OPERATOR’S MANUAL

For Models: M844K2, M844LK2, and M20CR2
Diesel engine exhaust and some of its constituents are known to the State of California to cause cancer, birth defects, and other reproductive harm.

— CALIFORNIA —
Proposition 65 Warning:
Read this operator's manual thoroughly before starting to operate your equipment. This manual contains information you will need to run and service your new unit.

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**Proprietary Information**

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Introduction

Servicing of marine engines and generator sets presents unique problems. In many cases boats cannot be moved to a repair facility. Marine engines cannot be compared to the servicing of automobiles, trucks or even farm equipment. Failures often occur in remote areas far from competent assistance. Marine engines are taxed far more severely than auto or truck engines; therefore, maintenance schedules must be adhered to more strictly.

Failures can begin with minor problems that are overlooked and become amplified when not corrected during routine maintenance.

As operator, it is your obligation to learn about your equipment and its proper maintenance. This is not a comprehensive technical service manual. Nor will it make the reader into an expert mechanic. Its aim is to aid you in maintaining your unit properly.

Unit Identification

MODELS INCLUDED

This manual covers the operating instructions for:

- M844K2 marine generator sets,
- M844LK2 marine generator sets, and
- M20CR2 commercial generator sets.

NOTE: There are two versions of the 844K2 engine. The standard engine is designated 844K2. The long-stroke engine is designated 844LK2. You will need to know which engine you have to use this manual and to order parts.

Fill in the model number of your unit in the blank space provided. This will give you a reference whenever service or maintenance is required:

My Northern Lights generator set MODEL number is:

Model Numbers

Model numbers give the unit's application, block model, aspiration, and RPM:

M - Northern Lights marine generator set

844:

Bore Cylinders
84 mm 4

L, C, 2

L - Long stroke version
C - Commercial version
2 - Tier 2 Compliant

M844K2 = Northern Lights marine diesel generator set with an 844 engine and a PX-300K generator end.

M844LK2 = Northern Lights marine diesel generator set with an 844L engine and a PX-300K generator end.

M20CR2 = Northern Lights 20 kW (@ 60 Hz) commercial grade marine generator set with a special generator end.
Serial Numbers

Your set has three serial numbers: an engine number stamped on the block, a generator plate, and a generator set plate.

Use the serial number on the generator set plate when ordering parts or in correspondence. The generator set plate is found on the service side of the generator and resembles the drawing in Figure 1.

Fill in the serial number of your unit in the box provided.

Figure 1: Generator set serial number plate.

Warranty

NOTE: If the warranty is to apply, the servicing instructions outlined in this manual must be followed. If further information is needed, please contact an authorized dealer or the factory.

Safety Rules

CAUTION: Accident reports show that careless use of engines causes a high percentage of accidents. You can avoid accidents by observing these safety rules. Study these rules carefully and enforce them on the job.

- Never leave engine without proper security.
- Turn the coolant tank cap slowly to relieve pressure before removing. Add coolant only when the engine is stopped and cool.
- Mount a fire extinguisher near engine.
- Always disconnect the battery ground strap before making adjustments.
- Operate engines in properly ventilated areas.
- Keep trash and other objects away from engine.
- Escaping fluids under pressure can penetrate your skin. Use a piece of cardboard or wood, not your hands, to search for leaks.
- Avoid wearing loose clothing without a belt when working around engines.
- Do not oil or grease engine while it is running.
- Use caution in handling fuel. Never refuel a hot or running engine. Do not smoke while filling fuel tank or servicing fuel system.
- Keep your hands, feet, hair and clothing away from power-driven parts.
- Check for any loose electrical connections or faulty wiring.
- Engines should be operated only by knowledgeable, qualified personnel.
- Look completely around engine to make sure that everything is clear before starting.
- Do not operate an engine that isn't in proper working order. If an unsafe operating condition is noted, tag the set and control panel so others will also know about the problem.
- Provide first aid kits.

CAUTION: This symbol is used throughout this book to alert you to possible danger areas. Please take special notice of these sections.
Marine Generator Component Locations

1. Coolant Fill
2. Expansion Tank/Exhaust Manifold/Heat Exch. Tank
3. Coolant Drain
4. Wet Exhaust Elbow
5. Junction Box
6. Vibration Mount
7. Starter
8. Coolant Thermostat (behind)

9. Belt Guard
10. Raw Water Pump
11. Alternator
12. Water Temperature Sender
13. DC Circuit Breaker
14. Secondary Fuel Filter
15. Fuel Return Line
16. Coolant Recovery Tank
17. Fuel Injector
18. Oil Fill (Top)
19. Fresh Water Pump
20. Injection Pump
21. Oil Fill (Side)
22. Raw Water Inlet
23. Oil Pressure Sender
24. Freshwater Block Drain
25. Fuel Return Line
26. Fuel Inlet Line
27. Oil Dipstick
28. Oil Filter
29. Lube Oil Drain
30. Control Panel Plug-in
31. Fuel Lift Pump
32. AC Circuit Breaker for Automatic Voltage Regulator
33. PTO (Optional)

Figure 2A and 2B: M844LK2 with PXK generator end.
1. **SHUTDOWN BYPASS-PREHEAT SWITCH**
   Two functions are built into this switch: the preheating of the engine, and bypassing of the engine safety shutdown circuit. Hold switch in the ON position 10 - 20 seconds before starting the engine, and continue holding on during engine cranking. Release the switch as soon as the engine is running. Holding the switch on too long can burn out the heater element.

2. **ENGINE CONTROL SWITCH**
   To start the engine, hold this switch in the START position until the engine is running.
   *NOTE: Excessive cranking of marine sets equipped with water lift muffler systems can cause engine damage. See page 6.*
   After the engine starts, release the switch and it will return to RUN position. To stop the engine, hold the switch in the STOP position until the engine has completely stopped.
   *NOTE: The rocker switch is used on Series 1 panels only, and has a light that glows when the set is running.*

3. **HOUR METER**
   Keeps track of engine running time.

4. **OIL PRESSURE GAUGE**
   Shows the oil pressure in the engine lubricating system.

5. **ENGINE TEMPERATURE GAUGE**
   Registers the temperature of the engine coolant.

6. **D.C. VOLTMETER OR AMMETER**
   When the engine is stopped, the voltmeter indicates the condition of the battery. When the engine is running, the voltmeter indicates the voltage output of the alternator.

For Series 4 Control Panels Only:

7. **A.C. VOLTMETER**
   Shows the generator output voltage.

8. **FREQUENCY METER (Hertz)**
   The frequency meter indicates alternating current frequency: 60 Hz (1800 RPM), or 50 Hz (1500 RPM).

9. **AMMETER/VOLTMETER SELECTOR SWITCH**
   Used to check voltage and current of each phase.

10. **A.C. AMMETER**
    Shows the generator load on each phase. The phase is selected with the Ammeter Selector switch (Item 9).
BREAK-IN PERIOD

1. The first 100 hours on a new or reconditioned engine are critical to its life and performance.
2. Frequently check the engine temperature and oil pressure gauges (sets with Series 3 or 4 panels).
3. Oil consumption is greater during break-in as piston rings take time to seat.
4. Break-In Oil Changes: Change engine oil and filter at 50 hours. Change oil and filter again at 100 hours (consult Lubricants section for oil recommendation).

Operating Instructions:
Maintain at least a 75% load on your generator set for the first 100 hours. If this is not possible, maintain no less than a 50% load to ensure proper seating of the piston rings. Vary the load to help seat the rings.

BEFORE STARTING

1. Check the water level by removing the pressure cap from the expansion tank or radiator. In order to give the cooling water an opportunity to expand, the level should be about 1 in. (2.5 cm) below the filler cap sealing surface when the engine is cold.
   
   CAUTION: Use protective clothing and open the filler cap carefully when the engine is warm to prevent burns.

2. Check the oil level in the crankcase with the dipstick. The oil level must be in the waffled area on the stick. Never allow the level to go below this area. Always add the same viscosity of oil as is already in the crankcase.
3. Check the fuel tank level and open any fuel valves.
4. Close the sea-cock; check, clean, and reassemble the sea strainer and re-open the sea-cock.
5. Place the battery switch in the ON position.
   
   NOTE: The battery switch must always be kept ON while the engine is running. If the switch is turned OFF while the engine is running, the battery charging regulator could be ruined.

STARTING

1. Hold the Shutdown Bypass-Preheat switch in the ON position for 10 to 20 seconds before starting a cold engine. Holding the switch too long can burn out the glow plugs. This step is not necessary if the engine is already warm.
2. While holding the Shutdown Bypass-Preheat switch in the ON position, push the Engine Control switch to the START position.
3. As soon as the engine starts, release both switches. Do not crank the starter for more than 20 seconds consecutively. If the engine fails to start with the first attempt, be sure that it has stopped completely before re-engaging.

   NOTE: Excessive cranking of the starter on Marine sets equipped with a water lift muffler can cause engine damage. If the engine does not start after three 20-second cranks, remove the impeller from the raw water pump. This will prevent the muffler from filling with water and backfilling the exhaust line and engine. Once the engine starts, shut it off immediately and re-install the impeller. Re-start the engine and check the exhaust overboard outlet for gushes of water.

OPERATING

1. Units with Series 3 and Series 4 Control Panels:
   check gauges often. Oil pressure must be above 15 PSI. The D.C. voltmeter should read between 11 and 15 volts at 80°F (25°C) ambient temperature.

   The water temperature gauge on Marine sets must be below 200°F (94°C). Check the A.C. voltage and frequency meters (Series 4 panel). If the gauges deviate from normal levels, shut down the generator set and investigate.

2. Let the unit run unloaded for a three to five minute warm-up period.
3. Apply electrical load.

STOPPING

1. Remove electrical load from the generator set.
2. Run the engine for a 3 to 5 minute cool down period.
3. Hold the Engine Control switch to the STOP position until the engine comes to a complete stop.
4. Shut off the seacock, fuel valve, and battery switch.
SHUTDOWNS AND ALARMS

1. Your unit is fitted with a system to protect it from high water temperature or low oil pressure.
   a. Generator sets have shutdown systems to stop the engine. They have no warning horns.
   b. Other alarms and shutdowns are available as optional equipment.
   NOTE: Do not rely on your warning to the exclusion of careful gauge monitoring. Watching your gauges can prevent damage to the unit and dangerous power losses.

2. Do the following when your warning or shutdown system is activated:
   a. Check the temperature gauge.
      If above 205°F (96°C), shut off the engine immediately.
   b. Use the Trouble Shooting Guide on page 20 to isolate the cause of the overheat.
   c. Make repairs. Restart your Marine set after the temperature gauge registers below 200°F (94°C).
   d. Watch the engine crankcase oil level.
      If the oil level is low, fill with recommended lubricating oil and restart. Watch the oil pressure gauge carefully and shut off the engine if it does not show a normal reading (20-60 PSI) after a few seconds of operation.
   e. Check the engine crankcase oil level.
   f. If the oil level is normal, DO NOT restart the engine. Call your dealer for assistance.

3. If shutdown is activated and the temperature gauge shows temperature within normal temperature range:
   a. Check the engine crankcase oil level.
   b. If the oil level is normal, DO NOT restart the engine. Call your dealer for assistance.

CAUTION: Do not remove the water fill cap of an overheated engine. Escaping high temperature steam can cause severe burns. Allow the engine to cool and then remove the cap slowly using protective clothing.

SPARE PARTS

1. Northern Lights recommends that you keep the following spare parts on hand for field service. The parts are available from your local Northern Lights dealer.
   Some marine models already have “On-Board-Kits,” a handy box that contains the most common parts you will need.

2. All owners should have the following spares:
   a. Primary and secondary fuel filter elements
   b. Oil filters
   c. Air filter
   d. Alternator belt
   e. Thermostat and gaskets
   f. Seawater pump impeller & gaskets (marine only)
   g. Glow plug
   h. Injector and washer

3. If your set is operating a long distance from a servicing dealer, add the following:
   a. Complete set of injectors
   b. Copper washers for injector change
   c. Complete set of glow plugs
   d. Fuel lift pump
The Servicing Schedule Chart below shows the service schedule required for proper maintenance of your generator set. More detailed coverage of each Service Point (SP) is listed on the page noted in the ‘page’ column.

**DAILY:**
- **SP1** Check oil level in engine
- **SP5** Check V-belt tension
- **SP7** Check primary fuel filter
- **SP13** Check coolant level
  - Check sea strainer (marine only)
  - Check raw water pump for leaks
- **SP18** Check electrolyte in batteries

**AFTER FIRST 50 HOURS:**
- **SP2/3** Change engine oil and filter
- **SP6** Adjust valves

**AFTER FIRST 100 HOURS:**
- **SP2/3** Change engine oil and filter

**EVERY 250 HOURS:**
- **SP2/3** Change engine oil and filter
- **SP4** Check air cleaner
- **SP19** Check state of charge of batteries

**EVERY 500 HOURS:**
- **SP8** Change primary fuel filter element
- **SP9** Change secondary fuel filter
- **SP22** Inspect condition of exhaust elbow

**EVERY 1000 HOURS:**
- **SP4** Change air cleaner element
- **SP6** Check valve clearances
- **SP11** Check injectors
- **SP17** Change impeller

**EVERY 2500 HOURS:**
- **SP12** Check fuel injection pump
- **SP14** Check and flush cooling system
- **SP15** Check and clean heat exchanger

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1) Perform all maintenance once a year even if hour level has not been reached.
2) Consult manufacturer’s maintenance schedule, note on chart.
3) Whenever necessary.
4) More often if necessary.
5) After first 50 hours, then after 100 hours, then at every 250 hours.
6) Clean injection nozzles every 1500 hours.
7) For EPA emission standards fuel nozzle needs to be cleaned every 1500 hours, the fuel nozzle and fuel pump need to be cleaned, adjusted, or repaired every 3000 hours, and the quality guarantee for these parts is 1500 hours or 2 years.
LUBRICATION - GENERAL

1. Use only clean, high quality lubricants stored in clean containers in a protected area.
2. These lubricants are acceptable:
   a. API Service CC/CD/CE single viscosity oils.
   b. API Service CC/CD/SF multi-viscosity oils.
3. Use the proper weight oil for your average operation temperature.

<table>
<thead>
<tr>
<th>Air Temperature</th>
<th>Single Viscosity</th>
<th>Multi-Viscosity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Above 32°F (0°C)</td>
<td>SAE 30W</td>
<td>SAE 15-40W</td>
</tr>
<tr>
<td>-10 to 32°F (-23 to 0°C)</td>
<td>SAE 10W</td>
<td>SAE 10-30W</td>
</tr>
<tr>
<td>Below -10°F (-23°C)</td>
<td>SAE 5W</td>
<td>SAE 5-20W</td>
</tr>
</tbody>
</table>

Figure 4: Lube Oils

4. Some increase in oil consumption may be expected when SAE 5W and SAE 5-20W oils are used. Check oil level frequently.
5. Never put additives or flushing oil in crankcase.

SP1. CHECKING OIL LEVEL

1. Check the oil level in the crankcase with the dipstick. The oil level must be in the waffled area on the stick. Never allow the level to go below this area. Follow the lubrication recommendations above.

SP2. OIL CHANGES

1. The set is delivered with special break-in oil. Change the engine oil and oil filter after 50 hours of operation. Use Service CC 30 weight oil during the first 100 hours.
2. Change the oil and filter again at 100 hours using the oil recommended in the above diagram. After this, change oil and filter every 250 hours.
3. During intermittent cold weather operation, change oil every 100 hours or six weeks, whichever comes first.
4. Change oil at the end of each season and the beginning of each season.
5. Change oil when engine is warm.
6. Dispose of waste oil in an approved manner.
7. Never use a flushing oil.
8. Loosen the clamp on the oil change tube. Remove cap. Drain oil. Replace the cap and tube.
9. Refill engine with recommended oil for the season.
10. Engine capacity with new oil filter is:

   844k2 and 844Lk2 – 2.1 gallons (8.2 liters)

SP3. CHANGING LUBE OIL FILTER

1. Change the lube oil filter every 250 hours.
2. Use a filter wrench to remove old filter. Dispose of filter in approved manner.
3. Make sure the gasket from the old filter is removed and discarded. Clean mount face.
4. Spread a thin film of engine oil on the rubber gasket on the new filter and screw it on nipple until gasket meets the sealing surface.
5. Using hands only – no wrench – tighten filter one-half turn farther. Overtightening can do damage to filter housing.
6. Fill engine with recommended oil. Start engine and check for leakage. Stop engine, wait 3 minutes, and check oil level. Add additional oil if necessary.
7. Oil filter part number is:

   844k2 and 844Lk2 – #24-03100
SP4. AIR CLEANER

1. Inspect air cleaner every 250 hours. In dusty conditions, check more often.
2. Marine sets: if dirty, wash element in soapy water. Rinse and dry thoroughly before re-installing. Replace if necessary. Part numbers are: M844k2 and M844Lk2 – #24-23100
3. C-Series sets: the element cannot be cleaned. Replace it when necessary. Part number is: M20CR2 – #24-28401
4. NOTE: Make absolutely sure no impurities enter the engine while changing the element. Do NOT run the engine with the air cleaner removed.

SP5. V-BELTS

1. Check the tension and wear on the V-belt daily.
2. Use your thumb to press on the belt at the midpoint between the crankshaft and alternator pulleys. The tension is correct if the belt can be depressed about 3/16 in. (5 mm).

![Figure 5: 844k2 and 844Lk2 Valve sequence](image)

**Figure 6: Valve Adjustment**

SP6. VALVE CLEARANCES

1. Adjust valve clearance after first 50 hours of operation and every 1000 hours thereafter.
2. Valve adjustments should be done after the cylinder head bolts have been re-tightened. Engine should be cold and NOT running.
3. Watch the valves while turning the engine over by hand. Turn until the inlet valve starts to open and the exhaust valve starts to close (the valves are rocking). Then turn the crankshaft one more full turn and adjust the clearance on both valves for this cylinder.
4. Loosen the lock nut and adjust the clearance between the rocker arm and valve guide of both the intake and exhaust valves with the adjustment screw (Figure 6). Clearance on both intake and exhaust valves should be 0.008 in. (0.2 mm).
5. Repeat steps 3 and 4 for each cylinder. Each set of valves must be adjusted individually.
6. Replace the rocker arm cover. Tighten cover nuts to 5 - 8 ft/lbs (0.8 - 2.3 kg/m).
**FUELS - GENERAL**

1. Use only clean, high quality fuels of the following specifications, as defined by ASTM designation D975 for diesel fuels:
   a. Use grade no. 2 diesel at ambient temperatures above freezing 32°F (0°C).
   b. Use grade no. 1 at ambient temperatures below freezing and for all temperatures at an altitude of above 5,500 ft. (1500 meters).
2. Use fuel having less that 1% sulphur (preferably less that 0.5%).
3. The cetane number should be a minimum of 45.
4. DO NOT use these unsuitable grades of fuel:
   a. Domestic heating oils, all types.
   b. Class B engine.
   c. Class D domestic fuels.
   d. Class E, F, G or H industrial or marine fuels.
   e. ASTM-D975-60T No. 4-D and higher number fuels.
5. Storing fuel:
   a. Keep dirt, scale, water, and other foreign matter out of fuel.
   b. Avoid storing fuel for long periods of time.
   c. Fill the fuel tank at the end of each day’s operation. This will reduce condensation and possible biological contamination.
   d. If biological contamination is detected or suspected, contact your dealer for assistance.

**SP7-9. FUEL FILTERS**

1. Your generator set should have a primary fuel filter installed. We recommend the Racor brand of fuel filter-water separators.
   a. Check the primary fuel filter daily as recommended by the filter manufacturer. Empty the collection bowl as necessary.
   b. Change the element as often as necessary or every 500 hours.
   c. If the bowl fills with water, change the primary and secondary element immediately.
2. Change secondary fuel filter every 500 hours.
   NOTE: The fuel filter on the engine is considered the “secondary fuel filter.”
   a. Remove the spin-on filter by turning it counterclockwise with a filter wrench. Fill the new cartridge with fuel and install it after applying engine oil to gasket surface. Screw on until the gasket surface comes into contact with sealing surface of filter base. Then, tighten it two-thirds of a turn by hand. Do not overtighten.
   b. Fuel filter part numbers are:

   **844K2 and 844LK2  –  #24-52020**
**SP10. BLEEDING THE FUEL SYSTEM**

**CAUTION:** Escaping diesel fuel under pressure can penetrate skin causing serious personal injury. Before disconnecting lines be sure to relieve all pressure. Before applying pressure, be sure all connections are tight and lines, pipes and hoses are not damaged. Fuel escaping from a very small hole can be almost invisible. Use a piece of cardboard or wood, rather than hands, to search for suspected leaks. If injured by escaping fuel, see a doctor at once. Serious infection or reaction can develop if proper medical treatment is not administered immediately.

1. The fuel system is self-bleeding. However, any system may need manual bleeding when:
   a. A new fuel filter is installed;
   b. The engine has run out of fuel;
   c. The fuel lines, injection pump or any other fuel system component has been removed and installed.
2. Loosen bleed bolt “A” (Figure 8) on top of the filter. Pump hand primer “B” on fuel lift pump until pure fuel (no bubbles) escapes from bleed bolt “A”. Tighten bleed screw “A”.
3. Loosen bleed screw “C”. Pump hand primer “B” until pure fuel (no bubbles) escapes. Then tighten bleed screw “C”.
4. If the engine does not start after the above bleeding process, loosen a fuel line at the injector while cranking the engine with the starter motor until pure fuel escapes. Then tighten the connection. Do each line **one-at-a-time**.
5. After the engine has started, use a piece of cardboard to look for fuel leaks.

**Figure 8: M844x2/M844Lx2 Fuel System.**
Figure 9: Remove delivery line flare nuts.

Figure 10: Remove delivery lines.

Figure 11: Cover lines, inlets and injection pump outlets.

Figure 12: Remove return line nuts.

Figure 13: Remove return line.

Figure 14: Unscrew injector.

Figure 15: Remove and replace copper sealing washer.

Figure 16: Reinstall injector. Torque to proper tightness.
**SP11. INJECTOR SERVICE**

1. Injectors should be checked every 1000 hours. Check should be made by a Northern Lights dealer or local injection repair station.

   **CAUTION:** Escaping diesel fuel under pressure can have sufficient force to penetrate the skin causing serious personal injury. If injured by escaping diesel fuel, see a doctor at once.

2. Injector removal:
   a. Clean loose dirt from around the injectors and the fuel lines.
   b. Relieve high pressure in the fuel lines by loosening the delivery line flare nuts at each injector (Figure 9).
   c. Remove delivery lines by disconnecting from injectors and injection pump (Figure 10). Remove all lines as an assembly; do not remove the spacers. Cover the ends of the lines, the injector inlets and injection pump outlets to keep dirt out (Figure 11).
   d. Remove the return line retaining bolts (Figure 12).
   e. Unscrew and remove the injectors (Figure 14).
   f. After removing the injectors, discard the copper sealing washers from the injector hole in the head (Figure 15). Cover holes to prevent dirt and debris from entering the cylinders.

3. Injector installation:
   a. Install a new copper sealing washer in each injector hole (Figure 15).
   b. Screw in injector and tighten to 44 - 51 ft/lbs (6 to 7 kgm) (Figure 16).
   **NOTE:** Overtightening can damage injector.
   c. Install return line using a new sealing washer below each connection. Tighten return line retaining bolts to 22 - 30 ft/lbs.
   d. Install delivery lines. Leave loose at injectors for bleeding.
   e. Crank engine to fill lines. Tighten lines at injectors to 11-18 ft./lbs. Start engine and check for leaks using a piece of paper or cardboard. 
   **DO NOT USE HAND TO CHECK FOR LEAKS.**

**SP12. INJECTION PUMP**

1. Since operating conditions may vary considerably, it is difficult to give a definite interval for checking the injection pump. But as a rule, pump settings, maximum speed, idle speed and exhaust smoke should be checked after every 2500 hours of operation. Service of the fuel injection pump should only be done if checks indicate pump malfunction.

2. Black smoke can be an indication of pump malfunction. Before servicing the pump, check other possible causes:
   a. Check cleanliness of air filter.
   b. Check valve clearances.
   c. Clean and check injectors.

3. Any repair which involves disassembly of the injection pump must be carried out by specially trained mechanics with the proper tools and test equipment.

   **NOTE:** All warranties on the engine become null and void if the injection pump seals are broken by unauthorized persons.

**COOLING SYSTEM - GENERAL**

**NOTE:** Marine sets – be sure to close the sea-cock before working on the engine cooling system.

**CAUTION:** The cooling water in the engine reaches extremely high temperatures. You must use extreme caution when working on hot engines to avoid burns. Allow the engine to cool before working on the cooling system. Open the filler cap carefully, using protective clothing when the engine is warm.

**SP13. CHECK THE COOLANT LEVEL**

1. Check the coolant level each day before starting the engine. Check the water level by removing the pressure cap from the expansion tank.

   In order to give the cooling water an opportunity to expand, the level should be about 1 in. (2.5 cm) below the filler cap sealing surface when the engine is cold.

2. The pressure valve in the filler cap releases when the pressure is approximately 7 PSI (0.5 bar). Use a cap pressure tester to check cap if you suspect it is faulty.
SP14. COOLING SYSTEM FLUSHING

1. Flush the cooling system every 2500 hours or every 12 months, whichever comes first.
2. Marine sets:
   a. Remove expansion tank cap and drain engine block.
   b. Open block drain cock. Remove hose from bottom of heat exchanger tank.
   c. Pour clean water into expansion tank until water coming from drains is free of discoloration and sediment. Let water drain completely. Close drains and refill with recommended mixture.
3. Coolant Specifications (marine and industrial):
   Use 50% distilled water / 50% ethylene glycol antifreeze mix. Antifreeze mixture is recommended as a good year-round coolant.
4. Check hoses and connections and repair any leakage.

SP15. HEAT EXCHANGER

1. Clean the heat exchanger core once a year or after 2500 hours of operation.
2. Drain expansion tank and heat exchanger.
3. Remove heat exchanger end covers and remove core.
4. Clean the inside of exchanger core tubes using a metal rod. Flush, inspect and clean again if necessary.
5. Reassemble. Fill the cooling system, start the engine and check for leaks.

SP17. RAW WATER PUMP

1. Change the seawater pump impeller every 1000 hours, or as needed.
2. Remove the pump end cover. Pry out the impeller using needle-nose pliers or two screwdrivers. Be sure you remove all pieces of failed impeller.
   NOTE: Place some kind of protection under the screwdrivers in order not to damage the pump housing. If the impeller has broken into pieces, remove front heat exchanger end cover and inspect for impeller pieces. Clean inlet to heat exchanger bundle and reassemble.
3. Clean the inside of the housing.
4. Press in the new impeller and place the sealing washers in the outer end of the impeller center if this has not already been done.
5. Replace the cover using a new gasket.
   NOTE: Make sure that there is always an extra impeller and cover gasket in reserve on board.

GENERATOR ENDS

The maintenance and operation recommendations for the generator end are in a separate Owner’s Manual. If you do not have one of these manuals, contact your local Northern Lights dealer.

ELECTRICAL SYSTEM - GENERAL

1. Never switch battery switch off or break the circuit between the alternator and batteries while the engine is running. Regulator damage can result.
2. Do NOT reverse the polarity of battery cables when installing the battery.
3. If welding on the unit, disconnect the regulator and battery. Isolate the leads.
4. Disconnect the battery cables when servicing the D.C. alternator.
5. Never test with a screwdriver, etc., against any terminal to see if it emits sparks.
6. Do not polarize the alternator or regulator.
7. A D.C. circuit breaker protects your control panel and wiring harness. It is located in the side of the generator junction box.
GLOW PLUGS

1. Each cylinder is supplied with a glow plug which serves to heat the combustion chamber.
2. To check the glow plugs, loosen the current carrying flat wire between the plus-poles of the glow plugs (Figure 17). Connect a D.C. test bulb between the plus-pole of the battery and the plus-pole of the glow plug. If the bulb lights up, the glow plug is functioning properly.
3. Check all glow plugs and replace any faulty ones.

Figure 17: Glow plugs.

BOOSTER BATTERIES

CAUTION: Battery gas can explode. Keep all flames and sparks away from batteries.

1. Before changing or using booster batteries, check battery electrolyte level. Add distilled water if necessary.
2. Booster and main batteries must have the same voltage rating.
3. First, connect positive (+) terminal of booster battery to positive (+) terminal of main battery. Then, connect negative (-) terminal of booster battery to ground on the engine block (see Figure 18).
4. Remove booster battery after starting engine.
5. Sealed batteries: See manufacturer charging and booster instructions.

SP 18-19. BATTERY CARE

1. Check electrolyte level daily. Add distilled water to manufacturer’s recommended level.
2. Batteries, cables and cable terminals should be checked and cleaned every 100 hours. Clean corrosion with a water and baking soda solution. Flush with clean water. Tighten terminals and grease them to inhibit corrosion.
3. Check the battery condition with a hydrometer every 250 hours.

SP20. P.T.O.

1. The electric clutch P.T.O. does not have any scheduled maintenance points. However, the equipment the P.T.O. powers may require maintenance. Consult the manufacturer of the driven equipment.

SP21. WINTERIZING / OUT-OF-SERVICE

1. Marine sets:
   a. Drain fresh water and seawater cooling systems completely. Remember to shut off seacocks before opening drain cocks.
   b. Drain water supply lines and wet exhaust line.
   c. Loosen the seawater pump cover and drain pump.
   d. Change the crankcase oil and filter.
   e. Loosen the alternator belt.
   f. Disconnect and clean battery. Remove to warm storage place if possible.
   g. Clean outside of unit. Paint any scratched or chipped surfaces. Put corrosion preventative on all exposed metal surfaces.

Figure 18: Battery connections.
## Troubleshooting

### DC ELECTRICAL SYSTEM

<table>
<thead>
<tr>
<th>PROBLEM</th>
<th>POSSIBLE CAUSE</th>
<th>RECOMMENDATION(S)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Battery Will Not Charge</td>
<td>Loose or corroded connections</td>
<td>• Clean and tighten battery connections.</td>
</tr>
<tr>
<td></td>
<td>Sulfated or worn out batteries</td>
<td>• Check specific gravity of each battery.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Check electrolyte level of each battery.</td>
</tr>
<tr>
<td></td>
<td>Loose or defective alternator belt</td>
<td>• Adjust belt tension.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Replace belt.</td>
</tr>
<tr>
<td>Starter Inoperative</td>
<td>Check DC circuit breaker</td>
<td>• If the breaker is tripped, reset it.</td>
</tr>
<tr>
<td></td>
<td>Loose or corroded connections</td>
<td>• Clean and tighten loose battery and harness plug connection.</td>
</tr>
<tr>
<td></td>
<td>Low battery output</td>
<td>• Check specific gravity of each battery.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Check electrolyte level of each battery.</td>
</tr>
<tr>
<td></td>
<td>Defective electrical system ground wire:</td>
<td>• Repair or replace.</td>
</tr>
<tr>
<td>Starter Cranks Slowly</td>
<td>Low battery output</td>
<td>• Battery is too small.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Battery cables are too small.</td>
</tr>
<tr>
<td></td>
<td>Check specific gravity of each battery</td>
<td>• Replace battery if necessary.</td>
</tr>
<tr>
<td></td>
<td>Check electrolyte level of each battery</td>
<td>• If low, fill cells with distilled water.</td>
</tr>
<tr>
<td></td>
<td>Crankcase oil too heavy</td>
<td>• Fill with oil of appropriate viscosity.</td>
</tr>
<tr>
<td></td>
<td>Loose or corroded connections</td>
<td>• Clean and tighten loose connections.</td>
</tr>
<tr>
<td>Entire Electrical System Does Not Function</td>
<td>Check DC circuit breaker</td>
<td>• If breaker is tripped, reset it.</td>
</tr>
<tr>
<td></td>
<td>Faulty connection</td>
<td>• Clean and tighten battery and harness plug connections.</td>
</tr>
<tr>
<td></td>
<td>Sulfated or worn out batteries</td>
<td>• Check specific gravity and electrolyte level of each battery.</td>
</tr>
</tbody>
</table>

If you cannot correct problems with these procedures, see your Northern Lights dealer.
<table>
<thead>
<tr>
<th>ENGINE PROBLEM</th>
<th>POSSIBLE CAUSE</th>
<th>RECOMMENDATION(S)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Engine Hard to Start or Will Not Start</td>
<td>Improper starting procedure</td>
<td>• See starting section of this manual. Take special note of Bypass Switch operation.</td>
</tr>
<tr>
<td></td>
<td>No fuel</td>
<td>• Check level of fuel in fuel tank.</td>
</tr>
<tr>
<td></td>
<td>Low battery output</td>
<td>• Check electrolyte level and condition.</td>
</tr>
<tr>
<td></td>
<td>Excessive resistance in starting circuit</td>
<td>• Clean and tighten all battery connections.</td>
</tr>
<tr>
<td></td>
<td>Crankcase oil too heavy</td>
<td>• Use oil of proper viscosity.</td>
</tr>
<tr>
<td></td>
<td>Improper type of fuel</td>
<td>• Consult fuel supplier and use proper type of fuel for operating condition.</td>
</tr>
<tr>
<td></td>
<td>Water, dirt or air in fuel system</td>
<td>• Drain, flush, fill and bleed system.</td>
</tr>
<tr>
<td></td>
<td>Clogged primary fuel filter element</td>
<td>• Clean or replace filter element.</td>
</tr>
<tr>
<td></td>
<td>Clogged secondary fuel filter element</td>
<td>• Replace filter element.</td>
</tr>
<tr>
<td></td>
<td>Dirty or faulty injection nozzles</td>
<td>• Have your dealer check injection nozzles.</td>
</tr>
<tr>
<td>Engine Runs Irregularly or Stalls Frequently</td>
<td>Below normal engine temperature</td>
<td>• Remove and check thermostat.</td>
</tr>
<tr>
<td></td>
<td>Clogged primary fuel filter element</td>
<td>• Clean or replace filter element.</td>
</tr>
<tr>
<td></td>
<td>Clogged secondary fuel filter element</td>
<td>• Replace secondary filter element.</td>
</tr>
<tr>
<td></td>
<td>Water or dirt in the fuel system</td>
<td>• Drain, flush, fill and bleed system.</td>
</tr>
<tr>
<td></td>
<td>Dirty or faulty injection nozzles</td>
<td>• Have your dealer check injection nozzles.</td>
</tr>
<tr>
<td></td>
<td>Air in fuel system</td>
<td>• Inspect clamps and hoses on suction side of fuel pump for air leak.</td>
</tr>
<tr>
<td></td>
<td>Improper type of fuel</td>
<td>• Consult fuel supplier and use proper type of fuel for operating condition.</td>
</tr>
<tr>
<td>Lack of Engine Power</td>
<td>Intake air restriction</td>
<td>• Service air cleaner.</td>
</tr>
<tr>
<td></td>
<td>Clogged primary fuel filter element</td>
<td>• Clean or replace filter element.</td>
</tr>
<tr>
<td></td>
<td>Clogged secondary fuel filter element</td>
<td>• Replace filter element.</td>
</tr>
<tr>
<td></td>
<td>Improper type of fuel</td>
<td>• Consult fuel supplier and use proper type of fuel for operating conditions.</td>
</tr>
<tr>
<td></td>
<td>Overheated engine</td>
<td>• See “Engine Overheats” in next category.</td>
</tr>
<tr>
<td></td>
<td>Below normal engine temperature</td>
<td>• Remove and check thermostat.</td>
</tr>
<tr>
<td></td>
<td>Improper valve clearance</td>
<td>• Reset valves. Best done by dealer.</td>
</tr>
<tr>
<td></td>
<td>Dirty or faulty injection nozzles</td>
<td>• Replace injectors. Best done by dealer.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• See your local dealer.</td>
</tr>
</tbody>
</table>
## Troubleshooting

<table>
<thead>
<tr>
<th>ENGINE PROBLEM</th>
<th>POSSIBLE CAUSE</th>
<th>RECOMMENDATION(S)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Engine Overheats</strong></td>
<td>Low coolant level</td>
<td>• Fill tank or radiator to proper level.</td>
</tr>
<tr>
<td></td>
<td>Keel cooling tubes have been painted (marine)</td>
<td>• Remove paint from tubes.</td>
</tr>
<tr>
<td></td>
<td>Cooling system needs flushing</td>
<td>• Flush cooling system.</td>
</tr>
<tr>
<td></td>
<td>Defective thermostat</td>
<td>• Remove and check thermostat.</td>
</tr>
<tr>
<td></td>
<td>Defective temperature gauge</td>
<td>• Check water temperature with thermometer and replace gauge if necessary.</td>
</tr>
<tr>
<td></td>
<td>Water pump impeller worn/broken</td>
<td>• Check impeller and replace if necessary.</td>
</tr>
<tr>
<td><strong>Engine Knocks</strong></td>
<td>Insufficient oil</td>
<td>• Call your dealer.</td>
</tr>
<tr>
<td></td>
<td>Injection pump out of time</td>
<td>• Call your dealer.</td>
</tr>
<tr>
<td></td>
<td>Below normal engine temperature</td>
<td>• Check your thermostats.</td>
</tr>
<tr>
<td></td>
<td>Engine overheating</td>
<td>• Check water temperature to see if temperature gauge is working properly.</td>
</tr>
<tr>
<td></td>
<td><strong>See “Engine Overheating” section.</strong></td>
<td></td>
</tr>
<tr>
<td><strong>High Fuel Consumption</strong></td>
<td>Improper type of fuel</td>
<td>• Use correct fuel for temperature.</td>
</tr>
<tr>
<td></td>
<td>Clogged or dirty air cleaner</td>
<td>• Service air cleaner.</td>
</tr>
<tr>
<td></td>
<td>Improper valve clearance</td>
<td>• See your dealer.</td>
</tr>
<tr>
<td></td>
<td>Injection nozzles dirty</td>
<td>• See your dealer.</td>
</tr>
<tr>
<td></td>
<td>Injection pump out of time</td>
<td>• See your dealer.</td>
</tr>
<tr>
<td></td>
<td>Engine not at proper temperature</td>
<td>• Check your thermostats.</td>
</tr>
<tr>
<td></td>
<td><strong>Check water temperature with thermometer and replace gauge if necessary.</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Below Normal Engine Temperature</strong></td>
<td>Thermostat not working properly</td>
<td>• Check thermostat.</td>
</tr>
<tr>
<td></td>
<td>Temperature gauge not working properly</td>
<td>• Check water temperature with thermometer.</td>
</tr>
<tr>
<td><strong>Low Oil Pressure</strong></td>
<td>Low oil level</td>
<td>• Fill crankcase to proper level.</td>
</tr>
<tr>
<td></td>
<td>Improper type of oil</td>
<td>• Drain and fill crankcase with correct oil.</td>
</tr>
<tr>
<td></td>
<td>Partially plugged oil filter</td>
<td>• Replace filter.</td>
</tr>
<tr>
<td><strong>High Oil Consumption</strong></td>
<td>Break-in period</td>
<td>• Oil consumption decreases after break in.</td>
</tr>
<tr>
<td></td>
<td>Crankcase oil too light</td>
<td>• Use proper viscosity oil.</td>
</tr>
<tr>
<td></td>
<td>Oil leaks</td>
<td>• Check for leaks in lines around gaskets and drain plug.</td>
</tr>
</tbody>
</table>

If you cannot correct problems with these procedures, see your Northern Lights dealer.
# Troubleshooting

<table>
<thead>
<tr>
<th>ENGINE PROBLEM</th>
<th>POSSIBLE CAUSE</th>
<th>RECOMMENDATION(S)</th>
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<tbody>
<tr>
<td><strong>Engine Emits Black or Gray Exhaust Smoke</strong></td>
<td>Clogged or dirty air cleaner</td>
<td>• Service air cleaner.</td>
</tr>
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<td></td>
<td>Defective muffler (back pressure too high)</td>
<td>• Have dealer check back pressure.</td>
</tr>
<tr>
<td></td>
<td>Improper fuel</td>
<td>• Use correct fuel for temperature.</td>
</tr>
<tr>
<td></td>
<td>Injection nozzles dirty</td>
<td>• See your dealer.</td>
</tr>
<tr>
<td></td>
<td>Engine timing off</td>
<td>• See your dealer.</td>
</tr>
</tbody>
</table>

| **Engine Emits White Smoke**       | Improper fuel                         | • Use correct fuel for temperature.    |
|                                    | Cold engine                           | • Warm up engine to normal operating temperature. |
|                                    | Defective thermostat                  | • Remove and check thermostat.         |
|                                    | Engine timing off                     | • See your dealer.                      |

If you cannot correct problems with these procedures, see your [Northern Lights](#) dealer.
## General Information

<table>
<thead>
<tr>
<th>Kilowatt Rating Prime</th>
<th>16 kW</th>
<th>12 kW</th>
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<tbody>
<tr>
<td>Rated RPM/Frequency</td>
<td>1800/60Hz</td>
<td>1500/50Hz</td>
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</tbody>
</table>

### Engine Type
- Lugger 4 cycle, swirl chamber diesel
- Lugger 4 cycle, swirl chamber diesel

### Cylinders
- Inline 4
- Inline 4

### Displacement
- 121in³ (1.995 liters)
- 121in³ (1.995 liters)

### Cycles
- 4
- 4

### Bore x Stroke
- 3.3 x 3.5 in (84 x 90 mm)
- 3.3 x 3.5 in (84 x 90 mm)

### Rotation (Facing Flywheel)
- counter-clockwise
- counter-clockwise

### Compression Ratio
- 22:1
- 22:1

### Crankcase Capacity including Oil Filter
- 2.1 gal (8.2 liter)
- 2.1 gal (8.2 liter)

### Aspiration
- Natural
- Natural

### Flywheel Housing Size
- SAE 4
- SAE 4

### Flywheel Drive Size
- C-107
- C-107

### Rated Flywheel HP
- 26 HP
- 21.5 HP

### Dry Weight w/Heat Exchanger, Single Phase
- 873 lbs. (396 kg)
- 873 lbs. (396 kg)

### Length
- 42 in (1067 mm)
- 42 in (1067 mm)

### Width
- 19.3 in (490 mm)
- 19.3 in (490 mm)

### Height
- 26.7 in (678 mm)
- 26.7 in (678 mm)

## Cooling System

### Approx. Coolant Cap.
- 1.4 gal (5.3 liter)
- 1.4 gal (5.3 liter)

### Minimum Through Hull Diameter
- 3/4 in (20 mm)
- 3/4 in (20 mm)

### Sea Water Pump Inlet Hose ID
- 3/4 in (20 mm)
- 3/4 in (20 mm)

### Minimum Sea Water Discharge
- 3/4 in (20 mm)
- 3/4 in (20 mm)

### Heat Rejection to Jacket Coolant
- 1018 BTU/min
- 763 BTU/min

### Fresh Water Pump Cap.
- 12.9 gpm (49 lpm)
- 10.7 gpm (40 lpm)

### Seawater Pump Cap.
- 9.0 gpm (34 lpm)
- 7.7 gpm (29 lpm)

### Maximum Seawater Pump Suction Head
- 39 in (990 mm)
- 39 in (990 mm)

### Keel Cooler TurboTube Length
- 4 feet (1.2 M)
- 4 feet (1.2 M)

### Keel Cooler Head Diameter
- 1 in (25.4 mm)
- 1 in (25.4 mm)

### Keel Cooler Water Hose ID
- 1.25 in (31.5 mm)
- 1.25 in (31.5 mm)

## D.C. Electrical

### Minimum Battery Capacity
- 120 Amp Hour
- 120 Amp Hour

### Battery Cable Size
- #1
- #1

### Starting Voltage, Negative Ground
- 12 Volt
- 12 Volt

## A.C. Electrical

### 120/240 Volt Amperage
- 66.6 amps
- –

### 120 Volt Amperage
- 133.2 amps
- –

### 110/220 Volt Amperage
- –
- 54.5 amps

### 240 Volt Amperage
- –
- 50.0 amps

### 110 Volt Amperage
- –
- 109.0 amps

### Phase
- 1 Phase Std. (3 Phase Opt.)
- 1 Phase Std. (3 Phase Opt.)

## Air Intake and Exhaust

### Air Consumption
- 65 cfm (1.8 M³/m)
- 54 cfm (1.5 M³/m)

### Maximum Exhaust Backpressure
- 48 in (1219 mm) H₂O
- 48 in (1219 mm) H₂O

### Wet Exhaust Elbow OD
- 2 in (51 mm)
- 2 in (51 mm)

### Exhaust Gas Volume
- 153 cfm (4.3 M³/m)
- 127 cfm (3.6 M³/m)

### Exhaust Gas Temperature
- 1022° F (550° C)
- 1022° F (550° C)

## Fuel System

### Minimum Suction Line
- 5/16-.3125 in (7.9 mm)
- 5/16-.3125 in (7.9 mm)

### Minimum Return Line
- 5/16-.3125 in (7.9 mm)
- 5/16-.3125 in (7.9 mm)

### Maximum Fuel Pump Suction Head
- 39 in (990 mm)
- 39 in (990 mm)

### Specific Fuel Consumption at Max. Load
- .377 lbs/hp/hr
- .406 lbs/hp/hr

### Approximate Fuel Rate at Max. Load
- 1.38 US gph (5.2 lph)
- 1.23 US gph (4.65 lph)

## Maximum Engine Operating Angle

### Continuous Operation
- Front Down: 0°
- Rear Down: 0°
- Left Down: 0°
- Right Down: 0°

### Intermittent Operation (Sustained up to two minutes)
- Front Down: 0° - 35°
- Rear Down: 0° - 35°
- Left Down: 0° - 23°
- Right Down: 0° - 23°

(More than 2 minutes requires use of a remote expansion tank)
<table>
<thead>
<tr>
<th>Kilowatt Rating</th>
<th>Prime 20 kW</th>
<th>16 kW</th>
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<tbody>
<tr>
<td>Rated RPM/Frequency</td>
<td>1800/ 60Hz</td>
<td>1500/ 50Hz</td>
</tr>
</tbody>
</table>

### General Information
- **Engine Type**: Lugger 4 cycle, swirl chamber diesel, Lugger 4 cycle, swirl chamber diesel
- **Cylinders**: Inline 4, Inline 4
- **Displacement**: 135 in³ (2.216 L), 135 in³ (2.216 L)
- **Cycles**: 4, 4
- **Bore x Stroke**: 3.3 x 3.9 in (84 x 100 mm), 3.3 x 3.9 in (84 x 100 mm)
- **Rotation (Facing Flywheel)**: counter-clockwise, counter-clockwise
- **Compression Ratio**: 22:1, 22:1
- **Crankcase Capacity including Oil Filter**: 2.1 gal (8.0 liter), 2.1 gal (8.0 liter)
- **Aspiration**: Natural, Natural
- **Flywheel Housing Size**: SAE 4, SAE 4
- **Flywheel Drive Size**: C-107, C-107
- **Rated Flywheel HP**: 32 HP, 26.5 HP
- **Dry Weight w/Heat Exchanger, Single Phase**: 970 lbs. (440 kg), 970 lbs. (440 kg)
- **Length**: 43.4 in (1102 mm), 43.4 in (1102 mm)
- **Width**: 19.3 in (490 mm), 19.3 in (490 mm)
- **Height**: 27.5 in (698 mm), 27.5 in (698 mm)

### Cooling System
- **Approx. Coolant Cap.**: 1.5 gal (5.7 liters), 1.5 gal (5.7 liters)
- **Minimum Through Hull Diameter**: 3/4 in (20 mm), 3/4 in (20 mm)
- **Minimum Sea Water Discharge**: 3/4 in (20 mm), 3/4 in (20 mm)
- **Heat Rejection to Jacket Coolant**: 1273 BTU/min, 1019 BTU/min
- **Fresh Water Pump Cap.**: 12.9 gpm (49 lpm), 10.7 gpm (40 lpm)
- **Saltwater Pump Cap.**: 9.0 gpm (34 lpm), 7.7 gpm (29 lpm)
- **Maximum Seawater Pump Suction Head**: 39 in (990 mm), 39 in (990 mm)
- **Keel Cooler Turbo Tube Length**: 5 feet (1.5 M), 5 feet (1.5 M)
- **Keel Cooler Head Diameter**: 1 in (25.4 mm), 1 in (25.4 mm)
- **Keel Cooler Water Hose ID**: 1.25 in (31.5 mm), 1.25 in (31.5 mm)

### D.C. Electrical
- **Minimum Battery Capacity**: 120 Amp Hour, 120 Amp Hour
- **Battery Cable Size**: #1, #1
- **Starting Voltage, Negative Ground**: 12 Volt, 12 Volt

### A.C. Electrical
- **120/240 Volt Amperage**: 83.3 amps, –
- **120 Volt Amperage**: 166.6 amps, –
- **110/220 Volt Amperage**: –, 78.7 amps
- **240 Volt Amperage**: –, 66.6 amps
- **110 Volt Amperage**: –, 145.4 amps
- **Phase**: 1 Phase Std. (3 Phase Opt.), 1 Phase Std. (3 Phase Opt.)

### Air Intake and Exhaust
- **Air Consumption**: 72 cfm (2.0 M³/m), 60 cfm (1.7 M³/m)
- **Maximum Exhaust Backpressure**: 48 in (1219 mm) H₂O, 48 in (1219 mm) H₂O
- **Wet Exhaust Elbow OD**: 2 in (51 mm), 2 in (51 mm)
- **Exhaust Gas Volume**: 171 cfm (4.8 M³/m), 142 cfm (4.0 M³/m)
- **Exhaust Gas Temperature**: 1022° F (550° C), 1022° F (550° C)

### Fuel System
- **Minimum Suction Line**: 5/16-.3125 in (7.9 mm), 5/16-.3125 in (7.9 mm)
- **Minimum Return Line**: 5/16-.3125 in (7.9 mm), 5/16-.3125 in (7.9 mm)
- **Maximum Fuel Pump Suction Head**: 39 in (990 mm), 39 in (990 mm)
- **Specific Fuel Consumption at Max. Load**: .383 lbs/ hp/hr, .369 lbs/ hp/hr
- **Approximate Fuel Rate at Max. Load**: 1.73 US gph (6.5 lph), 1.38 US gph (5.2 lph)

### Maximum Engine Operating Angle
- **Continuous Operation**: Front Down 0°, Rear Down 0° - 10°, Left Down 0° - 23°, Right Down 0° - 23°
- **Intermittent Operation**: Front Down 0° - 35°, Rear Down 0° - 35°, Left Down 0° - 35°, Right Down 0° - 35°
## M20CR2 Data

### Kilowatt Rating
- **Prime**: 20 kW
- **Rated RPM/Frequency**: 1800/60Hz

### General Information
- **Engine Type**: Lugger 4 cycle, swirl chamber diesel
- **Displacement**: 135 in$^3$ (2.216 L)
- **Bore x Stroke**: 3.3 x 3.9 in (84 x 100 mm)
- **Rotation (Facing Flywheel)**: counter-clockwise
- **Compression Ratio**: 22:1
- **Crankcase Capacity including Oil Filter**: 2.1 gal (8.0 liter)
- **Aspiration**: Natural
- **Flywheel Housing Size**: SAE 4
- **Flywheel Drive Size**: C-107
- **Rated Flywheel HP**: 32 HP
- **Dry Weight**: 890 lbs. (403 kg)
- **Length**: 47.75 in (1213 mm)
- **Width**: 21 in (533 mm)
- **Height**: 33 in (838 mm)

### Cooling System
- **Approx. Coolant Cap.**: 1.3 gal (4.8 liters)
- **Minimum Through Hull Diameter**: 3/4 in (20 mm)
- **Sea Water Pump Inlet Hose ID**: 3/4 in (20 mm)
- **Minimum Sea Water Discharge**: 3/4 in (20 mm)
- **Heat Rejection to Jacket Coolant**: 1273 BTU/min
- **Fresh Water Pump Cap.**: 12.9 gpm (49 lpm)
- **Seawater Pump Cap.**: 9.0 gpm (34 lpm)
- **Maximum Seawater Pump Suction Head**: 39 in (990 mm)
- **Keel Cooler Turbo Tube Length**: 5 feet (1.5 M)

### D.C. Electrical
- **Minimum Battery Capacity**: 120 Amp Hour
- **Battery Cable Size**: #1
- **Starting Voltage, Negative Ground**: 12 Volt

### A.C. Electrical
- **120/240 Volt Amperage**: 83.3 amps
- **120 Volt Amperage**: 166.6 amps
- **110/220 Volt Amperage**: –
- **240 Volt Amperage**: –
- **110 Volt Amperage**: –
- **Phase**: 1 Ø or 3 Ø Reconnectable

### Air Intake and Exhaust
- **Generator Cooling Air Flow**: 290 cFm (8.2 m$^3$/min)
- **Air Consumption**: 70 cfm (2.0 M$^3$/m)
- **Maximum Exhaust Backpressure**: 48 in (1219 mm) H$_2$O
- **Wet Exhaust Elbow OD**: 2 in (51 mm)
- **Exhaust Gas Volume**: 171 cfm (4.8 M$^3$/m)
- **Exhaust Gas Temperature**: 1022° F (550° C)

### Fuel System
- **Minimum Suction Line**: 5/16-.3125 in (7.9 mm)
- **Minimum Return Line**: 5/16-.3125 in (7.9 mm)
- **Maximum Fuel Pump Suction Head**: 39 in (990 mm)
- **Specific Fuel Consumption at Max. Load**: 185 grams/hp/hr
- **Approximate Fuel Rate at Max. Load**: 1.73 US gph (6.5 lph)

### Maximum Engine Operating Angle
- **Continuous Operation**: Front Down 0°, Rear Down 0° - 10°
- **Intermittent Operation** (Sustained up to two minutes): Front Down 0° - 35°, Rear Down 0° - 35°