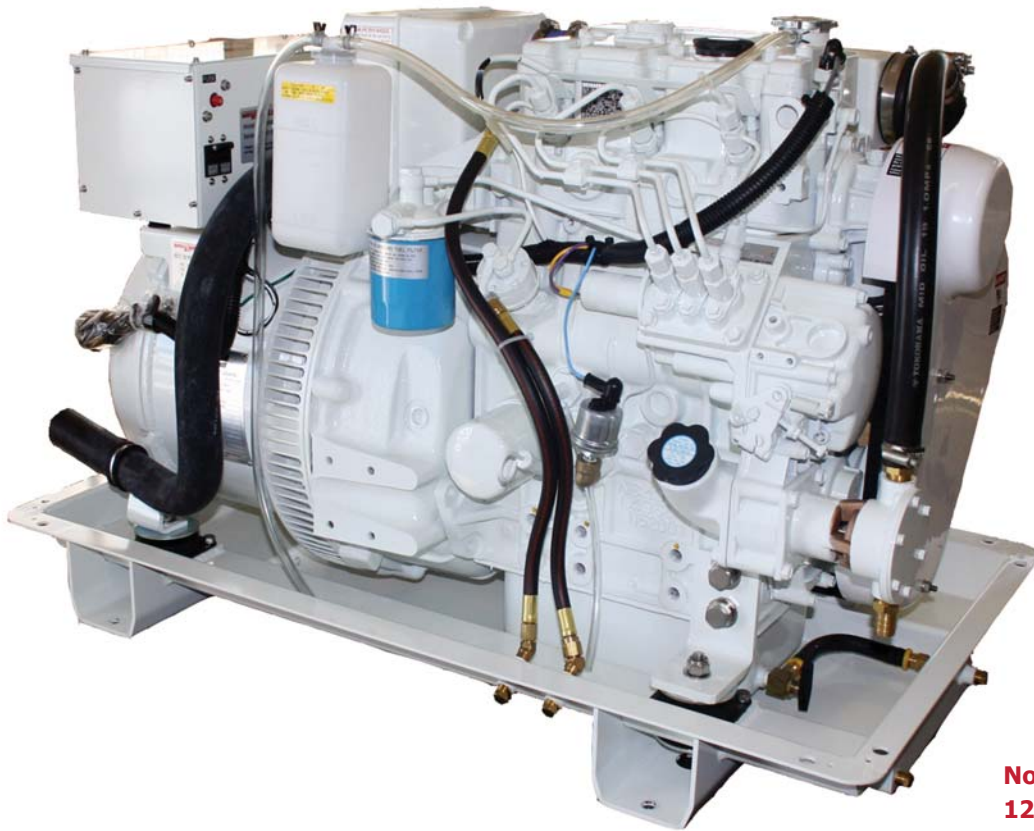


A Buyer's Guide to Choosing the Right Marine Generator.



Northern Lights
12 kW M843NW3



NORTHERN LIGHTS

www.northern-lights.com

Modern vessels are all bristling with water makers, refrigerators, air conditioners, and hydraulic systems. Even on small boats, you'll need a generator to run many of your accessories.

A generator can be a major investment. After the main engine, the most expensive single piece of equipment aboard is often the generator. Moreover, a generator can log two or three times as many hours as your mains, so choosing the right power producer is an important decision. You'll want a generator that's reliable, offers longevity, and delivers a comfortable time on board.

Choosing the right generator doesn't have to be mystifying if you work with an authorized generator dealer and analyze your requirements carefully.

This buyer's guide to choosing the right generator will familiarize you with a few terms and help you acquire a basic understanding of the different types of generators and how they operate.

AC or DC?

Since AC (alternating current) is much more suited to power distribution, generators that produce DC (direct current) have all but disappeared from the marine industry – AC generators are the standard today. Only a few DC generators are sold each year to repower older boats, making DC equipment expensive and difficult to find. DC

requirements can be taken off a DC alternator mounted on the main engine or an AC generator prime mover.

Inverter or Generator?

Inverters change DC power from your battery bank into AC power to run your AC equipment. Inverters work well for vessels that require only small amounts of power (1000-3500 watts) for short time periods. Boats with larger, consistent power demands and electric motors require a generator or both generator and inverter.

Engine, Hydraulic Drive, or Both?

Powered by a hydraulic pump on the main engine, hydraulic drive generators are best suited to boats with small, intermittent power requirements or long range cruisers. Generally, it is best to rely on a hydraulic generator when only small amounts of power are necessary because operating the main engine just for electricity is inefficient.

Operating Speed

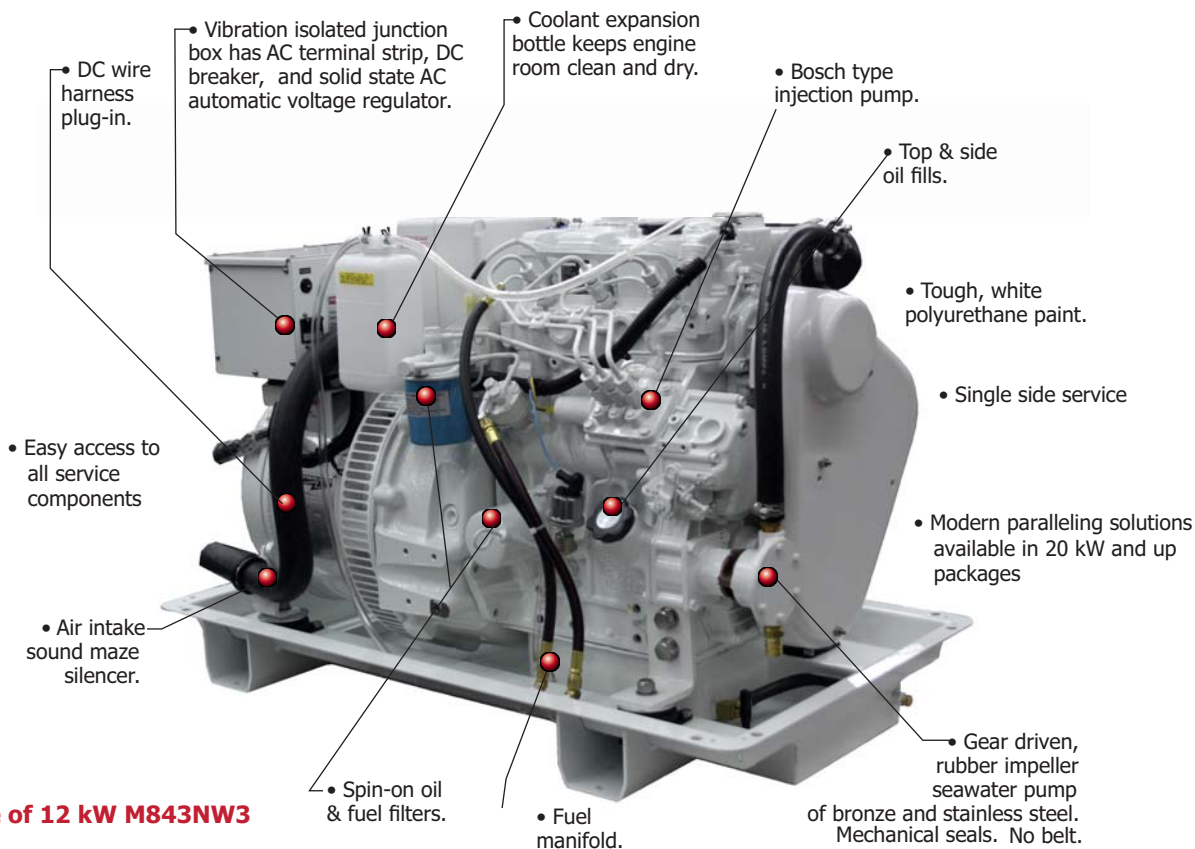
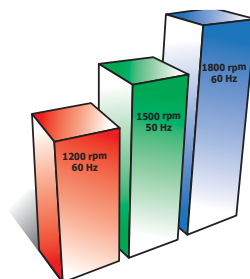
Electronic equipment is designed to use power with a fixed frequency, measured in hertz (Hz). The United States and Canada use 60 Hz; Europe, Australia, and much of Asia use 50 Hz. Choose the frequency used in the region where you will use your boat most.

The frequency output of a generator depends on its fixed engine speed. To produce 60 Hz of electricity, the engine operates at 1200, 1800, or 3600 rpm

(revolutions per minute). 50 Hz machines run at 1000, 1500, or 3000 rpm. Each has its advantages and drawbacks. 1200 rpm, six pole generators run 33% slower than conventional 1800 rpm generators. They are quieter and offer longer engine life; yet they are larger, heavier, and more expensive than 1800 rpm generators of similar output. 1200 rpm engines are not widely used today due in part to emissions standards.

Four pole generators, running at 1800 rpm for US power standards or 1500 rpm for European standards are most common. They offer great benefits – they are extremely fuel efficient, quiet, inexpensive, and dependable for the long haul.

3600 rpm, two pole generators are small and light, but these engines race at twice the speed of 1800 rpm generators. This increases noise and decreases the engine's life.



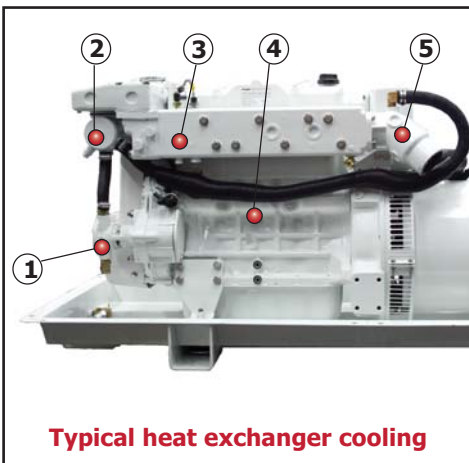
Service side of 12 kW M843NW3

Gas or Diesel?

When you need to decide between a gas or a diesel generator, check to see which your main engine uses, and match it. Keep in mind that the explosive nature of gasoline requires a spark-free generator.

Cooling Systems - Heat Exchanger, Keel Cooled, or Seawater Cooled?

Liquid cooled generator engines are engineered to be used in a marine environment, and they are available in three configurations: heat exchanger, keel cooled, or direct seawater. Your generator should have the same type of liquid cooling as your main engine. Generators that are heat exchanger cooled feature two cooling water circuits. The "seawater cooling circuit" includes a rubber impeller or centrifugal pump (1) that moves water from outside the boat, through a heat exchanger (2), and back overboard, often through the exhaust elbow (5). The "jacket water (also called freshwater) circuit" has a circulation pump that moves a coolant mixture through the heat exchanger where it is cooled by the seawater. The coolant is then pumped through the engine block (4) and exhaust manifold (3). Keel cooled generators have only the jacket water circuit. A circulation pump moves the coolant through a cooling grid on the bottom of the boat. Keel cooled generators require their own keel cooler so they are not tied to the main engine's grid.



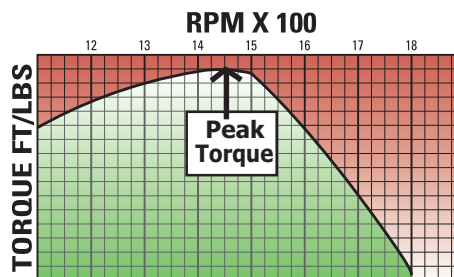
Typical heat exchanger cooling

Direct seawater cooling systems pump seawater through the engine. Corrosion and system contamination problems make direct cooling systems unsuitable for most marine applications. Air cooled generator engines exist, but they are not intended for use in a marine environment.

Engine Type

Generators with in-line engines are easy to install and service. Standard two and four cylinder engines are not well balanced and vibrate. Four-cylinder engines with counter-rotating balancing shafts eliminate vibration and provide excellent comfort on board. Three and six-cylinder engines are naturally balanced and smooth running. They produce the least vibration and are therefore the quietest. Since four pole generators operate at low rpms, the engine needs to produce its maximum torque near or below the operating speed.

Automotive engines produce maximum torque at higher speeds. For example, when an automotive engine runs at 1800 rpm, it is working at a point below peak torque. In a marine application, this will limit the engine's ability to pick up extra loads such as watermakers, air



conditioners, or refrigerators. Generator base engines that are made for heavy-duty, industrial applications offer you the strongest, most reliable low-end torque and provide the power to pick up supplementary electrical loads, even when running at full power.

Other Engine Features To Keep In Mind

- Cast-iron, liquid cooled exhaust manifolds increase safety. Dry manifolds can be a fire hazard. If there is a turbocharger, make sure it's liquid cooled.
- All service points should be gathered on one side for easy maintenance. This also allows the non-service side of the generator to be installed directly against a bulkhead to save space in the engine room.
- On larger machines, choose one with liquid cooled, replaceable cylinder liners. This will dramatically lower rebuild costs.
- You will also benefit from having safety shutdowns for high water temperature and low oil pressure on your next generator.
- Look for a design that minimizes potential failure points such as hoses, belts, and gaskets.

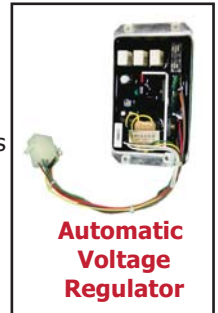
Single or Three-Phase?

Generators produce either single or three-phase power. Three-phase motors are less expensive than single-phase motors. And while three-phase power is better for motor starting and running, 20 kW generators and smaller usually feature single-phase motors.

Voltage Regulator

Most 60 Hz, three-phase pleasure-craft generators are set up for 120/208 volts. Single-phase generators are either 120, 240, or 120/240. Use the low voltage to run domestic appliances and the high voltage for your motors.

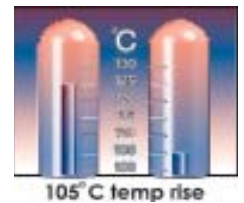
Voltage regulation is how closely the generator controls its voltage output. "Clean," symmetrical sine waves provide power that's safe for electronics and extends motor life. An externally regulated generator has an automatic voltage regulator (AVR) and holds



a close voltage tolerance. A self-regulated generator does not have an AVR, and its voltage varies to a greater degree.

Temperature Rise

When carrying a full load, a generator's copper windings heat up. The difference between the temperature of the ambient air and the windings is called "temperature rise" – it indicates the quality and quantity of copper in the generator. The lower the temperature rise, the higher the copper content, and the higher the quality. Marine generators should have a temperature rise of 95 to 105°C. This is especially important if the generator will be operating in the tropics or hot engine rooms.



The Right Size Generator

Selecting the right kilowatt size generator for your vessel is critical. If it is too small, it will wear out quickly, produce excessive exhaust smoke, and potentially damage electrical equipment. If it is too large, it will run under-loaded, lead to carbon buildup on the cylinder head, leave unburned fuel in the exhaust, and operate inefficiently. A generator should never run with less than a 25% load. 50% to 70% is optimal.

Two generators may be the best answer for a boat with varying power requirements. You can use a higher kW generator for high demand periods and a lower kW generator for times when power demand is minimal. Other options are to use a medium size generator that runs singularly or together with paralleling switch-gear or a simple split buss distribution panel.

Estimating Your Load

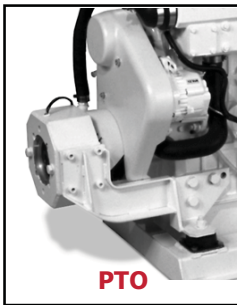
It is best to have your authorized generator dealer perform a load analysis of your vessel to determine the size of generator you require. Your dealer will start by asking for your estimated wattage load. Use this formula to calculate wattage: amps x volts = watts. Turning on appliances that utilize electric motors produces a current inrush, which can cause the voltage and frequency to dip and lights to dim. Depending on the quality and size of the motor being started, the amount of power necessary to start the electric appliance can be up to ten times its running wattage. This is why it is so important to supply your dealer with both the starting and running wattages of each motor. Your dealer can calculate the electrical load of all the equipment you will run at one time.

Accessories

Once you have determined the generator size, make a list of the optional equipment you will add to your boat.

Front PTO (power take off) is a great way to take mechanical power off the front of the engine to run hydraulics, deck machinery and bow thrusters. PTOs feature electric clutches and SAE standard mounting patterns.

To reduce engine noise and increase on-board comfort, sound enclosures are offered with many generators. Some sound enclosures make accessing the generator more difficult, so when you



PTO



Sound Enclosure

choose a sound enclosure, make sure it features panels that are easy to remove.

We recommend using circuit breakers to protect the generator from short circuits. Mount the circuit breakers as close as possible to the generator.

Other Equipment To Consider

- Mufflers and exhaust elbows - Generally, yachts and passenger vessels have wet exhaust systems. Workboats and fishing vessels tend to have dry exhaust systems. Remember, a generator that is keel cooled will need a seawater pump if you want a wet exhaust system. Wet exhaust systems must be installed correctly to keep water out of the engine. For more information see Northern Lights' "Please Don't Drown Me" guide to exhaust installation.
- A reliable primary fuel filter/water separator will protect your engine's fuel system.
- A separate battery to start the generator is important to take the advantage of redundant system design.
- Engine control panels with gauges let



Fuel Filter



TSCM Digital Control Panel

you monitor your generator. Control panels range from simple start/stop panels to highly advanced DC engine panels to panels that monitor both AC and DC functions. With wire harness extensions and multiple panels, you can control and monitor your generator from any location you choose - the bridge, the engine room, and even the master stateroom.

- Vibration isolation mounts provide a quiet and smooth time aboard.

Hydrolastic mounts deliver even smoother operation for larger generator sets.

- Additional shutdown systems, such as high exhaust temperature, engine over-speed, low water level, and low oil



Compound mounts

level add reliability.

- AC switchgear includes everything from auto-start systems to paralleling equipment that enable two generators to power one circuit. They can be as simple or as complex as required to run the generators. Remember that the more complex switchgears are, the more costly and problematic they become. Balance and a good electrical advisor are the keys here.

See Your Dealer

Once you have selected your generator and your options, take your shopping list to an authorized marine generator dealer. Choose a specialist in the field that handles a full line of generators and performs installations. Explain your application and let them make recommendations. With your knowledge of your boat and their generator expertise, your boat will have a great power system that will give you years of reliability.

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