

OM3-65

For Models: M65T13 & M50T13

OPERATOR'S MANUAL

Marine Generators | Marine Diesel Engines | Land-Based Generators



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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#OM3-65 for Models:
M65T13 & M50T13

*Read this operator's manual thoroughly before starting to operate your equipment.
This manual contains information you will need to run and service your new unit.*

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Proprietary Information

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Introduction

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

Failures 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.

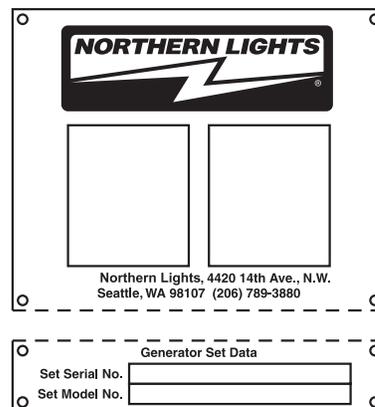
Model Numbers

M65T13 = 65 kW Northern Lights® commercial marine generator set with a John Deere Powertech Tier III 4045 engine block and an electronically controlled fuel system.

M50T13 = 50 kW Northern Lights® commercial marine generator set with a John Deere Powertech Tier III 4045 engine block and an electronically controlled fuel system.

Serial Numbers

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



Warranty

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



NOTICE: 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.

IMPORTANT SAFETY INSTRUCTIONS.

Electromagnetic equipment, including generator sets and their accessories, can cause bodily harm and life threatening injuries when improperly installed, operated or maintained. To prevent accidents be aware of potential dangers and act safely.



READ AND FOLLOW ALL SAFETY INSTRUCTIONS IN THIS MANUAL, PRIOR TO THE INSTALLATION OF ANY GENERATOR SET OR ACCESSORY. KEEP THESE INSTRUCTIONS FOR FUTURE REFERENCE.

Recognize Safety Symbols and Instructions

In addition to the information found in this section, this operator's manual uses three different signal words to outline potential dangers of a specific nature.

 DANGER	DANGER indicates a hazardous situation which, if not avoided, will result in death or serious injury.
 WARNING	WARNING indicates a hazardous situation which, if not avoided, could result in death or serious injury.
 CAUTION	CAUTION indicates a hazardous situation which, if not avoided, could result in minor or moderate injury.

Follow All Safety Instructions

Carefully read and understand all safety messages in this manual and on your machine's safety signs. Keep signs in good and clean condition. Replace missing or damaged signs. Be sure new equipment components and repair parts include the current safety signs. For replacement signs, proper placement of safety signs or clarification on any safety issue, consult your Northern Lights dealer or the factory. There can be additional safety information contained



on parts and components from outside suppliers that is not reproduced in this manual. Consult the suppliers for additional safety information.

Learn how to operate the machine and how to use the controls properly. Only trained personnel should operate machines, or work on or around them.

Keep you machine in proper working condition. UNAUTHORIZED MODIFICATIONS TO THE MACHINERY MAY IMPAIR ITS FUNCTION AND SAFETY PARAMETERS.

Prevent Bypass and Accidental Starting



Do not start engine by shorting across start terminal. Engine will start if normal circuitry is bypassed, creating a hazard by runaway machinery.



Start engine only from operator's station.

Handle Fuel Safely - Avoid Flames



Diesel is highly flammable and should be treated with care at all times. Do not refuel while smoking or when near sparks or open flame.

ALWAYS STOP ENGINE BEFORE FUELING MACHINE. Always fill portable fuel tank outdoors. Never fuel a hot engine.



Safety Rules (Continued)

Prevent accidental discharge of starting fluids by storing all cans in a cool, safe place, away from sparks or open flame. Store with cap securely on container. Never incinerate or puncture a fuel container.

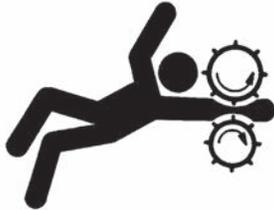
Prevent fires by keeping machine clean of accumulated trash, grease and debris. Always clean any spilled fuel as swiftly as possible. Do not store oily rags, which can ignite and burn spontaneously.

Be prepared if a fire starts. Keep a first aid kit and fire extinguisher handy. Keep emergency contact numbers for fire department, doctors, ambulance and hospital near the telephone.

Service Machines Safely

DANGER

Do not wear a necktie, scarf, necklace, rings or other jewelry, or any loose clothing when working near moving parts. Tie long hair behind your head. If any of these items get caught in moving machinery, severe injury or death could result.



Check for any loose electrical connections or faulty wiring.

Look completely around engine to make sure that everything is clear before starting.

Wear Protective Clothing

WARNING

To prevent catching anything in moving machinery, always wear close fitting clothes and safety equipment appropriate to the job.

Prolonged exposure to loud noise can cause hearing loss or impairment.

Wear suitable authorized hearing protection, such as earmuffs or plugs to protect against loud noises



Operating equipment requires the full attention of the operator. Do not use radio or music headphones while operating machinery.

Practice Safe Maintenance

CAUTION

Understand all service procedures before starting work. Keep area clean and dry. Never lubricate, service, or adjust machine while it is in operation.



Keep hands, feet and clothing away from power-driven equipment. When shutting down an engine, disengage all power and operator controls. Allow the engine to cool completely before beginning any service work.

Securely support any machinery elements that must be raised for service work with support or lifting machinery specifically intended for that purpose.

Keep all parts in good conditions and properly installed. Fix damage immediately. Replace any worn or broken parts. Remove any build up of grease, oil or debris.

Disconnect battery ground cable (-) before making any adjustments or service work.

Stay Clear of Rotating Drivelines

DANGER

Entanglement in rotating drivelines can cause serious injury or death. Keep shields in place at all times. Make sure that rotating shields turn freely in pace with the drivelines.

Do not wear loose fitting equipment around rotating drivelines. Stop the engine and make sure that all moving parts have stopped before making any adjustments, connections, or performing any other type of service to the engine or other driven equipment.



Safety Rules (Continued)

Install all Safety Guards



Direct contact with rotating fans, belts, pulley and drives can cause serious injury.



Keep all guards in place at all times during engine operation.

Wear close-fitting clothes. Stop the engine and be sure all fans, belts, pulleys and drives are stopped before making adjustments, connections, or cleaning near fans and their components.

Do not allow anything on your person to dangle into or come in contact with a moving fan, belt, pulley or drive. Fans can act as vacuums and pull materials up from below, so avoid that area as well while in service.

Safe Battery Handling



Prevent Battery Explosions

Battery gas is highly flammable. Battery explosions can cause severe injury or death. To help prevent battery explosions, keep sparks, lighted matches and open flame away from the top of battery. When checking battery electrolyte level, use a flashlight.



Never check battery charge by contacting the posts with a metal object. Use a volt-meter or hydrometer.

Frozen batteries may explode if charged. Never charge a battery that has not been allowed to warm to at least 16°C (60°F).

Always remove grounded (-) battery clamp first and replace ground clamp last.

Sulfuric acid in battery electrolyte is poisonous and strong enough to burn skin, eat holes into clothing and other materials, and cause blindness if splashed into eyes.

To Avoid Hazards:

- Fill batteries only in well-ventilated areas.
- Wear appropriate eye protection and rubber gloves.
- Never use air pressure to clean batteries.
- Wear appropriate ventilation equipment to avoid inhaling fumes when adding electrolyte.
- Do not spill or drip electrolyte.
- Use correct jump-start procedure if required.

If acid is spilled on skin or in eyes:

1. Flush skin with water.
2. Apply baking soda or lime to help neutralize acid.
3. Flush eyes with water for 15-30 minutes.
4. Get medical attention immediately.

If acid is swallowed:

1. DO NOT induce vomiting.
2. Drink large amounts of water or milk, without exceeding 2 liters (2 quarts)
3. Get medical attention immediately



Battery posts, terminals, and related accessories can contain lead and lead compounds, chemicals known to the State of California to cause cancer and reproductive harm. Wash hands after handling.

Handle Chemical Products Safely



Direct exposure to hazardous chemicals can cause serious injury. Among the potentially hazardous chemicals that may be used with Northern Lights products are lubricants, coolants, paints and adhesives.



All potentially hazardous chemicals come with a Material Safety Data Sheet (MSDS). The MSDS provides specific details on chemical products, including physical hazards, safety procedures and emergency response techniques

Safety Rules (Continued)

Read and understand the MSDS for each chemical before you start any job that includes it. Follow the procedures and use appropriate equipment exactly as recommended.

Contact your Northern Lights dealer or Northern Lights factory for MSDS's used on Northern Lights products.

Work in Well Ventilated Areas

! CAUTION

Exhaust fumes from engines contain carbon monoxide and can cause sickness or death. Work in well ventilated areas to avoid prolonged exposure to engine fumes. If it is necessary to run an engine in an enclosed area, route the exhaust fumes out of the area with an approved, leak proof exhaust pipe extension.

Remove Paint Before Welding or Heating

! WARNING

Hazardous fumes can be generated when paint is heated by welding, soldering or using a torch. To avoid potentially toxic fumes and dust, remove paint before heating.



- Remove paint a minimum of 100 mm (4 in.) from the area that will be affected by heat.
- If paint cannot be removed, wear an approved respirator.
- If you sand or grind paint, use an approved respirator.
- If you use solvent or paint stripper, remove stripper with soap and water before welding. Remove solvent or paint stripper containers from the area.
- Allow at least 15 minutes for fumes to disperse before welding or heating.

Do not use a chlorinated solvent in an area where welding will occur. Work only in areas that are well ventilated. Dispose of paint and solvent properly.

Service Cooling System Safely

! WARNING

Opening a pressurized cooling system can release explosive fluids and causing serious burns. Before opening any pressurized cooling system, make sure the



engine has been shut off. Do not remove a filler cap unless it is cool enough to comfortably grip with bare hands. Slowly loosen cap to relieve pressure before opening fully.

Avoid High Pressure Fluids

! WARNING

Relieve pressure prior to disconnecting pressurized lines. Escaping fluid under pressure can penetrate the skin causing serious injury. Always relieve pressure before disconnecting hydraulic or other pressurized lines. Tighten all connections firmly before re-applying pressure.



If searching for leaks, use a piece of cardboard. Always protect your hands and other body parts from high-pressure fluids.

If an accident occurs, see a doctor immediately. Any high pressure spray injected into the skin must be removed within a few hours to prevent the risk of gangrene or other infection.

Avoid Heating Near Pressurized Fluid Lines

! WARNING

Flammable spray can be generated by heating near pressurized fluid lines, resulting in severe burns and bodily injury. Pressurized lines can rupture when heat goes beyond the immediate flame area. Do not weld, solder or use a torch or open flame near pressurized lines or other flammable fluids.



Do Not Open High-Pressure Fuel System

! DANGER

Many Northern Lights engines use high-pressure fuel injection. High-pressure fluid remaining in fuel lines can cause serious injury. Do not disconnect or attempt any repair of fuel lines, sensors, or other

Safety Rules (Continued)

components between the high-pressure fuel pump and nozzles on engines with high pressure fuel systems.



ONLY AUTHORIZED TECHNICIANS CAN PERFORM REPAIRS ON AN HIGH PRESSURE FUEL INJECTION SYSTEMS.

Avoid Hot Exhaust



Avoid exposure to and physical contact with hot exhaust gases. Exhaust parts and streams can reach high temperatures during operation, leading to burns or other serious injury.



Cleaning exhaust filters can also lead to exposure to hot exhaust gas and the injury risk associated with it. Avoid exposure to and physical contact with hot exhaust gases when cleaning exhaust filters.

During auto or manual/stationary exhaust filter cleaning operations, the engine will run at elevated temperatures for an extended period of time. Exhaust parts and streams can reach high temperatures during operation, leading to burns or other serious injury.

Avoid Harmful Asbestos Dust



Inhaling asbestos fibers may cause lung cancer. Avoid breathing any dust that may be generated when handling components containing asbestos fibers, including some gaskets.



The asbestos used in these components is usually found in a resin or otherwise sealed. Normal handling of these components is not dangerous, as long as airborne dust containing asbestos is not generated.

Avoid creating dust. Never use compressed air for cleaning. Avoid brushing or grinding materials containing asbestos. When servicing, wear an approved respirator. A special vacuum cleaner is recommended to clean asbestos. If this vacuum is not available, apply a mist of oil or water on the

material containing asbestos. Keep all bystanders away from any area where asbestos dust may be generated.

Use Proper Lifting Equipment and Techniques



Lifting heavy components incorrectly can cause severe injury or damage to machinery. Avoid unbalanced loads. Do not use lifting eyes. Lift the generator set using lifting bars inserted through the lifting holes on the skid. Follow all recommended removal and installation procedures in this and associated Northern Lights manuals.



Use Proper Tools



Makeshift tools and procedures can create safety hazards. Always use appropriate tools for the job.



Use power tools only to loosen threaded parts and fasteners. For loosening and tightening hardware, always use the correct sized tools.

Do not use US measurement tools on metric fasteners, or vice versa. Use only service parts that meet Northern Lights specifications.

Dispose of Waste Properly



Disposing of waste improperly can threaten the environment and lead to unsafe working conditions. Potentially harmful waste used in Northern Lights equipment can include oil, fuel, coolant, filters and batteries.

Use leakproof containers to drain fluid. Do not use food or beverage containers that may mislead someone into drinking from them.

Do not pour waste onto the ground, down a drain or into any water source.

Lock Out / Tag Out Procedures

Scope

During maintenance, repairs or retooling of a Northern Lights generator set, simply turning the machine off or unplugging it while it is being worked on does not give enough protection to others who are not performing the maintenance or repair. Many serious accidents happen when someone thought the machine was turned off, or all of its energy was safely blocked or released.

General Policy

⚠ CAUTION

To avoid dangerous or hazardous situations, refrain from any of the following:

- Removing or bypassing a guard or other safety device
- Placing any part of your body in a position where you could be caught by moving machinery.
- Cleaning or oiling machinery when in operation.
- Adjusting circuits, chillers, pumps, air handlers, valves, circuit breakers or fans while in operation.
- Working on piping or high pressure systems.

Lock Out/Tag Out Instructions - Electrical Equipment

⚠ WARNING

Be sure the equipment's ON/OFF switch is in the OFF position and is unplugged from any electrical source before attempting to perform any type of work on the equipment. Obtain an electrical plug cap cover with a lockset. Secure the plug terminal end using the electrical plug lockout cap. Lock the cap and retain the key.

If the equipment is directly wired into an electrical box with a shut off switch, obtain a lock pad and/or the appropriate colored tags and place the lock and tag through the shut off lever. Retain the key until the repair is completed and the machine is safe to start. Be certain the shut off lever is in the OFF position before restarting. NEVER give a lock out key to unauthorized personnel.

If the equipment is directly wired into an electrical box without a shut off switch and lock out capability, then a circuit breaker lock out will be required. Obtain a circuit lock and tag set. Install the lock onto the circuit breaker box. Ensure the unit ON/OFF switch is in the OFF position before restarting.

Lock Out/Tag Out Instructions - Pneumatic and Hydraulic Equipment

⚠ WARNING

For servicing pneumatic and hydraulic equipment, the following additional procedures must be implemented, following completion of lock out/tag out procedures for the unit to be serviced:

Shut off air, water or supply valves at the equipment to be serviced.

Check the local bleed-off point for completed release of pressurized air, water or oil.

If shutting off of air, water or other material cannot be achieved at the local supply valve, shut off valves further back in the system and re-check the bleed-off point until complete shut-off is achieved.

Affix a DO NOT OPERATE tag to each valve handle that requires shut off. Each DO NOT OPERATE tag must be signed and dated by the authorized technician servicing the equipment.

Lock Out/Tag Out Instructions - Air Hose Connected Pneumatic Equipment

⚠ WARNING

Equipment connected to the compressed air system through an air hose with a detachable fitting must be shutdown and unplugged. Excess air must be bled prior to removing the air hose, prior to any maintenance or repair activities.

Affix a DO NOT OPERATE tag to the air hose near the detachable fitting. Each DO NOT OPERATE tag must be signed and dated by the authorized technician servicing the equipment. Check that the equipment cannot be operated by activating the ON switch.

Stored Energy

⚠ WARNING

Immediately after applying Lock Out or Tag Out devices, ensure that all potentially hazardous stored or residual energy is relieved, disconnected, restrained and otherwise rendered safe.

Verification of Isolation

⚠ CAUTION

Verify the machinery or equipment is actually isolated and de-energized prior to beginning work on a machine or on equipment that has been locked out.

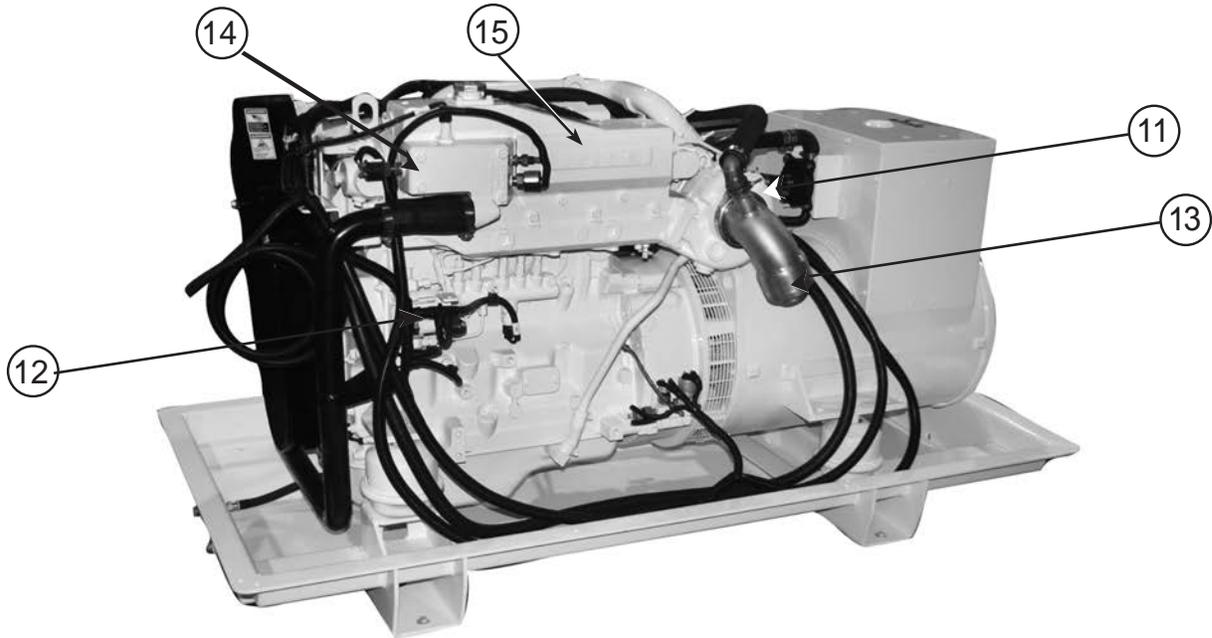
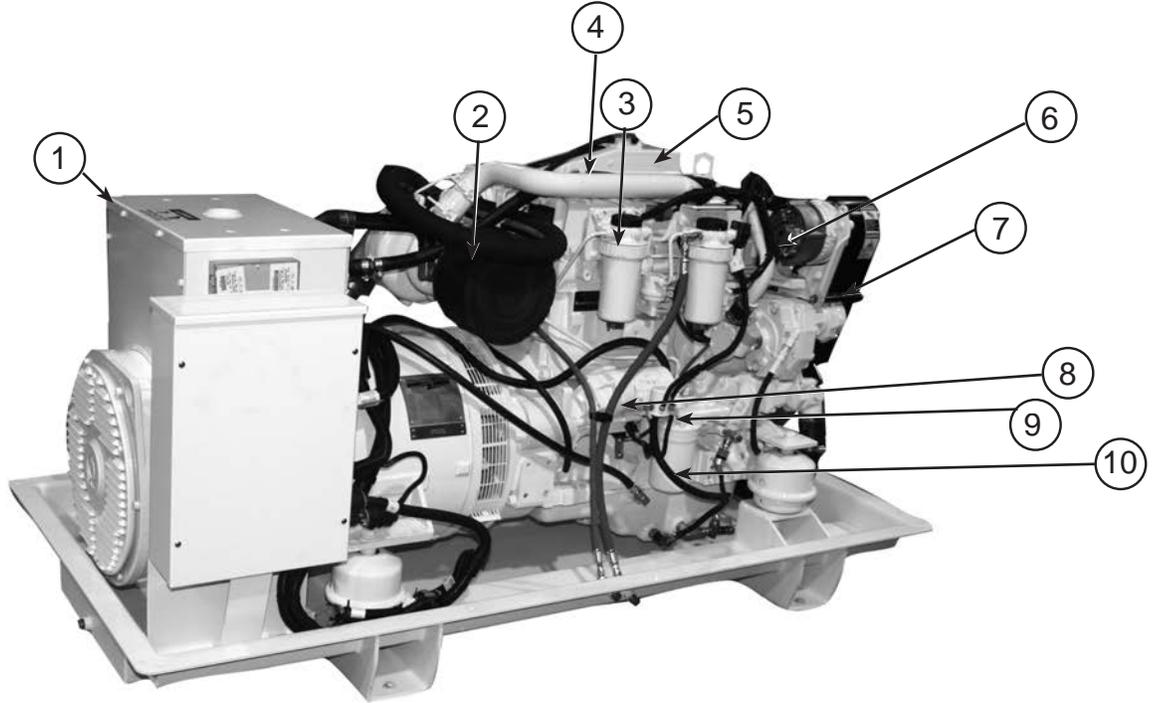
Restarting Procedures

⚠ CAUTION

Follow the procedures below prior to restoring energy:

- Ensure that all machinery or equipment is properly reassembled. Inspect the machinery or equipment to verify non-essential items have been removed.
- Ensure that all personnel are safely outside danger zones. Notify personnel that lock out/tag out devices have been removed and energy will be reapplied.
- Only authorized personnel may remove lock out/tag out devices or notices.

Component Locations



Figures 1 & 2: M65T13

- 1. Junction Box
- 2. Air Cleaner
- 3. Fuel Filter
- 4. Lube Oil Fill
- 5. Coolant Fill

- 6. Alternator
- 7. Belt Guard
- 8. Starter
- 9. Lube Oil Dipstick
- 10. Lube Oil Filter

- 11. Turbocharger
- 12. Fuel Injection Lines
- 13. Exhaust Elbow
- 14. Thermostat Cover
- 15. Expansion Tank

Component Locations

Figures 3 & 42: M50T13

Photo not available at time of publication. Please consult factory for more information.

Northern Lights Control Panels



Figure 7: Series 3B 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.
- 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°F (93.3°C) or drops below 140°F (60°C), 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.

Engine Operation

Normal Engine Operation

Observe engine coolant temperature and engine oil pressure. Temperatures and pressures will vary between engines and with changing operating conditions, temperatures, and loads. See GENERAL ENGINE SPECIFICATIONS in Specifications Section near end of manual for temperature and pressure specifications for your engine.

If coolant temperature rises above the maximum coolant temperature (see Specifications Section) reduce load on engine. Unless temperature drops quickly, stop engine and determine cause before resuming operation.

Operate the engine under a lighter load and at slower than normal speed for first 15 minutes after start-up. DO NOT run engine at slow idle unless necessary for maneuvering out of dock and harbor.

Stop engine immediately if there are any signs of part failure. Symptoms that may be early signs of engine problems are:

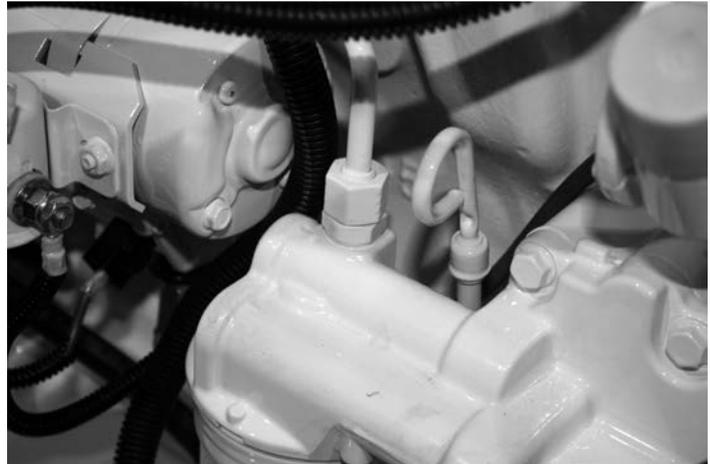
- Sudden drop in oil pressure
- Abnormal coolant temperatures
- High marine gear oil temperature
- Unusual noise or vibration
- Sudden loss of power
- Excessive black exhaust
- Excessive fuel consumption
- Excessive oil consumption
- Fluid leaks

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Break-In Service

The engine is ready for normal operation. However, extra care during the first 100 hours of operation will result in more satisfactory long-term engine performance and life. DO NOT exceed 100 hours of operation with break-in oil. See GENERAL ENGINE SPECIFICATIONS in Specifications Section near end of manual for oil pressure and coolant temperature specifications for your engine.

1. This engine is factory-filled with John Deere Engine Break-in Oil. Operate the engine at heavy loads with minimal idling during the break-in period.
2. If the engine has significant operating time at idle, constant speeds, and/or light load usage, or makeup oil is required in the first 100 hour period, a longer break-in period may be required. In these situations, an additional 100 hour break-in period is recommended using a new change of John Deere Engine Break-In Oil and a new John Deere oil filter.



Check Engine Oil

Continued on next page

IMPORTANT: DO NOT add makeup oil until the oil level is BELOW the ADD mark on dipstick. John Deere Engine Break-In Oil (TY22041) should be used to make up any oil consumed during the break-in period.

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3. Check engine oil level more frequently during engine break-in period. If oil must be added during this period, John Deere Engine Break-In Oil is preferred. See ENGINE BREAK-IN OIL, in Fuels, Lubricants, and Coolant Section.

Check Engine Oil

A—Crosshatch Pattern On Dipstick

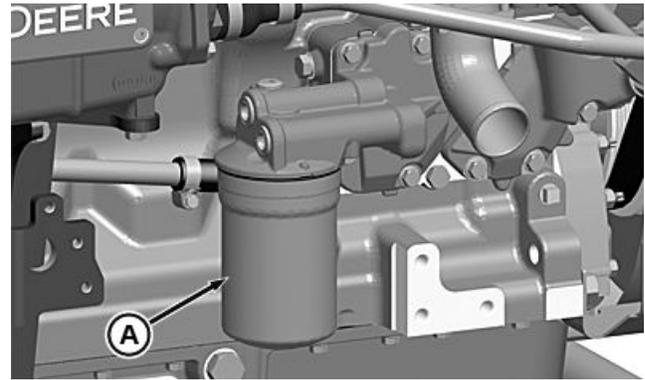
IMPORTANT: DO NOT use PLUS-50® Engine Oil during the break-in period of a new engine or engine that has had a major overhaul. PLUS-50 oil will not allow a new or overhauled engine to properly wear during this break-in period.

DO NOT fill above the crosshatch pattern (A) or the FULL mark, whichever is present. Oil levels anywhere within the crosshatch are considered in the acceptable operating range.

PLUS-50 is a trademark of Deere & Company

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4. During the first 20 hours, avoid prolonged periods of engine idling. If engine will idle longer than 5 minutes, stop engine.
5. After the first 100 hours (maximum), change engine oil and replace engine oil filter (A). (See CHANGE ENGINE OIL AND FILTER in Lubrication and Maintenance/250 Hour Section.) Fill crankcase with seasonal viscosity grade oil. (See DIESEL ENGINE OIL, in Fuels, Lubricants, and Coolant Section.)



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NOTE: Some increase in oil consumption may be expected when low viscosity oils are used. Check oil levels more frequently.

Remove Oil Filter

If air temperature is below -10°C (14°F), use an engine block heater.

A—Oil Filter

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6. Watch coolant temperature gauge (A) closely. If coolant temperature rises above maximum coolant temperature (see GENERAL ENGINE SPECIFICATIONS in Specifications Section), reduce load on engine. Check sea (raw) water strainer for plugging on heat exchanger engines. Unless temperature drops quickly, stop the engine and determine the cause before resuming operation.



A—Coolant Temperature Gauge

Coolant Temperature Gauge - Electronically Controlled Engine

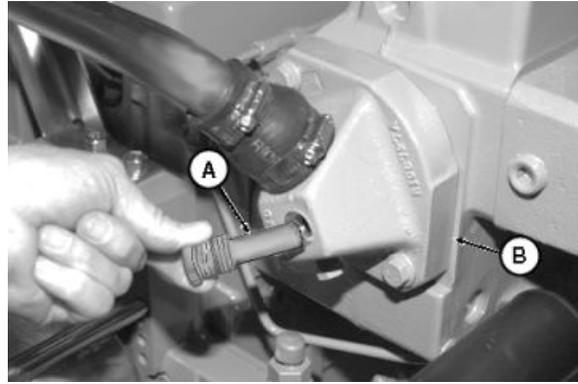
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7. Check poly-vee belt for proper alignment and seating in pulley grooves.

Two zinc plugs (A) are installed in the sea water cooling system to help neutralize the corrosive action of salt water on internal cavities of marine engine components. The reaction of the zinc, when exposed to the salt water, causes the plugs to deteriorate instead of critical engine components.

8. After the first 50—100 hours or 2—4 weeks of operation, remove zinc plug from each heat exchanger end cap (B) and inspect for corrosion to get an idea of rate of deterioration in sea water.

If rate of corrosion is slight at 50—100 hours or 2—4 weeks initial inspection, zinc plugs should be inspected at 250 hour intervals thereafter. (See INSPECT AND REPLACE ZINC PLUGS in Lubrication & Maintenance/250 Hour Section)



A—Zinc Plugs

B—End Cap

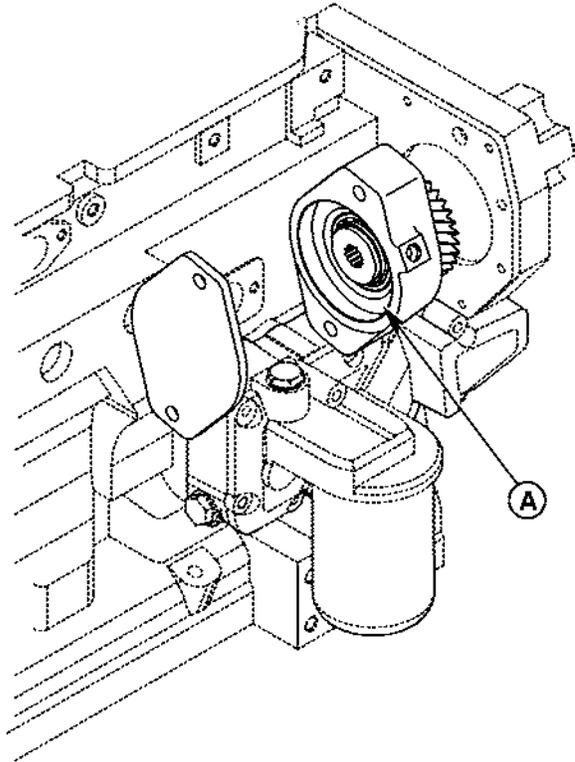
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Auxiliary Gear Drive Limitations

IMPORTANT: When attaching a sea water pump or other accessory to be driven by the auxiliary gear drive (A) (engine timing gear train at front of engine), power requirements of the accessory must be limited to values listed below:

- 30 kW (40 hp) Continuous Operation
- 37 kW (50 hp) Intermittent Operation

A—Auxiliary Gear Drive



Auxiliary Gear Drive

RG7634A—UN—22JAN99

RG, RG34710, 5555 -19-03JAN02-1/1

Generator Set Power Units

To assure that your engine will deliver efficient generator operation when needed, start engine and run at rated

speed (with 50%—70% load) for 30 minutes every 2 weeks. DO NOT allow engine to run extended period of time with no load.

RG, RG34710, 5556 -19-20MAY96-1/1

Emission-Related Installation & Instructions

Failing to follow these instructions when installing a certified engine in a vessel violates federal law (40 CFR 1068.105(b)), subject to fines or other penalties as described in the Clean Air Act.

If you install the engine in a way that makes the engine's emission control information label hard to read during normal engine maintenance, you must place a duplicate label on the vessel, as described in 40 CFR 1068.105.

Operating Procedures

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 #14).



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 before re-engaging.

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). Oil temperature should be 115°C (240°F) for normal operating temperature. The D.C. voltmeter should read between 13 and 14 volts (26-28 volts, 24 volt systems).
2. Check belt for good alignment.
3. Let the unit run unloaded for a three to five minute warm-up period before applying load.
4. Do not add full electrical load until engine is at operating temperature.

Shutdown

1. Turn the Engine Control Switch to the OFF position.
2. 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.

Operating Procedures

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:
 - a. Check the temperature gauge. If the temperature is above 215°F (102°C), shut off the engine immediately.
 - b. Use the Trouble Shooting Guide on pages 26- 28 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 210°F (99°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 was normal, DO NOT restart the engine. Call your Northern Lights or Luggier dealer for assistance.

BREAK-IN PERIOD

1. Your engine is ready to be put into service. However, the first 100 hours on a new or reconditioned engine are critical to its life and performance. This is especially true of an engine that runs at a constant speed such as a generator engine.
2. Operate the engine under various conditions, particularly heavy loads with minimal idling, to help seat engine components properly.
3. Oil consumption is greater during break-in as piston rings take time to seat.
4. Your engine comes equipped with break-in oil. Change engine oil and filter at 50 hours using API Service Category CC, CD, or CE break-in oil. Change the oil and filter again at 100 hours. (Consult the lubricants section for oil recommendation.)
5. Frequently check the engine temperature and oil pressure gauges.

Note:

Shutdown temperatures have been raised by 10°F for all Deere Engines.

Cold Weather Operation

Additional information on cold weather operation is available from your engine distributor or authorized servicing dealer.

Some engines are equipped with an air intake heater which will make starting the engine easier in cold weather. If equipped, follow steps 1–4 as listed under STARTING THE ENGINE, earlier in this section. Switch on the air intake heater for 30 seconds and then proceed to operate the starter. Follow remaining steps 5–11.

Synthetic oils improve flow at low temperatures, especially in arctic conditions.

⚠ CAUTION: Starting fluid is highly flammable. DO NOT use starting fluid on engines equipped with air intake heaters.

DO NOT use starting fluid near fire, sparks, or flames. DO NOT incinerate or puncture a starting fluid container.



Starting Fluid is Flammable

TS1356 —UN—18MAR92

OUOD006,0000080 -19-22JUN07-1/1

Using a Booster Battery or Charger

A 12-volt booster battery can be connected in parallel with battery(ies) on the unit to aid in cold weather starting. ALWAYS use heavy duty jumper cables.

CAUTION: Gas given off by battery is explosive. Keep sparks and flames away from battery. Before connecting or disconnecting a battery charger, turn charger off. Make last connection and first disconnection at a point away from battery. Always connect **NEGATIVE (-)** cable last and disconnect this cable first.

IMPORTANT: Be sure polarity is correct before making connections. Reversed polarity will damage electrical system. Always connect positive to positive and negative to ground. Always use 12-volt booster battery for 12-volt electrical systems and 24-volt booster battery(ies) for 24-volt electrical systems.

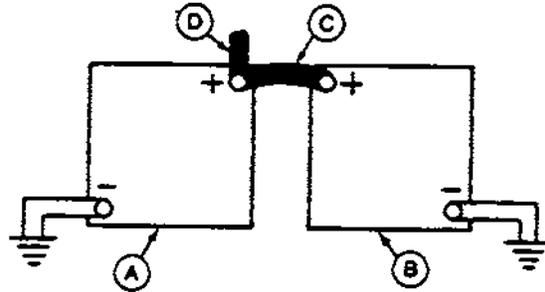
1. Connect booster battery or batteries to produce the required system voltage for your engine application.

NOTE: To avoid sparks, **DO NOT** allow the free ends of jumper cables to touch the engine.

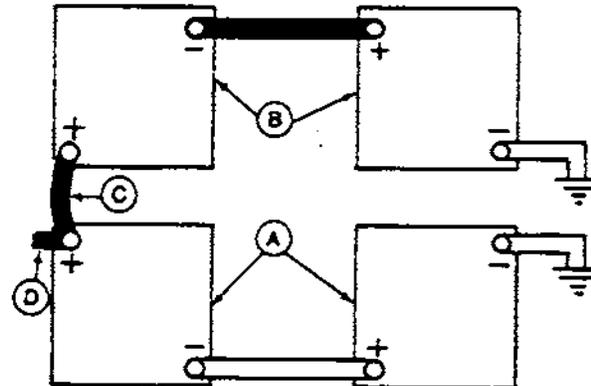
2. Connect one end of jumper cable to the **POSITIVE (+)** post of the booster battery.
3. Connect the other end of the jumper cable to the **POSITIVE (+)** post of battery connected to starter.
4. Connect one end of the other jumper cable to the **NEGATIVE (-)** post of the booster battery.
5. ALWAYS complete the hookup by making the last connection of the **NEGATIVE (-)** cable to a good ground on the engine frame and away from the battery(ies).
6. Start the engine. Disconnect jumper cables immediately after engine starts. Disconnect **NEGATIVE (-)** cable first.



Exploding Battery



12-Volt System



24-Volt System

A—12-Volt Machine Battery (ies)
 B—12-Volt Booster Battery (ies)
 C—Booster Cable
 D—Cable to Starting Motor

TS204—UN—23AUG88

RG4678—UN—14DEC88

RG4698—UN—14DEC88

RG, RG34710, 5564 -19-03JAN02-1/1

Welding Near Electronic Control Units

IMPORTANT: Do not jump-start engines with arc welding equipment. Currents and voltages are too high and may cause permanent damage.

1. Disconnect the negative (-) battery cable(s).
2. Disconnect the positive (+) battery cable(s).
3. Connect the positive and negative cables together. Do not attach to vehicle frame.
4. Clear or move any wiring harness sections away from welding area.
5. Connect welder ground close to welding point and away from control units.



TS953—UN—15MAY90

6. After welding, reverse Steps 1—5.

DX,WW,ECU02 -19-14AUG09-1/1

Keep Electronic Control Unit Connectors Clean

IMPORTANT: Do not open control unit and do not clean with a high-pressure spray. Moisture, dirt, and other contaminants may cause permanent damage.

1. Keep terminals clean and free of foreign debris. Moisture, dirt, and other contaminants may cause the terminals to erode over time and not make a good electrical connection.
2. If a connector is not in use, put on the proper dust cap or an appropriate seal to protect it from foreign debris and moisture.
3. Control units are not repairable.
4. Since control units are the components LEAST likely to fail, isolate failure before replacing by completing a diagnostic procedure. (See your John Deere dealer.)
5. The wiring harness terminals and connectors for electronic control units are repairable.

DX,WW,ECU04 -19-11JUN09-1/1

Lubrication and Maintenance

Use Correct Fuels, Lubricants, and Coolant

IMPORTANT: Use only fuels, lubricants, and coolants meeting specifications outlined in Fuels, Lubricants, and Coolant Section when servicing your John Deere Engine.

Consult your John Deere engine distributor, servicing dealer or your nearest John Deere Parts Network for recommended fuels, lubricants, and coolant. Also available are necessary additives for use when operating engines in tropical arctic, or any other adverse conditions.



Parts Network

TS100—UN—23AUG88

DPSG,OUOE003,20 -19-19JUN07-1/1

Lubrication and Maintenance Service Interval Chart—Propulsion and Prime Power Units

Item	Lubrication and Maintenance Service Intervals				
	Daily/Before Every Startup	250 Hour/6 Month	500 Hour/12 Month	2000 Hour/24 Month	Service As Required
Check Engine Oil Level and Coolant Level	•				
Check Sea Water Strainer	•				
Check Air Cleaner Dust Unloader Valve & Restriction Indicator Gauge ^a	•				
Visual Walkaround Inspection	•				
Drain Water From Fuel Filter	•				•
Change Engine Oil And Replace Oil Filter ^b		•			
Service Fire Extinguisher		•			
Service Battery		•			
Inspect and Replace Zinc Plugs		•			
Check Belt Tension and Wear (Manual Tensioner)		•			
Check Engine Mounts		•			
Replace Crankcase Vent Filter (If Equipped)			•		
Clean Crankcase Ventilation Assembly			•		
Check Air Intake Hoses, Connections, & System			•		
Replace Fuel Filter Elements			•		
Check Automatic Belt Tensioner and Belt Wear			•		
Check Cooling System			•		
Coolant Solution Analysis-Add SCAs as required			•		
Inspect and Clean Heat Exchanger Core and Aftercooler Core (If Equipped)			•		
Check Engine Speeds			•		
Check Engine Electrical Ground			•		
Check Crankshaft Vibration Damper (6-Cylinder)				•	
Pressure Test Cooling System				•	
Inspect and Repair Sea Water Pump				•	
Check and Adjust Engine Valve Clearance				•	
Flush And Refill Cooling System ^c				•	
Test Thermostats				•	
Add Coolant					•
Replace Air Cleaner Element					•
Service Dry Air Cleaner Element					•
Replace Alternator Drive Belt					•
Check Front PTO (If Equipped)					•
Bleed Fuel System					•

^a Replace primary air cleaner element when restriction indicator shows a vacuum of 625 mm (52 in.) H₂O, or when reset button has popped up (6068SFM75 / AFM75 only).

^b Change the oil for the first time before 100 hours maximum of (break-in) operation, then every 250 hours thereafter. If John Deere PLUS-50 or ACEA-E7, ACEA-E6, ACEA-E5 or ACEA-E4 oil is used along with the specified John Deere oil filter, the oil change interval may be extended by 50 percent to 375 hours.

^c If John Deere COOL-GARD is used, the flushing interval may be extended to 3000 hours or 36 months. If John Deere COOL-GARD is used and the coolant is tested annually AND additives are replenished as needed by adding a supplemental coolant additive, the flushing interval may be extended to 5000 hours or 60 months, whichever occurs first.

Lubrication and Maintenance Service Interval Chart—Standby Generator Sets

Item	Lubrication and Maintenance Service Intervals				
	Daily/Before Every Startup	250 Hour/6 Month	500 Hour/12 Month	2000 Hour/24 Month	Service As Required
Operate Engine at Rated Speed and 50%—70% Load for a Minimum of 30 Minutes. Perform every 2 weeks.					
Check Engine Oil Level and Coolant Level	•				
Check Sea Water Strainer	•				
Check Air Cleaner Dust Unloader Valve & Restriction Indicator Gauge ^a	•				
Visual Walkaround Inspection	•				
Drain Water From Fuel Filter	•				•
Change Engine Oil And Replace Oil Filter ^b		•			
Service Fire Extinguisher		•			
Service Battery		•			
Inspect and Replace Zinc Plugs		•			
Check Belt Tension and Wear (Manual Tensioner)		•			
Check Engine Mounts		•			
Replace Crankcase Vent Filter (If Equipped)			•		
Clean Crankcase Ventilation Assembly			•		
Check Air Intake Hoses, Connections, & System			•		
Replace Fuel Filter Elements			•		
Check Automatic Belt Tensioner and Belt Wear			•		
Check Cooling System			•		
Coolant Solution Analysis-Add SCAs as required			•		
Inspect and Clean Heat Exchanger Core and Aftercooler Core (If Equipped)			•		
Check Engine Speeds			•		
Check Engine Electrical Ground			•		
Check Crankshaft Vibration Damper (6-Cylinder)				•	
Pressure Test Cooling System				•	
Inspect and Repair Sea Water Pump				•	
Check and Adjust Engine Valve Clearance				•	
Flush And Refill Cooling System ^c				•	
Test Thermostats				•	
Add Coolant					•
Replace Air Cleaner Element					•
Service Dry Air Cleaner Element					•
Replace Alternator Drive Belt					•
Check Front PTO (If Equipped)					•
Bleed Fuel System					•

^a Replace primary air cleaner element when restriction indicator shows a vacuum of 625 mm (52 in.)H₂O.

^b During engine break-in, change the oil and filter for the first time before 100 hours of operation. Extended oil change interval of 375 hours can be used if John Deere PLUS-50 or ACEA-E7, ACEA-E6, ACEA-E5 or ACEA-E4 oil is used along with the specified John Deere oil filter.

^c If John Deere COOL-GARD is used, the flushing interval may be extended to 3000 hours or 36 months. If John Deere COOL-GARD is used and the coolant is tested annually AND additives are replenished as needed by adding a supplemental coolant additive, the flushing interval may be extended to 5000 hours or 60 months, whichever occurs first.

Lubrication & Maintenance/Daily

Daily Prestarting Checks

Do the following BEFORE STARTING THE ENGINE for the first time each day:

IMPORTANT: DO NOT add makeup oil until the oil level is **BELOW** the add mark.

Depending on application, oil dipstick (A) and oil filler cap (B) may be located on either the left or the right side of engine. In addition, oil may be added at rocker arm filler cap (C).

1. Check engine oil level on dipstick (A). Add as required, using seasonal viscosity grade oil. (See DIESEL ENGINE OIL in Fuels, Lubricants, and Coolant Section for oil specifications.)

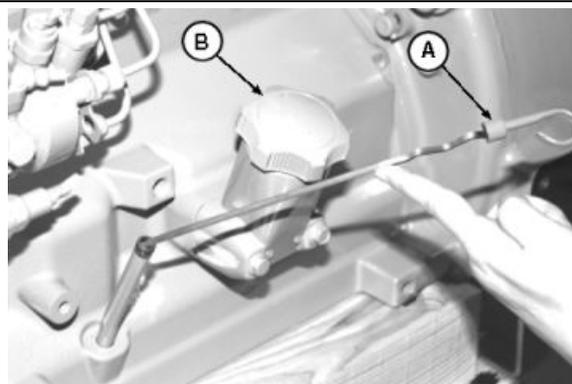
IMPORTANT: DO NOT fill above the top mark on the dipstick. Oil levels anywhere within crosshatch (D) are considered in the acceptable operating range.

A—Dipstick

B—Left Side Oil Filler Cap

C—Rocker Arm Filler Cap

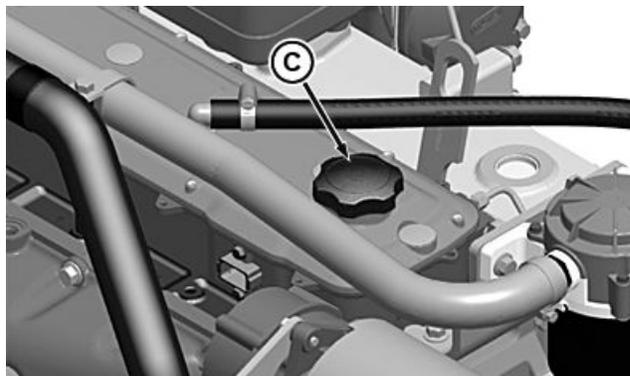
D—Crosshatch On Oil Dipstick



Left Side Dipstick - 4 Cylinder Only



Left Side Oil Filler and Dipstick Location



Rocker Arm Cover Filler Cap

Oil Fill Level on Dipstick

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RG9837 —UN—12JAN09

RG22038 —UN—28NOV12

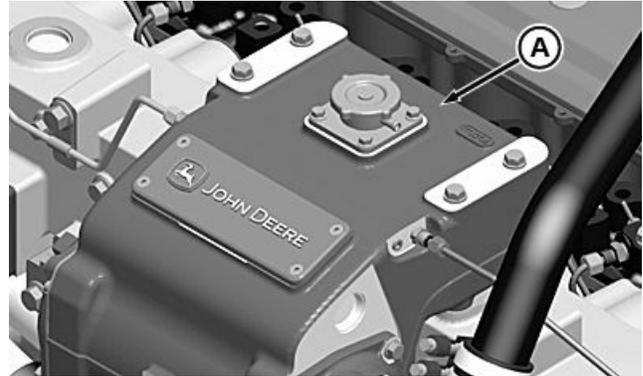
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RG22039 —UN—08JAN13



High-Pressure Fluids

A—Engine Side Tank



Engine Top Tank

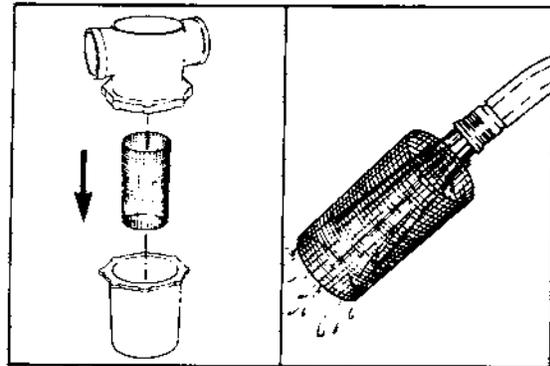
RG19661,00003D3 -19-29JAN13-2/4

TS281—UN—23AUG88

RG22040—UN—28NOV12

IMPORTANT: A restricted or clogged sea water strainer will result in hotter than normal (or overheated) engine coolant and marine gear oil temperatures.

3. The sea water strainer should be checked daily and cleaned as required, depending upon the operating environment.



Sea Water Strainer

Continued on next page

RG19661,00003D3 -19-29JAN13-3/4

RG5993—UN—27JAN92

5. Make a thorough inspection of the engine compartment. Look for oil or coolant leaks, worn drive belts, loose connections and trash build-up. Remove trash buildup and have repairs made as needed if leaks are found.

NOTE: Wipe all fittings, caps, and plugs before performing any maintenance to reduce the chance of system contamination.

Inspect:

- Engine shields and guards for trash build-up.
- Air intake system hoses and connections for cracks and loose clamps.
- Alternator drive belt for cracks, breaks or other damage.
- Water pump for coolant leaks.
- Coolant system for leaks.

NOTE: It is normal for a small amount of leakage to occur as the engine cools down and parts contract.

Excessive coolant leakage may indicate the need to replace the water pump seal. Contact your engine distributor or servicing dealer for repairs.

6. Turn key switch to "ON" position and check instruments for proper operation. Turn key switch "OFF".
7. Refer to manufacturer's literature for marine gear and generator set daily service recommendations.

Lubrication & Maintenance/250 Hour/6 Month

Changing Engine Oil and Replacing Oil Filter

NOTE: Change engine oil and filter for the first time before 100 hours maximum of operation, then every 250 hours thereafter.

If John Deere PLUS-50™ or ACEA-E7/E6/E5/E4 engine oil and a John Deere oil filter are used, the oil and filter change interval may be extended by 50 percent or to 375 hours.

IMPORTANT: If using BIODIESEL blends greater than B20, shorten oil change interval to half the recommended service interval or monitor engine oil using OILSCAN to ensure that fuel dilution does not exceed 5%.

NOTE: On Gen Set engines used as standby units, oil and filter change can be extended to 350 hours. No extended interval for oil/filter change is allowed beyond 350 hours.

OILSCAN™ or OILSCAN PLUS™ is a John Deere sampling program to help you monitor machine performance and identify potential problems before they cause serious damage. OILSCAN™ or OILSCAN PLUS™ kits are available from your John Deere dealer. Oil samples should be taken prior to the oil change. Refer to instructions provided with kit.

To change engine oil and oil filter:

1. Run engine approximately 5 minutes to warm up oil. Shut engine off.

*PLUS-50 is a trademark of Deere & Company.
OILSCAN is a trademark of Deere & Company.
OILSCAN PLUS is a trademark of Deere & Company.*

2. Change oil at any seasonal change in temperature when a new viscosity of oil is required.
 - 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.

NOTE: Drain plug location may vary, depending on the application.

Continued on next page

RG19661,00003D4 -19-28FEB13-1/3

- Turn filter element (A) using a suitable filter wrench to remove. Discard oil filter element.

NOTE: Depending on engine application, oil filter may be located on either side of the engine in a high- or low-mount location.

IMPORTANT: Filtration of oils is critical to proper lubrication. Always change filter regularly. Use filter meeting John Deere performance specifications.

- Apply clean engine oil to the new filter at the inner (B) and outer (C) seals and to filter threads.
- Wipe both sealing surfaces of the header (D, E) with a clean rag. Ensure that the notches in dust seal (F) are properly installed in the slots of the housing. Replace if damaged.

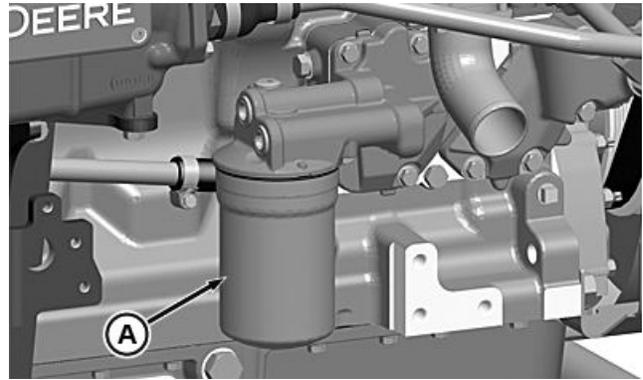
IMPORTANT: When installing filter element, HAND TIGHTEN only. A filter wrench may be used for REMOVAL ONLY.

- Install and tighten oil filter by hand until firmly against dust seal (F). DO NOT apply an extra 3/4 to 1-1/4 turn after gasket contact as done with standard filters.
- Tighten drain plug to specifications.

Specification

Oil Pan Drain Plug With Copper Washer—Torque.....	70 N·m (52 lb-ft)
Oil Pan Drain Plug With O-Ring—Torque.....	50 N·m (37 lb-ft)

- | | |
|-----------------------------|------------------------------------|
| A—Oil Filter Element | D—Sealing Surface On Header |
| B—Inner Seal | E—Sealing Surface On Header |
| C—Outer Seal | F—Dust Seal |



Oil Filter



Oil Filter Seals

Oil Filter Mounting Header

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RG11617 —UN—24OCT01

RG22046 —UN—29NOV12

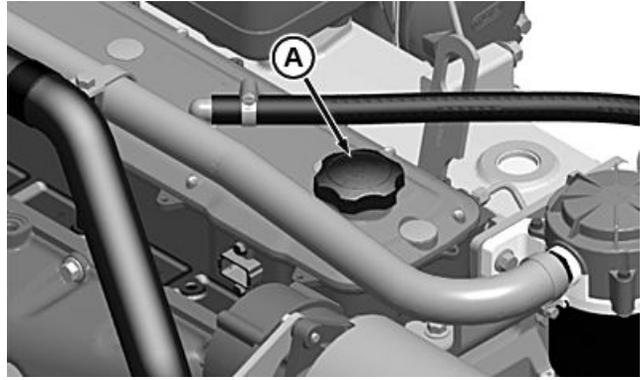
9. Fill engine crankcase with correct John Deere engine oil through rocker arm cover opening (A). (See DIESEL ENGINE OIL in Fuels, Lubricants, and Coolant Section for determining correct engine oil.)

To determine the correct oil fill quantity for your engine, see ENGINE CRANKCASE OIL FILL QUANTITIES in the Specifications Section of this manual.

IMPORTANT: Immediately after completing any oil change, crank engine for 30 seconds without permitting engine to start. This will help insure adequate lubrication to engine components before engine starts.

NOTE: Crankcase oil capacity may vary slightly. ALWAYS fill crankcase within crosshatch marks on dipstick. DO NOT overfill.

10. Start engine and run to check for possible leaks.
11. Stop engine and check oil level after 10 minutes. Oil level reading should be within crosshatch on dipstick.



A—Rocker Arm Cover Oil Filler Opening

RG19661,00003D4 -19-28FEB13-3/3

Servicing Battery

⚠ CAUTION: Battery gas can explode. Keep sparks and flames away from batteries. Use a flashlight to check battery electrolyte level.

Never check battery charge by placing a metal object across the posts. Use a voltmeter or hydrometer.

Always remove grounded **NEGATIVE (-)** battery clamp first and replace it last.

WARNING: Battery posts, terminals, and related accessories contain lead and lead compounds, chemicals known to the State of California to cause cancer and reproductive harm. **Wash hands after handling.**

1. On regular batteries, check electrolyte level. Fill each cell to bottom of filler neck with distilled water.

NOTE: Low-maintenance or maintenance-free batteries should require little additional service. However, electrolyte level can be checked by cutting the center section of decal on dash-line, and removing cell plugs. If necessary, add clean, soft water to bring level to bottom of filler neck.

2. Keep batteries clean by wiping them with a damp cloth. Keep all connections clean and tight. Remove



Exploding Battery

any corrosion, and wash terminals with a solution of 1 part baking soda and 4 parts water. Tighten all connections securely.

NOTE: Coat battery terminals and connectors with a mixture of petroleum jelly and baking soda to retard corrosion.

3. Keep battery fully charged, especially during cold weather. If a battery charger is used, turn charger off before connecting charger to battery(ies). Attach **POSITIVE (+)** battery charger lead to **POSITIVE (+)** battery post. Then attach **NEGATIVE (-)** battery charger lead to a good ground.

Continued on next page

RG, RG34710, 5568 -19-20MAY96-1/2

TS204—UN—23AUG88

CAUTION: Sulfuric acid in battery electrolyte is poisonous. It is strong enough to burn skin, eat holes in clothing, and cause blindness if splashed into eyes.

Avoid the hazard by:

1. Filling batteries in a well-ventilated area.
2. Wearing eye protection and rubber gloves.
3. Avoiding breathing fumes when electrolyte is added.
4. Avoiding spilling or dripping electrolyte.
5. Use proper jump start procedure.

If you spill acid on yourself:

1. Flush your skin with water.
2. Apply baking soda or lime to help neutralize the acid.
3. Flush your eyes with water for 10–15 minutes. Get medical attention immediately.

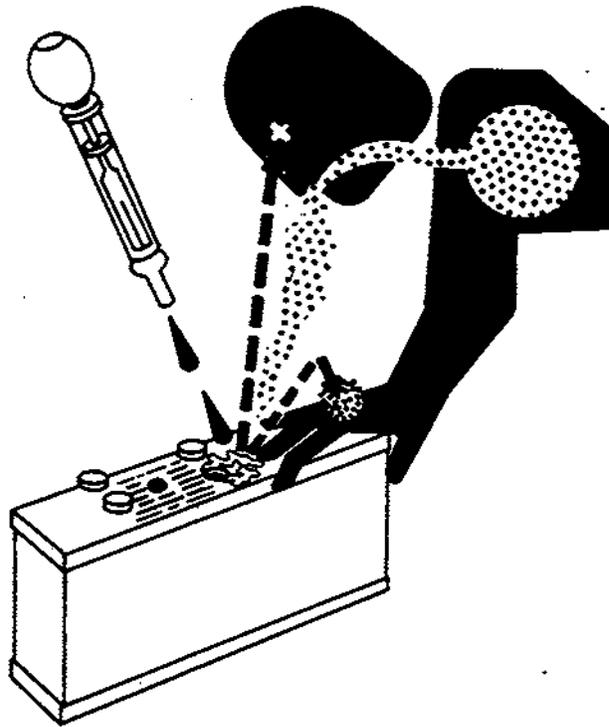
If acid is swallowed:

1. Drink large amounts of water or milk.
2. Then drink milk of magnesia, beaten eggs, or vegetable oil.
3. Get medical attention immediately.

In freezing weather, run engine at least 30 minutes to assure thorough mixing after adding water to battery.

If necessary to replace battery(ies), replacements must meet or exceed the following recommended capacities at -18°C (0°F):

Specification	
12 Volt Standard Duty Starter—Cold Cranking	
Amps.....	640
12 Volt Heavy Duty Starter—Cold Cranking	
Amps.....	800



Sulfuric Acid

24 Volt Standard Duty Starter—Cold Cranking	
Amps.....	570

TS203 —UN—23AUG88

Inspect and Replacing Zinc Plugs

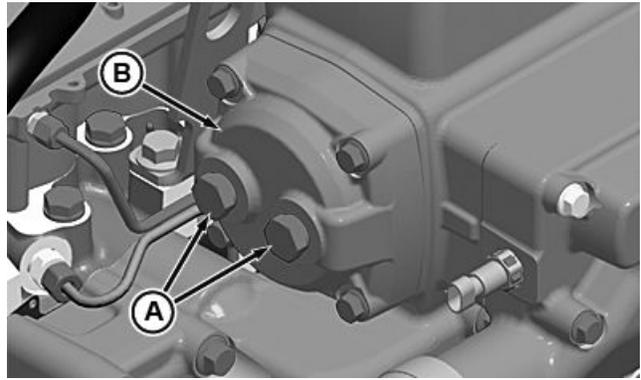
Two zinc plugs (A) are installed in the sea water cooling system to help reduce the corrosive action of salt in the sea water. The reaction of the zinc to sea water causes the plugs to deteriorate, instead of the more critical cooling system parts. Therefore, the zinc plugs **MUST BE** inspected every 250 Hours.

NOTE: Zinc plugs are located in each heat exchanger end cap and are mounted on hex-head pipe plug.

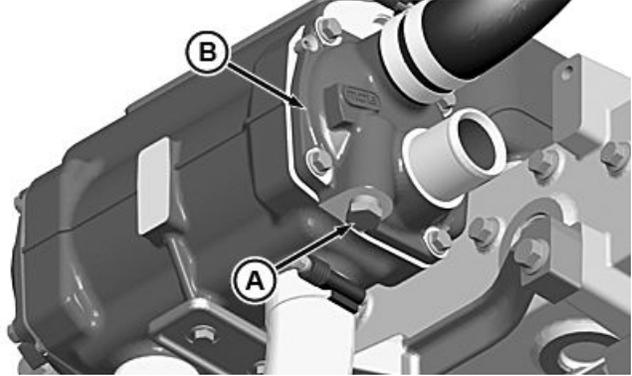
1. Remove zinc rod from each end cap (B) and observe condition of each.
2. Tap the zinc rods lightly with a hammer. If rod flakes apart when tapped, install a new zinc plug.

A—Zinc Plugs

B—End Cap



Inspect Zinc Plugs - 4 Cylinder



Inspect Zinc Plugs - 6 Cylinder

RG22137—UN—06DEC12

RG22048—UN—29NOV12

RG19661,00003D5 -19-29JAN13-1/2

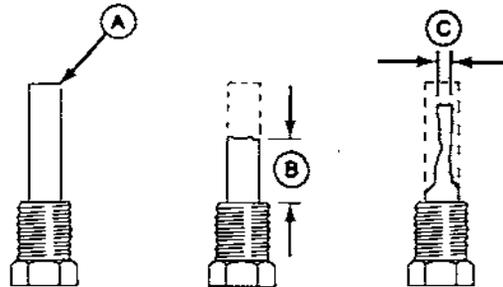
3. Measure zinc plugs (A) to determine the amount of erosion on length (B) and outer diameter (C).

If length is less than 15.9 mm (0.63 in.) or outer diameter is less than 4.8 mm (0.19 in.) on either plug, replace all zinc plugs.

NOTE: Zinc plug new part dimensions are 31.8 mm (1.25 in.) long and 9.5 mm (0.38 in.) outer diameter.

A—Measure Zinc Plugs
B—Measure Length

C—Measure Diameter



Zinc Plug Erosion

RG6007—UN—27JAN92

RG19661,00003D5 -19-29JAN13-2/2

Checking Belt Wear

1. Remove belt guard (A).
2. Swing tensioner arm (C) to remove all belt slack.
3. Remove and inspect belt for cracks, fraying, or stretched-out areas. Replace if necessary.

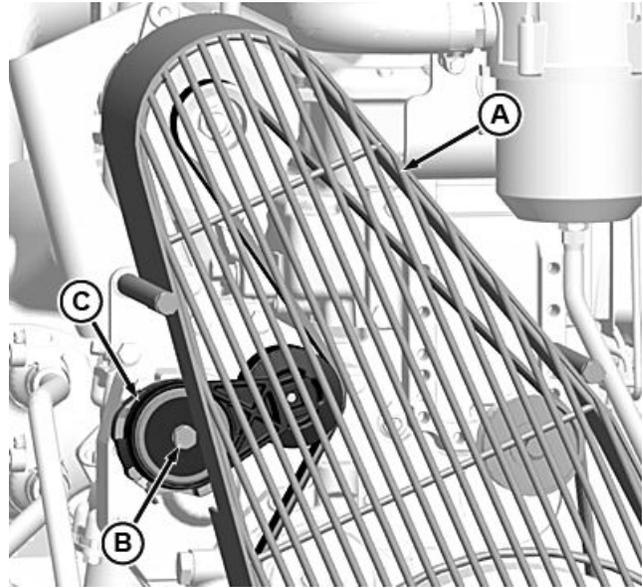
NOTE: While belt is removed, inspect pulleys and bearings. Rotate and feel for hard turning or any unusual sounds. If pulleys or bearings need replacement, see your John Deere dealer.

4. If tensioner has been removed, tighten tensioner mounting cap screw (B) to 70 N·m (52 lb-ft).
5. Install belt guard.

A—Belt Guard

B—Mounting Cap Screw

C—Tensioner Arm



Check Belt Wear

RG2049—JUN—29NOV12

RG19661.00003D6 -19-09MAR13-1/1

Replace Fuel Filter

⚠ CAUTION: Escaping fluid under pressure can penetrate the skin causing serious injury. Relieve pressure before disconnecting fuel or other lines. Tighten all connections before applying pressure. Keep hands and body away from pinholes and nozzles which eject fluids under high pressure. Use a piece of cardboard or paper to search for leaks. Do not use your hand.

If any fluid is injected into the skin, it must be surgically removed within a few hours by a doctor familiar with this type injury or gangrene may result. Doctors unfamiliar with this type of injury may call the Deere & Company Medical Department in Moline, Illinois, or other knowledgeable medical source.

1. Close fuel shut-off valve at bottom of fuel tank (not illustrated).
2. Clean entire area surrounding fuel filter assembly to keep debris from entering fuel system.
3. Loosen drain plug and air vent screw. Drain fuel into a suitable container.
4. Firmly grasp the filter or filter housing and rotate it clockwise 1/4 turn (when viewed from the top to remove from base).
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.

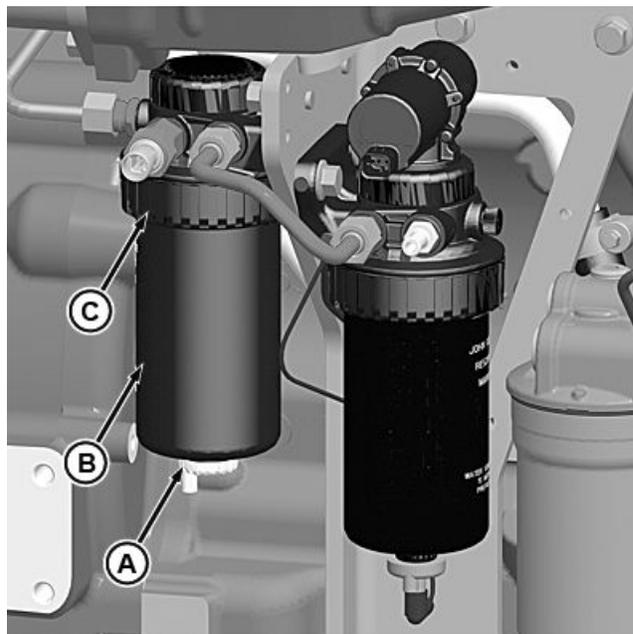
6. Install new filter element onto mounting base. Be sure element is properly indexed and firmly seated on base. It may be necessary to rotate filter for correct alignment.

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

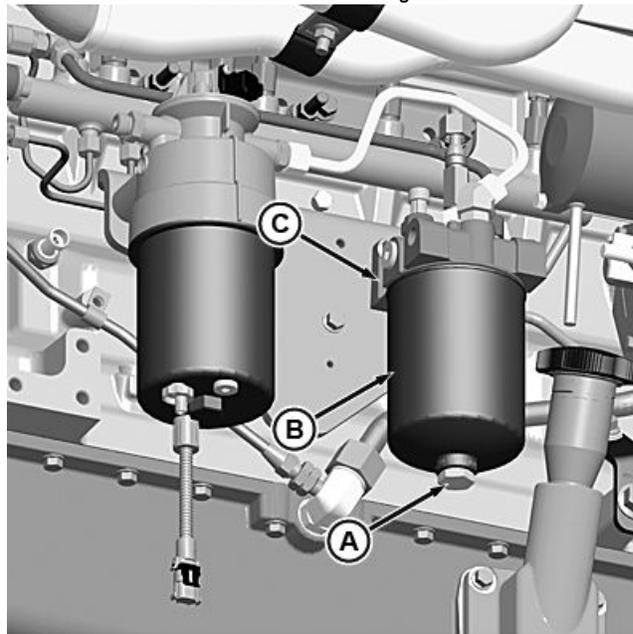
7. Align keys on filter element with slots in filter base.
8. Install retaining ring onto mounting base making certain dust seal is in place on filter base. Hand tighten ring (about 1/3 turn) until it "snaps" into the detent. DO NOT overtighten retaining ring.

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.



Fuel Filter - 4045 Engines



Fuel Filter - 6068 Engines

A—Drain
B—Filter/Filter Housing

C—Filter Base

9. Open fuel shut-off valve. 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. (See BLEEDING THE FUEL SYSTEM in Service as Required Section.)

RG19661,00003E4 -19-13FEB13-1/1

RG22096—UN—05DEC12

RG22079—UN—15FEB13

Replacing Fuel Filter/Water Separator

⚠ CAUTION: Escaping fluid under pressure can penetrate the skin causing serious injury. Relieve pressure before disconnecting fuel or other lines. Tighten all connections before applying pressure. Keep hands and body away from pinholes and nozzles which eject fluids under high pressure. Use a piece of cardboard or paper to search for leaks. Do not use your hand.

If any fluid is injected into the skin, it must be surgically removed within a few hours by a doctor familiar with this type injury or gangrene may result. Doctors unfamiliar with this type of injury may call the Deere & Company Medical Department in Moline, Illinois, or other knowledgeable medical source.

1. Close fuel shut-off valve at bottom of fuel tank (not illustrated).
2. Clean entire area surrounding fuel filter assembly to keep debris from entering fuel system.
3. Disconnect water in fuel sensor.
4. Drain fuel into a suitable container.
5. Firmly grasp the filter or filter housing and rotate it counterclockwise 1/4 turn. Remove ring with filter element (E).
6. Inspect filter mounting base for cleanliness. Clean as required.

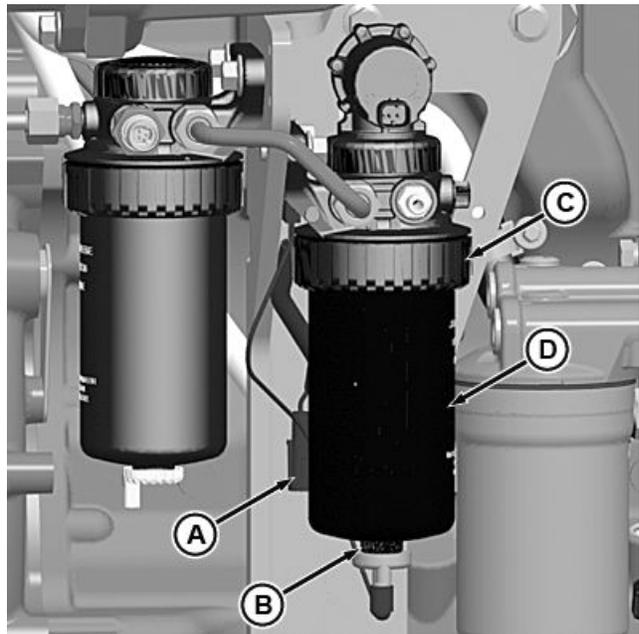
NOTE: Raised locators on fuel filter canisters must be indexed properly with slots in mounting base for correct installation.

7. Install new filter element onto mounting base. Be sure element is properly indexed and firmly seated on base. It may be necessary to rotate filter for correct alignment.
8. Align keys on filter element with slots in filter base.
9. Install retaining ring onto mounting base making certain dust seal is in place on filter base. Hand tighten ring (about 1/3 turn) until it "snaps" into the detent. DO NOT overtighten retaining ring.

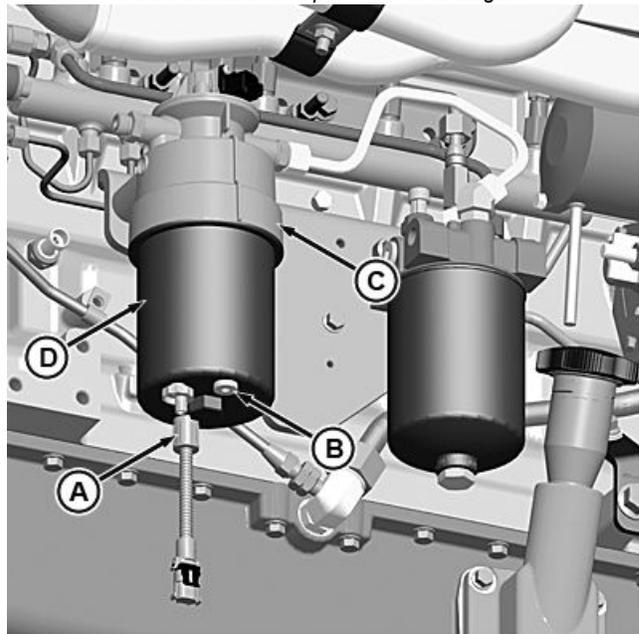
NOTE: The proper installation is indicated when a "click" is heard and a release of the retaining ring is felt.

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

10. Connect water in fuel sensor.
11. Open fuel shut-off valve. Whenever the fuel system has been opened up for service (lines disconnected or



Fuel Filter/Water Separator - 4045 Engine



Fuel Filter/Water Separator

A—Electrical Connector
B—Drain

C—Filter Base
D—Filter/Water Separator

filters removed), it will be necessary to bleed air from the system. (See BLEEDING THE FUEL SYSTEM in Service as Required Section.)

Checking Belt Tensioner Spring Tension and Belt Wear (Automatic Tensioner)

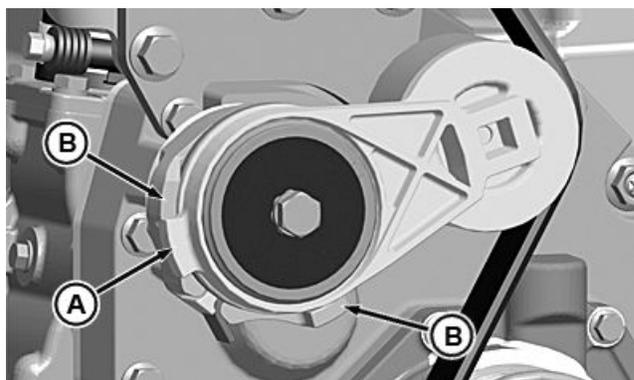
Belt drive systems equipped with automatic (spring) belt tensioners cannot be adjusted or repaired. The automatic belt tensioner is designed to maintain proper belt tension over the life of the belt. If tensioner spring tension is not within specification, replace tensioner assembly.

Checking Belt Wear

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.

Visually inspect cast stops (A and B) on belt tensioner assembly.

If the tensioner cast stop (A) on swing arm is hitting either fixed cast stop (B), check mounting brackets (alternator, belt tensioner, idler pulley, etc.) and the belt length. Replace belt as needed (see REPLACING FAN AND ALTERNATOR BELTS in Service As Required Section).



Cast Stops - Tensioner Arm

A— Tensioner Cast Stops

B— Fixed Cast Stops

RG22080 —UN—03DEC12

Continued on next page

RG19661,00003E6 -19-13FEB13-1/2

Checking Tensioner Spring Tension

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 procedure outlined below:

1. Release tension on belt using a long handled 1/2 inch drive tool in square hole in tensioner arm. (Earlier tensioner arms have bolt in place of square hole, and require breaker bar with socket.) Remove belt from pulleys.

NOTE: While belt is removed, inspect pulleys and bearings. Rotate and feel for hard turning or any unusual sounds. If pulleys or bearings need replacement, see your John Deere dealer.

2. Release tension on tension arm and remove drive tool.
3. Put a mark (A) on swing arm of tensioner as shown.
4. Measure 21 mm (0.83 in.) from (A) and put a mark (B) on tensioner mounting base.
5. Install torque wrench (C) so that it is aligned with centers of pulley and tensioner. Rotate the swing arm using a torque wrench until marks (A and B) are aligned.
6. Record torque wrench measurement and compare with specification below. Replace tensioner assembly as required.

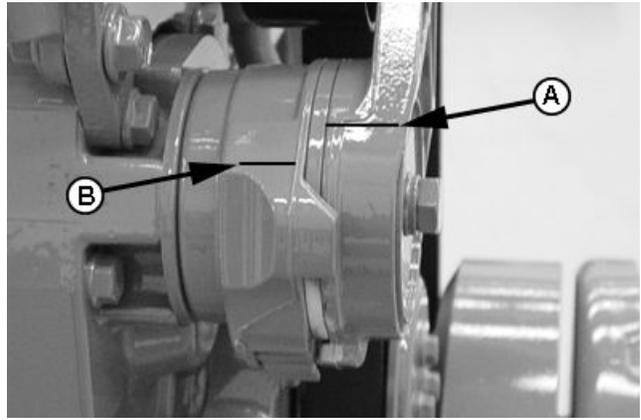
Specification

Spring Tension—Torque..... 18-22 N·m (13-16 lb-ft)

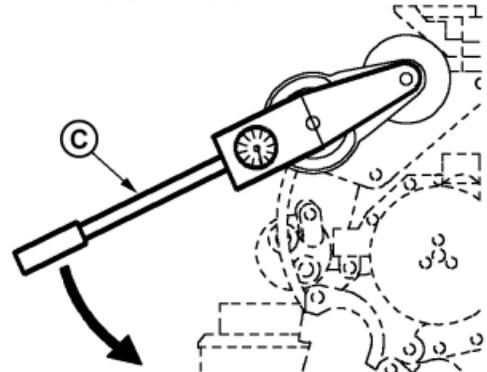
NOTE: Threads on belt tensioner roller cap screw are LEFT-HAND threads

A—Mark On Swing Arm
B—Mark On Tensioner
Mounting Base

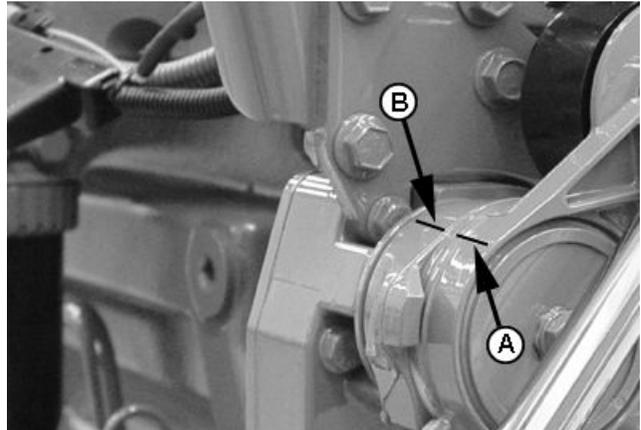
C—Torque Wrench



Marks on Tensioner



Align Torque Wrench With Pulley and Tensioner



Align Marks

RG13745 —UN—11NOV04

RG12065 —UN—28JAN02

RG13746 —UN—11NOV04

RG19661,00003E6 -19-13FEB13-2/2

Checking Cooling System

⚠ CAUTION: Explosive release of fluids from pressurized cooling system 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.

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.

1. Check entire cooling system for leaks. Tighten all clamps securely.



High-Pressure Fluids

2. Thoroughly inspect all cooling system hoses. Replace hoses when hard, flimsy, or cracked.

TS281—UN—23AUG88

RG, RG34710, 5580 -19-20MAY96-1/1

Replenishing Supplemental Coolant Additives (SCAs) Between Coolant Changes

IMPORTANT: Do not add supplemental coolant additives when the cooling system is drained and refilled with John Deere COOL-GARD®

NOTE: If system is to be filled with coolant that does not contain SCAs, the coolant must be precharged. Determine the total system capacity and premix with 3% John Deere Coolant Conditioner.

Through time and use, the concentration of coolant additives is gradually depleted during engine operation. Periodic replenishment of inhibitors is required, even when John Deere COOL-GARD® is used. The cooling system must be recharged with additional supplemental coolant additives available in the form of liquid coolant conditioner.

Maintaining the correct coolant conditioner concentration (SCAs) and freeze point is essential in your cooling system to protect against rust, liner pitting and corrosion, and freeze-ups due to incorrect coolant dilution.

John Deere LIQUID COOLANT CONDITIONER is recommended as a supplemental coolant additive in John Deere engines.

DO NOT mix one brand of SCA with a different brand.

Test the coolant solution at 500 hours or 12 months of operation using either John Deere coolant test strips or a COOLSCAN® or COOLSCAN PLUS® analysis. If a COOLSCAN® or COOLSCAN PLUS® analysis is not available, recharge the system per instructions printed on label of John Deere Liquid Coolant Conditioner.

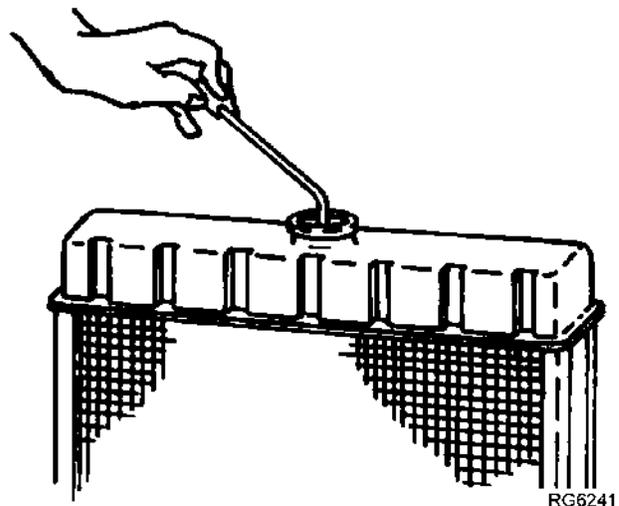
IMPORTANT: ALWAYS maintain coolant at correct level and concentration. DO NOT operate engine without coolant even for a few minutes.

If frequent coolant makeup is required, the glycol concentration should be checked with JT07298 Coolant/Battery Tester to ensure that the desired freeze point is maintained. Follow manufacturer's instructions provided with Coolant/Battery Tester.

Add the manufacturer's recommended concentration of supplemental coolant additive. DO NOT add more than the recommended amount.

The use of non-recommended supplemental coolant additives may result in additive drop-out and gelation of the coolant.

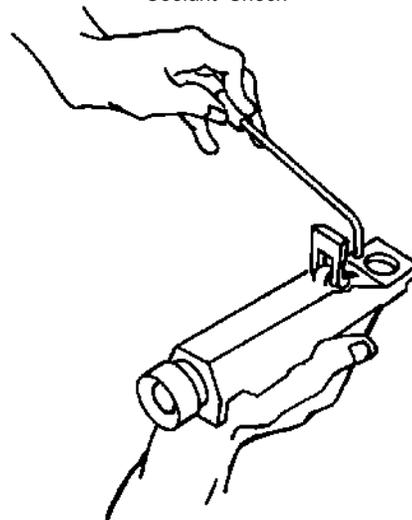
*COOL-GARD is a registered trademark of Deere & Company
COOLSCAN is a registered trademark of Deere & Company
COOLSCAN PLUS is a registered trademark of Deere & Company
COOLSCAN PLUS is a registered trademark of Deere & Company*



Coolant Check

RG6241

RG6261 —UN—08DEC97



JT07298 Coolant/Battery Tester

RG6262

RG6262 —UN—05DEC97

If other coolants are used, consult the coolant supplier and follow the manufacturer's recommendation for use of supplemental coolant additives.

See DIESEL ENGINE COOLANTS AND SUPPLEMENTAL ADDITIVE INFORMATION for proper mixing of coolant ingredients before adding to the cooling system.

Testing Diesel Engine Coolant

Maintaining adequate concentrations of glycol and inhibiting additives in the coolant is critical to protect the engine and cooling system against freezing, corrosion, and cylinder liner erosion and pitting.

Test the coolant solution at intervals of 12 months or less and whenever excessive coolant is lost through leaks or overheating.

Coolant Test Strips

Coolant test strips are available from your John Deere dealer. These test strips provide a simple, effective method to check the freeze point and additive levels of your engine coolant.

Compare the results to the supplemental coolant additive (SCA) chart to determine the amount of inhibiting additives in your coolant and whether more John Deere COOLANT CONDITIONER should be added.

COOLSCAN Or COOLSCAN PLUS

For a more thorough evaluation of your coolant, perform a COOLSCAN or COOLSCAN PLUS analysis. See your John Deere dealer for information about COOLSCAN or COOLSCAN PLUS.

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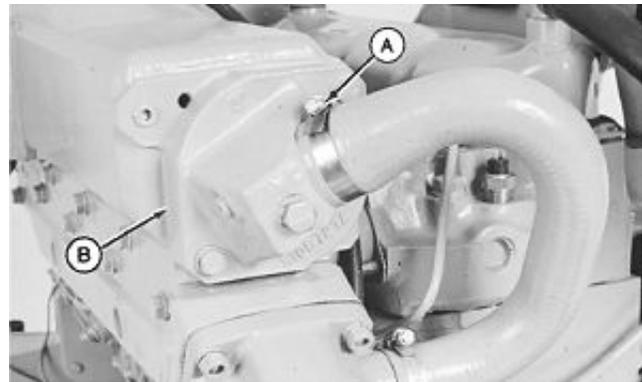
Remove, Inspect and Clean Engine Heat Exchanger Core

IMPORTANT: Initially remove and inspect the engine heat exchanger core at 250 hour or three month service interval on a new engine. Then, remove and clean at every 500 hour or 12 month interval thereafter.

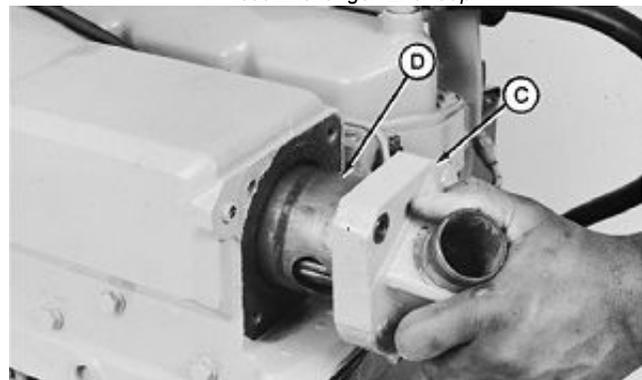
1. Close sea cocks and drain the sea water system.
2. Open drain cock on cylinder block and drain approximately two gallons of engine coolant into a clean container. Close drain cock.
3. Loosen hose clamp (A) and remove hose from rear end cap (B).
4. Remove two end cap mounting cap screws and remove end cap (C) with heat exchanger core (D) from rear of engine.

A—Clamp
B—End Cap

C—End Cap
D—Heat Exchanger Core



Heat Exchanger End Cap



RG6063 —UN—23JAN92

Continued on next page

RG19661,000040B -19-10MAR13-1/2

On All Engines:

NOTE: The heat exchanger core may be removed from housing when either end cap is removed. It is strongly recommended that both end caps be removed for cleaning when cleaning the heat exchanger core.

5. Remove remaining end cap from water manifold/heat exchanger housing. Remove end cap from heat exchanger core.

6. Thoroughly clean all buildup from both end caps and inspect zinc plug in each. Replace plugs as needed. (See INSPECT AND REPLACE ZINC PLUGS in 250 Hour Section.)

7. Use a 4.76 mm (3/16 in.) diameter brass rod to clean out any buildup in each heat exchanger tube. Run the rod the entire length of each tube to push debris out.

8. Flush the heat exchanger tubes with clean water, making sure all tubes are cleared of debris. Clean (with brass rod) and flush heat exchanger again if necessary to remove any remaining debris from tubes.



Clean Heat Exchanger

If you suspect that your heat exchanger core is defective, have your authorized servicing dealer or engine distributor pressure test for leaks. Replace heat exchanger core as required.

9. Remove and thoroughly clean water manifold/heat exchanger housing if needed.

RG19661,000040B -19-10MAR13-2/2

RG6066—UN—23JAN92

Install Heat Exchanger Core

Thoroughly inspect condition of end cap sealing O-rings (A). Sealing O-rings may be reused if not excessively worn or damaged during disassembly. Replace sealing rings as necessary.

Lubricate front and rear end cap O-rings with clean multi-purpose grease.

1. Install rear end cap, install cap screws and evenly tighten until end cap (B) is about 6.4 mm (0.25 in.) from housing (C). Index end cap in same position as removed.

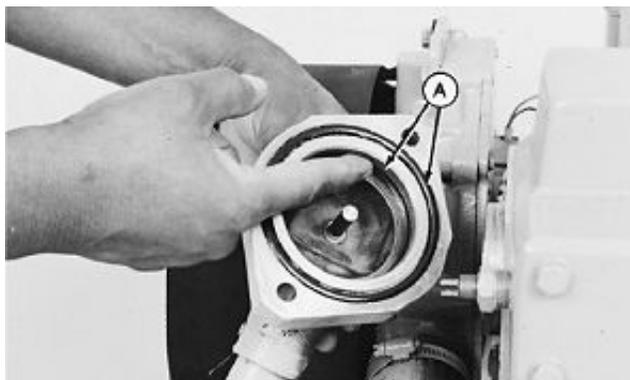
2. Install heat exchanger core. Make sure core is properly seated in rear end cap to avoid cutting O-ring.

3. Install front end cap with heat exchanger core properly seated in cap and cap properly indexed in same position as removed.

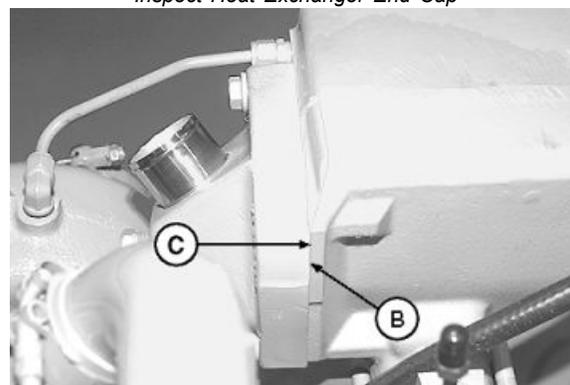
4. Install and evenly tighten front end cap screws until cap contacts housing. Evenly tighten rear end cap screws until cap contacts housing. Tighten front and rear end cap screws to 24 N·m (18 lb-ft).

5. Connect all water piping and tighten hose clamps securely. Fill cooling system with the proper amount and concentration of ethylene-glycol base antifreeze.

6. Open sea cock, start engine and check for leaks.



Inspect Heat Exchanger End Cap



Install Heat Exchanger

A—O-Rings
B—End Cap

C—Housing

Continued on next page

RG19661,000040F -19-10MAR13-1/2

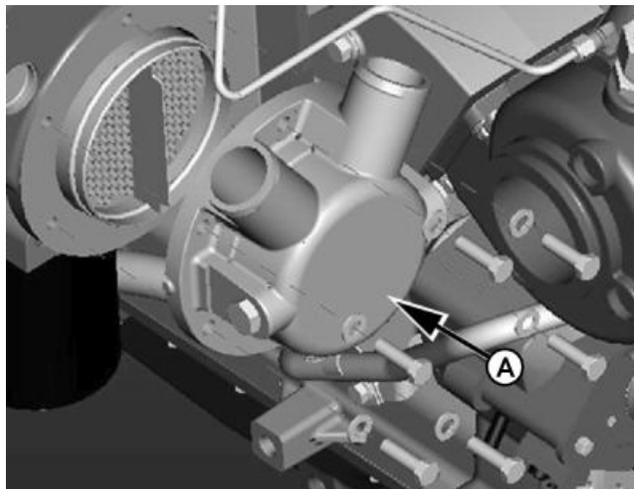
RG6067—UN—23JAN92

RG9848—UN—06JAN99

1. Insert two O-rings into front and rear end caps.
2. Lubricate ends of tube bundle lightly with clean multi-purpose grease.

NOTE: For proper orientation of the tube bundle, the core divider plate must be in line with inlet end cap divider slot with arrow pointing in the correct direction.

3. Install rear end cap (A) over tube bundle with core divider plate in slot on cap.
4. Guide heat exchanger core into heat exchanger tank. Align core divider vertically with stamped note indicating "This side up". (Core shown separated from cap for illustration purposes.)
5. Fasten rear end cap and core to tank with bolts and washers. Tighten bolts to 24 +/- 3 N·m (18 +/- 2 lb-ft).
6. Install front end cap (B) over core and bolt to tank. Ensure core holes are aligned with heat exchanger tank holes. Tighten bolts to 24 +/- 3 N·m (18 +/- 2 lb-ft).
7. Connect all water piping and tighten hose clamps securely. Fill cooling system with the proper amount and concentration of ethylene-glycol base antifreeze.
8. Open sea cock, start engine and check for leaks.



Install Core and Rear End Cap

RG15325—UN—19JUL07

A—Rear End Cap

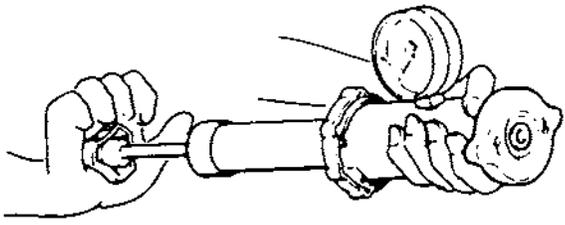
B—Front End Cap

RG15326—UN—19JUL07

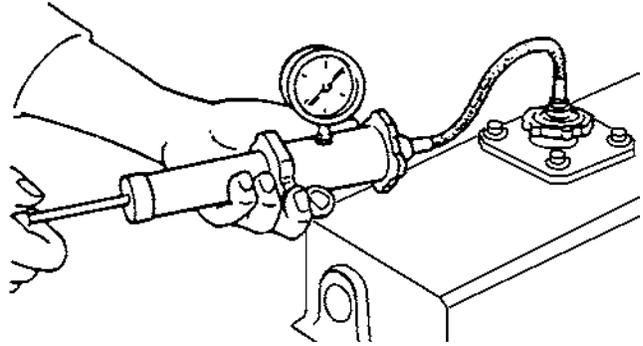
Install Front End Cap

RG19661.000040F -19-10MAR13-2/2

Pressure Testing Cooling System



RG6557 —UN—20JAN93



RG9850 —UN—06JAN99

CAUTION: Explosive release of fluids from pressurized cooling system 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 Coolant Filler Cap

1. Remove coolant filler cap and attach to an appropriate tester as shown.
2. Pressurize cap to specifications. Gauge should hold pressure for 10 seconds within the normal range if cap is acceptable.

If gauge does not hold pressure, replace pressure cap.

Specification

Radiator
Cap—Pressure.....110kPa (1.1 bar) (10 psi)

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

Test Cooling System

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

1. Allow engine to cool, then carefully remove coolant filler cap.
2. Fill tank with coolant to the normal operating level.
3. Connect gauge and adapter to filler neck. Pressurize cooling system to specifications.

IMPORTANT: DO NOT apply excessive pressure to cooling system, doing so may damage coolant tank and hoses.

Specification

Cooling System—Pressure..... 110kPa (10 psi)

4. With pressure applied, check all cooling system hose connections, coolant tank, 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.

RG19661,0000409 -19-08MAR13-1/1

Checking Engine Electrical Ground Connections

Keep all engine ground connections clean and tight to prevent electrical arcing which can damage electronic components.

Also see precautions in Troubleshooting Section when welding on engine or machine.

OUD002,0000169 -19-23NOV01-1/1

Lubrication&Maintenance/2000 Hour/24 Month

Checking and Adjusting Engine Valve Clearance

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

IMPORTANT: Valve clearance **MUST BE** checked and adjusted with engine **COLD**.

1. Remove rocker arm cover and crankcase ventilator tube.

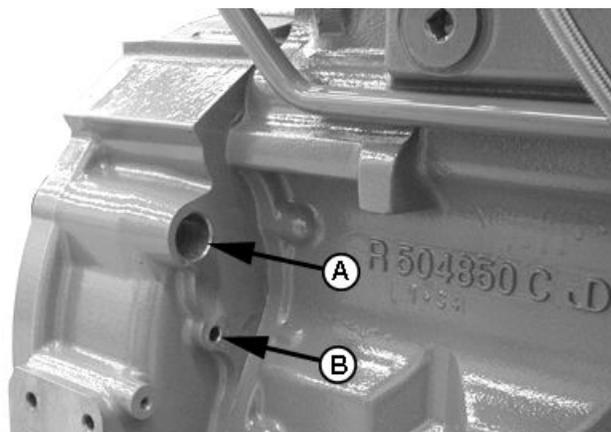
IMPORTANT: Visually inspect contact surfaces of valve tips, bridges and rocker arm wear pads. Check all parts for excessive wear, breakage, or cracks. Replace parts that show visible damage.

Rocker arms that exhibit excessive valve clearance should be inspected more thoroughly to identify damaged parts.

2. Remove plastic plugs or cover plate from engine timing/rotation hole (A) and timing pin hole (B).

NOTE: Some engines are equipped with flywheel housings which do not allow use of an engine flywheel rotation tool. These engines with straight nose crankshafts may be rotated from front nose of engine, using JDG966 Crankshaft Front/Rear Rotation Adapter.

3. Using JDE83 or JDG820 Flywheel Turning Tool, rotate engine flywheel in running direction (clockwise



Flywheel Housing Timing Holes

A—Timing/Rotation Hole

B—Timing Pin Hole

viewed from front) until No. 1 (front) cylinder is at TDC compression stroke. Insert JDG1571 or JDE81-4 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.

RG19661,00003D0 -19-29JAN13-1/4

4. Adjust valves to specifications below using the valve clearance adjustment procedure in the following blocks. Loosen the jam nut (A) on rocker arm adjusting screw. Turn adjusting screw until feeler gauge (B) slips with a slight drag. Hold the adjusting screw from turning with screwdriver and tighten jam nut to specifications. Recheck clearance again after tightening jam nut. Readjust clearance as necessary.

Specification

Intake Valve Clearance Adjustment (Rocker Arm-to-Bridge) (Engine Cold)—Clearance.....	0.36 mm (0.014 in.)
Exhaust Valve Clearance Adjustment (Rocker Arm-to-Bridge) (Engine Cold)—Clearance.....	0.46 mm (0.018 in.)
Rocker Arm Adjusting Screw Jam Nut—Torque.....	27 N·m (20 lb-ft)

Adjusting Valves

5. Install rocker arm cover and crankcase ventilator tube.
6. Reconnect battery terminal.

A—Adjusting Screw Jam Nut

B—Feeler Gauge

Continued on next page

RG19661,00003D0 -19-29JAN13-2/4

RG13749 —UN—11NOV04

RG13809 —UN—07DEC04

4-Cylinder Engine

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

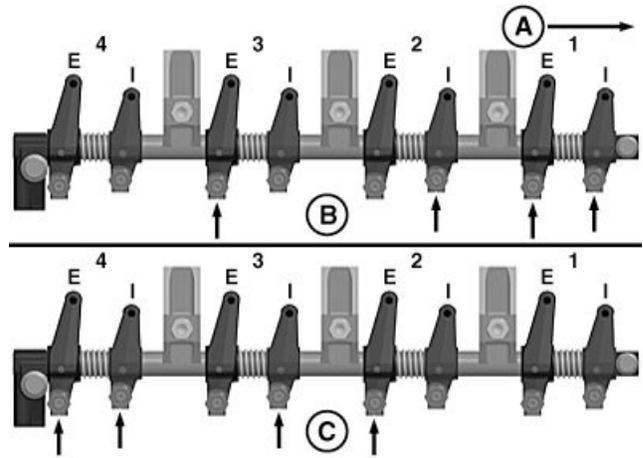
Lock No. 1 piston at TDC compression stroke (B).

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

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

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

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



4-Cylinder Engine Valve Adjustment

RG22378—UN—28JAN13

RG19661,00003D0 -19-29JAN13-3/4

6-Cylinder Engine:

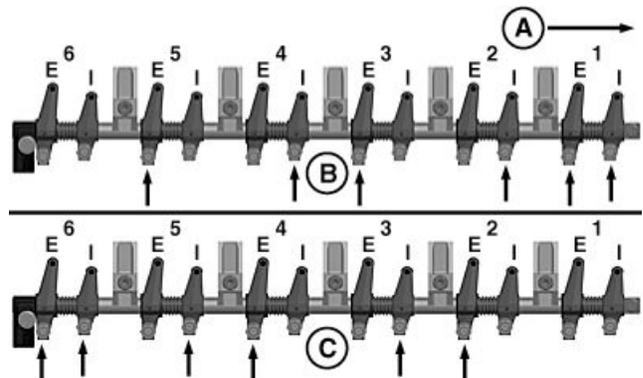
NOTE: Firing order is 1-5-3-6-2-4.

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

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

Turn crankshaft 360°. Lock No. 6 piston at TDC compression stroke (C).

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



6-cylinder Engine Valve Adjustment

RG22377—UN—28JAN13

RG19661,00003D0 -19-29JAN13-4/4

Flushing And Refilling Cooling System

⚠ CAUTION: Explosive release of fluids from pressurized cooling system 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.

NOTE: When John Deere COOL-GARD is used, the drain interval is 3000 hours or 36 months. The drain interval may be extended to 5000 hours or 60 months of operation, **provided that the coolant is tested annually AND additives are replenished, as needed, by adding a supplemental coolant additive (SCA).**

If COOL-GARD is not used, the flushing interval is 2000 hours or 24 months of operation.

Drain old coolant, flush the entire cooling system, test thermostats, and fill with recommended clean coolant using the following procedure.

1. Pressure test entire cooling system and pressure cap if not previously done. (See PRESSURE TESTING COOLING SYSTEM, in the Lubrication and Maintenance/500 Hour/12 Month Section.)
2. Slowly open the cap on the top tank (A) or heat exchanger to relieve pressure and allow coolant to drain faster.



High-Pressure Fluids



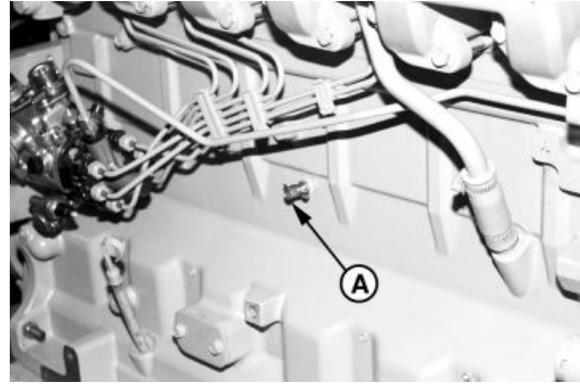
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RG19661,00003D1 -19-28JAN13-1/2

TS281—UN—29AUG88

RG22040—UN—28NOV12

3. Open engine block drain valve (A) on left side of engine. Drain all coolant from engine block.
4. Open heat exchanger or top tank drain valve. Drain all coolant from heat exchanger or top tank.
5. Remove thermostats at this time, if not previously done. Install cover (without thermostats) using old gasket and tighten cap screws to 47 N·m (35 lb-ft).
6. Test thermostat opening temperature. (See Inspecting Thermostats And Testing Opening Temperature following in this section).
7. Close all drain valves after coolant has drained.



Engine Block Drain Valve

⚠ CAUTION: Do not run engine longer than 10 minutes. Doing so may cause engine to overheat, causing burns when cooling system is draining.

A—Engine Block Drain Valve

8. Fill the cooling system with clean water. Run the engine about 10 minutes to stir up possible rust or sediment.
9. Stop engine, pull off lower cooling system hose and remove heat exchanger or top tank cap. Immediately drain the water from system before rust and sediment settle.
10. After draining water, close drain valves. Reinstall cap, lower cooling system hose and clamp. Fill the cooling system with clean water and a heavy duty cooling system cleaner such as Fleetguard® RESTORE™ and RESTORE PLUS™.
11. After cleaning the cooling system, drain cleaner and fill with water to flush the system. Run the engine about 10 minutes, remove heat exchanger or top tank cap and pull off lower cooling system hose to drain out flushing water.
12. Close all drain valves. Reinstall hoses and tighten clamps securely. Install thermostats using a new gasket.

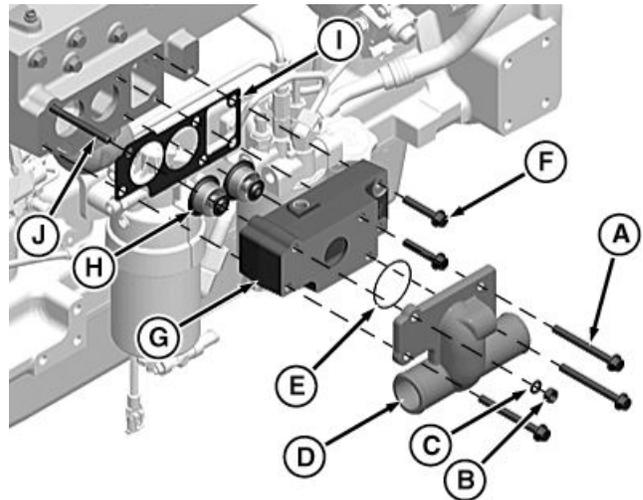
RG8019A —UN—19JUN00

Remove Thermostats

CAUTION: Explosive release of fluids from pressurized cooling system 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. **DO NOT** drain coolant until it has reached ambient temperature.

1. Visually inspect area around thermostat housing and cover for leaks.
2. Remove coolant tank pressure cap and partially drain coolant system.
3. Remove cap screws (A), nut (B) and washer (C) attaching coolant cover (D) with sealing O-ring (E) to the thermostat housing (G) and exhaust manifold.
4. Remove cap screws (F) attaching thermostat housing to the exhaust manifold.
5. Remove thermostat housing with gasket (I). Remove and discard all gasket material. Clean all sealing surfaces.
6. Inspect and test thermostats for proper opening temperature.
7. Install thermostats with a new gasket and pilot housing on stud (J). Install thermostat housing cap screws finger-tight.



Remove and Install Thermostats

- | | |
|---------------------------------|-----------------------------------|
| A—Cap Screws (Thermostat Cover) | F—Cap Screws (Thermostat Housing) |
| B—Nut | G—Thermostat Housing |
| C—Washer | H—Thermostats |
| D—Thermostat Cover | I—Gasket |
| E—O-ring | J—Stud |

8. Inspect thermostat cover sealing O-ring and replace if necessary. Install thermostat cover with O-ring, cap screws, washer and nut. Tighten nut and all cap screws to 35 N·m (25 lb.-ft.)

RG22482—UN—04MAR13

RG19661,0000405 -19-08MAR13-1/1

Inspecting Thermostats and Testing Opening Temperature

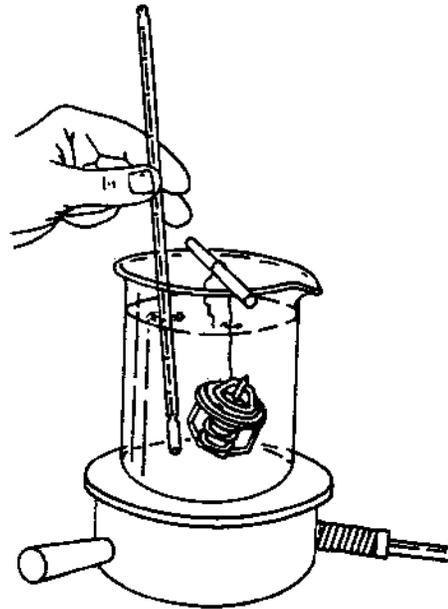
1. Remove thermostats. (See REMOVING THERMOSTATS earlier in this section.)
2. Visually inspect thermostats for corrosion or damage. Replace thermostats as a matched set as necessary.
3. Inspect thermostat with wiggle wire in vent notch. If wire movement is restricted, replace thermostat if cleaning does not free movement.

⚠ CAUTION: DO NOT allow thermostat or thermometer to rest against the side or bottom of container when heating water. Either may rupture if overheated.

4. Suspend thermostats and a thermometer in a container of water.
5. Stir the water as it heats. Observe opening action of thermostat and compare temperatures with specifications. See GENERAL ENGINE SPECIFICATIONS in Specification Section.

NOTE: Due to varying tolerances of different supplies, initial opening and full open temperatures may vary slightly from specified temperatures.

6. Remove thermostat and observe its closing action as it cools. In ambient air the thermostat should close completely. Closing action should be smooth and slow.



Thermostat And Thermometer In Water

7. If any one thermostat is defective, replace both thermostats.

RG5971 —UN—23NOV97

OUOD006,0000095 -19-19JUN07-1/1

Inspect and Repair Sea Water Pump (4045TFM85)

• Inspect pump housing for seal leakage

1. Inspect the sea water pump housing weep hole (A), if equipped, for evidence of water or oil indicating seal leakage.

If water leakage is evident, order a RE49490 Impeller Repair Kit and replace impeller and front housing/shaft seal.

If oil leakage is evident, order a RE49491 Major Repair Kit and replace all internal components except shaft. An arbor press and drivers are needed to install this kit. Have an experienced technician install this kit.

**A—Weep Hole (Earlier Engines
Only)**

Continued on next page

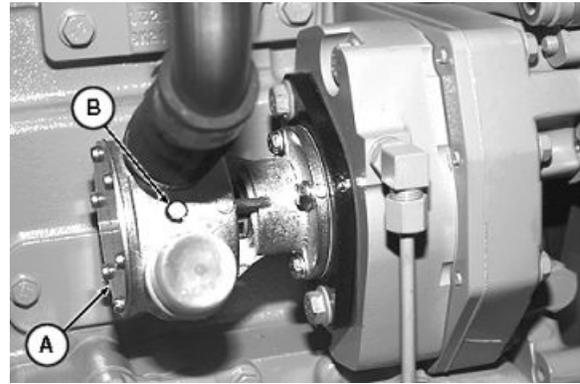
RG19661,0000401 -19-06MAR13-1/3

RG9852 —UN—05/JAN99

Remove and Inspect Impeller

1. Close sea cock and drain sea water system if not previously done.
2. Remove six cover plate cap screws with washers and remove cover plate (A) with O-ring. Remove impeller end cap from end of impeller bore.

NOTE: Normally the impeller can be removed by using two pair of pliers to grip impeller vanes on opposite sides of impeller. Rotating the pump shaft by hand may help free the impeller. Petroleum based lubricants can cause the impeller to swell, and are not recommended to free a stuck impeller.

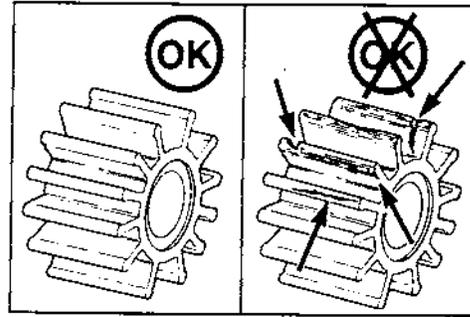


Remove Cover Plate

3. Carefully remove impeller with cam plate. Be careful not to damage impeller if in reusable condition. Remove key from shaft keyway.

The impeller must be installed in the same direction as removed. Mark the impeller to ensure installation in proper direction of rotation if impeller is reused.

4. Inspect impeller for damages such as tears, stress cracks, excess abrasions on vane ends, or chunks of material missing. Impellers that are run dry will overheat and fail the impeller blades at the root. Impellers that swell and stick, fail the impeller in the middle of the blade. If impeller replacement is necessary, order an impeller repair kit.



Inspect Sea Water Pump Impeller

IMPORTANT: If impeller has chunks of material missing, the heat exchanger, marine gear oil cooler and any other circuit that are cooled by raw water should be thoroughly cleaned and flushed.

A—Cover Plate

B—Cam Screw

6. Thoroughly clean impeller housing bore and cam plate (if cam plate is reused).

5. Remove cam screw (B) holding cam plate to impeller housing bore.

Continued on next page

RG19661,0000401 -19-06MAR13-2/3

RG9853 —UN—05JAN19

RG6243 —UN—23MAR92

Install Impeller

1. Apply LOCTITE® 242 (Deere Part No. TY9370) to curved side of cam plate near threaded hole and install cam plate into impeller housing bore, be sure holes in cam plate and housing are aligned. Apply LOCTITE® 242 to cam screw (B), install, and tighten.

The cam plate should be inspected to insure that none of the cam fingers are protruding which could cause impeller damage. The cam screw should also be inspected to insure that it does not protrude below the cam plate. Replace cam plate and cam screw or grind screw flush as needed.

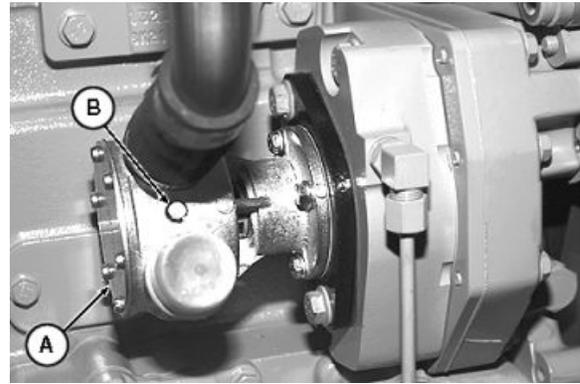
IMPORTANT: Petroleum based lubricants can cause the impeller to swell, and are not recommended to lubricate the impeller before installation.

2. Lubricate impeller blades with a non-petroleum based lubricant such as silicone or soapy water. Install impeller using a twisting motion and be sure the impeller blades are bent in the same direction as they were upon removal.

Be sure impeller is installed in same direction as removed if reusing existing impeller.

3. Rotate impeller to align keyway and slide the key in place. Install impeller end cap in end of impeller bore.

LOCTITE is a registered trademark of Loctite Corp.



Install Cover Plate

A—Cover Plate

B—Cam Screw

4. Using a new O-ring, install cover plate (A) onto impeller housing. Install six screws with washers. Tighten screws evenly.

5. Reconnect all water piping, if disconnected.

6. Open sea cock and prime sea water pump with water. Start engine and check for leaks.

RG9853—UN—05/JAN99

RG19661.0000401 -19-06MAR13-3/3

Inspect And Repair Sea Water Pump (4045AFM85/6068AFM85)

NOTE: Sea water pump with shaft key is illustrated. Sea water pumps with a splined shaft follow the same procedure

1. Close sea cocks and drain sea water system.
2. Remove cover plate (A) from sea water pump.

NOTE: Special impeller puller tool is provided with minor and major sea water pump rebuild kits. If tool is not available, the impeller can normally be removed by using two pair of pliers to grip impeller vanes on opposite sides of impeller. Rotating the pump shaft by hand may help free the impeller. Petroleum based lubricants can cause the impeller to swell, and are not recommended to free a stuck impeller.

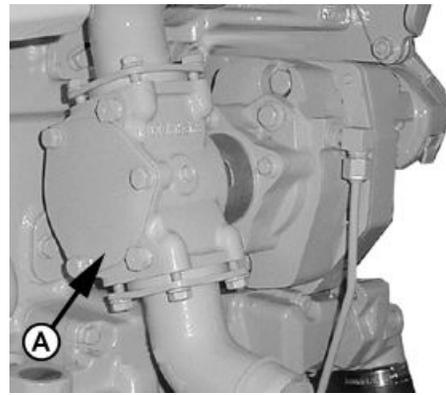
3. Remove impeller (B) and shaft key (C) (if equipped) from pump housing.
4. Remove O-ring (D).
5. Inspect cam plate (E) for evidence of heavy pitting or wear. Replace as needed.
6. Inspect impeller for damages such as tears, stress cracks, excess abrasions on vane ends, or chunks of material missing. Impellers that are run dry will overheat and fail the impeller blades at the root. Impellers that swell and stick, fail the impeller in the middle of the blade. If impeller replacement is necessary, order an impeller repair kit.

IMPORTANT: If impeller has chunks of material missing, the heat exchanger, aftercooler, marine gear oil cooler and any other circuit that are cooled by raw water should be thoroughly cleaned and flushed.

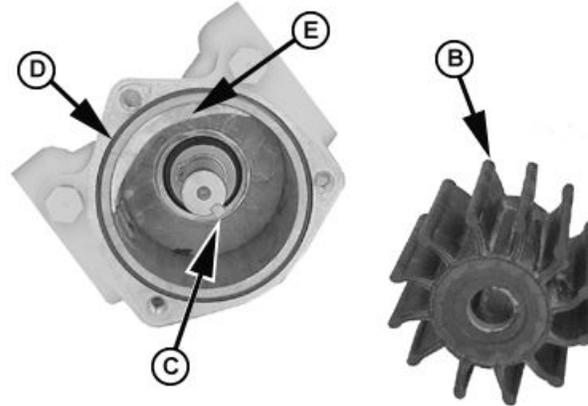
7. Install shaft key (C) (if equipped) on shaft.

IMPORTANT: Petroleum based lubricants can cause the impeller to swell, and are not recommended to lubricate the impeller before installation.

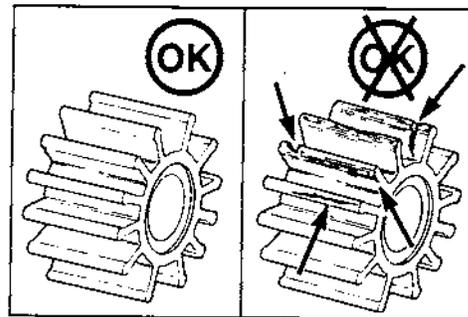
8. Lubricate new impeller blades with a non-petroleum based lubricant such as silicone or soapy water. Install impeller using a twisting motion and be sure the impeller blades are bent in the same direction as they were upon removal to prevent damage at startup. Rotate impeller on shaft to align keyways/splines and slide the impeller onto the shaft.
9. Using a new O-ring (D), install cover plate and tighten cap screws with washers securely.
10. Install sea water pump and tighten cap screws to 73 N·m (54 lb-ft).
11. Connect sea water inlet and outlet tubes. Tighten mounting cap screws **evenly** until secure.



Remove Cover Plate



Remove and Inspect Components



Inspect Sea Water Pump Impeller

A—Cover Plate
B—Impeller
C—Shaft Key

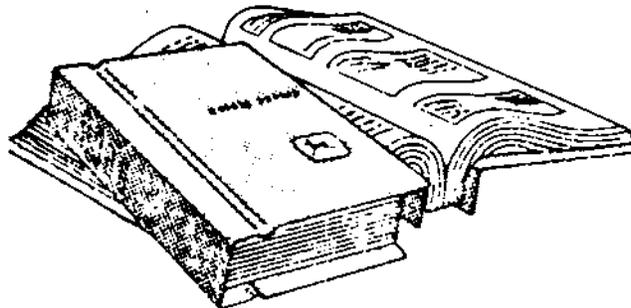
D—O-Ring
E—Cam Plate

12. Replace O-rings on oil tubes and install oil filter housing and oil tubes. Tighten mounting cap screws to 35 N·m (26 lb-ft).
13. Open sea cocks, start engine and check pump operation.

Service as Required

Additional Service Information

This is not a detailed service manual. If you want more detailed service information, use the form in the back of this manual to order a component technical manual.



RG4624—UN—15DEC88

RG, RG34710, 5591 -19-20MAY96-1/1

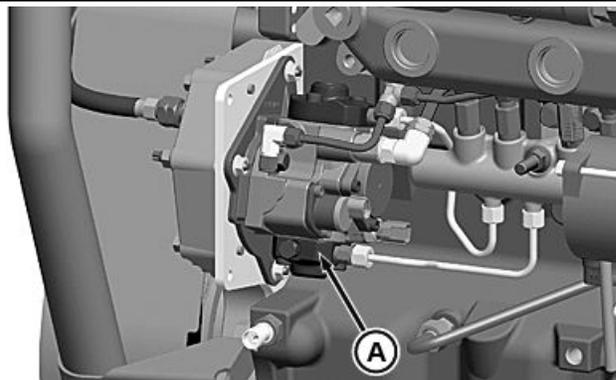
Do Not Modify Fuel System

IMPORTANT: Modification or alteration of the injection pump (arrow), the injection pump timing, or the fuel injectors in ways not recommended by the manufacturer will terminate the warranty obligation to the purchaser.

In addition, tampering with fuel system which alters emission-related equipment on engines may result in fines or other penalties, per EPA regulations or other local emission laws.

Do not attempt to service injection pump or fuel injectors yourself. Special training and special tools are required. (See your authorized servicing dealer or engine distributor.)

IMPORTANT: Never steam clean or pour cold water on a high-pressure fuel pump while it is still warm. To do so may cause seizure of pump parts.



Fuel Injection Pump

A—Fuel Injection Pump

RG22161—UN—06DEC12

RG19661,00003C1 -19-23JAN13-1/1

Adding Coolant

⚠ CAUTION: Explosive release of fluids from pressurized cooling system 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.

IMPORTANT: Never pour cold liquid into a hot engine, as it may crack cylinder head or block. **DO NOT** operate engine without coolant for even a few minutes.

John Deere TY15161 Cooling System Sealer may be added to the cooling system to stop leaks. **DO NOT** use any other stop-leak additives in the cooling system.

Air must be expelled from cooling system when coolant is added.

1. Loosen temperature sending unit fitting at rear of cylinder head or plug in side of thermostat housing to allow air to escape when filling system.

IMPORTANT: When adding coolant to the system, use the appropriate coolant solution. (See



High-Pressure Fluids

ENGINE COOLANT SPECIFICATIONS in Fuels, Lubricants, and Coolant Section for mixing of coolant ingredients before adding to cooling system.)

Do not overfill cooling system. A pressurized system needs space for heat expansion without overflowing at top of coolant tank.

2. Fill until coolant level touches bottom of coolant tank filler neck.
3. Tighten plugs and fittings when air has been expelled from system.

RG, RG34710, 5593 -19-04.JAN02-1/1

TS281—UN—23AUG88

Replacing Alternator Belt (With Automatic Tensioner)

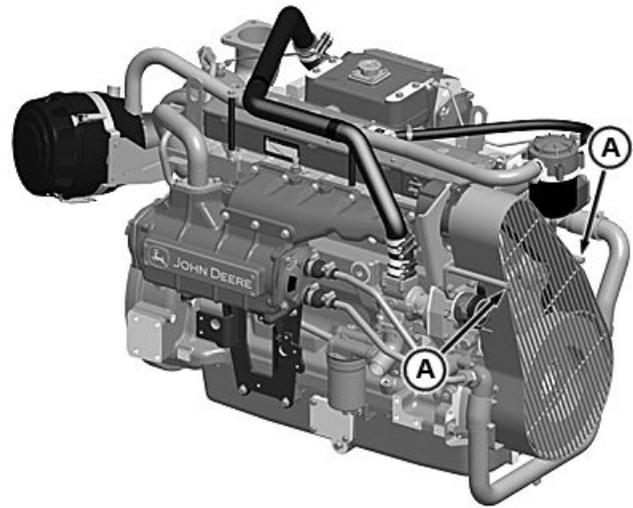
Refer to CHECKING BELT TENSIONER SPRING TENSION AND BELT WEAR in Lubrication and Maintenance/500 Hour/12 Month Section for additional information on the belt tensioner.

CAUTION: Belt guard should be in place at all times when engine is running.

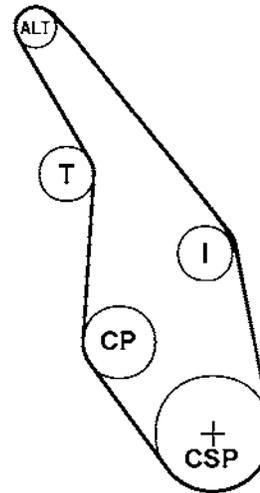
NOTE: While belt is removed, inspect pulleys and bearings. Rotate and feel for hard turning or any unusual sounds. If pulleys or bearings need replacement, see your John Deere dealer.

1. Remove cap screws (A) and carefully remove belt guard from engine.
2. Release tension on belt using a breaker bar and socket on tension arm and remove poly-vee belt from pulleys.
3. Inspect belts for cracks, fraying, or stretched out areas. Replace if necessary.
4. Install new belt, making sure belt is correctly seated in all pulley grooves. Refer to belt routing at right.
5. Apply tension to belt with tensioner. Remove socket.
6. Start engine and check belt alignment.

A—Cap Screws	I— Idler Pulley
ALT— Alternator	T— Tensioner
CSP—Crankshaft Pulley	CP—Coolant Pump



Remove Belt Guard



Belt Routing

RG22162—UN—06DEC12

RG12077—UN—26FEB02

RG19661,00003F4 -19-20FEB13-1/1

Drain Water From Fuel Filter

IMPORTANT: When using BIODIESEL blends, monitor water quantity more closely in the fuel filter element. Water in the filter separator may need to be drained more frequently.

If instrument panel provides a water in fuel warning, drain water or debris from filter using the following steps.

1. Loosen thumb screw (A) and drain water and debris into a suitable container. Tighten thumb screw.
2. Dispose of water and debris in an environmentally safe manner.

A—Thumb Screw



Drain Primary Fuel Filter - 6068SFM50 Shown

RG13253—UN—08DEC03

OUOD006,0000083 -19-16OCT07-1/1

Bleeding Fuel System

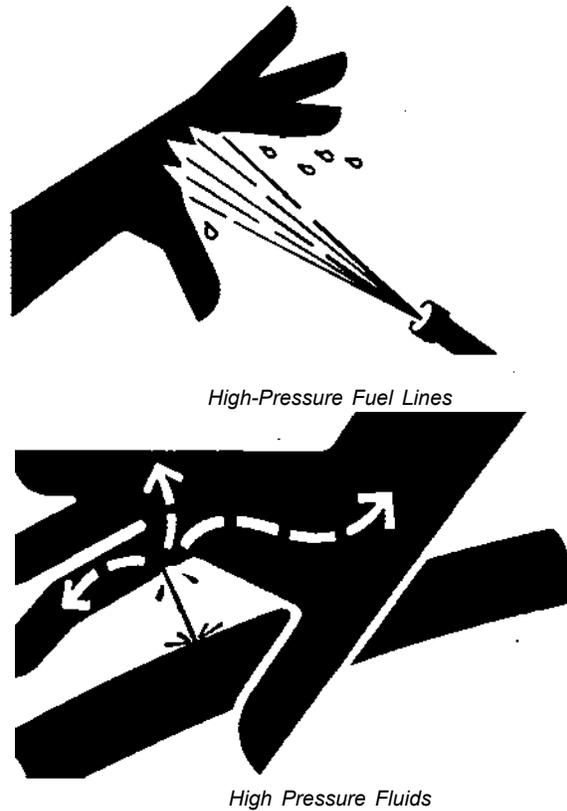
CAUTION: High-pressure fluid remaining in fuel lines can cause serious injury. Do not disconnect or attempt repair of fuel lines, sensors, or any other components between the high-pressure fuel pump and nozzles on engines with High Pressure Common Rail (HPCR) fuel system. Only technicians familiar with this type of system can perform repairs. (See your John Deere dealer.)

Escaping fluid under pressure can penetrate the skin causing serious injury. Avoid hazards by relieving pressure before disconnecting hydraulic or other lines. Tighten all connections before applying pressure. Search for leaks with a piece of cardboard. Protect hands and body from high pressure fluids.

If an accident occurs, see a doctor immediately. Any fluid injected into the skin must be surgically removed within a few hours or gangrene may result. Doctors unfamiliar with this type of injury may call the Deere & Company Medical Department in Moline, Illinois, or other knowledgeable medical source.

IMPORTANT: Four-valve cylinder head engines are especially sensitive to fuel contamination. Do not crack any fuel lines to bleed the fuel system.

NOTE: Normally the fuel system on these engines is self-priming and self-bleeding, and does not require a bleeding procedure by the operator.



If engine will not start after filter changes, turn ignition key ON for 60 seconds to prime the fuel system. It may be necessary to turn the key off and on again to reprime the system before starting.

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TS1343—UN—18MAR92

X9811—UN—23AUG88

Remove and Install Sea Water Pump (4045TFM85)

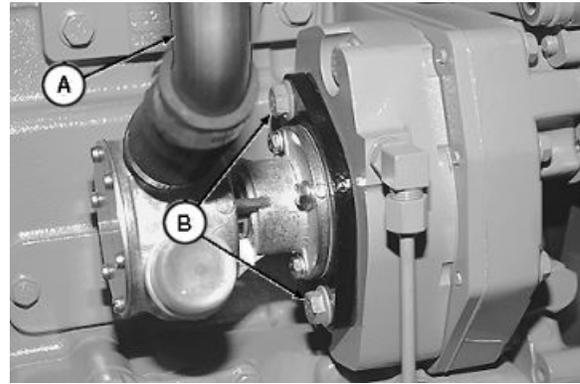
NOTE: Sea water pump may have two more mounting cap screws than illustrated. Remove/install procedure is unchanged.

• Remove Sea Water Pump:

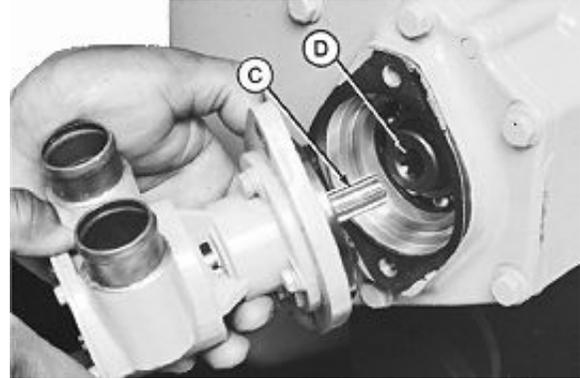
1. Close sea cock and drain sea water system, if not previously done.
2. Remove water inlet tube (shown removed) and outlet tube (A) from sea water pump.
3. Remove two cap screws (B) attaching sea water pump to gear housing. Withdraw pump from housing until splined shaft (C) is free from splined drive gear ID (D).
4. Clean all gasket material from both mating surfaces.

• Install Sea Water Pump:

1. Position a new gasket on water pump mounting flange. Install splined pump shaft in splined ID of drive gear.
2. Align mounting holes in water pump flange and gasket with threaded holes in gear housing. Install cap screws with washers and tighten cap screws to 47 N•m (35 lb-ft).
3. Connect water piping and tighten clamps.
4. Open sea cock, start engine, and check for leaks.



Remove Sea Water Pump



Install Sea Water Pump

A—Outlet Tube
B—Mounting Screws

C—Splined Shaft
D—Drive Gear Splined ID

RG9861—UN—06JAN99

RG9864—UN—06JAN99

RG19661,00003FE -19-02MAR13-1/1

Troubleshooting

General Troubleshooting Information

Troubleshooting engine problems can be difficult. Engine wiring diagrams are provided in this section to help isolate electrical problems on engines using John Deere wiring harness and instrument (gauge) panel.

Later in this section is a list of possible engine problems that may be encountered, accompanied by possible causes and corrections. The illustrated diagrams and troubleshooting information are of a general nature; final design of the overall system for your engine application may be different. See your engine distributor or servicing dealer if you are in doubt.

For Electronically Controlled Engines: The Engine Control Unit (ECU) has the ability to detect problems internally and in the electronic control system. This includes determining if any of the sensor input voltages are too high or too low, if the camshaft and crankshaft position sensor inputs are valid, and if the unit injector solenoids are responding properly.

If the ECU detects a problem with the electronic control system a Diagnostic Trouble Code (DTC) specific to the failed system will be stored in the ECU's memory.

There are two types of DTCs:

- Active
- Inactive (Stored)

Active DTCs indicate that the failure is occurring. These type of failures are sometimes called "hard" failures. They can be accessed on the diagnostic gauge (A) on the instrument panel.

Inactive or stored DTCs indicate that a failure has occurred in the past, but is not currently occurring. This type of "stored" DTC can be caused by an "intermittent" failure.



These could be problems such as a bad connection or a wire intermittently shorting to ground.

To access DTC's with the diagnostic gauge (A), see section 15 of this manual.

If a sensor or wiring fails and a DTC is active for the sensor, the ECU will use a substitute "limp home" value in its calculations to continue engine operation.

A list of DTCs is given later in this section with a description of each. Contact your engine servicing dealer to correct any DTCs which are displayed on the instrument panel.

Precautions for Welding

Remove paint before welding or heating (see Safety Section in this manual for more information on paint removal and high-pressure lines).

⚠ CAUTION: Avoid potentially toxic fumes and dust. Hazardous fumes can be generated when paint is heated by welding, soldering, or using a torch. Do all work outside or in a well ventilated area. Dispose of paint and solvent properly. If you sand or grind paint, avoid breathing the dust by wearing an approved respirator. If you use solvent or paint stripper, remove with soap and water before welding. Remove solvent or paint stripper containers and other flammable material from area before welding. Allow fumes to disperse at least 15 minutes before welding or heating.

IMPORTANT: Welding on the engine is NOT ALLOWED. If welding must be performed on the machine, follow these precautions.

IMPORTANT: High currents or electrostatic discharge into electronic components from welding may cause permanent damage.

1. Remove paint from the area to be welded and ground cable clamp location.
2. Disconnect the negative (-) battery cable(s) or open battery (-) switch if equipped.

3. Disconnect the positive (+) battery cable(s) or open battery (+) switch if equipped.
4. Clear or move any wiring harness sections away from the welding area.
5. Welding on engine components is not allowed.
6. Never connect the welder ground to any engine component or engine driven components that may be connected to the engine.
7. After welding, reverse steps 2—3.

DX,WELDING,PRECAUTIONS -19-06DEC10-1/1

TS953 —UN—15MAY90

Precautions For Welding On Vessels Equipped With Electronic Engine Control Unit (ECU)

IMPORTANT: ALWAYS disconnect Electronic Control Unit (ECU) 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.

1. Remove the ground connection for the engine control system-to-vessel frame.
2. Disconnect the connectors from the ECU.
3. Connect the welder ground close to the welding point and be sure ECU or other electronic components are not in the ground path.



Welding Precautions

DPSG,OUOD007,2898 -19-04NOV99-1/1

TS953 —UN—15MAY90

Engine Troubleshooting

NOTE: If using BIODIESEL blends above B20, the possibility of some of the symptoms listed below, such as power loss, could increase.

NOTE: Before troubleshooting the engine, first retrieve any fault codes on the diagnostic gauge display and perform the corrective actions. (See information later in this section.) If any problems remain, use the following charts to solve engine problems.

Symptom	Problem	Solution
Engine cranks but will not start	Incorrect starting procedure.	Verify correct starting procedure.
	No fuel.	Check fuel in tank and manual shut-off valve.
	Exhaust restricted.	Check and correct exhaust restriction.
	Fuel filter plugged or full of water.	Replace fuel filter or drain water from filter.
	Injection pump not getting fuel or air in fuel system.	Check fuel flow at supply pump or bleed fuel system.
	Faulty injection pump or nozzles.	Consult authorized diesel repair station for repair or replacement.
Engine hard to start or will not start	Engine starting under load.	Disengage PTO (if equipped).
	Improper starting procedure.	Review starting procedure.
	No fuel.	Check fuel tank.
	Air in fuel line.	Bleed fuel line.
	Cold weather.	Use cold weather starting aids.
	Slow starter speed.	See "Starter Cranks Slowly".
	Crankcase oil too heavy.	Use oil of proper viscosity.
	Improper type of fuel.	Consult fuel supplier; use proper type fuel for operating conditions.
	Water, dirt, or air in fuel system.	Drain, flush, fill, and bleed system.
	Clogged fuel filter.	Replace filter element.
	Dirty or faulty injection nozzles.	Have authorized servicing dealer or engine distributor check injectors.
	Electronic fuel system problem	See your authorized servicing dealer
	Injection pump shut-off not reset.	Turn key switch to "OFF" then to "ON".
Engine knocks	Low engine oil level.	Add oil to engine crankcase.

Symptom	Problem	Solution
	Injection pump out of time.	See your authorized servicing dealer or engine distributor.
	Low coolant temperature.	Remove and check thermostat.
	Engine overheating.	See "Engine Overheats".
Engine runs irregularly or stalls frequently	Low coolant temperature.	Remove and check thermostat.
	Clogged fuel filter.	Replace fuel filter element.
	Water, dirt, or air in fuel system.	Drain, flush, fill, and bleed system.
	Poor quality fuel.	Change to better quality fuel.
	Dirty or faulty injection nozzles.	Have authorized servicing dealer or engine distributor check injectors.
	Electronic fuel system problem	See your authorized servicing dealer
Below normal engine temperature	Defective thermostat.	Remove and check thermostat.
	Defective temperature gauge or sender.	Check gauge, sender, and connections.
Lack of power	Engine overloaded.	Reduce load.
	Intake air restriction.	Service air cleaner.
	Clogged fuel filter.	Replace filter elements.
	Improper type of fuel.	Use proper fuel.
	Overheated engine.	See "Engine Overheats".
	Below normal engine temperature.	Remove and check thermostat.
	Improper valve clearance.	See your authorized servicing dealer or engine distributor.
	Dirty or faulty injection nozzles.	Have authorized servicing dealer or engine distributor check injectors.
	Injector tip deposits	Use John Deere approved biodiesel fuel conditioners containing detergents.
	Injection pump out of time.	See your authorized servicing dealer or engine distributor.
	Turbocharger not functioning. (Turbocharger engines only.)	See your authorized servicing dealer or engine distributor.

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OUOD006,0000113 -19-16OCT07-2/5

Symptom	Problem	Solution
	Leaking exhaust manifold gasket.	See your authorized servicing dealer or engine distributor.
	Defective aneroid control line.	See your authorized servicing dealer or engine distributor.
	Restricted fuel hose.	Clean or replace fuel hose.
	Low fast idle speed.	See your authorized servicing dealer or engine distributor.
	Damaged propeller	Have propeller checked.
	Marine growth	Clean hull.
Low oil pressure	Low oil level.	Add oil.
	Improper type of oil.	Drain, fill crankcase with oil of proper viscosity and quality.
High oil consumption	Crankcase oil too light.	Use proper viscosity oil.
	Oil leaks.	Check for leaks in lines, gaskets, and drain plug.
	Restricted crankcase vent tube.	Clean vent tube.
	Defective turbocharger (if equipped).	See your authorized servicing dealer or engine distributor.
Engine emits white smoke	Improper type of fuel.	Use proper fuel.
	Low engine temperature.	Warm up engine to normal operating temperature.
	Defective thermostat.	Remove and check thermostat.
	Defective injection nozzles.	See your authorized servicing dealer or engine distributor.
	Engine out of time.	See your authorized servicing dealer or engine distributor.
Engine emits black or gray exhaust smoke	Improper type of fuel.	Use proper fuel.
	Clogged or dirty air cleaner.	Service air cleaner.
	Engine overloaded.	Reduce load.

Continued on next page

OUOD006,0000113 -19-16OCT07-3/5

Symptom	Problem	Solution
	Fuel injectors dirty.	Use John Deere approved biodiesel or diesel fuel conditioners containing detergents. If no improvement is seen, see your authorized servicing dealer or engine distributor.
	Engine out of time.	See your authorized servicing dealer or engine distributor.
	Turbocharger not functioning.	See your authorized servicing dealer or engine distributor.
	Electronic fuel system problem	See your authorized servicing dealer
Engine overheats	Engine overloaded.	Reduce load.
	Low coolant level.	Fill coolant tank to proper level, check coolant tank and hoses for loose connections or leaks.
	Faulty coolant tank cap.	Have serviceman check.
	Stretched poly-vee belt or defective belt tensioner.	Check automatic belt tensioner and check belts for stretching. Replace as required.
	Faulty sea (raw) water pump.	Check/replace impeller/pump.
	Low engine oil level.	Check oil level. Add oil as required.
	Cooling system needs flushing.	Flush cooling system.
	Defective thermostat.	Remove and check thermostat.
	Defective temperature gauge or sender.	Check water temperature with thermometer and replace, if necessary.
	Electronic fuel system problem	See your authorized servicing dealer
	Incorrect grade of fuel.	Use correct grade of fuel.
	Plugged heat exchanger.	Clean heat exchanger and core.
	Plugged keel cooler.	Flush and clean keel cooler. Check for marine growth on O.D. of keel cooler tubes.
	Trash or debris in engine compartment.	Clean engine compartment.
High fuel consumption	Improper type of fuel.	Use proper type of fuel.
	Clogged or dirty air cleaner.	Service air cleaner.

Continued on next page

OUOD006,0000113 -19-16OCT07-4/5

Troubleshooting

Symptom	Problem	Solution
	Engine overloaded.	Reduce load.
	Improper valve clearance.	See your authorized servicing dealer or engine distributor.
	Injection nozzles dirty.	See your authorized servicing dealer or engine distributor.
	Injector tip deposits	Use John Deere approved biodiesel fuel conditioners containing detergents.
	Engine out of time.	See your authorized servicing dealer or engine distributor.
	Defective turbocharger.	See your authorized servicing dealer or engine distributor.
	Low engine temperature.	Check thermostat.

OUOD006,0000113 -19-16OCT07-5/5

Electrical Troubleshooting

Symptom	Problem	Solution
Undercharged electrical system	Excessive electrical load from added accessories.	Remove accessories or install higher output alternator.
	Excessive engine idling.	Increase engine rpm when heavy electrical load is used.
	Poor electrical connections on battery, ground strap, starter, or alternator.	Inspect and clean as necessary.
	Defective battery.	Test battery.
Battery uses too much water	Defective alternator.	Test charging system.
	Cracked battery case.	Check for moisture and replace as necessary.
	Defective battery.	Test battery.
Batteries will not charge	Battery charging rate too high.	Test charging system.
	Loose or corroded connections.	Clean and tighten connections.
	Sulfated or worn-out batteries.	See your authorized servicing dealer or engine distributor.
Starter will not crank	Stretched poly-vee belt or defective belt tensioner.	Adjust belt tension or replace belt.
	PTO engaged (if equipped).	Disengage PTO.
	Marine gear control engaged.	Disengage marine gear.
	Loose or corroded connections.	Clean and tighten loose connections.
	Low battery output voltage.	See your authorized servicing dealer or engine distributor.
	Faulty start circuit relay.	See your authorized servicing dealer or engine distributor.
	Blown main system fuse.	Replace fuse.
Starter cranks slowly	Low battery output.	See your authorized servicing dealer or engine distributor.
	Crankcase oil too heavy.	Use proper viscosity oil.
	Loose or corroded connections.	Clean and tighten loose connections.
Starter and hour meter functions; rest of electrical system does not function	Blown fuse on magnetic switch.	Replace fuse.

Continued on next page

DPSG,OUOD007,335 -19-04JAN02-1/2

Troubleshooting

Symptom	Problem	Solution
Entire electrical system does not function	Faulty battery connection.	Clean and tighten connections.
	Sulfated or worn-out batteries.	See your authorized servicing dealer or engine distributor.
	Blown main system fuse.	Replace fuse.

DPSG,OUOD007,335 -19-04JAN02-2/2

Storage

Engine Storage Guidelines

1. John Deere engines can be stored outside for up to three (3) months with no long term preparation **IF COVERED BY WATERPROOF COVERING**. No outside storage is recommended without a waterproof covering.
2. John Deere engines can be stored in a standard overseas shipping container for up to three (3) months with no long term preparation.
3. John Deere engines can be stored inside for up to six (6) months with no long term preparation.
4. John Deere engines expected to be stored more than six (6) months **MUST** have long term storage preparation. (See PREPARING ENGINE FOR LONG TERM STORAGE, later in this section.)
5. Long term storage includes the use of a stabilized rust preventive oil to protect internal metal components of the engine. This oil should be an SAE 10 oil with 1-4 percent morpholine or equivalent vapor corrosion inhibitor. These rust preventive oils are available from area distributors.

IMPORTANT: DO NOT USE BIODIESEL DURING MACHINE STORAGE. When using biodiesel blends, switch to petroleum diesel for long term storage. Before storage, operate engine on at least one complete tank of petroleum diesel fuel to purge the fuel system. Follow normal storage procedures once the fuel system has been purged.

OUOD006,0000114 -19-16OCT07-1/1

Preparing Engine for Long Term Storage

The following storage preparations are used for long term engine storage up to one year. After that, the engine should be started, warmed up, and retreated for an extended storage period.

IMPORTANT: Any time your engine will not be used for over six (6) months, the following recommendations for storing it and removing it from storage will help to minimize corrosion and deterioration.

IMPORTANT: DO NOT USE BIODIESEL DURING MACHINE STORAGE. When using biodiesel blends, switch to petroleum diesel for long term storage. Before storage, operate engine on at least one complete tank of petroleum diesel fuel to purge the fuel system. Follow normal storage procedures once the fuel system has been purged.

1. Change engine oil and replace filter. (See CHANGE ENGINE OIL AND FILTER in Lubrication and Maintenance/500 Hour Section.) Used oil will not give adequate protection. Add one (1) ounce of rust preventive oil to the engine crankcase for every quart of oil. This rust preventive oil should be an SAE 10 oil with 1-4 percent morpholine or equivalent vapor corrosion inhibitor.
 2. Ensure the machine fuel tank is filled with high quality petroleum diesel fuel. Filling the tank completely will ensure that water does not build up due to condensation. For storage of more than one year, use John Deere PREMIUM DIESEL FUEL CONDITIONER (or equivalent) at the specified concentration.
 3. Service air cleaner. (See REPLACING AIR CLEANER FILTER ELEMENTS in Service As Required Section.)
 4. Draining and flushing of cooling system is not necessary if engine is to be stored only for several months. However, for extended storage periods of a year or longer, it is recommended that the cooling system be drained, flushed, and refilled. Refill with appropriate coolant. (See RECOMMENDED ENGINE COOLANT in Fuels, Lubricants, and Coolant Section and ADDING COOLANT in Service As Required Section.)
 5. Prepare a tank with a solution of diesel fuel and rust preventive oil, at ten (10) ounces of rust preventive oil per gallon of diesel fuel.
 6. Remove existing lines/plugs as required, and run a temporary line from the tank to the engine fuel intake, and another temporary line from the fuel return manifold to the tank, so rust preventive oil solution is circulated through the injection system during cranking.
 7. Crank the engine several revolutions with starter (do not allow the engine to start). This will allow rust preventive oil solution to circulate.
 8. Remove temporary lines installed in Step 6 above, and replace any lines/plugs previously removed.
- NOTE: One gallon of fuel/oil solution can be used to treat 100 engines; two gallons to treat 200 engines, etc. The oil could then be replenished by adding an additional five (5) ounces of rust preventive oil per gallon of solution. However, starting over with a new solution is recommended to dispose of any water or other impurities.*
9. Loosen, or remove and store, fan/alternator poly-vee belt.
 10. Remove and clean batteries. Store them in a cool, dry place and keep them fully charged.
 11. Disengage the clutch for any driveline.
 12. Clean the exterior of the engine with salt-free water and touch up any scratched or chipped painted surfaces with a good quality paint.
 13. Coat all exposed (machined) metal surfaces with grease or corrosion inhibitor if not feasible to paint.
 14. Seal all openings on engine with plastic bags and tape.
 15. Store the engine in a dry protected place. If engine must be stored outside, cover it with a waterproof canvas or other suitable protective material and use a strong waterproof tape.

Removing Engine from Long-Term Storage

Refer to the appropriate section for detailed services listed below or have your authorized servicing dealer or engine distributor perform services that you may not be familiar with.

1. Remove all protective coverings from engine. Unseal all openings in engine and remove covering from electrical systems.
2. Remove the batteries from storage. Install batteries (fully charged) and connect the terminals.
3. Install alternator poly-vee belt if removed. Adjust belt tension. (See CHECKING BELT TENSIONER SPRING TENSION AND BELT WEAR in Lubrication and Maintenance/500 Hour/12 Month Section.) Install belt guard.
4. Perform all appropriate prestarting checks. (See DAILY PRESTARTING CHECKS in Lubrication and Maintenance/Daily Section.)
5. Open sea water valve and prime the sea water system.
6. Open fuel valve, fill fuel filter/water separator with clean fuel and bleed the fuel system. (See BLEEDING THE FUEL SYSTEM in Service as Required Section.)

IMPORTANT: DO NOT operate starter more than 30 seconds at a time. Wait at least 2 minutes for starter to cool before trying again.

7. Crank engine for 20 seconds with starter (do not allow the engine to start). Wait 2 minutes and crank engine an additional 20 seconds to assure bearing surfaces are adequately lubricated.
8. Start engine and run at low idle and no load for several minutes. Warm up carefully and check all gauges before placing engine under load.
9. On the first day of operation after storage, check overall engine for leaks and check all gauges for correct operation.

NOTE: If using BIODIESEL blends after long term storage, frequency of fuel filter plugging may increase initially.

OUOD006,0000115 -19-16OCT07-1/1

Specifications

General Marine Engine Specifications - 4.5L

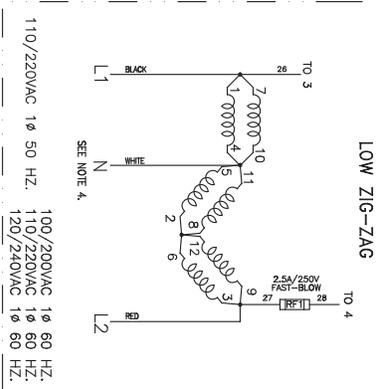
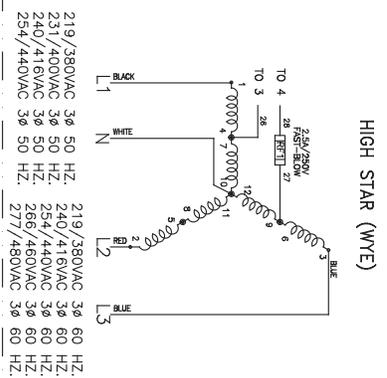
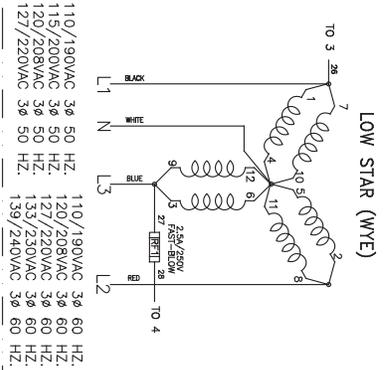
ITEM	UNIT OF MEASURE	ENGINE MODEL M50T13 - M65T13
General Data		
Engine Type		In-line, 4 cycle diesel
Aspiration		Turbocharged
Number of Cylinders		4
Bore	mm (in.)	106 (4.17)
Stroke	mm (in.)	127 (5.00)
Displacement	L (cu in.)	4.5 (275)
Combustion System		Direct Injection
Compression Ratio		16.0:1
Physical Dimensions:		
Width	mm (in.)	715 (28.1)
Height	mm (in.)	912 (35.9)
Length	mm (in.)	1007 (39.6)
Basic Dry Weight (approximate)	kg (lb)	n/a
Lubrication System (Propulsion Applications)		
Oil Pressure at Rated rpm ($\pm 35\%$)	kPa (psi)	—
Oil Pressure at Low Idle (800 rpm)	kPa (psi)	—
Lubrication System (Generator Applications)		
Oil Pressure at Rated rpm ($\pm 35\%$)	kPa (psi)	290 (42)
Cooling System (Liquid, pressurized with centrifugal pump)		
Recommended Pressure Cap	kPa (psi)	110 (16)
Coolant Temperature Operating Range	$^{\circ}\text{C}$ ($^{\circ}\text{F}$)	82-94 (180-202) 110
Coolant Temperature (Maximum)	$^{\circ}\text{C}$ ($^{\circ}\text{F}$)	(230)
Coolant Capacity	L (qt)	—
Valve Actuation		
Valve Clearance (Cold)		
Intake	mm (in.)	0.35 (0.014)
Exhaust	mm (in.)	0.45 (0.018)
Fuel System		
ECU Description		L16
Fuel Injection Type		HPCR
Governor Type		Electronic
Primary Fuel Filter		10 micron
Secondary Fuel Filter		2 micron
Electrical System		
Battery Capacity (Minimum)- 12 Volt System	CCA	625 500
Battery Capacity (Minimum)- 24 Volt System	CCA	
Air System		
Maximum Air Intake Restriction	in. H ₂ O (kPa) (psi)	25 (6.25) (1.0)

revised 5-4-17

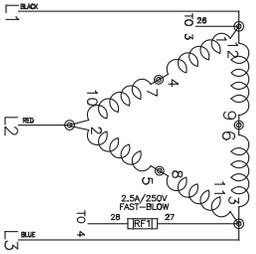
DC 24 Volt ISO Drawing

Drawing not available at time of publication. Please contact factory.

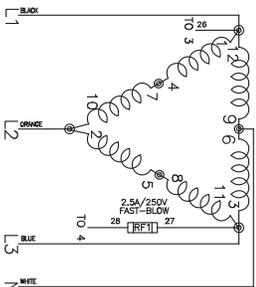
AC with APR 63-5 Drawing



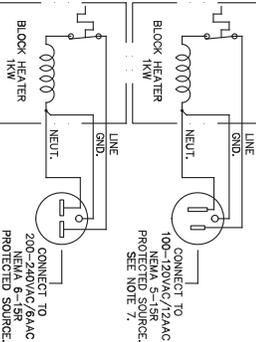
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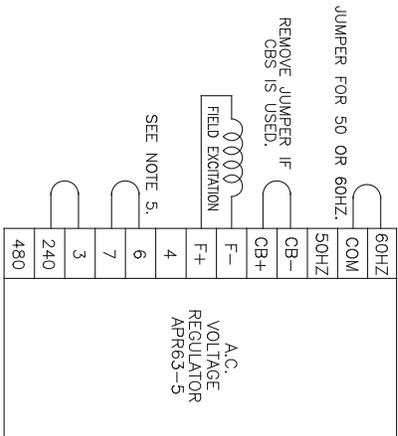
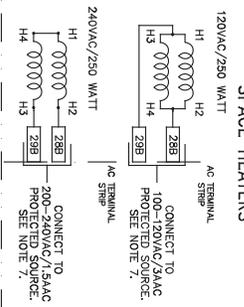
DELTA W/NEUTRAL



OPTIONAL BLOCK HEATERS



OPTIONAL GENERATOR SPACE HEATERS

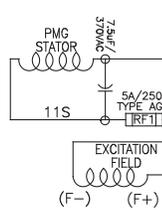
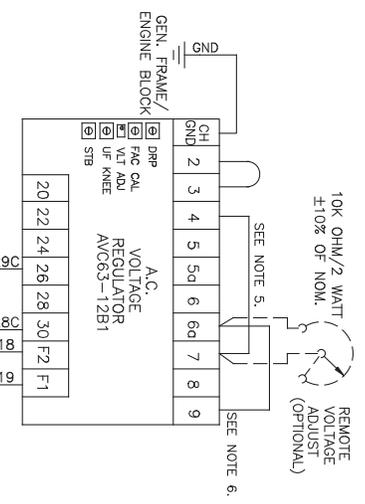
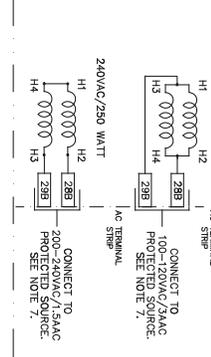
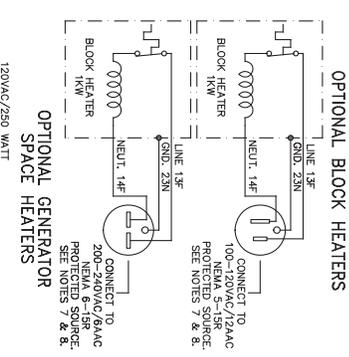
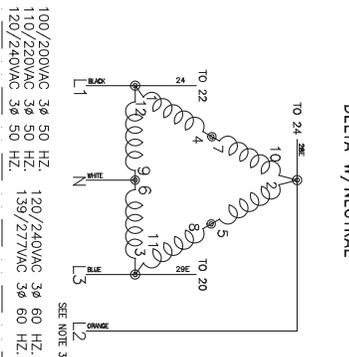
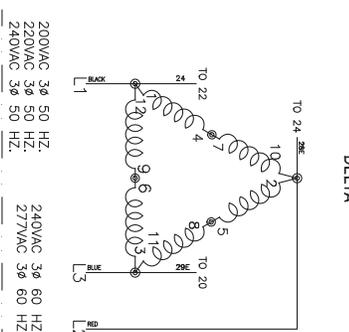
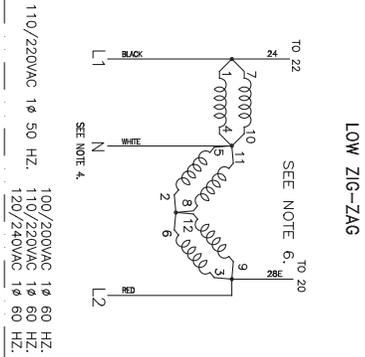
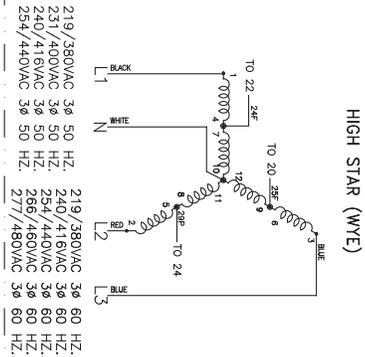
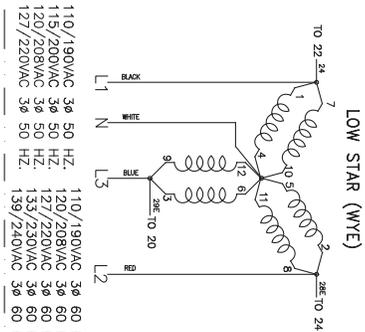


- NOTES:**
1. ALL INSTALLATION CONDUCTORS ARE TO BE AWG 14, TYPE MTW, 600VAC, 105°C, STRANDED.
 2. UNLESS COLOR CODED, ALL NU INSTALLED CONDUCTORS ARE TO BE GREY AND MUST BE IDENTIFIED BY WIRE MARKER AT EACH CONNECTION POINT.
 3. LINE TWO (HIGH LEG) TO BE MARKED ORANGE IN COMPLIANCE WITH ARTICLE 215.8 OF THE NATIONAL ELECTRIC CODE. VOLTAGE BETWEEN LINE TWO AND NEUTRAL IS FOUND BY MULTIPLYING THE LINE TO LINE VOLTAGE BY 1.73.
 4. IF LOWER (L-N) VOLTAGE IS NOT REQUIRED DO NOT BRING OUT NEUTRAL POINT (NO NEUTRAL CONDUCTOR).
 5. REMOVE JUMPER BETWEEN TERMINALS 6 AND 7 IF A REMOTE VOLTAGE ADJUST RHEOSTAT IS USED.
 6. GENSETS ARE TO BE GROUNDED BY CUSTOMER, AT CUSTOMER'S DISCRETION.
 7. DO NOT ENERGIZE HEATERS WHILE GENSET IS IN OPERATION.

200VAC 3Ø 50 HZ.	240VAC 3Ø 60 HZ.
220VAC 3Ø 50 HZ.	277VAC 3Ø 60 HZ.
240VAC 3Ø 50 HZ.	100/200VAC 3Ø 50 HZ.
	110/220VAC 3Ø 50 HZ.
	120/240VAC 3Ø 50 HZ.

110/220VAC 1Ø 50 HZ.	100/220VAC 1Ø 60 HZ.
120/240VAC 1Ø 50 HZ.	120/240VAC 1Ø 60 HZ.

AC with PMG & AVC63-12B1 Drawing



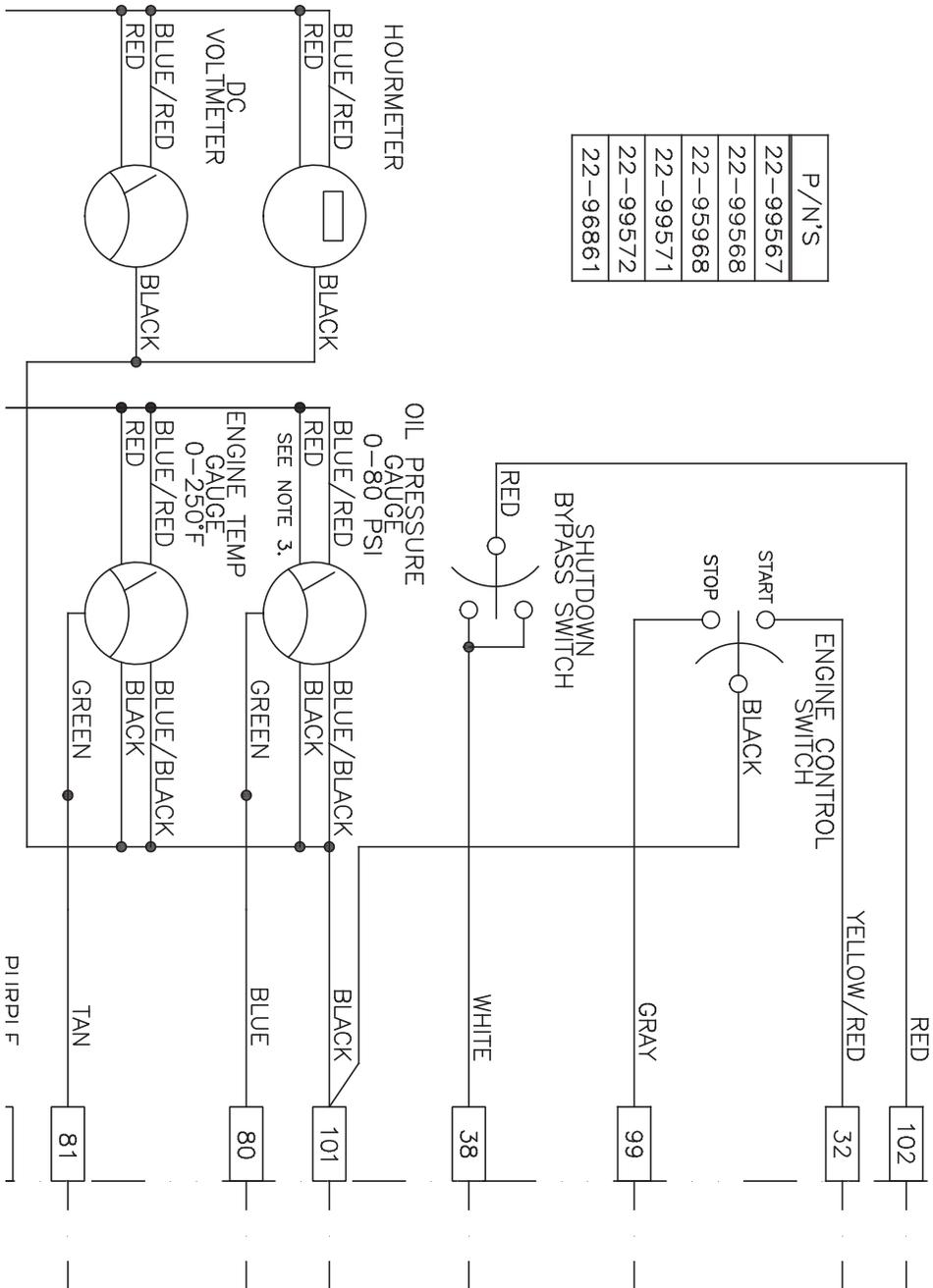
- NOTES:**
1. ALL INSTALLATION CONDUCTORS ARE TO BE AWG 14, TYPE MTW, 600VAC, 200VAC 3Ø 50 HZ., 220VAC 3Ø 50 HZ., 240VAC 3Ø 50 HZ.
 2. UNLESS COLOR CODED, ALL WIRE INSTALLED CONDUCTORS ARE TO BE GRAY AND MUST BE IDENTIFIED BY WIRE MARKER AT EACH CONNECTION POINT.
 3. LINE TWO (HIGH LEG) TO BE MARKED ORANGE IN COMPLIANCE WITH ARTICLE 215-8 OF THE NATIONAL ELECTRIC CODE. VOLTAGE BETWEEN LINE TWO AND NEUTRAL IS FOUND BY DIVIDING THE LINE TO LINE VOLTAGE BY 1.73.
 4. IF LOWER (L-N) VOLTAGE IS NOT REQUIRED DO NOT BRING OUT NEUTRAL POINT (NO NEUTRAL CONDUCTOR).
 5. REMOVE JUMPER BETWEEN TERMINALS 4 AND 7 IF A REMOTE VOLTAGE ADJUST RHEOSTAT IS USED. TURN THE INTERNAL VOLTAGE ADJUST POTENTIOMETER FULLY CLOCKWISE FOR PROPER REMOTE VAR OPERATION.
 6. REMOVE JUMPER BETWEEN TERMINALS 6a AND 9 FOR SINGLE PHASE SENSING.
 7. DO NOT ENERGIZE HEATERS WHILE UNIT IS IN OPERATION.
 8. REMOVE INTERNAL LEADS PLUS AND NEUTRAL HEATER LEADS TO TERMINALS NUMBERED AS INDICATED FOR MARINE DUTY UNITS ONLY.

S-3 Panel Drawing

CONTROL PANEL

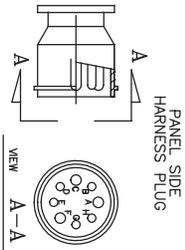
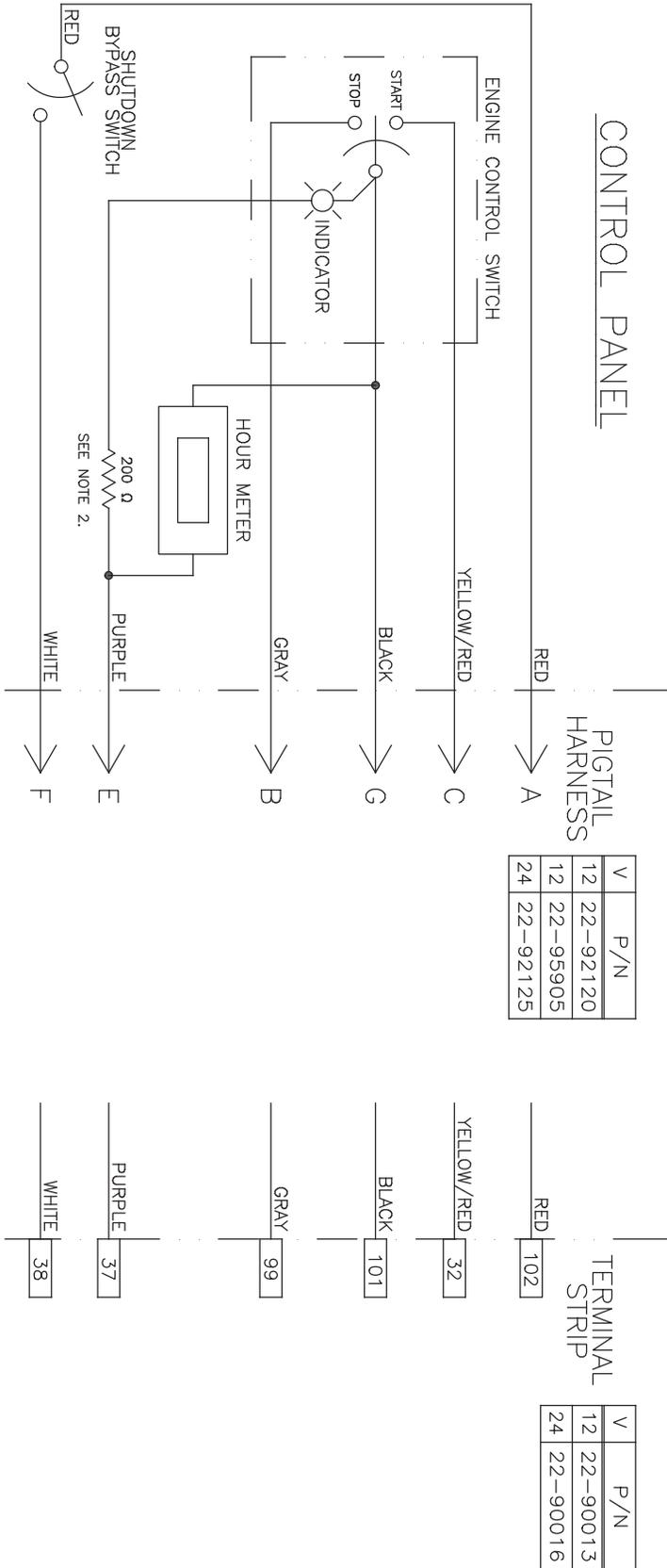
CUSTOMER
SUPPLIED
INTERCONNECTS

P/N'S
22-99567
22-99568
22-95968
22-99571
22-99572
22-96861



S-1 Panel Drawing

CONTROL PANEL



NOTES:

1. ALL INSTALLATION CONDUCTORS ARE TO BE AWG 14, TYPE MTW, 600VAC, 105°C, STRANDED, EXCEPT AS NOTED.



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