

STEP UP TO EXCELLENCE WITH X-CELL



TABLE OF CONTENTS

Kit Introduction	3
R/C Helicopter Safety	
Warning	
General Guidelines	
Academy of Model Aeronautics (AMA)	
Kit Assembly	
Required Tools	
Other Required Components	
Assembly Tips	
Kit Contents	7
Flybarless Head Assembly (Whiplash Kit #MA1033-3)	9
Flybarless Head Parts List	
Flybarless Head Assembly Instructions	
Flybarless Head Link Lengths	
Tail Assembly	12
Tail Assembly Parts List Tail Assembly Instructions	
,	
Gas Frame Assembly	
Gas Frame Assembly Parts List Gas Frame Assembly Instructions	
Electronics Mounting Positions	
Canopy Mounting	
Whiplash Gas User Guide	32
Safety	
Engine/Fuel/Oil	
Fuel Tank Plumbing	
Mufflers Air Filter	
Spark Plug	
Electronic Wiring	
Initial Mixture Settings	
Throttle Setup/Curves	
Governor Setup/Sensors	
Starting Rotor Blades	
Pitch Curves	
Gear Ratios	
Running	
Additional Support References	35
Kit Hardware and Parts	36
Warranty Information	37

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For updates to this manual, or any other Miniature Aircraft manual, go to www.miniatureaircraftusa.com.



KIT INTRODUCTION

Thank you for purchasing the X-Cell Whiplash by Miniature Aircraft. This model is the culmination of years of designing and manufacturing R/C helicopters. It is designed with the highest standards, and will provide years of enjoyment. Whether this is your first R/C model helicopter or you are an advanced R/C helicopter modeler, the X-Cell Whiplash is a fantastic choice for a "700 size" model.

R/C HELICOPTER SAFETY

A radio controlled model helicopter is not a toy, but rather a technically complex device that must be built and operated with care. It is also a fascinating and challenging part of the R/C sport, the mastery of which is very rewarding. A model helicopter must be built exactly in accordance with the building instructions. The kit manufacturer has spent much time and effort refining his product to make it reliable in operation and easy to build. The essentially bolt together construction can proceed quite rapidly, giving the builder a strong sense of accomplishment that encourages hasty progress from one construction phase to the next, so that the completed model can be more quickly seen and enjoyed. It is essential to recognize and guard against this tendency. Follow building instructions exactly. Vibration and stress levels are high and all fasteners and attachments must be secure for safe operation.

Note that this is the first use of the word SAFETY in these comments. Previously the kit manufacturer's efforts to ensure reliable operation were mentioned. That is ALL that he can do. Safe operation is the responsibility of the builder/flyer and starts with careful construction and continues with selection and installation of reliable radio equipment and engine.

The need for safety is nowhere greater than at the flying field. A number of guidelines for safe flight have been developed by experienced flyers and are set down here. It is urged that they be read, understood and followed.

WARNING! - RISK OF DEATH OR SERIOUS INJURY

Remote Control ("R/C") Helicopters can be dangerous. Inexperienced pilots of R/C Helicopters should be trained and supervised by experienced operators. All operators should use safety glasses and other appropriate safety equipment. All operators should exercise necessary precautions when fueling, repairing, maintaining, flying and storing R/C Helicopters, and when using or storing R/C Helicopter accessories, equipment, fuels, and related materials. R/C Helicopters should be used only in open areas free of obstacles and far enough from people to minimize the possibility of injury from the helicopter or any of its components falling or flying in unexpected directions.

This helicopter is not a toy but a complex flying machine that must be assembled with care by a responsible individual. Failure to exert care in assembly, or radio or accessory installation, may result in a model incapable of safe flight or ground operation. Rotating components are an ever present danger and source of injury to operators and spectators. Since the manufacturer and his agents have no control over the proper assembly and operation of his products, no responsibility or liability can be assumed for their use.

GENERAL GUIDELINES FOR SAFE R/C HELICOPTER FLIGHT

- First of all take care to get the right insurance to R/C helicopters.
- Fly only at approved flying fields and obey field regulations.
- · Follow frequency control procedures. Interference can be dangerous to all.
- Know your radio. Check all transmitter functions before each flight.
- · Be aware that rotating blades are very dangerous and can cause serious injury.
- Never fly near or above spectators or other modelers.
- If you're a beginner, get help trimming the model first and flight training later.
- Don't "track" the main blades by holding the tail boom. This is a temptation to builders who cannot hover yet and is very dangerous.
- Follow all recommended maintenance procedures for model, radio and engine.



ACADEMY OF MODEL AERONAUTICS

Miniature Aircraft highly recommends joining the Academy of Model Aeronautics (AMA).

- AMA is the Academy of Model Aeronautics.
- AMA is the world's largest model aviation association, representing a membership of more than 150,000 from every walk of life, income level and age group.
- AMA is a self-supporting, non-profit organization whose purpose is to promote development of model aviation as a recognized sport and worthwhile recreation activity.
- AMA is an organization open to anyone interested in model aviation.
- AMA is the official national body for model aviation in the United States. AMA sanctions more than a thousand model competitions throughout the country each year and certifies official model flying records on a national and international level.
- AMA is the organizer of the annual National Aeromodeling Championships, the world's largest model airplane competition.
- AMA is the chartering organization for more than 2,500 model airplane clubs across the country. AMA offers its chartered clubs official contest sanction, insurance and assistance in getting and keeping flying sites.
- AMA is the voice of its membership, providing liaison with the Federal Aviation Administration, the Federal Communications Commission, and other government agencies through our national headquarters in Muncie, Indiana. AMA also works with local governments, zoning boards and parks departments to promote the interests of local chartered clubs.
- AMA is an associate member of the National Aeronautic Association. Through NAA, AMA is recognized by the Fédération Aéronautique Internationale (FAI), the world governing body of all aviation activity, as the only organization which may direct U.S. participation in international aeromodeling activities.

For more detailed information, contact the Academy of Model Aeronautics 5161 E. Memorial Drive, Muncie, Indiana, 47302 or telephone (800) 435-9262. You may also visit the AMA website at www.modelaircraft.org



KIT ASSEMBLY (1033-3)

Your Whiplash kit will require a number of different supplies and tools to ensure the best final result. They are as follows:

REQUIRED LUBRICANTS AND COMPOUNDS:

- 1. Medium Strength Thread Locking Compound Loctite 243 Blue (MA3200-20)
- 2. Tri-Flow Oil (MA3200-12)
- 3. Synthetic Grease (MA3200-11)
- 4. Medium Cyanoacrylate (CA)
- 5. Retaining Compound Loctite 648 Green (MA3200-22)

REQUIRED TOOLS:

- 1. M4 Nut Driver
- 2. M5 Nut Driver
- 3. M5.5 Nut Driver
- 4. M7 Nut Driver
- 5. 1.5mm Allen Driver
- 6. 2.0mm Allen Driver
- 7. 2.5mm Allen Driver
- 8. 3.0mm Allen Driver
- 9. 4.0mm Allen Driver x2
- 10. 5.0mm Allen Driver
- 11. Needle Nose Pliers
- 12. Phillips Screwdriver
- 13. Razor Knife (X-acto)

OTHER REQUIRED COMPONENTS:

The X-Cell Whiplash is an airframe kit. To complete the model, several other items are required but are not included with the kit. There are many choices for these other required components, and any competent hobby retailer with R/C helicopter experience will be happy to make suggestions. You will need:

- 1. Engine, 23-29cc R/C format gas engine
- 2. Helicopter style muffler suited to the engine you choose.
- 3. Cyclic servos (Miniature Aircraft recommends high quality digital cyclic servos with no less than 80 oz. in. of torque.)
- 4. Throttle servo (Miniature Aircraft recommends a high quality ball bearing sevro)
- 4. R/C helicopter gyro (Miniature Aircraft recommends for Flybarless Kits a flybarless electronic unit with rudder gyro)
- 5. Rudder servo suitable for use with the gyro you choose. Digital servo is recommended.
- 6. R/C helicopter transmitter and receiver with at least 6 channels, and eCCPM capabilities.
- 7. 690-720mm Main Blades and 105mm Tail Blades
- 8. R/C helicopter starting and fueling equipment compatible with gasoline fuel
- 9. R/C helicopter engine governor is recommended

Refer to the "Whiplash Gas User Guide" on page 32 of this manual for more information on recommended equipment and setup.



IMPORTANT ASSEMBLY TIPS - PLEASE READ

- Follow the instructions. The methods of construction documented in this manual have been proven to work. Do not rush the build of your model! You have purchased a world class model helicopter kit, take your time and realize that the final result is now up to you. Take the time to fully understand each step and if you are unsure please contact Miniature Aircraft.
- Follow the order of assembly. The instructions have been organized into major sections and have been written in such a way that each step builds upon the work done in the previous step. Changing the order of assembly may result in unnecessary steps.
- Clean all metal parts. All of the steel parts in this kit are coated with a lubricant to prevent them from rusting. This coating can interfere with the adhesives and thread locks needed for assembly. Use a solvent such as alcohol or acetone to clean the various metal parts, especially threads. Be sure not to overtighten bolts as damage to bearings and other components will occur.
- It is very important to lightly sand the edges of all carbon fiber pieces. Miniature Aircraft recommends doing so prior to the assembly process. Carbon fiber edges can be sharp and can easily cut component wires and battery mounting straps. It is important to use safety precautions when creating carbon fiber dust. The use of a particulate mask, preferably one with a P100 HEPA filter is recommended. Always clean up carbon fiber dust with a damp rag right away.
- Use thread lock as indicated. Generally any bolt or screw that threads into a metal part requires thread lock. Model helicopters are subject to vibration and failing to use thread lock on any non-locking assembly may result in a part becoming loose or falling off.



KIT CONTENTS

Please take some time to familiarize yourself with the contents of the kit. The Whiplash kit has been broken down into three "bags". Each bag contains parts and hardware. The hardware for each bag will be used only for that bag. There will be no left over parts after each bag is assembled. The individual parts of the factory assembled parts are not listed out here. They can be found in the components section of the manual.

Bag 1 - Rotor Head FBL

Bag	Part No.	Part Description	Qty	Bag	Part No.	Part Description	Qty
1-A	0217	Swashplate - Factory	1	1-C	131-161	Main Blade Grip - Factory	2
1-Hardware	0051	M3x3 Set Screw	2	1-C	131-163	FBL Pitch Arm	2
1-Hardware	0107	M3x6 Threaded Steel Ball	3	1-C	131-187	Head Axle	1
1-Hardware	0109	M3x8 Threaded Steel Ball	4	1-Hardware	0107	M3x6 Threaded Steel Ball	2
1-Hardware	131-83	Anti-rotation Pin	1	1-Hardware	0061	M3x8 Socket Bolt	4
				1-Hardware	0086-1	M5x16 Flanged Socket Bolt	2
1-B	0869	Washout Link	2	1-Hardware	120-7-1	5x15 Safety Washer	2
1-B	128-176	Washout Pin	2	1-Hardware	131-183	Washer	2
1-B	128-195	Head Button	1				
1-B	128-314	Swashplate Follower - Factory	2	1-D	0133-1	M3x21.5 Ball Link	10
1-B	131-368	FBL Head Block	1	1-D	121-4	Servo To Swash Linkage Rod	3
1-Hardware	0067	M3x14 Socket Bolt	1	1-D	121-7	Swash To PA Linkage Rod	2
1-Hardware	0071	M3x18 Button Head Socket Bolt	2	1-D	131-408	FBL Main Shaft	1
1-Hardware	0447-1	M2 E-clip	2	1-Hardware	0021	M4 Lock Nut	1
				1-Hardware	0023	M5 Nut	2
				1-Hardware	0063	M3x10 Socket Bolt	2
				1-Hardware	0082-4	M5x32 Shouldered Socket Bolt	2
				1-Hardware	131-200	M4x33 Shouldered Socket Bolt	1

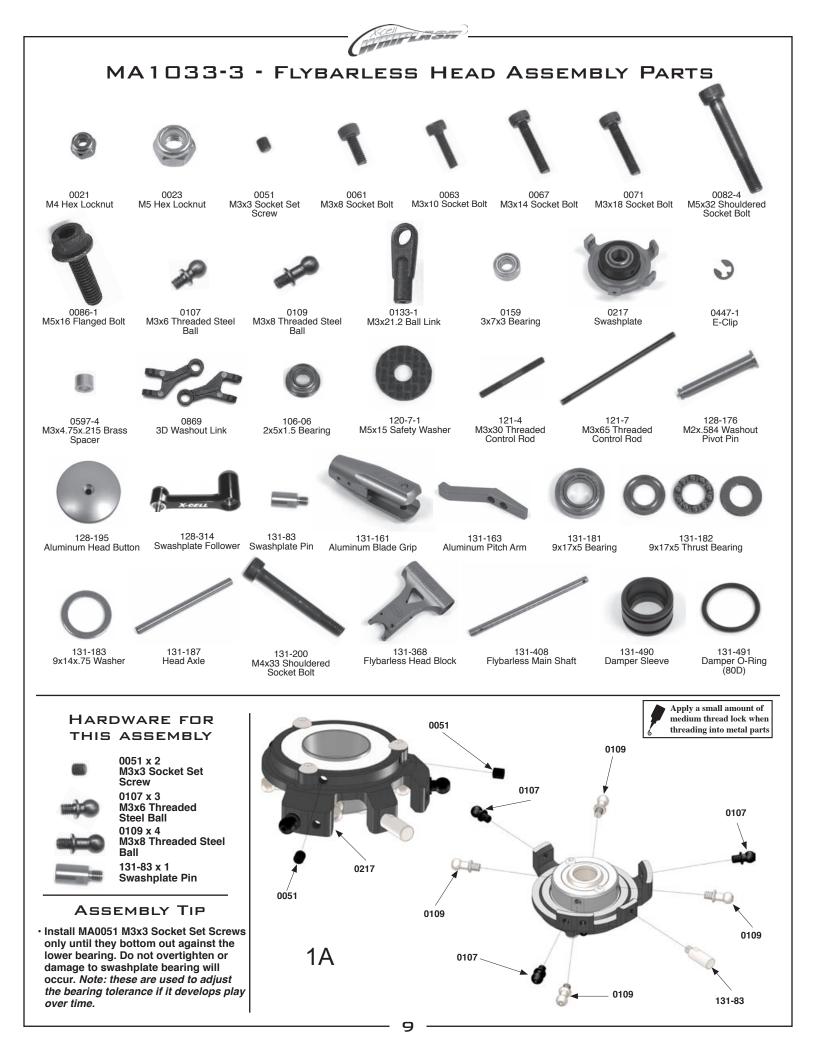
Bag 2 - Tail Assembly

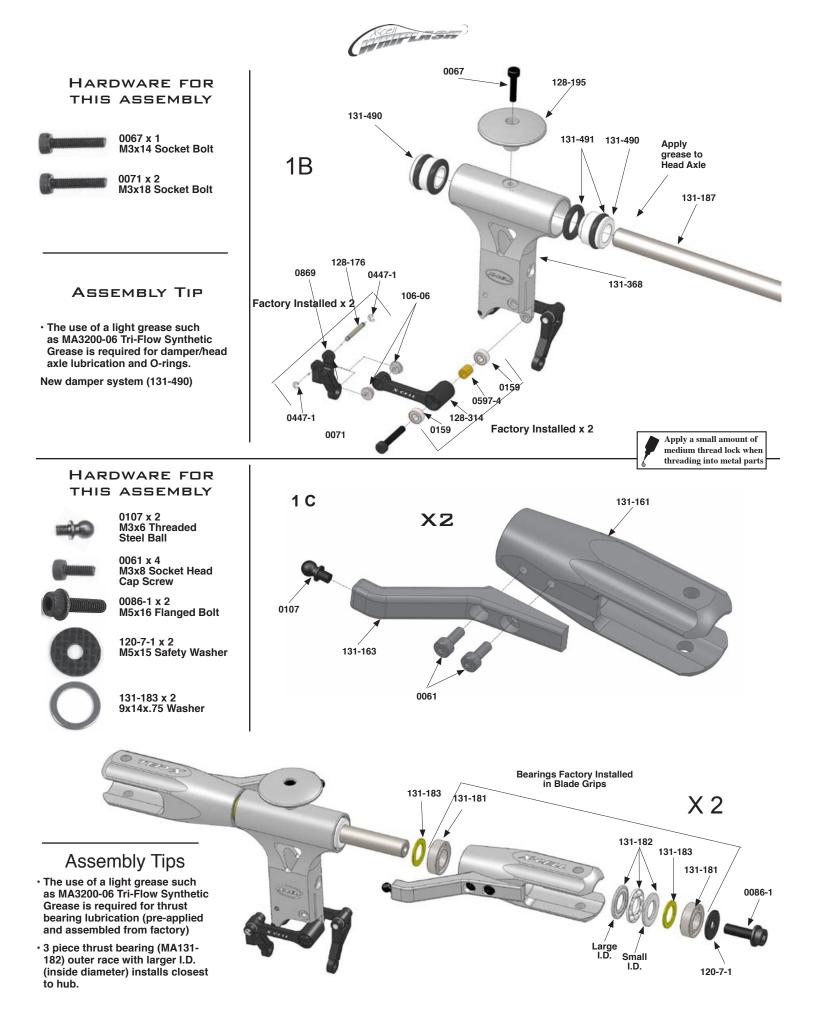
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2-Hardware 0063 M3x10 Socket Bolt	2
2 Hardware 0065 M2x12 Secket Belt	3
2-B-1 131-400 11 Ends 2 0 Hardware 0067 May14 Seclet Bol	2
2-B-1 131-480 11 Bearing Cup 2 2 A Hardware 0078 Max12 Sacket Belt	2
2-B-1 131-481 11 Bearing Cup O-Ring 4	2
2-B-1 131-482 TT Sleeve 2 2-B-1 131-485 TT Bearing 2 2-B-4 133-60 C/F Vertical Tail Fin Painted	1
2-Hardware 0015 2mm Hex Nut 2	
2-Hardware 0049-1 M2x12 Socket Bolt 2	

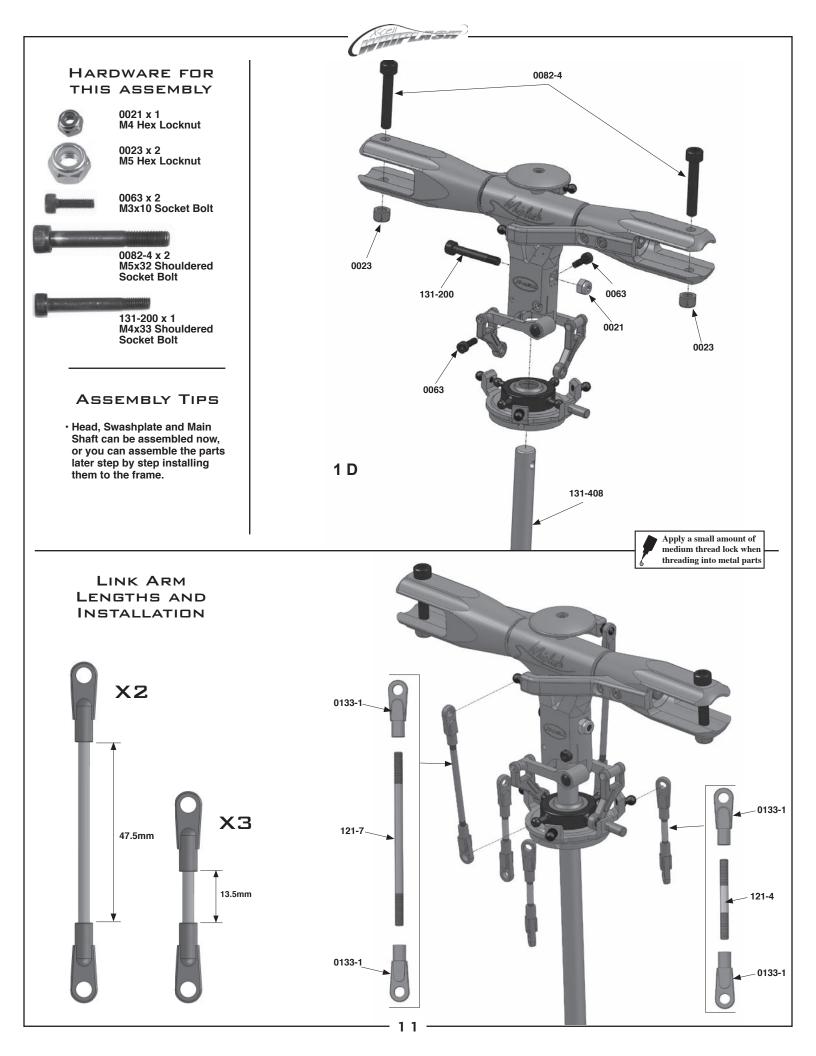
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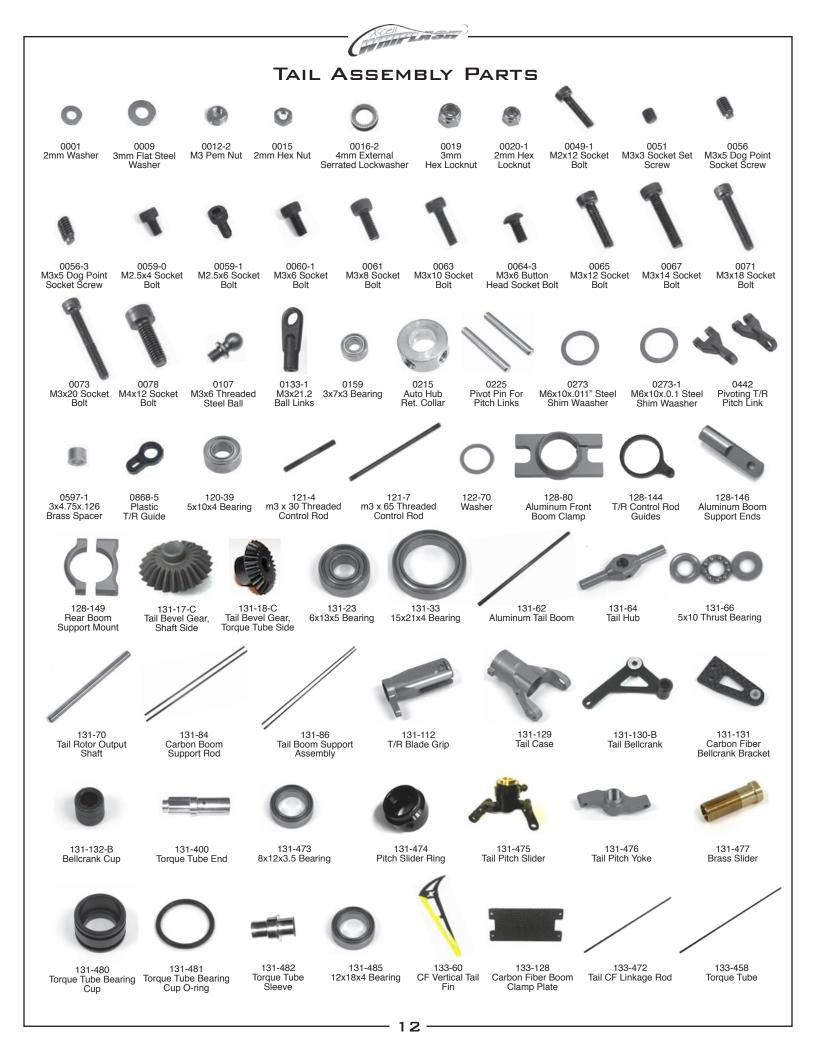
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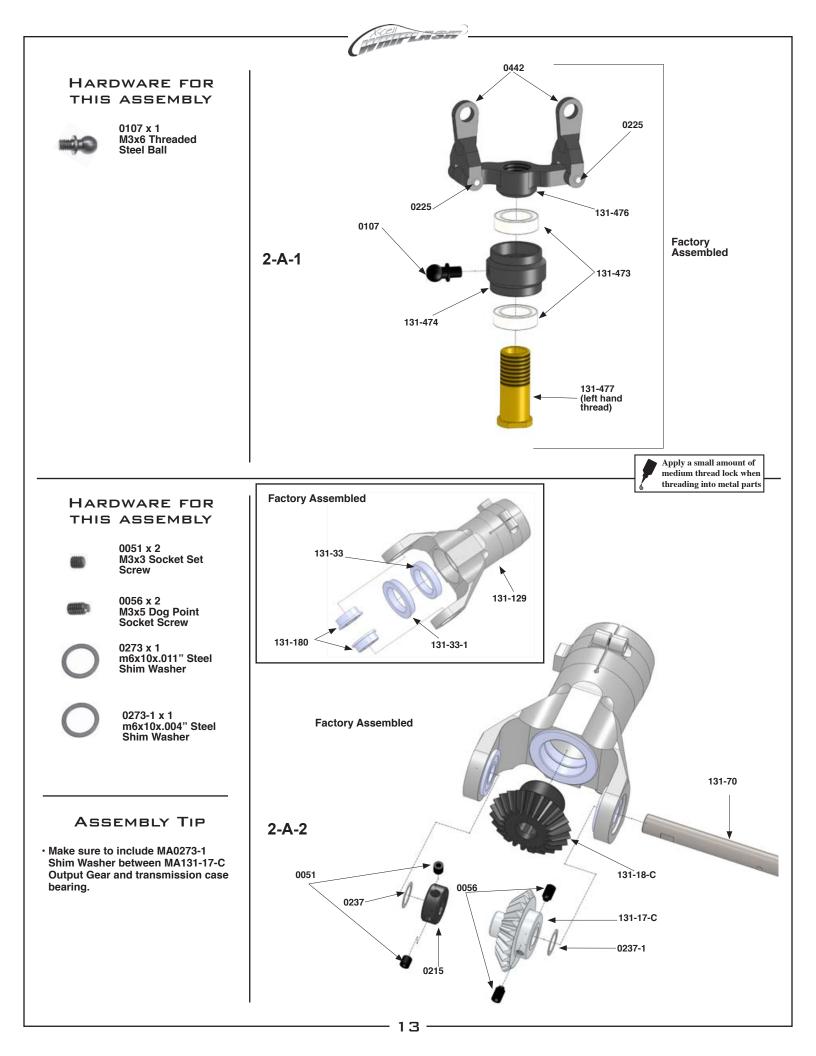
Bag	Part No.	Part Description	Qty	Bag	Part No.	Part Description	Qty
3-A-1 3-A-1 3-A-1 3-A-1 3-Hardware 3-Hardware	128-57 131-52 131-53 131-55 0032-2 0064-3	Tray Mount Delrin Tray Mount C/F Gyro Plate C/F Angled Battery Tray M3x8 Tapping Screw M3x6 Button Head	3 2 1 1 4 6	3-E-1 3-E-1 3-E-1 3-E-1 3-E-1 3-E-1 3-E-1	0133-1 106-22 121-6 128-59 131-150 131-153	C/F Canopy Breakaway Tabs	2 4 1 2 4
3-A-2 3-A-3		C/F Left Frame - Gas C/F Right Frame - Gas	1 1	3-E-1 3-E-1 3-E-1	131-154 131-451 131-452	Thumb Screw, not standoff Rear Canopy Post Splint	2 4 2 2 2 2 2 2
Frame Hardware	0003 0032 0060-1 0061 0063	3mm Washer 2.9x9.5 Tapping Screw M3x6 Socket Bolt M3x8 Socket Bolt M3x10 Socket Bolt	20 10 30 50 10	3-Hardware 3-Hardware 3-Hardware 3-Hardware 3-Hardware 3-Hardware	0003 0016-2 0015 0061 0063 0081 0103	3mm Washer M4 External Serrated Lock Washer 2mm Hex Nut 3x8 Socket Bolt 3x10 Socket Bolt M4x16 Socket Bolt 2mm Threaded Steel Ball	2 2 1 20 2 2 1
3-B 3-B 3-B 3-B 3-B 3-B 3-Hardware 3-Hardware 3-Hardware	128-58 131-21 131-46 131-47 131-186 131-420 131-429 0060-1 0063 0065	Frame Spacer Upper Main Bearing Block P/A Servo Rail C/F Servo Rail Spacer C/F Anti-rotation Bracket Mid Main Bearing Block C/F X-Brace M3x6 Socket Bolt M3x10 Socket Bolt M3x12 Socket Bolt	4 1 2 1 1 1 4 2 2	3-E-2 3-E-2 3-E-2 3-E-2 3-Hardware 3-Hardware 3-Hardware 3-Hardware 3-F	2500-24 131-382 131-454 2500-39 0003 0058-1 0073 0078-5 0405		2 2 2 4 4 4 4 4 4 1
3-C 3-C 3-C 3-C 3-Hardware	128-118 131-3 131-179 131-409 0057	6mm Hex Adaptor Start Shaft w/Sleeve X-Block Assembled Gas Clutch Bell M4x4 Set Screw	1 1 1 2	3-F 3-F 3-F 3-F 3-F 3-F 3-F	128-90 128-92 128-94 131-144 133-94 133-99	Tank Mounting Studs Fuel Tank Plug Fuel Nipple Rubber Fuel Tank Mount C/F Fuel Tank Plate Whiplash Gas Fuel Tank	2 1 1 4 1
BAG-S BAG-S BAG-S S-Hardware S-Hardware	0059-1	Mounting Block Elevator Servo Mount C/F Servo Plates 2.5mm Hex Nut M2.5x6 Socket Bolt	2 2 14 5 4	3-Hardware 3-Hardware 3-Hardware 3-Hardware	0011 0011-5 0014F 0060-1	5mm Washer Washer 5mm Hex Nut - Fine Threaded M3x6 Socket Bolt	1 1 2 4
S-Hardware S-Hardware S-Hardware 3-D-1	0059-7	M2.5x12 Socket bolt M2.5x20 Socket Bolt M2.5 Threaded Steel Ball C/F Bottom Plate - Gas	16 4 5 1	3-G 3-G 3-G 3-G 3-G 3-G	0390 133-137 3200-30 3200-48 3200-54	Wire Retainers Rubber Wire Grommet 20" Spiral Band for Wire and Cable 20" 3/4 Hook and Loop Tape 17" Adhesive Hook and Loop	3 2 1 1
3-D-2 3-D-2	128-57 133-107	Tray Mount C/F Front Doubler - Gas	3 2	BOX	133-144	Skids Blue	2
3-D-2 3-D-2 3-D-2	133-108 133-119 133-120	C/F Rear Doubler - Gas Flanged Clutch Spacer One Way Bearing Bracket - Factory	2 2 1	BOX	133-150	Air Filter	1
3-D-2 3-D-2	133-121 133-400	Gas Motor Mount Bottom Mount Spacer	1 4	BOX	133-252	Whiplash Canopy	1
3-D-2 3-Hardware	133-401 0009	Bottom Mount Spacer 3mm washer May 10 Sacket Belt	1 4	BOX	3000-73	Towel	1
3-Hardware 3-Hardware 3-Hardware	0063 0085 0085-3	M3x10 Socket Bolt M5x16 Socket Bolt M5x22 Socket Bolt	8 4 4	BOX BOX	133-430 3700-160	Whiplash Gas Instruction Manual Blade Holder	1
3-E 3-E 3-E 3-E 3-E 3-E 3-E 3-E 3-Hardware 3-Hardware 3-Hardware 3-Hardware 3-Hardware 3-Hardware	131-470 0875-1 132-117-E 131-424 131-440 131-469-1 0620-01 0620-02 0620-03 0021 0059-2 0088	70T Machined Crown Gear 10mm Split Main Shaft Collar 3 124T Main Gear Main Gear Hub Lower Main Bearing Block Auto Hub 1 Gear Support 15x21x.10 Shim Washer 15x21x.20 Shim Washer 15x21x.30 Shim Washer 15x21x.30 Shim Washer 4mm Lock Nut M2.5x8 Socket Bolt M3x8 Tapered Socket Bolt M3x7 Tapered Socket Bolt Jesus Bolt OWB V2	1 2 1 1 1 1 1 1 1 2 8 5 1				

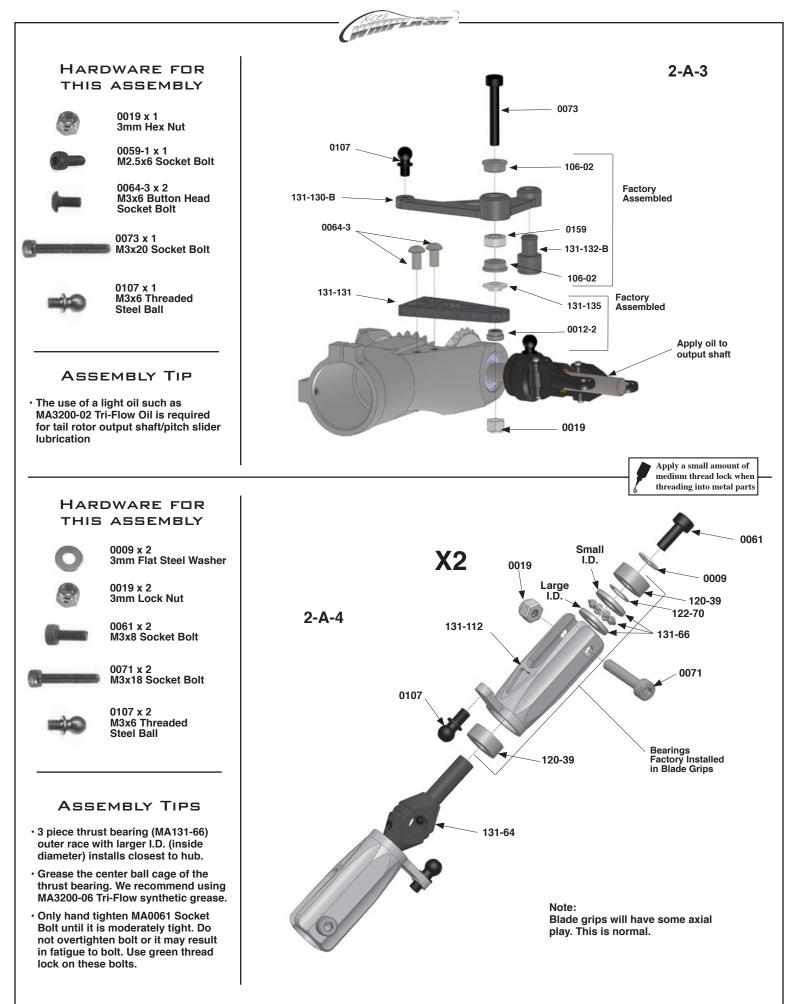


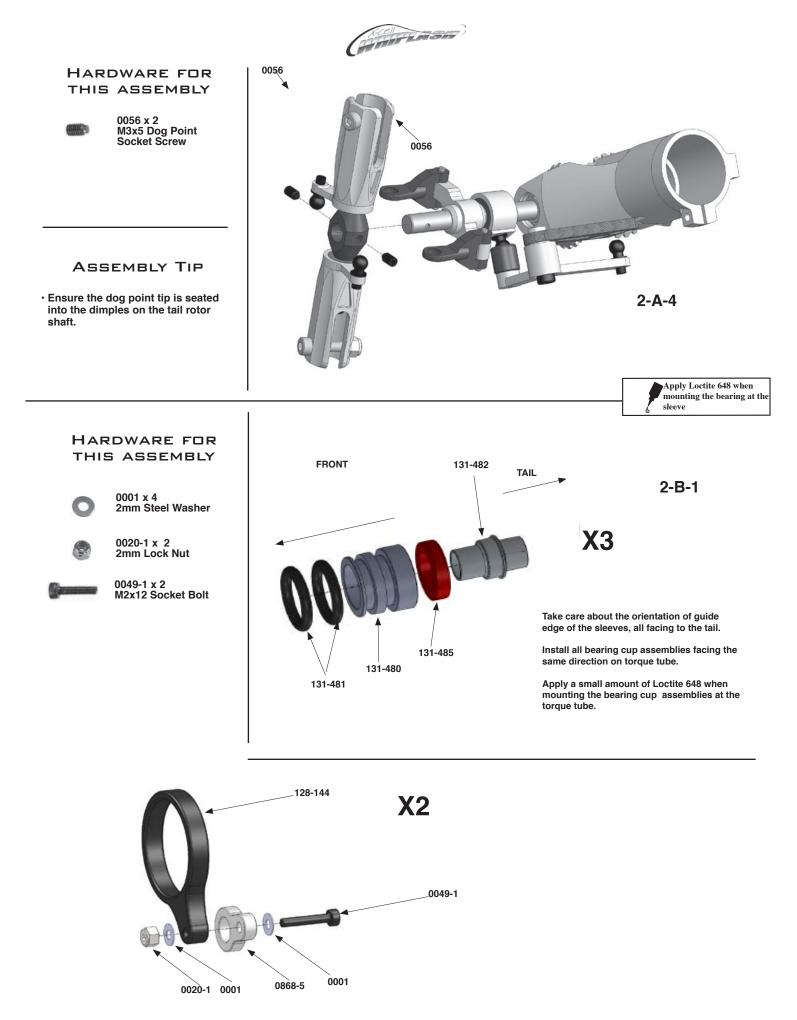


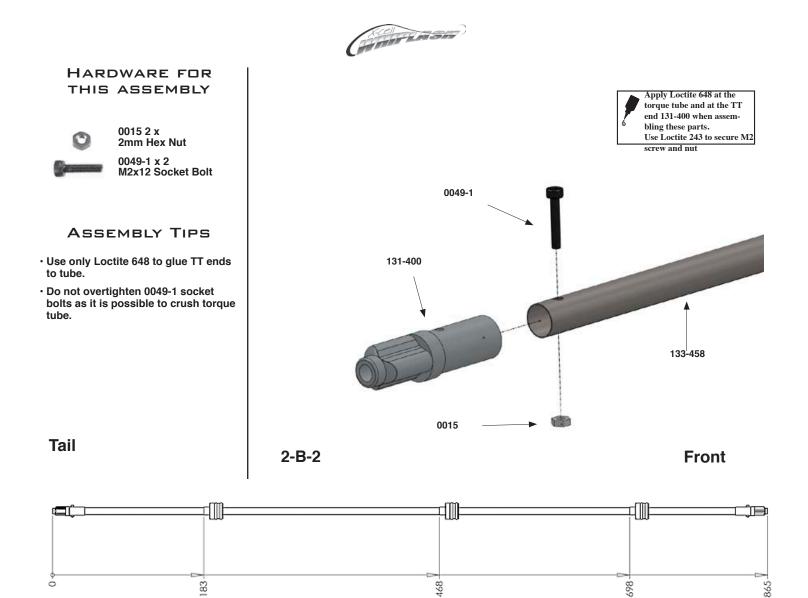




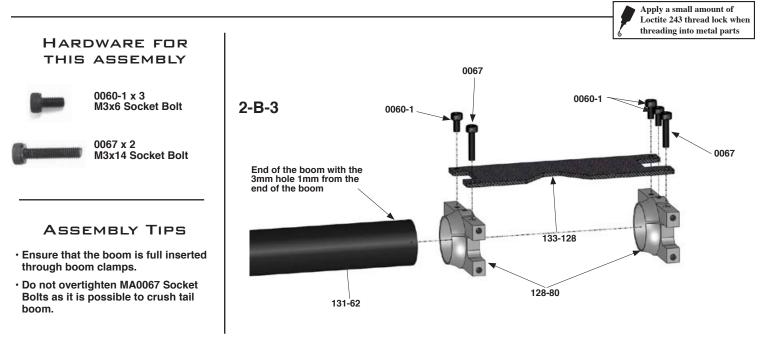


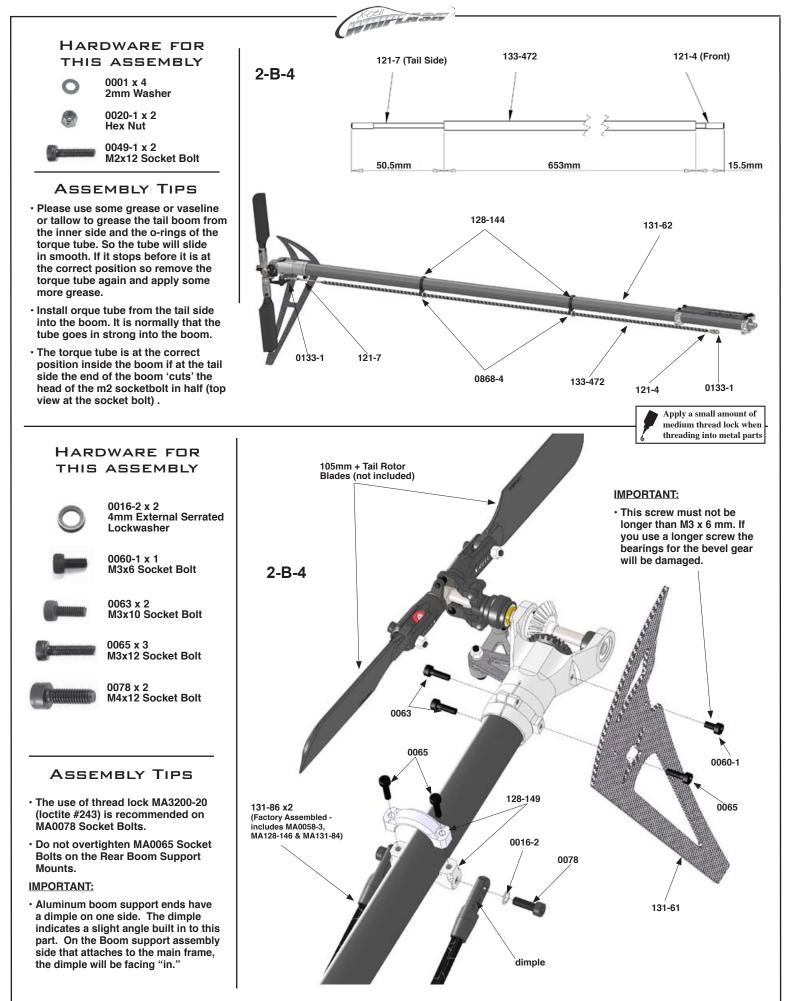




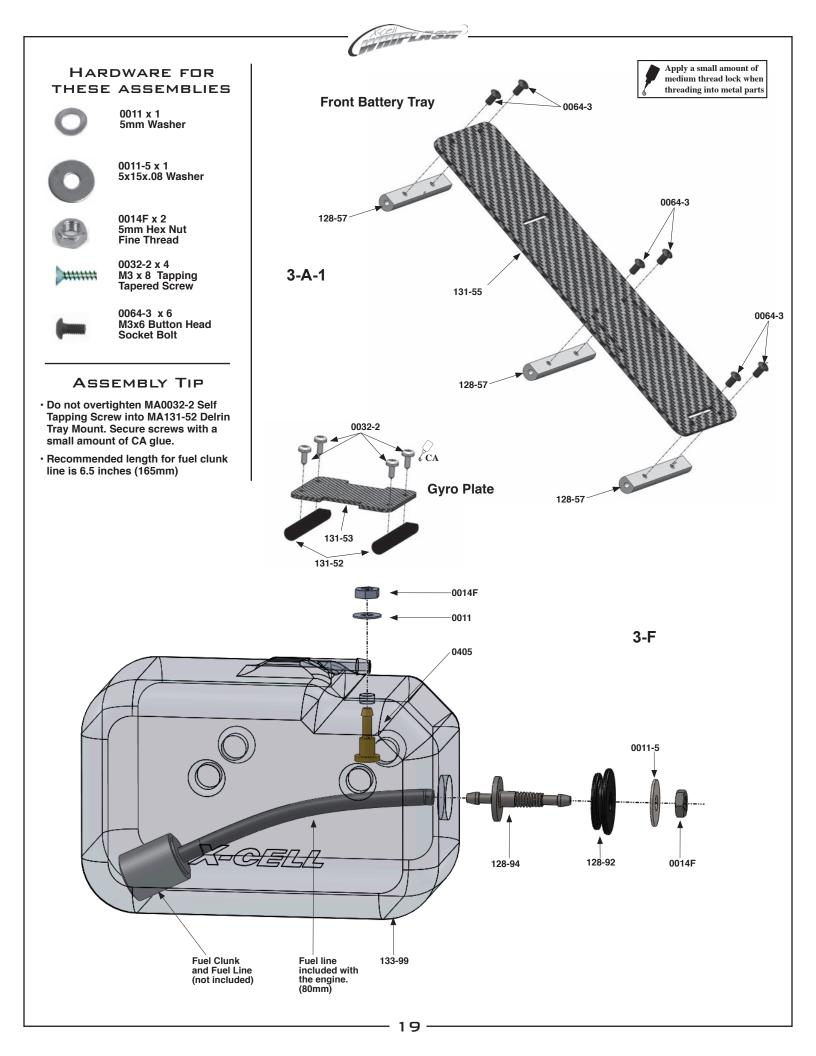


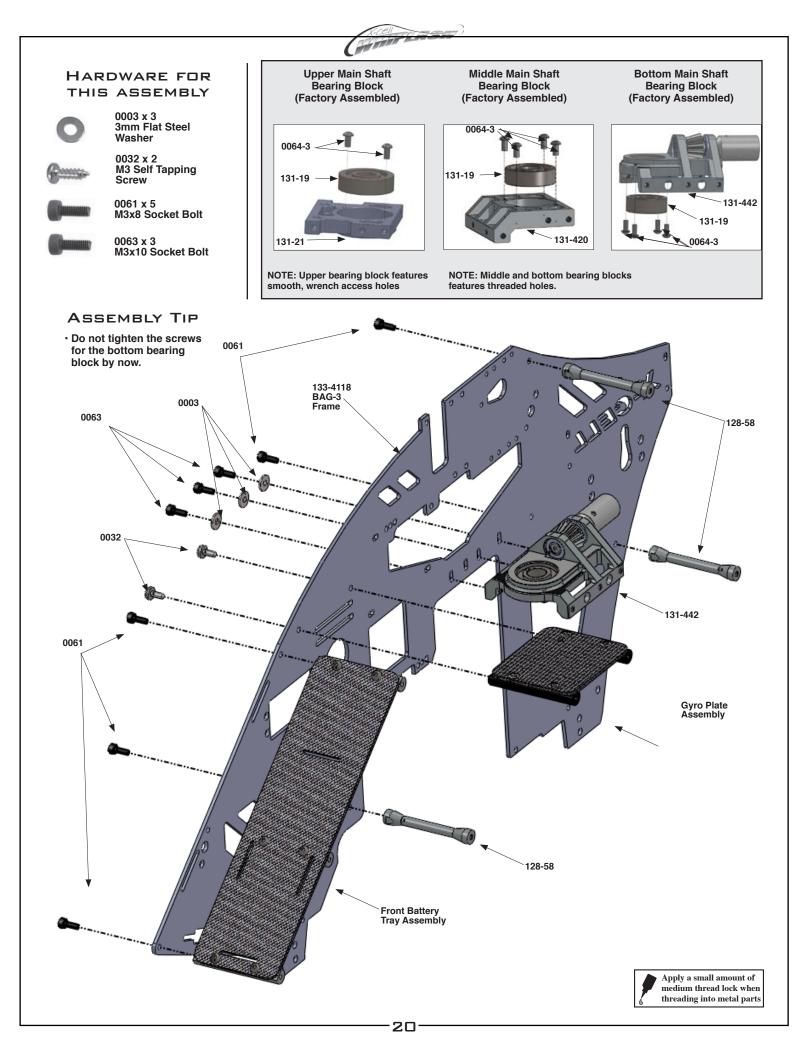
NOTE: Carefully glue bearing assemblies to torque tube making sure bearing locations are NOT equal distances from torque tub ends. Allow Loctite 648 to dry (about 2 hours) before installing into tail boom.

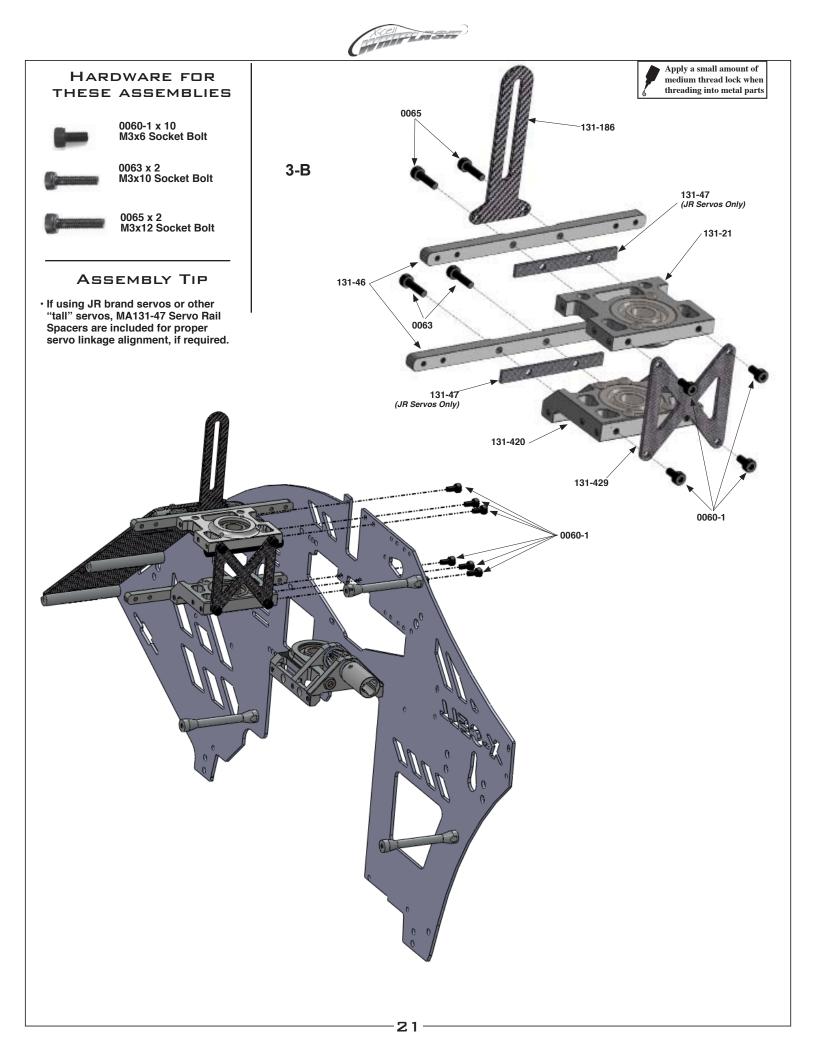


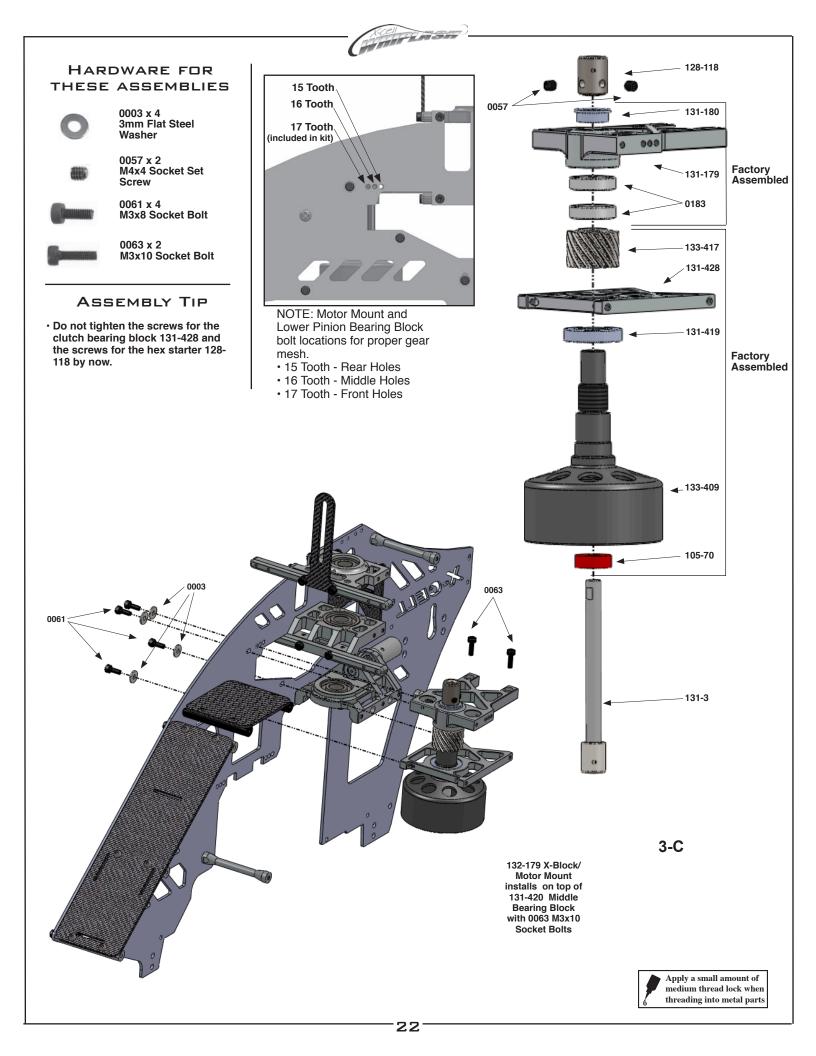


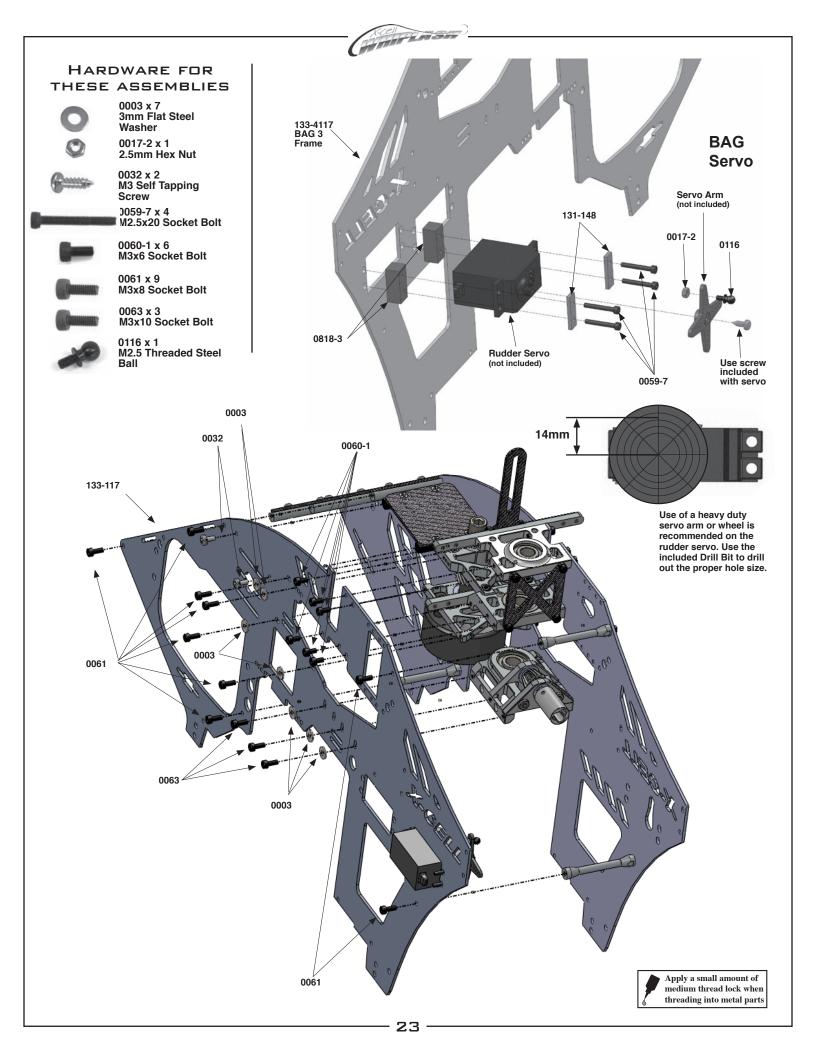


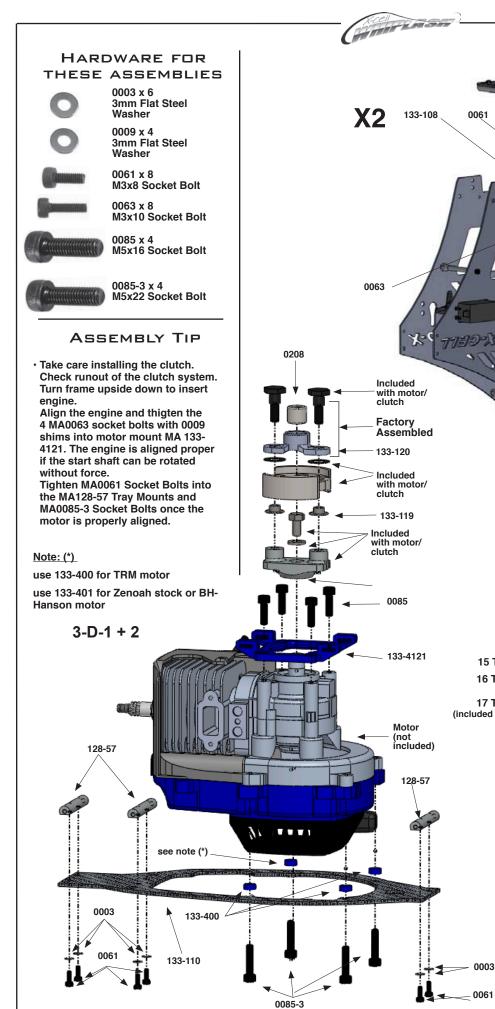


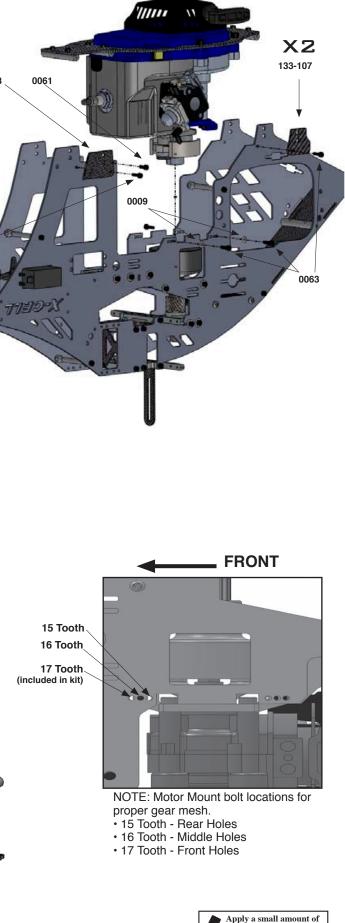






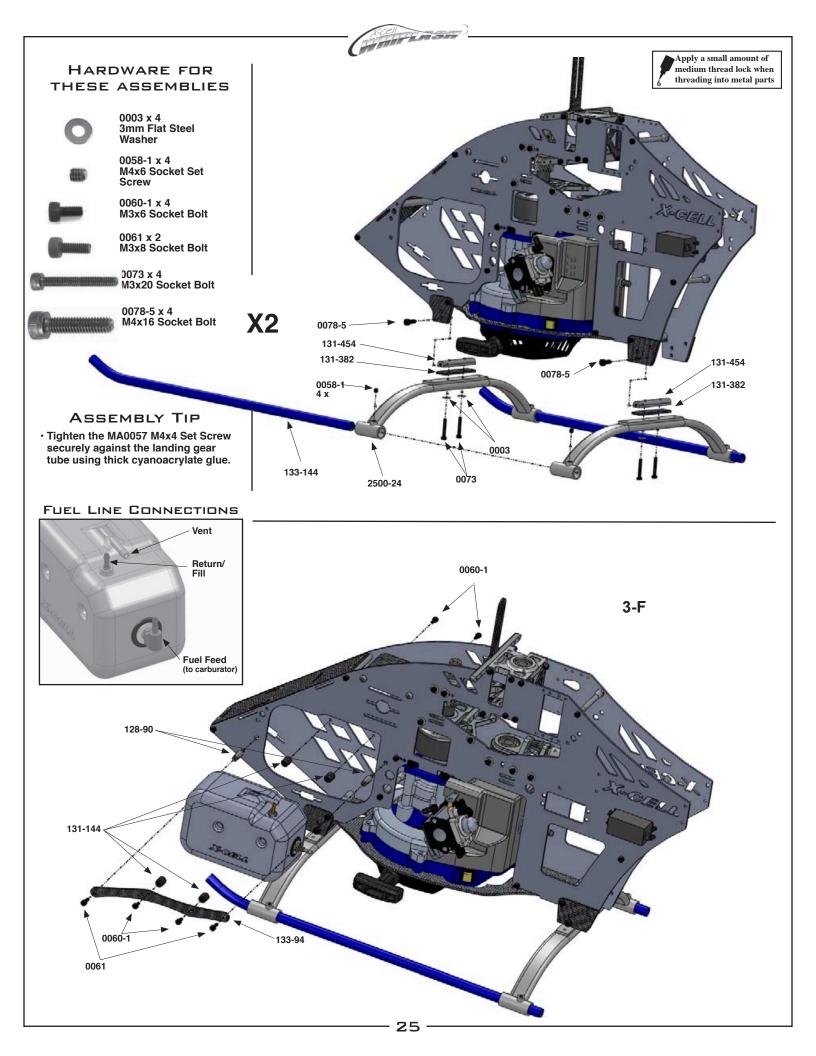


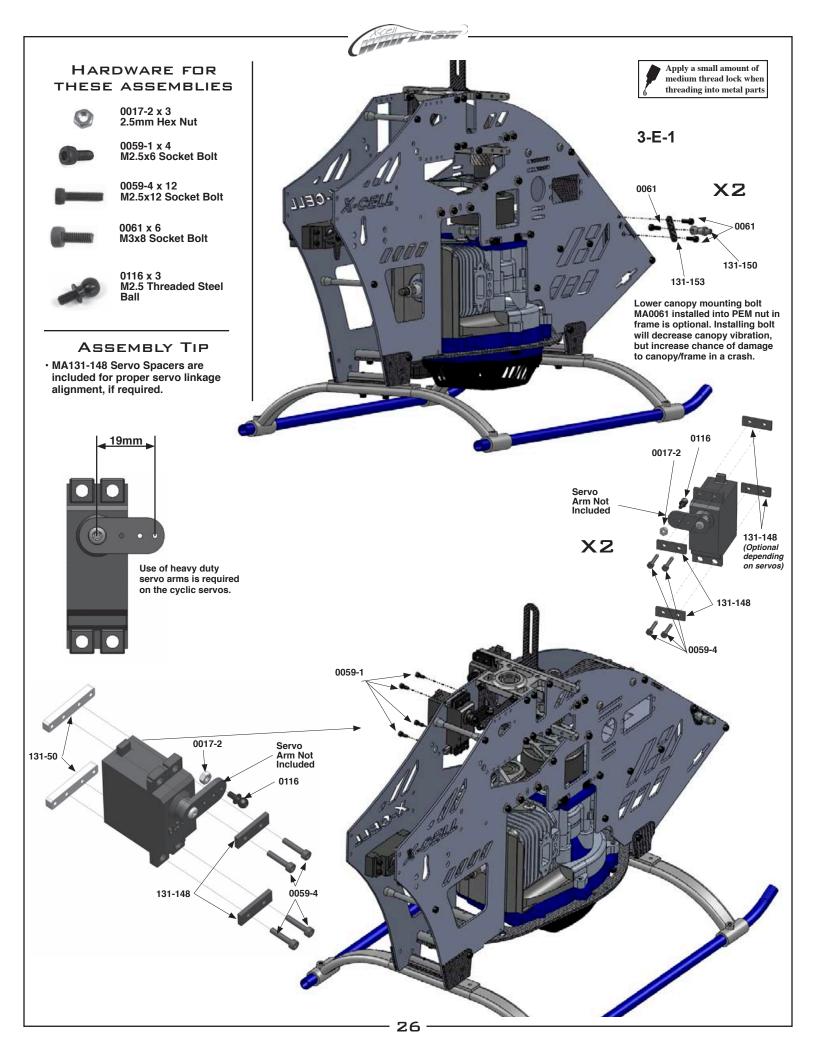




medium thread lock when

threading into metal parts





HARDWARE FOR THESE ASSEMBLIES



M4 Washer 0015 x 1 2mm Hex Nut

0004 x 1

0017-2 x 1 2.5mm Hex Nut

0021 x 1



M4 Hex Locknut 0059-3 x 4

M2.5x10 Socket Bolt



8 x 8800 M3x8 Tapered Socket Bolt



0088-3 x 5

M3x7 Tapered Socket Bolt

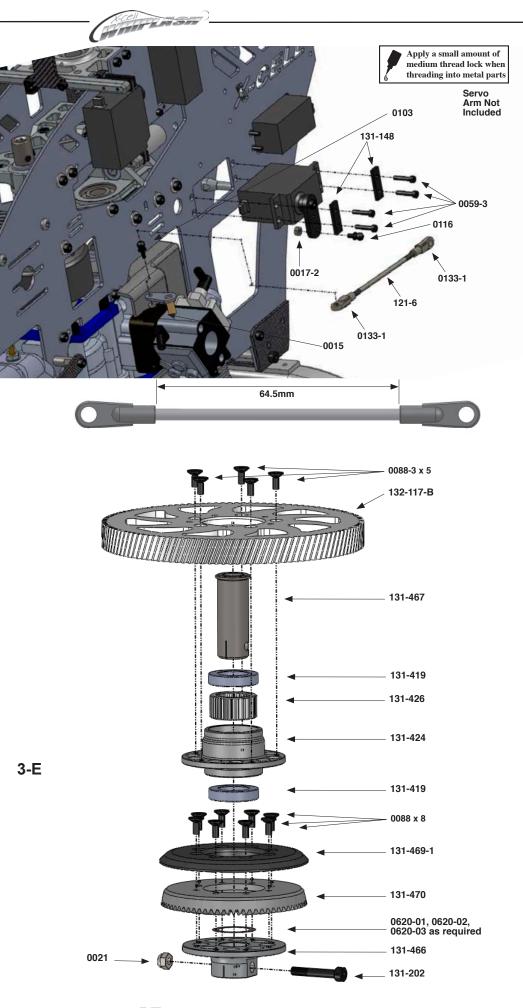
0103 x 1 M2 Threaded Steel Ball

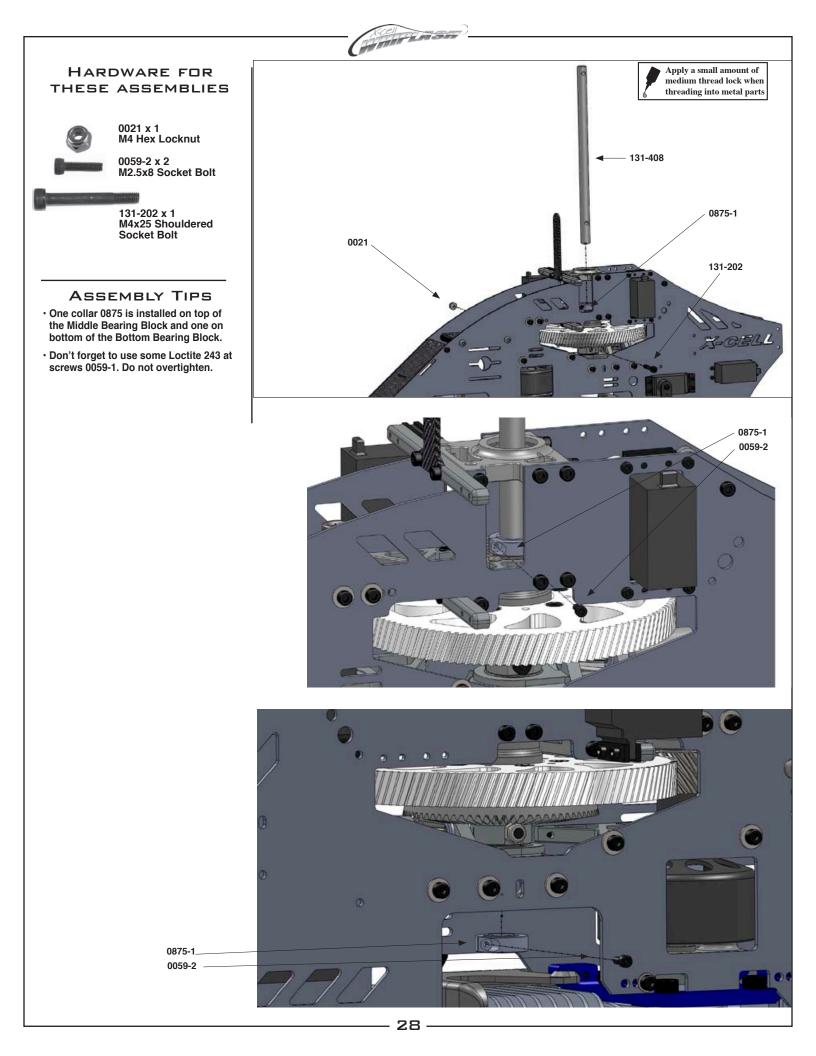
0116 x 1 M2.5 Threaded Steel Ball

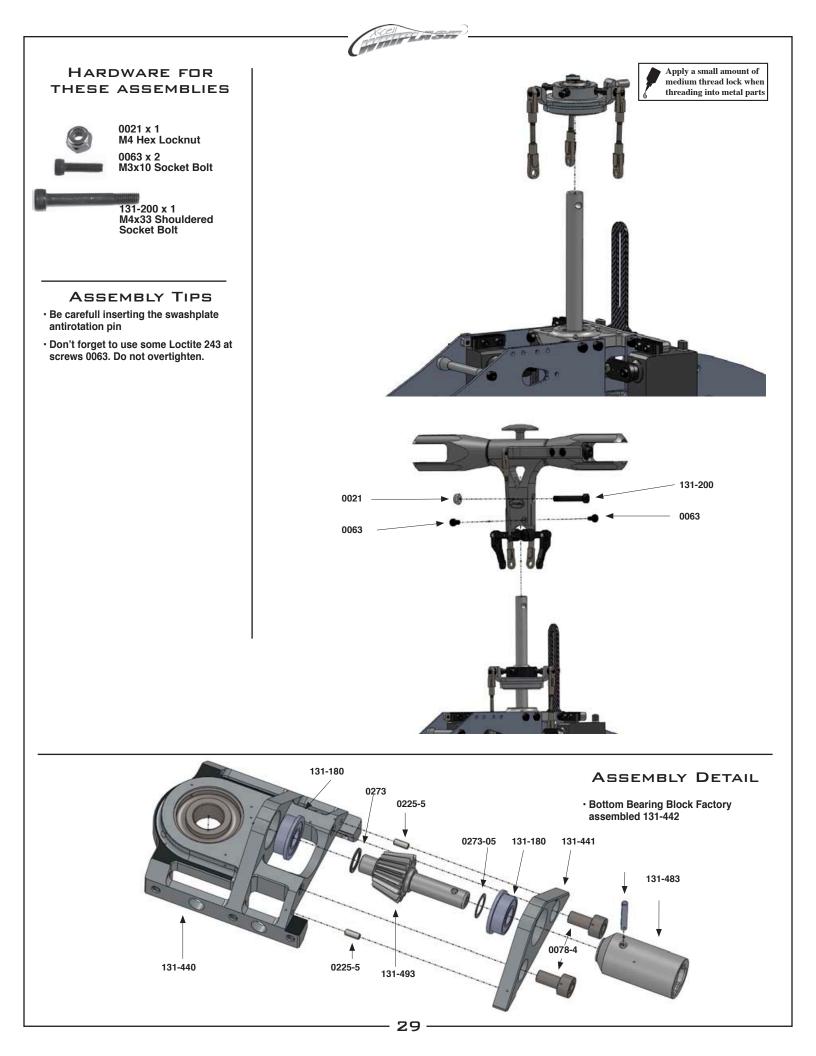
> 131-202 x 1 M4 Jesus Bolt OWB V2

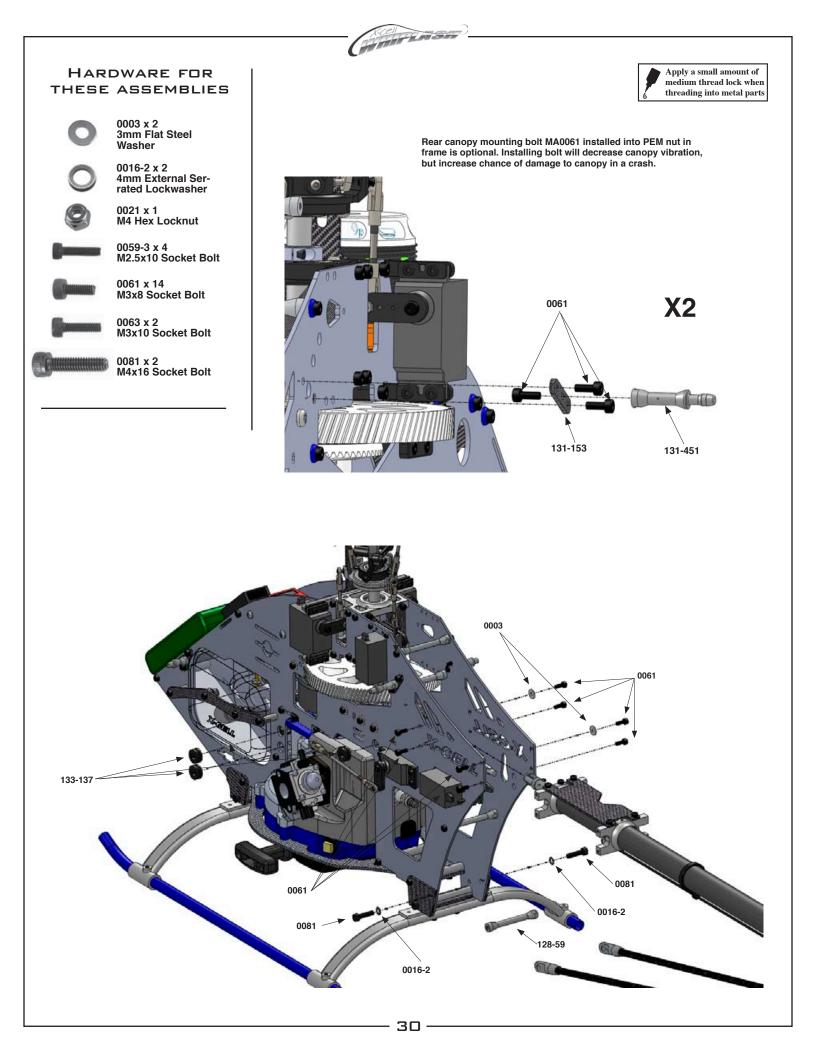
ASSEMBLY TIPS

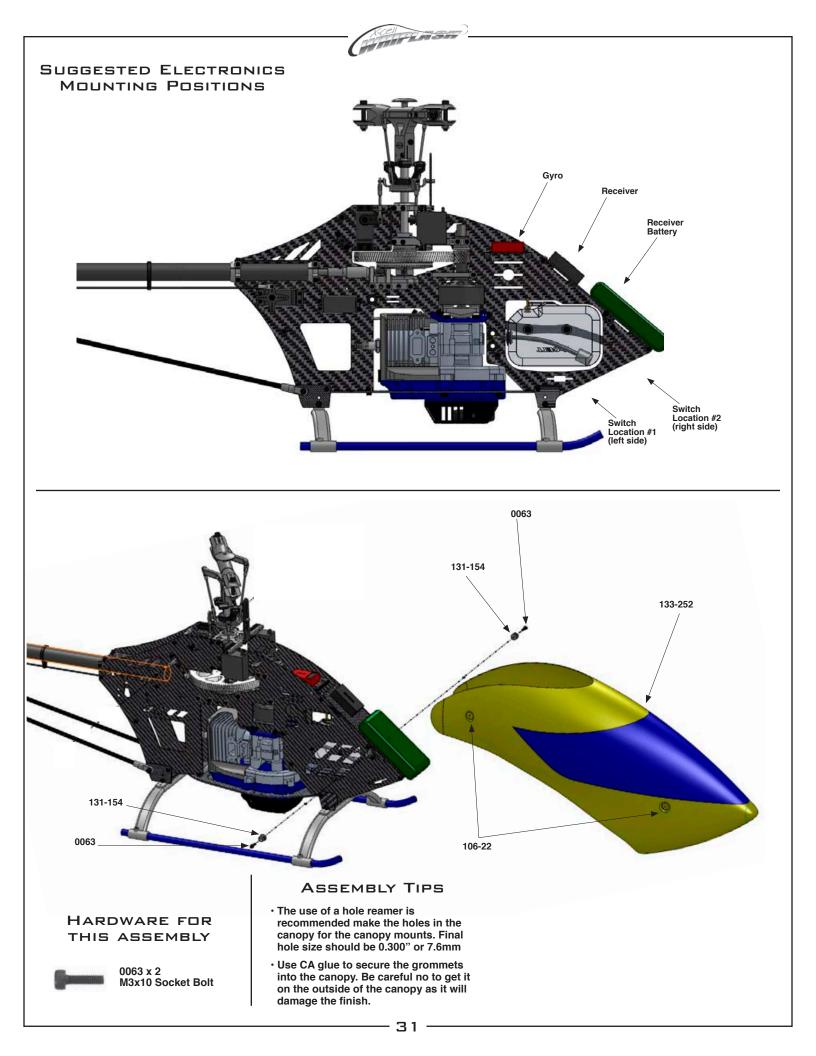
- Throttle linkage length is only an estimate. Linkage lengths will very depending on motor and servo brand.
- Use shim washer 0620-01 (0.1mm), -02 (0.2mm) and/or -03 (0.3mm) to set gear mesh for crown gear 0866-5-B. After Main Shaft is bolted to the Main Gear, adjust Bottom Main Shaft Bearing Block to eliminate any vertical play. Tighten Bottom Bearing Block bolts. Take care that the Bottom Main Shaft Bearing Block is horizontal ausgerichtet. Now check gear mesh of crown gear. If necessary remove or add 0620-0x shim washers. Gear mesh should be about 0.1mm.













WHIPLASH GAS USER GUIDE

Operating and maintaining your Whiplash Gas helicopter is not much different than the other Whiplash versions or any other model helicopter. The power system is different and its operation may be unfamiliar to those who have only flown electric or glow powered models. With that in mind this user guide will help you operate your Whiplash Gas helicopter from its first flight. The following sections address each of the areas that may be new or you may not be familiar with.

SAFETY

Gasoline or its equivalents is much more flammable than glow fuel. If you fly in an area with fire hazards, consider having access to a fire extinguisher in the event a fire occurs. Keep all flames or hot sources away from the fuel and fuel tank in both the model and your fuel can. A gasoline fire is very dangerous and destructive.

Also be aware that the engine muffler will operate at a significantly higher temperature than you may be accustomed to with a glow powered model. Contact with the muffler can easily cause a fire or bodily injury and it will be hot enough to easily peel off skin so be careful!

ENGINE

The Whiplash requires the acquisition of the RC format of either the Zenoah or Chung Yang motors. The model is not compatible with the PUH motor version used in the XCell Spectra G and many other models

These motors are available in 23cc (RC240), 26cc (RC270) and 29cc (RC290) versions. They are available from multiple sources in their stock form or from Zenoah specific motor tuners/modifiers. Some of the modified motors have different displacements

If you intend to run a stock, unmodified motor, it is recommended that you use the 23cc or 26cc version of the motor. They have the best inherent engine balance and will run the smoothest in the model

If you select a modified motor, the modifier can recommend the most appropriate motor from their selection for the Whiplash. The TRM VX300 Whiplash Edition and the BH Hanson 300 RC 3D Max versions have been extensively tested in the model

The major helicopter engine modifiers are TRM Power and BH Hanson, there are others available as well. It is highly recommended that you acquire a motor that has been properly balanced.

FUEL

The Zenoah motors for this kit are designed to run with common pump gasoline. The regular 87 octane is appropriate, it is not necessary or even desirable to use higher octane fuels unless specifically directed by an aftermarket modifier. All of these motors require an oil-premix to be run, you cannot use gasoline without first mixing in a lubricant

If your model is stored where fuel odor is undesirable, you can instead run Lantern/Camper fuel available at a sporting good or camping supply store. It is slightly more expensive than gasoline but has little odor and has approximately the same running characteristics. You also can use premixed fuel like Stihl Motomix or similar (does not smell).

If you are using a modified motor from an engine tuner, follow their instructions for type and volume of oil to premix with the fuel

If you are using a stock Zenoah motor, use a quality two stroke pre-mix oil.

Some oils that are commonly used:

- AMSOil Saber 100
- Yamalube 2R
- Honda HP2
- Klotz R50
- Stihl HP Ultra

When the motor is new and not yet broken in, run an oil mix of 32:1 per gallon of gasoline. For that ratio mix 4oz of the selected oil to each gallon of fuel. After running 1-2 gallons of fuel through the motor you can decrease the amount of oil used to the minimum support by the oil manufacturer but do not run less than a 40:1 premix ratio (no less than 3 oz of oil per gallon of fuel)

FUEL TANK PLUMBING

The carburetor on the motor contains a negative pressure fuel pump which draws fuel from the tank. As a result there is no need to run any sort of pressure system or header fuel tank.

It is however REQUIRED that the fuel tank be vented!

Follow the fuel tank plumbing directions in the assembly guide but make sure to either use a one way valve or use an 8-10" length of gasoline proof fuel line to create a tightly wound "fuel vent loop". Wrap the line into at least two loops and secure them with tie wraps or Velcro

Failure to properly vent the tank will result in the engine going lean in flight and it will likely quit running as a result of it.

Also make sure to use a filtered fuel clunk in the fuel tank. This works just like the "fuel magnet" if you're familiar with that product for glow models and will help keep the fuel clean and reduce air bubbles from being pumped into the carburetor.

32 -



MUFFLERS

The Zenoah RC motor comes equipped with a standard Zenoah steel canister muffler. The helicopter can be flown with this muffler however it does not offer a pleasing sound or improved performance. There are a number of aftermarket mufflers available for the Zenoah motors that will improve the sound significantly. Power improvements are based on too many factors to make a specific comparison

Good results have been had using the following optional mufflers:

- Hatori 957 (SB-12R4)
- RJX Gas Muffler
- TRM Power Pipe
- Zimmermann Gas Muffler 2651

After the motor has been run, re-check the muffler bolts to make sure they are tight. Do this for a couple of flights and then it will no longer be necessary unless the muffler becomes obviously loose.

AIR FILTER

The Zenoah RC format motors ship with an air cleaner. It is recommended that you always use an air cleaner whether it's the stock one or an optional one such as those offered by Miniature Aircraft (MA133-150). Running an unfiltered intake will shorten the life of the motor especially in the case of a crash where a large amount of foreign matter can be ingested into the motor.

SPARK PLUG

The spark plug included with the motor will normally operate correctly for a very long time. However if you should replace it MAKE SURE that you use a "resistor" plug. The plugs designation will usually end in an R. Failure to do this will result in you losing control of your model due to ignition interference with your radio

ELECTRONICS WIRING

The configuration of the Whiplash is such that only two electronic components must be in the general area of the ignition system on the motor. Take care to keep any wiring away from direct contact with the ignition wire as this can cause unexpected results. It is NOT necessary to run any additional shielding or insulated caps especially with 2.4Ghz radios but you may if you desire

If you are still running a PPM/PCM style radio, do not route the receiver antenna within 4 inches of any part of the ignition system

It is suggested that if possible you present at least one Receiver antenna on each side of the model. If you are running a receiver with multiple antennas try to position one on each side of the model. If your radio system uses satellites, it is suggested to install one on each side of the model. This will ensure that your receiver will be able to receive signal regardless of model orientation while flying

The model has two locations for an electronics on/off switch. Either position is suitable however it is suggested that you use a heavy duty switch due to the additional vibration that is typical of a gas powered engine.

INITIAL MIXTURE SETTINGS

Locate the low speed needle that is marked on the carburetor with an "L". This will be the one closest to the cylinder. Using a screwdriver turn it clockwise until it seats closed.

Don't overtighten. Now open the low speed needle 1-3/8 turns

Locate the high speed needle that is marked on the carburetor with an "H". This will be the one closest to the air filter or the intake side of the carburetor. Using a screwdriver turn it clockwise until it seats closed.

Don't overtighten. Now open the high speed needle 1-1/2 turns

This is a suitable initial setting at normal altitudes. At high altitudes a slightly leaner mixture may be needed

Turning the needles counter clockwise causes the mixture to be richer and turning them clockwise caused a leaner mixture

The needle settings are very sensitive especially the low speed needle. Very small adjustments are recommended, movements on the order of 1/16th of an inch at a time are appropriate.



THROTTLE SETUP/CURVES

Turn the idle set screw on the carburetor counter-clockwise until the throttle control arm no longer touches the screw at its full low position

Set the throttle channel at 50% of travel and then center the servo arm at a 90 degree angle to horizontal.

Install the ball on the bottom section of the arm 12mm from the center of the servo

Set the ATV's of the throttle channel to 130% on both high and low ends. If your radio won't support this percentage then set them at 100% and install the ball further out on the servo arm. You'll have to determine the correct position to mount it based on the ability to fully move the throttle through its travel

Now set the length on the throttle control rod such that the base of each link is 64.5mm apart from each other. This length is correct for Futaba servos. Other servos may require a slightly different length to account for differences in servo size/output position

Assuming the model will hover at a collective stick position of 75%, the following values will be approximately correct to achieve a 1750RPM hover speed

Normal Curve Points		Idle Up (Curve Points
#1	20%	#1	-100%
#2	35%	#2	-67%
#3	47%	#3	58%
#4	62%	#4	68%
#5	100%	#5	100%

Throttle hold position - 35%

GOVERNOR SETUP

If you intend to use a governor, you will need to follow the manufacturers instructions as to exactly how to set up the device

For governors that have a setting for "low" throttle positions (the lowest position that the governor can set the throttle at), this value may need to be significantly less than for a glow model since thee throttle position will be lower. If your governor consistently causes a head speed that is much higher than you have set, check to see if the governor supports this setting and if so lower it until the head speed is closer to your desired setting

GOVERNOR SENSORS

If you intend to use a governor, it will require a sensor of some sort to detect the engine RPM. You can devise your own method for installing the sensor that is provided with your governor or you can instead use a product known as the Stator Gator. This device replaces the push button "kill switch" and can be directly connected to your governor. For specific governor supported reference the companies website.

STARTING

Fill the fuel tank with the gas/oil mixture

Press the primer bulb on the carburetor several times until it fills with fuel

Power up the helicopter electronics and allow them to stabilize

Ensure that the throttle is at its low position (the arm on the carburetor) is pointing towards the front of the helicopter

If you are pull starting the helicopter, grab the rotor head of the helicopter and place your left foot up against the left skid of the helicopter to prevent it from moving

ALWAYS FIRMLY HOLD THE ROTOR HEAD while starting the model. If the throttle should unexpectedly be set at a high RPM setting due to an incorrect radio setup these motors have a great deal of torque and can accelerate the rotor head quickly causing injury or damage.

Now pull the starter briskly. If this the first start of the day, first close the choke on the carburetor (usually located on the bottom of the stock air filter) and pull the starter 3 times. Then open the choke fully and pull the starter until the motor starts, usually less than 5 pulls

If you are using a spin starter, simply insert the starter end in the start coupler on the top of the model, grasp the rotor head firmly and spin the motor over until the engine starts. You won't need to engage the choke.



ROTOR BLADES

The model flies nicely with 700mm blades. The stock configuration can support up to 720mm blades with no modification and there is an optional conversion kit available to allow the use of 750-810mm blades. Keep in mind that the std 6.88 gear ratio was designed for use with a 26cc engine and 700mm blades. If using a 29cc engine 710mm to 720mm blades work fine with std 6.88 gear ratio.

PITCH CURVES

Set up your pitch curves as you normally would. With stock motors and standard blades 11 degrees of max pitch will be appropriate. Of course you can set up the maximum the model will support but be careful of overloading and bogging the motor when doing hard maneuvers with large collective/cyclic pitch inputs.

If you are using modified motors then the rotor blade size and pitch curve settings will vary depending on the configuration

GEAR RATIOS

The standard 6.88:1 gear ratio has been found to provide good all around performance with a wide variety of model configurations. There are two optional ratios 7.3:1 and 7.8:1 which can easily be changed by replacing the pinion gear with optional ones. For more information about whether these might apply to your circumstances contact Miniature Aircraft.

RUNNING

In general terms, the model will operate just as any other internal combustion engine.

The model has demonstrated the best overall flight characteristics when operating between 1600 and 1950 RPM for the rotor head. This can be adjusted for your particular style of flying and desired characteristics.

You will find that if you are using a new motor, it will take between 3 and 5 gallons of fuel for it to seat or "break-in". You will notice a change in exhaust tone and improved overall running as this occurs. You may also need to adjust the mixture settings on the carburetor as the engine breaks in or if there are significant changes in operating conditions especially temperature, humidity or altitude.

There are too many possible combinations to properly describe the approach but in general terms you can check the color of the spark plug to determine the mixture setting.

- · If the spark plug has milk chocolate brown color, the mixture is roughly correct
- If the spark plug is grey or white, the mixture is too lean
- · If the spark plug is black and/or oily the mixture is too rich

Never lean either mixture needle to less than 1-1/4 turn from fully closed unless there are specific directions included with your motor that instruct otherwise. The carburetors typically found on these motors will be very lean at settings less than this.

If you find that the motor stops abruptly either during spool-up or while flying, if the model has plenty of fuel in the tank then the mixture is likely too lean. If it stops on spool up, adjust the low speed needle, if it stops while flying adjust the high speed needle.

These are over simplifications of the tuning process for more information consult with Miniature Aircraft or with a local Team representative or consult one of the gas specific forums mentioned at the end of this section.

ADDITIONAL SUPPORT REFERENCES:

Gas Powered Thoughts - http://www.gaspoweredthoughts.com Run Ryder Gas Forum or Miniature Aircraft Forum - http://www.runryder.com Helifreak Gas Forum or Miniature Aircraft Forum - http://www.helifreak.com



WHIPLASH KIT PARTS & HARDWARE

0003 0004	M3 Washer M4 Washer
0009	M3 Washer Small
0011	5mm Washer
0011-5	M5.3x20 Washer
0012-1	2.5mm Pem Nut
0012-2 0014F	3mm Pem Nut 5mn Hex Nut - Fine Thread
0014	2mm Hex Nut
0016-2	M4 External Serrated Lock Washer
0017-2	M2.5 Hex Nut
0019	M3 Lock Nut
0021	M4 Lock Nut
0023	M5 Nut
0032 0032-2	M3x9.5 Self Tapping Screw M3x8 Self Tapping Screw
0032-2	M2x12 Socket Bolt
0050-1	M2.5 Set Screw
0051	M3x3 Set Screw
0056	M3x5 Dog-Point Set Screw
0056-3	M3x8 Dog-Point Set Screw
0057	M4x4 Set Screw
0059-0	M2.5x4 Socket Bolt
0059-2 0059-3	M2.5x8 Socket Bolt M2.5x10 Socket Bolt
0059-3	M2.5x10 Socket Bolt
0060-1	M3x6 Socket Bolt
0061	M3x8 Socket Bolt
0063	M3x10 Socket Bolt
0064-3	M3x6 Button Head Socket Bolt
0064-4	M3x16 Button Head Socket Bolt
0065	M3x12 Socket Bolt M3x14 Socket Bolt
0067 0069	M3x14 Socket Bolt
0003	M3x18 Socket Bolt
0073	M3x20 Socket Bolt
0078	M4x12 Socket Bolt
0078-3	M4x6 Socket Bolt
0081	M4x16 Socket Bolt
0082-4	M5x32 Shouldered Socket Bolt
0085 0086-1	M5x16 Socket Bolt M5x16 Flanged Socket Bolt
0088	M3x8 Tapered Socket Bolt
0088-3	M3x7 Tapered Socket Bolt
0103	M2 Threaded Steel Ball
0107	M3x6 Threaded Steel Ball
0109	M3x8 Threaded Steel Ball
0116	M2.5 Threaded Steel Ball M2x21.2 Ball Link
0133 0133-1	M3x21.2 Ball Link
0159	3x7x3 Bearing
0183	10x19x5 Bearing
0208	10x12 One-Way Torrington
0214	Upper Swash Ring
0214-1	Lower Swash Ring
0215 0216	M6 Tail Shaft Collar Heim Ball
0210	Swash Plate Assembled
0218	20x32x7 Swash Bearing
0225	Link Pin
0225-5	Link Pin
0273	6x10x.011" Steel Washer
0273-05	6x10 Steel Washer
0283 0319	6x10x3 Flanged Bearing 8x16x5 Bearing
0390	Large Wire Lead Retainer
0405	Fuel Pick Up
0442	T/R Pitch Link
0447-1	M2 E Clip

0607 1	May 175y 196" Brace Spacer
0597-1	M3x4.75x.126" Brass Spacer
0597-4	Brass Spacer
0620-01	M15x21x.10 Washer
0620-02	M15x21x.20 Washer
	M15x21x.30 Washer
0620-03	
0818-3	Rectangular Mounting Block
0869	Washout Link
105-70	6x15x5 Bearing
105-100	Gasoline Fuel Line
106-02	3x7x3 Flanged Bearing
106-06	2x5x1.5 Flanged Bearing
106-22	5x11 Grommet
115-65	High Flex Fuel Line
120-7-1	5x15 Safety Washer
120-25	Swash To Mixer Linkage Rod
120-39	5x10x4 Ball Bearing
121-4	Servo To Swash Linkage Rod
121-6	M3x75 Threaded Control Rod
121-7	Swash To PA Linkage Rod
122-28	Brass Spacer
122-47	10x22x6 Bearing
122-48	
	22mm Circlip
122-70	M5x.25 S/S Shim Washer
127-86	M6x9.7x1.0 Shim Washer
128-57	Tray Mount
128-58	Main Frame Spacer
128-59	M4 Frame Spacer
128-80	Front Boom Clamp
128-90	Tank Plate Mounting Studs
128-92	Fuel Tank Plug
128-118	6mm Hex Adaptor
128-144	T/R Control Rod Guide
128-148	Boom Support
128-149	Rear Boom Support Mount
128-176	Washout Pin
128-195	Head Button
100 011	
128-314	Swashplate Follower Arm
131-3	Start Shaft
131-3 131-17B	Start Shaft Bevel Gear Shaft Side
131-3 131-17B 131-18B	Start Shaft Bevel Gear Shaft Side Tail Bevel Gear TT Side
131-3 131-17B	Start Shaft Bevel Gear Shaft Side Tail Bevel Gear TT Side
131-3 131-17B 131-18B 131-19	Start Shaft Bevel Gear Shaft Side Tail Bevel Gear TT Side 10x26x8 Main Shaft Bearing
131-3 131-17B 131-18B 131-19 131-21	Start Shaft Bevel Gear Shaft Side Tail Bevel Gear TT Side 10x26x8 Main Shaft Bearing Upper Main Shaft Bearing Block
131-3 131-17B 131-18B 131-19 131-21 131-23	Start Shaft Bevel Gear Shaft Side Tail Bevel Gear TT Side 10x26x8 Main Shaft Bearing Upper Main Shaft Bearing Block 6x13x5 Flanged Bearing - Tail Shaft
131-3 131-17B 131-18B 131-19 131-21	Start Shaft Bevel Gear Shaft Side Tail Bevel Gear TT Side 10x26x8 Main Shaft Bearing Upper Main Shaft Bearing Block
131-3 131-17B 131-18B 131-19 131-21 131-23 131-29	Start Shaft Bevel Gear Shaft Side Tail Bevel Gear TT Side 10x26x8 Main Shaft Bearing Upper Main Shaft Bearing Block 6x13x5 Flanged Bearing - Tail Shaft C/F X-Brace
131-3 131-17B 131-18B 131-19 131-21 131-23 131-29 131-33	Start Shaft Bevel Gear Shaft Side Tail Bevel Gear TT Side 10x26x8 Main Shaft Bearing Upper Main Shaft Bearing Block 6x13x5 Flanged Bearing - Tail Shaft C/F X-Brace 15x21x4 Bearing - Tail Gear
131-3 131-17B 131-18B 131-19 131-21 131-23 131-29 131-33 131-34	Start Shaft Bevel Gear Shaft Side Tail Bevel Gear TT Side 10x26x8 Main Shaft Bearing Upper Main Shaft Bearing Block 6x13x5 Flanged Bearing - Tail Shaft C/F X-Brace 15x21x4 Bearing - Tail Gear Front Tail Drive Transmission
131-3 131-17B 131-18B 131-19 131-21 131-23 131-23 131-29 131-33 131-34 131-35	Start Shaft Bevel Gear Shaft Side Tail Bevel Gear TT Side 10x26x8 Main Shaft Bearing Upper Main Shaft Bearing Block 6x13x5 Flanged Bearing - Tail Shaft C/F X-Brace 15x21x4 Bearing - Tail Gear
131-3 131-17B 131-18B 131-19 131-21 131-23 131-23 131-29 131-33 131-34 131-35	Start Shaft Bevel Gear Shaft Side Tail Bevel Gear TT Side 10x26x8 Main Shaft Bearing Upper Main Shaft Bearing Block 6x13x5 Flanged Bearing - Tail Shaft C/F X-Brace 15x21x4 Bearing - Tail Gear Front Tail Drive Transmission Boom Clamp W/TX Holes
131-3 131-17B 131-18B 131-19 131-21 131-23 131-29 131-33 131-34 131-35 131-46	Start Shaft Bevel Gear Shaft Side Tail Bevel Gear TT Side 10x26x8 Main Shaft Bearing Upper Main Shaft Bearing Block 6x13x5 Flanged Bearing - Tail Shaft C/F X-Brace 15x21x4 Bearing - Tail Gear Front Tail Drive Transmission Boom Clamp W/TX Holes P/A Servo Rail
131-3 131-17B 131-18B 131-19 131-21 131-23 131-23 131-33 131-34 131-35 131-46 131-47	Start Shaft Bevel Gear Shaft Side Tail Bevel Gear TT Side 10x26x8 Main Shaft Bearing Upper Main Shaft Bearing Block 6x13x5 Flanged Bearing - Tail Shaft C/F X-Brace 15x21x4 Bearing - Tail Gear Front Tail Drive Transmission Boom Clamp W/TX Holes P/A Servo Rail C/F Servo Rail Spacer
131-3 131-17B 131-18B 131-19 131-21 131-23 131-29 131-33 131-34 131-35 131-46 131-47 131-50	Start Shaft Bevel Gear Shaft Side Tail Bevel Gear TT Side 10x26x8 Main Shaft Bearing Upper Main Shaft Bearing Block 6x13x5 Flanged Bearing - Tail Shaft C/F X-Brace 15x21x4 Bearing - Tail Gear Front Tail Drive Transmission Boom Clamp W/TX Holes P/A Servo Rail C/F Servo Rail Spacer Elevator Servo Mount
131-3 131-17B 131-18B 131-19 131-21 131-23 131-23 131-33 131-34 131-35 131-46 131-47	Start Shaft Bevel Gear Shaft Side Tail Bevel Gear TT Side 10x26x8 Main Shaft Bearing Upper Main Shaft Bearing Block 6x13x5 Flanged Bearing - Tail Shaft C/F X-Brace 15x21x4 Bearing - Tail Gear Front Tail Drive Transmission Boom Clamp W/TX Holes P/A Servo Rail C/F Servo Rail Spacer
131-3 131-17B 131-18B 131-19 131-21 131-23 131-23 131-29 131-33 131-34 131-35 131-46 131-47 131-50 131-51	Start Shaft Bevel Gear Shaft Side Tail Bevel Gear TT Side 10x26x8 Main Shaft Bearing Upper Main Shaft Bearing Block 6x13x5 Flanged Bearing - Tail Shaft C/F X-Brace 15x21x4 Bearing - Tail Gear Front Tail Drive Transmission Boom Clamp W/TX Holes P/A Servo Rail C/F Servo Rail C/F Servo Rail Spacer Elevator Servo Mount Jack Shaft
131-3 131-17B 131-18B 131-19 131-21 131-23 131-23 131-29 131-33 131-34 131-35 131-46 131-47 131-50 131-51 131-52	Start Shaft Bevel Gear Shaft Side Tail Bevel Gear TT Side 10x26x8 Main Shaft Bearing Upper Main Shaft Bearing Block 6x13x5 Flanged Bearing - Tail Shaft C/F X-Brace 15x21x4 Bearing - Tail Gear Front Tail Drive Transmission Boom Clamp W/TX Holes P/A Servo Rail C/F Servo Rail C/F Servo Rail Spacer Elevator Servo Mount Jack Shaft Delrin Tray Mount
131-3 131-17B 131-18B 131-19 131-21 131-23 131-23 131-29 131-33 131-34 131-35 131-46 131-47 131-50 131-51 131-52 131-53	Start Shaft Bevel Gear Shaft Side Tail Bevel Gear TT Side 10x26x8 Main Shaft Bearing Upper Main Shaft Bearing Block 6x13x5 Flanged Bearing - Tail Shaft C/F X-Brace 15x21x4 Bearing - Tail Gear Front Tail Drive Transmission Boom Clamp W/TX Holes P/A Servo Rail C/F Servo Rail C/F Servo Rail Spacer Elevator Servo Mount Jack Shaft Delrin Tray Mount Gyro Plate
131-3 131-17B 131-18B 131-19 131-21 131-23 131-23 131-29 131-33 131-34 131-35 131-46 131-47 131-50 131-51 131-52	Start Shaft Bevel Gear Shaft Side Tail Bevel Gear TT Side 10x26x8 Main Shaft Bearing Upper Main Shaft Bearing Block 6x13x5 Flanged Bearing - Tail Shaft C/F X-Brace 15x21x4 Bearing - Tail Gear Front Tail Drive Transmission Boom Clamp W/TX Holes P/A Servo Rail C/F Servo Rail C/F Servo Rail Spacer Elevator Servo Mount Jack Shaft Delrin Tray Mount
131-3 131-17B 131-18B 131-19 131-21 131-23 131-23 131-29 131-33 131-34 131-35 131-46 131-47 131-50 131-51 131-52 131-53 131-55	Start Shaft Bevel Gear Shaft Side Tail Bevel Gear TT Side 10x26x8 Main Shaft Bearing Upper Main Shaft Bearing Block 6x13x5 Flanged Bearing - Tail Shaft C/F X-Brace 15x21x4 Bearing - Tail Gear Front Tail Drive Transmission Boom Clamp W/TX Holes P/A Servo Rail C/F Servo Rail C/F Servo Rail Spacer Elevator Servo Mount Jack Shaft Delrin Tray Mount Gyro Plate C/F Angled Battery Tray
131-3 131-17B 131-18B 131-19 131-21 131-23 131-23 131-29 131-33 131-34 131-35 131-46 131-47 131-50 131-51 131-52 131-53 131-55 131-62	Start Shaft Bevel Gear Shaft Side Tail Bevel Gear TT Side 10x26x8 Main Shaft Bearing Upper Main Shaft Bearing Block 6x13x5 Flanged Bearing - Tail Shaft C/F X-Brace 15x21x4 Bearing - Tail Gear Front Tail Drive Transmission Boom Clamp W/TX Holes P/A Servo Rail C/F Servo Rail Spacer Elevator Servo Mount Jack Shaft Delrin Tray Mount Gyro Plate C/F Angled Battery Tray Tail Boom
131-3 131-17B 131-18B 131-19 131-21 131-23 131-29 131-33 131-34 131-35 131-46 131-47 131-50 131-51 131-52 131-53 131-55 131-62 131-64	Start Shaft Bevel Gear Shaft Side Tail Bevel Gear TT Side 10x26x8 Main Shaft Bearing Upper Main Shaft Bearing Block 6x13x5 Flanged Bearing - Tail Shaft C/F X-Brace 15x21x4 Bearing - Tail Gear Front Tail Drive Transmission Boom Clamp W/TX Holes P/A Servo Rail C/F Servo Rail C/F Servo Rail Spacer Elevator Servo Mount Jack Shaft Delrin Tray Mount Gyro Plate C/F Angled Battery Tray Tail Boom Tail Hub
131-3 131-17B 131-18B 131-19 131-21 131-23 131-23 131-29 131-33 131-34 131-35 131-46 131-47 131-50 131-51 131-52 131-53 131-55 131-62	Start Shaft Bevel Gear Shaft Side Tail Bevel Gear TT Side 10x26x8 Main Shaft Bearing Upper Main Shaft Bearing Block 6x13x5 Flanged Bearing - Tail Shaft C/F X-Brace 15x21x4 Bearing - Tail Gear Front Tail Drive Transmission Boom Clamp W/TX Holes P/A Servo Rail C/F Servo Rail Spacer Elevator Servo Mount Jack Shaft Delrin Tray Mount Gyro Plate C/F Angled Battery Tray Tail Boom Tail Hub 4x10 Thrust Bearings - Tail Grips
131-3 131-17B 131-18B 131-19 131-21 131-23 131-29 131-33 131-34 131-35 131-46 131-47 131-50 131-51 131-52 131-53 131-55 131-62 131-64 131-66	Start Shaft Bevel Gear Shaft Side Tail Bevel Gear TT Side 10x26x8 Main Shaft Bearing Upper Main Shaft Bearing Block 6x13x5 Flanged Bearing - Tail Shaft C/F X-Brace 15x21x4 Bearing - Tail Gear Front Tail Drive Transmission Boom Clamp W/TX Holes P/A Servo Rail C/F Servo Rail C/F Servo Rail Spacer Elevator Servo Mount Jack Shaft Delrin Tray Mount Gyro Plate C/F Angled Battery Tray Tail Boom Tail Hub
131-3 131-17B 131-18B 131-19 131-21 131-23 131-29 131-33 131-34 131-35 131-46 131-47 131-50 131-51 131-52 131-53 131-55 131-62 131-64 131-66 131-69-1	Start Shaft Bevel Gear Shaft Side Tail Bevel Gear TT Side 10x26x8 Main Shaft Bearing Upper Main Shaft Bearing Block 6x13x5 Flanged Bearing - Tail Shaft C/F X-Brace 15x21x4 Bearing - Tail Gear Front Tail Drive Transmission Boom Clamp W/TX Holes P/A Servo Rail C/F Servo Rail Spacer Elevator Servo Mount Jack Shaft Delrin Tray Mount Gyro Plate C/F Angled Battery Tray Tail Boom Tail Hub 4x10 Thrust Bearings - Tail Grips T/R Push Rod
$\begin{array}{c} 131-3\\ 131-17B\\ 131-18B\\ 131-19\\ 131-21\\ 131-23\\ 131-23\\ 131-29\\ 131-33\\ 131-34\\ 131-35\\ 131-35\\ 131-46\\ 131-47\\ 131-50\\ 131-51\\ 131-52\\ 131-55\\ 131-52\\ 131-55\\ 131-62\\ 131-64\\ 131-66\\ 131-69-1\\ 131-70\\ \end{array}$	Start Shaft Bevel Gear Shaft Side Tail Bevel Gear TT Side 10x26x8 Main Shaft Bearing Upper Main Shaft Bearing Block 6x13x5 Flanged Bearing - Tail Shaft C/F X-Brace 15x21x4 Bearing - Tail Gear Front Tail Drive Transmission Boom Clamp W/TX Holes P/A Servo Rail C/F Servo Rail Spacer Elevator Servo Mount Jack Shaft Delrin Tray Mount Gyro Plate C/F Angled Battery Tray Tail Boom Tail Hub 4x10 Thrust Bearings - Tail Grips T/R Push Rod Tail Output Shaft
131-3 131-17B 131-18B 131-19 131-21 131-23 131-29 131-33 131-34 131-35 131-46 131-47 131-50 131-51 131-52 131-55 131-62 131-64 131-66 131-69-1 131-70 131-83	Start Shaft Bevel Gear Shaft Side Tail Bevel Gear TT Side 10x26x8 Main Shaft Bearing Upper Main Shaft Bearing Block 6x13x5 Flanged Bearing - Tail Shaft C/F X-Brace 15x21x4 Bearing - Tail Gear Front Tail Drive Transmission Boom Clamp W/TX Holes P/A Servo Rail C/F Servo Rail Spacer Elevator Servo Mount Jack Shaft Delrin Tray Mount Gyro Plate C/F Angled Battery Tray Tail Boom Tail Hub 4x10 Thrust Bearings - Tail Grips T/R Push Rod Tail Output Shaft Anti Rotation Pin
$\begin{array}{c} 131-3\\ 131-17B\\ 131-18B\\ 131-19\\ 131-21\\ 131-23\\ 131-23\\ 131-29\\ 131-33\\ 131-34\\ 131-35\\ 131-35\\ 131-46\\ 131-47\\ 131-50\\ 131-51\\ 131-52\\ 131-55\\ 131-52\\ 131-55\\ 131-62\\ 131-64\\ 131-66\\ 131-69-1\\ 131-70\\ \end{array}$	Start Shaft Bevel Gear Shaft Side Tail Bevel Gear TT Side 10x26x8 Main Shaft Bearing Upper Main Shaft Bearing Block 6x13x5 Flanged Bearing - Tail Shaft C/F X-Brace 15x21x4 Bearing - Tail Gear Front Tail Drive Transmission Boom Clamp W/TX Holes P/A Servo Rail C/F Servo Rail Spacer Elevator Servo Mount Jack Shaft Delrin Tray Mount Gyro Plate C/F Angled Battery Tray Tail Boom Tail Hub 4x10 Thrust Bearings - Tail Grips T/R Push Rod Tail Output Shaft Anti Rotation Pin Boom Support Rod
131-3 131-17B 131-18B 131-19 131-21 131-23 131-29 131-33 131-34 131-35 131-46 131-47 131-50 131-51 131-52 131-55 131-62 131-64 131-66 131-69-1 131-70 131-83 131-84	Start Shaft Bevel Gear Shaft Side Tail Bevel Gear TT Side 10x26x8 Main Shaft Bearing Upper Main Shaft Bearing Block 6x13x5 Flanged Bearing - Tail Shaft C/F X-Brace 15x21x4 Bearing - Tail Gear Front Tail Drive Transmission Boom Clamp W/TX Holes P/A Servo Rail C/F Servo Rail Spacer Elevator Servo Mount Jack Shaft Delrin Tray Mount Gyro Plate C/F Angled Battery Tray Tail Boom Tail Hub 4x10 Thrust Bearings - Tail Grips T/R Push Rod Tail Output Shaft Anti Rotation Pin Boom Support Rod
$\begin{array}{c} 131-3\\ 131-17B\\ 131-18B\\ 131-19\\ 131-21\\ 131-23\\ 131-23\\ 131-29\\ 131-33\\ 131-34\\ 131-35\\ 131-34\\ 131-35\\ 131-46\\ 131-52\\ 131-52\\ 131-52\\ 131-52\\ 131-55\\ 131-52\\ 131-64\\ 131-66\\ 131-69-1\\ 131-70\\ 131-83\\ 131-84\\ 131-86\\ \end{array}$	Start Shaft Bevel Gear Shaft Side Tail Bevel Gear TT Side 10x26x8 Main Shaft Bearing Upper Main Shaft Bearing Block 6x13x5 Flanged Bearing - Tail Shaft C/F X-Brace 15x21x4 Bearing - Tail Gear Front Tail Drive Transmission Boom Clamp W/TX Holes P/A Servo Rail C/F Servo Rail Spacer Elevator Servo Mount Jack Shaft Delrin Tray Mount Gyro Plate C/F Angled Battery Tray Tail Boom Tail Hub 4x10 Thrust Bearings - Tail Grips T/R Push Rod Tail Output Shaft Anti Rotation Pin Boom Support Rod Assembled Boom Support
131-3 131-17B 131-18B 131-19 131-21 131-23 131-29 131-33 131-34 131-35 131-34 131-35 131-46 131-47 131-50 131-51 131-52 131-62 131-64 131-66 131-69-1 131-70 131-83 131-84 131-86 131-112	Start Shaft Bevel Gear Shaft Side Tail Bevel Gear TT Side 10x26x8 Main Shaft Bearing Upper Main Shaft Bearing Block 6x13x5 Flanged Bearing - Tail Shaft C/F X-Brace 15x21x4 Bearing - Tail Gear Front Tail Drive Transmission Boom Clamp W/TX Holes P/A Servo Rail C/F Servo Rail Spacer Elevator Servo Mount Jack Shaft Delrin Tray Mount Gyro Plate C/F Angled Battery Tray Tail Boom Tail Hub 4x10 Thrust Bearings - Tail Grips T/R Push Rod Tail Output Shaft Anti Rotation Pin Boom Support Rod Assembled Boom Support T/R Blade Grip
131-3 131-17B 131-18B 131-19 131-21 131-23 131-29 131-33 131-34 131-35 131-34 131-35 131-46 131-47 131-50 131-51 131-52 131-53 131-55 131-62 131-64 131-66 131-69-1 131-70 131-83 131-84 131-86 131-112	Start Shaft Bevel Gear Shaft Side Tail Bevel Gear TT Side 10x26x8 Main Shaft Bearing Upper Main Shaft Bearing Block 6x13x5 Flanged Bearing - Tail Shaft C/F X-Brace 15x21x4 Bearing - Tail Gear Front Tail Drive Transmission Boom Clamp W/TX Holes P/A Servo Rail C/F Servo Rail Spacer Elevator Servo Mount Jack Shaft Delrin Tray Mount Gyro Plate C/F Angled Battery Tray Tail Boom Tail Hub 4x10 Thrust Bearings - Tail Grips T/R Push Rod Tail Output Shaft Anti Rotation Pin Boom Support Rod Assembled Boom Support T/R Blade Grip C/F Boom Clamp Plate
131-3 131-17B 131-18B 131-19 131-21 131-23 131-29 131-33 131-34 131-35 131-34 131-35 131-46 131-47 131-50 131-51 131-52 131-53 131-55 131-62 131-64 131-66 131-69-1 131-70 131-83 131-84 131-86 131-112	Start Shaft Bevel Gear Shaft Side Tail Bevel Gear TT Side 10x26x8 Main Shaft Bearing Upper Main Shaft Bearing Block 6x13x5 Flanged Bearing - Tail Shaft C/F X-Brace 15x21x4 Bearing - Tail Gear Front Tail Drive Transmission Boom Clamp W/TX Holes P/A Servo Rail C/F Servo Rail Spacer Elevator Servo Mount Jack Shaft Delrin Tray Mount Gyro Plate C/F Angled Battery Tray Tail Boom Tail Hub 4x10 Thrust Bearings - Tail Grips T/R Push Rod Tail Output Shaft Anti Rotation Pin Boom Support Rod Assembled Boom Support T/R Blade Grip
131-3 131-17B 131-18B 131-19 131-21 131-23 131-29 131-33 131-34 131-35 131-34 131-35 131-46 131-47 131-50 131-51 131-52 131-53 131-62 131-64 131-66 131-69-1 131-70 131-83 131-84 131-86 131-122 131-128 131-129	Start Shaft Bevel Gear Shaft Side Tail Bevel Gear TT Side 10x26x8 Main Shaft Bearing Upper Main Shaft Bearing Block 6x13x5 Flanged Bearing - Tail Shaft C/F X-Brace 15x21x4 Bearing - Tail Gear Front Tail Drive Transmission Boom Clamp W/TX Holes P/A Servo Rail C/F Servo Rail Spacer Elevator Servo Mount Jack Shaft Delrin Tray Mount Gyro Plate C/F Angled Battery Tray Tail Boom Tail Hub 4x10 Thrust Bearings - Tail Grips T/R Push Rod Tail Output Shaft Anti Rotation Pin Boom Support Rod Assembled Boom Support T/R Blade Grip C/F Boom Clamp Plate Tail Box
131-3 131-17B 131-18B 131-19 131-21 131-23 131-29 131-33 131-34 131-35 131-34 131-35 131-46 131-47 131-50 131-51 131-52 131-62 131-64 131-69-1 131-70 131-83 131-84 131-86 131-122 131-128 131-129 131-130	Start Shaft Bevel Gear Shaft Side Tail Bevel Gear TT Side 10x26x8 Main Shaft Bearing Upper Main Shaft Bearing Block 6x13x5 Flanged Bearing - Tail Shaft C/F X-Brace 15x21x4 Bearing - Tail Gear Front Tail Drive Transmission Boom Clamp W/TX Holes P/A Servo Rail C/F Servo Rail Spacer Elevator Servo Mount Jack Shaft Delrin Tray Mount Gyro Plate C/F Angled Battery Tray Tail Boom Tail Hub 4x10 Thrust Bearings - Tail Grips T/R Push Rod Tail Output Shaft Anti Rotation Pin Boom Support Rod Assembled Boom Support T/R Blade Grip C/F Boom Clamp Plate Tail Box Tail Pitch Control Bellcrank
131-3 131-17B 131-18B 131-19 131-21 131-23 131-29 131-33 131-34 131-35 131-34 131-35 131-46 131-47 131-50 131-51 131-52 131-62 131-64 131-69-1 131-70 131-83 131-84 131-86 131-122 131-128 131-129 131-130	Start Shaft Bevel Gear Shaft Side Tail Bevel Gear TT Side 10x26x8 Main Shaft Bearing Upper Main Shaft Bearing Block 6x13x5 Flanged Bearing - Tail Shaft C/F X-Brace 15x21x4 Bearing - Tail Gear Front Tail Drive Transmission Boom Clamp W/TX Holes P/A Servo Rail C/F Servo Rail Spacer Elevator Servo Mount Jack Shaft Delrin Tray Mount Gyro Plate C/F Angled Battery Tray Tail Boom Tail Hub 4x10 Thrust Bearings - Tail Grips T/R Push Rod Tail Output Shaft Anti Rotation Pin Boom Support Rod Assembled Boom Support T/R Blade Grip C/F Boom Clamp Plate Tail Box Tail Pitch Control Bellcrank C/F Tail Bellcrank Bracket
131-3 131-17B 131-18B 131-19 131-21 131-23 131-29 131-33 131-34 131-35 131-34 131-35 131-46 131-47 131-50 131-51 131-52 131-62 131-64 131-69-1 131-70 131-83 131-84 131-86 131-122 131-128 131-129 131-130	Start Shaft Bevel Gear Shaft Side Tail Bevel Gear TT Side 10x26x8 Main Shaft Bearing Upper Main Shaft Bearing Block 6x13x5 Flanged Bearing - Tail Shaft C/F X-Brace 15x21x4 Bearing - Tail Gear Front Tail Drive Transmission Boom Clamp W/TX Holes P/A Servo Rail C/F Servo Rail Spacer Elevator Servo Mount Jack Shaft Delrin Tray Mount Gyro Plate C/F Angled Battery Tray Tail Boom Tail Hub 4x10 Thrust Bearings - Tail Grips T/R Push Rod Tail Output Shaft Anti Rotation Pin Boom Support Rod Assembled Boom Support T/R Blade Grip C/F Boom Clamp Plate Tail Box Tail Pitch Control Bellcrank
131-3 131-17B 131-18B 131-19 131-21 131-23 131-29 131-33 131-34 131-35 131-34 131-35 131-46 131-47 131-50 131-51 131-52 131-62 131-64 131-69-1 131-70 131-83 131-84 131-86 131-122 131-128 131-129 131-130	Start Shaft Bevel Gear Shaft Side Tail Bevel Gear TT Side 10x26x8 Main Shaft Bearing Upper Main Shaft Bearing Block 6x13x5 Flanged Bearing - Tail Shaft C/F X-Brace 15x21x4 Bearing - Tail Gear Front Tail Drive Transmission Boom Clamp W/TX Holes P/A Servo Rail C/F Servo Rail Spacer Elevator Servo Mount Jack Shaft Delrin Tray Mount Gyro Plate C/F Angled Battery Tray Tail Boom Tail Hub 4x10 Thrust Bearings - Tail Grips T/R Push Rod Tail Output Shaft Anti Rotation Pin Boom Support Rod Assembled Boom Support T/R Blade Grip C/F Boom Clamp Plate Tail Box Tail Pitch Control Bellcrank C/F Tail Bellcrank Bracket

131-144	Rubber Fuel Tank Mounts
131-148	C/F Servo Plates
131-150	Front Canopy Post
131-151	Rear Canopy Post
131-153	C/F Breakaway Tab
131-154	Thumb Screw
131-161	Main Blade Grip
131-163	FBL Pitch Arm
131-166	4x8x3 Flanged Bearing
131-179	Whiplash X-Block
131-180	6x13x5 Flanged Bearing
131-181	9x17x5 Radial Bearing
131-182	9x17x5 Thrust Bearing (F9-17)
131-183	9x14x.030 Washer
131-184	9x14x.080 C/F Damper Washer
131-186	Anti Rotation Bracket
131-187	Head Axle
131-200	M4x33 Shouldered Socket Bolt
131-202	M4 Jesus Bolt OWB V2
131-368	FBL Head Block
131-400	Torque Tube End
131-408	FBL Main Shaft
131-420	Middle Main Shaft Bearing Block
131-424	Main Gear Hub
131-440	Bearing Block Mount
131-442	Bearing Block
131-454	Tray Mount
131-470	70 T Crown Gear
131-473	7x11x3 Bearing - Control Ring
131-474	Control Ring
	T/R Pitch Slider Assembly
131-475	Tail Pitch Yoke
131-476	
131-477	Brass Slider
131-480	Delrin TT Bearing Cup
131-481	TT Bearing Cup O Ring
131-482	Sleeve
131-483	Tail Drive Hub
131-485	12x18x4 Ball Bearing
131-490	Damper Sleeve
131-491	Damper O-Ring 80D
131-493	15 Tooth Pinion Gear
132-117B	Main Gear 124T
133-60	C/F Tail Fin
133-94	C/F Fuel Tank Plate
133-99	Fuel Tank
133-107	C/F Front Frame Doubler
133-108	C/F Rear Frame Doubler
133-110	C/F Bottom Plate
133-119	Flanged Clutch Spacer
133-120	One Way Bearing Bracket
133-121	Gas Motor Mount
133-135	Landing Gear Frame Post
133-137	Rubber Wire Grommet
133-140	Fuel Nipple
133-144	Skid Tube
133-252	Whiplash Canopy
133-409	Gas Clutch Bell
133-417	17T Pinion w/Sleeve
133-4117	C/F Left Frame - Gas
133-4118	C/F Right Frme - Gas
133-458	Torque Tube
133-60	Fin Painted
2500-24	White Tuff Strut II
3000-24	Towel
3200-30 3200-48	Spiral Band For Wire And Cable 3/4" Hook & Loop Tape
	3/4 Hook & Loop Tape 3/4"Adhesive Hook & Loop
3200-54	
3700-160	Foam Blade Guard



WARRANTY

The warranty covers defects in material or workmanship or missing components to the original purchaser for 30 days from the date of purchase. Miniature Aircraft will replace or repair, at our discretion, the defective or missing component. Defective components MUST BE returned to us prior to replacement.

Any part, which has been improperly installed, abused, crash damaged or altered by unauthorized agencies, is not covered. Under no circumstances will the buyer be entitled to consequential or incidental damages. The components used in this kit are made from special materials designed for special applications and design strengths. We recommend that all replacement parts be original parts manufactured by Miniature Aircraft, USA, to ensure proper and safe operation of your model. Any part used which was manufactured by any firm other than Miniature Aircraft VOIDS all warranties of this product by Miniature Aircraft.

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MOSER SAEGE 5 GAISSACH BY 83674 DE PHONE: +49.8042.5079.239 WEBSITE: HTTP://WWW.MINIATUREAIRCRAFTUSA.COM EMAIL: MINAIR@MINIATUREAIRCRAFTUSA.COM