HELIBUG THUNDERBIRD

Conversion Guide

For Thunder Tiger Raptor 90

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Version 1.0
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Revisions to this Manual

R1.0

- **01/12/12 –** Initial Release

For the most current version of this manual, please refer to www.helibug.com, visit the Thunderbird conversion page and download the most current guide

Errata

R1.0

None

Disclaimer

The author has made every attempt to depict the correct process for this conversion however ultimately the safe construction of this model is dependent upon its builder. The builder and pilot should follow all safety regulations and use common sense when operating this model.

The author has no responsibility for the integrity of any of the components of this assembly, the individual manufacturer's warranties apply to all components.

I. Safety Concerns

WARNING!

The radio controlled model helicopter built from this conversion kit is not a toy and is not meant for children. It is a flying machine capable of causing property damage and serious bodily harm to both the operator/assembler and/or spectator if not built and operated correctly and responsibly. Rotating components, especially the main rotor blades, are an ever-present danger. Model helicopters operate differently than model cars and airplanes. Helicopters by their nature are not positively stable, meaning that even if properly assembled and adjusted, helicopters will not recover from an unwanted flight attitude, nor will they hold any particular orientation without constant control inputs from the pilot.

IT IS YOUR EXCLUSIVE RESPONSIBILITY TO PROPERLY BUILD, MAINTAIN AND OPERATE THE HELICOPTER.

HELIBUG has spent considerable time making this product reliable and easy to build, but only the operator can insure that it is safe. Because the safe operation of this helicopter is beyond the control of the Manufacturer and distributor, the owner/operator assumes all risk of use.

II. Conversion Nomenclature

This conversion document will only address conversion specific differences from the standard Align build instructions. Unless otherwise indicated you should follow the original assembly instructions including all warnings, guidelines and tips.

2.A) Assembly Tips

1. Follow the order of assembly. The guide has been organized into major sections and has been developed 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
2. Sand sharp edges on any frame plate that Velcro® or wires may rub against to prevent them from being damaged over time by vibration
3. **As a general rule any bolt that threads into a metal part should have thread lock applied**
4. Photographs will contain assembly icons that indicate use of thread lock, adhesive or lubricant as needed. If an assembly has more than one of the same part number, application of thread lock, adhesive or lubricant will apply to all of the same numbered parts in that photograph Examples of the icons are as follows:

Thick Adhesive

Blue Thread Lock

Green Thread Lock

Lubricant

III. Conversion Prerequisites

In order to assemble this kit, you will need a complete Thunder Tiger Raptor 90 model (or its major assemblies) as well as some additional parts. They are as follows:

3.A) Donor Model Needed (as shown)

There are multiple editions of the Raptor 90 helicopter, the Basic edition, the Special Edition and the 3D.

Each has slightly different features and materials but maintains the same basic layout.

This conversion can be based upon any of them.

The documented conversion was done using the 3D version.

These are the parts you MUST have to be able to complete the conversion. You will need the entire tail boom assembly, the entire center frame assembly and rotor head, the lower main shaft bearing and three of the frame spacers. These can be removed from the fan shroud assembly.

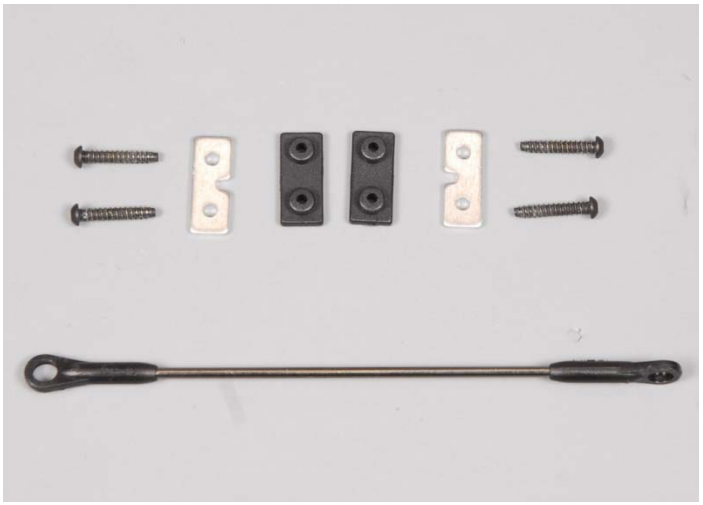
You will also need the landing gear, the front radio tray and the canopy

These are the components you will NOT need for the conversion. They are:

- The outer frames
- The motor mount
- The rear landing gear mount
- The cooling shroud
- The fan/clutch/pinion assembly
- The fuel tanks

If you have access to a crashed or partial kit, as long as the listed required components are in good working order you can complete the conversion

3.B) Additional Required Components (not all shown)



For this conversion, you must have the following parts

- 1 pack Align HN7038 T-REX 700 Clutch Bell
- 1 pack Align HN7036 T-REX 700 Start Shaft Set
- 2 pack Align HN6019 T-REX 600 Landing Gear blocks
- 1 each T-Rex 700 Clutch (one of the following)
  - *Align HN7039 T-REX 700 clutch and Lynx LX0052 Heavy Duty Clutch Liner (contains 2 liners)*
  - ***OR***
  - *Quick-UK TX7D11 T-REX 700 Upgrade Clutch*
  - ***OR***
  - *Lynx LX0135E T-REX 700 Upgrade Clutch*
- 3 feet of 1/8" ID Tygon Fuel Line
- 20 each additional 3mm x 8mm socket head bolts
- 4 each additional 3mm x 12mm socket head bolts
- Two sided tape (electronics mount)
- Two sided Velcro (electronics mount)
- 1 pack HN6062 Align Servo nut (or equivalent)
- 4 each 2.5mm servo mount screw
- 1 each BK0318 Raptor Elevator control rod + ball links

Motor

This kit uses the Zenoah/CY RC series of motors.

This is a self contained motor that is practically ready to use right from the box.

The following motor sizes are acceptable for these models

- Zenoah/CY RC230/RC240
- Zenoah/CY RC260/RC270
- Zenoah/CY RC290

Modified motors such as the TRM Power line offer balancing and power improvements. They are preferable to stock "out of the box" motors

Muffler

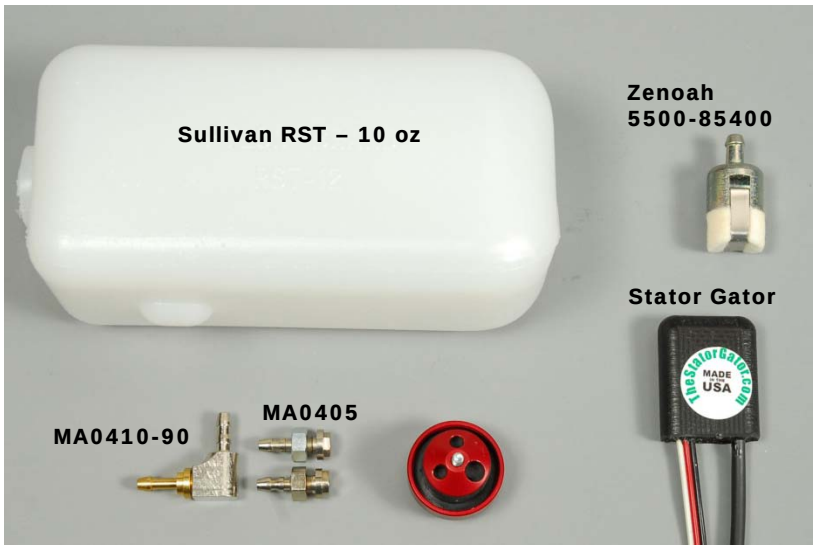
The RC style motors come standard with a muffler. It does not have a pleasant sound but will work acceptably.

You will need to either use the std Zenoah style muffler or acquire a third party muffler

The Hatori #956/957 Gas mufflers have proven to be acceptable alternatives.

Also the Century Torpedo V5 and Slim V2 can be used.

3.D) Optional Components



You may want to add some optional parts that simplify or improve the conversion. They are:

- Miniature Aircraft Fuel fittings (1 each 0410-90, 2 each 0405) or equivalent
- Zenoah Fuel pickup (1 each #5500-85400)
- Sullivan S478 Aluminum fuel tank cap
- Sullivan 12oz RST fuel tank
- Stator Gator GGS233-RC
- Stens vent valve 610-079

Optional Gear Ratios

Depending on what motor you want to use and how you intend to fly the model, you may want to change the gear ratio.

The Thunderbird conversion comes with a 14 tooth main gear. The Raptor typically comes with a 91 tooth main gear resulting in a gear ratio of 6.5:1

You can easily change the gear ratio to one of these options by simply replacing the main gear with one of these:

- **6.64:1 ratio** PV0186 93 tooth main gear
- **6.71:1 ratio** PV0189 94 tooth main gear
- **6.78:1 ratio** PV0188 95 tooth main gear

The clutch block mounts are slotted as are the bottom plate so the gear mesh can be adjusted depending on which ratio you have installed

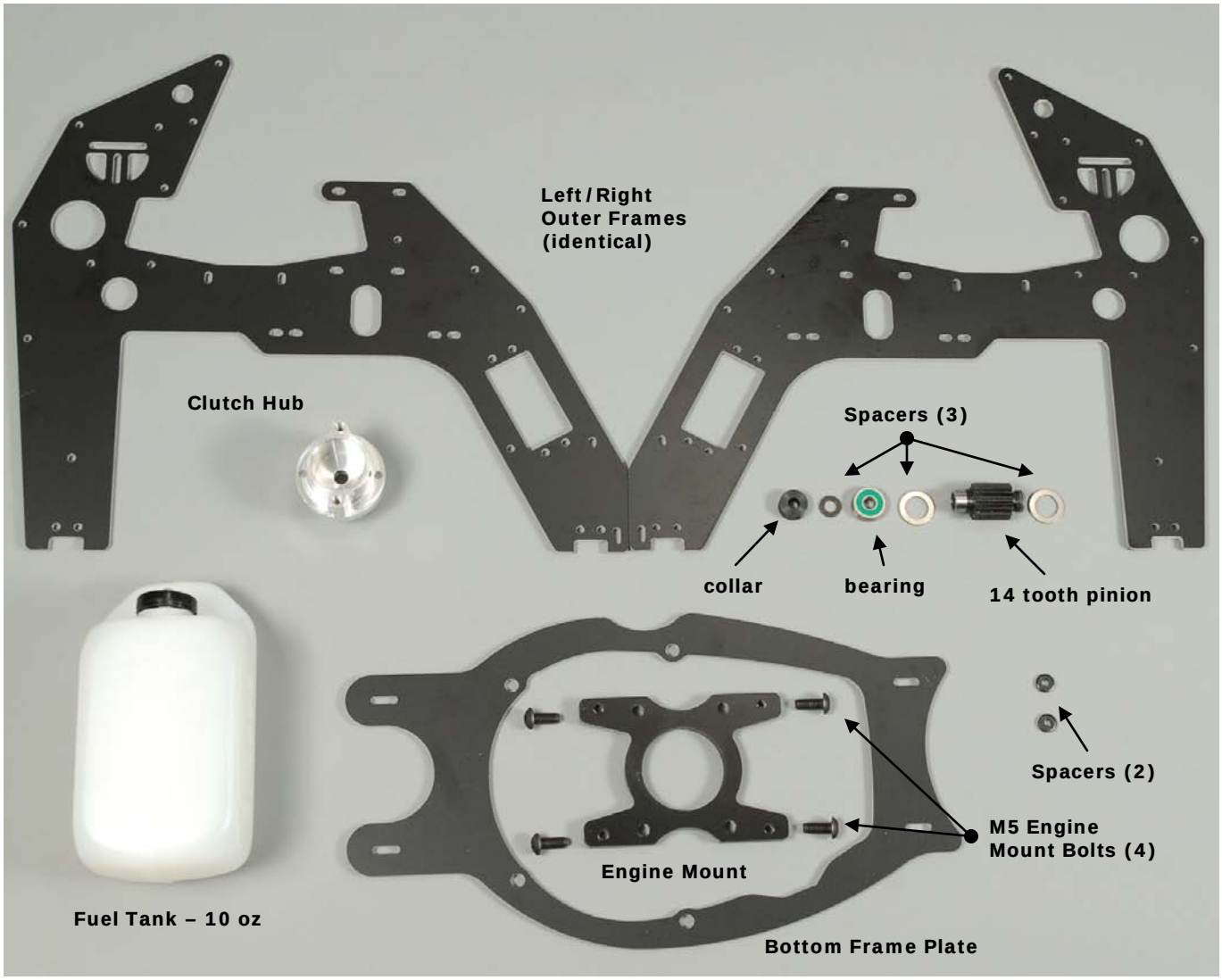
3.E) Documentation

The most recent version of this document can be downloaded from: www.helibug.com

IV. Pre Conversion Assemblies

Inspect the conversion package and locate each of the parts listed above. All relevant parts are required If you cannot locate any part contact the manufacturer.

4.A) Inventory – Conversion Kit



You will also need a donor Raptor 90 model and additional required parts previously shown.

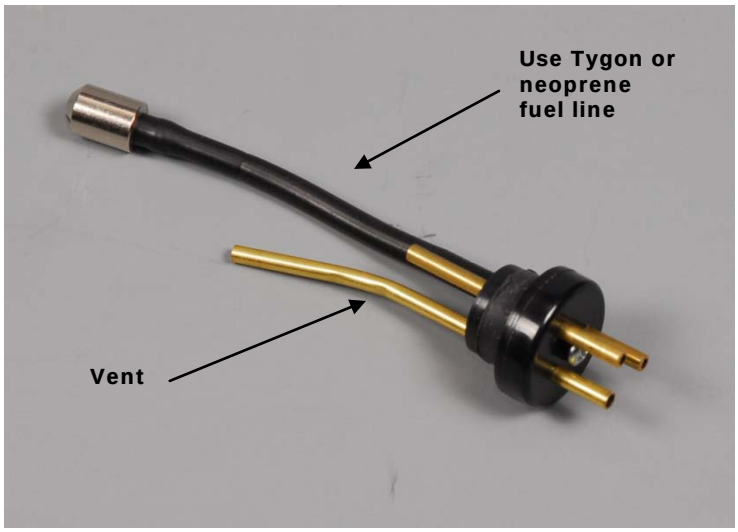
4.B) Assemble Fuel Tank

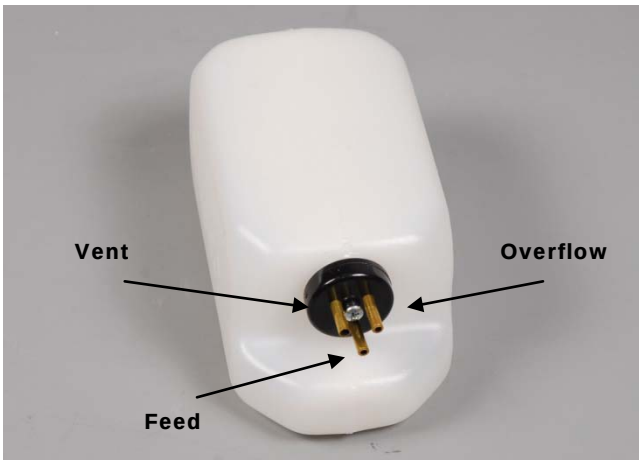
Stock Tank (provided with kit)

The kit includes a 10oz Dubro fuel tank plus a gas resistant stopper. The parts are inside the tank

You will assemble the stopper assembly like this, you cannot use the silicone based fuel line included in the tank. Use tygon or the rubber fuel tubing typically included with Zenoah motors. The correct length for this tube is about 3”

You will need to adjust the bend on the vent tube so that its opening will be at the top of the fuel tank, in whatever position you mount the tank





Insert the stopper assembly into the tank and tighten the screw until the stopper has firmly sealed the tank. If it leaks you can tighten this screw more.

Note, over time the plastic cap will deform and eventually fail and will need to be replaced

The fittings will be later plumbed as shown

Optional Tank Setup(see optional parts for details)

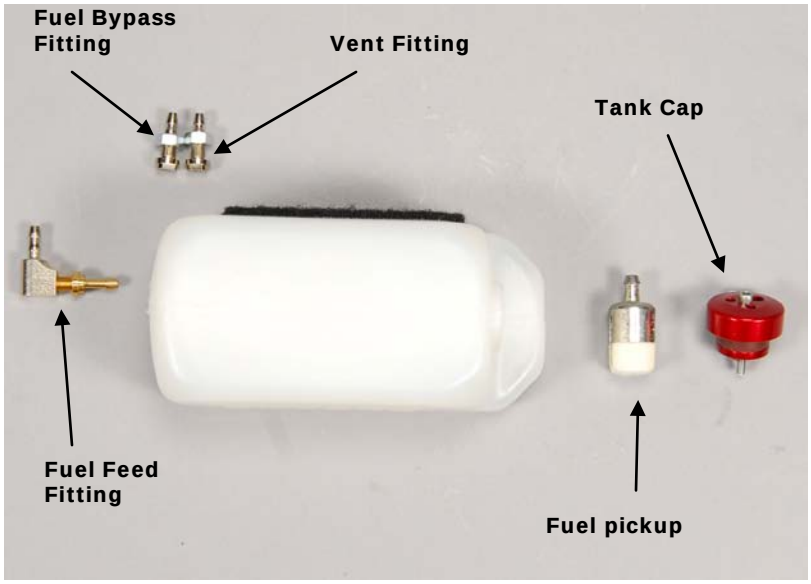
I like to use a more robust setup which also provides more capacity

I use a Sullivan RST 12oz tank plus the parts shown although everything here can be used with the included stock tank. The complete list is in the optional parts section of this document

The line on the fuel clunk is cut at 5” to allow the clunk to move around in the tank

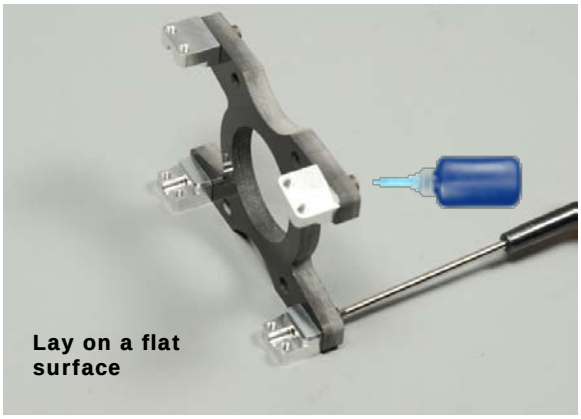
The tank is then assembled as shown. The fuel feed is on the side of the tank, the other 3 fittings are used for the vent, return and fill functions

- It is HIGHLY recommended that you use a felt fuel pickup filter common with these types of motors. This will result in more consistent fuel delivery to the motor and will not require a separate filter to be placed in the fuel tank pickup line
- Make sure to use either neoprene or Tygon fuel line inside the tank and that it is long enough and flexible enough to allow the clunk to move around in the tank as the helicopter maneuvers
- Adhesive backed Velcro will be used to help hold the tank into final position
- Final plumbing will be addressed in a later step

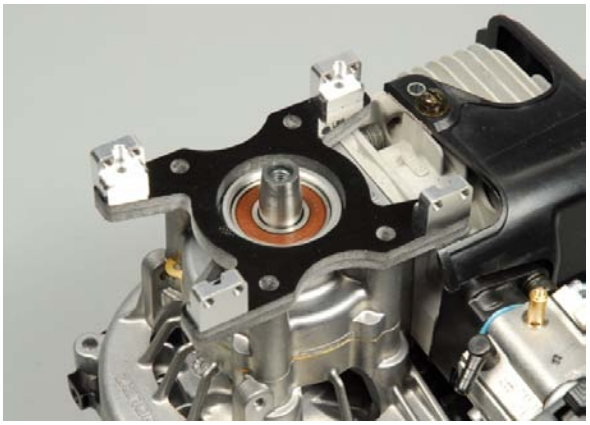


4.C) Engine Preparation

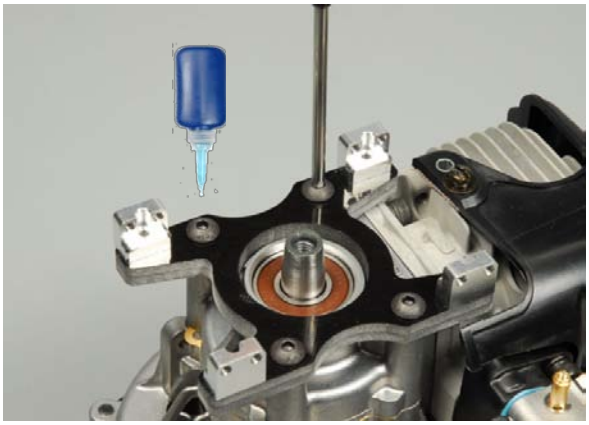
Assemble the engine mount parts as shown using M3x12mm socket head bolts



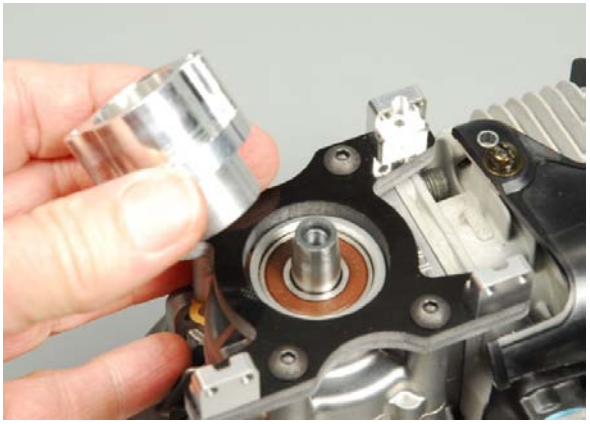
Lay the mount sideways as shown on a flat surface and fully tighten the mount bolts sing blue thread lock



Place the engine mount on the front of the engine as shown

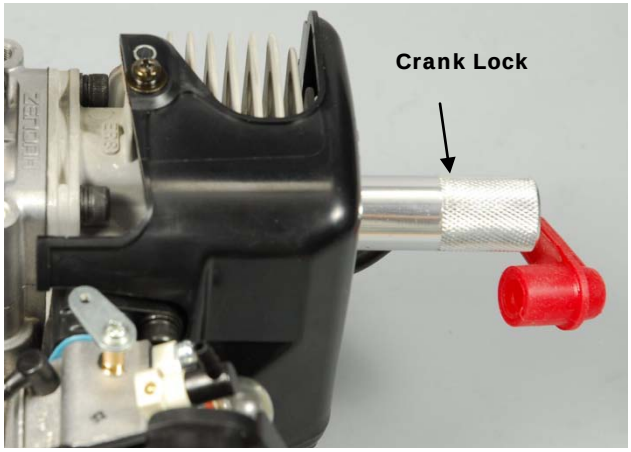


Using the M5 button head bolts secure the mount in place using blue thread lock

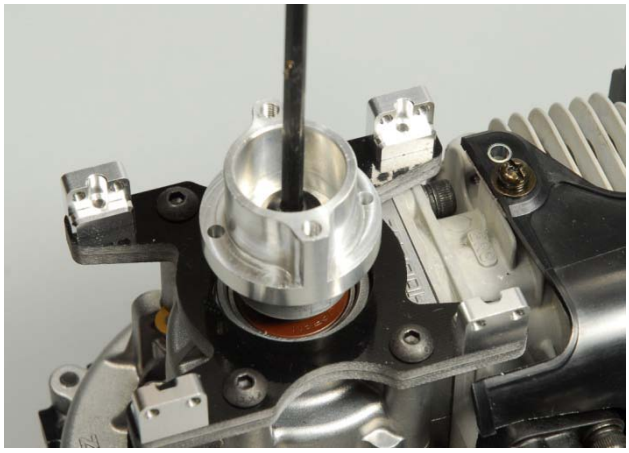


Install the clutch hub on the engine crank-shaft as shown

Use the button head 6mm bolt to secure the clutch hub to the crankshaft

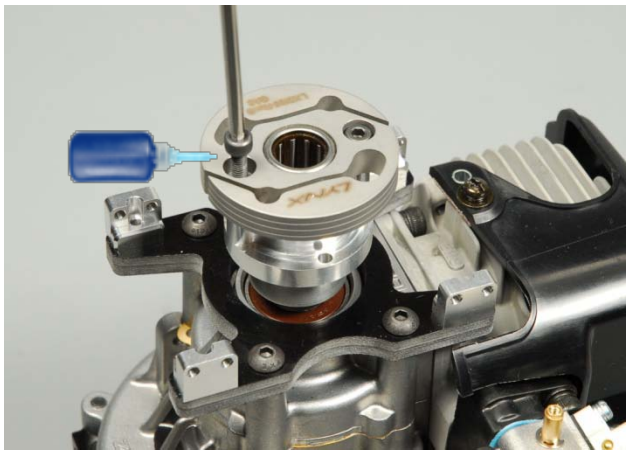


You'll need to use a crank lock as shown here to tighten the clutch hub. DO NOT hold the rear Flywheel as its possible to twist the crankshaft

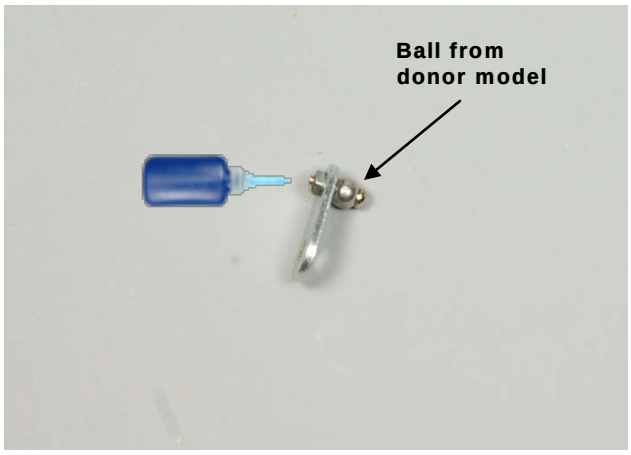


Install the M6 button head bolt as shown and tighten using blue thread lock.

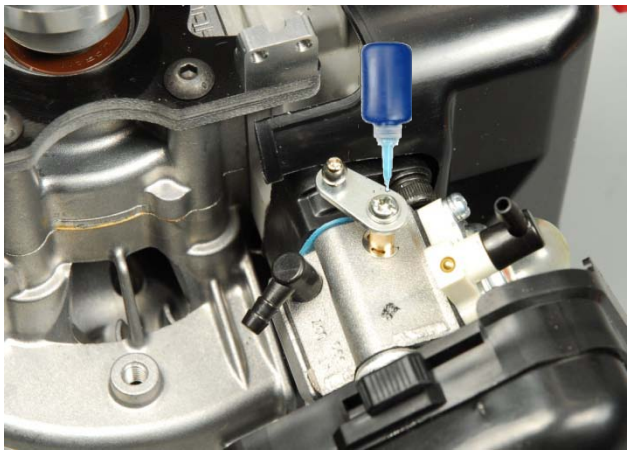
Position the clutch as shown on the clutch hub



Using the M4 mount bolts that came with the clutch install the clutch as shown using blue thread lock



Using one of the threaded balls from the donor model, remove the throttle arm from the motor and install as shown using thread lock



Reinstall the throttle arm on the carburetor in this position and tighten using thread lock. The arm may need to be flipped over first

If this is a new engine, the pull start will be positioned as shown.

This model cannot be top started with a spin starter so use of the pull start is required. In this position it will be very difficult to start the motor so it will need to be repositioned

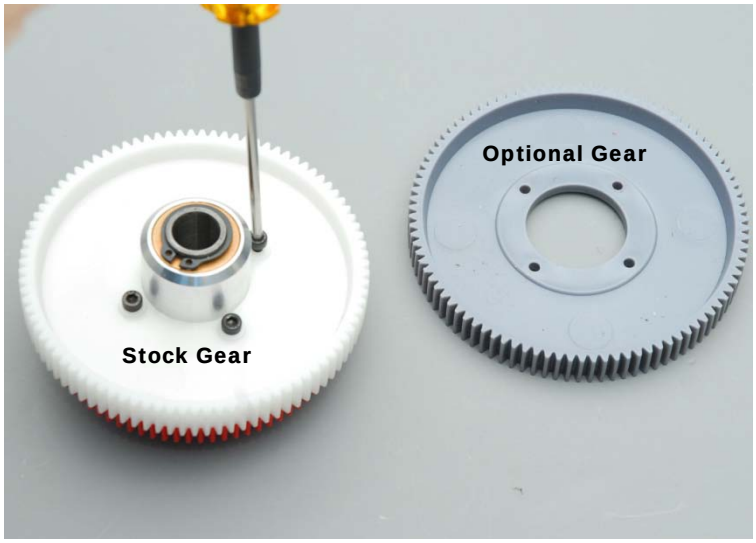
To reposition the pull starter, remove the four screws that retain the pull starter, remove the assembly and then reposition it as shown. Reinstall and tighten the screws

The motor is now ready for installation into the model in a later step

4.D) Gear Ratio Changes

If you intend to change the gear ratio of the model, now is the time to make the change

Select the Main Drive gear assembly then remove the four bolts that hold the main gear in place

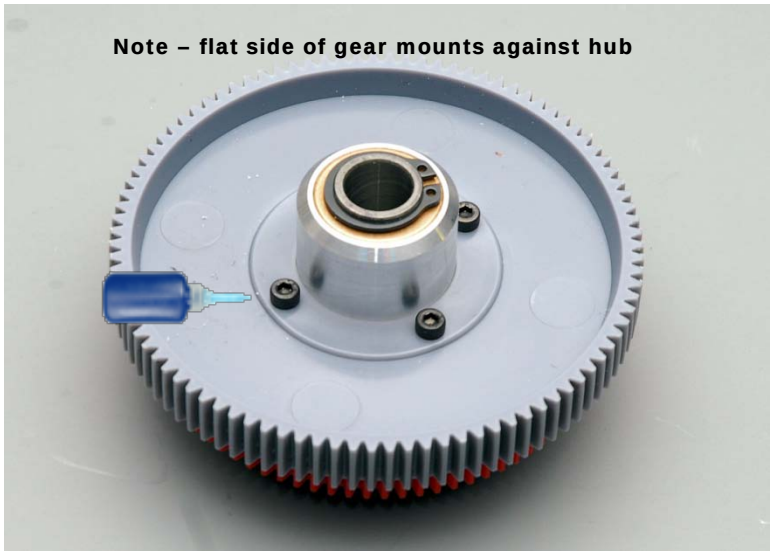


Remove the original gear and then slip the desired new gear in its place

Replace it with one of these selected gears:

6.64:1 ratio PV0186 93 tooth main gear
6.64:1 ratio PV0189 94 tooth main gear
6.78:1 ratio PV0188 95 tooth main gear

Reinstall the four mount bolts using blue thread lock as shown

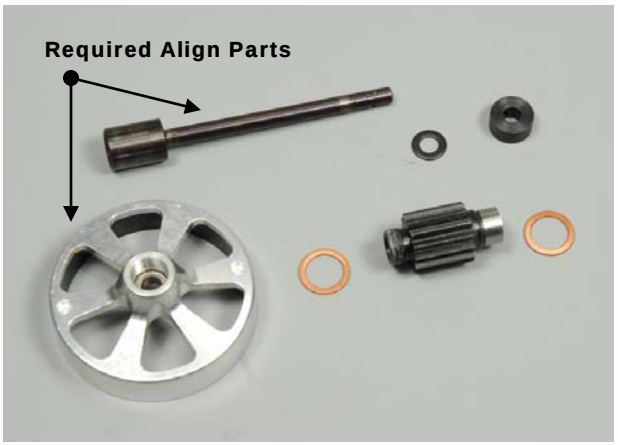


4.E) Clutch Stack Preparation

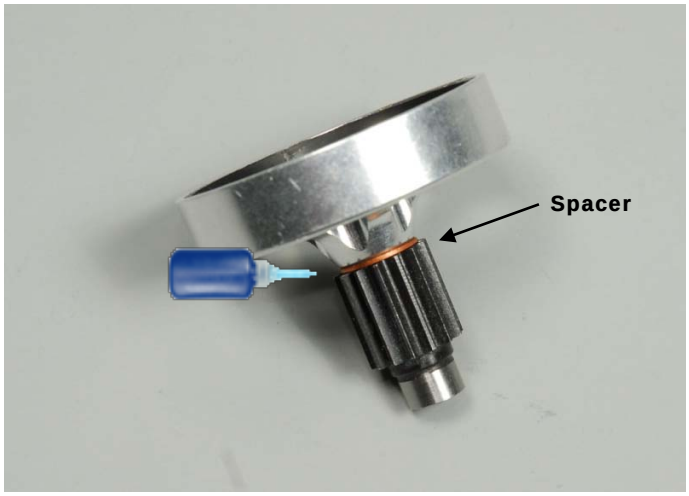
Separate the plastic block halves. The smaller upper bearing will be replaced with a new bearing provided in the conversion

Uninstall the clutch stack from the original model and then remove the clutch bell, pinion and start shaft, they won't be needed

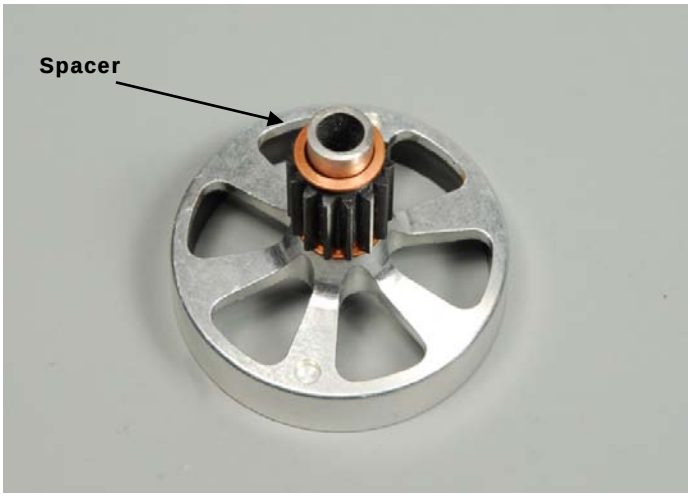
Here is the location for the bearing. Simply pull the old bearing out and slide the new one in place. Press it into the block. Don't reassemble the block yet, you wont' be able to install the retaining collar if you do



These are the parts needed for the new clutch, it's a combination of parts from the conversion kit and from the required parts list



Thread the new 14 tooth pinion gear into the Trex 700 clutch bell but make sure you drop one of the two copper washers over the threads before you do this. These washers act as spacers. Make sure to apply blue thread lock on the pinion threads before installing

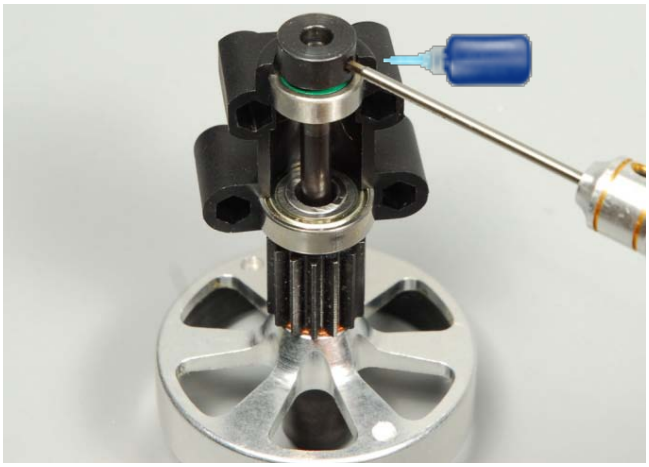


Drop the second washer over the top end of the pinion gear as shown

Now insert the machined end of the pinion gear into the lower bearing of the start block as shown. Use green thread lock to mate the two surfaces

Now slide the start shaft into the stack as shown

The supplied spacer goes over the end of the shaft that protrudes from the top of the block

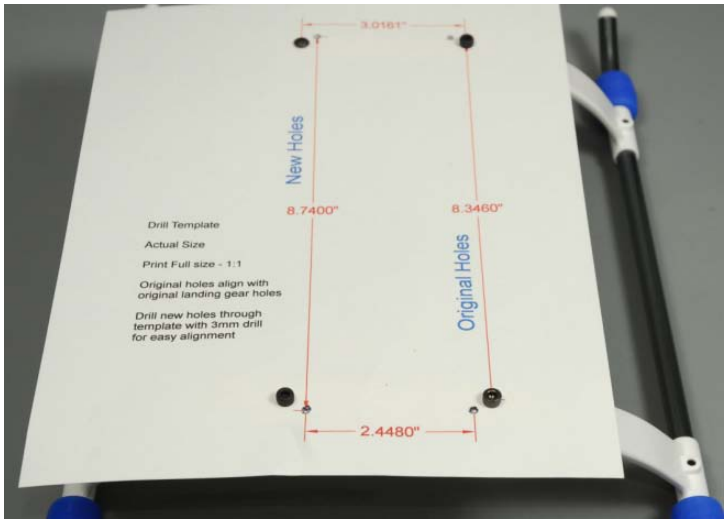


Now install the collar on top of the shaft and tighten the set screw to secure it using blue thread lock

This is somewhat marginal, the shaft isnt' really long enough for this but the set screw seems to keep it in place. The part I REALLY don't like is that there's no way to install a starter coupler without making a longer start shaft

Finally push the two clutch block halves back together and set this assembly aside. It will be installed in a later step.

4.F) Landing Gear Modification

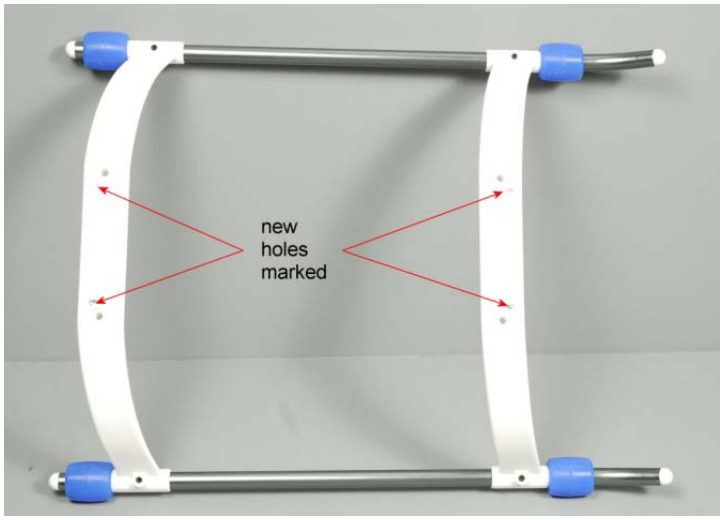


Print the landing gear drill guide found on the next page in this conversion guide and cut out the four 4mm landing gear mount holes

Lay it on the assembled landing gear as shown and insert the original 4mm mount bolts through the guide and into the landing gear

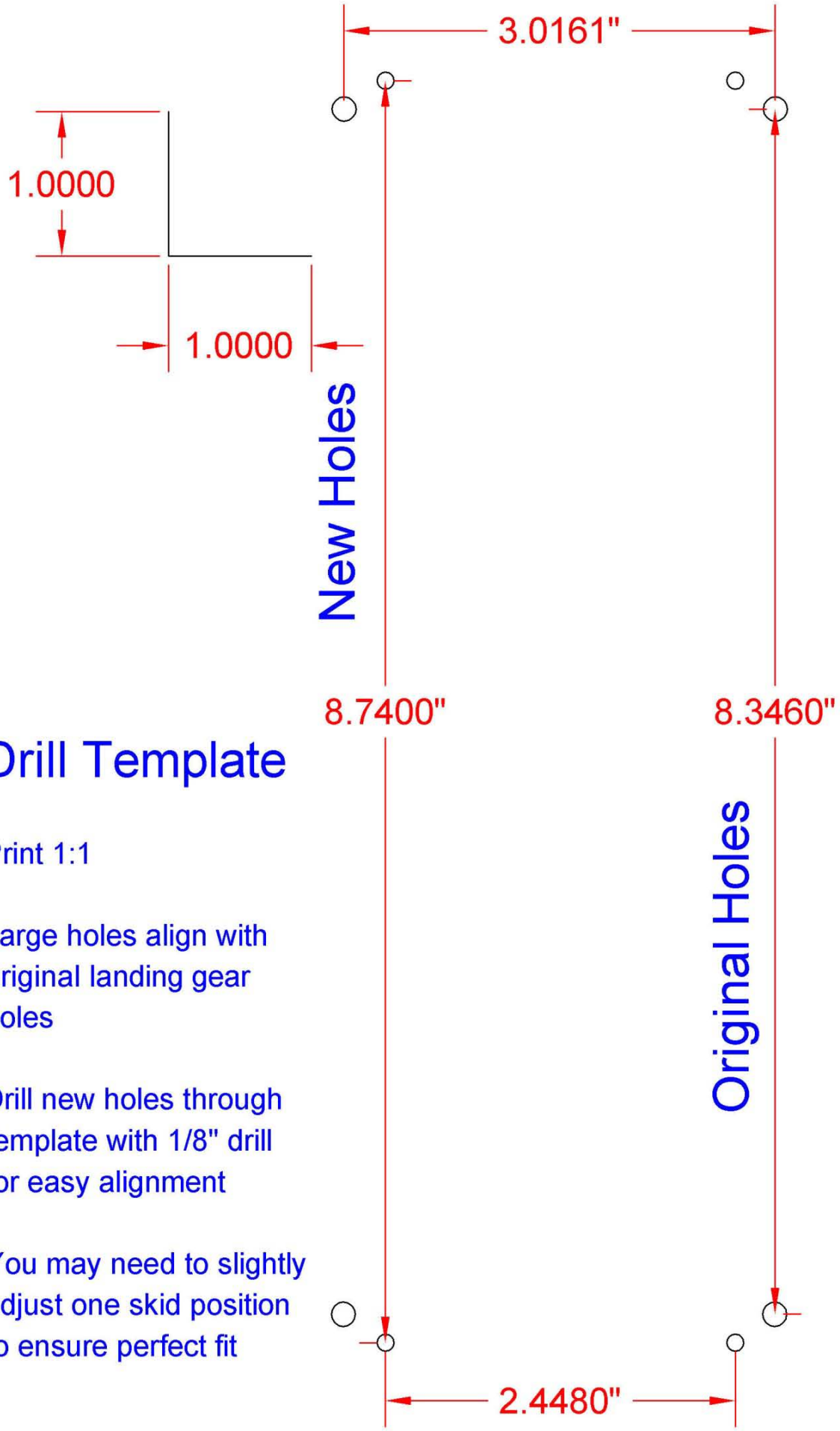
Either use a sharp instrument to mark the new holes on the landing gear through the guide or simply drill through the guide with the recommended drill size

You can use the guide to just drill the holes in line with the original mount holes however you'll have to reposition the struts. Also the struts have recesses on the bottom, this will cause some interference issues with the mount bolts/washers



When completed, the new mount holes will be slightly inside of the original mount holes and will be slightly off center of the original holes

If you want to reposition the struts on the landing gear you can drill the new holes in the same alignment as the original holes



Drill Template

Print 1:1

Large holes align with original landing gear holes

Drill new holes through template with 1/8" drill for easy alignment

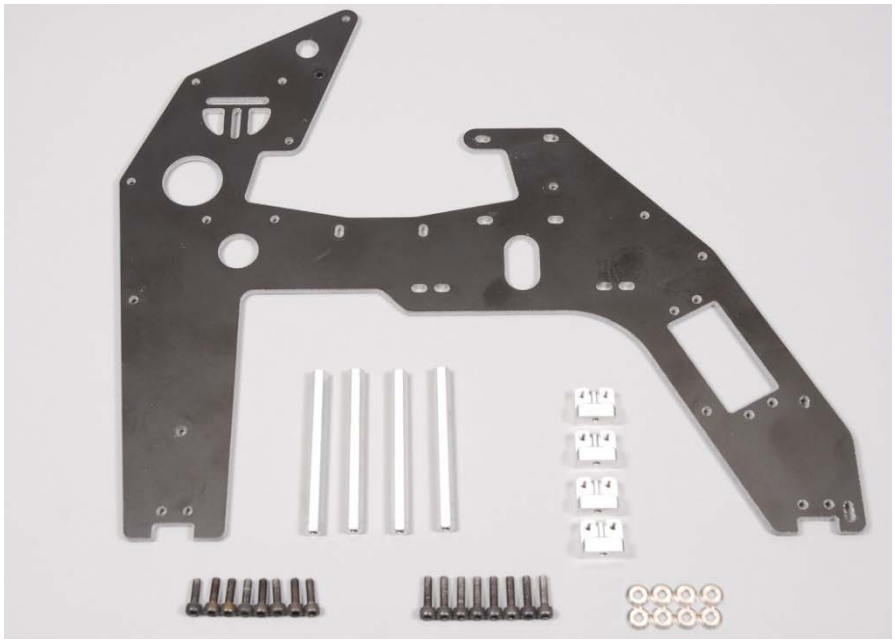
You may need to slightly adjust one skid position to ensure perfect fit

All of the pre-conversion work steps are now complete and the conversion is ready to be completed.

V. Conversion

Now the donor model parts will be combined with the pre-assembled components to complete the conversion

5.A) Assemble Frames

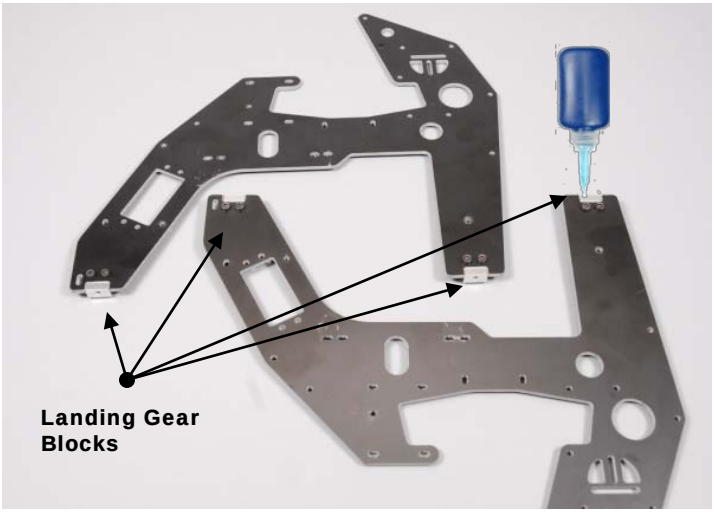


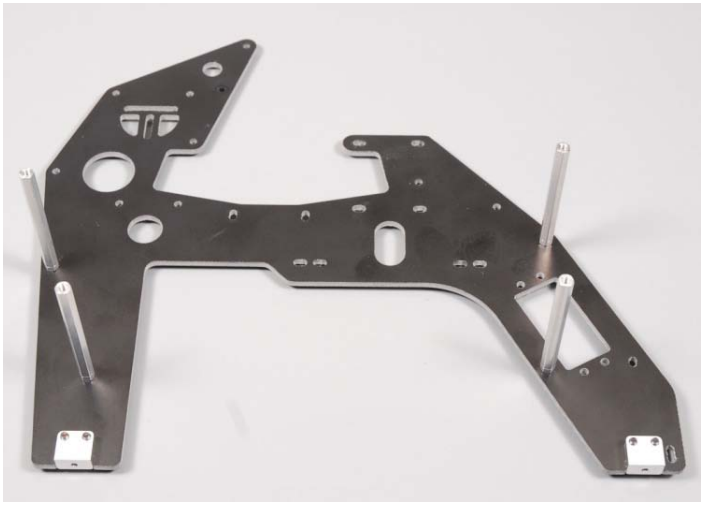
For initial assembly you'll need:

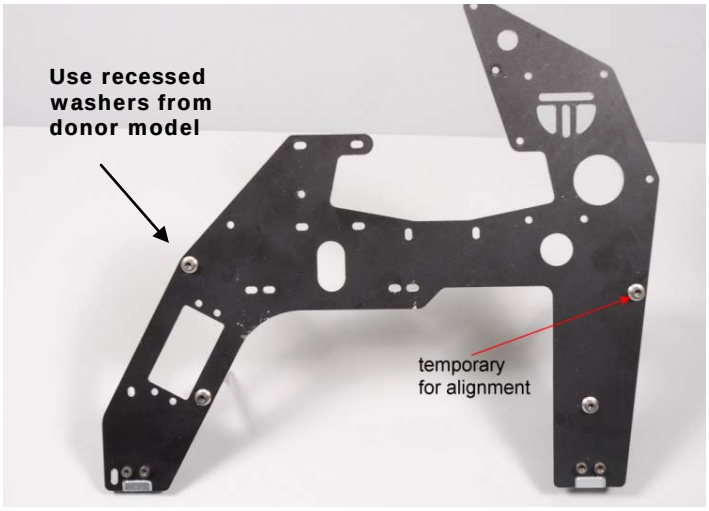
- The frame halves
- The four frame spacers
- Four landing gear blocks
- 8 – M3x8mm socket bolts
- 8 – M3x12mm socket bolts
- Bolt head washers from donor model

Install the four landing gear blocks into the two frame halves as shown. Make sure you install them on opposite sides of the two identical frames making a left and right side

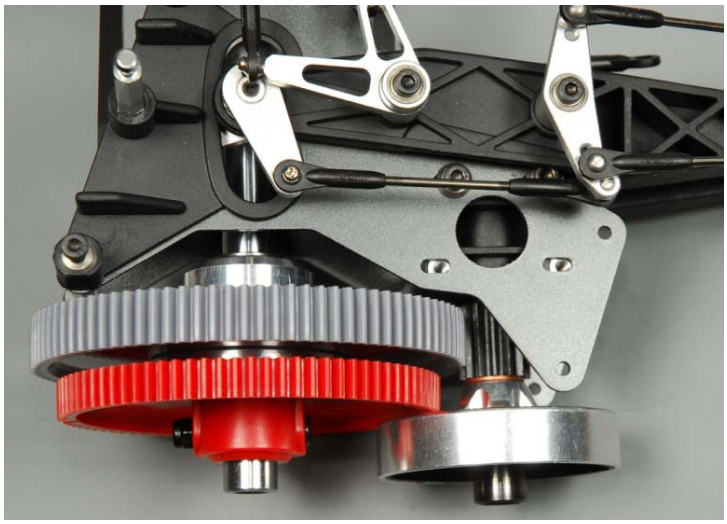
Use eight of the M3x8mm bolts with blue thread lock

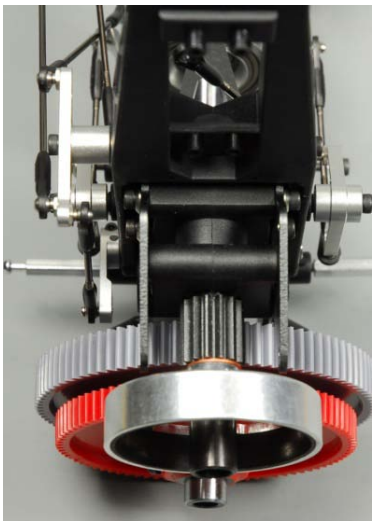


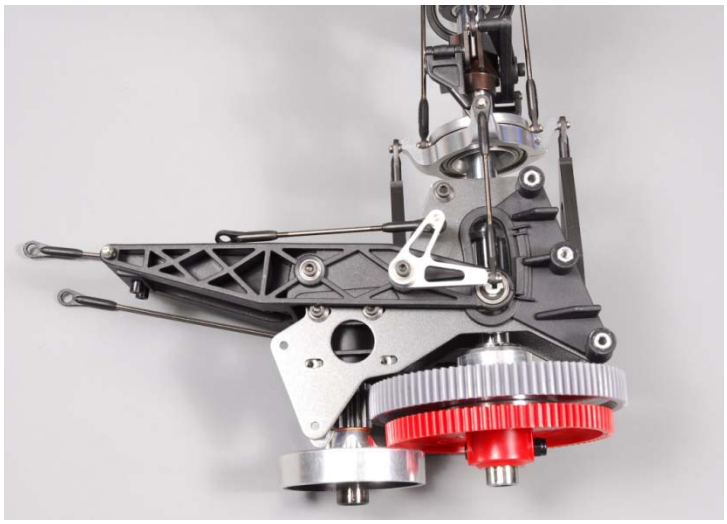




Install the four frame spacers in the positions shown on the left frame side. Use M3x12mm bolts. Do not fully tighten or use thread lock at this time. The rear spacer will later be used to install the boom struts. Its installed here just to ensure proper frame alignment in a later step



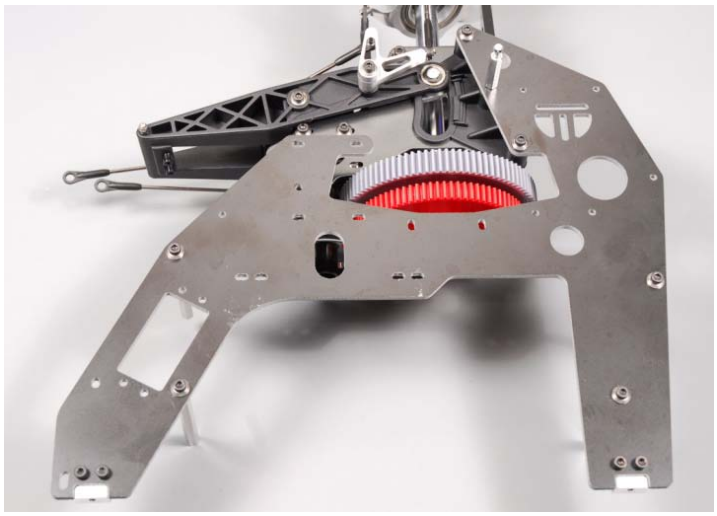


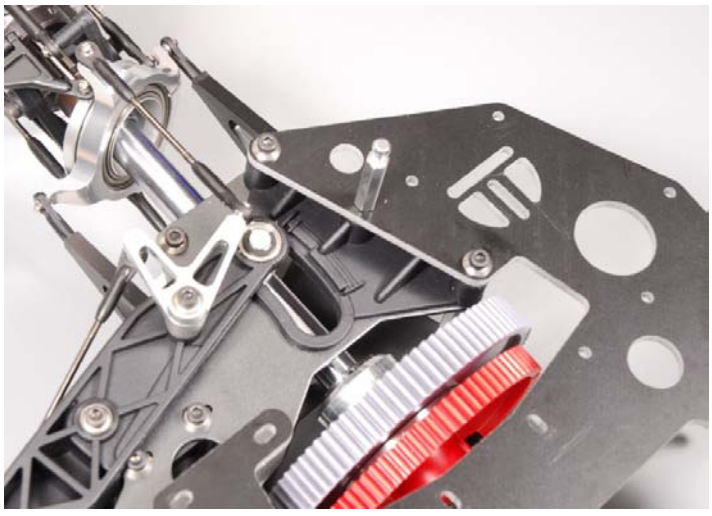


The upper frame assembly can be removed intact from the donor model

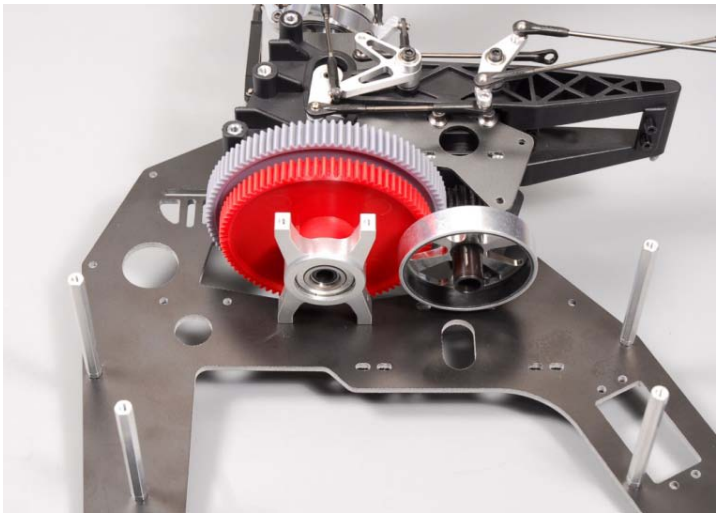
Select the previously assembled clutch block and clutch bell and insert it into the upper frame assembly. Use M3x12mm bolts for the upper four mounts but don't fully tighten or use thread lock yet

You'll have to remove the collective assembly to access the upper clutch block bolts

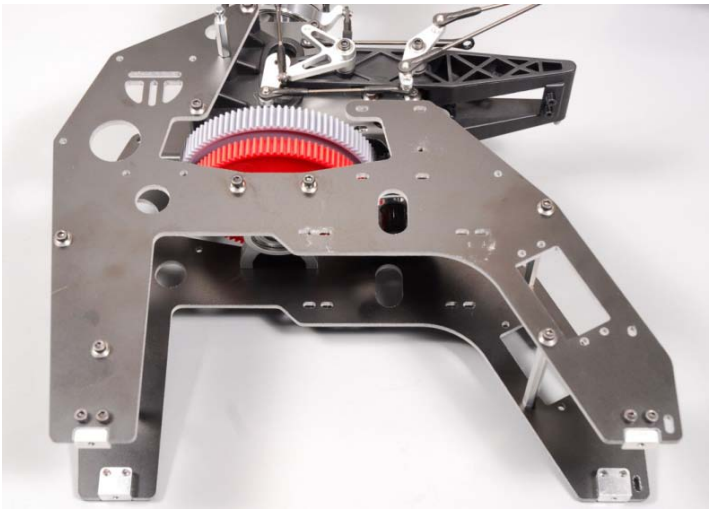




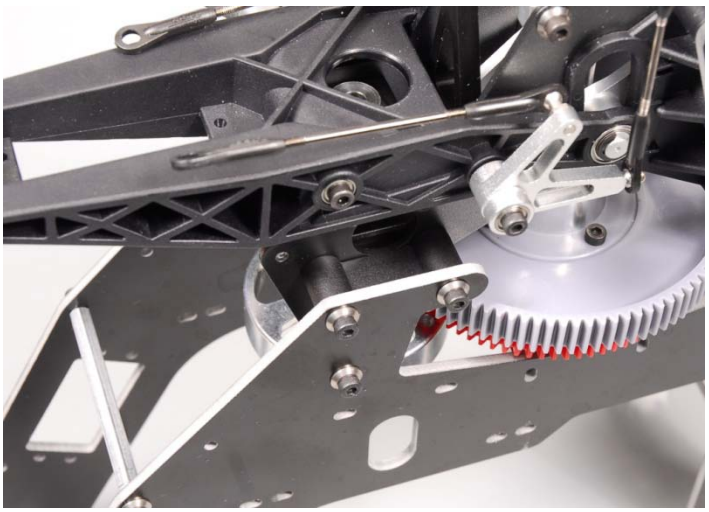
Select the previously prepared left frame and position it on the left side of the frame center assembly as shown. Attach it initially with the two original mount bolts that go through the outer frame and into the center frame as shown. For now don't fully tighten or apply thread lock

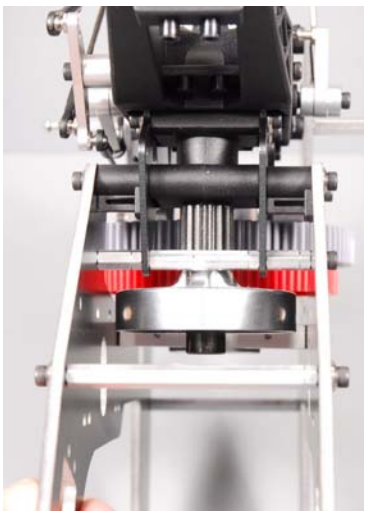


Install the lower main shaft block onto the left frame as shown using the original mount bolts. Again don't fully tighten or use thread lock yet



Now position the right frame on top of the left frame assembly as shown and install bolts for the frame spacers, main shaft block, rear frame mount and clutch assembly. Don't fully tighten at this time

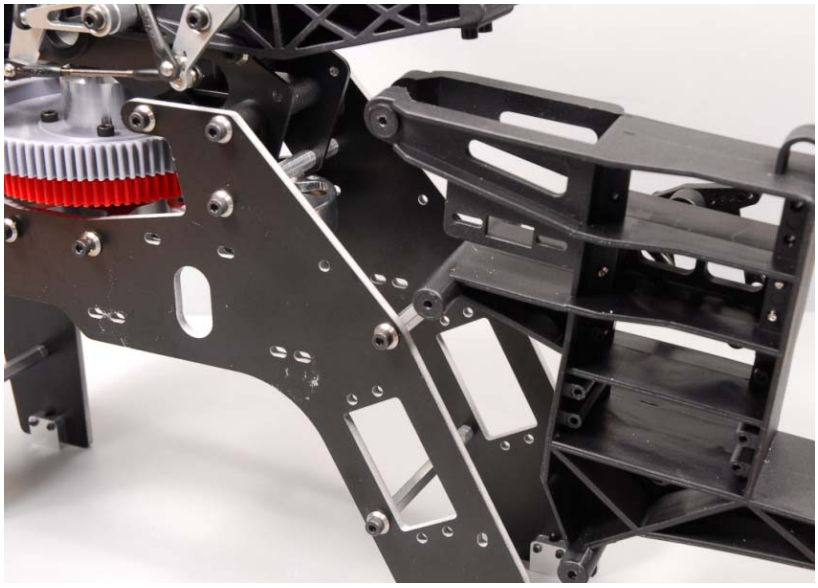




Reinstall the lower clutch block mount bolts/frame spacers as shown from the donor model. These bolts go through the outer frames, through the two plastic spacers and thread into the clutch block. Don't fully tighten or use thread lock at this time

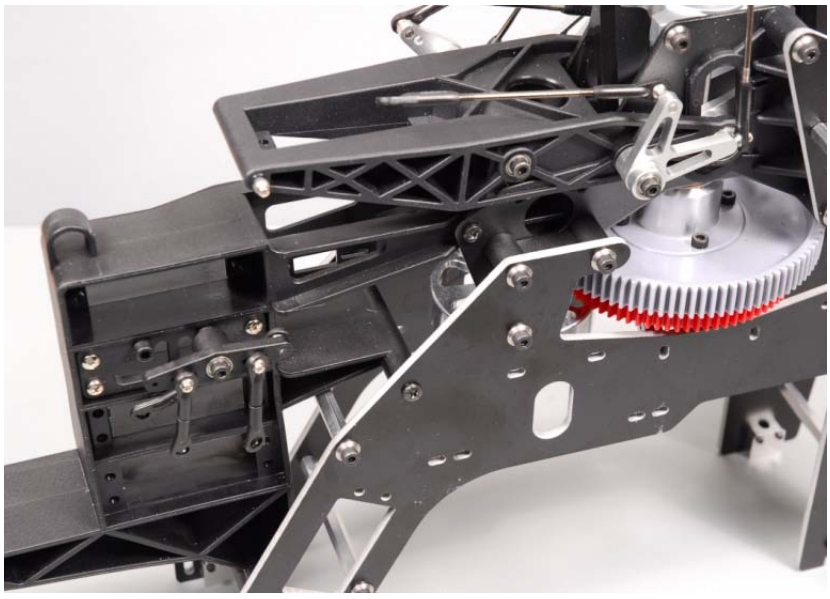
Also install the two small lower front frame spacers from the original model. These bolts go through the outer frame, through the hollow aluminum spacers and into the center threaded spacer. Again don't fully tighten yet

5.B) Radio Tray Installation

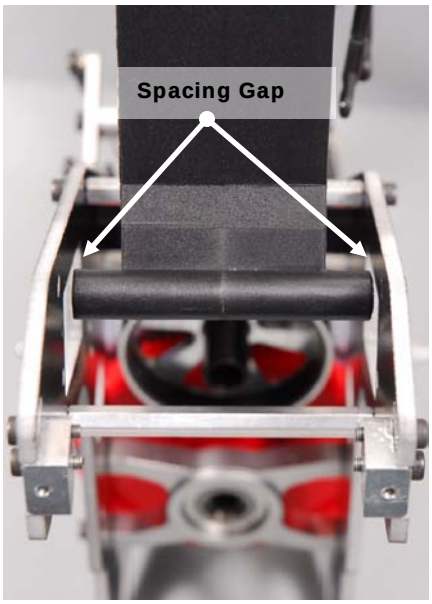


Set the radio tray from the donor model into the front of the frame assembly as shown

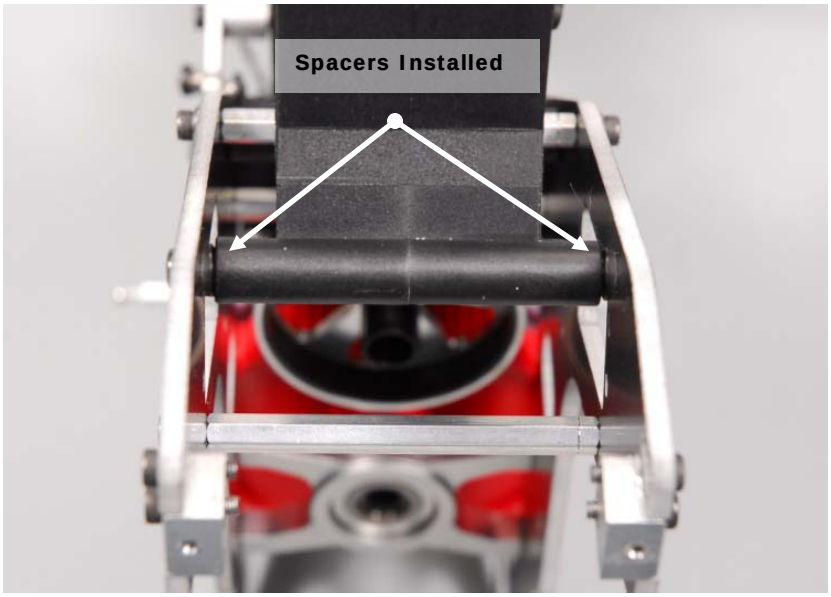
Select the two spacers shown from the conversion kit



Using the bolts from the original donor model attach the top four bolts of the radio tray to the frame assembly. Don't fully tighten yet



As you can see, there is a gap between the lower radio tray mounts and the outer frames

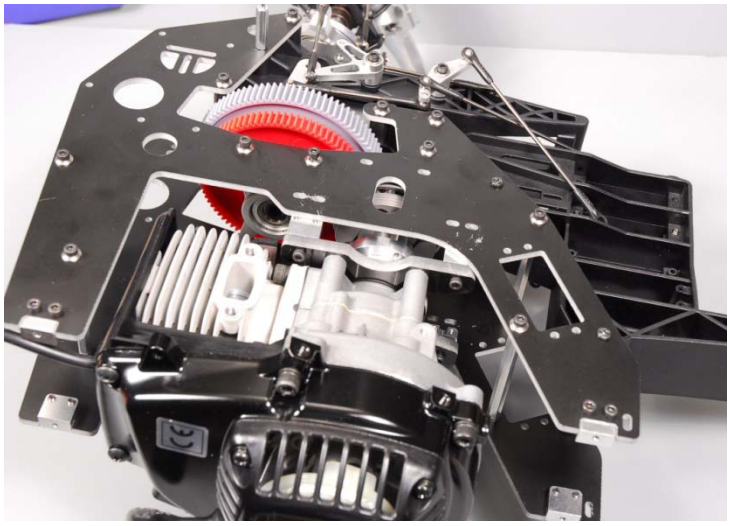


Slip each of the two spacers between the radio tray and the outer frame and thread the original bolts through the outer frame, spacers and into the radio tray. Don't fully tighten yet

This is what the assembly should look like at this point

Next the motor will be installed and the frame assembly completed

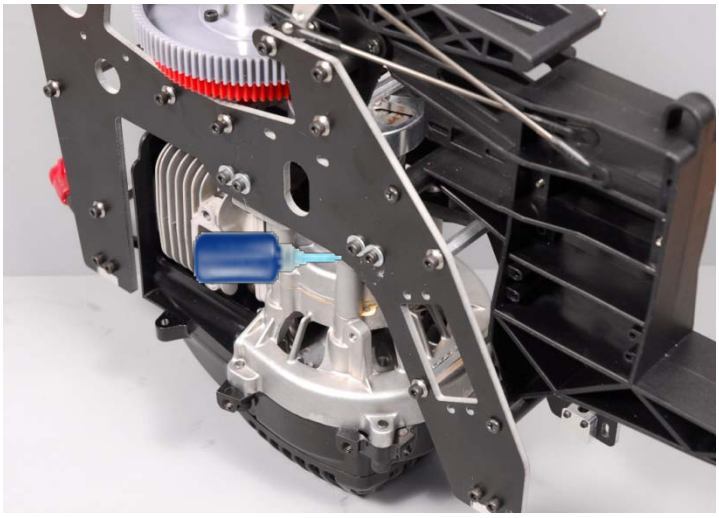
5.C) Motor Installation



Insert the previously prepared motor and mount into the frame assembly as shown.

The four mount blocks have to slip between the frames, the clutch bearing has to slip over the start shaft end and the clutch has to slip into the clutch bell.

With a little care this is not difficult to align.



Using eight M3 x 8mm socket bolts and washers, mount the four engine mount blocks to the side frames as shown. Don't fully tighten yet.

With the spark plug removed, pull the pull starter a few time to completely align the clutch.

Now fully tighten the eight engine mount bolts using using blue thread lock.

At this point you must fully tighten ALL of the frame bolts previously installed.

Make sure you use blue thread lock on those bolts that thread into metal receivers

5.D) Landing Gear Installation

Before the previously prepared landing gear can be installed, the lower frame plate needs to be installed.

This plate bolts onto the bottom of the motor so first remove the four M5 socket bolts from the cooling shroud on the motor. There are still two screws that hold the shroud in place so its position won't be affected.

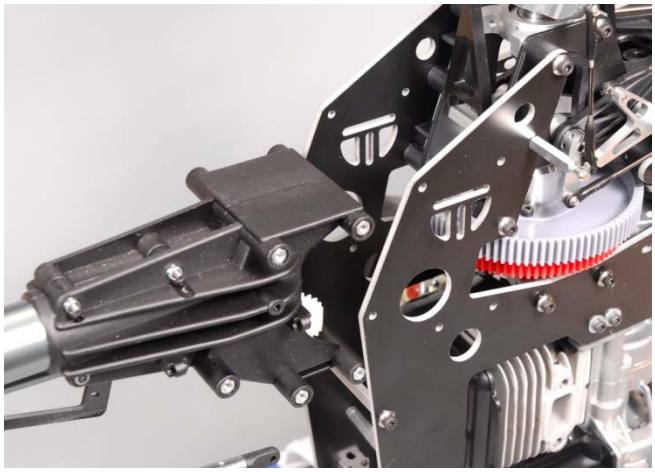
Place the plate in place as shown. Make sure it is properly aligned, it really won't fit but one way. Note the slight indentation on the exhaust side

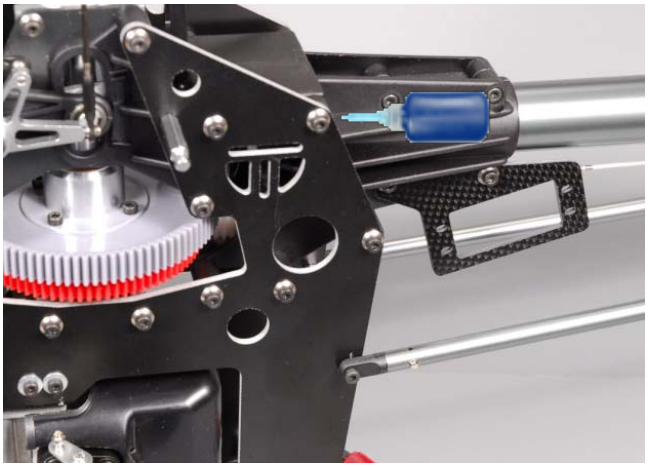
Now reinstall the shroud mount bolts through the bottom plate using blue thread lock

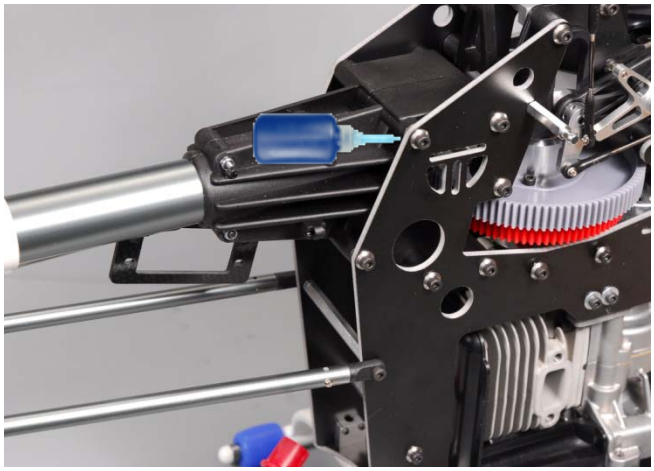
Make sure the landing gear mount slots align with the threaded holes in the four landing gear mount block

Position the landing gear as shown and mount using M3 bolts and washers and blue thread lock

5.E) Tail Boom Installation





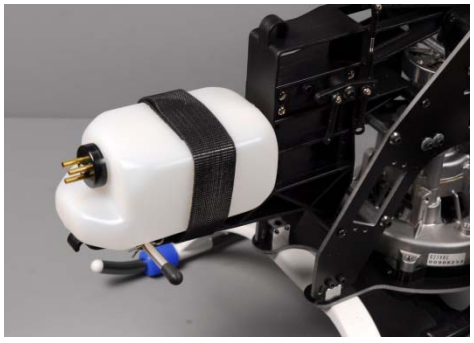


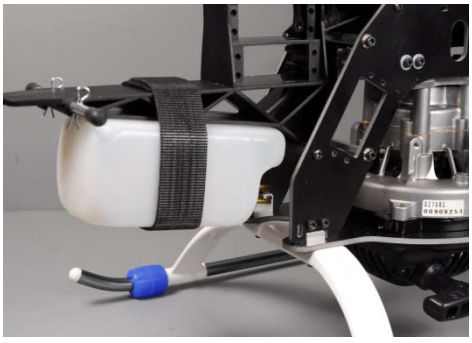
Select the tail boom assembly from the donor model and install it into the frame as shown using the original bolts. Fully tighten using blue thread lock

Note that the boom supports use one of the frame supports that was previously installed temporarily

Not all versions of the Raptor use a rear t/r servo mount as is shown here

5.F) Fuel Tank Installation

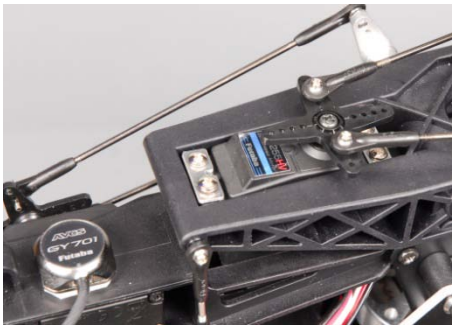




Select the previously assembled fuel tank. It can be installed on the top or bottom of the battery tray as shown above and still clear the canopy. Use two sided tape or adhesive backed Velcro to attach the tank and then use a Velcro strip to secure the tank in place. Fuel line plumbing will be addressed in a later step.

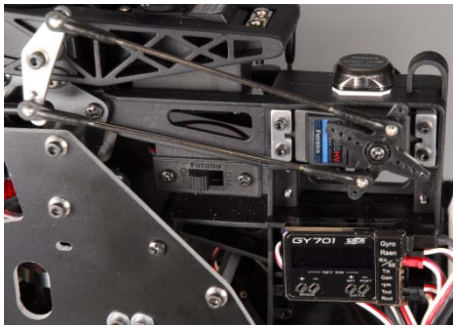
5.G) Electronics Installation

Aileron Servo



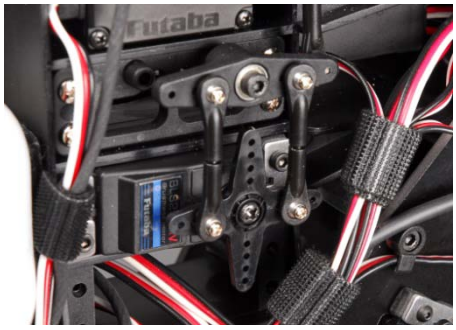
Mount the aileron servo using the original mount method. Shown is a typical gyro sensor installed

Elevator Servo



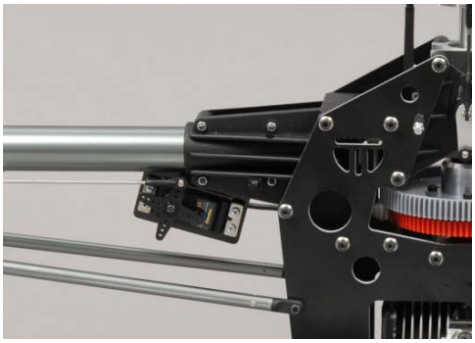
Mount the elevator servo using the original mount method. Also shown is the electronics switch position and the gyro control system mounted

Collective Servo

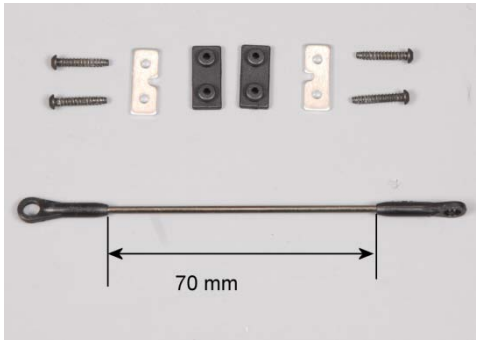


Mount the collective servo using the original mount method. Not all versions of the Raptor 90 use the push-pull collective setup as shown

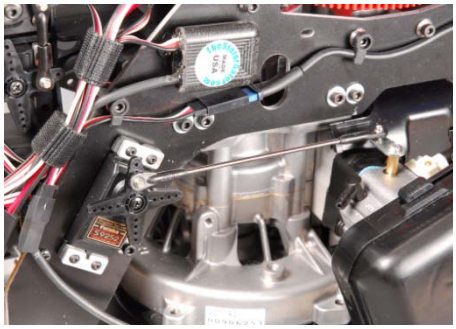
T/R Servo



Mount the t/r servo using the original mount method. Depending on which Raptor model you have this may mount in the front radio tray

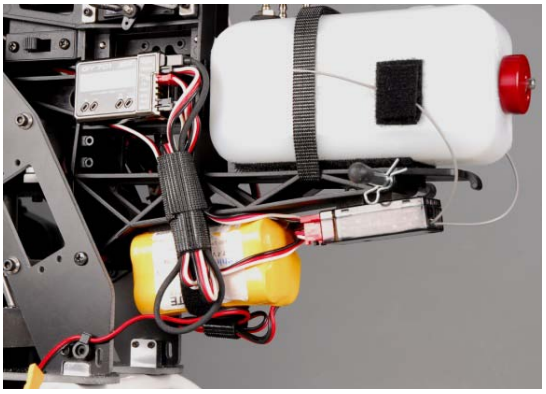


Throttle Servo



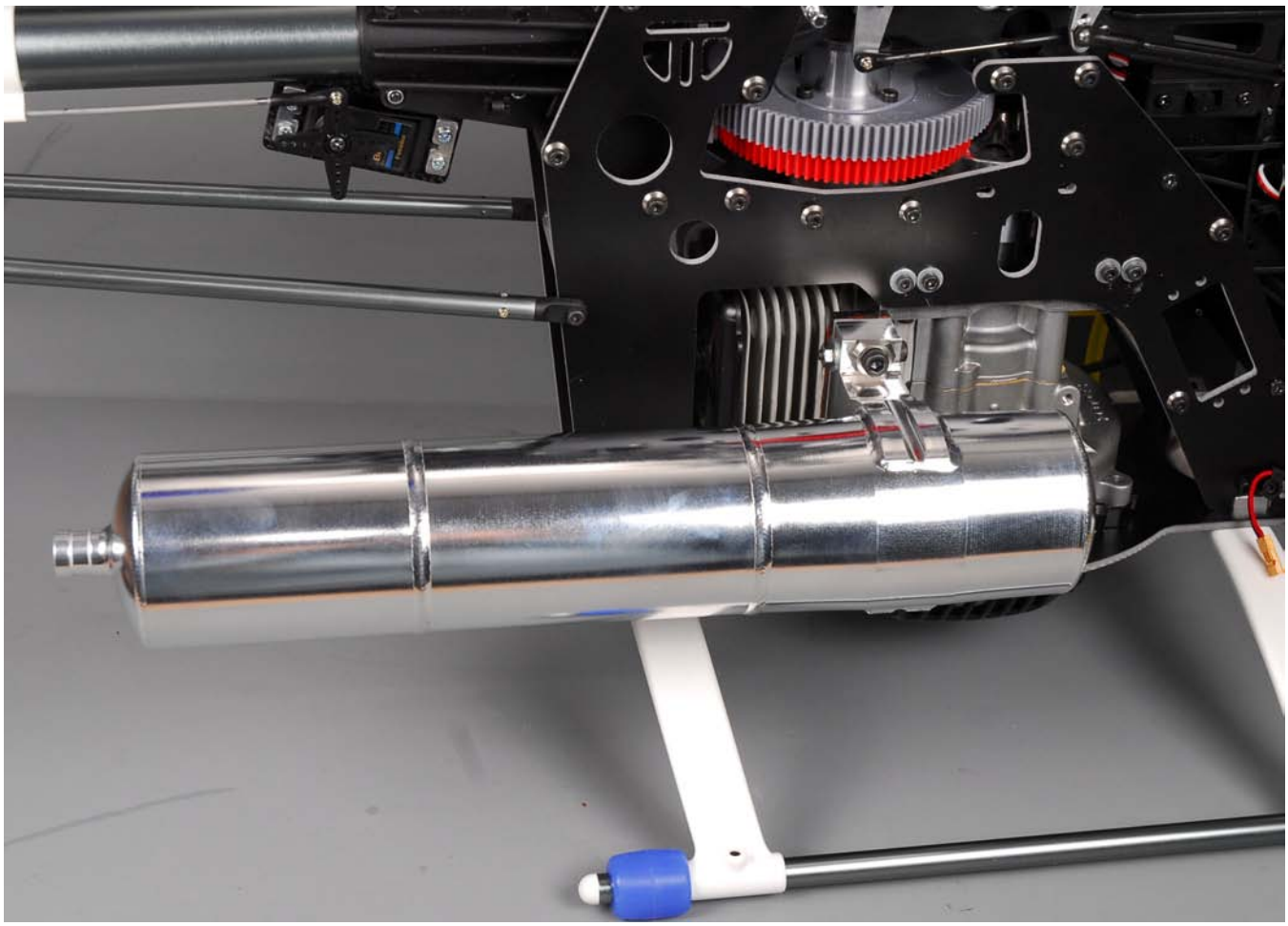
The throttle servo installation will be different from the original model. You will need the parts shown to mount the servo.

The rod length shown is approximate and may vary depending on what servo you have. See the throttle setup section later in this document for more details regarding the setup



Install the airborne batter and receiver. The example shown assumes that the tank is mounted on the top of the battery tray. If you have mounted your tank on the bottom of this tray then these parts would install on the top of the battery shelf.

5.H) Muffler Installation



Mount the muffler using the stock zenoah exhaust gasket.

If you are using the stock zenoah muffler, it will mount directly to the cylinder. Retighten it after running the motor while it it is still hot

Some mufflers as the Hatori shown use a separate header plate. Use the std exhaust gasket to mount the header and then use high temperature silicone RTV to attach the muffler to the header. Retighten all of the accessible bolts while the engine is hot

5.I) Canopy Installation

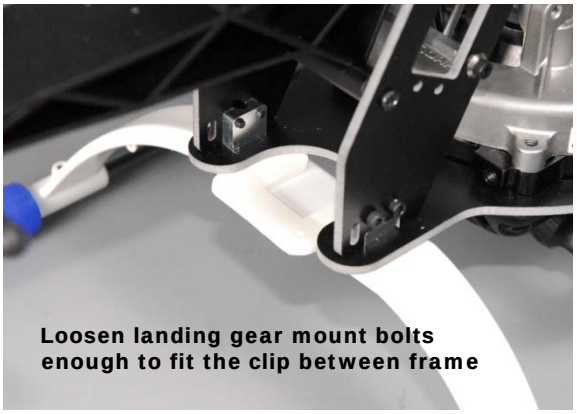
The original canopy will be used on the conversion however some minor modifications need to be made. They are not difficult or extensive to apply. Here's what needs to be done:

Stock Canopy Mount

This is the canopy clip at the bottom of the canopy. Because the frames are now different, this clip needs to be modified to fit

To mark the modifications on the clip, its going to be installed on the front landing gear strut as normal

Front Landing Gear Strut



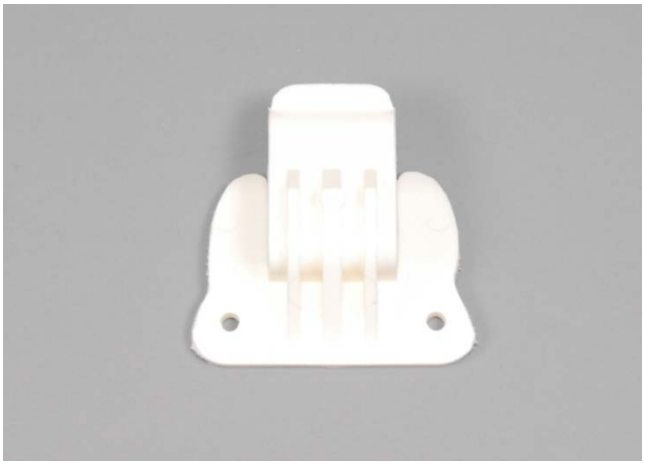
Loosen landing gear mount bolts enough to fit the clip between frame

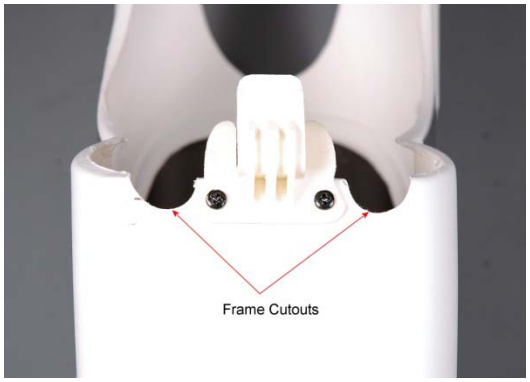
Loosen the front landing gear bolts enough that you can fit the clip underneath the frame bottom plate and clip it on the landing gear as shown

Then using a marker of some sort, mark an outline of the lower frame plate opening on the clip itself as shown

The marked clip should look like this. Take a grinding tool and grind off the edges of the clip down to the marking

When you're done it will look like this. Go ahead and mount it back on the canopy in its normal position and orientation. It will now clear the frame. However there is still a minor change necessary to the canopy before it can be installed

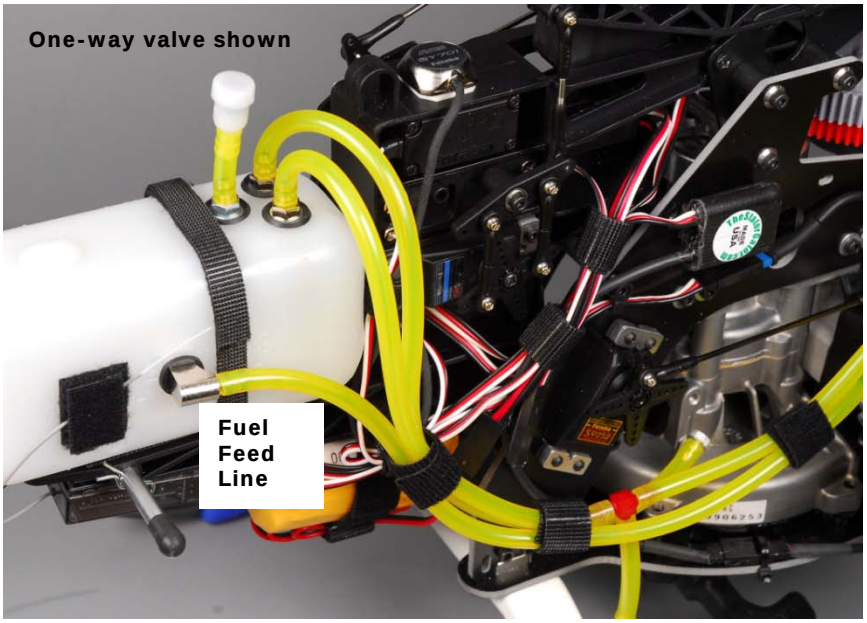




With a grinding tool make two small reliefs in the canopy on each side of the mount clip. This is for frame clearance. The exact size and shape isn't critical, it just needs to have clearance.

Now you can mount the canopy as it normally mounts. Check to make sure the clip and canopy isn't rubbing on any of the frame parts.

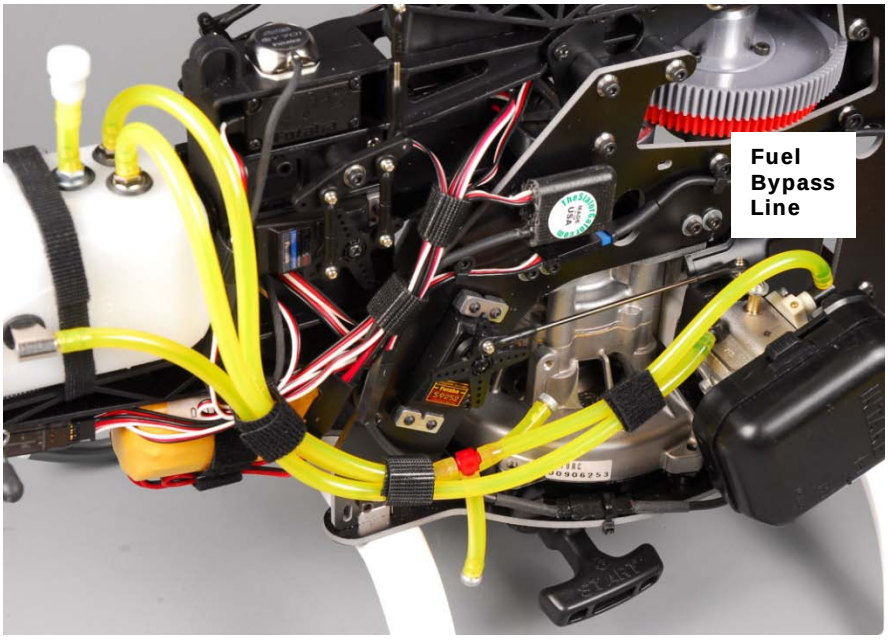
5.J) Fuel System Plumbing



This is only slightly different from normal glow plumbing

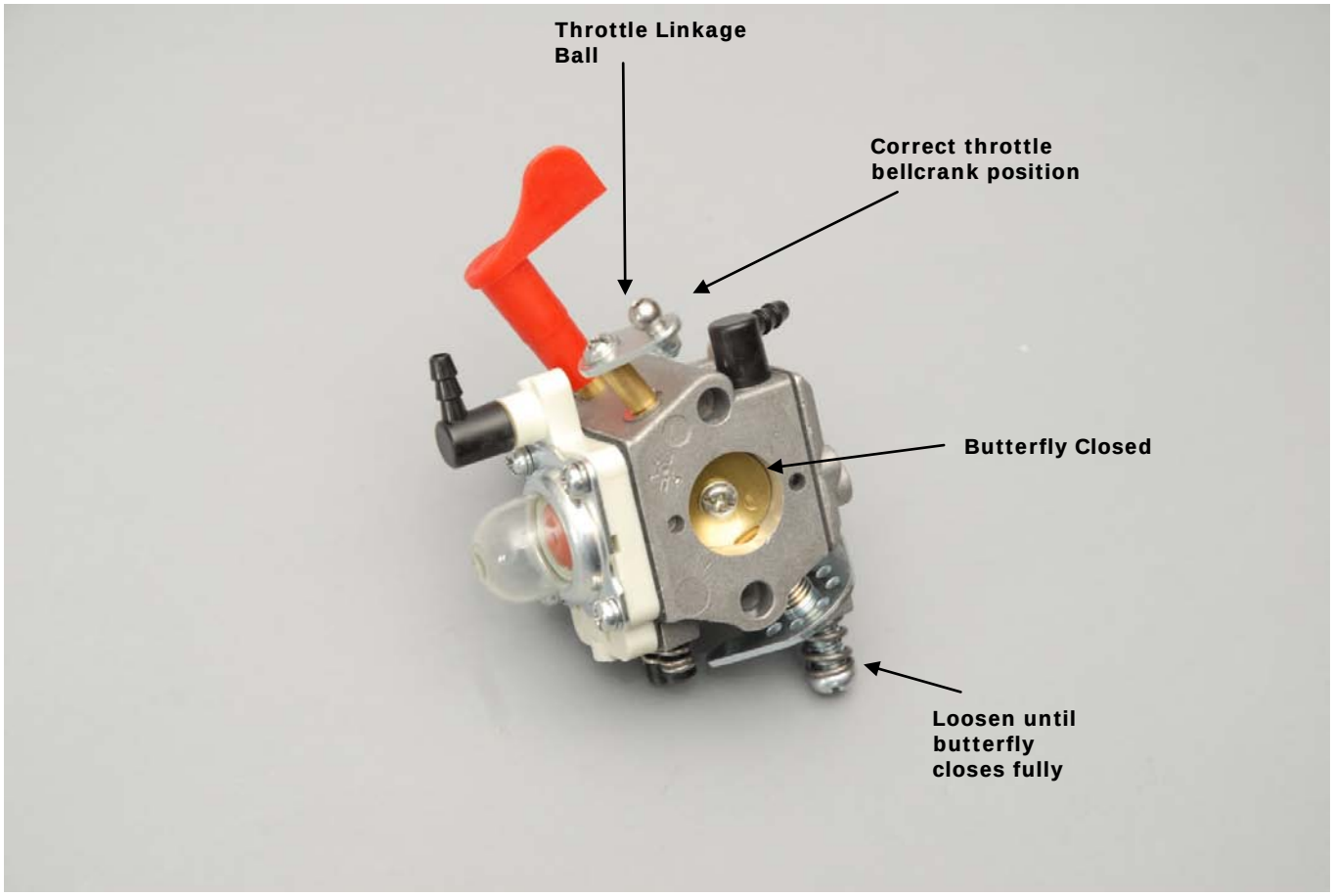
The plumbing will be the same whether you use the stock tank provided or the optional setup I recommend

1. A fuel feed line is needed from the tanks fuel clunk to the inlet side of the carburetor
2. A fuel return line is needed from the carburetors primer outlet back to the fuel tank



3. Because these motors use a fuel pump, a vent is needed on the tank to prevent it from pulling a vacuum, which will cause the motor to go lean. This is typically done two ways,
   - *either by connecting a piece of fuel line to an additional fitting on the tank and then tightly looping the line into consecutive circles and binding them together. This acts as a fuel trap and lets air enter but makes it harder for fuel to escape.*
   - *Or by installing a "one way valve" as shown*
4. You will still need a way to get fuel into the tank. You can either remove the fuel feed line from the carburetor and put fuel in/remove fuel through that line or you can use a T fitting in either the feed or overflow line to move fuel. Note - if you use the one way valve vent, you'll need an additional vent because it allows air INTO the tank not out as would be needed when filling the tank.

5.K) Throttle Setup



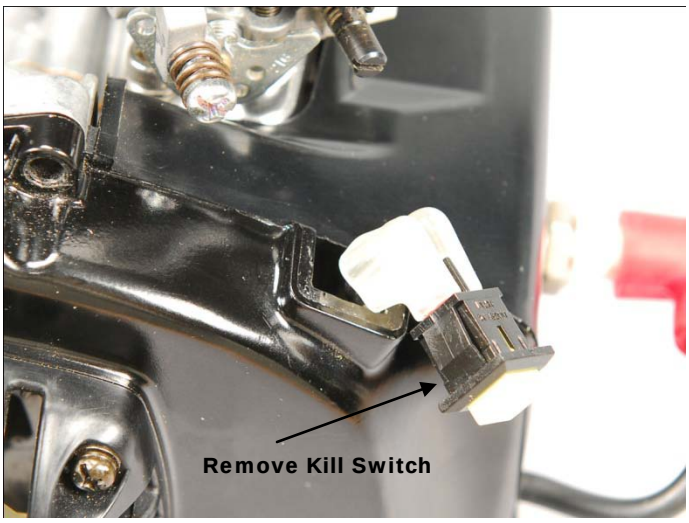
1. Throttle setup is considerably different for this gasoline powered motor than for a glow motor. The amount of throttle opening typically required is less.
2. The bell crank size on the carburetor is predefined
3. Make sure the linkage ball on the throttle servo is at approx 13mm from the arm center
4. For this model the length of the throttle control arm will be approximately 70mm from the bottom of each ball link
5. Also make sure it's moving in the correct direction for opening/closing the throttle. If necessary remove the air cleaner cover and visibly inspect this. Having the throttle linkage reversed can be dangerous.
6. Adjust the "idle screw" on the carburetor so that the throttle butterfly can completely close
7. At full low throttle, low trim (or throttle cut) the butterfly should be completely closed
8. And at full throttle the butterfly will be fully open
9. A good starting place for a throttle curve will be: 10%,20%,30%, 75%, 100%
   These settings may need to be field adjusted based on gear ratio, blades, flying style, etc.
10. If you are using a governor, make sure you change the gear ratio to match this model.

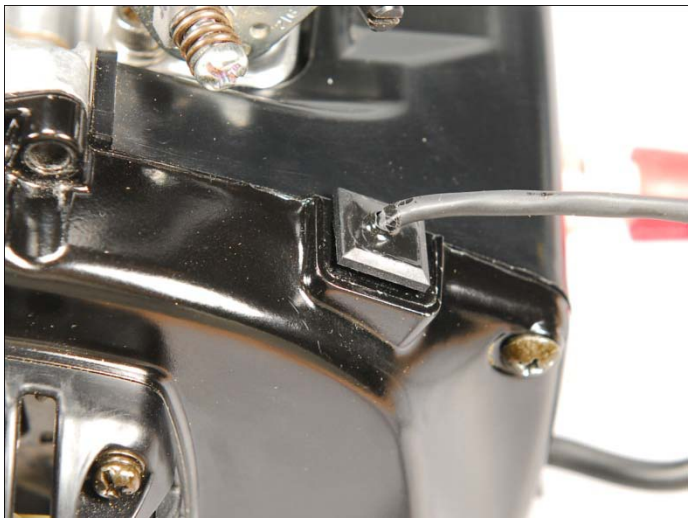
5.L) Pitch Setup

Initially use the manual recommended pitch settings. You will find that you will need to either reduce the max pitch settings or adjust your flying style to not use them for extended periods of time as they tend to bog the motor more which will cause it to overheat.

VI. Optional Parts

6.A) Stator Gator Governor Sensor

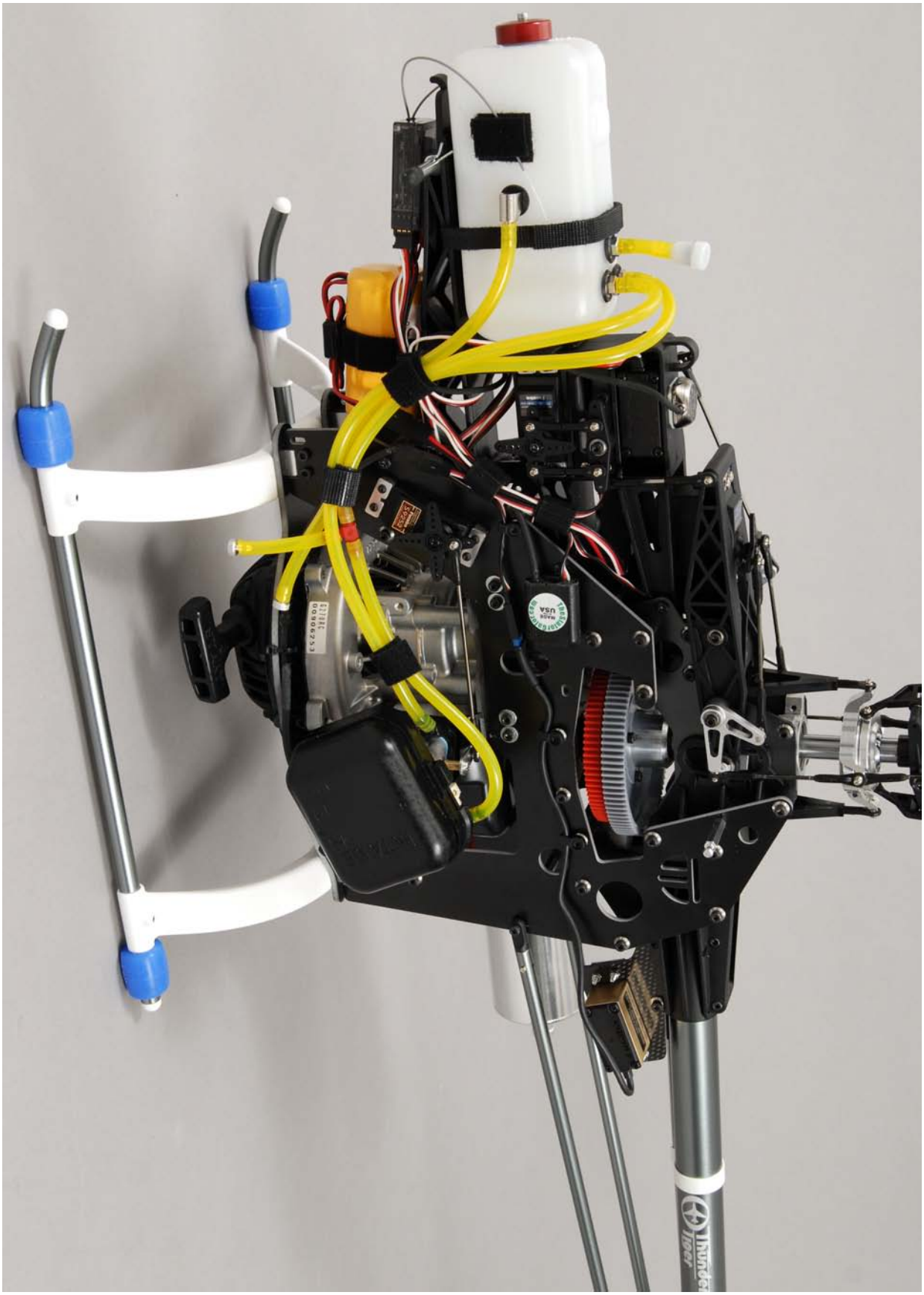


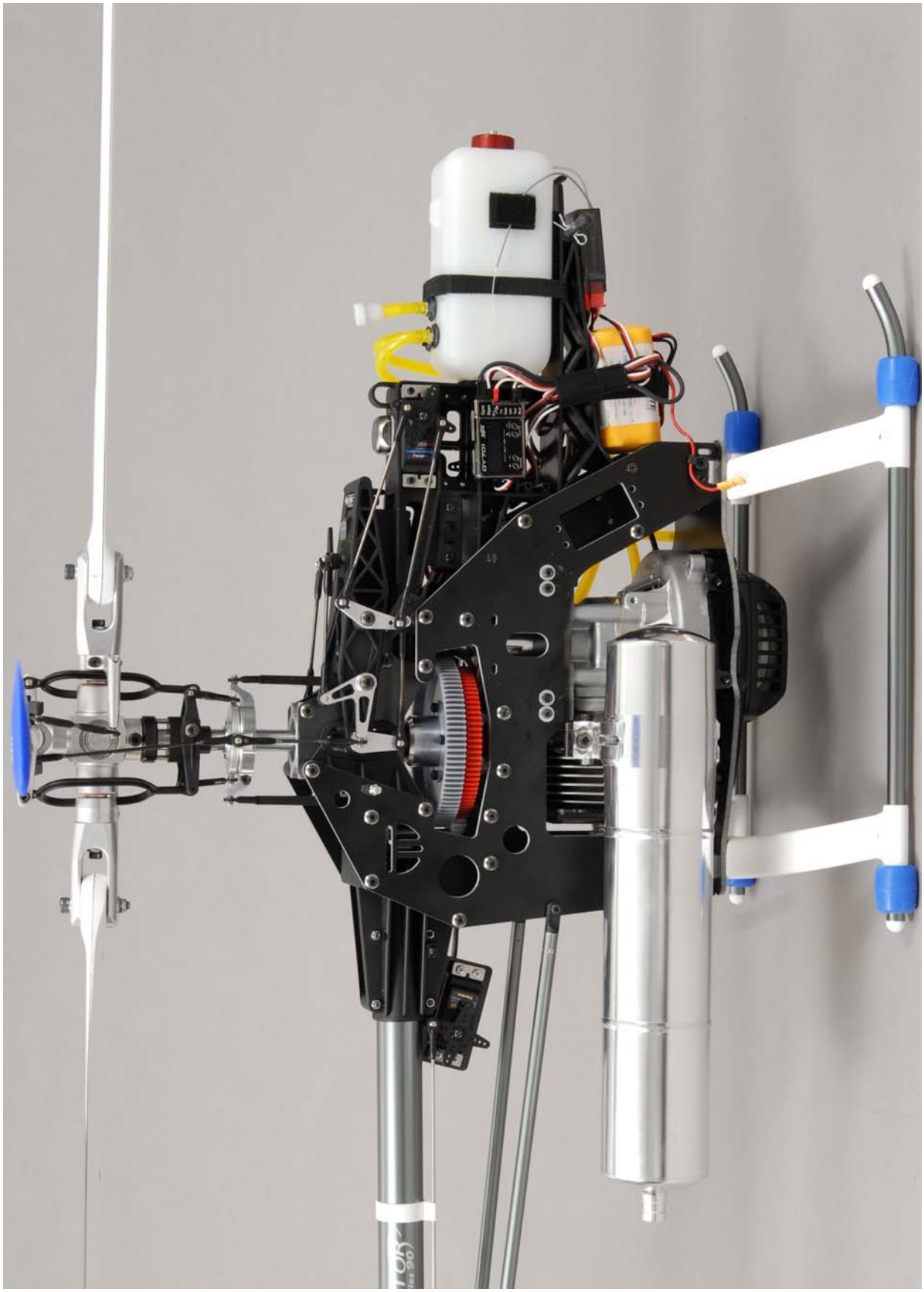


You may want to use an optional engine speed governor. If so you will need to adapt a sensor mount to detect engine speed.

One option is to use the Stator Gator sensor which replaces the kill switch button on the RC motor. To install the stator gator, simply remove the switch and plug the sensor in its place as shown.

This device is compatible with many different governors, for a list look for a topic on the Stator Gator on http://www.gaspoweredthoughts.com.





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Thunderbird Conversion
Thunder Tiger Raptor 90