

CRUISING HYDROGENERATOR Installation and instruction manual

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Contact	contact@wattandsea.com

Congratulations !

You have just purchased the most powerful hydrogenerator of its kind. Inspired by the requirements of ocean racing yachts, designed to take into account the stresses experienced by monohulls, this hydrogenerator will radically change your energy management at sea and become your main source of power while sailing.

This product has been thoroughly inspected. The product comes with the WATT&SEA warranty described in the "Warranty Terms" chapter of this installation guide. For traceability under the warranty, please register the product on our website: www.wattandsea.com

Designed & manufactured in France by:

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1. SAFETY PRECAUTIONS

While our primary concern in designing the hydrogenerator was your safety, certain precautions must nevertheless be taken when operating any mechanical or electrical equipment. Please keep the following safety factors in mind when installing and operating the hydrogenerator, and be aware at all times of the electrical and mechanical hazards inherent in operating the propeller.

1.1. *Mechanical hazards*

Rotating propeller blades present the greatest mechanical hazard. The hydrogenerator's blades are made of a composite material and can rotate at a speed of over 100 kph (62 mph).

At this speed, the blades are practically invisible and can cause serious injury.

**WARNING : WHEN INSTALLING THE HYDROGENERATOR, MAKE SURE THAT THE PROPELLER IS SAFELY POSITIONED OUT OF REACH.
DO NOT ATTEMPT TO STOP THE PROPELLER WITH YOUR HAND WHILE THE GENERATOR IS RUNNING.**

1.2. *Electrical hazards*

Heat in wiring systems often results from undersized cables or faulty connections. Batteries have a very high current carrying capacity. A short-circuit in their cables may result in an outbreak of fire. To prevent this hazard, you must install a 50 amp fuse between the converter and each battery.

If the fuse is defective, you must determine the reason before resetting or replacing it.

WARNING : ONLY A NEW FUSE OF EQUIVALENT AMPERAGE SHOULD BE USED TO REPLACE THE BLOWN FUSE.

WARNING : ALWAYS PLACE THE HYDROGENERATOR IN THE RAISED POSITION BEFORE WORKING ON IT.

1.3. *Installation*

Please observe the following precautions during installation :

- Remove the hydrogenerator from the water.
- Keep safety in mind at all times ! Have someone help you throughout the duration of the installation.

- Remember : the batteries should be connected last.

1.4. *Operation*

- Check the support structure, blades and electric circuits on a regular basis.
- While propeller blades are made of very strong materials, they may warp or break if they come into contact with a submerged object.

WARNING : NEVER TOUCH THE PROPELLER WHEN IT IS SPINNING.

WARNING : NEVER USE THE HYDROGENERATOR AS A STEP ONTO OR OFF THE BOAT AS THIS MAY WARP THE DRIVE SHAFT.

WARNING : WHEN RUNNING, THE CONVERTER CAN REACH VERY HIGH TEMPERATURES.

2. CONTENTS OF THE HYDROGENERATOR PACK

Check the contents of the package against the list below.

- 1 HYDROGENERATOR (with 2 meters of cable)
- 1 ASSEMBLY CRADLE
- 1 240 mm (9.5 in) THREE-BLADE PROPELLER
- 1 CONVERTER
- 2 strips of velcro
- 1 hydrogenerator connector
- 1 solar connector
- 3 battery connectors
- 1 ASSEMBLY KIT (2 stainless steel fork mountings + bolts)
- 1 M5x16 HSHC SCREW
- 1 M6x40 HSHC SCREW (keep for dismantling the propeller)
- 1 INSTRUCTION MANUAL



Fig. 1: The package and its contents

3. REQUIRED TOOLS & EQUIPMENT

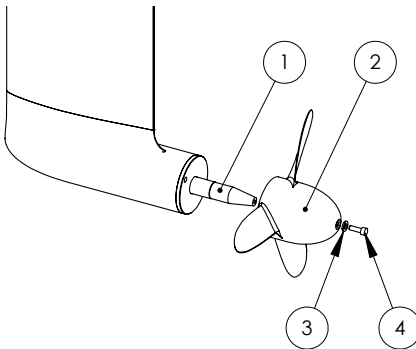
- Three-phase cable, minimum 3 x 2.5 mm² (0.1 in²), for connecting the hydrogenerator to the converter.
- Red and black 10 mm² cable to connect to the battery
- Joint connectors for 10 mm² (0.4 in²) battery cable.
- 50 amp fuse or thermal circuit breaker
- Waterproof connectors for the three-phase cables or junction box.
- WATT&SEA offers an optional connection kit with cable and pre-assembled waterproof power socket (Ref. WS-PL-C-001).
- Bolts for securing the cradle chain plate.

4. MECHANICAL INSTALLATION

Your hydrogenerator is shipped partially disassembled. Please read the instruction manual carefully before starting installation.

4.1. *Assembling the propeller*

- Slide the propeller onto the drive shaft.
- Check that the stainless steel washer (12) has been pre-mounted at the end of the propeller. If not, insert it.
- Insert the M5 x 16 HSHC screw (21).
- Hold the propeller with one hand and tighten the screw using a 4 mm (5/32") Allen key until the screw starts turning the propeller.



N	Designation
1	Drive shaft
2	Three-blade propeller
3	Stainless steel washer
4	M5x16 HSHC screw

Fig. 2: Exploded view of the drive shaft, propeller, washer and M5 screw

4.2. Positioning the hydrogenerator on the transom

Correctly positioning the hydrogenerator is crucial for optimizing its performance. The following criteria must be respected during installation:

- **Immersion depth:**

The hydrogenerator is supplied with a submerged aluminium leg measuring 610 mm (24 in) or 970 mm (38 in). The recommended depth between the surface and the propeller axis is 300 mm (12 in). The greater the depth, the farther the propeller will be from the wake of the hull, and the better the performance of the hydrogenerator. However, the longer the righting lever, the greater the stress on the mountings and when raising the hydrogenerator.

We recommend a length of 970 mm (38 in) as a satisfactory compromise for the majority of monohull installations.

The 610 mm (24 in) leg is suitable on multihulls that do not heel (cruising catamarans and trimarans), or on very wide monohulls when installed on each side.

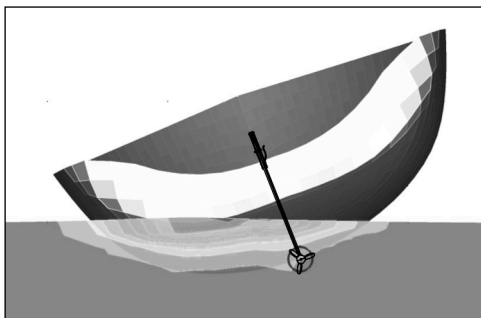
- **Flow quality:**

The quality of water flow is a key element for obtaining satisfactory power output.

N.B.: Do not position the hydrogenerator directly in the wake of an appendage or too close to a saildrive.

Wherever possible, position the hydrogenerator several inches to the side.

- **Example of installation with the longer leg (970 mm/38 in):**



*Fig. 3: Installation on a 10 m (33 ft) Figaro II heeling at 20° (CFD by CRAIN)
With the 970 mm (38 in) leg, the hydrogenerator is well submerged when heeling.*

- Examples of installations with the shorter leg (610 mm/24 in):

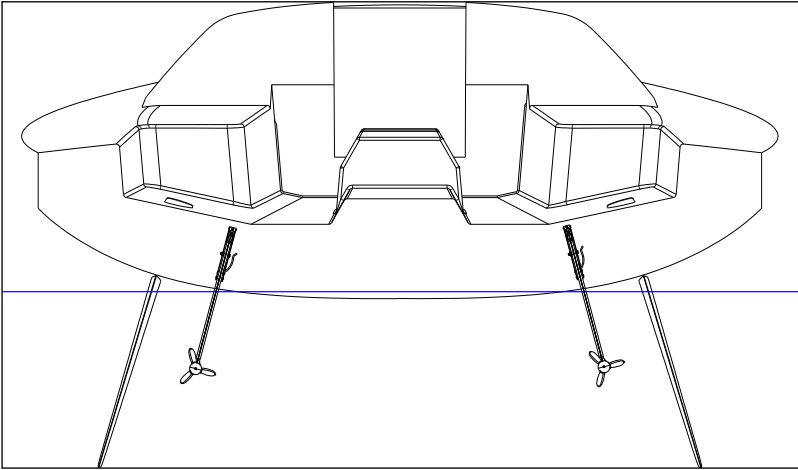
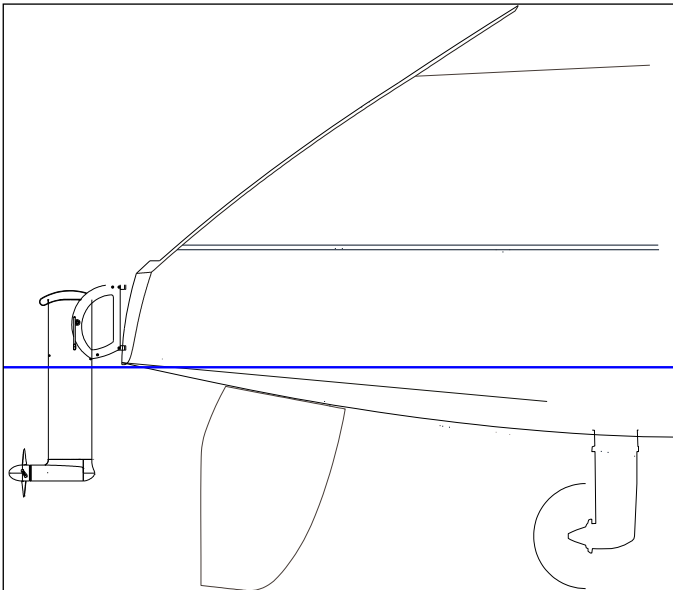


Fig. 4: Dual installation on a Pogo40 (© CN STRUCTURES)

The hydrogenerators are placed parallel to the rudders but approximately 30 cm



(12 in) to the inside to avoid their wakes.

Fig. 5: Installation on a catamaran (© OUTREMER YACHTING)

Here, the hydrogenerator is positioned to the side, out of the wake of the nearby rudder.

4.3. *Installing the cradle on the transom*

Depending on your boat's transom, its structure might need to be reinforced to take the stress on the mountings.

WARNING : Due to the size of the righting lever, the maximum theoretical stress on the cradle's mountings is estimated at around 300 kg (661 lbs). Your mounting system should be adapted accordingly.

The cradle must be adapted to the 8 mm (0.3 in) diameter chain plates that are securely mounted on the transom.

The chain plates must be mounted in such a way as to compensate for any tilt of the transom. The diagram below will help you adapt the mountings to your boat.

N.B.: The leg must be vertical in the lowered position.

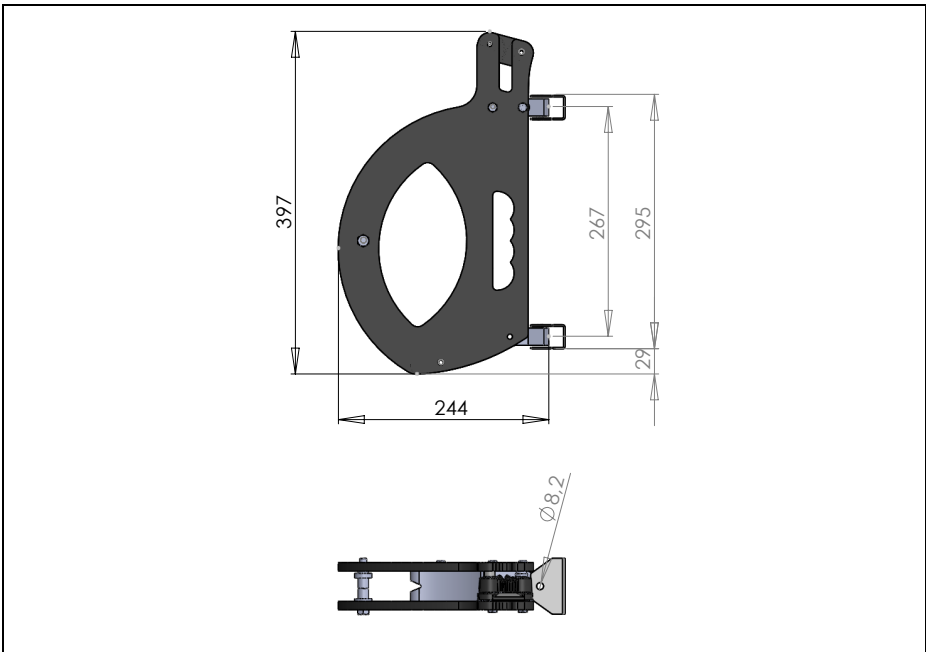


Fig. 6: Lifting cradle

4.4. Rigging the lowering/lifting system

Your hydrogenerator comes with a lifting system similar to those used for rudders. This lifting system provides good access to the propeller when the hydrogenerator is in the raised position, thereby facilitating the removal of any seaweed without having to lean out over the water.

Lowering and lifting are done using two lines attached to specific eyelets. The pin provided allows for locking the hydrogenerator in the lowered position.

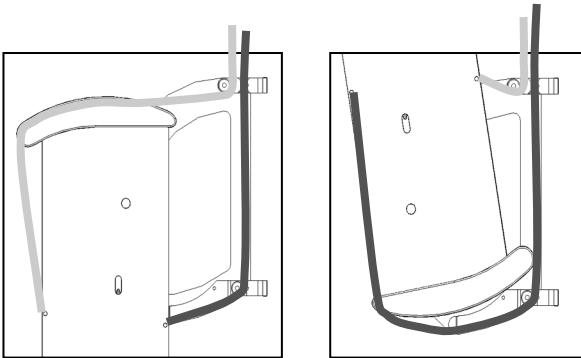


Fig. 7: View of the lowering/lifting lines

Maximum traction when lifting is about 40 kg (88 lbs). It is therefore recommended to rig 4:1 to 6:1 hoist to ease the use of the hydrogenerator.

N.B. : When the hydrogenerator is submerged, the leg should sit flush in the groove provided for this purpose. If this is not the case, the lateral support will be less efficient, and this may result in mechanical damage.

It is also advisable to hold the lifting end in place using an elastic cord to prevent it from leaving the groove.



Lifting the hydrogenerator



4.5. *Dismantling the propeller*

To dismantle the propeller, you should use the M6 extractor screw provided with the hydrogenerator.

- Unscrew the M5 screw that holds the propeller at the end of the drive shaft.
- In its place, insert the M6 screw and tighten it using the appropriate key. This will have the effect of effortlessly removing the propeller from its conical fitting.

N.B. : Any method for dismantling the propeller other than the one described above may result in damage to the hydrogenerator.

4.6. *Mounting the electronic converter*

The electronic converter is a box which is resistant to water and to passive ventilation, guaranteeing long-term protection even in humid environments.

The converter must nevertheless be installed inside the boat, preferably in the mechanical room in close proximity to the batteries.

WARNING : WHEN RUNNING, THE CONVERTER CAN REACH VERY HIGH TEMPERATURES. PLEASE REMEMBER THIS WHEN INSTALLING IT.

N.B. : To ensure proper ventilation, the converter must be mounted on a vertical bulkhead, with the ventilation grids in the vertical position.



As it is so light, the converter can be securely attached using the velcro provided.

- degrease the surface on which the converter will be installed
- place the strips of velcro provided on the converter
- remove the protective tabs
- firmly attach the converter to the surface

5. ELECTRICAL INSTALLATION

Recommendations concerning the electrical connections:

- Please refer to all local/national safety regulations before installation.
- All electrical transmission cables must be well insulated. For maximum protection, insert the cables into cable sheaths.

WARNING: ELECTRICAL CONNECTIONS MUST BE CHECKED ON A REGULAR BASIS TO DETECT ANY CORROSION, AND CLEANED WHEN NECESSARY.

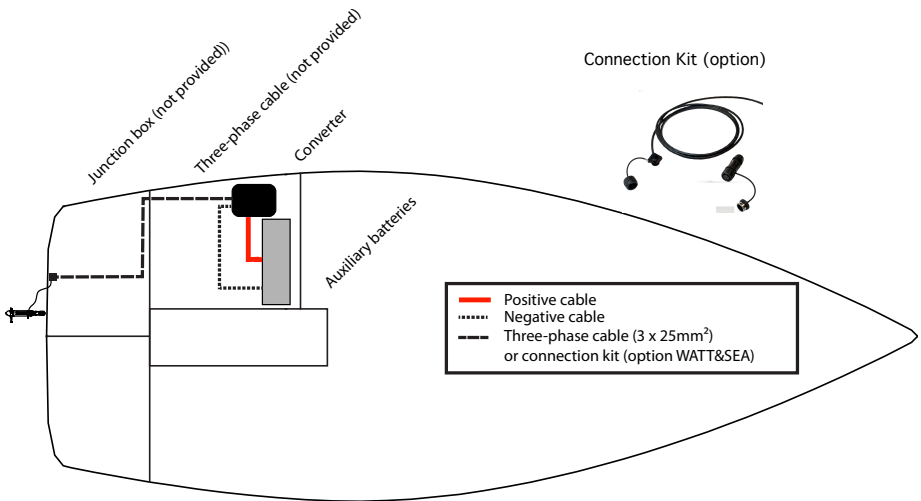


Fig.10: Wiring principle

5.1. *Three-phase wiring of the hydrogenerator*

WARNING : ALWAYS PLACE THE HYDROGENERATOR IN THE RAISED POSITION BEFORE WORKING ON IT.

The hydrogenerator is fitted with a small diameter electrical cable of sufficient length to pass through the transom. This is a three-phase cable.

- We recommend installing a 6 mm (0.2 in) diameter cable gland for the passage of the cable through the transom. Alternatively, you could use our connection kit with cable and pre-assembled waterproof power socket (Ref. WS-PL-C-001).
- Next, connect a larger diameter three-phase cable, minimum $3 \times 2.5 \text{ mm}^2$ (0.1 in^2), between the hydrogenerator and the converter.

N.B. : Using a cable with a diameter smaller than $3 \times 2.5 \text{ mm}^2$ (0.1 in^2) will affect both the output and the performance of the hydrogenerator.

- The converter is connected using the socket kit provided. See the installation guide for the kit, in the appendix.

N.B. : The converter is equipped with electrical connections for 2 hydrogenerators and an auxiliary 48V input (8 terminals in all).

The GND position must not be connected.



Fig. 8: connecting the hydrogenerator connector

5.2. Connecting the converter to the batteries

The converter must be placed as close as possible to the batteries in order to minimize losses due to cable length. The maximum recommended distance is 2 m.

The batteries are connected to the converter via a solar connector. See the installation guide in the appendix for instructions.

The converter has an internal 2-path balancer that makes it possible to charge two battery units separately. The 2 battery units must be at the same voltage.

WARNING: RISK OF OVERLOAD AND OF FIRE THE TWO BATTERY UNITS MUST BE THE SAME TYPE AND THE SAME VOLTAGE

WARNING: EACH BATTERY UNIT MUST BE PROTECTED WITH A 50 AMP FUSE

We recommend connecting the hydrogenerator converter directly to the auxiliary battery unit. The converter will monitor the batteries independently of the other onboard units and will charge them as and when required.

N.B.: Proper operation on one external charge balancer is not guaranteed and may require an additional adjustment. See your distributor.

WARNING : NEVER REVERSE THE POLARITY OF THE CONVERTER. THIS WILL CAUSE THE FUSE TO BLOW AND MAY SERIOUSLY DAMAGE THE HYDROGENERATOR.

5.3 Interpreting the LEDs

When the converter is not charging, the battery power is indicated by a pulse of color ranging from green (12.8V) to red (115V)

When the converter is charging, the output power is indicated by a constant color ranging from violet to blue (120W) then light blue (240W) and finally white (480W)

Flashes of color may be superimposed over the display, indicating a status or an error.

Situation	Visual	Comment
ABS voltage reached	1 short green flash	The battery is full
FLOAT voltage reached	1 long green flash	The battery is kept at 100%
Hydro braking	1 blue flash	The hydrogenerator is halted because it cannot apply enough power
Overheating	1 red flash	The box temperature has been reached
Generator problem	2 red flashes	Check the hydrogenerator's connection
Over voltage at input	3 red flashes	The solar panel or the hydrogenerator are applying a voltage that is too high
Other problem	4 red flashes	

6. INSTALLATION SUMMARY

The following guide sets out the main steps in the hydrogenerator installation procedure. This document is intended as a quick reference guide only. Please refer to the appropriate sections in this manual for detailed instructions.

1. Assemble the propeller (refer to 4.1).
2. Mechanically mount the hydrogenerator on the transom (refer to 4.2).
3. Install a 6 mm (0.2 in) diameter cable gland to fit the three-phase cable inside the boat and put a connection box inside the rear bulkhead (refer to 5.1). Alternatively, use the WATT&SEA connection kit with cable and pre-assembled waterproof power socket (sold as an option, Ref. WS-PL-C-001).
4. Mount the converter on a vertical bulkhead, as close as possible to the batteries (refer to 4.6).
5. Pass the three-phase cable from the transom to the converter. Connect the three-phase cable phases in the connection box (refer to 5.1).

Make sure that the propeller is not submerged and that the alternator cannot run during installation.

6. Run the converter's power cables through to the batteries (refer to 5.2).

DO NOT CONNECT the cables to the batteries before installation is complete.

7. Attach the battery connectors then connect the power cables to the batteries: red wire to the positive terminal, black wire to the negative terminal (refer to 0)
8. Once the converter is connected to the batteries, the LED will come on, indicating the current battery power, from red to green. When the propeller starts turning, the color of the LED will change to violet (10W) then blue (120W) and finally white (>300W)

7. SPECIFICATIONS

7.1 Technical characteristics 600W, 970mm and 610mm

- ♦ Hydrogenerator :
 Nominal power : 600W
 Nominal voltage : Three-phase, 40V
 Rated current : 9A
 Weight : 8.2 kg / 7.4 kg

- ♦ Converter :
 Nominal power : 500W
 ABS voltage regulator : 14.3V / 28.6V
 Floating voltage : 13.3V / 26.6V
 Rated current : 44A / 22A
 Weight : 1.5 kg
 Dim. : 210 x 105 x 60 mm

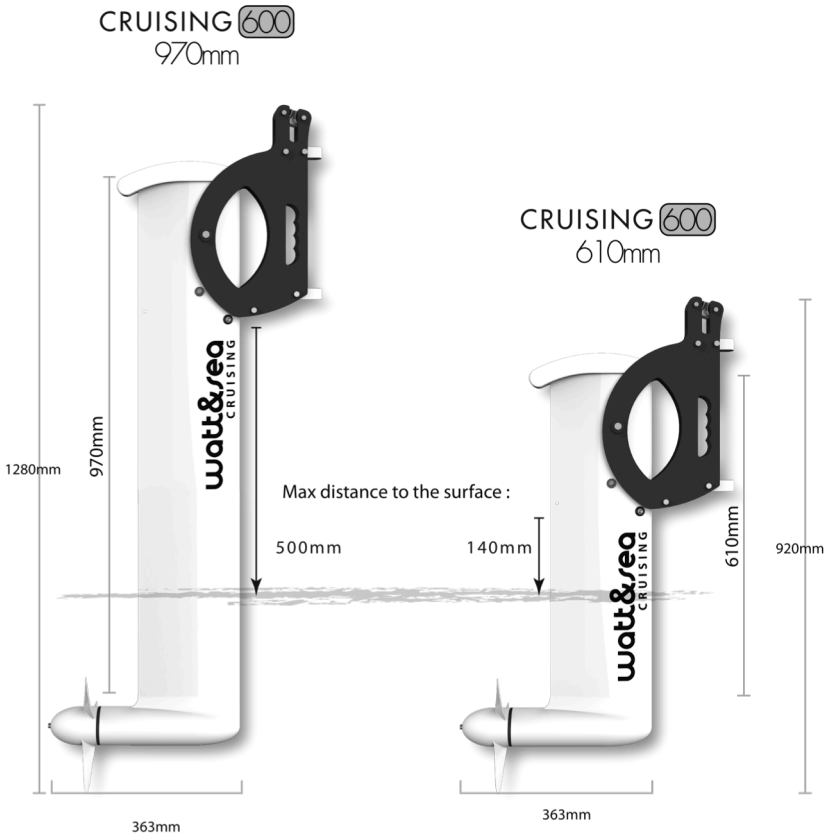


Fig.11: Dimensions of the 600W hydro generator

7.2 Technical characteristics 300W, 970mm and 610mm

- ♦ Hydrogenerator :
 Nominal power : 300W
 Nominal voltage : Three-phase, 40V
 Rated current : 9A
 Weight : 7.1 kg / 6.3 kg

- ♦ Converter :
 Nominal power : 600W
 ABS voltage regulator : 14.3V / 28.6V
 Floating voltage : 13.3V / 26.6V
 Rated current: 40A / 20A
 Weight : 1.5 kg
 Dim. : 210 x 105 x 60 mm

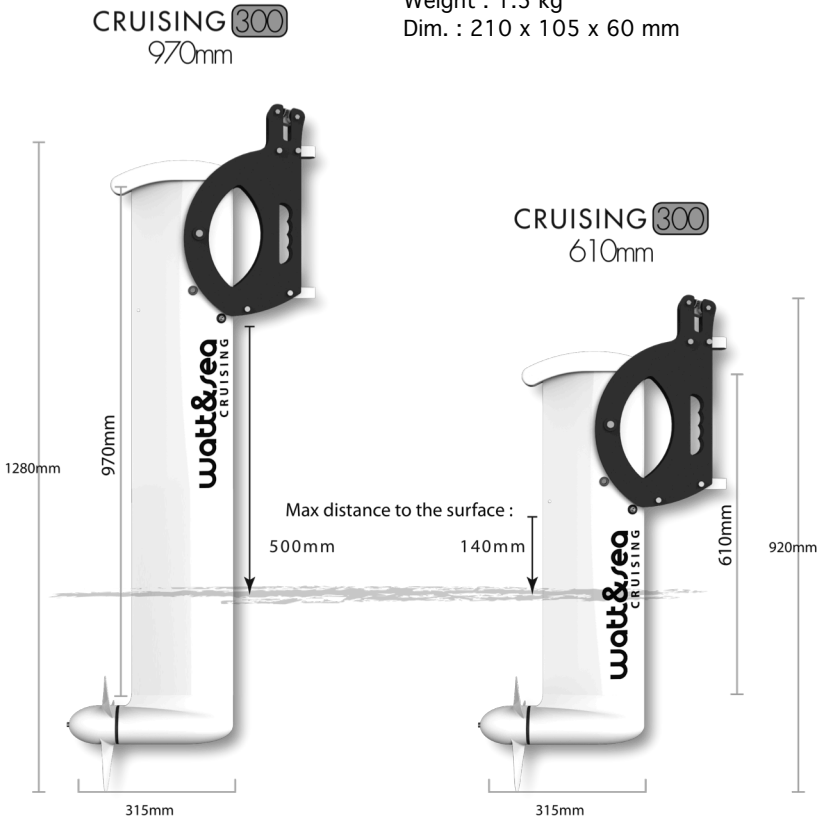


Fig.12: Dimensions of the 300 W hydrogenerator

7.3 *Operating principles*

- The hydrogenerator:

The hydrogenerator consists of a permanent magnet alternator producing a very low three-phase current (0-40V). This alternator technology allows for very high output, but has the disadvantage of generating high voltage during overspeed. To prevent the voltage from surging over 40V, the hydrogenerator is equipped with an electronic system that momentarily short-circuits the alternator during overspeed. This embedded circuit protects the systems located downstream of the alternator.

- Protection against overvoltage:

When the hydrogenerator is working overspeed, it produces a very characteristic and audible rumble. This can occur for several reasons:

1 - A cable has been disconnected or the fuse has blown and the converter is no longer connected up to the batteries. The hydrogenerator is freewheeling and is no longer slowed by the electromagnetic force.

2 - The batteries are charged or the battery capacity is too weak. The converter has completed charging the batteries, or the batteries cannot absorb enough energy to slow down the propeller.

3 - The boat is going faster than the propeller speed range and the converter is running at maximum capacity.

- The converter:

The converter turns the alternating current coming from the alternator into a continuous current compatible with the batteries. This voltage is regulated at several levels depending on the state of charge of the batteries. During charging, voltage is regulated at 14.3V/28.6V (absorption phase). When conditions allow for fully charging the batteries, the converter regulates to a lower voltage (13.8V/27.6V) to maintain the batteries without damaging them (maintenance/floating phase).

In dock, the converter offers the possibility of charging the batteries by connecting a 48V DC 10A power supply (not included) to the terminals (refer to 5.1).

7.4 Performance

As detailed in section 4.2 concerning the installation of the hydrogenerator on the transom, performance very much depends on position and the quality of water flow.

The chart below shows performance levels measured for a motorboat equipped with 200 mm (7.9 in), 240 mm (9.5 in) and 280 mm (11 in) diameter propellers and a calibrated speedometer.

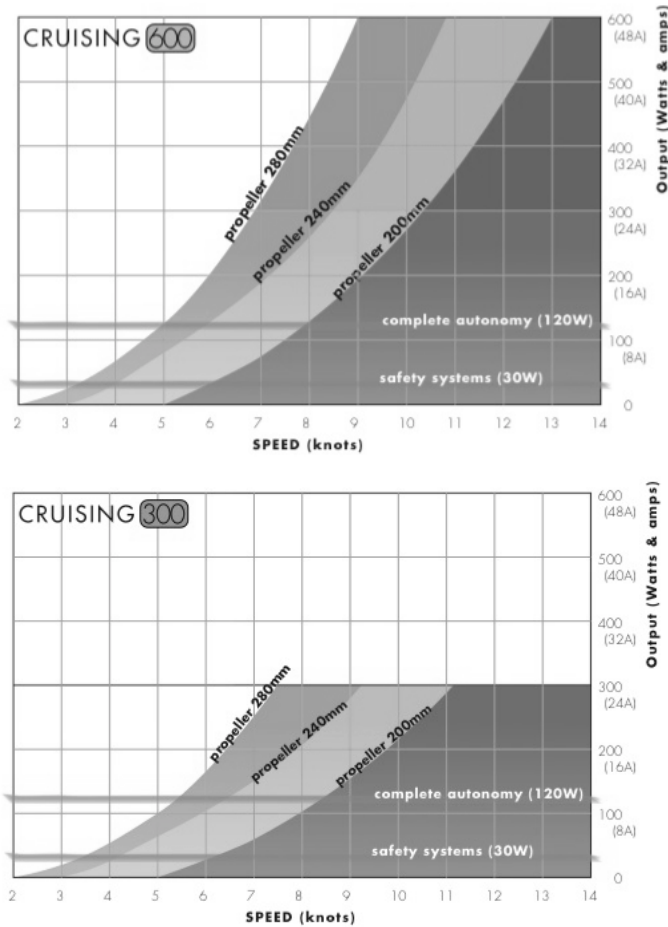


Fig.13: Power output related to boat speed

8 MAINTENANCE

Originally designed for ocean racing, the hydrogenerator benefits from the latest technology where resistance and reliability are concerned. All metallic parts are made from either specially treated aluminium or from A4 stainless steel.

Watertightness is guaranteed using cutting-edge industrial gaskets that have a service life of several thousand hours and can easily support circumnavigation of the globe.

The housing is filled with slightly pressurized lubricating oil to prevent any water seepage.

The hydrogenerator therefore requires no particular maintenance other than cleaning the external parts.

- The generator housing should be regularly cleaned and rinsed with fresh water.
- The generator and propeller mountings should be regularly inspected to ensure they are tight.
- The electrical connections should be inspected to ensure they are tight and corrosion-free.
- Do not operate the hydrogenerator with a damaged or unbalanced propeller. To do so would result in premature wear, or even a breakdown. The propeller should be replaced at the first opportunity.

WATT&SEA recommends a complete overhaul every two years or every 20,000 nautical miles in order to service the generator, change the oil and check the bearings.

9 LIST OF SPARES

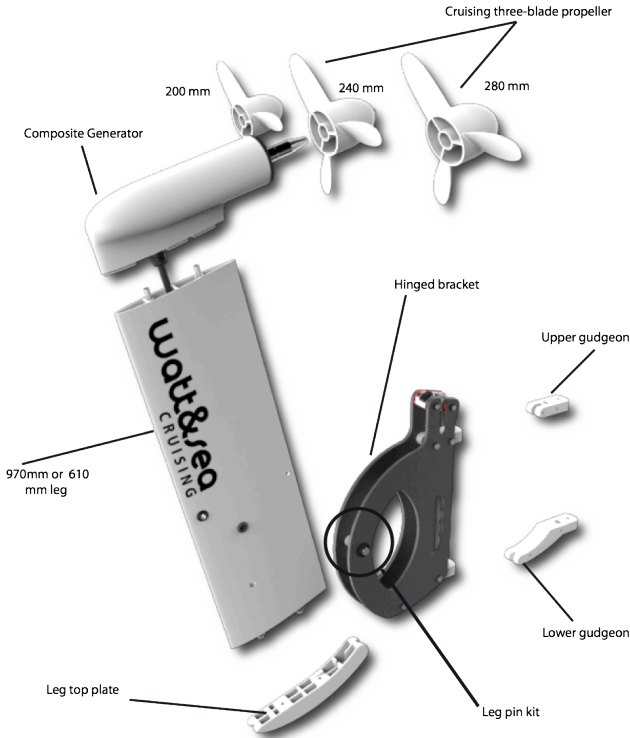


Fig.14: Exploded view of a hydrogenerator

REFERENCE	DESIGNATION
G-600-03	Composite generator 600W
G-300-03	Composite generator 300W
CV-03	12-24Vcc autodetected converter
K-03	Lifting bracket with cam-cleat
P-200-03	Cruising three-blade propeller, 200 mm (7.9 in)
P-240-03	Cruising three-blade propeller, 240 mm (9.5 in)
P-280-03	Cruising three-blade propeller, 280 mm (11 in)
WS-EP-C-001	Cruising propeller extraction kit
F-03	Fastening kit for transom
FS-03	Upper gudgeon
FI-03	Lower gudgeon
MA-970-03	Bare aluminium leg with 2 washers - 970 mm (38 in)
MA-610-03	Bare aluminium leg with 2 washers - 610 mm (24 in)
WS-SK-C-001	Leg pin kit
WS-TM-C-100	Leg top plate

10 F.A.Q.

10.1 Operation

- What power output can I expect to generate?

The power generated depends on the size of the propeller and the speed of navigation. The table in section 7.4 gives the output power values related to speed for different propeller sizes.

- What drag is to be expected?

Drag depends on the size of the propeller and the speed of navigation. We currently do not have any reliable data concerning the effective drag of the hydrogenerator, or the speed loss generated. Our lowering and lifting trials at constant speed have not shown any significant difference on the speedometer.

- What happens when the batteries are charged?

The electronic regulator automatically charges the batteries. When they are fully charged, the propeller freewheels.

- What happens in the case of an impact?

The design of the hydrogenerator, and especially its lifting system, integrates a fuse that will release the generator in the case of violent impact. However, the risk of direct impact on the generator is minimal given its position on the transom, behind the keel, centreboard, and rudder.

- Can I use the hydrogenerator with my boat's main engine?

The system is not designed to replace the engine's alternator. It can nevertheless be used while operating your engine. This presents no mechanical risk. However, electrical output will be significantly disrupted depending on the location of the generator and the water turbulence caused by the engine.

- Can I use the hydrogenerator when reversing?

The hydrogenerator must be lifted when reversing the boat in order to avoid any possible damage to the leg and cradle mountings.

10.2 Maintenance & repairs

- How reliable is the system?

The reliability of the hydrogenerator has been demonstrated in many ocean and round the world races. It benefits from advanced technological expertise as regards resistance.

- What maintenance will the system require?

Except for cleaning the exterior, the hydrogenerator has no wear parts and therefore requires no specific maintenance. WATT&SEA nevertheless recommends a complete overhaul in an approved repair centre every two years or every 20,000 nautical miles.

- Can the propeller be replaced?

The propeller is designed to be easily dismantled, requiring only the M6 extractor screw provided (refer to 4.5).

10.3 Return to port

- What do I do with the hydrogenerator when my boat is docked in port?

You can either leave the hydrogenerator in the raised position, or opt for a removable system and store it away.

11 WARRANTY

Coverage and warranty period : Our products are designed for very specific conditions of use. It is the responsibility of our customers to ensure the appropriate use of our products. Our systems are covered by a two-year warranty against any manufacturing defect. The warranty period starts on the date of purchase of our products by the distributor.

The warranty is limited to the standard replacement of a defective part or, if necessary, the entire system, upon receipt of the part in question. Under civil law, it is the responsibility of the purchaser to fulfil the burden of proof regarding the previous nature of the claimed latent defect.

Any returned systems or parts must be accompanied by the warranty returns form (see below), duly completed as follows : name and address of the customer, date of purchase, type of boat, defective parts, description of the structural or design defect, and description of the conditions under which the system was used.

Returned systems or parts shall only be accepted with the prior written consent of WATT&SEA, and must be returned by prepaid shipment. Should the replacement of the WATT&SEA product prove to be due to a defect covered by the warranty, these shipment costs shall be refunded.

Under no circumstances shall returned systems or parts be refunded; they shall only be replaced.

Situations not covered by the warranty :

This warranty shall not apply if the system :

- has suffered an accident, or undergone unauthorized alterations or repairs;
- has not been installed by a professional installer in strict compliance with the procedure specified by WATT&SEA in the installation and user manual supplied with the generator;
- has been :
 - o installed or serviced in an inappropriate manner, or used under too high a charge;
 - o subjected to abuse or neglect;
 - o used while sailing into reverse.

The warranty shall not take into account any failures due to simple wear and tear or normal ageing of the structures and materials, any scratches, or any cracks or starring that may appear following an impact.

Under no circumstances shall WATT&SEA be liable for any special, incidental or consequential damages.

Should you encounter a problem with your WATT&SEA hydrogenerator, please contact your distributor/installer.

REGISTER YOUR PRODUCT ONLINE

For traceability under the warranty, please register the product on our website: www.wattandsea.com. Registering your product has the following benefits:

*Confirmation of your ownership and safety notifications: by keeping a record of your registration, we will be able to trace your product and contact you quickly if necessary.

*Product information and news: choose to be among the first to hear about our latest products, helpful advice or product developments!

12 FORM FOR REQUESTING AN AFTER-SALES SERVICE RETURN

Owner	
Name:	Phone no.:
Address:	E-mail:
	Country:
Date of purchase of the hydrogenerator: Serial no. (see installation manual) - of the hydrogenerator: - of the converter:	Type of boat: Type of assembly on the transom (if custom-made, please specify):
Conditions of use (frequency/specific conditions having revealed the defect): 	
Defect noticed: 	
Date: Signature:	

Retailer/Installer	
Name:	Phone no.:
Address:	E-mail:
	Country:
Date of purchase of the hydrogenerator:	Has the defect been confirmed?
Has the installation been carried out in compliance with the instruction manual?	Installer contact details:
Defective subassemblies to be replaced:	
Date:	
Signature:	
After Sales returns authorization no.:	

