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OPERATION AND INSTALLATION MANUAL

FOR WARP DRIVE CARBON FIBER PROPELLER

CAUTION: FAILURE TO FOLLOW THESE INSTRUCTIONS WILL VOID ALL WARRANTIES, EXPRESSED AND IMPLIED. EXTREME CAUTION MUST BE EXERCISED TO PREVENT SEVERE BODILY INJURY OR DEATH.

Prop manual rev2, 11/13

Packing List

Items included:

Item	Component	Quantity
1	HP-L hub half WDHPL3 BACK (Engine side)	1
2	HP-L hub half WDHPL3 FRONT (Outside)	1
3	Solid carbon fiber blades	3
4	AN4-20A clamping bolts	12
5	¼" washers	24
6	¼" nylock nuts	12
7	Warp Drive professional protractor	1
8	Stoneguard leading edge tape kit with roller	3

Other items required(available from Warp Drive if not included with engine)

9	13mm threaded or unthreaded drive lugs(912 engines)	6
10	8mm x 75mm drilled head mounting bolts or 8mm x 90mm mounting bolts with 8mm nylocks	6
11	Faceplate (1/4")	1

*All versions of the Rotax 912 four stroke engines(912UL, 912UL-S, 912S, 914) require the use of the 13mm drive lugs that are pressed into the engine flange on the 101.6mm bolt pattern. It is **NOT ACCEPTABLE** to use the 75mm bolt pattern to mount the Warp Drive propeller on Rotax 912 engines. The engine side of the HP-L hub has been counter-bored to fit over the drive lugs.

Propeller Description and Features

Your Warp Drive propeller was manufactured using aerospace quality materials and processes. The blades are manufactured with solid carbon fiber tow material as the core with woven carbon cloth on both the front and back sides which results in an extremely rigid and durable blade. The finish on the blades is a flat black lacquer paint which provides UV and environmental protection. It is also very easy to touch up after normal use and wear or repair work after sustaining damage. The optional nickel leading edges will protect against rain and sand or other heavy abrasion areas.

The Warp Drive machined aluminum center hub is easily assembled and allows the user to infinitely adjust the pitch of the blades. The useable range of pitch on the Warp Drive propeller is between a minimum of 6 degrees and a maximum of 20 degrees at the tip of the blade. The actual pitch of the propeller will be determined by the design speed of the aircraft, engine specifications and propeller diameter and profile. The Warp Drive protractor provided with your propeller will allow you to adjust the pitch of your blades to within ¼ of a degree accurately.

The model number of your propeller is based on the diameter, rotation, options, number of blades and hub type. The diameter will be the overall length of the propeller when it is assembled. The rotation will be shown as either L(left hand) or R(right hand). The designation for the options are as follows: W=Nickel leading edge option, T=Tapered tip option. If your propeller does not have either of these options then the number of blades would come next. The number of blades will be either 2 or 3. The hub will be either HPL or HP.

Examples:

68RW3HPL = 68” prop, 3 blade, Nickel edges, HPL hub.

68RT3HPL = 68” prop, 3 blade, Tapered tips, HPL hub.

68RWT3HPL = 68” prop, 3 blade, Nickel edges, Tapered tips, HPL hub.

68R3HPL = 68” prop, 3 blade, HPL hub. (no blade options)

Your propeller was provided with a kit of Stoneguard leading edge tape. This tape will help protect against light abrasion if you do not have the nickel leading edges installed on your blades. It can also be used together with the nickel edges to protect even more of the leading edge when flying in high abrasion conditions. If you will be using the Stoneguard tape it is best to install them before the propeller is assembled.

Installing Stoneguard Leading Edge

1. Clean the leading edge of the blade with a rag and denatured alcohol. DO NOT use a cleaner stronger than denatured alcohol as this will remove the flat black lacquer paint finish and effect prop balance.
2. Remove the paper backing from the Stoneguard tape.
3. Carefully position the tape on the flat side of the blade, starting in 1/16" from the tip applying 1/2" width of the tape on the flat side.
4. Using the roller, slowly roll the tape in place on the flat side of the blade starting at the leading edge working out to the edge of the tape. Avoid capturing wrinkles or air bubbles under the tape. When you have rolled the entire strip properly, it will be clear and glossy.
5. Gradually roll the tape over the leading edge of the blade with the roller. If you capture an air bubble under the tape that cannot be worked out, use a pin to poke in the center of the bubble and roll smooth.

If your propeller does not have the nickel leading edges use the full 12" piece of Stoneguard. If your propeller has the nickel edges then cut the Stoneguard into two 6" pieces and apply on the leading edge inboard of the nickel. See Fig 1.

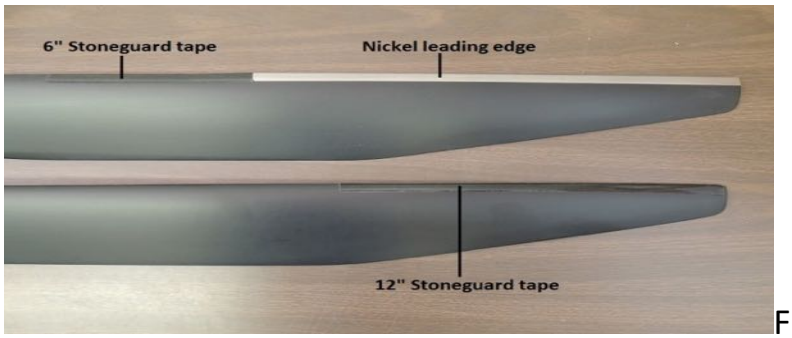

Fig 1

If you sustain damage to the Stoneguard leading edges, they can be removed by peeling the edge off lengthwise starting at the tip of the blade and working inward. Some of the adhesive may remain on the blade which can be softened with denatured alcohol and removed by rolling the adhesive off with your thumb like rubber cement.

Prop Assembly Manual

1. Place one ¼" washer on each of the AN4-20A clamping bolts(12) and insert them into one half of the HP-L hub. After inserting the clamping bolts, place the hub half on a flat surface with the bolt threads facing up. See **Fig 2**.
   NOTE: If the propeller is to be used on a tractor configuration, insert the clamping bolts into the hub half marked "FRONT". If the propeller is to be used on a pusher configuration, insert the clamping bolts into the hub half marked "BACK".

Fig 2

2. Place the three blades into the HP-L hub half with the front(airfoil) side of the blade facing down and the rear(flat) side of the blade facing up. This will ensure that the leading edges are all facing the same direction. The blades are not numbered as to their position in the hub.

3. Place the remaining HP-L hub half over the blades. Place the remaining ¼" washers over the AN4-20A clamping bolts followed by the nylock nuts(12) and finger tighten.

4. Tighten the twelve clamping bolts just enough that the blades can still rotate in the hub. If the blades will not turn, loosen the bolts slightly until the blades can move.

Installing Propeller to Engine

1. If you are using a spinner with your propeller, check to see if it uses a rear or forward bulkhead or both. Some skull cap spinners attach to the outside of the propeller hub with a ¼" mounting plate which will serve as the outer faceplate(required). If your engine uses drive lugs that press into the engine flange, make sure they are installed from the back side of the engine flange and protruding into the prop hub.

2. Install the rear spinner bulkhead(if used), the propeller assembly, forward spinner bulkhead(if used) and/or faceplate. Place one 5/16" washer on the mounting bolts and insert through the prop hub into the engine flange and finger tighten. The 6 mounting bolts should then be tightened to the point where the prop is snug against the flange while still allowing the blades to rotate. If the blades will not rotate, loosen the bolts slightly until the blades can be turned.

Setting blade pitch

Your propeller was supplied with a Warp Drive Professional Protractor for setting the blade pitch. When properly used, this protractor can help you set the pitch of your propeller to within ¼ of a degree. It can also be used for a variety of applications such as measuring wing surfaces, flaps, tail surfaces or anything needing to be measured in degrees.

The outer scale on the protractor is marked out in one degree increments. The only number of the inner scale on the center wheel is the zero at the top when the center vial is level. The white bar on the side is used to clamp the protractor to the blade tip using the two wing nuts. The red knurled knob is for locking the white wheel in place as you move from blade to blade. See **Fig 3**.

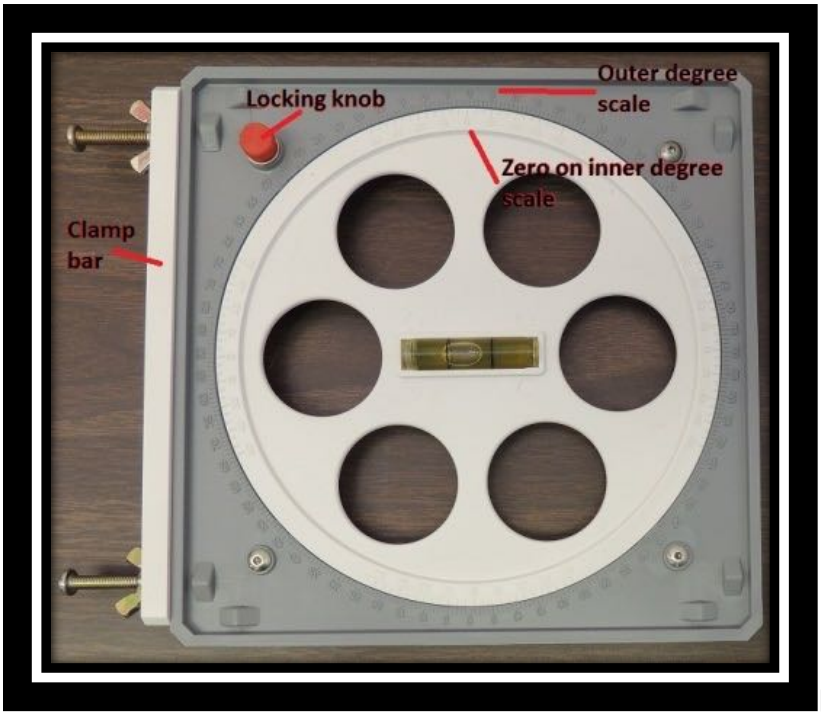

Fig 3

****ALWAYS MAKE SURE THE AIRCRAFT'S IGNITION SYSTEM IS "OFF" BEFORE CHECKING OR ADJUSTING THE PITCH OF YOUR PROPELLER!**

1. Determine your starting point. This measurement is taken at the hub of the propeller to determine the position of the aircraft. For example, if your aircraft is a tail dragger you may either take a reading at the hub to find how many degrees from vertical the hub is or you may raise the tail of the aircraft until the hub is vertical/plumb. If your aircraft is a tractor configuration, the measurement should be taken from the forward face of the prop hub. If your aircraft is a pusher configuration, the measurement should be taken from the rear face of the prop hub. See Fig 4.

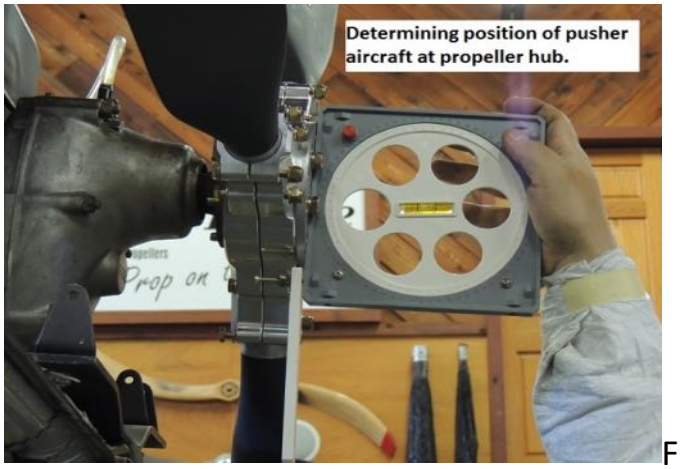

Fig 4

Fig 5

2. After you have measured your starting point with the protractor, then rotate the center wheel the desired amount of pitch you want in the blades. For example, if you have

leveled the aircraft and the zero on the inner scale lines up with the zero on the outer scale and you want 10 degrees pitch in the blades, rotate the center wheel so the zero on the inner scale lines up with the number 10 on the outer scale. When you have the desired pitch set in the protractor, tighten the red locking knob to lock the wheel in place. Rotate the propeller so that one blade is in a horizontal position. Next clamp the protractor to the VERY TIP OF THE BLADE with the square body on the flat(rear) side of the blade and the white clamping bar on the airfoil(front) side of the blade. See Fig 5. Rotate the blade by grasping at the collar area and twisting with one hand while grasping near the blade tip with the other hand and pushing/pulling the tip fore and aft. This will allow smaller increments of adjustments instead of simply twisting on the blade. As you are rotating the blade to set the pitch, pull outward to seat the collar in the hub.

NOTE: Always make sure when adjusting blade pitch that the thicker, straight leading edge of the blade is aiming forward and the sharper trailing edge is aiming rearward. If you have set the pitch and the leading edges are aimed rearward, your blades are pitched backwards. Take the protractor back to your starting point and rotate the center wheel the opposite direction and re-adjust the blades.

Once you have the first blade adjusted for pitch, snug the 4 clamping bolts down to hold the blade in place. Do not take the bolts to full torque at this time or you will not be able to adjust the remaining blades. Remove the protractor, rotate the propeller so that the next blade is in the same horizontal position, clamp the protractor to the blade tip and adjust the pitch. Repeat as necessary for remaining blades.

3. When all blades are set for pitch, use a calibrated inch pound torque wrench to bring the ¼" clamping bolts up to full torque. Use a criss-cross pattern in smaller increments until all bolts are to full torque. See **Fig 6** for bolt torque values.

4. Finally tighten the six mounting bolts to full torque. See Fig 6 for torque values.

HINT: Keep the protractor attached to the tip of the blade as you are torqueing the clamping bolts. Torqueing too much on one clamping bolt can start to rotate the blade pitch in that direction.

Bolt size	Recommended torque	Wrench/socket size
AN4-20A Clamp bolts	**120 in/lbs, 10 ft/lbs**	**7/16" or 11mm**
8mmx75mm or 8mmx90mm Mount bolts	**175 in/lbs, 14-15 ft/lbs**	**½" or 13mm**

Fig 6

REQUIRED TOOLS: Calibrated inch pound torque wrench, ¼" socket, ¼" open end wrench, 13mm socket, 13mm open end wrench.

5. With the brakes set and the aircraft tied down, start the engine and run it up to check the static RPM. Remember that the engine will increase in RPM from take-off to full throttle in flight. As a general rule it is recommended to set the static RPM of an engine at 400 – 500 RPM under its maximum RPM rating.
   CAUTION: THE TAKE-OFF OR FLAT OUT, LEVEL FLIGHT RPM AT WIDE OPEN THROTTLE MUST NOT EXCEED THE ENGINE MANUFACTURER'S RECOMMENDED LIMITS.
   If your initial engine static RPM is too high, adjust the blades to a higher pitch. If the initial static RPM is too low, adjust the blades to a lower pitch. It is recommended to make the pitch changes in one degree increments.

6. Once you have the desired engine static RPM, re-torque and safety wire and/or install nylocks on the six propeller mounting bolts. Re-torque the ¼" clamping bolts as well.

7. Install the spinner dome(if used).

After you have flown the aircraft, you may need to re-pitch the blade for fine tuning and desired performance. Make the necessary adjustments accordingly and re-torque all bolts until you have achieved the desired performance.

Your Warp Drive propeller was balanced before it left the factory. It is not necessary to balance the propeller unless minor repairs have been performed.

IMPORTANT: THE BOLT TORQUE MUST BE CHECKED AFTER THE FIRST 5 HOURS OF OPERATION AND THEN AFTER 50 HOURS OR AT LEAST ONCE A YEAR.

Acceptable Engine/Propeller Combinations

Prop	Max Diam	Min Diam	Weight	Approved Engines	Limits RPM/Horsepower
3 blade Standard chord (up to 70") or tapered tip (up to 72") with or without nickel	72"	60"	10 lbs max	Rotax 912UL, 912S, 914, 912IS, Viking	5,800 engine RPM, 80-115hp
3 blade Standard chord (up to 70") or tapered tip (up to 72") with or without nickel	72"	68"	10lbs max	Rotax 582 with C or E gearbox 3.47:1 ratio	6,800 engine RPM, 65hp
2 blade	72"	64"	8lbs max	Rotax 912UL	5,800 engine RPM, 80hp
2 blade	72"	64"	8lbs max	Rotax 582 with C or E gearbox 2.62:1 ratio	6,800 engine RPM, 65hp

Fig 7

Mass moment of inertia of acceptable propellers listed above is equal to or less than 5,700 kg/cm2. The diameters, weights and options are identical for both tractor and pusher aircraft configurations. All propellers listed are using theHPL hub.

Propeller Maintenance Manual

Repairs

It is common for a propeller to encounter foreign material that can cause anywhere from minor surface abrasion or small nicks to major blade damage. A pre-flight and post-flight inspection will help to ensure the best performance and longevity of hours of use from your Warp Drive propeller. The depth and severity of the damage will determine if the repairs can be performed by an approved LSA repairman, A&P, IA or the prop must be returned to the Warp Drive factory for inspection and repair or replacement.

1. Small nicks and gouges up to .125in(1/8") in the carbon fiber material can be filled and repaired by an A&P, IA or approved repairman using a high strength 5 or 10 minute repair epoxy kit(West System, Devcon, etc.) that is made for composite material repair. Do not sand the damaged area. Leave the broken or frayed fibers in place to give the repair epoxy a better surface to bond with. Clean the immediate damaged area with acetone or paint thinner. Fill the area with the repair epoxy and cover with masking tape to shape the repair to the original blade shape. Once the epoxy has cured, remove the masking tape, sand the area to a smooth surface matching the original shape. Re-paint the area with a flat black lacquer spray paint. After the paint has dried lightly sand the painted area with a medium grade Scotchbrite pad. This will take the area back to a factory finish. When re-painting the area be sure to keep the touch up paint to a minimum. Adding more paint than necessary can cause an out of balance situation. Re-balance the propeller.
2. If your propeller has the inlaid nickel leading edge protection installed, minor nicks and dents can be repaired by an A&P, IA or approved repairman. However, to properly repair the nickel leading edge area, the entire propeller should be returned to Warp Drive for inspection, repair and re-balancing. As a factory repair the damaged nickel edges will be removed, the damaged carbon fiber underneath will be repaired and a new nickel edge will be installed. The entire set will then be repainted and rebalanced to factory specs. If the damage is a minor nick then the area can be lightly sanded smooth. If the damage is a dent that bulges the leading edge out slightly then the area can be tapped smooth using a hammer and dolly.

The nickel edges can get built up with foreign material such as grass or bugs or it can get eroded from dust or sand. If the leading edges have build-up of foreign material simply use a medium grade Scotchbrite pad to remove the material. If the leading edges are heavily worn from sand then the blades must be returned to Warp Drive for inspection and repair.

3. In the event of a ground strike or major foreign object strike, ALL propeller components must be returned to Warp Drive for inspection and possible repair or replacement. This includes the propeller blades, hub, clamping bolts, mounting bolts, faceplate, spinner(if used) and prop extension(if used). The blades will be checked for structural integrity and the hub must be checked for bends as well as dye penetrant checked for cracks. It is also required to follow the engine manufacturer's instructions on inspecting for engine, reduction drive(if used) and prop flange damage.

Inspections

General inspection: There is no life limit set for Warp Drive propellers. Pre-flight and post-flight inspections should be performed to ensure the overall condition of the propeller and its airworthiness. Any service performed on the propeller must be documented on the Propeller Logbook(Fig 8). A visual inspection is the first defense against early failure of propellers.

1. If you see any changes in the surface such as roughness, cracks, bubbling or discoloration, **DO NOT** operate your aircraft.
2. Check the hub at annuals and after any known impact. The hub should be checked for cracks, corrosion or rust. **DO NOT** operate your aircraft if any of these conditions exist.
3. All hardware should be re-torqued after the first 5 hours of use, then 50 hours or at annuals. If the hardware has been over-torqued or loosened and re-torqued and no longer hold torque then discard and replace them.
4. If you feel vibration when running the engine, shut the engine off, check the pitch of the blades, check the torque of both the clamping and mounting hardware. The propeller has been statically balanced to within .2 gram before it left the factory. If you have

dynamic balancing available to you this can be performed with the propeller on the aircraft. This will balance the engine, reduction drive, if used, and propeller as one rotating assembly and reduce the amount of vibration and wear on the engine and other aircraft components.

5. It is okay to use an automotive wax or products such as Armor All to protect the finish of the blades. Applying these materials will help when cleaning the blades plus foreign material will not stick to the blades as easily during use.

2000 Hour Major Inspection: A major inspection of the propeller after 2000 hours of use is required and can be performed by an A&P, IA, approved repairman or it can be sent to the Warp Drive factory for inspection.

Propeller Removal

1. Remove spinner dome and examine it for damage and cracks.
2. Remove six prop mounting bolts. The bolts should be dimensionally checked against one another. Any bolts that exhibit stretching, corrosion or damage such as cracks or nicks need to be replaced.
3. Remove propeller assembly from the engine. Mark the hub halves to indicate how they were indexed when assembled.
4. Remove the four ¼" clamping bolts per blade and discard.
5. Remove one half of the prop hub and set aside.
6. Remove each blade from the hub and inspect the blade shanks for any wear or cracks. Inspect the entire length of each blade looking for any leading edge damage from strikes, fractures or finish wear. If any minor repairs are necessary follow the **Repair** instructions in this manual. If major repairs are necessary please return the propeller to the Warp Drive factory for inspection and repair or replacement.
7. Place the two hub halves back together with the alignment marks lining up. Check for gaps between the two hub halves. Next spin one of the hub halves to re-align in the next position. For example, if you have a 3 blade hub, spin one of the halves 120 degrees. If you have a 2 blade hub, spin one of the halves 180 degrees. Again check for gaps between the two hub halves. If there are gaps the hub must be replaced.
   If all parts are found in good condition, re-install the propeller following the **Prop Assembly** instructions in this manual.

Propeller Logbook

Date	Tach hours	Description of work performed	Signature

Fig 8