



K4 Kiwiprops™ Assembly

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DRAFT

BOSS ASSEMBLY - STAGE I



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2: BILL OF MATERIALS

- **A K4 Boss with the correct Spline or Shaft size**
K4 Bosses are common rotation-wise
- **A K4 SS Spring - Handed Opposite to the Prop**
- **A Blade Carrier which is Handed so select LEFT or RIGHT Hand**
- **A Nose Cone which will be either Saildrive or Shaft**
Lombardini Saildrive Units have a smaller OD .. see Drawings
Volvo Saildrives have an extended Nose Cone ..
Yanmar Saildrives have Nose Cones specific to SD20-50 and new SD60's
- **A Nut to match the mounting from the schematic above**
The length must match boss to align locking holes in nut
- **Vesconite™ Internal Boss / Blade Carrier Sleeve**
- **Vesconite™ Aft Washer – Boss / Blade Carrier Rear thrust and seal**
Vesconite™ Forward Washer to fit to Collar
- **Four blades of the required diameter**
Note with the larger 100 mm = 4" Boss K3 Blade sizes increase by 1" when mounted on a K4 Boss
- **Four Reversing Tri Rollers with 316 SS M8 Attachment Screw**
Current Reverse Screws are M8 x 1.25 – Circle(s) on upper face for M8 ID
- **Single M10 x 10 mm with spigot extension to lock Nut in SS 316**
Seven M10 x 10 set screws to blank off unused threads in boss
- **Four pitch adjustment screws M8 x 30 mm in SS 316**
Four 1/2" x # 4 SS Pozi Self tapping screws for the blades
- **Four 1/4" x 25 mm Titanium Threaded Blade Retention Pins with Caps**
- **Four SS 316 M8 x 40 Cap Screws to lock the Nose Cone**
One SS 316 M8 x 40 Cap Screws to lock Collar
- **Loctite™ for the reversing rollers**
- **3M 5200 / SIKA Equivalent for the Nose Cones & Collar**
- **CALTX DELO ESI Grease or Marine quality equivalent**
- **Appropriate Hand Tools, Turpentine & Cleaning rags etc**

3: GENERAL

The following Chapters describe the Assembly of the various sub- components that go to make up a Boss Assembly which is held in stock by mounting type.

Only when a specific Customer Order is received are the Bosses then numbered and the appropriate blade set mounted and the Pitch set to the specific order requirements.

The actions described below relate to one specific assembly.

Normally these would be assembled in small batches to make it simpler and easier to remember the assembly routines.

TURNING THE SHAFT DOWN TO A STANDARD IS ALWAYS RECOMMENDED AS THE OPTIMAL SOLUTION FOR NON STANDARD TAPERS. OFTEN BY USING A STEEPER ISO 1:10 TAPER & KEY AN EXISTING SHAFT CAN BE RETAINED

4: BOSS SELECTION CRITERIA

The following boss units are available for assembly into K4 units.

Detailed dimensions for each boss / nut / key are available at:

<http://www.kiwiprops.co.nz/cms/index.php/k4resources4bladed-unit/k4-attachment-options>

NB: ALL UNITS ARE AVAILABLE IN BOTH LEFT & RIGHT HAND ROTATION:

SPLINE ALL SAILDRIVES SAE 16/32 17 tooth on 28 mm

ISO 30
ISO 35
ISO 40

SAE 1.250"
SAE 1.375" NOT CURRENTLY STOCKED
SAE 1.500"

BLANK BORED FOR LOCAL MACHINING

THIS IS WHERE MACHINING SHAFT DOWN TO STANDARD IS NOT AN OPTION

5: PREPARING NOSE CONE & COLLAR

All propellers have either a Saildrive or Shaft Nose Cone irrespective of any other features such as shaft diameter or rotation.

The Saildrive nose unit is designed to fair the body of the propeller to the larger gear casing of the Saildrive. The shaft drive nose unit is designed to fair the body of the propeller down to the much smaller shaft dimensions.

NB: LOMBARDINI NOSE CONES ARE REDUCED IN OUTSIDE DIAMETER TO 3.5" – Refer Drawings

DEPENDING UPON THE MODEL OF SAILDRIVE TO BE FITTED TO – THE FORWARD FACE WHICH IS SUPPLIED EXTENDING 7.00 mm FORWARD WILL NEED TO BE TRIMMED AS PER THE K3 UNITS.

A WEB PAGE LABELLED: NOSE CONE TRIM will provide the required dimensions.

AT: <http://www.kiwiprops.co.nz/cms/index.php/resources-general/nose-cone-trim>

In each case the nose cone and collar perform two other critical functions which are not obvious from a cursory examination.

- First the M50 x 2.5 thread inside each Nose Cone unit fits over the thread on the boss and absorbs all the forward thrust of the propeller. It transfers this initially from the blades on the Blade Carrier - through the spring tail collar - then through the Nose Cone – then through the Boss to the shaft to provide forward motion.
- Second the Spring Collar contains a hole into which one end of the torsion spring is mounted so that it can absorb the torsion of the spring and transfer this through the Collar which is locked to the boss. It also provides the facility to preload the torsion spring and adjust the amount of tension to ensure proper operation of the propeller and ensure that the blade carrier always returns to a position which will allow the blades to feather. This it will not do unless the blade carrier is returned to the neutral position or feathered with the spring.

While the external profile of these components is very different the internal dimensions and method of attachment are absolutely identical. The same comments thus apply to either unit. The Saildrive Nose Cone is machined ex GF-PP – the smaller Nose Cone for shaft installations ex SS 316.

Once the Saildrive or Shaft choice has been made every other instruction for preparation is common.

PREPARING THE NOSE CONE: ILLUSTRATIVE

6: REGISTRATION BOSS AND BLADE CARRIER

Unlike K3 units - All K4 units are handed with the pitch stop cast in so there is no separate machining of the tripod. Select the required hand of blade carrier from stock to match the W/Order.

NB: REMOVE ANY BURRS FROM BOTH ENDS OF THE BLADE CARRIER BORE WITH A DEBURRING TOOL IF REQUIRED – CHECK THE GREASE HOLE HAS BEEN BORED AND COUNTER SUNK

HONE THE REAR FACE WITH STONE & CRC TO REMOVE ANY BURRS ON THIS SURFACE

SMEAR THE INTERNAL DIAMETER OF THE B/CARRIER WITH GREASE THEN INSERT THE K4 VESCONITE™ SLEEVE INTO THE B/CARRIER AND ENSURE IT TRAVELS TO THE RETENTION RIM ON THE FORWARD END THAT PREVENTS THE SLEEVE FROM TRAVELLING FORWARD

NB: CHECK THE GREASE HOLE OF ~ 1.7 – 1.9 mm HAS BEEN BORED IN THE CASTING IN ONE OF THE M10 NUT LOCKING SCREW RECESSES AS PER THE K3 UNIT PRIOR TO ASSEMBLY

NB: CHECK ANY BURRS ON THE INNER FACE OF THE GREASE HOLE HAVE BEEN REMOVED AND CANNOT FOUL THE MOVING CONTACT FACES INTERNALLY

CAUTION: THE ASSEMBLED 0.004" = .10 mm CLEARANCE IS CRITICAL !

Check for any inclusions in the castings not already detected and reject if necessary.
Check that the internal surfaces swept by the dogs are clean.

Scrub the unit with soap and water paying particular attention to all the recesses on both faces to remove any swarf or grime which could cause excessive wear in the unit in use.

Fit the K4 Aft Washer in Vesconite™ to the B/Carrier recess and ensure it is free to move and sits flat to the surface all round the perimeter.

Mount the Boss selected by smearing all surfaces with grease and sliding into the B/Carrier. Remember unlike K3 units – Bosses are not Handed so any boss of the correct mounting is correct.

Remember however to ensure you have the correct hand of B/Carrier which are handed.

With 4 blades and 2 x Drive Dogs – the unit is symmetric about the dogs so they can be mounted on either side of the B/Carrier. Either registration will be perfectly correct – Unlike the K3 unit.

Turn the boss sharply back and forth.
It must rotate freely and close with a distinctive click at the end of degree of freedom to indicate movement is both full and free.

Holding it against the stops alternatively in each direction, slide the boss out and check to see first if it turns any further which would indicate some form of binding preventing it from closing correctly onto the faces of the dog.

When $\frac{3}{4}$ of the way out look down to ensure the dogs are engaging correctly and there is not for example some metal in the corner of the swept section of the casting which is again preventing the dogs closing fully and correctly. Again – this is unlikely to be an issue for lost wax castings.

This is very important as it is always assumed this action is correct before commencing assembly.

If this action was to change over time, perhaps from a small casting fault that was eroded with use, then the position of the rollers would change and this would impact upon the correct feathering and or reversing action.

Hold the assembly up to the light and check that the faces at the circumference of each casting that coincide are meeting correctly and that no light is visible through this joint.

On units that have been broached for a keyway - ensure that any burr or rolled burr at the end of the internal keyway is removed using a screwdriver and file edge. This is required to ensure that the nut will pull up correctly on the flat internal face without binding on any swarf.

Remove any burrs remaining both on the inside of the taper and keyway and particularly at the nut end where the keyway broach has run out and the internal nut recess has been machined. Use a small chisel or screw driver to bend any swarf off so allowing the nut to pull up cleanly.

The nut length and nut recess in the boss must match the designed lengths so that the M10 spigot for the Vernier locking of the nut is aligned fore and aft prior to being rotated for final alignment.

CHECK FOR BURRS OR CASTING DEFECTS INSIDE THE SPLINE ON SAILDRIVE UNITS AS A BUBBLE IN THE WAX TRANSLATES TO A METAL PROTRUSION THAT CAN INTERFERE WITH MOUNTING.

CHECK THAT ALL SAILDRIVES CAN BE MOUNTED FRONT FACE FIRST OVER THE GO SPLINE AND TRAVEL TO A DEPTH SUCH THAT THE END OF THE SPLINE REACHES THE END OF THE BOSS SPLINE.

TEST AGAINST BOTH YANMAR AND VOLVO STYLE SPLINES THAT VARY FRACTIONALLY

CHECK THAT THE MATCHING NUT GOES EASILY AND FULLY INTO THE NUT RECESS IN THE BOSS AND THAT THE LOCKING HOLES IN THE NUT ALIGN LENGTHY WISE WITH THE LOCKING SCREW HOLES IN THE BOSS. SKIM THE NUT OUTSIDE Ø IF REQUIRED AND DE-BURR THE LOCKING HOLES

7: INSTALLING THE REVERSING ROLLERS

Wash the unit with soap and water to remove any CRC and dirt.
Rinse and place each hole under the tap to ensure they are scrupulously clean.

Ensure the flat has been machined for the M8 Reverse Screw landing. Sand this down if required using the tool that ensures a 90° face symmetric to the M8 tapped hole.

Match 4 Tri Roller & Screw sets to ensure they are operating correctly and most importantly that a flat protrudes ~ 0.015" from the base of the screw upon which it can pull up whilst leaving the roller free to turn on the shank of the screw.

GREASE THE UPPER SURFACE OF THE SCREW PRIOR TO MOUNTING THE REVERSE ROLLER WHICH WILL PREVENT LOCTITE™ THAT SEEPS FORM THE THREAD WICKING UP AND LOCKING THE REVERSE ROLLER THAT MUST REMAIN FREE TO ROTATE IN USE.

USE MAXIMUM STRENGTH 272 LOCTITE™ FOR PERMANENT MOUNTING

Mount the boss again in the vice surface protected with the first hole vertical.

Obtain the Loctite™ from the fridge and squirt a drop ensuring it goes right around the thread inside. Wipe off any on the top surface as it will bind with the roller. Insert a rag in the nut recess to ensure no Loctite runs into the inner recess where it would interfere with the nut clearances. Wipe off any surplus. **ALSO SMEAR A THIN COAT OF LOCTITE™ ONTO THE SCREW THREAD AS WELL**

This process is unchanged from the similar K3 routine and can be duplicated including the pin punching of the internal boss surface to lock the M8 Reverse Screw into the boss making coming loose virtually impossible without heat or severe corrosion to loosen the Loctite™

Smear a small coating of grease into the reverse roller surfaces that interface with the screw. This will prevent the Loctite™ causing the reverse rollers to bind together later with Loctite™ wicking up to freeze the bearing surface and locking the Tri Roller which must be free to move.

Holding the roller up on the screw to prevent it catching under the lip insert the screw using a ball headed Allen Key. At the end of the thread mount the long handle of the Allen Key and quite firmly but not over stressing - turn the screw so that the shoulder pulls down firmly onto the ground surface.

The screw will go very tight quite quickly when this occurs.
Check at this stage that the roller is turning freely.

TORQUE FOR AN M8 X 1.25 SCREW IS 24 ft lbs or 18 Nm

A TORQUE WRENCH MUST ALWAYS BE USED TO TIGHTEN THESE SCREWS.

**TORQUE TO 18 Nm (24 ft lbs) - DO NOT TIGHTEN WITHOUT A TORQUE WRENCH
THIS MUST BE DONE PROMPTLY AS THE LOCTITE™ WILL START TO HARDEN QUICKLY**

STORE SO NO DAMAGE CAN RESULT TO THE BOSS UNTIL FINAL ASSEMBLY.

Wipe any excess Loctite™ from the inside to prevent it running down and interfering with the taper or spline when it hardens and is very difficult to remove.

NB: Ensure there is no Loctite on the flat which will seep into the roller set and very effectively lock the roller onto the screw and prevent it rotating when engaging the reverse function. Remove with the edge of a rag and CRC to remove any excess Lotite™

Repeat for the other 3 screws.
Check again that all rollers are still turning quite freely.

Finally fail-safe punch / lock the Reverse Rollers into the Boss as per the K3 mounting.

NB: Once set the rollers can only be removed with heat from a gas torch. Any attempt to remove them without heat will simply result in the screw twisting off and the loss of the boss.

9: SELECTING THE SPRING

Spring Hand Rotation selection is identical to K3 units namely:

LEFT HANDED Propellers use a **RIGHT HANDED** spring.
RIGHT HANDED Propellers use a **LEFT HANDED** spring.

All K4 Springs are manufactured from 4 mm 316 Stainless in an NC mill and then heat-treated.

NB: REJECT ANY SPRING WHERE THE LEGS ARE NOT AT RIGHT ANGLES IN BOTH PLANES

The springs will always be in separate boxes appropriately marked but each must be checked that it is as marked. *A right handed spring will screw inwards when rotated to the right ie Clockwise.* Conversely a left handed spring will only screw in when rotated to the **LEFT** or Anti Clockwise. This is no different from a normal bolt which all have **RIGHT** Handed threads.

Check that both ends of the spring when inserted into the spring hole on the blade carrier will go down such that the coils lie flat against the face. This caters for a user subsequently reassembling the unit. Ensure both ends are chamfered for easy entry.

It may be necessary to countersink the recess in the Blade Carrier to ensure the spring lies flat with no contact between the rounded corner bend of the spring and the hole in the B/Carrier.

NB: CHECK that the ends of the spring have been ground at a 45 deg bevel to ensure they mount easily into the Collar when assembled and do not protrude through to interfere with the Nose Cone.

There is little spare room in the B/Carrier casting that contains the spring. Checking both ends ensures that if ever reassembled off site and reversed the spring will still fit.

Add the spring to the other items required for the subassembly.

NB: LABEL carefully when assembling multiple units at the same time. The choice of the wrong spring rotation will cause much difficulty if discovered at final assembly when the spring will not preload without jamming.

The spring shown would wind itself in the direction of the arrow if rotated clockwise or **RIGHT HANDED** viewed from the perspective of the arrow. It is thus a **RIGHT HANDED** Spring.

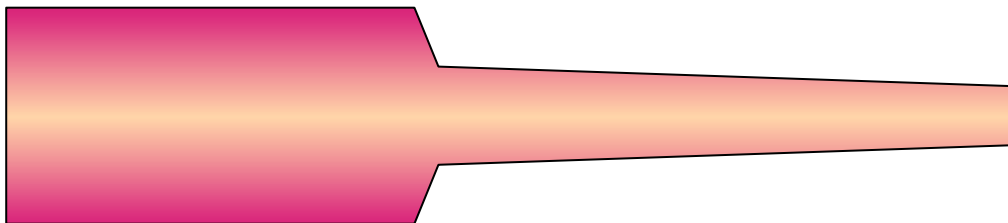
10: FINAL BOSS ASSEMBLY - TOOLING REQUIREMENTS

If available – the shaft on the vessel may well be the optimal mounting, but will require initial assembly then mounting with only the final stages of assembly taking place in situ so to speak.

We have found that a piece of dowel mounted vertically in a small vice with a square end to ensure it is held firmly with a flat to ensure the propeller stays at the correct height for ease of assembly is critical to the overall assembly operation.

The dowel should be tapered to allow for the smaller end of the tapered bosses to be mounted firmly.

A tapered length of 100 mm or 4 ins with a large end diameter of 30 mm tapering down from 20 mm is ideal. Allow additional length to mount in the vice and ensure the unit is held above the vice.



To ensure the ability of holding the unit while the internal torsion spring is pre-tensioned it is essential to have mounted vertically on a work bench to enable secure holding of the boss.

For shaft mountings with a taper it is necessary to have a strong engineers vice mounted on the workbench – preferably with jaws which take a round shaft of ~ 1.50" or 35 mm in diameter.

Ideally you would have 2 stub shafts turned from rod stock.

One an ISO taper of 1:10, the other an SAE taper of 1:16 ie The shaft will reduce in diameter by 1/16 " every 1 " of length. Similarly for the ISO shaft which will reduce in diameter by 1 mm every 10 mm.

The ISO shaft will reduce from a minimum of 30 mm to 19 mm and is thus 110 mm long. The SAE shaft will reduce from > 1.250" to 0.750" and is thus 8 ins long.

If available – the shaft on the vessel may well be the optimal mounting.

11: FINAL BOSS ASSEMBLY

First mount the tapered wooden spigot in one vice and the appropriate stub shaft in another so that the unit may be mounted firmly to preload the internal spring.

This requires that the boss does not turn under the spring while the collar is being rotated and then tightened up onto the boss.

Registration of drive dogs in the B/Carrier can adopt either of the two positions.

Without turning the blade carrier relative to the boss – by using a knife insert ~ one teaspoon of Marine Grease into each side of the boss and the blade carriers sectors that receive the dogs. Smear the entire bearing mating surfaces on the Boss to ensure smooth rotation after assembly.

**NB: ENSURE THE ENTIRE BOSS BEARING SURFACE IS COVERED WITH GREASE
DRY AREAS HAVE THE POTENTIAL TO BIND UNDER INITIAL OPERATION**

INSERT THE AFT WASHER WITH THE UPSTAND FACING FORWARD INTO THE B/CARRIER

Lower the boss into the blade carrier. Pull the boss down fully and turn either way to ensure it is operating smoothly and any surplus grease is squeezed out which will then need to be wiped off with a clean rag.

Mount this subassembly onto the wooden spigot over the nut recess with the nose of the unit up.

Now using the knife again insert more of the grease into the groove between the Nose of the the B/Carrier where the spring is to go. Attempt to keep the areas adjacent free of grease to ensure a clean surface.

NB: Leave the area over the spring hole free so it can be subsequently located visually.

Now insert the spring into the groove with one end of the spring going into the hole in the blade carrier. Press it home into the recess. Using a clean rag and Mineral Turps carefully clean all around the boss which is going to take the threaded Nose Cone and which will contain the 3M 5200.

Remove the 3M 5200 Fast Cure from the freezer where it is kept in a dry atmosphere to avoid curing between units prior to final assembly and allow it to come to room temperature.

Ideally this should be removed from the freezer and allowed to climb to room temperature at least an hour before use.

Extrude a small bead into the slot on the Collar and Nose Cone. Work down with a spatula until it is full of sealant prior to final assembly when excess will squeeze out.

Now smear a light coating of grease around the perimeter of the nose cone face that will move against the B/Carrier.

Clean with Mineral Turps if necessary and a clean rag.

Now mount the forward thrust washer ex Vesconite™ into the recess on the rear face of the Collar and ensure the forward end of the spring fits neatly into the chamfered hole on the aft face.

Run the M8 x 40 Cap Screw over the slot now full of mastic which will ensure some will be on the threads to provide locking of this screw.

Insert a long M8 x 75 into the tapped hole as this will be used to pre-tension the spring.

Now tighten the Nose Cone up on the thread until the assembly just goes tight. Back off enough to just free up the assembly leaving ~ 0.01 mm or 0.004" clearance.

Tighten the 2 M8 x 40 Cap Screws holding the Nose Cone tight on the thread. Ensure the matching balance screws on the other side again with mastic on the threads for locking are tightened home.

Now rotate the collar using the extended M8 screw to tension the spring so it will restore the B/Carrier to feathered position.

Spring Tension should be as per the K3 tension levels to just initiate movement.



EXAMPLE: Pre loading the torsion spring on a **RIGHT HANDED** propeller unit:

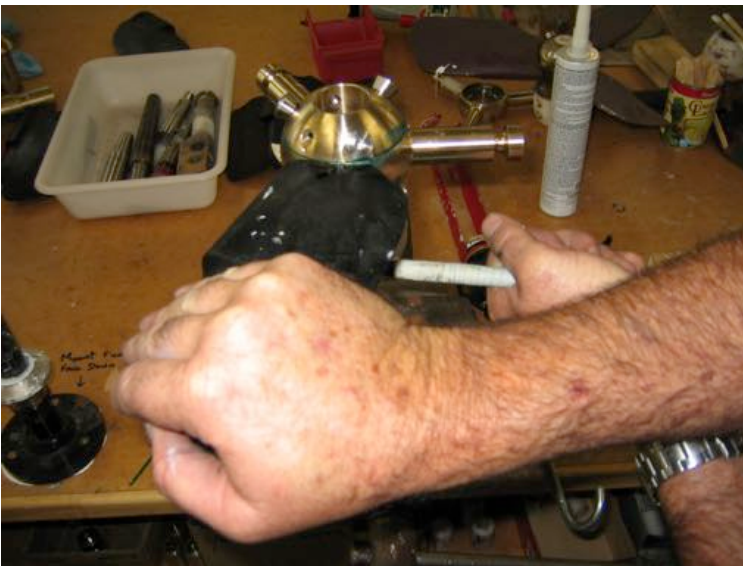
Mount one end of the spring balance in a leg groove and ensuring that the tension is always at right angles to the leg – adjust the spring tension so that a force of :

1.0 – 1.4 Kg or 2.2 – 3.0 lbs

is required to **initiate** movement of the leg against the spring from a feathered or returned position.

This obviously assumes a smooth motion with no sticking forces are present

This will ensure an adequate but not excessive spring tension which can impact on reversing engagement – particularly with small low powered motors.



The blade should now rotate freely and fully into the reverse position against the internal drive dogs and be returned by the spring without binding to a feathered position.

NOW TIGHTEN THE 4 x CAP SCREWS HOME WITH A TORQUE WRENCH TO

= 2 N.m FOR SAILDRIVES

= 2.5 N.m FOR SHAFT STYLE CONES

NB: ADD TORQUE TO PRE USED NOSE CONES

WAIT 20 SECS THEN REPEAT TIGHTENING

CAUTION: THE ABOVE STEP IS CRITICAL AS IT ALLOWS THE 3M TO CREEP OUT

This will ensure the nose cone is stable on the boss against the spring tension while the 3M 5200 sets which will take at least 24 hours.



CONDUCT A FINAL FULL AND FREE TEST BY ROTATING THE UNIT FULLY INTO THE REVERSE POSITION AT LEAST 5 TIMES TO ENSURE SMOOTH OPERATION WITH NO BINDING OF THE BLADE CARRIER ON THE BOSS

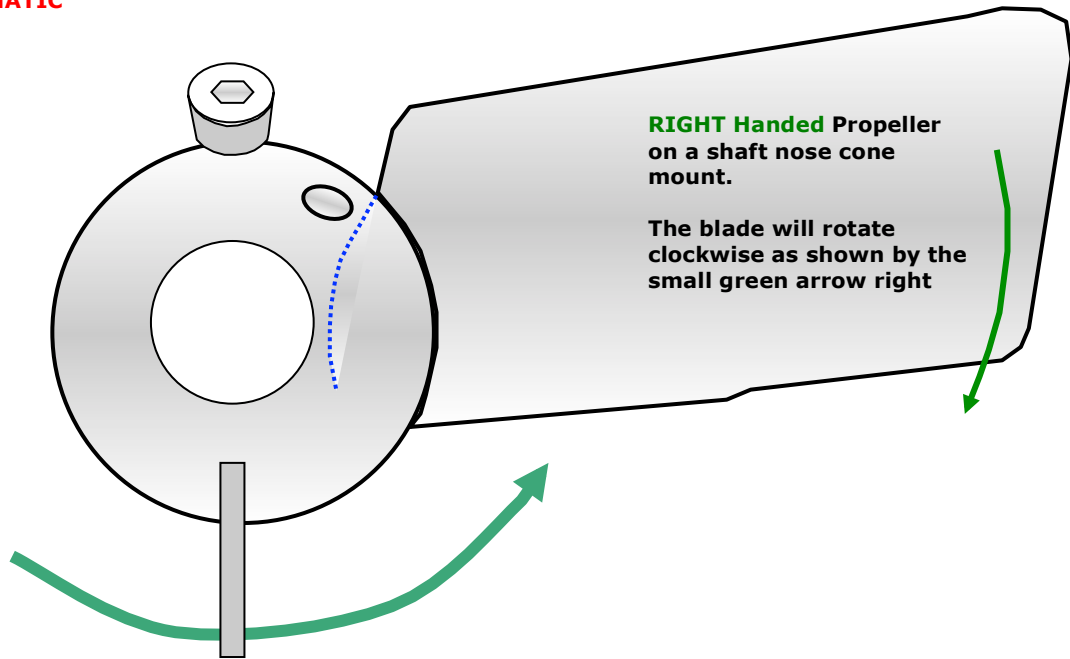
Clean up holding the unit as shown to access the nose with a clean rag and clean mineral turps.

Finish with a clean dry rag.

SPRING TENSION SCHEMATIC

GREEN arrow below indicates the direction of motion to wind the nose cone for a **RIGHT HANDED** propeller to pre-load the torsion spring correctly

Note the tool that engages the cap screw to provide leverage

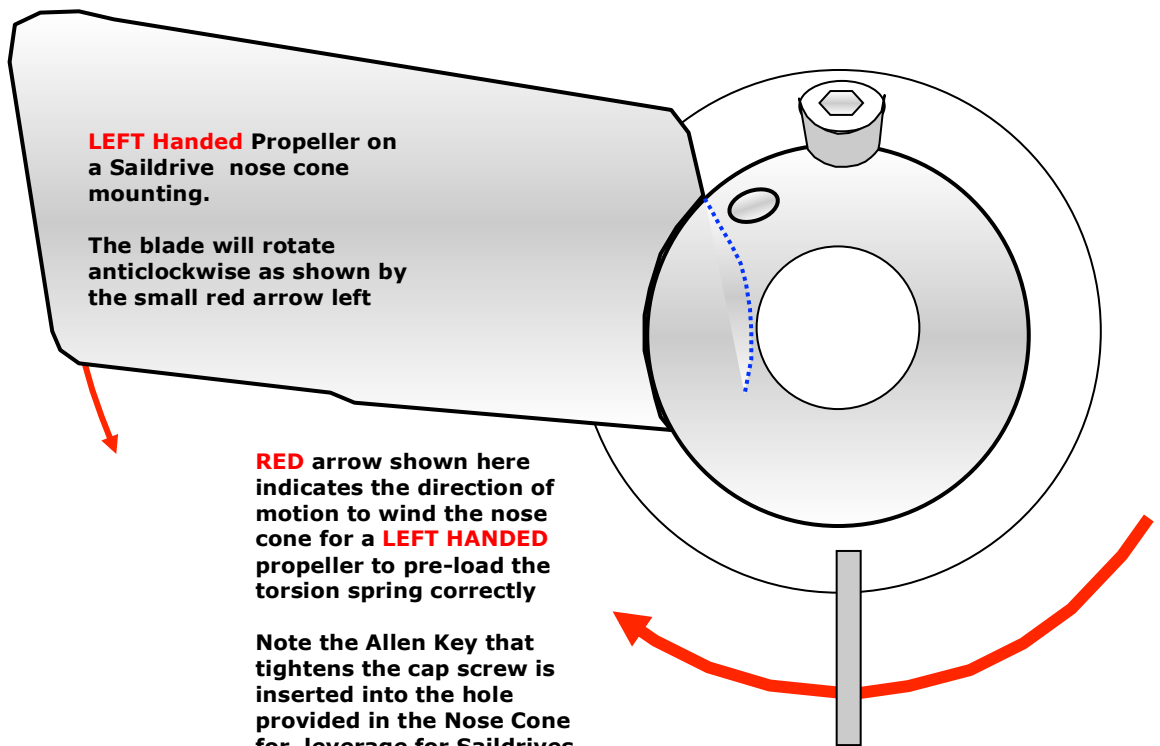


LEFT Handed Propeller on a Saildrive nose cone mounting.

The blade will rotate anticlockwise as shown by the small red arrow left

RED arrow shown here indicates the direction of motion to wind the nose cone for a **LEFT HANDED** propeller to pre-load the torsion spring correctly

Note the Allen Key that tightens the cap screw is inserted into the hole provided in the Nose Cone for leverage for Saildrives



Finally punch the series of alignment marks in a line between the Boss / B/Carrier / Collar / Nose.

The purpose of these marks is simply to make re-assembly easier as lining up these marks will both reset the spring tension and also ensure the threaded Nose Cone is positioned where it will deliver the correct tolerances in the assembled unit that will allow free movement without binding or excess tolerances.

12: SUMMARY OF ASSEMBLY OPERATIONS

The following notes provide an overview of assembly of a unit and may be used in conjunction with the previous chapters for specific cross reference where there is any elaboration required for a particular assembly operation.

FUNCTION OVERVIEW ...

1: Select a boss using the Boss Selection Chart to match the particular orders to be assembled – Remove 3M 5200 / SIKA from freezer to thaw

2: Select the B/Carrier of the correct Hand

Clean and de-burr Blade Carrier – Check grease holes bored
Assemble the Boss with a Blade Carrier – Check for interference
Registration can be either side of recess

3: De-Burr Flats on Boss & Internal Tap burrs
Wash with soap and water with Teepol

Install the 4 x Reversing Tri Rollers with Loctite – Check free
Punch threads with Pin Punch to lock permanently

4: Select Collar to accept spring tail – check spring mounts flush
Mount Forward Veconite™ washer over Collar and check free

5: Select the Nose Cone – Shaft or Saildrive (Lombardini option)
Machine Nose Cone Face to required Nose Cone Trim pattern.
Check the thread is free on the boss with M50 x 2.5 thread

6: **INSERT FEELER GAUGES UNDER COLLAR FOR CLEARANCE TOLERANCES**
These ensure tolerances when Nose Cone is tightened on thread

7: Select the Spring – Chamfer ends and check depth

8: Assemble the Boss with grease and 3M 5200 / SIKA on the Locking Screws only
Tighten Nose Cone to eliminate tolerances
Back off to allow 0.10 or 0.004" clearances from feeler gauges

9: Preload the internal Torsion Spring – Tighten the split Collar

Seal and clean up the Nose Cone joints with 3M 5200 / SIKA and exit holes of the screws to provide a clean finished unit.

Torque Nose Cone screws down over split join
Torque Collar screws down over split join onto boss

Clean up unit with Mineral Turps – Leave to dry