Varifold designs sail quieter!

Even to the untutored eye close examination of a Varifold folding sailboat propeller says excellent design and build quality. Hardly surprising when you realize that Bruntons Propellers are far from just being a supplier of propellers to builders and owners of leisure craft. The company designs and supplies propellers of the most advanced design to navies and commercial ship builders around the world and this expertise has been a big part of the success of Varifold. Sail boat owners have often endured high noise, vibration and cavitation levels, poor astern performance and unreliable blade opening when using folding propellers in the past. Today, with Varifold range covering all sizes of yacht, owners can experience and enjoy Varifold's performance, reliability, very low noise and vibration characteristics giving a better, quieter and more enjoyable sailing experience. This technical brief will explain some of the hydrodynamics behind the Varifold design and what makes them such an attractive option for sailboat owners and in particular how they deal with boat wake.

First it is important to understand that Varifold's performance is achieved by state of the art blade design and proper helical pitch distribution, including pitch reduction towards the blade tip. 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. No other manufacturer offers this full package on such a wide range of folding propellers.

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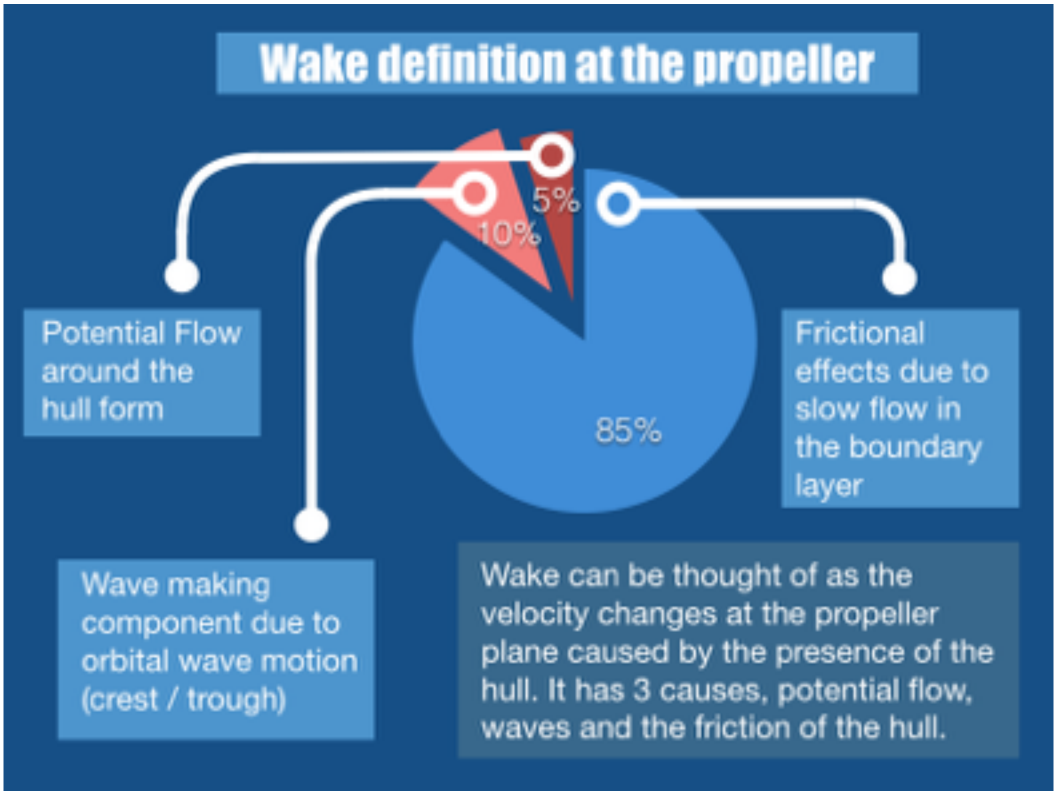
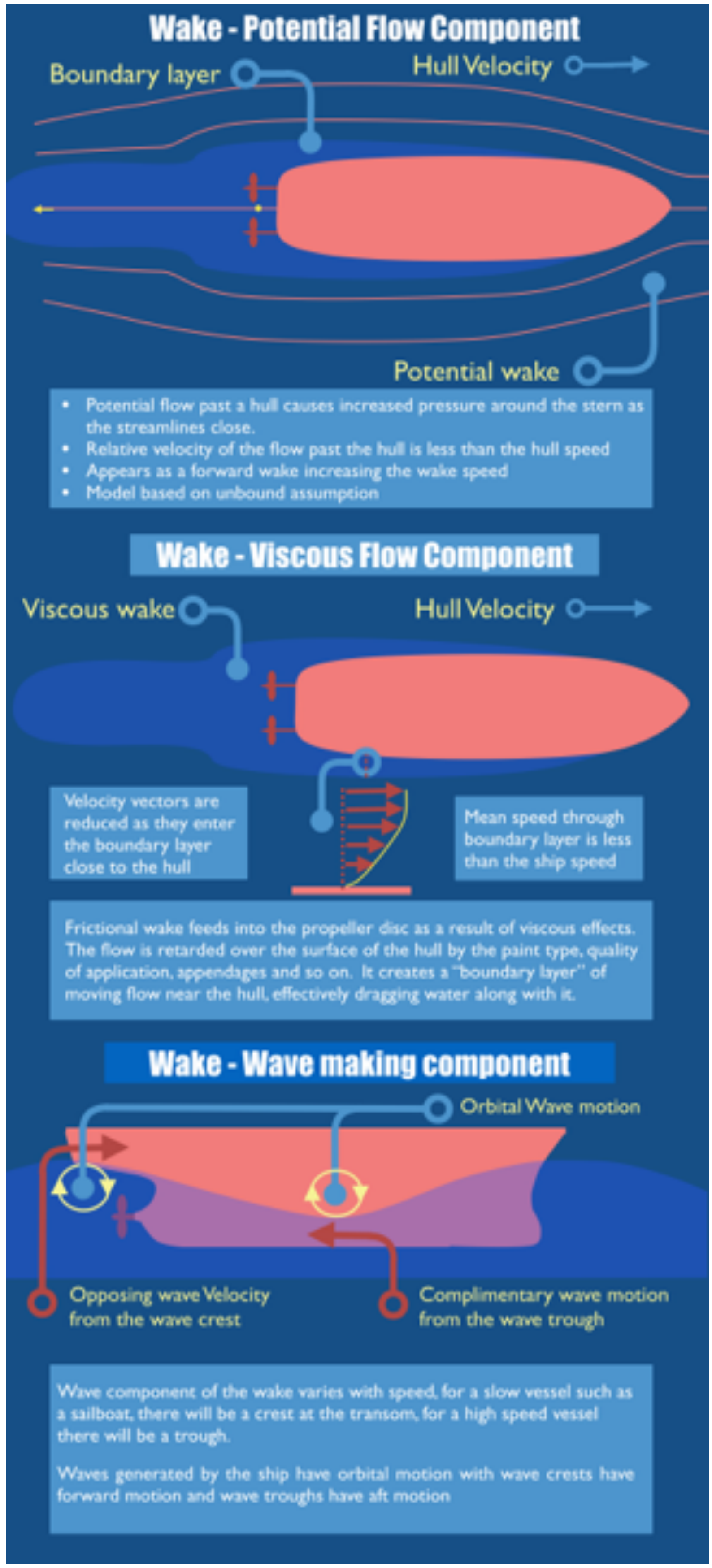
One of the key points to understand about the operation on any vessel is the environment the propeller works in and the role wake plays on both the performance of the propeller and onboard comfort. Under sail, motive power is a linear force on the sails providing a smooth and quiet form of propulsion. Screw propellers on the other hand, rely on rotational velocity and the lift generated by each of the blades to generate forward speed. An ideal scene would be to have the propeller operating in unrestricted, clean flow, something the hydrodynamic guys call an open water propeller. But in real life the flow has to be pushed out of the way by the bow, be dragged over the paint surface, work its way over the latest barnacle outcrop, past the centerboard and into the propeller plane. After this journey the velocity in the propeller disk is not ideal and is known as the wake gain, or wake fraction. The wake is caused by 3 main factors, potential flow around the hull, friction of the hull and the waves the vessel makes. The contribution to the wake proportions on the chart to the left are for a typical vessel. In reality these depend upon the type of vessel and the speed of the vessel and several other factors.



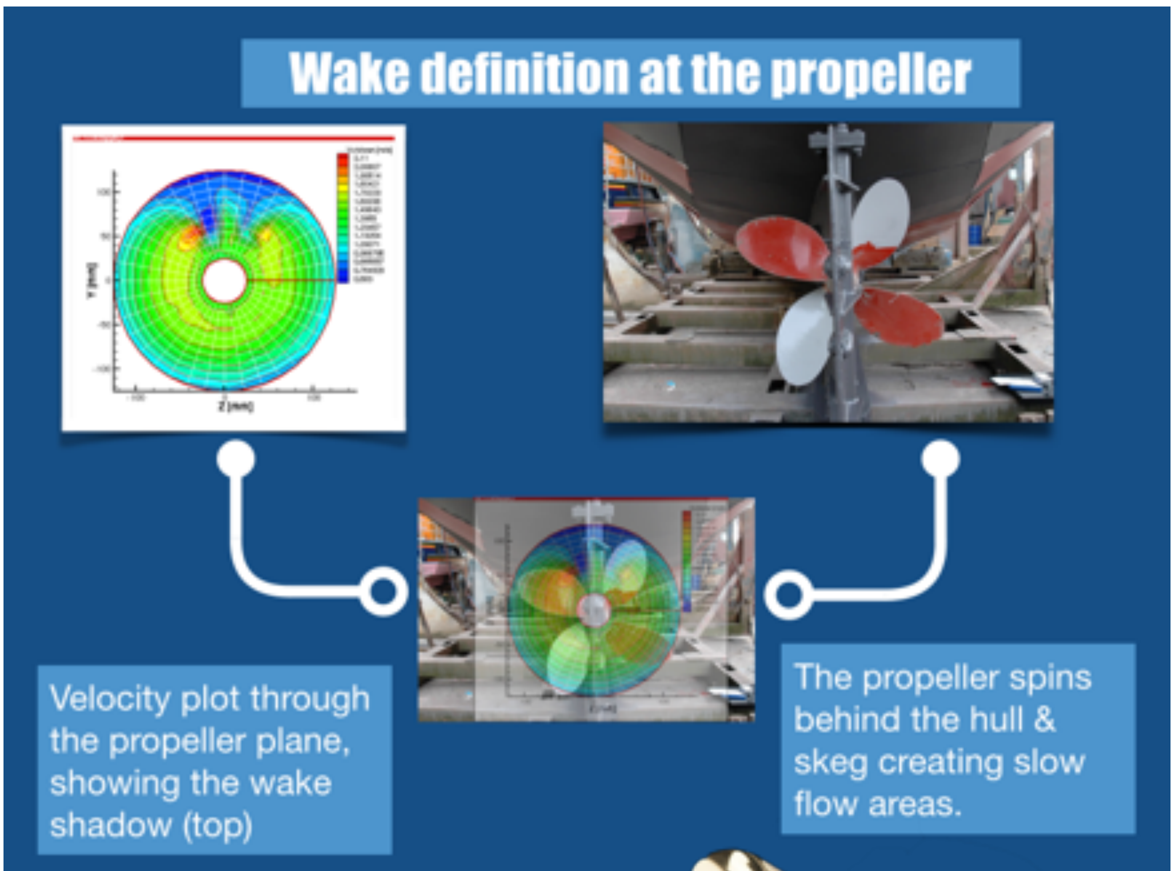
To explain the Naval Architecture a little better, the infographic on the right will help. The flow around any propeller near the hull is affected by the presence of the hull and it is usually less than the flow a little away from the hull. The flow is slowed down on it's journey around the vessel by many factors, even changing the flow direction, making it go further slows things down.

So the first item that slows flow down is the potential flow effect. Naval Architects often assume the flow as being potential i.e. free of viscosity as it simplifies calculations and by and large is a good assumption when modeling a hull. You can see from the infographic that the flow has to move around the hull, but with the continuity laws for the fluid to go further parts have to speed up, when they do you get a pressure drop. At the stern when the flow comes back together this slows the flow due to the increased pressure, giving it the appearance of forward velocity.

The second component is by for the largest and is the frictional component due to the paint, surface finish, appendages and so on. Any aspect that has a frictional drag associated with it, even things like openings will all cause flow separation and drag. The friction of the hull form creates what is known as a boundary layer, a volume of fluid close to the hull that is effectively dragged along with it. This boundary layer can be inches or feet wide depending on the vessel. For single screw vessels it is important as the propeller operates in this slower turbulent flow.



The last component is one many owners might not realize as being contributory. Waves have a circular motion and you can be with or against a wave depending upon the speed. Think how a wave runs up a beach once it cannot travel any further, the rotation is translated to forward linear motion. A crest therefore is moving forward and a trough is moving backward. The ideal scenario would be a trough at the transom so that there is no water being forced forward opposing the vessel. It is a little tough to grasp but for sailboats at regular speeds the crest at the stern is actually slowing you down and it enters the propeller disc slowing the flow down in turn.



Putting this all together you get a velocity distribution at the propeller disc as shown above, the blue at the top is the slow flow and the green at the bottom is ambient flow.

In real terms this gives a velocity difference, as the blade swings in and out of this region it will experience similar effects to an aircraft wing in turbulence, that is vibrations. To minimize the effect of the blade passing through these velocity changes becoming resonant Varifold has a curved leading edge known as skew. This is important as it allows the blade to pass through the "wake shadow" gently rather than the shock effect of a straight leading edge blade, bang, bang, bang. The varifold skew distribution coupled with the pitch distribution is technology transferred from Bruntons Mega Yacht business and is one of the key benefits in fitting a Varifold propeller. The noise saving can be as much as 10 dB. This is in combination with true blade section design gives the Varifold a comfortable working environment where it can perform admirably and quietly. The wake optimized design means also that the likelihood of cavitation is suppressed and that the pressure pulses on the hull above the propeller plane are less likely to cause resonant noise and vibration elsewhere in the hull structure.

All of these benefits are expected in a fixed pitch propeller, but not in a folding sailboat propeller. Varifold stems this gap and allows sailors to enjoy their passion on a quieter and more efficient sailboat. The remarkable Varifold propeller range has grown from a single two bladed model to include three and four blade versions. Varifold is the propeller of choice for many highly respected yacht manufacturers and their customers. Varifolds are now being fitted to Swans, Baltic Yachts, Leopard Catamarans, Wally's and Moody's to name but a few. If your yacht has an engine from 20hp to 750hp, there is a Varifold for you which will provide high thrust with smooth and quiet running. The four blade has already proved its abilities, having been fitted to yachts where existing propellers have been unable to cope with large engines operating in light structures. Varifold's unique design provides excellent power both ahead and astern with minimum noise and vibration. Tests have shown noise levels can be reduced by up to 10dB.