6090 PowerTech™ OEM Diesel Engines (Final Tier 4/Stage IV platform)

COMPONENT TECHNICAL MANUAL

9.0 L OEM Diesel Engines — Final Tier 4/Stage IV platform

CTM117719 01AUG13 (ENGLISH)

For complete service information also see:

OEM Engine Accessories	**CTM67**
JDPS Master Tool Manual	**TM111119**
Application List	**CTM106819**

John Deere Power Systems
LITHO IN U.S.A.

Introduction

Foreword

This repair manual is valid for the engines.

This manual is written for an experienced technician. Essential tools required in performing certain service work are identified in this manual.

Live with safety: Read the safety messages in the introduction of this manual and the cautions presented throughout the text of the manual.

This is the safety-alert symbol. When you see this symbol on the machine or in this manual, be alert to the potential for personal injury.

Information in this manual is organized in sections and sub divided into groups.

Section 01 covers the safety measures to follow while repairing the engine; engine identification features, engine emission & application details, and information about the fuels, lubricants & coolants.

Section 02 covers the Repair and Adjustment procedures.

Section 03 explains Systems Theory of Operation.

Section 04 is the diagnostics section that provides troubleshooting procedures to find problems.

Section 05 lists all applicable service equipment and tools, other materials needed to do the job.

Section 06 details all specifications, wear tolerances, torque values and contains the wiring diagrams.

This manual contains SI Metric units of measure followed immediately by the U.S. customary units of measure. Most hardware on these engines is metric sized.

Read each block of material completely before performing service to check for differences in procedures or specifications. Follow only the procedures that apply to the component you are working on.

Component Technical Manuals are concise service guides for specific components. Component technical manuals are written as stand-alone manuals covering multiple machine applications.

Fundamental service information is available from other sources covering basic theory of operation, fundamentals of troubleshooting, general maintenance, and basic type of failures and their causes.

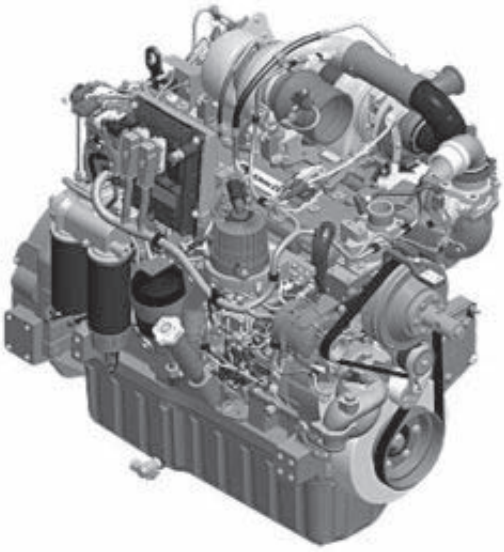
CALIFORNIA PROPOSITION 65 WARNING
Diesel engine exhaust and some of its constituents are known to the State of California to cause cancer, birth defects and other reproductive harm.

RE38635,00000D9 -19-03SEP09-1/1

Record of Changes

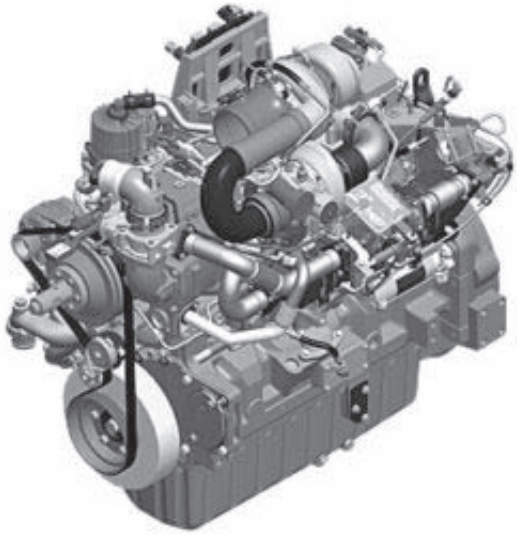
ZE59858,0000235 -19-18JAN13-1/1

Identification Views



RG22199 —UN—12DEC12

Final Tier 4 6090 Engine — Right Front View



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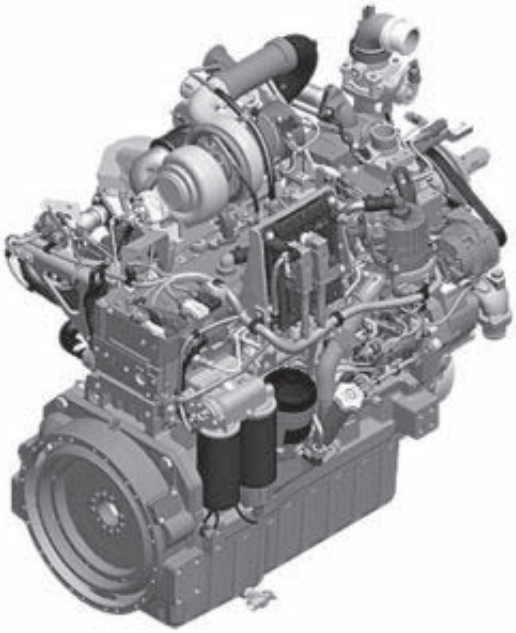
Final Tier 4 6090 Engine — Left Front View



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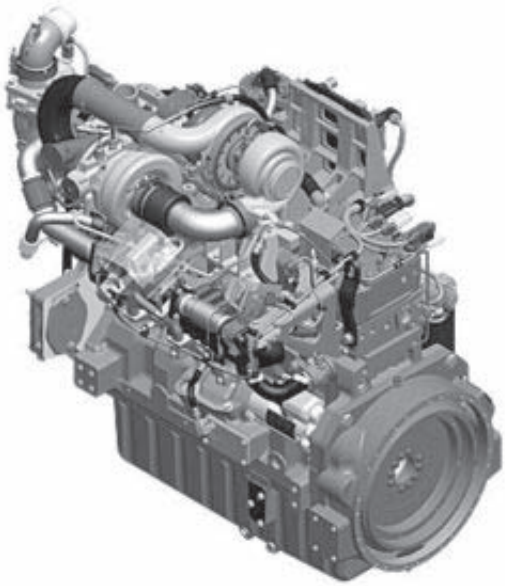
Final Tier 4 6090 Engine — Right Rear View



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Final Tier 4 6090 Engine — Left Rear View

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Related Manuals

Tool Manual

When working through the instructions in this manual, you may require the use of special tools. For a complete listing of John Deere approved essential and dealer fabricated engine tools, please refer to the JDPS Master Tool Manual Technical Manual (TM).

Application List Manual

For more information on which engine manuals should be referred to for a specific machine or engine, please refer to the Application List Manual Component Technical Manual (CTM). This manual provides a listing of machine and engine models, and their appropriate base engine and fuel system manual numbers. For OEM applications, the operators manual number for the engine is also included.

JR74534,000029B -19-08OCT10-1/1

Training Information

John Deere University offers the following related training for the engine covered in this manual. More information on each of these courses can be found online on the John Deere University website (example: https://jdu.deere.com/).

Course Title
Service ADVISOR Overview
Diesel Engine Systems I
Diesel Engine Systems II
Electrical Systems I
Electrical Systems II
Hydraulic Systems I
Hydraulic Systems II
Hydraulic Methods & Techniques
Service ADVISOR Methods & Techniques
Electrical Methods & Techniques
John Deere Custom Performance
Diesel Fuel Fundamentals
John Deere Plus 50™ II & Cool-Gard™ II
Engine – Final Tier 4 / Stage IV Sales & Marketing Qualification DLM
Engine – Integrated Emissions Control System Overview
Engine – Introduction to Final Tier 4 / Stage IV Technologies

ZE59858,0000237 -19-04JUN13-1/1

Definition of Terms

Actuator	A device controlled by the ECU to perform a certain function.
Analog	Signal which has a continuous range of possible voltages, usually 0 V (low) to 24 V (high).
Application	Either a movable or stationary piece of equipment that the engine is placed in. Applications include, Tractors, Harvesters, Loaders, Irrigation Pumps, Generator Sets, and others.
BAP	Barometric Air Pressure. Pressure of the atmosphere (atmospheric pressure).
Boost	Pressurized air in the intake manifold.
CAC	Charge Air Cooler. Cools the compressed air from the turbine before it enters the intake manifold.
CAN	Controller Area Network. The network on applications that allows communication between the engine control unit and some components.
Circuit Power	Power supplied to a device for use by its internal component circuits.
Crankshaft Position Sensor	Used to determine the angular position and velocity of the crankshaft in the 360° field of rotation.
DEF	Diesel Exhaust Fluid. A urea water solution that is injected into the exhaust stream before the SCR to reduce NOx.
Digital	A signal which consists of only two levels of voltage — usually 0 V (low) to 24 V (high).
DOC	Diesel Oxidation Catalyst. Part of the exhaust filter or aftertreatment device. Used to help reduce emissions.
DPF	Diesel Particulate Filter. Part of the exhaust filter or aftertreatment device. Used to help reduce emissions.
DTC	Diagnostic Trouble Code. A code that is stored in ECU memory when it detects a problem in the electronic control system. There are two types of codes: Active and Stored. These codes are displayed on monitor panels and can be recalled by the service tool.
ECT	Engine Coolant Temperature. The temperature of the engine coolant.
ECU	Engine Control Unit. Computer that controls the fuel, air, and ignition systems on the engine.
EGR	Exhaust Gas Recirculation. Used to help reduce emissions.
EI	An Electronic Injector that is regulated by the ECU to control the proper amount of fuel on High-Pressure Common rail fuel systems.
EOL	This is the abbreviation for End of Line which is where the ECU gets programmed at the factory.
EUI	An Electronic Unit Injector that is regulated by the ECU to control the proper amount of fuel on non-High-Pressure Common rail fuel systems.
FMI	Failure Mode Identifier. The second part of a two-part code that identifies control system fault codes according to the J1939 standard. This two-digit code identifies the type of failure that has occurred. The first half of the code is the Suspect Parameter Number (SPN).
H-Bridge	Circuits in the ECU set up in an H-configuration. This allows for current to be reversed to drive DC motors forward and reverse.
HPCR	High-Pressure Common-Rail. A device that distributes high-pressure fuel to the injectors.
Input	This identifies a signal as an input to a device or control unit.

Continued on next page

J1939	The Society of Automotive Engineers (SAE) standard for communication between the electronic control units on heavy-duty vehicles, both on- and off-highway.
JDCP	John Deere Custom Performance Program allows the customer to select software features and feature combinations prior to loading the software into the ECU. It is also one way by which embedded software is managed and updated in control units without removal of the control unit from the machine.
JDPS	John Deere Power Systems.
MAP	Manifold Air Pressure. The pressure of the air in the intake manifold, sometimes referred to as ”boost” pressure.
MAT	Manifold Air Temperature. The temperature of the air in the intake manifold.
Meter Zero	This is the value the multimeter reads in the ohm position, when the meter lead tips are held together.
Mis-pin	An incorrect placement of male pins or female sockets within an electrical connector. Also known as an incorrect swapping of wires and terminals.
NOx	Nitrogen oxides. A gas that is produced as a by product of combustion, especially at higher combustion temperatures.
OOR	Out-of-Range. The signal received by the ECU is out of the expected range of the device.
OORH	Out-of-Range High. Signal sensed by the ECU is higher than the component can produce (outside of acceptable limit). For some circuit types, this could be caused by an open input wire, an open ground wire, or an input wire shorted to a voltage higher than the ECU expects (+ battery).
OORL	Out-of-Range Low. Signal sensed by the ECU is lower than the component can produce (outside of acceptable limits). For some circuit types, this could be caused by an input wire or circuit power wire shorted to ground.
Output	This identifies a signal as an output from a device or control unit.
Pin	A style of terminal that makes the electrical connection to a connector. Also called a male terminal.
Pressure Relief Valve	Used in conjunction with the pressure control valves to control the fuel pressure in the HPCR.
PWM	Pulse Width Modulation. A digital electronic signal of a fixed frequency. The on-time of the signal is increased or decreased (modulated) to indicate a change in condition.
SCR	Selective Catalytic Reduction. Used in conjunction with DEF to reduce NOx emissions coming out of the exhaust.
RAM	Random Access Memory. The portion of the computer memory within the ECU that is used when the ECU is running. All data in this memory is lost when the ECU is ”OFF”.
Socket	A style of terminal that makes the electrical connection to a connector. Also called a female terminal or receptacle.
Pressure Control Valve	Two pressure control valves regulate the amount of fuel that the high-pressure fuel pump supplies to the HPCR.
SDS	Software Delivery System. Used by JDPS to maintain software and programming records.
Sensor	Device used by the ECU to monitor various engine parameters.
SPN	Suspect Parameter Number. The first half of a two-part code that identifies control system fault codes according to the J1939 Standard. The SPN identifies the system or component that has the failure. The second half of the code is the Failure Mode Identifier (FMI).
TDC	Top Dead Center. Point of uppermost piston travel.
Throttle Rate	How quickly the ECU changes the engine fuel rate in response to a throttle increase signal. Throttle rate has no impact on deceleration.

Continued on next page

RE38635,0000078 -19-01MAR13-2/3

Trim Options	Options that can be enabled or disabled in the ECU programming, such as throttle selection, torque adjustment, governor gains, derates, and shutdowns, and others.
TWV	Two-Way Valve. A component in the Electronic Injector (EI).
VGT	Variable Geometry Turbo. Used to reduce emissions.
WIF	Water-In-Fuel. The WIF sensor sends a signal to the ECU when water is detected in the fuel.

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Trademarks	
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Contents

Original Instructions. All information, illustrations and specifications in this manual are based on the latest information available at the time of publication. The right is reserved to make changes at any time without notice.

Section 01
General Information

Contents

Understand Signal Words

A signal word—DANGER, WARNING, or CAUTION—is used with the safety-alert symbol. DANGER identifies the most serious hazards.

DANGER or WARNING safety signs are located near specific hazards. General precautions are listed on CAUTION safety signs. CAUTION also calls attention to safety messages in this manual.

TS187 —19—30SEP88

DX,SIGNAL -19-03MAR93-1/1

Recognize Safety Information

This is a safety-alert symbol. When you see this symbol on your machine or in this manual, be alert to the potential for personal injury.

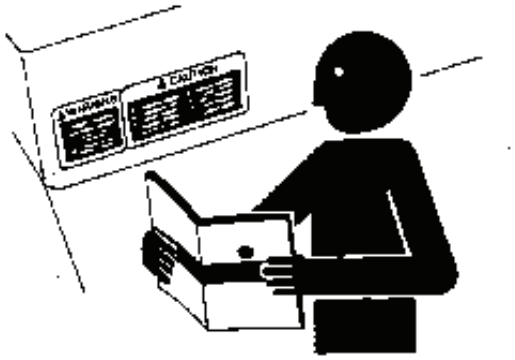
Follow recommended precautions and safe operating practices.

T81389 —UN—28JUN13

DX,ALERT -19-29SEP98-1/1

Replace Safety Signs

Replace missing or damaged safety signs. See the machine operator's manual for correct safety sign placement.



TS201 —UN—15APR13

DX,SIGNS1 -19-04JUN90-1/1

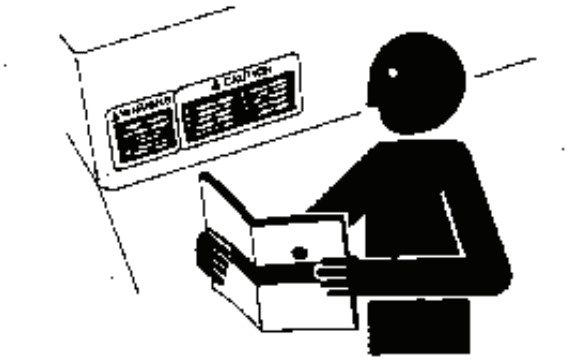
Follow Safety Instructions

Carefully read all safety messages in this manual and on your machine safety signs. Keep safety signs in good condition. Replace missing or damaged safety signs. Be sure new equipment components and repair parts include the current safety signs. Replacement safety signs are available from your John Deere dealer.

There can be additional safety information contained on parts and components sourced from suppliers that is not reproduced in this operator's manual.

Learn how to operate the machine and how to use controls properly. Do not let anyone operate without instruction.

Keep your machine in proper working condition. Unauthorized modifications to the machine may impair the function and/or safety and affect machine life.



TS201 —UN—15APR13

If you do not understand any part of this manual and need assistance, contact your John Deere dealer.

DX,READ -19-16JUN09-1/1

California Proposition 65 Warning

Diesel engine exhaust, some of its constituents, along with certain machine components contain or emit chemicals known to the State of California to cause cancer and birth defects or other reproductive harm. In addition, certain fluids contained in the machine and certain products of component wear contain or emit chemicals known to the State of California to cause cancer and birth defects or other reproductive harm.

RG41061,000001F -19-12JAN10-1/1

Exhaust Filter Cleaning

Servicing machine or attachments during exhaust filter cleaning can result in serious personal injury. Avoid exposure and skin contact with hot exhaust gases and components.

During auto or manual/stationary exhaust filter cleaning operations, the engine will run at elevated idle and hot temperatures for an extended period of time. Exhaust gases and exhaust filter components reach temperatures hot enough to burn people, or ignite, or melt common materials.

RG17488 —UN—21AUG09

DX,FILTER -19-20JAN10-1/1

Avoid Hot Exhaust

Servicing machine or attachments with engine running can result in serious personal injury. Avoid exposure and skin contact with hot exhaust gases and components.

Exhaust parts and streams become very hot during operation. Exhaust gases and components reach temperatures hot enough to burn people, ignite, or melt common materials.

RG17488 —UN—21AUG09

DX,EXHAUST -19-20AUG09-1/1

Work In Ventilated Area

Engine exhaust fumes can cause sickness or death. If it is necessary to run an engine in an enclosed area, remove the exhaust fumes from the area with an exhaust pipe extension.

If you do not have an exhaust pipe extension, open the doors and get outside air into the area.

TS220 —UN—15APR13

DX,AIR -19-17FEB99-1/1

Dispose of Waste Properly

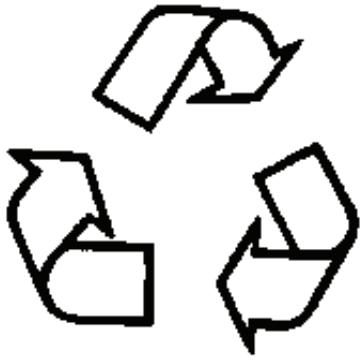
Improperly disposing of waste can threaten the environment and ecology. Potentially harmful waste used with John Deere equipment include such items as oil, fuel, coolant, brake fluid, filters, and batteries.

Use leakproof containers when draining fluids. 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.

Air conditioning refrigerants escaping into the air can damage the Earth's atmosphere. Government regulations may require a certified air conditioning service center to recover and recycle used air conditioning refrigerants.

Inquire on the proper way to recycle or dispose of waste from your local environmental or recycling center, or from your John Deere dealer.



TS1133 —UN—15APR13

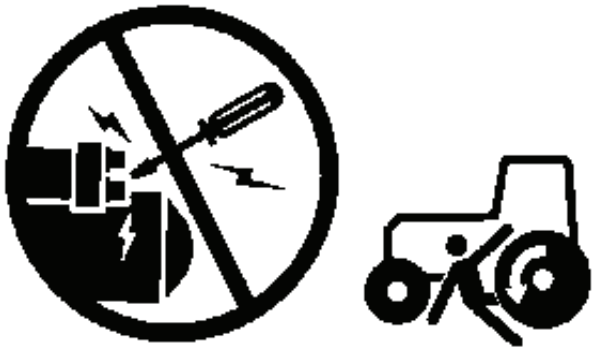
DX,DRAIN -19-03MAR93-1/1

Prevent Machine Runaway

Avoid possible injury or death from machinery runaway.

Do not start engine by shorting across starter terminals. Machine will start in gear if normal circuitry is bypassed.

NEVER start engine while standing on ground. Start engine only from operator's seat, with transmission in neutral or park.



TS177 —UN—11JAN89

DX,BYPAS1 -19-29SEP98-1/1

Practice Safe Maintenance

Understand service procedure before doing work. Keep area clean and dry.

Never lubricate, service, or adjust machine while it is moving. Keep hands, feet , and clothing from power-driven parts. Disengage all power and operate controls to relieve pressure. Lower equipment to the ground. Stop the engine. Remove the key. Allow machine to cool.

Securely support any machine elements that must be raised for service work.

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

On self-propelled equipment, disconnect battery ground cable (-) before making adjustments on electrical systems or welding on machine.

On towed implements, disconnect wiring harnesses from tractor before servicing electrical system components or welding on machine.

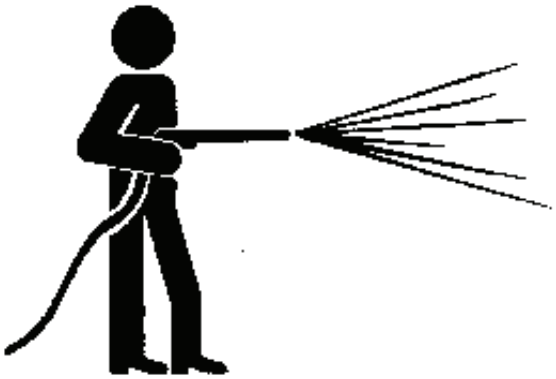
TS218 —UN—23AUG88

DX,SERV -19-17FEB99-1/1

Work in Clean Area

Before starting a job:

- Clean work area and machine.
- Make sure you have all necessary tools to do your job.
- Have the right parts on hand.
- Read all instructions thoroughly; do not attempt shortcuts.



T6642EJ —UN—18OCT88

DX,CLEAN -19-04JUN90-1/1

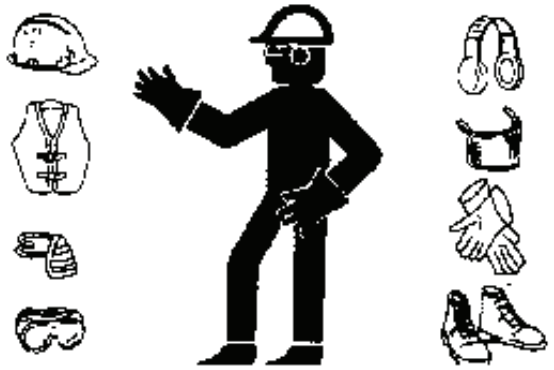
Wear Protective Clothing

Wear close fitting clothing and safety equipment appropriate to the job.

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

Wear a suitable hearing protective device such as earmuffs or earplugs to protect against objectionable or uncomfortable loud noises.

Operating equipment safely requires the full attention of the operator. Do not wear radio or music headphones while operating machine.



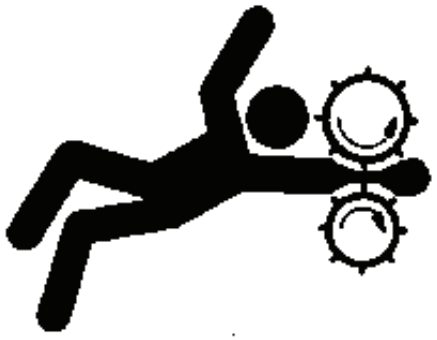
TS206 —UN—15APR13

DX,WEAR -19-10SEP90-1/1

Service Machines Safely

Tie long hair behind your head. Do not wear a necktie, scarf, loose clothing, or necklace when you work near machine tools or moving parts. If these items were to get caught, severe injury could result.

Remove rings and other jewelry to prevent electrical shorts and entanglement in moving parts.



TS228 —UN—23AUG88

DX,LOOSE -19-04JUN90-1/1

Use Proper Tools

Use tools appropriate to the work. Makeshift tools and procedures can create safety hazards.

Use power tools only to loosen threaded parts and fasteners.

For loosening and tightening hardware, use the correct size tools. DO NOT use U.S. measurement tools on metric fasteners. Avoid bodily injury caused by slipping wrenches.

Use only service parts meeting John Deere specifications.

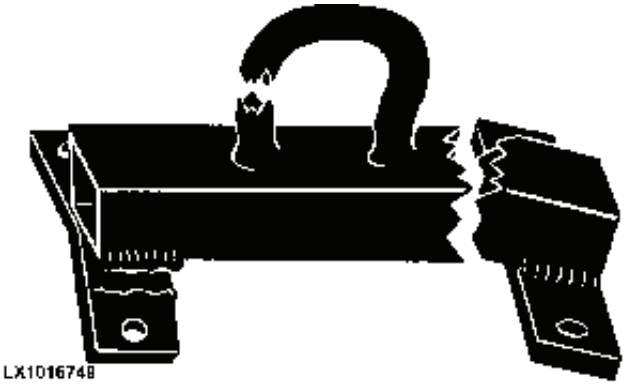
TS779 —UN—08NOV89

DX,REPAIR -19-17FEB99-1/1

Construct Dealer-Made Tools Safely

Faulty or broken tools can result in serious injury. When constructing tools, use proper, quality materials, and good workmanship.

Do not weld tools unless you have the proper equipment and experience to perform the job.



DX,SAFE,TOOLS -19-10OCT97-1/1

Support Machine Properly

Always lower the attachment or implement to the ground before you work on the machine. If the work requires that the machine or attachment be lifted, provide secure support for them. If left in a raised position, hydraulically supported devices can settle or leak down.

Do not support the machine on cinder blocks, hollow tiles, or props that may crumble under continuous load. Do not work under a machine that is supported solely by a jack. Follow recommended procedures in this manual.

When implements or attachments are used with a machine, always follow safety precautions listed in the implement or attachment operator's manual.

DX,LOWER -19-24FEB00-1/1

Use Proper Lifting Equipment

Lifting heavy components incorrectly can cause severe injury or machine damage.

Follow recommended procedure for removal and installation of components in the manual.

DX,LIFT -19-04JUN90-1/1

Protect Against Noise

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

Wear a suitable hearing protective device such as earmuffs or earplugs to protect against objectionable or uncomfortable loud noises.

TS207 —UN—23AUG88

DX,NOISE -19-03MAR93-1/1

Illuminate Work Area Safely

Illuminate your work area adequately but safely. Use a portable safety light for working inside or under the machine. Make sure the bulb is enclosed by a wire cage. The hot filament of an accidentally broken bulb can ignite spilled fuel or oil.

TS223 —UN—23AUG88

DX,LIGHT -19-04JUN90-1/1

Install All Guards

Rotating cooling system fans, belts, pulleys, 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 fans, belts, pulleys, and drives are stopped before making adjustments, connections, or cleaning near fans and their drive components.

TS677 —UN—21SEP89

DX,GUARDS -19-18AUG09-1/1

Stay Clear of Rotating Drivelines

Entanglement in rotating driveline can cause serious injury or death.

Keep all shields in place at all times. Make sure rotating shields turn freely.

Wear close-fitting clothing. Stop the engine and be sure that all rotating parts and drivelines are stopped before making adjustments, connections, or performing any type of service on engine or machine driven equipment.

TS1644 —UN—22AUG95

DX,ROTATING -19-18AUG09-1/1

Protect Against High Pressure Spray

Spray from high pressure nozzles can penetrate the skin and cause serious injury. Keep spray from contacting hands or body.

If an accident occurs, see a doctor immediately. Any high pressure spray injected into the skin must be surgically removed within a few hours or gangrene may result. Doctors unfamiliar with this type of injury should reference a knowledgeable medical source. Such information is available from Deere & Company Medical Department in Moline, Illinois, U.S.A.

TS1343 —UN—18MAR92

DX,SPRAY -19-16APR92-1/1

Service Cooling System Safely

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.

TS281 —UN—15APR13

DX,RCAP -19-04JUN90-1/1

Remove Paint Before Welding or Heating

Avoid potentially toxic fumes and dust.

Hazardous fumes can be generated when paint is heated by welding, soldering, or using a torch.

Remove paint before heating:

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

Do not use a chlorinated solvent in areas where welding will take place.

TS220 —UN—15APR13

Do all work in an area that is well ventilated to carry toxic fumes and dust away.

Dispose of paint and solvent properly.

DX,PAINT -19-24JUL02-1/1

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.

TS953 —UN—15MAY90

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

Wait Before Opening High-Pressure Fuel System

High-pressure fluid remaining in fuel lines can cause serious injury. Only technicians familiar with this type of system should perform repairs. Before disconnecting 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, confirm that the fuel pressure is relieved.

TS1343 —UN—18MAR92

ZE59858,00000A4 -19-30JUL13-1/1

Avoid High-Pressure Fluids

Inspect hydraulic hoses periodically – at least once per year – for leakage, kinking, cuts, cracks, abrasion, blisters, corrosion, exposed wire braid or any other signs of wear or damage.

Replace worn or damaged hose assemblies immediately with John Deere approved replacement parts.

Escaping fluid under pressure can penetrate the skin causing serious injury.

Avoid the hazard 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 should reference a knowledgeable medical source. Such information is available in English from Deere & Company Medical Department in Moline, Illinois, U.S.A., by calling 1-800-822-8262 or +1 309-748-5636.

X9811 —UN—23AUG88

DX,FLUID -19-12OCT11-1/1

Avoid Heating Near Pressurized Fluid Lines

Flammable spray can be generated by heating near pressurized fluid lines, resulting in severe burns to yourself and bystanders. Do not heat by welding, soldering, or using a torch near pressurized fluid lines or other flammable materials. Pressurized lines can accidentally burst when heat goes beyond the immediate flame area.

TS953 —UN—15MAY90

DX,TORCH -19-10DEC04-1/1

Avoid Static Electricity Risk When Refueling

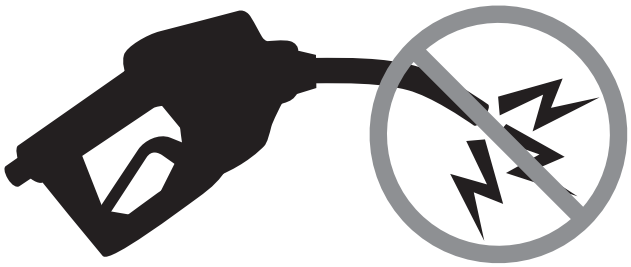
The removal of sulfur and other compounds in Ultra-Low Sulfur Diesel (ULSD) fuel decreases its conductivity and increases its ability to store a static charge.

Refineries may have treated the fuel with a static dissipating additive. However, there are many factors that can reduce the effectiveness of the additive over time.

Static charges can build up in ULSD fuel while it is flowing through fuel delivery systems. Static electricity discharge when combustible vapors are present could result in a fire or explosion.

Therefore, it is important to ensure that the entire system used to refuel your machine (fuel supply tank, transfer pump, transfer hose, nozzle, and others) is properly grounded and bonded. Consult with your fuel or fuel system supplier to ensure that the delivery system is in compliance with fueling standards for proper grounding and bonding practices.

RG22142 —UN—21AUG13



RG21992 —UN—21AUG13

ZE59858,0000011 -19-25JUN13-1/1

Handle Fluids Safely—Avoid Fires

When you work around fuel, do not smoke or work near heaters or other fire hazards.

Store flammable fluids away from fire hazards. Do not incinerate or puncture pressurized containers.

Make sure machine is clean of trash, grease, and debris.

Do not store oily rags; they can ignite and burn spontaneously.

TS227 —UN—15APR13

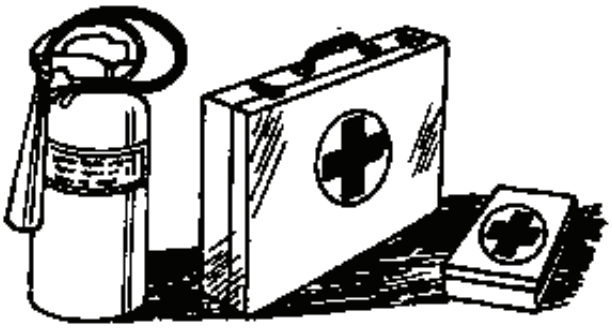
DX,FLAME -19-29SEP98-1/1

Prepare for Emergencies

Be prepared if a fire starts.

Keep a first aid kit and fire extinguisher handy.

Keep emergency numbers for doctors, ambulance service, hospital, and fire department near your telephone.



TS291 —UN—15APR13

DX,FIRE2 -19-03MAR93-1/1

Handling Batteries Safely

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 (-) battery clamp first and replace grounded clamp last.

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

Avoid hazards by:

- Filling batteries in a well-ventilated area
- Wearing eye protection and rubber gloves
- Avoiding use of air pressure to clean batteries
- Avoiding breathing fumes when electrolyte is added
- Avoiding spilling or dripping electrolyte
- Using correct battery booster or charger procedure.

If acid is spilled on skin or in eyes:

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

If acid is swallowed:

1. Do not induce vomiting.
2. Drink large amounts of water or milk, but do not exceed 2 L (2 qt.).
3. Get medical attention immediately.

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.**

TS204 —UN—15APR13

TS203 —UN—23AUG88

DX,WW,BATTERIES -19-02DEC10-1/1

Prevent Acid Burns

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 15—30 minutes. Get medical attention immediately.

If acid is swallowed:

1. Do not induce vomiting.
2. Drink large amounts of water or milk, but do not exceed 2 L (2 quarts).
3. Get medical attention immediately.

TS203 —UN—23AUG88

DX,POISON -19-21APR93-1/1

Prevent Battery Explosions

Keep sparks, lighted matches, and open flame away from the top of battery. Battery gas can explode.

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

Do not charge a frozen battery; it may explode. Warm battery to 16°C (60°F).

TS204 —UN—15APR13

DX,SPARKS -19-03MAR93-1/1

Live With Safety

Before returning machine to customer, make sure machine is functioning properly, especially the safety systems. Install all guards and shields.

TS231 —19—07OCT88

DX,LIVE -19-25SEP92-1/1

Engine Serial Number Plate Information

The engine serial number plate is located on the left-hand side of engine block next to the oil cooler.

IMPORTANT: The engine serial number plate can be easily destroyed. Remove the plate or record the information elsewhere, before "hot tank" cleaning the block.

Engine Serial Number (A)

Each engine has a 13-digit John Deere engine serial number identifying the producing factory, engine model designation, and a six digit sequential number. The following is an example:

RG6090U123456

RG ..... Factory Code Producing Engine

- RG ..... Waterloo, Iowa, USA

6090 ..... Number of Cylinders and Total Displacement

- 6090 ..... 6 cylinders, 9.0 liters

U ..... Emission Certification

- U or V ..... Final Tier 4/Stage IV

123456 ..... Engine Serial Number

Engine Model Number (B)

H ..... Engine Aspiration

- D ..... Naturally aspirated
- T ..... Turbocharged
- A ..... Turbocharged and aftercooled, air-to-coolant
- H ..... Turbocharged and aftercooled, air-to-air
- S ..... Turbocharged and aftercooled, air-to-sea water

F ..... User Type

- F ..... OEM (John Deere Power Systems)
- XX ..... Other letters are used to identify John Deere equipment manufacturing locations

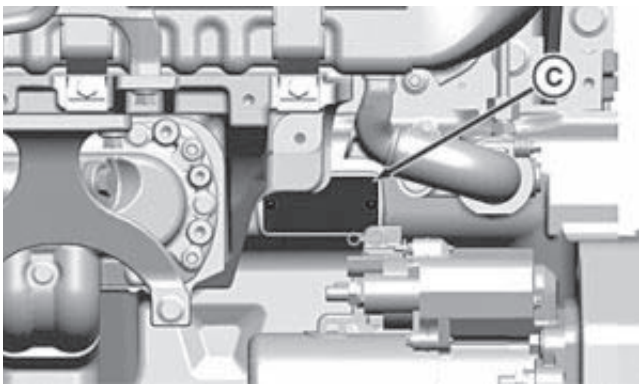
C ..... Industrial

- C ..... Industrial
- G ..... Gen-Set

09 ..... Engine Configuration

- 09 ..... PSS (Series Turbocharger, DOC/DPF and SCR)

RG21898 —UN—15AUG13

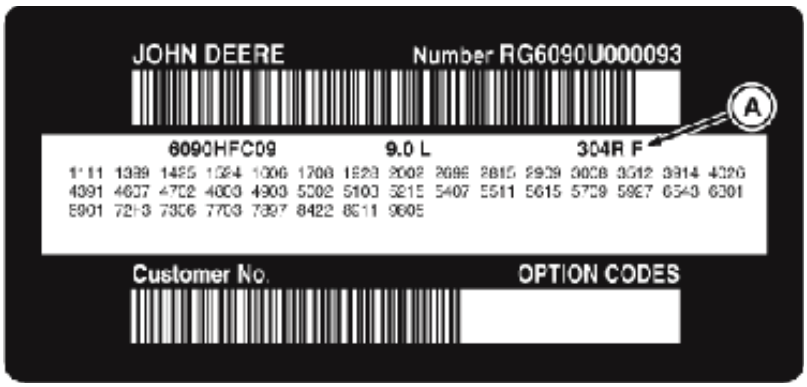


RG21899 —UN—24SEP12

A—Engine Serial Number
B—Engine Model Number
C—Identification Plate Location

,0000293 -19-07FEB13-1/1

OEM Engine Option Code Label



RG21900 —UN—09MAY13

In addition to the serial number plate, engines have an engine option code label affixed to the rocker arm cover. These codes indicate which of the engine options were installed on your engine at the factory. When in need of parts or service, furnish your authorized servicing dealer or engine distributor with these numbers.

,0000294 -19-26SEP12-1/1

Information Relative to Emissions Regulations

Depending on the final destination, engines can meet the emissions regulations according to the US Environmental Protection Agency (EPA), California Air Resources Board (CARB) and for Europe, the Directive 97/68/EC relating the measures against emissions of particles and gaseous pollutant from internal combustion engines. Such engines are called “CERTIFIED” and receive an emission label affixed on the engine.

Emissions regulations prohibit tampering with the emission-related components listed below which would render that component inoperative or to make any adjustment on the engine beyond published specifications. It is illegal to install any part or component where the principle effect of that component is to bypass, defeat, or render inoperative any engine component or device which would affect the engine's conformance to the emission regulations.

IMPORTANT: To summarize, it is illegal to do anything except return the engine to its original published specifications.

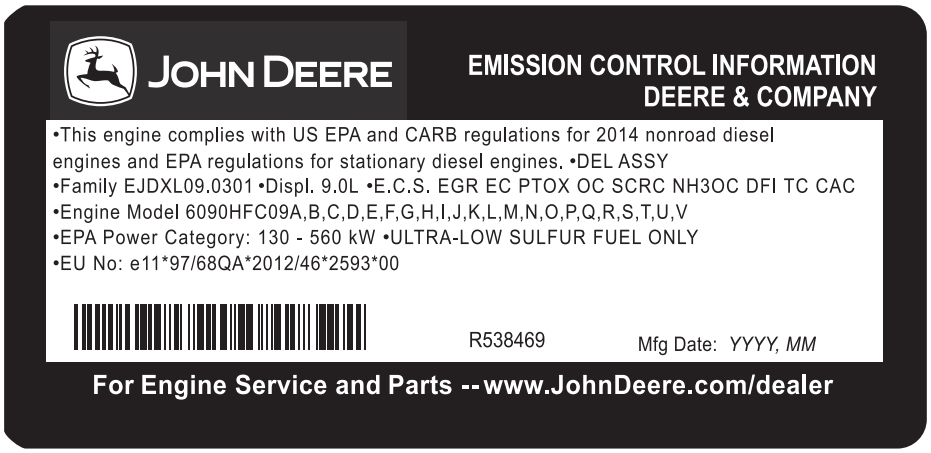
List of emission-related components:

NOTE: Not all applications will be equipped with all of the below emissions devices.

- Charge air cooling system
- Crankcase ventilation system
- DOC and DPF
- Fuel dosing system
- Fuel injection system
- ECU, software, sensors, actuators, and associated wiring
- EGR system
- Exhaust system
- Intake manifold
- SCR system
- Turbochargers

,0000295 -19-18JUN13-1/1

Emissions Control System Certification Label



RG21946A —UN—15AUG13

CAUTION: Statutes providing severe penalties for tampering with emissions controls may apply to the user or dealer.

The emissions warranty applies to those engines marketed by John Deere that have been certified by the United States Environmental Protection Agency (EPA) and/or California Air Resources Board (CARB); and used in the United States and Canada in Non-road equipment. The presence of an emissions label like the one shown signifies that the engine has been certified with the EPA and/or CARB. The EPA and CARB warranties only apply to new engines having the certification label affixed to the engine and sold as stated above in the geographic areas. The presence of an EU number in the third line of the label signifies that the engine has been certified with the European Union countries per Directive 97/68/EC.

The EPA and/or CARB emissions warranties do not apply to the EU countries.

Emission Control System(s) Laws

The U.S. EPA and California ARB prohibit the removal or rendering inoperative of any device or element of design installed on or in engines/equipment in compliance with applicable emission regulations prior to or after the sale and delivery of the engines/equipment to the ultimate purchaser.

NOTE: The hp/kW rating on the engine emissions certification label specifies the gross engine hp/kW, which is flywheel power without fan. In most applications this will not be the same rating as the advertised vehicle hp/kW rating.

,00002B8 -19-15JUL13-1/1

Diesel Exhaust Fluid (DEF) — For Use In Selective Catalytic Reduction Equipped Engines

Diesel exhaust fluid (DEF) is a high purity liquid that is injected into the exhaust system of engines quipped with selective catalytic reduction (SCR) systems. Maintaining the purity of DEF is important to avoid malfunctions in the SCR system. Engines requiring DEF shall use a product that meets the requirements for aqueous urea solution 32 (AUS 32) according to ISO 22241-1.

The use of John Deere Diesel Exhaust Fluid is recommended. John Deere Diesel Exhaust Fluid is available at your John Deere dealer in a variety of package sizes to suit your operational needs.

If John Deere Diesel Exhaust Fluid is not available, use DEF that is certified by the American Petroleum Institute (API) Diesel Exhaust Fluid Certification Program or by the AdBlue™ Diesel Exhaust Fluid Certification Program. Look for the following API symbol or the AdBlue™ name on the container.

In some cases, DEF is referred to by one or more of these names:

- Urea
- Aqueous Urea Solution 32
- AUS 32
- AdBlue
- NOx Reduction Agent
- Catalyst Solution

RG23664 —UN—28JUN13

AdBlue is a trademark of VDA, the German Association of the Automotive Industry.

ZE59858,0000060 -19-28JUN13-1/1

Storing Diesel Exhaust Fluid (DEF)

CAUTION: Avoid contact with eyes. In case of contact, immediately flush eyes with large amounts of water for a minimum of 15 minutes. Reference the Materials Safety Data Sheet (MSDS) for additional information.

Do not ingest DEF. In the event DEF is ingested, contact a physician immediately. Reference the Materials Safety Data Sheet (MSDS) for additional information.

IMPORTANT: It is unlawful to tamper with or remove any component of the aftertreatment system. Do not use DEF that does not meet the required specifications or operate the engine with no DEF.

Never attempt to create DEF by mixing agricultural grade urea with water. Agricultural grade urea does not meet the necessary specifications and can damage the aftertreatment system.

Do not add any chemicals or additives to DEF in an effort to prevent freezing. Any chemicals or additives added to DEF can damage the aftertreatment system.

Never add water or any other fluid in place of, or in addition to DEF. Operating with a modified DEF or using an unapproved DEF can damage the aftertreatment system.

Storage information provided below is for reference and is to be used as a guideline only.

It is preferred to store DEF out of extreme ambient temperatures. DEF freezes at –11 C (12 °F). Exposure to temperatures greater than 30 °C (86 °F) can degrade DEF over time.

Dedicated DEF storage containers must be sealed between uses to prevent evaporation and contamination. Containers made of polyethylene, polypropylene, or stainless steel are recommended to transport and store DEF.

Ideal conditions for storage of DEF are:

- Store at temperature between -5—30 °C (23—86 °F)
- Store in dedicated containers sealed to avoid contamination and evaporation.

Under these conditions, DEF is expected to remain useable for a minimum of 18 months. Storing DEF at higher temperatures can reduce its useful life by approximately 6 months for every 5 °C (9 °F) temperature above 30 °C (86 °F).

If unsure how long or under what conditions DEF has been stored, test DEF. See Testing Diesel Exhaust Fluid (DEF).

Long term storage in the DEF tank (over 12 months) is not recommended. If long term storage is necessary, test DEF prior to operating engine. See Testing Diesel Exhaust Fluid (DEF).

It is recommended to purchase DEF in quantities that will be consumed within 12 months.

ZE59858,0000061 -19-28JUN13-1/1

Refilling Diesel Exhaust Fluid (DEF) Tank

CAUTION: Avoid contact with eyes. In case of contact, immediately flush eyes with large amounts of water for a minimum of 15 minutes. Reference the Materials Safety Data Sheet (MSDS) for additional information.

Do not ingest DEF. In the event DEF is ingested, contact a physician immediately. Reference the Materials Safety Data Sheet (MSDS) for additional information.

IMPORTANT: Use only distilled water to rinse components that are used to deliver DEF. Tap water can contaminate DEF. If distilled water is not available, rinse with clean tap water, then thoroughly rinse with ample amounts of DEF.

If DEF is spilled or contacts any surface other than the storage tank, immediately clean the surface with clear water. DEF is corrosive to painted and unpainted metallic surfaces and can distort some plastic and rubber components.

If DEF is filled into engine fuel tank, do not operate engine until system is properly purged of DEF. Contact your John Deere dealer immediately to determine how to clean and purge the system.

Reasonable care should be taken when refilling the DEF tank. Ensure that the DEF tank cap area is free of debris prior to removing the cap. Seal containers of DEF between use to prevent contamination and evaporation.

Avoid splashing DEF and do not allow DEF to come into contact with skin, eyes, or mouth.

DEF is not harmful to handle, but DEF can be corrosive to materials such as steel, iron, zinc, nickel, copper, aluminum, and magnesium. Use suitable containers to transport and store DEF. Containers made of polyethylene, polypropylene, or stainless steel are recommended.

RG22487 —UN—21AUG13

DEF Symbol

Avoid prolonged contact with skin. In case of accidental contact, wash skin immediately with soap and water.

Keep anything used to store or dispense DEF clean of dirt and dust. Wash and rinse containers or funnels thoroughly with distilled water to remove contaminants.

If an unapproved fluid, such as diesel fuel or coolant is added to the DEF tank, contact your John Deere dealer immediately to determine how to clean and purge the system.

If water has been added to the DEF tank, a tank cleaning is necessary. See Cleaning DEF Tank in this manual. After refilling the tank, check the DEF concentration. See Testing Diesel Exhaust Fluid (DEF).

If DEF has been added to the fuel tank or other fluid compartment, contact your John Deere dealer immediately to determine how to clean and purge the system to prevent damage. **Do not operate engine until system is properly purged of DEF.**

The operator must maintain appropriate DEF levels at all times. Check the DEF level daily and refill the tank as needed. The filling port is identified by a blue colored cap embossed with the DEF symbol.

ZE59858,0000062 -19-28JUN13-1/1

Testing Diesel Exhaust Fluid (DEF)

IMPORTANT: Using DEF with the correct concentration is critical to engine and aftertreatment system performance. Extended storage and other conditions can adversely alter the DEF concentration.

If DEF quality is questionable, draw a sample out of the DEF tank or storage tank into a clear container. DEF must be crystal clear with a light ammonia smell. If DEF appears cloudy, has a colored tint, or has a profound ammonia smell, it is likely not within specification. DEF in this condition should not be used. Drain tank, flush with distilled water and refill with new or good DEF. After refilling the tank, check the DEF concentration.

If the DEF passes the visual and smell test, check the DEF concentration with a handheld refractometer calibrated to measure DEF.

DEF concentration should be checked when the engine has been stored for extended periods, or if there is suspicion the engine or packaged DEF fluid has been contaminated with water.

Two approved tools are available through your John Deere dealer. Part number JDG11594 is a digital tool providing an easy to read concentration measurement. Part number JDG11684 is a low-cost alternative tool providing an analog reading. Follow instructions included with either tool to obtain the measurement.

The correct DEF concentration is 31.8% to 33.2% urea. If the DEF concentration is not within specification, drain the DEF tank, flush with distilled water and fill with new or good DEF. If packaged DEF is not within specification, dispose of DEF packages and replace with new or good DEF.

ZE59858,0000063 -19-28JUN13-1/1

Disposal of Diesel Exhaust Fluid (DEF)

Although there is little issue with minor spillage of DEF on the ground, large amounts of DEF should be contained. If large spills occur, contact local environmental authorities for assistance with clean-up.

If a substantial quantity of DEF is not within specification, contact the DEF supplier for assistance with disposal. Do not dump substantial quantities of DEF onto the ground or send DEF to wastewater treatment facilities.

ZE59858,0000064 -19-28JUN13-1/1

Diesel Fuel

Consult your local fuel distributor for properties of the diesel fuel available in your area.

In general, diesel fuels are blended to satisfy the low temperature requirements of the geographical area in which they are marketed.

Diesel fuels specified to EN 590 or ASTM D975 are recommended. Renewable diesel fuel produced by hydrotreating animal fats and vegetable oils is basically identical to petroleum diesel fuel. Renewable diesel that meets EN 590 or ASTM D975 is acceptable for use at all percentage mixture levels.

Required Fuel Properties

In all cases, the fuel shall meet the following properties:

Cetane number of 43 minimum. Cetane number greater than 47 is preferred, especially for temperatures below –20 °C (–4 °F) or elevations above 1500 m (5000 ft.).

Cold Filter Plugging Point (CFPP) should be at least 5 °C (9 °F) below the expected lowest temperature or **Cloud Point** below the expected lowest ambient temperature.

Fuel lubricity should pass a maximum scar diameter of 0.52 mm as measured by ASTM D6079 or ISO 12156-1. A maximum scar diameter of 0.45 mm is preferred.

Diesel fuel quality and sulfur content must comply with all existing emissions regulations for the area in which the engine operates. DO NOT use diesel fuel with sulfur content greater than 10 000 mg/kg (10 000 ppm).

Sulfur content for Interim Tier 4, Final Tier 4, Stage III B, and Stage IV engines

- Use ONLY ultra low sulfur diesel (ULSD) fuel with a maximum of 15 mg/kg (15 ppm) sulfur content.

Sulfur Content for Tier 3 and Stage III A Engines

- Use of diesel fuel with sulfur content less than 1000 mg/kg (1000 ppm) is RECOMMENDED
- Use of diesel fuel with sulfur content 1000—2000 mg/kg (1000–2000 ppm) REDUCES oil and filter change intervals.
- BEFORE using diesel fuel with sulfur content greater than 2000 mg/kg (2000 ppm), contact your John Deere dealer

Sulfur Content for Tier 2 and Stage II Engines

- Use of diesel fuel with sulfur content less than 2000 mg/kg (2000 ppm) is RECOMMENDED.
- Use of diesel fuel with sulfur content 2000–5000 mg/kg (2000–5000 ppm) REDUCES the oil and filter change interval
- BEFORE using diesel fuel with sulfur content greater than 5000 mg/kg (5000 ppm), contact your John Deere dealer

Sulfur Content for Other Engines

- Use of diesel fuel with sulfur content less than 5000 mg/kg (5000 ppm) is recommended.
- Use of diesel fuel with sulfur content greater than 5000 mg/kg (5000 ppm) REDUCES the oil and filter change intervals.

IMPORTANT: Do not mix used diesel engine oil or any other type of lubricating oil with diesel fuel.

Improper fuel additive usage may cause damage on fuel injection equipment of diesel engines.

ZE59858,0000075 -19-28JUN13-1/1

Supplemental Diesel Fuel Additives

Diesel fuel can be the source of performance or other operational problems for many reasons. Some causes include poor lubricity, contaminants, low cetane number, and a variety of properties that cause fuel system deposits. These and others are referenced in other sections of this Operator's Manual.

To optimize engine performance and reliability, closely follow recommendations on fuel quality, storage, and handling, which are found elsewhere in this Operator's Manual.

To further aid in maintaining performance and reliability of the engine's fuel system, John Deere has developed a family of fuel additive products for most global markets. The primary products include Fuel-Protect Diesel Fuel Conditioner (full feature conditioner in winter and summer formulas) and Fuel-Protect Keep Clean (fuel injector deposit removal and prevention). Availability of these and other products varies by market. See your local John Deere dealer for availability and additional information about fuel additives that might be right for your needs.

Use of non-John Deere fuel additives can result in fuel system damage, power loss and other reductions in performance, system fouling, and unwarrantable failures. Consult your John Deere dealer or fuel supplier to ensure use of proper fuel additives.

ZE59858,000007B -19-28JUN13-1/1

Lubricity of Diesel Fuel

Most diesel fuels manufactured in the United States, Canada, and the European Union have adequate lubricity to ensure proper operation and durability of fuel injection system components. However, diesel fuels manufactured in some areas of the world may lack the necessary lubricity.

IMPORTANT: Make sure the diesel fuel used in your machine demonstrates good lubricity characteristics.

Fuel lubricity should pass a maximum scar diameter of 0.45 mm as measured by ASTM D6079 or ISO 12156-1.

If fuel of low or unknown lubricity is used, add John Deere Fuel-Protect Diesel Fuel Conditioner (or equivalent) at the specified concentration.

Lubricity of Biodiesel Fuel

Fuel lubricity can improve significantly with biodiesel blends up to B20 (20% biodiesel). Further increase in lubricity is limited for biodiesel blends greater than B20.

DX,FUEL5 -19-14APR11-1/1

Handling and Storing Diesel Fuel

CAUTION: Reduce the risk of fire. Handle fuel carefully. DO NOT fill the fuel tank when engine is running. DO NOT smoke while you fill the fuel tank or service the fuel system.

Fill the fuel tank at the end of each day's operation to prevent water condensation and freezing during cold weather.

Keep all storage tanks as full as practicable to minimize condensation.

Ensure that all fuel tank caps and covers are installed properly to prevent moisture from entering. Monitor water content of the fuel regularly.

When using biodiesel fuel, the fuel filter may require more frequent replacement due to premature plugging.

Check engine oil level daily prior to starting engine. A rising oil level may indicate fuel dilution of the engine oil.

IMPORTANT: The fuel tank is vented through the filler cap. If a new filler cap is required, always replace it with an original vented cap.

When fuel is stored for an extended period or if there is a slow turnover of fuel, add a fuel conditioner to stabilize the fuel and prevent water condensation. Contact your fuel supplier for recommendations.

DX,FUEL4 -19-14APR11-1/1

Biodiesel Fuel

Biodiesel fuel is comprised of mono-alkyl esters of long chain fatty acids derived from vegetable oils or animal fats. Biodiesel blends are biodiesel mixed with petroleum diesel fuel on a volume basis.

Before using fuel containing biodiesel, review the Biodiesel Use Requirements and Recommendations in this Operator's Manual.

Environmental laws and regulations can encourage or prohibit the use of biofuels. Operators should consult with appropriate governmental authorities prior to using biofuels.

All John Deere Engines with Exhaust Filter (Released 2011 and After)

While 5% blends (B5) are preferred, biodiesel concentrations up to a 20% blend (B20) in petroleum diesel fuel can be used. Biodiesel blends up to B20 can be used ONLY if the biodiesel (100% biodiesel or B100) meets ASTM D6751, EN 14214, or equivalent specification. Expect a 2% reduction in power and a 3% reduction in fuel economy when using B20.

Biodiesel concentrations above B20 can harm the engine's emission control systems and should not be used. Risks include, but are not limited to, more frequent stationary regeneration, soot accumulation, and increased intervals for ash removal.

John Deere approved fuel conditioners, which contain detergent and dispersant additives, are required when using B20, and are recommended when using lower biodiesel blends.

All John Deere Engines Excluding Exhaust Filter (Primarily Released Prior to 2012)

While 5% blends (B5) are preferred, biodiesel concentrations up to a 20% blend (B20) in petroleum diesel fuel can be used. Biodiesel blends up to B20 can be used ONLY if the biodiesel (100% biodiesel or B100) meets ASTM D6751, EN 14214, or equivalent specification. Expect a 2% reduction in power and a 3% reduction in fuel economy when using B20.

These John Deere engines can operate on biodiesel blends above B20 (up to 100% biodiesel). Operate at levels above B20 ONLY if the biodiesel is permitted by law and meets the EN 14214 specification (primarily available in Europe). Engines operating on biodiesel blends above B20 might not fully comply with or be permitted by all applicable emissions regulations. Expect up to a 12% reduction in power and an 18% reduction in fuel economy when using 100% biodiesel.

John Deere approved fuel conditioners, which contain detergent and dispersant additives, are required when using B20, and are recommended when using lower biodiesel blends.

Biodiesel Use Requirements and Recommendations

The petroleum diesel portion of all biodiesel blends must meet the requirements of ASTM D975 (US) or EN 590 (EU) commercial standards.

Biodiesel users in the U.S. are strongly encouraged to purchase biodiesel blends from a BQ-9000 Certified Marketer and sourced from a BQ-9000 Accredited Producer (as certified by the National Biodiesel Board). Certified Marketers and Accredited Producers can be found at the following website: http://www.bq9000.org.

Biodiesel contains residual ash. Ash levels exceeding the maximums allowed in either ASTM D6751 or EN14214 can result in more rapid ash loading and require more frequent cleaning of the Exhaust Filter (if present).

The fuel filter can require more frequent replacement, when using biodiesel fuel, particularly if switching from diesel. Check engine oil level daily prior to starting engine. A rising oil level can indicate fuel dilution of the engine oil. Biodiesel blends up to B20 must be used within 90 days of the date of biodiesel manufacture. If used, biodiesel blends above B20 must be used within 45 days from the date of biodiesel manufacture.

When using biodiesel blends up to B20, the following must be considered:

- Cold weather flow degradation
- Stability and storage issues (moisture absorption, microbial growth)
- Possible filter restriction and plugging (usually a problem when first switching to biodiesel on used engines.)
- Possible fuel leakage through seals and hoses (primarily an issue with older engines)
- Possible reduction of service life of engine components

Request a certificate of analysis from your fuel distributor to ensure that the fuel is compliant with the specifications provided in this Operator's Manual.

Consult your John Deere dealer for approved fuel conditioners to improve storage and performance with biodiesel fuels.

The following must also be considered if using biodiesel blends above B20:

- Possible coking or blocked injector nozzles, resulting in power loss and engine misfire if John Deere approved fuel conditioners are not used
- Possible crankcase oil dilution (requiring more frequent oil changes)
- Possible lacquering or seizure of internal components
- Possible formation of sludge and sediments
- Possible thermal oxidation of fuel at elevated temperatures
- Possible compatibility issues with other materials (including copper, lead, zinc, tin, brass, and bronze) used in fuel handling equipment
- Possible reduction in water separator efficiency
- Possible damage to paint if exposed to biodiesel

Continued on next page

DX,FUEL7 -19-29AUG12-1/2

- Possible corrosion of fuel injection equipment
- Possible elastomeric seal and gasket material degradation (primarily an issue with older engines)
- Possible high acid levels within fuel system
- Because biodiesel blends above B20 contain more ash, using blends above B20 can result in more rapid ash loading and require more frequent cleaning of the Exhaust Filter (if present)

IMPORTANT: Raw pressed vegetable oils are NOT acceptable for use as fuel in any concentration in John Deere engines. Their use could cause engine failure.

DX,FUEL7 -19-29AUG12-2/2

Testing Diesel Fuel

A fuel analysis program can help to monitor the quality of diesel fuel. The fuel analysis can provide critical data such as cetane number, fuel type, sulfur content, water content, appearance, suitability for cold weather operations, bacteria, cloud point, acid number, particulate contamination, and whether the fuel meets specification.

Contact your John Deere dealer for more information on diesel fuel analysis.

DX,FUEL6 -19-14APR11-1/1

Fuel Filters

The importance of fuel filtration cannot be overemphasized with modern fuel systems. The combination of increasingly restrictive emission regulations and more efficient engines requires fuel system to operate at much higher pressures. Higher pressures can only be achieved using fuel injection components with very close tolerances. These close manufacturing tolerances have significantly reduced capacities for debris and water.

John Deere brand fuel filters have been designed and produced specifically for John Deere engines.

To protect the engine from debris and water, always change engine fuel filters as specified in this manual.

DX,FILT2 -19-14APR11-1/1

Minimizing the Effect of Cold Weather on Diesel Engines

John Deere diesel engines are designed to operate effectively in cold weather.

However, for effective starting and cold weather operation, a little extra care is necessary. The information below outlines steps that can minimize the effect that cold weather may have on starting and operation of your engine. See your John Deere dealer for additional information and local availability of cold weather aids.

Use Winter Grade Fuel

When temperatures fall below 0°C (32°F), winter grade fuel (No. 1-D in North America) is best suited for cold weather operation. Winter grade fuel has a lower cloud point and a lower pour point.

Cloud point is the temperature at which wax will begin to form in the fuel and this wax causes fuel filters to plug. **Pour point** is the lowest temperature at which movement of the fuel is observed.

NOTE: On average, winter grade diesel fuel has a lower Btu (heat content) rating. Using winter grade fuel may reduce power and fuel efficiency, but should not cause any other engine performance effects. Check the grade of fuel being used before troubleshooting for low power complaints in cold weather operation.

Air Intake Heater

An air intake heater is an available option for some engines to aid cold weather starting.

Ether

An ether port on the intake is available to aid cold weather starting.

CAUTION: Ether is highly flammable. Do not use ether when starting an engine equipped with glow plugs or an air intake heater.

Coolant Heater

An engine block heater (coolant heater) is an available option to aid cold weather starting.

Seasonal Viscosity Oil and Proper Coolant Concentration

Use seasonal grade viscosity engine oil based on the expected air temperature range between oil changes and a proper concentration of low silicate antifreeze as recommended. (See DIESEL ENGINE OIL and ENGINE COOLANT requirements in this section.)

Diesel Fuel Flow Additive

Use John Deere Fuel-Protect Diesel Fuel Conditioner (winter formula), which contains anti-gel chemistry, or equivalent fuel conditioner to treat non-winter grade fuel (No. 2-D in North America) during the cold weather season. This generally extends operability to about 10°C (18°F) below the fuel cloud point. For operability at even lower temperatures, use winter grade fuel.

IMPORTANT: Treat fuel when outside temperature drops below 0°C (32°F). For best results, use with untreated fuel. Follow all recommended instructions on label.

BioDiesel

When operating with biodiesel blends, wax formation can occur at warmer temperatures. Begin using John Deere Fuel-Protect Diesel Fuel Conditioner (winter formula) at 5°C (41°F) to treat biodiesel fuels during the cold weather season. Use B5 or lower blends at temperatures below 0°C (32°F). Use only winter grade petroleum diesel fuel at temperatures below -10°C (14°F).

Winterfronts

Use of fabric, cardboard, or solid winterfronts is not recommended with any John Deere engine. Their use can result in excessive engine coolant, oil, and charge air temperatures. This can lead to reduced engine life, loss of power and poor fuel economy. Winterfronts may also put abnormal stress on fan and fan drive components potentially causing premature failures.

If winterfronts are used, they should never totally close off the grill frontal area. Approximately 25% area in the center of the grill should remain open at all times. At no time should the air blockage device be applied directly to the radiator core.

Radiator Shutters

If equipped with a thermostatically controlled radiator shutter system, this system should be regulated in such a way that the shutters are completely open by the time the coolant reaches 93°C (200°F) to prevent excessive intake manifold temperatures. Manually controlled systems are not recommended.

If air-to-air aftercooling is used, the shutters must be completely open by the time the intake manifold air temperature reaches the maximum allowable temperature out of the charge air cooler.

For more information, see your John Deere dealer.

DX,FUEL10 -19-20APR11-1/1

John Deere Break-In™ Plus Engine Oil

New engines are filled at the factory with John Deere Break-In Plus™ Engine Oil. During the break-in period, add John Deere Break-In™ Plus Engine Oil, as needed to maintain the specified oil level.

During the initial operation of a new or rebuilt engine, change the oil and filter between a minimum of 100 hours and maximum equal to the interval specified for John Deere Plus-50™ II oil.

Operate the engine under various conditions, particularly heavy loads with minimal idling, to help seat engine components properly.

After engine overhaul, fill the engine with John Deere Break-In™ Plus Engine Oil.

If John Deere Break-In™ Plus Engine Oil is not available, use an SAE 10W-30 viscosity grade diesel engine oil meeting one of the following:

- API Service Category CJ-4
- ACEA Oil Sequence E9
- ACEA Oil Sequence E6

If one of these oils is used during the initial operation of a new or rebuilt engine, change the oil and filter between a minimum of 100 hours and a maximum of 250 hours.

IMPORTANT: Do not use any other engine oils during the initial break-in of a new or rebuilt engine.

John Deere Break-In™ Plus Engine Oil can be used for all John Deere diesel engines at all emission certification levels.

After the break-in period, use John Deere Plus-50™ II or other diesel engine oil as recommended in this manual.

Break-In Plus is a trademark of Deere & Company
Plus-50 is a trademark of Deere & Company.

DX,ENOIL16 -19-20APR11-1/1

Diesel Engine Oil — Interim Tier 4, Final Tier 4, Stage IIIB, and Stage IV

Use oil viscosity based on the expected air temperature range during the period between oil changes.

John Deere Plus-50™ II is the recommended engine oil.

Extended service intervals may apply when John Deere Plus-50™ II engine oil is used. Refer to the engine oil drain interval table and consult your John Deere dealer for more information.

If John Deere Plus-50™ II engine oil is not available, engine oil meeting one or more of the following may be used:

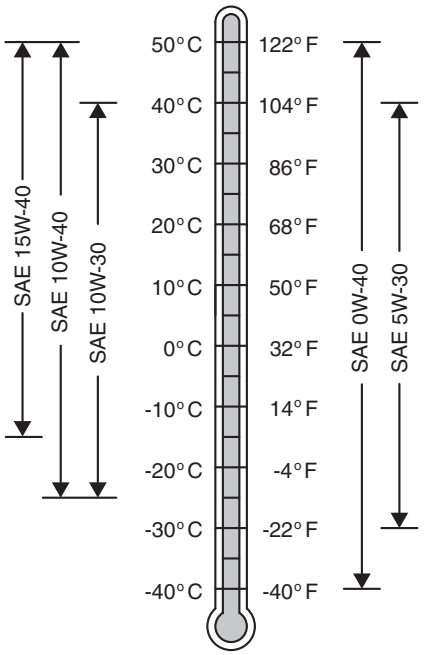
- API Service Category CJ-4
- ACEA Oil Sequence E9
- ACEA Oil Sequence E6

DO NOT use engine oil containing more than 1.0% sulfated ash, 0.12% phosphorus, or 0.4% sulfur.

Multi-viscosity diesel engine oils are preferred.

Diesel fuel quality and fuel sulfur content must comply with all existing emissions regulations for the area in which the engine operates.

IMPORTANT: Use only ultra low sulfur diesel (ULSD) fuel with a maximum sulfur content of 15 mg/kg (15 ppm).



Oil Viscosities for Air Temperature Ranges

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DX,ENOIL14 -19-05SEP13-1/1

Engine Oil and Filter Service Intervals—Interim Tier 4, Final Tier 4, Stage III B, and Stage IV — OEM Applications

Recommended oil and filter service intervals are based on a combination of oil pan capacity, type of engine oil and filter used, and sulfur content of the diesel fuel. Actual service intervals also depend on operation and maintenance practices.

Use oil analysis to evaluate the condition of the oil and to aid in selection of the proper oil and filter service interval. Contact your John Deere dealer for more information on engine oil analysis.

Change the oil and oil filter at least once every 12 months even if the hours of operation are fewer than the otherwise recommended service interval.

Diesel fuel sulfur content affects engine oil and filter service intervals. Higher fuel sulfur levels reduce oil and filter service intervals.

Use of diesel fuel with sulfur content less than 15 mg/kg (15 ppm) is REQUIRED.

IMPORTANT: To avoid engine damage:

- **Reduce oil and filter service intervals by 50% when using biodiesel blends greater than B20. Oil analysis may allow longer service interval.**
- **Use only approved oil types.**

Plus-50 is a trademark of Deere & Company

Approved Oil Types

- John Deere Plus-50™ II
- "Other Oils" include API CJ-4, ACEA E9, and ACEA E6.

NOTE: The 500 hour extended oil and filter change interval is only allowed if all of the following conditions are met:

- *Engine equipped with an extended drain interval oil pan.*
- *Use of diesel fuel with sulfur content less than 15 mg/kg (15 ppm).*
- *Use of John Deere Plus-50™ II oil.*
- *Use of an approved John Deere oil filter.*

	Engine Oil and Filter Service Intervals	
Oil Pan Capacity (L/kW)	≥ 0.10	≥ 0.12
John Deere Plus-50™ II	375 hours	500 hours
Other Oils	250 hours	250 hours

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Diesel Engine Oil and Filter Service Intervals

See applicable operator's manual for service intervals.

ZE59858,0000089 -19-10JUL13-1/1

Mixing of Lubricants

In general, avoid mixing different brands or types of oil. Oil manufacturers blend additives in their oils to meet certain specifications and performance requirements.

Mixing different oils can interfere with the proper functioning of these additives and degrade lubricant performance.

Consult your John Deere dealer to obtain specific information and recommendations.

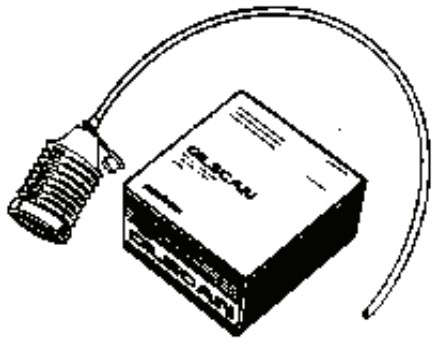
DX,LUBMIX -19-18MAR96-1/1

Oilscan™ and CoolScan™

Oilscan™ and CoolScan™ are John Deere sampling programs to help you monitor machine performance and identify potential problems before they cause serious damage.

Oil and coolant samples should be taken from each system before its recommended change interval.

Check with your John Deere dealer for the availability of Oilscan™ and CoolScan™ kits.



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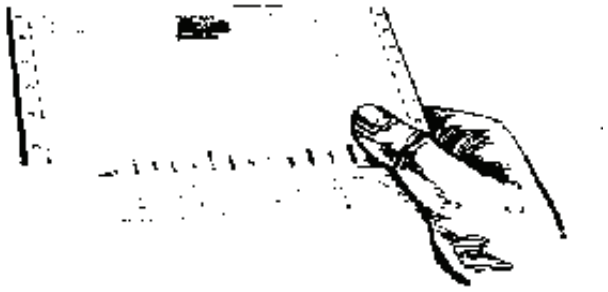

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Oilscan is a trademark of Deere & Company
CoolScan is a trademark of Deere & Company

DX,OILSCAN -19-13SEP11-1/1

Alternative and Synthetic Lubricants

Conditions in certain geographical areas may require lubricant recommendations different from those printed in this manual.

Some John Deere brand coolants and lubricants may not be available in your location.

Consult your John Deere dealer to obtain information and recommendations.

Synthetic lubricants may be used if they meet the performance requirements as shown in this manual.

The temperature limits and service intervals shown in this manual apply to both conventional and synthetic lubricants.

Re-refined base stock products may be used if the finished lubricant meets the performance requirements.

DX,ALTER -19-11APR11-1/1

Lubricant Storage

Your equipment can operate at top efficiency only when clean lubricants are used.

Use clean containers to handle all lubricants.

Store lubricants and containers in an area protected from dust, moisture, and other contamination. Store containers on their side to avoid water and dirt accumulation.

Make certain that all containers are properly marked to identify their contents.

Properly dispose of all old containers and any residual lubricant they may contain.

DX,LUBST -19-11APR11-1/1

Oil Filters

Filtration of oils is critically important for proper operation and lubrication. John Deere brand oil filters have been designed and produced specifically for John Deere applications.

John Deere filters adhere to engineering specifications for quality of the filter media, filter efficiency rating, strength of the bond between the filter media and the element end cap, fatigue life of the canister (if applicable), and pressure capability of the filter seal. Non-John Deere branded oil filters might not meet these key John Deere specifications.

Always change oil filters regularly as specified in this manual.

DX,FILT1 -19-11APR11-1/1

Diesel Engine Coolant

Preferred coolants

The following pre-mix engine coolants are preferred:

- John Deere COOL-GARD™ II
- John Deere COOL-GARD II PG

COOL-GARD II pre-mix coolant is available in several concentrations with different freeze protection limits as shown in the following table.

COOL-GARD II pre-mix	Freeze Protection Limit
COOL-GARD II 20/80	-9 °C (16 °F)
COOL-GARD II 30/70	-16 °C (3 °F)
COOL-GARD II 50/50	-37 °C (-34 °F)
COOL-GARD II 55/45	-45 °C (-49 °F)
COOL-GARD II PG 60/40	-49 °C (-56 °F)
COOL-GARD II 60/40	-52 °C (-62 °F)

Not all COOL-GARD II pre-mix products are available in all countries.

Use John Deere COOL-GARD II PG when a non-toxic coolant formulation is required.

Additional Recommended Coolants

The following engine coolant is also recommended:

- John Deere COOL-GARD II Concentrate in a 40–60% mixture of concentrate with quality water.

IMPORTANT: When mixing coolant concentrate with water, do not use less than 40% or greater than 60% concentration of coolant. Less than 40% gives inadequate additives for corrosion protection. Greater than 60% can result in coolant gelation and cooling system problems.

Other Coolants

Other ethylene glycol or propylene glycol base coolants may be used if they meet one of the following specifications:

- Pre-mix coolant meeting ASTM D6210 requirements
- Coolant concentrate meeting ASTM D6210 requirements in a 40% to 60% mixture of concentrate with quality water

If coolant meeting one of these specifications is unavailable, use a coolant concentrate or pre-mix coolant that has a minimum of the following chemical and physical properties:

- Provides cylinder liner cavitation protection according to either the John Deere Cavitation Test Method or a fleet study run at or above 60% load capacity.
- Is formulated with a nitrite-free additive package.
- Protects the cooling system metals (cast iron, aluminum alloys, and copper alloys such as brass) from corrosion.

Water Quality

Water quality is important to the performance of the cooling system. Distilled, deionized, or demineralized water is recommended for mixing with ethylene glycol and propylene glycol base engine coolant concentrate.

Coolant Drain Intervals

Drain and flush the cooling system and refill with fresh coolant at the indicated interval, which varies with the coolant used.

When COOL-GARD II or COOL-GARD II PG is used, the drain interval is 6 years or 6000 hours of operation.

If a coolant other than COOL-GARD II or COOL-GARD II PG is used, reduce the drain interval to 2 years or 2000 hours of operation.

IMPORTANT: Do not use cooling system sealing additives or antifreeze that contains sealing additives.

Do not mix ethylene glycol and propylene glycol base coolants.

Do not use coolants that contain nitrites.

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ZE59858,0000079 -19-01JUL13-1/1

Water Quality for Mixing with Coolant Concentrate

Engine coolants are a combination of three chemical components: ethylene glycol (EG) or propylene glycol (PG) antifreeze, inhibiting coolant additives, and quality water.

Water quality is important to the performance of the cooling system. Distilled, deionized, or demineralized water is recommended for mixing with ethylene glycol and propylene glycol base engine coolant concentrate.

All water used in the cooling system should meet the following minimum specifications for quality:

Chlorides	<40 mg/L
Sulfates	<100 mg/L
Total Solids	<340 mg/L
Total Dissolved I Hardness	<170 mg/L
pH	5.5—9.0

IMPORTANT: Do not use bottled drinking water because it often contains higher concentrations of total dissolved solids.

Freeze Protection

The relative concentrations of glycol and water in the engine coolant determine its freeze protection limit.

Ethylene Glycol	Freeze Protection Limit
40%	–24 °C (–12 °F)
50%	–37 °C (–34 °F)
60%	–52 °C (–62 °F)
Propylene Glycol	**Freeze Protection Limit**
40%	–21 °C (–6 °F)
50%	–33 °C (–27 °F)
60%	–49 °C (–56 °F)

DO NOT use a coolant-water mixture greater than 60% ethylene glycol or 60% propylene glycol.

ZE59858,000007E -19-02JUL13-1/1

Operating in Warm Temperature Climates

John Deere engines are designed to operate using glycol base engine coolants.

Always use a recommended glycol base engine coolant, even when operating in geographical areas where freeze protection is not required.

IMPORTANT: Water may be used as coolant *in emergency situations only.*

Foaming, hot surface aluminum and iron corrosion, scaling, and cavitation will occur when water is used as the coolant, even when coolant conditioners are added.

Drain cooling system and refill with recommended glycol base engine coolant as soon as possible.

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Testing Coolant Freeze Point

The use of a handheld coolant refractometer is the quickest, easiest, and most accurate method to determine coolant freeze point. This method is more accurate than a test strip or a float-type hydrometer which can produce poor results.

A coolant refractometer is available through your John Deere dealer under the SERVICEGARD™ tool program. Part number 75240 provides an economical solution to accurate freeze point determination in the field.

To use this tool:

1. Allow cooling system to cool to ambient temperatures.
2. Open radiator cap to expose coolant.
3. With the included dropper, collect a small coolant sample.
4. Open the lid of the refractometer, place one drop of coolant on the window and close the lid.
5. Look through the eyepiece and focus as necessary.
6. Record the listed freeze point for the type of coolant (ethylene glycol coolant or propylene glycol coolant) being tested.

RG23673 —UN—01JUL13

SERVICEGARD Part Number 75240

RG23674 —UN—01JUL13

Image with a drop of 50/50 coolant placed on the refractometer window

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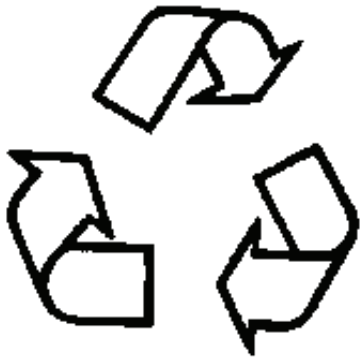
Disposing of Coolant

Improperly disposing of engine coolant can threaten the environment and ecology.

Use leakproof containers when draining fluids. 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.

Inquire on the proper way to recycle or dispose of waste from your local environmental or recycling center, or from your John Deere engine distributor or servicing dealer.



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Recycle Waste

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Section 02
Repair and Adjustments

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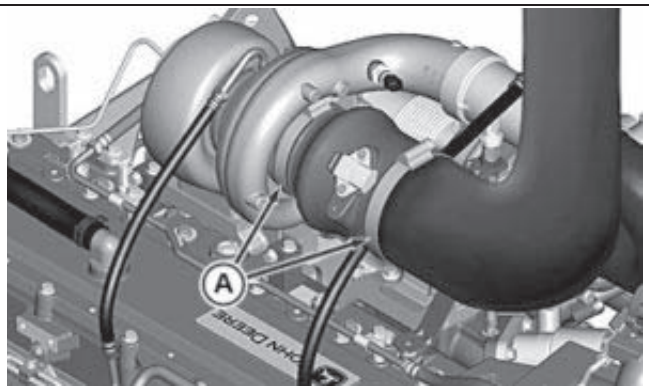
Check Air Intake System

Special Tool:
•None

Consumable Material:
• Primary Air Filter Element

1. Inspect air cleaner filter elements. (See operator's manual) Replace if needed.
2. Check condition of air hoses, tubes, clamps and pipes. Replace hoses and or pipes that are cracked, split, or otherwise in poor condition.
3. Check hose clamps (A) are in position and tight.



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Hose Clamps

A—Hose Clamps

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Check and Service Cooling System

Special Tools:
• Heavy Gauge Wire

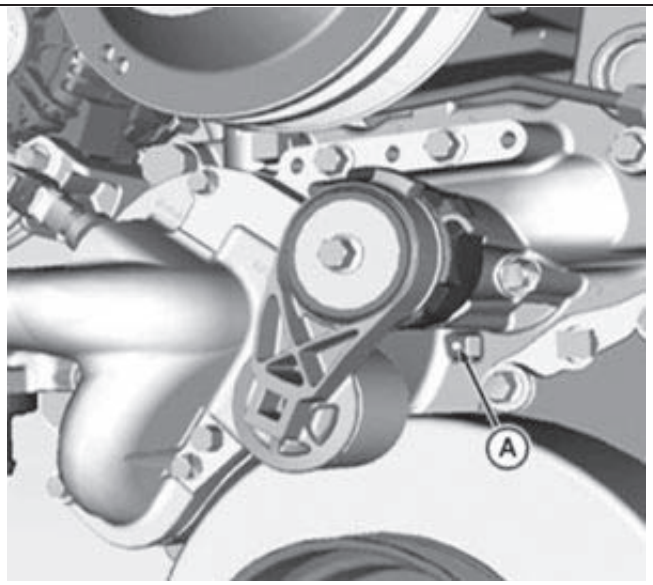
Consumable Material:
• Weep Hole Filter

• John Deere COOL-GARD II or

• John Deere COOL-Gard II PG

1. Remove trash that has accumulated on or near radiator.
2. Visually inspect entire cooling system and all components for leaks or damage. Repair or replace as necessary.
3. Remove the foam filter (B) from weep hole (A) located in the timing gear cover. Discard filter. Inspect the weep hole for any restrictions.
4. Insert a heavy gauge wire deep into weep hole (A) to make sure hole is open.
5. Install new foam filter (B).

A—Weep Hole **B—Weep Hole Foam Filter**



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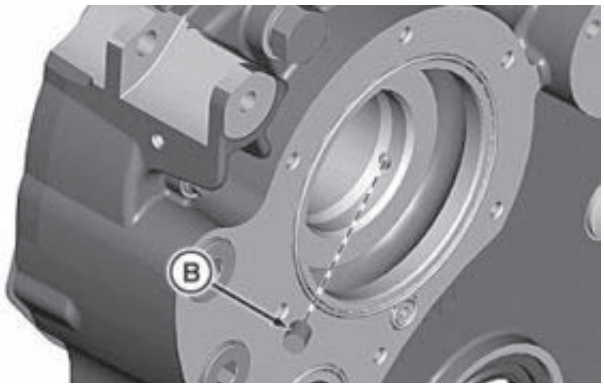

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Weep Hole Filter

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CAUTION: Do not drain coolant until the coolant temperature is below operating temperature. Always loosen coolant pump drain plug (A) and block drain valve (B) slowly to relieve any excess pressure.

IMPORTANT: Both coolant pump drain plug and block drain valve must be opened to completely drain the engine.

6. Drain and flush cooling system. For coolant drain intervals, see Diesel Engine Coolant in Section 01 Group 002.
7. Remove and check thermostat(s). See Thermostat — Removal in Section 02 Group 070.

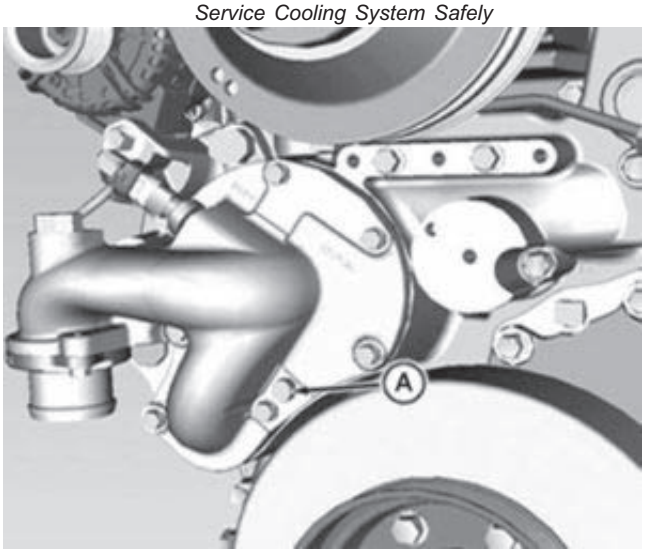
IMPORTANT: Air must be expelled from cooling system when system is refilled. See Coolant System — Air Bleeding in Section 02 Group 070.

8. Fill cooling system with coolant. See Diesel Engine Coolant in Section 01 Group 002.
9. Run engine until it reaches operating temperature. Check entire cooling system for leaks.
10. After engine cools, check coolant level.
11. Check system for holding pressure. See Cooling System Test in Section 04, Group 155.

A—Coolant Pump Drain Plug B—Block Drain Valve

TS281 —UN—15APR13

Service Cooling System Safely



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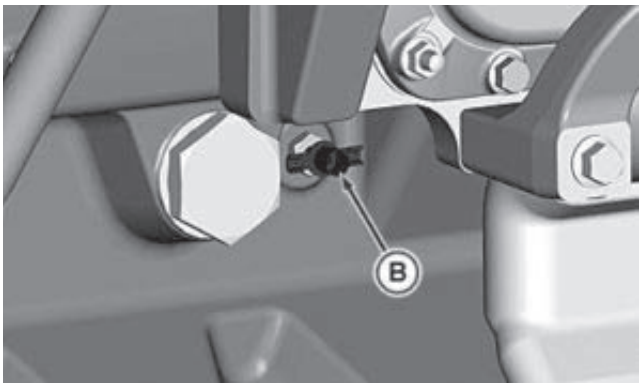

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Cylinder Block Drain Valve

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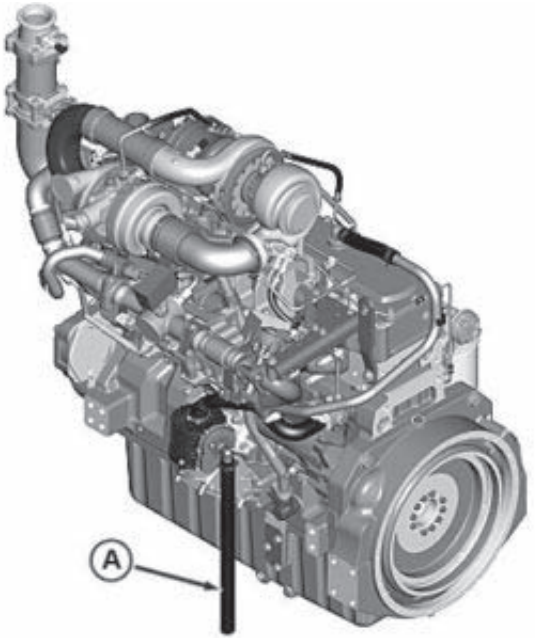
Check Crankcase Vent System

1. Inspect crankcase ventilation system for restrictions. Lack of ventilation causes sludge to form in crankcase. This can lead to clogging of oil passages, filters, and screens, resulting in serious engine damage.
2. Clean crankcase vent tube (A) with solvent and compressed air if restricted. Install and tighten hose clamps securely.



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Crankcase Vent Tube

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Check Electrical System

Special Tools:
•None

Consumable Material:
•Ammonia Solution
•Petroleum Jelly
•Baking Soda
•Clean Water

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 (-) 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. Clean batteries and cables with damp cloth. If corrosion is present, remove it and wash terminals with a solution of ammonia or baking soda in water. Then flush area with clean water.
2. Coat battery terminals and connectors with petroleum jelly mixed with baking soda to retard corrosion.
3. Test batteries. If batteries are not near full charge, try to find out why.

TS204 —UN—15APR13

Prevent Battery Explosions

4. On low-maintenance batteries, check level of electrolyte in each cell of each battery. Level should be to bottom of filler neck. If water is needed, use clean, mineral-free water.

   If water must be added to batteries more often than every 250 hours, alternator may be overcharging.

NOTE: Water cannot be added to maintenance-free batteries.

5. If batteries appear to be either undercharged or overcharged, check alternator and charging circuit.
6. Check tension of drive belts. See Belt Tensioner — Spring Tension Check in Section 02 Group 070.
7. Check operation of starter motor and instruments.

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Check Exhaust System

Special Tools:
•None

Consumable Materials:
•None

1. Inspect exhaust system for leaks or restrictions. The series turbocharger option on Tier 4 engines results in multiple joints in the exhaust. Check manifold for cracks. Repair or replace as necessary.
2. Check that turbocharger-to-exhaust gas recirculator (EGR) cooler, etc, clamps are securely tightened and do not leak.
3. Check exhaust stack for evidence of oil leakage past valve stem seals.

   Oil in exhaust stack may be caused by excessive valve stem-to-guide clearance or excessive light load engine idling.

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Clean Engine

Special Tools:
•None

Consumable materials:
•Plastic
•Tape

CAUTION: DO NOT power wash the exhaust filter assembly or selective catalytic reduction (SCR) assembly when they are hot. The clamps securing sections of the filter may loosen, resulting in exhaust gas leaks.

CAUTION: Do not work on filter assembly when external temperature exceeds 50° C (120° F).

1. Cap or plug all openings on engine. If electrical components (starter, alternator, etc.) are not removed prior to cleaning, cover with plastic and tape securely to prevent moisture from entering.
2. Steam-clean engine thoroughly.

IMPORTANT: Never steam clean or pour cold water on the high-pressure fuel pump while it is still warm. To do so may cause seizure of pump parts. Also, avoid electrical components, wiring, the ECU, and sensors.

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