Lap Fitting A Propeller To A Shaft

27-MAY-2011

Slide The Prop On The Taper

Step #1 The first step is to slide the prop or prop hub onto the shaft without the key. Be sure the shaft & prop hub are clean. Once it is slid into place and seated as deeply as it will go mark around the leading edge with a Sharpie marker, as seen in this photo.

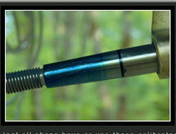
27-MAY-2011

Coat The Taper With Prussian Blue

You'll want to have some Prussian Blue on hand to coat the taper with. You can buy it at NAPA and it costs about $3.00. A small tube goes a long way. You don't need a ton of it but it does not like to coat evenly so you may have some low spots and thick spots which are not a huge deal.

27-MAY-2011

Slide The Prop/Hub Onto The Shaft Again



Slide the prop or hub onto the shaft again and seat it like you did when making the mark. Once seated lock the shaft and spin the hub around it about five-ten times and remove the hub or prop.

There are a number of techniques to using Prussian Blue. I find this one works well but some prefer other methods. The only critical thing is that your method results in a good fit.

In this photo you can see a clean area at the leading edge of the taper where the Prussian Blue has been wiped off. This clean area is the only area this new prop and shaft made good contact. This represents less than 15% contact and even with the prop nuts tight you might have only ever seen 20% contact. This can lead to point loading the shaft and a possible shaft fracture.

This shaft was brand new and made by a shop that does military shafting and has the calibrated dies to test the taper (not all shops have or use these calibrated test dies and they are normally only used to make sure the machines are in tolerance). This taper was tested, with Blue, and was spot on. That leaves the Flex-O-Fold prop taper as the likely culprit here.

This type of "fit" is not uncommon. The sad part is that most yards never even bother to check the fit and instead just slap the prop on. Fits like this are common because machines wear and differ slightly. The prop was machined at one shop, in another country, and the shaft at another.

21-MAY-2010

Apply Compound To Shaft

The process of lap fitting your prop to the prop shaft taper makes certain both the shaft and prop mate together on the taper well with no high or low spots and you achieve max shaft to prop mating.

When you see the inside of a prop with rings or high and low spots it was not reamed or lap fit properly. The mating of the two surfaces is actually very simple to do. They fit to each other through the act of rotating the prop around a locked shaft with the valve grinding compound in-between the two surfaces. The idea to to achieve a 70%+ contact area or better during this process. You can further check your work with Prussian Blue but it's not totally necessary.

Ideally, this should be done any time you replace a shaft or prop and are mating a new prop to an old shaft or if you are unsure whether it has ever been done. You DO NOT want to over do this though.

Step #2 Remove the key and apply a liberal amount of valve grinding compound to the shaft and slather the area where the prop will sit.

02-FEB-2010

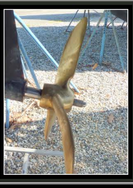
Valve Grinding Compound

The compound you use for this task is commonly referred to as valve grinding compound. I've used Clover Compound by Loctite and also the compound by Permatex which is available at most any NAPA Auto.

For this task I do prefer the oil lubricated valve grinding compounds as opposed to the water based versions. With the water based product the prop seems to bind more and is "grabby" when rotating it around the shaft. For this pictorial I used oil based Permatex brand. Any fine valve grinding compound will work.

21-MAY-2010

Slide The Prop Onto The Shaft



Once you have the compound on the shaft slide the prop onto the shaft but do not drive it on hard. Once it feels seated and is not wobbling on the shaft begin to rotate the prop on the shaft. It helps if you have locked the gear box into gear.

Rotate the prop about 5 times then remove it and inspect the mating surfaces.

21-MAY-2010

After Lap Fitting

Here is what it looks like after rotating and before wiping the valve grinding compound off the shaft. The picture with the compound wiped off came out all blurry so I'll need to take another one at some point. It should be noted that the prop is the part that will give up more material as it is significantly softer than most shafting unless you have an old bronze shaft.

The shaft and inside of the prop should look evenly ground with no spots that have not been honed.

27-MAY-2011

After 20 Turns

This article is a conglomeration of two different installs because the Prussian Blue pics came out blurry on the Campbell Sailor shoot. Either way this is what it will begin to look like after lap fitting. The Prussian Blue will be evenly distributed when done. Be sure to use some forward pressure on the prop when spinning it on the Prussian Blue. This one still needs a little more but not much.

When sliding the prop off the Prussian Blue use a quick straight back pull, no spinning, and try not to drag it along the shaft as you can make a mess if your new "evidence". You will invariably have some drag marks but you want as much fit evidence left on the shaft as possible.

When all was said and done with the Flex-O-Fold & Campbell Sailor there was better than 90% contact between prop & shaft. The entire process takes about 15 minutes to fit a prop to the shaft.

21-MAY-2010

High / Low Spots

In this photo you can see a couple of either high or low spots about half way down the inside of the prop & the concentric "rings" I was talking about.

This prop was worse before I started but the shots down through the bore never came out good enough to publish (note to self remember to bring flash!) This photo was only after about five rotations. I spun it a total of 22 rotations and these high/low spots were no longer visible making for a much better fit interface.

21-MAY-2010

Clean The Prop & Shaft

To clean the inside of the prop I use a terry cloth towel doused in denatured alcohol. Simply pull it through the prop a few times and you will be ready to install it.

Always check the keyway and make sure all the grinding compound is out of the it as well. If you can't get it clean with a rag you can use a q-tip to clean the keyway.

21-MAY-2010

Install The Propeller

To install the propeller you'll want to follow these simple steps.

1) Slide the prop onto the shaft, without the key, until it will not move any further.

2) Mark the leading edge of the prop where it meets the shaft with a fine tip Sharpie marker. This is your insert depth mark. When installed with the key, and torqued down, you should no longer see the fine point Sharpie marking.

3) Install the key and slide the prop over it and up the shaft. If you can't get to your mark the key is jamming the prop and needs to be readjusted.

4) Thread on the big nut and insert a block of wood between the hull and prop to lock it.

5) Torque the large nut preferably using the right sized wrench. These nuts are soft and can be rounded easily so a proper fitting wrench is a very good idea. The nuts for a 1" shaft are usually, but not always, 1 1/4".

6) Once the prop has been torqued down remove the large nut and replace it with the thinner nut and torque it down.

7) To properly torque the prop nut you may need a block of wood between the hull & prop. Please use EXTREME caution doing this with folding or feathering props, in fact try NOT to. Even older fixed blade props that have been re-pitched can be too soft for this approach. Always use the wood as close to the hub root as you can get.

The best method for torquing the nut is to use a high quality strap wrench on the shaft instead of a block of wood but you'll want a decent one as the cheap ones tend to slip on small diameter shafts.

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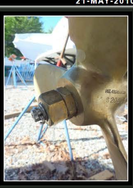
Proper Installation of Nuts



Yes, the small nut is supposed to go on first acting like a lock washer, with the big nut backing it up. I always torque with the big nut then flip flop them and lock them onto each other with two wrenches.

Once the nuts are on and torqued install your cotter pin. I have found that if I don't really bend over the cotter that it can hook weeds. Ideally you don't want to bend them that much, but figure out what works for your local waters.

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