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the crew REPORT

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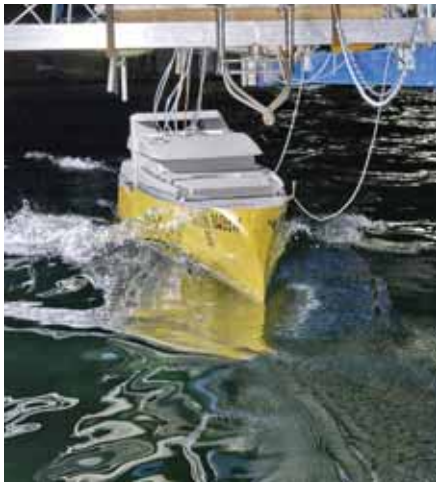
A Fuelish Game to Play

Whether the motivation is environmental or economical, reducing the fuel consumption of a superyacht has its benefits. Unless your vessel decides to put down roots in a home port and leave adventure to the rest of the fleet, other options need to be considered in order to reduce the guzzle of gas. There are manifold ways of improving fuel efficiency, from changing hardware to operational practice; *TCR* asked two knowledgeable establishments for their recommendations.



Feadship's MY Predator*: tests in a seakeeping and manoeuvring basin (left) and on full scale (right).*

Performance Analysis

High bunker prices and worldwide economic awareness make the issue of fuel saving important in all fields of shipping. Environmental care is furthermore an important driving force for reduction of fuel consumption. Low fuel consumption is essential in Atlantic crossings due to limited bunker capacity of superyachts. Superyacht captains and crew are confronted with high fuel prices but have the possibility to reduce fuel consumption through operational measures.

Reducing fuel consumption onboard superyachts requires a different approach to commercial vessels, however the basic physics is still the same. The Maritime Research Institute Netherlands (MARIN) has over 75 years of experience in model testing of ships and yachts. These model tests are done to find an optimal compromise between onboard comfort (ship motion and vibrations) and fuel economy. In designing and operating superyachts, as with passenger vessels, the compromise often tilts towards onboard comfort, surrendering on fuel economy. Whereas in commercial cargo shipping, crew comfort is often secondary to fuel economy. The need for operational measures to reduce fuel consumption is therefore high in superyachts.

The approach to reducing fuel consumption at MARIN is to concentrate on the physics of ship hydromechanics, which is applicable to all vessels. Measures introduced for the commercial fleet are therefore also applicable for superyachts. The main difference in fuel saving between superyachts and commercial vessels is the unclear balance between fuel costs and "cargo income" for superyachts. The benefit of increasing speed to arrive at a specific time – say for charter – or the loss due to decreasing speed cannot be weighted against the financial consequences of the decision. Optimisation of the speed for a certain trip is therefore difficult. On departure, a navigating officer will normally choose a higher speed setting to make up for potential bad weather or other delays later on. Along the route, when it becomes clear that the ETA will be met, speed will be reduced to avoid waiting times at port. Due to the non-linear speed-power relationship, the fuel consumption of this scenario is higher than when a constant, lower speed setting is used. This can be done when the performance of the vessel is known in relation to weather conditions expected along the route (see information below on fuel consumption and weather).

Other potential fuel savings on superyachts can be found in the settings of the autopilot and ship trim. The autopilot setting is important in superyachting as tests have shown that active use of the rudder increases the fuel consumption.

Onboard Analysis

Essential in fuel savings, onboard analysis should be carried out and displayed directly to the crew. Performance analysis consists of correcting for environmental conditions (wind, waves, current and water depth) and loading conditions. By doing this, a comparison can be made between different trips without the interference of these different conditions in the results. By changing the autopilot settings and where possible the trim, the difference in performance can be found in the analysis results. This will result in extensive knowledge of the yacht's performance over time.

In addition, by long-term monitoring the decrease of the hull performance can be discovered, which is caused by hull and propeller fouling and roughening of the hull due to damages caused by, for example, anchor chains.

Performance Results

Performance monitoring shows that the effect of fouling on both the hull and the propeller is significant. With superyachts at high speeds, the frictional resistance is relatively low compared to the wave making resistance (a function of the hull's shape). Since fouling only affects frictional resistance, it can be said that the relative effect of fouling on the fuel consumption is less for superyachts than for commercial vessels sailing at speeds below 20 knots.

On the other hand, a reduction of ten per cent in the frictional resistance due to periodical cleaning of the hull still has a significant reduction in fuel consumption. With the operational profile of superyachts where a large amount of time is spent in the harbour and in warm waters, the hull and propeller are liable to fouling. In this case the effect of fouling on the frictional resistance might even be higher than the aforementioned ten per cent, which in turn makes the effect of fouling on the fuel consumption a serious issue.

Fouling on the propeller for superyachts is similar to commercial vessels. Full-scale tests of a commercial vessel have shown an increase in propeller efficiency as high as 14 per cent due to propeller cleaning and polishing. Periodical in-water cleaning of the propeller will save several percent on the fuel bill. Exact figures can be determined by performance monitoring.

By Maarten Flikkema, MARIN www.marin.nl

Marine Weather

Navigational decisions must be taken without undermining safety and comfort of the guests, which are primary concerns for both the captain and the marine weather forecaster. However, how the vessel is controlled in the weather may have more impact on the operational costs of a yacht than would be originally presumed.

Before taking the weather factor into the equation, however, it has to be said that the fuel consumption is also dependent on the vessel performance and design. For example, in displacement yachts fuel consumption levels are good at moderate speed, but increase disproportionately at higher speeds due to the increased power required to counteract wave resistance (which is high as its hull is more robust and heavier than a high-speed vessel, ensuring greater stability). High-speed yachts are more sensitive to wind and sea as they plane on the water; in certain conditions they become difficult to operate, especially at high speed, and sudden changes in wind speed can negatively affect their stability.

It is not just the wave impact speed that has an effect on the yacht, but also its direction. The worst direction in which to travel is directly into the waves, as the distance between each crest is shortest. The vessel can find itself in a situation where the bow of the yacht has not completely recovered stability after hitting a wave before the next hits. This "tormented" tack inevitably has a large impact on fuel consumption, so it is important to adjust the speed and use flaps, where fitted, for optimised trim.

One significant technological improvement has been the introduction of pod propulsion systems – more efficient than normal propeller-and-shaft engines because they are able to run constantly at an optimised number of revs per minute. Considerable reduction of fuel costs are also attained through proper speed-power setting, optimum trim and autopilot settings that have proven to improve efficiency by five to ten per cent.

However, performance analysis on its own does not save fuel or reduce emissions. Comparing current performance with that of previous trips helps, but it is also important to use weather reports to optimise speed and trim to improve performance.

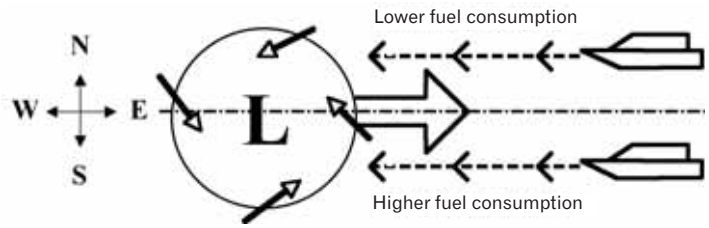
How far a vessel travels is important and charter companies are becoming »

increasingly aware of the energy crisis. This means, for example, paying more attention to destination choice and determining the most cost-effective route.

One has to bear in mind that sometimes the direct route is not always the fastest or most favourable. For example, in the northern hemisphere when having to cross a low pressure system that is moving eastwards, you need to take into account various factors in order to establish the route based on where the vessel is positioned and how fast it is moving in relation to the low. These factors include whether the low is weakening or deepening, any variations to wind speed and direction determined by orography (the study of mountain ranges) or other factors. For a yacht making a westerly route into this low, it is more beneficial to pass over its northern sector to find more favourable conditions, whilst on the southern sector winds and waves will come against the direction in which the yacht is moving, generating a much higher fuel consumption (see Figure 1).

Usually, the best way forward is to make an optimisation, finding the balance between distance covered and the time taken for a passage. Another important factor is the stability of the yacht and in this context the yachts without stabilisers suffer more in heavy marine weather conditions.

Figure 1



It should also be considered that, although good planning for a passage is crucial, conditions can change enroute, sometimes even significantly – especially on long passages. This is why continuous observation of the actual weather and the frequency of weather updates become very useful.

Often, saving fuel is easier said than done because a captain has to stick to tight schedules or sometimes change plans to accommodate the guests' wishes to head to a different location or escape a long spell of wet/windy/cool weather.

In general, however, it is not possible to choose the exact best route to reduce fuel consumption. Often, especially with guests onboard, the most important thing is that they enjoy the voyage and to stick the plan. Cruising speed can be better optimised with longer passages, but an unexpected change of marine conditions or the necessity to reach a destination in timely fashion make it impossible to reduce the speed of the vessel.

Nowadays, naval engineers and architects are paying increasing attention to the problem of fuel consumption; but undoubtedly good weather route planning and the extreme care that captains give choosing favourable sea conditions issue will make the difference in the future to save on operating costs and make a lower environmental impact. ■

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