixture a little fatter to aid in cooling, but we've flight tested this in Las Vegas during scorching 106° days and it works just fine.

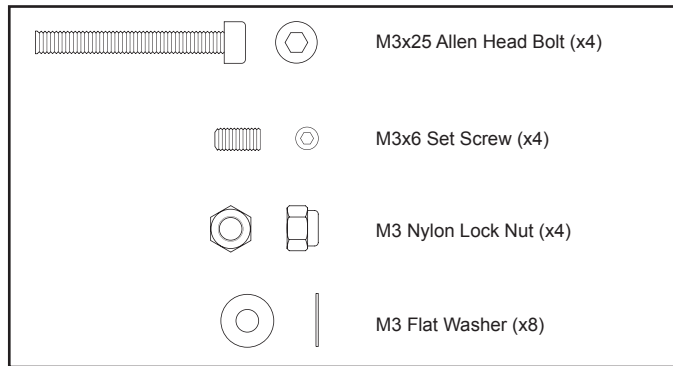


This photo of the front of the Pantera main frame assembly may help you more clearly see the nifty two front mounts for accessory servos. The one on the port side is available for use with a retract servo. Their 180° operating cycle is ideal for operating scale accessories as well. Similarly, the starboard mount is perfect for connecting a servo to the main needle valve of the engine, delivering tremendous benefits to the scale modelers in particular. That's because once the mechanics of the model are buried within a fuselage, the cooling flow of air, or the lack thereof, may pose more of a problem (depending on how tightly cowled everything is, of course). As a result, setting the the needle valve can be more fickle. Hence, with this servo, making an inflight adjustment can be a real life saver!

The problem with isometric drawings is they can be difficult for some folks to understand. While they're great at aiding in a clearer understanding of what goes where, they're also easy to get lost in. The purpose of this detail photo is pretty simple. Basically we want you to clearly see where the lone M3x12 Socket (Allen) Head Bolt fits. There are three bolts on the right side of the frame securing the two-piece gyroscope platform. Assembly is with M3x10 Socket head Bolts except for the middle of the three on this right side - as detailed in this photo. By the way, the left side of the model uses the AUD3014SS (M3x14 Set Screw) in the same location onto which is secured the CNC-machined 6061 aluminum Servo Support Boss.



Step 6 – Landing Gear Assembly



*** PRO TIP** - Replacing the Allen Head Bolts with a pair of zip ties in each of the four mounting holes will let the gear break loose in a hard arrival thereby reducing damage. Aggressive 3D pilots may also prefer the smaller AUD0033 landing gear struts because they're lighter and present less parasitic drag.

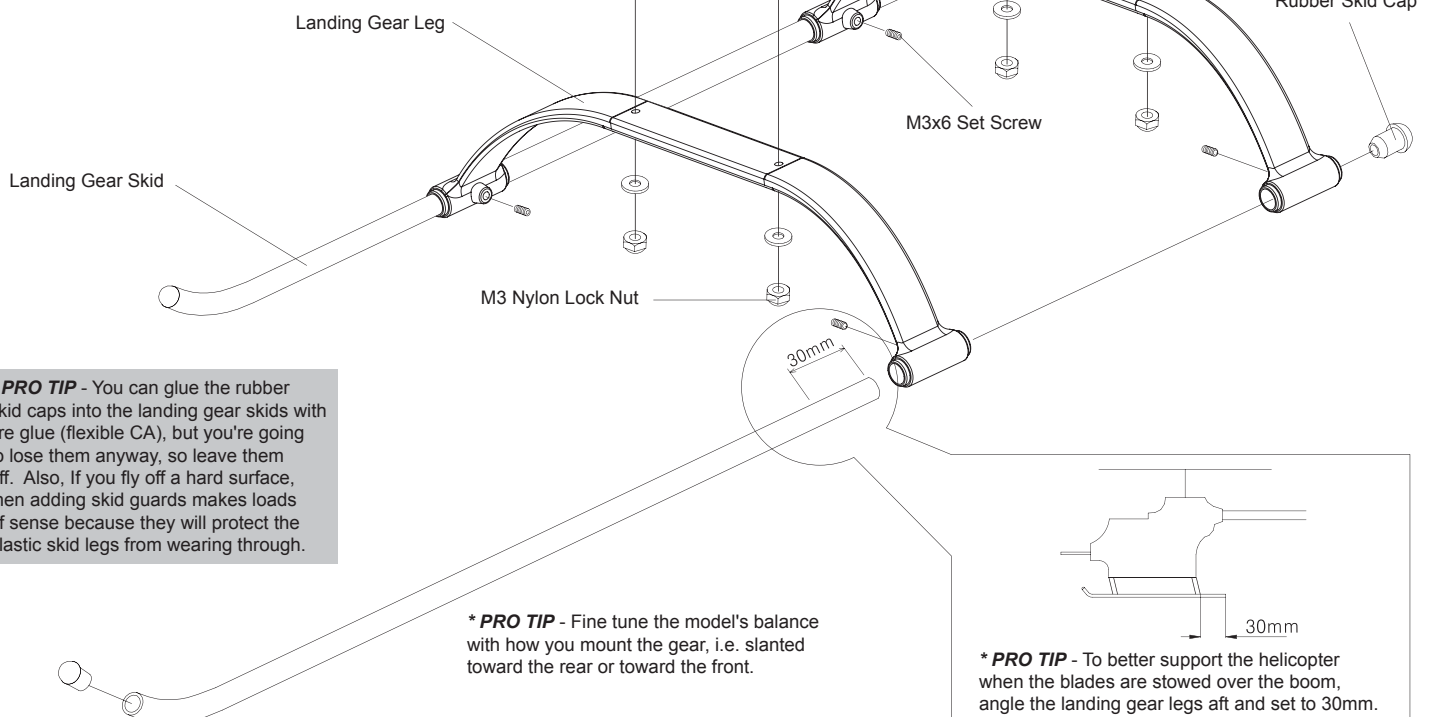


PDR0009x Skid Guards

These help prevent the gear legs from wearing through when you fly off of hard surfaces like concrete and asphalt. They're available in several colors; add **Y** for yellow, **P** for pink, or **B** for black to the end of the part number.

M3x25 Allen Head Bolt

*** NOTE:** If you forget to install the fuel tank before the skids go on, just remove the two aft bolts and if you hold your tongue just right you can flex the frames and the front of the tank sufficiently to slip it into place.



*** PRO TIP** - You can glue the rubber skid caps into the landing gear skids with tire glue (flexible CA), but you're going to lose them anyway, so leave them off. Also, If you fly off a hard surface, then adding skid guards makes loads of sense because they will protect the plastic skid legs from wearing through.





*** PRO TIP** - Fine tune the model's balance with how you mount the gear, i.e. slanted toward the rear or toward the front.

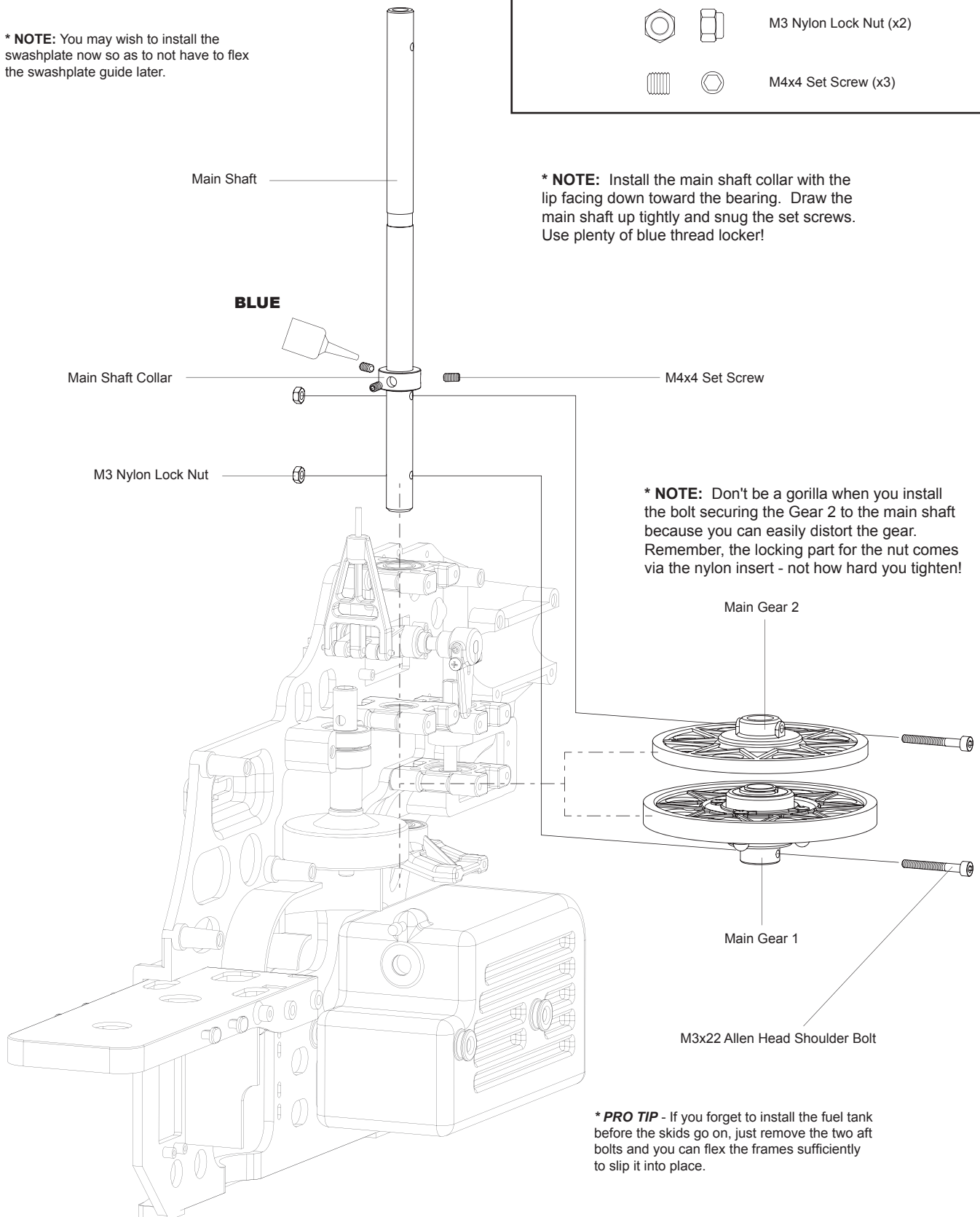
*** PRO TIP** - To better support the helicopter when the blades are stowed over the boom, angle the landing gear legs aft and set to 30mm.




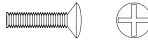





Step 7 – Main Shaft Assembly

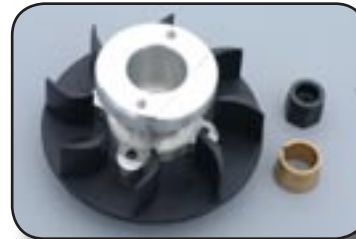
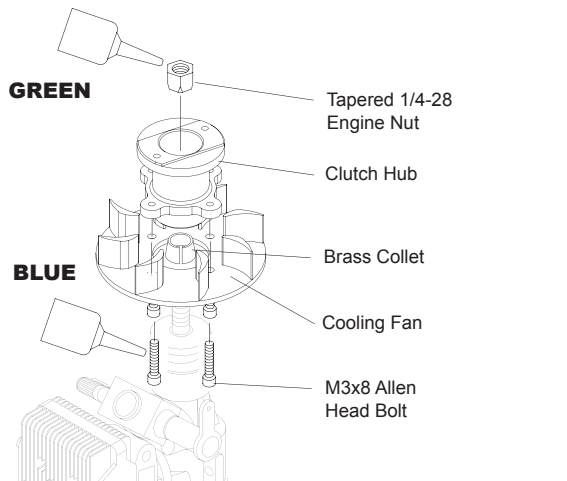
*** NOTE:** You may wish to install the swashplate now so as to not have to flex the swashplate guide later.

		M3x22 Allen Head Shoulder Bolt (x2)
		M3 Nylon Lock Nut (x2)
		M4x4 Set Screw (x3)



Step 8.1 – Fan and Clutch Assembly

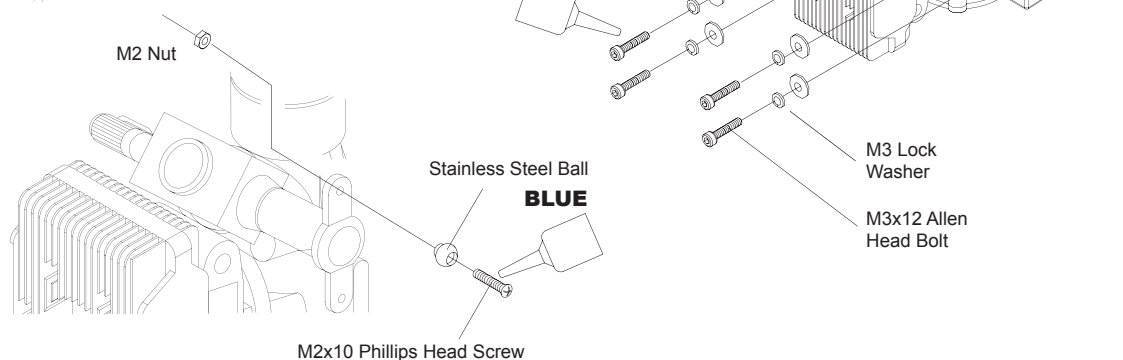
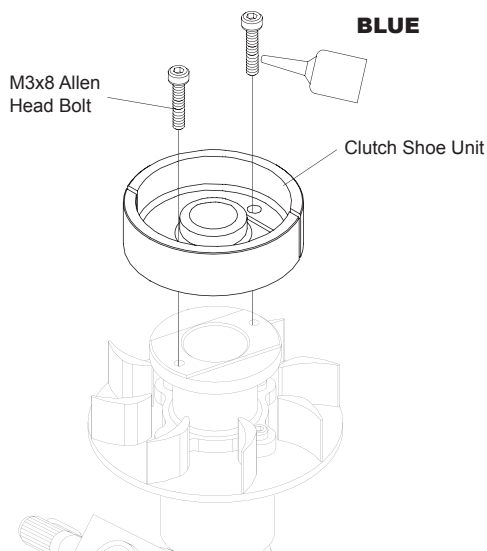
	M3x12 Allen Head Bolt (x4)		M2x10 Phillips Head Screw (x1)
	M3x8 Allen Head Bolt (x4)		M2 Nut (x1)
	M3 Flat Washer (x4)		Stainless Steel Ball (x1)
	M3 Lock Washer (x4)		



The fan hub sits between a tapered brass collet and a special tapered steel engine nut so you can adjust for minimum runout. Competing designs use a screw-on fan hub thereby forcing you to live with the resulting runout.



Milling a slot creates a cutaway fan hub, which lets you see inside the sophisticated mount.



Step 8.2 – Fan and Clutch Assembly

Photos - Jim Van Scoyk

Clutch Hub Installation

Slide the brass collet onto the crankshaft (remove the black thrust washer). Next, slip the clutch hub (with fan installed) into place and finger tighten the special tapered engine nut. With the crankshaft locked to prevent rotation, begin to tighten the nut with the socket - but as you do so, rotate the clutch hub assembly so that it centers. Then, taking care that the hub isn't too tight to rotate, use a dial indicator such as the **ProModeler® PDR0091** to adjust the runout to below 0.005". While this can be a tedious process - often taking an hour or more, diligence will be rewarded with an extremely smooth running helicopter because the engine is the primary source of high frequency vibration. Once you fully tighten the tapered engine nut, check the runout one more time to make sure it's not moved and apply green (wicking) thread locker such as **Loctite® 290** (if you apply blue thread locker first it may begin to set up before you finish dial indicating the clutch hub).



* **NOTE:** You can't see it in this photo, but the engine's backplate has been removed. This is so that a tool for locking the engine's crankshaft can be inserted to prevent the engine's crankshaft from rotating. The idea is that when the crankshaft is fixed in place you can adjust where the assembly fits to it by twisting slightly as you seek the least amount of runout. Naturally, you remove the locking tool each time you make an adjustment so you may rotate the crankshaft as you read the runout on the face of the dial indicator. Anyway, the tedious part comes in when you repeat this over and over until you find the least amount of runout.

* **PRO TIP** - If you're using a governor with a magnetic pickup, now's the time to use either thick CA or epoxy to secure the magnets into place on the underside of the cooling fan! Next, bolt the pickup to the engine mount because it's easier to do now, whilst you have the engine assembly in your hand, versus later when the engine has been installed into the helicopter's main frame assembly. Many governor pickups are supplied with two brackets, one for .50-.55-class engines and one for .61-91-class engines. If you're using the popular Futaba GV-1 Governor, the small bracket is too short and the big bracket doesn't fit. On the next page we show you what to do in order to use the large bracket with the .46-.55-class engines - it's simple!



Step 8.3 – Governor Sensor Installation



You'll need a punch to dimple the surface of the bracket to prevent the drill bit from walking on you.



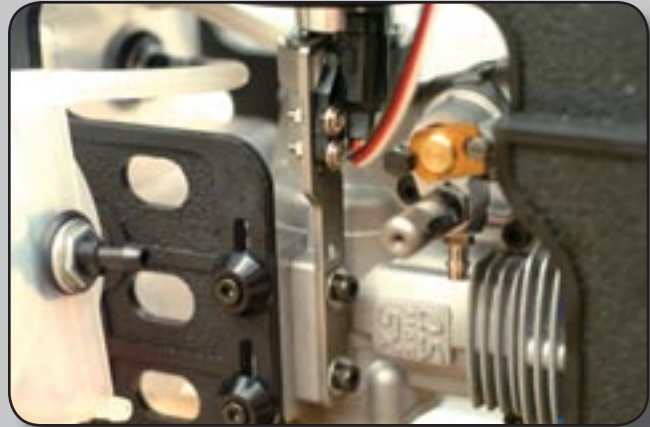
This is the sensor, the magnets, and the mounting hardware. Note how I've dimpled the surface.



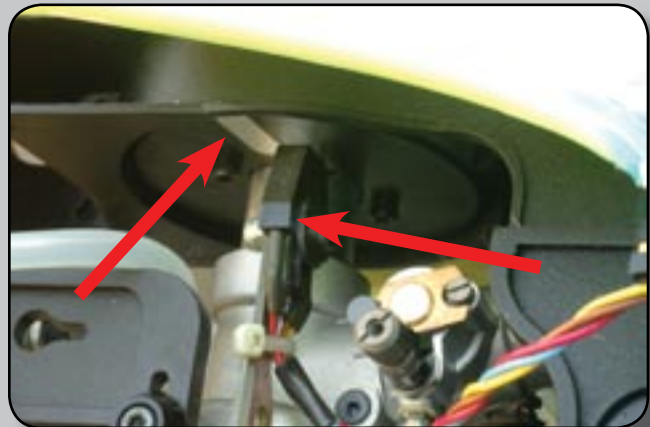
The correct size to drill the hole is with the 5/32" drill bit. However, the bracket is made of hardened steel so first make a 1/16" hole, then step through the drill series until you drill the last diameter with the 5/32" bit.



If you want your drill bits to last, the smart thing to do is use oil to lubricate the bit as it cuts. We're using 3-in-one oil, but any oil, even motor oil will do the trick just as well.



There you go, the finished job with the sensor installed on a large mounting bracket. The advantage of this bracket is it's bigger and resists engine vibrations - protecting the sensor.



By the way, we prefer to use a **Hotwings Optical Sensor** as slinging a magnet is never a factor because it uses a piece of reflective foil instead. These are **PDR0084F** (Futaba GV-1) or **PDR0084T** (Throttle Jockey, RevMax, Youngblood ATG, etc.)

Step 9 – Engine And Fuel System

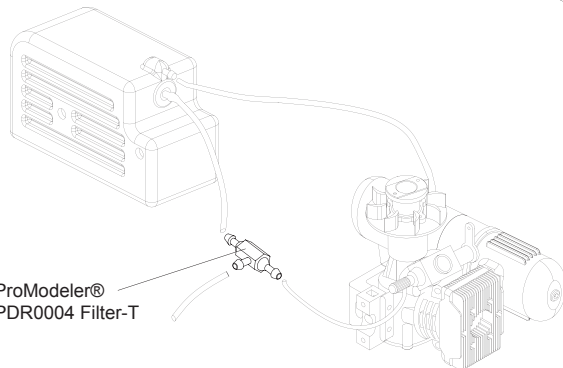
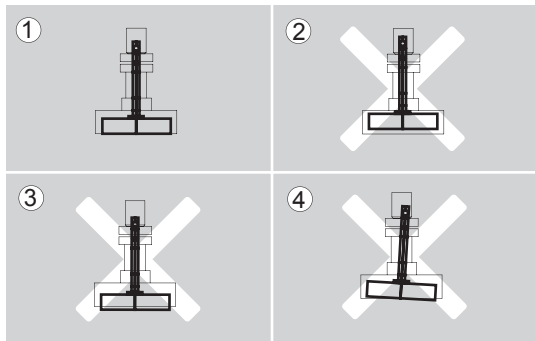


M3x38 Allen Head Bolt (x2)



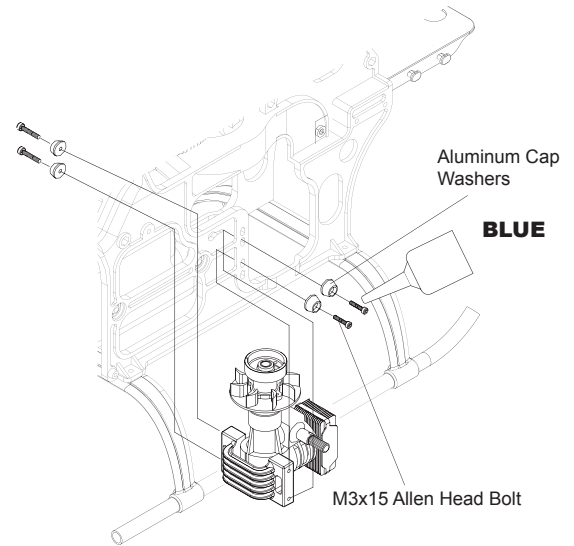
M3x15 Allen Head Bolt (x4)

Properly aligning the clutch shoe unit with the clutch bell assembly is crucial to longevity. The goal is for the clutch shoe unit to be evenly presented within the clutch bell assembly and for the lower edge of the clutch shoe unit to align evenly with the lower edge of the clutch liner within the clutch bell. In illustration 2, the clutch shoe unit has been presented too high and the clutch shoes may be rubbing the inside of the clutch bell. In number 3, the clutch shoe unit is too low and doesn't fully contact the clutch liner. In number 4 the clutch shoe unit is presented at an angle and thus, won't contact the clutch liner evenly.



ProModeler®
PDR0004 Filter-T

Plumb the fuel tank to the engine as shown. Use a high quality 3/32" silicone fuel tubing like blue Du-Bro® #197. The vent line of the tank goes to the muffler's pressure nipple and the tank's feed line goes to the engine. However, if you're using a 2-ounce header tank like a **ProModeler® PDR0016**, then the fuel tank's feed line goes to the header tank's vent line and the header tank's feed line goes to the engine (they're connected in series). Finally, it's smart to use a fuel filter. A 3-way fuel filter like a **ProModeler® PDR0004 Filter-T** as shown is handy because you're not removing the engine's fuel line each time you fuel up thus reducing the possibility of inflight failure. For convenience, other accessories like **ProModeler® PDR0003 Shut Off & Plug** make access to the fuel line easier, but if you use one, make sure to install the shut off on the engine side of the filter. Finally, the **PDR0011 Fuel Filter Support** makes for a handy way to mount the T-filter as an assembly to the model.



*** PRO TIP** - Insert the muffler bolts in the engine case **before** installing the engine.

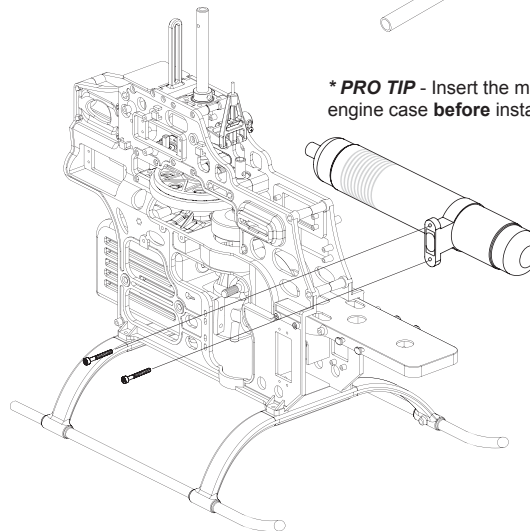
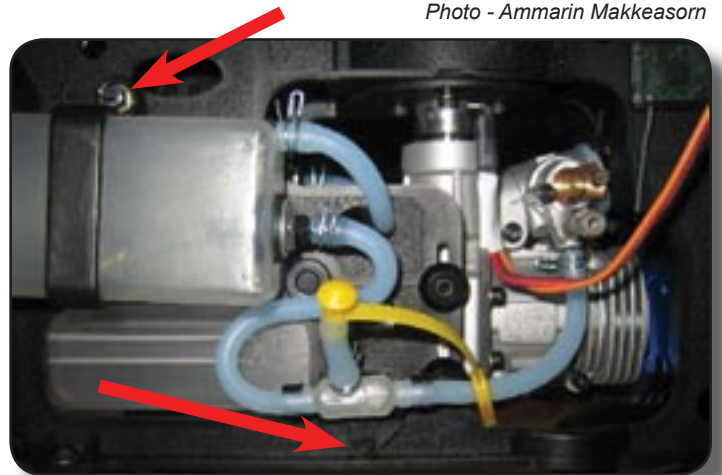


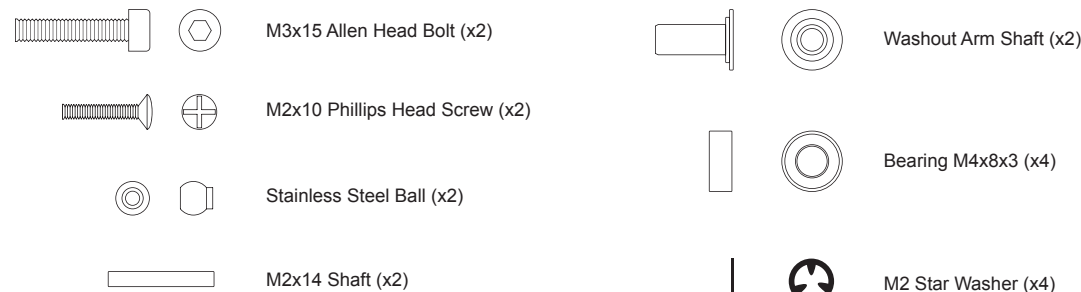
Photo - Ammarin Makkeasorn



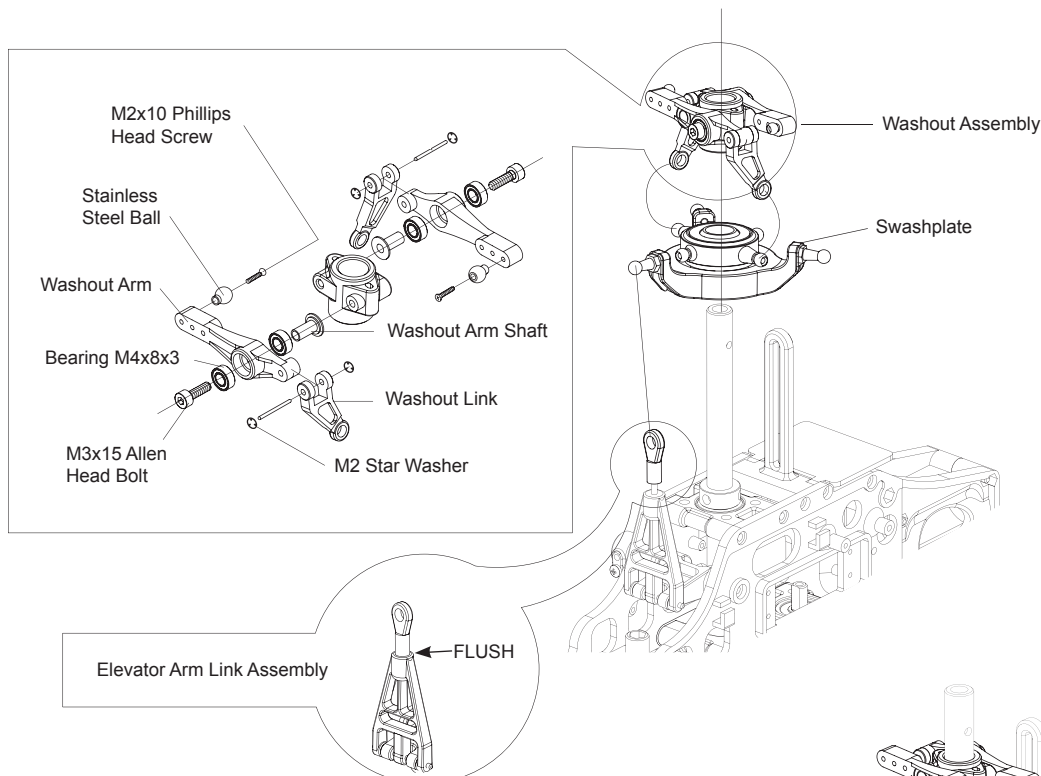
*** NOTE:** A neat plumbing job makes life easier down the road. Installing a **PDR0016 Header Tank, 2-oz** is easy. All you need is an M3x15 Allen Head Bolt and an M3 Nylon Locking nut because there's a boss and a predrilled hole. But the **PDR0011 Fuel Filter Support** bracket is trickier because you have to drill the hole yourself - use an M3x10 Allen Head Bolt. The advantage is the superb support it provides the **PDR0004 Filter-T**, and the **PDR0003 Shutoff & Plug**.



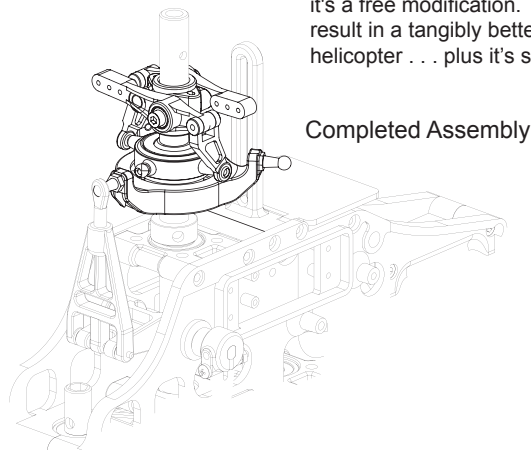
Step 10 – Swashplate and Washout



*** NOTE:** Look closely for a lightly molded ring around the lip on one side of the link for the Elevator Arm Assembly. This ring-side is slightly larger than the other side. Install this link by snapping the ring-side over the ball on the swashplate. Conversely, the Washout Links also have a molded ring, but they're assembled with the ring-side facing outward. They're quite hard to snap over the ball on the swashplate, but this is normal.



*** PRO TIP** - Eyeball the washout assembly diagram closely, then once you've slipped the washout arm with bearings onto the washout arm shaft and bolted it to the washout base, check each arm for excess play. If it's too loose, first make sure it's not the bolt which is loose. But be careful since it just threads into plastic. If that's not it, back the bolt out and remove the assembly and look to see if the washout arm shaft isn't just a hair too long. If it is you'll see it sticking past the inner race of the bearing in the washout arm - it's pretty easy to discern. If this is the case, then file off a few thousandths (or however much is needed) to make it almost flush, or slightly proud of the inner race. This is called "blueprinting" and top pilots will blueprint every assembly of their helicopter. Most of us aren't top pilots, but the fact is blueprinting an assembly like this is simple, easy, and best of all, it's a free modification. And it may result in a tangibly better handling helicopter . . . plus it's satisfying!



*** PRO TIP** - As supplied, the Pantera may be tuned mildly for novices or wild for aggressive 3D flight. Tuning to better suit your style of flight is easy. For example, the washout arms have three mounting holes. The innermost results in very gentle characteristics (but may require slight clear-ancing with a Dremel), whilst the outermost position is for experts - most will be happy with the middle position. Also included are tuning standoffs; four black ones (4mm x 2.8mm) and two silver ones (4mm x 4mm). You may use two to four blacks, or the silvers to extend the two short balls on the upper ring of the swashplate to increase agility, or use some on the Hiller lever instead. For aggressive 3D, the **ProModeler® PDR0069 3D Swashball Kit** may suit you better because at 4.25mm long these stand-offs provide even greater throw and thus, are a great tool in the arsenal of the pilot seeking to extend the performance envelope via tuning.



Supplied standoffs



PDR0069 3D Swashball Kit

*** PRO TIP** - To make installation of the M2x10 Phillips Head screws into the plastic washout arms easier, first use an M2 Allen Head screw (without the ball) because the Allen wrench has less chance of slipping and stabbing your finger than the #0 Phillips Screwdriver. This will create threads in the plastic with less fumbling. Alternatively, use a 2mm tap to create the threads. Also, it only takes 2 or 3 turns of the screw to create these 'starter' threads. Finally, remove the socket head, or cap, screw and install the Phillips head screw and ball as shown.



Step 11 – Rotor Head Assembly

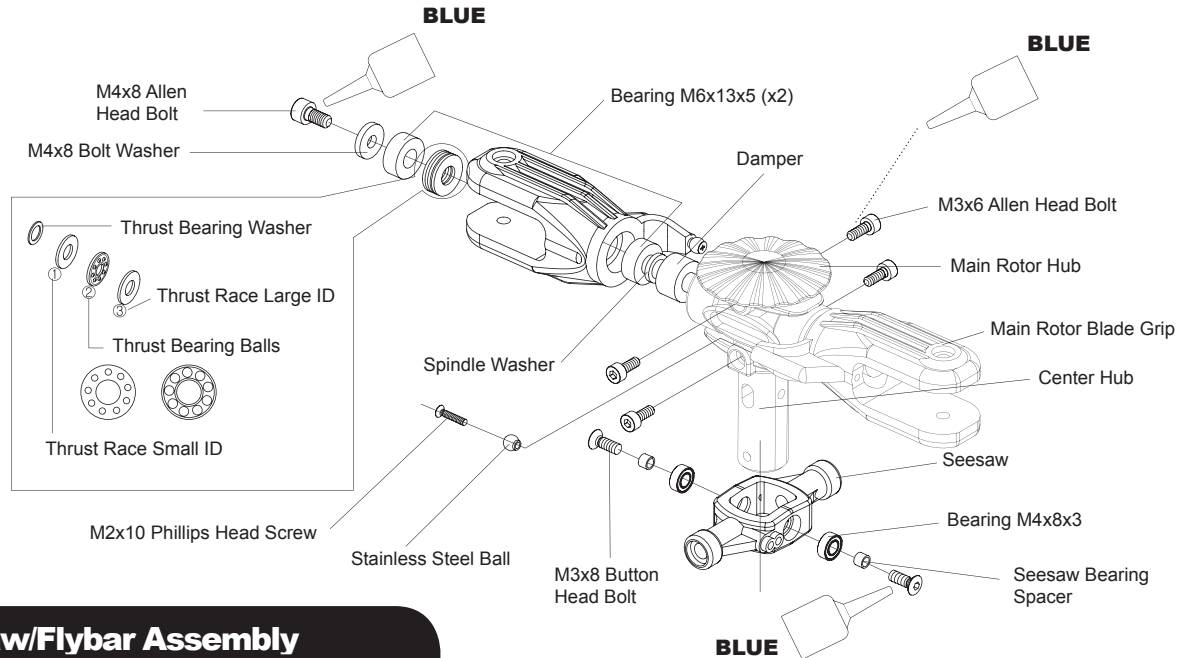
		M4x8 Allen Head Bolt (x2)
		M3x6 Allen Head Bolt (x4)
		M3x8 Button Head Bolt (x2)
		M2x10 Phillips Head Screw (x2)

The main rotor head assembly is the heart of the Pantera 50. We've flight tested the head to 2250 RPM (140 gm. carbon blades and everything balanced to a fare-thee-well, of course) with no ill effects, but we recommend 1850 RPM as the practical RPM limit. Operate beyond this and you're on your own. That said, it's not unusual for professional 3D pilots to run it at 2000 RPM because the high headspeed is the key to them getting the rapid response desired for quick flips and tumbles. The head is preassembled, but you **must** disassemble it to grease the thrust bearings because they only have a light protective machine oil. Ensure the small ID thrust race is on the blade side, cup the ball holder so that they retain grease, followed by the large race. Also, lightly smear the ID of the dampers with grease for the spindle shaft. **Inspect and re-lube every 4-gallons.**









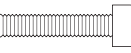









Not sure how to properly assemble the thrust bearings plus the other bearings and spacers in the main rotor blade grips? View this short 3:30 minute long video, to learn how easy it really is!



Click image to play

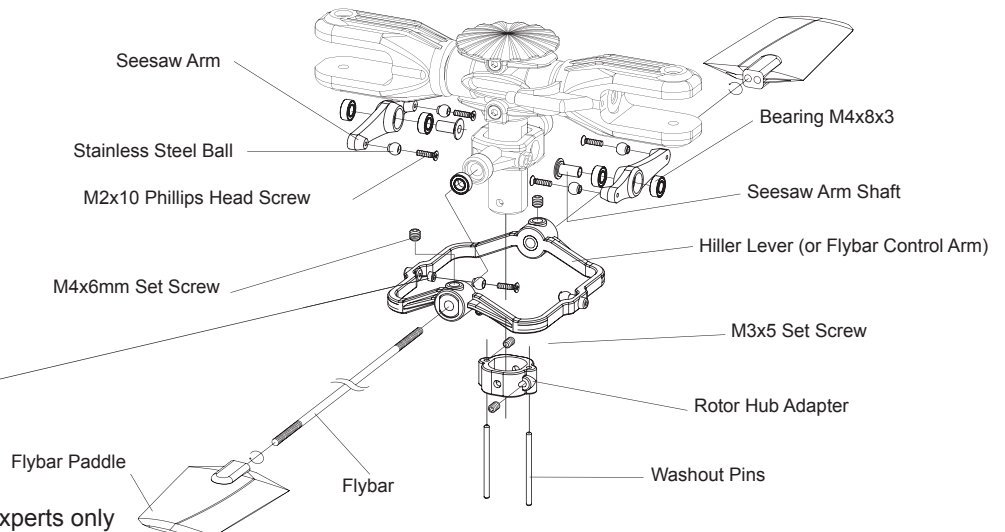


Step 12.1 – Seesaw/Flybar Assembly

		M2x10 Phillips Head Screw (x6)			Stainless Steel Ball (x6)			M2x30 Washout Pin (x2)
		M4x6 Set Screw (x2)			M3x15 Allen Head Bolt (x2)			M3x5 Set Screw (x2)
		Bearing M4x8x3 (x6)			M4x2.8 Bushing (x2)			Seesaw Arm Shaft (x2)

*** PRO TIP** - As with the washout arm assembly in Step 9, blueprinting the seesaw arm assembly is a prudent use of your time and efforts.

*** PRO TIP** - You may wish to add one or even two of the M4x2.8 standoffs for more aggressive 3D flight, but increase the length of the M2 Phillips Head screw to compensate - you've been warned.

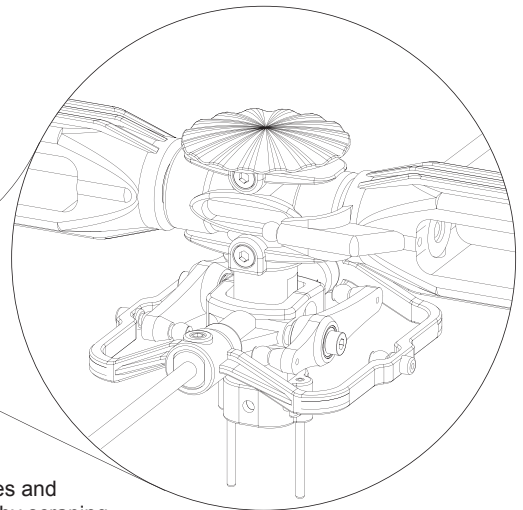
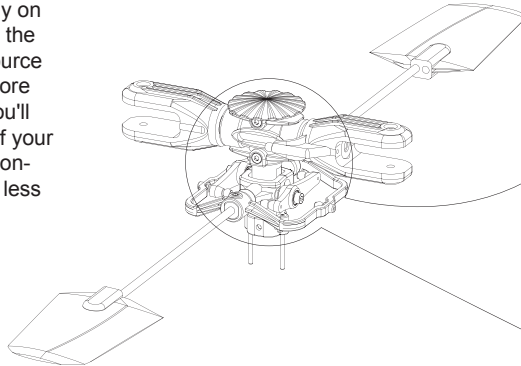


*** NOTE:** Aft hole for experts only

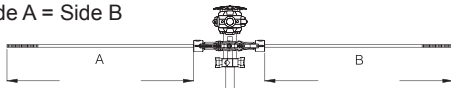


Step 12.2 – Seesaw/Flybar - continued

*** PRO TIP** - For a silky smooth helicopter balance the entire rotating assembly on a high point type balancer because the main rotor system is the primary source of low frequency vibrations. The more time spent, the more satisfaction you'll have with the overall performance of your model and the greater component longevity you will experience because less stresses are induced.

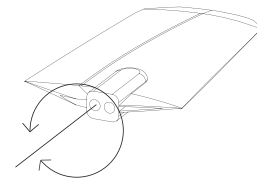


*** NOTE:** Side A = Side B



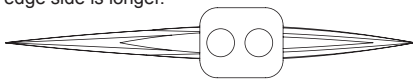
*** PRO TIP** - Weigh the paddles and lighten the heavier of the two by scraping lightly with a sharp X-Acto® blade until they weigh exactly the same.

Make certain the flybar is perfectly centered within the assembly. Next, give the Hiller lever assembly (or flybar control arm) a squeeze to take up the slight play present in the system. Alternatively, while you may choose to fit washers between the aluminum insert in the Hiller lever assembly and the bearing in the end of the seesaw, we've found a squeeze works better. However, before snugging the set screws, verify the flybar is indeed centered as usually it's off a few thousandths. Measure the length accurately using a tool like a **Pro-Modeler® PDR0093 6" Digital Caliper**. Next, scribe a line on the flybar and use a Dremel® tool with a cutoff disk simply cut to the line thereby adjusting the length to be perfectly equal on both sides - but debur the end before assembly! Alternatively, screw the paddles onto the unsecured flybar (without tightening the set screws yet), align the paddles to each other, and then slide the entire assembly around until you achieve perfect balance. As it turns out, as long as it balances it doesn't really matter if one paddle is 1mm farther out than the other because it doesn't make any difference to flight quality, or vibration. The seesaw, however, must not exert any drag when you do this and the links must be left off. When it balances, carefully align the paddles to the Hiller lever assembly and gently snug the set screws. Finally, remove one set screw at a time, thread-lock, squeeze the assembly as noted above, reinsert and tighten. Repeat with the other set screw.



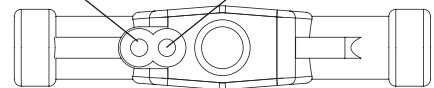
Slide a short section of fuel tubing over the end of flybar until 1" sticks past the edge. Next, add a drop of thick CA in the plastic paddle hole and screw the paddle onto the flybar until the paddle just contacts the end of the tubing. It is **CRITICAL** that no part of the thread be visible as the flybar may break where it changes x-section otherwise! You can remove the fuel tubing later by splitting it with a sharp X-Acto® blade. Next, repeat the process for the other paddle.

*** NOTE:** Trailing edge side is longer.



There are two sets of holes in each flybar paddle. The trailing edge hole is designed for stationary flips and tumbles as evident by prowess during stationary maneuvers and decreased stability in forward flight. Conversely, the leading edge hole is more stable in forward flight while still maintaining agility and good 3D performance.

1:1 ratio **0.7:1 ratio**



Tuning Tip: The seesaw arms may be mounted in one of two holes, inboard, or closer to the center of the main shaft's rotation, or outboard, closer to the flybar paddles. The outer mounting hole results in a 1:1 Bell Hiller mixing ratio. Use these for smoother flight. The inner holes result in a 0.7:1 Bell-Hiller mixing ratio and are where you mount the arms for aggressive 3D flight.



Step 13 – Upper Control Linkages

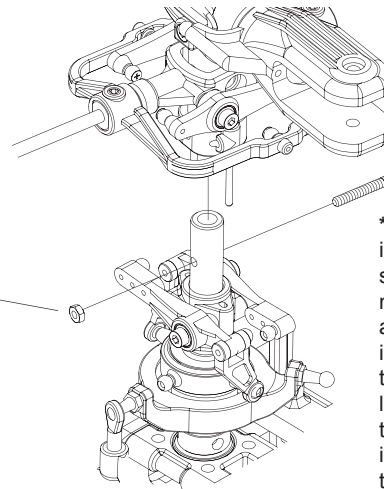


M3x20 Allen Head Bolt (x1)



M3 Nylon Lock Nut (x1)

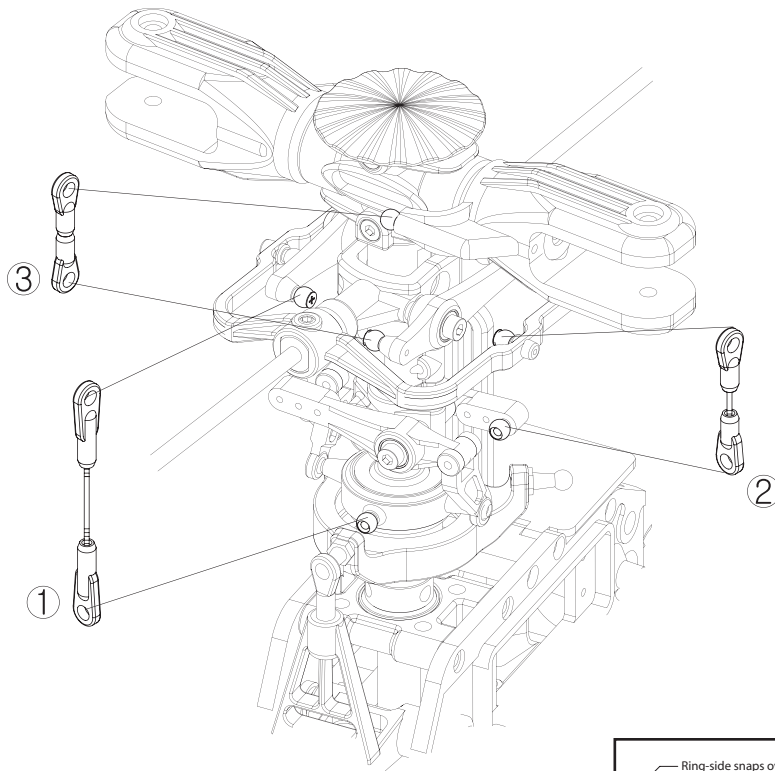
Insert the main rotor head assembly onto the main shaft. Align the opening in the aluminum center hub with that of the main shaft. Insert the Jesus bolt and tighten securely.



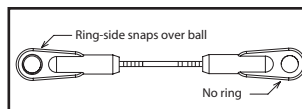
M3x20 Allen Head Bolt

*** NOTE:** No disrespect intended, but the bolt that secures the head to the main shaft on both model and full-scale helicopters is quite commonly called, the Jesus Bolt. Pilot's lore has it that's because the pilot must have faith in it, and if it breaks, those are the last words uttered as the helicopter goes down.

M3 Nylon Lock Nut



The upper control linkages have been assembled for you. However, it's incumbent upon you to verify that each linkage pair is the correct length and exactly the same as the opposite linkage . . . it's critical. This is best done accurately with a tool such as the **ProModeler® PDR0093 6" Digital Caliper** because you can make fine adjustments and thus, ensure each upper control linkage is the exact same as its complementary pair.

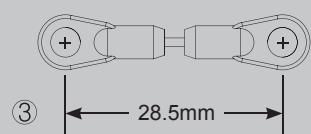
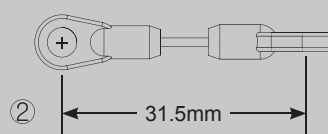
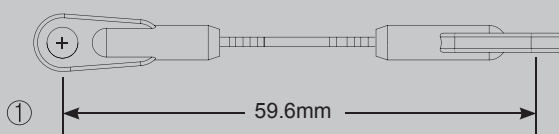


Look closely for a lightly molded ring around the lip on one side of the links. This ring-side is slightly larger than the other. Install the link by snapping the ring-side down over the ball.

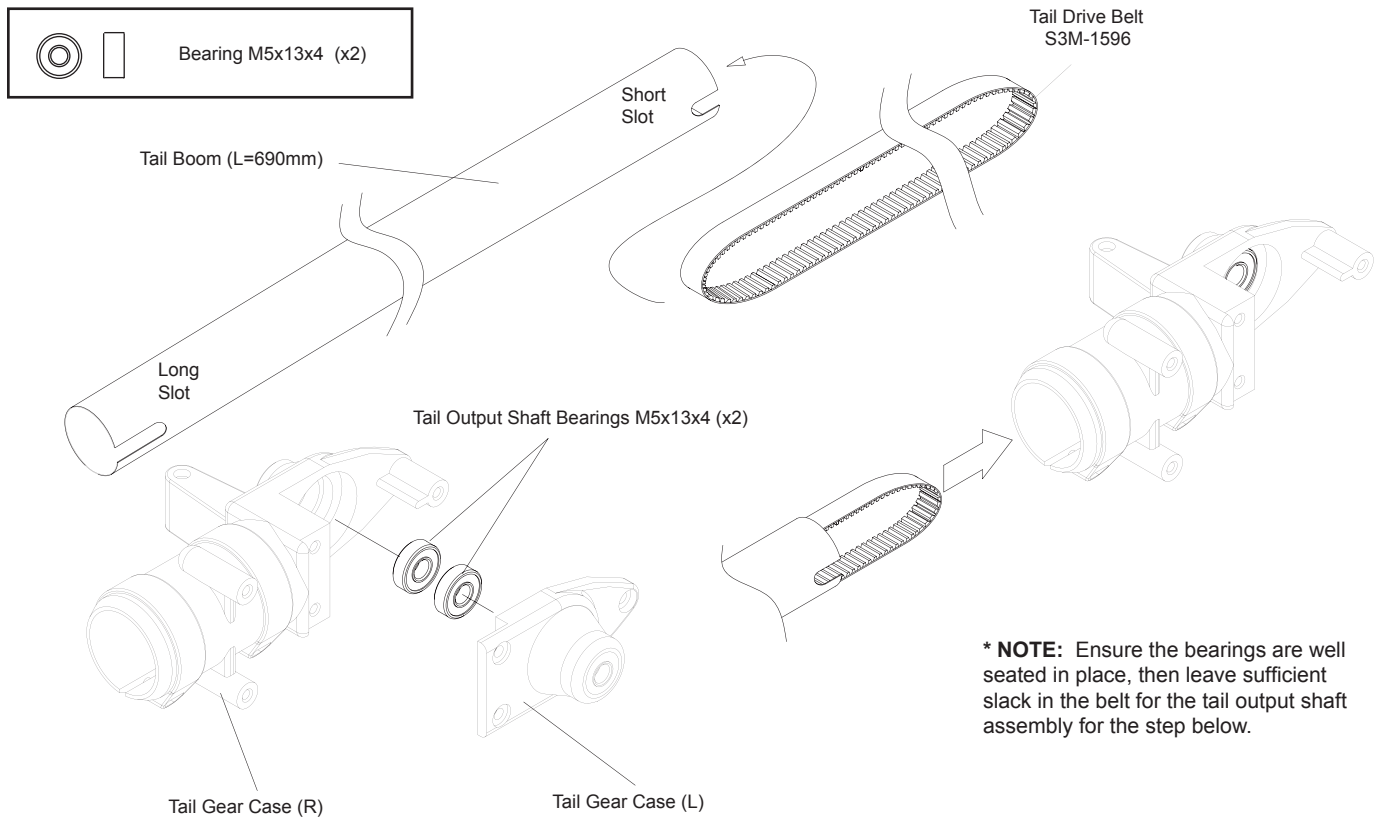
Swahplate to Seesaw Arm Linkage

Washout Arm to Hiller Control Lever

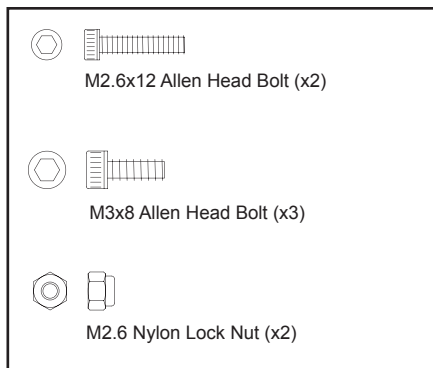
Seesaw Arm to Blade Grip



Step 14 – Tail Gear Box And Belt



Step 15 – Tail Output Shaft Assembly



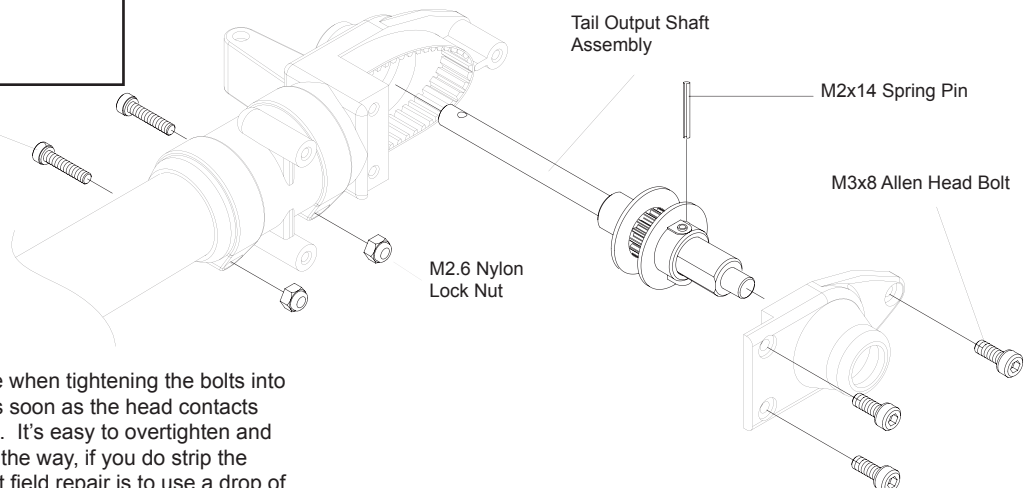
*** NOTE:** Removing or replacing the spring pin can be a pain if you don't have the right tool, which is why we preassemble it for you. What you really need is the PDR0095 Drift, 2mm - and best of all, it's not too expensive.



PDR0095 Drift, 2mm

*** NOTE:** Seat the tail gear case fully onto the tail boom before snugging the bolts.








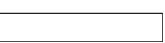
M2.6x12 Allen Head Bolt



*** PRO TIP** - Use care when tightening the bolts into the tail gear case - as soon as the head contacts the case half, that's it. It's easy to overtighten and strip the threads. By the way, if you do strip the plastic case, a decent field repair is to use a drop of medium CA in the hole then just re-install the screw!



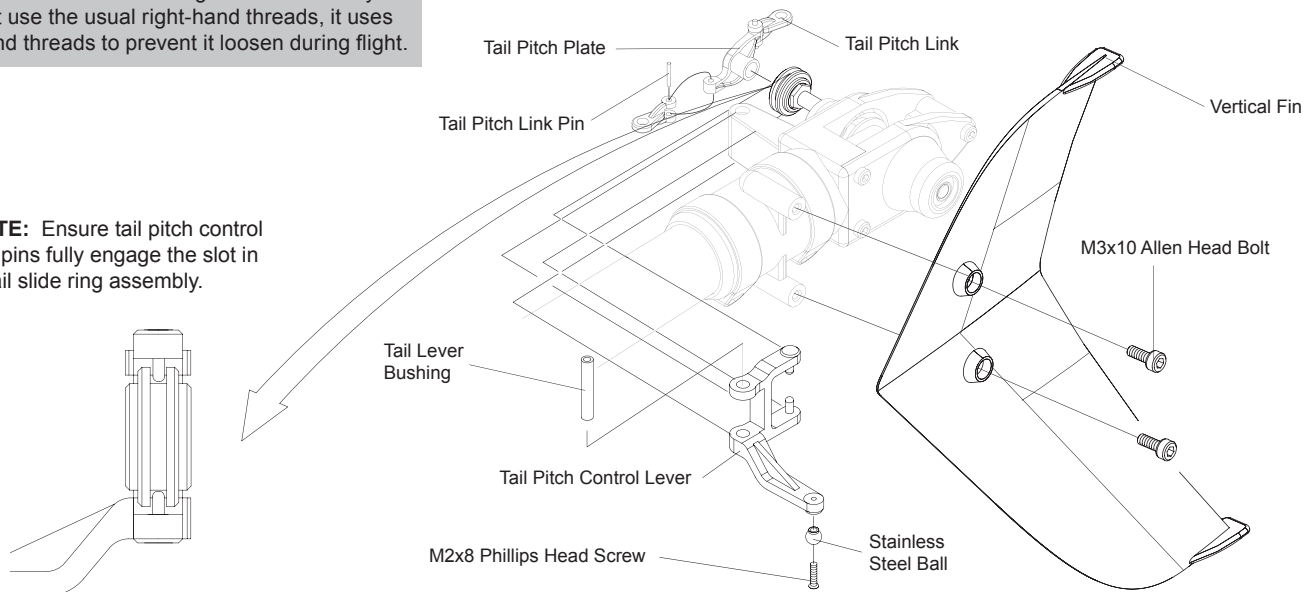
Step 16 – Tail Pitch Lever & Vertical Fin

		M3x10 Allen Head Bolt (x2)			Stainless Steel Ball (x1)
		M2x8 Phillips Head Screw (x2)			Tail Lever Bushing (x1)

*** NOTE:** The Tail Slide Ring Sleeve assembly doesn't use the usual right-hand threads, it uses left-hand threads to prevent it loosen during flight.



*** NOTE:** Ensure tail pitch control lever pins fully engage the slot in the tail slide ring assembly.



We've been honored that some of the best 3D pilots in the world have chosen to use our models as a "beater" for practicing the presentation of their 3D routines. Thus, as a direct consequence (because they fly their model harder than mere mortals) their ideas occasionally lead to improvements or new products - like these ProModeler© PDR0079 3D Guide Pins.



This mod involves AUD0010 Tail Pitch Control Lever, and requires an X-Acto® with a #11 blade, a drill, the appropriate drill bit and 3mm tap, as well as PDR-0079 3D Guide Pins. These may increase the service life of the tail pitch control lever under the grueling abuse imposed by aggressive 3D pilots.



PDR0079 3D Guide Pins

Step 1 - Remove AUD0010 Tail Pitch Control Lever from the Tail Gear Case Assembly by using a drift to drive out the tail lever bushing - a makeshift drift can be an Allen driver.

Step 2 - Use the X-Acto® blade to slice off the two plastic nubs which fit the grooves to drive AUD0014 Tail Slide Ring.













Step 3 - Drill and tap for 3 mm. This is easy because there is a round molded recess directly opposite (on each side) from where the pins were. Just be careful to center the drill bit beforehand and go for it. If you screw up, it's not the end of the World, another AUD0010 Tail Pitch Control Lever is inexpensive.

Step 4 - Using a drop of plastic CA glue as a thread locker and an Allen driver, screw in the PDR0079 3D Guide Pins.

Step 5 - That's it! Reinstall the modified Tail Pitch Control Lever.



Step 17 – Tail Rotor Assembly

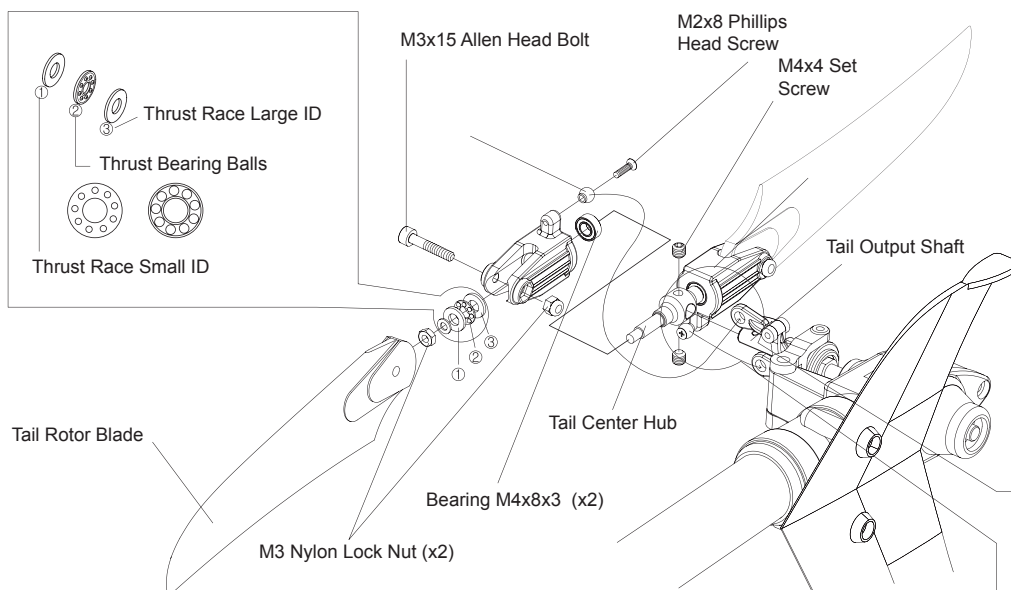
		M3x15 Allen Head Bolt (x2)			M3 Nylon Lock Nut (x4)
		M2x8 Phillips Head Screw (x2)			Stainless Steel Ball (x2)
		M4x4 Set Screw (x2)			Bearing M4x8x3 (x4)

*** PRO TIP** - The thrust bearings in the tail rotor grip assembly must be greased just as with the main rotor thrust bearings. While the head was preassembled for you, the tail rotor grips weren't. Just as with the main rotor thrust bearings, carefully, ensure the small ID race is on the blade side, and similarly you want to cup the ball holder so that it retains the grease while it is rotating. Periodic maintenance is required as with the head, so plan to disassemble and re-lube them every case of fuel.

*** NOTE:** Make certain the tail rotor blade closest to the main shaft is trailing edge down as shown in the diagram. Alternatively, when the tip of the lowermost blade is pointing toward the ground, the trailing edge should be aft, just like the rudder on an airplane or boat.

*** Note:** Tail rotor bearings take more abuse than you might believe. Just mix oily exhaust, dirt, and the typical 10,000 RPM and the gritty goop is forced through the bearings. Here's what may result after just 4 gallons of fuel. But the real wonder is, how on Earth these bearings survive as long as they do?

Photo - Gus Petraits



*** NOTE:** Ensure the set screws seat fully within the holes at the end of the tail output shaft.



*** CAUTION:** Overtightening the tail rotor blade bolts may lead to cracking of the tail grip. **The proper procedure is to tighten the bolt until, when the blade is horizontal, it will almost swing under its own weight, but requires a light tap or shake to move it.** Folks, losing a tail rotor blade in flight is no fun . . . and could lead to serious injury and/or a crash!

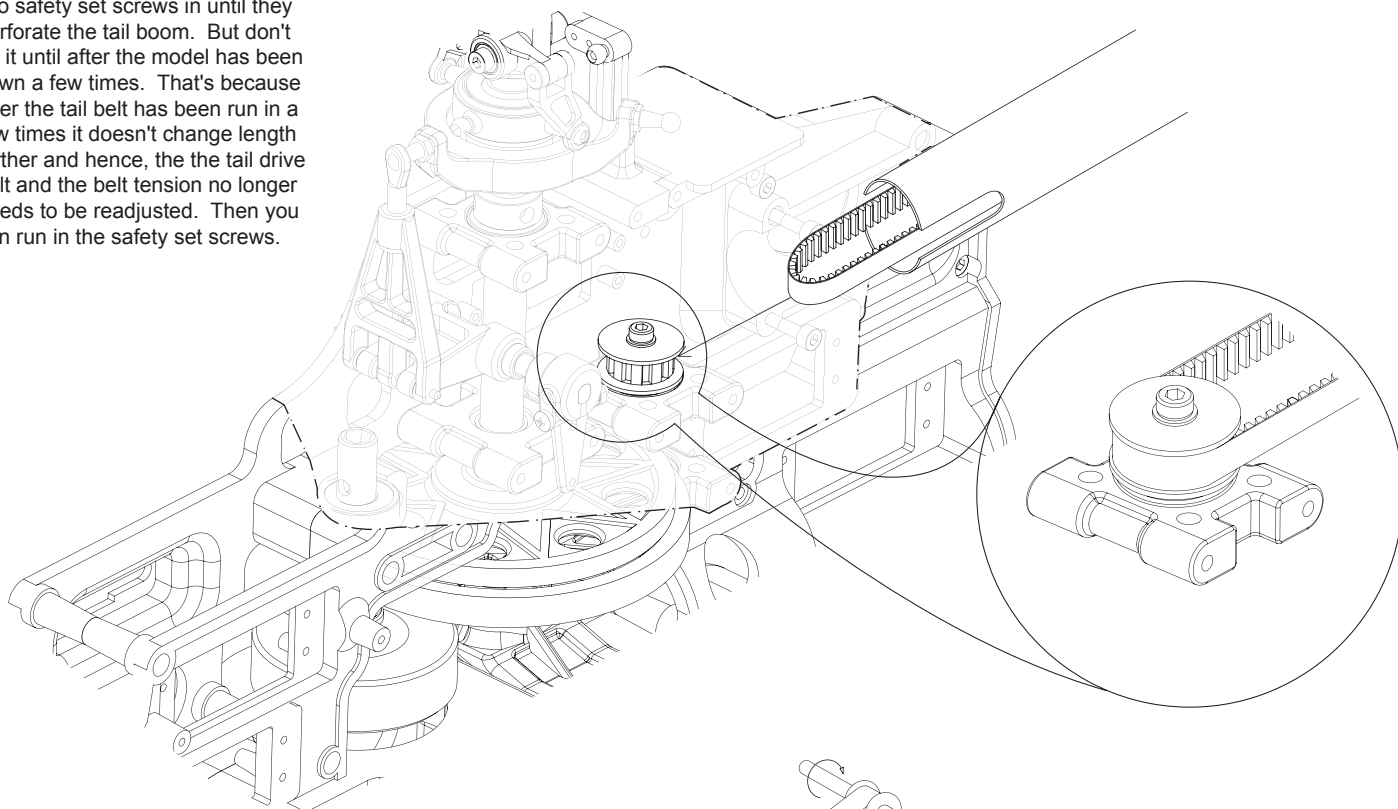
There are distinct advantages to having an ultra-high speed tail assembly - as does the Pantera 50. For example, there are maneuvers during which a slower rotating tail will blow out, thereby ruining the maneuver. A perfect example of this is the 3D maneuver called a Funnel. Guys usually fit longer blades to increase available thrust. This works, of course, but it puts greater stress on the system because it's being asked to handle loads it wasn't designed for, and this doesn't affect the angle at which it stalls (the stall's onset is around 16-18°). There's another way to skin this cat . . . the answer is to spin the blades faster. This increases the thrust and does it at a lower angle of attack, thereby delaying the onset of the stall. Thus, unlike older 50-class designs, which typically use 4.5:1 (tail gear ratio), the Pantera employs a much faster 5.3:1 tail gear ratio - it's about 18% faster! Hence, all things being equal, your Pantera 50 will outperform your pal's 50-class heli.



Step 18 – Tail Boom Assembly

It's been determined the tail rotor system is most effective when the tail rotor blades rotate such that the blade which is closest to the main rotor is rotating upwards. Thus, when viewed from the right side of the model, the disk is rotating counterclockwise. For this reason, the tail output shaft in the proper direction. This is referred to as the orientation of the belt. The simplest way to make sure it's correct is to make it's hard - but doable) and observe the tail drive belt is running straight up and down (and isn't kinked). Then grasp the end of the drive belt and ease the tail belt over the drive pulley. The last thing is to check that the slots in the tail boom engaged the guides in the aft frame. By the way, don't be a gorilla as you can crush the tail boom pretty easily!

* NOTE: Remember to run the two safety set screws in until they perforate the tail boom. But don't do it until after the model has been flown a few times. That's because after the tail belt has been run in a few times it doesn't change length further and hence, the tail drive belt and the belt tension no longer needs to be readjusted. Then you can run in the safety set screws.

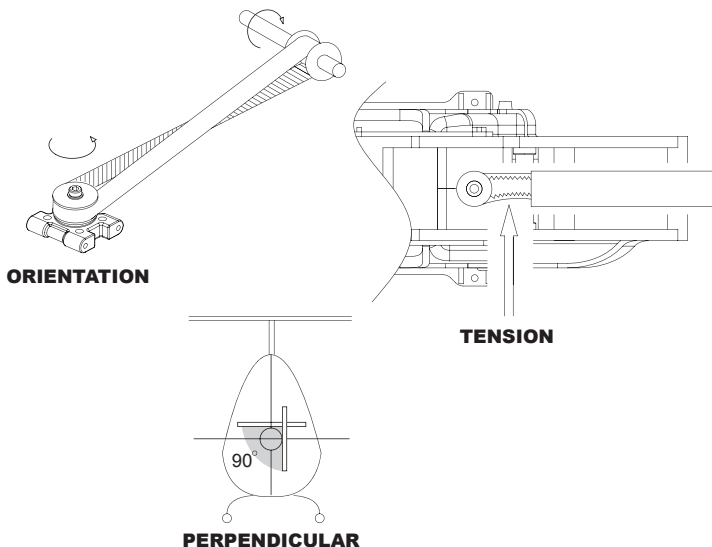


VERIFY - T.O.P.

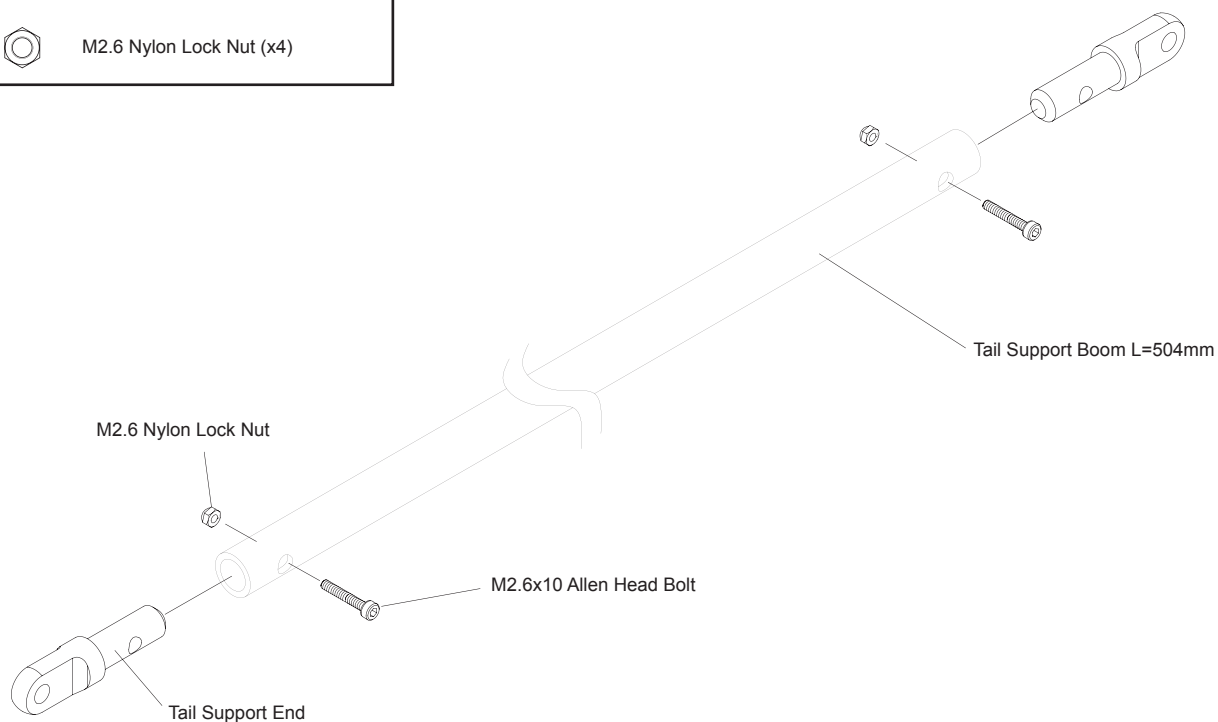
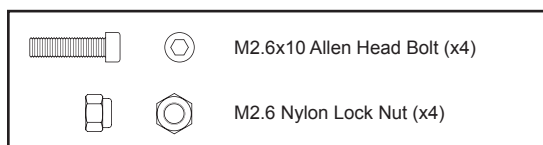
TENSION: Ensure there is a little slack in the tail rotor drive belt. Reach in with your fingertip, or with the tip of a screwdriver, and push one side against the other. They should almost touch without great effort.

ORIENTATION: The tail drive belt must be oriented correctly to ensure the proper rotation of the tail rotor output shaft. There is a 90° clockwise twist when viewed from the front of the tail boom assembly.

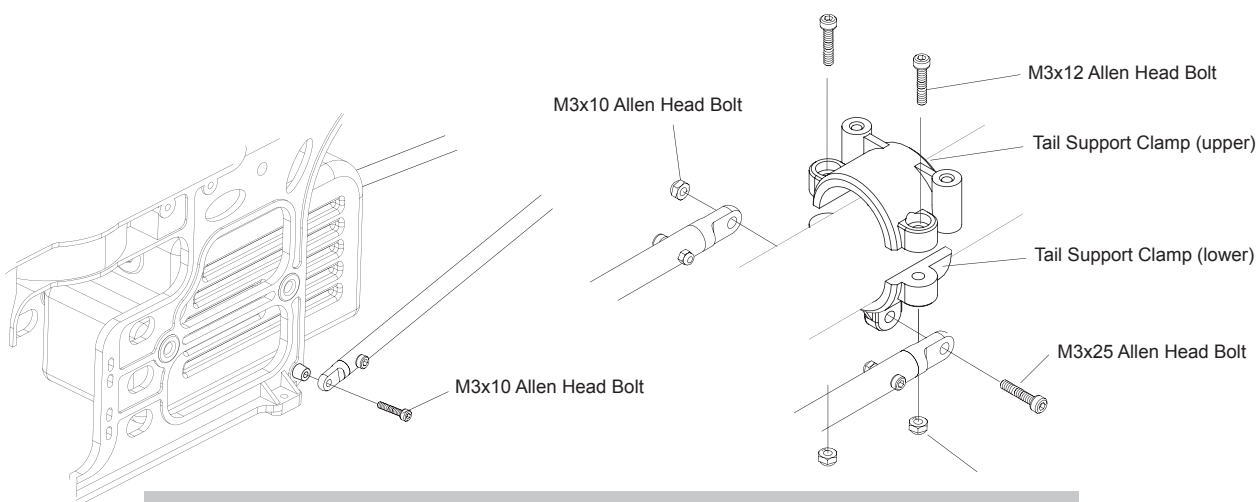
PERPENDICULAR: Ensure the slots in the forward tail boom engaged the guides in the aft frame and thus, the tail output shaft is perpendicular to the main shaft



Step 19 – Tail Boom Supports

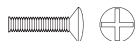


Step 20 – Tail Boom Support Clamp



*** PRO TIP** - You may wish to provide additional clearance between the tail boom supports where they join the tail support clamp. Substitute a longer M3x35 bolt for the M3x25 bolt and add two short (1/4" long) pieces of fuel tubing, one on each side, to space the supports outward. The additional benefit is the tail support ends will flex during a crash and are less likely to break.

Step 21 – Servo Installation



M2x8 Phillips Head Screw (x1)



Rubber Grommet (x2)



M2 Nut (x1)

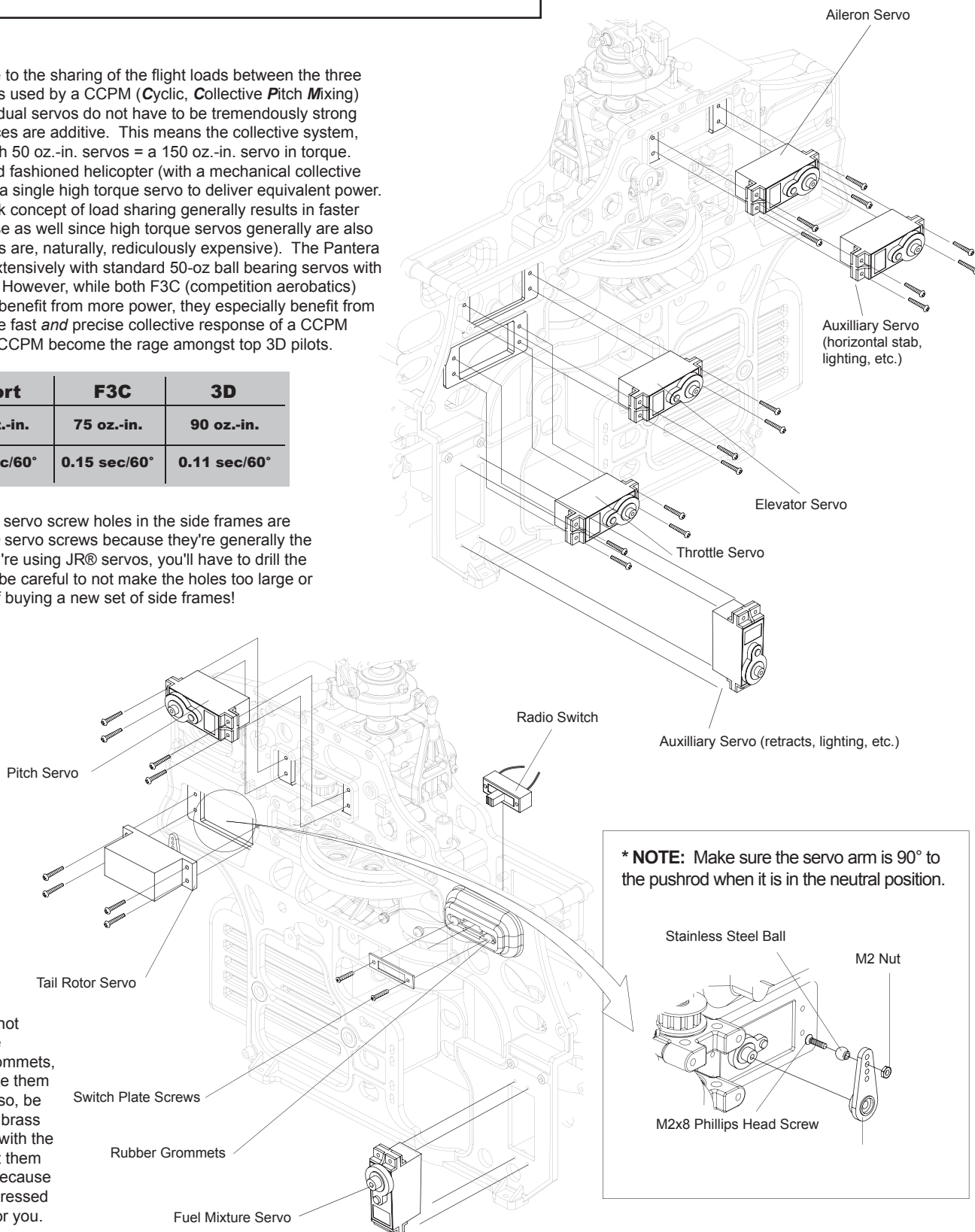


Stainless Steel Ball (x1)

* **PRO TIP** - Due to the sharing of the flight loads between the three swashplate servos used by a CCPM (Cyclic, Collective Pitch Mixing) system, the individual servos do not have to be tremendously strong because their forces are additive. This means the collective system, when using 3 each 50 oz.-in. servos = a 150 oz.-in. servo in torque. Conversely, an old fashioned helicopter (with a mechanical collective system) relies on a single high torque servo to deliver equivalent power. CCPM's teamwork concept of load sharing generally results in faster collective response as well since high torque servos generally are also slower (exceptions are, naturally, ridiculously expensive). The Pantera has been flown extensively with standard 50-oz ball bearing servos with excellent results. However, while both F3C (competition aerobatics) and 3D pilots will benefit from more power, they especially benefit from faster servos. The fast *and* precise collective response of a CCPM helicopter is why CCPM become the rage amongst top 3D pilots.

	Sport	F3C	3D
Torque	50 oz.-in.	75 oz.-in.	90 oz.-in.
Speed	0.2 sec/60°	0.15 sec/60°	0.11 sec/60°

* **PRO TIP** - The servo screw holes in the side frames are sized for Futaba® servo screws because they're generally the smallest, so if you're using JR® servos, you'll have to drill the holes larger. But be careful to not make the holes too large or you'll find yourself buying a new set of side frames!

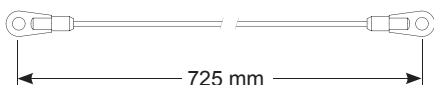
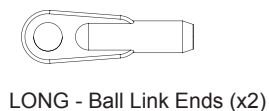
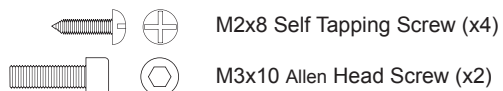


* **PRO TIP** - Do not overcompress the servo's rubber grommets, which serve isolate them from vibration. Also, be certain to use the brass eyelets (included with the servos) and insert them from the bottom because they set the compressed grommet height for you.

* **NOTE:** Make sure the servo arm is 90° to the pushrod when it is in the neutral position.



Step 22 – Tail Rotor Pushrod & H. Fin



Length when servo arm and tail rotor control arm are set perpendicular to the tail boom - neutral.

LONG - HD (heavy duty) Ball Link Ends

*** NOTE:** Slip the four red bushings onto the pushrod before adding the second link - you've been warned!

TR (tail rotor) Pushrod (red) Bushings

TR pushrod = 680mm between the inside edge of the ball link ends.

*** PRO TIP** - Assembling the AUD2003 Ball Link Ends to the AUD1521 Tail Rotor Pushrod becomes a lot easier if you first use a 5/64 drill bit (.078") and drill out the slightly undersized holes before threading them onto the pushrod.

*** NOTE:** Set horizontal fin perpendicular to main shaft.

M3x10 Allen Head Screw

Horizontal Fin

130mm

110mm

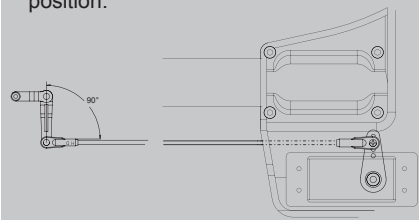
110mm

130mm

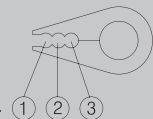
TR Pushrod Guide

M2x8 Self Tapping Screw

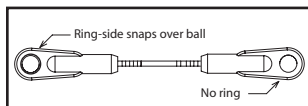
The TR pushrod linkage should make as perfect a 90° angle to the servo arm and link when it's in the neutral position.



Adjust the 3-position pushrod guides so the red TR bushing has the minimum pushrod friction.



*** PRO TIP** - After you complete adjustment, add a drop of thin CA at the top of each guide to "spot weld" it to the boom. It's easy to later break the guide free.



Look closely for a lightly molded ring around the lip on one side of the links. This ring-side is slightly larger than the other. Install the link by snapping the ring-side down over the ball.

Step 23 – Avionics Protection

The importance of protecting the avionics package (receiver, gyro amplifier, governor, and battery pack) from the primary vibrations caused by the engine and the secondary vibrations induced by the main and tail rotors cannot be overemphasized. These forces may lead to premature failure of the avionics components leading to intermittent or permanent loss of control and possibly property damage, injury, or even death. Use a high quality wrap such as Du-Bro® No. 514 - 1/2" (12.7mm) thick foam rubber. Do not use plastic bubble-wrap, open-cell foam, or servo tape for mounting these delicate components unless directed to do so by their manufacturer.

* **PRO TIP** - The gyroscope platform should be cleaned by lightly wiping down with acetone before using the mounting tape supplied by the gyroscope manufacturer.

* **NOTE:** Use the included rubber grommets to isolate the receiver switch from vibration induced failure and don't overcompress them!

Gyroscope

Receiver

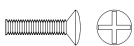
* **PRO TIP** - Use #64 rubber bands to secure avionics package. These are a maintenance item and should be checked during the preflight. Alternatively, use nylon Zip Ties, or Velcro® straps.

Battery Pack

* **PRO TIP** - A sport pilot will be well served with a 4-cell 2400mAh NiCd battery pack for most uses. We designed the model with a voltage limit (typically regulated down to 5.3V, but it really depends on what your component manufacturer suggests as a voltage limit). However, it's not recommended running the servos on higher voltage. The prudent pilot will check batteries before each and every flight with a battery checker which places a simulated load on the battery pack.



Step 24 – Servo Arms & Control Balls



M2x8 Phillips Head Screw (x4)



Stainless Steel Ball (x4)



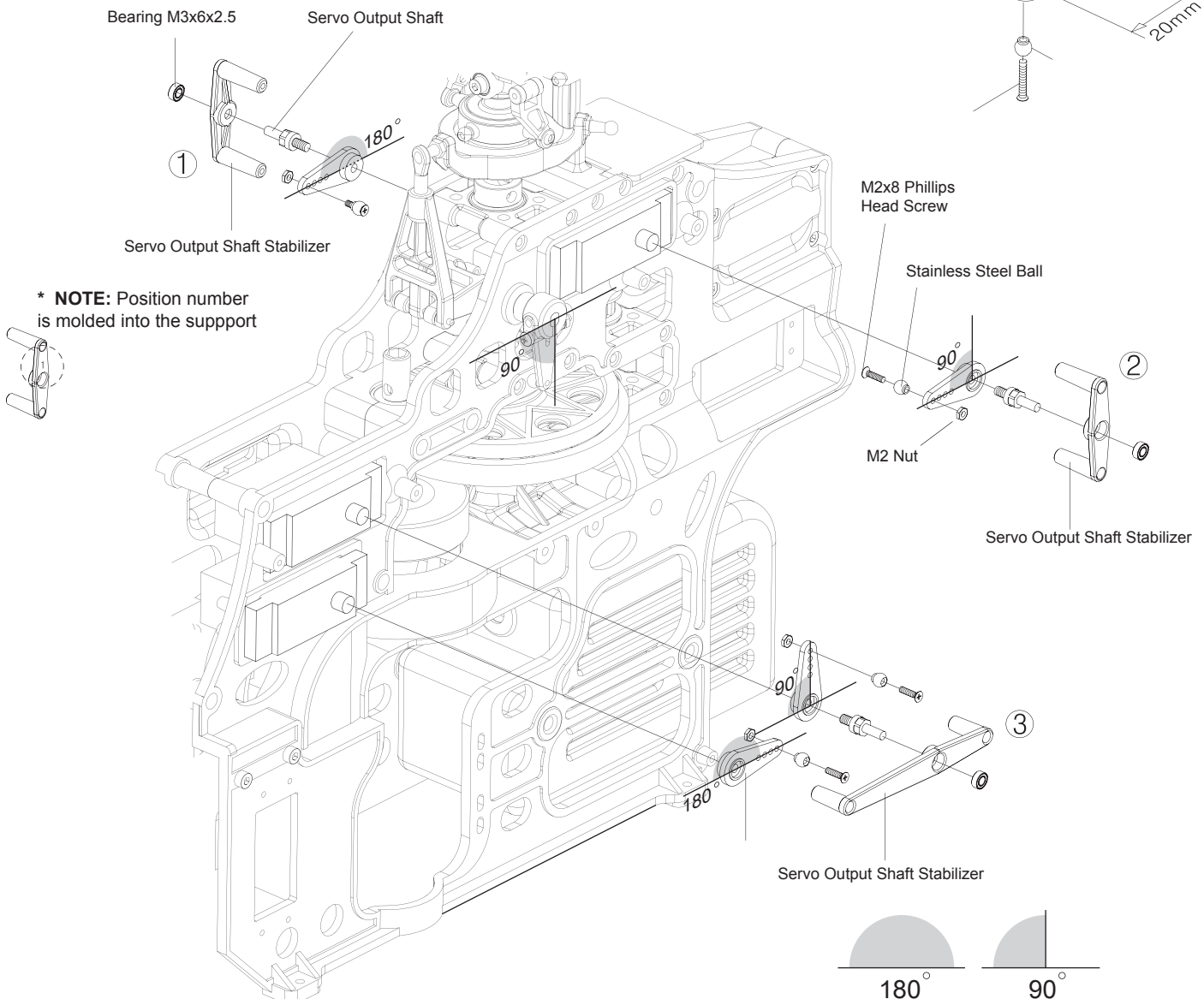
M2 Nut (x4)



Bearing M3x6x2.5 (x3)

* **NOTE:** The three CCPM servos work best with an output location of between **18-20 mm**. We're partial to the Du-Bro® HD servo arms. Part: #670 Futaba®, #671 JR®, #672 Hitec®, and #856 Airtronic® brand servos.

* **PRO TIP** - The servo output shaft stabilizers are long enough to permit fitting any servo and any arm, but that usually leaves them sticking out a bit. So after you finish fitting the servos, and all the linkages are built, just trim the output shaft stabilizers standoffs to bring them closer to the servo arm itself. Next, look to see if you need to trim the canopy edge, where the pushrods to the swashplate pass, for a little bit for clearance.



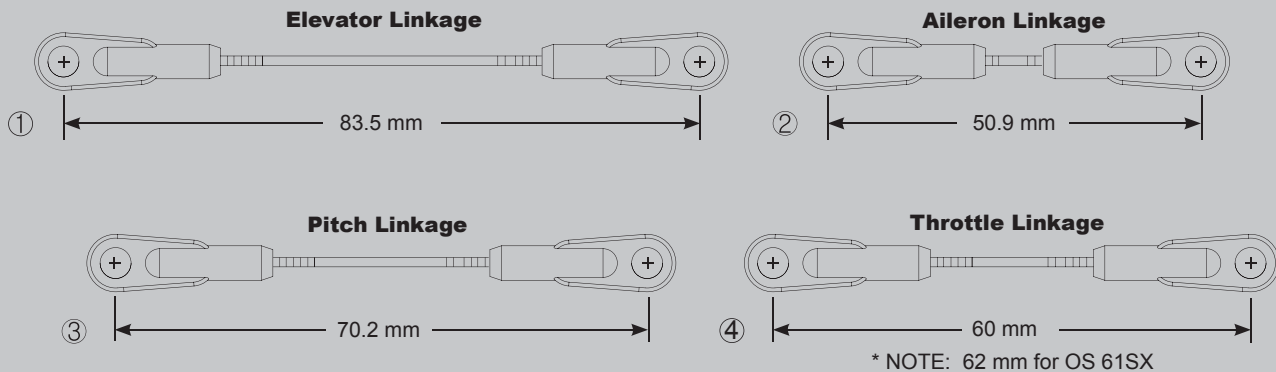
The servo output shafts included with Pantera 50 feature a 2.6mm thread and are designed for plastic gears because this is what's typically found with popular Futaba® and Hitec® servos. However, JR®, and other brands may use either a 2.5mm or even a 3 mm machine thread. Since we cannot anticipate all the possibilities a modeler may encounter, we've made some of these others available as options. They are AUD3068MT-25 for 2.5mm studs and -30 for the 3mm studs (machine threads). Finally, if the fit of the output shaft is too tight in the bearing, use crocus cloth or 600 grit sandpaper to polish the shaft to fit.

* **PRO TIP** - The goal when setting up linkages is to avoid differential throw. The way to do this is to ensure a symmetrical throw results from each side of the servo output shaft, i.e. as the servo arm/control arm linkage moves. The neutral position is always mid-stick, which is when both ends of any servo arm and control arm should be perpendicular, i.e. 90° to the pushrod. Thus, when you set up your servos, first set up the model as a helicopter in the transmitter, second adjust the direction of travel for all the servos (NOR or REV). Third, work to get the best mechanical position possible for the arm on the servo splines such that you obtain either 90° or 180° to the servo case.



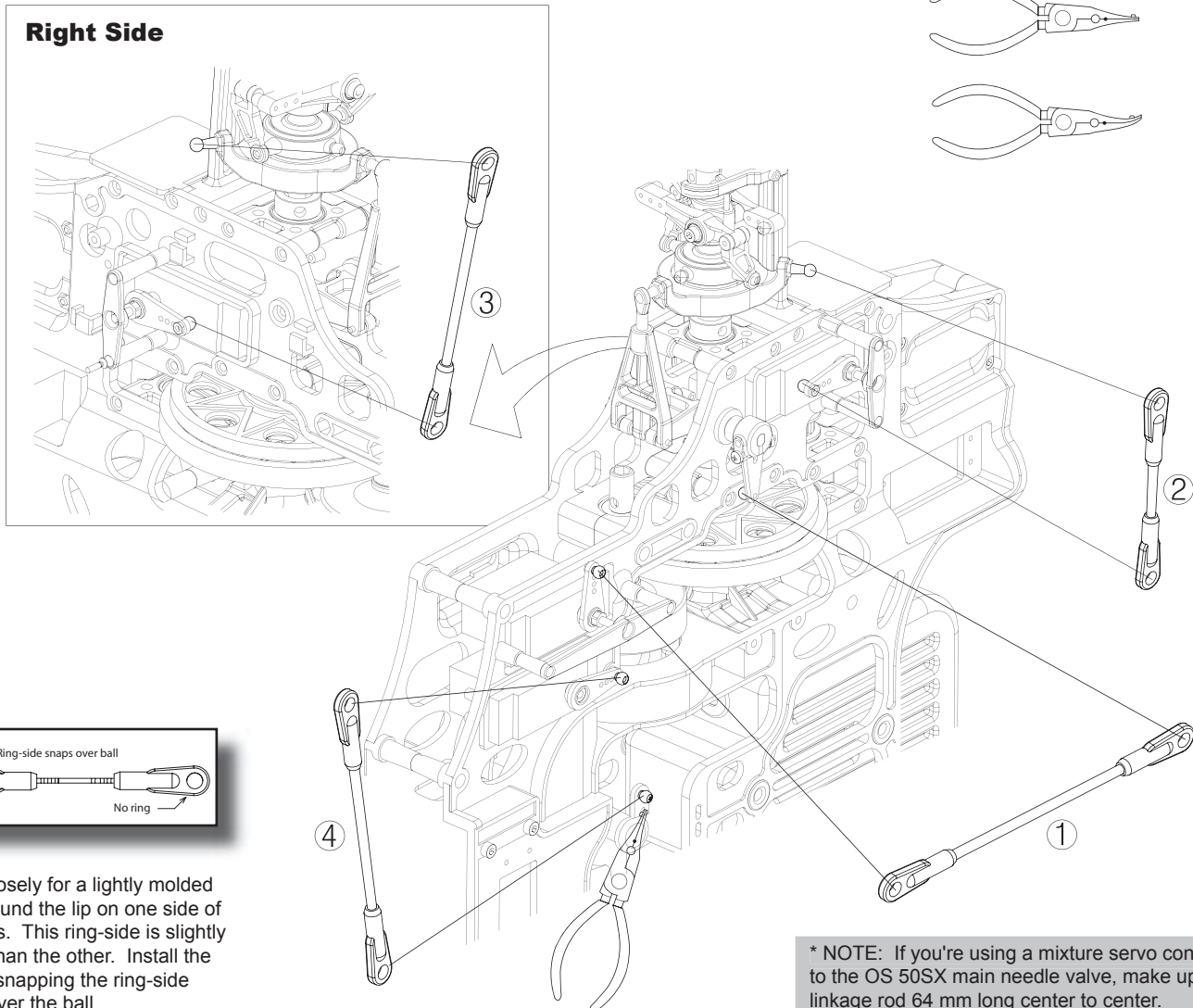
Step 25 – Servo Linkage Rods

The pushrods are preassembled for your convenience. These dimensions are approximate. For symmetrical throw, when in the neutral position, all linkages (elevator, aileron, pitch, and throttle) must make a 90° angle at each end.

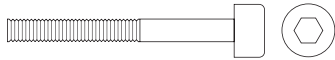


* **PRO TIP** - Both curved and straight tip ball link pliers are required at different times. We prefer **ProModeler® PDR0069 Straight Tip** and **PDR0070 Curved Tip** both in our workshop and at the field.

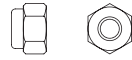
Right Side



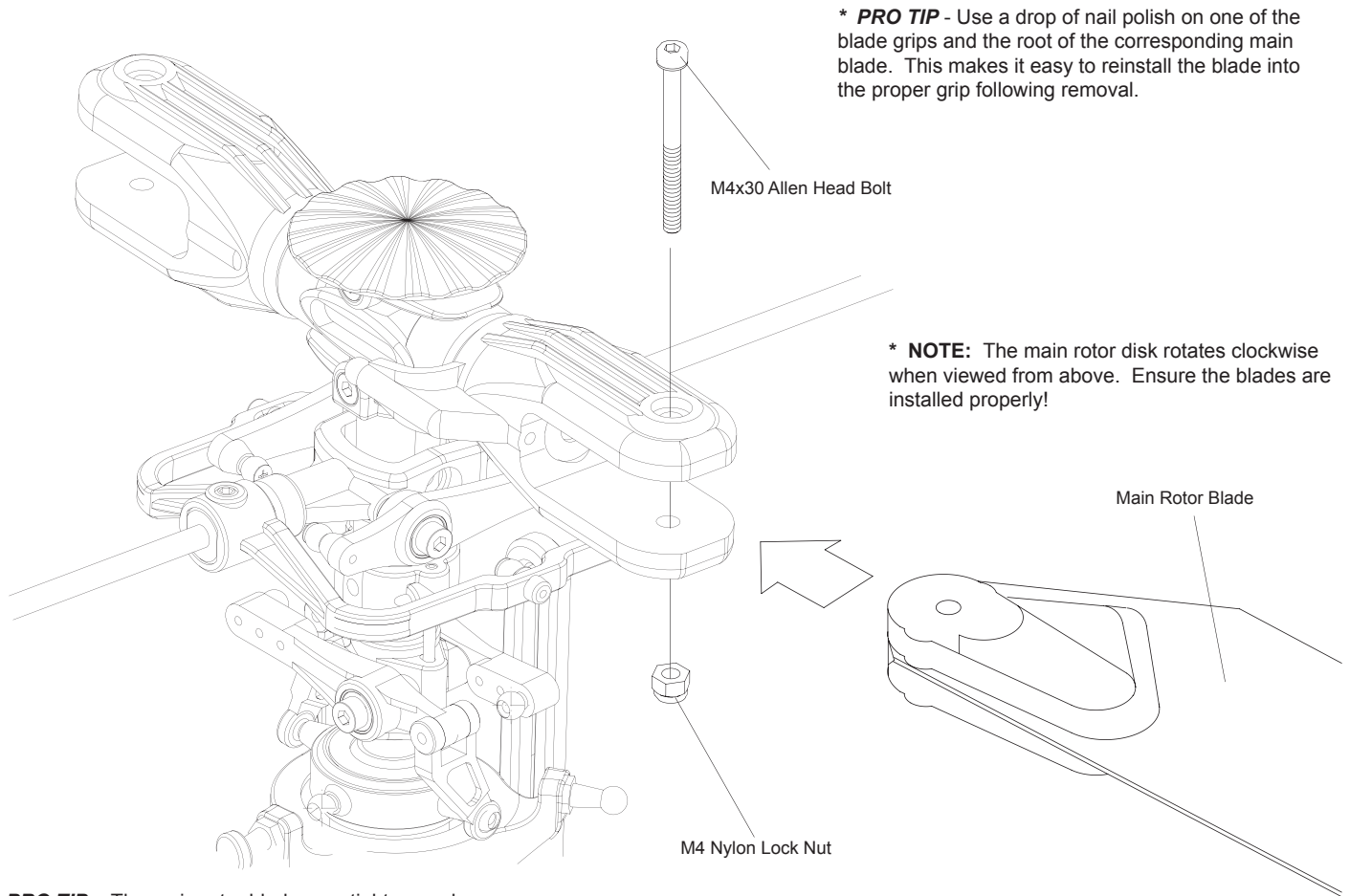
Step 26 – Main Rotor Blades



M4x30 Allen Head Bolt (x2)



M4 Nylon Lock Nut (x2)



*** PRO TIP** - Use a drop of nail polish on one of the blade grips and the root of the corresponding main blade. This makes it easy to reinstall the blade into the proper grip following removal.

*** NOTE:** The main rotor disk rotates clockwise when viewed from above. Ensure the blades are installed properly!

*** PRO TIP** - The main rotor blades are tight enough when you can move them by hand, yet when you hold the helicopter on its side (with the blades extended), they do not swing loose from their own weight.

*** NOTE:** The 4 large black plastic shim washers (included with the blade bolts) are 1mm thick and designed to properly position 12mm main blades within the 14mm main rotor blade grip.

The Panthera 5

a set of 600mm blades will be all they'll ever want. Very experienced pilots, i.e. those with excellent collective management skills may find it beneficial to use longer blades - perhaps a set of 620mm blades. As in all things, however, there is a trade off and increasing the rotor disk area is no different. To begin with, the resulting decreased rotor disk loading leads to increased agility. The price to be paid though is that because of the increased agility comes the ability to actually bend parts while flying because the Panthera may stop and start much more quickly.

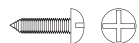
Hence, the

live in Denver, CO or Mexico City, DF. The resulting high altitude leads to a decrease in specific power output from all internal combustion engines because of the decreased density of the air. The term for this is density altitude and pilots living where there are high-density altitudes experience

powered it! Thus, we've made it easy to install a .61 engine into the Panthera via the AUD0062S option parts. The increased displacement of the .61 engine helps make up for the power loss experienced by high density altitudes. However, once again the specter of a trade off raises its ugly head. To wit, the .61 engine weighs more than the .50 engine and that raises the disk loading. The solution in this case is to simply use longer blades to bring the disk loading back down, i.e. 620mm blades. Naturally, somebody will wonder about installing a .70 or even a .91-class engine (since they're physically the same size as a .61) into a Panthera . . . to which we respond - don't be crazy. However, since we may have a screw loose ourselves, we have these required parts available too. Anyway, as it turns out, the 8.7:1 gearing of the stock Panthera is perfect for either the .50SX or the .61SX (and remember, there are plenty of these sitting around in drawers because they were quickly obsoleted when the 61-class helis were stretched to become 70 and later 90-class helis). Anyway, the gear ratio isn't so perfect for the .70 or the .91 engines. Hence, we've got a 7.9:1 gear available as part of the long conversion kit AUD0062L (so named because of the longer tail boom and belt included - up to 680mm blades). These kind of torque monsters in a Panthera result in ncredibly awesome performance, and ballistic rates of



Step 27 – Canopy & Windshield



M2x8 Self Tapping Screw (x6)



Canopy Mount Rubber Grommet (x4)

* **NOTE:** Counterclockwise tail rotor rotation.

* **NOTE:** Clockwise main rotor rotation.

M2x8 Self Tapping Screw

* **PRO TIP** - Use a small drill bit, or even a modeler's pin as an auger, to make the holes to start the screws.

Canopy

Canopy Mount Rubber Grommet

* **PRO TIP** - Cut to the molded trim line using Lexan-type scissors and fasten with self-tapping screws.

