

PERFORMANCE MEASUREMENT ON ELECTRIC BOAT



Case Study By **Nika Pockaj**, Marketing Manager, Alfastreet Marine, and **Bernard Jerman**, Regional Sales Manager SEE, Dewesoft

The Slovenian boutique boat builder, Alfastreet Marine, has introduced a brand-new boat model – the 28 Cabin Electric. To evaluate the performance of a fully electric version of this model, equipped with twin electric Piktronik 10 kW engines, Alfastreet needed to test its stability and performance and also to compare data from simulations with actual measurements. The Dewesoft Power Analyzer was applied to measure the electrical power of the two electric motors and the boat speed in real-life situations.

The company Alfastreet Marine is a producer of boutique boats, small and intimate vessels for leisure, that at this moment come in three different sizes – 18ft, 23ft, and 28ft. With 10 years of experience Alfastreet boats, today are sold in 20 countries worldwide, 75% of these boats sold are electric.

In design and development, Alfastreet pays attention to every single detail to ensure an optimal combination between

functionality, timeless design, and high usability - all this to create the best experience on the water.



Figure 1. The ergonomics cockpit of type 28 offers comfortable seating for 12 persons.

Alfastreet Marine offers a wide range of boats with customized options. Buying a boat, each of the customers has to customize their own boat by the design, but also, by the propulsion system and type. Selecting either electric, diesel, petrol, or semi-hybrid

propulsion - each has different performance results.

Depending on the selected propulsion system, Alfastreet uses displacement or planing hulls. The displacement hull has a convex, bottom contour or planing surface and does not ride high on the water like a planing hull, but is plowing through and parting the water, while a planing hull has a flat or concave bottom contour and plane up on top of the water.



Electric Range	Motor Range
Length: 8,6 m / 28' 3"	Length: 8,6 m / 28' 3"
Length over all: 9,8 m / 32' 2"	Length over all: 9,8 m / 32' 2"
Beam: 2,9 m / 9' 6"	Beam: 2,9 m / 9' 6"
Empty weight: 4300 kg / 9480 lbs.	Empty weight: 4300 kg / 9480 lbs.
Draft: 0,8 m / 2' 7"	Draft: 0,8 m / 2' 7"
Max persons: 12 adults	Max persons: 12 adults
CE certificate: C	CE certificate: C
Engine: Up to 50 kW	Engine: Up to 450 kW

Table 1. The type 28 Cabin specifications including both types of propulsion.

THE CHALLENGE

The 28 Cabin models come with a variety of customization options but the main advantage of the boat is the use of two types of hulls. Using two varieties of hulls enables better performance, stability, and maximum efficiency on the water. Whatever engine is chosen, the 28 Cabin Sport should be a safe and comfortable cruiser that exudes quality and enjoyment even when reaching higher speeds.

The electric version of the 28ft Cabin Electric model is designed for the luxurious leisure experience on board and with her unique displacement hull design offers optimized performance, as well a low electricity consumption.

Knowing the performance capability of the boat is important since each customer has different demands for the speed, range, engine power, and lithium ion battery pack.

The goal is to have data that can be presented to the customers with the intention of a better and even more understandable presentation of the boat and its features. Results should show the advantages of the boat and its navigability.

THE SOLUTION

The Dewesoft power meters provide the most flexible solution for all power analysis calculations as well as electrical power and mechanical power measurements. It is a combination of multiple products in a single device:

- Power Analyzer,
- Combustion Analyzer,
- Oscilloscope,
- RAW Data Logger,
- Spectrum Analyzer,
- CAN logger,
- etc.

and delivers synchronous acquisition of all data - electrical data, mechanical data, vehicle bus data, positioning data, video, etc.

Dewesoft Power Analyzer is used in a variety of different applications in several industries. In this case, a SIRIUSi single slice data acquisition system with High Voltage and Low Voltage amplifiers with AC and DC current clamps was used.

Dewesoft Power Analyzer allows the use of different current transducers and sensors, depending on the required measurement accuracy or the available space for sensor installation.



Figure 2. SIRIUSi HS 4x HV, 4x LV with DS-BP2i. Measurement Setup

The 28 Cabin Electric boat is best suited for sailing on lakes because of the displacement hull design, nevertheless, measurements were performed at sea using this hardware setup:

- SIRIUSi HS 4x HV, 4x LV DAQ system
- DS-CLAMP-1800DC current clamps
- DS-BP2i battery pack
- DS-IMU1 inertial sensor
- Logitech C920 webcam

Data recording, visualization, and analysis were done with the DewesoftX software package with the POWER-OPTION. For the electrical power calculation, the DC Power system configuration of this Power option was used.

The voltage signal from the batteries was connected to the HV amplifier, DS-CLAMP-1800DC current clamps were connected to the LV amplifier. The current clamps were chosen for this application as they are easy to mount. Dewesoft battery packs, DS-BP2i with a total capacity of 192Wh gave some hours of equipment power autonomy.

Besides electrical values, boat speed and position were also important parameters meaning that also a DS-IMU1 inertial sensor has to be applied. Such sensors are a combination of multiple sensors like gyroscope, accelerometer, magnetometer, pressure sensor, and a high-speed GNSS receiver. Coupled with sophisticated algorithms they deliver very accurate and reliable navigation and orientation.

For the visualization of the testing process, a standard webcam was connected as well.



Figure 3. The DS-IMU1 and a Logitech webcam connected to the PC.

The setup was prepared and all sensors connected within just half an hour as the current clamps with TEDS chips inside

the connectors are automatically recognized in the Dewesoft software.

MEASUREMENTS

To verify the specifications of two electric motors and the power on the batteries, measurements of DC current and voltage on the batteries (charging and discharging) and calculations of the power output had to be performed.

The stability and the performance of the boat were tested in different real-life situations measurements were done at different driving conditions - during extreme maneuvering and maximum speeds:

- Steady acceleration
- Rapid deceleration
- Turn
- Single motor ride
- Turn with one motor



Figure 4. A webcam and an inertial sensor allow the creation of a measurement screen that is both comprehensive and clear.

The various maneuvers were performed during the test. The measurement screen comprises all the data needed - showing the DC voltage, current, and active power for each battery, while video and data from the inertial sensor provide additional information on the testing conditions. The current signals - the blue and gray curves, indicate that several steady acceleration tests were performed.

The screenshot above shows the measurement of steady acceleration that was repeated several times. Alfastreet is mainly interested in the final speed of the boat and the power and efficiency of both powertrains. The measured boat speed is an indication that 28 Cabin Electric is designed for a luxurious cruising experience.

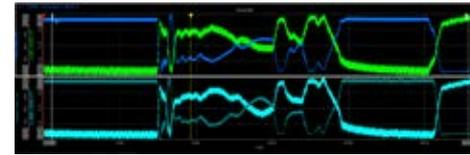


Figure 5. Voltage and current (blue and gray) signals during the deceleration test of the boat.

MEASUREMENT RESULTS

The measurements in detail documented the technical characteristics of the boat - characteristics of the interaction between the electric twin 10kW motors and the displacement hull of the boat. Furthermore, the test results confirmed the previously done simulations regarding the maximum engine power and the maximum final speed of the boat.

The test has shown that measurements of different parameters can be performed quickly with one SIRIUS system and different sensors. As an upgrade to these measurements, a test of electrical quantities could be performed directly on both electric motors to give an even better insight into the electric motor performance.

CONCLUSION

Alfastreet is actively expanding their market and the most selling boats are electric boats, especially suitable for the lakes, where the fuel drive is forbidden.

As a producer, Alfastreet has to know the performance of the boat and its characteristics while driving. Such results, especially for the new boats such as this one, will bring a better understanding of the options for improvements and also a better selling predisposition with more information.

With these measurements, Alfastreet gained exact knowledge of the characteristics of the tested electric boat, and can now better assume other characteristics with different propulsion. They can also use the characteristics for technical declaration and for sale descriptions promoting the advantages of the type 28 Cabin Electric.

The measurements performed are the basis for the boat buyers to design their version of the electric boat. For the customers of Alfastreet, the most-needed information is the maximal range, maximal speed, and cruise speed to better know which vessel and which propulsion to choose - and the measurements are declaring those most accurately.