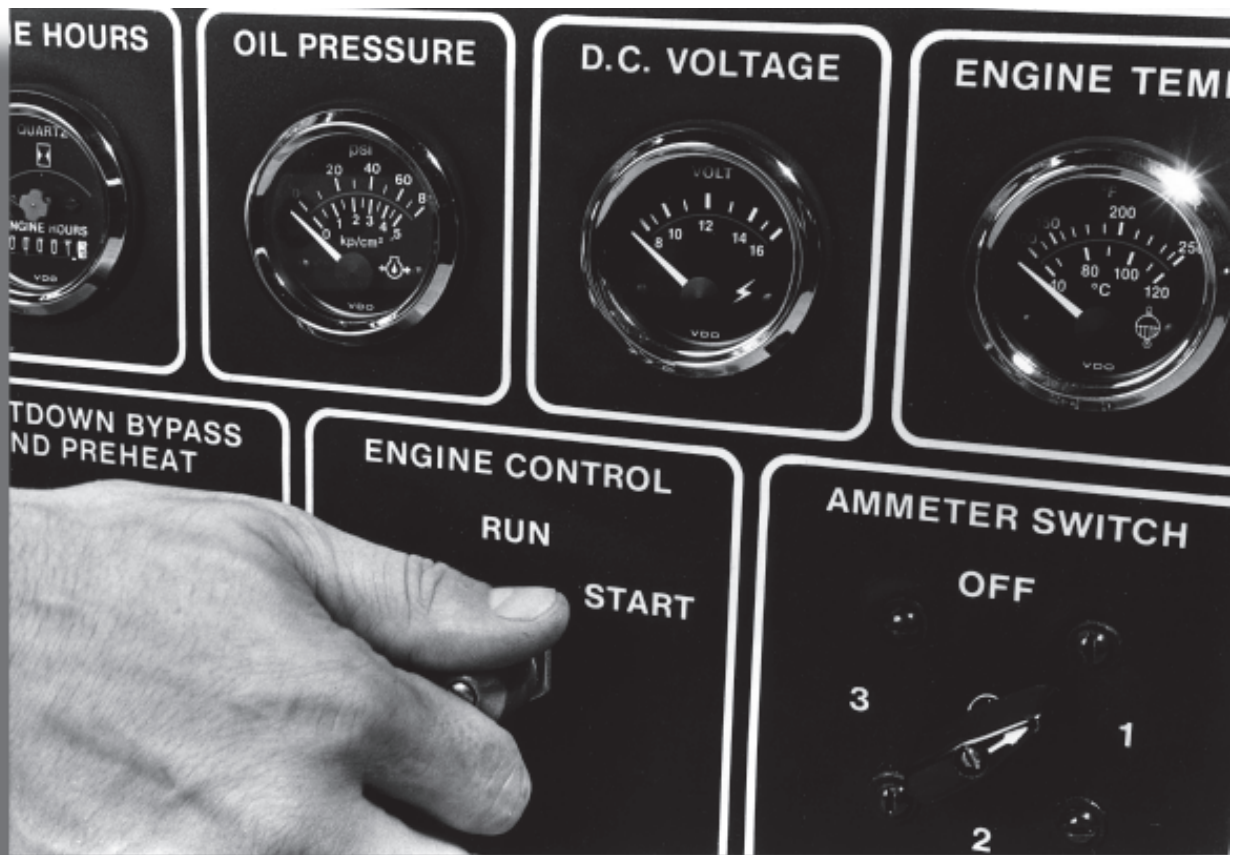


OPERATOR'S MANUAL

OM175C2

For Model:
M175C2



NORTHERN LIGHTS



— CALIFORNIA —
Proposition 65 Warning:

*Diesel engine exhaust and some of its constituents
are known to the State of California to cause
cancer, birth defects, and other reproductive harm.*



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PART NO.: OM175C2 04/05

OPERATOR'S MANUAL

OM175C2 for Model M175C2

*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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Introduction

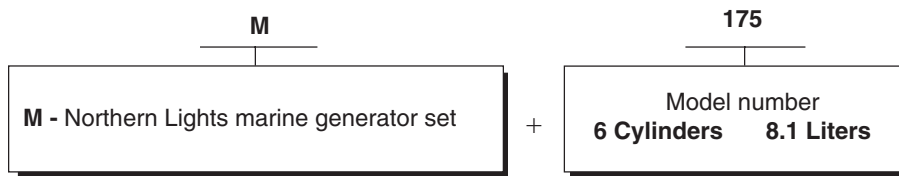
Servicing of marine engines and generator sets presents unique problems. In many cases boats cannot be moved to a repair facility. Marine engines cannot be compared to the servicing of automobiles, trucks or even farm equipment. Failures often occur in remote areas far from competent assistance. Marine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

Failures 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.

Model Numbers

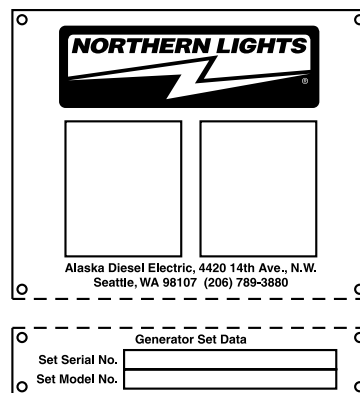
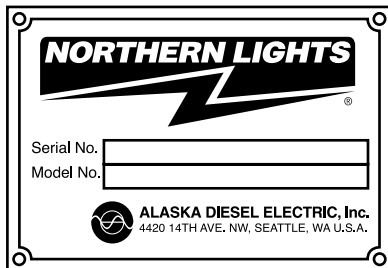
Model numbers give the unit's application, block model, aspiration, and RPM:



M175C2 = Northern Lights® turbocharged, 1800 RPM marine diesel generator set with a John Deere 6081 Tier II engine block, two valve with high pressure common rail.

Serial Number Plates

When referencing Alaska Diesel Electric equipment by serial number, please refer only to the number stamped on the Northern Lights® serial number plate.



A warranty registration certificate is supplied with your set. The extent of coverage is described in the Limited Warranty Statement. We recommend that you study the statement carefully.

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 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.
- Always disconnect ECU (Electronic Control Unit) connectors and engine control system-to-vessel ground before welding. High currents or electro-static discharge in electronic components from welding may cause permanent damage.
- 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.

CALIFORNIA Proposition 65 Warning:

Diesel engine exhaust and some of its constituents are known to the State of California to cause cancer, birth defects, and other reproductive harm.



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

M175C2 Component Locations

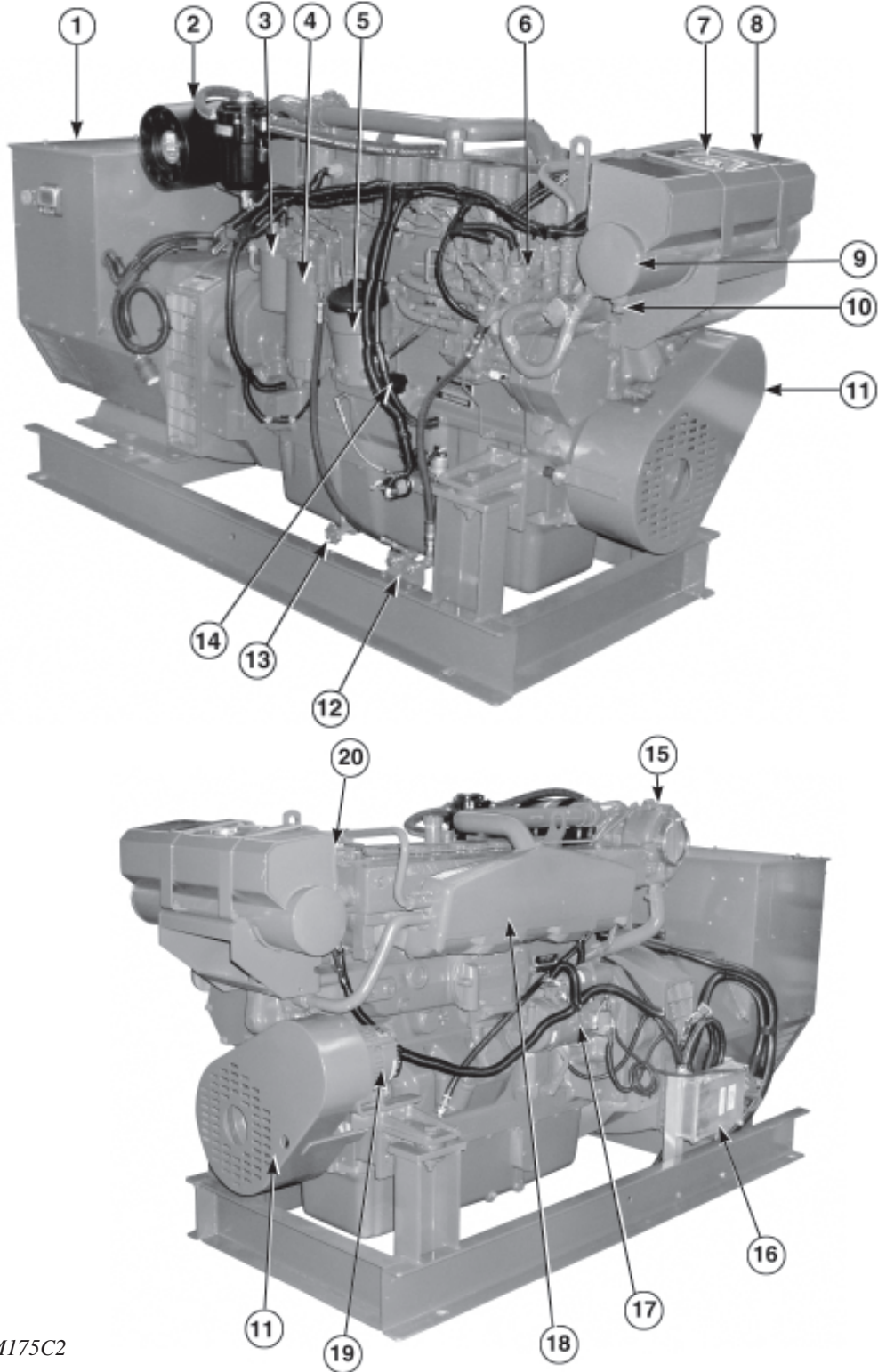


Figure 1 & 2: M175C2

- | | | | |
|--------------------------|--------------------------|-----------------------------|----------------------|
| 1. Junction Box | 7. Coolant Fill | 13. Lube Oil Drain | 19. Alternator |
| 2. Air Cleaner | 8. Expansion Tank | 14. Lube Oil Fill | 20. Thermostat Cover |
| 3. Secondary Fuel Filter | 9. Heat Exchanger | 15. Turbocharger | |
| 4. Primary Fuel Filter | 10. Heat Exchanger Zincs | 16. Electronic Control Unit | |
| 5. Lube Oil Filter | 11. Belt Guard | 17. Starter | |
| 6. Injection Pump | 12. Fuel Manifold | 18. Aftercooler | |



Figure 3: Series 3 Generator Control Panel

1. SHUTDOWN BYPASS SWITCH

This switch bypasses the safety shutdown feature during the starting process.

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.

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.

NOTE: The rocker switch is used on Series 1 panels only, and has a light that glows when the set is running.

3. OIL PRESSURE GAUGE

The oil pressure gauge shows the oil pressure in the engine lubricating system. If the pressure drops below 15 PSI at a speed higher than idling, stop the engine and investigate.

4. COOLANT TEMPERATURE GAUGE

Water temperature gauge shows the temperature of the cooling water. If the gauge registers over 200° or drops below 140°, stop the engine and investigate.

5. HOUR METER

Keeps track of the engine running time.

6. DC VOLTMETER

When the engine is running, it indicates the voltage output of the alternator.

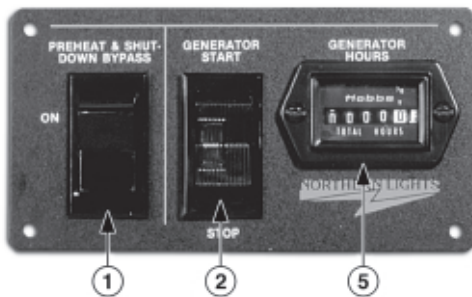


Figure 4: Series 1-B Generator Control Panel



Figure 5: Series 3C Generator Control Panel

Northern Lights Control Panel



Figure 6: Series 4 Generator Control Panel

1. SHUTDOWN BYPASS SWITCH

This switch bypasses the safety shutdown feature during the starting process.

2. ENGINE CONTROL SWITCH

The control switch starts and stops the engine.

3. OIL PRESSURE GAUGE

The oil pressure gauge shows the oil pressure in the engine lubricating system. If the pressure drops below 15 PSI at a speed higher than idling, stop the engine and investigate.

4. COOLANT TEMPERATURE GAUGE

Water temperature gauge shows the temperature of the cooling water. If the gauge registers over 200° or drops below 140°, stop the engine and investigate.

5. HOUR METER

Keeps track of the engine running time.

6. DC VOLTMETER

When the engine is running, it indicates the voltage output of the alternator.

7. AC VOLTMETER

The voltmeter shows the generator output voltage, phase to phase. If the voltage fluctuates greatly from the normal reading, shut down the unit and investigate.

8. FREQUENCY METER

Indicates engine speed. The correct reading for 1800 RPM sets is 60 Hz. If meter does not indicate correct hertz, stop and investigate.

9. AMMETER SELECTOR SWITCH

The ammeter switch is used for checking each phase for load condition. Leave it in the ON position while the engine is running.

10. AC AMMETER

The ammeter indicates the phase load. Check for load unbalance. If the unbalance is greater than 30%, have an electrician balance the load properly. This will ensure longer generator life and better economy.

BEFORE STARTING

1. Check the water level by removing the pressure cap from the expansion tank. In order to give the cooling water room to expand, the level should be about 1 3/4 in. (4-5 cm) below the filler cap sealing surface when the engine is cold. When filling with coolant, the venting cock on top of the turbocharger should be opened to ensure that no air pockets form in the cooling system (see **Service Point #12**).



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 should be between the “waffled area” and the “oo”. Never allow the level to go below the “oo”. Always add the same viscosity of oil as is already in the crankcase (see **Service Point #1**).
3. Check the fuel tank level and open any fuel valves.
4. Disengage clutch, if equipped.
5. Close the seacock, check and clean the strainer and reopen the seacock.
6. 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. While holding the Shutdown Bypass switch in the ON position, push the Engine Control switch to the START position
2. As soon as the engine starts, release both switches.
Do not crank the starter for more than 20 seconds.
3. If the engine fails to start the first time, be sure the starter has stopped for at least 2 minutes before reengaging.

NOTE: If there is a governor locked at a specific speed on the generator set, there may not be a slow idle function, so in that case operate the engine at high idle for 1 to 2 minutes before adding load. If the stand-by generator set is loaded as soon as it reaches rated speed, this procedure would not apply.

Operating

1. Check Gauges Often: Oil pressure must be above 29 PSI (if not above 15 PSI within 5 seconds of starting, the engine should be stopped and the problem should be explored.) Normal oil pressure is 50 PSI at rated load speed (1800 to 2500 RPM). The DC voltmeter should read between 13 -14 volts (26 - 28 volts, 24 volt systems).
2. Check AC voltage and frequency meters (Series 4 Panel). If gauges deviate from normal levels, shut down the set and investigate.
3. Check belt for good alignment.
4. Let the unit run unloaded for a three to five minute warm-up period before applying load.
5. Do not add full electrical load until engine is at maximum operating temperature.

Shutdown

1. Unload the generator and run for three to five minutes for cool down period.
2. Turn the Engine Control Switch to the OFF position.
3. Close the sea cock and fuel valves, and put the battery switch in the OFF position if the unit will be off for an extended period.

NOTE: Do not turn the battery switch to OFF while the engine is running.

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 or shutdown system 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 shutdown system is activated: (next page)

Operating Procedures

- a. Check the temperature gauge. If the temperature is above 205°F (97°C) shut off the engine immediately.
- b. Use the Trouble Shooting Guide on pages 22- 24 to isolate the cause of the overheat.



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.**

- c. Make repairs and restart after the temperature gauge registers below 180°F (83°C).
 - d. Watch the temperature gauge regularly and turn off the unit if the temperature rises above 200°F (94°C). Repeat the troubleshooting process.
3. If the 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 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 after a few seconds of operation.
 - c. If the oil level is normal, DO NOT restart the engine. Call your Northern Lights or Luger dealer for assistance.

BREAK-IN PERIOD

1. **The first 100 hours on a new or reconditioned engine are critical to its life and performance.**
2. **Constantly check the engine temperature and oil pressure gauges.**
3. **Oil consumption is greater during break-in as piston rings and cylinder liners 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 (See Gear Owner's Manual for break-in oil change procedures. Consult Lubricants Section for oil recommendation).**

OPERATING INSTRUCTIONS

Maintain at least a 75% load on your 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 rings.

Servicing Schedule Chart

The Servicing Schedule Chart below shows the service schedule required for proper maintenance of your marine engine or 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
- SP8 Check primary fuel filter
- SP15 Check cooling water level

AFTER FIRST 50 HOURS:

- SP2 Change engine oil
- SP3 Change lube oil filter

EVERY 50 HOURS:

- SP21 Check electrolyte in batteries

AFTER FIRST 100 HOURS/ EVERY TWO WEEKS ⁵:

- SP2 Change engine oil after first 100 hrs., then check every 2 wks.
- SP3 Change oil filter after first 100 hrs., then check every 2 wks.
- SP4 Check air cleaner valve & restriction indicator gauge ⁶
- SP7 Check crankshaft vibration damper ⁷
- SP15 Check coolant level

EVERY 250 HOURS:

- SP2 Change engine oil & filters (fuel filter/water bowl)
- SP4 Replace air cleaner
- SP5 Check V-belt condition

- SP9 Change primary filter element (Racor)

- SP25 Check engine mounts

EVERY 500 HOURS / YEARLY:

- SP7 Check crankshaft vibration damper
- SP10 Change secondary fuel filter
- SP11 Check injectors
- SP14 Check turbocharger boost pressure
- SP16 Check cooling system
- SP20 Change impeller in raw water pump
- SP22 Check the state of the charge of the batteries
- SP26 Clean crankcase vent tube
- SP27 Check air intake hoses
- SP29 Check electrical ground connection
- SP30 Check engine speeds

EVERY 2000 HOURS:

- SP6 Check & adjust valve clearance
- SP12 Check fuel injection pump
- SP16 Flush cooling system
- SP17 Check and clean heat exchanger
- SP18 Check and clean gear oil cooler
- SP23 Test thermostats
- SP31 Adjust variable speed (droop)

POINT	SERVICE PAGE	OPERATION	DAILY	50 Hours	100 Hours	250 Hours	500 Hours	2000 Hours
ENGINE:								
SP1	15	Check oil level	●	●				
SP2	15	Change engine oil		●	●	●		
SP3	15	Change lube oil filters		●	●	●		
SP4	15	Check air cleaner valve	●					
SP5		Check belt condition				●		
SP6	16	Check valve clearances						●
SP7	17	Check crankshaft vibration damper					●	
SP25		Check engine mounts				●		
SP27		Check air intake hoses					●	
SP30		Check engine speeds					●	
FUEL SYSTEM:								
SP8	17	Check primary filter (Racor)	●					
SP9	17	Change primary filter element (Racor)				●		
SP10	17	Change secondary fuel filter					●	
SP11		Check injectors					●	
SP12		Check fuel injection pump						●
TURBOCHARGER:								
SP13	23	Check air, oil & cooling water lines for leakage			●			
SP14	23	Check boost pressure					●	
COOLING SYSTEM:								
SP15	25	Check cooling water level	●					
SP16	25	Check cooling system, flush @ 2000 hrs.					●	●
SP17	25	Check and clean heat exchanger					●	
SP18		Check and clean gear oil cooler						●
SP19	25-26	Check zinc electrodes			●			
SP20	26	Change impeller in raw water pump					●	
ELECTRICAL SYSTEM:								
SP21	27	Check electrolyte level in batteries		●				
SP22	27	Check condition of batteries with hydrometer					●	
SP23		Test thermostats						●
SP29		Check electrical ground connection					●	

- 1) Change the oil and filter before the first 100 hours of operation during engine break-in.
- 2) Perform all maintenance once a year even if hour level has not been reached.
- 3) Consult manufacturer's maintenance schedule, note on chart.
- 4) Whenever necessary.

- 5) Operate engine at rated speed with 50-70% load for 30 minutes at least.
- 6) Replace air cleaner element when restriction indicator shows vacuum of 625 mm (25 in.) H₂O.
- 7) Replace damper every 4500 hours or after 60 months.

Service Record

Service Point	OPERATION	HOURS/DATE									
50 HOURS											
SP21	Check electrolyte in batteries										
100 HOURS											
SP9	Change primary fuel filter element										
SP13	Check turbocharger air, oil & cooling lines for leakage										
SP19	Check zinc electrodes										
250 HOURS											
SP2	Change engine oil										
SP3	Change lubricating oil filters										
SP4	Replace air cleaner										
SP5	Check belt condition										
SP9	Change primary filter element										
SP25	Check engine mounts										
500 HOURS											
SP7	Check crankshaft damper										
SP10	Change secondary fuel filter										
SP11	Check injectors										
SP14	Check turbocharger boost pressure										
SP16	Check cooling system										
SP17	Check and clean heat exchanger										
SP20	Change impeller in raw water pump										
SP22	Check state of charge of batteries										
EVERY 2000 HOURS											
SP6	Check valve clearances / Test thermostats										
SP12	Check fuel injection pump										
SP18	Check and clean gear oil cooler										
SP16	Flush cooling system										

LUBRICATION

Break-in oil

1. Use one of the following during the first 100 hours of operation:
 - a. John Deere Engine Break-In Oil
 - b. API Service CE oil
 - c. ACEA Specification E1
2. *Do not use* John Deere PLUS-50 oil or engine oils meeting API CG4, API CF4, ACEA E3, or ACEA E2 performance levels during the first 100 hours of operation of a new or rebuilt engine. These oils will not allow the engine to break-in properly.

Lubrication - General

1. Use only clean, high quality lubricants stored in clean containers in a protected area.
2. These oils are acceptable after the first 100 hours:
 - a. API Service CC/CD single viscosity oils.
 - b. API Service CD/CG-4/CF-4 multi-viscosity oils.
 - c. ACEA Specification E3/E2 multi-viscosity oils.
 - d. CCMC Specification D5 and Mercedes Benz MB228.3.
 - e. CCMC Specification D4 and Mercedes Benz MB228.1.
3. Use the proper weight oil for your average operation temperature.

Air Temperature	Single Viscosity	Multi Viscosity
Above 32°F (0°C)	SAE-30W	SAE15-40W
-10°F to 32°F (-23°C to 0°C)	SAE-10W	SAE10-30W
Below -10°F (-23°C)	SAE-5W	SAE5-20W

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. CHECK ENGINE OIL LEVEL

1. Check the oil level in the crankcase, with the oil dipstick, daily.
2. The oil level must be between the “Waffled area” and the “oo”. Never allow the level to go below the “oo”.
3. Always add the same viscosity of oil as is already in the crankcase.

SP2. OIL CHANGES

1. Using the oil recommended above, change the engine oil and filter after the first 50 hours of operation, the first 100 hours and every 250 hours thereafter.
2. During intermittent cold weather operation, change oil every 100 hours or six weeks, whichever comes first.
3. Change oil at any seasonal change in temperature when a new viscosity of oil is required.
 - a. Run engine 5 minutes to warm up oil, shut off engine.
 - b. Remove plug from outlet in base frame. Screw in owner-supplied drain hose.
 - c. Open valve at oil pan outlet. After oil has been drained into suitable container, close valve, remove drain hose and replace plug in base frame outlet.
 - d. Refill engine with recommended oil.
 - e. Crank engine for 30 seconds without letting engine start. This will ensure lubrication of engine components before engine starts.
 - f. Start engine and check for leaks. Stop engine and check oil level after 10 minutes.
4. Engine Lube Oil Capacity:

M175C2	30.1 qts.	28.5 liters
--------	-----------	-------------

SP3. CHANGING 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.
4. Lubricate the rubber gasket on the new filter and screw it on nipple until gasket meet 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 and check oil level. Add additional oil if necessary.

SP4. AIR CLEANER

1. Inspect air cleaner valve daily. Replace filter when indicator show a vacuum of 625 mm (25 in.) H₂O.
2. Clean the rubber tube at the cleaner. Loosen the hose clamp and the attaching strip for the cleaner.
3. Make sure the rubber tube is in good condition and that new filter is absolutely clean and installed properly.
4. Start the engine and check for leaks.

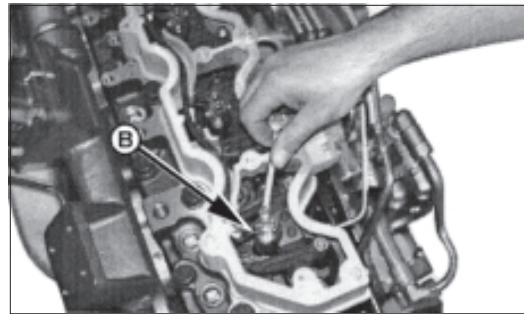
NOTE: Make absolutely sure no impurities enter the engine while changing the element. Do not run the engine with the air cleaner removed.

SP6. VALVE CLEARANCES

! *Caution: Always disconnect the negative (-) battery terminal when making valve adjustments to prevent accidental starting of the engine.*

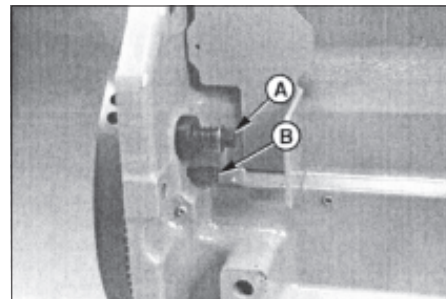
The following special tools will be needed:
 JDE 820 or JDE 81-1 Flywheel Turning Tool and
 JDE 81-4 Timing Pin.

1. Valve clearances must be checked and adjusted with the engine cold.
2. Disconnect the wiring harness.
3. Remove rocker arm cover with ventilator tube.
4. Remove the wires from electronic injectors. (Fig. 7B)
5. Take off carrier.
6. Remove plastic plugs in cylinder block bores.
7. Check all contact surfaces of valve tips and rocker arms for excessive wear or cracks, replace parts that show damage. If any of the rocker arms show excessive valve clearance check them more thoroughly for damage.
7. Rotate flywheel in clockwise direction (viewed from water pump) with the Flywheel Turning Tool until the Timing Pin (Fig. 8A&B) engages timing hole in the flywheel. Both rocker arms for No. 1 cylinder will be loose at Top Dead Center. If they are not, remove the timing pin and rotate the flywheel one complete turn and reinstall the timing pin in the flywheel. Use a bent feeler gauge (Fig. 9) to check the valve clearances on numbers 1, 3, and 5 exhaust valves and numbers 1, 2, and 4 intake valves.
9. Valve checking clearance (Rocker arm to valve tip):
 Intake Valve: 0.016- 0.020 in. (0.41- 0.51 mm)
 Exhaust Valve: 0.026- 0.030 in. (0.66- 0.76 mm)
10. If valves need to be adjusted, adjust valve clearance on number 1, 3, and 5 exhaust valves and number 1, 2, and 4 intake valves to below specification. Loosen the nut on the rocker arm adjusting screw and turn the adjusting screw until the feeler gauge slips with a slight drag. Tighten the lock nut while holding the adjusting screw with a screwdriver.
11. Valve clearances (Rocker arm to valve tip):
 Intake Valve: 0.018 in. (0.46 mm)
 Exhaust Valve: 0.028 in. (0.71 mm)
 Valve Adjusting Screw Lock
 Nut Torque.....27 N•m (20 lb-ft)



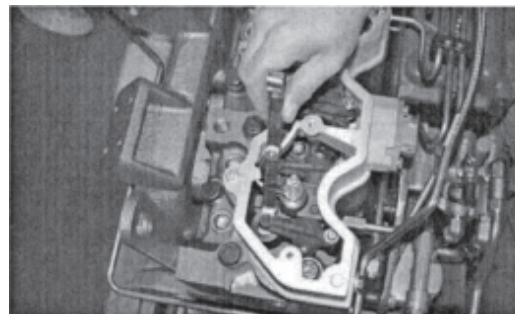
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RG7013

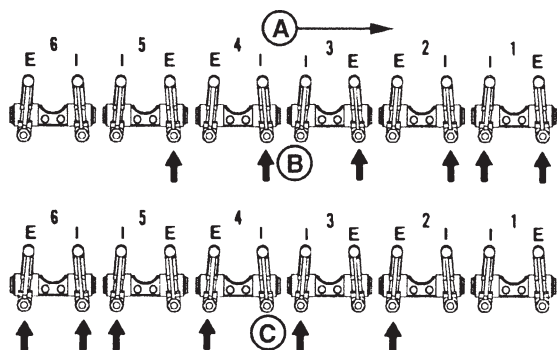
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 A- Flywheel Turning Tool B- Timing Pin



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Compression stroke at Top dead center shown below.



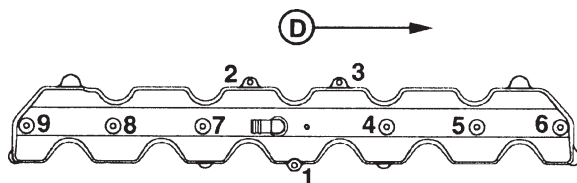
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Fig. 10

- A - Front of Engine
- B - No. 1 Cylinder "TDC"
- C - No. 6 Cylinder "TDC"

After adjusting valves tighten rocker arm cover capscrews in the order as shown below.



RG11620

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Fig. 11

- D - Front of Engine

FUELS - GENERAL

1. Use only clean, high quality fuels of the following specifications, as defined by ASTM designation D975 or EN590 for diesel fuels:
 - a. Use grade no. 2 diesel at ambient temperatures above freezing 30°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. Sulphur content should not exceed 0.5% (preferably less than 0.05%).
3. The cetane number should be a minimum of 45. Greater than 50 is preferred.
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.
 - f. JP4
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.

SP8-10. FUEL FILTERS

1. Your engine or 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 every 250 hours or whenever necessary.
 - c. If the bowl fills with water, change the primary and secondary elements immediately.
2. Change secondary fuel filter every 600 hours.

NOTE: The fuel filter on the engine is considered the "secondary fuel filter". The engine will be fitted with a quick change disposable secondary fuel filter.

 - a. Turn off the fuel.
 - b. Open the filter drain plug and drain the filter
 - c. Remove the secondary fuel filter by turning the filter clamp counter clockwise until the filter cartridge slides out.

Servicing

NOTE: Before installing a new filter cartridge make sure the surfaces where the cartridge comes in contact with the mounting plate are absolutely clean. Dirt can be washed into the fuel injection system. This may result in severe damage to the fuel injection pump or nozzles.

- d. Install new filter cartridge.
- e. Fuel filter cartridge numbers are:
RE503676 Primary & RE506428 Secondary
- f. Turn on the fuel.

SP 7. CHECKING CRANKSHAFT DAMPER

Note: Always replace two dampers as a set on units equipped with dual dampers.

1. Remove belts.
2. Try to turn the vibration damper in both directions while grasping it with both hands. If rotation can be felt, the damper is defective and should be replaced.



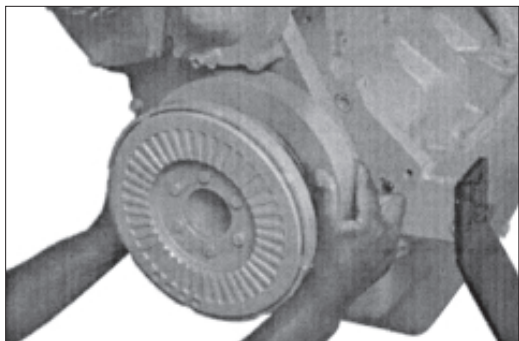
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Single Damper

Fig. 12



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Dual Damper

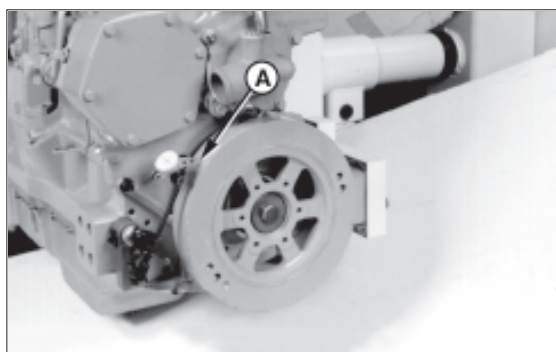
Fig. 13

Note: The vibration damper assembly should be replaced every 4500 hours or 60 months, whichever occurs first, as the vibration damper assembly is not repairable. Always replace the vibration damper when the crankshaft is replaced or a major engine overhaul takes place.

3. To check the vibration damper radial runout, place the dial indicator touching the outer diameter of the damper (Fig. 14). For dual dampers, check the runout on the inner damper only (Fig. 15).
4. Make sure the engine is at operating temperature then rotate the crankshaft using the JD820 Fly-wheel turning tool.
5. If the runout reading exceeds the below specification, replace the vibration damper.

Vibration Damper Maximum

Radial Runout.....1.02 mm (0.040 in.)



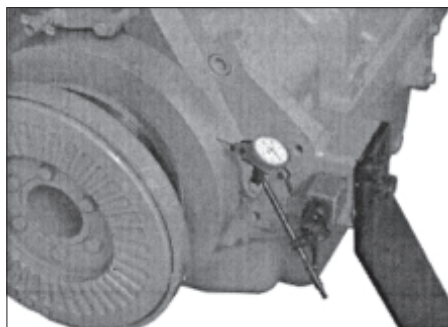
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Fig. 14

Position of dial for single damper



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Fig. 15

Position of dial for dual damper

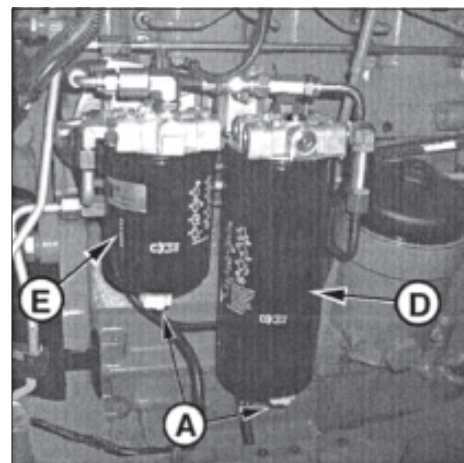
BLEEDING THE FUEL SYSTEM

⚠ CAUTION: Escaping diesel fuel under pressure can penetrate the skin, causing serious personal injury. Before disconnecting lines be sure to relieve all pressure. Before applying pressure to the system be sure all connections are tight and the 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 the 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.

Do not disconnect or attempt repair of fuel lines, sensors, or any other components between the high-pressure fuel pump and nozzles on engines with High Pressure Common Rail fuel systems as high pressure fluid remaining in the fuel lines could cause serious injury. Only technicians familiar with this system should attempt repair.

Due to the High Pressure Common Rail system, the fuel in the filter is likely to be under high pressure. To relieve pressure (and avoid injury) prior to removing filter, open valve (Fig. 16 A) on the bottom of the water separator bowl.

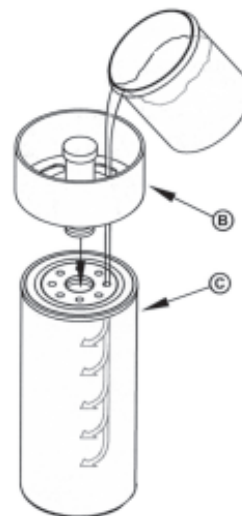
1. Whenever the fuel system has been opened for service, (lines disconnected, filter changed, etc.) it will be necessary to bleed air from the system.
2. Fuel filters must be pre-filled whenever they are being removed or replaced.
3. To properly drain water from the filter the drain valve must be unthreaded completely and the valve should drop down approximately 12 mm (0.5 in.).
4. Open the drain valve (Fig. 16-A) on the primary (Fig. 16-D) and secondary (16-E) filters and drain the water and contaminants from the water separator bowl.
5. Pre-fill the fuel filters (Fig. 17-C) using the pre-fill cup (17-B).



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Fig. 16



RG13296

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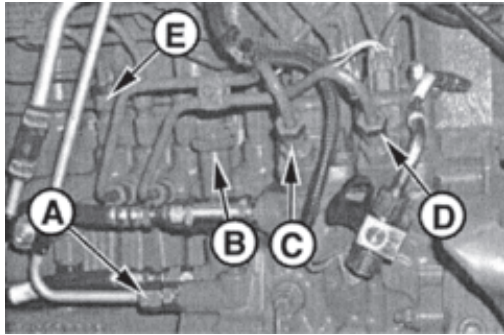
Fig. 17

6. To bleed the fuel system, loosen the fuel outlet (Fig. 18-A) on the transfer pump. Unlock and operate hand primer (Fig. 18-B) until a steady flow of fuel without bubbles comes out of the connection. This could take 270 to 330 strokes until the fuel flow comes out clear of bubbles. Then retighten the fuel line.

Torque Specification:

Fuel Outlet Lines Torque.....24 N•m (18 lb-ft)

7. Operate hand primer (18-B) until a steady flow of fuel comes out of the hose. Pump hand primer while disconnecting JTO3472 coupler from diagnostic port.



RG13270

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All rights reserved. *Fig. 18*

P11. INJECTORS

- Fuel injectors should be checked by a Northern Lights dealer or qualified fuel injection shop every 500 hours.



IMPORTANT: Do not attempt to service injection pump or fuel injectors yourself - special training and tools are required. In addition, modification or alteration of the injection pump, fuel injectors, or the injection pump timing in ways that are not recommended by the manufacturer could terminate the warranty. And tampering with the fuel system that leads to alteration of emission related equipment on the engine could result in fines or other penalties per EPA regulations or other local emission laws.

- Loosen the high-pressure fuel supply line (18-C) and operate hand pump until a stream of fuel without bubbles comes out. Tighten the high pressure fuel supply line to the specification as follows.

High Pressure Fuel Line Torque.....24 N•m (18 lb-ft)

- Loosen one of the high-pressure fuel supply lines (18-D) and use hand pump until steady stream of fuel comes out. Tighten the high-pressure fuel supply line to the above specification.
- Loosen fuel line fitting on fuel rail flow limiter #6 (18-E). Use a rag to put around the fitting to absorb excess fuel. Pump the hand primer fuel flows steadily. Tighten the line back to above specification.
- Pump the hand primer about 30 more times and then lock it by pulling up then pushing down.
- Crank the engine no more than 15 seconds. If the engine fails to start, wait another 15 seconds and then crank for an additional 15 seconds. If it starts, then run it at 1200 to 1500 RPM for 3 to 5 minutes. If the engine still fails to start, loosen the fuel line fitting on the High Pressure Common Rail flow limiter (Fig. 18-E). Use a rag around the fitting to absorb the fuel and pump the hand primer until a steady flow of fuel comes out of the flow limiter. Tighten the fuel lines to the specification below and lock the hand primer by pulling up, then pushing down on it to lock it.

High Pressure Fuel Line Torque.....24 N•m (18 lb-ft)

SP12. TURBOCHARGER

1. Check for air leaks every 200 hours. Air leakage will lower engine output and may cause black exhaust smoke and soot.
2. Listen along air line while engine is running. A whistling or hissing sound indicates leakage.
3. Leakage on the pressure side, between turbo and engine, can be found by applying soapy water to the air line.
4. Tighten the hose clamps, replace hose or gaskets as required.
5. Check to see that the lubrication and cooling lines are tight and without leaks.

SP13. TURBO BOOST

1. This check measures the amount of air the turbo is pushing into the engine. It should be done by an authorized dealer every 500 hours.
2. On the inlet manifold there is a 1/8" NPT threaded port. Remove the plug and install the boost gauge hose. Refer to your engine specifications for correct pressure.

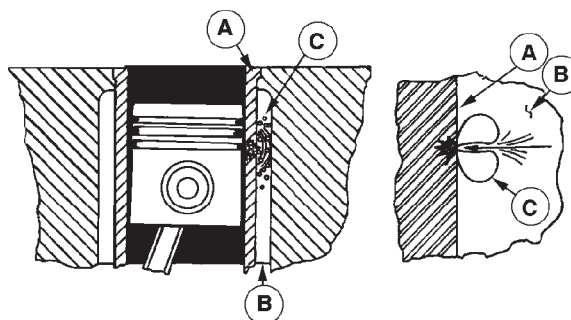
COOLING REQUIREMENTS

1. To meet cooling system protection requirements, the coolant solution must consist of:
 - a. **Quality water**
 - b. **Ethylene glycol concentrate (EGC) commonly known as antifreeze.**
 - c. **Supplemental coolant additives (SCA's).**
2. A coolant solution of ethylene glycol concentrate (EGC-antifreeze), quality water and supplemental coolant additives (SCA's) **MUST** be used **YEAR ROUND** to protect against freezing, boil-over, liner erosion or pitting and to provide a stable, noncorrosive environment for cooling system components.
3. **Ethylene glycol coolant concentrate (antifreeze) normally DOES NOT contain the SCA chemical inhibitors needed to control liner pitting or erosion, rust, scale, and acidity.**

LINER EROSION (PITTING)

1. Cylinder liner walls (Fig. 19-A) which are in contact with engine coolant (19-B) can be eroded or pitted unless the proper concentration and type of SCA's are present in the coolant. Water pump impellers are also susceptible to pitting.

2. Vapor bubbles (Fig. 19-C) are formed when the piston's impact causes the liner walls to vibrate, sending pressure waves into the coolant.
3. These tiny vapor bubbles collect on the surface of metal parts. As the bubbles collapse (pop) a microscopic piece of metal is eroded from the metal part. Over a period of time, this pitting may progress completely through the cylinder liner of a wet-sleeve, heavy-duty diesel engine. This allows coolant to enter the combustion chamber. Engine failure or other serious damage will result.



A - Cylinder Liner Walls B - Engine Coolant C - Vapor Bubbles

Figure 19

4. Unprotected engines with low quality water as coolant can have liner failure in as few as 500 hours.

WATER QUALITY

1. Distilled, deionized, soft water is preferred for use in cooling systems. Bottled distilled water from a food store or water supplier is recommended. Tap water often has a high mineral content. Tap water should NEVER be put in a cooling system unless first tested by a water quality laboratory. Do not use water made by the reverse osmosis method unless it has been PH neutralized.
2. Here are acceptable water quality specifications:

Contaminates	Parts per Million	Grains per Gallon
Maximum Chlorides	40	2.5
Maximum Sulfates	100	5.9
Maximum Dissolved Solids	340	20.0
Maximum Total Hardness	170	10.0
PH Level 5.5 to 9.0		

Servicing

- If chlorides, sulfates or total dissolved solids are higher than the above given specification, the water must be distilled, demineralized, or deionized before it is used in a cooling system.
- If total hardness is higher than 170 ppm and all other parameters are within the given specifications, the water must be softened before it is used to make coolant solution.

EGC: ETHYLENE GLYCOL CONCENTRATE (ANTIFREEZE)



CAUTION: EGC (Antifreeze) is flammable. Keep it away from any open flame. Avoid contact with eyes. Avoid contact with skin. Do not take internally. In case of contact, immediately wash skin with soap and water. For eyes, flush with large amounts of water for at least 15 minutes. Call a physician. **KEEP OUT OF REACH OF CHILDREN.** Follow all warnings on the container.

- Ethylene glycol coolant concentrate is commonly mixed with water to produce an engine coolant with a low freeze point and high boiling point.
- A **low silicate** form of ethylene glycol coolant is recommended for all diesel engines.
- Use an ethylene glycol coolant concentrate meeting ASTM D 4985P, SAEJ1941, General Motors Performance Specification GM1899M, or formulated to GM6038M.
- This product is concentrated and should be mixed to the following specification.
- If additional coolant solution needs to be added to the engine due to leaks or loss, the glycol concentration should be checked with a hydrometer to assure that the desired freeze point is maintained.

	Distilled Water %	EGC % Antifreeze	Freeze Point	Boiling Point
Optimum	50%	50%	-37°C -34°F	+109°C +226°F
Minimum	60%	40%	-24°C -12°F	+106°C +222°F
Maximum	40%	60%	-52°C -62°F	+111°C +232°F

IMPORTANT

- DO NOT** use methyl alcohol or methoxy propanol base EGC. These concentrates are not compatible with chemicals used in supplemental coolant additives. Damage can occur to rubber seals on cylinder liners which are in contact with coolant.
- DO NOT** use an EGC containing sealer or stop-leak additives.
- DO NOT** use EGC containing more than 0.1% anhydrous metasilicate. This type of concentrate, which is intended for use in aluminum engines, may cause a gel-like deposit to form that reduces heat transfer and coolant flow. Check container label or consult with supplier.

SUPPLEMENTAL COOLANT ADDITIVE (SCA)



CAUTION: Supplemental coolant additive contains alkali. Avoid contact with eyes. Avoid contact with skin. Do not take internally. In case of contact immediately wash skin with soap and water. For eyes, flush with large amounts of water for at least 15 minutes. Call a physician. **KEEP OUT OF REACH OF CHILDREN.** Follow all warnings on the container.

- Important heat exchanger cooled engines**
Additional SCA's should NOT be added to the mixture of EGC/H₂O on initial fill up of engines with a coolant conditioner-filter. A high SCA concentration will result and can cause silicate-dropout. When this happens, a gel-type deposit is created in the cooling system which retards heat transfer and coolant flow.
- If additional SCA's are needed, prepare a mixture of 50% quality water and 50%EGC (antifreeze). Add liquid SCA at a rate of 3%, by volume.
Example: 30 mL of SCA per liter of H₂O/EGC mixture (1.0 fl oz of SCA per qt of H₂O/EGC). Add the resulting mixture to the cooling system in quart increments. Run the engine for 2 hours and retest the coolant. Continue process until SCA concentration meets recommended levels.
- SCA is available from your Northern Lights dealer in the following sizes.
Pint - Part Number.....20-00002
1/2 gallon - Part Number.....20-00003
- DO NOT** use any coolant system additives containing soluble oil.

COOLANT TESTING

1. Coolant test kits are available to allow on-site evaluation of the coolant condition.
2. The kits use small strips of paper which are dipped into the coolant. The paper changes color and indicates the SCA concentration. It also indicates the amount of EGC (antifreeze).
3. Test kits are available through your Northern Lights or Lugger Dealer.
 4 Pack - Part Number.....20-00005
 50 Pack - Part Number.....20-00010

SP14. CHECKING COOLANT LEVEL.



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.*

1. Check the coolant level each day before starting the engine.
2. Remove the pressure cap from the expansion tank and check water level. In order to give the coolant an opportunity to expand, the level should be about 1 3/4 in. (4-5 cm) below the filler cap sealing surface when the engine is cold. When filling with coolant, the venting cock on top of the turbocharger (for engines fitted with turbocharger) should be opened to ensure that no air pockets form in the cooling system.
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.
4. The makeup coolant, added to compensate for loss or leaks, must meet engine coolant requirements outlined in previous section.

SP15. FLUSHING THE 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.*

1. Flush the cooling system and check for leaks and blockage every 600 hours, or yearly. **The engine must be stopped and cold.**
2. Close the seacock.
3. Remove the pressure cap from the expansion tank with caution. If applicable, open the cooling system air vent on top of turbocharger.
4. Open the drains on the exhaust manifold and engine block. Drain the fresh water system (see Component Locations, page 4). Thermostats should be removed to allow entire cooling system to be drained.
5. For vessels with keel cooling, the vessel must be out of the water to allow draining of the keel cooler.
6. With drains open, pour clean water into the expansion tank. When the water from drain is clear and free from discoloration and sediment, close that drain. When all drains are closed, flushing is complete. Install thermostats with new gaskets.
7. Fill the fresh water system by pouring the recommended coolant mixture as described in previous sections.
8. Close cooling system air vent on turbocharger. Loosen temperature sending unit fitting in cylinder head or plug in thermostat housing to allow air to escape. Retighten fitting and plug when all air is expelled.
9. Open the seacock.
10. Start the engine. Check hoses and connections and repair any leakage. Run engine until it reaches operating temperature to mix solutions through the entire system.

SP16. HEAT EXCHANGER CLEANING

1. Drain the cooling system.
2. Remove the cooling water pipes between the heat exchanger and the water pump inlet.
3. Disconnect hose to seawater pump.
4. Unscrew the attaching bolts holding the heat exchanger to the expansion tank.
5. Remove bolts holding heat exchanger cover.
6. Wash the core inside and out. If necessary, chemical agents can be used. Also clean the accessible parts of the heat exchanger housing.
7. Reassemble, using new gaskets and sealing rings.

SP18. ZINC ANODES

1. Zincs are installed in the cooling system to protect your engine from electrolysis. Check them faithfully every 250 hours. If you are in warm salt water or where electrolysis is a known problem, check them more often. If the rod flakes apart when tapped, install a new zinc plug.

Heat exchanger cooled engine:

- a. Drain the raw water from heat exchanger (see Component Locations).
- b. Remove zinc holders from back of the tank and from front and port side of the heat exchanger (see Component Locations).

Keel Cooled engines.

- a. Drain expansion tank and remove zinc holder from tank (see Component Locations).
2. Scrape or steel brush the zinc electrode clean. If more than 50% of the electrode has eroded away, replace it with a new one. The electrode screws out of the holder.
 3. Reinstall the zinc holders. Be sure the threads are clean and have good metal to metal contact.

SP19. RAW WATER PUMP

Heat exchanged cooled engines only.

1. Change the sea water pump impeller as needed.
2. Remove the pump end cover. Remove impeller with water pump pliers. Be sure you remove all pieces of a failed impeller.
3. Clean the inside of the housing.
4. Press in the new impeller and place the sealing washer 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 there is always an extra impeller and cover gasket in reserve and on-board.

SP20, 21. DRIVEN EQUIPMENT

Gears and PTO's

1. Manufacturer's service recommendations vary. See your Owner's Manual for service information. If you do not have a manual, see your local dealer for the equipment in question.

NOTE: Some PTO and marine gears have rigid lubrication requirements. Follow service recommendations closely.

Generator Ends

2. 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. When welding on the unit, disconnect the regulator and battery. Isolate the leads.
4. Disconnect battery cables when servicing the DC alternator.
5. Never test with a screwdriver, etc., against any terminal to see if it emits sparks.
6. A DC circuit breaker protects your control panel and wiring harness.

BOOSTER BATTERIES



CAUTION: Battery Gas Can Explode. Keep all flames and sparks away from batteries. Turn charger off before connecting or disconnecting battery charger. Make last connection and first connection at a point away from battery. Always connect Negative (-) cable last and disconnect this cable first.

1. Before changing or using booster batteries, check battery electrolyte level. Add distilled water.
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.

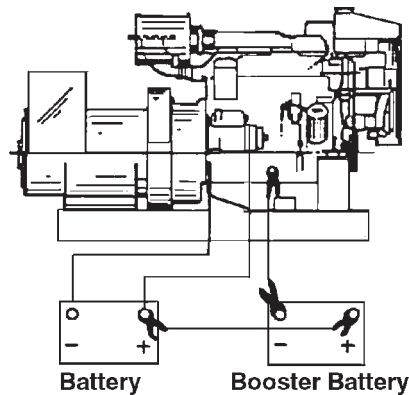


Figure 20: Booster Battery Connections

4. Then, connect negative (-) terminal of booster battery to ground on the engine block away from battery (see Fig. 20). *Note: Always use 12 volt booster battery for 12 volt electrical systems and 24 volt booster batteries for 24 volt electrical systems.*
5. Remove booster battery after starting engine, disconnecting the negative (-) cable first.
6. Sealed batteries: see manufacturer charging and booster instructions.

SP16-17. BATTERY CARE - LEAD/ACID TYPE BATTERIES



CAUTION: Sulfuric Acid in battery is poisonous, can burn skin and holes in clothing. Fill batteries in well-ventilated areas wearing eye protection and rubber gloves.

1. Check electrolyte level every 50 hours or once per month. 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 750 hours.

SP24. WINTERIZING, OUT-OF-SERVICE

If the generator set will not be used for more than 6 months the following preparations should be taken for long term storage:

1. Change the engine oil and replace the filter. Service the air cleaner.
2. Drain, flush, and refill the cooling system.
3. Crank the engine a few times with a starter.
4. Remove and clean batteries.
5. All engine openings should be sealed with plastic bags and tape.
6. Store in a dry protected place.

To Remove Generator Set from Long-Term Storage:

1. Take off all protective coverings and unseal all the openings that were covered up.
2. Install batteries that are fully charged and connect the terminals.
3. Install the fan and alternator belts if they had been removed.
4. Fill the fuel tank.
5. Perform all pre-start checks.
6. Crank the engine for 20 seconds with the starter, without letting the engine start. Wait 2 minutes and crank the engine an additional 20 seconds to make sure all bearing surfaces are well coated.
7. Start the engine and run at no load in a low idle for several minutes. Make sure the engine is warmed up and check gauges before going under load.
8. Check all gauges and check for leaks.

Troubleshooting

DC ELECTRICAL SYSTEM

✓ Battery Will Not Charge

Loose or corroded connections:

- Clean and tighten battery connections.

Sulfated or worn out batteries:

- Check specific gravity of each battery cell.
- Check electrolyte level of each battery cell.

Loose or defective alternator belt:

- Adjust belt tension.
- Replace belt.

✓ Starter Inoperative

Engine drivelines engaged:

- Disengage.

Faulty start circuit relay or blown fuse:

- See dealer/ replace fuse.

Loose or corroded connections:

- Clean and tighten loose battery and harness plug connection.

Low battery output:

- Check specific gravity of each battery cell.
- Check electrolyte level of each battery cell.

Defective electrical system ground wire:

- Repair or replace.

✓ Starter & Hour Meter work but rest of Electrical System does not

Blown fuse on magnetic switch:

- Replace fuse.

✓ Starter Cranks Slowly

Low battery output:

- Battery is too small.
- Battery cables are too small.

Check specific gravity of each battery cell:

- Replace battery if necessary.

Check electrolyte level of each battery cell:

- If low, fill cells with distilled water.

Crankcase oil too heavy:

- Fill with oil of appropriate viscosity.

Loose or corroded connections:

- Clean and tighten loose connections.

✓ Entire Electrical System Does Not Function

Check DC circuit breaker:

- If breaker is tripped, reset it.

Faulty connection:

- Clean and tighten battery, harness plug, ground strap, starter, or alternator connections.

Sulfated or worn out batteries:

- Check specific gravity and electrolyte level of each battery cell.

✓ Undercharged System

Added accessories making too big a load:

- Remove accessories or install higher output alternator.

ENGINE

✓ Engine Hard to Start or Will Not Start

Improper starting procedure:

- See starting section of this manual. Take special note of Bypass Switch operation.

No fuel:

- Check level of fuel in fuel tank.

Low battery output:

- Check electrolyte level and condition.

Excessive resistance in starting circuit:

- Clean and tighten all battery connections.

Crankcase oil too heavy:

- Use oil of proper viscosity.

Improper type of fuel:

- Consult fuel supplier and use proper type of fuel for operating condition.

Water, dirt or air in fuel system:

- Drain, flush, fill and bleed system.

Clogged primary fuel filter element:

- Clean or replace filter element.

Clogged secondary fuel filter element:

- Replace filter element.

Dirty or faulty injection nozzles:

- Have your dealer check injection nozzles.

Electronic Control Unit faulty:

- See authorized service dealer.

✓ Engine Runs Irregularly or Stalls Frequently

Below normal engine temperature:

- Remove and check thermostat.

Clogged primary fuel filter element:

- Clean or replace filter element.

Clogged secondary fuel filter element:

- Replace secondary filter element.

Water or dirt in the fuel system:

- Drain, flush, fill and bleed system.

Dirty or faulty injection nozzles:

- Have your dealer check injection nozzles.

Air in fuel system:

- Inspect clamps and hoses on suction side of fuel pump for air leak, bleed fuel system.

Improper type of fuel or crankcase oil:

- Consult fuel supplier and use proper type of fuel or crankcase oil for operating condition.

If you cannot correct problems with these procedures, see your **Lugger or Northern Lights** dealer.

✓ Lack of Engine Power

Intake air restriction:

- Service air cleaner.

Clogged primary fuel filter element:

- Clean or replace filter element.

Clogged secondary fuel filter element:

- Replace filter element.

Improper type of fuel:

- Consult fuel supplier and use proper type of fuel for operating conditions.

Overheated engine:

- See “Engine Overheats” in next category.

Below normal engine temperature:

- Remove and check thermostat.

Improper valve clearance:

- Reset valves. Best done by dealer.

Dirty or faulty injection nozzles:

- Replace injectors. Best done by dealer.
- See your local dealer.

✓ Engine Overheats

Low coolant level:

- Fill tank or radiator to proper level.
- Check hoses for loose connections and leaks.

Engine overloaded:

- Reduce load.

Low engine oil level:

- Check oil.

Keel cooling tubes have been painted (marine):

- Remove paint from tubes.

Cooling system needs flushing:

- Flush cooling system.

Damaged cylinder head gasket:

- Replace.

Belt stretched or loose:

- Adjust belt tension. Replace belt as needed.

Defective thermostat:

- Remove and check thermostat.

Defective temperature gauge:

- Check water temperature with thermometer and replace gauge if necessary.

Water pump impeller worn/broken:

- Check impeller and replace if necessary.

✓ Engine Knocks

Insufficient oil:

- Call your dealer.

Poor fuel quality:

- Drain and replace fuel.

Injection pump out of time:

- Call your dealer.

Below normal engine temperature:

- Check your thermostats.
- Check water temperature to see if temperature gauge is working properly.

Electronic Control Unit has problems:

- See qualified dealer.

Air intake system has air leak on suction side:

- Check hoses and pipe connections - repair.

✓ High Fuel Consumption

Air in fuel system:

- Bleed fuel system.

Engine overloaded:

- Reduce load.

Leaks in fuel supply system:

- Locate leaks and repair.

Improper type of fuel:

- Use correct fuel for temperature.

Clogged or dirty air cleaner:

- Service air cleaner.

Improper valve clearance defective:

- See your dealer.

Injection nozzles dirty:

- See your dealer.

Defective turbocharger:

- See dealer.

Injection pump out of time:

- See qualified dealer.

Engine not at proper temperature:

- Check your thermostats.
- Check water temperature with thermometer and replace gauge if necessary.

Compression too low:

- Determine cause of low compression and repair.

Coolant in combustion chamber (cylinder head gasket failure or cracked cylinder head)

- See dealer - repair or replace.

✓ Fuel in Oil

Cracked cylinder head:

- Locate crack, repair, or replace as needed. See dealer.

If you cannot correct problems with these procedures, see your **Lugger or Northern Lights** dealer.

Troubleshooting

✓ **Coolant in Crankcase**

Cylinder head gasket damaged:

- Replace. See dealer.

Cylinder head or block cracked:

- Locate crack, repair or replace. See dealer.

Cylinder liner seals leaking:

- Remove and inspect cylinder liners.

Coolant pump seal or bearing leaking:

- Replace seals. See dealer.

✓ **Below Normal Engine Temperature**

Thermostats not working properly:

- Check thermostats.

Temperature gauge not working properly:

- Check water temperature with thermometer.

✓ **Low Oil Pressure**

Low oil level:

- Fill crankcase to proper level.

Improper type of oil:

- Drain and fill crankcase with correct oil.

Partially plugged oil filter:

- Replace filter.

Excessive main or connecting rod bearing clearance:

- Determine bearing clearance. See dealer.

✓ **High Oil Consumption**

Break-in period:

- Oil consumption decreases after break in.

Crankcase oil too light:

- Use proper viscosity oil.

Oil leaks:

- Check for leaks in lines around gaskets and drain plug.

Crankshaft oil seals possibly faulty:

- Replace seals. See dealer.

Cylinder liners or pistons worn or scored.

- Inspect and replace if needed. See dealer.

Worn valve guides or stems.

- Inspect and measure, replace if needed. See dealer.

✓ **Engine Emits Black or Gray Exhaust Smoke**

Clogged or dirty air cleaner:

- Service air cleaner.

Defective muffler (back pressure too high):

- Have dealer check back pressure.

Engine overloaded:

- Reduce load.

Improper fuel:

- Use correct fuel for temperature.

Injection nozzles dirty:

- See your dealer.

Turbocharger not functioning:

- See dealer.

Engine out of time:

- See your dealer.

Electronic Control Unit problem.

- See qualified dealer.

✓ **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 out of time:

- See your dealer.

Engine compression too low:

- See dealer.

Coolant in combustion chamber (cylinder head gasket failure or cracked cylinder head):

- See dealer - repair or replace.

✓ **Abnormal Engine Noise**

Main or connecting rod bearings worn:

- Check bearing clearance. See your dealer.

Crankshaft end play excessive:

- Check end play. See your dealer.

Main bearing caps loose:

- Check bearing clearances, replace bearings and screws as needed. See your dealer.

Connecting rod bushings and piston pins worn:

- Inspect the rod bushings and piston pins. See your dealer.

Scored pistons:

- Check pistons. See dealer.

Excessive backlash or worn timing gears:

- Check timing gear backlash. See dealer.

Valve clearance excessive:

- Check and adjust valve clearance. See dealer.

Camshaft lobes worn:

- Inspect camshaft. See dealer.

Rocker arm shafts possibly worn:

- Check rocker arm shafts. See dealer.

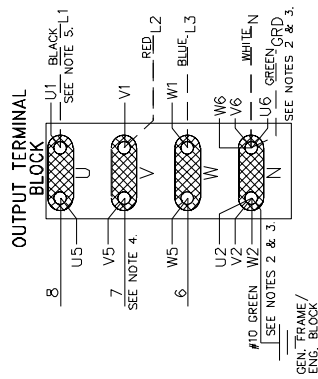
Turbocharger noise:

- Check turbocharger. Repair or replace.

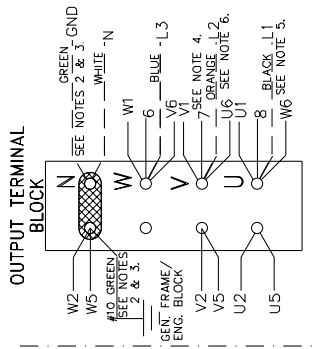
Engine not lubricated properly:

- Check oil and filter.

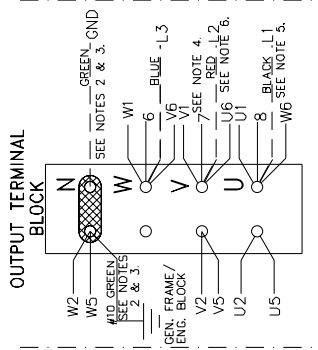
If you cannot correct problems with these procedures, see your **Lugger or Northern Lights** dealer.



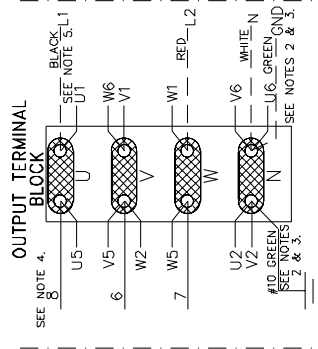
12 WIRE LOW WYE 3Ø
 110/190VAC - 127/220VAC 50 HZ.
 120/208VAC - 139/240VAC 60 HZ.



12 WIRE DELTA W/NEUTRAL 3Ø
 110/220VAC - 147/254VAC 50 HZ.
 120/240VAC - 170/277VAC 60 HZ.
 L2 IS HIGH LEG



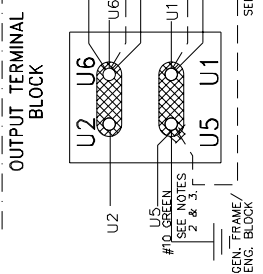
12 WIRE DELTA 3Ø
 220VAC - 254VAC 50 HZ.
 240VAC - 277VAC 60 HZ.



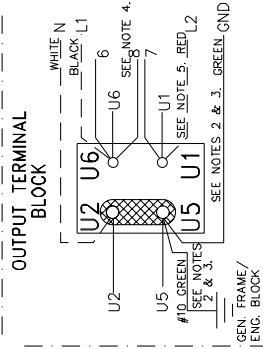
12 WIRE ZIG ZAG 1Ø
 120/240VAC 1Ø 60 HZ.
 110/220VAC 1Ø 50 HZ.



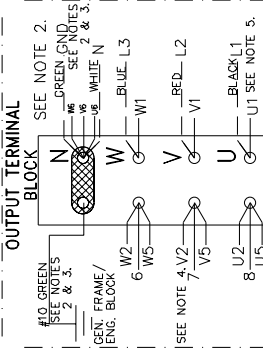
INDICATES LINK BAR USED.



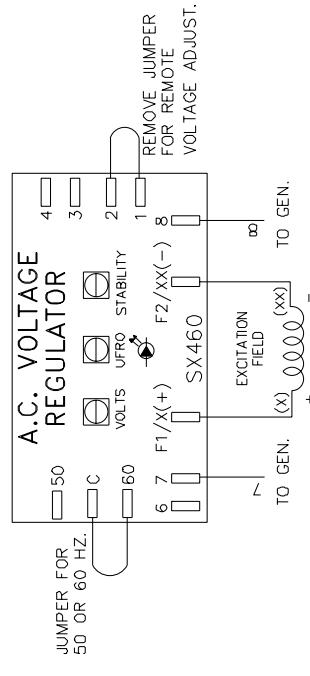
PARALLEL 4 WIRE 1Ø
 110VAC 50 HZ.
 120VAC 60 HZ.



SERIES 4 WIRE 1Ø
 110/220VAC 50 HZ.
 120/240VAC 60 HZ.



12 WIRE HIGH WYE 3Ø
 220/380VAC - 254/440VAC 50 HZ.
 240/416VAC - 277/480VAC 60 HZ.



NOTES:

1. ALL INSTALLATION CONDUCTORS TO BE AWG 14, TYPE MTW, 105°C, MULTISTRAND, 600VAC, EXCEPT AS NOTED.
2. INDUSTRIAL GENSETS ONLY: GROUNDING IS TO BE IN ACCORDANCE WITH THE NATIONAL ELECTRICAL CODE AND ANY APPLICABLE LOCAL CODES.
3. MARINE GENSETS ARE TO BE GROUNDED BY CUSTOMER ONLY, AT CUSTOMER'S DISCRETION.
4. CONNECT LEADS SEVEN AND EIGHT TO TERMINALS SEVEN AND EIGHT ON THE SX460. ISOLATE LEAD SIX USING ELECTRICAL TAPE OR A WIRE NUT.
5. HIDDEN (DASHED) LINES INDICATE CUSTOMER SUPPLIED AND CONNECTED MAIN OUTPUT CONDUCTORS. SIZING DETERMINED PER INSTALLATION.
6. HIGH LEG IS TO BE MARKED ORANGE WHEREVER NEUTRAL IS PRESENT, IN ACCORDANCE WITH ARTICLE 215-8 OF THE NATIONAL ELECTRICAL CODE.
7. DELETE NEUTRAL CONNECTION IF L-N VOLTAGE IS NOT REQUIRED.

A.C. Wiring - M175C2 with
 SX460 AVR, 4 and 12 Wire
 Drawing B-5703C

On Board Spare Parts

Safety at sea depends on careful preparation, product knowledge, and having the right tools and parts. Below is a list of parts Alaska Diesel Electric, Inc. recommends you carry onboard at all times.

Onboard Parts Kits are available from your dealer. "Standard" Kits are suitable for inland and offshore cruising. "World Class" Kits are for world cruising and trans-ocean cruising.

We consider these minimum quantities. Your vessel's operating conditions may require more of a given part. Consult your dealer.

Item	Description	Standard	World Class
1	Lube Oil Filter	4	4
2	Air Filter Element	1	1
3	Fuel Filter	2	2
4	Injector	0	6
5	Thermostat	2	2
6	Thermostat Ring	2	2
7	Relay	0	2
8	Valve Cover Gasket	1	2
9	Gasket Kit Top	0	1
10	Gasket Kit Bottom	0	1
11	Zinc*	6	12
12	Raw Water Pump Impeller*	2	2
13	Raw Water Pump Cover Gasket*	2	2
14	Raw Water Pump*	0	1
15	Set of Alternator Belts	1	1
16	Fuel Washer Kit	Std.1	w/c 1

*Heat exchanger cooled engines only