

Introduction

Congratulations! You have just purchased a Contra-Rotating Propeller Drive System, which has been specially designed for use in f3a pattern competition.

Contra-Rotating Drive systems for full scale airplanes have been known since World War II, but since then, despite their many advantages, they have only seen occasional use in certain military applications. This has been for two reasons.

1. When Contra-Rotating Propeller Technology was being developed the jet engine was also being introduced, and while Contra-Rotating Propeller Systems had efficiency advantages over jet engines, jet engines held out the promise of more performance, and airplanes that could fly higher and faster than the speed of sound.
2. In the commercial airline industry the ability to fly jets at great heights, and with less cabin noise, also won out over the efficiency benefits of Contra-Rotating Systems.

Benefits

However, for pattern flying the advantages that a Contra-Rotating System offers are considerable:

1. Contra-Rotating Propellers eliminate the gyroscopic effects that exist when flying with a single propeller. Gyroscopic effects cause an airplane to yaw whenever the elevator is applied. The more elevator that is applied, the greater this yawing effect. Contra-Rotating systems eliminate this, so there is no yawing of the airplane whenever the elevator is applied, and consequently, no radio mixing is required to remove it.
2. Contra-Rotating Propellers significantly reduce the maximum torque that goes into the fuselage of the airplane. With a single propeller system the torque that goes into turning the propeller also reacts out against the motor mounts and the fuselage of the airplane, so if the motor is generating 5 N.m of torque to turn the propeller, the motor is also trying to rotate the fuselage with this same 5 N.m of torque. Whereas, with a Contra Rotating System the torque is divided by the gear ratio of the gearbox, so if the Drive is using a gearbox with a 10:1 gear ratio, then the torque into the fuselage is only 0.5 N.m. This means that an airplane with a Contra-Rotating Propeller System won't change aileron trim on the downlines, or when entering a spin, or when coming in for a landing. With a single propeller system all of these situations will require different amounts of trim, which all need to be mixed in. However, with a Contra-Rotating Propeller System the trim never changes, so no mixing is needed.
3. Contra-Rotating Propeller Systems eliminate the P-Factor effects that tend to yaw an airplane when the thrust line doesn't coincide with the flight path of the airplane. This effect reverses when the airplane is flying inverted, so while right thrust in the motor can compensate somewhat when the airplane is flying right side up, rudder to throttle mixing is needed to compensate when the airplane is flying inverted. With a Contra-Rotating System no right thrust in the motor is required, and consequently no mixing is needed.
4. Contra-Rotating Propeller Drive Systems have two propellers that provide more than twice the braking power that a single propeller system provides so ESC motor braking isn't needed. Also, since Contra-Rotating Drive Systems have propellers that spin in opposite directions, each propeller generates an equal, but opposite braking torque, which eliminates the aileron trim effect that is seen on downlines when ESC motor braking is used with single propeller setups.
5. Contra-Rotating Propeller systems are 15% to 20% more energy efficient than equivalent single propeller systems. This is because the air passing through the blades of the propellers is accelerated twice in order to generate thrust, instead of a single time as it is with single propeller systems. This means that each of

the two propellers in a Contra-Rotating System is doing half the work that the propeller in a single propeller system needs to do so they can do their work with fewer viscous losses, and fewer losses due to radial air flow along the length of the propeller blades.

6. The air that goes through the first propeller in a Contra Rotating System acquires a rotational twist, which is then cancelled out by the reverse rotation of the second prop. This has two benefits. The rotational energy in the air is recovered as useful thrust, which increases propeller efficiency, and the air exiting the rear propeller flows straight back over the fuselage without rolling and yawing the airplane as it blows against the wings, the stab, and the rudder. This effect is most pronounced when the plane is flying slowly, such as during takeoff, or at the end of long verticals. A Contra Rotating system compensates for these effects so takeoffs are straight and true, and the airplane tracks straight when flying slowly after long vertical uplines.

Specifications

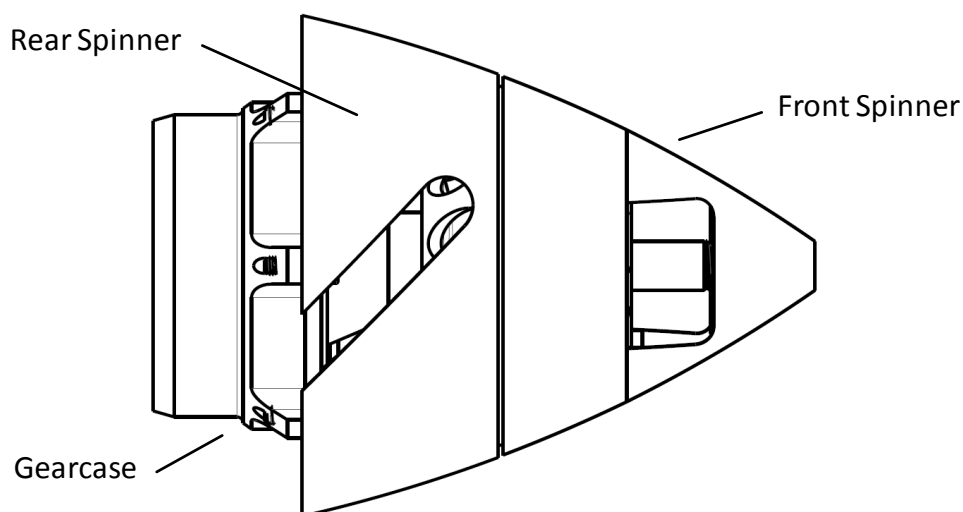
1. Drive Mass, excluding Propellers and Mounting Plates, but including Adapter Manifold – 295g
2. Propeller Mass – 50g each +/- 5g
3. Spinner Diameter – 82mm
4. Spinner Length – 85mm
5. Propeller Diameter – 22" (558.8 mm)
6. Maximum Wattage – 3500W
7. Propeller Balance – within 0.05g at tip in two perpendicular directions

Main System Components

Your Contra Rotating Propeller System has the following main system components:

The Contra Rotating Drive Unit

This is the part of your system that contains the planetary gearbox, the spinners, and attachments for mounting the propellers. In order to attach this Drive to your motor you will need to disassemble the Drive Unit, and bolt the rear Gearcase Housing onto an Adapter Manifold that is attached to the motor.



Contra Rotating Drive Unit

The Propellers

Each propeller is fabricated with carbon fiber and epoxy, which makes them very light, and very stiff. Propeller weight and stiffness are important in a Contra-Rotating Propeller Drive System because it's necessary for each propeller to maintain proper distance from the other. Also, there are turbulent forces that buffet each prop as the front and rear blades pass each other. This is because this happens four times per revolution, and consequently turbulent forces impact the propeller blades at four times the frequency of the spinning propellers. So, in order to avoid critical resonances, the resonant frequencies of the propeller blades must be four times that of an equivalent single prop. Fortunately however, the propeller rpm in a Contra-Rotating System is less than that of an equivalent single prop system, but this still doesn't fully compensate for this effect.

The propellers come as a set that includes both front and rear props. The rear prop is pitched to rotate in a clockwise direction, whereas the front prop is pitched to rotate in the opposite counterclockwise direction. Also, each propeller is designed so that it can only fit on the front or the rear, whichever is appropriate for each propeller. This means that it is not possible to incorrectly assemble either prop.

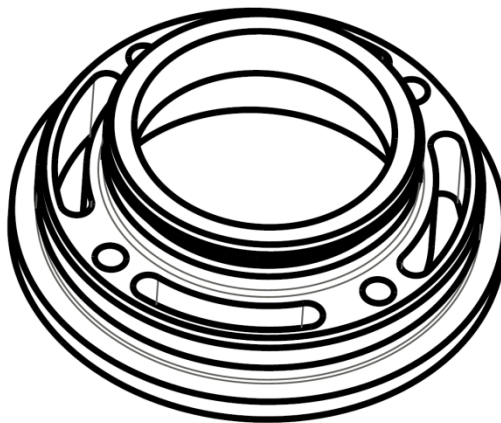
Each propeller is factory balanced to within 0.05g equivalent mass at the tip of the propeller, both along the length of the blade, and across the hub.

The Motor

Your Contra Rotating Propeller Drive System does not come with a motor. This must be provided by you. The System is compatible with either the Hacker C50 Competition Motors, or the Neu f3a Motors. Each motor is fitted to the Drive with an Adapter Manifold that is specific to each motor.

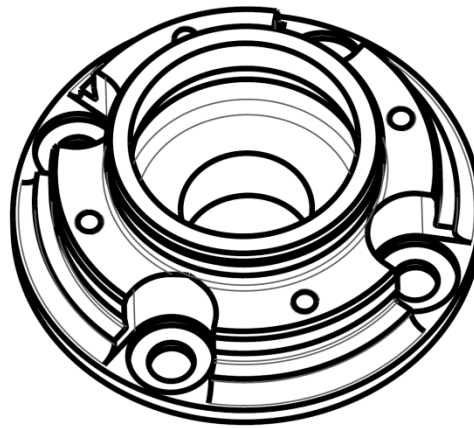
The Motor Adapter Manifold

There are two Motor Adapter Manifolds available. One for Hacker C50 Competition Motors, and one for Neu f3a Motors.



Hacker C50

In the case of Hacker C50 Motors, the Adapter Manifold is used as a spacer to maintain the correct axial distance between the motor and the Drive Unit. The Motor Mounting Screws pass through the Adapter Manifold and attach directly to the motor.



Neu f3a

The Neu f3a Motors the Adapter Manifold is attached to the motor first with four 4mm cap screws and the Contra Drive Unit is then bolted to the Manifold with 4 M2.5x10 cap screws.

In both cases the Adapter Manifold aligns to a cylindrical datum on the motor, and with a cylindrical datum on the Drive Unit. The alignment between the Adapter Manifold and the Drive Unit is maintained with an O-Ring that is compressed between both assemblies. This ensures that the Pinion Gear on the Drive Unit is properly aligned with the pinion gear on the motor. This is important to prevent binding during operation.

The Neu f3a Adapter Manifold is designed to work with both the old and newer versions of the Neu f3a motor. A small adapter ring is included that can be used to make the Adapter Manifold work with the newer Nue motors.

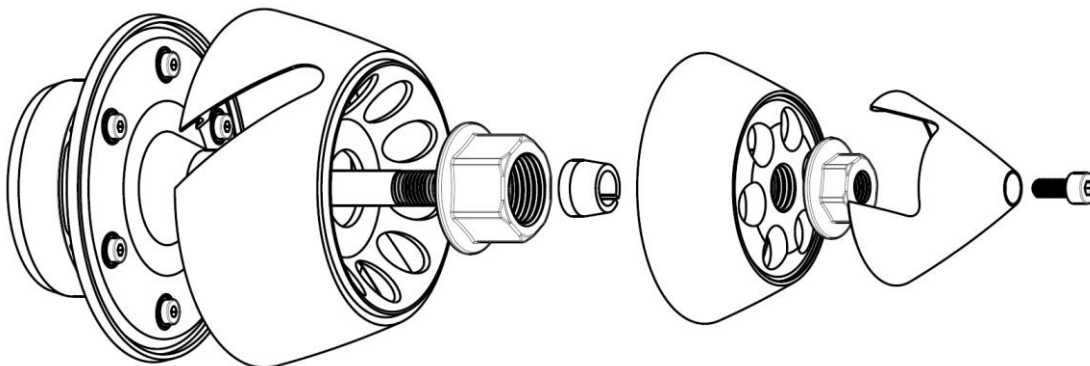
The Electronic Speed Control

Your Contra Rotating Propeller Drive System does not come with an Electronic Speed Control. This must be provided by you. Many Speed Controls will work, but it is recommended that the Control that is used be rated for at least 90 Amps.

Installation

Assembling and installing your Contra-Rotating Propeller Drive is not difficult, but it does require you to disassemble the Drive Unit in order to do so.

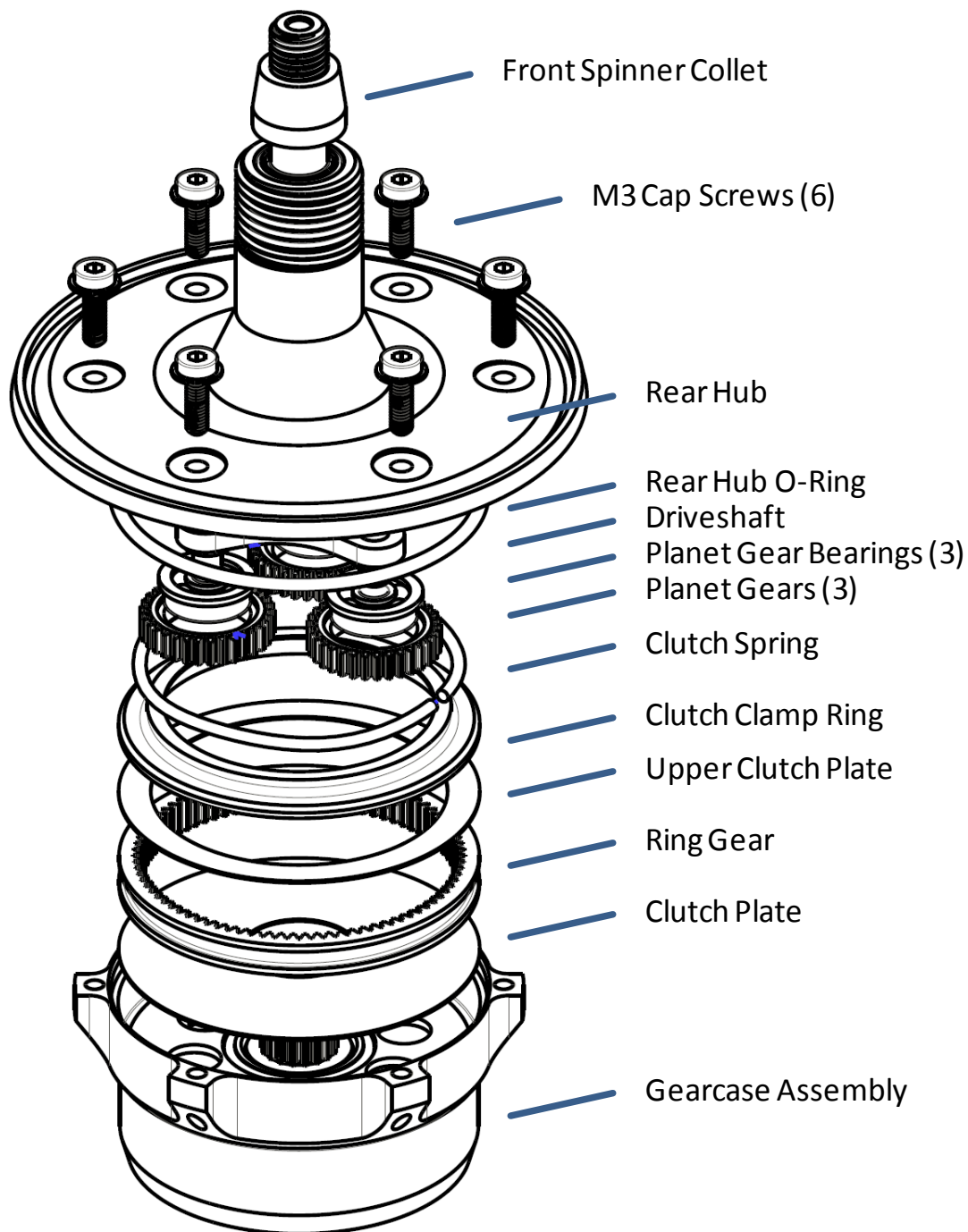
The first step is to remove the front and rear Spinner assemblies as follows:



Spinner Removal

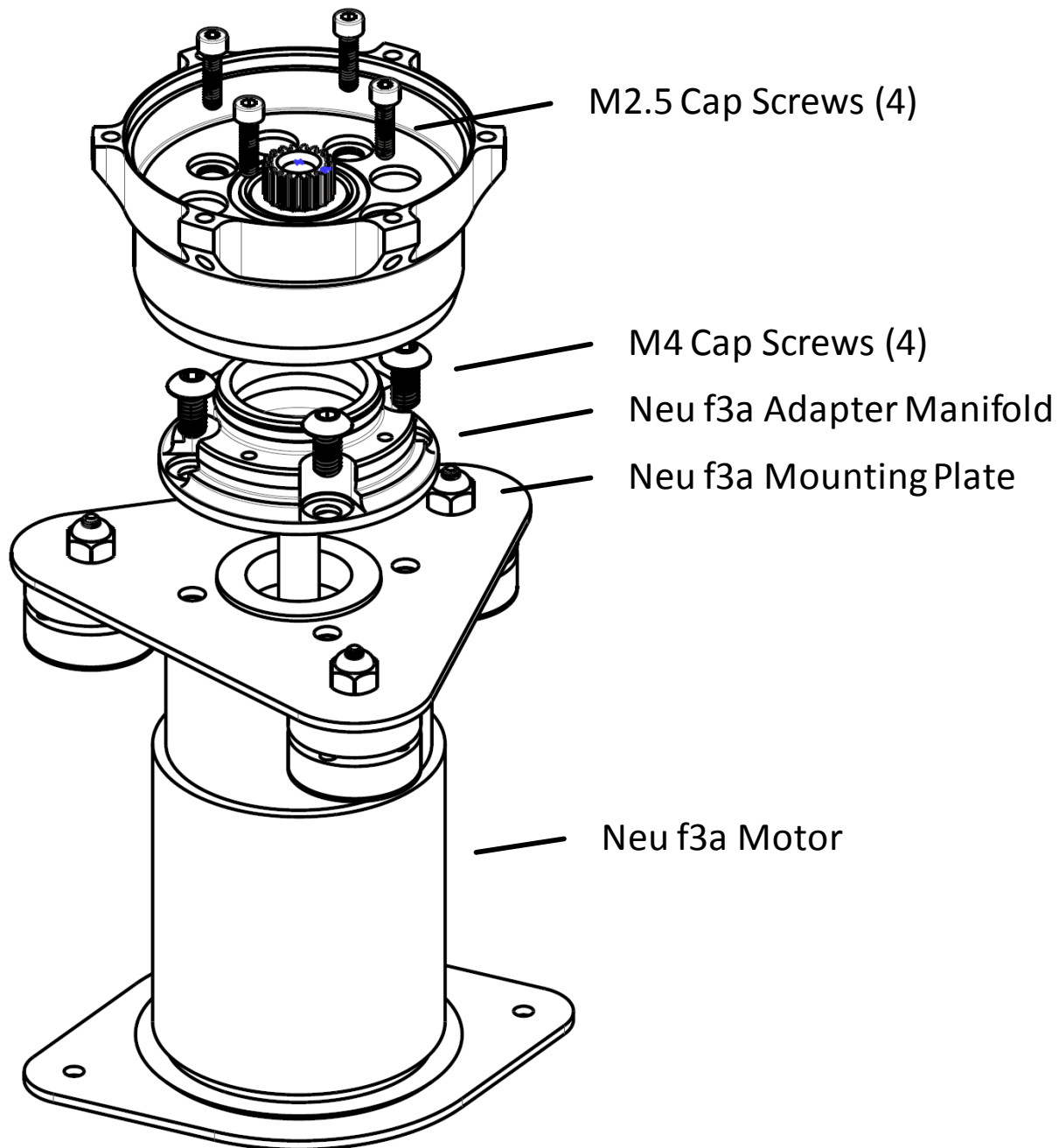
One important thing to note is that the nut holding the rear propeller has a left-hand thread, so it will be necessary to turn it in the opposite direction when removing it. Once the Spinners have been disassembled, the next step is to remove the six M3 socket head cap screws on the face of the Rear Hub.

Now it will be possible to pull the Rear Hub away from the Gearcase Housing and disassemble the Drive as follows:



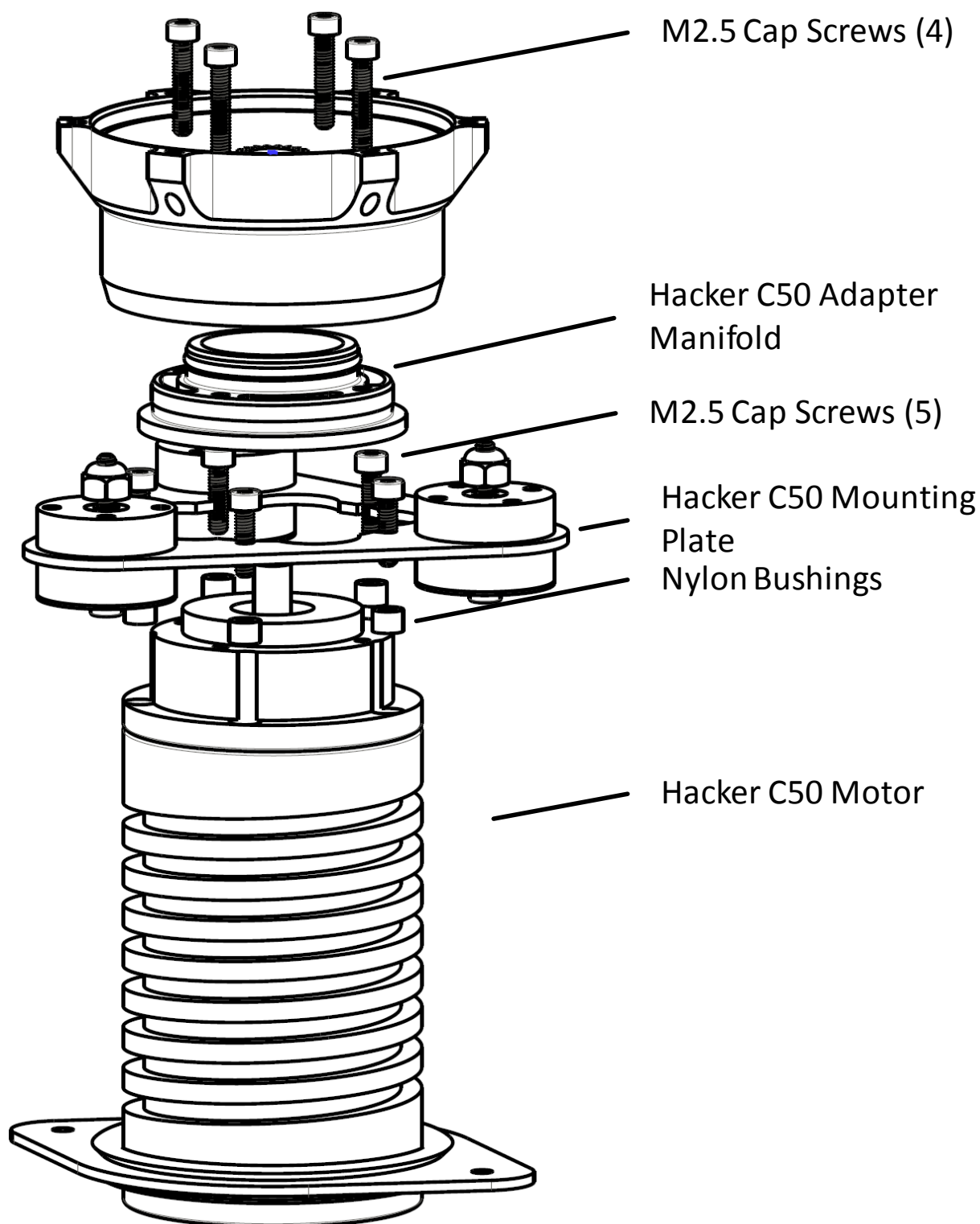
Contra Drive Unit Disassembly

At this point all of the components except the Gearcase Housing Assembly can be carefully put aside, (preferably on top of a clean rag ...) and the Gearcase Housing can be assembled to the motor using the Motor Adapter Manifold that is appropriate for whichever motor is being used. In the case of the Neu f3a motor the assembly is as follows:



Neu f3a Motor Gearcase Housing Assembly

In the case of the Hacker C50 Competition Motor, the assembly is as follows:



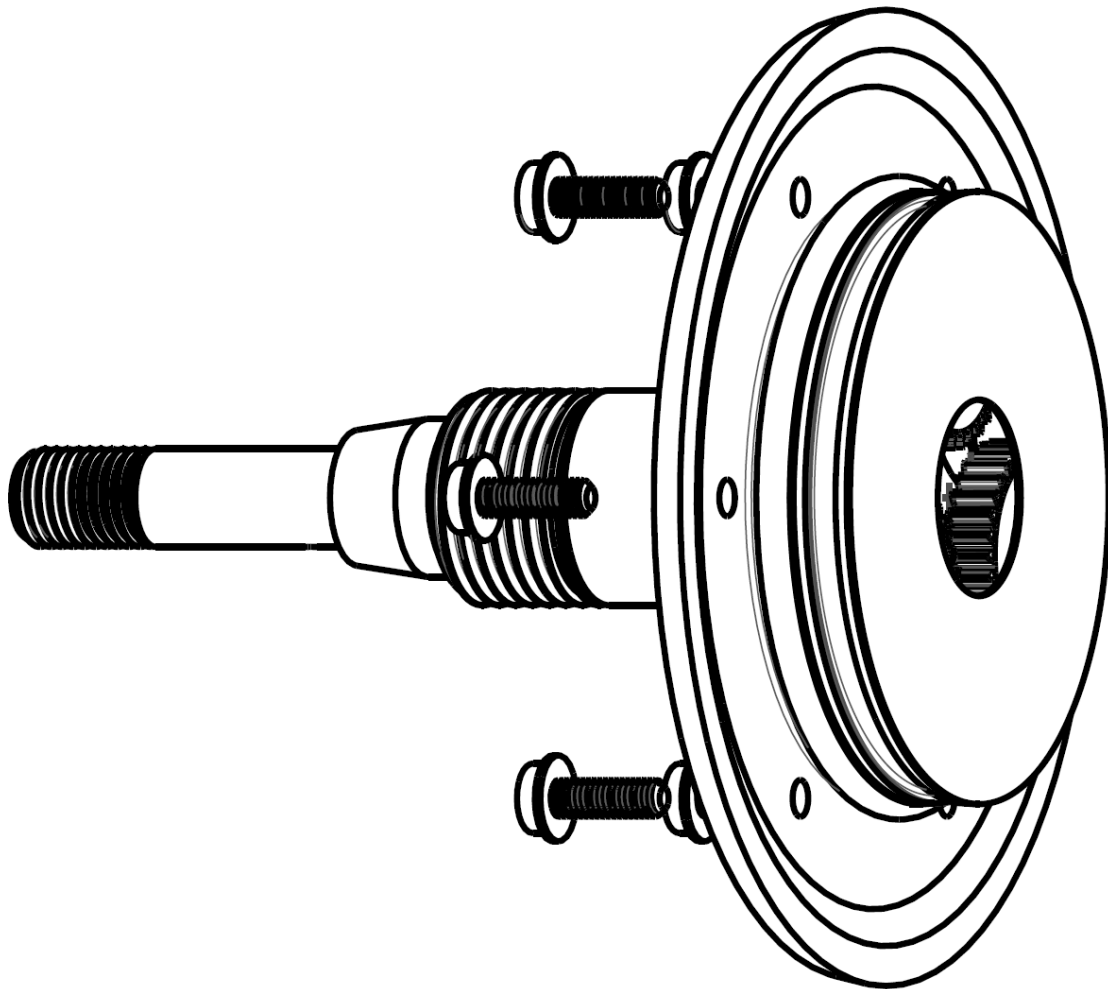
Hacker C50 Motor Gearcase Housing Assembly

The Nylon Bushings are used to fill the counter bore holes in the Hacker C50 Motor Front Cap. They are pressed flush with the top surface of the Front Motor Housing and then the remaining assembly can take place.

The five M2.5 Cap Screws are used to attach the Mounting Plate to the Hacker C50 Motor Front Cap, and then the Adapter Manifold is sandwiched between the back of the Contra Drive Unit, and the front of the motor. 4 M2.5x12 cap screws are then used to screw the whole assembly together.

Note that the Mounting Plate can be attached to the motor first, and the motor assembly can be installed in the plane before the Gearcase Housing is assembled. This makes it easier to assemble the entire unit through the nose of the plane.

After the Gearcase Housing is assembled to the motor, the Contra Drive Unit can be reassembled. Make sure to re-grease the gears and internal components using the supplied syringe of grease. The recommended method for reassembling the Contra Drive Unit is to pre-assemble all of the components onto the Rear Hub. Refer to previous exploded views of the Contra Drive Unit to make sure that all parts are included. The Rear Hub Pre-Assembly should look like as follows:



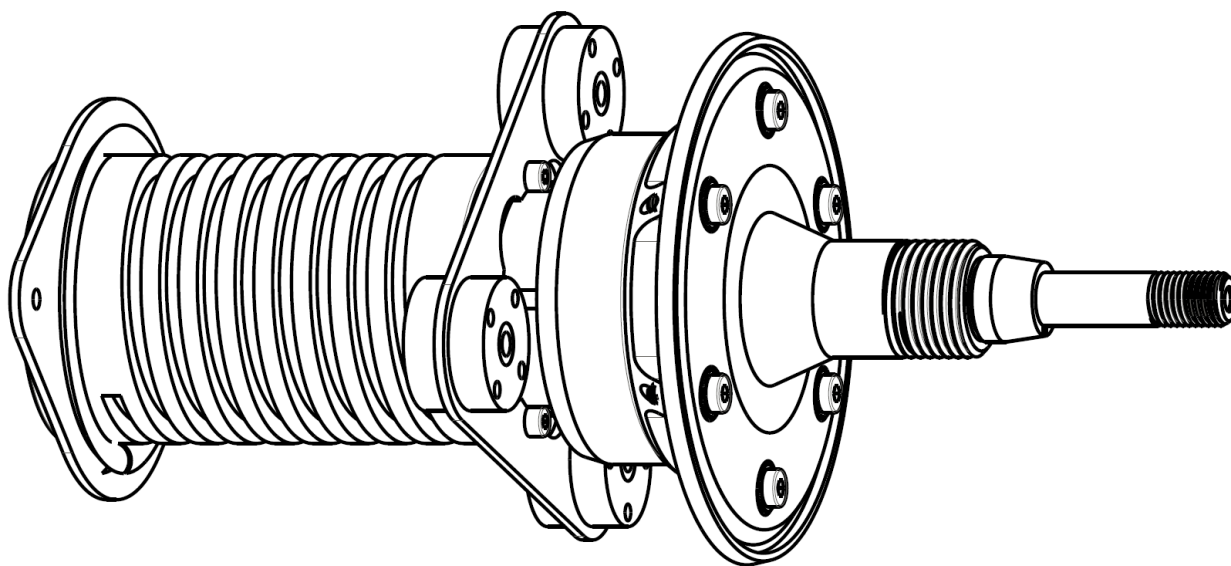
Rear Hub Assembly

It's important that all parts are properly aligned. Make sure that the Planet Gears are oriented with the recess towards the Driveshaft so that the flat bottom of the Gears faces towards the Gearcase Housing. The parts can be held in place temporarily with grease.

As the Rear Hub Assembly is mated with the Gearcase Housing, care must be taken to ensure that the Pinion Gear in the Gearcase Housing meshes properly with the Planet Gears in the Rear Housing Assembly. At all times the Gears should rotate freely, and if at any time they don't, then the Rear Hub Assembly must be checked to make sure that all of the components are properly pre-assembled.

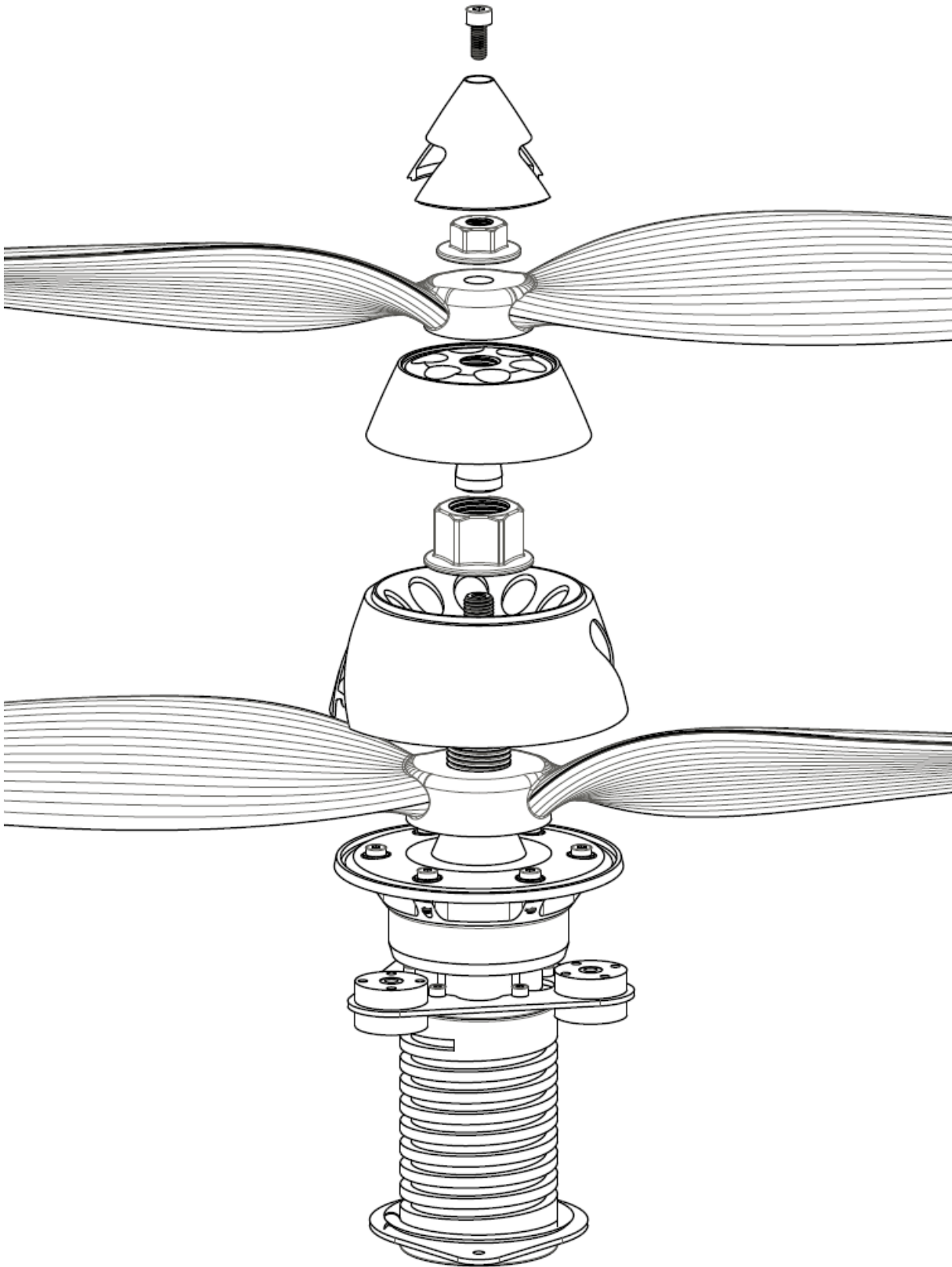
Once the Rear Hub Assembly is properly meshed with the Gearcase Housing, the 6 M3x10 socket head cap screws can be carefully tightened down. However, it's important to remember that as these screws are tightened the Wire Spring inside the Gearcase Housing is slowly compressing the Clutch Plates and the Ring Gear, so it's important to tighten the screws evenly, and all at the same time. Also, as the screws begin to compress the Wire Spring, it's necessary to rotate the Driveshaft a few times to align the Ring Gear concentrically with the Pinion Gear before the Wire Spring locks it into position.

The Driveshaft should rotate freely. If it turns roughly, or exhibits roughness, disassemble the Drive Unit and reassemble it. The finished assembly should look like this:



Contra Drive Unit & Motor Assembly

At this point the Spinners and Propellers can be installed. The Propellers and Spinners assemble as follows:



Assembling Props & Spinners

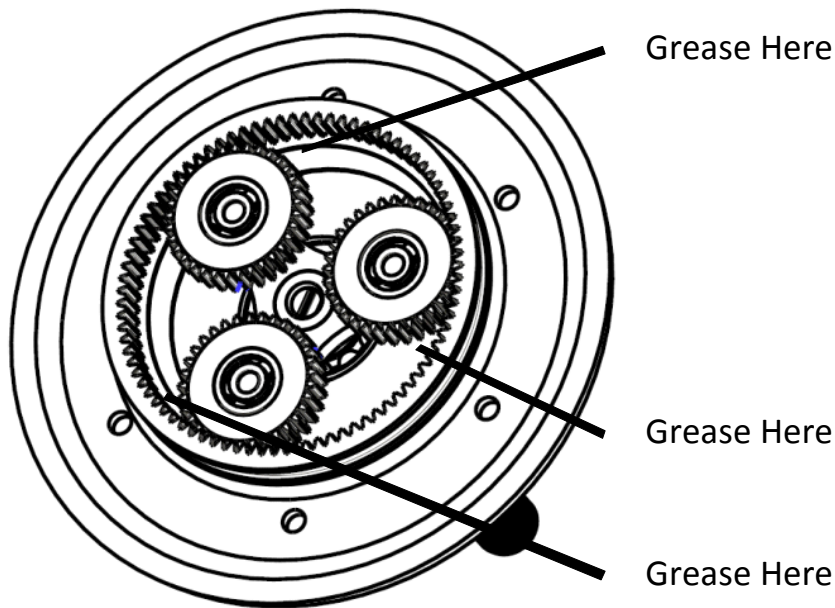
When assembling the Propellers and Spinners, it is recommended that the following guidelines be followed:

1. It's important to remember that the nut for the rear propeller has a left-hand thread, so you need to reverse the direction when you tighten or loosen it.
2. The nut for the rear propeller requires a 22m spanner, and it is recommended that a closed end box spanner wrench be used to avoid scratching the anodized coating on the aluminum Spinners.
3. When tightening the propeller nuts, do not hold the propellers near the tips, because the tips are fragile, and can potentially crack and break when you apply wrench torque.
4. Both Propeller Nuts can be torqued in the same way that propeller nuts on single propeller systems are torqued. However, to guard against over torquing, the maximum torque that should be applied is 30 N.m.
5. Care must be taken to avoid over torquing the M4 bolt that holds the Front Spinner on. This is because overtightening this bolt will elastically deform and ovalize the Front Spinner and the Front Hub. In order to prevent this from happening the M4 Spinner Bolt has a locking patch that creates a frictional thread locking torque when it's threaded into the end of the Driveshaft. This means that the M4 Spinner Bolt can be tightened just enough to seat the Front Spinner without elastically deforming the assembly, and without the Front Spinner coming loose and falling off during flight.
6. Do not use Loctite on the Propeller Nuts. Doing so will make it impossible to remove the nuts after the propellers start to slip.

Maintenance

It is recommended that the gearbox be disassembled and re-greased every 50 flights, or after 8 hours of runtime, whichever comes first. The recommended grease is Rheolube 374A from Nye Lubricants Inc. This is a Military Specification synthetic grease that is suitable for high speed bearings and high speed gears. This grease will not fling off due to centrifugal force when the gearbox is spinning.

Grease should be applied to the following locations:



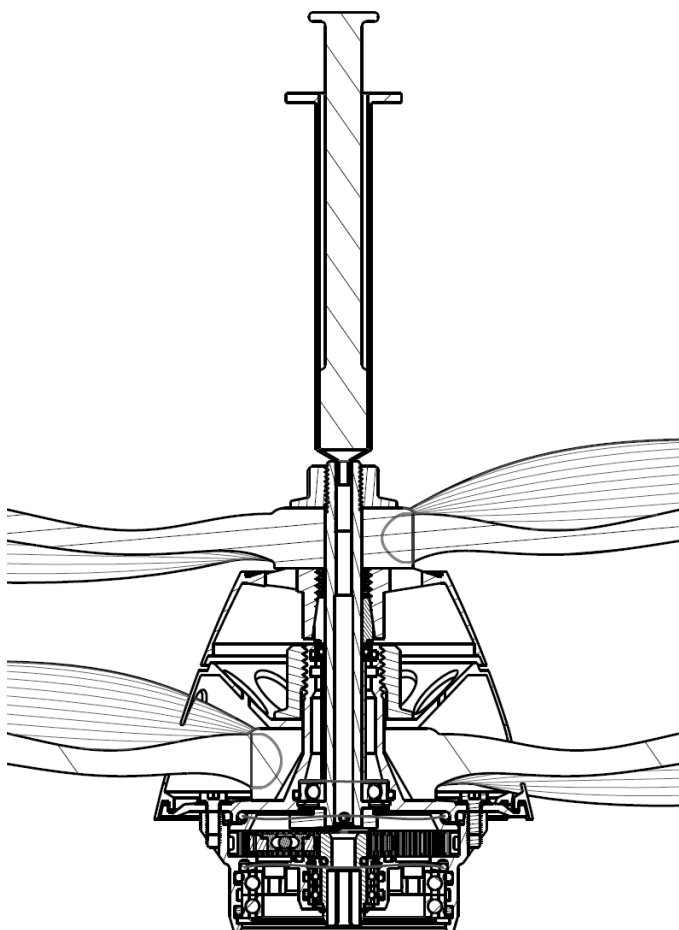
Grease Locations

Each location should have a quantity of grease that's large enough to fit within a 10mm diameter sphere. In addition, the Spline in the motor rotor shaft should also be greased as well.

Also, make sure that the flanges on the Planet Gear Bearings are sandwiched between the Planet Gears, and the Driveshaft Carrier. The smooth flat sides of the Planet Gears need to be towards the rear of the Drive.

External Greasing

It is also possible to re-grease the Drive gearbox without disassembling it. This is done by using the supplied syringe of grease to inject grease into the hollow center of the Driveshaft. This is shown in the following illustration:



External Greasing

The Front Spinner is removed, and grease is injected directly into the threaded hole in the Driveshaft. Approximately 4ml of grease should be injected.

The following maintenance advice is also offered:

1. Do not use greases that are loaded with Dry Lubricants like Molybdenum Disulfide. This is because dry lubricants will plate out on the running surfaces of bearings, potentially causing clearance issues, and they will cause the Clutch Plates to slip, which will impair the function of the Spring Loaded Clutch.

2. It is recommended that removable Loctite 222 be used on the M2.5 bolts that attach the Gearcase Housing to the Motor, or Motor Adapter Manifold, and the M4 Socket Head Cap Screws that bolt the Neu f3a Adapter Manifold to the Neu f3a Motor.
3. Loctite is not needed for the M3 Cap Screws that attach the Rear Hub to the Gearcase Housing, because these bolts are spring loaded by the Wire Spring.
4. Do not use Loctite on the Propeller Nuts. Doing so will make it impossible to remove the nuts after the propellers start to slip.
5. Do not use solvents of any kind to clean the bearings, or the internal portions of the gearbox. This is because solvents will wash away the grease inside the shielded bearings, causing them to fail prematurely. Use a dry clean rag, or paper towel instead.

Maximum Bolt Torques are as Follows:

1. Propeller Nuts – 30 N.m
2. M3 Socket Head Cap Screws – 1.0 N.m
3. M2.5 Socket Head Cap Screws – 0.5 N.m
4. M4 Socket Head Cap Screws (excluding Spinner Bolt ...) – 1.75 N.m
5. M4 Socket Head Cap Screw Spinner Bolt – Just enough to overcome frictional torque.

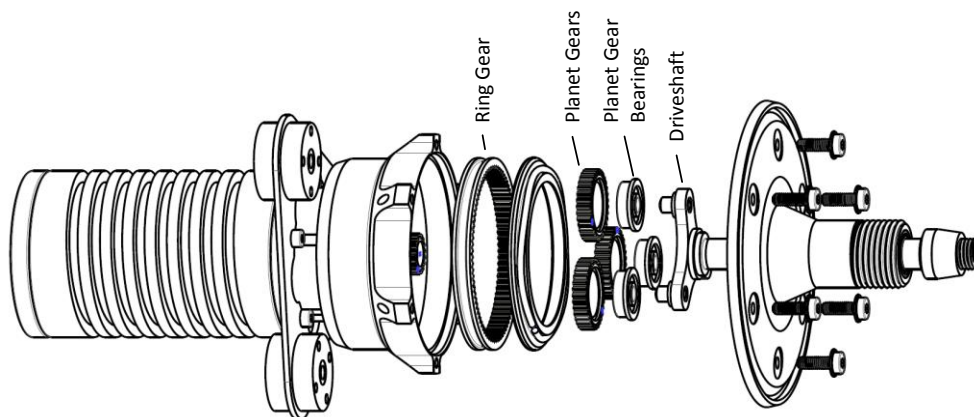
Changing Gearbox Gear Ratios

Replaceable Gear Sets are available so that the performance of the Drive can be matched to the Plane, the Pattern Schedule, and the available Battery Capacity. A complete Replaceable Gear Set is comprised of the following matched components:

1. A Ring Gear
2. A Driveshaft and Carrier Assembly with Planet Gear Bearings
3. Three Planet Gears

Changing the Gear Set can be accomplished without removing the Motor and Drive Assembly from the plane. First the Front and Rear Spinners and Propellers are removed. (See earlier illustration for guidance ...)

The Rear Hub is then removed, and the Gearbox is disassembled as follows:



Swapping Out Gear Sets

The Driveshaft, the Planet Gears, and the Ring Gear are all replaced, and the Drive Unit is reassembled.

Make sure that the recess on the planet gears is facing forward towards the props, and that the bearing flanges are nested inside the recess. Also, make absolutely sure that the ring gears and the planet gears from different gear ratios are not mixed up. Doing so will result in mechanical failure of the Contra Drive Gear Set.

Selecting the Right Gear Ratio

All available gear ratios are listed in the following table:

| Props | Gearset | Downline Braking | Horizontal Speed | Vertical Pulling Power |
|---|--------------------|------------------|------------------|------------------------|
| 22x18 Rear, 22x18 Front | 9.89:1 | +++ | + | +++ |
| | 10.15:1 | +++ | + | +++ |
| | 10.33:1 | +++ | + | +++ |
| | 10.56:1 | +++ | + | +++ |
| [22x20 Rear, 22x20 Front] & [22x20 Rear, 22x18 Front] | 9.89:1 | ++ | ++ | ++ |
| | 10.15:1 | ++ | ++ | ++ |
| | 10.33:1 | ++ | ++ | ++ |
| | 10.56:1 | ++ | ++ | ++ |
| [22x22 Rear, 22x22 Front] & [22x22 Rear, 22x20 Front] | 9.89:1 | + | +++ | ++ |
| | 10.15:1 | + | +++ | ++ |
| | 10.33:1 | + | +++ | ++ |
| | 10.56:1 | + | +++ | ++ |

Gear ratios that are unsuitable for specific props are crossed out and marked in red. Downline braking, horizontal speed, & vertical pulling power are rated in the last three columns. These ratings are relative, and based on flight testing, not numerical calculations.

Balancing Propellers

Your Contra Drive propellers are balanced to within 0.05 grams when measured at the tip both along the length of the blades, and across the hub perpendicular to the blades.

If you need to rebalance the propellers, you can do as follows:

The propeller blades are hollow, and there is access to these hollow chambers through two holes in the center hub. Balancing a propeller can be accomplished by adding a few drops of epoxy through the hub into the hollow section of the lighter blade. Use a syringe with a small short flexible tube to dispense the epoxy, and then flip the blade hard enough to fling the wet epoxy to the end of the blade. If you add too much epoxy, flip the blade in the other direction to redistribute the epoxy back towards the hub. When the propeller is suitably balanced, lay it flat until the epoxy sets.

If you need to balance the propeller across the hub, add equal amounts of epoxy into both blades and set the prop on its side so the epoxy settles around the hub on the lighter side of the propeller.

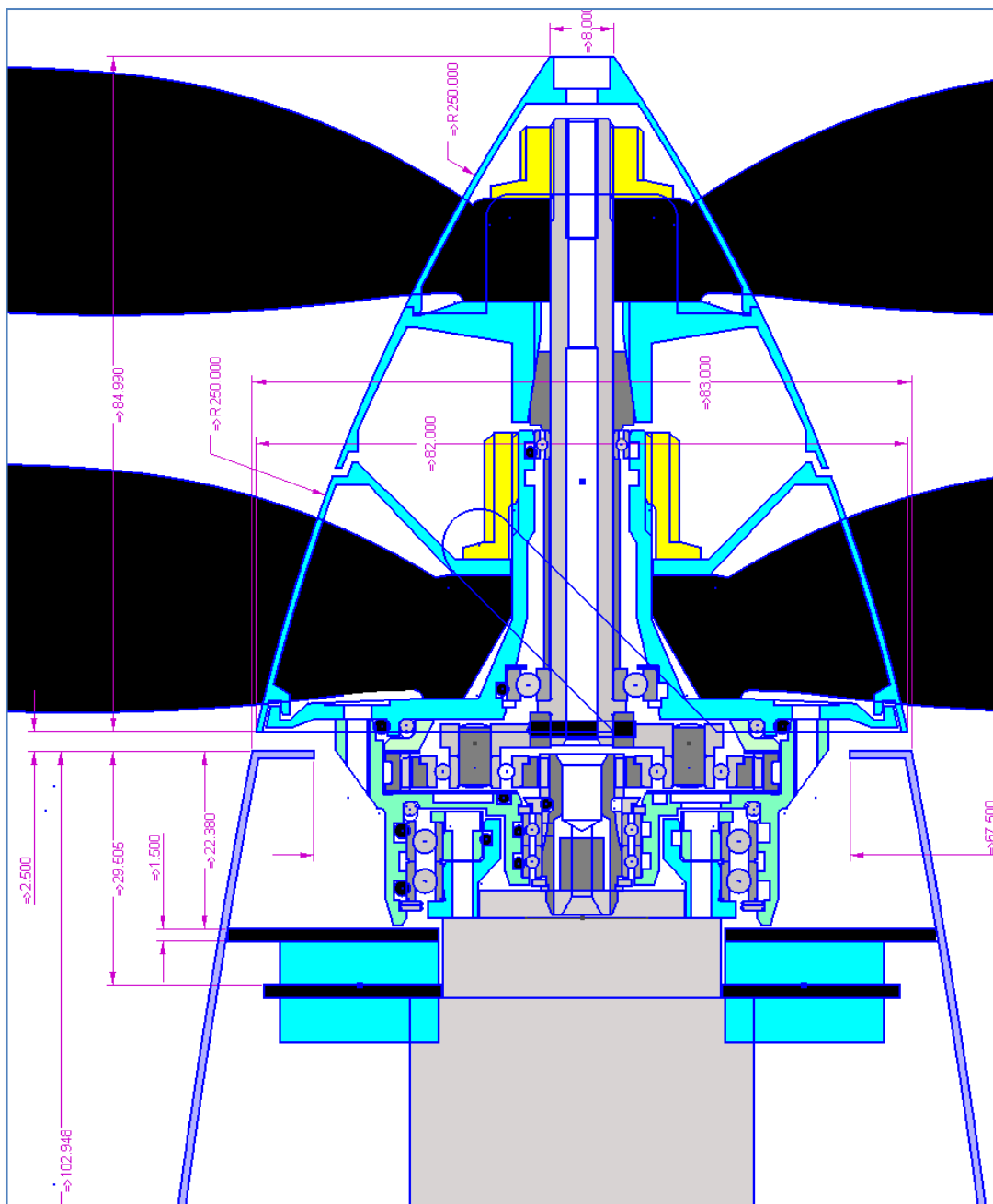
Performance Charts

This Chart is a mapping of Contra Rotating Propeller Drive System performance as a function of Motor Type, Propeller Pitch, and Gearbox Reduction Ratio. The purpose of this chart is to help assist in selecting the right motor, propeller, battery, and gear ratio. The numbers listed don't take into account any kind of throttle management that the pilot might use:

| Motor | Prop Pitch | Performance | | Gear Ratio | | | |
|------------------|------------------|------------------|---------------|--------------|-------|-------|-------|
| | | | | 9.84 | 10.15 | 10.33 | 10.56 |
| Neu f3a | 18 | Battery (mah) | 2010 Masters | 4,500 | 4,390 | 4,319 | 4,239 |
| | | | 2010 F3A F | 3,800 | 3,707 | 3,647 | 3,580 |
| | | Speed (mph) | Horizontal | 81.3 | 79.2 | 78.0 | 76.5 |
| | | | Vertical | 61.2 | 58.9 | 57.5 | 55.8 |
| | | Current Draw (A) | Static | 85.2 | 79.6 | 76.6 | 72.8 |
| | | | Max | 88.0 | 82.2 | 79.1 | 75.2 |
| | | | Horizontal | 25.8 | 23.9 | 22.8 | 21.5 |
| | | Vertical | 66.8 | 63.3 | 61.4 | 59.0 | |
| | | 19 | Battery (mah) | 2010 Masters | 4,649 | 4,528 | 4,459 |
| | 2010 F3A F | | | 3,926 | 3,823 | 3,765 | 3,695 |
| | Speed (mph) | | Horizontal | 87.2 | 85.0 | 83.7 | 82.1 |
| | | | Vertical | 65.3 | 62.9 | 61.5 | 59.8 |
| | Current Draw (A) | | Static | 88.6 | 82.8 | 79.7 | 75.9 |
| | | | Max | 92.0 | 86.1 | 83.0 | 79.0 |
| | | | Horizontal | 30.7 | 28.5 | 27.3 | 25.8 |
| | Vertical | | 72.0 | 68.2 | 66.1 | 63.6 | |
| | 20 | | Battery (mah) | 2010 Masters | 4,912 | 4,777 | 4,703 |
| | | 2010 F3A F | | 4,148 | 4,034 | 3,972 | 3,894 |
| | | Speed (mph) | Horizontal | 92.9 | 90.5 | 89.2 | 87.5 |
| | | | Vertical | 69.1 | 66.6 | 65.2 | 63.4 |
| | | Current Draw (A) | Static | 91.8 | 86.0 | 82.7 | 78.8 |
| | | | Max | 96.0 | 90.0 | 87.0 | 83.0 |
| | | | Horizontal | 37.4 | 34.8 | 33.3 | 31.6 |
| | | Vertical | 77.9 | 73.7 | 71.4 | 68.7 | |
| | | 21 | Battery (mah) | 2010 Masters | 5,218 | 5,066 | 4,982 |
| | 2010 F3A F | | | 4,406 | 4,278 | 4,207 | 4,123 |
| | Speed (mph) | | Horizontal | 98.2 | 95.7 | 94.3 | 92.5 |
| | | | Vertical | 72.6 | 70.2 | 68.7 | 66.9 |
| | Current Draw (A) | | Static | 94.9 | 89.0 | 85.7 | 81.7 |
| | | | Max | 100.0 | 94.0 | 91.0 | 86.9 |
| | | | Horizontal | 45.3 | 42.1 | 40.3 | 38.3 |
| | Vertical | | 83.9 | 79.3 | 76.9 | 73.8 | |
| | 22 | | Battery (mah) | 2010 Masters | 5,477 | 5,308 | 5,214 |
| | | 2010 F3A F | | 4,625 | 4,483 | 4,403 | 4,308 |
| Speed (mph) | | Horizontal | 102.7 | 100.2 | 98.7 | 96.9 | |
| | | Vertical | 75.9 | 73.5 | 72.1 | 70.3 | |
| Current Draw (A) | | Static | 98.0 | 91.9 | 88.6 | 84.5 | |
| | | Max | 103.4 | 98.2 | 94.9 | 90.7 | |
| | | Horizontal | 52.9 | 49.2 | 47.1 | 44.6 | |
| Vertical | | 89.2 | 84.4 | 81.7 | 78.5 | | |
| Hacker C50-14XL | | 18 | Battery (mah) | 2010 Masters | 4,500 | 4,385 | 4,322 |
| | 2010 F3A F | | | 3,800 | 3,703 | 3,649 | 3,585 |
| | Speed (mph) | | Horizontal | 74.3 | 72.4 | 71.3 | 69.9 |
| | | | Vertical | 52.6 | 50.4 | 49.1 | 47.4 |
| | Current Draw (A) | | Static | 65.9 | 61.5 | 59.1 | 56.1 |
| | | | Max | 68.0 | 64.0 | 61.0 | 58.0 |
| | | | Horizontal | 19.2 | 17.7 | 16.9 | 15.9 |
| | Vertical | | 55.4 | 52.5 | 50.9 | 49.0 | |
| | 19 | | Battery (mah) | 2010 Masters | 4,672 | 4,552 | 4,486 |
| | | 2010 F3A F | | 3,945 | 3,844 | 3,788 | 3,720 |
| | | Speed (mph) | Horizontal | 79.9 | 77.8 | 76.6 | 75.1 |
| | | | Vertical | 56.2 | 53.9 | 52.5 | 50.8 |
| | | Current Draw (A) | Static | 68.6 | 64.0 | 61.5 | 58.5 |
| | | | Max | 71.5 | 67.0 | 64.2 | 61.0 |
| | | | Horizontal | 22.8 | 21.1 | 20.1 | 19.0 |
| | | Vertical | 59.3 | 56.2 | 54.4 | 52.3 | |
| | | 20 | Battery (mah) | 2010 Masters | 4,879 | 4,751 | 4,680 |
| | 2010 F3A F | | | 4,120 | 4,012 | 3,952 | 3,877 |
| | Speed (mph) | | Horizontal | 85.3 | 83.0 | 81.7 | 80.2 |
| | | | Vertical | 59.5 | 57.1 | 55.7 | 53.9 |
| | Current Draw (A) | | Static | 71.2 | 66.5 | 64.0 | 60.9 |
| | | | Max | 74.5 | 70.0 | 67.0 | 64.0 |
| | | | Horizontal | 27.8 | 25.8 | 24.7 | 23.4 |
| | Vertical | | 63.7 | 60.3 | 58.4 | 56.1 | |
| | 21 | | Battery (mah) | 2010 Masters | 5,121 | 4,980 | 4,899 |
| | | 2010 F3A F | | 4,325 | 4,205 | 4,137 | 4,054 |
| | | Speed (mph) | Horizontal | 90.2 | 87.8 | 86.5 | 84.9 |
| | | | Vertical | 62.5 | 60.1 | 58.7 | 56.9 |
| | | Current Draw (A) | Static | 73.6 | 68.9 | 66.3 | 63.1 |
| | | | Max | 78.0 | 73.0 | 70.3 | 67.1 |
| | | | Horizontal | 33.7 | 31.3 | 30.0 | 28.4 |
| | | Vertical | 68.1 | 64.4 | 62.4 | 59.9 | |
| | | 22 | Battery (mah) | 2010 Masters | 5,379 | 5,220 | 5,130 |
| | 2010 F3A F | | | 4,542 | 4,408 | 4,332 | 4,238 |
| Speed (mph) | Horizontal | | 94.5 | 92.1 | 90.7 | 89.1 | |
| | Vertical | | 65.4 | 63.0 | 61.7 | 59.9 | |
| Current Draw (A) | Static | | 76.1 | 71.3 | 68.6 | 65.4 | |
| | Max | | 81.0 | 75.0 | 73.8 | 70.1 | |
| | Horizontal | | 39.5 | 36.6 | 35.1 | 33.1 | |
| Vertical | 72.1 | | 68.2 | 66.0 | 63.4 | | |

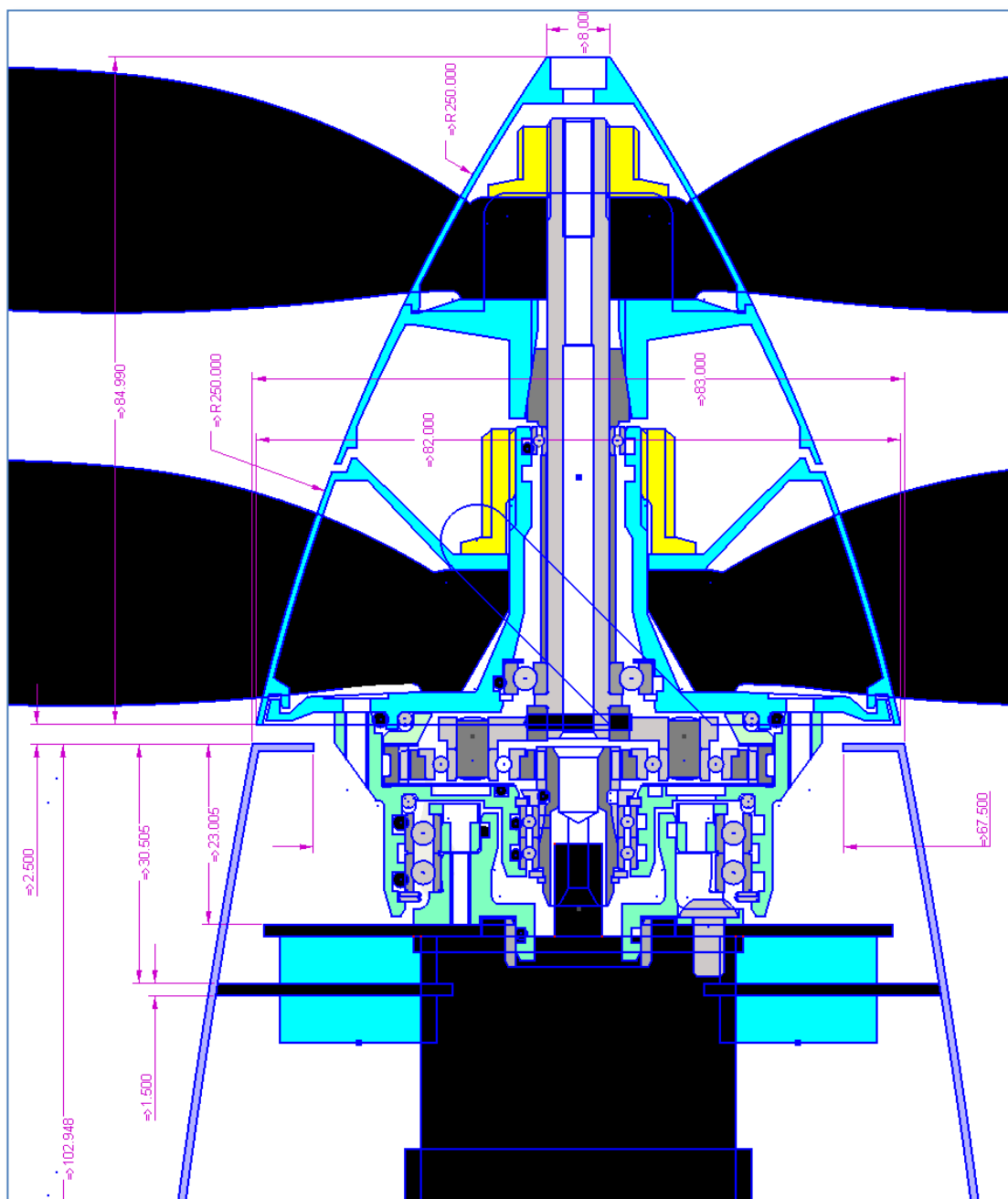
Installation

This is a layout that shows a typical installation using the Hacker C50 Competition Motor:



Hacker C-50 Competition Motor Installation

This is a layout that shows a typical installation using the neu f3a Motor:



Neu f3a Motor Installation

In both cases the use of Budd Engineering Soft Mounts is Shown.

Motor Mounts

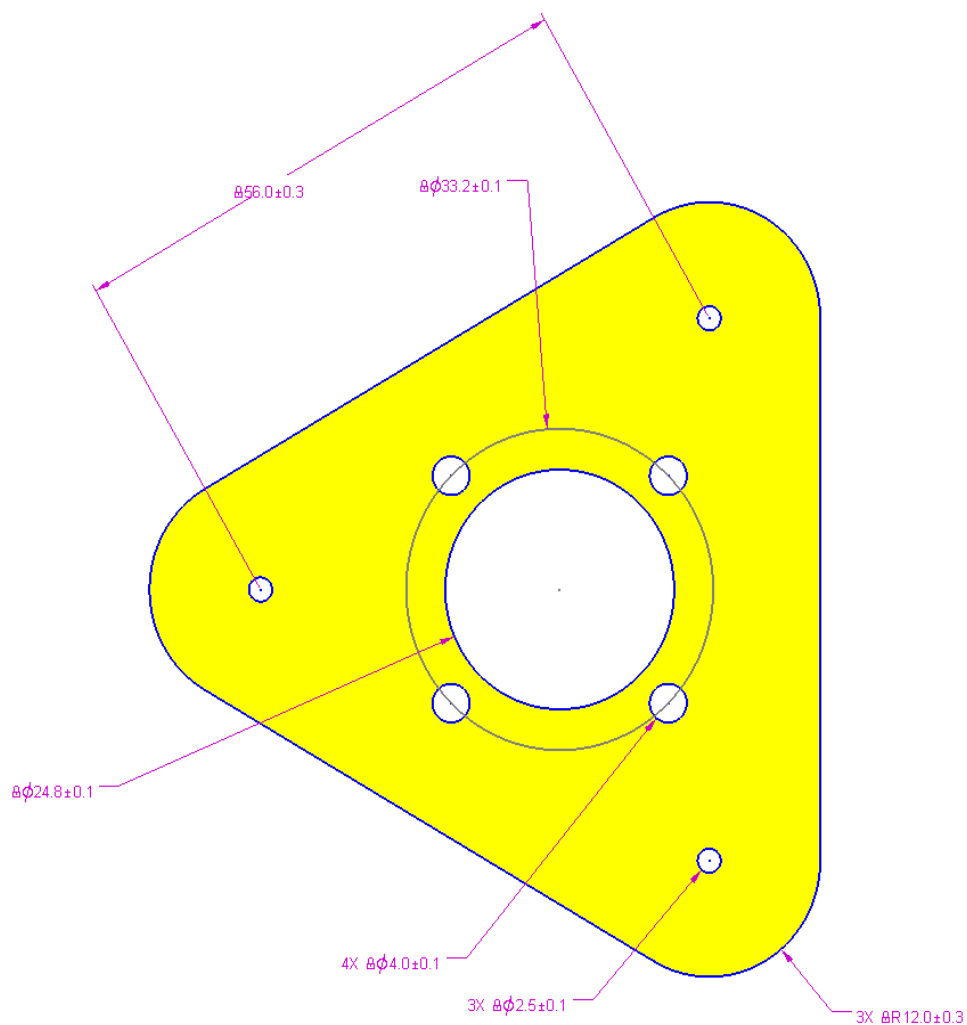
A set of two generic motor mounting plates are included. These plates are as follows:

- ## 1. Rear Fuselage Support Plate

2. Front Fuselage Support Plate

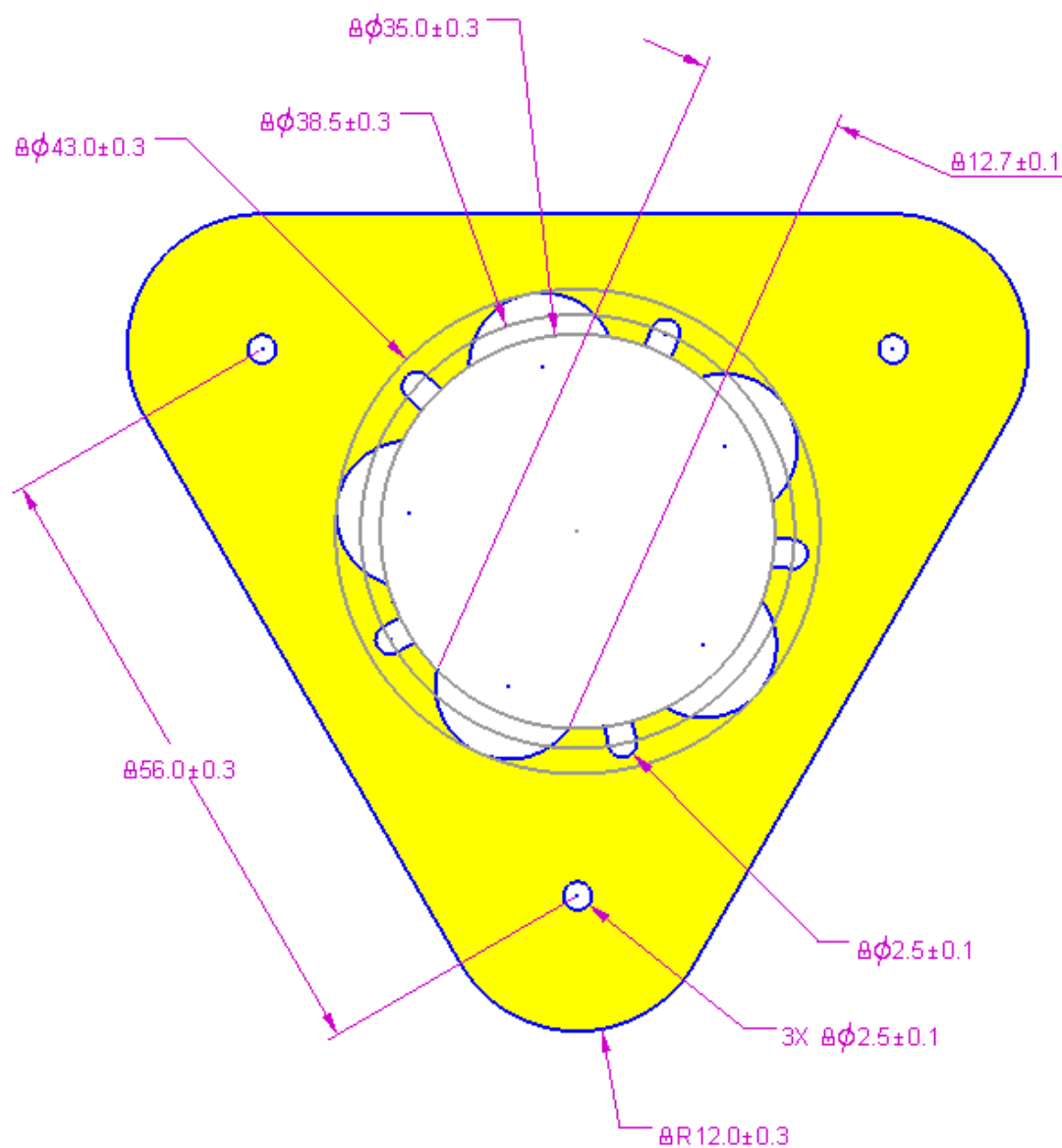
Each Motor Adapter Manifold Kit comes with a set of Front and Rear Motor Plates that are specific to each Motor.

Dimensioned drawing of the Motor Support Plate for the Neu f3a Motor is as follows:



Front Motor Support Plate for Neu f3a

Dimensioned drawing of the Motor Support Plate for Hacker C50 Motors is as follows:



Front Motor Support Plate for Hacker C50

In all cases the material required is 1.5mm Carbon Fiber Epoxy Laminate Sheet.

It is highly recommended that the Front Motor Support Plates be rubber mounted to the fuselage. This is because there can be considerable noise that comes from interaction of the two propellers, and this noise needs to be isolated from the fuselage in order to prevent the fuselage from acting as a resonant amplifier that makes the noise louder.

Rubber Mounts

There are two choices for rubber mounts:

Vibration Isolators from “Budd Engineering” - These rubber mounts are light, and very compact. They can also take compressive and tensile loads, and they do a good job of controlling the side to side movement of the Drive. Three are required. They can be acquired from this website: www.buddengineering.com

Rubber “Lord Style” Mounts – These rubber mounts are cylinders of rubber with threaded attachments bonded to each ends of the cylinder. These mounts do the best job of isolating vibration, but the rubber compound needs to be chosen carefully because there is a tradeoff between vibration isolation and side to side movement of the Drive when power is applied. This movement isn’t in response to motor torque. It’s because the motor / rubber mount system has a critical resonant frequency at about half the rpm of the propellers, and as the propellers accelerate through this resonant frequency, small side to side movements are amplified. The recommended rubber mount is part number V10Z 2-304A from www.vibrationmounts.com. Three are required.

An important point to note is that since the braking force from both propellers on a Contra Rotating Drive System is more than double that of an equivalent single propeller system, it’s reasonable to expect that the rubber mounts will compress on the downlines. This means that extra clearance is required between the Rear Spinner and the nose of the plane in order to avoid contact. A minimum of 3mm of clearance is recommended.

Also, since the Gearcase Housing rotates with the Rear Propeller, it’s necessary to ensure adequate clearance between the sides of the Gearcase Housing, and the stationary elements in the nose of the plane. If contact does occur, the motor mounts can be damaged, as well as the rest of the structure in the nose of the plane. One good practice is to make sure that smooth cylindrical part of the Gearcase Housing touches before the mounting lugs do.

Plane Setup

Motor Setup & Radio Mixes

The Motor should be set up with zero degrees of right thrust, and a 0.5 degree of downthrust. The only mixes that might be required are as follows:

1. Elevator to rudder for knife edge flight.
2. Aileron to rudder for knife edge flight.
3. Elevator to throttle for downlines

Whether or not these mixes are needed will be plane and center of gravity specific, but other than these, no other mixes should be required.

ESC Electronic Braking

It is recommended that no ESC braking be used. This is because the two Contra Rotating Propellers provide a double braking effect, and since the gear ratio in the gear box is significantly lower than is

typical for gearboxes used with single prop setups, there is also a gearbox braking effect that is in addition to the double effect from the two props.

Also, the two Contra Rotating Propellers both generate braking torques that are equal and opposite to the other, which results in no aileron trim change on downlines. However, if ESC braking is also used, it results in a torque imbalance and then there is aileron trim change on downlines.

Setting up for Landing

The double braking effect causes the plane to slow down very quickly when the motor is throttled back, so additional care should be taken when setting up for landing. Generally you will want to come in higher than normal, and push the nose down as you come in on final. Initially it might appear that you are going to overshoot the landing but as soon as you pull the throttle back the plane will slow very quickly and you will be able to place it at your feet.

Rudder Profile

One of the consequences of using a zero degrees right thrust motor setup is that the rudder becomes considerably more sensitive. This is because the aerodynamic forces acting on the plane when it is flying in a hands-off trim condition are considerably smaller than when right thrust is used.

In some planes this effect manifests as “Yaw Instability” which can prevent the plane from acquiring a good “locked on” feel. One useful analogy is to consider how straight an arrow flies with and without the feathers on the tail. Without the feathers the arrow doesn’t track straight, whereas with the feathers the arrow tracks straight and true.

One solution to this problem that has worked well has been to modify the profile of the trailing edge of the rudder to provide more aerodynamic drag. The most successful profiles have flared the trailing edge out to as much as 25mm. The effect is that the plane locks on and tracks very straight and true. The rudder seems to remain as effective as before, but it is much easier to make very precise rudder corrections without having to worry about releasing the rudder slowly to avoid overshoot when the fuselage yaws back into the line of flight.

Warranty & Liability

This Contra Rotating Propeller Drive System is guaranteed against manufacturing defects for a period of one year from the date of purchase. Liability is limited to full replacement cost of the product.

Safety Warnings

It is necessary to state that this product is intended for experienced hobbyists/modelers, and consequently there is an implicit assumption that the user has prior knowledge and experience with radio controlled model airplanes, pattern flying, electric motors, electric motor power systems, as well as general knowledge concerning safety and safe operation of the aforementioned.

The following safety warnings are Specific to the Contra Drive:

1. **Use only Carbon Fiber reinforced Epoxy Resin Propellers that have been designed for Contra-Rotating Propeller Drive Systems.** This is because plastic propellers are too heavy, and they do not have the required stiffness to avoid excessive deflection and the possibility of exciting resonant frequencies in the propeller blades.
2. **Do not fly with Propellers that have cracks or splits!** Doing so can potentially result in structural failure, and/or contact between the front and rear propeller blades.
3. **Do not stand, or sit, in the arc of propeller blades!** Doing so can result in serious injury or death.
4. **Do not over tighten propeller nuts!** Doing so can cause structural failure of the propeller hubs, and/or the propeller blades
5. **Do not hold propellers near the tips when tightening propeller nuts!** Doing so can cause structural failure of the propeller blades. Instead, hold the propeller blades as close to the spinner as possible. If a propeller splits or cracks while tightening a propeller nut, replace it before operating the Contra Drive Unit.
6. **Do not attempt to repair propellers that are cracked or split!** Doing so can cause structural failure of the propeller blades during operation.

