Tell Me Why I Need PropExpert…

Comments from Donald MacPherson, HydroComp's Technical Director

Maybe you don't need PropExpert. And if you don't, we won't try and push it on you. But, as a manufacturer, vendor, designer or boat builder, if you frequently need to choose propellers or transmissions for work boat or pleasure craft applications or need to see what a particular propeller is going to do on a boat, then perhaps you do need PropExpert.

Let's be honest with each other – ***you are placing your company's reputation for competence in the hands of your software***, as I also do in my own use of PropExpert. At HydroComp, we utilize our software products as part of a sizeable consulting business, and I personally am perhaps our most critical and outspoken "customer".

The following comments are offered as the thoughts of someone who is both its developer and a discriminating user.

I currently use other software. Why change?

For certain well-behaved applications, like ocean-going freighters, almost any software will do. These are lightly loaded propellers with sufficient diameter, and it is likely that all of the different software will quite closely reach the same recommendation. It is where the propellers are more heavily loaded, as for fast craft or towing vessels, that basic software is less reliable.

To see how your current capabilities stack up against PropExpert, …

Ask yourself, "Does my software..."

...analyze the selected propeller "on-the-hull"?

In its simplest form, all propeller software can select diameter and pitch given only speed, power and RPM. This, of course, assumes that the speed is accurate and that the engine is capable of driving the hull to that speed.

PropExpert runs a two-stage calculation. First, it makes an optimum recommendation for the design speed, power and RPM. Then, it analyzes this propeller against its defined thrust requirements (its predicted drag curve) and modifies the design speed as required until a proper match is found. This analysis not only determines achievable top speed, but also thrust, power, efficiency, cavitation and even fuel consumption.

Remember, a propeller selection is not just running a few numbers through a formula. It is finding the best propeller that meets the needs of a vessel, and the only way to know this is to explicitly evaluate how the propeller will actually perform on the vessel.

...solve for the best gear ratio?

Sometimes we have the opportunity to help determine the best gear ratio, as well as the best propeller. There are different ways that this can be performed, but typical methods do not always point to the most efficient ratio. Based on our work for the large motor yacht industry, we have developed and incorporated into PropExpert unique algorithms to find this most-efficient gear ratio [see *Professional Boatbuilder* Dec/Jan 1997].

...evaluate cavitation and blade strength?

It is fairly simple to determine the amount of cavitation on a propeller, and whether there is adequate blade area to handle it. As more-and-more of our applications are for highly loaded propellers, however, it is altogether something different to predict the effect of excessive cavitation and also whether the blade material can handle high thrust loading.

PropExpert can evaluate the amount of cavitation as described above, but it can also determine if the propeller is likely to develop "thrust breakdown" due to excessive cavitation. It contains formula to calculate the reduction in thrust and power accordingly. In other words, with PropExpert you can actually see the "overspin" typically found with fully cavitating propellers. You can also check if standard blade material is adequate for the application, or if you need something higher strength, such as nickel-aluminum bronze.

...provide for different propeller styles (e.g., Gawn)?

In 1975, a Dutch research institute produced the first numerical formula for marine propellers. These algorithms form the basis for virtually all propeller software. The propeller style (called the B-series) was typically used on ocean-going cargo ships, but it also saw use on tugs, trawlers and other vessel types. Also known as the Troost style, it is a well-used, efficient design.

Many programs base their calculations for all propellers on these B-series formula. Unfortunately, not all propellers are of the B-series type. In fact, for work boats and pleasure craft, the vast majority of propellers are not B-series. Why? B-series propellers are prone to early cavitation and thrust breakdown. To handle growing levels of cavitation and thrust loading over the years, alternative designs, such as the Gawn (or ogival) propeller, are now much more popular. With its flat face, the ogival propeller is also easier to manufacture and repair.

What this has to do with propeller software is simply that you get wrong answers trying to size a Gawn propeller with a B-series formula. The difference in recommended pitch, for example, can be greater than 5% – a huge difference if this is 5% overpitched and the engine is now overloaded.

…handle unconventional propellers (e.g., folding and feathering models)?

Propellers that are not of a standard fixed-pitch type can still be evaluated with PropExpert. The approach used in PropExpert is to base the performance of the propeller on one of the standard types (e.g., Gawn, B-series) and apply suitable thrust and power correction factors. The goal is to have PropExpert predict compatible thrust and power relationships that correlate well with the actual performance. Each model of folding and feathering propeller is different, so there is no one set of standard factors, but you can easily find these by matching the PropExpert calculations to known trial performance.

...allow you to consider alternatives, such as 5 blades or cupping?

Contemporary solutions to the excessive cavitation we see with highly-loaded applications include higher blade area propellers (like that found with the newer 5-bladed propellers) and cupping. It is not widely known that these 5-bladed propellers require different design criteria, such as a lower tip speed limit to account for the greater water restriction between the blades. Also, it was not possible until recently to determine the effect of cup on thrust and power performance.

Both of these features need to be explicitly evaluated. PropExpert employs proper criteria for these more contemporary options, and is the only commercial product that considers the effect of cup. (Not only does HydroComp create the software, but we also develop the technology. We did the new development of the numerical cupped propeller performance model, presented to the 1997 *Propeller Symposium* of the Society of Naval Architects and Marine Engineers.)

...optionally use sea trial data to predict speed?

As we noted above, getting the proper design speed is critical to the proper selection of the propeller parameters and gear ratio. Reliably predicting speed is therefore very important. When you have very little data about the vessel, it is difficult to get a confident result.

While PropExpert allows you to use an "average hull formula" to predict speed – which has proven quite good – an even better way is to "correct" this average speed prediction based on results of a sea trial. When doing a repowering analysis, for example, we often know that the boat was making a certain speed at a given RPM. We know its engine, gear and propeller. PropExpert can take this data, "back-engineer" its actual thrust-making and power-absorbing performance, and use this thrust and power to anchor the speed prediction to this know real-world performance.

For a boat with a poorly operating propeller, it is this feature, as much as any, which insures that the proper propeller correction can be determined the first time. With PropExpert, those days of trying two or three propellers before you got it right are gone.

...incorporate engine power curves into the calculation?

Propellers for towing vessels have been traditionally sized with a bollard calculation - where the speed is zero and the RPM is the engine's rated value. Then the thrust calculated at this condition is represented as the "bollard pull". While this is a simple calculation to compare vessels such as tugs, it is a completely fictional scenario. Water speed into the propeller is never zero (there is some advance velocity), but more importantly, an engine does not always have the power to run the engine up to full RPM. This is particularly true when a propeller has been sized for some intermediate compromise speed and the propeller is actually somewhat overpitched for the bollard condition.

PropExpert utilizes an appropriate engine power curve for its towing calculations. You can even enter specific values for any engine, as you might do with the new electronic control engines. You can see cases of engine overload as PropExpert finds the equilibrium RPM where the propeller needs what the engine is actually capable of delivering.

In summary

PropExpert uses real-world models for its calculations. It does not rely on simplistic approximations of vessel or propeller performance. All of the features I have described above were added to insure the reliability that we demand from PropExpert. ***If you recommend or evaluate propellers or reduction gears, and are involved in applications that are pushing your current ability to get reliable results, then you might need PropExpert.***

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