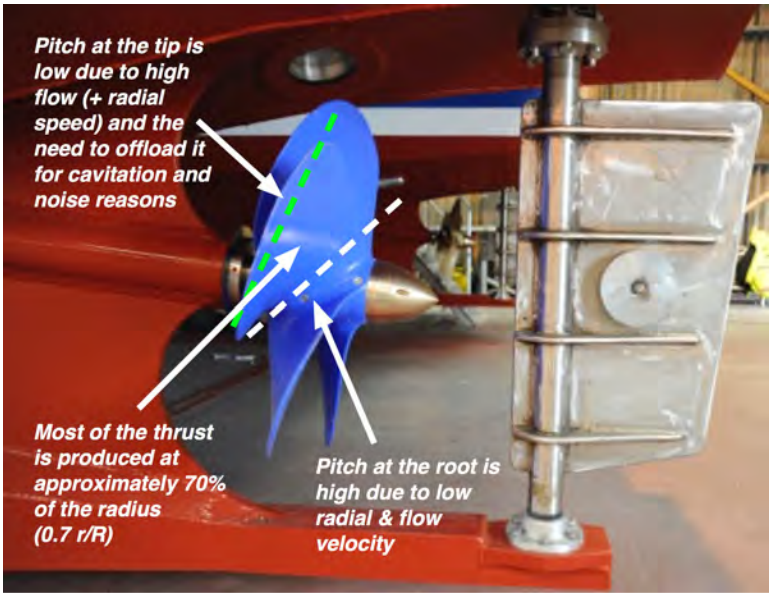
The advantages of Varifold's true helical pitch distribution

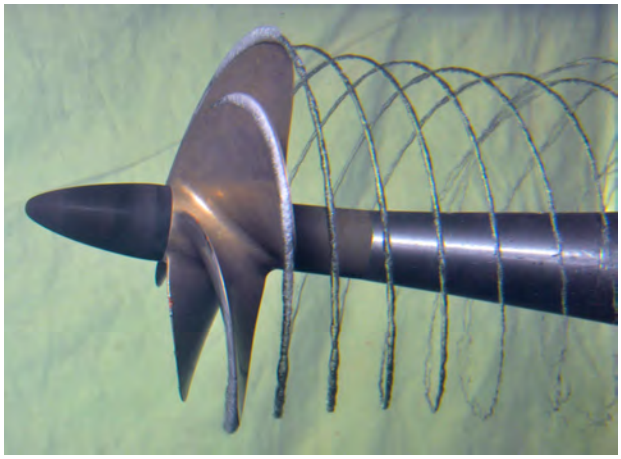
There are many options to choose from when selecting a sailboat propeller. Do you choose fixed pitch from the manufacturer? Or a folding propeller? What about a feathering propeller? Each of these designs have their strengths and weaknesses, this technical bulletin will explain the benefits of adopting a Varifold Folding Sailboat Propeller as your next propeller of choice.

There are three main types of sailboat propeller, the fixed pitch, the feathering and the folding propeller. The first is the fixed pitch and is the most common design. This is a standard no frills off the shelf unit which powers great, but when under sail it will windmill, i.e. rotate on its own if not locked off. This rotation, or even locking of the propeller, all costs energy. So aside from wave making resistance, frictional drag inherent in any vessel you are not getting the full effect of the wind in your sails as you are effectively dragging a "bucket of water" behind you.

So how do we reduce this? Well the second, and fairly popular option is to use a feathering propeller. This type of propeller "thinks" like an aircraft propeller. The pitch is set dynamically depending upon the rotation of the propeller. When the shaft is not turning the blades take the least path of resistance and align themselves with the flow, effectively weathervaning and generating little or no lift. The drag of the propeller has been reduced significantly but to feather effectively the blade needs to present a small area to the flow that does not create lift or turbulence. The blade shape of a feathering propeller is similar to those on a turbo-prop plane, they are straight with little or no pitch distribution (twist if you like), to the blade. This is a requirement of the design, so that the blades remain still and streamlined when not in use. While this works great for aircraft, water is a different medium. Naval Architects have to contend with the lower efficiencies from this simple blade design together with other flow phenomenon that limit the design such as cavitation.



For a feathering type propeller, the pitch at the root, mid-blade and tip are all the same to allow for the feathering to occur. This means that there will be not enough pitch at the root and too much pitch at the tip owing to the linear distribution, i.e. all the same pitch. However modern propellers use a pitch distribution, which means that the pitch is optimized at different radii of the blade for the correct inflow angle. At the root where the radial speed and inflow speed are slower, the pitch is higher and can easily be up to 45 degrees, depending upon the design. The pitch is reduced at the mid blade region where the propeller does most of it's work to generate thrust. Then towards the tip, the water and rotational speed of the blade are fastest of all, so less pitch is required but an additional reduction is introduced to help suppress cavitation even further known as tip unloading.



To return to the aircraft analogy there is another important aspect to consider which will limit the use of a feathering propeller and it has to do with lift. Lift in it's simplest form is created when water flows faster over one side of a propeller blade than the other. The flow under the blade makes a positive pressure and most people think it is this force that creates the lift, it is not. The water that goes over the top of the blade has to leave the blade at the same time as the bottom, according to the continuity law, but clearly it has further to go. The additional distance is achieved by the flow speeding up, but this causes the pressure to drop, known as the Bernoulli effect. It is this pressure drop which creates the lift. When this pressure drop falls below the vaporization pressure of the water it will "cold boil" or cavitate. The process is actually very similar to water boiling, except instead of heat you use low pressure to boil the water. Think Hunt for Red October and submarines, all those bubbles! Well the bubbles are like your car wheels spinning and getting nowhere, again wasted energy. But it is also noisy and with lots of vibration as the bubbles are vacuum filled and constantly imploding. So for feathering propellers they are good under sail, but under motor they are prone to noise and vibration from cavitation, and other flow phenomena due to the unoptimized pitch distribution at the root and the tip.

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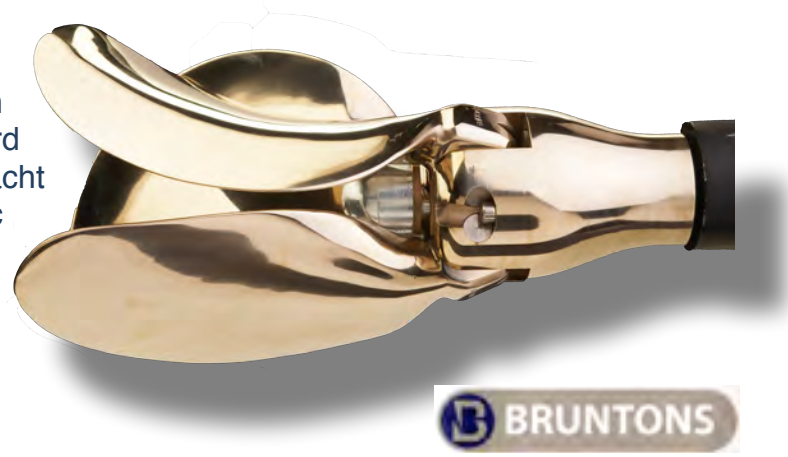
So how do we fix that? Well the third way is to use the benefits of both the fixed pitch propellers blade section, shape and pitch distribution coupled with the ability to move the blades into a low drag regime like a feathering propeller. The Varifold concept was built on this idea of good blade design with the blades able to pivot out of the flow when not in use. The Varifold performance is achieved by state of the art blade design (true airfoil sections) and proper blade pitch distribution to offload the tip (reduce the pitch) by 15%. As mentioned above, this tip off-loading radically reduces cavitation and, in combination with the skewed blade design, greatly reduces noisy pressure pulses against the hull that are responsible for the vibration and noise when under motor. This is something Brunton's Propellers incorporates with their fixed propeller designs for luxury Motor Yachts! The Varifold propeller hub is also streamlined, with the blades neatly tucked behind this profile. The blade tips overlap very slightly when the propeller is folded, this enables the blades to open effortlessly when going astern. The hydrodynamic pressures as well as the centrifugal force deploy the blade.

Finally it is important to understand that sailboat propellers generally use a smaller Blade area ratio (BAR) because the blades have to fold or rotate. The low BAR makes the propellers prone to cavitation and noise. To combat this you need good blade sections, correct pitch distribution and careful use of other factors such as blade camber to give an efficient and low noise design. Bruntons Propellers have incorporated their extensive propeller knowledge to solve these challenges and deliver a truly special propeller - The Varifold.

The Varifold Folding Sailboat Propeller has already proved to be a very successful propulsion package for large sailing yachts. It is now standard equipment on a growing number of high quality yacht manufacturers; these include; Swan, Baltic Yachts, CNB France, Southern Wind, Oyster Marine, Solaris Yachts and many other one off build projects from 15m to 50m.



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