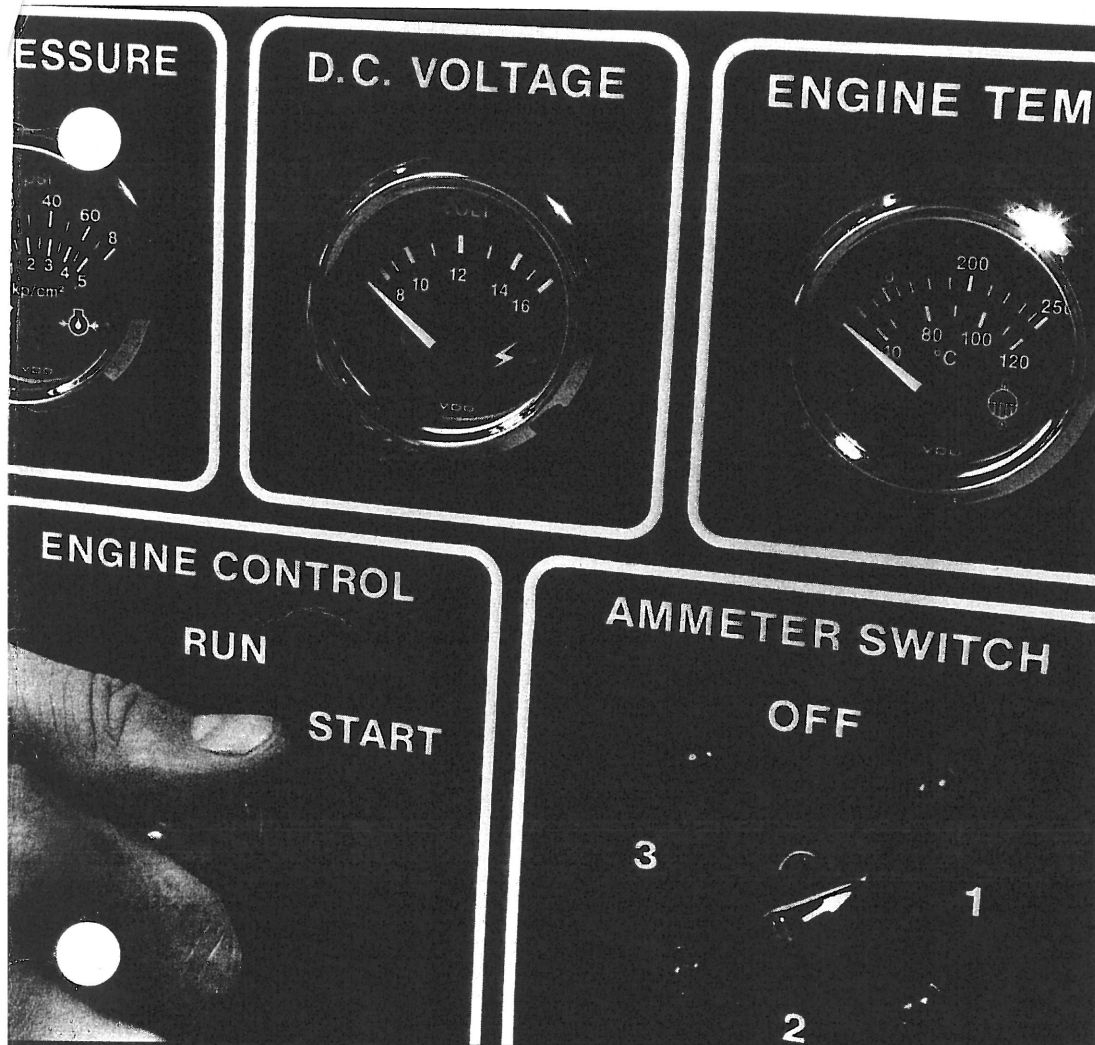


OPERATOR'S MANUAL

Publication #0311 for models:

NL445D1, NL445T1, NL445T2 and NL668T2





— 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.*

**ALASKA
DIESEL
ELECTRIC**



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Introduction

Please read this operator's manual thoroughly before starting to operate your equipment. This manual contains information you will need to run your new unit.

Servicing of generator sets presents unique problems. In many cases a set cannot be moved to a repair facility. Failures often occur in remote areas far from competent assistance. 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

This manual covers the operating instructions for the Northern Lights NL445 and NL668 series industrial generator sets

Model Numbers

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

M / NL

M	- Northern Lights marine generator set
NL	- Northern Lights industrial generator set

+ 445 (4045)

Northern Lights (John Deere) Model number of engine block	
4 cylinder	4.5 liters

+ D, T & Q

D	- Naturally Aspirated
T	- Turbocharged
Q	- 1200 RPM

NL445D = Northern Lights naturally aspirated 1800 RPM industrial diesel generator set; Deere 4045 block.

NL445T1 = Northern Lights turbocharged 1800 RPM industrial diesel generator set; Deere 4045 block.

NL445T2 = Northern Lights turbocharged 1800 RPM industrial diesel generator set; Deere 4045 block.

NL668T2 = Northern Lights turbocharged 1800 RPM industrial diesel generator set; Deere 6068 block.

Serial Numbers

Your set has three serial numbers:

- ① an engine number stamped on the block,
- ② a generator plate, and
- ③ 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.

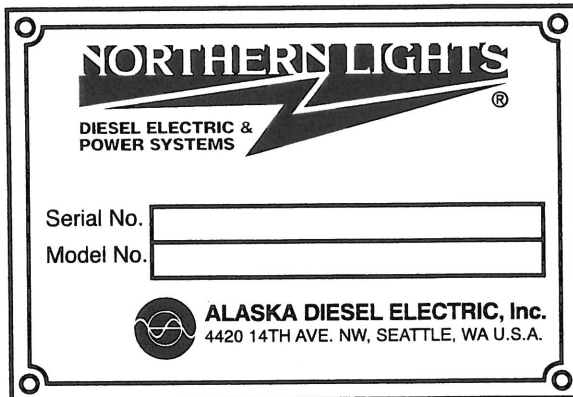


Figure 1: Generator set serial number plate.

Warranty

A warranty registration certificate is supplied with your set. It entitles the original purchaser of our equipment to a warranty covering material or assembly faults. 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.



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

Safety Rules



CAUTION: Accident reports indicate that the 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 the engine.
- Always disconnect the battery ground strap before making adjustments.
- Operate engines in properly ventilated areas.
- Keep trash and other objects away from engines.
- 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 the engine while it is running.
- Use caution in handling fuel. Never refuel a hot or running engine. Do not smoke while filling the fuel tank or servicing the 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 the engine to make sure that everything is clear before starting.
- Do not operate an engine that is not 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.

NL445 Generator Component Locations

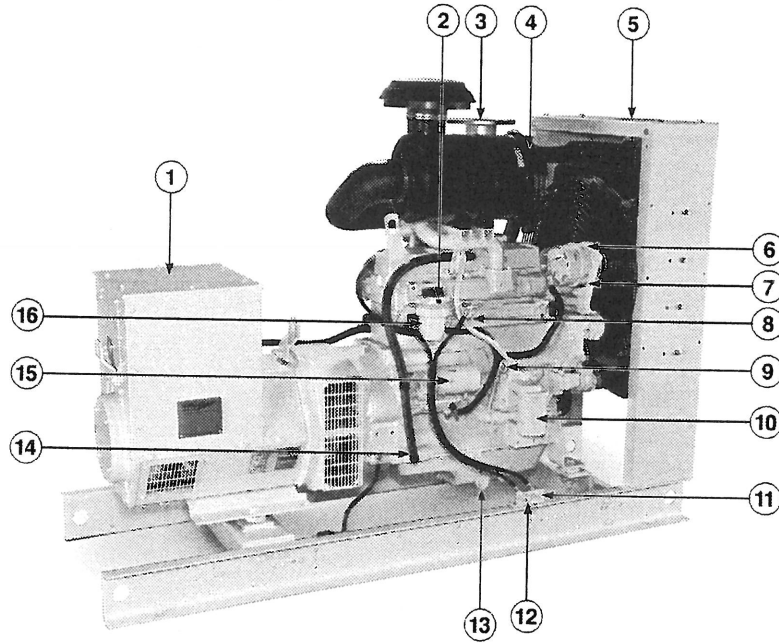


Figure 2A: NL445T2 Service Side

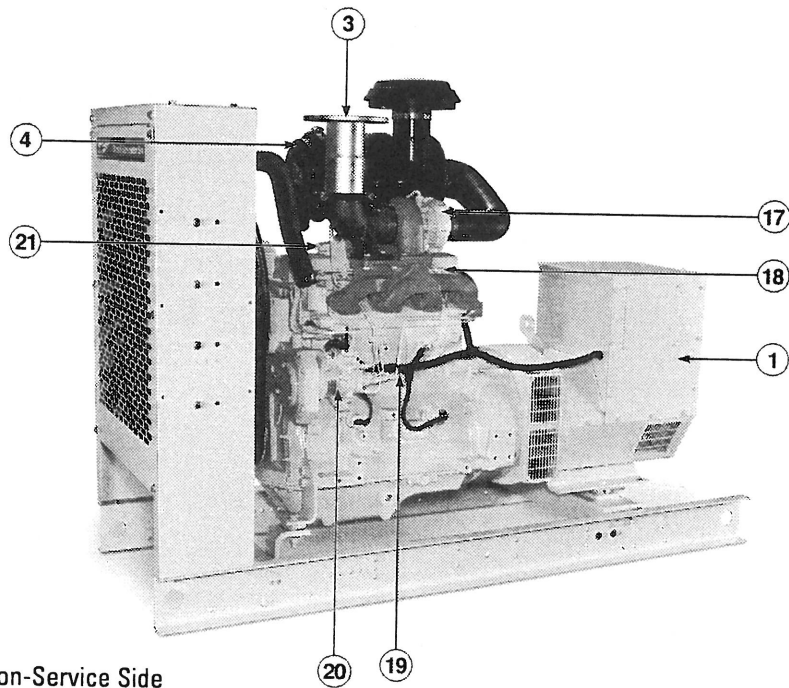


Figure 2B: NL445T2 Non-Service Side

- | | | | |
|---------------------------|----------------------|--------------------|-------------------------|
| 1. Generator Junction Box | 7. Poly-vee Belt | 12. Fuel Return | 17. Turbocharger |
| 2. Fuel Bleed Screw | 8. Fuel Lift Pump | 13. Lube Oil Drain | 18. Injectors |
| 3. Exhaust Outlet | 9. Lube Oil Dipstick | 14. Crankcase Vent | 19. Block Drain Cock |
| 4. Air Cleaner | 10. Lube Oil Filter | 15. Starter | 20. Fuel Injection Pump |
| 5. Coolant Fill | 11. Fuel Inlet | 16. Fuel Filter | 21. Lube Oil Fill |
| 6. D.C. Alternator | | | |

NL668 Generator Component Locations

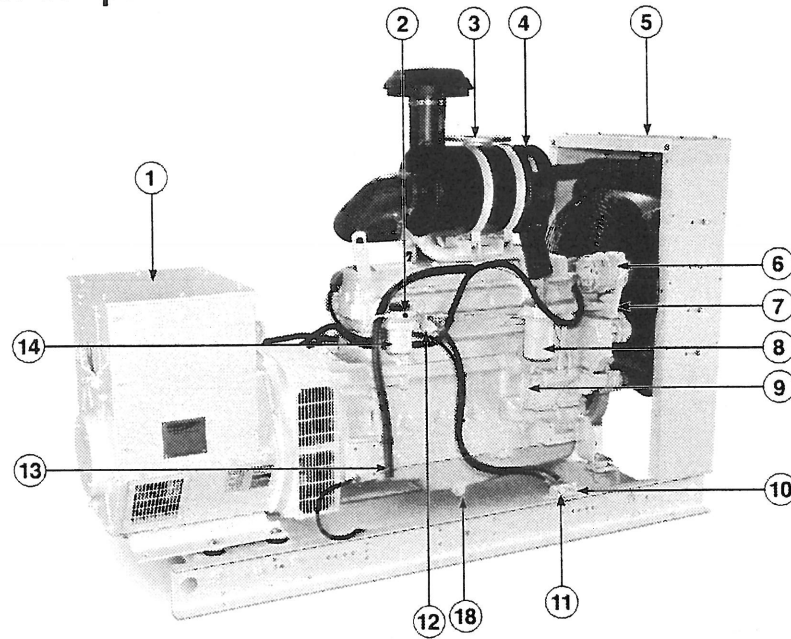


Figure 3A: NL668T2 Service Side

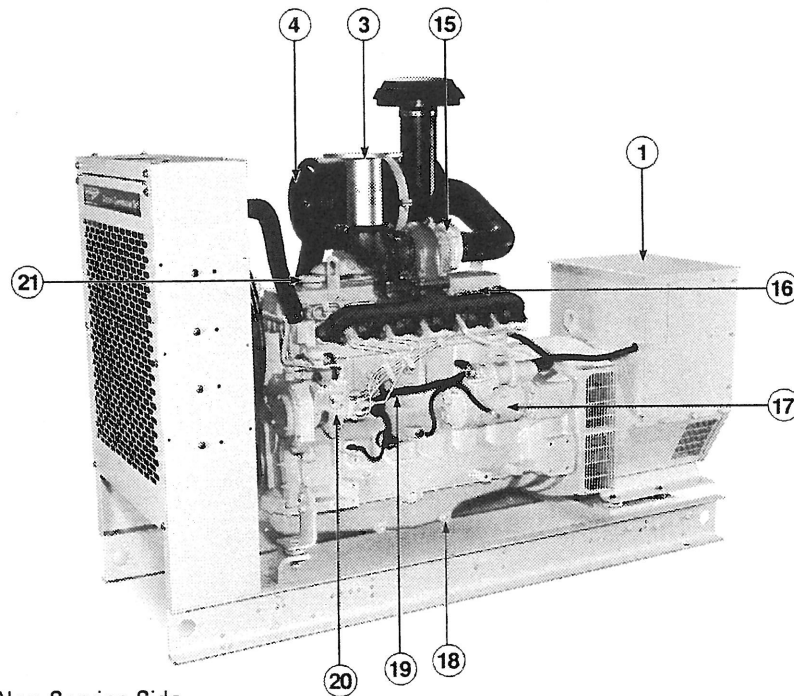


Figure 3B: NL668T2 Non-Service Side

- | | | | |
|---------------------------|----------------------|--------------------|-------------------------|
| 1. Generator Junction Box | 7. Poly-vee Belt | 12. Fuel Lift Pump | 17. Starter |
| 2. Fuel Bleed Screw | 8. Lube Oil Filter | 13. Crankcase Vent | 18. Lube Oil Drain |
| 3. Exhaust Outlet | 9. Lube Oil Dipstick | 14. Fuel Filter | 19. Block Drain Cock |
| 4. Air Cleaner | 10. Fuel Inlet | 15. Turbocharger | 20. Fuel Injection Pump |
| 5. Coolant Fill | 11. Fuel Return | 16. Injectors | 21. Lube Oil Filter |
| 6. D.C. Alternator | | | |

Control Panels

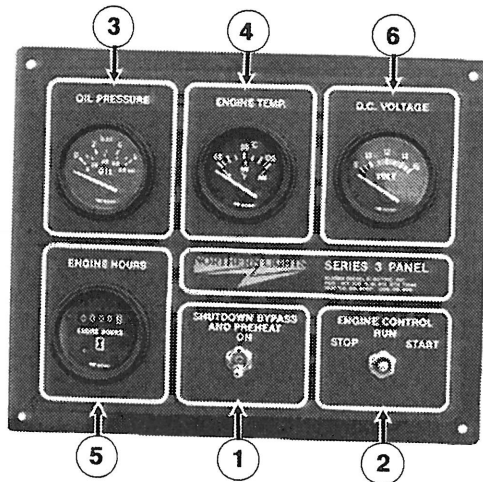


Figure 4: Series 3-B Generator Control Panel

1. SHUTDOWN BYPASS

The function of this switch is to bypass the engine safety shutdown circuit while starting the engine.

2. ENGINE CONTROL SWITCH

To start the engine, hold the switch in the START position until the engine is running.

NOTE: Excessive cranking may cause engine damage.

After the engine starts, release the switch and it will return to the RUN position. To stop the engine, hold the switch in the STOP position.

3. OIL PRESSURE GAUGE

The oil pressure gauge shows the oil pressure in the engine lubricating system.

4. WATER TEMPERATURE GAUGE

Registers the temperature of cooling water.

5. HOUR METER

Keeps track of engine running time.

6. D.C. VOLTMETER

When the engine is stopped, with the bypass switch on, the voltmeter indicates the condition of the battery. When the engine is running, the voltmeter indicates the voltage output of the alternator.

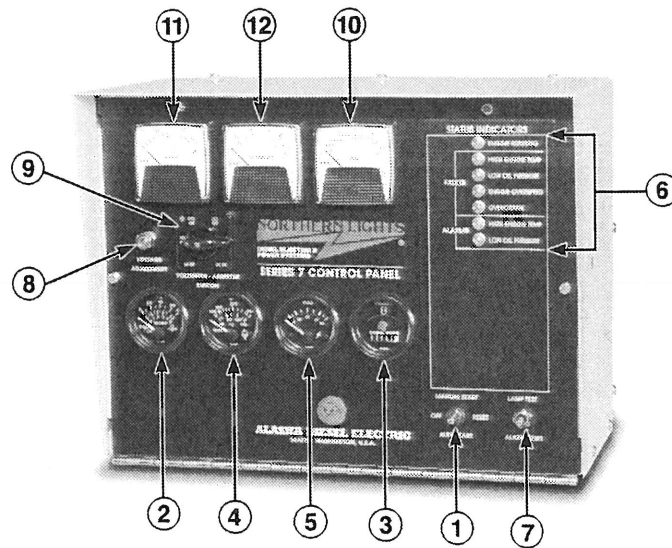


Figure 5-A: Series 7 Generator Control Panel

1. SHUTDOWN BYPASS SWITCH / ENGINE CONTROL SWITCH

Auto-Start Panels (S-7.2, S-7.4, S-7.5 & S-7.6)

When the switch is placed in the auto-start position, the unit will automatically start when a contact close signal is received from the Automatic Transfer Switch. To manually start the unit, place the switch in the MANUAL start position. If the unit automatically shuts down due to an engine fault, correct the fault and move the switch to the RESET position. To stop the unit, move the switch to the OFF position

2. OIL PRESSURE GAUGE

The oil pressure gauge shows the oil pressure in the engine lubricating system.

3. HOUR METER

Keeps track of engine running time.

4. WATER TEMPERATURE GAUGE

Registers temperature of cooling water.

5. D.C. VOLTMETER

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

6. STATUS INDICATOR PANEL

Engine monitoring alarms and lamps for monitoring engine functions.
S-7.3 includes 5 lights; S-7.4 includes 7 lights; S-7.5 includes 12 lights; and S-7.6 includes 16 lights.

7. LAMP TEST AND ALARM RESET BUTTON

Press UP to test the indicator lights and press DOWN to reset the alarm lights.

8. A.C. VOLTAGE ADJUSTMENT RHEOSTAT

Voltage has been set at factory and should only be adjusted by factory trained personnel.

9. VOLTMETER - AMMETER SELECTOR SWITCH

Used to check each phase for voltage and amperage.

10. FREQUENCY METER (Hertz)

The frequency meter indicates alternating current frequency: 60 Hz (1800 RPM) or 50Hz (1500 RPM).

11. A.C. VOLTMETER

Shows the generator output voltage. The phase is selected with the Voltmeter-Ammeter selector switch.

12. A.C. AMMETER

Shows the generator load on each phase. The phase is selected with the Voltmeter-Ammeter selector switch.

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. After overhaul, fill engine with John Deere engine break-in oil or API class CE oil.
5. Break-In Oil Changes: Change engine oil and filter at 100 hours. Change oil and filter again at 250 hours (consult Lubricants Section for oil recommendation).
6. Retighten head bolts and adjust valves at 50 hours.

Operating Instructions

IMPORTANT: *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 the piston rings.*

BEFORE STARTING

1. Check the water level by removing the pressure cap from the radiator. In order to give the cooling water 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 (Service Point 14).



CAUTION: *To prevent burns use protective clothing and open the filler cap only when the engine is cold.*

2. Check the oil level in the crankcase with the dipstick. The oil level should be between the "waffled area" and the "o o". Never allow the level to go below the "o o". 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 on the tank and at the secondary fuel filter.
4. Turn on any optional battery switch that may have been installed.

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 ON position, push Engine Control Switch to START position.
2. As soon as the engine starts, release both switches. Do not crank starter for more than 30 seconds. If engine fails to start the first time, be sure starter has stopped before reengaging.

OPERATING

1. Check gauges often. Oil pressure must be above 40 PSI. The D.C. voltmeter should read between 13 and 14 volts at 60° F (16° C) ambient temperature. Water temperature gauge must be below 221° F (105° C). Check AC voltage and frequency meters (Series 7 Panel). If gauges deviate from normal levels, shut down the set and investigate.
2. Let the unit run unloaded for a three to five minute warm-up period.
3. Do not add full electrical load until engine is at maximum operating temperature.

Shutdown Procedures

1. Unload the generator.
2. Run engine for a 3 to 5 minute cool down period.
3. Move engine control switch to the STOP position until engine stops completely.
4. Put the battery switch in OFF position.
5. Shut off fuel valve at tank.

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 warning or shutdown system is activated:
 - a. Check the temperature gauge. If above 221° F (105° C), reduce load on engine unless the temperature drops quickly. Stop the engine and determine the cause before resuming operation.
 - b. Use the Trouble Shooting Guide in this manual 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 caps 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 221° F (105° C). Repeat troubleshooting.
3. If the warning or 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 (above 40 PSI) after a few seconds of operation.
 - c. If the oil level is normal, DO NOT restart the engine. Call your Northern Lights dealer for assistance.

Spare Parts

1. ADE recommends that you keep the following spare parts on hand for field service. The parts are available from your local Northern Lights dealer.
 - a. Primary and secondary fuel filter elements
 - b. Oil filters
 - c. Air filter elements
 - d. Alternator belt
 - e. Thermostat and gaskets
 - f. Injector and washer
2. If your set is operating a long distance from a servicing dealer, add the following:
 - a. Complete set of injectors
 - b. For injector change, keep a complete set of carbon stop seals.
 - c. Fuel lift pump.

Service Schedule Chart

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 pages that follow.

▼ OPERATION	Service Intervals:					
	Daily	50 Hours (2 Weeks)	250 Hours	600 Hours (12 Months)	1200 Hours (24 Months)	2000 Hours
Visual walk-around inspection	X					
ENGINE:						
SP1 Check oil level	X					
SP2 Change engine oil ¹			X			
SP3 Change lube oil filters ¹			X			
SP4 Check (replace) air cleaner ^{1, 3}			X	X		
SP5 Check automatic belt tensioner and belt wear ¹				X		
SP6 Check and adjust valve clearances ¹				X	X	
SP20 Clean crankcase vent tube				X		
SP21 Check crankshaft vibration damper (6-cylinder units only)					X	
FUEL SYSTEM:						
SP7 Check primary filter (Racor) ²	X					
SP8 Change primary filter element ^{2, 3}			X			
SP9 Change secondary fuel filter ^{1, 3}				X		
SP10 Check injectors ¹				X		
SP11 Check fuel injection pump						X
TURBOCHARGER:						
SP12 Check air lines and oil lines for leakage ¹			X			
SP13 Check boost pressure				X		
COOLING SYSTEM:						
SP14 Check cooling water level	X					
SP15 Check and flush cooling system					X	
SP16 Check and clean radiator and radiator fins	X					
SP22 Pressure test cooling system					X	
ELECTRICAL SYSTEM:						
SP17 Check electrolyte level in batteries ^{1, 3}		X				
SP18 Check condition of batteries with hydrometer ¹			X			
OUT-OF-SERVICE:						
SP19 Winterizing or out-of-service ³						

Notes: 1. Perform all maintenance once a year, even if hour level has not been reached. 2. Consult manufacturer's maintenance schedule, not on chart. 3. When necessary.

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 CG-4/CF-4 single viscosity oils.
 - b. API Service CG-4/CF-4 multi-viscosity oils.
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	SAE5-30W

4. Some increase in oil consumption may be expected when SAE 5W and SAE 5-30W 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 “L” and “H”. Never allow the level to go below the “L”.
3. Always add the same viscosity of oil as is already in the crankcase.

SP2: Oil Changes

1. Using the oil recommended in the previous diagram, change the engine oil and filter after 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.

4. Change oil when engine is warm.
 - a. Remove plug from outlet in base frame. Screw in owner-supplied drain hose.
 - b. 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.
 - c. Refill engine with recommended oil.
5. Dispose of waste oil in an approved manner.
6. Engine Lube Oil Capacity:

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 three-quarters to one and one-quarter 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.

NL445D1	2.25 gal (9.0 qt)	8.5 liters
NL445T1	3.60 gal (14.5 qt)	13.5 liters
NL445T2	3.60 gal (14.5 qt)	13.5 liters
NL668T2	5.00 gal (20.0 qt)	19.0 liters

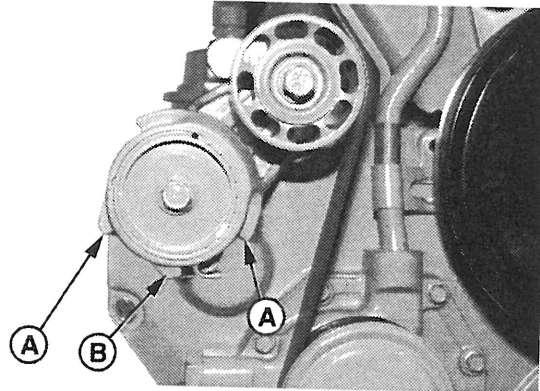
SP4: Air Cleaner

1. Inspect air cleaner every 100 hours. Replace filter every 600 hours, or yearly, whichever comes first.
2. Clean the rubber tube at the filter. Loosen the hose clamp and the attaching strip for the filter.
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.

SP5: Poly-Vee Belts

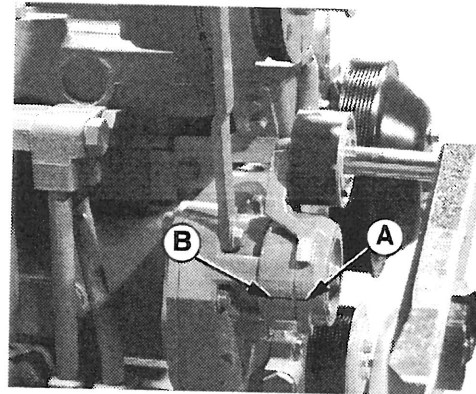
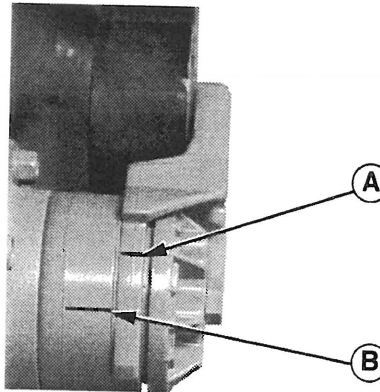
1. Belt drive systems equipped with automatic (spring) belt tensioners cannot be adjusted or repaired. The automatic belt tensioner is designed to maintain proper belt tension over the life of the belt. If tensioner spring tension is not within specification, replace tensioner assembly.
2. Checking Belt Wear



- a. The belt tensioner is designed to operate within the limit of arm movement provided by the cast stops (A and B) when correct belt length and geometry is used.
- b. Visually inspect cast stops (A and B) on belt tensioner assembly.
- c. If the tensioner stop on swing arm (A) is hitting the fixed stop (B), check mounting brackets (alternator, belt tensioner, idler pulley, etc.) and the belt length. Replace belt as needed (see next procedure).

3. Checking Tensioner Spring Tension

- a. A belt tension gauge will not give an accurate measure of the belt tension when automatic spring tensioner is used. Measure tensioner spring tension using a torque wrench and the procedure outlined below:



- Release tension on belt using a breaker bar and socket on tension arm. Remove belt from pulleys.
- Release tension on tension arm and remove breaker bar.
- Put a mark (A) on swing arm of tensioner as shown.
- Measure 21 mm (0.83 in) from (A) and put a mark (B) on tensioner mounting base.
- Rotate the swing arm using a torque wrench until marks (A & B) are aligned.
- Record torque wrench measurement and compare with specification below. Replace tensioner assembly as required.

- b. Spring Tension Specification = 18-22 N•m (13-16 lb-ft)

SP6: Valve Clearance

NOTE: *If desired, have your authorized servicing dealer or engine distributor adjust the engine valve clearance.*

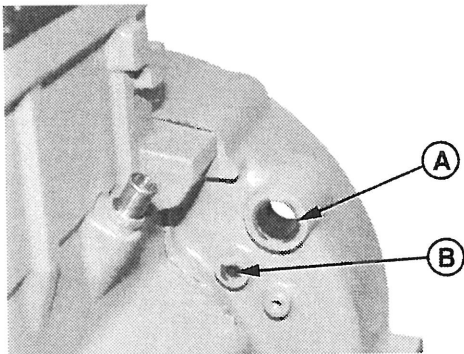


CAUTION: *To prevent accidental starting of engine while performing valve adjustments, always disconnect the NEGATIVE (-) battery terminal.*

IMPORTANT: *Engine valve clearance must be checked and adjusted when engine is cold.*

1. Remove rocker arm cover and crankcase ventilator tube.

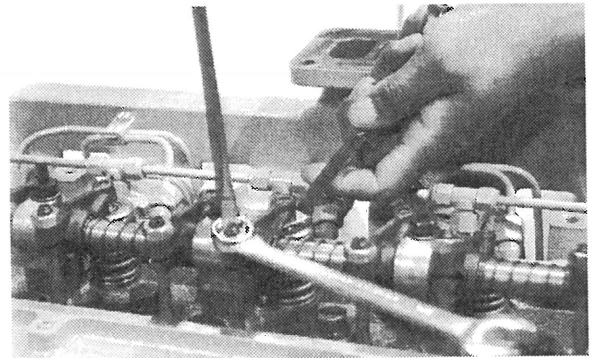
IMPORTANT: *Visually inspect contact surfaces of valve tips and rocker arm wear pads. Check all parts for excessive wear, breakage, or cracks. Replace parts that show visible damage. Rocker arms that exhibit excessive valve clearance should be inspected more thoroughly to identify damaged parts.*



2. Remove plastic plugs or cover plate from flywheel housing timing holes (A).
3. Using either JD281A, JDG820, or JDE83 Flywheel Turning Tool and JDE81-4 Timing Pin, rotate engine in running direction (clockwise viewed from front) until No. 1 cylinder is at Top Dead Center (TDC) Compression stroke. Insert timing pin in flywheel.

If No. 1 cylinder rocker arms are loose, the engine is at No. 1 "TDC Compression".

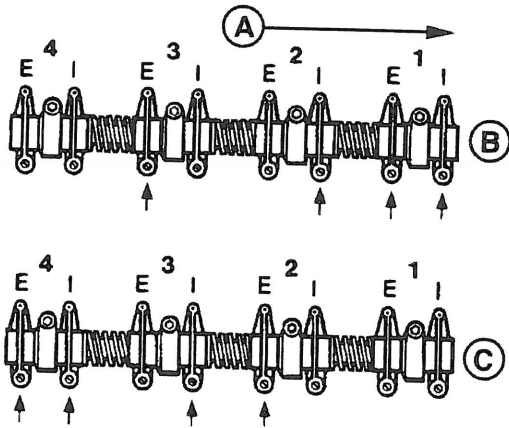
If No. 1 cylinder rocker arms are not loose, rotate engine one full revolution (360°) to No. 1 "TDC Compression".



4. With engine lock-pinned at "TDC" of No. 1 piston's compression stroke, check and adjust (as needed) valve clearance to following specifications, as directed in the procedures (on next page) for 4 or 6 cylinder engines
 - a. Intake Valve Clearance Specification
= 0.35 mm (0.014 in)
 - b. Exhaust Valve Clearance Specification
= 0.45 mm (0.018 in)
5. If valves need adjusting, loosen the locknut on rocker arm adjusting screw. Turn adjusting screw until feeler gauge slips with a slight drag. Hold the adjusting screw from turning with screwdriver and tighten locknut to 27 N•m (20 lb-ft). Recheck clearance again after tightening locknut. Readjust clearance as necessary.
6. Replace rocker arm cover and crankcase ventilator tube.

4-CYLINDER ENGINES:

NOTE: Firing order is 1 - 3 - 4 - 2



- A - Front of Engine
- B - No. 1 Piston at TDC Compression Stroke
- C - No. 4 Piston at TDC Compression Stroke
- E - Exhaust Valve
- F - Intake Valve

Lock No. 1 piston at TDC compression stroke (B).

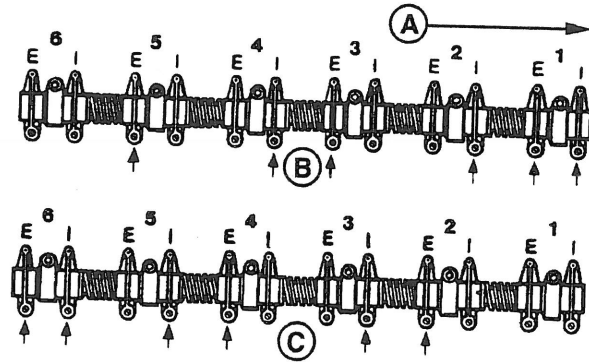
Adjust valve clearance on No. 1 and No. 3 exhaust valves and No. 1 and No. 2 intake valves.

Rotate flywheel 360°. Lock No. 4 piston at TDC compression stroke (C).

Adjust valve clearance on No. 2 and No. 4 exhaust valves and No. 3 and No. 4 intake valves.

6-CYLINDER ENGINES:

NOTE: Firing order is 1 - 5 - 3 - 6 - 2 - 4



- A - Front of Engine
- B - No. 1 Piston at TDC Compression Stroke
- C - No. 6 Piston at TDC Compression Stroke
- E - Exhaust Valve
- F - Intake Valve

Lock No. 1 piston at TDC compression stroke (B).

Adjust valve clearance on No. 1, No. 3, and No. 5 exhaust valves and No. 1, No. 2, and No. 4 intake valves.

Rotate flywheel 360°. Lock No. 6 piston at TDC compression stroke (C).

Adjust valve clearance on No. 2, No. 4, and No. 6 exhaust valves and No. 3, No. 5, and No. 6 intake valves.

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 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. Use fuel having less than 0.5% sulphur (between 0.5% and 1% half service interval on oil and filter).
3. The cetane number should be a minimum of 40.
4. DO NOT use these unsuitable grades of fuel:
 - a. Domestic heating oils, all types.
 - b. Class B engine fuels.
 - 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.

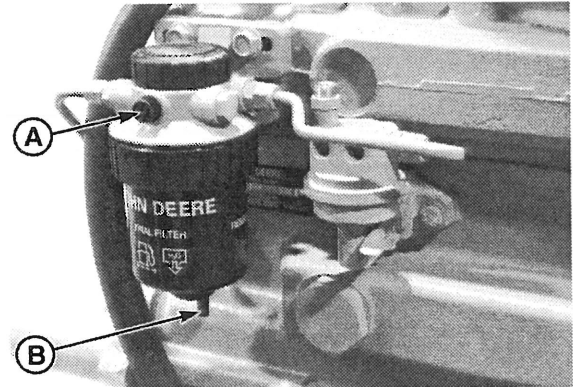
SP7: Fuel Filters

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 200 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 spin-on disposable secondary fuel filter.*

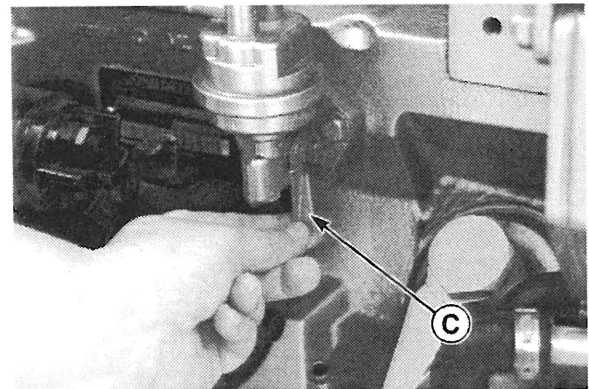
Periodically, the fuel filter should be checked for water or debris.

IMPORTANT: *Drain water into a suitable container and dispose of properly.*



- a. Loosen drain plug (B) at bottom of fuel filter two or three turns.
- b. Loosen air bleed plug two full turns (A) on fuel filter base and drain water from bottom until fuel starts to drain out.
- c. When fuel starts to drain out, tighten drain plug securely.

After draining water from the fuel filter, the filter must be primed by bleeding all air from the fuel system.



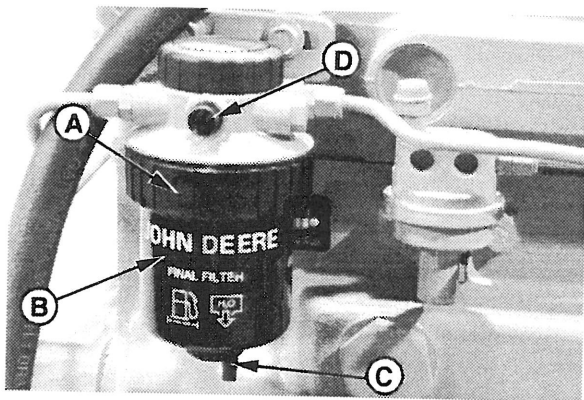
- d. Operate primer lever of the fuel supply pump (C) until fuel flow is free from air bubbles.
- e. Tighten bleed plug securely, continue operating hand primer until pumping action is not felt. Push hand primer inward (toward engine) as far as it will go.

If the fuel system needs further bleeding of air, see BLEEDING THE FUEL SYSTEM, later in this manual.

SP8: Replacing the Fuel Filter Element



CAUTION: Escaping diesel fuel under pressure can penetrate the skin, causing serious personal injury. Before disconnecting fuel or other 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 your 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. Close the fuel shut-off valve, if equipped.
2. Thoroughly clean the fuel filter assembly and surrounding area.
3. Loosen the drain plug (C) and drain fuel into a suitable container.
4. Firmly grasp the retaining ring (A) and rotate it counterclockwise one-quarter turn. Remove ring with filter element (B).

NOTE: Lifting up on the retaining ring as it is rotated helps to get it past the raised locators.

5. Inspect filter mounting base for cleanliness. Clean as required.

NOTE: Raised locators on fuel filter canister must be indexed properly with slots in mounting base for correct installation.

6. Install new filter element onto mounting base. Be sure element is properly indexed and firmly seated on base. It may be necessary to rotate the filter for correct alignment.

If equipped with a water separator, remove filter element from water separator bowl. Drain and clean separator bowl. Dry with compressed air. Install water separator bowl onto new element. Tighten securely.

7. Align keys on filter element with slots in filter base.
8. Install retaining ring onto mounting base making certain dust seal is in place on filter base. Hand tighten ring (about one-third turn) until it "snaps" into the detent. DO NOT overtighten retaining ring.

NOTE: The proper installation is indicated when a "click" is heard and a release of the retaining ring is felt.

A plug is provided with the new element for plugging the used element.

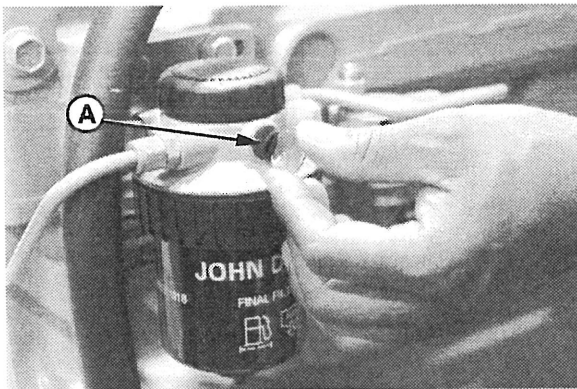
9. Open fuel shut-off valve and bleed the fuel system (see BLEEDING THE FUEL SYSTEM). Tighten bleed plug (D).

Bleeding the Fuel System

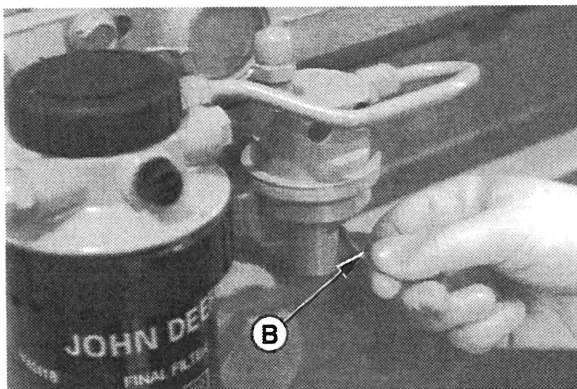


CAUTION: Escaping diesel fuel under pressure can penetrate the skin, causing serious personal injury. Before disconnecting fuel or other lines, be sure to relieve all pressure. Before applying pressure to the system, be sure all connections are tight and the lines, pipes, and hoses are not damaged. Fuel escaping from a very small hole can be almost invisible. Use a piece of cardboard or wood rather than your 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.

Whenever the fuel system has been opened up for service (lines disconnected or filters removed), it will be necessary to bleed air from the system.



1. Loosen the air bleed vent screw (A) two full turns by hand on fuel filter base.

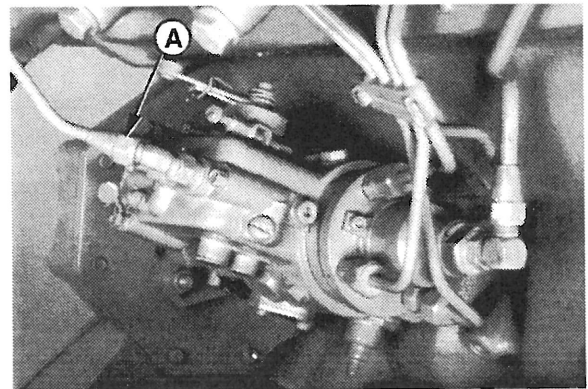


2. Operate supply pump primer lever (B) until fuel flow is free of air bubbles.

3. Tighten bleed plug securely, continue operating hand primer until pumping action is not felt. Push hand primer inward (toward engine) as far as it will go.
4. Start the engine and check for leaks.

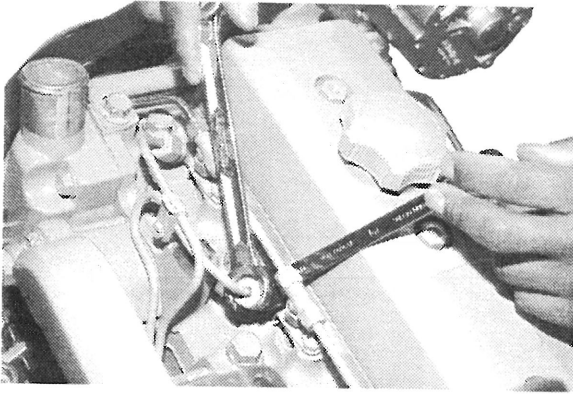
If engine will not start, it may be necessary to bleed air from fuel system at the fuel injection pump or injection nozzles as explained next.

AT FUEL INJECTION PUMP



1. Slightly loosen fuel return line connector (A) at fuel injection pump.
2. Operate fuel supply pump primer lever until fuel, without air bubbles, flows from fuel return line connection.
3. Tighten return line connector to 16 N•m (12 lb-ft).
4. Leave hand primer in the inward position toward cylinder block.

AT FUEL INJECTION NOZZLES



1. On engines equipped with electric fuel shut-off solenoid, energize solenoid.
2. Using two open-end wrenches, loosen fuel line connection at injection nozzle.
3. Crank engine over with starting motor (but do not start engine) until fuel free of bubbles flows out of the loosened connection. Retighten connection to 27 N•m (20 lb-ft).
4. Repeat procedure for remaining injection nozzles (if necessary) until all air has been removed from the fuel system.

If the engine still will not start, see your authorized servicing dealer or engine distributor.

SP10: Injectors

Fuel injectors should be checked by a Luggar-Northern Lights dealer or qualified fuel injection shop every 600 hours.

SP11: Injection Pump

1. Since operating conditions may vary considerably, it is difficult to give a definite service interval. But, as a rule, the pump settings, maximum speed, idle speed and exhaust smoke should be checked by your dealer after every 2000 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 malfunctions. Before servicing pump, check the 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 devices.

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

SP12: Turbocharger

1. Check for air leaks every 250 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 lines are tight and without leaks.

SP13: Turbo Boost

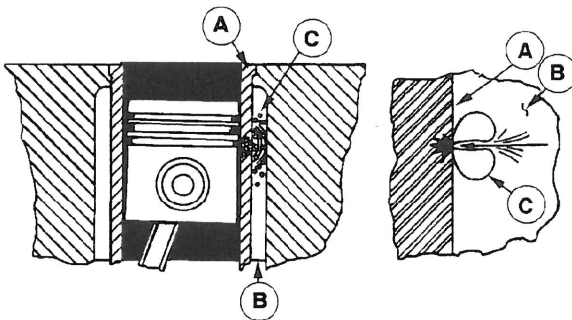
1. This check measures the amount of air the turbo is pushing into the engine. It should be done by an authorized dealer every 600 hours.

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 (A) which are in contact with engine coolant (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 (C) are formed when the piston's impact causes the liner walls to vibrate, sending pressure waves into the coolant.



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

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.
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.
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
Maximum Total Hardness	170	10
PH Level	5.5 to 9.0	

3. 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.
4. 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.

Ethylene Glycol Concentrate – EGC (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.

1. Ethylene glycol coolant concentrate is commonly mixed with water to produce an engine coolant with a low freeze point and high boiling point.
2. A low silicate form of ethylene glycol coolant is recommended for all diesel engines.
3. Use an ethylene glycol coolant concentrate meeting ASTM D 4985P, SAEJ1941, General Motors Performance Specification GM1899M, or formulated to GM6038M.
4. This product is concentrated and should be mixed to the following specification.

	Distilled Water %	EGC % Antifreeze	Freezing 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

5. 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.

IMPORTANT

1. 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.

2. DO NOT use an EGC containing sealer or stop-leak additives.
3. 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.

Supplemental Coolant Additive (SCA)



CAUTION: Supplemental coolant additive (SCA) 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.

1. Important:
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.
2. 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.

3. SCA is available from your Northern Lights dealer in the following sizes.
Pint Part Number: #20-00002
1/2 gallon Part Number: #20-00003
4. 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.*

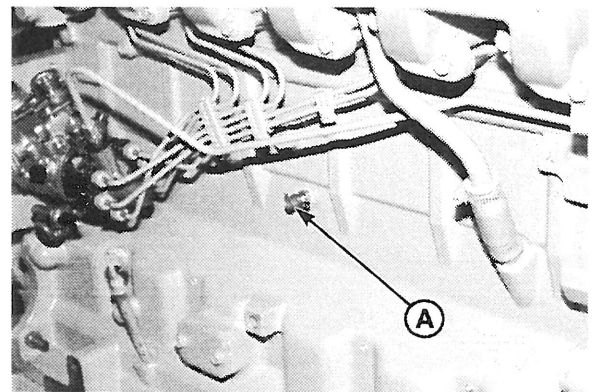
1. Check the coolant level each day before starting the engine.
2. Remove the pressure cap from the radiator and check water level. In order to give the coolant an opportunity to expand, the level should be about 1 3/4 in. (4-5 cm) below the filler cap sealing surface when the engine is cold.
3. The pressure valve in the filler cap releases when the pressure is approximately 10 PSI (0.7 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.*

Drain old coolant, flush the entire cooling system, replace thermostats, and fill with recommended clean coolant every 24 months or 1200 hours.



1. Pressure test entire cooling system and pressure cap if not previously done (see PRESSURE TESTING COOLING SYSTEM).
2. Slowly open the engine cooling system filler cap or radiator cap to relieve pressure and allow coolant to drain faster.
3. Open engine block drain valve (A) on left side of engine. Drain all coolant from engine block.
4. Open radiator drain valve. Drain all coolant from the radiator.
5. Remove thermostats at this time, if not previously done. Install cover (without thermostats) and tighten cap screws to 47 N•m (35 lb-ft).
6. Close all drain valves after coolant has drained.
7. Fill the cooling system with clean water. Run the engine about ten minutes to stir up possible rust or sediment.

8. Stop engine and immediately drain the water from system before rust and sediment settle.
9. After draining water, close drain valves and fill the cooling system with clean water and a cooling system cleaner such as Fleetguard® RESTORE™ and RESTORE PLUS™. Follow manufacturer's directions on label.
10. After cleaning the cooling system, drain cleaner and fill with water to flush the system. Run the engine about ten minutes, then drain out flushing water.
11. Close all drain valves on engine and radiator. Install thermostats using a new gasket.

IMPORTANT: *Air must be expelled from cooling system when system is refilled. Loosen temperature sending unit fitting at rear of cylinder head or plug in thermostat housing to allow air to escape when filling system. Retighten fitting or plug when all the air has been expelled.*

12. Add coolant to radiator until coolant touches bottom of filler neck.
13. Run engine until it reaches operating temperature. This mixes the solution uniformly and circulates it through the entire system. The normal engine coolant temperature range is 82° C - 94° C (180° F - 202° F).
14. After running engine, check coolant level and entire cooling system for leaks.

SP16: Clean Radiator

1. Remove debris from radiator fins daily.
2. In very dusty applications, clean the radiator with compressed air or steam cleaner every 100 hours.

Generators

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.

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. Do not polarize the alternator or regulator.
7. A DC circuit breaker protects your control panel and wiring harness.

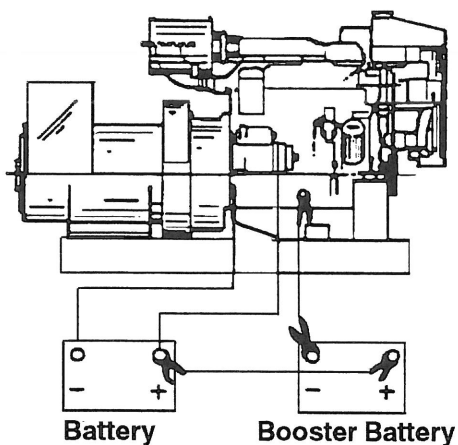
Booster Batteries



CAUTION: *Battery Gas Can Explode. Keep all flames and sparks away from batteries.*

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.
4. Then, connect negative (-) terminal of booster battery to ground on the engine block.

5. Remove booster battery after starting engine.
6. Sealed batteries: see manufacturer charging and booster instruction.



Booster Battery Connections

SP17 - SP18: Battery Care

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 250 hours.
4. Recommended battery capacity:

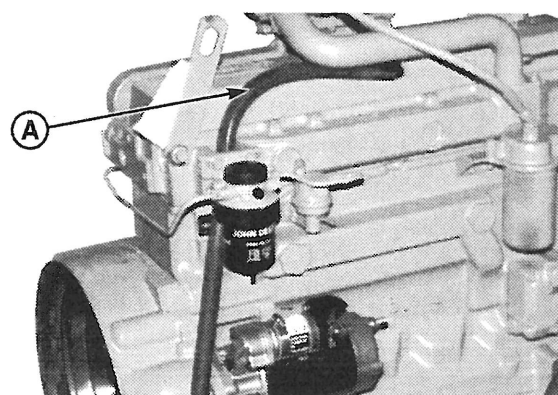
NL445	640 CCA	12 Volt
NL668	800 CCA	12 Volt

SP19: Winterizing / Out-of-Service

1. Check freshwater antifreeze mixture. If refilling, start the engine to circulate the coolant.
2. Fill fuel tank and add biocide as per manufacturer's instructions.

SP20: Cleaning Crankcase Vent Tube

If you operate the engine in dusty conditions, clean the tube at shorter intervals.

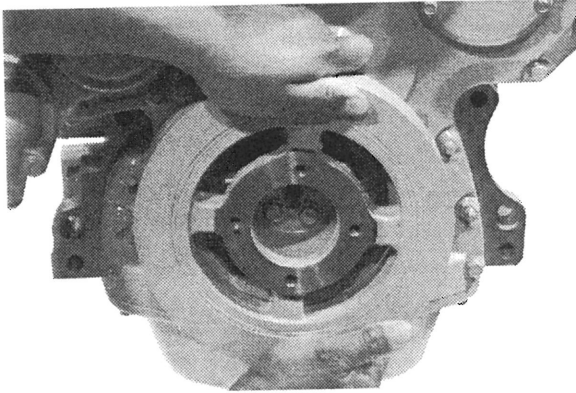


1. Remove and clean crankcase vent tube (A) every 12 months or 600 hours.
2. Install the vent tube. Be sure the O-ring fits correctly in the rocker arm cover for elbow adapter. Tighten hose clamp securely.

SP21: Checking Crankshaft Vibration Damper (6-Cylinder Engine Only)

Every 24 months or 1200 hours.

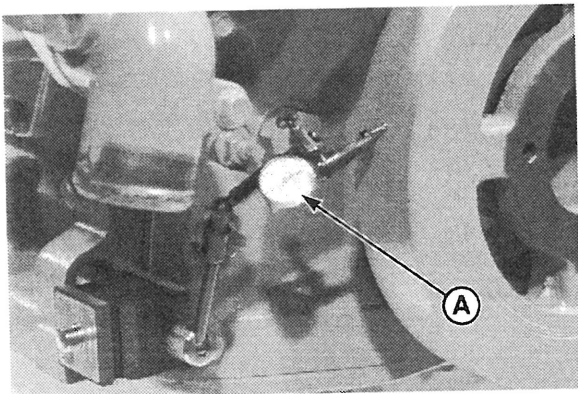
1. Run engine to operating temperature and stop.
Remove belts (shown removed).



2. Grasp vibration damper with both hands and attempt to turn it in both directions. If rotation is felt, damper is defective and should be replaced.

IMPORTANT: *The vibration damper assembly is not repairable and should be replaced every 4500 hours or 60 months, whichever occurs first.*

3. Check vibration damper radial runout by positioning a dial indicator (A) so probe contacts damper outer diameter.



4. With engine at operating temperature, rotate crankshaft using either JD281A, JDG820, or JDE83 Flywheel Turning Tool.

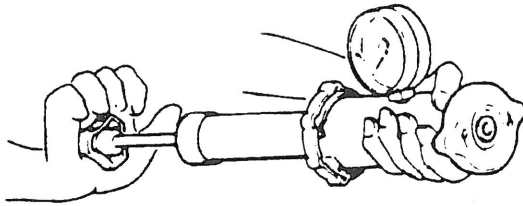
5. Note dial indicator reading. If runout exceeds specifications given below, replace vibration damper.

Damper Radial Runout Specification
Maximum 1.50 mm (0.060 in)

SP22: Pressure Testing Cooling System



CAUTION: Explosive releases of fluids from pressurized cooling systems can cause serious burns. Shut off engine. Only remove filler cap when cool enough to touch with bare hands. Slowly loosen cap to first stop to relieve pressure before removing completely.



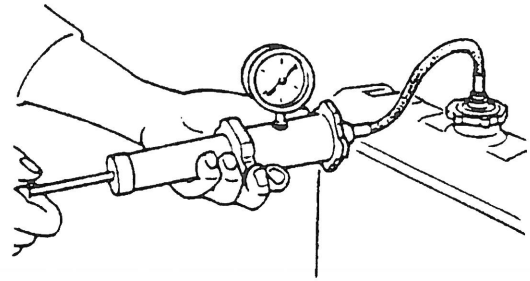
Test Radiator Cap:

1. Remove radiator cap and attach to D05104ST Tester as shown.
2. Pressurize cap to 70 kPa (0.7 bar)(10 psi)*. Gauge should hold pressure for 10 seconds within the normal range if cap is acceptable.

If gauge does not hold pressure, replace radiator cap.

3. Remove the cap from the gauge, turn it 180°, and retest cap. This will verify that the first measurement was accurate.

*Test pressures recommended are for all Deere OEM cooling systems. On specific applications, test cooling system and pressure cap according to the recommended pressure for that application.



Test Cooling System:

NOTE: Engine should be warmed up to test overall cooling system.

1. Allow engine to cool, then carefully remove radiator cap.
2. Fill radiator with coolant to the normal operating level.

IMPORTANT: Do not apply excessive pressure to cooling system, doing so may damage radiator and hoses.

3. Connect gauge and adapter to radiator filler neck. Pressurize cooling system to 70 kPa (0.7 bar) (10 psi)*.
4. With pressure applied, check all cooling system hose connections, radiator, and overall engine for leaks.

If leakage is detected, correct as necessary and pressure test system again.

If no leakage is detected, but the gauge indicated a drop in pressure, coolant may be leaking internally within the system or at the block-to-head gasket. Have your servicing dealer or distributor correct this problem immediately.

*Test pressures recommended are for all Deere OEM cooling systems. On specific applications, test cooling system and pressure cap according to the recommended pressure for that application.

Troubleshooting

If the procedures on the following pages are unable to correct any problems you may be experiencing with your unit, please contact your local Northern Lights dealer for further assistance.

DC Electrical System

Battery Will Not Charge

POSSIBLE CAUSE(S)	RECOMMENDATION(S)
Loose or corroded connections	<ul style="list-style-type: none"> • Clean and tighten battery connections.
Sulfated or worn out batteries	<ul style="list-style-type: none"> • Check specific gravity of each battery. • Check electrolyte level of each battery.
Loose or defective alternator belt	<ul style="list-style-type: none"> • Inspect auto belt tensioner. Replace if necessary. • Replace belt. • Defective alternator.

Starter Inoperative

POSSIBLE CAUSE(S)	RECOMMENDATION(S)
Check DC circuit breaker	<ul style="list-style-type: none"> • If the breaker is tripped, reset it.
Loose or corroded connections	<ul style="list-style-type: none"> • Clean and tighten loose battery and harness plug connection.
Low battery output	<ul style="list-style-type: none"> • Check specific gravity of each battery. • Check electrolyte level of each battery.
Defective electrical system ground wire	<ul style="list-style-type: none"> • Repair or replace.

Starter Cranks Slowly

POSSIBLE CAUSE(S)	RECOMMENDATION(S)
Low battery output	<ul style="list-style-type: none"> • Battery is too small. • Battery cables are too small.
Check specific gravity of each battery	<ul style="list-style-type: none"> • Replace battery if necessary.
Check electrolyte level of each battery	<ul style="list-style-type: none"> • If low, fill cells with distilled water.
Crankcase oil too heavy	<ul style="list-style-type: none"> • Fill with oil of appropriate viscosity.
Loose or corroded connections	<ul style="list-style-type: none"> • Clean and tighten loose connections.

DC Electrical System (continued)

Entire Electrical System Does Not Function

POSSIBLE CAUSE(S)	RECOMMENDATION(S)
Check DC circuit breaker	• If breaker is tripped, reset it.
Faulty connection	• Clean and tighten battery and harness plug connections.
Sulfated or worn out batteries	• Check specific gravity and electrolyte level of each battery.

Engine Troubleshooting

Engine Hard to Start or Will Not Start

POSSIBLE CAUSE(S)	RECOMMENDATION(S)
Improper starting procedure	• See starting section of this manual. Take special note of Bypass Switch operations.
No fuel	• Check level of fuel in fuel tank.
Low battery output	• Check electrolyte level and specific gravity of battery.
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 conditions.
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.

Engine Troubleshooting (continued)

Lack of Engine Power

POSSIBLE CAUSE(S)	RECOMMENDATION(S)
Engine overload	<ul style="list-style-type: none"> • Reduce load.
Intake air restriction	<ul style="list-style-type: none"> • Service air cleaner.
Clogged primary fuel filter element	<ul style="list-style-type: none"> • Clean or replace filter element.
Clogged secondary fuel filter element	<ul style="list-style-type: none"> • Replace secondary filter element.
Improper type of fuel	<ul style="list-style-type: none"> • Consult supplier and use proper type of fuel for operating conditions.
Overheated engine	<ul style="list-style-type: none"> • See "Engine Overheats" in next category.
Below normal engine temperature	<ul style="list-style-type: none"> • Remove and check thermostat.
Improper valve clearance	<ul style="list-style-type: none"> • Reset valves. Best done by dealer. • See your local dealer.
Dirty or faulty injection nozzles	<ul style="list-style-type: none"> • Replace injectors. Best done by dealer. • See your local dealer.
Injection pump out of time	<ul style="list-style-type: none"> • See your local dealer.
Turbocharger malfunction	<ul style="list-style-type: none"> • Stop the engine. • Remove the air cleaner. • Make sure the compressor wheel is stationary and then rotate it with your hand to see whether it is stiff to rotate. • First rotate the wheel under light pressure, then by lightly pulling axially. If the wheel is stiff to rotate, the blades are damaged, or the blades hit the housing, the turbocharger should be replaced as soon as possible.

Engine Troubleshooting (continued)

Engine Runs Irregularly or Stalls Frequently

POSSIBLE CAUSE(S)	RECOMMENDATION(S)
Below normal engine temperature	<ul style="list-style-type: none"> Remove and check thermostat.
Clogged primary fuel filter element	<ul style="list-style-type: none"> Clean or replace filter element.
Clogged secondary fuel filter element	<ul style="list-style-type: none"> Replace secondary filter element.
Water or dirt in fuel system	<ul style="list-style-type: none"> Drain, flush, fill, and bleed system.
Dirty or faulty injection nozzles	<ul style="list-style-type: none"> Have your dealer check injection nozzles.
Air in fuel system	<ul style="list-style-type: none"> Inspect clamps and hoses on suction side of fuel pump for air leak.
Improper type of fuel	<ul style="list-style-type: none"> Consult fuel supplier and use proper type of fuel for operating conditions.

Engine Overheats

POSSIBLE CAUSE(S)	RECOMMENDATION(S)
Engine overloaded	<ul style="list-style-type: none"> Reduce load.
Low coolant level	<ul style="list-style-type: none"> Fill tank or radiator to proper level. Check hoses for loose connections and leaks.
Cooling system needs flushing	<ul style="list-style-type: none"> Flush cooling system.
Defective thermostat	<ul style="list-style-type: none"> Remove and check thermostat.
Defective temperature gauge/sender	<ul style="list-style-type: none"> Check water temperature with thermometer and replace gauge or sender if necessary.

Engine Knocks

POSSIBLE CAUSE(S)	RECOMMENDATION(S)
Insufficient oil	<ul style="list-style-type: none"> Check dipstick. Call your dealer.
Injection pump out of time	<ul style="list-style-type: none"> Call your dealer.
Below normal engine temperature	<ul style="list-style-type: none"> Check your thermostat. Check water temperature to see if temperature gauge is working properly.
Engine overheating	<ul style="list-style-type: none"> See "Engine Overheating" section.

Engine Troubleshooting (continued)

High Fuel Consumption

POSSIBLE CAUSE(S)	RECOMMENDATION(S)
Improper type of fuel	<ul style="list-style-type: none"> • Use correct fuel for temperature.
Clogged or dirty air cleaner	<ul style="list-style-type: none"> • Service air cleaner.
Engine overload	<ul style="list-style-type: none"> • Reduce load.
Improper valve clearance	<ul style="list-style-type: none"> • See your local dealer.
Injection nozzles dirty	<ul style="list-style-type: none"> • See your local dealer.
Injection pump out of time	<ul style="list-style-type: none"> • See your local dealer.
Engine not at proper temperature	<ul style="list-style-type: none"> • Check your thermostats. • Check water temperature with thermometer and replace gauge if necessary.
Defective turbocharger	<ul style="list-style-type: none"> • See your local dealer.

Below Normal Engine Temperature

POSSIBLE CAUSE(S)	RECOMMENDATION(S)
Thermostat not working properly	<ul style="list-style-type: none"> • Check thermostat.
Temperature gauge not working properly	<ul style="list-style-type: none"> • Check water temperature with thermometer and replace gauge if necessary.

Low Oil Pressure

POSSIBLE CAUSE(S)	RECOMMENDATION(S)
Low Oil Level	<ul style="list-style-type: none"> • Fill crankcase to proper level.
Improper type of oil	<ul style="list-style-type: none"> • Drain and fill crankcase with correct oil.
Partially plugged oil filter	<ul style="list-style-type: none"> • Replace filter.

Engine Troubleshooting (continued)

High Oil Consumption

POSSIBLE CAUSE(S)	RECOMMENDATION(S)
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.
Restricted crankcase vent tube	• Clean the vent tube.
Engine overheats	• See "Engine Overheats" in previous category.
Defective turbocharger	• See you local dealer.

Engine Emits Black or Gray Exhaust Smoke

POSSIBLE CAUSE(S)	RECOMMENDATION(S)
Clogged or dirty air cleaner	• Service air cleaner.
Defective muffler (back pressure too high)	• Have dealer check back pressure.
Improper fuel	• Use correct fuel for temperature.
Engine overload	• Reduce load.
Injection nozzles dirty	• See your local dealer.
Engine out of time	• See your local dealer.
Defective turbocharger	• See your local dealer.

Engine Emits White Exhaust Smoke

POSSIBLE CAUSE(S)	RECOMMENDATION(S)
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 local dealer.
Defective injection nozzles	• See your local dealer.

Unit Specifications

	NL445D1	NL445T1
AC Output¹		
Stand-by Rating ¹	40 kW @ 1800 RPM/60 Hz	60 kW @ 1800 RPM/60 Hz
Prime Rating ¹	36 kW @ 1800 RPM/60 Hz	55 kW @ 1800 RPM/60 Hz
Stand-by Rating ¹	33 kW @ 1500 RPM/50 Hz	51 kW @ 1500 RPM/50 Hz
Prime Rating ¹	30 kW @ 1500 RPM/50 Hz	46 kW @ 1500 RPM/50 Hz
Phase	Three phase standard. Single phase available on all units.	
Voltages - 60 Hz	120/208, 120/240, 127/220, 139/240, 220/380, 240/416, 254/440 and 277/480	
Voltages - 50 Hz	110/190, 110/220, 115/230, 120/208, 127/220, 220/380, 240/416	

Engine

	4045D150	4045T150
John Deere Model	4045D150	4045T150
Aspiration/Cylinders	Natural 4	Turbo 4
Displacement	276 in ³ (4.5 l)	276 in ³ (4.5 l)
Bore	4.19 in (106 mm)	4.19 in (106 mm)
Stroke	4.33 in (110 mm)	5.00 in (127 mm)
HP at 1800 RPM ²	64 cont. (71 int.)	90 cont. (100 int.)
Specific Fuel Rate ³	0.367 lb/bhp/hr	0.348 lb/bhp/hr
Apx. Fuel Rate full load ⁴	3.0 gal/hr (11.3 lph)	4.2 gal/hr (15.9 lph)
Apx. Fuel Rate 3/4 load ⁴	2.4 gal/hr (9.1 lph)	3.3 gal/hr (12.5 lph)
Apx. Fuel Rate 1/2 load ⁴	1.8 gal/hr (6.8 lph)	2.5 gal/hr (9.5 lph)
Total Fuel Flow	29.6 gal/hr (112 lph)	29.6 gal/hr (112 lph)
Max. Fuel Transfer Pump Suction Lift	3 ft (0.9 m)	3 ft (0.9 m)
Intake Air Flow at 1800 rpm	117 cfm (3.3 M ³ M)	187 cfm (5.3 M ³ M)
Exhaust Flow	318 cfm (8 M ³ M)	480 cfm (13.6 M ³ M)
Exhaust Temperature	1103°F (595°C)	946°F (508°C)
Max. Back Pressure	30 in H ₂ O (760 cm H ₂ O)	30 in H ₂ O (760 cm H ₂ O)
Heat Rejection ⁵	1820 btu/min	2445 btu/min

Dimensions⁶

	NL445D1	NL445T1
Length	77.5 in (197 cm)	77.5 in (197 cm)
Width	28 in (71 cm)	28 in (71 cm)
Height	52.1 in (132 cm)	57.0 in (145 cm)
Approximate Weight	1715 lbs (778 kgs)	1847 lbs (837 kgs)

Notes:

- kW rating with fan and radiator at 0.8 power factor, average generator efficiency and full range of voltages.
- Net flywheel hp rating for fully equipped engine at 1800 RPM under SAE J816b. Derations: Consult factory for derations if your application requirements are above 77° F (25°C) ambient temperature and/or 600 feet (177 meters) altitude above sea level.
- Based on prime HP rating at 1800 RPM.
- Based on prime kW rating at 1800 RPM. Actual rate may vary depending on operating conditions.
- Based on stand-by rating at 1800 RPM.
- 1800 rpm, 3 phase base sets. Consult factory for dimensionally critical applications.

Unit Specifications

NL445T2

NL668T2

AC Output¹

Stand-by Rating ¹	70 kW @ 1800 RPM/60 Hz	100 kW @ 1800 RPM/60 Hz
Prime Rating ¹	66 kW @ 1800 RPM/60 Hz	90 kW @ 1800 RPM/60 Hz
Stand-by Rating ¹	59 kW @ 1500 RPM/50 Hz	85 kW @ 1500 RPM/50 Hz
Prime Rating ¹	56 kW @ 1500 RPM/50 Hz	80 kW @ 1500 RPM/50 Hz
Phase	Three phase standard. Single phase available on all units.	
Voltages - 60 Hz	120/208, 120/240, 127/220, 139/240, 220/380, 240/416, 254/440 and 277/480	
Voltages - 50 Hz	110/190, 110/220, 115/230, 120/208, 127/220, 220/380, 240/416	

Engine

John Deere Model	4045T250	6068T250
Aspiration/Cylinders	Turbo 4	Turbo 6
Displacement	276 in ³ (4.5 l)	414 in ³ (6.8 l)
Bore	4.19 in (106 mm)	4.19 in (106 mm)
Stroke	5.00 in (127 mm)	5.00 in (127 mm)
HP at 1800 RPM ²	102 cont. (113 int.)	150 cont. (166 int.)
Specific Fuel Rate ³	0.343 lb/bhp/hr	0.347 lb/bhp/hr
Apx. Fuel Rate full load ⁴	4.9 gal/hr (18.5 lph)	6.8 gal/hr (25.7 lph)
Apx. Fuel Rate 3/4 load ⁴	3.8 gal/hr (14.4 lph)	5.2 gal/hr (19.7 lph)
Apx. Fuel Rate 1/2 load ⁴	2.8 gal/hr (10.60 lph)	3.7 gal/hr (14.0 lph)
Total Fuel Flow	29.6 gal/hr (112 lph)	29.6 gal/hr (112 lph)
Max. Fuel Transfer Pump Suction Lift	3 ft (0.9 m)	3 ft (0.9 m)
Intake Air Flow at 1800 rpm	198 cfm (5.6 M ³ M)	314 cfm (8.9 M ³ M)
Exhaust Flow	522 cfm (14.8 M ³ M)	858 cfm (24.3 M ³ M)
Exhaust Temperature	1000°F (538°C)	1063°F (573°C)
Max. Back Pressure	30 in H ₂ O (760 cm H ₂ O)	30 in H ₂ O (760 cm H ₂ O)
Heat Rejection ⁵	2730 btu/min	3924 btu/min

Dimensions⁶

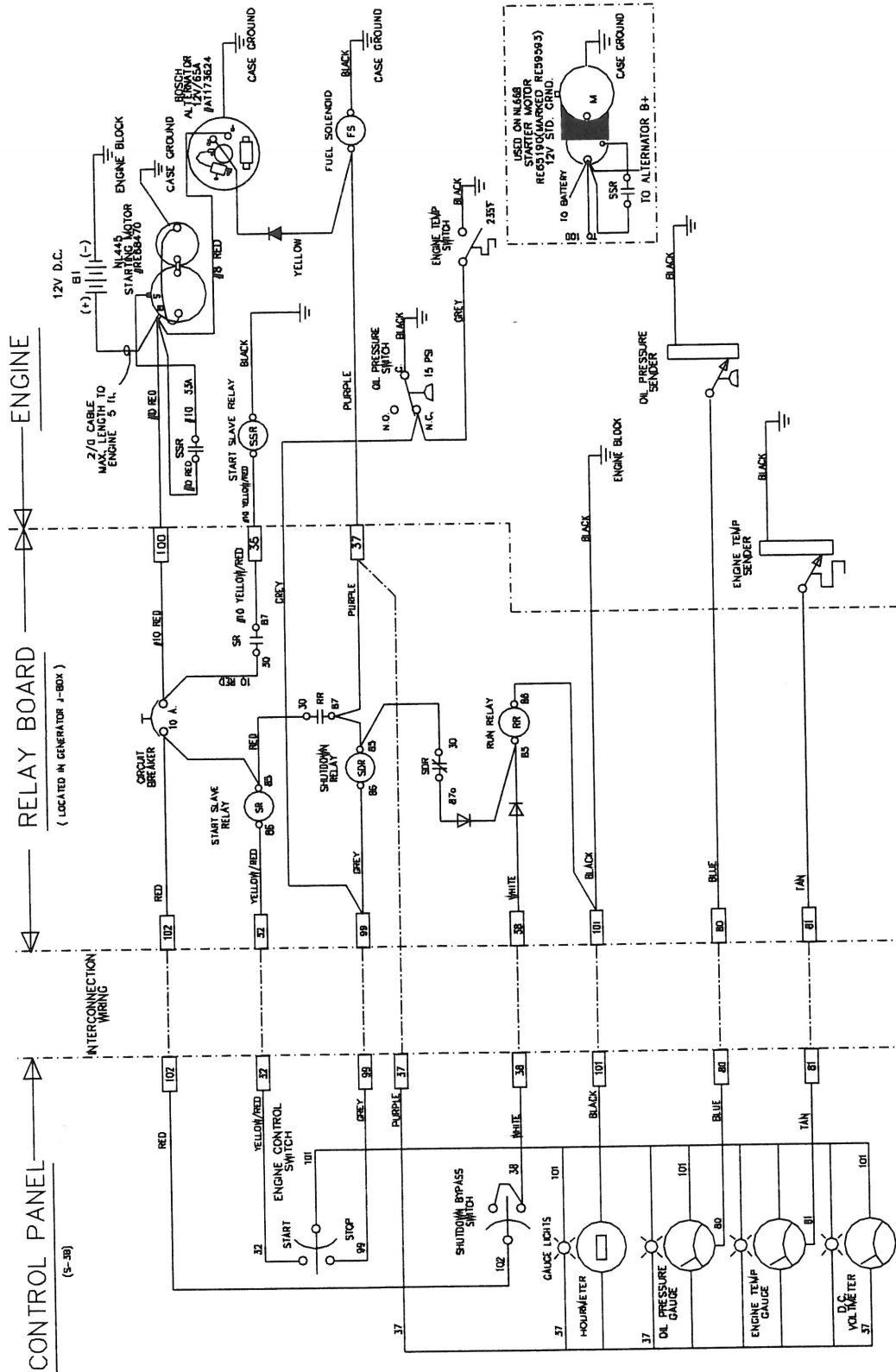
Length	77.5 in (197 cm)	84.3 in (214 cm)
Width	28 in (71 cm)	28 in (71 cm)
Height	57.0 in (145 cm)	61.1 in (155 cm)
Approximate Weight	1958 lbs (888 kgs)	2400 lbs (1088 kgs)

Notes:

1. kW rating with fan and radiator at 0.8 power factor, average generator efficiency and full range of voltages.
2. Net flywheel hp rating for fully equipped engine at 1800 RPM under SAE J816b. Derations: Consult factory for derations if your application requirements are above 77° F (25°C) ambient temperature and/or 600 feet (177 meters) altitude above sea level.
3. Based on prime HP rating at 1800 RPM.
4. Based on prime kW rating at 1800 RPM. Actual rate may vary depending on operating conditions.
5. Based on stand-by rating at 1800 RPM.
6. 1800 rpm, 3 phase base sets. Consult factory for dimensionally critical applications.

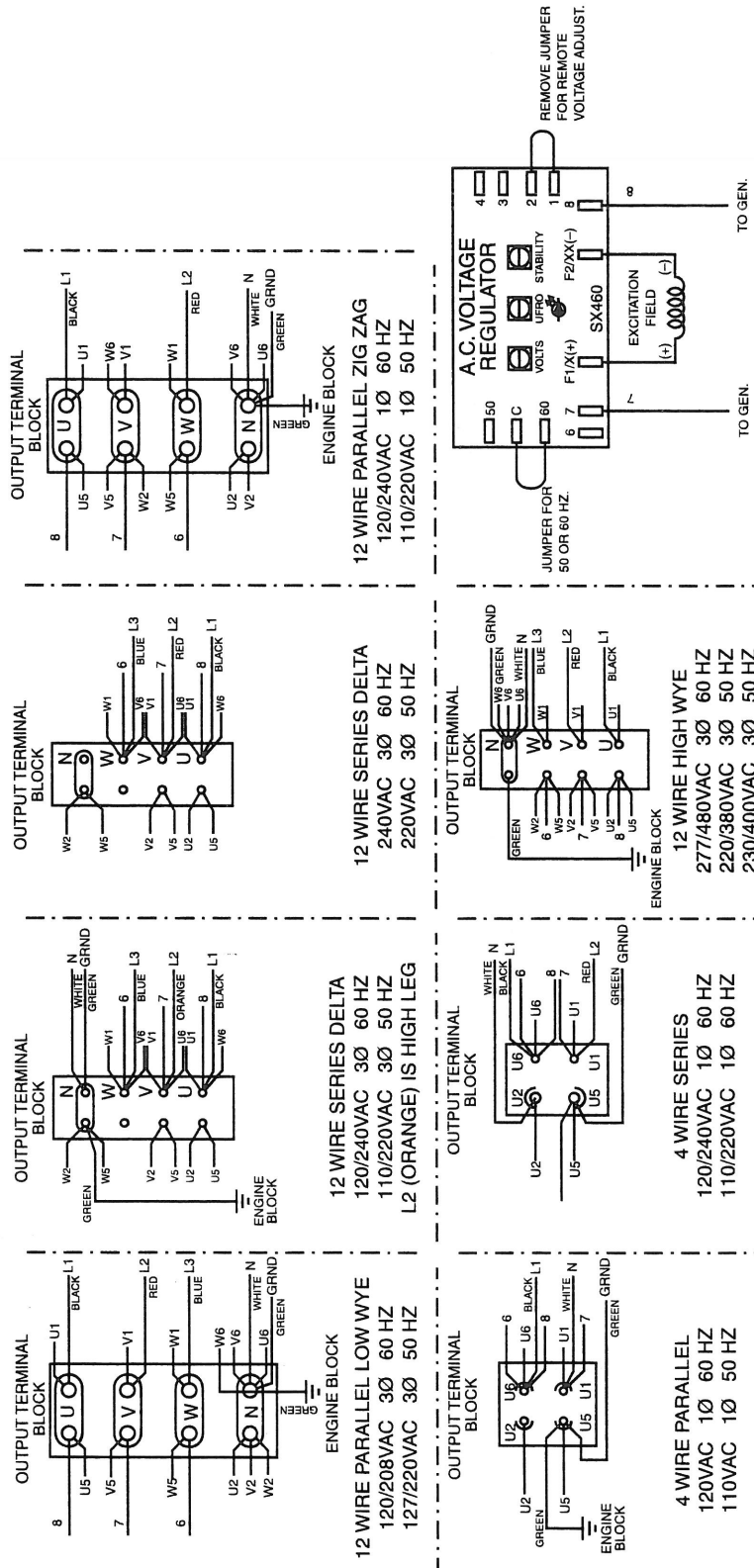
D.C. Wiring Diagram

#C-3998



A.C. Wiring Diagram

#B-5703



- NOTES:**
1. GROUNDING TO BE IN ACCORDANCE WITH THE N.E.C., AND ANY APPLICABLE LOCAL CODES.
 2. DO NOT GROUND GENERATOR IF USED ON AN ISOLATED GROUND SYSTEM.
 3. CONNECT LEADS SEVEN AND EIGHT TO TERMINALS SEVEN AND EIGHT ON THE SX 460. ISOLATE LEAD SIX USING ELECTRICAL TAPE OR A WIRE NUT.

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