

# HYDRO GENERATOR

**RONDAL**  
ULTIMATE RELIABILITY

**DAME**  
NOMINATED  
2024

# PLAN FOR THE UNEXPECTED





## PRODUCTS THAT ENSURE ULTIMATE RELIABILITY IN ANY SITUATION

Rondal designs and manufactures high-performance sailing systems and equipment for superyachts. Rondal is recognized as the best for its unrivalled Dutch build quality and innovative technical solutions, achieved through a dedicated focus on continuous improvement in both products and services.

As a building partner, Rondal leverages decades of experience and relieves the client by taking on turnkey projects. The products of Rondal ensure ultimate reliability in any situation.

The Rondal team consists of approximately 75 professionals, including highly qualified engineers, composite workers, CNC machine operators, welders, and mechanics, as well as a host of complementary specialists.

With decades of experience in composite and aluminum engineering and manufacturing, Rondal serves the market with specialized products for both sailing yachts and motor yachts.





### **THE RONDAL HYDRO GENERATOR**

Rondal's Hydro Generators enable regenerative sailing for large yachts, functioning independently of the propulsion system. Engineered for maximum efficiency, these systems minimize drag while maximizing electrical output, allowing diesel generators to be switched off while maintaining sailing speed. This provides a sustainable sailing experience without compromising performance.

The Hydro Generator family includes three variants: The Hydro Generator 15000 (15 kW output) for superyachts, the Hydro Generator 9000 Performance (9 kW output) for large yachts with a moderate cruising speed and the Hydro Generator 9000 High Speed (9 kW output) for large yachts with a high cruising speed.



### HYDRO GENERATOR 15000

The largest model in the Rondal Hydro Generator family for 50+ meters sailing yachts. The Hydro Generator 15000 can continuously produce 15 kW of electricity. It is designed for superyachts with a cruising speed under sail of 12 to 16 knots. The propeller achieves extremely high efficiency across a wide speed range, with a standardized shaft and bracket shared by the entire Hydro Generator family. Made of bronze, the propeller has a diameter of 670 mm, and the output voltage is 100 volts DC.



### HYDRO GENERATOR 9000 PERFORMANCE

The Hydro Generator 9000 Performance is designed for large sailing yachts between 20 and 50 meters, with a typical sailing speed of 9 to 14 knots. The e-motor has a small diameter to reduce drag. The e-motor has a small diameter to reduce drag, while the propeller is optimized for speeds between 11 and 13 knots, delivering an impressive 76% efficiency for maximum output with minimal drag. Made of bronze, the propeller has a diameter of 670 mm, and the output voltage is 50 volts DC.



### HYDRO GENERATOR 9000 HIGH SPEED

The Hydro Generator 9000 High Speed is designed for sailing yachts in a range between 20 and 50 meters, with typical sailing speeds of 9 to 16 knots. It shares the same pod as the Hydro Generator 9000 Performance, but features a different propeller optimized for higher speeds, making it ideal for yachts with (very) high sailing speeds, including multihulls. The propeller is made from glass-reinforced nylon, making the Hydro Generator 9000 HS a more economical choice.



	HG 15000	HG 9000 PERFORMANCE	HG 9000 HIGH SPEED
PROPELLER MATERIAL	Bronze	Bronze	PA12GF
PROPELLER DIAMETER [MM]	670	670	670
MAX. OUTPUT (ELECTRICAL) [kW]	15	9	9
MAX. SPEED [KNOTS]	16.0	13.9	15.9
EFFICIENCY* [%]	75%	76%	73%
FREEWHEELING DRAG AT 10 KNOTS* [kN]	0.250	0.242	0.223
OUTPUT VOLTAGE [V]	100	50	50
CLASS APPROVAL FOR ATTACHMENT TO HULL >24M	Lloyd's Register		
COOLING	Passive (water cooled)		

\*Data from MARIN, including drag from pod and bracket

## DESIGNED FOR EFFICIENCY

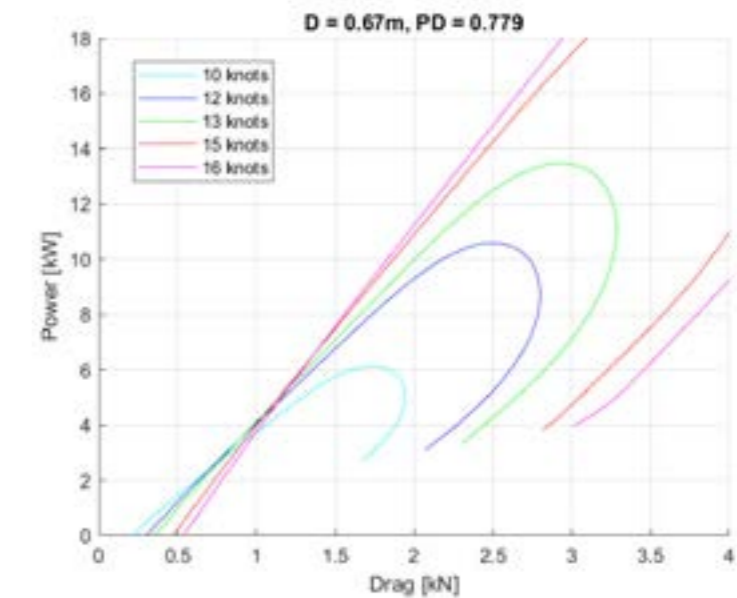
Operational data and market feedback from yachts using regeneration show that regeneration is most frequently used when drag is low. Consequently, the Rondal Hydro Generator is engineered for optimal regeneration efficiency. Regeneration efficiency is defined as  $\eta = P/VT$ , where P represents the power of the propeller, V is the water flow speed, and T is the thrust (drag) of the propeller. This efficiency is essential for achieving an optimal power-to-drag ratio.

The dedicated propeller design by MARIN has achieved an exceptional regeneration efficiency of 0.73 to 0.76, depending on the model. MARIN's data models were validated through measurements in one of its towing tanks, which confirmed that the propeller performed as calculated. In fact, the tank tests demonstrated even lower drag than anticipated.

## LOW DRAG DURING FREEWHEELING

When not in use, the regeneration propeller freewheels to minimize drag. Because there is no propulsion requirement, the shape and pitch of the propeller differ significantly from a normal propeller designed for propulsion.

This design results in much lower drag during freewheeling, making additional complexity, such as folding or feathering the propeller, unnecessary. The freewheeling drag at 10 knots is between 0.22 and 0.25 kN, which causes no noticeable speed loss on a typical large yacht.





## INTEGRATION

The Hydro Generator is attached to the hull as a non-essential appendage. The bracket is permanently fixed to the hull, allowing the Hydro Generator itself to be installed or removed without any modifications. This can even be done under water, though special care is required.

The bracket is designed to evenly distribute all forces on the hull and to create a standardized connection. The upper part of the Hydro Generator features a structural hollow stainless steel shaft that houses the cables. This shaft is inserted from below through the hole in the bracket, fixated inside the hull, and the cables are then connected.

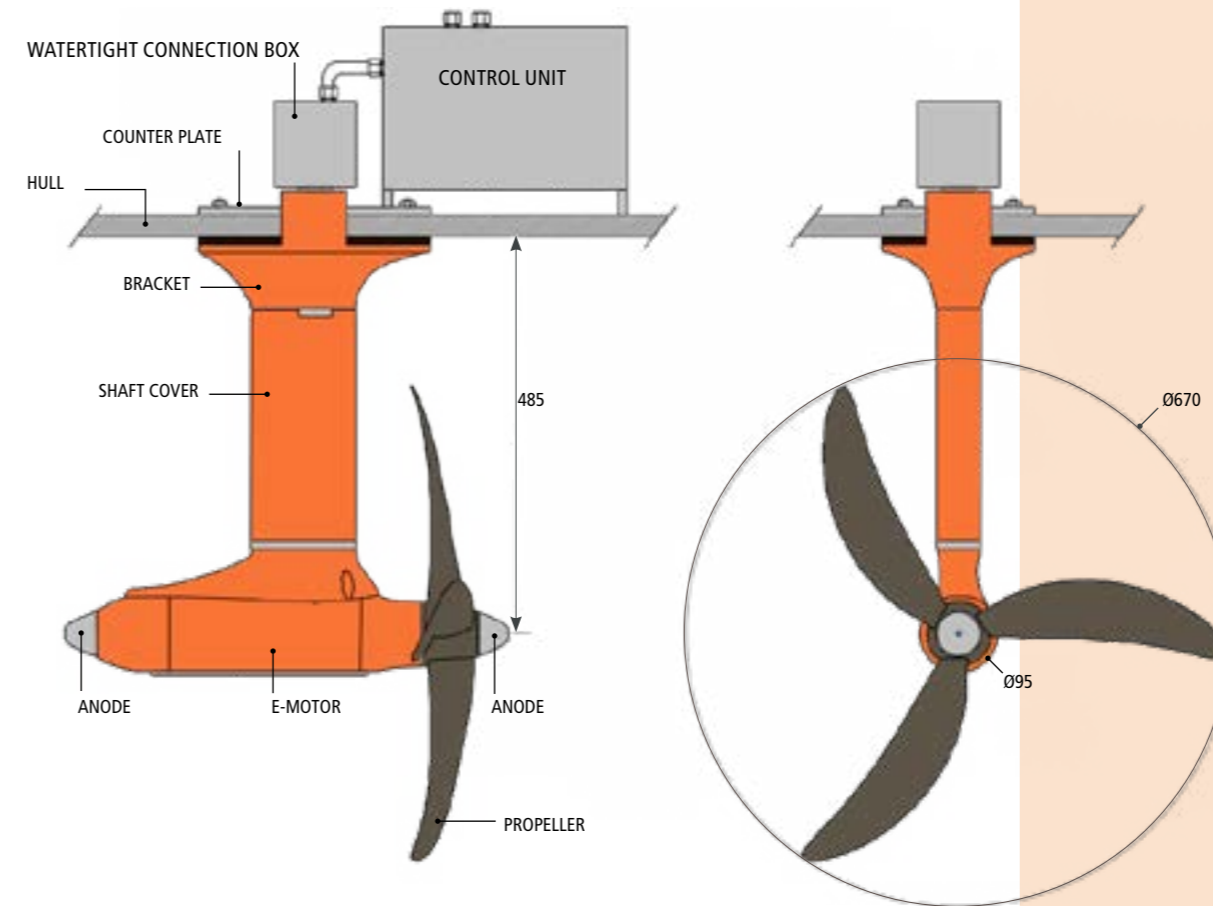
The integration is approved by Lloyd's Register for Class-approved hulls over 24 meters. In case of a hard collision, the Hydro Generator is designed to break off at a designated point in the shaft, ensuring the hull remains undamaged. Integration details for different hull materials are available.

## REMOVING THE PROPELLER

If the Hydro Generator is not in use for an extended period, or if extremely low drag is required for racing, the propeller can be removed. This can be done by a diver and only requires the removal of two bolts. A shaping piece is provided to temporarily replace the propeller, reducing drag by approximately 70%.



## CONTROL UNIT



## LOCATION

The placement of the Hydro Generator must be determined individually for each yacht. In general, several factors should be considered, including:

- Permanently submerged, even at heel angles
- Accessible from inside (e.g., not located in a tank)
- Uninterrupted water flow (e.g., not directly behind the keel)
- Not positioned directly in front of the rudder or propellers
- Located in an area with high water flow speed (such as near midship)

Rondal can provide general advice for selecting the best location; however, a study by the naval architect who designed the hull is recommended.

Inside the yacht, a control unit is to be installed, housed within a protective stainless steel box placed on or near the shaft. Three cables extend from the control unit: one control cable and two power cables (+/-).



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