PowerTech™ E 2.4 L and 3.0 L Diesel Engines

COMPONENT TECHNICAL MANUAL

2.4 L and 3.0 L Diesel Engines Component Technical Manual

CTM101019 07JUN11 (ENGLISH)

For complete service information also see:

OEM Engine Accessories CTM67
Application List..... CTM106819

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

Foreword

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 Other Materials needed to do the job. Tool information can be located in the JDPS Master Tool Manual.

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.

MK41968,0000060 -19-05APR11-1/1

Record Of Changes

Publication and Translation Date			
CTM101019			
Section / Group	**Block Title**	**Comment**	**Update Date**
04/160	Diagnostic Instructions and Information	Updated Diagnostic Trouble Code (DTC) Group Locator	5 October 2010
04/161	Engine Position Diagnostics	Added DTCs: 000636.02 — Camshaft Position Signal Invalid 000190.00 — Engine Speed Extremely High, 000190.16 — Engine Speed Moderately High	24 September 20100
04/163	Lubrication and Cooling Systems Diagnostics	Added DTCs: 000100.04 — Engine Oil Pressure Signal Out of Range Low, 000100.04 — Engine Oil Pressure Signal Moderately Low, 000100.31 — Engine Oil Pressure is Not Zero with Engine Stopped.	24 September 20100
04/164	Fuel System Diagnostics	Added DTCs: 000094.17 — Low-Pressure Fuel Signal Slightly Low, 000094.18 — Low-Pressure Fuel Signal Moderately Low, 000651.13 — Injector #1 Calibration Fault, 000652.13 — Injector #2 Calibration Fault, 000653.13 — Injector #3 Calibration Fault, 000654.13 — Injector #4 Calibration Fault, 000655.13 — Injector #5 Calibration Fault	24 September 20100
04/165	Engine Control Unit (ECU) and Throttle Diagnostics	Added DTCs: 000028.03 — Digital Throttle Signal Out of Range High, 000028.04 — Digital Throttle Signal Out of Range Low, 003509.03 — Sensor Supply #1 Voltage Out of Range High, 003509.04 — Sensor Supply #1 Voltage Out of Range Low, 003510.03 — Sensor Supply #2 Voltage Out of Range High, 003510.04 — Sensor Supply #2 Voltage Out of Range Low	24 September 20100
04/166	Application Diagnostics	Added DTCs: 000237.02 — VIN Security Data Invalid, 000237.13 — VIN Option Code Security Data Conflict, 000237.31 — VIN Security Data Missing, 001110.31 — Engine Protection Shutdown Active	24 September 20100

MK41968,0000061 -19-05NOV10-1/1

Related Manuals

MK41968,0000062 -19-11AUG08-1/1

Training Information

Sr no.	Code	Course Title	Delivery Type
1	CSP-18-31001	Engine - Adjustments & Diagnostics - PowerTech 4024 and 5030 / 2.4 L and 3.0 L (Tier 2/Stage II) - ILT	Classroom
2	CSP-18-31002	Engine - Adjustments & Diagnostics - PowerTech E 4024 and 5030 / 2.4 L and 3.0 L (Interim Tier 4/Stage III A and Tier 3/Stage III A) - ILT	Classroom
3	CSP-18-32001	Engine - Adjustments, Diagnostics and Teardown - PowerTech 4024 and 5030 / 2.4 L and 3.0 L	Classroom
4	CAP-18-23276	Engine - Application Engineering 102 - Applying a John Deere Engine - Fundamentals	Distance Learning Classroom (DLC)
5	CSP-18-31103	Engine - PIP - PowerTech 4024 and 5030 Injection Pump Spring Replacement	Web-based Course (DLM)
6	CAP-18-35110	Engine - Sales Qualification - PowerTech 4024 and 5030 / 2.4 L and 3.0 L	Web-based Course (DLM)
7	CAP-18-35112	Engine - Sales Qualification - PowerTech E 4024 and 5030 / 2.4 L and 3.0 L (Tier 3/Stage III A and Interim Tier 4/Stage III B)	Web-based Course (DLM)
8	CSP-18-31102	Engine - Technical Qualification - PowerTech 4024 and 5030 / 2.4L and 3.0L - Electronic Governor	Web-based Course (DLM)
9	CSP-18-31101	Engine - Technical Qualification - PowerTech 4024 and 5030 / 2.4L and 3.0L (Tier 2/Stage II)	Web-based Course (DLM)
10	CSP-18-31104	Engine - Technical Qualification - PowerTech E 4024 and 5030 / 2.4 L and 3.0 L (Tier 3/Stage III A and Interim Tier 4/Stage III B) Engine - Technical Qualification - PowerTech E 4024 and 5030 / 2.4 L and 3.0 L (Tier 3/Stage III A and Interim Tier 4/Stage III B)	Web-based Course (DLM)
11	DEV-18-51076	Engine - Train-the-Trainer - 4024/5030, 2.4/3.0 L; 4045/6068, 4.5/6.8 L; 6090, 9.0 L; 6135, 13.5 L; Custom Performance	Classroom
12	DEV-18-51001	Engine - Train-the-Trainer - Adjustments & Diagnostics - PowerTech 4024 and 5030 / 2.4 L and 3.0 L (Tier 2/Stage II)	Classroom

MK41968,0000063 -19-11SEP08-1/1

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 volts (low) to 24 volts (high).
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 vehicles that allows communication between controllers.
Circuit Power	This is power supplied to a device for use by its internal component circuits.
Crank Sensor	Used to determine the angular position and velocity of the crankshaft in the 360° field of rotation.
Digital	A signal which consists of only two levels of voltage — usually 0 volts (low) to 24 volts (high).
DTC	Diagnostic Trouble Code. This is a code that is stored in the ECU's 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.
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.
Input	This identifies a signal as an input to a device or controller.
IFS	Integrated Fuel System. The type of fuel delivery system.
J1939	The Society of Automotive Engineers (SAE) standard for communication between the electronic controllers 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 controllers without removal of the controller 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 multi-meter reads in the ohm position, when the meter lead tips are held together.
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.

Continued on next page

Output	This identifies a signal as an output from a device or controller.
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.
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”.
Suction Control Valve	Suction Control Valve regulates the amount of fuel that the high pressure fuel pump supplies 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.
Trim Options	Options that can be enabled or disabled in the ECU programming, such as throttle selection, torque adjustment, governor gains, derates and shutdowns, etc.
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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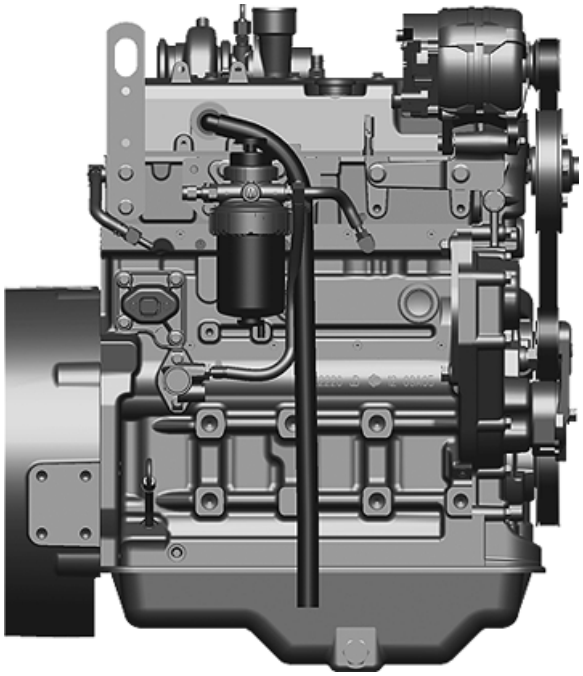
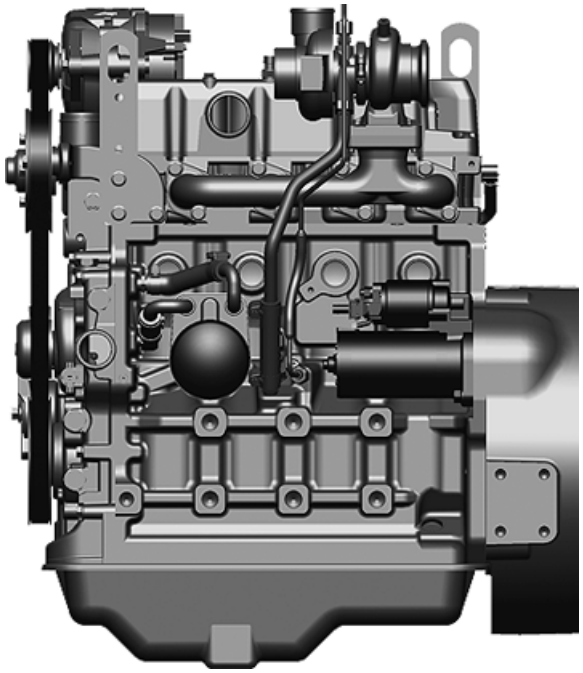
PowerTech™ E 2.4L and 3.0L Diesel Engines



RG15510 —UN—21SEP07

2.4 L Right Side View



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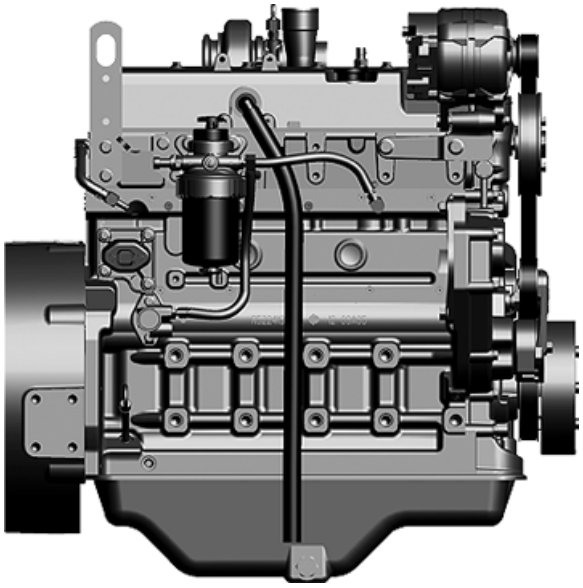
2.4 L Left Side View



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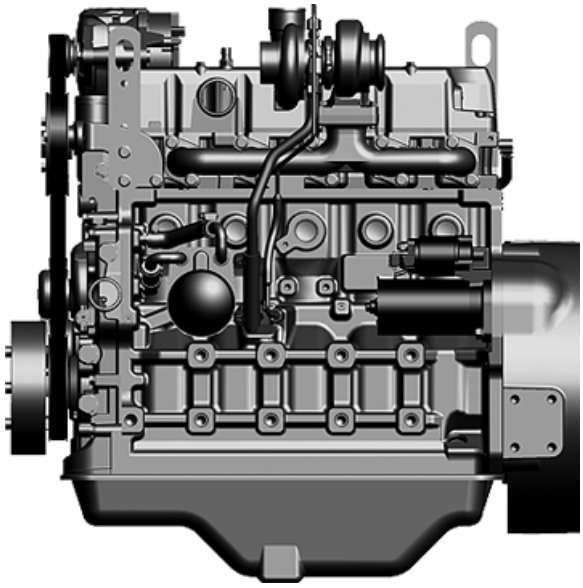
3.0 L Right Side View



RG15513 —UN—21SEP07

3.0 L Left Side View

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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.

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General Information

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About The Group

MK41968,0000066 -19-28AUG08-1/1

Avoid Harmful Asbestos Dust

Avoid breathing dust that may be generated when handling components containing asbestos fibers. Inhaled asbestos fibers may cause lung cancer.

Components in products that may contain asbestos fibers are brake pads, brake band and lining assemblies, clutch plates, and some gaskets. The asbestos used in these components is usually found in a resin or sealed in some way. Normal handling is not hazardous as long as airborne dust containing asbestos is not generated.

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

TS220 —UN—23AUG88

Keep bystanders away from the area.

DX,DUST -19-15MAR91-1/1

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

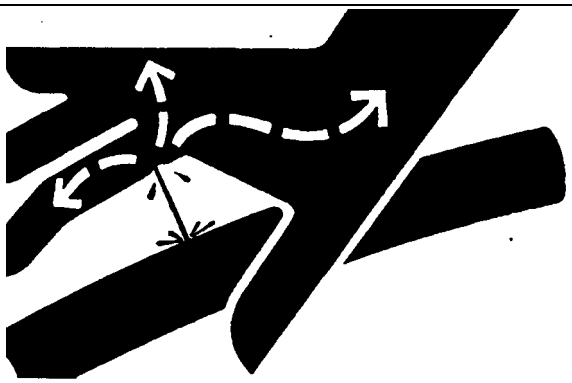
Avoid High-Pressure Fluids

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 from Deere & Company Medical Department in Moline, Illinois, U.S.A.



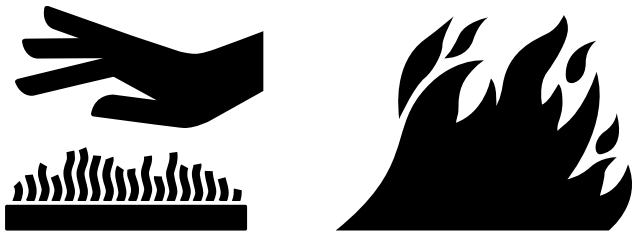
X9811 —UN—23AUG88

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

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.



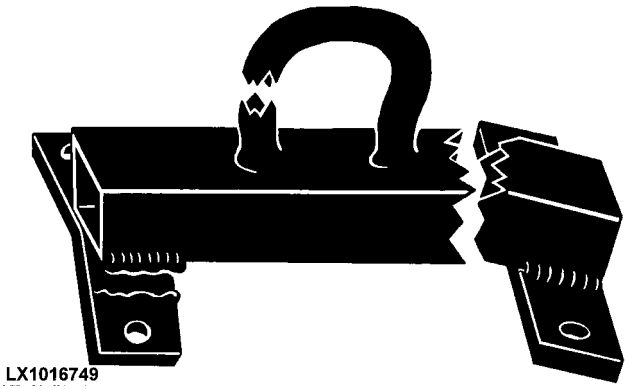
RG17488 —UN—21AUG09

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

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.



LX1016749 —UN—01JUL97

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

Dispose of Waste Properly

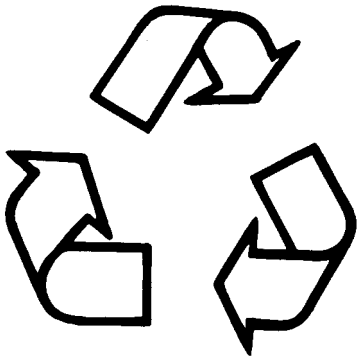
Improperly disposing of waste can threaten the environment and ecology. Potentially harmful waste used with John Deere equipment include such items as oil, fuel, coolant, brake fluid, filters, and batteries.

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—26NOV90

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

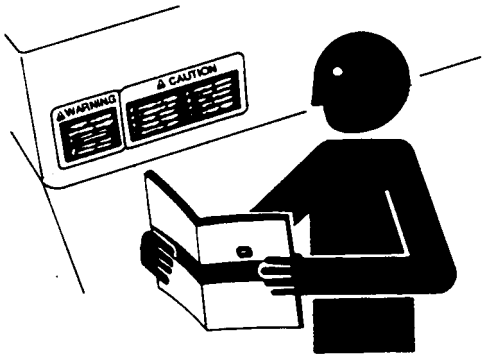
Follow Safety Instructions

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.

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.

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



TS201 —UN—23AUG88

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

Handle Chemical Products Safely

Direct exposure to hazardous chemicals can cause serious injury. Potentially hazardous chemicals used with John Deere equipment include such items as lubricants, coolants, paints, and adhesives.

A Material Safety Data Sheet (MSDS) provides specific details on chemical products: physical and health hazards, safety procedures, and emergency response techniques.

Check the MSDS before you start any job using a hazardous chemical. That way you will know exactly what the risks are and how to do the job safely. Then follow procedures and recommended equipment.

(See your John Deere dealer for MSDS's on chemical products used with John Deere equipment.)

TS1132 —UN—26NOV90

DX,MSDS,NA -19-03MAR93-1/1

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—23AUG88

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

Handle Fuel Safely—Avoid Fires

Handle fuel with care: it is highly flammable. Do not refuel the machine while smoking or when near open flame or sparks.

Always stop engine before refueling machine. Fill fuel tank outdoors.

Prevent fires by keeping machine clean of accumulated trash, grease, and debris. Always clean up spilled fuel.

TS202 —UN—23AUG88

DX,FIRE1 -19-03MAR93-1/1

Handle Starting Fluid Safely

Starting fluid is highly flammable.

Keep all sparks and flame away when using it. Keep starting fluid away from batteries and cables.

To prevent accidental discharge when storing the pressurized can, keep the cap on the container, and store in a cool, protected location.

Do not incinerate or puncture a starting fluid container.

TS1356 —UN—18MAR92

DX,FIRE3 -19-16APR92-1/1

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:

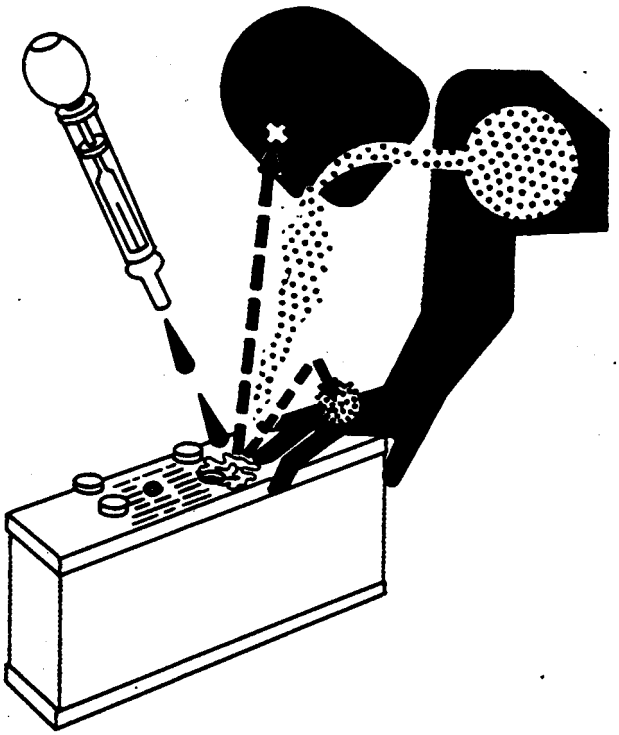
1. Flush skin with water.
2. Apply baking soda or lime to help neutralize the acid.
3. Flush eyes with water for 15—30 minutes. Get medical attention immediately.

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—23AUG88

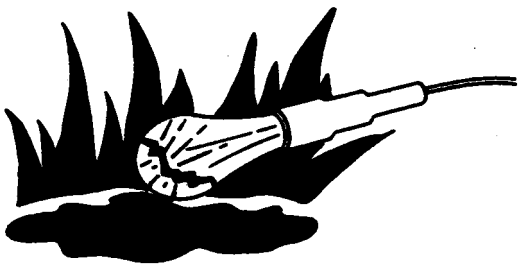


TS203 —UN—23AUG88

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

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

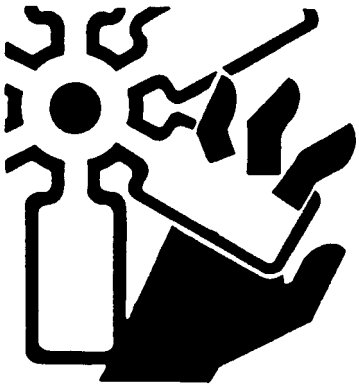
DX,LIGHT -19-04JUN90-1/1

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

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

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:

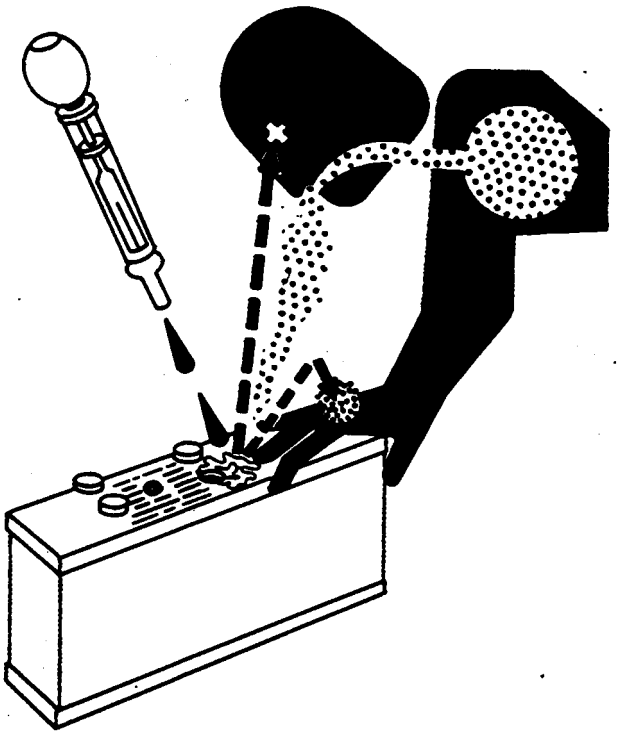
1. Filling batteries in a well-ventilated area.
2. Wearing eye protection and rubber gloves.
3. Avoiding breathing fumes when electrolyte is added.
4. Avoiding spilling or dripping electrolyte.
5. Use proper jump start procedure.

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—23AUG88

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

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

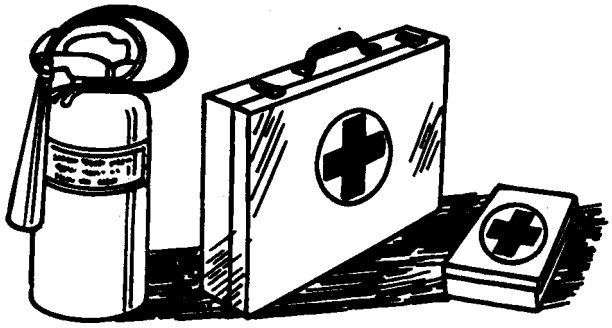
DX,SERV -19-17FEB99-1/1

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—23AUG88

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

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.

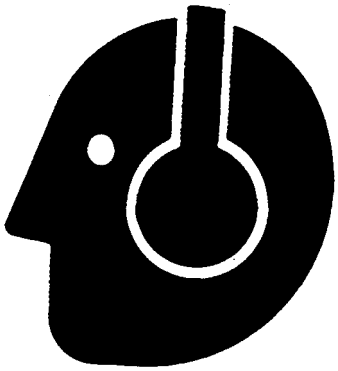
TS1343 —UN—18MAR92

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

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

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—07DEC88

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

Remove Paint Before Welding or Heating

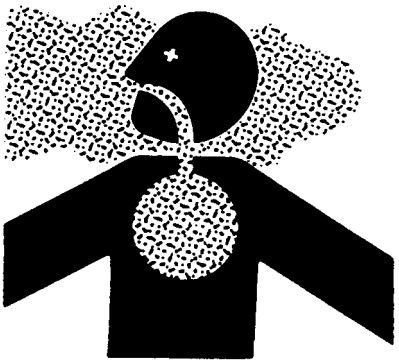
Avoid potentially toxic fumes and dust.

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—23AUG88

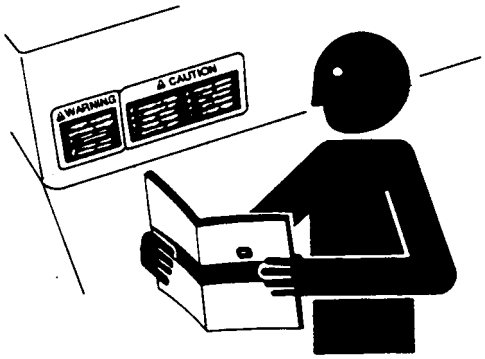
Do all work in an area that is well ventilated to carry toxic fumes and dust away.

Dispose of paint and solvent properly.

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

Replace Safety Signs

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



TS201 —UN—23AUG88

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

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.

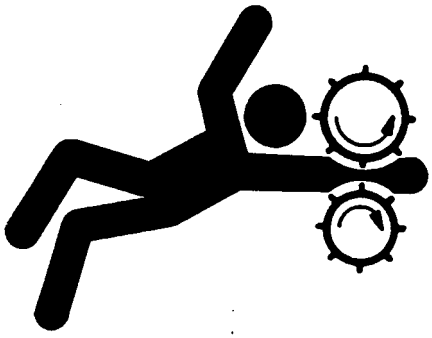
TS281 —UN—23AUG88

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

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

Stay Clear of Rotating Drivelines

Entanglement in rotating driveline can cause serious injury or death.

Keep tractor master shield and driveline shields in place at all times. Make sure rotating shields turn freely.

Wear close fitting clothing. Stop the engine and be sure PTO driveline is stopped before making adjustments, connections, or cleaning out PTO driven equipment.

TS1644 —UN—22AUG95

DX,PTO -19-12SEP95-1/1

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.

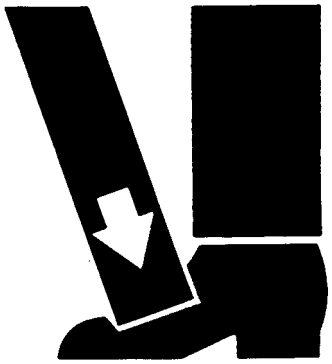
TS187 —19—30SEP88

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

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.



TS226 —UN—23AUG88

DX,LIFT -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

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, wait a minimum of 15 minutes after engine is stopped.

TS1343 —UN—18MAR92

DX,WW,HPCR2 -19-07JAN03-1/1

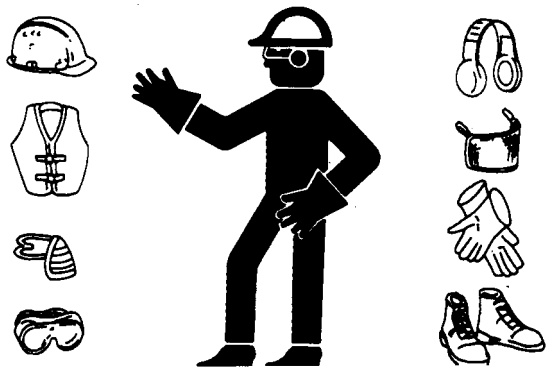
Wear Protective Clothing

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.



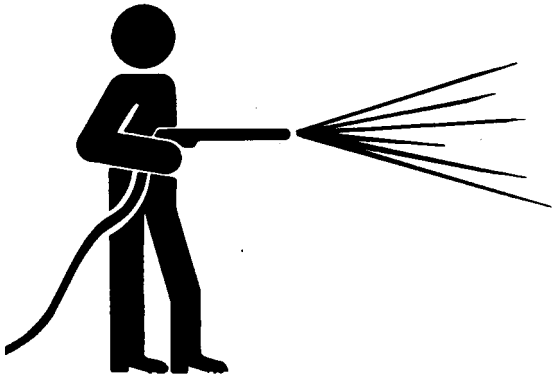
TS206 —UN—23AUG88

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

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.



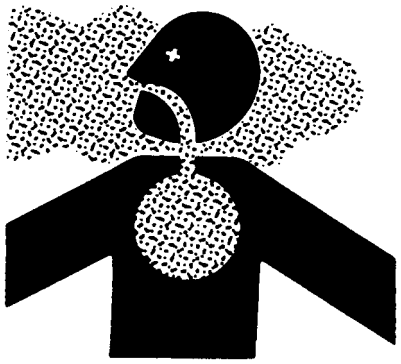
T6642EJ —UN—18OCT88

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

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—23AUG88

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

Engine Model Designation

John Deere engine model designation includes number of cylinders, displacement in liters, aspiration, user code, and application code. For example:

4024HF285 Engine

4 ..... Number of cylinders
024 ..... Liter designation
H ..... Aspiration code
F ..... User code
285 ..... Application Code

Aspiration Code

H ..... Turbocharged and air-to-air aftercooled

User Code

F ..... OEM

Application Code

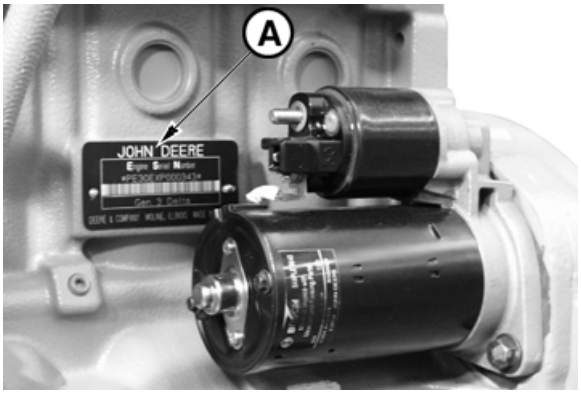
285 (Tier 3/Stage III A) ..... see Application manual, CTM106819.
295 (Interim Tier 4/Stage III B) ... see Application manual, CTM106819.

RG19661,000024F -19-15DEC09-1/1

Engine Serial Number Plate

IMPORTANT: The engine serial number plate (A) can be easily destroyed. Before "hot tank" cleaning the block, remove the plate.

Your engine's serial number plate (A) is located on the left-hand side of cylinder block behind the starter motor.



RG12687 —UN—12DEC02

13-Digit Engine Serial Number Plate

BK34394,00000B1 -19-25SEP07-1/1

Record Engine Serial Number

Engine Serial Number (B)

Each engine has a 13-digit John Deere engine serial number identifying the producing factory, engine model designation, and a 6-digit sequential number. The following is an example:

PE4024L123456

PE	**Engine Manufacturing Location**
PE	Torreon, Mexico
4	**Number of Cylinders**
024	**Displacement in Liters** (2.4 Liters)
L	**Emission Tier Level**
L, M, N, P...	Tier 3/Stage IIIA emission certified engine
R, U, V, W, X, Y, Z	Tier 4/Stage IV emission certified engine
123456	**6-digit unique sequence number**

Record all of the numbers and letters found on your engine serial number plate in the spaces provided below.

This information is very important for repair parts or warranty information.

RG15591 —UN—25SEP07

Engine Serial Plate

Engine Serial Number (B)

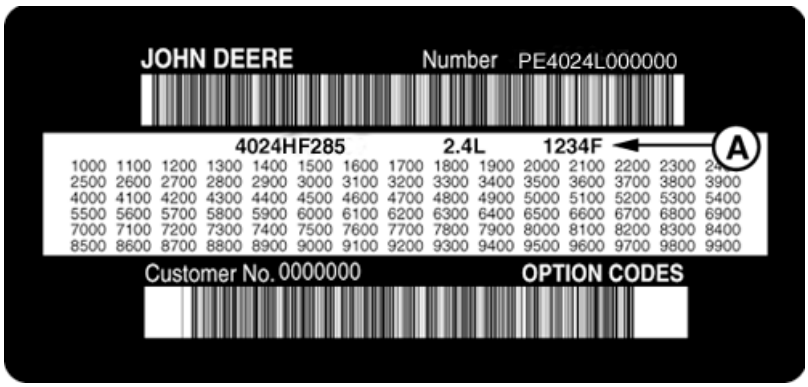
_____

Engine Model Number (C)

_____

BK34394,00000AF -19-28SEP07-1/1

OEM Engine Option Code Label



RG15592 —UN—25SEP07

Engine Option Codes

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

Always provide option code information and engine base code (A) when ordering repair parts. A listing of option codes is given in Parts Catalogs and Operator's Manuals.

NOTE: Before "hot tank" cleaning, ensure that option codes are recorded elsewhere.

BK34394,00000B0 -19-27SEP07-1/1

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 the emissions of particles and gaseous pollutant from internal combustion engines. Such engines are called "CERTIFIED" and receive an emission label stuck on the engine.

The 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 also illegal to install a 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. **To summarize, it is illegal to do anything except return the engine to its original published specifications.**

List of emission-related components:

- Fuel injection system
- Intake manifold
- Turbocharger
- Charge air cooling system
- Piston

BK34394,00000B2 -19-27SEP07-1/1

Emissions Control System Certification Label

CAUTION: Statutes providing severe penalties for tampering with emissions controls may apply at the user's location.

The emissions warranty described below applies only 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 mobile 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 emissions warranty does not apply to the EU countries.

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.

BK34394,00000B3 -19-27SEP07-1/1

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 is basically identical to petroleum diesel fuel that is created by Hydrotreating fats and oils. 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 45 minimum. Cetane number greater than 50 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 0.45 mm as measured by ASTM D6079 or ISO 12156-1.

Sulfur content:

- Diesel fuel quality and fuel sulfur content must comply with all existing emissions regulations for the area in which the engine operates.
- Use of diesel fuel with sulfur content less than 0.10% (1000 ppm) is STRONGLY recommended.
- Use of diesel fuel with sulfur content 0.10% (1000 ppm) to 0.50% (5000 ppm) may result in REDUCED oil and filter change intervals as shown in the table.
- BEFORE using diesel fuel with sulfur content greater than 0.50% (5000 ppm), contact your John Deere dealer.

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

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

DX,FUEL1 -19-05OCT07-1/1

Biodiesel Fuel

Biodiesel is a fuel 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.

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.bq-9000.org.

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

John Deere approved fuel conditioners containing detergent/dispersant additives are recommended when using lower biodiesel blends, but are required when using blends of B20 or greater.

John Deere engines can also operate on biodiesel blends above B20 (up to 100% biodiesel) ONLY if the biodiesel meets the EN 14214 specification (primarily available in Europe). Engines operating on biodiesel blends above B20 may not fully comply with 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 containing detergent/dispersant additives are required.

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

Biodiesel blends up to B20 must be used within 90 days of the date of biodiesel manufacture. Biodiesel blends from B21 to B100 must be used within 45 days of the date of biodiesel manufacture.

Request a certificate of analysis from your fuel distributor to ensure that the fuel is compliant with the above specifications.

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

When using biodiesel fuel, the engine oil level must be checked daily. If oil becomes diluted with fuel, shorten oil change intervals. Refer to Diesel Engine Oil and Filter Service Intervals for more details regarding biodiesel and engine oil change intervals.

The following must be considered when using biodiesel blends up to B20:

- Cold weather flow degradation
- Stability and storage issues (moisture absorption, oxidation, 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
- Possible reduction of service life of engine components

The following must also be considered when using biodiesel blends above B20.

- Possible coking and/or blocked injector nozzles, resulting in power loss and engine misfire if John Deere approved fuel conditioners containing detergent/dispersant additives are not used
- Possible crankcase oil dilution, requiring more frequent oil changes
- Possible corrosion of fuel injection equipment
- Possible lacquering and/or seizure of internal components
- Possible formation of sludge and sediments
- Possible thermal oxidation of fuel at elevated temperatures
- Possible elastomer seal and gasket material degradation (primarily an issue with older engines)
- Possible compatibility issues with other materials (including copper, lead, zinc, tin, brass, and bronze) used in fuel systems and fuel handling equipment
- Possible reduction in water separator efficiency
- Potential high acid levels within fuel system
- Possible damage to paint if exposed to biodiesel

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 -19-04OCT07-1/1

Handling and Storing Diesel Fuel

CAUTION: 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 bio-diesel 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 -19-19DEC03-1/1

Filling Fuel Tank

CAUTION: Handle fuel carefully. Do not fill the fuel tank when engine is running.

DO NOT smoke while filling fuel tank or servicing fuel system.

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.

Fill fuel tank at the end of each day's operation to prevent condensation in tank. As moist air cools, condensation may form and freeze during cold weather.

TS202 —UN—23AUG88

RG,RG34710,7527 -19-30JUN97-1/1

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 PREMIUM DIESEL FUEL CONDITIONER (or equivalent) at the specified concentration.

Lubricity of Biodiesel Fuel

Significant improvement in lubricity can occur with biodiesel blends up to B20. The gain in lubricity above a 20% blend is limited.

DX,FUEL5 -19-05OCT07-1/1

Testing Diesel Fuel

DIESELSCAN™ is a John Deere fuel analysis program that can be used to monitor the quality of your fuel. The DIESELSCAN analysis verifies fuel type, cleanliness, water content, suitability for cold weather operation, and whether the fuel meets specifications.

Check with your John Deere dealer for availability of DIESELSCAN kits.

DIESELSCAN is a trademark of Deere & Company

DX,FUEL6 -19-14NOV05-1/1

Diesel Engine Coolant

The engine cooling system is filled to provide year-round protection against corrosion and cylinder liner pitting, and winter freeze protection to -37°C (-34°F). If protection at lower temperatures is required, consult your John Deere dealer for recommendations.

John Deere COOL-GARD™ Prediluted Coolant is preferred for service.

John Deere COOL-GARD Prediluted Coolant is available in a concentration of either 50% ethylene glycol or 55% propylene glycol.

Additional recommended coolants

The following engine coolant is also recommended:

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

John Deere COOL-GARD coolants do not require use of supplemental coolant additives, except for periodic replenishment of additives during the drain interval.

Other fully formulated coolants

Other fully formulated low silicate ethylene or propylene glycol base coolants for heavy-duty engines may be used if they meet one of the following specifications:

- ASTM D6210 prediluted (50%) coolant
- ASTM D6210 coolant concentrate in a 40% to 60% mixture of concentrate with quality water

Coolants meeting ASTM D6210 do not require use of supplemental coolant additives, except for periodic replenishment of additives during the drain interval.

Coolants requiring supplemental coolant additives

Other low silicate ethylene glycol base coolants for heavy-duty engines may also be used if they meet one of the following specifications:

- ASTM D4985 ethylene glycol base prediluted (50%) coolant
- ASTM D4985 ethylene glycol base coolant concentrate in a 40% to 60% mixture of concentrate with quality water

Coolants meeting ASTM D4985 require an initial charge of supplemental coolant additives, formulated for protection of heavy duty diesel engines against corrosion and cylinder liner erosion and pitting. They also require periodic replenishment of additives during the drain interval.

Other coolants

It is possible that neither John Deere COOL-GARD nor coolants meeting one of the coolant standards listed above is available in the geographical area where service is performed. If these coolants are unavailable, use a coolant concentrate or prediluted coolant with a quality additive package that provides cylinder liner cavitation protection and protects the cooling system metals (cast iron, aluminum alloys, and copper alloys such as brass) from corrosion.

The additive package must be part of one of the following coolant mixtures:

- ethylene glycol or propylene glycol base prediluted (40% to 60%) coolant
- ethylene glycol or propylene glycol base coolant concentrate in a 40% to 60% mixture of concentrate with quality water

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.

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

IMPORTANT: Do not mix ethylene glycol and propylene glycol base coolants.

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DX,COOL3 -19-27OCT05-1/1

Supplemental Coolant Additives

The concentration of coolant additives is gradually depleted during engine operation. For all recommended coolants, replenish additives between drain intervals by adding a supplemental coolant additive every 12 months or as determined necessary by coolant testing.

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

IMPORTANT: Do not add a supplemental coolant additive when the cooling system is drained and refilled with John DeereCOOL-GARD™.

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

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

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

DX,COOL4 -19-07NOV03-1/1

Drain Intervals for Diesel Engine Coolant

Drain the factory fill engine coolant, flush the cooling system, and refill with new coolant after the first 3 years or 3000 hours of operation.

Subsequent drain intervals are determined by the coolant used for service. At each interval, drain the coolant, flush the cooling system, and refill with new coolant.

When John Deere COOL-GARD is used, the coolant drain interval is 3 years or 3000 hours of operation.

If COOL-GARD is not used, the drain interval is reduced to 2 years or 2000 hours of operation.

DX,COOL12 -19-18OCT01-1/1

Light Duty Diesel Engine Coolant (for diesel engines without wet sleeve cylinder liners)

The engine cooling system is filled to provide year-round protection against corrosion and cylinder liner pitting, and winter freeze protection to -37°C (-34°F). If protection at lower temperatures is required, consult your John Deere dealer for recommendations.

The following engine coolants are preferred:

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

Use John DeereCOOL-GARD™ II PG Premix 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.

Other Coolants

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

- ASTM D3306 prediluted (50%) coolant
- ASTM D3306 coolant concentrate in a 40—60% mixture of concentrate with quality water

If these coolants are unavailable, use an engine coolant concentrate or prediluted coolant with a minimum of the following chemical and physical properties:

- Is formulated with a quality nitrite-free additive package.
- Protects the cooling system metals (cast iron, aluminum alloys, and copper alloys such as brass) from corrosion.

The coolant concentrate or prediluted coolant shall be of a quality that is suitable for all-aluminum engines.

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 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 John Deere COOL-GARD II is used, the drain interval is six years or 6000 hours of operation.

When John Deere COOL-GARD II PG is used, the drain interval is five years or 5000 hours of operation.

If a coolant other than COOL-GARD II or COOL-GARD II PG is used, reduce the drain interval to two 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.

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DX,COOL18 -19-20APR11-1/1

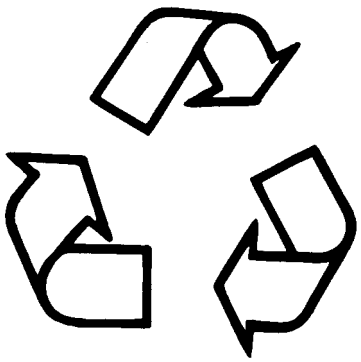
Disposing of Coolant

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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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.

DX,COOL6 -19-18MAR96-1/1

Testing Diesel Engine Coolant

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™ and COOLSCAN PLUS™

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

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COOLSCAN PLUS is a trademark of Deere & Company

DX,COOL9 -19-19DEC03-1/1

Additional Information About Diesel Engine Coolants and Supplemental Coolant Additives

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

Coolant specifications

Some products, including John Deere COOL-GARD™ Prediluted Coolant, are fully formulated coolants that contain all three components in their correct concentrations. Do not add an initial charge of supplemental coolant additives to these fully formulated products.

Coolants meeting ASTM D6210 do not require an initial charge of supplemental coolant additives.

Some coolant concentrates, including John Deere COOL-GARD Coolant Concentrate, contain both glycol antifreeze and inhibiting coolant additives. Mix these products with quality water, but do not add an initial charge of supplemental coolant additives.

Coolants meeting ASTM D4985 require an initial charge of supplemental coolant additives.

Replenish coolant additives

The concentration of coolant additives is gradually depleted during engine operation. Periodic replenishment of inhibitors is required, even when John Deere COOL-GARD or another fully formulated coolant is used. Follow the recommendations in this manual for the use of supplemental coolant additives.

Why use supplemental coolant additives?

Operating without proper coolant additives will result in increased corrosion, cylinder liner erosion and pitting, and other damage to the engine and cooling system. A simple mixture of ethylene glycol or propylene glycol and water will not give adequate protection.

Use of supplemental coolant additives reduces corrosion, erosion, and pitting. These chemicals reduce the number of vapor bubbles in the coolant and help form a protective film on cylinder liner surfaces. This film acts as a barrier against the harmful effects of collapsing vapor bubbles.

Avoid automotive-type coolants

Never use automotive-type coolants (such as those meeting ASTM D3306). These coolants do not contain the correct additives to protect heavy-duty diesel engines. They often contain a high concentration of silicates and may damage the engine or cooling system.

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

Chlorides	<40 mg/L
Sulfates	<100 mg/L
Total dissolved solids	<340 mg/L
Total hardness	<170 mg/L
pH	5.5 to 9.0

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.

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DX,COOL7 -19-19DEC03-1/1

Diesel Engine Break-In Oil

New engines should be filled at the factory with John DeerePLUS-50 ™oil. During the break-in period, add John DeerePLUS-50 ™15W-40 oil as needed to maintain the specified oil level. (Order TY6389.)

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Diesel Engine Oil

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

John Deere PLUS-50™ oil is preferred.

Oil meeting one of the following specifications are also recommended:

- ACEA Oil Sequence E7
- ACEA Oil Sequence E6
- ACEA Oil Sequence E5
- ACEA Oil Sequence E4

Extended service intervals may apply when John Deere PLUS-50™, ACEA E7, ACEA E6, ACEA E5, or ACEA E4 engine oils are used. Consult your John Deere dealer for more information.

Other oils may be used if they meet one or more of the following:

- John Deere TORQ-GARD SUPREME™
- API Service Category CJ-4
- API Service Category CI-4 PLUS
- API Service Category CI-4
- API Service Category CH-4
- ACEA Oil Sequence E3

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.

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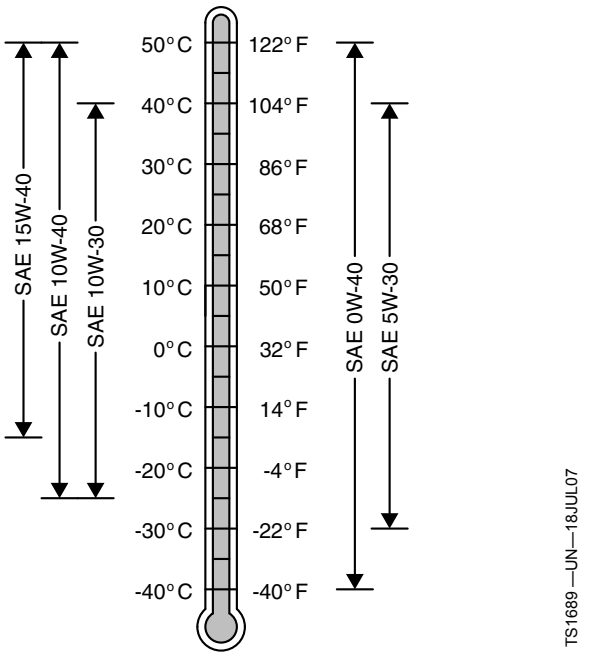

Oil Viscosities for Air Temperature Ranges

DO NOT use diesel fuel with sulfur content greater than 1.0% (10 000 ppm).

DX,ENOIL7 -19-06APR07-1/1

Extended Diesel Engine Oil Service Intervals

When John Deere PLUS-50™ oil is used with the specified John Deere filter, the service interval for engine oil and filter changes may be increased by 50% but not to exceed a maximum of 500 hours.

When ACEA E7, ACEA E6, ACEA E5, or ACEA E4 oils are used with specified John Deere filter, use engine oil analysis to determine if the service interval for engine oil and filter changes may be increased by a maximum of 50% but not to exceed 500 hours.

If John Deere PLUS-50™, ACEA E7, ACEA E6, ACEA E5, or ACEA E4 oils are used with other than the specified John Deere filter, change the engine oil and filter at the normal service interval.

If John Deere TORQ-GARD SUPREME™, API CJ-4, API CI-4 PLUS, API CI-4, API CH-4, or ACEA E3 oils are used, change the engine oil and filter at the normal service interval.

If API CG-4, API CF-4, or ACEA E2 oils are used, change the engine oil and filter at 50% of the normal service interval.

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DX,ENOIL6 -19-13SEP06-1/1

Grease

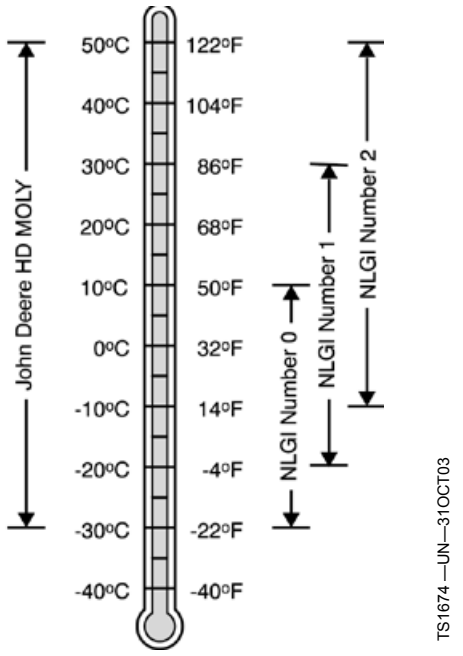
Use grease based on NLGI consistency numbers and the expected air temperature range during the service interval.

John Deere HD MOLY GREASE preferred.

Other greases may be used if they meet the following:

- NLGI Performance Classification GC-LB with 3% to 5% molybdenum disulfide

IMPORTANT: Some types of grease thickeners are not compatible with others. Consult your grease supplier before mixing different types of grease



DX,GREA4 -19-07NOV03-1/1

Lubricant Storage

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

Use clean containers to handle all lubricants.

Whenever possible, 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 -19-18MAR96-1/1

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

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 oils.

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

DX,ALTER -19-15JUN00-1/1

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 Blend Diesel Fuel

When temperatures fall below -10°C (14°F), winter blend diesel fuel is best suited for cold weather operation. Winter blend diesel 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 an average, winter blend diesel fuel has a lower BTU (heat content) rating. Using winter blend diesel 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 to aid cold weather staring.

Ether

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

CAUTION: Do not use ether when (1) starting with an engine equipped with glow plugs or (2) when starting with 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 this section.)

Diesel Fuel Flow Additive

Use John Deere Premium Diesel Fuel Conditioner (winter formula) which contains anti-gel chemistry, or equivalent to treat Grade No.2-D fuel during the cold weather season. This generally extends operability about 10°C (18°F) below its Cloud Point. For operability at temperatures further below, winter grade fuel (a blend of No.2-D and No.1-D, or straight No.1-D fuel) is best suited for cold weather operation.

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.

CAUTION: Do not use ether when starting with an air intake heater.

Biodiesel

When running with BIODIESEL blends wax formation can generate at warmer temperatures. Begin to use John Deere Premium Biodiesel Conditioner (winter) at 5°C (40°F) to treat biodiesel fuels during the cold weather season. Below 0°C (32°F) John Deere requires the use of B5 or lower blends. Below -10°C (14°F) John Deere requires the use of winter blend diesel fuel.

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.

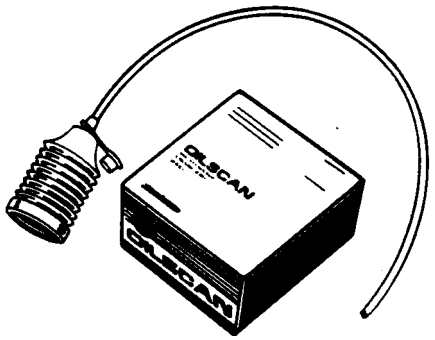
DX,FUEL10 -19-04OCT07-1/1

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 prior to its recommended change interval.

Check with your John Deere dealer for the availability of OILSCAN ™ and COOLSCAN ™ kits.



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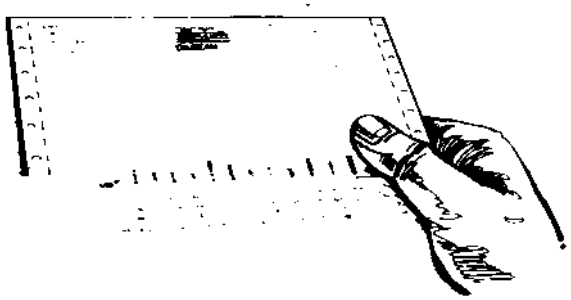

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Essential, Recommended and Fabricated Tools for this Group

NOTE: Order tools according to information given in the U.S. SERVICEGARD Catalog or from the European Microfiche Tool Catalog (MTC).

- D05223ST—Engine Repair Stand
- JDG1676—Engine Adapter
- JDG23—Engine Lifting Sling
- JDG1676—Engine Mounting Fixture

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Engine Stand Safety Precautions

The engine repair stand should be used only by qualified service technicians familiar with this equipment.

To maintain shear strength specifications, alloy steel Class 12.9 or SAE Grade 8 or higher cap screws must be used to mount adapters and engine to repair stand. Use LOCTITE® 242 Thread Lock and Sealer (Medium Strength) on cap screws when installing lifting straps on engine. Tighten cap screws to specifications given.

For full thread engagement, be certain that tapped holes in adapters and engine blocks are clean and not damaged. A thread length engagement equal to 1-1/2 screw diameters minimum is required to maintain strength requirements.

To avoid structural or personal injury, do not exceed the maximum capacity rating of 2722 kg (6000 lb). Maximum capacity is determined with the center of the engine located not more than 330 mm (13 in.) from the mounting hub surface of the engine stand.

The center of balance of an engine must be located within 51 mm (2 in.) of the engine stand rotating shaft. Engine center of balance is generally located a few millimeters above the crankshaft.

To prevent possible personal injury due to engine slippage, recheck to make sure engine is solidly mounted before releasing support from engine lifting device.

Never permit any part of the body to be positioned under a load being lifted or suspended. Accidental slippage may result in personal injury.

The lifting jack is to be used when it is necessary to lift the engine for rotation. When working on the engine, the jack should be at its lowest position to keep the center of gravity and the possibility of tipping low.

To prevent possible personal injury due to sudden engine movement, lower the engine by operating jack release valve slowly. Do not unscrew release valve knob more than two turns from its closed position.

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RG,RG34710,45 -19-27SEP07-1/1

Engine Overhaul Guidelines

Engine life and performance will vary depending on operating conditions and the level of regular engine maintenance. Engines can be brought back to original performance standards through proper overhaul procedures and replacement of parts with genuine John Deere service parts. Overhauling the engine prior to failure can avoid costly repairs and downtime.

Consider installing a John Deere overhaul kit when:

- The engine begins to experience power loss and there are no known engine component failures.
- The engine is hard to start due to low cranking compression.
- The engine begins to smoke and there are no known engine component failures.
- The engine begins to use oil. Refer to Section 04 for acceptable oil consumption.
- The engine has high usage hours and the owner wants to take preventive measures to avoid high-cost repairs and costly downtime.

Overhaul kits may be available for John Deere engines in your area.

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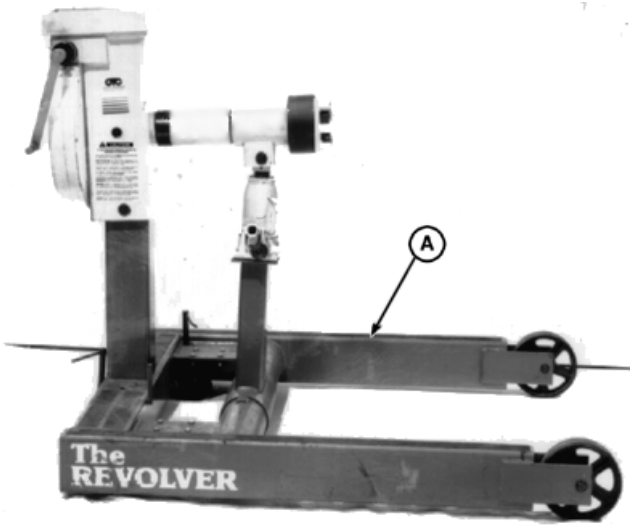
Engine Repair Stand

NOTE: Only the 2722 kg (6000 lb) heavy duty engine repair stand (A) No. D05223ST manufactured by Owatonna Tool Co., Owatonna, Minnesota, is referenced in this manual. When any other repair stand is used, consult the manufacturer's instructions for mounting the engine.

Refer to machine technical manual for steps to remove engine from machine.

A—D05223ST Engine Repair Stand



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Engine Repair Stand

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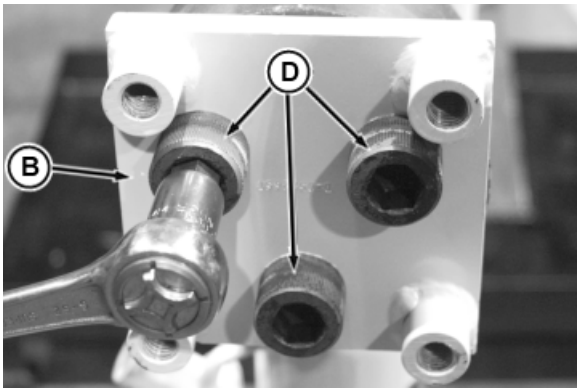
Adapters Installation on Engine Repair Stand

1. Attach the D05226ST Special Adapter (B) to mounting hub (A) of the engine repair stand, using SAE Grade 8 socket head cap screws (D), to the following specifications.

Specification
D05226ST Special Adapter-to-Mounting Hub SAE Grade 8 Socket Head Cap Screws. —Torque..... 600 N•m (450 lb-ft).

2. Attach the JDG1676 Engine Adapter (C) to the special adapter, using four SAE Grade 8 caps screws (E), to the following specifications.

Specification
JDG1676 Engine Adapter-to-Special Adapter SAE Grade 8 Cap Screws.—Torque..... 135 N•m (100 lb-ft).



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Engine Repair Stand Adapters

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Engine Lifting Procedure

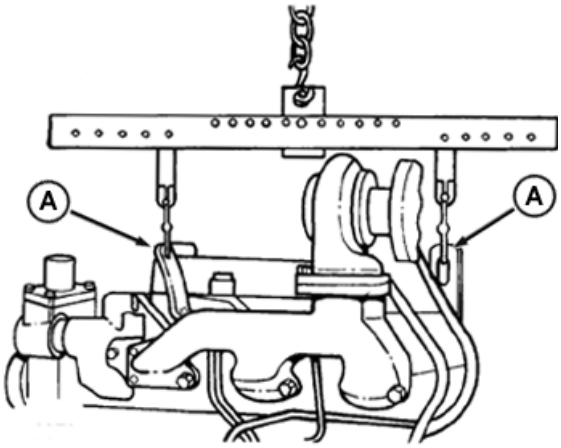
CAUTION: Use extreme caution when lifting and NEVER permit any part of the body to be lifted or suspended.

Lift engine with longitudinal loading on lift sling and lift brackets only. Angular loading greatly reduces lifting capacity of sling and brackets.

1. Attach JDG23 Engine Lifting Sling (or other suitable sling) to engine lifting straps (A) and overhead hoist on floor crane.

NOTE: If engine does not have lifting straps, they can be procured through service parts. Use of an engine lifting sling is the ONLY APPROVED method for lifting engine.

2. Carefully lift engine to desired location.



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Lifting Engine with Lifting Sling

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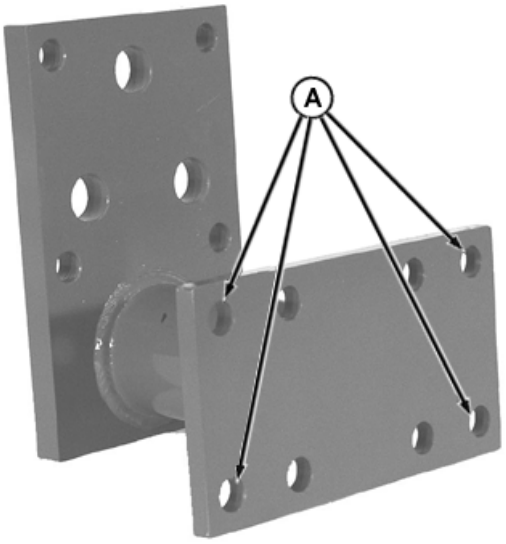
Engine Mounting on Repair Stand

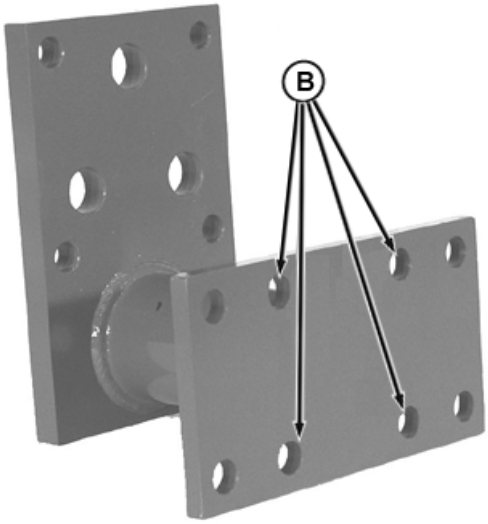
CAUTION: NEVER remove the overhead lifting equipment until the engine is securely mounted onto the repair stand and all mounting hardware is tightened to specified torque. Always release the overhead lifting equipment slowly.

Mount the engine to JDG1676 using M16 X 45mm (1.75 in.) cap screws.



RG17942 —UN—08DEC09

4024 Engine



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5030 Engine

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Clean Engine

1. Cap or plug all openings (air intake, exhaust, fuel, coolant, etc.).
2. Remove electrical components (starter, alternator, etc.). Cover electrical components that are not removed with plastic and tape securely to prevent moisture damage.
3. Thoroughly steam clean engine.

RG41183,0000041 -19-27SEP07-1/1

Disconnect Turbocharger Oil Inlet Line

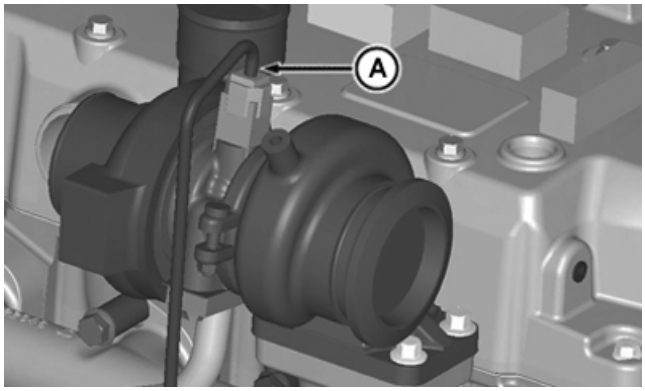
1. Drain all engine oil and coolant, if not previously done.

IMPORTANT: When servicing turbocharged engines on a rollover stand, disconnect turbocharger oil inlet line (A) from oil filter housing or turbocharger before rolling engine over. Failure to do so may cause a hydraulic lock upon starting engine. Hydraulic lock may cause possible engine failure.

Hydraulic lock occurs when trapped oil in the oil filter housing drains through the turbocharger, the exhaust and intake manifolds, and then into the cylinder head.

After starting the engine, the trapped oil in the manifold and head is released into the cylinder(s), filling them with oil, causing hydraulic lock and possible engine failure.

2. Disconnect turbocharger oil inlet line at turbocharger or oil filter housing.



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Turbocharger Oil Inlet Line

A—Oil Inlet Line

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Engine Disassembly Sequence

The following sequence is suggested when complete disassembly for overhaul is required. Refer to the appropriate repair group when removing individual engine components.

1. Mount engine on a safety approved repair stand.
2. Drain coolant and oil. Perform John Deere OILSCAN and COOLSCAN analysis. (Group 02)
3. Remove engine wiring harness, sensors and engine control unit. (Group 110)
4. Remove fan belt, fan, belt tensioner, alternator bracket and alternator. (Group 20)
5. Remove turbocharger and exhaust manifold. (Group 80)
6. Remove vent tube and rocker arm cover. If option code label is located on rocker arm cover, be careful not to damage label. (Group 20)
7. Remove glow plug wiring harness and glow plugs. (Group 20)
8. Remove dipstick, oil filter, oil cooler, hoses and adapter housing (if equipped). (Group 60)
9. Remove fuel supply pump, fuel filter base and fuel lines. (Group 90)
10. Remove starting motor. (Group 100)
11. Remove rocker arm assembly and push rods. Keep rods in order (Group 20). Check for bent push rods and condition of wear pad contact surfaces on rockers.
12. Remove electronic unit pumps, injectors and high pressure injection lines. (Group 90)
13. Remove cylinder head. Check piston-to-cylinder head clearance. Remove and inspect valves and cylinder head valve seats. (Group 20)
14. Remove cam followers. Keep followers in order. (Groups 20 and 90)
15. Remove flywheel and flywheel housing. (Group 40)
16. Remove oil pan and oil intake tube. (Group 60)
17. Remove crankshaft pulley. (Group 40)
18. Remove coolant pump and thermostat. (Group 20)
19. Remove timing gear cover. (Group 50)
20. Remove oil pressure regulating valve assembly and oil pump. (Group 60)
21. Remove camshaft gear/timing wheel and camshaft. Perform wear checks. (Group 50)
22. Remove balancer shafts. (Group 50)
23. Stamp cylinder number on connecting rod. Remove pistons and rods. (First, perform wear checks with PLASTIGAGE®.) (Group 30)
24. Remove crankshaft and main bearings. (First, perform wear checks with PLASTIGAGE®PLASTIGAGE.) (Group 40)
25. Remove piston cooling orifices. (Group 30)
26. Remove camshaft and balancer shaft bushings. (Group 50)
27. Remove cylinder block plugs when block is to be put in a “hot tank”. (Group 30)
28. Clean cylinder bores with nylon brush. (Group 30)
29. Measure cylinder block. (Groups 30, 40, and 50)

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Engine Assembly Sequence

The following assembly sequence is suggested when engine has been completely disassembled. Be sure to check run-out specifications, clearance tolerances, torques, sealant materials as engine is assembled. Refer to the appropriate repair group when assembling engine components.

1. Install all plugs and serial number plate in cylinder block (if removed). (Group 30)
2. Install piston cooling orifices. (Group 30)
3. Install new balancer shaft bushings and camshaft bushings. (Group 50)
4. Install main bearings and crankshaft. PLASTIGAGE® bearings. (Group 40)
5. Install flywheel housing, rear oil seal, and flywheel. (Group 40)
6. Install pistons and rods. Measure piston protrusion. (Group 30)
7. Install balancer shafts, if equipped. Check end play. (Group 50)
8. Install camshaft, friction washer, camshaft gear and timing wheel. Insure correct gear alignment. (Group 50)
9. Install cylinder head gasket and cylinder head. (Group 20)
10. Install electronic unit injection pumps, high pressure injection lines and injector nozzles. (Group 90)
11. Install hydraulic lifters, push rods, and rocker arm assembly. (Group 20)
12. Install glow plugs and wiring harness. (Group 20)
13. Install fuel supply pump. (Group 90)
14. Install fuel filter assembly. (Group 90)
15. Install oil cooler, new oil filter, and dipstick. (Group 60)
16. Install oil pump and oil pressure regulating valve into timing gear cover. (Group 60)
17. Install timing gear cover with new front seal. (Group 50)
18. Install oil intake tube and oil pan. (Group 60)
19. Install coolant pump and thermostat. (Group 70)
20. Install rocker arm cover. (Group 20)
21. Install alternator bracket, alternator, belt tensioner, fan belt and fan.
22. Install exhaust manifold and turbocharger. (Group 80)
23. Install engine sensors, wiring harness and engine control unit. (Group 110)
24. Fill engine with clean oil. (Group 02)
25. Flush cooling system and refill with proper coolant. (Group 150)
26. Perform engine break-in and standard performance checks. See PERFORM ENGINE BREAK-IN in this group.

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Engine Break-In Guidelines

Engine break-in should be performed after overhaul or when the following repairs have been made:

- Main bearings, rod bearings, crankshaft, or any combination of these parts have been replaced.
- Pistons, rings have been replaced or cylinder bore has been honed.
- Rear crankshaft oil seal and wear sleeve have been replaced. (Primary objective is to see if oil seal still leaks.)
- Cylinder head has been removed.
- Unit Injection pump has been removed or critical adjustments have been made. (Primary objective is to check power.)

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Perform Engine Break-In

Before starting, fill engine with seasonal viscosity grade oil and with coolant meeting specifications. (See DIESEL ENGINE OIL and DIESEL ENGINE COOLANT SPECIFICATIONS in Fuels, Lubricants, and Coolant Section.)

1. During the first 20 hours, avoid prolonged periods of engine idling or sustained maximum load operation. Warm-up engine carefully and operate at normal loads. If engine will idle longer than 5 minutes, stop engine.

IMPORTANT: Do not use break-in oil in this engine.

2. Check oil level daily or every 10 hours during engine break-in period. If oil must be added during this period, use John DeerePLUS-50 ™oil. (See DIESEL ENGINE OIL in Fuels, Lubricants, and Coolant section.)

PLUS-50 is a trademark of Deere & Company.

3. Watch coolant temperatures (A) closely during break-in period. Also check coolant level daily or every 10 hours and check for leaks.

NOTE: The coolant temperature gauge is an (optional) orderable accessory.

4. Check poly-vee belt for proper alignment and seating in pulley grooves.
5. Change oil and filter every 250 hours/6 months. (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.)

IMPORTANT: DO NOT operate engine when oil level is below ADD mark on dipstick. Check oil level before starting engine for the first time.

RG41183,000004E -19-09JAN07-1/1

Essential, Recommended and Fabricated Tools For This Group

NOTE: Order tools according to information given in the U.S. SERVICEGARD Catalog or from the European Microfiche Tool Catalog (MTC).

- D01168AA — Spring Compression Tester
- D05012ST — Precision “Bevelled Edge” Straightedge and Feeler Gauge
- D17024BR — End Brush
- JDE138 — Valve Spring Compressor
- JDG1678 — Hydraulic Lifter Bleed-Down Tool
- JT05949 — Valve Guide Knurler Kit

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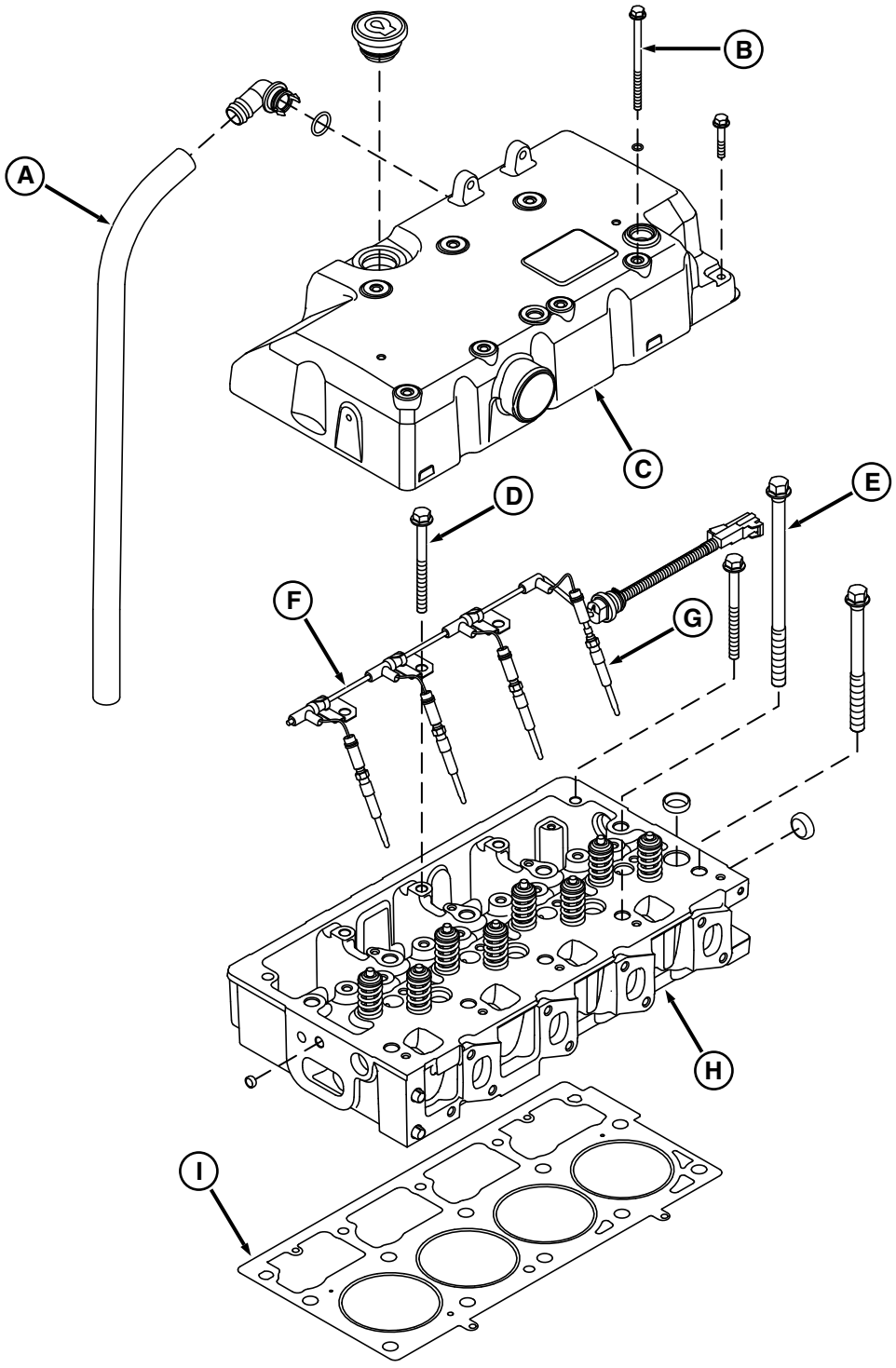
Cylinder Head Exploded View



Cylinder Head Exploded View

A—Vent Tube
B—Rocker Arm Cover Cap Screw
C—Rocker Arm Cover/Intake Manifold
D—Cylinder Head/Glow Plug Wiring Harness Cap Screw
E—Cylinder Head Cap Screw
F—Glow Plug Wiring Harness
G—Glow Plug
H—Cylinder Head
I— Cylinder Head Gasket

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Cylinder Head and Valves — Troubleshooting Guide

Make preliminary inspection of cylinder head and valve assembly during disassembly.

Look for the following conditions:

Sticking Valves:

- Carbon deposits on valve stem.
- Worn valve guides.
- Scored valve stems.
- Warped valve stems.
- Misaligned or broken valve springs.
- Worn or distorted valve seats.
- Insufficient lubrication.

Warped, Worn, or Distorted Valve Guides:

- Lack of lubrication.
- Cylinder head distortion.
- Excessive heat.
- Unevenly tightened cylinder head cap screws.

Distorted Cylinder Head and Gasket Leakage:

- Loss of cylinder head cap screw torque.
- Broken cylinder head cap screw(s).
- Overheating from low coolant level operation.
- Coolant leakage into cylinder causing hydraulic failure of gasket.
- Cracked cylinder head.
- Cracked cylinder bore.
- Damaged or incorrect gasket.
- Overpowering or overfueling.
- Damaged cylinder head or block surfaces.
- Improper surface finish on cylinder head.
- Improperly tightened cylinder head cap screws.
- Faulty gasket installation (misaligned).

Worn or Broken Valve Seats:

- Misaligned valves.
- Distorted cylinder head.
- Carbon deposits on seats due to incomplete combustion.
- Valve spring tension too weak.
- Excessive heat.
- Improper valve clearance.
- Improper valve timing.
- Incorrect valve installed.

Burned, Pitted, Worn, or Broken Valves:

- Worn or distorted valve seats.
- Loose valve seats.
- Worn valve guides.
- Insufficient cooling.
- Cocked or broken valve springs.
- Improper engine operation.
- Improper valve train timing.
- Faulty valve rotators.
- Warped or distorted valve stems.
- “Stretched” valves due to excessive spring tension.
- Warped cylinder head.
- Bent push rods.
- Carbon build-up on valve seats.
- Rocker arm failure.
- Incorrect valve installed.
- Incorrect piston-to-valve clearance.

Improper Valve Clearance:

- Inefficient use of fuel.
- Engine starts harder.
- Maximum engine power will not be achieved.
- Shorter service life of valve train.
- Greater chance for engine to overheat.

Excessive Recession:

- Worn valve guides.
- Bent valves.
- Debris passed through valve train.

MK41968,00002BF -19-16NOV09-1/1

Cylinder Head — Removal

NOTE: Before head removal, check for external leaks, damages to cylinder head & gasket.

NOTE: It is not necessary to remove engine from machine to service cylinder head on all applications. Refer to your Machine Technical Manual for engine removal procedure, if required. The turbocharger may be removed from the engine, if desired.

1. Perform Fan Assembly — Removal.

   Special Tools:
   • None

2. Perform Fan and Alternator Belt — Removal.

   Special Tools:
   • None

3. Perform Engine Wiring Harness — Removal.

   Special Tools:
   • None

4. Perform Alternator — Removal.

   Special Tools:
   • None

5. Perform Idler Pulley(s) with Lift Strap — Removal.

   Special Tools:
   • None

6. Perform Turbocharger — Removal.

   Special Tools:
   • None

7. Perform Exhaust Manifold — Removal.

   Special Tools:
   • None

8. Perform Fuel Filter — Removal.

   Special Tools:
   • None

9. Perform Rocker Arm Cover — Removal.

   Special Tools:
   • None

10. Perform Rocker Arm Assembly — Removal.

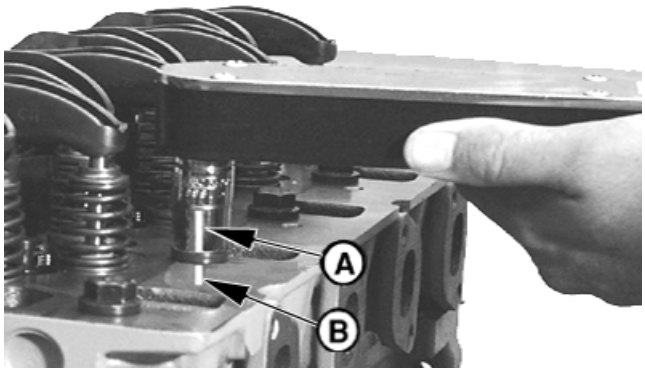
    Special Tools:
    • JDG1678—Hydraulic Lifter Bleed-down Tool

11. Perform Glow Plug Wiring Harness — Removal.

    Special Tools:
    • None

12. Perform Glow Plugs — Removal.

    Special Tools:
    • None



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Cylinder Head Torque Check

A—Socket **B—Cylinder Head Surface**

13. Perform Electronic Unit Pump Wiring Harness — Removal.

    Special Tools:
    • None

14. Perform Electronic Unit Pump — Removal.

    Special Tools:
    • JDG1704—Flywheel Turning Tool

15. Perform Injection Nozzle — Removal.

    Special Tools:
    • JDG1822—Nozzle Puller

16. **Cylinder Head — Removal**

    Special Tools:
    • None

    a. If a cylinder head gasket failure has occurred, check and record torque on each cylinder head cap screw before removing.
    Check cylinder head cap screw torque:

    1. Make a reference mark (in-line) on socket (A) and cylinder head surface (B).
    2. Loosen cap screw at least 1/2 turn.
    3. Retighten cap screw (using a torque wrench) until reference marks align and record torque.

    b. Remove all cylinder head cap screws.

IMPORTANT: DO NOT use screwdrivers or pry bars between cylinder block and head to loosen head gasket seal. Screwdrivers or pry bars can damage cylinder head and block gasket surfaces.

    c. Lift cylinder head from block. If cylinder head sticks, use a soft hammer to tap cylinder head.

    d. Remove cylinder head gasket.

    e. Perform Cylinder Head and Gasket — Inspection.

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Cylinder Head — Cleaning and Inspection

1. Inspect combustion face for evidence of physical damage, oil or coolant leakage, or gasket failure prior to cleaning the cylinder head. Repair or replace cylinder head if there is evidence of physical damage, such as cracking, abrasion, distortion, or valve seat 'torching'.
2. Inspect all cylinder head passages for restrictions.
3. Scrape gasket material, oil, carbon, and rust from head. Use a powered wire brush to clean sealing surfaces.

IMPORTANT: Be sure to remove all plugs before cleaning head, as parts can be damaged or destroyed by hot tank solutions.

4. Clean cylinder head in a chemical hot tank, or with solvent and a brush.
5. Dry with compressed air and blow out all passages.

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Cylinder Head — Flatness Check

Special Tools:
• D05012ST-A — Bevelled Edge StraightEdge

1. Check cylinder head flatness using StraightEdge and feeler gauge. Check lengthwise, crosswise, and diagonally in several places.

Specification	
Cylinder Head Flatness—Maximum Acceptable Out-of-Flat for every 150 mm (6 in)	0.05 mm (0.002 in.)
Maximum Acceptable Out-of-Flat for every 25 mm (1 in)	0.025 mm (0.001 in.)

2. If out-of-flat exceeds specifications, the cylinder head must be reconditioned or replaced. (See Cylinder Head — Thickness Check in this group.)

RG12816 —UN—09FEB03

Cylinder Head Flatness Check

MK41968,00002CA -19-16NOV09-1/1

Cylinder Head — Thickness Check

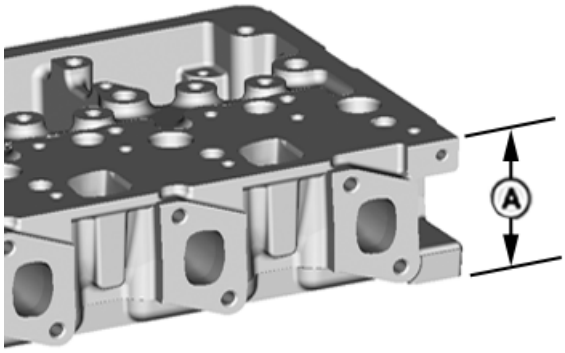
1. Measure head thickness (A) from valve cover gasket rail-to-combustion face.

Specification	
Cylinder Head—Thickness	77.5—78.5 mm (3.052—3.091 in.)
Combustion Face Surface Finish (Surface Mill Only to AA Finish)	0.8—3.2 micrometers (60—110 micro-in.)
Maximum Wave Depth	0.01 mm (0.0004 in.)

2. If cylinder head thickness is less than wear limit, DO NOT attempt to resurface. Install a new cylinder head.

Specification	
Resurfacing Head—Maximum Material Removal	0.76 mm (0.030 in.)

NOTE: If necessary to resurface cylinder head, a MAXIMUM of 0.762 mm (0.030 in.) can be ground from new part dimension. Remove ONLY what is necessary to restore flatness.



RG16720 —UN—27JAN09

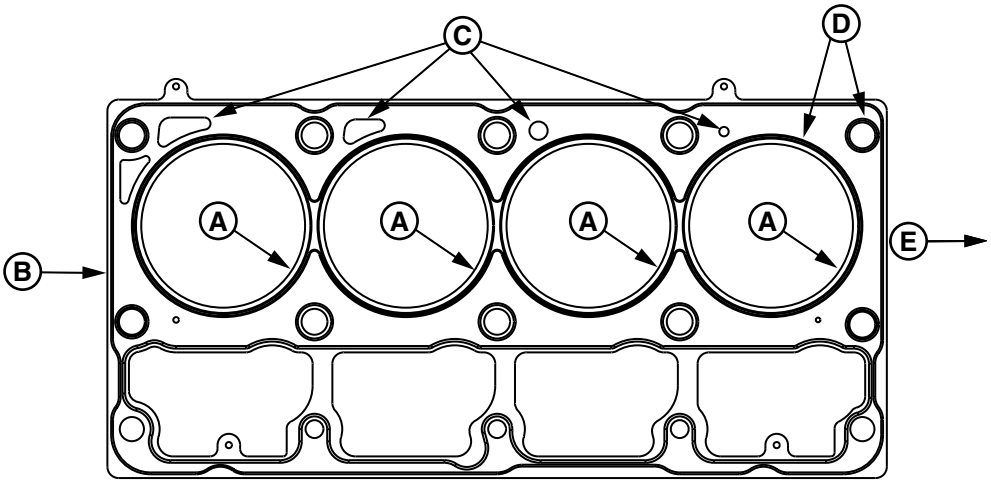
Cylinder Head Thickness Check

IMPORTANT: After resurfacing, check flatness as described earlier and check surface finish on combustion face of head.

Check valve recess after grinding. See Valve Seat — Recess Measurement in this group. Valve face may be ground to bring this characteristic within specification.

MK41968,00002AF -19-16NOV09-1/1

Cylinder Head and Gasket — Inspection



RG12815 —UN—09FEB03

Head Gasket Inspection

A—Combustion Seals (Flanges)
B—Gasket Body
C—Coolant Port
D—Polymer Beading Strip
E—Front of Engine

The following inspection procedures are recommended whenever a head gasket joint failure occurs, or when joint disassembly takes place.

1. Review historical data relating to machine operation, maintenance and repair, along with diagnostic observations. Note all areas requiring further inspection and analysis.
2. Perform Rocker Arm Cover — Removal. Check for presence of coolant in the oil.
3. Record head cap screw torques prior to removal. Upon removal, check cap screw length differences.
4. Remove cylinder head using appropriate lifting devices to prevent handling damage to head gasket. (See Cylinder Head — Removal in this Group.)
5. Observe surfaces of removed head gasket.

   Examine combustion seals (A) for the following:

   - Flange severed/expanded/cracked/deformed.
   - Adjacent body area burned/eroded.
   - Fire ring severed/displaced/missing.
   - Flange sealing pattern eccentric/contains voids.
   - Discoloration of flange and adjacent body areas.
   - Flange surfaces rough/abraded/channelled.

   Examine gasket body (B) for the following:

   - Combustion gas erosion paths or soot deposits originating at combustion seals.
   - Extreme discoloration/hardening/embrittlement in localized areas.
   - Polymer missing/damaged in port area (D).
   - Oil or coolant paths from port areas.
   - Localized areas of low compression.
6. Before cleaning components, inspect head, block, and liners for evidence of combustion gas and fluid leakage. Inspect cylinders and valve ports for unusual deposits.
7. Clean block, head, liners, and cap screws. (See Groups 020 and 030.)
8. Proceed with the following dimensional checks and visual inspections:

   Cylinder Head (See this group, Cylinder Head and Valves)

   - Check surface flatness/finish.
   - Inspect for surface damage.
   - Check cylinder head thickness, if resurfacing.

   Cylinder Block (See Group 030, Cylinder Block, Piston and Rods)

   - Check surface flatness/finish.
   - Inspect for surface damage.
   - Check top deck to crankshaft centerline dimension.
   - Inspect cap screw bosses; must be clean/intact.

   Cylinder Head Cap Screws (See in this group, Cylinder Head Cap Screw — Inspection)

   - Inspect for corrosion damage.
   - Inspect condition of threads.
   - Inspect for straightness.
   - Check length.
9. When inspections and measurements have been completed, determine most probable causes of joint failure. Make all necessary repairs to joint components, cooling system, and fuel injection system.
10. Reassemble the engine according to procedures and specifications in the repair groups of this manual.

MK41968,00002CB -19-16NOV09-1/1

Cylinder Head Cap Screw — Inspection

1. Inspect cap screws for corrosion, damage and overall condition of threads for indication of other problems.
2. DO NOT RE-USE large diameter flange-head cap screws. The smaller diameter cap screws may be reused.

RG6319 —UN—23NOV97

Cylinder Head Cap Screw

MK41968,00002CC -19-16NOV09-1/1

Cylinder Head (4-Cylinder) — Installation

IMPORTANT: ALWAYS thoroughly inspect cylinder head gasket for possible manufacturing imperfections. Return any gasket that does not pass inspection.

ALWAYS use NEW cap screws when installing cylinder head. Cap screws may be used only one time.

DO NOT use multi-viscosity oils to lubricate cap screws, SAE 30W is recommended.

1. **Cylinder Head (4-Cylinder) Installation**

   Special Tools:
   • None

   Consumables:
   • Head Gasket, Head Cap Screws, SAE 30W Oil

   a. Place new head gasket on cylinder block with part number tab to rear (A). Do not use sealant; install dry.

   b. Position cylinder head over guide studs and lower onto cylinder block.

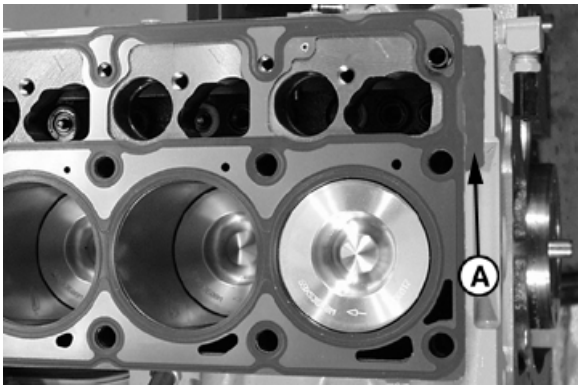
   c. Dip entire cap screw in clean engine oil. Remove excess oil from screw.

   d. Install flanged-head cylinder head cap screws hand tight.

   e. Tighten cap screws No. 1 through 10 in order to initial torque specification.

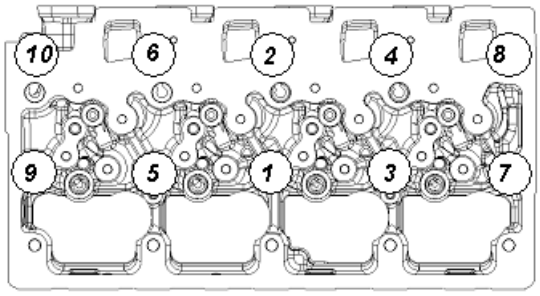
   f. Starting with No. 1 completely loosen the cap screw. Re-tighten to specification and torque-turn required. Repeat on each individual cap screw in the sequence for cap screws 2 - 8.

   g. Completely loosen cap screw No. 9. Re-tighten to specification and torque-turn required. Repeat on cap screw No. 10.



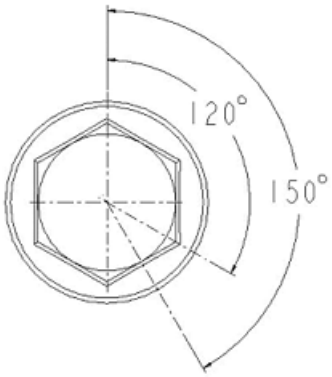
RG12514 —UN—12DEC02

Cylinder Head Gasket



RG12512 —UN—12DEC02

Torque Sequence - 4 Cylinder



RG12988 —UN—18JUN03

Torque Turn

Specification	
Initial Cylinder Head Cap Screw—Torque	110 N•m (81 ft-lb)
Final Cylinder Head Cap Screws No.1 - No.8—Torque	70 N•m (52 ft-lb) plus 150° +10/-0
Final Cylinder Head Cap Screws No.9 - No.10—Torque	70N•m (52 ft-lb) plus 120° +10°/-0°

2. Perform Injection Nozzle — Installation.

   Special Tools:
   • None

   Consumables:
   • Injection Nozzle O-Ring, Copper Sealing Washer, Petroleum Jelly, Engine Oil

3. Perform Electronic Unit Pump — Installation.

   Special Tools:
   • JDG1704—Flywheel Turning Tool

   Consumables:
   • Parker O Lube™, Engine Oil

4. Perform Electronic Unit Pump Wiring Harness — Installation.

   Special Tools:
   • None

   Consumables:
   • LOCTITE ® 222 (purple), **non-nylon** tie band

5. Perform Glow Plugs — Installation.

   Special Tools:
   • None

   Consumables:
   • None

Continued on next page

MK41968,00002CD -19-01JUN10-1/2

6. Perform Glow Plug Wiring Harness — Installation.

   Special Tools:
   • None

   Consumables:
   • None

7. Perform Rocker Arm Assembly — Installation.

   Special Tools:
   • JDG1678—Hydraulic Lifter BleedDown Tool

   Consumables:
   • TY6333 High-Temperature Grease, LOCTITE® 242 Thread Lock and Sealant, Engine Oil

8. Perform Rocker Arm Cover — Installation.

   Special Tools:
   • None

   Consumables:
   • O-rings, Rocker Arm Cover Gasket

9. Perform Fuel Filter — Installation.

   Special Tools:
   • None

   Consumables:
   • None

10. Perform Exhaust Manifold — Installation.

    Special Tools:
    • None

    Consumables:
    • Exhaust Manifold Gasket

11. Perform Turbocharger — Installation.

    Special Tools:
    • None

    Consumables:
    • PT569 NEVER-SEEZ® Compound, Engine Oil

12. Perform Idler Pulley(s) with Lift Strap — Installation.

    Special Tools:
    • None

    Consumables:
    • None

13. Perform Alternator — Installation.

    Special Tools:
    • None

    Consumables:
    • None

14. Perform Fan and Alternator Belt — Installation.

    Special Tools:
    • None

    Consumables:
    • None

15. Perform Engine Wiring Harness — Installation.

    Special Tools:
    • None

    Consumables:
    • None

16. Perform Fan Assembly — Installation.

    Special Tools:
    • None

    Consumables:
    • None

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MK41968,00002CD -19-01JUN10-2/2

Cylinder Head (5-Cylinder) — Installation

IMPORTANT: ALWAYS thoroughly inspect cylinder head gasket for possible manufacturing imperfections. Return any gasket that does not pass inspection.

ALWAYS use NEW cap screws when installing cylinder head. Cap screws may be used only one time.

DO NOT use multi-viscosity oils to lubricate cap screws, SAE 30W is recommended.

1. **Cylinder Head (5-Cylinder) Installation**

   Special Tools:
   • None

   Consumables:
   • Head Gasket, Head Cap Screws, SAE 30W Oil

   a. Place new head gasket on cylinder block. Do not use sealant; install dry.

   b. Position cylinder head over guide studs and lower onto cylinder block.

   c. Dip entire cap screw in clean engine oil. Remove excess oil from screw.

   d. Install flanged-head cylinder head cap screws.

   e. Torque cap screws No. 1 through No. 12 in order to specification.

   f. Starting with No. 1 completely loosen cap screw. Re-torque to specification and torque-turn required. Repeat on each individual cap screw (2-10) in the sequence.

   g. Completely loosen cap screw No. 11. Re-torque to specification and torque-turn required. Repeat on cap screw No. 12.

Specification

Initial Cylinder Head Cap Screw—Torque	110 N•m (81 ft-lb)
Final Cylinder Head Cap Screws No.1 - No.10—Torque	70 N•m (52 ft-lb) plus 150° +10°/-0°
Final Cylinder Head Cap Screws No.11 - No.12—Torque	70N•m (52 ft-lb) plus 120° +10°/-0°

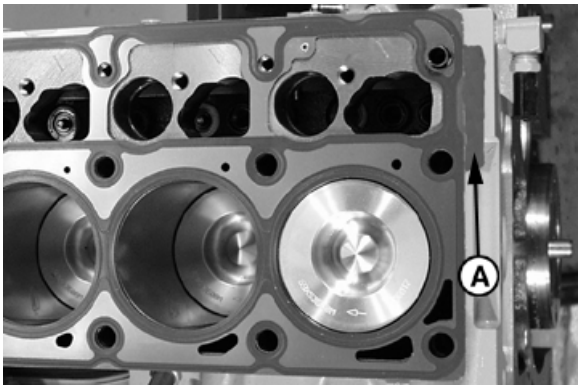
2. Perform Injection Nozzle — Installation.

   Special Tools:
   • None

   Consumables:
   • Injection Nozzle O-Ring, Copper Sealing Washer, Petroleum Jelly, Engine Oil

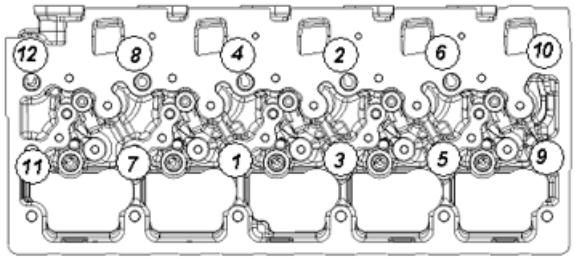
3. Perform Electronic Unit Pump — Installation.

   Special Tools:
   • JDG1704—Flywheel Turning Tool



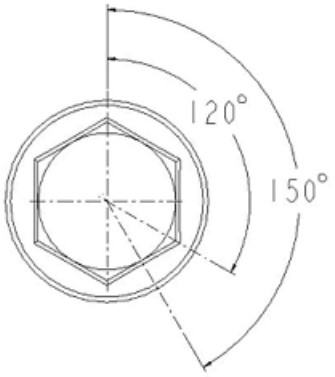
RG12514 —UN—12DEC02

Cylinder Head Gasket



RG12513 —UN—12DEC02

5 Cylinder Head Torque Sequence



RG12988 —UN—18JUN03

Torque Turn

   Consumables:
   • Parker O Lube™, Engine Oil

4. Perform Electronic Unit Pump Wiring Harness — Installation.

   Special Tools:
   • None

   Consumables:
   • LOCTITE ® 222 (purple), **non-nylon** tie band

5. Perform Glow Plugs — Installation.

   Special Tools:
   • None

   Consumables:
   • None

Continued on next page

6. Perform Glow Plug Wiring Harness — Installation.

   Special Tools:
   • None

   Consumables:
   • None

7. Perform Rocker Arm Assembly — Installation.

   Special Tools:
   • JDG1678—Hydraulic Lifter BleedDown Tool

   Consumables:
   • TY6333 High-Temperature Grease, LOCTITE® 242 Thread Lock and Sealant, Engine Oil

8. Perform Rocker Arm Cover — Installation.

   Special Tools:
   • None

   Consumables:
   • O-rings, Rocker Arm Cover Gasket

9. Perform Fuel Filter — Installation.

   Special Tools:
   • None

   Consumables:
   • None

10. Perform Exhaust Manifold — Installation.

    Special Tools:
    • None

    Consumables:
    • Exhaust Manifold Gasket

11. Perform Turbocharger — Installation.

    Special Tools:
    • None

    Consumables:
    • PT569 NEVER-SEEZ® Compound, Engine Oil

12. Perform Idler Pulley(s) with Lift Strap — Installation.

    Special Tools:
    • None

    Consumables:
    • None

13. Perform Alternator — Installation.

    Special Tools:
    • None

    Consumables:
    • None

14. Perform Fan and Alternator Belt — Installation.

    Special Tools:
    • None

    Consumables:
    • None

15. Perform Engine Wiring Harness — Installation.

    Special Tools:
    • None

    Consumables:
    • None

16. Perform Fan Assembly — Installation.

    Special Tools:
    • None

    Consumables:
    • None

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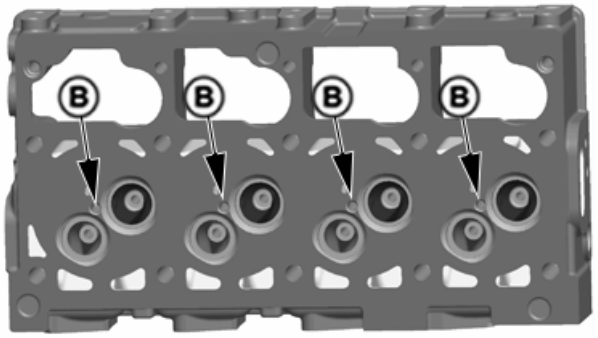
MK41968,00002CE -19-02JUN10-2/2

Injector Nozzle Bore — Cleaning and Inspection

Cylinder head nozzle seating surface and bore must be free of debris and carbon deposits.

Blow out debris with compressed air and clean fuel injection nozzle bores with a plastic brush before inspection or repair.

NOTE: A few drops of light oil or kerosene will help clean the bores.



RG16806 —UN—16FEB09

Nozzle Bore Cleaning

MK41968,00002B0 -19-16NOV09-1/1

Rocker Arm Cover — Removal

1. Perfom Fan and Alternator Belt — Removal

   Special Tools:
   • None

2. Perform Alternator — Removal

   Special Tools:
   • None

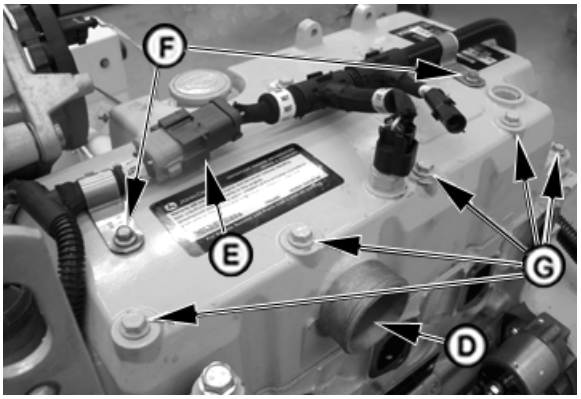
3. Remove air intake hose from turbocharger (shown removed).

4. Disconnect wiring harness sensor connectors (E). Remove engine wiring harness P-clamp cap screws (F) and engine wiring harness.
   See Engine Wiring Harness — Removal.

   Special Tools:
   • None

5. Remove rocker arm cover cap screws and O-rings (G). Inspect O-rings for nicks and cuts, replace as necessary. Remove rocker arm cover.

6. Clean surface of rocker arm cover of all gasket material and oil. Using a clean rag, cover intake ports on cylinder head and remove gasket material and oil from cylinder head.



RG16772 —UN—04FEB09

Rocker Arm Cover — Removal

D—Turbocharger Intake Hose
E—Sensor Connector
F—Engine Wiring Harness Clamp Cap Screws
G—Rocker Arm Cover Cap Screws

MK41968,00002CF -19-14APR10-1/1

Rocker Arm Assembly — Removal

1. Perfom Fan and Alternator Belt — Removal.

   Special Tools:
   • None

2. Perform Alternator — Removal.

   Special Tools:
   • None

3. Perform Rocker Arm Cover — Removal.

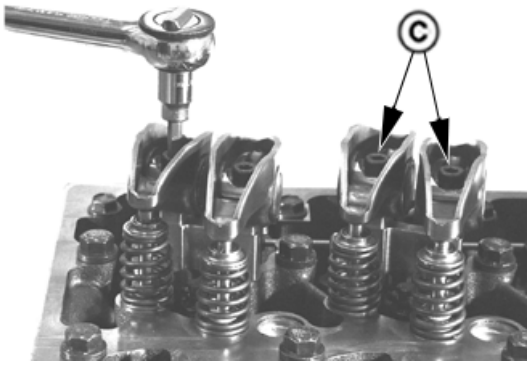
   Special Tools:
   • None

4. **Rocker Arm Assembly Removal**

NOTE: Note location of parts as rocker arms are disassembled, to aid in assembly.

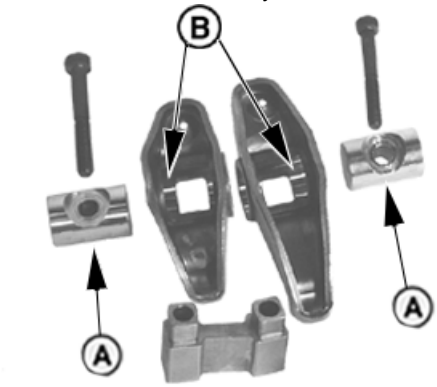
Remove screws (C) and rocker arm assembly from cylinder head.

A—Rocker Arm Shaft
B—Rocker Arm
C—Screws



RG16740 —UN—28JAN09

Rocker Arm Assembly Removal



RG16761 —UN—30JAN09

Rocker Arm Components

MK41968,00002B1 -19-14APR10-1/1

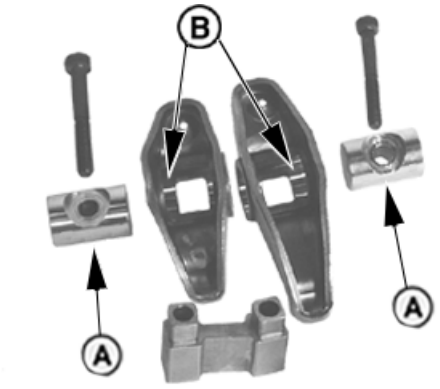
Rocker Arm Assembly — Inspection

1. Check the rocker arm bore inner diameter (ID) and rocker arm shaft outer diameter (OD).
2. Inspect the wear on the rocker arm pads. If the surface is worn out, replace the rocker arm.
3. Inspect the parts for wear or damage. Replace any parts that are damaged or not within specifications.

Specification

Rocker Arm Bore—ID.....20.979 - 21.005 mm (0.825 - 0.826 in.)
Rocker Arm shaft —OD.....20.932 - 20.962 mm (0.824 - 0.825 in.)

A—Rocker Arm Shaft **B—Rocker Arm**



RG16761 —UN—30JAN09

Rocker Arm Assembly Inspection

RG16756 —UN—29JAN09

Wear Check on Rocker Arm Pad

MK41968,00002B3 -19-16NOV09-1/1

Rocker Arm Assembly — Installation

Tools:
• JDG1678— Hydraulic Lifter Bleed-Down Tool

Consumables:
• TY6333 High-Temperature Grease, LOCTITE ® 242 Thread and Lock Sealant, Engine Oil

4-cylinder

NOTE: This procedure provides standardized assembly instructions for installing rocker arms, push rods and cam followers .

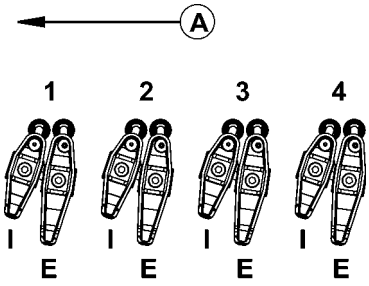
NOTE: Firing order is 1-3-4-2

1. **Rocker Arm Assembly Installation**

   a. Find TDC end of compression stroke of No.1 piston.

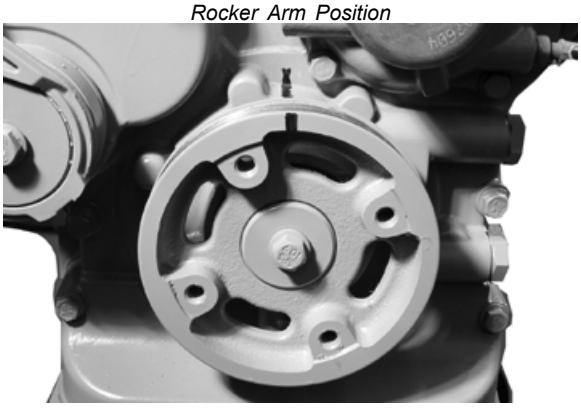
   - Lock crankshaft at TDC with timing pin (cylinder block/flywheel).
   - Mark front of engine and pulley/damper at the 12 o'clock position.

A— Front of Engine **E — Exhaust Rocker Arm**
I — Intake Rocker Arm



RG12854 —UN—21FEB03

Rocker Arm Position



RG12851 —UN—24FEB03

Crankshaft Pulley

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MK41968,00002D1 -19-14APR10-1/8

IMPORTANT: Any time rocker arm cap screws are loosened, the cam followers for that cylinder must be bled down. Failure to remove engine oil from the follower will result in bent push rods.

b. Using JDG1678—Hydraulic Lifter Bleed-Down Tool, **slowly** compress the cam follower piston. Alternate compressing each follower to provide additional time for the engine oil to escape through the top or the small hole in the follower.

IMPORTANT: Repeat as required to insure all engine oil has been expelled from the follower.

NOTE: If using new cam followers, expelling oil from the follower is not necessary..

c. Dip hydraulic cam follower head in TY6333 High-Temperature Grease and place one follower in each follower bore in the cylinder block.

d. Dip each end of the push rod in TY6333 High-Temperature Grease. Install push rod in each follower.

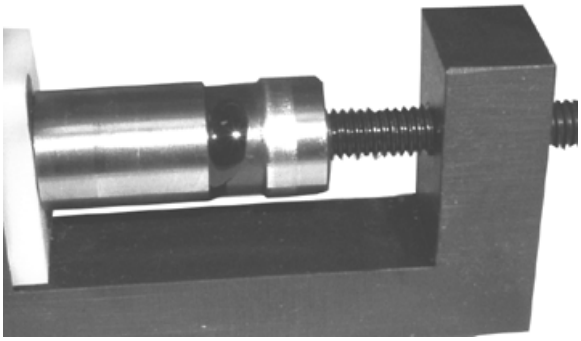
IMPORTANT: Install push rod with copper plated end up.

e. Apply LOCTITE® 242 Thread and Lock Sealant to the bottom 4 to 8 threads (A) of the rocker arm assembly capscrews. Install assembly in position in the cylinder head and engage the cap screws 2 to 4 threads.

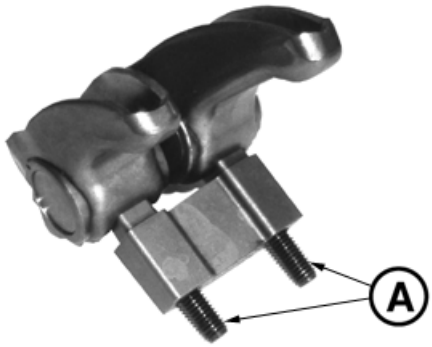
f. Remove the timing pin and rotate the engine clockwise (viewed from the front) 90 degrees to insure valves of the first two cylinders in sequence do not contact pistons during assembly.

RG12858 —UN—08MAY03

JDG1678 Hydraulic Lifter Bleed-Down Tool

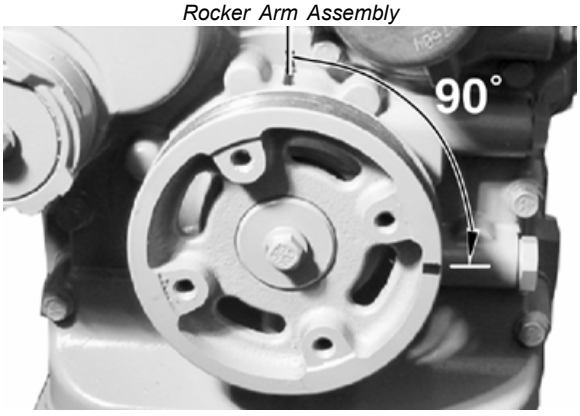


RG12859 —UN—24FEB03



RG12856 —UN—24FEB03

Rocker Arm Assembly



RG12852 —UN—21FEB03

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MK41968,00002D1 -19-14APR10-2/8

g. Slowly tighten both rocker arm cap screws on No. 1 and No. 3 cylinder to specifications. Insure rocker arm pad is aligned with valve stem.

Specification	
Rocker Arm Alignment —Torque	40 N·m (30 lb-ft)

IMPORTANT: Failure to have valves in the seated position will result in bent push rods when the engine is rotated.

h. Insure the No. 1 and No. 3 cylinder valve springs have returned to seated valve position (A) before moving to the next step.

Specification	
A – Top of valve spring retainer to cylinder head—Height	37.0 mm (1.46 in.) minimum

RG12857 —UN—06MAR03

i. Rotate the engine clockwise (when viewed from the front) 315 degrees (45 degrees short of a full rotation) to insure valves for the No. 2 and No. 4 cylinder do not contact the piston. Engine should rotate freely. If there is resistance to rotation, **stop**, wait one minute and slowly resume rotation. Inspect all push rods for bending.

RG12853 —UN—21FEB03

j. Slowly tighten both rocker arm cap screws on No. 2 and No. 4 cylinder to specifications. Insure rocker arm pad is aligned with valve stem.

Specification	
Rocker Arm Capscrew —Torque	40 N·m (30 lb-ft)

Continued on next page

MK41968,00002D1 -19-14APR10-3/8

IMPORTANT: Failure to have valves in the seated position will result in bent push rods when the engine is rotated.

k. Insure the No. 2 and No. 4 cylinder valve springs have returned to seated valve position (A) before moving to the next step.

Specification	
A – Top of valve spring retainer to cylinder head—Height	37.0 mm (1.46 in.) minimum

RG12857 —UN—06MAR03

l. Rotate engine two complete revolutions in a clockwise direction (when viewed from the front). During engine rotation:

- Inspect push rods for bending by aligning valves in the seated position and rotating the push rod. The rod should turn freely with the fingers.
- Insure rocker arm pads are centered on the valve stems. If they are not, loosen capscrews slightly, realign rocker arm and tighten to specifications.

Specification	
Rocker Arm Capscrew —Torque	40 N·m (30 lb-ft)

m. Generously lubricate all rocker arm pedestal joints with clean engine oil.

2. Perform Rocker Arm Cover — Installation.

   Special Tools:
   • None

   Consumables:
   • O-rings, Gasket

3. Perform Alternator — Installation.

   Special Tools:
   • None

   Consumables:
   • None

4. Peform Fan and Alternator Belt — Installation.

   Special Tools:
   • None

   Consumables:
   • None

MK41968,00002D1 -19-14APR10-4/8

5-cylinder

NOTE: This procedure provides standardized assembly instructions for installing rocker arms, push rods and cam followers .

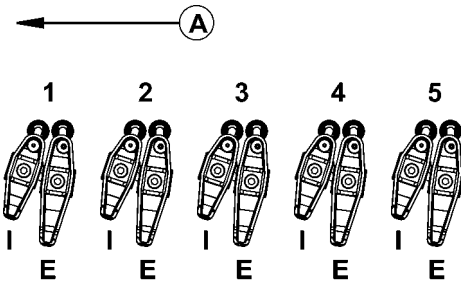
NOTE: Firing order is 1-2-4-5-3

1. **Rocker Arm Assembly Installation**

   a. Find TDC end of compression stroke of No. 1 piston.

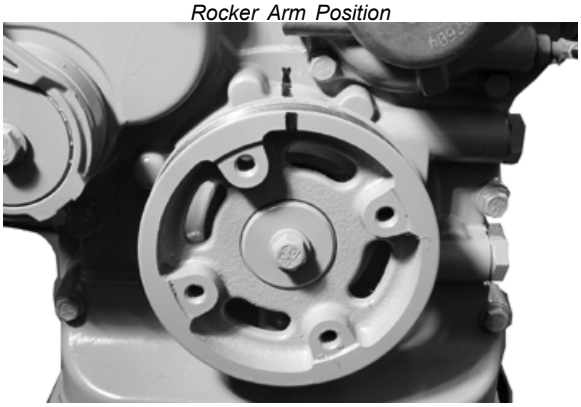
   - Lock crankshaft at TDC with timing pin (cylinder block/flywheel).
   - Mark front of engine and pulley/damper at the 12 o'clock position.

A— Front of Engine
I — Intake Rocker Arm
E — Exhaust Rocker Arm



RG12855 —UN—21FEB03

Rocker Arm Position



RG12851 —UN—24FEB03

Crankshaft Pulley

Continued on next page

MK41968,00002D1 -19-14APR10-5/8

IMPORTANT: Any time rocker arm cap screws are loosened, the cam followers for that cylinder must be bled down. Failure to remove engine oil from the follower will result in bent push rods.

b. Using JDG1678—Hydraulic Lifter Bleed-Down Tool, **slowly** compress the cam follower piston. Alternate compressing each follower to provide additional time for the engine oil to escape through the top or the small hole in the follower.

IMPORTANT: Repeat as required to insure all engine oil has been expelled from the follower.

c. Dip hydraulic cam follower head in TY6333 High-Temperature Grease and place one follower in each follower bore in the cylinder block.

d. Dip each end of the push rod in TY6333 High-Temperature Grease. Install push rod in each follower.

IMPORTANT: Install push rod with copper plated end up.

e. Apply LOCTITE® 242 Thread and Lock Sealant to the bottom 4 to 8 threads (A) of the rocker arm assembly capscrews. Install assembly in position in the cylinder head and engage the cap screws 2 to 4 threads.

f. Slowly tighten both rocker arm cap screws on No. 3 cylinder to specifications. Insure rocker arm pad is aligned with valve stem.

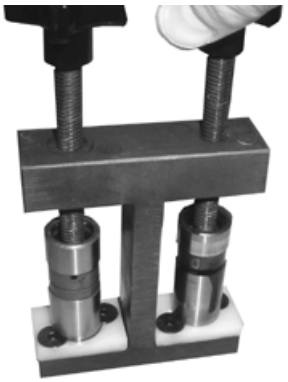
Specification	
Rocker Arm Alignment —Torque	40 N·m (30 lb-ft)

IMPORTANT: Failure to have valves in the seated position will result in bent push rods when the engine is rotated.

g. Insure the No. 3 cylinder valve springs have returned to seated valve position (A) before moving to the next step.

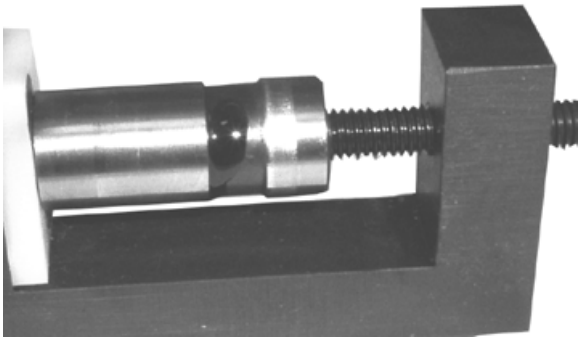
Specification	
A – Top of valve spring retainer to cylinder head—Height	37.0 mm (1.46 in.) minimum

h. Remove the timing pin and rotate the engine clockwise (viewed from the front) 90 degrees to insure valves for the No.1 and No. 2 cylinder do not contact the piston.

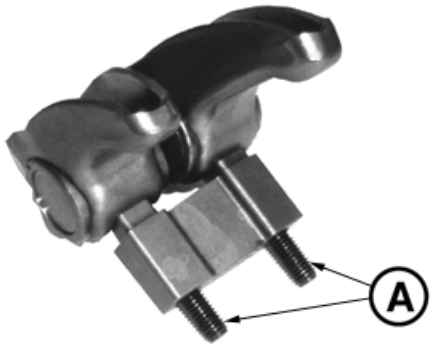


RG12858 —UN—08MAY03

JDG1678 Hydraulic Lifter Bleed-Down Tool

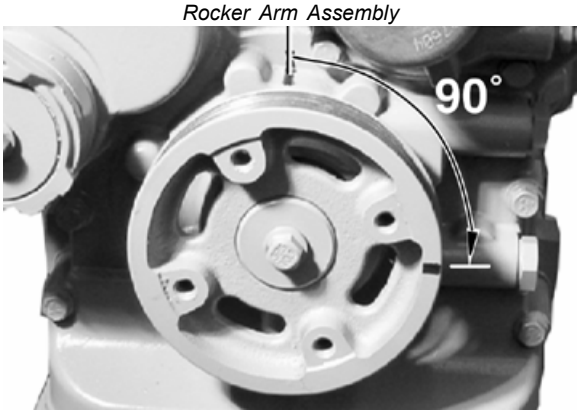


RG12859 —UN—24FEB03



RG12856 —UN—24FEB03

Rocker Arm Assembly



RG12852 —UN—21FEB03

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MK41968,00002D1 -19-14APR10-6/8

i. Slowly tighten both rocker arm cap screws on No. 1 and No. 2 cylinders to specifications. Insure rocker arm pad is aligned with valve stem.

Specification

Rocker Arm Alignment —Torque.....40 N·m

IMPORTANT: Failure to have valves in the seated position will result in bent push rods when the engine is rotated.

j. Insure the No. 1 and No. 2 cylinder valve springs have returned to seated valve position (A) before moving to the next step.

Specification

A – Top of valve spring retainer to cylinder head—Height..... 37.0 mm (1.46 in.) minimum

RG12857 —UN—06MAR03

RG12853 —UN—21FEB03

k. Rotate the engine clockwise (when viewed from the front) 315 degrees (45 degrees short of a full rotation) to insure valves for the No. 4 and No. 5 cylinder do not contact the piston. Engine should rotate freely. If there is resistance to rotation, **stop**, wait one minute and slowly resume rotation. Inspect all push rods for bending.

l. Slowly tighten both rocker arm cap screws on No. 4 and No. 5 cylinder to specifications. Insure rocker arm pad is aligned with valve stem.

Specification

Rocker Arm Capscrew —Torque..... 40 N·m (30 lb-ft)

Continued on next page

MK41968,00002D1 -19-14APR10-7/8

IMPORTANT: Failure to have valves in the seated position will result in bent push rods when the engine is rotated.

m. Insure the No. 4 and No. 5 cylinder valve springs have returned to seated valve position (A) before moving to the next step.

Specification	
A – Top of valve spring retainer to cylinder head—Height	37.0 mm (1.46 in.) minimum

RG12857 —UN—06MAR03

n. Rotate engine two complete revolutions in a clockwise direction (when viewed from the front). During engine rotation:

- Inspect push rods for bending by aligning valves in the seated position and rotating the push rod. The rod should turn freely with the fingers.
- Insure rocker arm pads are centered on the valve stems. If they are not, loosen capscrews slightly, realign rocker arm and tighten to specifications.

Specification	
Rocker Arm Capscrew —Torque	40 N·m (30 lb-ft)

o. Generously lubricate all rocker arm pedestal joints with clean engine oil.

p. Perform Rocker Arm Cover — Installation.
Special Tools:
• None
Consumables:
• O-rings, Gasket

2. Perform Rocker Arm Cover — Installation.
Special Tools:
• None
Consumables:
• O-rings, Gasket

3. Perform Alternator — Installation.
Special Tools:
• None
Consumables:
• None

4. Perform Fan and Alternator Belt — Installation.
Special Tools:
• None
Consumables:
• None

MK41968,00002D1 -19-14APR10-8/8

Rocker Arm Cover — Installation

Special Tools:
• None

Consumables:
• O-rings, Gasket

1. **Rocker Arm Cover Installation**

   a. Inspect rocker arm cover for serviceability. Replace if cracked or otherwise damaged.

   b. Clean all gasket sealing surfaces.

NOTE: Use new gasket, every time the rocker arm cover is removed during engine or cylinder head overhaul.

   c. Install rocker arm cover gasket on alignment pins and place rocker arm cover on the cylinder head.

   d. Install rocker arm cover cap screws (G) with O-rings and tighten to specification.

Specification

Rocker Arm Cover Cap Screws—Torque	12 N•m (9 lb-ft)

   e. Install alternator (C) with mounting bracket and tighten screws (B).

   f. Install poly-vee belt (A).

   g. Install engine wiring harness & engine wiring harness P-clamp cap screws (F). Connect wiring harness sensor connectors (E).

   h. Install air inlet hose and tighten hose clamps.

2. Perform Alternator — Installation.

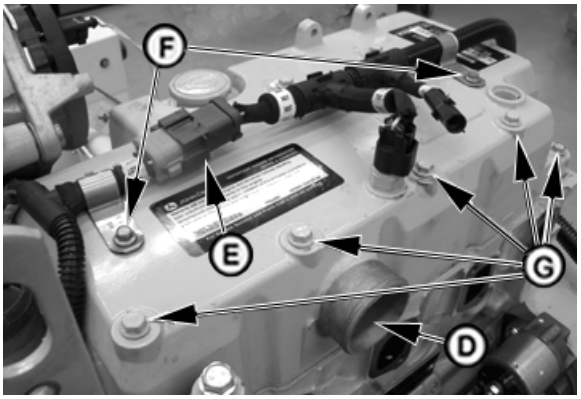
   Special Tools:
   • None

   Consumables:
   • None

3. Perform Fan and Alternator Belt — Installation.

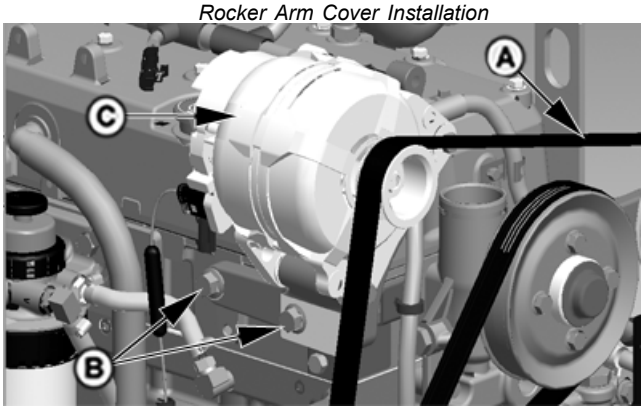
   Special Tools:
   • None

   Consumables:
   • None



RG16772 —UN—04FEB09

Rocker Arm Cover Installation



RG16730 —UN—28JAN09

Installing Alternator

A—Poly-vee Belt
B—Screws
C—Alternator
D—Turbocharger Intake Hose
E—Sensor Connector
F—Engine Wiring Harness Clamp Cap Screws
G—Rocker Arm Cover Cap Screws

4. Perform Engine Wiring Harness — Installation.

   Special Tools:
   • None

   Consumables:
   • None

MK41968,00002D2 -19-14APR10-1/1

Valve — Adjustment Procedure

Automatic adjustment of hydraulic lifters eliminates the need for valve-lash adjustment.

MK41968,00002C0 -19-18JUN09-1/1

Valve — Removal

NOTE: It is not necessary to remove engine from machine to service cylinder head on all applications. Refer to your Machine Technical Manual for engine removal procedure, if required. The turbocharger may be removed from the engine, if desired.

1. Perform Fan Assembly — Removal.

   Special Tools:
   • None

2. Perform Fan and Alternator Belt — Removal.

   Special Tools:
   • None

3. Perform Engine Wiring Harness — Removal.

   Special Tools:
   • None

4. Perform Alternator — Removal.

   Special Tools:
   • None

5. Perform Idler Pulley(s) with Lift Strap — Removal.

   Special Tools:
   • None

6. Perform Turbocharger — Removal.

   Special Tools:
   • None

7. Perform Exhaust Manifold — Removal.

   Special Tools:
   • None

8. Perform Fuel Filter — Removal.

   Special Tools:
   • None

9. Perform Rocker Arm Cover — Removal.

   Special Tools:
   • None

10. Perform Rocker Arm Assembly — Removal.

    Special Tools:
    • JDG1678—Hydraulic Lifter Bleed-down Tool

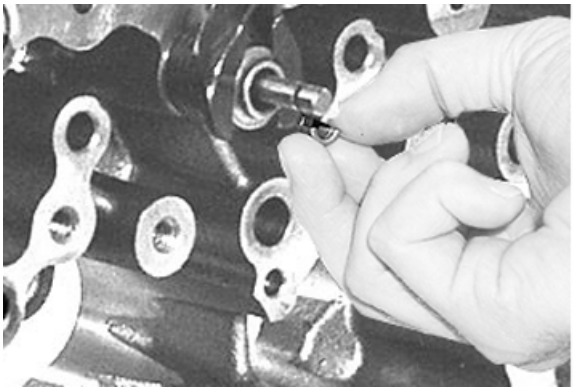
11. Perform Glow Plug Wiring Harness — Removal.

    Special Tools:
    • None

12. Perform Glow Plugs — Removal.

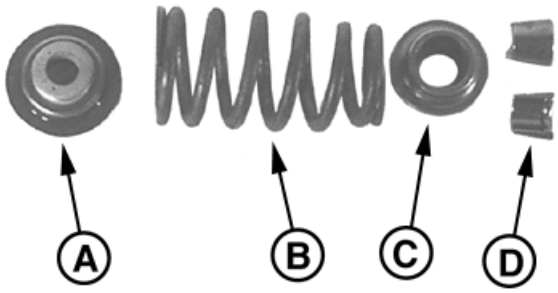
    Special Tools:
    • None

13. Perform Electronic Unit Pump Wiring Harness — Removal.



RG12812 —UN—09FEB03

Valve Spring Removal Tool



RG12813 —UN—09FEB03

Valve Spring and Components

A—Valve Stem Seal
B—Valve Spring
C—Valve Spring Cap
D—Retainer Locks

    Special Tools:
    • None

14. Perform Electronic Unit Pump — Removal.

    Special Tools:
    • JDG1704—Flywheel Turning Tool

15. Perform Injection Nozzle — Removal.

    Special Tools:
    • JDG1822—Nozzle Puller

16. Perform Cylinder Head — Removal.

    Special Tools:
    • None

17. **Valve — Removal**

    Special Tools:
    • JDE138 —Valve Spring Compressor

NOTE: A small magnet may be used to aid removal of valve retainer locks.

    a. Using JDE138—Valve Spring Compressor, compress valve springs far enough to remove retainer locks (D).

Continued on next page

MK41968,00002D3 -19-02JUN10-1/2

b. Release spring tension and remove valve rotator (C) and valve spring (B).

c. Remove valves from cylinder head.

NOTE: Identify all parts for assembly in same location.

d. Remove valve stem seals (A) from valve guide tower.

MK41968,00002D3 -19-02JUN10-2/2

Valve — Cleaning and Inspection

1. Hold each valve firmly against a soft wire wheel on a bench grinder.

IMPORTANT: Any carbon left on the stem will affect alignment in valve refacer. DO NOT use a wire wheel on plated portion of valve stem. Polish the valve stem with steel wool or crocus cloth to remove any scratch marks left by the wire brush.

2. Make sure all carbon is removed from valve head, face and unplated portion of stem.

MK41968,00002D4 -19-16NOV09-1/1

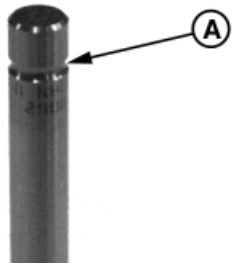
Valve — Measurement

1. Clean and inspect valves, valve stems, stem tips, and retainer lock groove (A). Replace valves that are worn or damaged.

Specification	
Intake Valve Head—OD	36.87—37.13 mm (1.452—1.462 in.)
Exhaust Valve Head—OD	33.87—34.13 mm (1.333—1.344 in.)

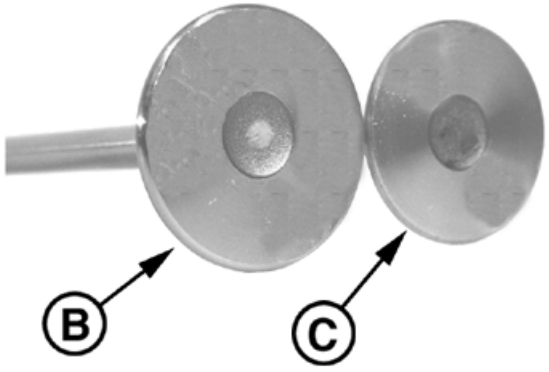
NOTE: Intake valve has a larger head OD (B).

A—Retainer Lock Groove
B—Intake Valve
C—Exhaust Valve



RG7429 —UN—03NOV97

Valve Stem



RG12814 —UN—12MAY03

Intake/Exhaust Valve Identification

Continued on next page

MK41968,00002C1 -19-16NOV09-1/3

2. Measure valve stem OD. Record measurements and compare with valve guide ID. See Valve Guide — Measurement.

Specification

Intake Valve Stem—OD.....6.987—7.013 mm (0.2751—0.2761 in.)

Exhaust Valve Stem—OD.....6.974—7.000 mm (0.2746—0.2755 in.)

RG7430 —UN—23NOV97

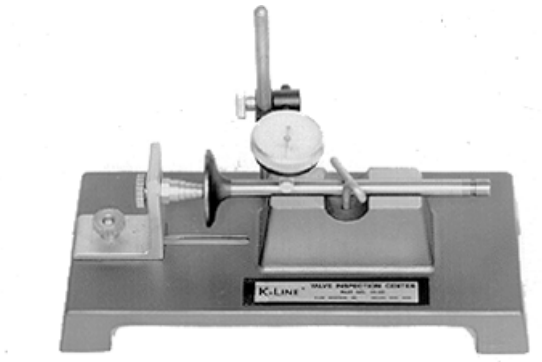
Valve Stem Measurement

MK41968,00002C1 -19-16NOV09-2/3

3. Using a valve inspection center, determine if valves are out of round, bent, or warped.

Specification

Valve Face—Maximum Runout (Intake and Exhaust).....0.038 mm (0.0015 in.)



RG4234 —UN—05DEC97

Valve Inspection Center

MK41968,00002C1 -19-16NOV09-3/3

Valve — Grinding

1. Check valves for cracks & sharp edges.

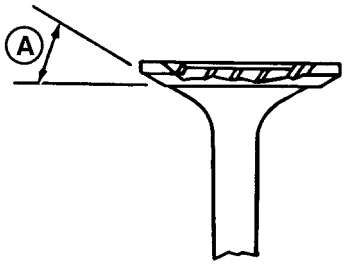
IMPORTANT: DO NOT nick valve head-to-stem radius when grinding valves. A nick could cause the valve to break. Break all sharp edges after grinding.

2. Re-face serviceable valves to specified angle (A).

Specification

Valves—Face Angle..... 29.25° ± 0.25°

A—Valve Face Angle



RG4755 —UN—31OCT97

Valve Face Angle Check

MK41968,00002D5 -19-16NOV09-1/1

Valve — Installation

Tools:
• JDE138—Valve Spring Compressor

Consumables:
• Engine Oil

1. Lubricate valve stems and guides with clean engine oil.

NOTE: Valves must move freely in guide and seat properly in head to form an effective seal.

2. Insert valves in head (if valves are reused, install in same location from which removed).
3. Install valve springs and spring caps.
4. Compress valve springs using JDE138 Valve Spring Compressor and install retainer locks on valve stems.
5. Strike end of each valve three or four times with a soft mallet (non-metallic) to insure proper positioning of the retainer locks.
6. Recheck valve recess. (See 'Valve — Adjustment Procedure' earlier in this group.)
7. Perform Cylinder Head Installation. See:

   Cylinder Head (4-Cylinder) — Installation.

   Special Tools:
   • None

   Consumables:
   • Head Gasket, Head Cap Screws, SAE 30W Oil

   or

   Cylinder Head (5-Cylinder) — Installation

   Special Tools:
   • None

   Consumables:
   • Head Gasket, Head Cap Screws, SAE 30W Oil
8. Perform Injection Nozzle — Installation.

   Special Tools:
   • None

   Consumables:
   • Injection Nozzle O-Ring, Copper Sealing Washer, Petroleum Jelly, Engine Oil
9. Perform Electronic Unit Pump — Installation.

   Special Tools:
   • JDG1704—Flywheel Turning Tool

   Consumables:
   • Parker O Lube™, Engine Oil
10. Perform Electronic Unit Pump Wiring Harness — Installation.

    Special Tools:
    • None

    Consumables:
    • LOCTITE ® 222 (purple), **non-nylon** tie band
11. Perform Glow Plugs — Installation.

    Special Tools:
    • None

    Consumables:
    • None
12. Perform Glow Plug Wiring Harness — Installation.

    Special Tools:
    • None

    Consumables:
    • None
13. Perform Rocker Arm Assembly — Installation.

    Special Tools:
    • JDG1678—Hydraulic Lifter BleedDown Tool

    Consumables:
    • TY6333 High-Temperature Grease, LOCTITE® 242 Thread Lock and Sealant, Engine Oil
14. Perform Rocker Arm Cover — Installation.

    Special Tools:
    • None

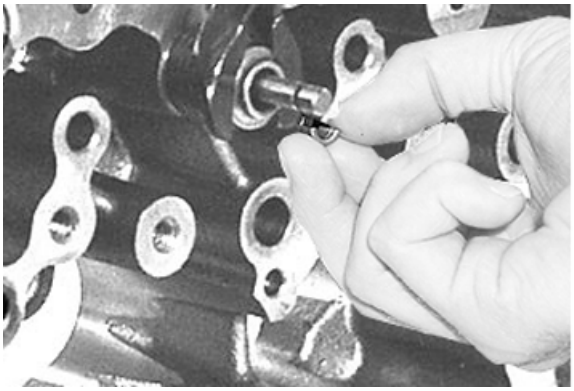
    Consumables:
    • O-rings, Rocker Arm Cover Gasket
15. Perform Fuel Filter — Installation.

    Special Tools:
    • None

    Consumables:
    • None
16. Perform Exhaust Manifold — Installation.

    Special Tools:
    • None

    Consumables:
    • Exhaust Manifold Gasket



RG12812 —UN—09FEB03

Valve spring Compressor and Retainer Locks

Continued on next page

MK41968,00002D6 -19-02JUN10-1/2

17. Perform Turbocharger — Installation.

    Special Tools:
    • None

    Consumables:
    • PT569 NEVER-SEEZ® Compound, Engine Oil

18. Perform Idler Pulley(s) with Lift Strap — Installation.

    Special Tools:
    • None

    Consumables:
    • None

19. Perform Alternator — Installation.

    Special Tools:
    • None

    Consumables:
    • None

20. Perform Fan and Alternator Belt — Installation.

    Special Tools:
    • None

    Consumables:
    • None

21. Perform Engine Wiring Harness — Installation.

    Special Tools:
    • None

    Consumables:
    • None

22. Perform Fan Assembly — Installation.

    Special Tools:
    • None

    Consumables:
    • None

LOCTITE is a trademark of Loctite Corp.
NEVER-SEEZ is a registered trademark of Emhart Chemical Group.

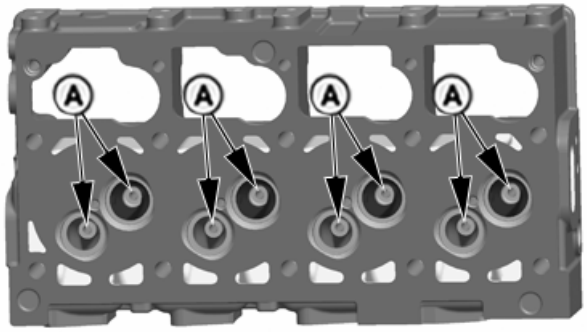
MK41968,00002D6 -19-02JUN10-2/2

Valve Guide — Cleaning and Inspection

NOTE: A few drops of light oil or kerosene will help clean the guides.

Blow out any debris in the valve guide with compressed air.

Clean the valve guide with a plastic brush before measurement or repair.



RG16805 —UN—16FEB09

Valve Guide Cleaning

MK41968,00002C2 -19-16NOV09-1/1

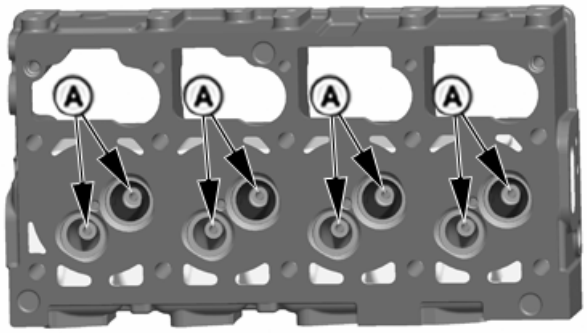
Valve Guide — Measurement

1. Perform Valve Guide — Cleaning and Inspection.
2. Measure valve guides inner diameter (ID) using a telescopic gauge and a micrometer.
3. Record measurements and compare readings with valve stem outside diameter (OD) to determine stem-to-guide clearance.

   See Valve — Measurement in this group.

Specification

Valve Guide—ID.....7.025—7.051 mm (0.2765—0.2775 in.) in new head
Intake Valve Stem—OD.....6.987—7.013 mm (0.2750—0.2761 in.)
Exhaust Valve Stem—OD.....6.974—7.000 mm (0.2745—0.2755 in.)
New Guide to Intake Valve Stem—Clearance.....0.012—0.064 mm (0.0004—0.0025 in.)



RG16805 —UN—16FEB09

Valve Guide Measurement

New Guide to Exhaust Valve Stem—Clearance.....0.025—0.077 mm (0.0009—0.0030 in.)

MK41968,00002C3 -19-16NOV09-1/1

Valve Guide — Knurling

Special Tools:
• JT05949—Valve Guide Knurler Kit

IMPORTANT: Valve guide knurling should only be done by experienced personnel familiar with equipment and capable of maintaining required specification.

ALWAYS knurl valve guides before reaming to assure proper valve guide-to-stem clearance.

1. Use the JT05949 Valve Guide Knurler Kit exactly as directed by the manufacturer to knurl valve guides
2. After knurling, ream valve guide to finished size to provide specified stem-to-guide clearance.

Specification

Intake Valve Clearance—Clearance..... 0.028 —0.080 mm (0.0011—0.0032 in.)

RG12818 —UN—09FEB03

Knurling Valve Guides

Exhaust Valve Clearance—Clearance.....0.041—0.093 mm (0.0016—0.0037 in.)

MK41968,00002D7 -19-16NOV09-1/1

Valve Seat — Cleaning and Inspection

Special Tools:
• D17024BR—End Brush

1. Use an electric hand drill with D17024BR—End Brush to remove all carbon on valve seats.
2. Inspect seats for excessive wear, cracks, or damage.
3. Check entire combustion face for rust, scoring, pitting, or cracks.

RG12819 —UN—09FEB03

Valve Seat Cleaning and Inspection

MK41968,00002D8 -19-16NOV09-1/1

Valve Seat — Recess Measurement

Measure valve recession (A) using a depth gauge (C). .

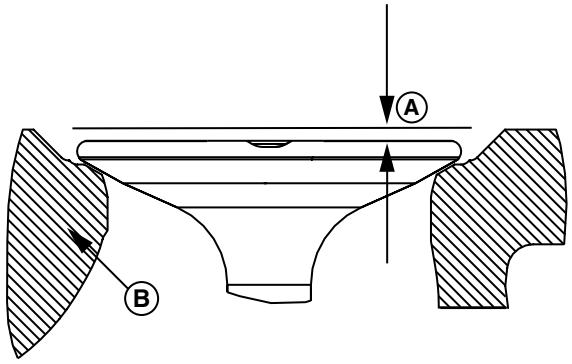
Specification	
Intake Valve—Recess in Cylinder Head	0.08—1.40 mm (0.031—0.055 in.)
Exhaust Valve—Recess in Cylinder Head	0.08—1.40 mm (0.031—0.055 in.)

If the measurement is less than the specified limit, perform Valve — Measurement.

If valve is not serviceable, perform Valve Seat — Grinding

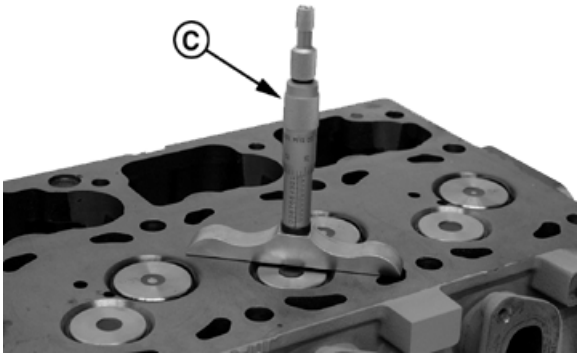
Replace valve or cylinder head (B) if measurement exceeds specification.

A—Valve Recess
B—Cylinder Head
C—Depth Gauge



RG12820 —UN—09FEB03

Valve Recess Measurement



RG12821 —UN—09FEB03

Valve Recess Measurement

MK41968,00002C4 -19-16NOV09-1/1

Valve Seat — Grinding

Special Tools:
• JT05893—Engine Valve Seat Grinder Set

Consumables:
• Bluing Dye

IMPORTANT: Valve seats should never be cut. Cutting a valve seat can damage its sealing surface, which may result in leaks or valve/seat failure. Valve seats should be ground and lapped.

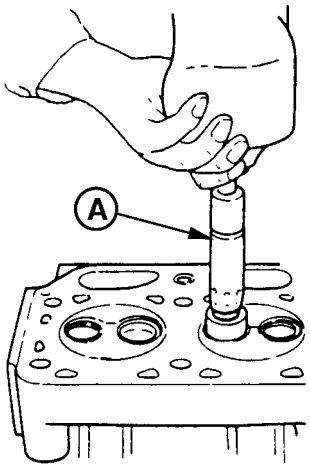
NOTE: LIGHTLY grind valve seats for a few seconds only to avoid excessive valve seat width.

1. Grind valve seats (C) using a seat grinder (A).

   For intake and exhaust valve seats use a 30° seat grinder. Follow tool manufacturers instructions.
2. Measure valve seat width (D) after grinding.
3. If seat is too wide after grinding, grind lower seat surface (B) using a 45° seat grinder for intake and 30° seat grinder for exhaust until seat width is close to specifications.
4. If valve seats are ground, measure valve recession and check contact pattern between the seat and valve with bluing dye. See Valve Seat — Recess Measurement in this section.

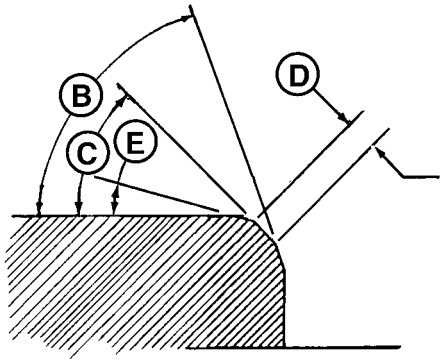
Valve Seat Grinding Specifications—Specification

Lower Seat	
Surface—Intake	45°
Exhaust	30°
Valve Seat	
Surface—Intake and	
Exhaust	30°
Seat Width—Intake	1.96 mm (0.077 in.)
Exhaust	1.82 mm (0.072 in.)
Upper Seat	
Surface—Intake and	
Exhaust	15°



M82039A —UN—09FEB03

Valve Seat Grinder



M82040A —UN—09FEB03

Valve Seat Grinding Specifications

A—Seat Grinder
B—Lower Seat Surface
C—Valve Seat Surface
D—Seat Width
E—Upper Seat Surface

NOTE: If valve recession exceeds maximum specifications or seats cannot be reconditioned, replace valves, valve seats (if equipped) and/or cylinder head.

MK41968,00002D9 -19-01JUN10-1/1

Valve Spring — Cleaning and Inspection

Clean the springs to remove any dirt.

Inspect valve springs for alignment, wear, and damage.

RG2732 —UN—28AUG09

Valve Spring

MK41968,00002C5 -19-16NOV09-1/1

Valve Spring — Measurement

Special Tools:
D01168AA—Spring Compression Tester

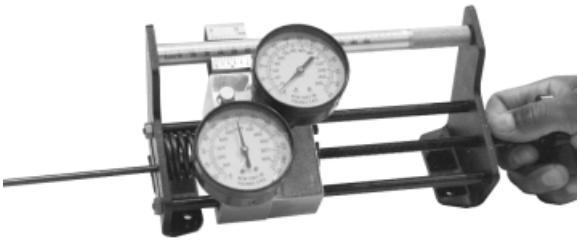
Using D01168AA Spring Compression Tester, check valve spring tension.

Spring height must be within the specifications.

Valve Springs—Specification

Spring Free Length[1] 0 N (0 lb-force)—Height	46.2 mm (1.818 in.)
Spring Compressed 250 N (56 lb-force)—Height	35.8 mm (1.41 in.)
Spring Compressed 515 N (116 lb-force)—Height	25.6 mm (1.01 in.)

[1]Free Length may vary slightly between valve springs.



RG7427 —UN—21MAY98

Valve Spring Compression Tester

MK41968,00002C6 -19-16NOV09-1/1

Cylinder Block, Piston and Rod — Troubleshooting Guide

Scuffed or Scored Pistons:

- Overheating.
- Overfueling.
- Insufficient lubrication.
- Insufficient cooling.
- Improper piston-to-cylinder bore clearance.
- Coolant leakage into crankcase.
- Misaligned or bent connecting rod.
- Improperly installed piston.
- Low oil level.
- Improper operation.
- Incorrect connecting rod bearing clearance.
- Carbon build-up in ring groove.
- Improper engine break-in.
- Worn piston.
- Contaminated oil.
- Distorted cylinder bore.
- Plugged piston cooling orifice.
- Ingestion of dust through air intake.

Worn or Broken Compression Rings:

- Insufficient lubrication.
- Insufficient cooling.
- Improper ring installation.
- Improper timing.
- Abrasives in combustion chamber.

Clogged Oil Control Ring:

- Improper oil.
- Excessive blow-by.
- Contaminated oil.
- Improper periodic service.
- Low operating temperature.

Stuck Rings:

- Improper oil classification.
- Improper periodic service.
- Poor operating conditions.
- Coolant leakage into crankcase.
- Excessive cylinder bore taper.
- Insufficient Cooling
- Insufficient Lubrication

Mottled, Grayish or Pitted Compression Rings:

- Internal coolant leaks.

Dull Satin Finish and Fine Vertical Scratches on Rings:

- Dirt and abrasives in air intake system.

Piston Pin and Snap Ring Failure:

- Misaligned connecting rod.
- Excessive crankshaft end play.
- Incorrect snap rings.
- Snap ring not installed properly - not seated in groove.

Broken Connecting Rod:

- Inadequate piston-to-cylinder bore clearance.
- Worn connecting rod bearing.
- Distorted cylinder bore.
- Piston pin failure.
- Cap screws not tightened properly.
- Wrong cap with connecting rod.

Cylinder Wear and Distortion:

- Incorrectly installed compression rings.
- Insufficient lubrication.
- Uneven cooling around cylinder bore.
- Inadequate piston-to-cylinder bore clearance.
- Cylinder bore damage.

Warped Cylinder Block:

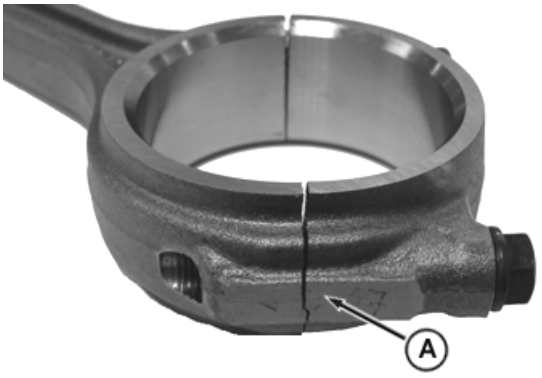
- Insufficient cooling.

RG41183,000002E -19-17NOV09-1/1

Connecting Rods — General Information

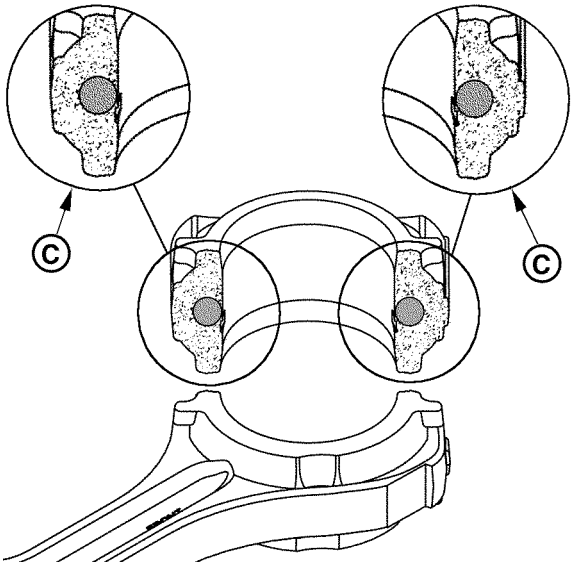
To create the PRECISION JOINT™, the connecting rod is notched with a laser beam. Then a precision mandrel in the rod bore is powered to separate the cap from the body at the joints (A) and (C).

- Care must be exercised when inspecting and handling the precision joint connecting rods. Do not nick the joint surfaces. Never scrape these surfaces with a wire brush or other tool. Cap MUST BE kept with the parent rod.
- Due to the machining process, PRECISION JOINT™ rod and cap have two grooves each, while the bearing inserts have a single tang. The extra grooves are not used. Install cap and rod with tangs to same side.
- Never use connecting rod bolts more than once for final engine assembly. Once bolts have been tightened to final torque, they must not be reused.



RG17363 —UN—03JUL09

Connecting Rod



RG16836 —UN—06MAR09

Precision Joint™ Rod

PRECISION JOINT is a trademark of Deere & Company

RG41183,000002F -19-17NOV09-1/1

Connecting Rod Bearings — Inspection and Measurement (Rods and Crankshaft Removed from Engine)

1. Inspect rod bearings for damage or wear.
2. Measure crankshaft rod journal OD at several points.

Specification

Crankshaft
Journal—OD.....59.987—60.013 mm (2.361—2.363 in.)

3. Assemble connecting rod, cap, and bearings with OLD cap screws. Tighten cap screws to 35 N•m (18 ft-lb). Tighten cap screw an additional 90° (See Connecting Rod Cap Screws — Torque-Turn, in this group).
4. Measure assembled rod bearing ID.

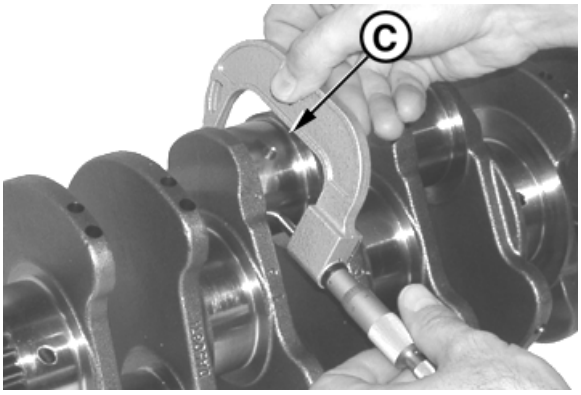
Specification

Assembled Rod
Bearing—ID.....60.030—60.073 mm (2.363—2.365 in.)

5. Subtract crankshaft journal OD from rod bearing ID to determine oil clearance. Replace bearing if oil clearance is out of specification.

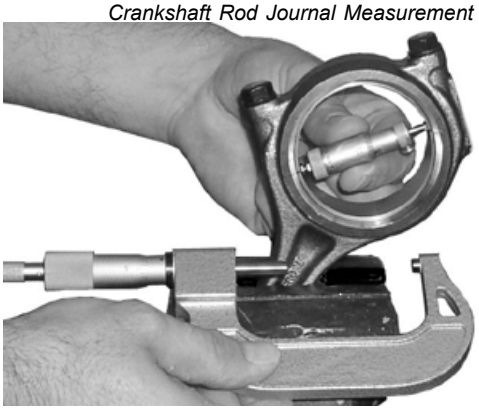
Specification

Connecting Rod
Bearing-to-Journal
Minimum—Clearance.....0.017 mm (0.001 in.)
Maximum—Clearance.....0.086 mm (0.003 in.)



RG12777 —UN—04JUN03

Crankshaft Rod Journal Measurement



RG12778 —UN—07JAN03

Rod Bearing ID Measurement

RG41183,000003A -19-18JUN09-1/1

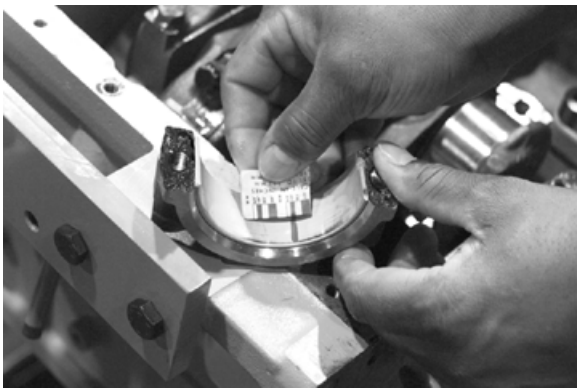
Connecting Rod Bearings — Inspection and Measurement (Rods and Crankshaft in Engine)

1. Remove rod cap. Place a piece of PLASTIGAGE® in enter of bearing. Install rod cap using OLD cap screws. Tighten cap screws to 35 N•m (18 ft-lb). Tighten cap screw an additional 90° (See Connecting Rod Cap Screws — Torque-Turn in this group).
2. Remove rod cap. Compare width of PLASTIGAGE® with scale provided on package to determine clearance. Replace bearings if oil clearance is out of specification.

Specification

Connecting Rod
Bearing-to-Journal
Minimum—Clearance.....0.017 mm (0.001 in.)

PLASTIGAGE is a trademark of DANA Corp.



RG12700 —UN—07JAN03

Rod Oil Clearance Measurement

Maximum—Clearance.....0.086 mm (0.003 in.)

MK41968,0000004 -19-01JUN10-1/1

Connecting Rod and Cap — Inspection

1. Inspect rod and cap for wear or damage, such as chips or nicks in the joint area (A).

IMPORTANT: Do not nick the joint surfaces of the rod and cap. This is very critical on PRECISION JOINT™ rods to ensure proper seating. Never scrape these surfaces (C) with a wire brush or other tool. The interlocking mating surfaces must be preserved.

2. Inspect in and around cap screw holes (B) in cap. If any imperfections are found, replace rod and cap.
3. Carefully clamp rod in a soft-jawed vise (cap end upward).

IMPORTANT: Never use new connecting rod cap screws when checking rod bore ID. Use new cap screws only for final assembly of connecting rods.

4. Install cap WITHOUT bearing inserts. Use old cap screws.

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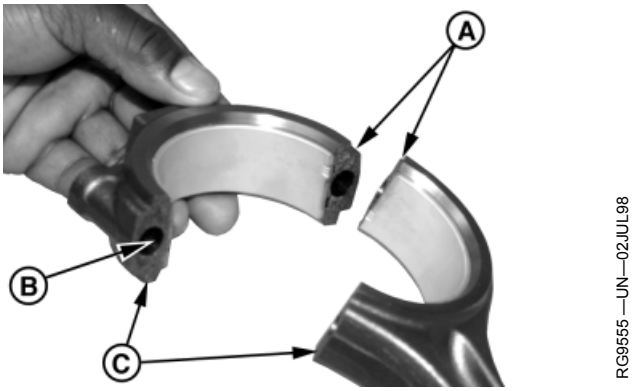


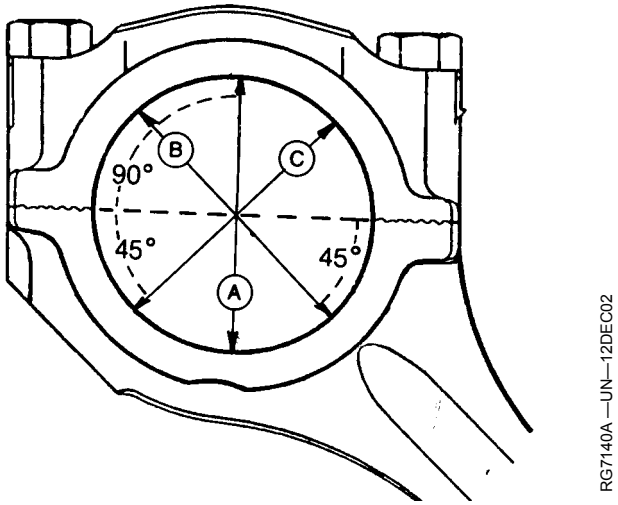
Precision Joint™ Rod and Cap

5. Tighten cap screws to 35 N•m (18 ft-lb). Tighten cap screw an additional 90° (See Connecting Rod Cap Screws — Torque-Turn in this group).

RG41183,000003C -19-17NOV09-1/2

6. Using an inside micrometer, measure rod bore at center of bore and record measurements as follows:
   - At right angle to rod-to-cap joint (A).
   - At 45 degrees left of measurement step “A” (B).
   - At 45 degrees right of measurement step “A” (C).
7. Compare measurements to specifications.

Specification	
Connecting Rod Bore (Without Bearing Inserts)—ID	63.437—63.463 mm (2.498—2.499 in.)



Rod Bearing ID Measurement

RG41183,000003C -19-17NOV09-2/2

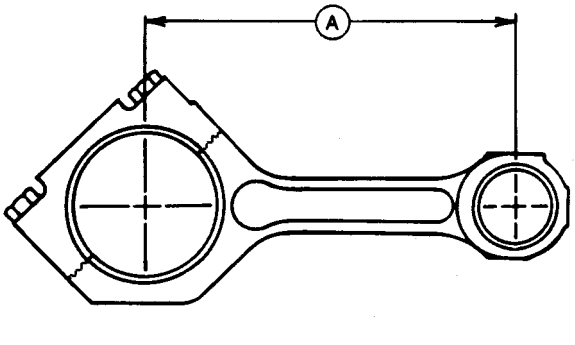
Connecting Rod Center-to-Center — Bore Measurement

Measure rod center-to-center bores (A).

Compare with the specifications given below. Replace rod if necessary.

Specification	
Rod Bearing Bore-to-Piston Pin Bushing Bore (Center-to-Center)—Measurement	169.975 — 170.025 mm (6.692— 6.694 in.)

A—Center-to-Center Measurement



Rod Center-to-Center Bore Measurement

RG41183,0000042 -19-17NOV09-1/1

Connecting Rod Cap Screws — Torque-Turn

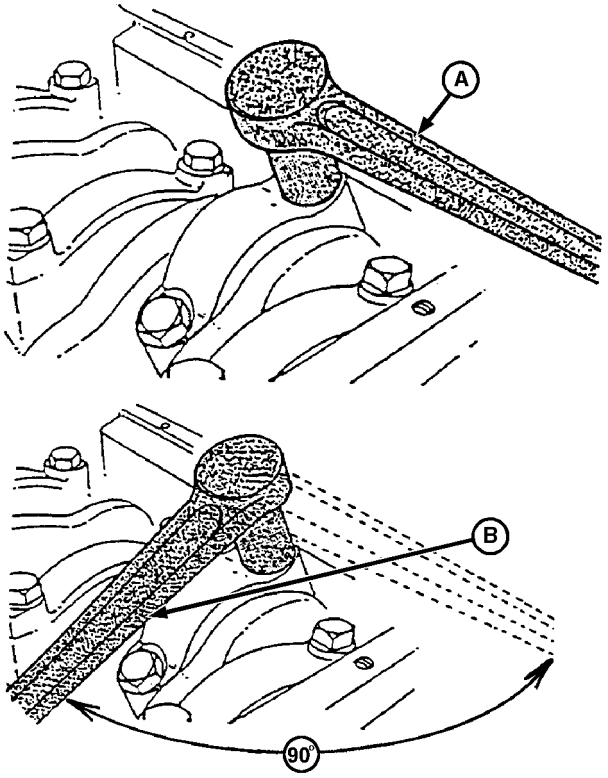
Engine Axis Method

1. After tightening cap screws to initial torque values, mark connecting rod cap and socket.
2. Position handle of wrench parallel to center-line of engine crankshaft axis (A).
3. Tighten 1/4 turn (90—100°) clockwise until handle of wrench is perpendicular to centerline of engine crankshaft axis (B) as shown.

Specification	
Connecting Rod Cap Screws—Torque-Turn	1/4 Turn (90—100°) After Initial Torque

A—Parallel to Centerline Crankshaft

B—Perpendicular to Centerline Crankshaft



Rod Cap Screws Torque-Turn

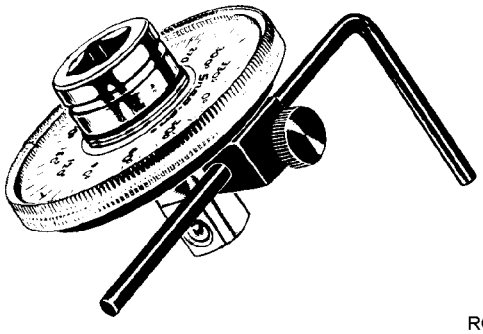
Continued on next page

RG,10,DT7386 -19-17NOV09-1/2

JT05993 Torque Angle Gauge Method

Special Tools:
• JT05993—Torque Turn Tool

After tightening cap screws to initial torque values provided earlier, follow directions provided with JT05993 Gauge and torque-turn each cap screw 90°—100°.



Torque Angle Gauge

RG,10,DT7386 -19-17NOV09-2/2

Cylinder Bore — Deglazing

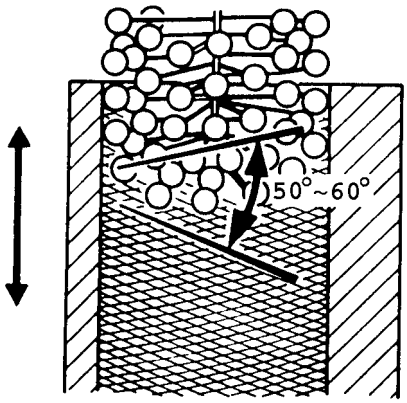
If cylinder bores have slight uneven wear, or minor flaws or damage, they can possibly be corrected by deglazing.

IMPORTANT: If cylinder bores are to be deglazed with crankshaft installed in engine, put clean shop towels over crankshaft to protect journal and bearing surfaces from any abrasives.

1. Deglaze cylinder bores using a flex-hone with 180 grit stones.
2. Use flex-hone as instructed by manufacture to obtain a **50 - 60° cross-hatch pattern** as shown.

IMPORTANT: Do not use gasoline, kerosene or commercial solvents to clean cylinder bores. Solvents will not remove all abrasives from cylinder walls.

3. Remove excess abrasive residue from cylinder walls using a clean dry rag. Clean cylinder walls using clean white rags and warm soapy water. Continue to clean until white rags show no discoloration.



Cylinder Bore Deglazing

RG41183,0000039 -19-17NOV09-1/1

Cylinder Bore — Reboring

NOTE: The cylinder block can be rebored to use oversize pistons and rings. Pistons and rings are available in 0.25 mm (0.010 in.) and 0.50 mm (0.020 in.) oversizes for all engines. (See Cylinder Bore — Inspection and Measurement in this group.)

1. Align center of bore to drill press center.

IMPORTANT: Check stone for wear or damage. Use a rigid hone with 280 silicone carbide grit stones.

2. Adjust hone so lower end is 193.5 mm (7.62 in.) from top of the cylinder deck.
3. Adjust rigid hone stones until they contact narrowest point of cylinder.
4. Coat cylinder with honing oil. Hone should turn by hand. Adjust if too tight.
5. Run drill press at about 250 rpm. Move hone up and down in order to obtain a **50—60° crosshatch pattern**.

NOTE: Measure bore when cylinder is cool.

6. Stop press and check cylinder diameter.

NOTE: Finish should not be smooth. It should have a 50—60° crosshatch pattern.

7. Remove rigid hone when cylinder is within 0.12 mm (0.004 in.) of desired size.
8. Use a flex hone with 180 grit stones for honing to final size. Recommeded surface finish is Rpk 0.42 max, Rvk 1.5-2.5, Rk 0.5-1.5, MR2 65-85%.
9. Check bore for size, taper and out-of-round. (See Cylinder Bore — Inspection and Measurement in this group.) Maximum lead-in chamfer diameter is 88.0 mm (3.464 in.)

IMPORTANT: Do not use solvents to clean cylinder bore. Solvents will not remove all metal particles and abrasives produced during honing.

10. Clean cylinder thoroughly using warm soapy water until clean white rags show no discoloration.
11. Dry cylinder and apply engine oil.

RG,RG34710,8119 -19-17NOV09-1/1

Cylinder Block — Cleaning and Inspection

Before inspecting and cleaning cylinder block, remove all of the following:

- piston cooling orifices (A) (See Piston Cooling Orifices — Removal later in this group)
- soft plugs (B)
- oil gallery plugs (C)
- all external and internal mounted components (refer to the proper group for removal procedures)

IMPORTANT: If block is cleaned in a hot tank, be sure to remove any aluminum parts such as nameplates (D). Aluminum parts can be damaged or destroyed by hot tank solutions.

1. Clean block thoroughly using cleaning solvent, pressure steam or a hot tank.
2. All passages and crevices must be clear of sludge, and grease.
3. All coolant passages must be clear of lime deposits and scale.
4. Carefully inspect block for cracks or damage. If a cracked block is suspected, pressure-test the block. A procedure for pressure testing is outlined in FOS (Fundamentals of Service) Manual—ENGINES. Replace cracked or damaged blocks.
5. If cylinder block is serviceable, clean out all threaded holes for cylinder head mounting cap screws in top deck of cylinder block, using an M12 tap. Remove debris or fluid from tapped holes with compressed air.
6. After service of cylinder block, reinstall piston cooling orifices. (See Piston Cooling Orifices — Installation in this group.)

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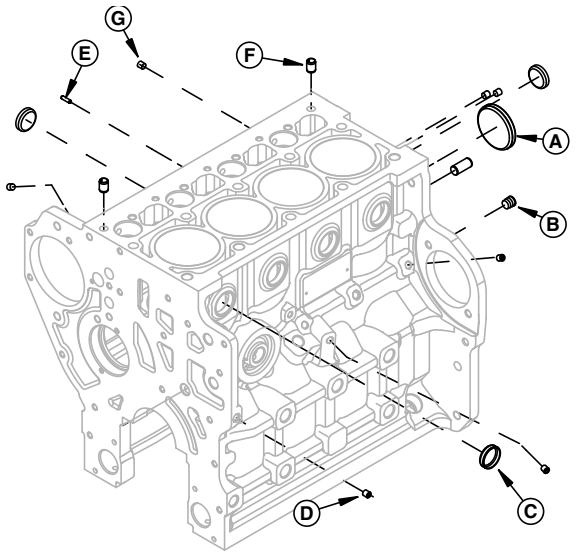
TEFLON is a registered trademark of Du Pont Co.



RG12694 —UN—17DEC02

Cylinder Block Plugs and Caps

A—Camshaft Bore Cap
B—Plug (Oil Gallery)
C—Cap
D—Plug (Oil Gallery)
E—Roller Follower Guide Pin
F—Guide Stud
G—Plug (Fuel Gallery)

7. Apply LOCTITE® 277 to steel caps/soft plugs and install caps in block.
8. Apply LOCTITE® 592 Pipe Sealant with TEFLON® to coolant gallery plugs. Install plugs and tighten to specifications.

Cylinder Block Oil and Coolant Gallery Plugs—Specification

Plug (Oil Gallery)—Torque.....15 N·m (11 lb-ft)

RG41183,0000041 -19-17NOV09-1/1

Cylinder Block — Main Bearing Bore Measurement

Measure main bearing bore diameter.

Specification

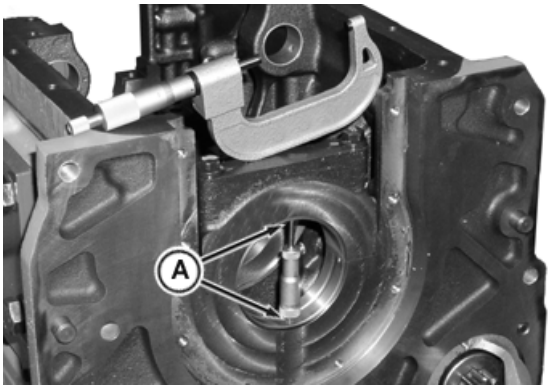
Cylinder Block Main Bearing Bore—ID.....79.892—79.918 mm (3.145—3.146 in.)

If bearing diameter exceeds specifications, replace bearing inserts.

If bearing clearance (bearing ID minus crankshaft main bearing journal OD) exceeds specification, replace bearing inserts and crankshaft or have crankshaft journals ground undersize by a qualified machine shop and install undersized bearing inserts.

Specification

Main Bearing ID—Clearance.....0.021—0.090 mm (0.0008—0.0035 in.)



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Main Bearing Bore Measurement

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Cylinder Bore — Inspection and Measurement

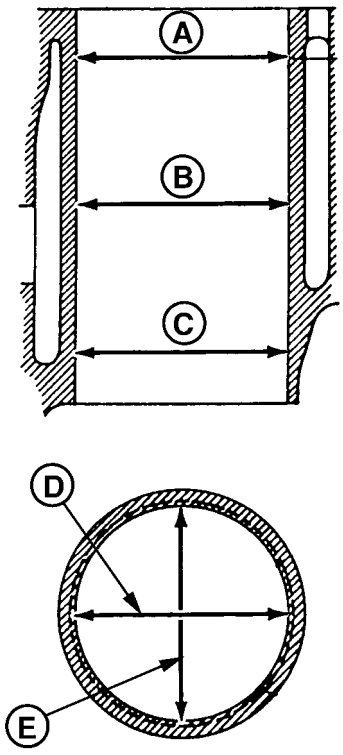
Measure cylinder bore diameter at three positions: top, middle and bottom. At these three positions, measure in both directions; along crankshaft center line and in direction of crankshaft rotation.

NOTE: If engine has had a previous major overhaul, oversize pistons and rings may have been installed.

- Slight uneven wear, flaws, or minor damage may be corrected by deglazing. (See Cylinder Bore — Deglazing in this group.)
- If cylinder bore exceeds wear limit, replace cylinder block or have cylinder rebored. (See Cylinder Bore — Reboring in this group.)
- If cylinder is rebored, oversize pistons and rings must be installed. Pistons and rings are available in 0.25 mm (0.010 in.) and 0.50 mm (0.020 in.) oversizes.
- If clearance (cylinder bore ID minus piston OD) exceeds specification, replace cylinder block, piston or both.

Cylinder Bore Specifications

4024 and 5030	Standard	Wear Limit
Standard Size	85.987—86.013 mm (3.385—3.386 in.)	86.130 mm (3.391 in.)
0.25 mm (0.010 in) Oversize Bore	86.237—86.263 mm (3.395—3.396 in.)	86.380 mm (3.401 in.)
0.50 mm (0.020 in) Oversize Bore	86.487—86.513 mm (3.405—3.406 in.)	86.630 mm (3.411 in.)
Piston-to-Cylinder Bore Clearance	0.079—0.137 mm (0.003—0.005 in.)	— —



M82053A —UN—25APR00

Cylinder Bore Inspection & Measurement

A—Top Position
B—Middle Position
C—Bottom Position
D—Direction of Crankshaft Rotation
E—Direction of Crankshaft Centerline

RG41183,0000048 -19-17NOV09-1/1

Cylinder Block — Top Deck Flatness Measurement

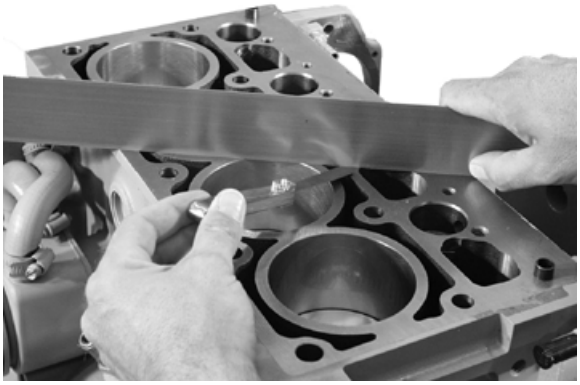
Special Tools:
• D05012ST—Precision Straightedge

Consumables:
• None

IMPORTANT: When cylinder block top deck or main bearing bores are machined, the dimension from crankshaft centerline to top deck will be changed. Make sure this dimension is within specifications, otherwise piston may contact cylinder head.

Measure cylinder block top deck flatness using D05012ST Precision Straightedge and feeler gauge. If flatness is not as specified, clean up top deck of cylinder block.
Resurface as required.

Specification	
Cylinder Block Flatness—Maximum Acceptable Out-of-Flat for every 150 mm (6 in)	0.05 mm (0.002 in.)
Maximum Acceptable Out-of-Flat for every 25 mm (1 in)	0.025 mm (0.001 in.)



RG12680 —UN—12DEC02

Cylinder Block Top Deck Flatness Measurement

Main Bearing Bore Centerline-to-Cylinder Block Top Deck —Distance	274.96—275.04 mm (10.825—10.828 in.)

RG41183,000001F -19-18JUN09-1/1

Piston and Connecting Rod Assembly — Removal

CAUTION: Do not drain engine coolant until it cools below operating temperature. Then slowly loosen coolant pump cover drain valve (A) to relieve any pressure.

1. Drain all engine coolant (A).
2. Drain engine oil.
3. Perform Engine Wiring Harness — Removal.

   Special Tools:
   • None
4. Perform Fan and Alternator Belt — Removal.

   Special Tools:
   • None
5. Perform Alternator — Removal.

   Special Tools:
   • None
6. Remove the idler pulley & lift strap. See in Group 70:

   Idler Pulley(s) with Lift Strap — Removal.

   Special Tools:
   • None
7. Perform Turbocharger — Removal.

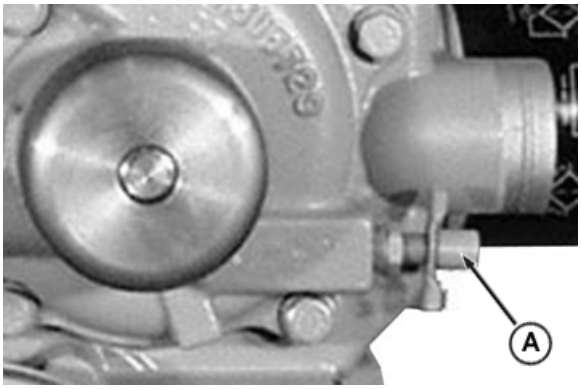
   Special Tools:
   • None
8. Perform Exhaust Manifold — Removal.

   Special Tools:
   • None
9. Perform Fuel Filter — Removal.

   Special Tools:
   • None
10. Perform Rocker Arm Cover — Removal.

    Special Tools:
    • None
11. Perform Rocker Arm Assembly — Removal.

    Special Tools:
    • JDG1678—Hydraulic Lifter BleedDown Tool



RG17261 —UN—19JUN09

Coolant Pump Drain Valve

12. Perform Glow Plug Wiring Harness — Removal.

    Special Tools:
    • None
13. Perform Glow Plugs — Removal.

    Special Tools:
    • None
14. Perform Electronic Unit Pump Wiring Harness — Removal.

    Special Tools:
    • None
15. Perform Electronic Unit Pump — Removal.

    Special Tools:
    • JDG1704—Flywheel Turning Tool
16. Perform Injection Nozzle — Removal.

    Special Tools:
    • None
17. Perform Cylinder Head — Removal.

    Special Tools:
    • None
18. Perform Oil Pan — Removal

    Special Tools:
    • None
19. Perform Oil Pick-up Tube Assembly — Removal

    Special Tools:
    • None

Continued on next page

RG41183,0000030 -19-02JUN10-1/4

20. **Piston and Connecting Rod Assembly Removal**

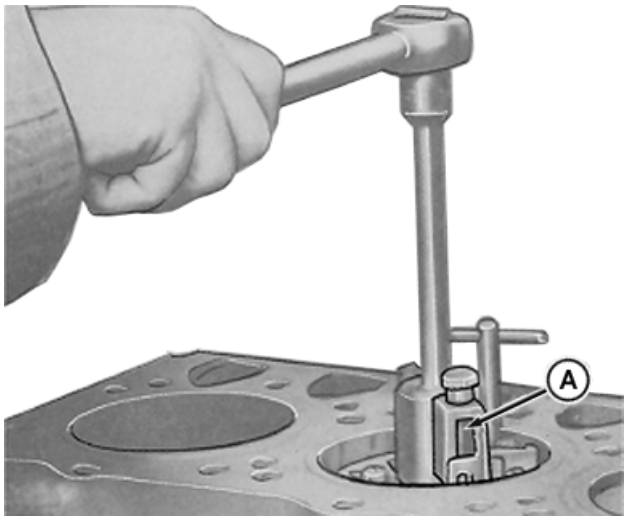
Special Tools:
• None

NOTE: Always follow manufacture's directions provided with ridge reamer.

IMPORTANT: Do not disturb cylinder block parent material with ridge reamer.

a. Remove carbon from cylinder bore with a scraper or reamer (A). Use compressed air to remove loose material from cylinders.

A—Ridge Reamer



Carbon Removal from Cylinder Bore

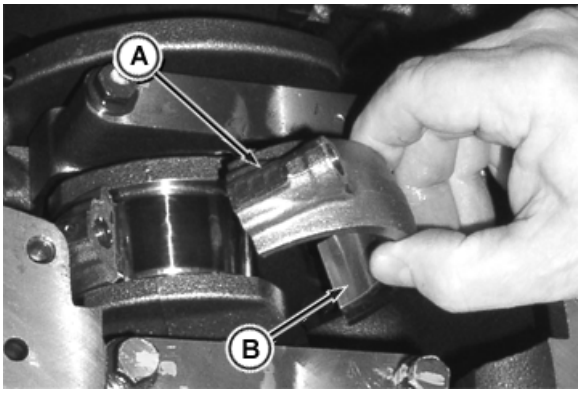
RG41183,0000030 -19-02JUN10-2/4

IMPORTANT: DO NOT use pneumatic wrenches on rod cap screws. Using pneumatic wrenches may cause thread damage.

Keep bearing inserts with their respective rods and caps. Mark rods, pistons, and caps to insure correct assembly in same location as removed.

b. Remove all rod caps (A) with bearings (B).

A—Rod Caps **B—Bearings**



Connecting Rod Caps Removal

Continued on next page

RG41183,0000030 -19-02JUN10-3/4

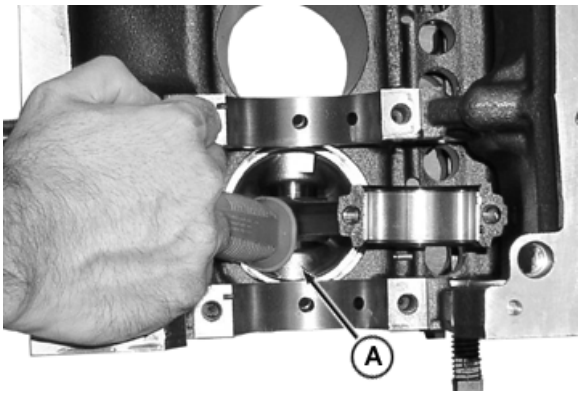
IMPORTANT: Be careful not to let rod nick crankshaft bearing surface as piston and rod assembly is removed.

Be extremely careful not to let connecting rod hit cylinder bore when removing piston and rod assembly.

Piston/connecting rod assemblies and cylinders are matched. Pistons must be installed in the cylinders from which they are removed.

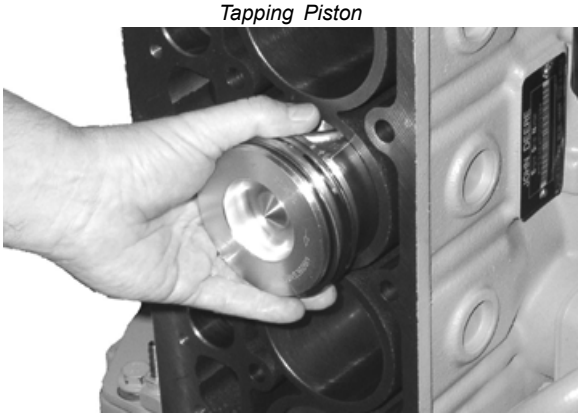
NOTE: Crankshaft is shown removed for picture purposes. Piston and rod assembly can be removed with crankshaft installed.

c. Gently tap piston (A) through top of cylinder block from the bottom. Once piston rings have cleared cylinder bore, hold on to piston to prevent piston from dropping.



RG17264 —UN—19JUN09

Tapping Piston



RG12537 —UN—12DEC02

Holding Piston

RG41183,0000030 -19-02JUN10-4/4

Piston and Connecting Rod Assembly — Tear Down

Special Tools:
• JDG135—Piston Ring Expander

IMPORTANT: Do NOT reuse piston rings.

1. Remove piston rings using JDG135 Piston Ring Expander.
2. Remove piston snap rings. Remove piston pin and connecting rod from piston.

NOTE: Discard snap rings, DO NOT reuse.

RG12538 —UN—12DEC02

Piston Rings Removal

RG12539 —UN—12DEC02

Snap Ring Removal

RG41183,0000031 -19-17NOV09-1/1

Piston and Connecting Rod — Reassemble

Special Tools:
• None

Consumables:
• Snap Rings, Engine Oil

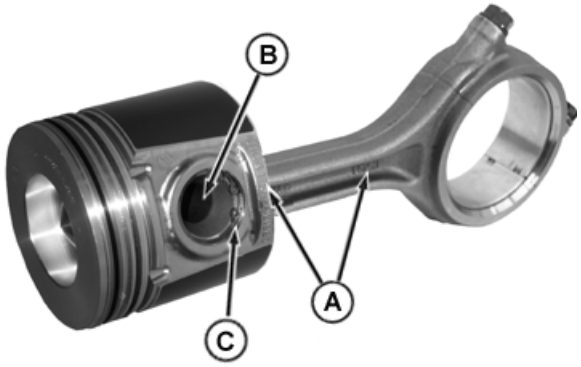
1. Lubricate piston pin and bushing with clean engine oil.

NOTE: Pistons are marked with an arrow on top of piston. Arrow must point to side marked 'FRONT' on connecting rod when assembled.

2. Assemble pistons and connecting rods, making sure the word 'FRONT' (A) on side of piston and side of connecting rod are facing same direction.
3. Insert piston pin (B) into piston pin bore.

NOTE: Always use new snap rings during assembly.

4. Install NEW piston pin snap rings with ring gap (C) facing down to the 6 o'clock position at bottom of piston (viewed from rod end) and square edge of ring facing away from piston pin. Make sure snap rings are seated in grooves of piston pin bore.
5. Perform Piston Rings — Installation.



RG17265 —UN—29JUN09

Piston and Connecting Rod Assembly

A—Marked 'Front'
B—Piston Pin
C—Snap Ring Gap

Special Tools:
• JDE135—Universal Piston Ring Expander

Consumables:
• Piston Rings, Engine Oil

RG41183,0000021 -19-17NOV09-1/1

Piston and Connecting Rod Assembly — Installation

1. **Piston and Connecting Rod Assembly Installation**

   Special Tools:
   • JDG1690—Piston Ring Compressor

   Consumables:
   • Connecting Rod Cap Screws, Engine Oil

IMPORTANT: Be careful so crankshaft journals and cylinder block bore walls are not damaged by connecting rod when installing piston and connecting rod assembly.

a. Coat cylinder block bore, pistons and inside of piston ring compressor with clean engine oil.

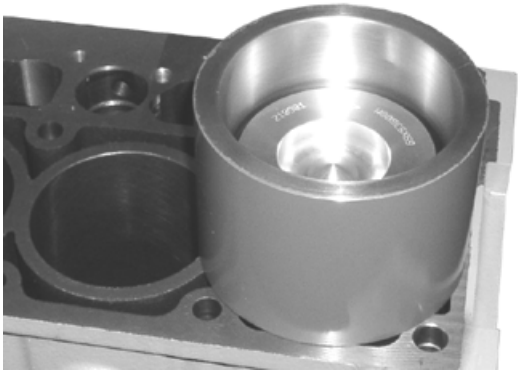
b. Carefully place the JDG1690 Piston Ring Compressor with piston and rod over cylinder bore so the word 'FRONT' on side of rod and on the piston faces toward the front of the engine.

NOTE: Be sure the word 'FRONT' on connecting rod faces toward the front of the engine.

If arrow indicating 'FRONT' is not visible on top of pistons, refer to the side of the piston by the piston pin for the word 'FRONT'.

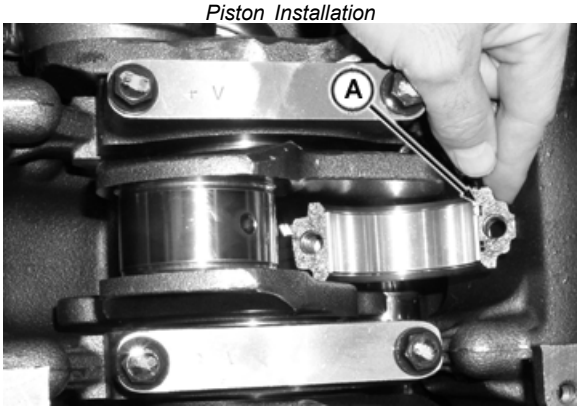
c. With piston centered in ring compressor and rings staggered correctly, push piston down until top ring is into the cylinder block bore.

d. Install bearing insert in connecting rod with tang in groove (A).



RG12695 —UN—07JAN03

Piston Installation



RG17266 —UN—19JUN09

Tang Groove on PRECISION JOINT™ Connecting Rod

e. Apply clean engine oil on insert and crankshaft journal. Carefully pull connecting rod and insert against crankshaft journal.

Continued on next page

MK41968,000003B -19-02JUN10-1/3

NOTE: Due to the manufacturing process, the PRECISION JOINT™ rod and cap both have two grooves, while the bearing insert has a single tang. Only the one groove in the rod and cap is used for the bearing tang.

f. Install bearing insert in connecting rod cap with tang (A) in groove (B).

IMPORTANT: On PRECISION JOINT™ connecting rods, make sure cap is properly aligned on rod with edges flush and interlocking surfaces sealed tightly. The flat on the side of the cap should align with the connecting rod. The cylinder number stamped on the rod and cap must be the same.

g. Apply clean engine oil to bearing insert. Install cap on connecting rod with tangs to same side.

IMPORTANT: NEVER use connecting rod cap screws more than once for final engine assembly. Once rod cap screws have been tightened to final torque-turn specification, they must not be reused for another final assembly.

h. Dip NEW connecting rod cap screws in clean oil and install.

i. Tighten cap screws alternately to initial torque specification.

Specification	
Connecting Rod Cap Screws—Initial Torque	35 N·m (18 lb-ft)

j. Torque-turn all cap screws to 90—100°. (See Connecting Rod Cap Screws — Torque-Turn in this group.)

2. Perfrom Oil Pick-up Tube Assembly — Installation

   Special Tools:
   • None

   Consumables:
   •LOCTITE® 242, Engine Oil

3. Perform Oil Pan — Installation.

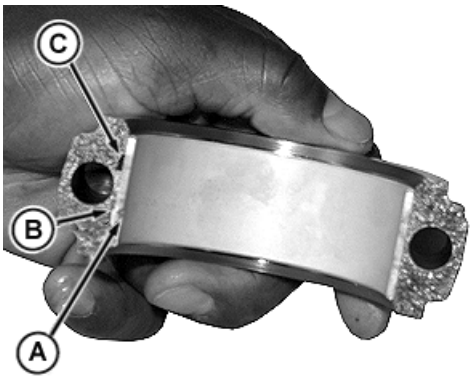
   Special Tools:
   • None

   Consumables:
   •LOCTITE® 5910 (PM37512) Silicone Sealant, Drain Plug O-ring, Engine Oil

4. Perform Cylinder Head Installation. (See Cylinder Head (4-Cylinder) — Installation or Cylinder Head (5-Cylinder) — Installation

   Special Tools:
   • None

   Consumables:
   • Head Gasket, Head Cap Screws, SAE 30W Oil



RG17267 —UN—19JUN09

PRECISION JOINT™ Rod

A—Tang
B—Groove
C—Extra Groove (Not Used)

5. Perform Injection Nozzle — Installation.

   Special Special Tools:
   • None

   Consumables:
   • Injection Nozzle O-Ring, Copper Sealing Washer, Petroleum Jelly, Engine Oil

6. Perform Electronic Unit Pump — Installation.

   Special Tools:
   • JDG1704—Flywheel Turning Tool

   Consumables:
   • Parker O Lube™, Engine Oil

7. Perform Electronic Unit Pump Wiring Harness — Installation.

   Special Tools:
   • None

   Consumables:
   • LOCTITE® 222 (purple), **non-nylon** tie band

8. Perform Glow Plugs — Installation.

   Special Tools:
   • None

   Consumables:
   • None

9. Perform Glow Plug Wiring Harness — Installation.

   Special Tools:
   • None

   Consumables:
   • None

10. Perform Rocker Arm Assembly — Installation.

    Special Tools:
    • JDG1678—Hydraulic Lifter BleedDown Tool

Continued on next page

MK41968,000003B -19-02JUN10-2/3

Consumables:
• TY6333 High-Temperature Grease, LOCTITE® 242, Engine Oil

11. Perform Rocker Arm Cover — Installation.

    Special Tools:
    • None

    Consumables:
    • O-rings, Rocker Arm Cover Gasket

12. Perform Fuel Filter — Installation.

    Special Tools:
    • None

    Consumables:
    • None

13. Perform Exhaust Manifold — Installation.

    Special Tools:
    • None

    Consumables:
    • Exhaust Manifold Gasket

14. Perform Turbocharger — Installation.

    Special Tools:
    • None

    Consumables:
    • PT569 NEVER-SEEZ® Compound, Engine Oil

15. Perform Idler Pulley(s) with Lift Strap — Installation.

    Special Tools:
    • None

    Consumables:
    • None

16. Perform Alternator — Installation.

    Special Tools:
    • None

    Consumables:
    • None

17. Perform Fan and Alternator Belt — Installation.

    Special Tools:
    • None

    Consumables:
    • None

18. Perform Fan Assembly — Installation.

    Special Tools:
    • None

    Consumables:
    • None

19. Perform Engine Wiring Harness — Installation.

    Special Tools:
    • None

    Consumables:
    • None

20. Refill engine oil and engine coolant.

PRECISION JOINT is a trademark of Deere & Company
LOCTITE is a trademark of Loctite Corp.
NEVER-SEEZ is a registered trademark of Emhart Chemical Group.

MK41968,000003B -19-02JUN10-3/3

Piston — Cleaning And Inspection

CAUTION: Always follow manufacturer's instructions, and safety steps exactly.

1. Clean piston ring grooves using a piston ring groove cleaning tool.

IMPORTANT: When washing pistons, always use a stiff bristle brush—NOT A WIRE BRUSH—to loosen carbon residue.

DO NOT bead blast ring groove areas.

2. Clean pistons by any of the following methods:

   - Immersion-Solvent 'D-Part'
   - Hydra-Jet Rinse Gun
   - Hot water with liquid detergent soap

   If cleaning with hot water and liquid detergent, soak pistons in a 50 percent solution of liquid household detergent and hot water for 30 to 60 minutes. Use a stiff bristle brush—NOT A WIRE BRUSH—to loosen carbon residue. Dry with compressed air.

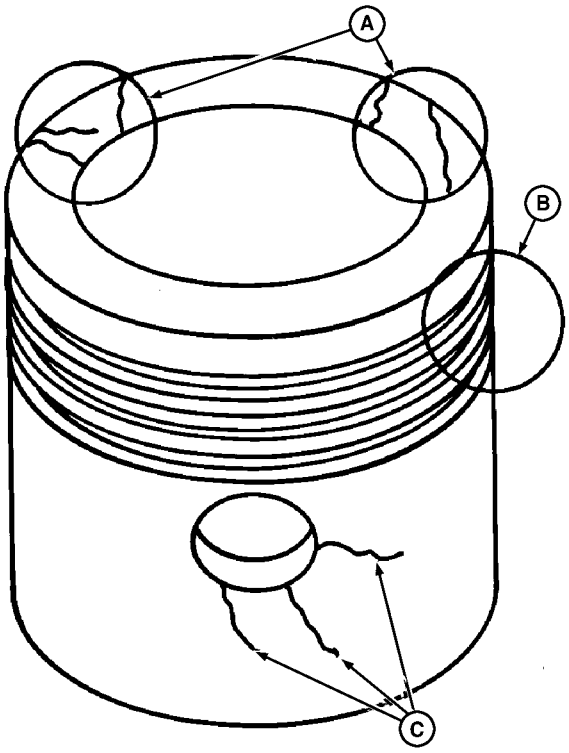
3. Carefully inspect pistons under magnification. Check for:

   - Signs of fatigue
   - Fine cracks in the piston head (A)
   - Bent or broken ring lands (B)
   - Cracks in the skirt (C) at inner and outer ends of piston pin bore
   - Excessive piston skirt wear. (Original machining marks must be visible.)

   If any imperfections are found, replace the piston.

RG7465 —UN—23NOV97

Cleaning Piston Ring Grooves



RG3326 —UN—04DEC97

RG3326

A—Piston Head
B—Ring Lands
C—Skirt

Piston Defects (Exaggerated)

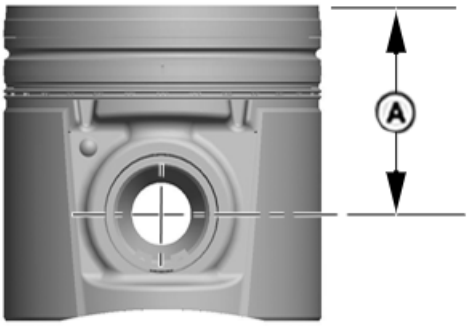
RG41183,0000032 -19-18NOV09-1/1

Piston — Height Measurement

Measure piston height (A) from center of piston pin bore to top of piston.

Specification

Piston—Height.....53.415—53.465 mm (2.103—2.105 in.)



RG16892 —UN—17MAR09

Piston Height Measurement

RG41183,0000036 -19-18NOV09-1/1

Piston Pins and Bushings — Inspection

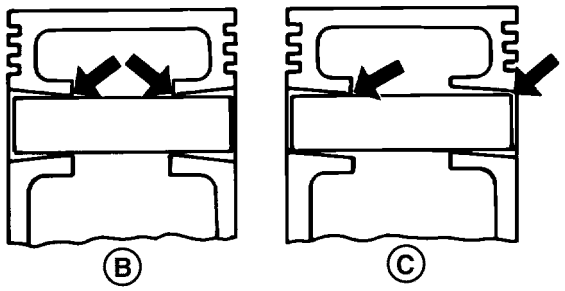
Special Tools:
• None

Consumables:
• None

1. Visually inspect piston pin. Pin must be in good condition with no visible wear.

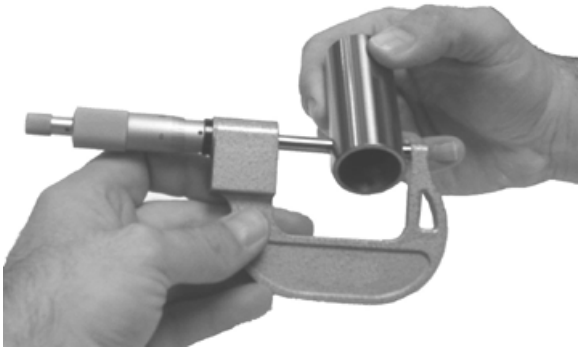
IMPORTANT: Do not attempt to polish or refinish piston pin. Pin has a highly polished surface.

2. Dip piston pin in clean engine oil.
3. Install pin through piston. Pin should pass through piston using only light thumb pressure.
4. Insert pin from both sides. If pin enters freely, but binds in the center, the bore could be tapered (B).
5. Insert pin to check for bore alignment (C). Pin should not 'click' or need to be forced into bore on opposite side.
6. Measure piston pin OD. Replace if not within specification.



RG4747 —UN—31OCT97

Piston Pin Wear Points

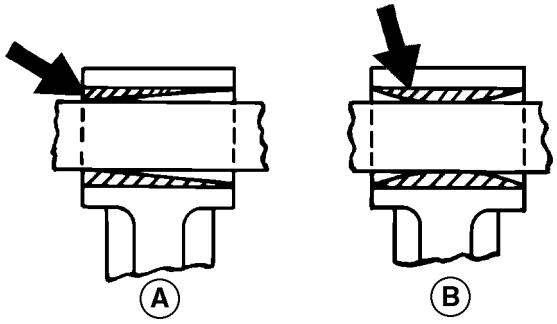

RG12672 —UN—12DEC02

Piston Pin OD Measurement

Specification	
Piston Pin—OD	29.994—30.000 mm (1.1809—1.1811 in.)
Wear Limit	29.980 mm (1.1803 in.)
Piston Pin—Length	67.75—68.00 mm (2.667—2.677 in.)

RG41183,000003D -19-18NOV09-1/2

7. Insert pin from either side of rod bushing. If pin is free on one end, but tight on the other, the bore could be tapered (A). If pin enters freely from both sides, but is tight in the center, bore is bell mouthed (B).



RG7647A —UN—12DEC02

Piston Pin Wear Points in Connecting Rod

RG41183,000003D -19-18NOV09-2/2

Piston Pin — Bore Measurement

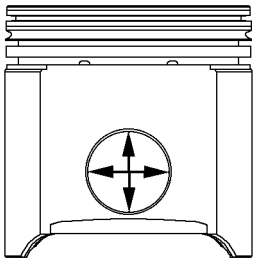
Special Tools:
• None

Consumables:
• None

Measure piston pin bore. If bore is not within specification, replace piston.

Specification

Piston Pin Bore—ID.....30.003—30.009 mm (1.1812—1.1815 in.)



RG7402 —UN—23NOV97

Piston Pin Bore Measurement

RG41183,0000034 -19-18NOV09-1/1

Piston Skirt — Measurement

Special Tools:
• None

Consumables:
• None

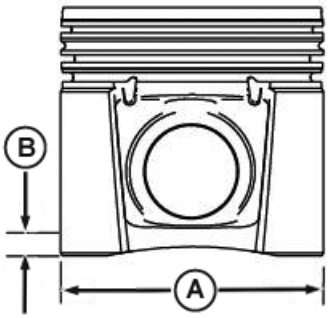
1. Measure piston Skirt (A) 90° to piston pin bore and 12 mm (0.5 in.) from bottom of piston (B). Record measurement.

Specification

Piston Skirt (Measurement Taken at Bottom of Skirt 12 mm (0.5 in.) from Bottom of Piston—Diameter.....85.876—85.908 mm (3.381—3.382 in.)

2. Perform Cylinder Bore — Inspection and Measurement.

   Special Tools:



RG16857 —UN—03JUL09

Piston Skirt Wear

• None

Consumables:
• None

Compare with the piston measurement.

RG41183,0000035 -19-18NOV09-1/1

Piston Cooling Orifices — Removal

1. Drain engine coolant from the cooling system.
2. Drain engine oil from the crankcase.
3. Perform Fan Assembly — Removal.

   Special Tools:
   • None
4. Perform Engine Wiring Harness — Removal.

   Special Tools:
   • None
5. Perform Fan and Alternator Belt — Removal.

   Special Tools:
   • None
6. Perform Alternator — Removal.

   Special Tools:
   • None
7. Perform Idler Pulley(s) with Lift Strap — Removal.

   Special Tools:
   • None
8. Perform Turbocharger — Removal.

   Special Tools:
   • None
9. Perform Exhaust Manifold — Removal.

   Special Tools:
   • None
10. Perform Fuel Filter — Removal.

    Special Tools:
    • None
11. Perform Rocker Arm Cover — Removal.

    Special Tools:
    • None
12. Perform Rocker Arm Assembly — Removal.

    Special Tools:
    • JDG1678—Hydraulic Lifter Bleed-down Tool
13. Perform Glow Plug Wiring Harness — Removal.

    Special Tools:
    • None
14. Perform Glow Plugs — Removal.

    Special Tools:
    • None
15. Perform Electronic Unit Pump Wiring Harness — Removal.

    Special Tools:
    • None
16. Perform Electronic Unit Pump — Removal.

    Special Tools:
    • JDG1704—Flywheel Turning Tool
17. Perform Injection Nozzle — Removal.

    Special Tools:
    • None
18. Perform Cylinder Head — Removal.

    Special Tools:
    • None
19. Perform Fan Pulley — Removal.

    Special Tools:
    • None
20. Perform fan bearing removal. See:

    Fan Bearing (Standard-Duty) — Removal.

    Special Tools:
    • JDG1679—Fan Bearing Remover & Installer Kit
    • JDG10409—Wrench Adapter

    or

    Fan Bearing (Heavy-Duty) — Removal.

    Special Tools:
    • JDG10409—Wrench Adapter
21. Perform Automatic (Spring) Belt Tensioner — Removal.

    Special Tools:
    • None
22. Perform Coolant Pump — Removal.

    Special Tools:
    • None
23. Perform Crankshaft Pulley/Damper — Removal.

    Special Tools:
    • JDG1571—Timing Pin
24. Perform Timing Gear Cover — Removal.

    Special Tools:
    • None
25. Perform Flywheel — Removal.

    Special Tools:
    • None
26. Perform Flywheel Housing — Removal.

    Special Tools:
    • None
27. Perform Crankshaft Rear Oil Seal and Housing — Removal.

    Special Tools:
    • None

Continued on next page

RG41183,0000020 -19-02JUN10-1/3

28. Perform Oil Pan — Removal.

    Special Tools:
    • None

29. Perform Oil Pick-up Tube Assembly — Removal.

    Special Tools:
    • None

30. Perform Piston and Connecting Rod Assembly — Removal.

    Special Tools:
    • None

31. Perform Crankshaft Main Bearings and Thrust Washers — Removal.

    Special Tools:
    • None

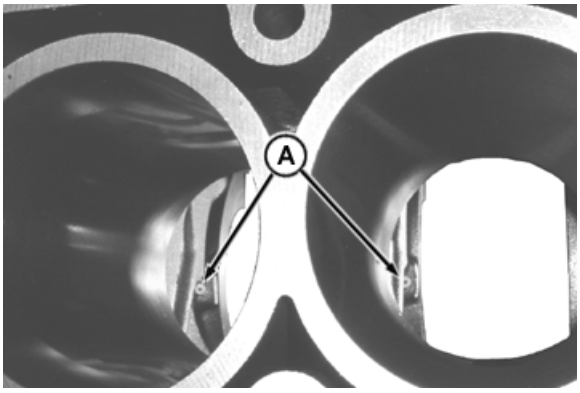
32. Perform Crankshaft — Removal.

    Special Tools:
    • None

33. **Piston Cooling Orifices Removal**

IMPORTANT: A piston cooling orifice failure could cause damage to pistons, piston pins, rod pin bushings and liners. If a piston cooling orifice is left out, low or no oil pressure will result. New spray jets are recommended during engine overhaul.

Remove piston cooling orifices (A).



RG12682 —UN—03JUL09

Piston Cooling Orifices

RG41183,0000020 -19-02JUN10-2/3

Piston Cooling Orifices — Inspection

1. Clean each piston cooling orifice to make sure it is not plugged or damaged.
2. Measure the orifice diameter. It should not exceed 1.7 mm (0.07 in.).
3. Replace if damaged, plugged or if it does not remain securely in position.

MK41968,00002DB -19-16JUL09-1/1

Piston Cooling Orifices — Installation

Special Tools:
• JDG1697—Piston Spray Jet Driver

Consumables:
• None

1. Install orifices using JDG1697 Installer.
2. Perform Piston and Connecting Rod Assembly — Installation.

   Special Tools:
   • JDG1690—Piston Ring Compressor

   Consumables:
   • Connecting Rod Cap Screws, Engine Oil
3. Perform Oil Pick-up Tube Assembly — Installation.

   Special Tools:
   • None

   Consumables:
   • LOCTITE® 242, Engine Oil
4. Perform Oil Pan — Installation.

   Special Tools:
   • None

   Consumables:
   • PM710XX280 Silicone Sealant, Drain Plug Oring, Engine Oil
5. Perform Cylinder Head Installation. See:

   Cylinder Head (4-Cylinder) — Installation.

   or

   Cylinder Head (5-Cylinder) — Installation.

   Special Tools:
   • None

   Consumables:
   • Head Gasket, Head Cap Screws, SAE 30W Oil
6. Perform Injection Nozzle — Installation.

   Special Tools:
   • None

   Consumables:
   • Injection Nozzle O-Ring, Copper Sealing Washer, Petroleum Jelly, Engine Oil
7. Perform Electronic Unit Pump — Installation.

   Special Tools:
   • JDG1704—Flywheel Turning Tool

   Consumables:
   • Parker O Lube™, Engine Oil
8. Perform Electronic Unit Pump Wiring Harness — Installation.

   Special Tools:
   • None

   Consumables:
   • LOCTITE® 222 (purple), **non-nylon** tie band
9. Perform Glow Plugs — Installation.

   Special Tools:
   • None

   Consumables:
   • None
10. Perform Glow Plug Wiring Harness — Installation.

    Special Tools:
    • None

    Consumables:
    • None
11. Perform Rocker Arm Assembly — Installation.

    Special Tools:
    • JDG1678—Hydraulic Lifter BleedDown Tool

    Consumables:
    • TY6333 High-Temperature Grease, LOCTITE® 242, Engine Oil
12. Perform Rocker Arm Cover — Installation.

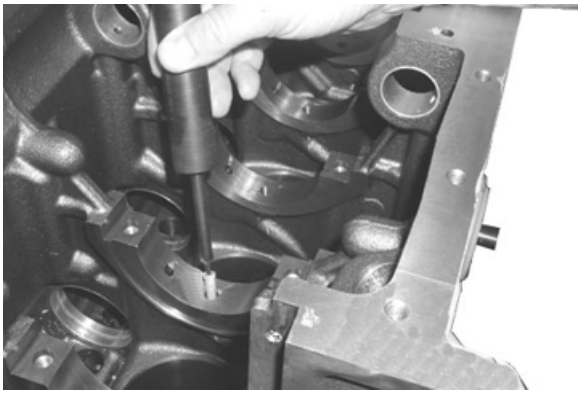
    Special Tools:
    • None

    Consumables:
    • O-rings, Rocker Arm Cover Gasket, LOCTITE® 5900 (PM37512)
13. Perform Fuel Filter — Installation.

    Special Tools:
    • None

    Consumables:
    • None
14. Perform Exhaust Manifold — Installation.

    Special Tools:
    • None



RG12681 —UN—12DEC02

Piston Cooling Orifice Installation

Continued on next page

MK41968,00002DC -19-02JUN10-1/2

Consumables:
• Exhaust Manifold Gasket

15. Perform Turbocharger — Installation.

    Special Tools:
    • None

    Consumables:
    • PT569 NEVER-SEEZ® Compound, Engine Oil

16. Perform Idler Pulley(s) with Lift Strap — Installation.

    Special Tools:
    • None

    Consumables:
    • None

17. Perform Alternator — Installation.

    Special Tools:
    • None

    Consumables:
    • None

18. Perform Fan and Alternator Belt — Installation.

    Special Tools:
    • None

    Consumables:
    • None

19. Perform Engine Wiring Harness — Installation.

    Special Tools:
    • None

    Consumables:
    • None

20. Perform Fan Assembly — Installation.

    Special Tools:
    • None

    Consumables:
    • None

21. Refill engine oil and engine coolant.

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MK41968,00002DC -19-02JUN10-2/2

Piston Ring Groove — Wear Check

1. Perform Piston — Cleaning and Inspection
2. Check ring grooves using a new piston ring and a feeler gauge.
3. Measure clearance at several points. Compare measurements with specifications. Replace piston if ring clearance exceeds specifications.

Specification	
Piston Ring-to-Groove Clearance—New Piston Ring (First Compression Ring Groove)—Maximum Clearance	0.12 mm (0.005 in.)
Piston Ring-to-Groove Clearance—New Piston Ring (Second Compression Ring Groove)—Maximum Clearance	0.098 mm (0.004 in.)
Piston Ring-to-Groove Clearance—New Piston Ring (Third Oil Control Ring Groove, Standard Ring)—Maximum Clearance	0.09 mm (0.004 in.)

RG12540 —UN—01MAY03

Piston Ring Groove Wear Check

RG41183,0000033 -19-18NOV09-1/1

Piston Rings — Installation

Special Tools:
• JDE135—Piston Ring Expander Tool

Consumables:
• Piston Rings, Engine Oil

1. **Piston Rings Installation**

IMPORTANT: Piston rings can be damaged if expanded too far. Expand piston rings only as far as necessary to install rings on piston.

a. Use JDE135—Piston Ring Expander or any other suitable piston ring expander for a proper installation and to prevent any damage to the piston and piston rings. Install oil expander ring in bottom ring groove. Position end gap toward either side of piston pin.

b. Install oil control ring (C) in bottom ring groove over ring expander. Install with end gap on opposite side of piston from ring expander gap.

NOTE: Identify ring top as follows:

If rings are marked with depression ('pip'), mark should be on top as shown (A). Ring with two depression marks goes in the second groove.

If ring is marked with paint strip, hold ring with gap facing you and turn ring so that paint strip is to the left side of gap.

c. Identify top side of compression rings. Top side of compression rings will be identified by marks on the top side of two rings.

d. Install compression ring (B) in center ring groove with top of ring toward top of piston.

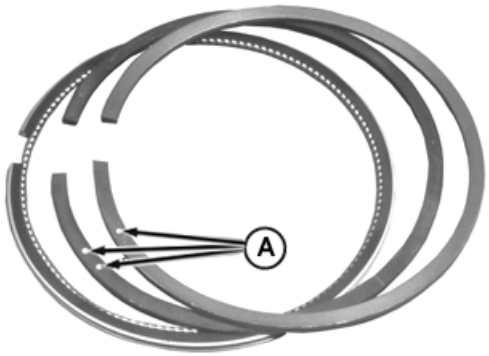
e. Position gap in compression ring (B) on opposite side (180°) of piston from oil control ring (C) gap.

f. Install compression ring (D) in top ring groove with top of ring toward top of piston.

A—Depression Marks
B—Rectangular Compression Ring
C—Oil Control Ring
D—Keystone Compression Ring

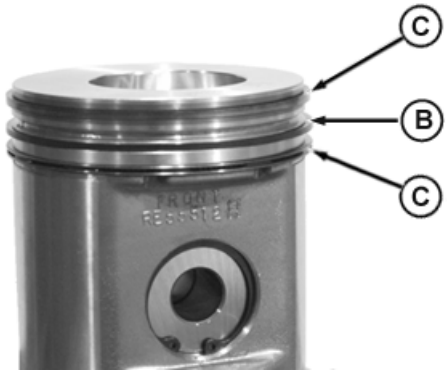
Piston Ring Expander Tool

RG17360 —UN—03JUL09



Compression Rings

RG17361 —UN—03JUL09



Piston Ring Locations

RG17362 —UN—03JUL09

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RG41183,0000023 -19-02JUN10-1/4

g. Position gap in compression ring (D) 120° from compression ring (B) gap.

2. Coat pistons, cylinder bores, and inside of JDE135 Piston Ring Expander, with clean engine oil.
3. Perform Piston and Connecting Rod — Reassemble.

   Special Tools:
   • None

   Consumables:
   • Snap Rings, Engine Oil
4. Perform Piston and Connecting Rod Assembly — Installation.

   Special Tools:
   • JDG1690—Piston Ring Compressor

   Consumables:
   • Connecting Rod Cap Screws, Engine Oil
5. Perfrom Oil Pick-up Tube Assembly — Installation.

   Special Tools:
   • None

   Consumables:
   •LOCTITE® 242, Engine Oil
6. Perform Oil Pan — Installation.

   Special Tools:
   • None

   Consumables:
   •PM710XX280 Silicone Sealant, Drain Plug O-ring, Engine Oil
7. Perform Cylinder Head Installation.
   (See Cylinder Head (4-Cylinder) — Installation or Cylinder Head (5-Cylinder) — Installation.

   Special Tools:
   • None

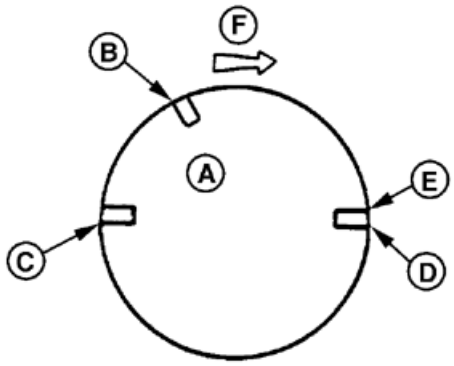
   Consumables:
   • Head Gasket, Head Cap Screws, SAE 30W Oil
8. Perform Injection Nozzle — Installation.

   Special Special Tools:
   • None

   Consumables:
   • Injection Nozzle O-Ring, Copper Sealing Washer, Petroleum Jelly, Engine Oil
9. Perform Electronic Unit Pump — Installation.

   Special Tools:
   • JDG1704—Flywheel Turning Tool

   Consumables:
   • Parker O Lube™, Engine Oil
10. Perform Electronic Unit Pump Wiring Harness — Installation.



RGCD5781B —UN—12DEC02

A—Piston Head
B—Top Compression Ring
C—Oil Control Ring Gap
D—Expander Ring Gap
E—Bottom Compression Ring Gap
F—Front of Engine

   Special Tools:
   • None

   Consumables:
   • LOCTITE 222® (purple), **non-nylon** tie band
11. Perform Glow Plugs — Installation

   Special Tools:
   • None

   Consumables:
   • None
12. Perform Glow Plug Wiring Harness — Installation.

   Special Tools:
   • None

   Consumables:
   • None
13. Perform Rocker Arm Assembly — Installation.

   Special Tools:
   • JDG1678—Hydraulic Lifter BleedDown Tool

   Consumables:
   • TY6333 High-Temperature Grease, LOCTITE 242®, Engine Oil
14. Perform Rocker Arm Cover — Installation.

   Special Tools:
   • None

   Consumables:
   • O-rings, Rocker Arm Cover Gasket
15. Perform Fuel Filter — Installation.

   Special Tools:
   • None

   Consumables:
   • None

Continued on next page

RG41183,0000023 -19-02JUN10-2/4

16. Perform Exhaust Manifold — Installation.

    Special Tools:
    • None

    Consumables:
    • Exhaust Manifold Gasket

17. Perform Turbocharger — Installation.

    Special Tools:
    • None

    Consumables:
    • PT569 NEVER-SEEZ® Compound, Engine Oil

18. Install lift strap. See in Group 60:

    Idler Pulley(s) with Lift Strap — Installation.

    Special Tools:
    • None

    Consumables:
    • None

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RG41183,0000023 -19-02JUN10-3/4

19. Install pulley and mounting bracket (D), and screw (A).
20. Install lift strap (C) and screws (B).
21. Perform Alternator — Installation.

    Special Tools:
    • None

    Consumables:
    • None

22. Perform Fan and Alternator Belt — Installation.

    Special Tools:
    • None

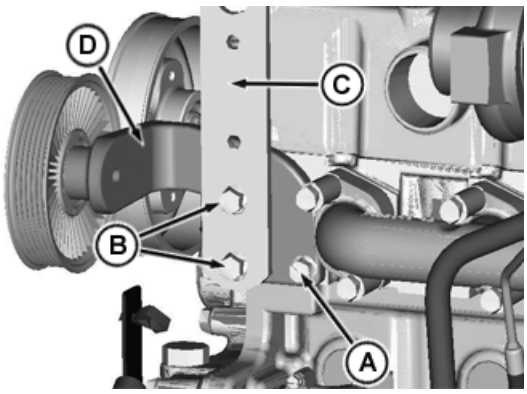
    Consumables:
    • None

23. Perform Engine Wiring Harness — Installation.

    Special Tools:
    • None

    Consumables:
    • None

24. Refill engine oil and engine coolant.



RG16727 —UN—19JUN09

Idler Pulley Mounting Bracket

A—Pulley Mounting Bracket
B—Screws
C—Lift Strap
D—Bracket Mounting Screw

RG41183,0000023 -19-02JUN10-4/4

Piston-to-Cylinder — Bore Clearance Measurement

Special Tools:
• None

Consumables:
• None

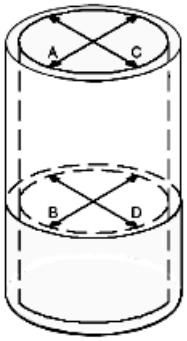
1. Measure piston OD.
2. Record measurement and compare measurement obtained from matching cylinder bore.

Specification

Piston —OD.....85.876—85.908 mm (3.381—3.382 in.)
Cylinder Bore—ID.....85.987—86.013 mm (3.385—3.386 in.)

IMPORTANT: ALWAYS measure cylinder bore at room temperature.

3. Measure cylinder bore parallel to piston pin at top end of ring travel (A).
4. Measure bore in same position at bottom end of ring travel (B).
5. Measure bore at right angle to piston pin at top end of ring travel (C).
6. Measure bore in same position at bottom end of ring travel (D).



RG12699 —UN—13APR04

7. Compare measurements A, B, C, and D to determine if cylinder bore is tapered or out-of-round.
8. Compare cylinder bore ID with matched piston OD. Replace piston and cylinder block if they exceed wear specifications given.

Specification

Piston-to-Cylinder Bore Clearance (Measured at Bottom of Piston Skirt)
—Clearance.....0.095—0.153 mm (0.003—0.006 in.)

RG41183,0000037 -19-18NOV09-1/1

Piston — Protrusion Measurement

Tools:
• JDG451—Piston Liner Height Gauge

Consumables:
• No consumables

1. Press down on top of piston to remove oil clearances before measuring piston protrusion.

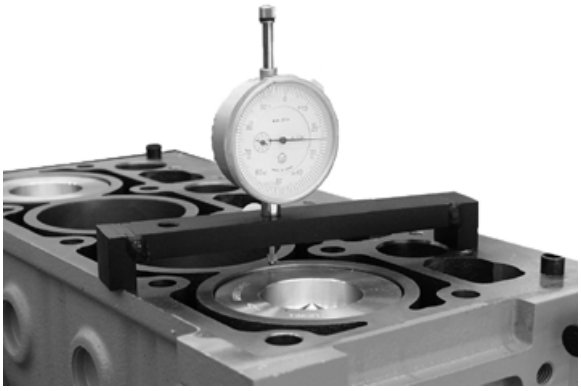
NOTE: If JDG451 is not available, a dial indicator with magnetic base can be used to measure piston protrusion.

Use JDG451 Height Gauge (or use a magnetic base dial indicator) to measure piston protrusion. Place gauge on top of cylinder block so dial indicator can be set to 'zero' with top of block.

2. Position gauge across piston as close to center line of piston pin as possible. While pressing gauge downward, rotate crankshaft until piston is at TDC position. Measure piston height over the piston pin axis at the front and rear outermost diameter of the piston.
3. Piston protrusion must be within specifications to prevent piston-to-exhaust valve contact.
4. Measure piston protrusion and compare to the following specifications.

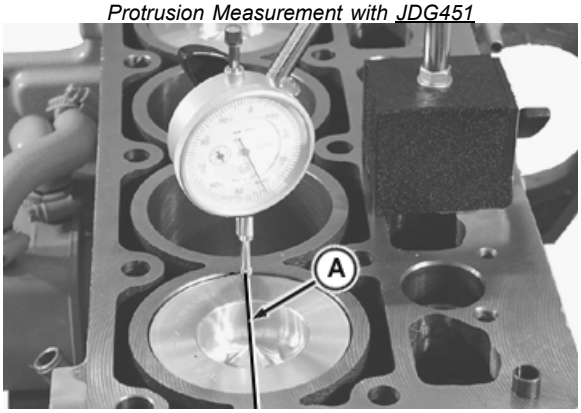
Piston Protrusion—Specification

Aspiration Type: T and H—Piston Protrusion	0.765—0.953 mm (0.03—0.038 in.)



RG12696 —UN—07JAN03

Protrusion Measurement with JDG451



RG17366 —UN—03JUL09

Magnetic Base Indicator

5. If protrusion does not meet specifications, check dimensions of piston, connecting rod, cylinder block, crankshaft, and bearings to determine the cause.

RG41183,0000028 -19-18NOV09-1/1

Engine Tightness Check

1. Rotate crankshaft several revolutions to be sure engine rotates without excessive tightness.
2. Check cylinder bores for deep scratches caused by an improperly installed or broken piston ring.
3. Check side clearance of rods. Must have less than 0.574 mm (0.022 in.) side-to-side movement.

RG,10,DT7385 -19-18NOV09-1/1

Essential Recommended and Fabricated Tools for this Group

IMPORTANT: Order tools according to information given in the U.S. SERVICEGARD™ Catalog or from the European Microfiche Tool Catalog (MTC).

- JDG1571—Timing Pin
- JDG1660—Timing Gear Cover Alignment Tool
- JDG22—Seal Remover
- JDG719—Seal Puller Adapter
- JDE382—Shank
- JDE383—Slide Hammer
- D17526CI (English, in.) Dial Indicator
or D17527CI (Metric, mm) Dial Indicator
- JDG1704—Turning Tool
or JDG10221—Turning Tool
- JDG698A Seal and Wear Sleeve Remover
- JDG1703 Rear Oil Seal Housing Aligner
- JT30041A Pilot
- JT30040B Seal/Wear Sleeve Installer
- JT30042—Driver

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MK41968,000001C -19-14SEP09-1/1

Crankshaft and Main Bearing — Troubleshooting Guide

Scored Main Bearing (Diagnosis also applies to Connecting Rod Bearing):

- Oil starvation.
- Contaminated oil.
- Engine parts failure.
- Excessive heat.
- Poor periodic service.

Galled or 'Wiped' Bearings:

- Fuel in lubricating oil (incomplete combustion).
- Coolant in lubrication system.
- Insufficient bearing oil clearance.
- Parts not lubricated prior to engine operation.
- Wrong bearing size.

Inconsistent Wear Pattern:

- Misaligned or bent connecting rod.
- Warped or bowed crankshaft.
- Distorted cylinder block.

Broken Main Bearing Caps:

- Improper installation.
- Dirt between bearing and crankshaft journal.
- Low oil pressure.
- Oil pump failure.

Cracked, Chipped or Broken Bearings:

- Overspeeding.
- Excessive idling.
- Lugging.
- Excessive oil clearance.
- Improper installation.

MK41968,00002E1 -19-19NOV09-1/1

Crankshaft Pulley/Damper — Removal

IMPORTANT: Never apply thrust on outer ring of damper. Use of heavy duty puller mounted to auxiliary mounting holes is preferred method for removal. Do not drop or hammer on damper.

1. Perform Fan and Alternator Belt — Removal.

   Special Tools:
   • None

2. **Crankshaft Pulley/Damper Removal**

   Special Tools:
   • JDG1571—Timing Pin

   a. Install JDG1571 Timing Pin to prevent crankshaft rotation.

   b. Remove damper from pulley, if equipped (shown removed).

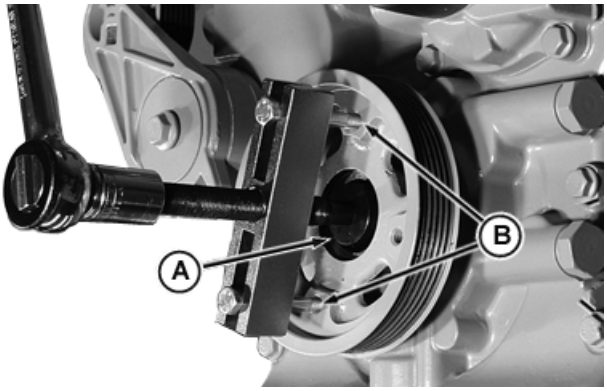
   c. Remove cap screw and washer securing pulley from crankshaft.

   d. Install a thread protector (A) in nose of crankshaft and secure a heavy duty puller to pulley using the auxiliary mounting holes (B).

CAUTION: Crankshaft pulley may suddenly release from crankshaft. Plan a safe handling procedure to avoid personal injury or damage to pulley.

   e. Remove pulley from crankshaft.

   f. Remove friction washer and o-ring.



RG17624 —UN—10SEP09

Crankshaft Pulley Removal

A—Crankshaft Pulley Washer B—Auxiliary Mounting Holes

MK41968,00002E3 -19-14APR10-1/1

Crankshaft Pulley and Wear Sleeve — Inspection

NOTE: Front oil seal wear sleeve is not a service part. If sleeve is worn, replace with new pulley assembly.

1. Inspect front pulley wear sleeve for grooves and damage.
2. Clean wear sleeve and smooth any surface imperfections with polishing cloth.
3. Protect belt pulley grooves, pilot bore and threads from paint.

RG12920 —UN—23MAY03

Crankshaft Pulley with Wear Sleeve

MK41968,00002E4 -19-15JUL09-1/1

Crankshaft Front Oil Seal — Removal (Without Removing Timing Gear Cover)

NOTE: If timing gear cover is to be removed, remove seal after cover is removed.

Front Crankshaft Oil Seal Removal

1. Perform Fan and Alternator Belt — Removal.

   Special Tools:
   • None

2. Perform Crankshaft Pulley/Damper — Removal.

   Special Tools:
   • None

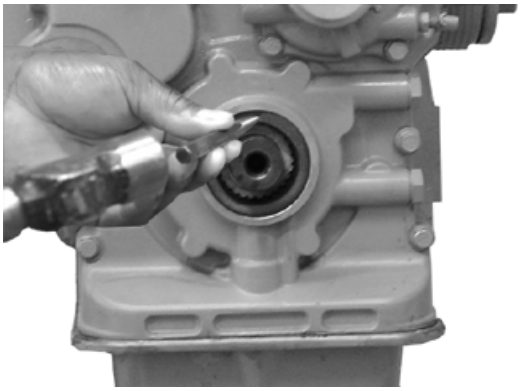
3. **Crankshaft Front Oil Seal Removal**

   Special Tools:
   • JDE38-2—Shank
   • JDE38-3—Slide Hammer
   • JDG22—Seal Remover

   a. Check oil seal for wear, damage, or leakage.

IMPORTANT: On unitized oil seal applications, holes must be drilled at outer edge of seal case. Screws will pull seal against wear ring, removing both pieces.

   b. Center punch seal casing at 12 o'clock position and drill 1/8 in. hole in casing.
   Remove seal from timing gear cover using JDG22 Seal Remover or JDG719 Seal Puller Adapter along with JDE38-2 Shank and JDE38-3 Slide Hammer. Be careful not to damage seal bore in timing gear cover.



RG12966 —UN—04JUN03

Crankshaft Oil Seal/Wear Sleeve

RG12967 —UN—04JUN03

Slide Hammer Installed in Oil Seal

MK41968,00002E6 -19-14SEP09-1/1

Crankshaft Front Oil Seal — Installation

1. **Front Crankshaft Oil Seal Installation**

   Special Tools:
   • JDG1660—Timing Gear Cover Alignment Tool

   Consumables:
   • Lithium Grease

   a. Inspect and clean ID of timing gear cover.

   b. Apply light coat of lithium grease to ID of seal.

   c. Install oil seal using JDG1660 Timing Gear Cover Alignment tool. Carefully drive the oil seal into the cover until the until the seal bottoms on the timing gear cover flange.

2. Perform Crankshaft Pulley/Damper — Installation.

   Special Tools:
   • JDG1571—Timing Pin

   Consumables:
   • LOCTITE® 7649 (PM37509) Clean and Cure Primer, SAE 30 Engine Oil

3. Perform Fan and Alternator Belt — Installation.

   Special Tools:
   • None

   Consumables:
   • None

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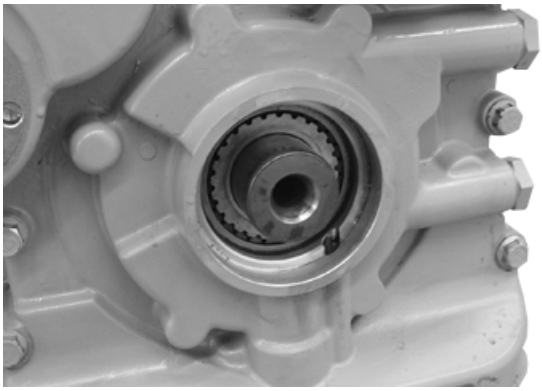

RG12909 —UN—23MAY03

Clean Seal Bore

RG12921 —UN—23MAY03

MK41968,0000020 -19-14SEP09-1/1

Crankshaft Pulley/Damper — Installation

IMPORTANT: Never apply thrust on outer ring of damper or pulley. Do not drop or hammer on damper.

1. **Crankshaft Pulley/Damper Installation**

   Special Tools:
   • JDG1571—Timing Pin

   Consumables:
   • Lithium Grease, LOCTITE® 7649 (PM37509) Primer, SAE 30 Engine Oil

   a. Install JDG1571 timing pin to prevent engine rotation.

   b. Inspect and clean nose of crankshaft using LOCTITE® 7649 (PM37509) clean and cure primer.

IMPORTANT: ALWAYS use a new cap screw, friction washer and o-ring. A friction washer is not specified for all engine applications.

   c. Install friction washer (A) against the front face of the crankshaft gear.

   d. Lightly lubricate o-ring (B) with soap and slide into position against crank gear.

   e. Apply a thin coat of lithium grease to the lead-in area of the O.D. wear sleeve surface on the crankshaft pulley. The flat leading edge of the crankshaft pulley contacting the crankshaft gear must remain clean and dry.

   f. Position pulley on crankshaft.

   g. Dip cap screw in clean SAE 30 engine oil.

   h. Install pulley on crankshaft using the washer (C) and cap screw (D). Tighten cap screw to specification.

Specification	
Initial Pulley Mounting Cap Screw—Torque	100 N·m (74 lb-ft)

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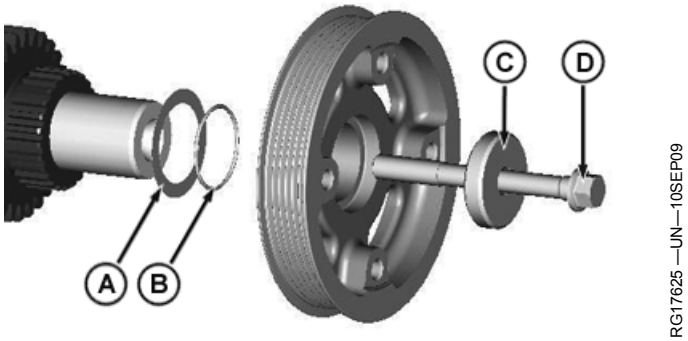


RG17625 —UN—10SEP09

Crankshaft Pulley Installation

A—Friction Washer
B—O-Ring
C—Crankshaft Pulley Washer
D—Crankshaft Pulley Cap Screw

   i. Loosen cap screw completely. Retighten cap screw to specification.

Specification	
Final Pulley Mounting Cap Screw—Torque Turn	50 N•m + 90° (37 lb-ft + 90°)

   j. Install damper, if equipped to specifications.

Specification	
Damper Cap Screws—Torque	64 N·m (48 lb-ft)

2. Perform Fan and Alternator Belt — Installation.

   Special Tools:
   • None

   Consumables:
   • None

MK41968,00002E7 -19-19NOV09-1/1

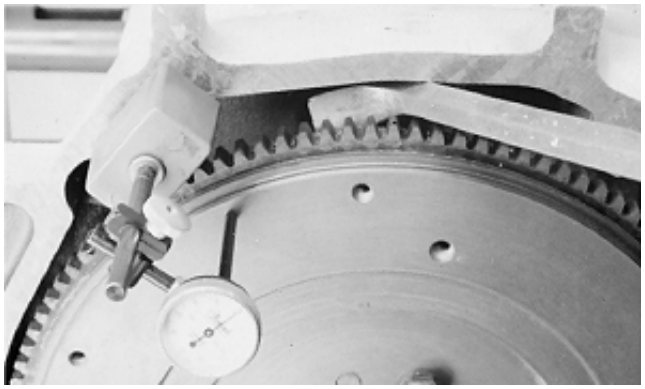
Crankshaft End Play Check

Measure end play prior to removing crankshaft to determine condition of thrust bearings.

1. Position dial indicator to contact face of flywheel, on front crankshaft nose, on damper, or front pulley assembly, if installed.
2. Using a pry bar, gently push crankshaft as far to rear of engine as possible.
3. Zero the dial indicator.
4. Gently pry the crankshaft as far forward as possible. Note indicator reading. If end play is not within specifications, install new thrust bearings.

Specification

Crankshaft—End Play.....0.089—0.396 mm (0.004—0.016 in.)



T88331 —UN—14OCT88

Crankshaft End Play Check

MK41968,00002E8 -19-17SEP09-1/1

Crankshaft Rear Oil Seal and Wear Sleeve — Handling Precautions

Use the following precautions for handling seal and wear sleeve assembly (A):

- Always install seal and wear sleeve assembly immediately after removal from plastic bag to avoid possible dirt contamination.
- No lubrication of any kind is to contact seal when installing. Use of a lubricant may result in premature seal failure.
- Install oil seal/wear sleeve assembly with the open side of seal and wear sleeve ID chamfer toward the engine. If seal is reversed, engine oil may be lost because grooves in oil seal lip would be incorrect with respect to direction of crankshaft rotation.

RG5640A —UN—31OCT97

Crankshaft Rear Oil Seal

A—Wear Sleeve

MK41968,00002E9 -19-19NOV09-1/1

Crankshaft Rear Oil Seal and Housing — Removal

Special Tools:
• JDG698—Seal and Wear Sleeve Remover

The crankshaft rear oil seal (A) and wear sleeve (B) are fabricated as a non-separable part.

Rear Oil Seal Removal

1. Adjust forcing screw (C) on JDG698A Seal and Wear Sleeve Remover and position screw so it centers tool on crankshaft flange.
2. Using the slots in JDG698A Remover as a template, mark three locations on seal casing where screws should be installed for removal purposes. Remove tool from crankshaft flange.

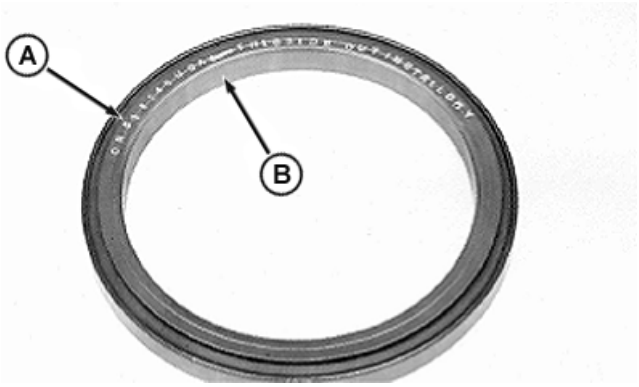
IMPORTANT: Holes must be drilled at outer edge of seal case. Screws will pull seal against wear ring, thereby removing both pieces.

3. Drill a 3/16 in. hole through wear sleeve lip and seal casing at the three marked locations.
4. Position JDG698A Remover on end of crankshaft.
5. Install three 2-1/2 in. (approximate) sheet metal screws with washers (B) into slots of removal tool and thread screws into holes in seal casing. Evenly tighten screws until plate is flush with rear face of crankshaft.
6. Tighten forcing screw (plate should pull evenly against the three screws) until seal assembly is removed from engine

Rear Oil Seal Housing Removal

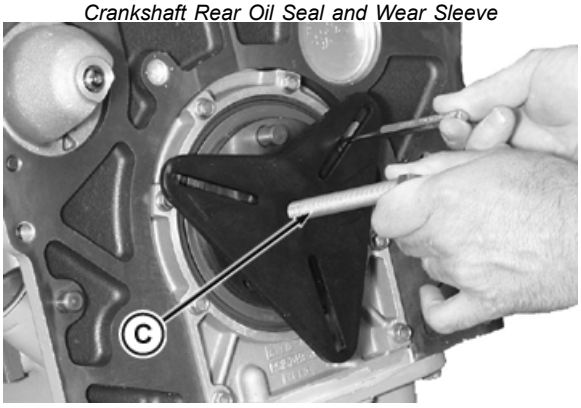
1. Remove rear oil seal housing cap screws.
2. Inspect seal housing for any damage and replace if required.

A—Oil Seal
B—Wear Sleeve
C—Forcing Screw
D—Sheet Metal Screws



RG17626 —UN—10SEP09

Crankshaft Rear Oil Seal and Wear Sleeve

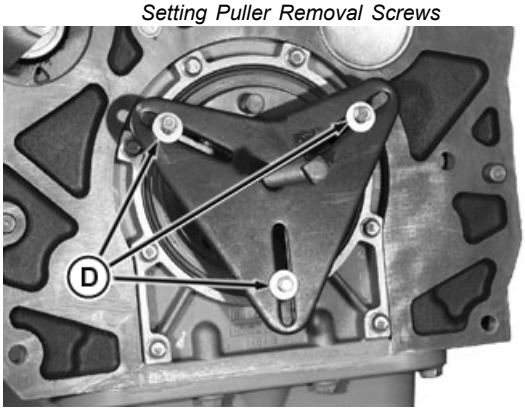


RG17627 —UN—10SEP09

Unitized Crankshaft Rear Oil Seal/Wear Sleeve Puller

RG12925 —UN—27MAY03

Setting Puller Removal Screws



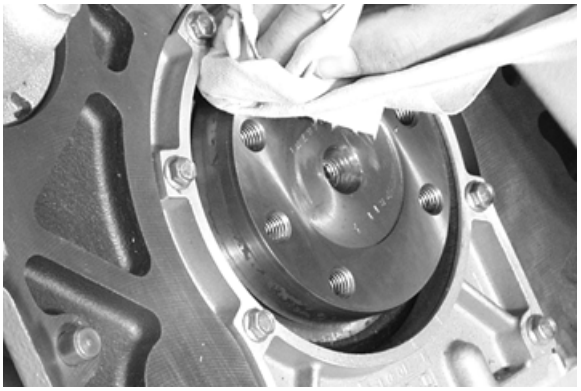
RG17628 —UN—10SEP09

Puller in Position

MK41968,00002EA -19-19NOV09-1/1

Crankshaft Flange — Cleaning and Inspection

1. Look for nicks or burrs on wear ring surface and bore in flywheel housing. If necessary, use polishing cloth to remove nicks or burrs.
2. Clean OD of crankshaft flange and ID of flywheel housing with cleaning solvent, acetone, or any other suitable cleaner that will remove sealant, if previously applied. (Brake Kleen, Ignition Cleaner and Drier are examples of commercially available solvents that will remove sealant from flange.)



RG12922 —UN—05JUN03

Clean Crankshaft Flange

MK41968,00002EB -19-19NOV09-1/1

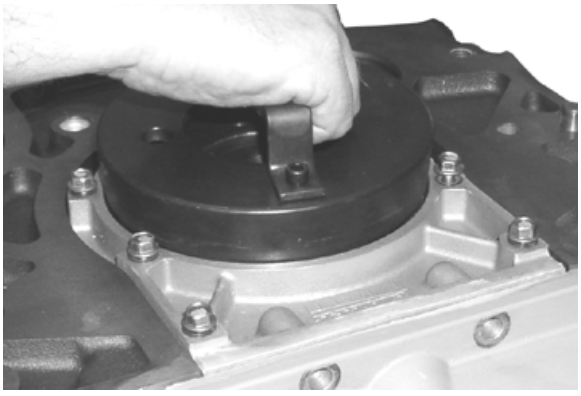
Crankshaft Rear Oil Seal Housing — Installation

Special Tools:
• JDG1703—Rear Oil Seal Housing Aligner

Consumables:
• LOCTITE® 5910 (PM37512) Silicone Sealant, Cleaning Solvent

1. Look for nicks or burrs in seal housing bore. If necessary, use polishing cloth to remove nicks or burrs.
2. Clean sealing surfaces of the cylinder block and seal housing with cleaning solvent, acetone, or any other suitable cleaner that will remove sealant. (Brake Kleen, Ignition Cleaner and Drier are examples of commercially available solvents that will remove sealant from flange)
3. Apply a continuous 2.0—4.0 mm (0.08—0.16 in.) bead of LOCTITE® 5910 (PM37512) Silicone Sealant to the mounting surface of the seal housing and place in position.

   Install all seal housing cap screws and tighten finger-tight.
4. Place JDG1703 Rear Oil Seal Housing Aligner into the seal housing bore and over the crankshaft flange to center the housing.
5. Tighten cap screws to specifications in sequence as shown.



RG12926 —UN—27MAY03

Rear Oil Seal Housing Aligner

RG17631 —UN—11SEP09

Rear Oil Seal Torque Sequence

Specification	
Rear Oil Seal Housing	
Cap Screws—Torque	17 N•m (13 lb-ft)

LOCTITE is a trademark of Loctite Corp.

MK41968,00002EF -19-19NOV09-1/1

Crankshaft Rear Oil Seal — Installation

Special Tools:
• JT30041A—Rear Oil Seal/Wear Sleeve Installer Set

Consumables:
• Cleaning Solvent

IMPORTANT: No lubrication of any kind is to contact seal when installing. Use of a lubricant may result in premature seal failure. Install seal and wear sleeve assembly immediately after removal from plastic bag to avoid possible dirt contamination.

1. Clean OD of crankshaft flange and ID of seal housing with cleaning solvent, acetone, or any other suitable cleaner that will remove sealant, if previously applied. (Brake Kleen, Ignition Cleaner and Drier are examples of commercially available solvents that will remove sealant from flange.)

   Make sure that OD of crankshaft flange and ID of seal housing bore are free from nicks or burrs.

2. Install JT30041A Pilot (A) from the JT30040B Seal/Wear Sleeve Installer Set on end of crankshaft using two 38 mm (1-1/2 in.) socket-head cap screws.

   Tighten both cap screws until they touch base of pilot, then back them off approximately 1/2 turn.

3. Install JT30042 Driver over JT30041A Pilot until driver cross-plate bottoms on pilot. This will properly center pilot with crankshaft flange.

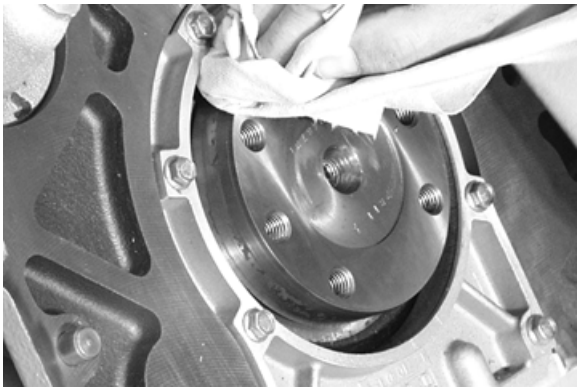
NOTE: It may be necessary to lift up on pilot to install driver to full depth over pilot and crankshaft flange.

   Tighten two pilot socket head cap screws securely. Remove driver from pilot.

IMPORTANT: Handle the rear oil seal assembly carefully. If wear sleeve surface is scratched, gouged or any sealant (liquid) is present, order a new seal assembly.

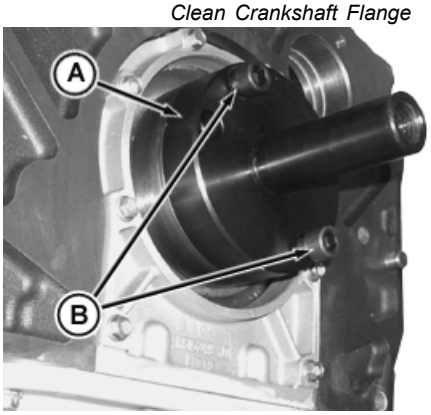
4. Carefully start oil seal over pilot and crankshaft flange with open side of seal toward engine.

A—Pilot **B—Cap Screws**



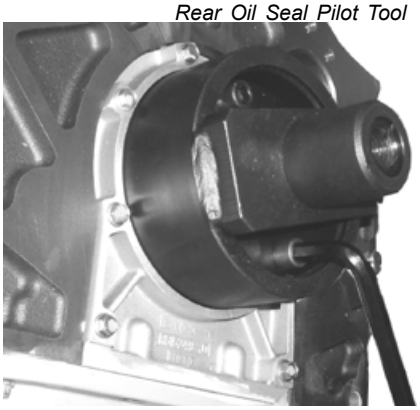
RG12922 —UN—05JUN03

Clean Crankshaft Flange



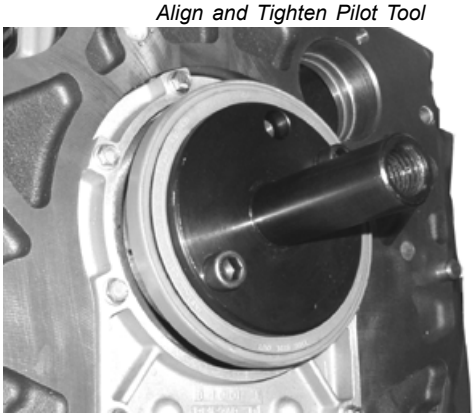
RG17629 —UN—11SEP09

Rear Oil Seal Pilot Tool



RG17630 —UN—11SEP09

Align and Tighten Pilot Tool

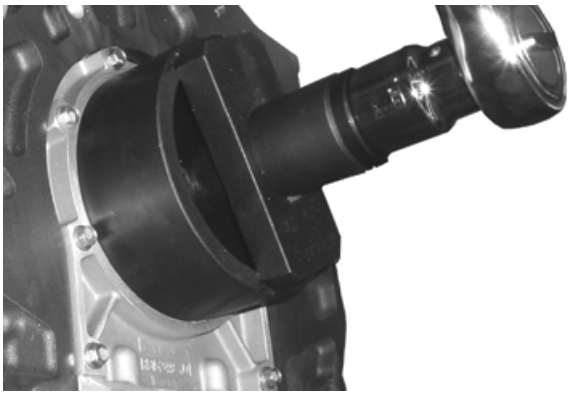


RG12930 —UN—27MAY03

Seal Installation

Continued on next page

5. Attach JT30042 Driver and thrust washer to the guide plate with cap screw. Tighten the cap screw until driver bottoms on pilot.
6. Remove seal driver and pilot plate. Check that seal assembly is properly positioned on crankshaft flange and installed square in rear seal housing bore.



RG12947 —UN—05JUN03

Rear Seal Driver Tool

RG12944 —UN—04JUN03

Rear Oil Seal Installed

MK41968,00002EC -19-11SEP09-2/2

Crankshaft Main Bearings and Thrust Washers — Removal

1. Drain engine coolant from the cooling system.
2. Drain engine oil from the crankcase.
3. Perform Fan Assembly — Removal.

   Special Tools:
   • None
4. Perform Fan and Alternator Belt — Removal.

   Special Tools:
   • None
5. Perform Fan Pulley — Removal.

   Special Tools:
   • None
6. Remove fan bearing. See:

   Fan Bearing (Standard-Duty) — Removal.

   Special Tools:
   • JDG1679—Fan Bearing Remover & Installer Kit
   • JDG10409—Wrench Adapter

   or

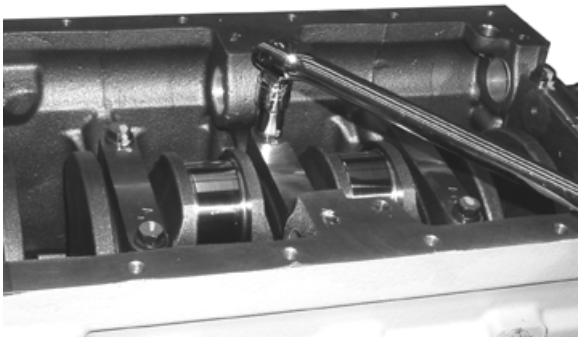
   Fan Bearing (Heavy-Duty) — Removal.

   Special Tools:
   • JDG10409—Wrench Adapter
7. Remove the idler pulley below the alternator. See:

   Idler Pulley(s) with Lift Strap — Removal.

   Special Tools:
   • None
8. Perform Automatic (Spring) Belt Tensioner — Removal.

   Special Tools:
   • None



RG12933 —UN—03JUN03

Main Bearing Cap Screw Torque Check

9. Perform Coolant Pump — Removal.

   Special Tools:
   • None
10. Perform Crankshaft Pulley/Damper — Removal.

    Special Tools:
    • JDG1571—Timing Pin
11. Perform Oil Pan — Removal.

    Special Tools:
    • None
12. Perform Oil Pick-up Tube Assembly — Removal.

    Special Tools:
    • None
13. Timing Gear Cover — Removal.

    Special Tools:
    • None
14. **Crankshaft Main Bearings and Thrust Washers — Removal**

    Special Tools:
    • None

Continued on next page

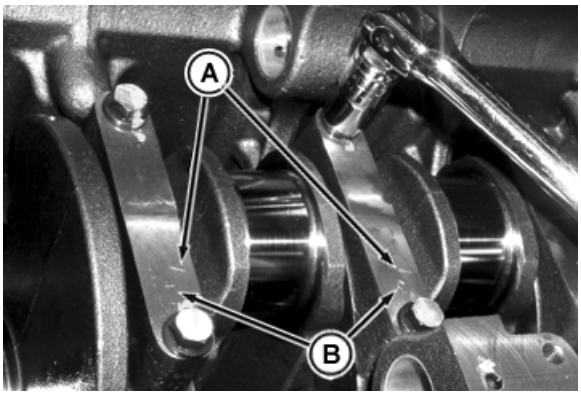
MK41968,00002F0 -19-14APR10-1/3

IMPORTANT: Before removing main bearing caps, check for proper torque on all main bearings.

NOTE: When crankshaft is to be removed, leave front and rear main bearing caps installed until all connecting rod caps have been removed.

a. Check main bearing caps for arrows (A) stamped in main bearing cap, and numbers (B) stamped on cap and oil pan rail. Arrow points toward the front of engine.
If there are no numbers, stamp corresponding numbers on cap and oil pan rail to ensure correct placement of bearing caps during reassembly.

A—Stamped Arrows **B—Stamped Numbers**



RG17953 —UN—11DEC09

Crankshaft Main Bearing Caps

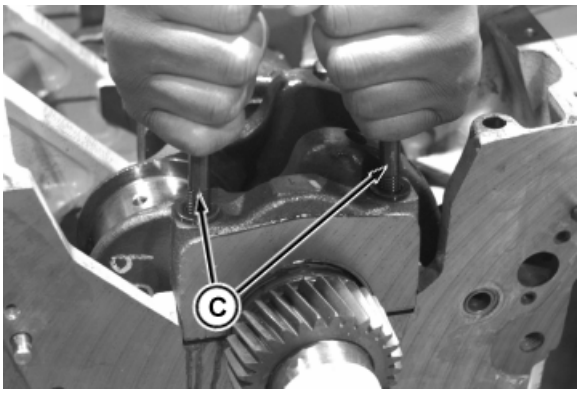
MK41968,00002F0 -19-14APR10-2/3

b. Remove main bearing caps by extending cap screws (C) and forcing heads of screws together. Wiggle bearing cap back and forth while applying an upward force with cap screws until free from main bearing cap support.

IMPORTANT: Keep matched bearings with their respective main bearing cap for comparison with crankshaft journal (surface wear) from which removed.

c. Visually inspect condition of bearing inserts and crankshaft main journals as bearing caps are removed.

C—Cap Screws



RG17954 —UN—11DEC09

Crankshaft Main Bearing Cap Screws

MK41968,00002F0 -19-14APR10-3/3

Crankshaft Main Thrust Journal Width and Thrust Washers — Measurement

1. Inspect thrust surfaces of the thrust washers and the thrust bearing journal on crankshaft and replace as necessary.

   Measure and record crankshaft main thrust journal width.

   If crankshaft thrust journal width is not within specifications, replace crankshaft.

2. Measure and record thickness of main thrust washer.

RG12792 —UN—05JUN03

Main Thrust Journal Width Measurement

Specification	
Crankshaft Main Thrust Bearing Journal Width—Width	31.302—31.378 mm (1.2340—1.2350 in.)
Crankshaft Main Thrust Washer—Overall Thickness	2.95—3.05 mm (0.120—0.116 in.)

MK41968,00002F1 -19-19NOV09-1/1

Crankshaft Main Bearing Cap — ID Measurement

1. Remove bearing inserts from caps and cylinder block. Keep inserts in correct order if they are to be reused.
2. Clean and inspect caps for damage. Small burrs or nicks on flat surfaces may be removed with a file. Use a medium-grit polishing cloth to dress curved bearing surfaces.
3. Install bearing caps (without bearings) in cylinder block. Tighten cap screws to specifications.

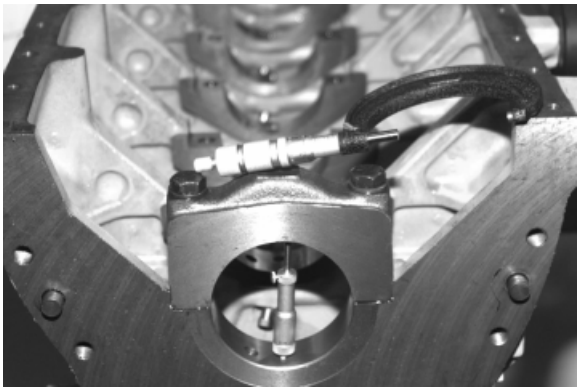
Specification	
Main Bearing Cap Screws—Torque	80 N•m (59 lb-ft)

4. Measure ID of bearing cap bores.

Specification	
Crankshaft Main Bearing Bore (Without Bearings)—ID	79.892—79.918 mm (3.1454—3.1464 in.)
Crankshaft Main Bearing Bore Centerline-to-Top Deck—Distance	274.960—275.040 mm (10.8252—10.8283 in.)

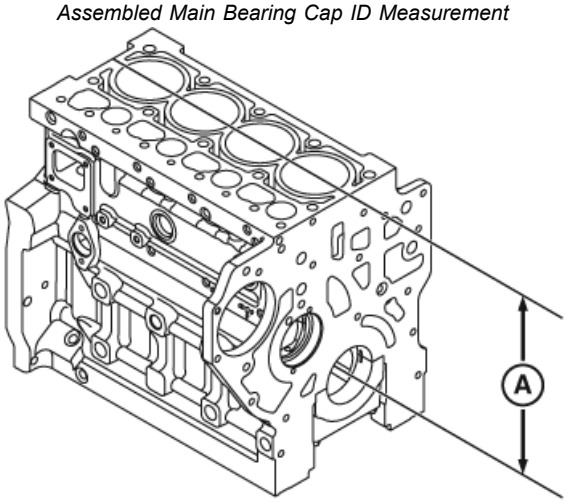
5. If bearing caps are damaged or bore is not within specification, replace cylinder block.

Replace crankshaft if it does not fall within above specifications.



RG7537 —UN—23NOV97

Assembled Main Bearing Cap ID Measurement



RG16329 —UN—22JUL09

Cylinder Block to Crankshaft Centerline

A—Top Deck-to-Centerline Bearing Bore

MK41968,00002F2 -19-19NOV09-1/1

Crankshaft — Removal

1. Drain engine coolant from the cooling system.
2. Drain engine oil from the crankcase.
3. Perform Fan Assembly — Removal.

   Special Tools:
   • None
4. Perform Engine Wiring Harness — Removal.

   Special Tools:
   • None
5. Perform Fan and Alternator Belt — Removal.

   Special Tools:
   • None
6. Perform Alternator — Removal.

   Special Tools:
   • None
7. Perform Idler Pulley(s) with Lift Strap — Removal.

   Special Tools:
   • None
8. Perform Turbocharger — Removal.

   Special Tools:
   • None
9. Perform Exhaust Manifold — Removal.

   Special Tools:
   • None
10. Perform Fuel Filter — Removal.

    Special Tools:
    • None
11. Perform Rocker Arm Cover — Removal.

    Special Tools:
    • None
12. Perform Rocker Arm Assembly — Removal.

    Special Tools:
    • JDG1678—Hydraulic Lifter Bleed-down Tool
13. Perform Glow Plug Wiring Harness — Removal.

    Special Tools:
    • None
14. Perform Glow Plugs — Removal.

    Special Tools:
    • None
15. Perform Electronic Unit Pump Wiring Harness — Removal.

    Special Tools:
    • None
16. Perform Electronic Unit Pump — Removal.

    Special Tools:
    • JDG1704—Flywheel Turning Tool
17. Perform Injection Nozzle — Removal.

    Special Tools:
    • None
18. Perform Cylinder Head — Removal.

    Special Tools:
    • None
19. Perform Fan Pulley — Removal.

    Special Tools:
    • None
20. Perform fan bearing removal. See:

    Fan Bearing (Standard-Duty) — Removal.

    Special Tools:
    • JDG1679—Fan Bearing Remover & Installer Kit
    • JDG10409—Wrench Adapter

    or

    Fan Bearing (Heavy-Duty) — Removal.

    Special Tools:
    • JDG10409—Wrench Adapter
21. Perform Automatic (Spring) Belt Tensioner — Removal.

    Special Tools:
    • None
22. Perform Coolant Pump — Removal.

    Special Tools:
    • None
23. Perform Crankshaft Pulley/Damper — Removal.

    Special Tools:
    • JDG1571—Timing Pin
24. Perform Timing Gear Cover — Removal.

    Special Tools:
    • None
25. Perform Flywheel — Removal.

    Special Tools:
    • None
26. Perform Flywheel Housing — Removal.

    Special Tools:
    • None
27. Perform Crankshaft Rear Oil Seal and Housing — Removal.

    Special Tools:
    • None

Continued on next page

28. Perform Oil Pan — Removal.

    Special Tools:
    • None

29. Perform Oil Pick-up Tube Assembly — Removal.

    Special Tools:
    • None

30. Perform Piston and Connecting Rod Assembly — Removal

    Special Tools:
    • None

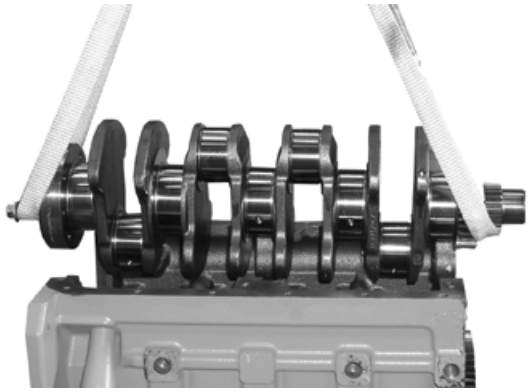
31. Perform Crankshaft Main Bearings and Thrust Washers — Removal.

    Special Tools:
    • None

32. **Crankshaft — Removal**

    Special Tools:
    • None

CAUTION: Crankshaft is heavy. Plan a proper handling procedure to avoid injury. Do not use lifting sling on connecting rod or main journals.



RG12931 —UN—03JUN03

Crankshaft Removal

a. Attach a lifting sling to crankshaft. Using proper lifting equipment, carefully raise crankshaft out of cylinder block.

b. Clean crankshaft, especially oil passages, using solvent and compressed air.

c. Place crankshaft on clean V-blocks.

d. If main bearing inserts are to be replaced, remove inserts from cylinder block. Otherwise, leave bearing inserts in block until assembled ID has been measured.

Continued on next page

MK41968,00002F3 -19-02JUN10-2/3

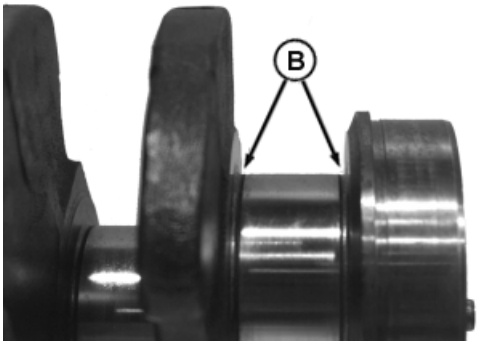
Crankshaft — Inspection

NOTE: If vibration damper damage was discovered during tear down, it is recommended that the crankshaft be magna-fluxed. This will verify whether of not it has microscopic cracks or fissures. .

1. Thoroughly clean crankshaft. Clear restrictions from all oil passages.

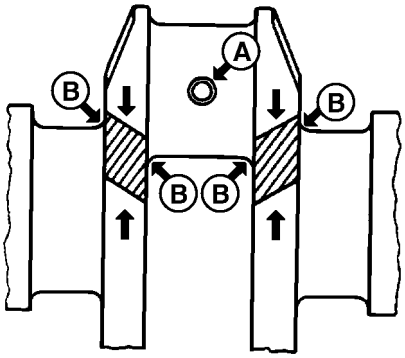
IMPORTANT: Small cracks may not be visible to the eye. Use a method such as the Fluorescent Magnetic Particle Method. This method magnetizes the crank, employing magnetic particles which are fluorescent and glow under "black light". The crankshaft must be de-magnetized after inspection.

2. Inspect crankshaft for signs of load stress, cracks, scoring, or journal scratches. Replace crankshaft if cracks are found.
3. Check each journal for evidence of excessive overheating or discoloration. If either condition exists, replace crankshaft since heat treatment has probably been destroyed.
4. Inspect front crankshaft gear for cracks, chipped teeth, or excess wear. Replace crankshaft as required.
5. Carefully inspect the rear hub of the crankshaft in the area of the wear sleeve contact surface for evidence of a rough or grooved condition. Any imperfections in this area will result in oil leakage. Slight ridges may be cleaned up with emery cloth or crocus cloth.
6. Carefully check the crankshaft for cracks in the area of rod journal holes (A) and at journal fillets (B). Replace crankshaft if any cracks are found.



RG17676 —UN—24SEP09

Crankshaft Main Bearing Journal Fillets



RGCD7147 —UN—30OCT97

Crankshaft Rod Bearing Journal Holes/Fillets

A—Rod Journal Hole **B—Journal Fillets**

MK41968,00002F4 -19-25SEP09-1/1

Crankshaft Journal and Main Bearing ID — Measurement

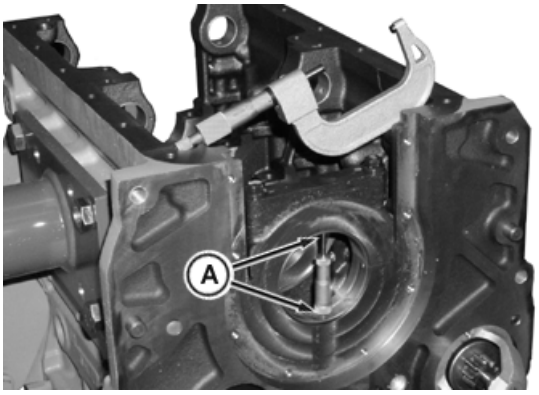
1. With crankshaft removed from engine, assemble main bearing caps with bearing inserts. Be sure inserts are installed correctly.
2. Tighten main bearing cap screws to specifications.

Specification	
Main Bearing Cap Screws—Torque	80 N·m (59 lb-ft)

3. Measure and record main bearing assembled ID (A) at several points with an inside micrometer.
4. Measure and record crankshaft main journal OD (B) and rod journal OD (C) at several points around each journal.
5. Compare measurements with specifications given below.

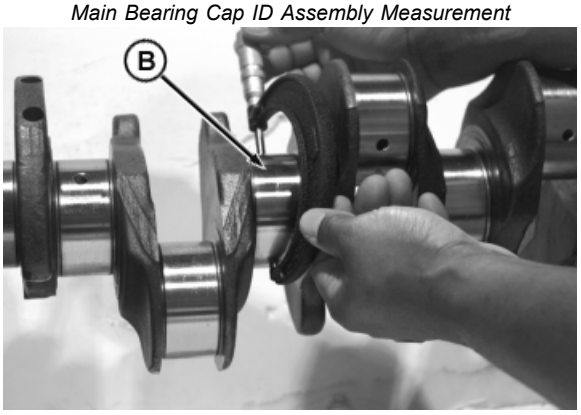
Specification	
Crankshaft Main Bearing—ID	75.034—75.077 mm (2.9541—2.9558 in.)
Crankshaft Main Journal—OD	74.987—75.013 mm (2.9522—2.9533 in.)
Crankshaft Rod Journal—OD	59.987—60.013 mm (2.36170—2.3627 in.)
Crankshaft Main Bearing-to-Journal—Oil Clearance	0.021—0.090 mm (0.0008—0.0035 in.)
Crankshaft Main or Rod Journal—Maximum Taper	0.010 mm (0.0004 in.)
Crankshaft Main or Rod Journal—Maximum Out-of-Round	0.008 mm (0.0003 in.)

Replace crankshaft if it does not fall within above specifications.



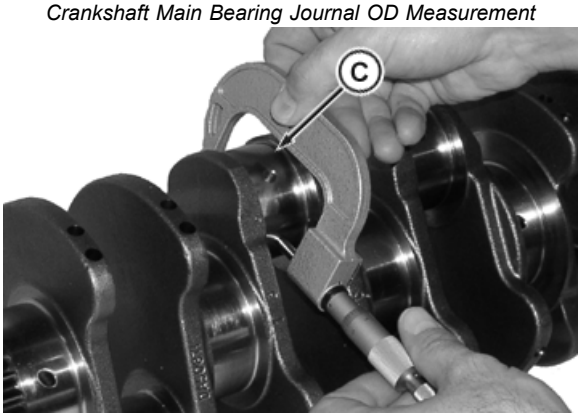
RG17672 —UN—24SEP09

Main Bearing Cap ID Assembly Measurement



RG17673 —UN—24SEP09

Crankshaft Main Bearing Journal OD Measurement



RG17674 —UN—24SEP09

Crankshaft Rod Bearing Journal OD Measurement

A—Main Bearing ID
B—Main Journal OD
C—Rod Journal OD

MK41968,00002F5 -19-24SEP09-1/1

Crankshaft Grinding — Guidelines

IMPORTANT: Crankshaft grinding should be done ONLY by experienced personnel on equipment capable of maintaining crankshaft size and finish specifications. Undercut and rolled fillets (B) have taken the place of ground (tangential) fillets. DO NOT grind within this undercut area when undersize bearings are used.

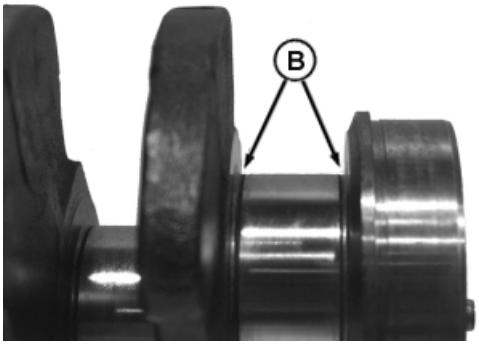
Crankshafts have micro-finished journal surfaces.

IMPORTANT: If undersize bearings are installed, recheck bearing-to-journal clearance. If oil clearance is not within specifications, premature wear of bearings and journals will result.

If the crankshaft is to be reground, use the following recommended guidelines:

1. Compare the crankshaft journal measurements taken during inspection and determine the size which the journals are to be reground.
2. Grind all main journals or all connecting rod journals to the same required size.

IMPORTANT: Care must be taken to avoid localized heating which often produces grinding cracks. Use coolant generously to cool the crankshaft while grinding. DO NOT crowd the grinding wheel into the work. Grind crankshaft with journals turning counterclockwise, as viewed from the front end of the crankshaft. Lap or polish journals in opposite direction of grinding.



RG17676 —UN—24SEP09

Crankshaft Main Bearing Journal Fillets

B—Fillets

3. Polish or lap the ground surfaces to the specified finish to prevent excessive wear of the journals.
4. Stone the edge of all oil holes in the journal surfaces smooth to provide a radius of approximately 1.50 mm (0.060 in.).
5. When finished grinding, inspect the crankshaft by the fluorescent magnetic particle method, or other similar method to determine if cracks have originated due to the grinding operation.
6. De-magnetize the crankshaft after inspection.
7. Thoroughly clean the crankshaft and oil passages with solvent. Dry with compressed air.

MK41968,00002F6 -19-25SEP09-1/1

Crankshaft Grinding — Specifications

Bearing Size	Crankshaft Main Journal OD	Crankshaft Rod Journal OD
Standard	74.987—75.013 mm (2.952—2.953 in.)	59.987—60.013 mm (2.3616—2.3627 in.)
0.25 mm (0.010 in.) Undersize	74.733—74.759 mm (2.9422—2.9433 in.)	59.733—59.759 mm (2.3516—2.3527 in.)

Main and Connecting Rod Journal Surface Finish (AA)	Lap 0.20 µm (8 AA)
Thrust Surface Finish (AA)	Lap 0.40 µm (16 AA)
Thrust Bearing Journal Width	31.302—31.378 mm (1.2324—1.2353 in.)
Direction of Crankshaft Rotation (viewed from flywheel end):	
Grinding	Clockwise
Lapping	Counterclockwise
Engine Stroke	105 mm (4.1338 in.)
Main Journal Maximum Runout (Concentricity) Relative to End Journals	0.080 mm (0.0034 in.)
Main Journal Maximum Runout (Concentricity) Between Adjacent Journals	0.050 (mm (0.0020 in.)

MK41968,00002F7 -19-24SEP09-1/1

Crankshaft Main Bearings and Thrust Washers — Installation

IMPORTANT: If new main bearings or thrust washers are installed, they must be installed as a matched set.

During assembly, apply a liberal coating of clean engine oil to:

- All main bearing webs in block
- Both sides of main bearings and thrust washers
- Entire O.D. of crankshaft main bearing journals

1. **Crankshaft Main Bearings and Thrust Washers Installation**

   Special Tools:
   • None

   Consumables:
   • Engine Oil

   a. Install upper main bearing inserts in block. Be sure locating tabs (A) on inserts are properly positioned with slot in block web and that holes in the main bearing web are aligned with oil holes in the bearing inserts.

CAUTION: Crankshaft is heavy. Plan a proper lifting procedure to avoid injuries. Do not use lifting sling on connecting rod or main journals.

   b. Carefully position crankshaft onto main bearing inserts using a hoist and lift sling.

   c. Lubricate the thrust washers with clean engine oil. Install the front and rear thrust washers (C) into the thrust cavity between the cylinder block upper web and the crankshaft with the profiled surfaces facing the crankshaft.

NOTE: Thrust bearing must be installed with slots facing crankshaft flanges in the upper cylinder block web.

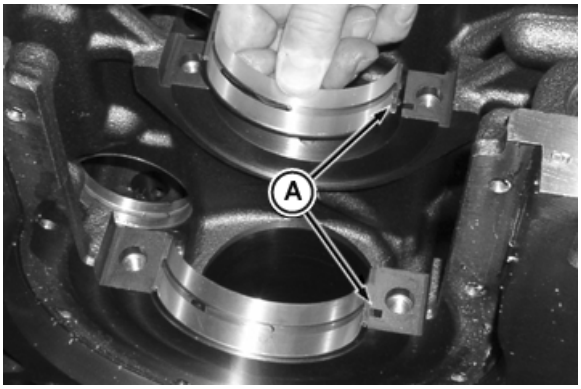
IMPORTANT: Always use new main bearing cap screws.

   d. Dip entire main bearing cap screws in clean engine oil and position them in main bearing caps. Apply a liberal amount of oil to bearing inserts in caps.

   e. Install each bearing cap (B), bearings, and cap screws (E) with the recesses and tabs aligned in matching order. Make sure bearing tabs also match up before tightening cap screws.

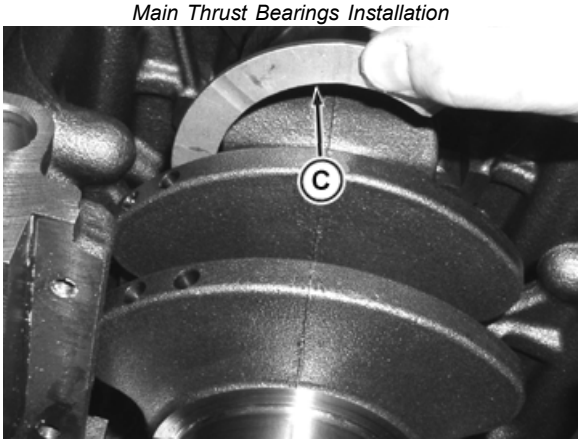
NOTE: Make sure main bearing caps are installed on the bearing bosses from which they were removed. The numbers stamped on the caps are in numerical order from the front of the engine.The arrow should point to the front of the engine (D).

IMPORTANT: Do not use pneumatic wrench to install main bearing cap screws, as damage may occur to threads.



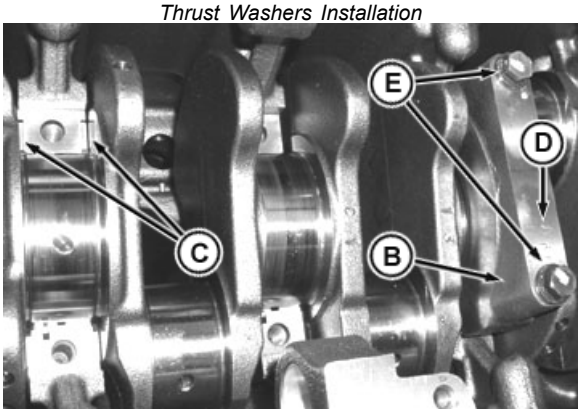
RG17691 —UN—30SEP09

Main Thrust Bearings Installation



RG17692 —UN—30SEP09

Thrust Washers Installation



RG17693 —UN—30SEP09

Main Bearing Caps Installation

RG12797 —UN—04JUN03

Main Bearing Cap Screws Installation

A—Locating Tabs
B—Bearing Cap
C—Thrust Washer
D—Stamped Number and Direction Arrow Location
E—Cap Screws

Continued on next page

MK41968,0000024 -19-02JUN10-1/3

f. Before tightening cap screws on main bearing caps, insure the thrust bearings are retained by the thrust bearing cap.

g. Tighten all main bearing cap screws to specified torque.

Specification

Crankshaft Main Bearing Cap Screws—Torque..... 80 N·m (59 lb-ft)

h. Turn crankshaft by hand. If it does not turn easily, disassemble parts and determine the cause.

2. Perform Crankshaft End Play Check.

3. Perform Piston and Connecting Rod Assembly — Installation.

   Special Tools:
   • JDG1690—Piston Ring Compressor

   Consumables:
   • Connecting Rod Cap Screws, Engine Oil

4. Perfrom Oil Pick-up Tube Assembly — Installation.

   Special Tools:
   • None

   Consumables:
   • LOCTITE® 242 Thread Lock and Sealer, Engine Oil

5. Perform Oil Pan — Installation.

   Special Tools:
   • None

   Consumables:
   •LOCTITE® 5910 (PM37512) Silicone Sealant, Drain Plug O-ring, Engine Oil

6. Perform Crankshaft Rear Oil Seal Housing — Installation.

   Special Tools:
   • None

   Consumabes:
   • Cleaning Solvent, LOCTITE® 5910 (PM37512) Silicone Sealant

7. Perform Flywheel Housing — Installation.

   Special Tools:
   • None

   Consumabes:
   • LOCTITE® 242 Thread and Lock Sealant

8. Perform Flywheel — Installation.

   Special Tools:
   • JDG1571—Timing Pin

   Consumabes:
   • LOCTITE® 242 Thread Lock and Sealer (Medium Strength)

9. Perform Timing Gear Cover — Installation.

   Special Tools:
   • JDG1660—Alignment tool

   Consumabes:
   • LOCTITE® 5127 (PM38657) Silicone Sealant

10. Perform Crankshaft Pulley/Damper — Installation.

    Special Tools:
    • JDG1571—Timing Pin

    Consumabes:
    • LOCTITE® 7649 (PM37509) Clean and Cure Primer

11. Perform Coolant Pump — Installation.

    Special Tools:
    • None

    Consumabes:
    • LOCTITE® 5127 (PM38657) Silicone Sealant

12. Perform Automatic (Spring) Belt Tensioner — Installation.

    Special Tools:
    • None

    Consumabes:
    • None

13. Install fan bearing. See:

    Fan Bearing (Standard-Duty) — Installation.

    Special Tools:
    • JDG1679—Fan Bearing Remover & Installer Kit

    Consumables:
    • None

    or

    Fan Bearing (Heavy-Duty) — Installation.

    Special Tools:
    • JDG10409—Wrench Adapter

    Consumables:
    • LOCTITE® 242 Thread Lock and Sealant

14. Perform Fan Pulley — Installation.

    Special Tools:
    • None

    Consumabes:
    • None

15. Install cylinder head. See:

    Cylinder Head (4-Cylinder) — Installation or Cylinder Head (5-Cylinder) — Installation

    Special Tools:
    • None

    Consumables:
    • Head Gasket, Head Cap Screws, SAE 30W Oil

16. Perform Injection Nozzle — Installation.

Continued on next page

Special Special Tools:
• None

Consumables:
• Injection Nozzle O-Ring, Copper Sealing Washer, Petroleum Jelly, Engine Oil

17. Perform Electronic Unit Pump — Installation.

    Special Tools:
    • JDG1704—Flywheel Turning Tool

    Consumables:
    • Parker O Lube™, Engine Oil

18. Perform Electronic Unit Pump Wiring Harness — Installation.

    Special Tools:
    • None

    Consumables:
    • LOCTITE® 222 (purple), **non-nylon** tie band

19. Perform Glow Plugs — Installation.

    Special Tools:
    • None

    Consumables:
    • None

20. Perform Glow Plug Wiring Harness — Installation.

    Special Tools:
    • None

    Consumables:
    • None

21. Perform Rocker Arm Assembly — Installation.

    Special Tools:
    • None

    Consumables:
    • LOCTITE® 222 (purple), **non-nylon** tie band

22. Perform Rocker Arm Cover — Installation.

    Special Tools:
    • None

    Consumables:
    • O-rings, Rocker Arm Cover Gasket

23. Perform Fuel Filter — Installation.

    Special Tools:
    • None

    Consumables:
    • None

24. Perform Exhaust Manifold — Installation

    Special Tools:
    • None

    Consumables:
    • Exhaust Manifold Gasket

25. Perform Turbocharger — Installation.

    Special Tools:
    • None

    Consumables:
    • PT569 NEVER-SEEZ® Compound, Engine Oil

26. Perform Idler Pulley(s) with Lift Strap — Installation

    Special Tools:
    • None

    Consumables:
    • None

27. Perform Alternator — Installation.

    Special Tools:
    • None

    Consumables:
    • None

28. Perform Fan and Alternator Belt — Installation.

    Special Tools:
    • None

    Consumables:
    • None

29. Perform Engine Wiring Harness — Installation.

    Special Tools:
    • None

    Consumables:
    • None

30. Refill engine oil and engine coolant.

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NEVER-SEEZ is a registered trademark of Emhart Chemical Group.

MK41968,0000024 -19-02JUN10-3/3

Crankshaft Main Bearing Oil Clearance — Check

NOTE: The use of PLASTIGAGE ® will determine wear (crankshaft-to-bearing oil clearance) but will not determine condition of either bearing or journal surface.

1. Place a strip of PLASTIGAGE ® (A) in the center of the main bearing cap (with insert) about three-fourths of the width of the bearing or on crankshaft journal to measure oil clearance.
2. Use clean (SAE 30) oil on PLASTIGAGE ® to prevent smearing.
3. Install cap and tighten cap screws to specifications.

Specification	
Crankshaft Main Bearing Cap Screws—Torque	80 N·m (59 lb-ft)

4. Remove cap and compare width of PLASTIGAGE ® with scale provided on wrapper to determine clearance.

Specification	
Crankshaft Main Bearing-to-Journal—Oil Clearance	0.020—0.090 mm (0.0008—0.0035 in.)

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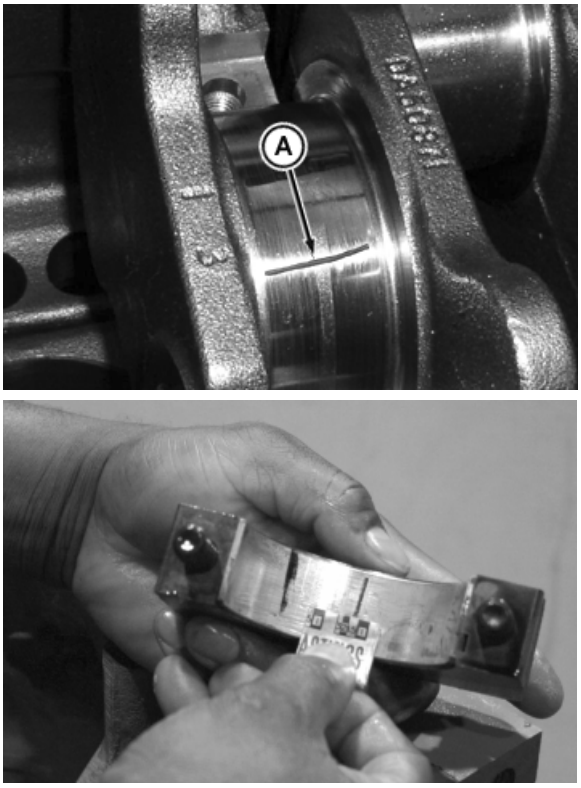


Using PLASTIGAGE

MK41968,00002FA -19-24SEP09-1/1

Flywheel — Inspection

1. Inspect the clutch contact face for scoring, overheating, or cracks. Replace or resurface flywheel if defective.
2. Examine flywheel ring gear for worn or broken teeth. Replace ring gear if defective, as described later in this group.

MK41968,00002FB -19-09SEP09-1/1

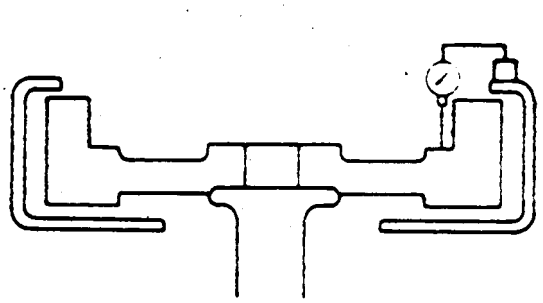
Flywheel Face — Flatness Check

1. Mount dial indicator base on flywheel housing. Position pointer to contact driving ring mounting surface. Do not allow pointer to contact driving ring mounting holes.

IMPORTANT: Maintain constant end pressure on crankshaft to hold shaft against thrust bearing when measuring flywheel face runout.

2. Rotate flywheel by turning crankshaft. Read total indicator movement. Resurface flywheel face or replace as required.

Specification	
Flywheel Face Flatness—Maximum Variation	0.23 mm (0.009 in.) 0.013 mm (0.0005 in.)



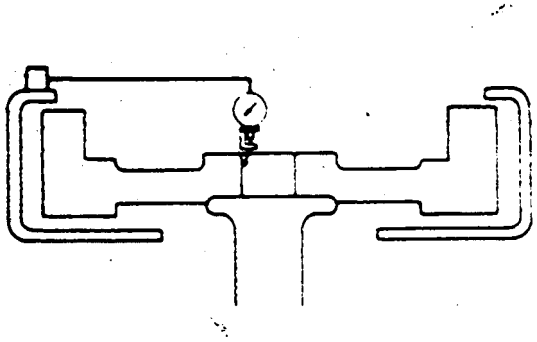
Flywheel Face Flatness Check

MK41968,00002FC -19-19NOV09-1/1

Flywheel Pilot Bearing Bore — Concentricity Check

1. Mount dial indicator on flywheel housing face and position pointer to contact ID of pilot bearing bore in flywheel.
2. Rotate flywheel by turning crankshaft. Read total dial indicator movement.

Specification	
Flywheel Bearing Bore Concentricity—Maximum Variation	0.127 mm (0.005 in.)



R22214 —UN—14DEC88

Flywheel Bearing Bore Concentricity Check

MK41968,00002FD -19-19NOV09-1/1

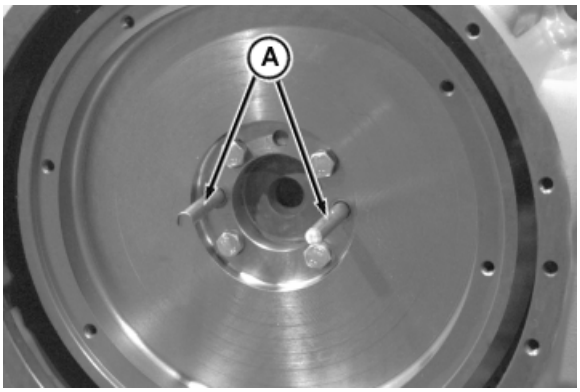
Flywheel — Removal

Special Tools:
• JDG1571—Timing Pin

CAUTION: Flywheel is heavy. Plan a proper lifting procedure to avoid personal injury.

1. Insert JDG1571 timing pin to prevent crankshaft rotation. Remove two cap screws and install guide studs (A) in their place. Remove the remaining cap screws.
2. Pry flywheel out of crankshaft.

NOTE: If flywheel to housing clearance will not allow use of a pry bar, install a punch through timing pin hole or remove starting motor and tap on flywheel face to drive from crankshaft.



RG17650 —UN—15SEP09

Flywheel Removal

A—Guide Studs

MK41968,00002FE -19-19NOV09-1/1

Flywheel — Inspection

1. Inspect the clutch contact face for scoring, overheating, or cracks. Replace or resurface flywheel if defective
2. Examine flywheel ring gear for worn or broken teeth. Replace ring gear if defective, as described later in this group. See:

Flywheel Ring Gear — Removal.

Special Tools:
• None

MK41968,000001D -19-19NOV09-1/1

Flywheel Ring Gear — Removal

CAUTION: Oil fumes or oil can ignite above 193°C (380°F). Use a thermometer and do not exceed 182°C (360°F). Do not allow a flame or heating element to be in direct contact with the oil. Heat the oil in a well ventilated area. Plan a safe handling procedure to avoid burns.

1. Perform Flywheel — Removal.

   Special Tools:
   • JDG1571—Timing Pin

2. **Flywheel Ring Gear Removal**

   Special Tools:
   • None

   a. Place the flywheel on a solid flat surface.

   b. Drive ring gear off with a brass drift (A) and hammer.

RG17632 —UN—11SEP09

Flywheel with Ring Gear

A—Brass Drift

RG19661,000000D -19-19NOV09-1/1

Flywheel Ring Gear — Installation

1. **Flywheel Ring Gear Installation**

   Special Tools:
   • None

   Consumables:
   • None

IMPORTANT: If flame heat is used, be sure gear is heated uniformly around circumference. DO NOT OVERHEAT. SEE CAUTION. Overheating may also destroy original heat treatment of gear.

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   a. Heat new ring gear to 148°C (300°F) using either heated oil, oven heat, or flame heat.

   b. Install ring gear against shoulder of flywheel.

2. Perform Flywheel — Installation.

   Special Tools:
   • JDG1571—Timing Pin

   Consumables:
   • LOCTITE® 242 Thread Lock and Sealer (Medium Strength), Flywheel Cap Screws

MK41968,000001E -19-15SEP09-1/1

Flywheel Housing — Removal

1. Perform Flywheel — Removal.

   Special Tools:
   • JDG1571—Timing Pin

2. **Flywheel Housing Removal**

   Special Tools:
   • None

   a. Remove starting motor if desired. Starting motor and flywheel housing may be removed as an assembly.

CAUTION: The flywheel housing is heavy. Plan a proper handling procedure to avoid injuries.

   b. Remove flywheel housing-to-cylinder block cap screws (A). Remove flywheel housing from block.

RG17652 —UN—17SEP09

Flywheel Housing

A—Cap Screws

RG19661,0000013 -19-17SEP09-1/1

Flywheel Housing — Installation

1. **Flywheel Housing Installation**

   Special Tools:
   • None

   Consumables:
   • None

   a. Inspect and clean cylinder block and flywheel housing and mating surfaces.

CAUTION: The flywheel housing is heavy. Plan a proper handling procedure to avoid injuries.

   b. Install flywheel housing on cylinder block and tighten cap screws (A) to specifications.

Specification

Initial Flywheel Housing
Cap Screws—Torque.....35 N•m (26 lb-ft)
Final Flywheel Housing
Cap Screws—Torque.....140 N•m (105 lb-ft)

NOTE: Some flywheel housings may use a sheet metal plate as part of the enclosure, install as necessary.

2. Perform Flywheel — Installation.

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RG17652 —UN—17SEP09

Flywheel Housing

A—Cap Screws

Special Tools:
• JDG1571—Timing Pin

Consumables:
• LOCTITE® 242 Thread Lock and Sealant (Medium Strength)

RG19661,000001F -19-01JUN10-1/1

Flywheel — Installation

Special Tools:
• JDG1571—Timing Pin

Consumables:
• LOCTITE® 242 Thread Lock and Sealer (Medium Strength), Flywheel Cap Screws

CAUTION: Flywheel is heavy. Plan a proper handling procedure to avoid injuries.

IMPORTANT: Flywheel MUST BE clean and free of any oil, grease or debris.

1. Install two guide studs (A) in crankshaft cap screw threaded holes. Place flywheel on studs and slide into position against crankshaft.

IMPORTANT: ALWAYS use new flywheel cap screws when flywheel has been removed. Inspect cap screws to insure they have sealant. If required, apply LOCTITE® 242 Thread Lock and Sealer (Medium Strength) to cap screws threads.

2. Start cap screws in crankshaft. Do not tighten until guide studs are removed and all cap screws are started. Insert JDG1571 timing pin to prevent crankshaft rotation. Tighten cap screws in a cross-shaped sequence to specifications.

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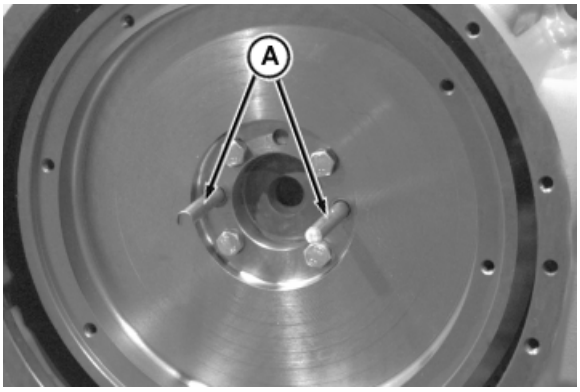


RG17650 —UN—15SEP09

Flywheel and Guide Studs

A—Guide Studs

Specification

Initial Flywheel Mounting
Cap Screws—Torque.....30 N•m (20 lb-ft)
Final Flywheel Mounting
Cap Screws—Torque.....110 N•m (80 lb-ft)

RG19661,000000E -19-15SEP09-1/1

Assembled ID of Main Bearing Caps — Measurement

1. Remove bearing inserts from caps and cylinder block. Keep inserts in correct order if they are to be reused.
2. Clean and inspect caps for damage. Small burrs or nicks on flat surfaces may be removed with a file. Use a medium-grit polishing cloth to dress curved bearing surfaces.
3. Install bearing caps (without bearings) in cylinder block. Tighten cap screws to specifications.

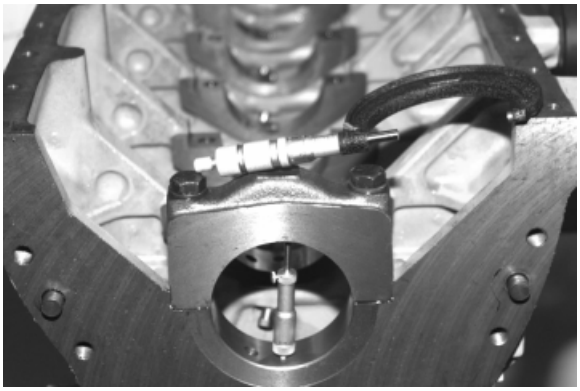
Specification	
Main Bearing Cap Screws—Torque	80 N·m (59 lb-ft)

4. Measure ID of bearing cap bores.

Specification	
Crankshaft Main Bearing Bore (Without Bearings)—ID	79.892—79.918 mm (3.1454—3.1464 in.)
Crankshaft Main Bearing Bore Centerline-to-Top Deck—Distance	274.960—275.040 mm (10.8252—10.8283 in.)

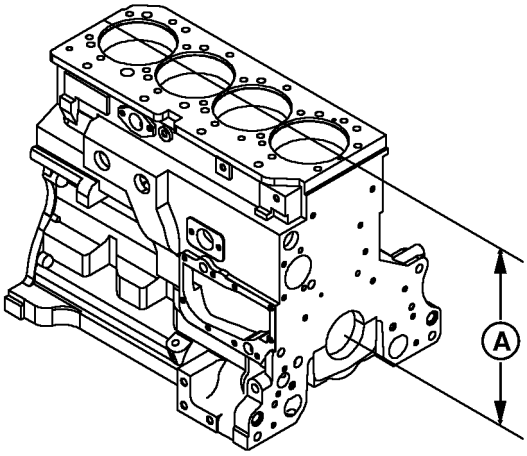
5. If bearing caps are damaged or bore is not within specification, replace cylinder block.

A—Top Deck-to-Centerline Bearing Bore



RG7537 —UN—23NOV97

Measuring Assembled Main Bearing Cap ID



RG7405 —UN—03NOV97

Cylinder Block to Crankshaft Centerline

RG19661,000001C -19-09JAN07-1/1

Essential, Recommended and Fabricated Tools For This Group

NOTE: Order tools according to information given in the U.S.SERVICEGARD™ Catalog or from the European Microfiche Tool Catalog (MTC).

- JDG1691—Balancer Shaft Bushing Service Set
- JDG1571—Timing Pin
- JDG1694—Camshaft Bushing Service Set
- JDG1678—Hydraulic Lifter Bleeddown Tool

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MK41968,000000D -19-17JUL09-1/1

Balancer Shafts — Removal (If Equipped)

1. Drain engine oil and engine coolant.
2. Perform Fan Assembly — Removal.

   Special Tools:
   • None
3. Perform Fan and Alternator Belt — Removal.

   Special Tools:
   • None
4. Perform Fan Pulley — Removal.

   Special Tools:
   • None
5. Perform fan bearing removal. See:

   Fan Bearing (Standard-Duty) — Removal.

   Special Tools:
   • JDG1679—Fan Bearing Remover & Installer Kit
   • JDG10409—Wrench Adapter

   or

   Fan Bearing (Heavy-Duty) — Removal.

   Special Tools:
   • JDG10409—Wrench Adapter
6. Remove the idler pulley below the alternator. See:

   Idler Pulley(s) with Lift Strap — Removal.

   Special Tools:
   • None
7. Perform Automatic (Spring) Belt Tensioner — Removal.

   Special Tools:
   • None
8. Perform Coolant Pump — Removal.

   Special Tools:
   • None
9. Perform Crankshaft Pulley/Damper — Removal.

   Special Tools:
   • JDG1571—Timing Pin
10. Perform Oil Pan — Removal.

    Special Tools:
    • None
11. Perform Oil Pick-up Tube Assembly — Removal.

    Special Tools:
    • None
12. Perform Timing Gear Cover — Removal.

    Special Tools:
    • None
13. **Balancer Shafts Removal**

    Special Tools:
    • None

    a. Rotate crankshaft until balancer weight cap screws point straight down into the oil pan.

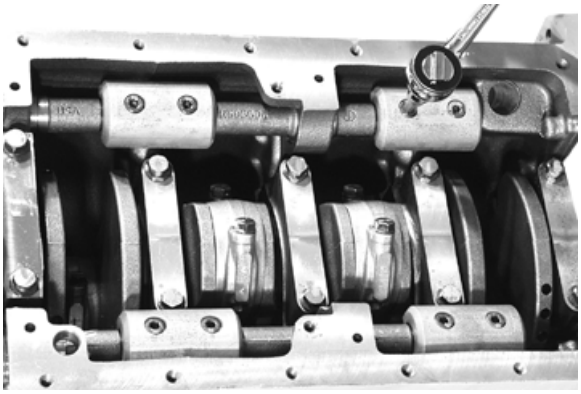
    b. Remove weights from balancer shafts.

IMPORTANT: Identify left and right balancer shafts for correct assembly. Permanently mark a letter “R” or letter “L” on the thrust plate for identification.

    c. Remove two cap screws from balancer shaft thrust plate.

NOTE: When removing balancer shafts, use caution to insure shaft journals and bushings are not damaged.

    d. Carefully remove balancer shafts.



RG13037 —UN—16JUL03

Balancer Weights Removal

RG13039 —UN—16JUL03

Balancer Shaft Removal

MK41968,0000300 -19-14APR10-1/1

Balancer Shaft Bushings and Journals — Inspection and Measurement

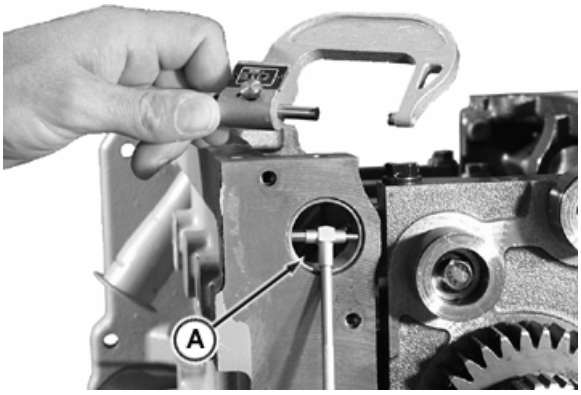
Special Tools:
• None

Consumables:
• None

1. Inspect, measure and record bushing ID (A) at all locations.
2. Measure balancer shaft journal OD (B). Difference between journal OD and bushing ID is oil clearance.

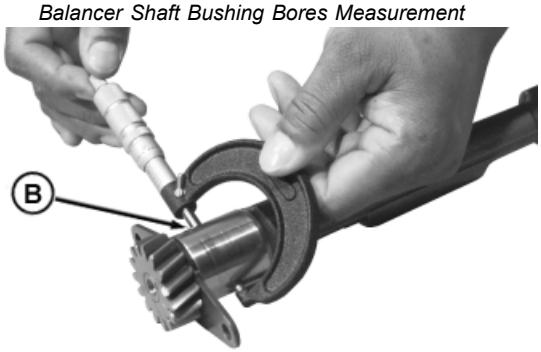
   If oil clearance is not within specification, install new bushings and, if necessary, new balancer shaft.

Specification	
Balancer Shaft Bushing (New)—ID	30.038—30.104 mm (1.1826—1.1852 in.)
Balancer Shaft Journal —OD	29.987—30.013 mm (1.1806—1.1816 in.)
Balancer Shaft Journal-to-Bushing —Oil Clearance	0.025—0.117 mm (0.0009—0.0046 in.)
Cylinder Block Bore for Balancer Shaft Bushing—ID	33.500—33.526 mm (1.3189—1.3199 in.)



RG17353 —UN—02JUL09

Balancer Shaft Bushing Bores Measurement



RG17354 —UN—02JUL09

Balancer Shaft Journal OD Measurement

A—Bushing ID **B—Journal OD**

MK41968,0000301 -19-15JUL09-1/1

Balancer Shaft Gears and Thrust Plates — Inspection

Special Tools:
• None

Consumables:
• None

1. Inspect for broken, cracked or excessively worn gears. Replace balancer shaft gear, if defects are found.
2. Inspect thrust plate (A) for scoring, excessive wear and cracks. Replace balancer shaft thrust plate, if defects are found.

Specification	
Balancer Shaft Thrust Plate (New)—End Play	Not to exceed 0.45 mm (0.02 in.)

RG17355 —UN—02JUL09

Balancer Shaft Thrust Plate

A—Thrust Plate

MK41968,0000302 -19-25AUG09-1/1

Balancer Idler Gears and Shafts — Removal (If Equipped)

1. Drain engine oil.
2. Perform Fan Assembly — Removal

   Special Tools:
   • None
3. Perform Fan and Alternator Belt — Removal.

   Special Tools:
   • None
4. Perform Fan Pulley — Removal.

   Special Tools:
   • None
5. Perform fan bearing removal. See:

   Fan Bearing (Standard-Duty) — Removal.

   Special Tools:
   • JDG1679—Fan Bearing Remover & Installer Kit
   • JDG10409—Wrench Adapter

   or

   Fan Bearing (Heavy-Duty) — Removal.

   Special Tools:
   • JDG10409—Wrench Adapter
6. Remove the idler pulley below the alternator. See:

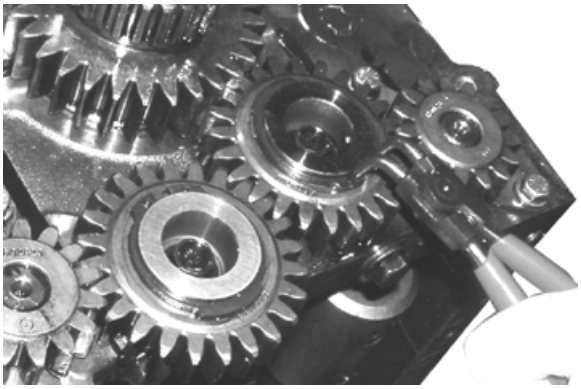
   Idler Pulley(s) with Lift Strap — Removal.

   Special Tools:
   • None
7. Perform Automatic (Spring) Belt Tensioner — Removal.

   Special Tools:
   • None
8. Perform Coolant Pump — Removal.

   Special Tools:
   • None
9. Perform Crankshaft Pulley/Damper — Removal.

   Special Tools:
   • JDG1571—Timing Pin
10. Perform Oil Pan — Removal.



RG13038 —UN—16JUL03

Balancer Idler Gear Removal

RG17356 —UN—02JUL09

Balancer Idler Gear

   Special Tools:
   • None
11. Perform Oil Pick-up Tube Assembly — Removal.

    Special Tools:
    • None
12. Perfrom Timing Gear Cover — Removal.

    Special Tools:
    • None
13. **Balancer Idler Gears and Shafts Removal**

    a. Remove snap ring, idler gear and shaft.

    b. Perform Balancer Idler Gears and Shafts — Inspection (If Equipped).
    Special Tools:
    • None
    Consumables
    • None

MK41968,0000303 -19-14APR10-1/1

Balancer Idler Gears and Shafts — Inspection (If Equipped)

Special Tools:
• None

Consumables:
• LOCTITE® 242

1. Inspect the idler gear for worn bushings, chipped or cracked gear teeth and worn or scored idler shafts.
2. If the idler gear shaft does not meet specifications, remove from the main bearing cap. Idler shaft cap screw may be reused if the screw and main bearing cap threads are free of oil and debris.

Specification

Idler Gear Shaft—OD.....38.517—38.543 mm (1.5164—1.5174 in.)

3. Install new idler shaft, apply LOCTITE ® 242 to cap screw and tighten to specification.

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RG17356 —UN—02JUL09

Balancer Idler Gear

Specification

Idler Shaft Cap Screw—Torque.....40 N•m (30 lb-ft)

MK41968,0000304 -19-25AUG09-1/1

Balancer Idler Gear Bushing and Shaft — Measurement (If Equipped)

Special Tools:
• None

Consumables:
• None

Measure idler gear bushing ID and shaft OD to determine oil clearance. Replace worn parts if measurements exceed specifications.

Specification

Idler Gear Bushing—ID.....38.586—38.662 mm (1.5191—1.5221 in.)
Idler Gear Shaft —OD.....38.517—38.543 mm (1.5164—1.5174 in.)

MK41968,0000305 -19-25AUG09-1/1

Balancer Idler Gears and Shafts — Installation (If Equipped)

1. **Balancer Idler Gears and Shafts Installation**

   Special Tools:
   • None

   Consumables:
   • LOCTITE ® 242, TY6333 High-Temperature Grease

   a. Remove snap ring.

   b. Remove idler gears and inspect for worn bushings, chipped or cracked gear teeth and worn or scored idler shafts.

   c. If the idler gear shaft does not meet specifications, remove from the main bearing cap. Idler shaft cap screw may be reused if the screw and main bearing cap threads are free of oil and debris. Install new idler shaft, apply LOCTITE® 242 to cap screw and tighten to specification.

Specification

Idler Shaft Cap Screw—Torque	40 N·m (30 lb-ft)

   d. Apply TY6333 High-Temperature Grease to the idler shaft, install idler gear on the balancer idler shaft and install snap ring.

2. Perform Timing Gear Cover — Installation.

   Special Tools:
   • JDG1660—Alignment tool.

   Consumables:
   • LOCTITE® 5127 (PM38657) silicone sealant

3. Perform Oil Pick-up Tube Assembly — Installation.

   Special Tools:
   • None

   Consumables:
   • LOCTITE® 242, Engine Oil

4. Perform Oil Pan — Installation.

   Special Tools:
   • None

   Consumables:
   • LOCTITE® 5900 (PM37512) , Drain Plug O-ring, Engine Oil

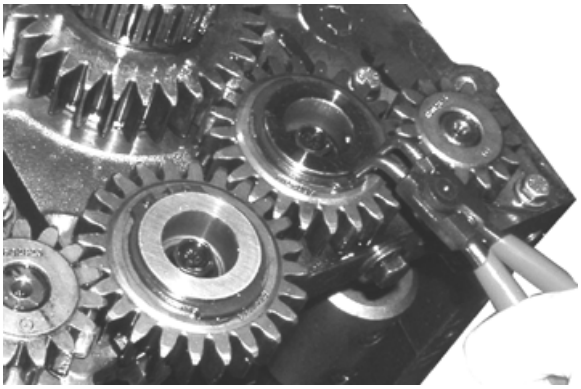
5. Perform Crankshaft Pulley/Damper — Installation.

   Special Tools:
   • JDG1571—Timing Pin

   Consumables:
   • None

6. Perform Coolant Pump — Installation.

   Special Tools:
   • None



RG13038 —UN—16JUL03

Balancer Idler Gear Removal

RG17356 —UN—02JUL09

Balancer Idler Gear

   Consumables:
   • Cleaning Solvent, LOCTITE® 5127 (PM38657) silicone sealant

7. Perform Automatic (Spring) Belt Tensioner — Installation.

   Special Tools:
   • None

   Consumables:
   • None

8. Install the idler pulley below the alternator. See:

   Idler Pulley(s) with Lift Strap — Installation.

   Special Tools:
   • None

   Consumables:
   • None

9. Perform fan bearing installation. See:

   Fan Bearing (Standard-Duty) — Installation.

   Special Tools:
   • JDG1679—Fan Bearing Remover & Installer Kit

   Consumables:
   • None

   or

   Fan Bearing (Heavy-Duty) — Installation.

Continued on next page

MK41968,0000306 -19-11DEC09-1/2

Special Tools:
• JDG10409—Wrench Adapter

Consumables:
• LOCTITE® 242 Thread Lock and Sealant

10. Perform Fan Pulley — Installation.

    Special Tools:
    • None

    Consumables:
    • None

11. Perform Fan and Alternator Belt — Installation.

    Special Tools:
    • None

    Consumables:
    • None

12. Perform Fan Assembly — Installation.

    Special Tools:
    • None

    Consumables:
    • None

13. Refill engine oil.

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MK41968,0000306 -19-11DEC09-2/2

Balancer Bushings — Removal

1. Drain engine oil and engine coolant.
2. Perform Fan Assembly — Removal

   Special Tools:
   • None
3. Perform Fan and Alternator Belt — Removal.

   Special Tools:
   • None
4. Perform Fan Pulley — Removal.

   Special Tools:
   • None
5. Perform fan bearing removal. See:

   Fan Bearing (Standard-Duty) — Removal.

   Special Tools:
   • JDG1679—Fan Bearing Remover & Installer Kit
   • JDG10409—Wrench Adapter

   or

   Fan Bearing (Heavy-Duty) — Removal.

   Special Tools:
   • JDG10409—Wrench Adapter
6. Remove the idler pulley below the alternator. See:

   Idler Pulley(s) with Lift Strap — Removal.

   Special Tools:
   • None
7. Perform Automatic (Spring) Belt Tensioner — Removal.

   Special Tools:
   • None
8. Perform Coolant Pump — Removal

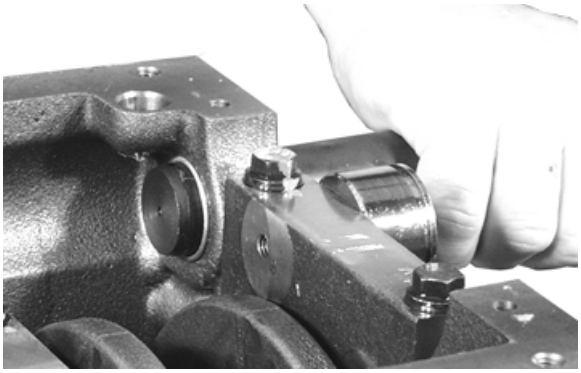
   Special Tools:
   • None
9. Perform Crankshaft Pulley/Damper — Removal.

   Special Tools:
   • JDG1571—Timing Pin
10. Perform Oil Pan — Removal.

    Special Tools:
    • None
11. Perform Oil Pick-up Tube Assembly — Removal.

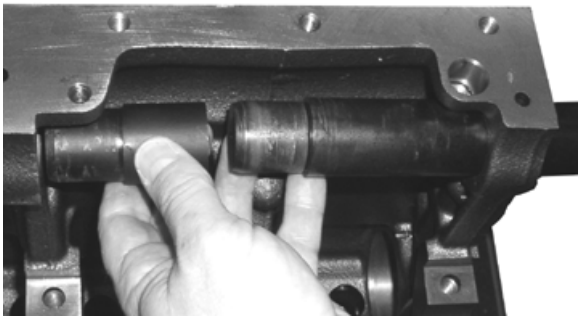
    Special Tools:
    • None
12. Perfrom Timing Gear Cover — Removal.

    Special Tools:
    • None



RG13040 —UN—16JUL03

Front Balancer Shaft Bushing Removal



RG13043 —UN—16JUL03

Rear Balancer Bushing Driver Extension

RG13042 —UN—16JUL03

Rear Balancer Bushing Removal

13. Perform Balancer Shafts — Removal (If Eqipped).

    Special Tools:
    • None
14. **Balancer Bushings Removal**

    Special Tools:
    • JDG1691—Balancer Shaft Bushing Service Set

    a. Using JDG1691-3 Driver, remove the front balancer shaft bushing from the cylinder block.

    b. Remove bushing from driver and place JDG1691-2 Driver Extension on JDG1691-3 Driver.

    c. Remove the rear balancer bushing with JDG1691-3 Driver and JDG1691-2 Driver Extension.

MK41968,0000307 -19-01JUN10-1/1

Balancer Bushings — Installation

IMPORTANT: On balancer shaft equipped engines, make sure oil holes in bushing and block are aligned for proper bushing and journal lubrication.

1. **Balancer Bushings Installation**

   Special Tools:
   • JDG1691—Balancer Shaft Bushing Service Set

   Consumables:
   • None

   a. Lubricate rear balancer bushing with clean engine oil and install with JDG1691-3 Driver until the tool shoulder hits the front face of the cylinder block.

   b. Lubricate the front balancer bushing with clean engine oil and install with JDG1691-1 Driver until the tool shoulder hits the front face of the cylinder block.

   c. Inspect bushings to insure oil holes are in alignment.

2. Perform Balancer Shafts — Installation (If Equipped).

   Special Tools:
   • None

   Consumables:
   • None

3. Perform Timing Gear Cover — Installation.

   Special Tools:
   • JDG1660—Alignment tool.

   Consumables:
   • LOCTITE® 5127 (PM38657) silicone sealant

4. Perform Oil Pick-up Tube Assembly — Installation.

   Special Tools:
   • None

   Consumables:
   • LOCTITE® 242, Engine Oil

5. Perform Oil Pan — Installation.

   Special Tools:
   • None

   Consumables:
   • LOCTITE® 5900 (PM37512) , Drain Plug O-ring, Engine Oil

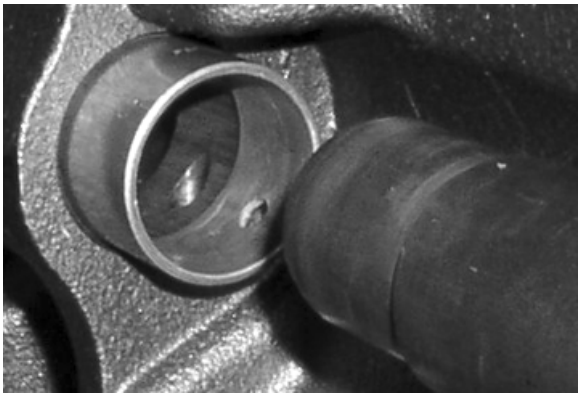
6. Perform Crankshaft Pulley/Damper — Installation.

   Special Tools:
   • JDG1571—Timing Pin

   Consumables:
   • None

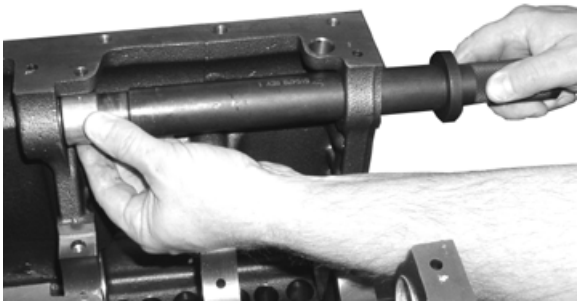
7. Perform Coolant Pump — Installation.

   Special Tools:
   • None



RG13046 —UN—16JUL03

Oil Supply Holes Alignment



RG13044 —UN—16JUL03

Rear Balancer Shaft Bushing Installation

   Consumables:
   • Cleaning Solvent, LOCTITE® 5127 (PM38657) silicone sealant

8. Perform Automatic (Spring) Belt Tensioner — Installation.

   Special Tools:
   • None

   Consumables:
   • None

9. Install the idler pulley below the alternator. See:

   Idler Pulley(s) with Lift Strap — Installation.

   Special Tools:
   • None

   Consumables:
   • None

10. Perfrom fan bearing installation. See:

    Fan Bearing (Standard-Duty) — Installation.

    Special Tools:
    • JDG1679—Fan Bearing Remover & Installer Kit

    Consumables:
    • None

    or

    Fan Bearing (Heavy-Duty) — Installation.

Continued on next page

MK41968,0000308 -19-27AUG09-1/2

Special Tools:
• JDG10409—Wrench Adapter

Consumables:
• LOCTITE® 242 Thread Lock and Sealant

11. Perform Fan Pulley — Installation.

Special Tools:
• None

Consumables:
• None

12. Perform Fan and Alternator Belt — Installation.

Special Tools:
• None

Consumables:
• None

13. Perform Fan Assembly — Installation.

Special Tools:
• None

Consumables:
• None

14. Refill engine oil.

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MK41968,0000308 -19-27AUG09-2/2

Balancer Shafts — Installation (If Equipped)

1. **Balancer Shafts Installation (If Equipped)**

   Special Tools:
   • JDG1571—Timing Pin

   Consumables:
   • TY6333 High-Temperature Grease

   a. Using JDG1571 Timing Pin, lock No. 1 piston at TDC compression stroke.

   b. Lubricate balancer shaft bushings and journals with TY6333 High-Temperature Grease.

NOTE: When installing balancer shafts, use caution to insure shaft journals and bushings are not damaged.

IMPORTANT: The counterbore cap screw holes for the balancer weights should be orientated directly down in to the oil pan with the crankshaft at the TDC position.

   c. Install balancer shafts assemblies by engaging the balancer gear with the idler gear.

   d. Tighten thrust plate cap screws to specifications.

Specification	
Balancer Shaft Thrust Plate Cap Screws—Torque	16 N·m (12 lb-ft)

   e. Install balancer weights and tighten cap screws to specifications.

Specification	
Balancer Shaft Weight Cap Screws—Torque	33 N·m (25 lb-ft)

2. Perform Timing Gear Cover — Installation.

   Special Tools:
   • JDG1660—Alignment tool.

   Consumables:
   • LOCTITE® 5127 (PM38657) silicone sealant

3. Perform Oil Pick-up Tube Assembly — Installation.

   Special Tools:
   • None

   Consumables:
   • LOCTITE® 242, Engine Oil

4. Perform Oil Pan — Installation.

   Special Tools:
   • None

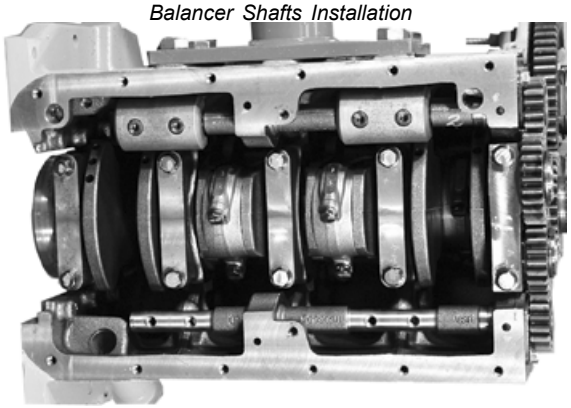
   Consumables:
   • LOCTITE® 5900 (PM37512) , Drain Plug O-ring, Engine Oil

5. Perform Crankshaft Pulley/Damper — Installation.

   Special Tools:
   • JDG1571—Timing Pin

RG13039 —UN—16JUL03

Balancer Shafts Installation



RG13625 —UN—16APR04

Balancer Weights Orientation

   Consumables:
   • None

6. Perform Coolant Pump — Installation.

   Special Tools:
   • None

   Consumables:
   • Cleaning Solvent, LOCTITE® 5127 (PM38657) silicone sealant

7. Perform Automatic (Spring) Belt Tensioner — Installation.

   Special Tools:
   • None

   Consumables:
   • None

8. Install the idler pulley below the alternator. See:

   Idler Pulley(s) with Lift Strap — Installation.

   Special Tools:
   • None

   Consumables:
   • None

9. Perform fan bearing installation. See:

   Fan Bearing (Standard-Duty) — Installation.

   Special Tools:
   • JDG1679—Fan Bearing Remover & Installer Kit

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Consumables:
• None

or

Fan Bearing (Heavy-Duty) — Installation.

Special Tools:
• JDG10409—Wrench Adapter

Consumables:
• LOCTITE® 242 Thread Lock and Sealant

10. Perform Fan Pulley — Installation.

    Special Tools:
    • None

    Consumables:
    • None

11. Perform Fan and Alternator Belt — Installation.

    Special Tools:
    • None

    Consumables:
    • None

12. Perform Fan Assembly — Installation.

    Special Tools:
    • None

    Consumables:
    • None

13. Refill engine oil.

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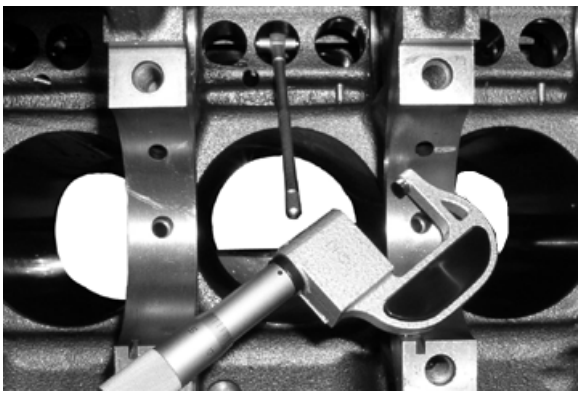
MK41968,0000309 -19-27AUG09-2/2

Camshaft Follower Machined Bore Measurement

Measure camshaft follower bore diameter at all bore locations.

Specification	
Camshaft Follower Bore in Block—ID	21.428—21.454 mm (0.8436—0.8446 in.)
Camshaft Follower (New)—OD	21.392—21.404 mm (0.8422—0.8427 in.)

If any one camshaft follower bore ID and follower-to-bore clearance exceeds specified maximum, install a new cylinder block.



RG12675 —UN—12DEC02

Camshaft Follower Bore Measurement

MK41968,000030A -19-29SEP09-1/1

Camshaft Bushing Bores in Block Measurement

Replaceable bushings (A) are installed in all camshaft bores with the exception of the front camshaft bore.

1. Visually inspect and measure camshaft bushing ID. If bushing is worn or not within specification, install new bushings. See:

   Camshaft Bushings — Installation.

   Special Tools:
   • JDG1691—Balancer Shaft Bushing Service Set

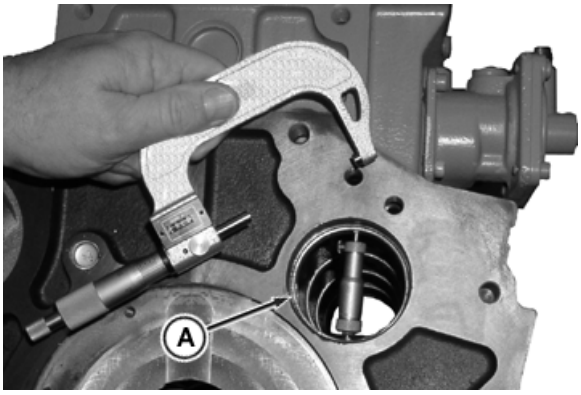
   Consumables:
   • None

2. If necessary to replace bushing, remove bushing and measure bore diameter in block. If bushing bore (B) in block is not within specification, repair or replace cylinder block as required.

3. Measure remaining camshaft bores in block and compare with specification given. Replace cylinder block as needed.

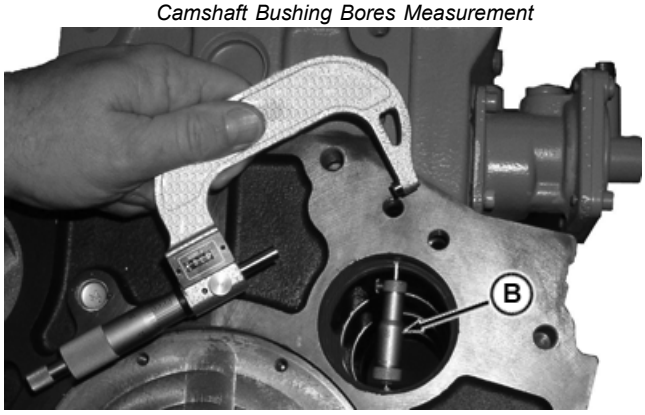
Specification

Camshaft Bore In Block (With Bushing)—ID	60.05 - 60.102 mm (2.364 - 2.366 in.)
Camshaft Journal-to-Bushing—Oil—Clearance	0.037 - 0.115 mm (0.001 - 0.004 in.)



RG17950 —UN—10DEC09

Camshaft Bushing Bores Measurement



RG17951 —UN—10DEC09

Camshaft Bores Measurement

MK41968,000030B -19-01JUN10-1/1

Camshaft — Removal

1. Drain engine oil from crankcase
2. Drain coolant from cooling system.
3. Perform Fan Assembly — Removal.

   Special Tools:
   • None
4. Perform Engine Wiring Harness — Removal.

   Special Tools:
   • None
5. Perform Rocker Arm Cover — Removal.

   Special Tools:
   • None
6. Perform Rocker Arm Assembly — Removal.

   Special Tools:
   • JDG1678—Hydraulic Lifter Bleed-down Tool
7. Remove wiring leads from each unit pump terminal. See:

   Electronic Unit Pump Wiring Harness — Removal.

   Special Tools:
   • None
8. Perform Electronic Unit Pump — Removal.

   Special Tools:
   • JDG1704—Flywheel Turning Tool
9. Perform Fan and Alternator Belt — Removal.

   Special Tools:
   • None
10. Perform Fan Pulley — Removal.

    Special Tools:
    • None
11. Perform fan bearing removal. See:

    Fan Bearing (Standard-Duty) — Removal.

    Special Tools:
    • JDG1679—Fan Bearing Remover & Installer Kit
    • JDG10409—Wrench Adapter

    or

    Fan Bearing (Heavy-Duty) — Removal.

    Special Tools:
    • JDG10409—Wrench Adapter
12. Remove the idler pulley below the alternator. See:

    Idler Pulley(s) with Lift Strap — Removal.

    Special Tools:
    • None
13. Perform Automatic (Spring) Belt Tensioner — Removal.

    Special Tools:
    • None
14. Perform Coolant Pump — Removal.

    Special Tools:
    • None
15. Perform Crankshaft Pulley/Damper — Removal.

    Special Tools:
    • JDG1571—Timing Pin
16. Perform Oil Pan — Removal.

    Special Tools:
    • None
17. Perform Oil Pick-up Tube Assembly — Removal.

    Special Tools:
    • None
18. Perform Timing Gear Cover — Removal.

    Special Tools:
    • None
19. Perform Oil Pump — Removal.

    Special Tools:
    • None
20. Perform Camshaft Gear and Timing Wheel — Removal.

    Special Tools:
    • JDG1571—Timing Pin
21. **Camshaft Removal**

    Special Tools:
    • None

    a. Remove two special screws (A) holding the front camshaft bearing assembly in place.

IMPORTANT: DO NOT allow camshaft lobes to drag in bushing or honed bores by rotating camshaft.

    b. Carefully remove camshaft with front bearing assembly from cylinder block.

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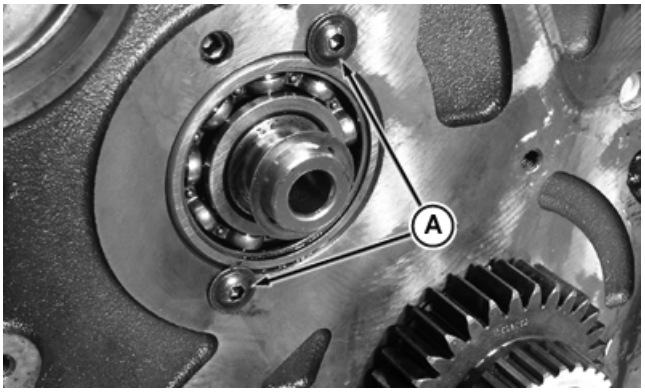


Camshaft Bearing Retaining Screws

MK41968,000030C -19-14APR10-2/2

Camshaft — Inspection

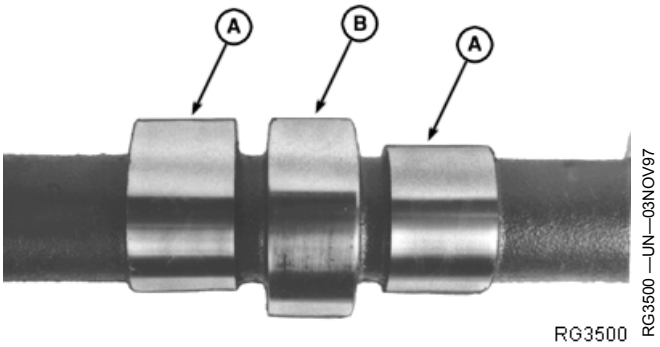
Special Tools
• None

Consumables:
• Cleaning Solvent

1. Clean camshaft in solvent. Dry with compressed air.
2. Inspect all camshaft lobes (A) and journals (B) for wear or damage. Replace camshaft, if required.
3. Inspect camshaft gear for broken, cracked or excessively worn teeth. Replace camshaft, if required.

IMPORTANT: New camshaft followers can be used with old camshaft. DO NOT reuse old camshaft followers with a new camshaft.

NOTE: Very light score marks are acceptable if valve lift is within specification. If pitting or galling exists, replace camshaft.



Camshaft Lobe Inspection

A—Lobes **B—Journal**

MK41968,000030D -19-25AUG09-1/1

Camshaft Bushing ID and Journal OD — Inspection and Measurement

Special Tools
• None

Consumables:
• None

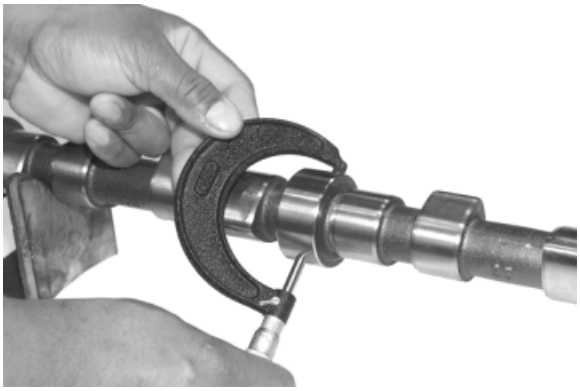
All engine camshafts have a replaceable bushing installed in No. 1 (front) camshaft bore.

1. Measure camshaft journals. If a camshaft journal is damaged or does not meet specification, install a new camshaft.
2. Measure camshaft bushing ID and remaining bores in cylinder block. If camshaft bore is damaged or is not within specification, have a qualified machine shop install new bushings.

   If No. 1 camshaft bushing ID does not meet specifications, replace camshaft bushing.

Camshaft Bearing Bores and Journals—Specification

Camshaft Journals—OD	59.987—60.013 mm (2.3617—2.3627 in.)



Camshaft Journal OD Measurement

Camshaft Journal, Front No. 1 (Ball Bearing)—OD	35.004—35.020 mm (2.2031—2.2042 in.)
Camshaft Bushings—ID	60.051—60.127 mm (2.3642—2.3672 in.)
Camshaft Journal-to-Bushing—Oil Clearance	0.038—0.140 mm (0.0015—0.0055 in.)

MK41968,000030E -19-31AUG09-1/1

Camshaft Bushings — Removal

Remove Camshaft Bushings

1. Drain engine oil from crankcase
2. Drain coolant from cooling system.
3. Perform Fan Assembly — Removal.

   Special Tools:
   • None
4. Perform Engine Wiring Harness — Removal.

   Special Tools:
   • None
5. Perform Rocker Arm Cover — Removal.

   Special Tools:
   • None
6. Perform Rocker Arm Assembly — Removal.

   Special Tools:
   • JDG1678—Hydraulic Lifter Bleed-down Tool
7. Remove wiring leads from each unit pump terminal. See:

   Electronic Unit Pump Wiring Harness — Removal.

   Special Tools:
   • None
8. Perform Electronic Unit Pump — Removal.

   Special Tools:
   • JDG1704—Flywheel Turning Tool
9. Perform Fan and Alternator Belt — Removal.

   Special Tools:
   • None
10. Perform Fan Pulley — Removal.

    Special Tools:
    • None
11. Perform fan bearing removal. See:

    Fan Bearing (Standard-Duty) — Removal.

    Special Tools:
    • JDG1679—Fan Bearing Remover & Installer Kit
    • JDG10409—Wrench Adapter

    or

    Fan Bearing (Heavy-Duty) — Removal.

    Special Tools:
    • JDG10409—Wrench Adapter
12. Remove the idler pulley below the alternator. See:

    Idler Pulley(s) with Lift Strap — Removal.

    Special Tools:
    • None
13. Perform Automatic (Spring) Belt Tensioner — Removal.

    Special Tools:
    • None
14. Perform Coolant Pump — Removal.

    Special Tools:
    • None
15. Perform Crankshaft Pulley/Damper — Removal.

    Special Tools:
    • JDG1571—Timing Pin
16. Perform Oil Pan — Removal.

    Special Tools:
    • None
17. Perform Oil Pick-up Tube Assembly — Removal.

    Special Tools:
    • None
18. Perform Timing Gear Cover — Removal.

    Special Tools:
    • None
19. Perform Oil Pump — Removal.

    Special Tools:
    • None
20. Perform Camshaft Gear and Timing Wheel — Removal.

    Special Tools:
    • JDG1571—Timing Pin
21. Perform Camshaft — Removal

    Special Tools:
    • None
22. **Camshaft Bushings Removal**

    Special Tools:
    • JDG1694—Camshaft Bushing Service Set

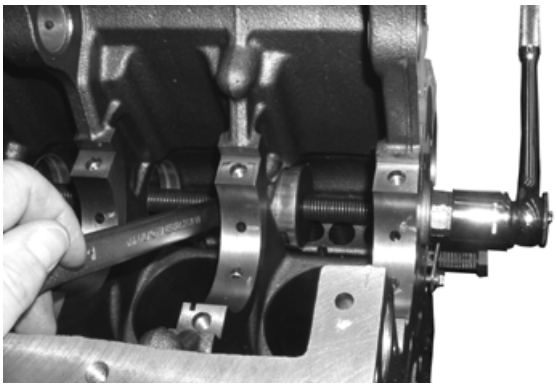
Continued on next page

IMPORTANT: Block must be replaced if camshaft bore is damaged. Be careful when removing or installing bushing. Cylinder block bore may be damaged if puller is not properly piloted in bushing. Be sure puller is properly piloted before pulling bushing.

a. Using JDG1694 Cam Bushing tools, insert 313793 Forcing Screw through JDG1694-3 Front Guide Bushing and first bearing.

b. Install JDG1694-2 Installer, washer and hex nut. Tighten hex nut until bushing is free of block bore. Remove puller and discard bushing.

c. Repeat procedure for the remaining bearings, moving the tool from bore-to-bore. JDG1694-2 Rear Guide can be used to remove the last bearing.



RG13562 —UN—25FEB04

Camshaft Bushings Removal

d. Clean and inspect bores in cylinder block. If bore is damaged, replace cylinder block.

Continued on next page

MK41968,000030F -19-14APR10-2/3

Camshaft Bushings — Installation

1. **Camshaft Bushings Installation**

   Special Tools
   • JDG1694—Camshaft Bushing Service Set

   Consumables:
   • TY6333 High-Temperature Grease

IMPORTANT: Bushings must be installed so oil supply hole in bushing aligns with oil drilling in block bore.

   a. Mark orientation of oil supply hole on front face of block and on bushing to help with bushing alignment during installation.

   b. Apply TY6333 High-Temperature Grease to ID and OD of new bushing and to ID of bushing bore. Slide bushing onto JDG1694 Bushing Installer so notched end of bushing will be toward front end of engine when installed.

   c. Thread JDG1694 Bushing Installer on 313793 Forcing Screw. With bushing started, square in bore and oil hole aligned, tighten nut until flange of bushing driver bottoms against face of block.

   d. Remove bushing tool and forcing screw from cylinder block and check oil supply hole for correct alignment. If holes are not aligned, remove and discard bushing. Install a new bushing.

   e. Repeat for remaining bushings, and insure that oil supply holes are aligned.

2. Perform Camshaft — Installation.

   Special Tools:
   • None

   Consumables:
   • LOCTITE® 242 Thread Lock and Sealant, LOCTITE® 609 Joint Sealing Compound, TY6333 High-Temperature Grease

3. Perform Camshaft Gear and Timing Wheel — Installation.

   Special Tools:
   • None

   Consumables:
   • None

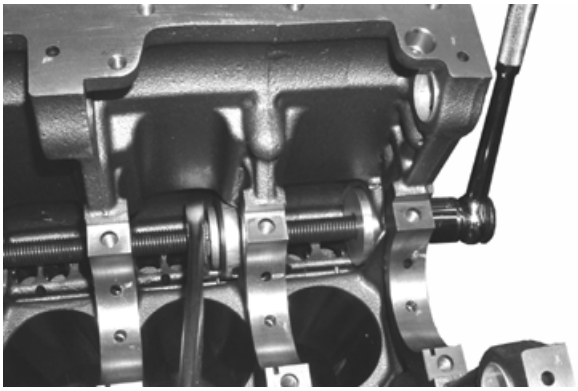
4. Perform Oil Pump — Installation.

   Special Tools:
   • None

   Consumables:
   • LOCTITE® 242 Thread Lock and Sealant

5. Perform Timing Gear Cover — Installation.

   Special Tools:
   • JDG1660—Alignment tool.



Cam Bushings Installation

   Consumables:
   • LOCTITE® 5127 (PM38657) Silicone Sealant, LOCTITE® 242 Thread Lock and Sealant

6. Perform Oil Pick-up Tube Assembly — Installation.

   Special Tools:
   • None

   Consumables:
   • LOCTITE® 242 Thread Lock and Sealant, Engine Oil

7. Perform Oil Pan — Installation.

   Special Tools:
   • None

   Consumables:
   • LOCTITE® 5900 (PM37512) , Drain Plug O-ring, Engine Oil

8. Perform Crankshaft Pulley/Damper — Installation.

   Special Tools:
   • JDG1571—Timing Pin

   Consumables:
   • None

9. Perform Coolant Pump — Installation.

   Special Tools:
   • None

   Consumables:
   • Cleaning Solvent, LOCTITE® 5127 (PM38657)

10. Perform Automatic (Spring) Belt Tensioner — Installation.

    Special Tools:
    • None

    Consumables:
    • None

11. Install the idler pulley below the alternator. See:

    Idler Pulley(s) with Lift Strap — Installation.

    Special Tools:
    • None

Continued on next page

Consumables:
• None

12. Perform fan bearing installation. See:

    Fan Bearing (Standard-Duty) — Installation.

    Special Tools:
    • JDG1679—Fan Bearing Remover & Installer Kit

    Consumables:
    • None

    or

    Fan Bearing (Heavy-Duty) — Installation.

    Special Tools:
    • JDG10409—Wrench Adapter

    Consumables:
    • LOCTITE® 242 Thread Lock and Sealant

13. Perform Fan Pulley — Installation.

    Special Tools:
    • None

    Consumables:
    • None

14. Perform Fan and Alternator Belt — Installation.

    Special Tools:
    • None

    Consumables:
    • None

15. Perform Electronic Unit Pump — Installation.

    Special Tools:
    • JDG1704—Flywheel Turning Tool

    Consumables:
    • Parker O Lube™, Engine Oil

16. Connect wiring harness ring terminals to the unit pumps. See:

    Electronic Unit Pump Wiring Harness — Installation.

    Special Tools:
    • None

    Consumables:
    • LOCTITE® 222 (purple), **non-nylon** tie band

17. Perform Rocker Arm Assembly — Installation.

    Special Tools:
    • JDG1678—Hydraulic Lifter Bleed Down Tool

    Consumables:
    • TY6333 High-Temperature Grease, LOCTITE® 242 Thread Lock and Sealant, Engine Oil

18. Perform Rocker Arm Cover — Installation.

    Special Tools:
    • None

    Consumables:
    • O-rings, Rocker Arm Cover Gasket, LOCTITE® 5900 (PM37512)

19. Perform Engine Wiring Harness — Installation.

    Special Tools:
    • None

    Consumables:
    • None

20. Perform Fan Assembly — Installation.

    Special Tools:
    • None

    Consumables:
    • None

21. Refill engine coolant in cooling system.

22. Refill engine oil in the crankcase.

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MK41968,0000310 -19-14APR10-2/2

Camshaft Lobe Height — Measurement

Special Tools:
• None

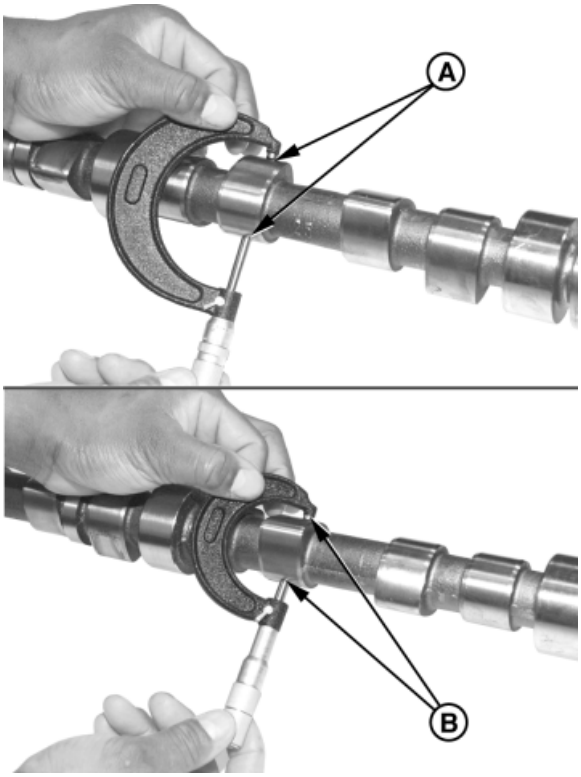
Consumables:
• None

1. Measure each camshaft lobe at highest point (A) and at narrowest point (B). The difference between these dimensions is camshaft lobe height. If height is not within specification on any lobe, install a new camshaft.

Specification	
Camshaft Intake Lobe—Height	7.05—7.31 mm (0.278—0.288 in.)
Camshaft Exhaust Lobe—Height	6.89—7.15 mm (0.271—0.281 in.)

2. Measure fuel supply pump camshaft lobe diameter. If diameter is not within specification or lobe surface is grooved, install a new camshaft.

Specification	
Fuel Supply Pump Camshaft Lobe —Diameter	42.67—42.93 mm (1.68—1.69 in.)



Camshaft Lobe Height Measurement

A—High Point **B—Narrow Point**

MK41968,0000311 -19-31AUG09-1/1

Camshaft Followers — Inspection

Special Tools:
• JDG1678—Hydraulic Lifter Bleed-down Tool

Consumables:
• None

1. Inspect followers for uneven wear or damage. Also inspect corresponding camshaft lobe for wear or damage. Replace as necessary.
2. Remove oil from followers using JDG1678 Hydraulic Lifter Bleed-down Tool. Insure the push rod seat will compress smoothly without binding.
3. Measure follower OD and follower bore ID in cylinder block.

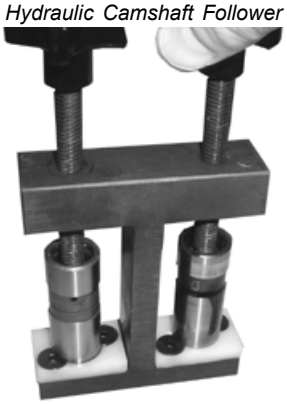
Specification	
Camshaft Follower—OD	21.387—21.405 mm (0.8420—0.8427 in.)
Camshaft Follower Bore—ID	21.428—21.454 mm (0.8436—0.8446 in.)
Camshaft Follower-to-Bore—Clearance	0.023—0.067 mm (0.0009—0.0026 in.)

Replace camshaft followers that are not within specification.

Replace cylinder block if any one camshaft follower bore is not within specification.

RG13048 —UN—22JUL03

Hydraulic Camshaft Follower



RG12858 —UN—08MAY03

JDG1678 Hydraulic Bleed-Down Tool

MK41968,0000312 -19-31AUG09-1/1

Camshaft — Installation

1. **Camshaft Installation**

   Special Tools:
   • None

   Consumables:
   • LOCTITE® 242 Thread Lock and Sealant, LOCTITE® 609 Joint Sealing Compound, TY6333 High-Temperature Grease

   a. Lubricate camshaft bearing journals, lobes, and followers with TY6333 High-Temperature Grease.

IMPORTANT: DO NOT allow camshaft lobes to drag on camshaft bore or bushing surfaces while installing camshaft. Bearing surfaces may become scratched or scored. Rotate camshaft during installation to avoid obstruction in any bore.

   b. Install camshaft and bearing assembly in cylinder block. Insure bearing is seated completely in the cylinder block.

   c. Apply LOCTITE® 242 Thread Lock and Sealant to special camshaft retaining screws and tighten to specifications.

Specification	
Camshaft Retaining Screws—Torque	15 N·m (11 lb-ft)

   d. Apply LOCTITE® 609 Joint Sealing Compound to cup plug and install in the cylinder block rear flange.

2. Perform Camshaft Gear and Timing Wheel — Installation.

   Special Tools:
   • None

   Consumables:
   • None

3. Perform Oil Pump — Installation.

   Special Tools:
   • None

   Consumables:
   • LOCTITE® 242 Thread Lock and Sealant

4. Perform Timing Gear Cover — Installation.

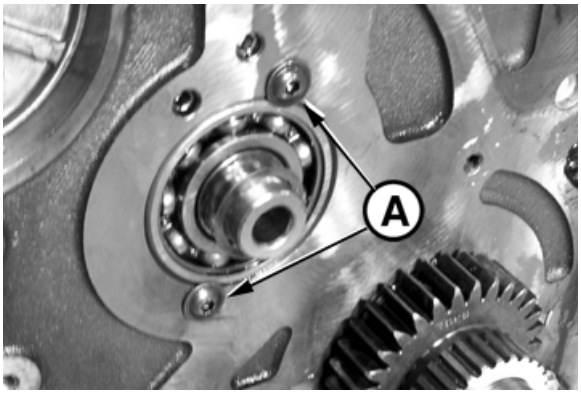
   Special Tools:
   • JDG1660—Alignment tool.

   Consumables:
   • LOCTITE® 5127 (PM38657) Silicone Sealant, LOCTITE® 242 Thread Lock and Sealant

5. Perform Oil Pick-up Tube Assembly — Installation.

   Special Tools:
   • None

   Consumables:
   • LOCTITE® 242 Thread Lock and Sealant, Engine Oil



RG13051 —UN—23JUL03

Camshaft Bearing Retaining Screws

6. Perform Oil Pan — Installation.

   Special Tools:
   • None

   Consumables:
   • LOCTITE® 5900 (PM37512) , Drain Plug O-ring, Engine Oil

7. Perform Crankshaft Pulley/Damper — Installation.

   Special Tools:
   • JDG1571—Timing Pin

   Consumables:
   • None

8. Perform Coolant Pump — Installation.

   Special Tools:
   • None

   Consumables:
   • Cleaning Solvent, LOCTITE® 5127 (PM38657)

9. Perform Automatic (Spring) Belt Tensioner — Installation.

   Special Tools:
   • None

   Consumables:
   • None

10. Install the idler pulley below the alternator. See:

    Idler Pulley(s) with Lift Strap — Installation.

    Special Tools:
    • None

    Consumables:
    • None

11. Perform fan bearing installation. See:

    Fan Bearing (Standard-Duty) — Installation.

    Special Tools:
    • JDG1679—Fan Bearing Remover & Installer Kit

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Consumables:
• None

or

Fan Bearing (Heavy-Duty) — Installation.

Special Tools:
• JDG10409—Wrench Adapter

Consumables:
• LOCTITE® 242 Thread Lock and Sealant

12. Perform Fan Pulley — Installation.

    Special Tools:
    • None

    Consumables:
    • None

13. Perform Fan and Alternator Belt — Installation.

    Special Tools:
    • None

    Consumables:
    • None

14. Perform Electronic Unit Pump — Installation.

    Special Tools:
    • JDG1704—Flywheel Turning Tool

    Consumables:
    • Parker O Lube™, Engine Oil

15. Connect wiring harness ring terminals to the unit pumps. See:

    Electronic Unit Pump Wiring Harness — Installation.

    Special Tools:
    • None

    Consumables:
    • LOCTITE® 222 (purple), **non-nylon** tie band

16. Perform Rocker Arm Assembly — Installation.

    Special Tools:
    • JDG1678—Hydraulic Lifter Bleed Down Tool

    Consumables:
    • TY6333 High-Temperature Grease, LOCTITE® 242 Thread Lock and Sealant, Engine Oil

17. Perform Rocker Arm Cover — Installation.

    Special Tools:
    • None

    Consumables:
    • O-rings, Rocker Arm Cover Gasket, LOCTITE® 5900 (PM37512)

18. Perform Engine Wiring Harness — Installation.

    Special Tools:
    • None

    Consumables:
    • None

19. Perform Fan Assembly — Installation.

    Special Tools:
    • None

    Consumables:
    • None

20. Refill engine coolant in cooling system.

21. Refill engine oil in the crankcase.

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MK41968,0000313 -19-14APR10-2/2

Camshaft Gear and Timing Wheel — Removal

1. Drain engine coolant from the cooling system.
2. Drain engine oil from the crankcase.
3. Perform Fan Assembly — Removal.

   Special Tools:
   • None
4. Perform Fan and Alternator Belt — Removal.

   Special Tools:
   • None
5. Perform Fan Pulley — Removal.

   Special Tools:
   • None
6. Perform fan bearing removal. See:

   Fan Bearing (Standard-Duty) — Removal.

   Special Tools:
   • JDG1679—Fan Bearing Remover & Installer Kit
   • JDG10409—Wrench Adapter

   or

   Fan Bearing (Heavy-Duty) — Removal.

   Special Tools:
   • JDG10409—Wrench Adapter
7. Remove the idler pulley below the alternator. See:

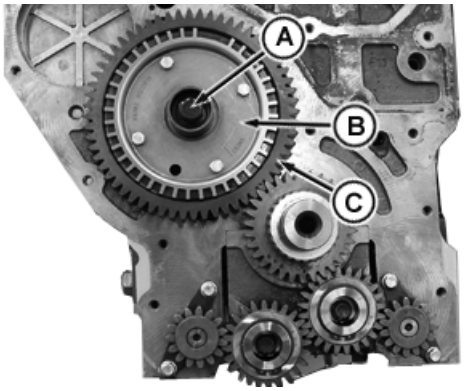
   Idler Pulley(s) with Lift Strap — Removal.

   Special Tools:
   • None
8. Perform Automatic (Spring) Belt Tensioner — Removal.

   Special Tools:
   • None
9. Perform Coolant Pump — Removal.

   Special Tools:
   • None
10. Perform Crankshaft Pulley/Damper — Removal.

    Special Tools:
    • JDG1571—Timing Pin
11. Perform Oil Pan — Removal.



RG17567 —UN—01SEP09

Camshaft Gear and Camshaft Timing Wheel

A—Camshaft Cap Screw
B—Camshaft Gear
C—Camshaft Timing Wheel

   Special Tools:
   • None
12. Perform Oil Pick-up Tube Assembly — Removal.

    Special Tools:
    • None
13. Perform Timing Gear Cover — Removal

    Special Tools:
    • None
14. Perform Oil Pump — Removal

    Special Tools:
    • None
15. **Camshaft Gear and Timing Wheel Removal**

    Special Tools:
    • JDG1571—Timing Pin

    a. Rotate crankshaft to position the No. 1 piston at TDC and pin the flywheel using JDG1571 Timing Pin.

    b. Remove camshaft cap screw (A).

NOTE: Camshaft gear and camshaft timing wheel may be removed as an assembly, if desired

    c. Remove camshaft gear (B) and camshaft timing wheel (C) assembly.

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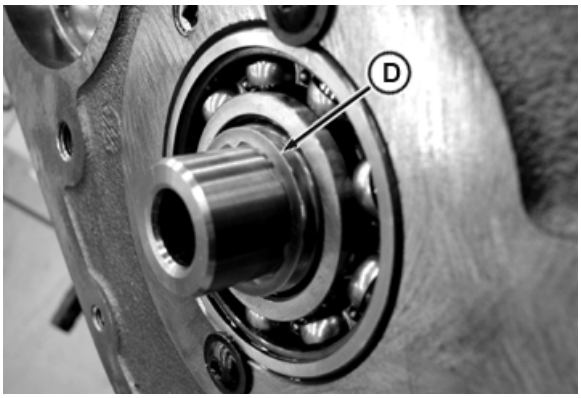
d. Remove friction washer (D) from camshaft.

D—Camshaft Friction Washer



RG17568 —UN—01SEP09

Friction Washer Location

RG17569 —UN—01SEP09

Friction Washer

MK41968,0000019 -19-14APR10-2/2

Camshaft Gear and Timing Wheel — Installation

1. **Camshaft Gear and Timing Wheel Installation**

   Special Tools:
   • None

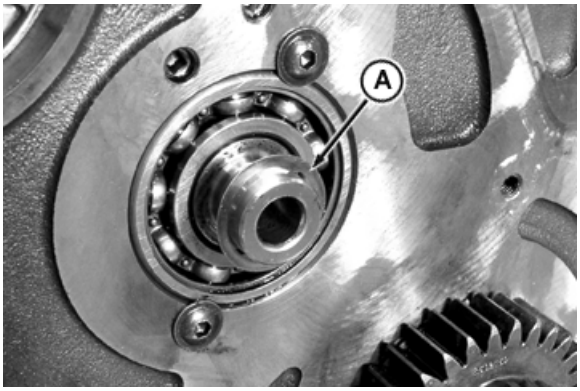
   Consumables:
   • Camshaft Gear Cap Screw, Camshaft Friction Washer

   a. Insure camshaft is secure in the correct position. See:
   Camshaft — Timing
   Special Tools:
   • JDG1700—Camshaft Timing Service Kit
   • JDG1700P6—Timing Gauge Holddown Clamp and Cap Screw
   Consumables:
   • None

IMPORTANT: Always use a new friction washer and cap screw when installing camshaft gear.

   b. Install the new friction washer (A) on camshaft nose.

IMPORTANT: Insure timing marks on the crankshaft, camshaft gear and camshaft timing wheel are aligned.



RG17570 —UN—01SEP09

Friction Washer on Camshaft

RG17569 —UN—01SEP09

Friction Washer

MK41968,000001A -19-11DEC09-1/4

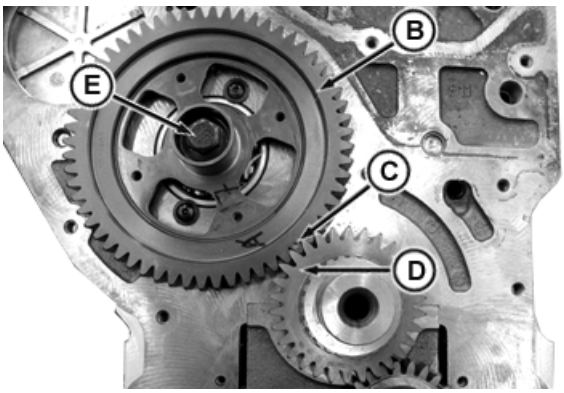
   c. Install the camshaft gear (B) on the camshaft while engaging the crankshaft gear teeth to align the mark on the camshaft gear tooth (C) with the mark on the crankshaft gear (D).

   d. Lubricate the new camshaft gear cap screw (E) with clean engine oil and tighten to specification.

Specification	
Camshaft Gear Cap Screw—Torque	90 N·m (68 lb-ft)

   e. Loosen camshaft gear cap screw and retighten to specification.

Specification	
Camshaft Gear Cap Screw—Torque Turn	30 N·m + 90° (23 lb-ft + 90°)



RG17571 —UN—01SEP09

Camshaft Gear Alignment and Installation

B—Camshaft Gear
C—Mark on Camshaft Gear Tooth
D—Mark on Crankshaft Gear
E—Camshaft Gear Cap Screw

Continued on next page

MK41968,000001A -19-11DEC09-2/4

f. If the camshaft timing wheel (F) has been removed, assemble it to the camshaft drive gear with the marks aligned. Install all cap screws finger tight to position the wheel and tighten cap screws in a cross sequence to specifications.

Specification

Camshaft Timing Wheel
Cap Screws—Torque..... 16 N·m (12 lb-ft)

g. Remove JDG1571 Timing Pin.

2. Perform Timing Gear Cover — Installation

   Special Tools:
   • JDG1660—Alignment Tool

   Consumables:
   • LOCTITE® 5127 (PM38657) Silicone Sealant, LOCTITE® 242 Thread Lock and Sealant

3. Perform Oil Pick-up Tube Assembly — Installation.

   Special Tools:
   • None

   Consumables:
   • LOCTITE® 242 Thread Lock and Sealant, Engine Oil

4. Perform Oil Pan — Installation.

   Special Tools:
   • None

   Consumables:
   • LOCTITE® 5900 (PM37512) Silicone Sealant, Drain Plug O-ring, Engine Oil

5. Perform Crankshaft Pulley/Damper — Installation.

   Special Tools:
   • JDG1571—Timing Pin

   Consumables:
   • None

6. Perform Coolant Pump — Installation.

   Special Tools:
   • None

   Consumables:
   • Cleaning Solvent, LOCTITE® 5127 (PM38657) Silicone Sealant

7. Perform Automatic (Spring) Belt Tensioner — Installation.

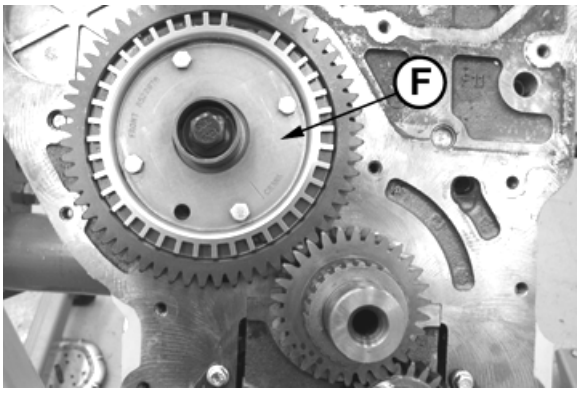
   Special Tools:
   • None

   Consumables:
   • None

8. Install the idler pulley below the alternator. See:

   Idler Pulley(s) with Lift Strap — Installation.

   Special Tools:
   • None



RG15594 —UN—26SEP07

Camshaft Timing Wheel Installed

RG15595 —UN—25SEP07

Aligned Marks

   Consumables:
   • None

9. Perform fan bearing installation. See:

   Fan Bearing (Standard-Duty) — Installation.

   Special Tools:
   • JDG1679—Fan Bearing Remover & Installer Kit

   Consumables:
   • None

   or

   Fan Bearing (Heavy-Duty) — Installation.

   Special Tools:
   • JDG10409—Wrench Adapter

   Consumables:
   • LOCTITE® 242 Thread Lock and Sealant

10. Perform Fan Pulley — Installation.

    Special Tools:
    • None

    Consumables:
    • None

11. Perform Fan and Alternator Belt — Installation.

    Special Tools:
    • None

Continued on next page

MK41968,000001A -19-11DEC09-3/4

Consumables:
• None

12. Perform Fan Assembly — Installation.

Special Tools:
• None

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Consumables:
• None

13. Refill engine oil.

14. Refill engine coolant.

MK41968,000001A -19-11DEC09-4/4

Camshaft — Timing

Special Tools:
• JDG1700—Timing Gauge
• JDG1700P6—Timing Gauge Hold-down Clamp and Cap Screw

Consumables:
• None

1. Locate true TDC of the No. 1 piston by using a dial indicator and/or timing wheel. See in Section 03, Group 030:

   Piston — Protrusion Measurement

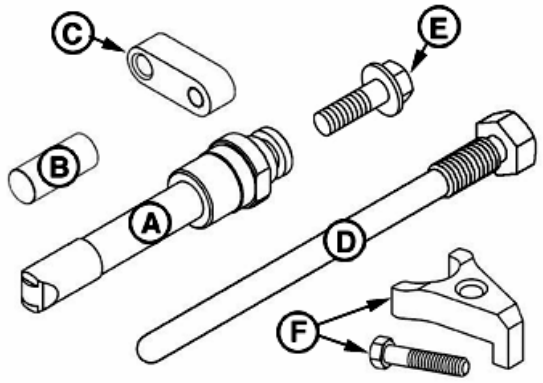
   Special Tools:
   • JDG451—Piston Liner Height Gauge

   Consumables:
   • None

   Secure flywheel to cylinder block rear flange with a large C-clamp to prevent crankshaft rotation.

IMPORTANT: JDG1700-5-1 Gauge is a precision tool machined to duplicate the injection pump and follower position for start of fuel injection. It should be handled with care to avoid damage.

2. Install JDG1700-5-1 Timing Gauge (A) in the Number 1 injection pump bore in the cylinder bloc. Secure gauge in the cylinder block using JDG1700P6 timing gauge hold-down clamp and cap screw.
3. Rotate the camshaft **counter-clockwise**, viewed from the front of the engine, until the camshaft stops against the timing tool.
4. Place JDG1700-5-2 (B) Cam Follower in the last **exhaust** camshaft follower bore (Number 4 or Number 5) in the cylinder block.



RG13560A —UN—22JUL09

JDG1700 Camshaft Timing Tool Set

A—JDG1700-5-1 Timing Gauge
B—JDG1700-5-2 Cam Follower
C—JDG1700-3 Lock Plate
D—JDG1700-2 Forcing Screw
E—Lock Plate Cap Screw
F—JDG1700P6 Timing Gauge Clamp and Cap Screw

5. Install JDG1700-3 (C) Lock Plate on the cylinder block for the last (Number 4 or Number 5) cylinder using the injection pump clamp cap screw hole. Do not tighten lock plate cap screw at this time.
6. Assemble JDG1700-2 (D) Forcing Screw through JDG1700-3 Lock Plate until it contacts JDG1700-5-2 Cam Follower. Tighten lock plate cap screw. **Slowly** tighten the forcing screw down on the JDG1700-5-2 (B) Cam Follower. The camshaft will now be prevented from rotating in either direction.

MK41968,0000315 -19-01JUN10-1/1

Timing Gear Cover — Removal

IMPORTANT: Whenever the aluminum timing gear cover or water pump are replaced, the cooling system should be flushed and serviced. Ensure system, including radiator, is completely drained.

1. Drain engine coolant from the cooling system.
2. Drain engine oil from the crankcase.
3. Perform Fan Assembly — Removal.

   Special Tools:
   • None
4. Perform Fan and Alternator Belt — Removal.

   Special Tools:
   • None
5. Perform Fan Pulley — Removal.

   Special Tools:
   • None
6. Perform fan bearing removal. See:

   Fan Bearing (Standard-Duty) — Removal.

   Special Tools:
   • JDG1679—Fan Bearing Remover & Installer Kit
   • JDG10409—Wrench Adapter

   or

   Fan Bearing (Heavy-Duty) — Removal.

   Special Tools:
   • JDG10409—Wrench Adapter
7. Remove the idler pulley below the alternator. See:

   Idler Pulley(s) with Lift Strap — Removal.

   Special Tools:
   • None
8. Perform Automatic (Spring) Belt Tensioner — Removal.

   Special Tools:
   • None
9. Perform Coolant Pump — Removal.

   Special Tools:
   • None
10. Perform Crankshaft Pulley/Damper — Removal.

    Special Tools:
    • JDG1571—Timing Pin
11. Perform Oil Pan — Removal.

    Special Tools:
    • None
12. Perform Oil Pick-up Tube Assembly — Removal.

    Special Tools:
    • None
13. **Timing Gear Cover Removal**

    Special Tools:
    • None

    a. Remove all caps screws and the timing gear cover.

    b. Perform Timing Gear Cover — Cleaning & Inspection
    Special Tools:
    • None

MK41968,0000316 -19-14APR10-1/1

Timing Gear Cover — Cleaning and Inspection

Special Tools:
• None

Consumables:
• Cleaning Solvent

1. Drive crankshaft front oil seal out of cover.
2. Remove old sealant from cylinder block and timing gear cover gasket surfaces.
3. Clean timing gear cover in solvent. Dry with compressed air.
4. Inspect cover for cracks or damage. Make sure seal bore is clean and free of nicks and burrs.
5. Insure all sealing surfaces are clean and free of grease and oil.

MK41968,0000317 -19-25AUG09-1/1

Timing Gear Cover — Installation

1. **Timing Gear Cover Installation**

   Special Tools:
   • JDG1660—Alignment Tool

   Consumables:
   • LOCTITE® 5127 (PM38657) Silicone Sealant, LOCTITE® 242 Thread Lock and Sealant

   a. Install “L” shaped coolant gasket (A).

   b. Apply a continuous 2—4 mm (0.08—0.16 in.) bead of LOCTITE® 5127 (PM38657) Silicone Sealant to machined sealing surfaces.

   c. Align oil pump spline (B) in timing gear cover to spline on crankshaft and install timing gear cover using JDG1660 Alignment tool. Secure timing gear cover to cylinder block with the cap screw at location number 4.

   d. Apply a continuous 2—4 mm (0.08—0.16 in.) bead of LOCTITE® 5127 (PM38657) Silicone Sealant on water pump flange and install cap screws at locations 1, 13, 15, 16 and 17.

   e. Apply LOCTITE® 242 to cap screw and install in location 9.

   f. Install remaining cap screws and tighten all cap screws to initial and final specifications as shown in the tightening sequence.

Specification
Timing Gear Cover-to-Cylinder Block Cap Screws - Initial—Torque	20 N·m (16 lb-ft)

Specification
Timing Gear Cover-to-Cylinder Block Cap Screws - Final—Torque	40 N·m (30 lb-ft)

2. Perform Oil Pick-up Tube Assembly — Installation.

   Special Tools:
   • None

   Consumables:
   • LOCTITE® 242 Thread Lock and Sealant, Engine Oil

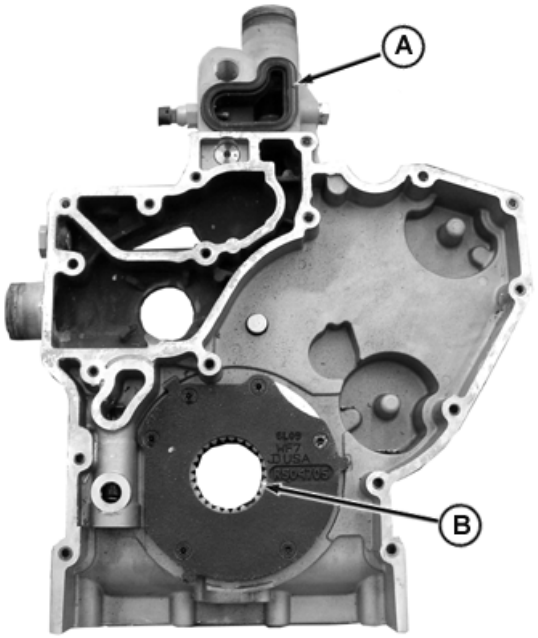
3. Perform Oil Pan — Installation.

   Special Tools:
   • None

   Consumables:
   • LOCTITE® 5900 (PM37512) Silicone Sealant, Drain Plug O-ring, Engine Oil

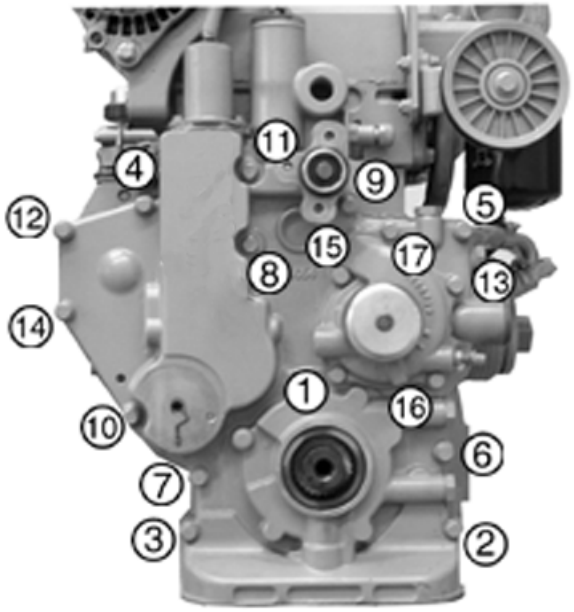
4. Perform Crankshaft Pulley/Damper — Installation.

   Special Tools:



RG17527 —UN—28AUG09

Timing Gear Cover Installation



RG15596 —UN—26SEP07

Timing Gear Cover Cap Screw Tightening Sequence

   • JDG1571—Timing Pin

   Consumables:
   • None

5. Perform Coolant Pump — Installation.

   Special Tools:
   • None

Continued on next page

MK41968,0000318 -19-31AUG09-1/2

Consumables:
• Cleaning Solvent, LOCTITE® 5127 (PM38657) Silicone Sealant

6. Perform Automatic (Spring) Belt Tensioner — Installation.

   Special Tools:
   • None

   Consumables:
   • None

7. Install the idler pulley below the alternator. See:

   Idler Pulley(s) with Lift Strap — Installation.

   Special Tools:
   • None

   Consumables:
   • None

8. Perform fan bearing installation. See:

   Fan Bearing (Standard-Duty) — Installation.

   Special Tools:
   • JDG1679—Fan Bearing Remover & Installer Kit

   Consumables:
   • None

   or

   Fan Bearing (Heavy-Duty) — Installation.

   Special Tools:
   • JDG10409—Wrench Adapter

   Consumables:
   • LOCTITE® 242 Thread Lock and Sealant

9. Perform Fan Pulley — Installation.

   Special Tools:
   • None

   Consumables:
   • None

10. Perform Fan and Alternator Belt — Installation.

    Special Tools:
    • None

    Consumables:
    • None

11. Perform Fan Assembly — Installation.

    Special Tools:
    • None

    Consumables:
    • None

12. Refill engine oil.

13. Refill engine coolant.

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MK41968,0000318 -19-31AUG09-2/2

Essential, Recommended and Fabricated Tools For This Group

- JT01724—(5/16 in.)
- JT01720—Atuator Pin
- JT01718—Slide Hammer
- JDG1658—Dipstick Tube Driver
- JDG1721—Oil Pressure Regulator Valve Installer

MK41968,0000009 -19-22MAY09-1/1

General Lubrication System Information

The oil filter is located on the left side of the engine. The oil filter may be located horizontally directly connected to the oil cooler or positioned vertically with the vertical oil filter header mounted near the idler pulley.

Dipsticks and oil fill locations can be located on either side of the engine. The oil fill can also be located on the rocker arm cover.

The pressure regulating valve is located in the front timing gear cover next to the oil pump. There is a bypass valve located in the oil cooler and will open if the oil filter is clogged. Oil coolers are full-flow, plate-type coolers.

The oil pump is a gerotor pump located in the front timing gear cover and is used in both 4 and 6-cylinder engines.

For flow diagram and more information on the lubrication system, see Lubrication System Operation in Section 03, Group 120.

NOTE: For Lubrication system diagnostics, see Engine Oil Consumption in Section 04, Group 150

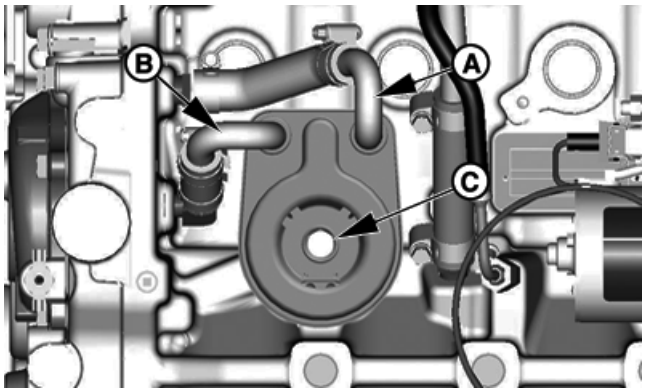
RG41183,0000027 -19-01JUN10-1/1

Oil Cooler — Removal

Special Tools:
- None

1. Drain coolant from system.
2. Remove oil filter from oil cooler. (shown removed)
3. Disconnect inlet line (A) and outlet line (B) at oil cooler.
4. Remove nipple (C) and lift out oil cooler.
5. Discard packing.

A—Inlet Line
B—Outlet Line
C—Nipple



RG16938 —UN—26MAR09

Oil Cooler Removal

MK41968,000031C -19-01SEP09-1/1

Oil Cooler — Installation

Special Tools:
• None

Consumables:
• Packing Seal, O-rings, Engine Oil

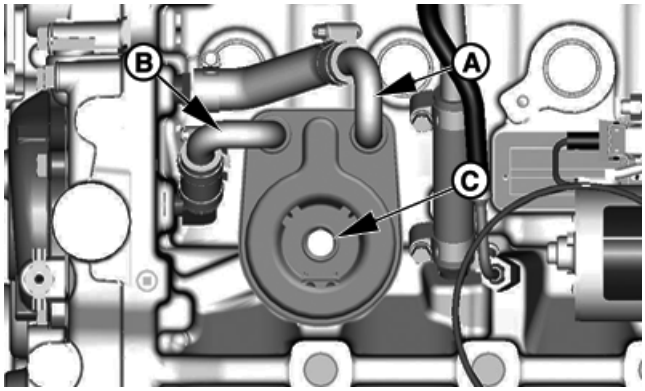
Horizontal Oil Filter Installation

1. Install new packing between oil cooler and cylinder block.
2. Install nipple (C) and tighten to specification.

Specification

Oil Cooler
Nipple—Torque.....37 N•m (27 lb-ft)

3. Connect coolant inlet line (A) and outlet line (B) to the oil cooler.
4. Apply a thin coating of clean engine oil to the oil filter gasket.



RG16938 —UN—26MAR09

Oil Cooler Installation

A—Inlet Line
B—Outlet Line
C—Nipple

5. Install oil filter until gasket contacts the oil cooler. Tighten oil filter an additional 3/4 to 1-1/4 turns.

MK41968,000031D -19-18FEB10-1/2

Vertical Oil Filter Installation

1. Install oil filter header (B) to cylinder head and tighten to specification.

Specification

Oil Filter Header Cap
Screw—Torque.....34 N•m (25 lb-ft)

2. Install idler pulley to oil filter header (B) and tighten to specification.

Specification

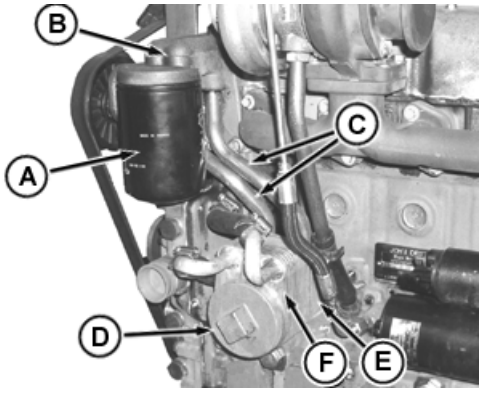
Idler Pulley Cap
Screw—Torque.....63 N•m (46 lb-ft)

3. Install new O-rings into the bottom of the oil filter header and install header inlet and outlet lines (C).
4. Install new O-rings into oil cooler adapter (E). Install new seal between cylinder block and oil cooler adapter. Connect to the header inlet and outlet lines (C).
5. Install the oil cooler (F) to the oil cooler adapter (E). Insert the threaded nipple through the oil cooler and tighten to specification.

Specification

Threaded
Nipple—Torque.....37 N•m (27 lb-ft)

6. Connect coolant lines to the oil cooler adapter and tighten clamps.
7. Install the oil cooler cover (D) with a new seal and tighten to specification.



RG18127 —UN—17FEB10

Vertical Oil Filter Configuration

A—Oil Filter
B—Oil Filter Header
C—Header Inlet and Outlet Lines
D—Oil Cooler Cover
E—Oil Cooler Adapter
F—Oil Cooler

Specification

Oil Cooler Cover
Plate—Torque.....37 N·m (27 lb-ft)

8. Apply a thin coating of clean engine oil to the oil filter gasket. Install oil filter until gasket contacts the oil filter header. Tighten oil filter (A) an additional 3/4 to 1-1/4 turns.

MK41968,000031D -19-18FEB10-2/2

Oil Dipstick Tube — Removal

Tools:
• JT01724—(5/16 in.)
• JT01720—Atuator Pin
• JT01718—Slide Hammer

1. Remove dipstick.
2. Using JT01724 (5/16 in.) Collet, JT01720 Actuator Pin, and JT01718 Slide Hammer, remove dipstick tube from block.

MK41968,000031E -19-15SEP09-1/1

Oil Dipstick Tube — Installation

Tools:
• JDG1658—Dipstick Tube Driver

Consumables:
• LOCTITE® 609 Retaining Compound

1. Coat end of new dipstick tube with LOCTITE® 609 Retaining Compound.
2. Using JDG1658 Dipstick Tube Driver. Install dipstick tube until shoulder bottoms.
3. Install dipstick.

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MK41968,000031F -19-05NOV09-1/1

Oil Pan — Removal

Special Tools:
• None

1. Drain engine oil.
2. Remove all cap screws and remove oil pan.
3. Remove all gasket material from oil rail and cylinder block mounting surfaces. Clean surfaces from oil, grease, and dirt.

NOTE: Observe position of oil pan, cap screws, and drain plug for reassembly.

MK41968,0000320 -19-15SEP09-1/1

Oil Pan — Installation

Special Tools:
• None

Consumables:
• LOCTITE® 5910 (PM37512) Silicone Sealant, Drain Plug O-ring, Engine Oil

Apply a continuous 2—4 mm (0.08—0.16 in.) bead of LOCTITE® 5910 (PM37512) Silicone Sealant to mounting surface on the cylinder block (A).

NOTE: Guide pins (M8 x 1.25) may be used while installing oil pan.

Carefully install oil pan on cylinder block and tighten all oil pan-to-cylinder block cap screws as follows:

4-Cylinder Engines

1. Tighten cap screws 1-10 and 15-16 to specification.

Specification	
Oil Pan Cap Screws —Torque	32 N•m (24 lb-ft)

2. Tighten cap screws 11-14 and 17-18 to specification.

Specification	
Oil Pan Cap Screws —Torque	25 N•m (18 lb-ft)

3. Re-torque all cap screws to specifications listed above.

IMPORTANT: Allow sealant to cure for a minimum of 8 hours before operating engine.

4. Install drain plug with new O-ring and tighten to specification.

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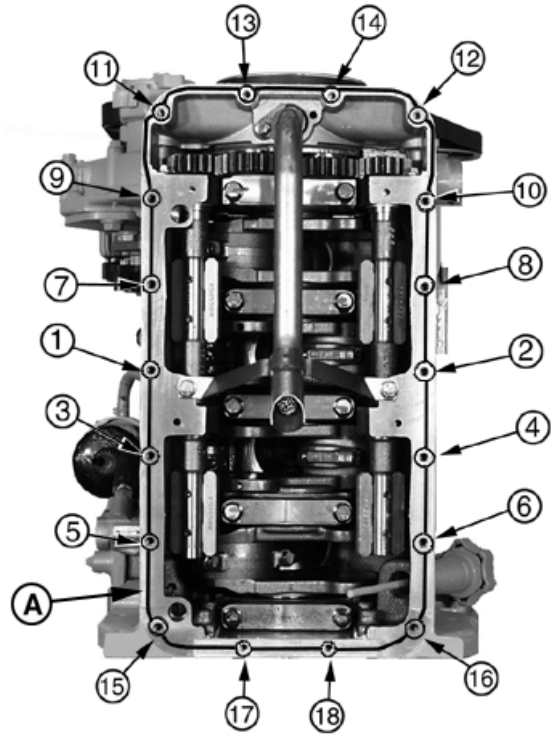


RG12992 —UN—23JUN03

4-Cylinder Engine Torque Sequence

A—Sealant Path

Specification	
Oil Pan Drain Plug—Torque	35 N•m (26 lb-ft)

5. Refill engine oil.

Continued on next page

MK41968,0000321 -19-18FEB10-1/2

5-Cylinder Engines

1. Tighten cap screws 1-12 and 17-18 to specification.

Specification	
Oil Pan Cap Screws —Torque	32 N•m (24 lb-ft)

2. Tighten cap screws 13-16 and 19-20 to specification.

Specification	
Oil Pan Cap Screws —Torque	25 N•m (18 lb-ft)

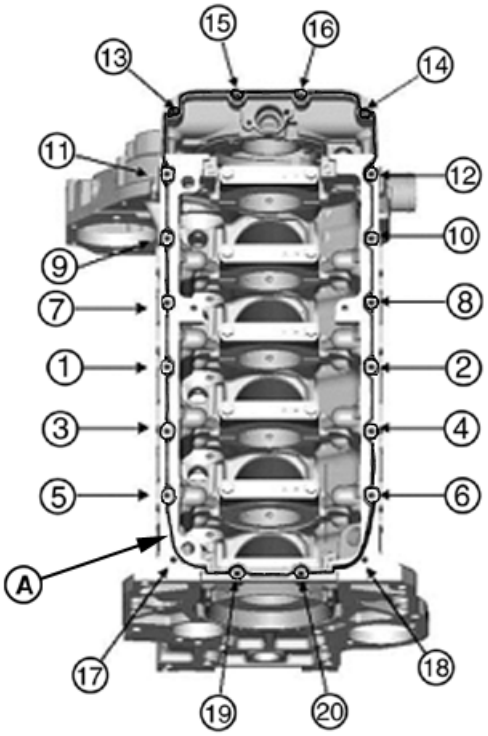
3. Re-torque all cap screws to specifications listed above.

IMPORTANT: Allow sealant to cure for a minimum of 8 hours before operating engine.

4. Install drain plug with new O-ring and tighten to specification.

Specification	
Oil Pan Drain Plug—Torque	35 N•m (26 lb-ft)

5. Refill engine oil.



RG12993 —UN—23JUN03

5-Cylinder Engine Torque Sequence

MK41968,0000321 -19-18FEB10-2/2

Oil Pick-Up Tube Assembly — Removal

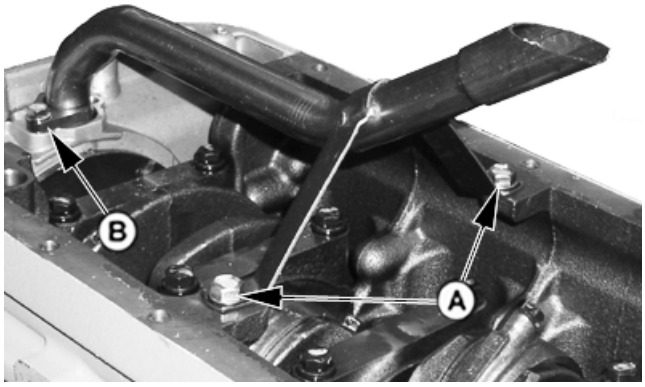
1. Drain engine oil.
2. Perform Oil Pan — Removal.

   Special Tools
   • None
3. Clean all gasket material from surfaces
4. **Oil Pick-Up Tube Assembly Removal**

   Special Tools:
   • None

   a. Remove cap screws (A) and cap screw with clamp (B).

   b. Remove oil pick-up tube.



RG17164 —UN—22MAY09

Oil Pick-Up Tube Removal

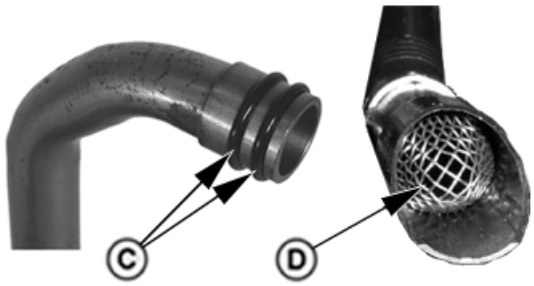
A—Cap Screws **B—Clamp**

MK41968,0000322 -19-18FEB10-1/1

Oil Pick-Up Tube Assembly — Inspection

1. Inspect O-rings (C) and replace as necessary.
2. Clean any debris from oil pick-up tube screen (D) and inspect for any damage. If screen is damaged, replace oil pick-up tube.

C—O-rings **D—Pick-Up Tube Screen**



RG17165 —UN—22MAY09

O-rings and Pick-Up tube Screen Inspection

MK41968,0000324 -19-15SEP09-1/1

Oil Pick-Up Tube Assembly — Installation

Special Tools:
• None

Consumables:
• LOCTITE® 242 Thread and Lock Sealant, Engine Oil

1. **Oil Pick-Up Tube Assembly Installation**
   a. Lubricate O-rings with clean engine oil and install oil pick-up tube into timing gear cover.
   b. Apply LOCTITE® 242 Thread and Lock Sealant to screws (A) and install the screws. Tighten to specification.

Specification	
Oil Pick-up Tube Support Bracket Screws—Torque	28 N•m (21 lb-ft)

   c. Install cap screw with clamp (B) and tighten to specification.

Specification	
Oil Pick-up Tube Hold Down Clamp Cap Screw—Torque	16.5 N•m (12 lb-ft)

2. Perform Oil Pan — Installation

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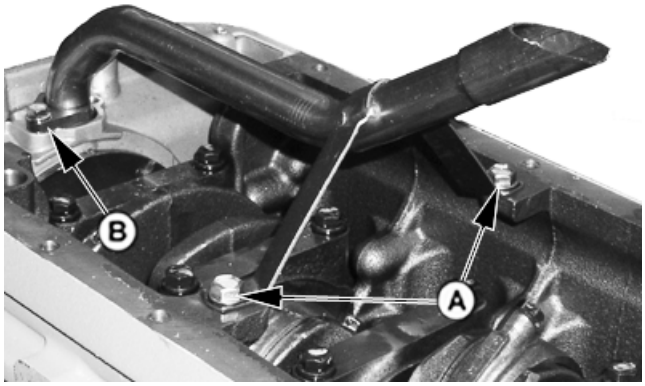


RG17164 —UN—22MAY09

Oil Pick-Up Tube Installation

A—Cap Screws **B—Clamp**

Special Tools:
• None

Consumables:
• LOCTITE® 5910 (PM37512) Silicone Sealant, Drain Plug O-ring, Engine Oil

3. Refill engine oil.

MK41968,0000323 -19-05NOV09-1/1

Oil Pressure Regulating Valve — Removal

1. Drain engine oil.
2. Perform Oil Pan — Removal.

   Special Tools:
   • None
3. Perform Fan Assembly — Removal.

   Special Tools:
   • None
4. Perform Fan and Alternator Belt — Removal.

   Special Tools:
   • None
5. Perform Fan Pulley — Removal.

   Special Tools:
   • None
6. Perform fan bearing removal. See:

   Fan Bearing (Standard-Duty) — Removal.

   Special Tools:
   • JDG1679—Fan Bearing Remover & Installer Kit
   • JDG10409—Wrench Adapter

   or

   Fan Bearing (Heavy-Duty) — Removal.

   Special Tools:
   • JDG10409—Wrench Adapter
7. Perform Automatic (Spring) Belt Tensioner — Removal.

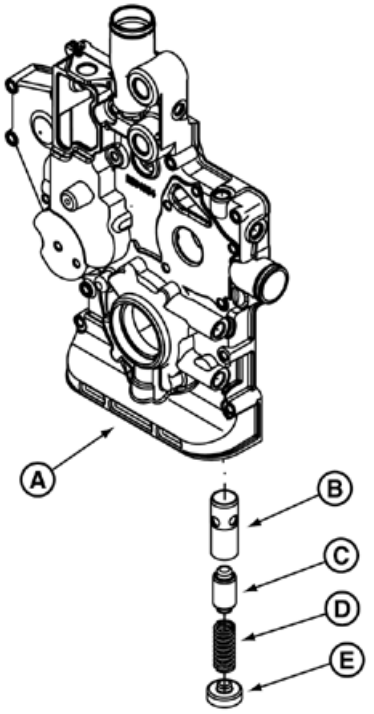
   Special Tools:
   • None
8. Perform Alternator — Removal.

   Special Tools:
   • None
9. Perform Coolant Pump — Removal.

   Special Tools:
   • None
10. Perform Crankshaft Pulley/Damper — Removal.

    Special Tools:
    • JDG1571—Timing Pin

NOTE: The timing gear cover only needs to be removed from 4-cylinder engines that are equipped balancer shafts.



RG12989 —UN—19JUN03

Oil Pressure Regulating Valve

A—Timing Gear Cover
B—Valve Seat
C—Valve
D—Compression Spring
E—Plug

11. Perform Timing Gear cover — Removal.

    Special Tools:
    • None
12. **Oil Pressure Regulating Valve Removal**

    Special Tools:
    • None

    a. Remove plug (E) from timing gear cover.

    b. Remove valve (C), compression spring (D) and valve seat (B).

    c. Inspect parts for excessive wear or damage. Replace as necessary.

MK41968,0000325 -19-01JUN10-1/1

Oil Pressure Regulating Valve — Installation

1. **Oil Pressure Regulating Valve Installation**

   Special Tools:
   • JDG1721—Oil Pressure Regulator Valve Installer

   Consumables:
   • None

   a. Install valve seat (B) using JDG1721-2 to proper positioning.

   b. Install valve (C) and compression spring (D) into valve seat (B).

   c. Install plug (E) into bore. Using JDG1721-1, tap plug to proper depth. This tool also stakes the bore to ensure plug installation.

2. Perform Timing Gear Cover — Installation (if removed).

   Special Tools:
   • JDG1660—Alignment Tool

   Consumables:
   • LOCTITE® 5127 (PM38657) Silicone Sealant, LOCTITE® 242 Thread Lock and Sealant

3. Perform Oil Pan — Installation.

   Special Tools:
   • None

   Consumables:
   • LOCTITE® 5910 (PM37512) Silicone Sealant, Drain Plug O-ring, Engine Oil

4. Perform Crankshaft Pulley/Damper — Installation.

   Special Tools:
   • JDG1571—Timing Pin

   Consumables:
   • None

5. Perform Coolant Pump — Installation.

   Special Tools
   • None

   Consumables:
   • Cleaning Solvent, LOCTITE®5910 (PM37512) Silicone Sealant

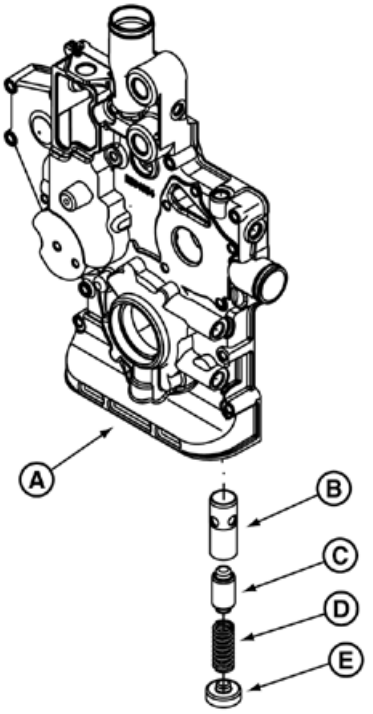
6. Perform Alternator — Installation.

   Special Tools
   • None

   Consumables:
   • None

7. Perform Automatic (Spring) Belt Tensioner — Installation.

   Special Tools
   • None



RG12989 —UN—19JUN03

Oil Pressure Regulating Valve

A—Timing Gear Cover
B—Valve Seat
C—Valve
D—Compression Spring
E—Plug

   Consumables:
   • None

8. Perform fan bearing installation. See:

   Fan Bearing (Standard-Duty) — Installation.

   Special Tools
   • JDG1679—Fan Bearing Remover & Installer Kit

   Consumables:
   • None

   or

   Fan Bearing (Heavy-Duty) — Installation.

   Special Tools
   • JDG10409—Wrench Adapter

   Consumables:
   • LOCTITE® 242 Thread Lock and Sealant

9. Perform Fan Pulley — Installation.

   Special Tools:
   • None

   Consumables:
   • None

10. Perform Fan and Alternator Belt — Installation.

Continued on next page

MK41968,0000326 -19-01JUN10-1/2

Special Tools
• None

Consumables:
• None

11. Perform Fan Assembly — Installation.

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MK41968,0000326 -19-01JUN10-2/2

Oil Pump — Removal

1. Drain engine oil.
2. Perform Oil Pan — Removal.

   Special Tools:
   • None
3. Perform Fan Assembly — Removal.

   Special Tools:
   • None
4. Perform Fan and Alternator Belt — Removal.

   Special Tools:
   • None
5. Perform Fan Pulley — Removal.

   Special Tools:
   • None
6. Perform fan bearing removal. See:

   Fan Bearing (Standard-Duty) — Removal.

   Special Tools:
   • JDG1679—Fan Bearing Remover & Installer Kit
   • JDG10409—Wrench Adapter

   or

   Fan Bearing (Heavy-Duty) — Removal.

   Special Tools:
   • JDG10409—Wrench Adapter
7. Perform Automatic (Spring) Belt Tensioner — Removal.

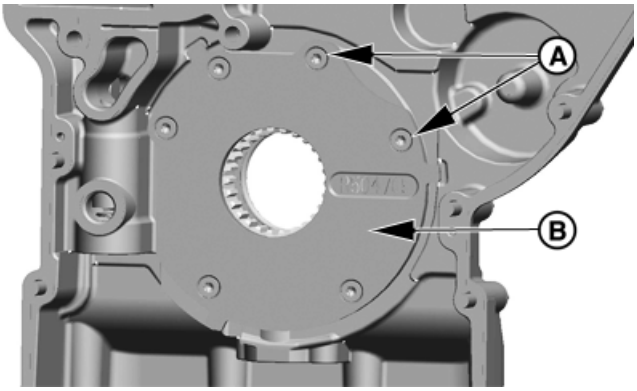
   Special Tools:
   • None
8. Perform Alternator — Removal.

   Special Tools:
   • None
9. Perform Coolant Pump — Removal.

   Special Tools
   • None

   Consumables:
   • None
12. Refill engine oil.

MK41968,0000326 -19-01JUN10-2/2



RG16932 —UN—24MAR09

Oil Pump Cover Plate

A—Screws **B—Oil Pump Cover**

Special Tools:
• None

10. Perform Crankshaft Pulley/Damper — Removal.

    Special Tools:
    • JDG1571—Timing Pin

NOTE: The timing gear cover only needs to be removed from 4-cylinder engines that are equipped balancer shafts.

11. Perform Timing Gear cover — Removal.

    Special Tools:
    • None
12. **Oil Pump Removal**

    Special Tools:
    • None

    a. Remove six cap screws (A) and oil pump cover (B).

    b. Perform Oil Pump — Inspection.

    c. Remove rotors from pump housing.

MK41968,0000327 -19-02JUN10-1/1

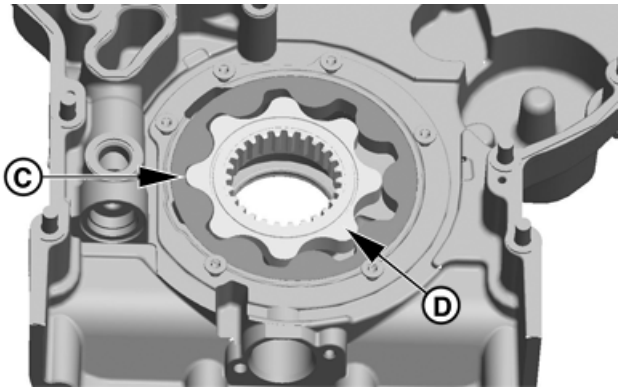
Oil Pump — Inspection

1. Inspect the oil pump cover and gerotor gear (D) for excessive wear.
2. Measure clearance at point (C). If not within specification replace oil pump.

Specification

Oil Pump
Rotor—Clearance.....0.05 — 0.195 mm (0.0019 — 0.0077 in.)

3. Remove rotors from pump housing.
4. Inspect pump housing for excessive wear and replace as necessary.



RG16931 —UN—24MAR09

Gerotor Inspection

MK41968,0000005 -19-15SEP09-1/1

Oil Pump — Installation

1. **Oil Pump Installation**

   Special Tools:
   • None

   Consumables:
   • LOCTITE® 242 Thread and Lock Sealant, Engine Oil

   a. Apply a thin coat of clean engine oil to oil pump housing area in the timing gear cover and to the gerotor.

   b. Install gerotor assembly into pump housing. Check that the gerotor assembly spins freely.

   c. Apply a thin coat of clean engine oil to oil pump cover.

   d. Apply LOCTITE® 242 to cap screws and install oil pump cover. Tighten cap screws in sequence as shown, to specification.

Specification

Oil Pump Cover Cap Screws—Torque..... 11.5 N•m (8 lb-ft)

2. Perform Timing Gear Cover — Installation (if removed).

   Special Tools:
   • JDG1660—Alignment tool.

   Consumables:
   • RE524832 Silicone Sealant, LOCTITE® 242 Thread and Lock Sealant

3. Perform Oil Pan — Installation.

   Special Tools
   • None

   Consumables:
   • LOCTITE® 5910 (PM37512) Silicone Sealant, Drain Plug O-ring, Engine Oil

4. Perform Crankshaft Pulley/Damper — Installation.

   Special Tools:
   • JDG1571—Timing Pin

   Consumables:
   • None

5. Perform Coolant Pump — Installation.

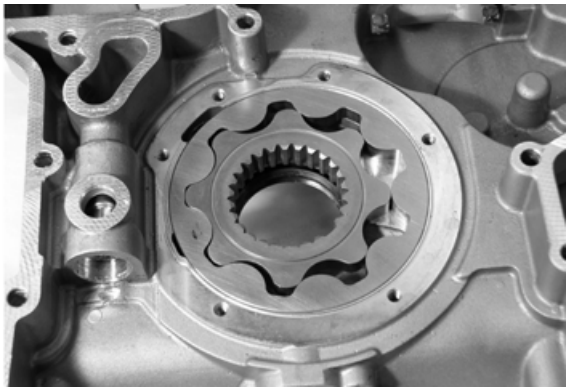
   Special Tools
   • None

   Consumables:
   • Cleaning Solvent, LOCTITE®5910 (PM37512) Silicone Sealant

6. Perform Alternator — Installation.

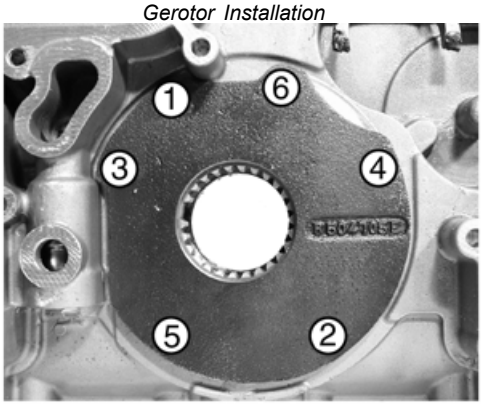
   Special Tools
   • None

   Consumables:
   • None



RG13028 —UN—07JUL03

Gerotor Installation



RG16933 —UN—24MAR09

Torque Sequence

7. Perform Automatic (Spring) Belt Tensioner — Installation.

   Special Tools
   • None

   Consumables:
   • None

8. Perform fan bearing installation. See:

   Fan Bearing (Standard-Duty) — Installation.

   Special Tools
   • JDG1679—Fan Bearing Remover & Installer Kit

   Consumables:
   • None

   or

   Fan Bearing (Heavy-Duty) — Installation.

   Special Tools
   • JDG10409—Wrench Adapter

   Consumables:
   • LOCTITE® 242 Thread Lock and Sealant

9. Perform Fan Pulley — Installation.

   Special Special Tools:
   • None

Continued on next page

MK41968,0000329 -19-02JUN10-1/2

Consumables:
• None

10. Perform Fan and Alternator Belt — Installation.

    Special Tools
    • None

    Consumables:
    • None

11. Perform Fan Assembly — Installation.

    Special Tools
    • None

    Consumables:
    • None

12. Refill engine oil.

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MK41968,0000329 -19-02JUN10-2/2

Essential, Recommended and Fabricated Tools For This Group

NOTE: Order tools according to information given in the U.S. SERVICEGARD™ Catalog or from the European Microfiche Tool Catalog (MTC).

SERVICEGARD is a trademark of Deere & Company

- JDG10409—Wrench Adapter

MK41968,000000F -19-29JUL09-1/1

Belt Tensioner — Spring Tension and Belt Wear (Automatic Tensioner) Check

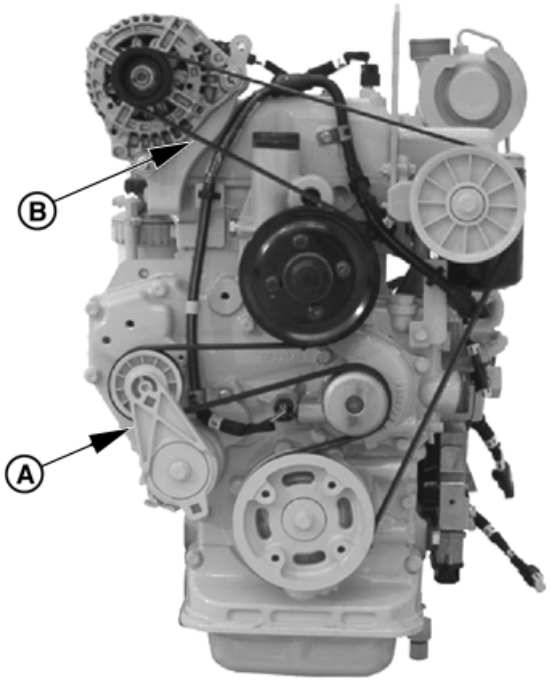
Belt drive systems equipped with an automatic (spring) belt tensioner cannot be adjusted or repaired. The automatic belt tensioner is designed to maintain proper belt tension over the life of the belt. If tensioner spring tension is not within specification, replace tensioner assembly.

Belt Wear Check

The belt tensioner (A) is designed to operate within the limit of arm movement when correct belt length and geometry is used.

Visually inspect poly-vee belt (B) for excessive wear and cracks.

A—Belt Tensioner **B—Poly-Vee Belt**



Belt Wear Inspection

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MK41968,0000334 -19-04NOV09-1/2

Tensioner Spring Tension Check

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 breaker bar and socket on tension arm. Remove belt from pulleys.
2. Release tension on tension arm and remove breaker bar.
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.

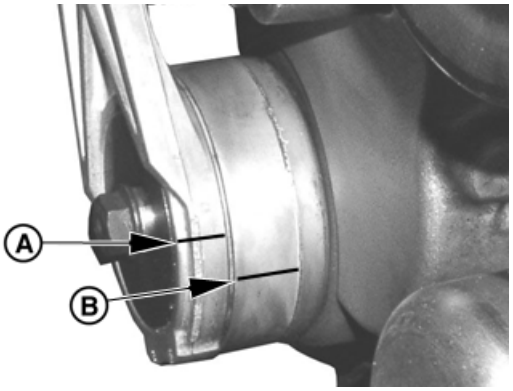
NOTE: Threads on belt tensioner roller cap screw are LEFT-HAND threads.

5. Install torque wrench (C) so that it is aligned with center of pulley and tensioner. Rotate the swing arm with the 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

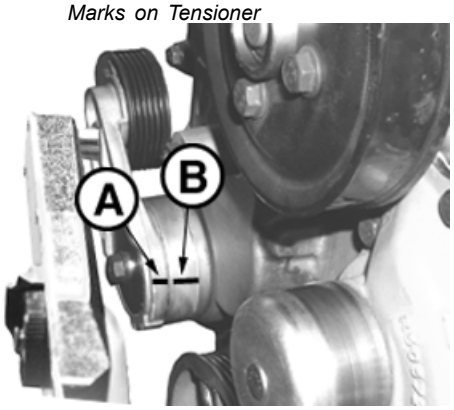
Spring Tension—Torque.....18-22 N•m (13-16 lb-ft)

A—Mark On Swing Arm
B—Mark On Tensioner Mounting Base
C—Torque Wrench



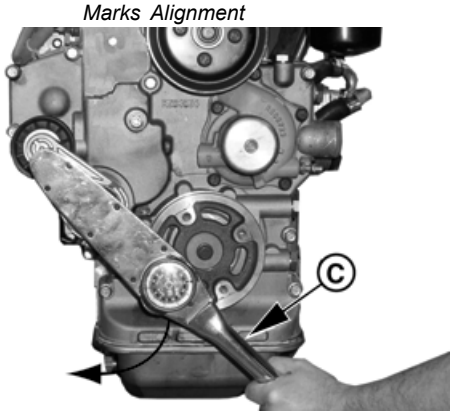
RG17016 —UN—26APR09

Marks on Tensioner



RG12824 —UN—19FEB03

Marks Alignment



RG17018 —UN—26APR09

Torque Wrench Alignment with Pulley and Tensioner

MK41968,0000334 -19-04NOV09-2/2

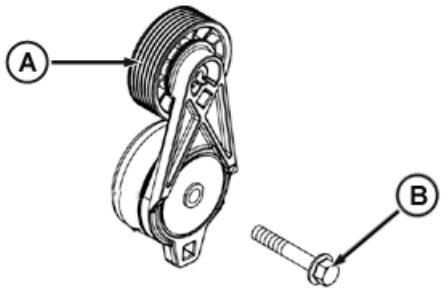
Automatic (Spring) Belt Tensioner — Removal

Special Tools:
• None

IMPORTANT: Belt tensioner cap screw is left-hand threaded.

1. Perform Fan and Alternator Belt — Removal

   Special Tools:
   • None
2. Remove mounting screw (B) and belt tensioner.
3. Inspect sheave (A).



RG17835 —UN—22OCT09

Tensioner Sheave Inspection

A—Sheave **B—Mounting Screw**

MK41968,000032D -19-22OCT09-1/1

Automatic (Spring) Belt Tensioner — Installation

Special Tools:
• None

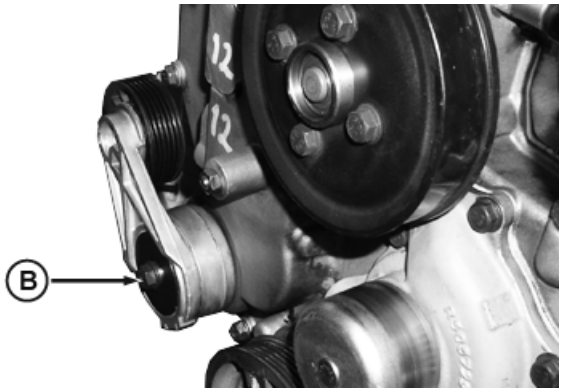
Consumables:
• None

1. Install belt tensioner and tighten cap screw (B) to specifications.

Specification	
Belt Tensioner-to-Timing Cover and Engine Cap Screw—Torque	50 N•m (37 lb-ft)

2. Perform Fan and Alternator Belt — Installation.

   Special Tools:
   • None



RG17836 —UN—22OCT09

Belt Tensioner Mounting Cap Screw

Consumables:
• None

MK41968,0000330 -19-05NOV09-1/1

Coolant Pump — Removal

Special Tools:
• None

CAUTION: Explosive release of fluids from pressurized cooling system can cause serious burns. Do not drain coolant until the coolant temperature is below operating temperature. Always loosen cooling system filler cap, radiator cap, or drain valve slowly to relieve pressure.

IMPORTANT: Whenever the aluminum timing gear cover or coolant pump is replaced, the cooling system must be flushed and serviced, regardless of time/hours since last coolant change. Ensure system, including radiator, is completely drained.

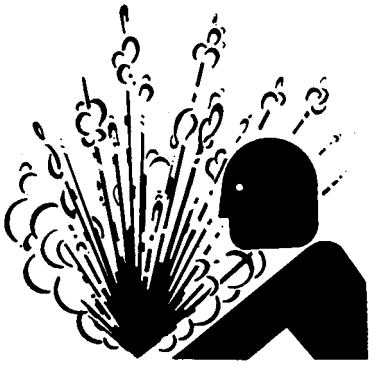
1. Inspect weep hole (A) for oil or coolant leakage.
   - Oil leakage indicates a damaged sealed bearing.
   - Coolant leakage indicates a damaged housing seal.
2. Drain coolant.
3. Perform Fan Assembly — Removal.

   Special Tools:
   • None
4. Perform Fan and Alternator Belt — Removal.

   Special Tools:
   • None
5. **Coolant Pump Removal**

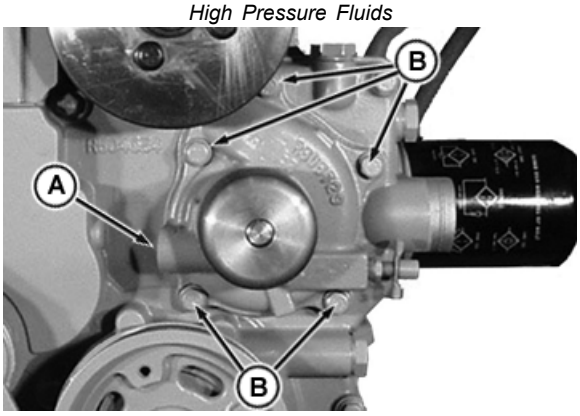
   a. Remove mounting cap screws (B) and coolant pump.

   b. Clean mounting surfaces of pump and timing gear cover. Surfaces should be free of defects and old gasket sealing material.



TS281 —UN—23AUG88

High Pressure Fluids



RG17909 —UN—06NOV09

Weep Hole and Mounting Screws

RG12949 —UN—09JUN03

Clean Coolant Pump Gasket Surface

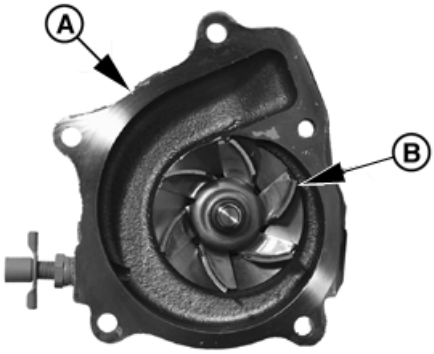
MK41968,0000331 -19-06NOV09-1/1

Coolant Pump Parts — Cleaning and Inspection

1. Inspect coolant pump housing (A) for cracks or damage. Replace coolant pump if defects are found.
2. Inspect coolant pump impeller (B) for worn or damaged vanes. Rotate impeller to ensure it turns freely without binding. Replace coolant pump if defects are found.

NOTE: Coolant pumps are available with different diameter impellers to ensure adequate coolant flow for a given engine application. Be sure to replace the coolant pump with the same size impeller.

Specification	
Standard Flow Coolant Pump Impeller—Diameter	56 mm (2.20 in.)
High Flow Coolant Pump Impeller—Diameter	70 mm (2.75 in.)



RG17017 —UN—26APR09

Coolant Pump Inspection

MK41968,0000332 -19-05NOV09-1/1

Coolant Pump — Installation

Special Tools:
• None

Consumables:
• Cleaning Solvent, Hylomar 3400 (RE524832) Silicone Sealant

1. **Coolant Pump Installation**

   a. Clean sealing surfaces of the coolant pump housing and timing gear cover with cleaning solvent, acetone, or any other suitable cleaner that will remove sealant. (Brake Kleen, Ignition Cleaner and Drier are examples of commercially available solvents)

   b. Apply a continuous 3—4 mm (0.12—0.16 in.) bead of Hylomar 3400 (RE524832) silicone sealant (A) to the mounting surface of the coolant pump and place in position using two cap screws as guides.

   c. Install remaining cap screws and tighten all cap screws finger tight. Tighten cap screws to specifications in sequence as shown.

Specification	
Coolant Pump-to-Timing Cover Cap Screws—Torque	40 N·m (30 lb-ft)

2. Perform Fan and Alternator Belt — Installation.

   Special Tools:
   • None

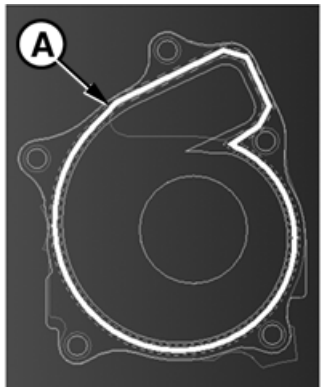
   Consumables:
   • None

3. Perform Fan Assembly — Installation.

   Special Tools:
   • None

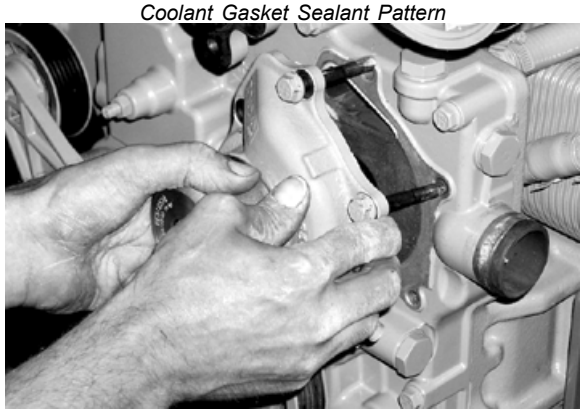
   Consumables:
   • None

IMPORTANT: Air must be expelled from cooling system when refilled. Loosen temperature sending unit fitting in the timing gear cover to allow air to escape when filling system. Tighten fitting when all the air has been expelled.



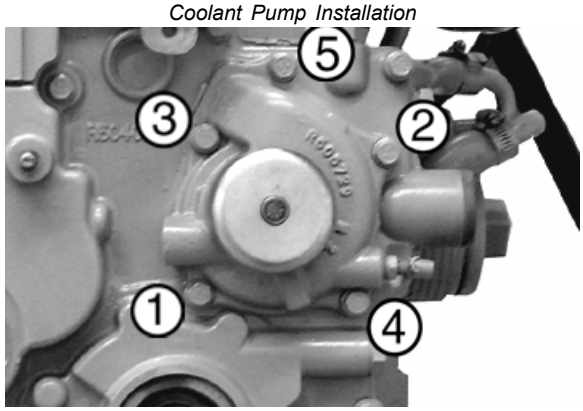
Coolant Gasket Sealant Pattern

RG12953 —UN—12JUN03



Coolant Pump Installation

RG12981 —UN—12JUN03



Coolant Pump Torque Sequence

RG12951 —UN—11JUN03

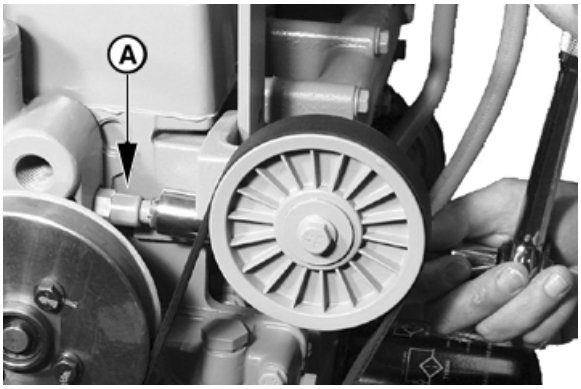
4. Fill cooling system with proper coolant.

MK41968,0000333 -19-05NOV09-1/1

Cooling System — Deaeration

Deaeration is normally accomplished by the jiggle pin or notch in the thermostat flange. However, a pocket of air can stay on the top rear of the engine. When refilling the cooling system, loosen the coolant temperature sensor (A) or a coolant line at the highest point of the system to allow air to escape.

A—Coolant Temperature Sensor



RG17019 —UN—26APR09

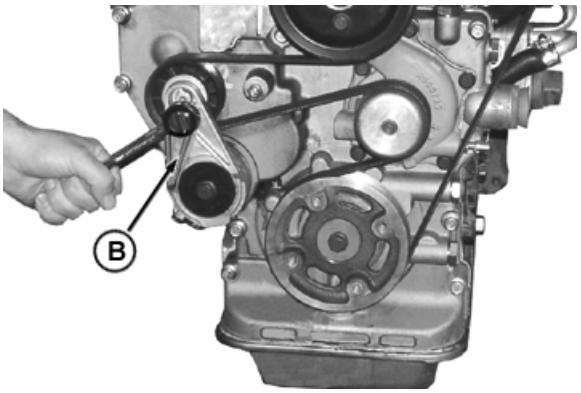
Cooling System Deaeration

MK41968,0000335 -19-27APR09-1/1

Fan and Alternator Belt — Removal

Special Tools:
• None

1. Inspect belts for cracks, fraying, or stretched out areas. Replace if necessary.
2. Release tension on belt using a 3/8-inch drive arm (B) on tension arm.
3. Remove poly-vee belt from pulleys.



RG17015 —UN—05NOV09

Belt Removal

MK41968,0000336 -19-27APR09-1/1

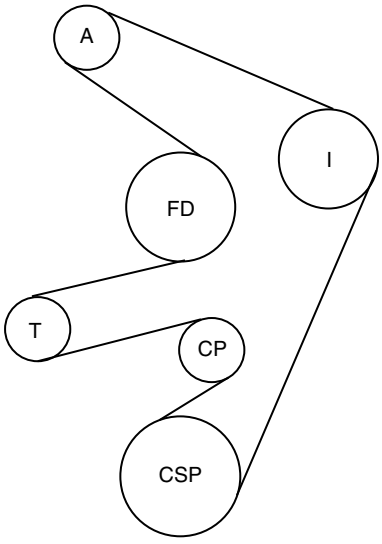
Fan and Alternator Belt — Installation

Special Tools:
• None

Consumables:
• None

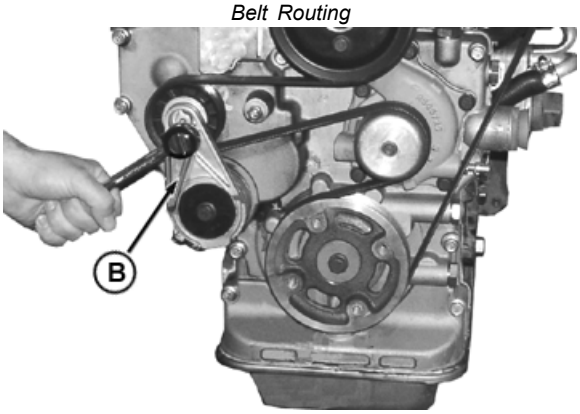
1. Install new belt, making sure belt is correctly seated in all pulley grooves. Refer to belt routing at right for your application.
2. Best method to install belt is:
   Back-wrap it around the fan pulley (FD), route it over the alternator (A), over top of the idler pulley (I), then down and around the crankshaft pulley (CSP). Finally, use a 3/8-inch drive arm to rotate the tensioner (T) to the tensioned position and slip the belt (back-wrap) over the coolant pump pulley (CP), then release the tensioner.
3. Apply tension to belt with drive arm (B). Remove drive arm.
4. Start engine and check belt alignment.

A—Alternator
B—Drive Arm
CP—Coolant Pump
CSP—Crankshaft Pulley
FD—Fan Drive
I— Idler Pulley
T—Tensioner



RG12799 —UN—21JAN03

Belt Routing



RG17015 —UN—05NOV09

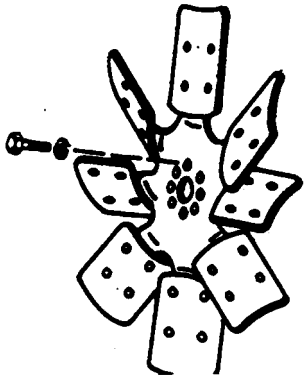
Belt Installation

MK41968,0000337 -19-05NOV09-1/1

Fan Assembly — Removal

Special Tools:
• None

1. Remove the fan-to-pulley hub cap screws (with lock washers) & remove fan.
2. Perform Fan Assembly — Inspection.



RG4797 —UN—14DEC88

Engine Fan

MK41968,0000338 -19-04NOV09-1/1

Fan Assembly — Inspection

1. Inspect fan blades for bent or damaged condition.
2. Bent blades reduce cooling system efficiency and throw the fan out of balance.
3. Replace fan if blades are bent or damaged.

MK41968,0000339 -19-29JUL09-1/1

Fan Assembly — Installation

Special Tools:
• None

Consumables:
• None

Several fan drive ratios are available, allowing a closer matching of fan speed to application.

NOTE: Engines may be equipped with either suction-type fan or a blower-type fan, depending on application. Take care to install the fan correctly. Refer to illustrations to identify fan type and corresponding installation.

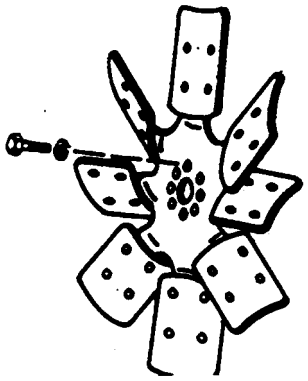
1. Install fan on pulley or pulley hub.

   Install blower-type fan with concave side of blade toward radiator.

   Install suction-type fan with concave side of blade toward engine.

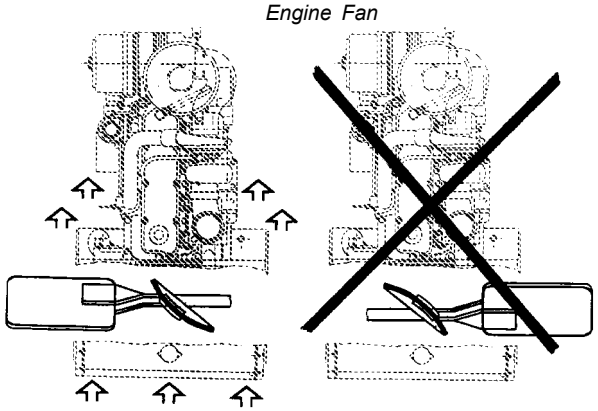
2. Tighten cap screws (with lock washers) to specifications.

Specification	
Fan-to-Pulley Hub M8	
Cap Screws—Torque	35 N·m (26 lb-ft)
Fan-to-Pulley Hub M10	
Cap Screws—Torque	70 N·m (52 lb-ft)



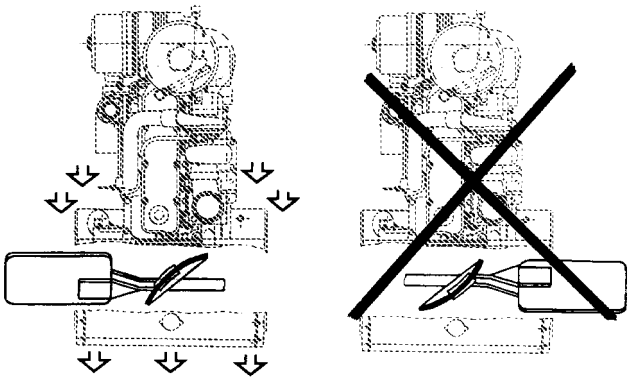
RG4797 —UN—14DEC88

Engine Fan



CD30648 —UN—16JUN98

Suction Fan (Top View)



CD30649 —UN—16JUN98

Blower Fan (Top View)

MK41968,000033A -19-29JUL09-1/1

Fan Pulley — Removal

Special Tools:
• None

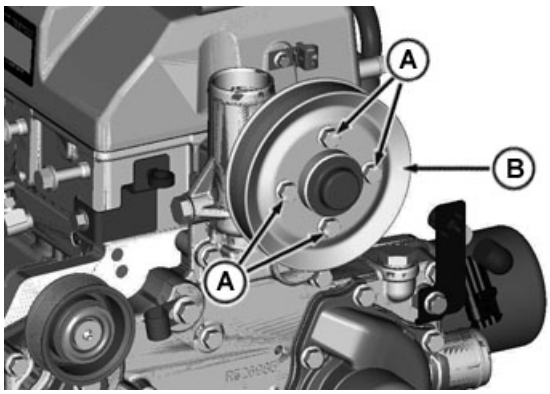
1. Perform Fan Assembly — Removal.

   Special Tools:
   • None

2. Perform Fan and Alternator Belt — Removal.

   Special Tools:
   • None

3. Remove four screws (A) and fan pulley (B).



RG17421 —UN—29JUL09

Fan Pulley Removal

MK41968,0000010 -19-04NOV09-1/1

Fan Pulley — Installation

Special Special Tools:
• None

Consumables:
• None

1. Install fan pulley (B) and cap screws (A). Tighten caps screws to specification.

Specification

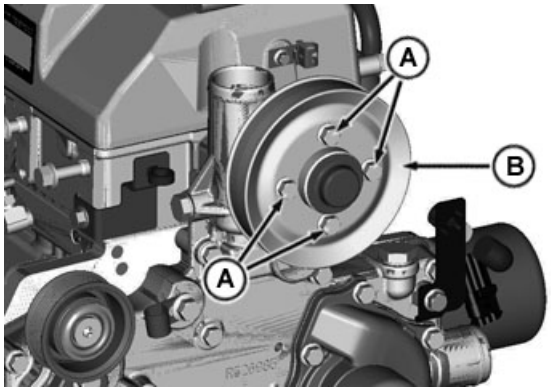
Fan Pulley Cap Screw—Torque..... 32 N•m (24 lbft)

2. Perform Fan and Alternator Belt — Installation.

   Special Tools:
   • None

   Consumables:
   • None

3. Perform Fan Assembly — Installation.



RG17421 —UN—29JUL09

Fan Pulley Installation

Special Tools:
• None

Consumables:
• None

MK41968,0000011 -19-04NOV09-1/1

Idler Pulley(s) with Lift Strap — Removal

1. Perform Fan Assembly — Removal.

   Special Tools:
   • None

2. Perform Fan and Alternator Belt — Removal.

   Special Tools:
   • None

3. **Idler Pulley(s) with Lift Strap Removal**

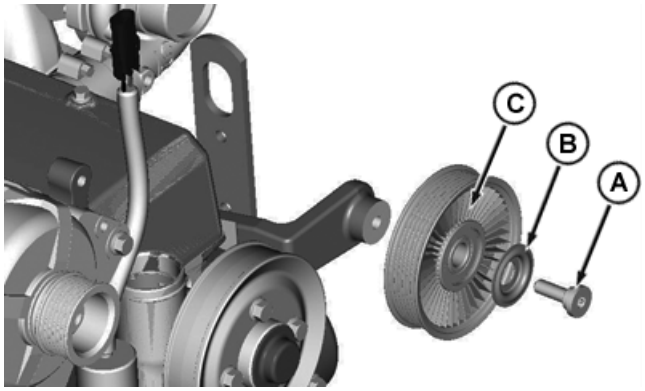
   Special Tools:
   • None

   a. Remove socket head screw (A), dust shield (B) and the idler pulley (C)

   b. Remove caps screws (D), Lift strap (E) and the mounting bracket (F).

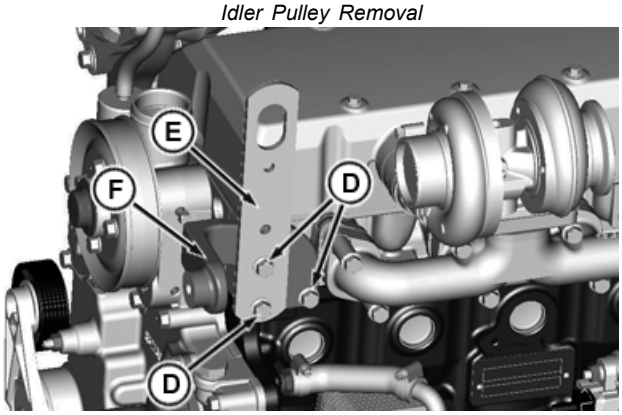
NOTE: Some applications may have an additional idler pulley.

A—Socket Head Screw
B—Dust Shield
C—Idler Pulley
D—Cap Screw
E—Lift Strap
F—Mounting Bracket
I— Idler Pulley



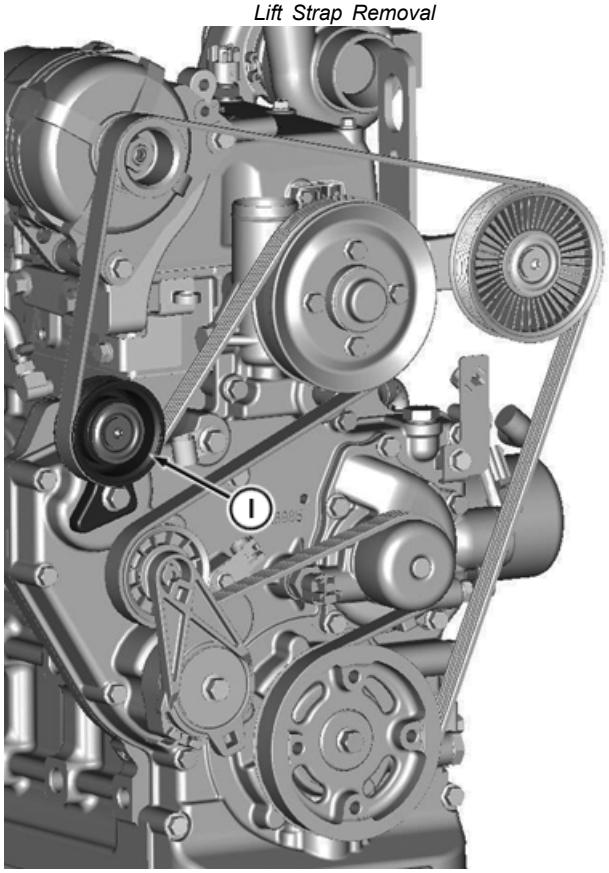
RG17433 —UN—31JUL09

Idler Pulley Removal



RG17434 —UN—31JUL09

Lift Strap Removal



RG17435 —UN—31JUL09

Additional Idler Pulley Location

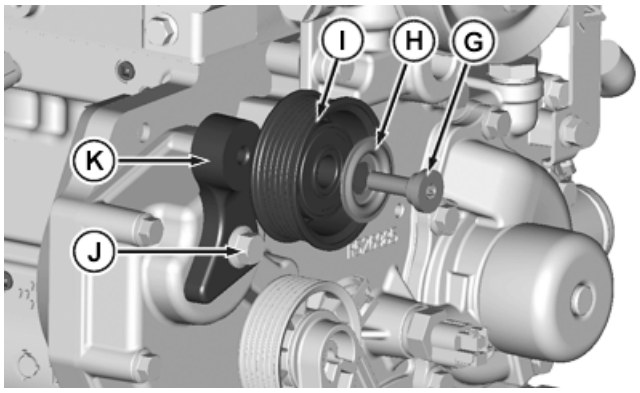
Continued on next page

MK41968,0000017 -19-04NOV09-1/2

c. Remove socket head screw (G), dust shield (H) and the idler pulley (I)

d. Remove screw (J) and mounting bracket (K).

G—Socket Head Screw
H—Dust Shield
I— Idler Pulley
J— Cap Screw
K—Mounting Bracket



RG17436 —UN—31JUL09

Additional Pulley Removal

MK41968,0000017 -19-04NOV09-2/2

Idler Pulley(s) with Lift Strap — Installation

Special Tools:
• None

Consumables:
• None

1. **Idler Pulley(s) with Lift Strap Installation**

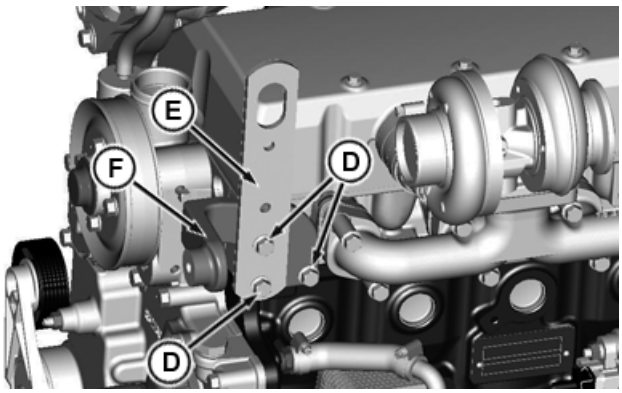
a. Install mounting bracket (F), lift strap (E) and tighten caps screws (D) to specification.

Specification	
Idler Pulley Mounting Bracket Cap Screw—Torque	40 N•m (30 lb-ft)

b. Install idler pulley (C), dust shield (B) and socket head screw (A). Orient the dust shield as shown. Tighten socket head screw to specification.

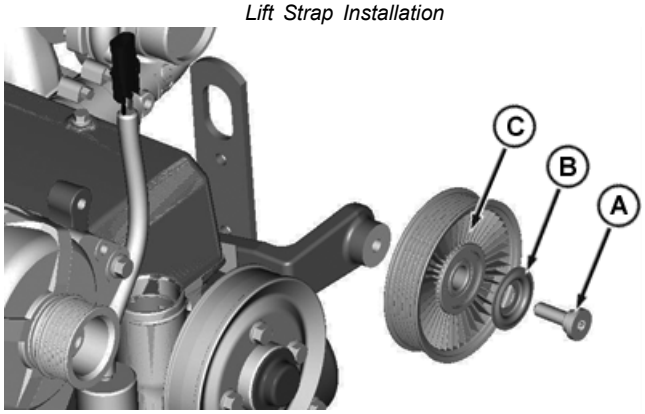
Specification	
Socket Head Screw—Torque	50 N•m (37 lb-ft)

A—Socket Head Screw
B—Dust Shield
C—Idler Pulley
D—Cap Screw
E—Lift Strap
F—Mounting Bracket
I— Idler Pulley



RG17434 —UN—31JUL09

Lift Strap Installation



RG17433 —UN—31JUL09

Idler Pulley Installation

Continued on next page

MK41968,0000018 -19-04NOV09-1/2

NOTE: Some applications may have an additional idler pulley.

c. Install idler pulley bracket (K) to timing gear cover, making sure the pin seats in the orientation hole in the cover. Install cap screw (J) and tighten to specification.

Specification

Bracket Mounting Cap Screw—Torque ..... 80 N•m (59 lb-ft)

d. Install additional idler pulley (I), dust shield (H) and tighten socket head screw (G). Orient the dust shield as shown.
Tighten socket head screw to specification.

Specification

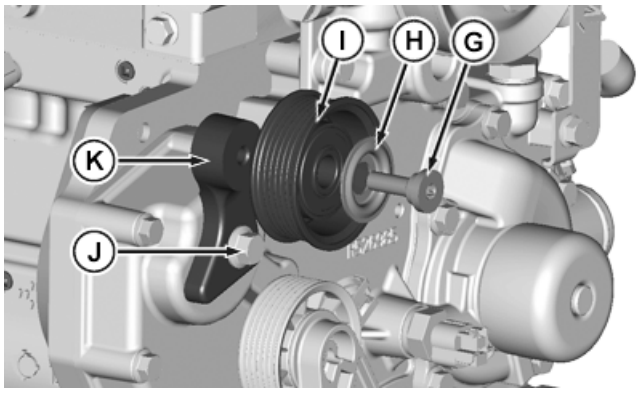
Socket Head Screw—Torque ..... 50 N•m (37 lb-ft)

2. Perform Fan and Alternator Belt — Installation.

Special Tools:
• None

Consumables:
• None

3. Perform Fan Assembly — Installation.



RG17436 —UN—31JUL09

Additional Pulley Removal

G—Socket Head Screw
H—Dust Shield
I— Idler Pulley
J— Cap Screw
K—Mounting Bracket

Special Tools:
• None

Consumables:
• None

MK41968,0000018 -19-04NOV09-2/2

Fan Bearing (Standard-Duty) — Removal

1. Perform Fan Assembly — Removal.

   Special Tools:
   • None

2. Perform Fan and Alternator Belt — Removal.

   Special Tools:
   • None

3. Perform Fan Pulley — Removal.

   Special Tools:
   • None

4. **Standard-Duty Fan Bearing Removal**

   Special Tools:
   • JDG1679—Fan Bearing Remover & Installer Kit
   • JDG10409—Wrench Adapter

   a. Position JDG1679-7 Puller (A) behind the fan hub/bearing assembly. Install JDG1679-1 Forcing Screw (B) in the open alternate fan height position machined hole.

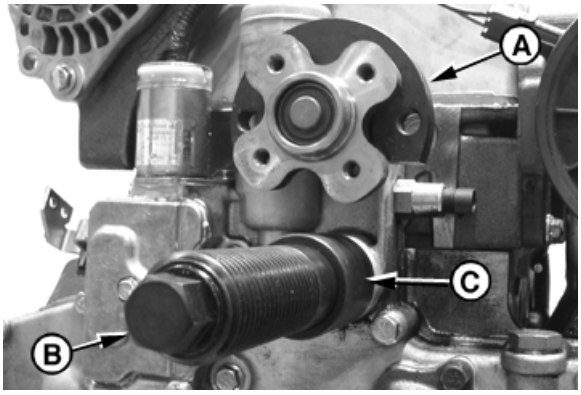
   b. Slide JDG1679-6 Spacer (C), JDG1679-2 Base (D) and JDG1679-3 Washer (E) over the forcing screw. Install JDG1679-4 Special Nut (F) on forcing screw and tighten.

   c. Slide long cap screws (G) through JDG1679-2 Base and thread into JDG1679-7 Puller.

   d. Pull fan hub/bearing assembly from the fan bushing by alternately turning each cap screw approximately one revolution.

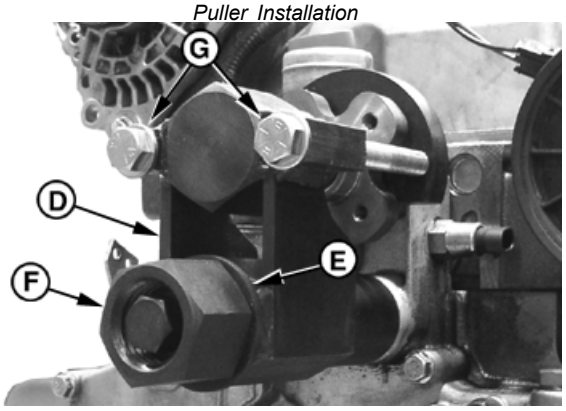
   e. Carefully remove fan bearing bushing (I) from the timing gear cover using JDG1679-5 Insert Wrench (H), a thin profile 32 mm (1-1/4 in.) open-end wrench or JDG10409 Wrench Adapter.

A—JDG1679-7 Puller
B—JDG1679-1 Forcing Screw
C—JDG1679-6 Spacer
D—JDG1679-2 Base
E—JDG1679-3 Washer
F—JDG1679-4 Special Nut
G—Cap Screws
H—JDG1679-5 Insert Wrench
I— Fan Bearing Bushing



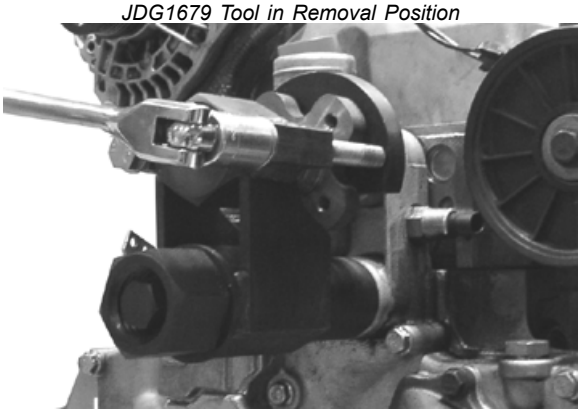
RG13018 —UN—26JUN03

Puller Installation

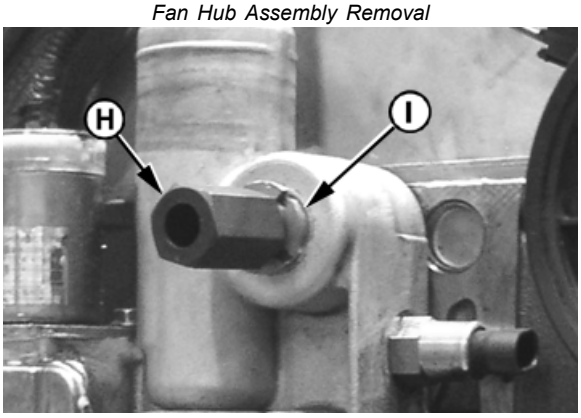


RG13019 —UN—26JUN03

JDG1679 Tool in Removal Position


RG13020 —UN—26JUN03

Fan Hub Assembly Removal



RG13021 —UN—27JUN03

Fan Bearing Bushing

MK41968,0000012 -19-14APR10-1/1

Fan Bearing (Standard-Duty) — Installation

Special Tools:
• JDG1679—Fan Bearing Remover & Installer Kit

Consumables:
• None

1. **Fan Bearing (Standard-Duty) Installation**

   a. Install fan bearing bushing (I) in the timing gear cover upper or lower fan mount boss. Tighten to specifications using JDG1679-5 Insert Wrench (H), a thin profile 32 mm (1-1/4 in.) open-end wrench or JDG10409 Wrench Adapter.

Specification

Fan Bushing—Torque.....87 N•m (75 lb-ft)

   b. Install JDG1679-1 Forcing Screw (B) in the open alternate fan height position machined hole.

   c. Slide JDG1679-2 Installer Tool (D) over forcing screw while holding the fan hub/bearing assembly (C) in position.

   d. Install JDG1679-3 Washer (E) and JDG1679-4 Special Nut (F).

   e. Slowly turn nut, forcing the fan hub/bearing assembly into the fan bushing. Turn nut until the tool body contacts the forcing screw collar.

   f. Remove tools, install fan pulley and tighten cap screws to specifications.

Specification

Fan Pulley Cap Screw—Torque.....32 N•m (24 lb-ft)

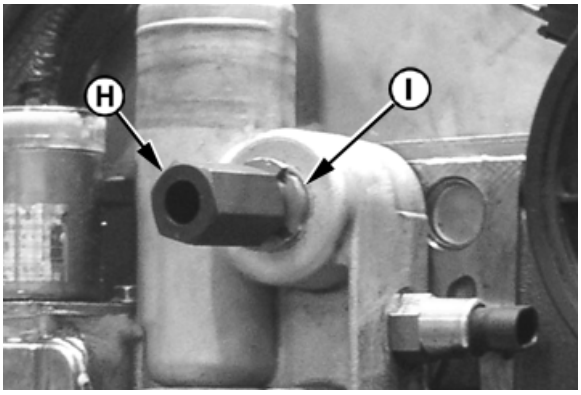
2. Perform Fan Pulley — Installation.

   Special Tools:
   • None

   Consumables:
   • None

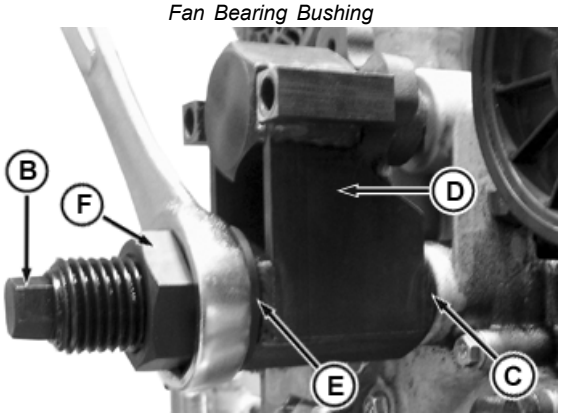
3. Perform Fan and Alternator Belt — Installation.

   Special Tools:
   • None



RG13021 —UN—27JUN03

Fan Bearing Bushing



RG17485 —UN—20AUG09

Forcing Screw Installment

B—JDG1679-1 Forcing Screw
C—Fan Hub/Bearing Assembly
D—JDG1679-2 Base
E—JDG1679-3 Washer
F—JDG1679-4 Special Nut
H—JDG16795 Insert Wrench
I— Fan Bearing Bushing

   Consumables:
   • None

4. Perform Fan Assembly — Installation.

   Special Tools:
   • None

   Consumables:
   • None

MK41968,0000014 -19-14APR10-1/1

Fan Bearing (Heavy-Duty) — Removal

1. Perform Fan Assembly — Removal.

   Special Tools:
   • None

2. Perform Fan and Alternator Belt — Removal.

   Special Tools:
   • None

3. Perform Fan Pulley — Removal.

   Special Tools:
   • None

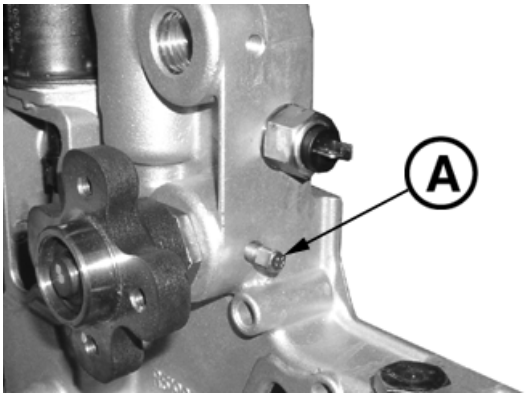
4. **Heavy-Duty Fan Bearing Removal**

   Special Tools:
   • JDG10409—Wrench Adapter

   a. Remove fan hub assembly retaining set screw (A).

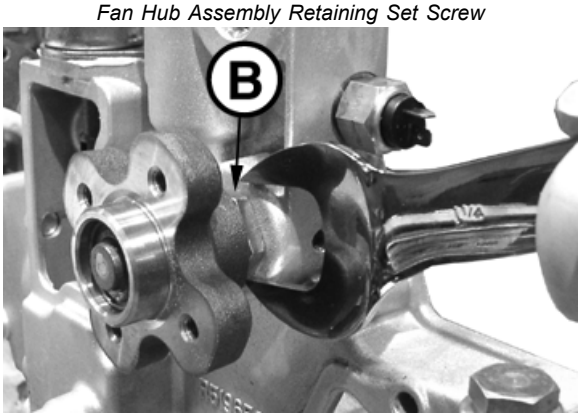
   b. Remove the fan hub assembly (B) using a thin profile 32 mm (1-1/4 in.) open-end wrench or JDG10409 Wrench Adapter.

A—Fan Hub Retaining Set Screw
B—Fan Hub Assembly
C—JDG10409 Wrench Adapter



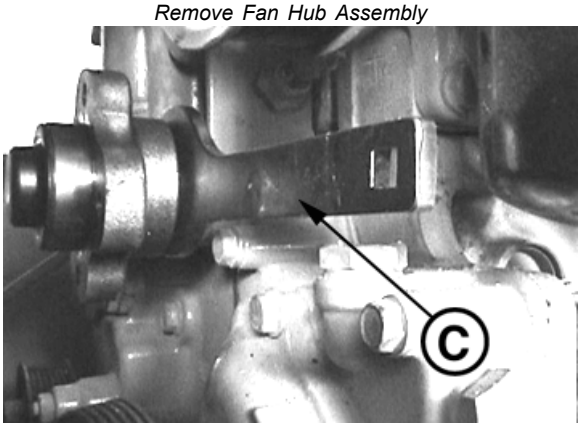
RG13634 —UN—01SEP04

Fan Hub Assembly Retaining Set Screw



RG13635 —UN—01SEP04

Remove Fan Hub Assembly



RG14951 —UN—11JUL06

Tighten Fan Bushing

MK41968,0000015 -19-14APR10-1/1

Fan Bearing (Heavy-Duty) — Installation

Special Tools:
• JDG10409—Wrench Adapter

Consumables:
• LOCTITE® 242 Thread Lock and Sealant

1. **Fan Bearing (Heavy-Duty) Installation**

   a. Apply LOCTITE® 242 Thread Lock and Sealer to new fan hub assembly and install at the desired fan height location. Tighten fan hub assembly to specifications using JDG10409 Wrench Adapter (C) with a standard length (12 in.) 3/8-in.drive torque wrench. Actual installed fan hub assembly torque is 100 N·m (75 lb-ft).

Specification	
Fan Hub Assembly Torque with JDG10409 Wrench Adapter—Torque	68 N·m (50 lb-ft)

   b. Apply LOCTITE® 242 Thread Lock and Sealer to fan hub assembly retaining set screw (A). Install and tighten to specifications.

Specification	
Fan Bushing Set Screw—Torque	15 N·m (10 lb-ft)

2. Perform Fan Pulley — Installation

   Special Tools:
   • None

   Consumables:
   • None

3. Perform Fan and Alternator Belt — Installation.

   Special Tools:
   • None

   Consumables:
   • None

4. Perform Fan Assembly — Installation.

   Special Tools:
   • None

   Consumables:
   • None

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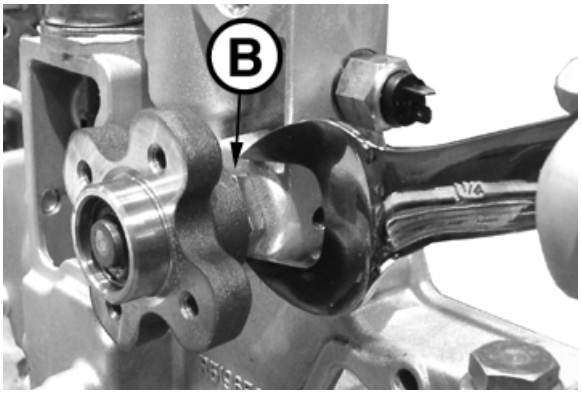
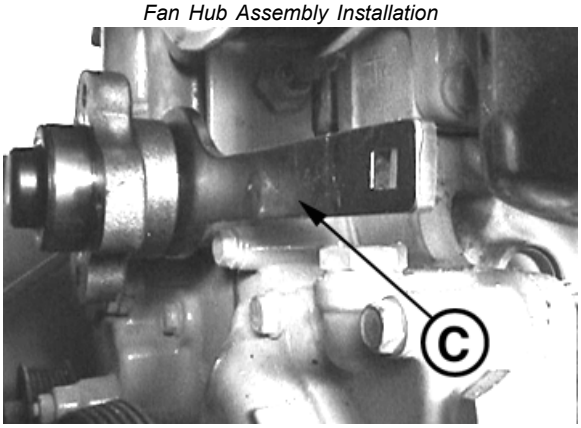


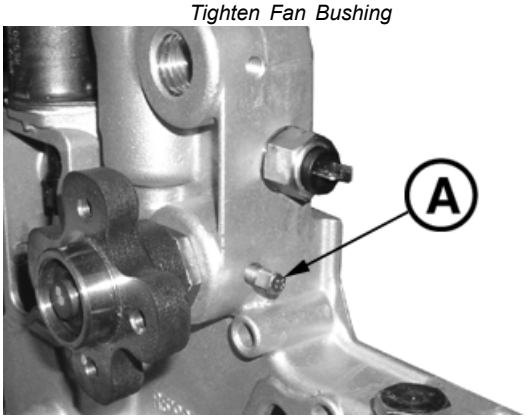
RG13635 —UN—01SEP04

Fan Hub Assembly Installation



RG14951 —UN—11JUL06

Tighten Fan Bushing



RG13634 —UN—01SEP04

Fan Hub Assembly Retaining Set Screw

A—Fan Hub Retaining Set Screw
B—Fan Hub Assembly
C—JDG10409 Wrench Adapter

MK41968,0000016 -19-14APR10-1/1

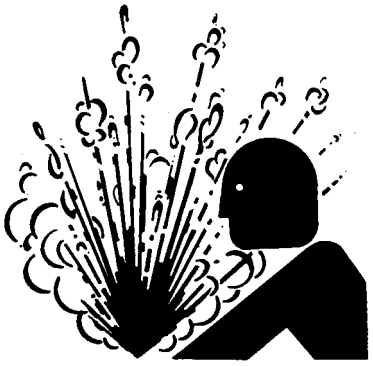
Thermostat — Removal

Special Tools:
• None

CAUTION: Explosive release of fluids from pressurized cooling system can cause serious burns. DO NOT drain coolant until it has cooled below operating temperature. Always loosen radiator pressure cap or drain valve slowly to relieve pressure.

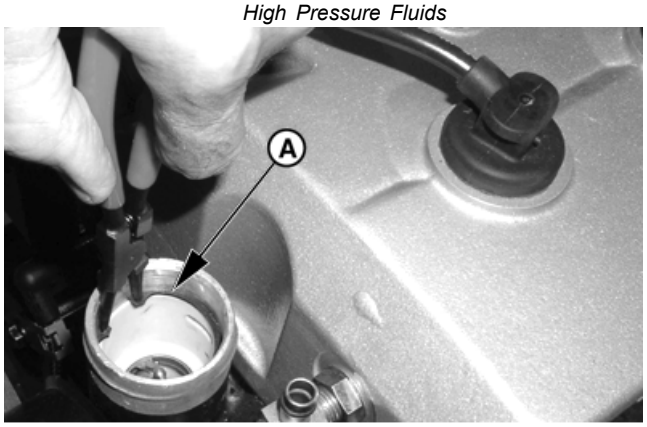
1. Visually inspect area around thermostat housing on top of engine timing gear cover for leaks.
2. Remove radiator pressure cap and partially drain cooling system.
3. Remove coolant hose (shown removed) from thermostat housing.
4. Remove snap ring (A) from thermostat housing.
5. Remove thermostat (B) from thermostat housing.
6. Clean and check thermostat housing for cracks or damage.

A—Snap Ring **B—Thermostat**



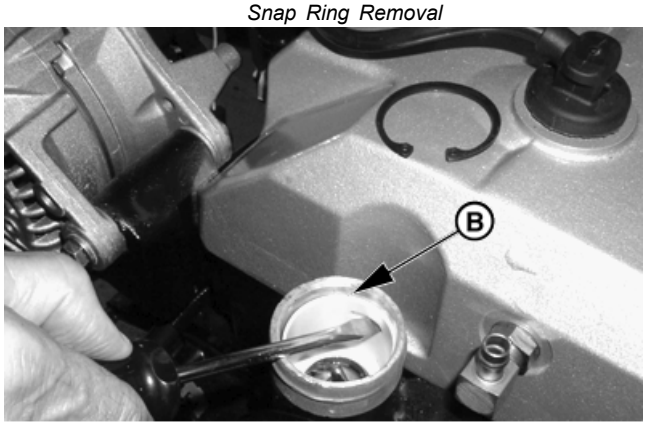
TS281 —UN—23AUG88

High Pressure Fluids



RG17021 —UN—26APR09

Snap Ring Removal



RG17022 —UN—26APR09

Thermostat Removal

MK41968,000033D -19-27APR09-1/1

Thermostat — Installation

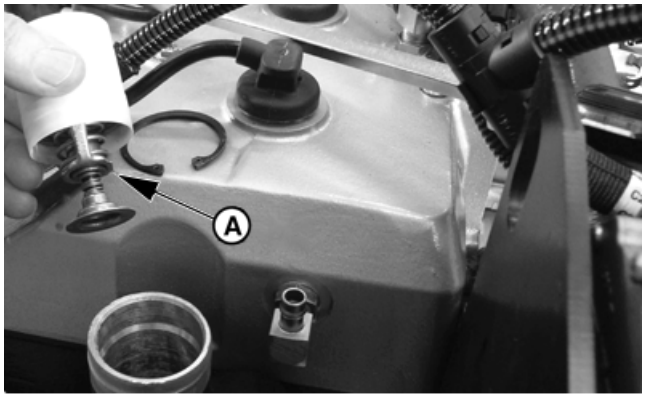
Special Tools:
• None.

Consumables:
• None

1. Insert thermostat (A) in housing.
2. Install snap ring (B) in groove.
3. Install coolant hose to thermostat cover. Tighten clamp.
4. If not already done, fill cooling system and check for leaks.

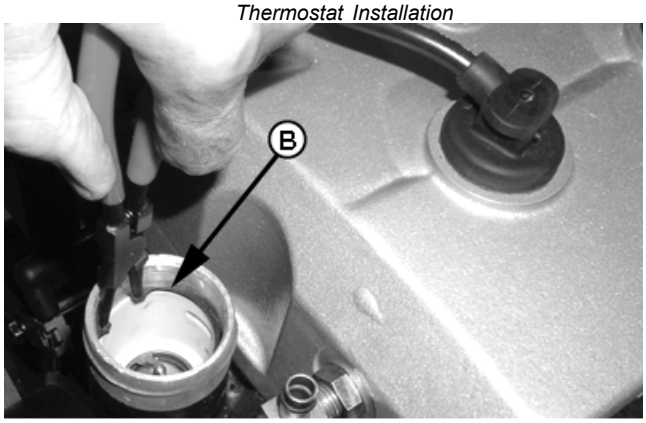
IMPORTANT: Air must be expelled from cooling system when filling. Loosen temperature sending unit fitting at rear of cylinder head or plug in thermostat housing to allow air to escape when filling system. Tighten fitting or plug when all air has been expelled.

A—Thermostat **B—Snap Ring**



RG17023 —UN—26APR09

Thermostat Installation



RG14929 —UN—13JUL06

Snap Ring Installation

MK41968,000032F -19-29JUL09-1/1

Essential, Recommended and Fabricated Tools For This Group

There are no special tools involved in this group.

MK41968,0000008 -19-21MAY09-1/1

Exhaust Manifold — Removal

Standard Exhaust Manifold — Removal

1. Perform Turbocharger — Removal.

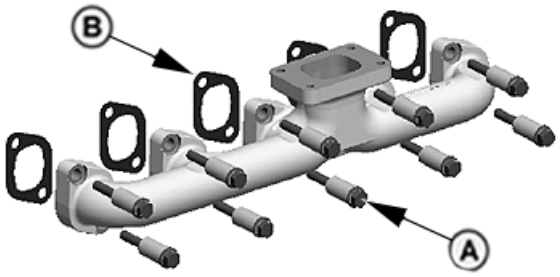
   Special Tools:
   • None

2. **Standard Exhaust Manifold Removal**

   Special Tools:
   • None

   a. Remove cap screws and spacers (A)

   b. Remove exhaust manifold, manifold gaskets (B) and discard.



RG17057 —UN—29APR09

Exhaust Manifold Assembly

A—Cap Screws with Spacers **B—Gaskets**

MK41968,000033F -19-14SEP09-1/2

Low Mount Exhaust Manifold — Removal

1. Perform Turbocharger — Removal.

   Special Tools:
   • None

2. **Low Mount Exhaust Manifold Removal**

   Special Tools:
   • None

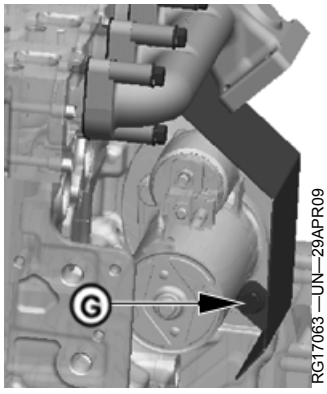
   a. Remove heat shield mounting cap screw (G).

   b. Remove 2 mounting nuts (E) and the heat shield (F).

   c. Remove 6 cap screws with spacers (B), 2 studs with nuts and exhaust manifold (D) with gaskets (A).

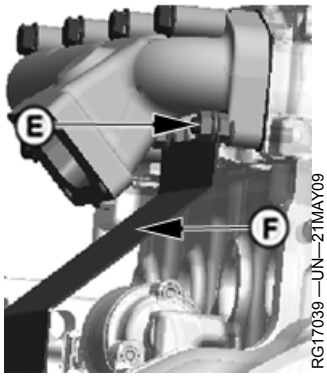
   d. Perform Exhaust Manifold — Inspection.

A—Exhaust Manifold Gasket
B—Cap Screws with Spacers
C—Nuts and Studs
D—Exhaust Manifold
E—Heat Shield Mounting Nuts
F—Heat Shield
G—Heat Shield Mounting Cap Screw



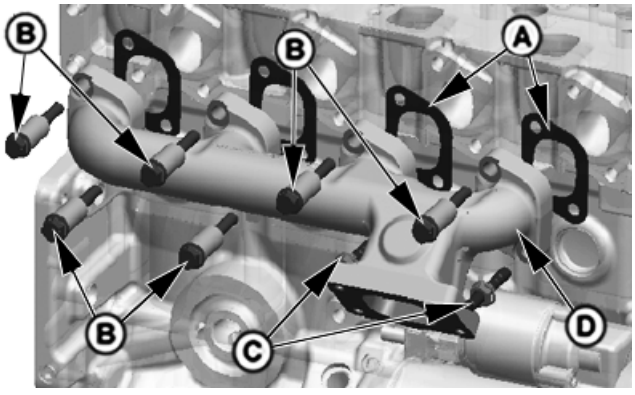
RG17063 —UN—29APR09

Heat Shield Mounting Cap Screw



RG17039 —UN—21MAY09

Heat Shield Mounting Nuts



RG17038 —UN—21MAY09

Low Mount Exhaust Manifold Removal

MK41968,000033F -19-14SEP09-2/2

Exhaust Manifold — Inspection

1. Remove all residue and gasket material from all gasket surfaces.
2. Thoroughly clean passages in the exhaust manifold.
3. Inspect exhaust manifold for cracks or damage.
4. Inspect machined mounting surfaces for burrs or other defects which might prevent gaskets from sealing properly. Replace parts as needed.

MK41968,0000340 -19-28APR09-1/1

Exhaust Manifold — Installation

Special Tools:
• None

Consumables:
• Exhaust Manifold Gaskets

Standard Exhaust Manifold Installation

1. **Standard Exhaust Manifold Installation**
   a. Align new gaskets (B) on exhaust manifold and exhaust ports.
   b. Install all cap screws with spacers (A) and finger tight to maintain gasket alignment.
   c. Tighten cap screws on No. 2 and No. 3 cylinders to specification.

Specification	
Exhaust Manifold Cap Screw—Torque	32 N•m (24 lb-ft)

   d. Tighten cap screws on No. 1 and No. 4 cylinders to specification.
   For 5-Cylinder engines tighten No. 1, No. 4, and No. 5 cylinders to specification.

Specification	
Exhaust Manifold Cap Screw—Torque	32 N•m (24 lb-ft)

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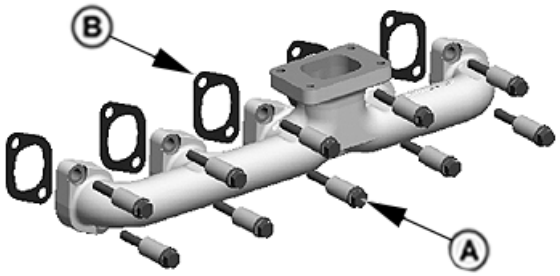

RG17057 —UN—29APR09

Exhaust Manifold Assembly

A—Cap Screws with Spacers **B—Gaskets**

2. Perform Turbocharger — Installation.

   Special Tools:
   • None

   Consumables:
   • Mounting Gasket, Drain Tube Gasket, LOCTITE® 592, PT569 NEVER-SEEZ® Compound, Engine Oil

Continued on next page

MK41968,0000007 -19-14SEP09-1/2

Low Mount Exhaust Manifold Installation

1. **Low Mount Exhaust Manifold Installation**

   a. Align new gaskets (A) on exhaust manifold and exhaust ports.

   b. Insert 6 spacers and cap screws (B), 2 studs and nuts (C). Finger tight to assure gasket alignment.

   c. Tighten cap screws on No. 2 and No. 3 cylinders to specification.

Specification

Exhaust Manifold Cap Screw—Torque.....32 N•m (24 lb-ft)

   d. Tighten cap screws on No. 1 and No. 4 cylinders to specification.
   For 5-Cylinder engines tighten No. 1, No. 4, and No. 5 cylinders to specification.

Specification

Exhaust Manifold Cap Screw—Torque.....32 N•m (24 lb-ft)

   e. Place heat shield (F) on two studs and align the third point of contact to starter.

   f. Install 2 nuts (E) on studs and tighten to specification.

   g. Install cap screw (G) in starter hole and tighten to specification.

Specification

Heat Shield Mounting Nuts—Torque.....32 N•m (24 lb-ft)
Heat Shield Mounting Cap Screw—Torque.....32 N•m (24 lb-ft)

2. Perform Turbocharger — Installation.

Special Tools:
• None

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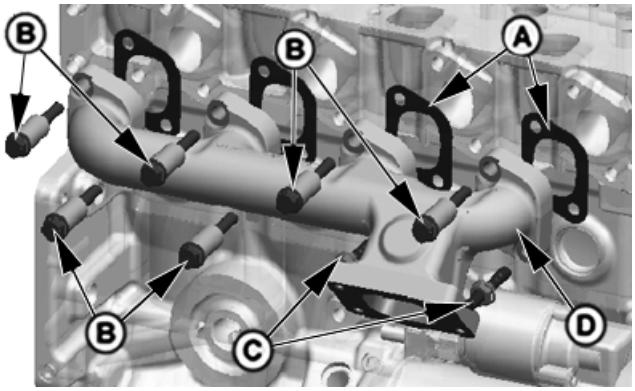
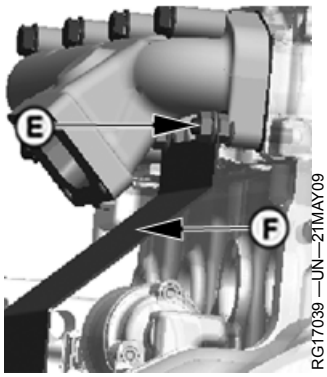


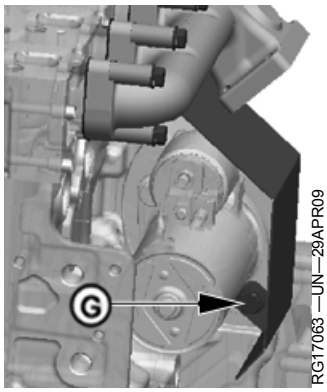
RG17038 —UN—21MAY09

Exhaust Manifold Installation



RG17039 —UN—21MAY09

Heat Shield Mounting Nuts



RG17063 —UN—29APR09

Heat Shield Mounting Cap Screw

A—Exhaust Manifold Gasket
B—Cap Screws with Spacers
C—Nuts and Studs
D—Exhaust Manifold
E—Heat Shield Mounting Nuts
F—Heat Shield
G—Heat Shield Mounting Cap Screw

Consumables:
• Mounting Gasket, Drain Tube Gasket, LOCTITE® 592, PT569 NEVER-SEEZ® Compound, Engine Oil

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Extending Turbocharger Life

Turbochargers are designed to last the life of the engine, but, because they operate at such high speeds (100,000 rpm or more); a moment's carelessness can cause them to fail in seconds.

The major causes of turbocharger failures are:

- **Lack of Lube Oil (Quick Starts and Hot Shutdowns)**
- **Oil Contamination**
- **Ingestion of Foreign Objects**
- **Restricted Oil Drainage**
- **Low Oil Level**
- **Operation on Excessive Side Slopes**
- **Abnormally High Exhaust Temperatures**
- **Oil in Charge Air Cooler**

Lack of Lube Oil

Oil not only lubricates the turbocharger's spinning shaft and bearings, it also carries away heat. When oil flow stops or is reduced, heat is immediately transferred from the hot turbine wheel to the bearings, which are also heating up because of the increased friction due to the lack of oil. This combination causes the turbocharger shaft temperature to increase rapidly.

If oil flow does not increase and the process continues, bearings will fail. Once the bearings fail (which can happen in just seconds) seals, shaft, turbine and compressor wheels can also be damaged.

The principle causes of turbocharger bearing lubrication problems are low oil pressure, a bent, plugged or undersized oil lube supply line, plugged or restricted oil galleries in the turbocharger, or improper machine start-up and shutdown procedure.

Oil levels and pressure should always be closely monitored and all worn hoses and lines should be replaced. The turbocharger oil supply line should be checked frequently to make sure it is not kinked or bent and it should always be replaced with a line of equal size, length and strength.

The easiest way to damage a turbocharger is through improper start-up and shutdown procedures. Always idle the engine for at least 30 seconds (no load) after start-up and before shutdown. Warming the engine up before applying a load allows oil pressure to build up and lines to fill with oil.

Idling the engine before shutdown allows the engine and turbocharger to cool. "Hot" shutdowns can cause the turbocharger to fail because after high-speed operation the turbocharger will continue to rotate long after the engine has been shut off and oil pressure has dropped to zero. This will cause heat to build up and possibly damage bearings. It can also cause carbon and varnish deposits to form.

Oil Contamination

A second cause of turbocharger failures is contaminated oil. It can be caused by a worn or damaged oil filter or not changing the lube oil at recommended intervals. Expecting the oil filter to remove dirt, sand, metal chips, etc. from the oil before they reach the engine or turbocharger can be a costly mistake because contaminated oil may completely bypass the engine oil filter if the oil filter or oil cooler is clogged, if the filter element is improperly installed, or if the oil is thick during cold weather.

Four good ways of avoiding oil contamination are:

- Always inspect the engine thoroughly during major overhaul. Look especially for any sludge or debris left in lube oil galleries.
- Change lube oil at recommended intervals. Analysis of oil samples at filter change periods can help identify potentially harmful contaminants in the oil.
- Clean the area around the oil fill cap before adding oil.
- Use a clean container when adding oil.

Ingestion of Foreign Objects

The third cause of turbocharger damage is the ingestion of foreign objects. These particles can be ingested and cause damage to the turbocharger on both compressor and turbine sides. This is easy to avoid.

On the compressor side, foreign objects usually take the form of dust, sand, or shreds of air cleaner element that enter through improperly installed air cleaner elements. Leaky air inlet piping (loose clamps or torn rubber joints) or torn pleats in dry-type air cleaner elements also create problems.

The result is erosion of compressor blades that can cause the delicately balanced wheel to wobble.

IMPORTANT: Whenever an internal engine failure (valve, valve seat, piston) occurs, a thorough inspection of the turbocharger MUST BE performed before returning engine to service.

Restricted Oil Drainage

A fourth cause of turbocharger damage is restricted lube oil drainage. The lubricating oil carries away heat generated by friction of the bearings and from the hot exhaust gases. If drainage back to the sump is impeded, the bearings will overheat with damage that will ultimately lead to failure.

There are two primary reasons for restricted drainage. A blocked drain tube, due to either damage or a buildup of sludged oil, or high crankcase pressure, which can be due to restricted crankcase breather or excessive engine blow-by.

Continued on next page

RG,RG34710,1256 -19-19MAY09-1/2

Periodically check both the turbocharger oil drain tube and engine breather tube for damage or restriction. Correction of these conditions leads to longer turbocharger life.

Abnormally High Exhaust Temperatures

A fifth cause of turbocharger damage is abnormally high exhaust temperatures. Elevated exhaust temperatures cause coking of oil which can lead to bearing failure. Extreme over-temperature operation can cause wheel burst.

There are two basic causes of over-temperature. The first is restricted air flow and the second is overpowering the engine. In either case the engine has more fuel than available air for proper combustion; this over-fueled condition leads to elevated exhaust temperatures.

Causes of restricted air flow can include damaged inlet piping, clogged air filters, excessive exhaust restriction, or operation at extreme altitudes. Overpowering generally is due to improper fuel delivery or injection timing. If over temperature operation has been identified, an inspection of the air inlet and exhaust systems should be performed. Also, check the fuel delivery and timing.

Oil in Charge Air Cooler

The sixth cause of turbo charger failure is oil in charge air cooler. Oil residue from a previous turbocharger failure collects in the charge air cooler. If not cleaned out, this oil will be ingested into the engine on subsequent start up causing an over speed situation and a possible second failure of turbocharger.

Anytime there has been a turbocharger failure, it is absolutely necessary to make certain that the charge air cooler, lines and/or hoses have been thoroughly cleaned out. All contamination, especially oil must be removed. For cleaning the charge air cooler, use John Deere Coolant System Cleaner PMCC2638 or equivalent as per the instructions. Use compressed air to completely dry the inside of the charge air cooler.

RG,RG34710,1256 -19-19MAY09-2/2

Glow Plugs — Removal

1. Perform Engine Wiring Harness — Removal.

   Special Tools:
   • None

2. Perform Fan and Alternator Belt — Removal.

   Special Tools:
   • None

3. Perform Alternator — Removal.

   Special Tools:
   • None

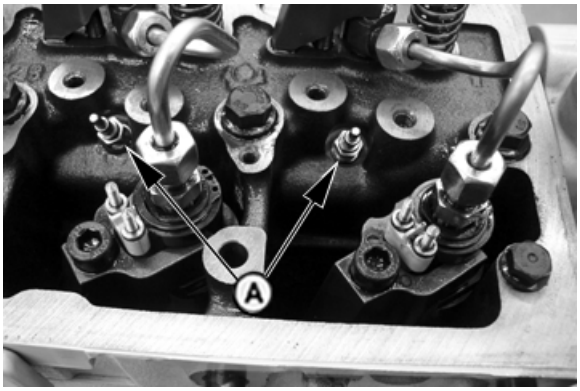
4. Perform Rocker Arm Cover — Removal.

   Special Tools:
   • None

5. Perform Glow Plug Wiring Harness — Removal.

   Special Tools:
   • None

6. **Glow Plugs Removal**



RG17047 —UN—28APR09

Glow Plugs Removal

Special Tools:
• None

a. Remove glow plugs (A) from cylinder head.

b. Inspect plug for defects and worn tip. Replace if required.

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Glow Plugs — Installation

Special Tools:
• None

Consumables:
• None

1. Install glow plugs and tighten to specification.

Specification

Glow Plug—Torque..... 13 N·m (9 lb-ft)

2. Perform Glow Plug Wiring Harness — Installation.

   Special Tools:
   • None

   Consumables:
   • None

3. Perform Rocker Arm Cover — Installation.

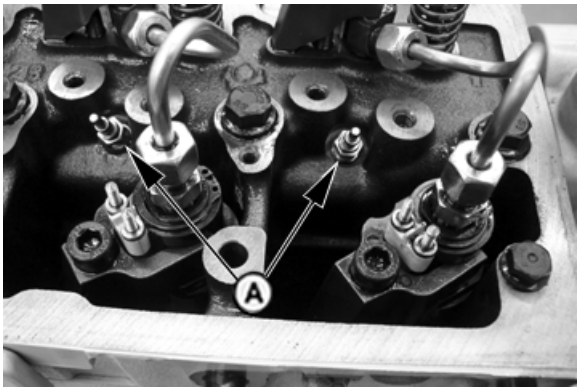
   Special Tools:
   • None

   Consumables:
   • O-rings, Rocker Arm Cover Gasket

4. Perform Alternator — Installation.

   Special Tools:
   • None

   Consumables:
   • None



RG17047 —UN—28APR09

Glow Plugs Installation

5. Perform Fan and Alternator Belt — Installation.

   Special Tools:
   • None

   Consumables:
   • None

6. Perform Engine Wiring Harness — Installation.

   Special Tools:
   • None

   Consumables:
   • None

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Glow Plug Wiring Harness — Removal

NOTE: It is not necessary to remove engine from machine to service cylinder head on all applications. Refer to your Machine Technical Manual for engine removal procedure, if required. The turbocharger may be removed from the engine, if desired.

1. Perform Engine Wiring Harness — Removal.

   Special Tools:
   • None

2. Perform Fan and Alternator Belt — Removal.

   Special Tools:
   • None

3. Perform Alternator — Removal.

   Special Tools:
   • None

4. Perform Rocker Arm Cover — Removal.

   Special Tools:
   • None

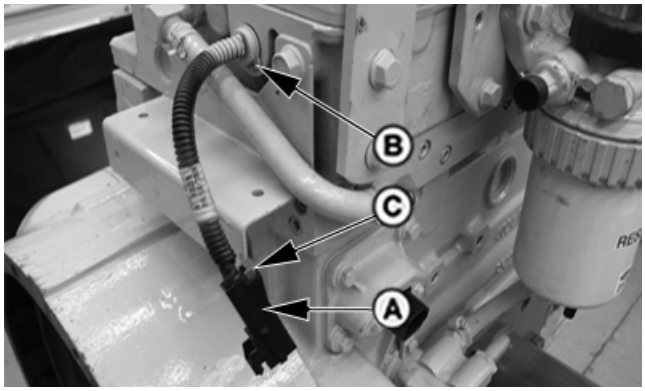
5. **Glow Plug Wiring Harness Removal**

   Special Tools:
   • None

   a. Disconnect glow plug wiring harness connector (A) from main engine harness (not shown).

   b. Remove snap ring (B) from wiring harness plug at the cylinder head.

   c. Remove the connector locking clip (C). Remove the connector (A) from the wire harness wiring lead by pushing the lead into the connector and releasing the clip from inside the connector with a pointed tool.



RG17089 —UN—04MAY09

Wiring Harness Removal

RG15584 —UN—24SEP07

Connector Removal

A—Wiring Harness Connector to Main Engine Harness
B—Snap Ring
C—Wiring Harness Locking Clip

Continued on next page

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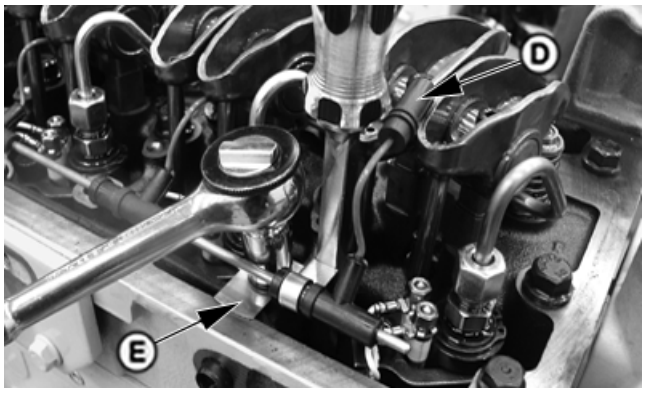
d. Pull the wiring harness connectors (D) off the glow plugs.

e. Hold the wiring harness clip (E) to prevent it from turning and remove the cylinder head/glow plug harness cap screws (F).

f. Remove wiring harness assembly from the cylinder head.

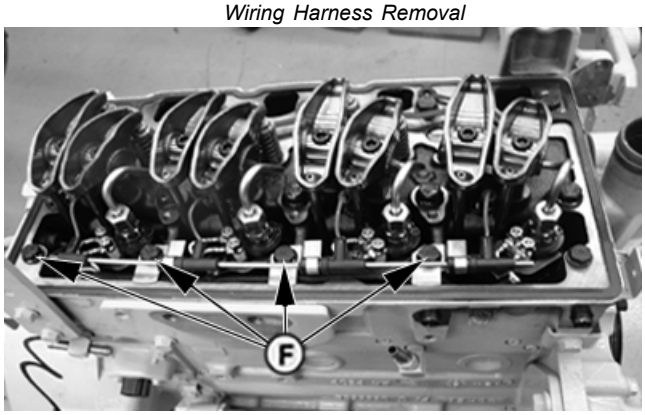
g. Inspect wiring harness for defects, broken wires and worn insulation. Replace as required.

D—Wiring Harness Connector
E—Harness Clip
F—Cap Screw



RG17090 —UN—04MAY09

Wiring Harness Removal



RG17091 —UN—04MAY09

Cylinder Head/Wiring Harness Cap Screws

MK41968,0000344 -19-14APR10-2/2

Glow Plug Wiring Harness — Installation

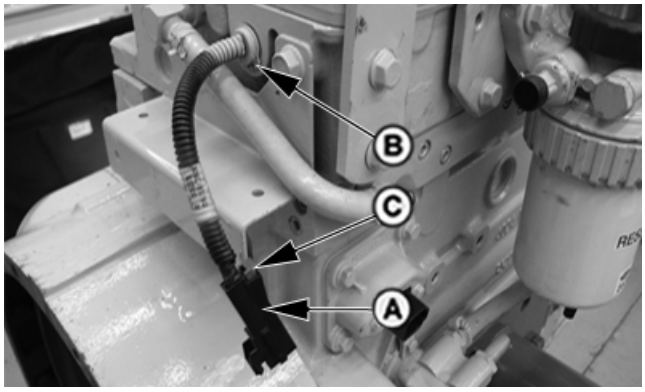
1. **Glow Plug Wiring Harness Installation**

   Special Tools:
   • None

   Consumables:
   • Engine Oil

   a. Insert the wiring harness lead through the hole at the rear of the cylinder head. Push the harness plug securely into the cylinder head and install the snap ring (B). Install the wiring connector (A) and secure to the wiring lead with the locking clip (C).

NOTE: The smaller diameter cylinder head cap screws used to attach the glow plug wiring harness may be reused.



RG17089 —UN—04MAY09

Wiring Harness Installation

A—Wiring Harness Connector to Main Engine Harness
B—Snap Ring
C—Wiring Harness Locking Clip

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MK41968,0000345 -19-14APR10-1/2

b. Dip cylinder head/glow plug harness cap screws in clean engine oil and install wiring harness assembly on the cylinder head. Hold the harness clips (E) in position to prevent the clip from turning and tighten cap screws to specification.

Specification	
Cylinder Head / Glow Plug Wire Harness Cap Screw—Torque	28 N•m (21 lb-ft)

c. Install wiring connectors (D) securely onto glow plugs.

d. Connect glow plug wiring harness to the main engine wiring harness.

2. Perform Rocker Arm Cover — Installation.

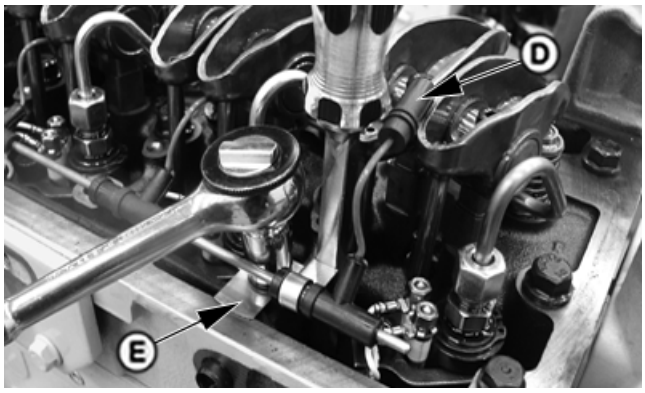
   Special Tools:
   • None

   Consumables:
   • O-rings, Rocker Arm Cover Gasket

3. Perform Alternator — Installation.

   Special Tools:
   • None

   Consumables:
   • None



RG17090 —UN—04MAY09

Wiring Harness Installation

4. Perform Fan and Alternator Belt — Installation.

   Special Tools:
   • None

   Consumables:
   • None

5. Perform Engine Wiring Harness — Installation.

   Special Tools:
   • None

   Consumables:
   • None

MK41968,0000345 -19-14APR10-2/2

Intake Manifold — Removal

The intake manifold is an integral part of the rocker arm cover. See in Section 2 Group 20 -

Rocker Arm Cover — Removal.

Special Tools:
• None

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Intake Manifold — Inspection

IMPORTANT: All intake manifold connections at the turbocharger and engine cylinder head must be tight to prevent loss of power resulting from lack of intake manifold pressure.

Intake manifold hose and rocker arm cover cap screws should be inspected periodically for tightness.

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Intake Manifold — Installation

IMPORTANT: All intake manifold connections at the turbocharger and engine cylinder head must be tight to prevent loss of power resulting from lack of intake manifold pressure.

The intake manifold is an integral part of the rocker arm cover. See in Section 02, Group 20 -

Rocker Arm Cover — Installation

Special Tools:
• None

Consumables:
• O-rings, Rocker Arm Cover Gasket

MK41968,0000348 -19-14SEP09-1/1

Turbocharger — Removal

Special Tools:
• None

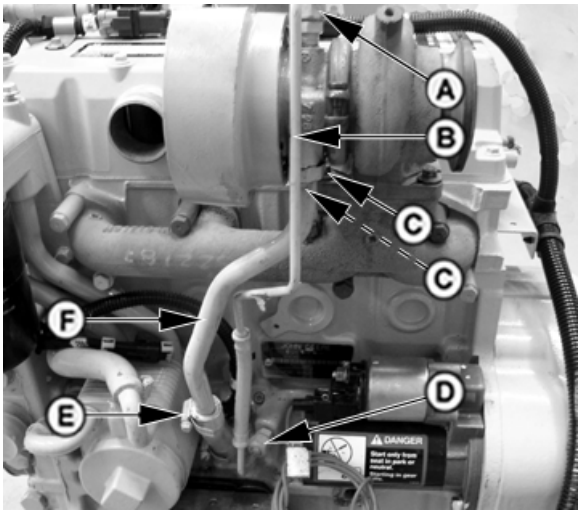
CAUTION: After operating engine, allow exhaust system to cool before removing turbocharger.

IMPORTANT: When cleaning turbocharger, do not spray directly into compressor cover or turbine housing. If turbocharger inspection is required, do not clean exterior prior to removal. Doing so may wash away evidence of a potential failure mode. See Turbocharger — Inspection in this group.

Standard Turbocharger Removal (MHI and BW type)

1. Remove air intake and exhaust piping from turbocharger (shown removed).
2. Remove fittings (A), (D) and oil inlet line (B). Discard gasket.
3. Remove clamp (E), 2 cap screws (C) and oil return line (F)
4. Remove 4 turbocharger mounting cap screws (G) and turbocharger. Discard gasket.
5. Cap or plug all openings on engine (exhaust and intake manifold related) and place turbocharger on a clean flat table for inspection.
6. Perform Turbocharger Failure Analysis, if failure mode has not been determined.
7. Perform Turbocharger — Inspection.

A—Oil Inlet Turbocharger Fitting
B—Oil Inlet Line
C—Cap Screws
D—Oil Inlet Cylinder Block Fitting
E—Oil Return Tube Clamp
F—Oil Return line
G—Turbocharger Cap Screws



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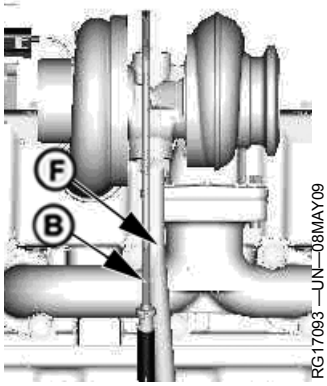
Turbocharger Removal (MHI Type Shown)



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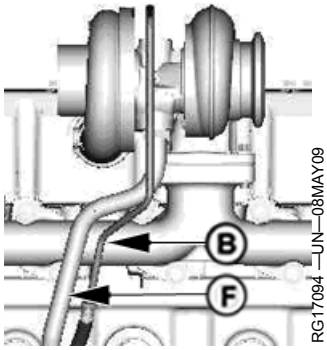
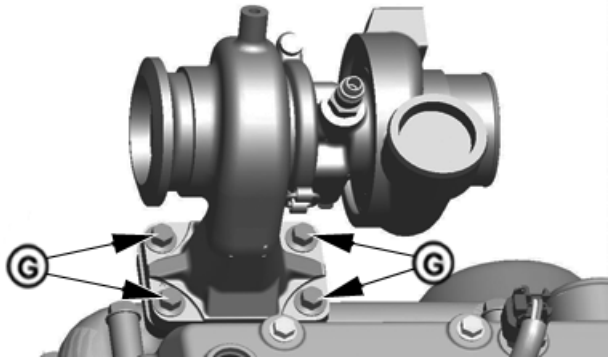
Oil Supply and Return Lines (BW 4 Cylinder Engine Type)



RG17094 —UN—08MAY09

Oil Supply and Return Lines (BW 5 Cylinder Engine Type)



RG17098 —UN—07MAY09

Turbocharger Cap Screws (MHI Type Shown)

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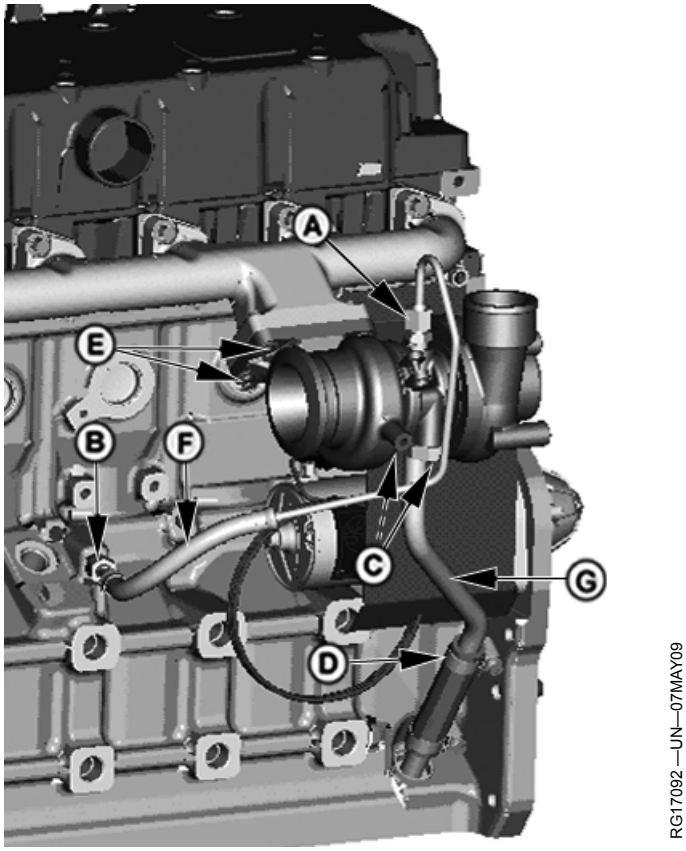
MK41968,0000349 -19-02JUN10-1/2

Low Mount MHI Turbocharger Removal

1. Remove air intake and exhaust piping from turbocharger (shown removed).
2. Remove fittings (A), (B) and remove oil intake line (F).
3. Remove clamp (D), 2 screws (C) and turbocharger oil return line (G). Discard gasket.
4. Remove 4 turbocharger mounting cap screws (E) and turbocharger. Remove and discard gasket.
5. Cap or plug all openings on engine (exhaust and intake manifold related) and place turbocharger on a clean flat table for inspection.
6. Perform Turbocharger Failure Analysis, if failure mode has not been determined.
7. Perform Turbocharger — Inspection.

A—Oil Inlet Turbocharger Fitting
B—Oil Inlet Cylinder Block Fitting
C—Cap Screws
D—Clamp
E—Cap Screws
F—Oil Intake Line
G—Oil Return Line



Low Mount MHI Turbocharger

MK41968,0000349 -19-02JUN10-2/2

Turbocharger Failure Analysis

The following is a guide for diagnosing the cause of turbocharger failures after removal from the engine.

Problem	Possible Cause	Suggested Remedy
COMPRESSOR HOUSING INLET DEFECTS		
Foreign Object Damage	Objects left in intake system.	Disassemble and inspect intake system for foreign objects (this group).
		Inspect engine for internal damage.
	Leaking and/or defective intake system.	Inspect air intake system connections including air filter; repair as required (this group).
		Inspect air intake related engine components.
Compressor Wheel Rub	Bearing failure.	Determine if engine and/or operator contributed to lack of lubrication, contaminated lubrication, excessive temperature, or debris generating engine failure in progress. Correct as required.
	Manufacturing defects.	Correct as required.
COMPRESSOR HOUSING OUTLET DEFECTS		
Oil and/or Dirt in Housing	Restricted air intake system.	Inspect and clean air cleaner.
	Prolonged periods of low rpm engine idling.	Check with operator to confirm conditions. (See Operator's Manual.)
	Defective oil seal ring.	Repair as required (this group).
	Restricted oil drain line.	Inspect and clear oil drain line as required.
TURBINE HOUSING INLET DEFECTS		
Oil in Housing	Internal engine failure.	Inspect and repair engine as required. **Make certain to check all oil lines/hoses for oil residue. If oil is found, it is ABSOLUTELY NECESSARY to make certain the lines and Charge Air Cooler or Heat Exchanger have been thoroughly cleaned out. Failure to do so can result in engine failure. Remove CAC and use John Deere Coolant System Cleaner PMCC2638, or equivalent. Dry the components with compressed air and BE CERTAIN all water is removed.**
	Oil leaking from compressor housing seal.	Verify that oil is in compressor housing and refer to "Compressor Housing Outlet Defects" as listed earlier in this chart.
Center Wall Deteriorated	Excessive operating temperature.	Check for restricted air intake.
		Check engine for overfueling.
		Check injection pump timing.
TURBINE HOUSING OUTLET DEFECTS		
Turbine Wheel Rub	Bearing failure.	Determine if engine and/or operator contributed to lack of lubrication, contaminated lubrication, excessive temperature, or debris generating engine failure in progress. Correct as required.
	Manufacturing defect.	Correct as required (this group).
Foreign Object Damage	Internal engine failure.	Inspect and repair engine as required.
	Objects left in intake system.	Disassemble and inspect air intake system (this group).

Continued on next page

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TURBINE HOUSING OUTLET DEFECTS

	Leaking air intake system.	Correct as required (this group).
Oil and/or Excessive Carbon	Internal engine failure.	Verified by oil in turbine housing.
	Turbine seal failure.	Inspect for excessive heat from overfueling and/or restricted air intake.
	Prolonged periods of low rpm engine idling.	Ask operator to run engine under load or at a higher rpm (See Operator's Manual).
	Restricted oil drain line.	Inspect and clear oil drain line as required.

EXTERNAL CENTER HOUSING AND JOINT DEFECTS

Leaks from Casting	Defective casting.	Replace turbocharger (this group).
	Defective gasket.	Verify if leaks are occurring at gasket joints.
Leaks from Joints	Loose attaching screws.	Tighten to specifications in CTM (this group).
	Defective gasket.	Inspect and repair as required.

INTERNAL CENTER HOUSING DEFECTS

Excessive Carbon Build-Up in Housing or on Shaft	Hot engine shutdown.	Review proper operation with operator as shown in operator's manual.
	Excessive operating temperature.	Restricted air intake; overfueling or mistimed engine.
	Restricted oil drain line.	Inspect and clean oil drain lines as required.
	Operating engine at high speeds and loads immediately after start-up.	Idle engine for a few minutes to allow oil to reach bearings before applying heavy loads.

RE38635,000002E -19-08JUL08-2/2

Turbocharger — Inspection

The following inspection procedure is recommended for systematic failure analysis of a suspected failed turbocharger. This procedure will help to identify when a turbocharger has failed, and why it has failed so the primary cause of the failure can be corrected.

Proper diagnosis of a non-failed turbocharger is important for two reasons. First, identification of a non-failed turbocharger will lead to further investigation and repair of the cause of a performance complaint.

Second, proper diagnosis eliminates the unnecessary expense incurred when a non-failed turbocharger is replaced.

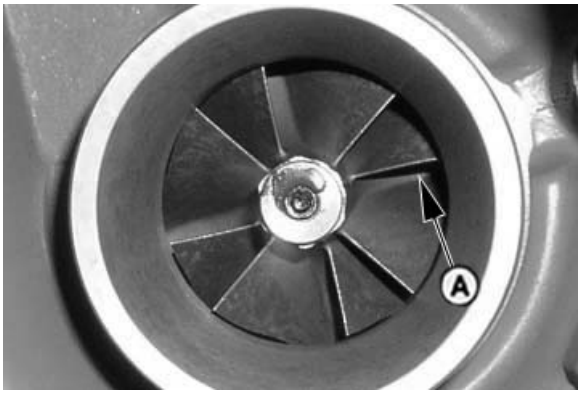
The recommended inspection steps, which are explained in detail on following pages, are:

- Compressor Housing Inlet and Compressor Wheel
- Compressor Housing Outlet
- Turbine Housing Inlet
- Turbine Housing Outlet and Turbine Wheel
- External Center Housing and Joints
- Perform Axial End Play Test

NOTE: To enhance the turbocharger inspection, an inspection sheet (Form No. DF-2280 available from Distribution Service Center—English only) can be used that lists the inspection steps in the proper order and shows potential failure modes for each step. Check off each step as you complete the inspection and record any details or problems obtained during inspection. Retain this with the work order for future reference.

Compressor Housing Inlet and Compressor Wheel

1. Check compressor inlet and compressor wheel (A) for foreign object damage.



RG17136 —UN—19MAY09

Inlet and Compressor Wheel Check

A—Compressor Wheel

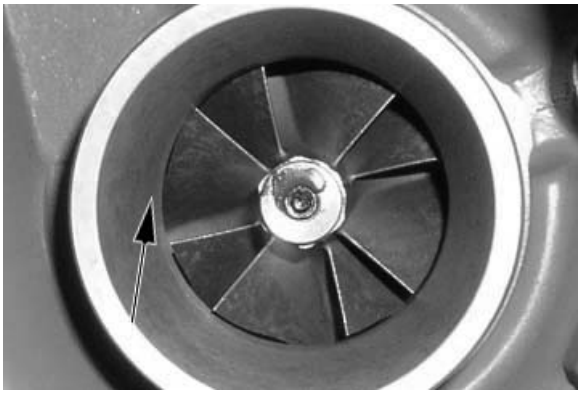
NOTE: Foreign object damage may be extensive or minor. In either case, the source of the foreign object must be found and corrected to eliminate further damage.

2. Mark findings on your checklist and continue the inspection.

RG41183,0000029 -19-14SEP09-1/11

NOTE: You will need a good light source for this check.

3. Check compressor inlet for wheel rub on the housing (arrow). Look very closely for any score marks on the housing itself and check the tips of the compressor wheel blades for damage.



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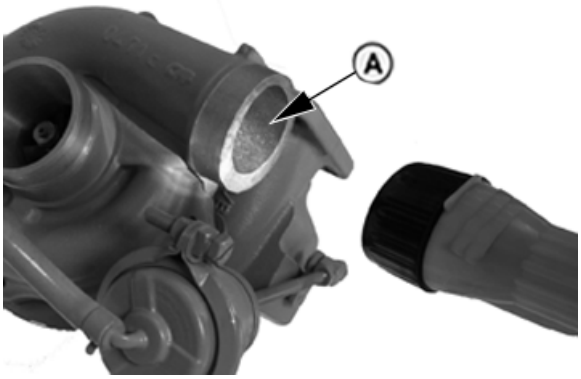
Compressor Housing Outlet

1. Check compressor housing outlet (A). The outlet should be clean and free of dirt or oil.
2. Mark it on your checklist if dirt or oil is found and continue the inspection.

A—Compressor Housing Outlet



RG17138 —UN—19MAY09

Compressor Housing Outlet

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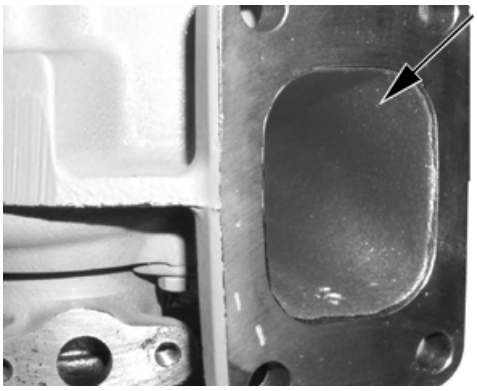
Turbine Housing Inlet

Check the turbine housing inlet (arrow) for oil in housing, excessive carbon deposit.

NOTE: If the inlet is wet with oil, or has excessive carbon deposits, an engine problem is likely.



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Turbine Housing Inlet Check

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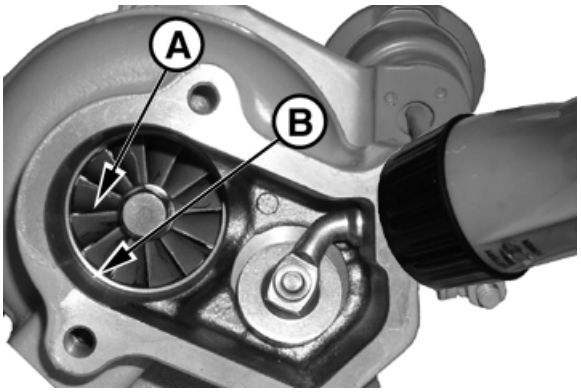
Turbine Housing Outlet and Turbine Wheel

1. Use a flashlight to look up inside the turbine housing outlet (A) and check blades (B) for foreign object damage.

A—Blades **B—Turbine Housing Outlet**



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Turbine Wheel and Outlet Check

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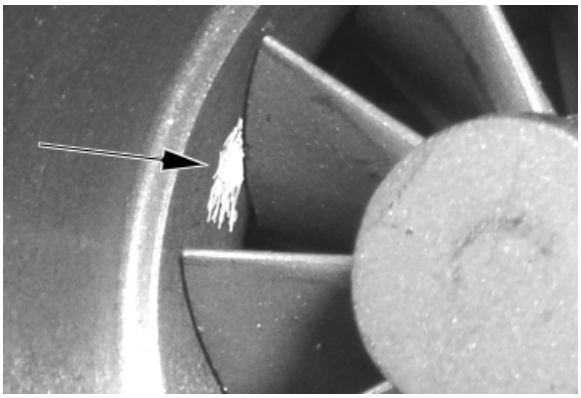
2. Inspect the wheel blades and housing for evidence of wheel rub (arrow). Wheel rub can bend the tips of the blades with the housing showing wear or damage.



Turbine Wheel Blades Check

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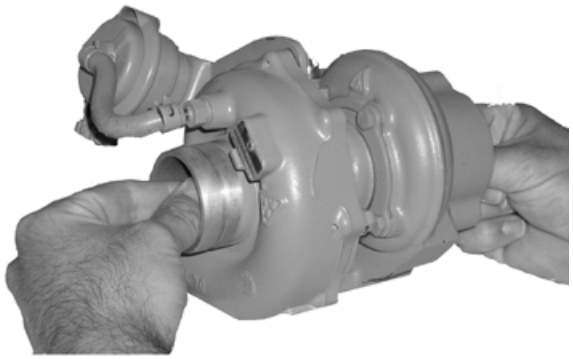
3. Rotate the shaft, using both hands, to check rotation and clearance. The shaft should turn freely, however, there may be a slight amount of drag.



Shaft Rotation and Clearance Check

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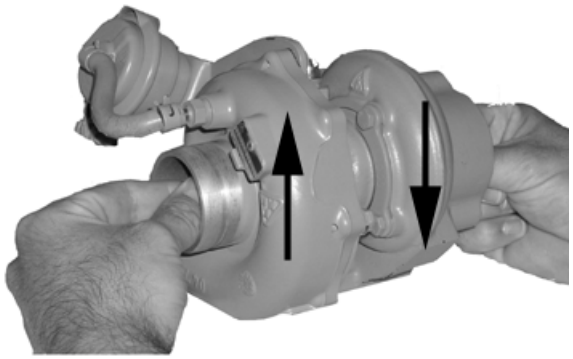
IMPORTANT: Use only moderate hand force (3-4 pounds) on each end of shaft.

4. Next, pull up on the compressor end of the shaft and press down on the turbine end while rotating shaft. Neither the compressor wheel nor the turbine wheel should contact the housing at any point.

NOTE: There will be some 'play' because the bearings inside the center housing are free floating.



Compressor and Turbine Wheels Contact Check

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External Center Housing and Joints

Visually check the outside of the center housing, all connections to the compressor, and turbine housing for oil.

NOTE: If oil is present, make sure it is not coming from a leak at the oil supply or return line.

IMPORTANT: Before you finalize your conclusion that the turbocharger has not failed, it is strongly recommended that the following procedures of checking radial bearing clearance and axial bearing endplay with a dial indicator be performed. These procedures are not required if a failure mode has already been identified.

RG12520 —UN—12DEC02

Center Housing Check

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Perform Axial Bearing End Play Test

This test will give an indication of the condition of the thrust bearing within the center housing and rotating assembly.

1. Mount magnetic base dial indicator so that indicator tip rests on flat surface on turbine end of shaft. Preload indicator tip and zero dial on indicator.
2. Move shaft axially back and forth by hand.
3. Observe and record total dial indicator movement.

Specification	
Turbocharger Shaft—Axial Bearing End Play	0.064—0.114 mm (0.0025—0.0045 in.)

If bearing end play is not within specification, install a replacement turbocharger.

RG12527 —UN—12DEC02

Axial Bearing End Play Check

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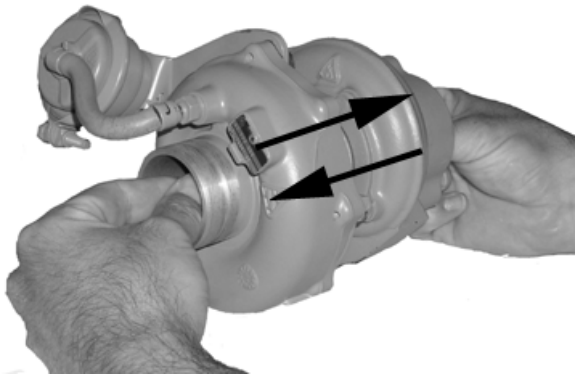
4. Next, check shaft end play by moving the shaft back and forth (arrows) while rotating. There will be some endplay but not to the extent that the wheels contact the housings.

NOTE: These diagnostic procedures will allow you to determine the condition of the turbocharger. If the turbocharger has failed, analysis of your inspection notes should direct you to the specific areas of the engine to correct the problems causing the turbocharger failure. It is not unusual to find that a turbocharger has not failed. If your turbocharger passes all the inspections, the problem lies somewhere else.



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Shaft End Play Check

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Turbocharger — Installation

Special Tools:
• None

Consumables:
• Mounting Gasket, Drain Tube Gasket, LOCTITE® 592, PT569 NEVER-SEEZ® Compound, Engine Oil

IMPORTANT: If turbocharger failed because of foreign material entering the air intake system, be sure to examine the system and clean as required to prevent a repeat failure.

Standard Turbocharger Installation (MHI and BW Type)

1. Perform Turbocharger — Prelube.
2. Apply PT569 NEVER-SEEZ® Compound to the 4 turbocharger mounting cap screws. Install turbocharger with a new gasket and the 4 cap screws (G) on the exhaust manifold. Tighten to specification.

Specification	
Turbocharger-to-Exhaust Manifold Cap Screws—Torque	32 N·m (22 lb-ft)

3. Apply LOCTITE® 592 to the threads of the oil inlet line fittings (A), (D) and install the oil inlet line (B) on the turbo charger and cylinder block. Tighten to specification.

Specification	
Turbocharger Oil Inlet Line (Turbocharger End)—Torque	19 N•m (14 lb-ft)
Turbocharger Oil Inlet Line (Block End)—Torque	16 N•m (12 lb-ft)

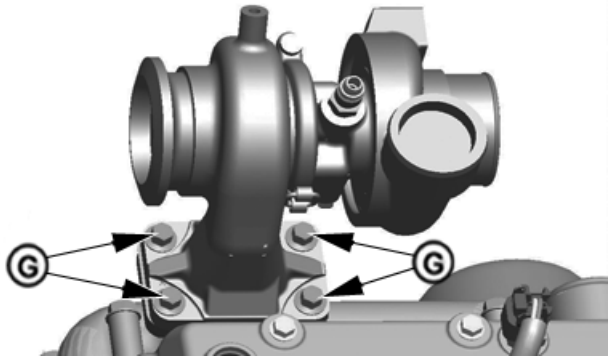
4. Install oil return line (F) with new gasket, 2 cap screws (C) to turbocharger. Install the oil return hose with clamps (E), between turbocharger drain line & cylinder block. Tighten to specification.

Specification	
Turbocharger Oil Return Tube (Turbocharger End) Cap Screws—Torque	36 N·m (26 lb-ft)
Oil Return Tube (Block End) Clamp—Turns	2-3 Beyond Hand Tight

5. Install air intake and exhaust piping to turbocharger. Tighten all connections securely. (For vehicle engines, refer to machine Technical Manual.)

IMPORTANT: BEFORE STARTING an engine with a new or repaired turbocharger, crank the engine over (but do not start) for several seconds to allow engine oil to reach turbocharger bearings. DO NOT crank engine longer than 30 seconds at a time to avoid damaging starting motor.

6. Start and run engine at low idle while checking oil inlet and air piping connections for leaks.



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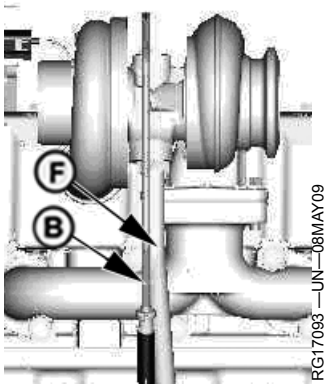
Turbocharger Cap Screws (MHI Type Shown)



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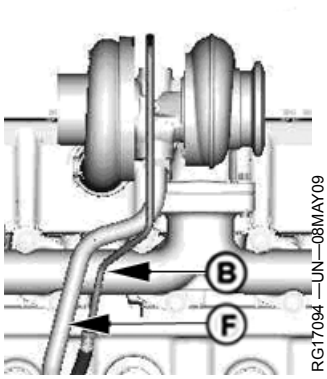
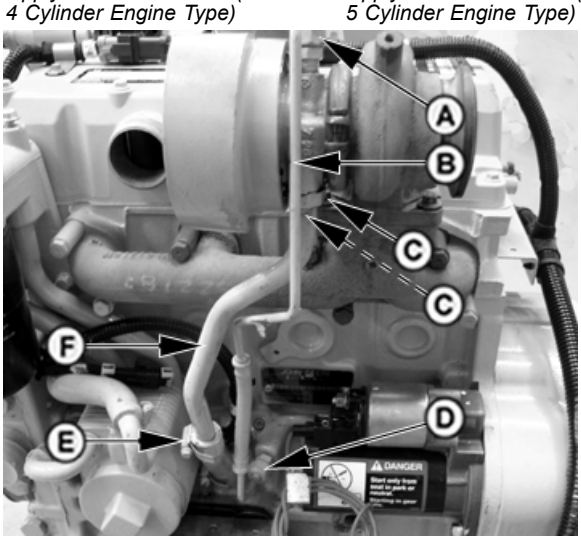
Oil Supply and Return Lines (BW 4 Cylinder Engine Type)



RG17094 —UN—08MAY09

Oil Supply and Return Lines (BW 5 Cylinder Engine Type)



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Turbocharger Installation (MHI Type Shown)

A—Oil Inlet Turbocharger Fitting
B—Oil Inlet Line
C—Cap Screws
D—Oil Inlet Cylinder Block Fitting
E—Oil Return Tube Clamp
F—Oil Return line
G—Turbocharger Cap Screws

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LOCTITE is a trademark of Loctite Corp.
NEVER-SEEZ is a trademark of Emhart Chemical Group

RG19661,0000277 -19-14SEP09-2/3

Low Mount MHI Turbocharger Installation

1. Perform Turbocharger — Prelube.
2. Apply PT569 NEVER-SEEZ® Compound to the 4 turbocharger mounting cap screws. Install turbocharger with a new gasket and 4 cap screws on the exhaust manifold. Tighten cap screws to specification.

Specification	
Turbocharger-to-Exhaust Manifold Cap Screws—Torque	32 N·m (22 lb-ft)

3. Apply LOCTITE® 592 to the threads of the oil supply line fittings (A), (B) and install the oil supply line on the turbo charger and cylinder block. Tighten to specification.

Specification	
Turbocharger Oil Inlet Line (Turbocharger End)—Torque	19 N•m (14 lb-ft)
Turbocharger Oil Inlet Line (Block End)—Torque	16 N•m (12 lb-ft)

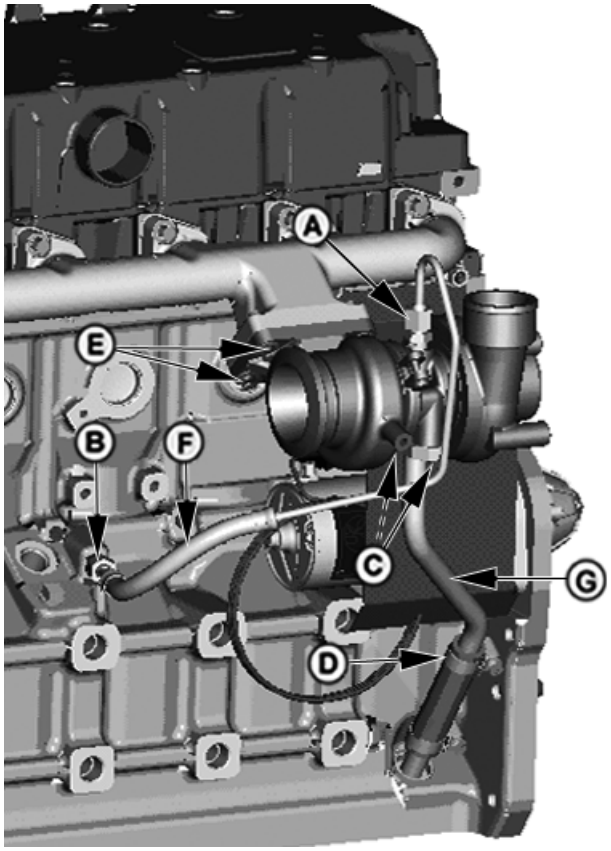
4. Install oil return line with new gasket, 2 cap screws to turbocharger. Install the oil return hose with clamps, between turbocharger drain line & cylinder block. Tighten to specification.

Specification	
Turbocharger Oil Return Tube (Turbocharger End) Cap Screws—Torque	36 N·m (26 lb-ft)
Oil Return Tube (Block End) Clamp—Turns	2-3 Beyond Hand Tight

5. Connect air intake and exhaust piping to turbocharger. Tighten all connections securely. (For vehicle engines, refer to machine Technical Manual.)

IMPORTANT: BEFORE STARTING an engine with a new or repaired turbocharger, crank the engine over (but do not start) for several seconds to allow engine oil to reach turbocharger bearings. DO NOT crank engine longer than 30 seconds at a time to avoid damaging starting motor.

6. Start and run engine at low idle while checking oil inlet and air piping connections for leaks.



RG17092 —UN—07MAY09

Low Mount MHI Turbocharger

A—Oil Inlet Turbocharger Fitting
B—Oil Inlet Cylinder Block Fitting
C—Cap Screws
D—Clamp
E—Cap Screws

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LOCTITE is a trademark of Loctite Corp.

RG19661,0000277 -19-14SEP09-3/3

Turbocharger — Repair

Turbochargers used on the engines covered in this manual are available through service parts as a complete remanufactured assembly only.

Individual components for repair are not available.

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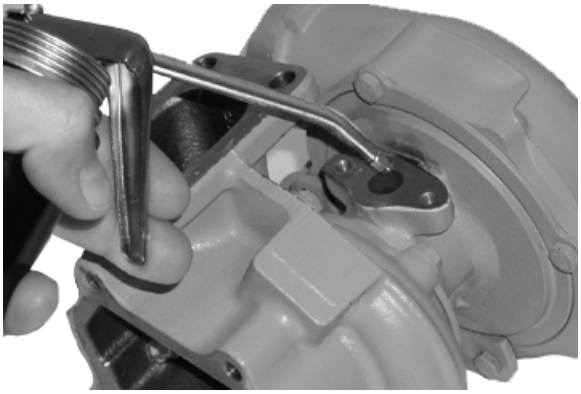
Turbocharger — Prelube

IMPORTANT: DO NOT spin the rotor assembly with compressed air. Damage to bearings can occur when using compressed air.

Fill oil return (drain) port with clean engine oil and spin rotating assembly by hand to properly lubricate bearings.

If turbocharger is to be stored for an extended period of time, lubricate internally and install protective covers on all openings.



RG12516 —UN—12DEC02

Turbocharger Prelube

RG41183,0000028 -19-28APR09-1/1

Essential, Recommended and Fabricated Tools For This Group

- JDG1704—Fylwheel Turning Tool
- JDG10221—Fylwheel Turning Tool
- • JDG1822—Nozzle Puller

MK41968,000000B -19-02SEP09-1/1

Electronic Unit Pump — Removal

1. Perform Engine Wiring Harness — Removal

   Special Tools:
   • None

2. Perform Alternator & Fan Belt — Removal

   Special Tools:
   • None

3. Perform Alternator — Removal

   Special Tools:
   • None

4. Perform Rocker Arm Cover — Removal.

   Special Tools:
   • None

5. Perform Rocker Arm Assembly — Removal.

   Special Tools:
   • None

6. Perform Electronic Unit Pump Wiring Harness — Removal.

   Special Tools:
   • None

7. **Electronic Unit Pump Removal**

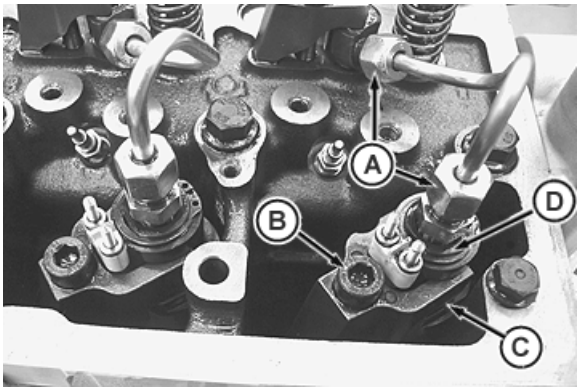
   Special Tools:
   • None

NOTE: Place parts on a clean bench and identify parts for reassembly.

a. Remove high pressure line nuts (A) if not previously removed. Remove injection pump clamp cap screw (B).

b. Carefully remove the unit pump (D) with clamp (C). If the pump is difficult to remove, rotate the crankshaft two revolutions.

c. Inspect cam follower, cam roller and spring for excessive wear and fatigue. Replace injection unit assembly if necessary.



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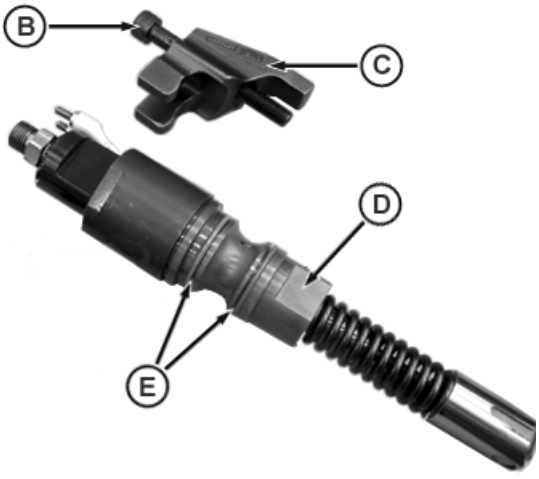
Electronic Unit Pump Removal



RG17177 —UN—27MAY09

Electronic Unit Pump with Clamp

A—High Pressure Injection Line Nuts
B—Unit Pump Hold-Down Screw
C—Unit Pump Clamp
D—Electronic Unit Pump
E—O-rings

d. Inspect o-rings (E) for nicks and cuts. Replace damaged o-rings.

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Electronic Unit Pump — Installation

IMPORTANT: If rocker arm assembly was removed, the hydraulic lifters will need to be bled down. Refer to the valve train instructions to insure cam followers and valve train components are properly installed when the rocker arm supports have been removed. See Rocker Arm Assembly — Installation in Section 02, Group 20 in this manual.

The unit pump must be installed with the pump camshaft follower at the lowest position on the camshaft base circle and aligned properly in the follower bore. This can be visually confirmed by observing the movement of the camshaft follower with relation to the cylinder block casting as the crankshaft is turned. Several pumps may be installed at the same cam position:

1. **Electronic Unit Pumps Installation**

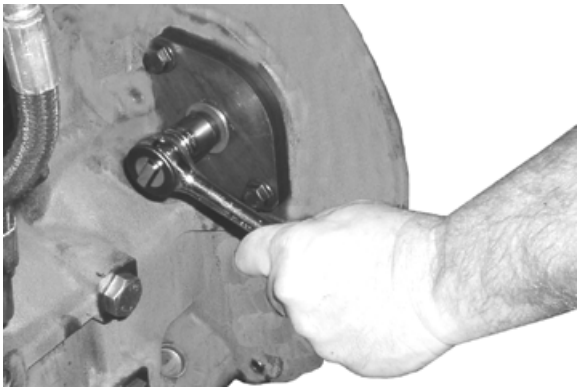
   Special Tools:
   • JDG1704—Fylwheel Turning Tool (or)
   • JDG10221—Fylwheel Turning Tool

   Consumables:
   • Engine Oil, Parker O-Lube

   a. Using JDG1704 or JDG10221 Turning Tool, rotate engine crankshaft in running direction (clockwise as viewed from front) as follows. The No. 1 cylinder is defined as the cylinder closest to the engine-mounted fan.

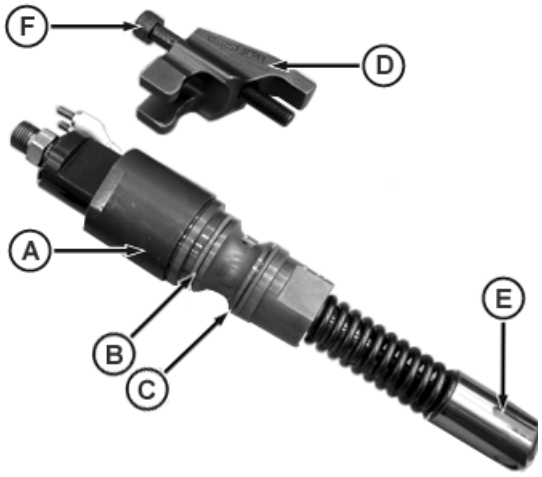
      - 4 cylinder - Position crankshaft with No 1 cylinder at TDC compression and install No. 3 and No. 4 unit pumps. Rotate crankshaft 360° and install No. 1 and No. 2 unit pumps.
      - 5 cylinder - Position crankshaft with No. 1 cylinder at 180° at TDC compression and install No. 3, No. 4 and No. 5 unit pumps. Rotate crankshaft 360° and install No. 1 and No. 2 unit pumps

   b. Inspect the electronic unit pump (A) to ensure o-rings are intact and in the right location. The unit pump top o-ring (B) is light green and the lower o-ring (C) is dark red. Lubricate o-rings and top pump land with Parker O-Lube. Avoid getting excess lubricant in the fuel inlet opening.



RG14623 —UN—07DEC05

JDG1704 Flywheel Turning Tool



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Electronic Unit Pump Assembly with Clamp

A—Electronic Unit Pump
B—Upper O-ring (Light Green)
C—Lower O-ring (Dark Red)
D—Pump Clamp
E—Anti-rotation Notch
F—Pump Clamp Cap Screw

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c. Apply a light coat of clean engine oil to the pump follower. Slide the pump clamp (D) on the pump from the electrical connector side. Position the pump so that the electrical connector is oriented to the RH rear of the cylinder head.

d. Align the pump follower anti-rotation notch (E) toward the center of the engine and carefully insert the pump with clamp into the cylinder block bore. Rotate the pump as required to engage the anti-rotation pin in the cylinder block. **Do not force pump assembly to seat.**
Apply clean engine oil to the unit pump clamp cap screw (F) and tighten to specifications.

Specification	
Electronic Unit Pump Clamp Cap Screw—Torque	70 N·m (52 lb-ft)

2. Perform Electronic Unit Pump Wiring Harness — Installation

   Special Tools:
   • None

   Consumables:
   • LOCTITE® 222 (purple)

3. Perform Rocker Arm Assembly — Installation

   Special Tools:
   • JDG1678—Hydraulic Lifter Bleed-down Tool

   Consumables:
   • TY6333 HighTemperature Grease, LOCTITE® 242, Engine Oil

4. Perform Rocker Arm Cover — Installation

   Special Tools:
   • None

   Consumables:
   • O-rings, Gasket

5. Perform Alternator — Installation

   Special Tools:
   • None

   Consumables:
   • None

6. Perform Fan and Alternator Belt — Installation

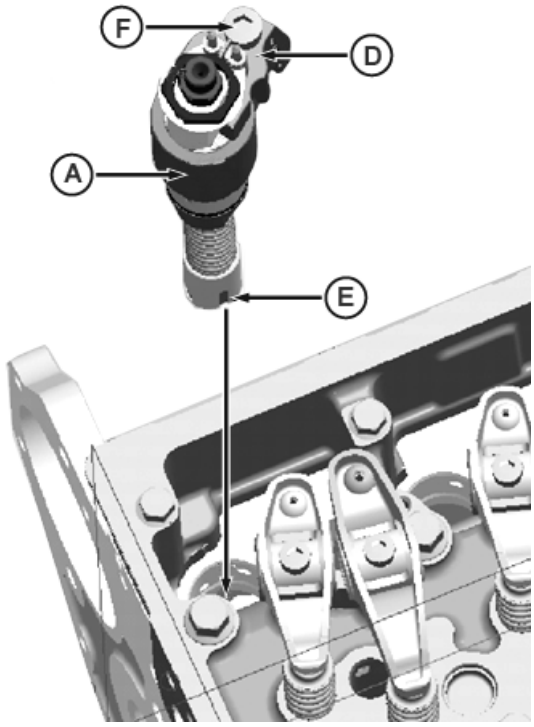
   Special Tools:
   • None

   Consumables:
   • None

7. Perform Engine Wiring Harness — Installation

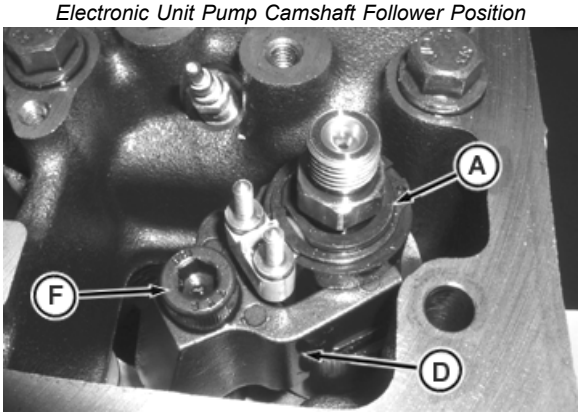
   Special Tools:
   • None

   Consumables:
   • None



RG17192 —UN—27MAY09

Electronic Unit Pump Camshaft Follower Position



RG17180 —UN—27MAY09

Installed Electronic Unit Pump

A—Electronic Unit Pump
D—Pump Clamp
E—Anti-rotation Notch
F—Pump Clamp Cap Screw

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MK41968,000034C -19-01JUN10-2/2

Electronic Unit Pump Wiring Harness — Removal

1. Perform Engine Wiring Harness — Removal

   Special Tools:
   • None

2. Perform Fan and Alternator Belt — Removal

   Special Tools:
   • None

3. Perform Alternator — Removal

   Special Tools:
   • None

4. Perform Rocker Arm Cover — Removal

   Special Tools:
   • None

5. Perform Rocker Arm Assembly — Removal

   Special Tools:
   • None

6. Perform Glow Plug Wiring Harness — Removal

   Special Tools:
   • None

7. **Electronic Unit Pump Wiring Harness Removal**

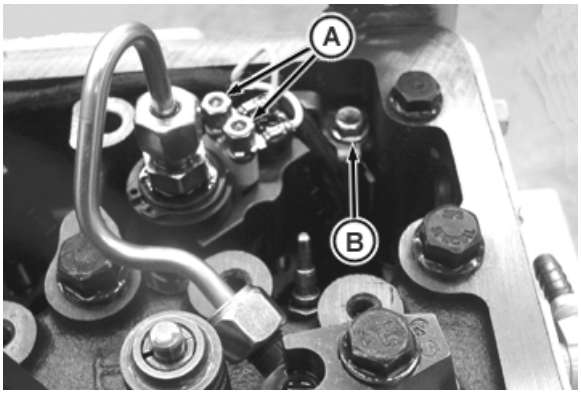
   Special Tools:
   • None

   a. Carefully loosen and remove wiring leads (A) from each unit pump terminal.
   Remove wiring harness clamp cap screw (B) located at the rear of the cylinder head.

   b. Remove 4 screws (D) and connector cover (C) from the right hand rear side of the cylinder block. Remove wiring harness connector from the connector cover.

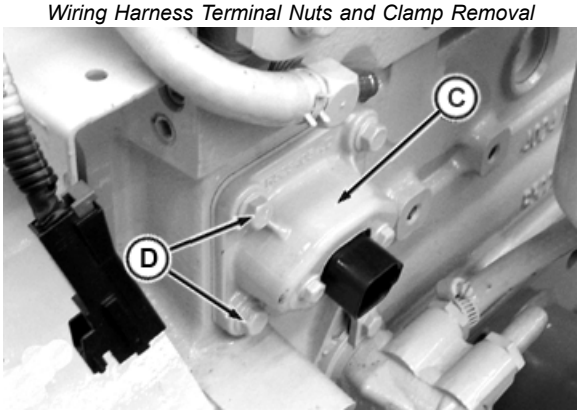
   c. Carefully pull the harness connector up through the cylinder head and block.

   d. Inspect wiring harness for damage and worn insulation. Replace as required.



RG17182 —UN—27MAY09

Wiring Harness Terminal Nuts and Clamp Removal



RG17183 —UN—28MAY09

Wiring Harness Connector Cover Removal

RG15569 —UN—20SEP07

Remove EUP Wiring Harness

A—EUP Wiring Harness Nuts
B—EUP Wiring Harness Clamp Cap Screw
C—EUP Wiring Harness Connector Cover
D—Connector Cover Mounting Screws

MK41968,000034D -19-01JUN10-1/1

Electronic Unit Pump Wiring Harness — Installation

1. **Electronic Unit Pump Wiring Harness Installation**

   Special Tools:
   • None

   Consumables:
   • LOCTITE® 222 (purple)

   a. Install wiring harness support bracket (B) at the right hand rear side of the cylinder head. Tighten mounting screw (A) to specification.

Specification

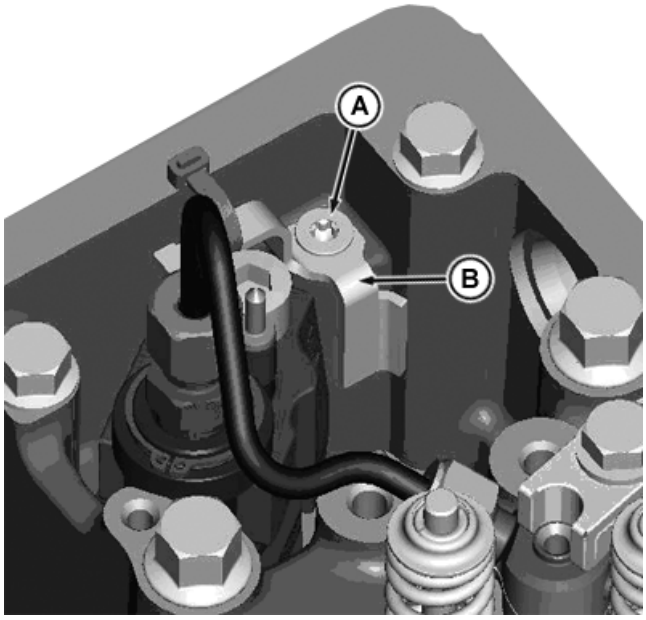
Wiring Harness Support Bracket Cap Screw—Torque.....15 N·m (11 lb-ft)

   b. Insert the end of the wiring harness with the connector down through the cylinder head and block until the connector (C) is at the opening in the cylinder bock. Install the connector (C) into the cover (G). Apply LOCTITE ® 222 (purple) to screws and attach wiring connector to the cover. Tighten screws to specifications.

Specification

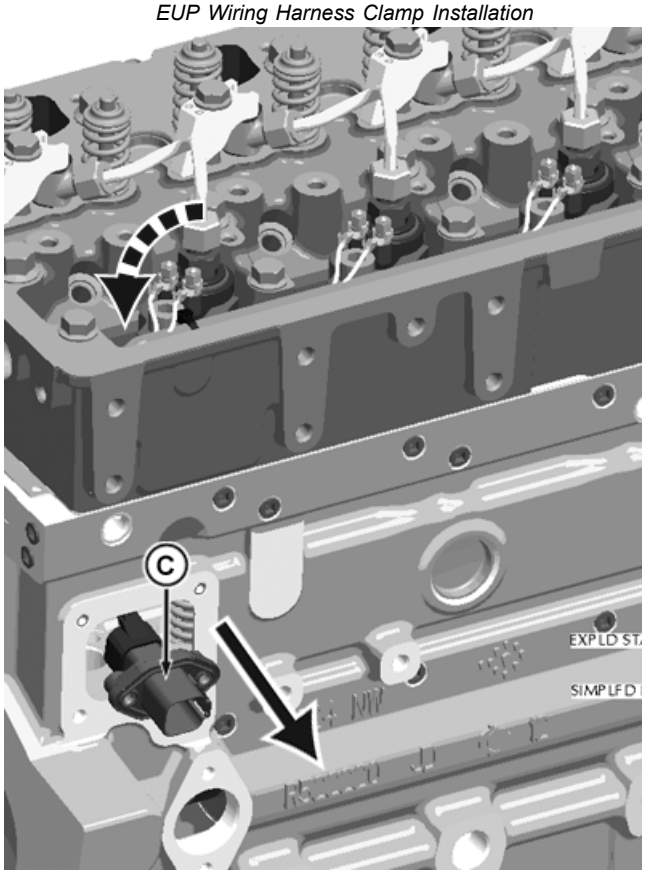
Wiring Harness Screws—Torque..... 2 N·m (18 lb-in.)

A—Bracket Screw
B—Bracket
C—Connector



RG17184 —UN—29MAY09

EUP Wiring Harness Clamp Installation



RG17185 —UN—29MAY09

Locate Harness to Connector

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Continued on next page

MK41968,0000355 -19-01JUN10-1/2

c. Position the harness in the cast recesses (E) in the cylinder head. Connect wiring harness ring terminals (F) to the unit pumps. Tighten harness nuts to specifications.

Specification

EUP Wiring Harness
Nuts—Torque..... 3 N·m (26 lb-in.)

d. Install cover (C) with gasket (D) to cylinder block. Apply LOCTITE ® 222 (purple) to cap screws and tighten to specifications.

Specification

Wiring Harness
Connector Cover Cap
Screw—Torque.....15 N·m (11 lb-ft)

e. Attach wiring harness to wiring harness support bracket using a **non-nylon** tie band. Insure wiring harness is secure against the side of the cylinder head to prevent interference with the push rods.

2. Perform Glow Plug Wiring Harness — Installation

   Special Tools:
   • None

   Consumables:
   • None

3. Perform Rocker Arm Assembly — Installation

   Special Tools:
   • JDG1678—Hydraulic Lifter BleedDown Tool

   Consumables:
   • TY6333 HighTemperature Grease, LOCTITE® 242, Engine Oil

4. Perform Rocker Arm Cover — Installation

   Special Tools:
   • None

   Consumables:
   • O-rings, Gasket

5. Perform Alternator — Installation

   Special Tools:
   • None

   Consumables:
   • None

6. Perform Fan and Alternator Belt — Installation

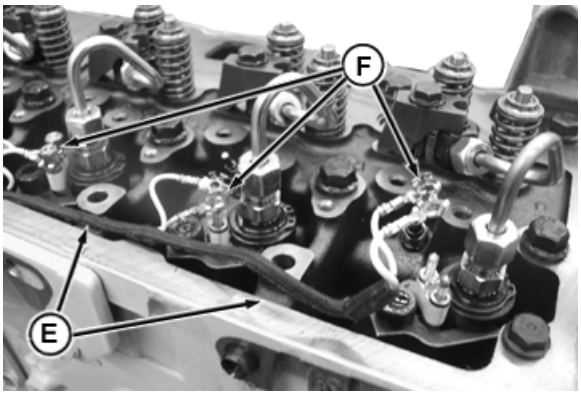
   Special Tools:
   • None

   Consumables:
   • None

7. Perform Engine Wiring Harness — Installation

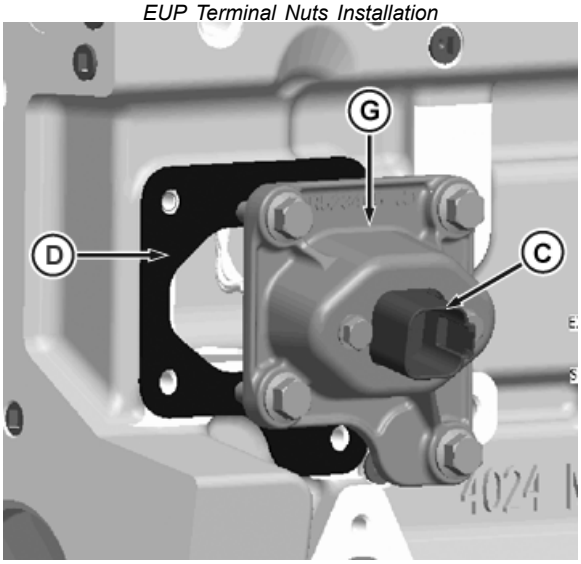
   Special Tools:
   • None

   Consumables:
   • None



RG17187 —UN—27MAY09

EUP Terminal Nuts Installation



RG17186 —UN—29MAY09

EUP Wiring Harness Connector

C—Connector Cover
D—Gasket
E—Cast Recesses
F—Ring Terminals
G—Connector Cover

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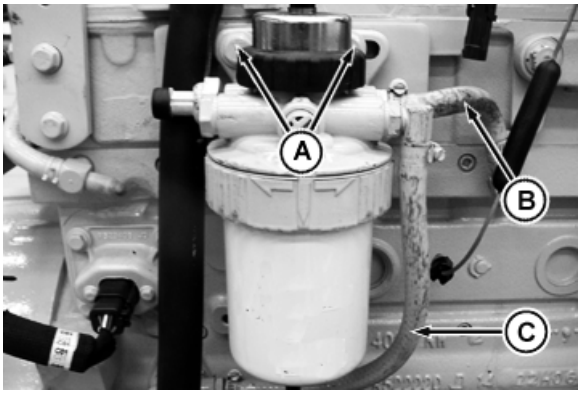
MK41968,0000355 -19-01JUN10-2/2

Fuel Filter — Removal

Special Tools:
• None

1. Remove fuel lines from the fuel pump to filter base (C) and fuel filter base to cylinder head fitting (B).
2. Remove fuel filter base cap screws (A) and remove filter assembly from mounting bracket.
3. If required, remove fuel filter bracket from cylinder head.

A—Mounting Cap Screws
B—Filter to Cylinder Head Hose
C—Pump to Filter Hose



RG17188 —UN—01JUN09

Fuel Filter Base

MK41968,0000350 -19-02SEP09-1/1

Fuel Filter — Installation

Special Tools:
• None

Consumables:
• None

1. If removed, install fuel filter bracket to the cylinder head and tighten cap screws to specifications.

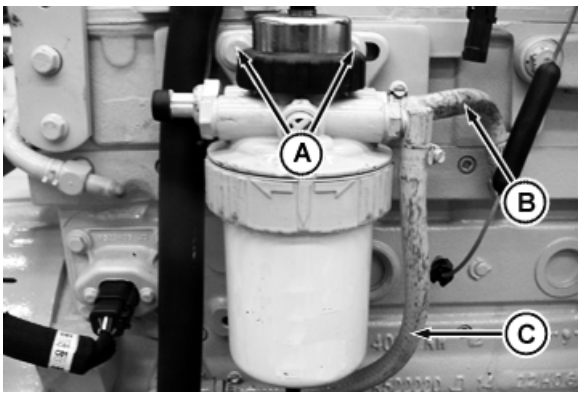
	Specification
Fuel Filter Bracket Cap Screws—Torque	40 N·m (30 lb-ft)

2. Install fuel filter base to cylinder head mounting bracket and tighten cap screws (A) to specifications.

	Specification
Fuel Filter Base Cap Screws—Torque	40 N·m (30 lb-ft)

3. Install the fuel line (B) from the filter base to cylinder head fitting. Install the fuel line (C) from the fuel supply pump to the filter and tighten the hose clamps to specifications.

	Specification
Fuel Line Hose Clamps—Torque	1.8 ±0.4 N•m (16 lb-in)



RG17188 —UN—01JUN09

Fuel Filter Base

A—Mounting Cap Screws
B—Filter to Cylinder Head Hose
C—Pump to Filter Hose

MK41968,0000351 -19-02SEP09-1/1

Injection Nozzle — Removal

IMPORTANT: Rocker arm assemblies must be removed when servicing the injection nozzles and the hydraulic lifters will need to be bled down. Refer to the valve train instructions to insure cam followers and valve train components are properly installed when the rocker arm supports have been removed. See Rocker Arm Assembly — Installation in Section 02, Group 20.

1. Perform Engine Wiring Harness — Removal

   Special Tools:
   • None

2. Perform Fan and Alternator Belt — Removal

   Special Tools:
   • None

3. Perform Alternator — Removal

   Special Tools:
   • None

4. Perform Rocker Arm Cover — Removal.

   Special Tools:
   • None

5. Perform Rocker Arm Assembly — Removal.

   Special Tools:
   • None

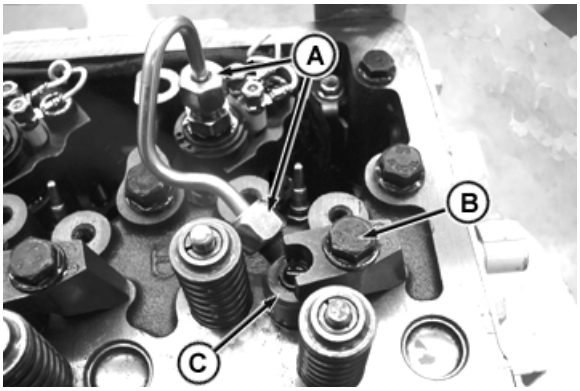
6. **Injection Nozzle Removal**

   Special Tools:
   • JDG1822—Nozzle Puller

   a. Using a backup wrench, loosen the line nuts (A) and remove the high pressure injection line from the injection nozzle and the electronic unit pump.

   b. Remove the injection nozzle hold-down clamp cap screw (B).

   c. Using JDG1822 Nozzle Puller, remove the nozzle (C) from the cylinder head.



RG17189 —UN—27MAY09

Injection Nozzle Removal

RG17190 —UN—27MAY09

Injection Nozzle

A—High Pressure Injection Line Nuts
B—Injection Nozzle Clamp Cap Screw
C—Injection Nozzle
D—Injection Nozzle O-Ring
E—Injection Nozzle Sealing Washer

NOTE: Anytime the nozzle is removed from the cylinder head, the copper washer and O-ring must be replaced.

d. Remove the O-ring (D), sealing washer (E) from nozzle and discard.

MK41968,0000352 -19-01JUN10-1/1

Injection Nozzle — Inspection

Clean the injection nozzle and insure that all carbon deposits have been removed.

There should be no tip cracks or signs of a poor spray pattern.

Injection Nozzle Tip

MK41968,0000353 -19-02SEP09-1/1

Injection Nozzle — Installation

IMPORTANT: Rocker arm assemblies must be removed when servicing the injection nozzles and the hydraulic lifters will need to be bled down. Refer to the valve train instructions to insure cam followers and valve train components are properly installed when the rocker arm supports have been removed. See Rocker Arm Assembly — Installation in Section 02, Group 20.

1. **Injection Nozzle Installation**

   Special Tools:
   • None

   Consumables:
   • O-rings, Copper Washer, Engine Oil, Petroleum Jelly

NOTE: Anytime the nozzle is removed from the cylinder head, the copper washer and O-ring must be replaced.

   a. Install new O-ring (D) and copper washer (E).

   b. Lubricate O-ring with petroleum jelly and insert injection nozzle into cylinder head bore using thumb pressure only while aligning the end of the high pressure line with the nozzle and pump. **Do not drive the nozzle into the bore by tapping or hammering - it will be seated properly when the clamp is tightened**. Tighten high pressure line nut finger-tight on the injection nozzle.

   c. Apply clean engine oil to the nozzle hold-down clamp cap screw and tighten to specifications. Loosen nozzle clamp cap screw and retighten to specifications.

Specification

Nozzle Clamp Cap Screw
- Initial—Torque..... 20 N·m (15 lb-ft)

Specification

Nozzle Clamp Cap Screw
- Final—Torque..... 35 N·m (26 lb-ft)

   d. Using a backup wrench, tighten high pressure injection line nuts to specifications.

Specification

High Pressure Injection
Line Nut—Torque..... 24 N·m (18 lb-ft)

2. Perform Rocker Arm Assembly — Installation

   Special Tools:
   • JDG1678—Hydraulic Lifter BleedDown Tool

   Consumables:
   • TY6333 High Temperature Grease, LOCTITE® 242, Engine Oil

3. Perform Rocker Arm Cover — Installation

   Special Tools:
   • None

   Consumables:
   • O-rings, Gasket

4. Perform Alternator — Installation

   Special Tools:
   • None

   Consumables:
   • None

5. Perform Fan and Alternator Belt — Installation

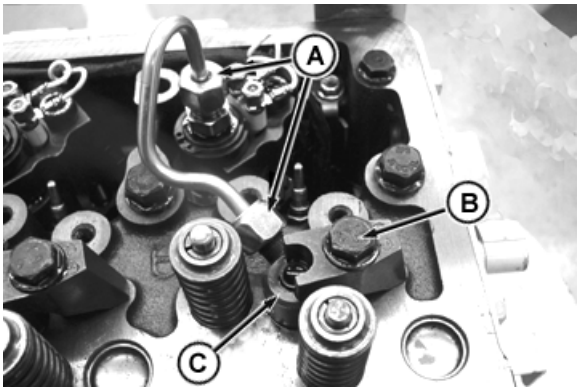
   Special Tools:
   • None

   Consumables:
   • None

6. Perform Engine Wiring Harness — Installation

   Special Tools:
   • None

   Consumables:
   • None



RG17189 —UN—27MAY09

Injection Nozzle Installation

RG17190 —UN—27MAY09

Injection Nozzle

A—High Pressure Injection Line Nuts
B—Injection Nozzle Clamp Cap Screw
C—Injection Nozzle
D—Injection Nozzle O-Ring
E—Injection Nozzle Sealing Washer

Continued on next page

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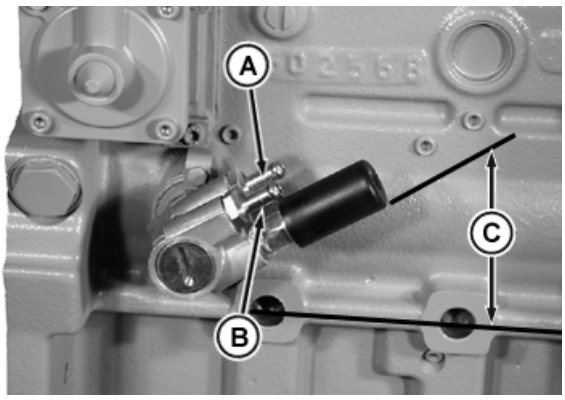
MK41968,0000354 -19-01JUN10-2/2

Low Pressure Fuel Pump — Removal

Special Tools:
• None

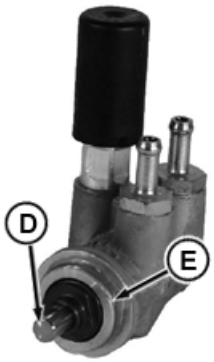
1. Removal fuel outlet line (A) and inlet line (B), shown removed.
2. Remove cap screws and clamps and remove fuel supply pump.
3. Clean and inspect push rod (D) for excessive wear and O-ring (E) for damage. Replace O-ring as needed.

A—Fuel Outlet
B—Fuel Inlet
C—20° Angle
D—Supply Pump Push Rod
E—O-ring



RG17191 —UN—27MAY09

Fuel Supply Pump Removal



RG17179 —UN—27MAY09

Fuel Supply Pump

MK41968,0000356 -19-02SEP09-1/1

Low Pressure Fuel Pump — Installation

Special Tools:
• None

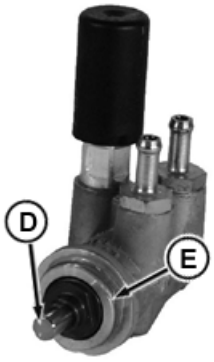
Consumables:
• AR54749 Soap Lubricant, Engine Oil

1. Apply clean engine oil to push rod (D).
2. Apply AR54749 Soap Lubricant to o-ring (E).
3. Install fuel supply pump in a upright position at approximately 30° angle (C) as illustrated and tighten screws to specification.

Specification	
Fuel Supply Pump Mounting Screws—Torque	12 N•m (9 lb-ft)

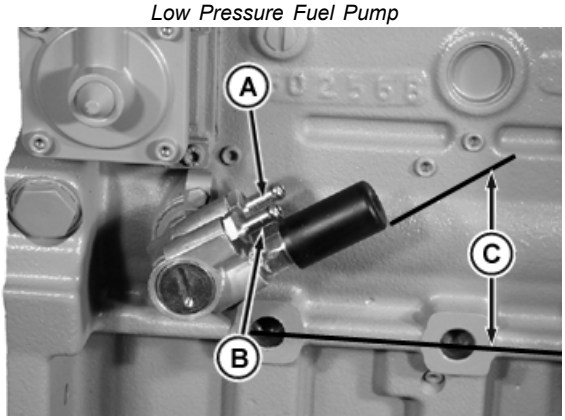
4. Install fuel supply pump inlet and outlet lines.

A—Fuel Outlet
B—Fuel Inlet
C—30° Angle
D—Pump Push Rod
E—O-ring



RG17179 —UN—27MAY09

Low Pressure Fuel Pump



RG17191 —UN—27MAY09

Low Pressure Fuel Pump Installation

RG19661,0000261 -19-02SEP09-1/1

Essential, Recommended and Fabricated Tools For This Group

There are no special tools involved in this group.

MK41968,000000C -19-05JUN09-1/1

Alternator — Removal

IMPORTANT: Always disconnect battery negative (—) cables before removing alternator or a short circuit could result.

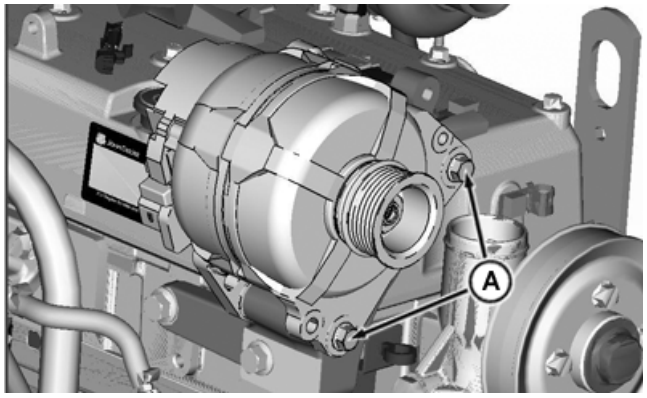
1. Disconnect battery ground (—) cable.
2. Disconnect positive (+) red wire and regulator connector.
3. Perform Fan and Alternator Belt — Removal.

   Special Tools:
   • None
4. **Alternator Removal**

   Special Tools:
   • None

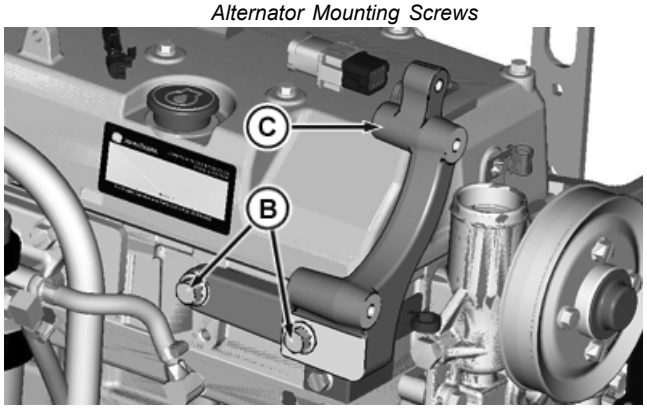
   a. Remove cap screws (A) and alternator.

   b. Remove screws (B) and mounting bracket (C).



RG17211 —UN—05JUN09

Alternator Mounting Screws



RG17212 —UN—05JUN09

Alternator Bracket

MK41968,000035A -19-05JUN09-1/1

Alternator — Installation

1. **Alternator Installation**

   Special Tools:
   • None

   Consumables:
   • None

   a. If removed, install alternator mounting bracket (C) and screws (B).

   b. Install alternator on bracket and tighten caps screws (A) to specification.

Specification

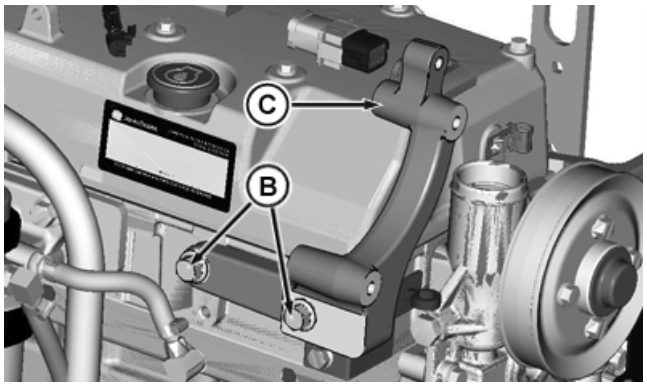
Alternator Cap Screws—Torque..... 40 N·m (29.5 lb-ft)

2. Perform Fan and Alternator Belt — Installation

   Tools:
   • None

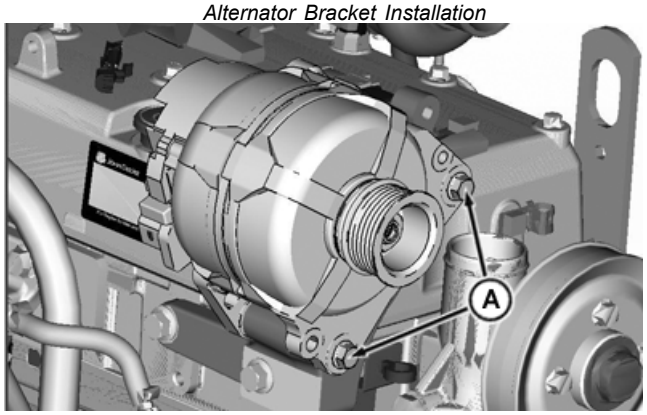
   Consumables:
   • None

3. Connect positive (+) red wire and regulator connector.
4. Connect battery ground (—) cable.



RG17212 —UN—05JUN09

Alternator Bracket Installation



RG17211 —UN—05JUN09

Alternator Installation

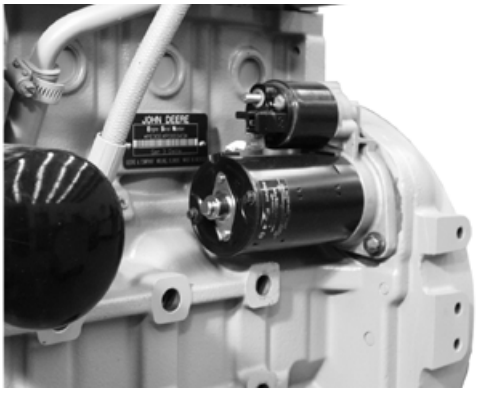
MK41968,000035B -19-14APR10-1/1

Starter Motor — Removal

Special Tools:
• None

⚠ CAUTION: Disconnect battery ground strap or serious injury could result if tools ground electrical system.

1. Remove ground strap from battery.
2. Remove wiring to starter motor.
3. Remove mounting cap screws and starter motor.



RG12969 —UN—04JUN03

Starter Motor Removal

MK41968,0000358 -19-05JUN09-1/1

Starter Motor — Installation

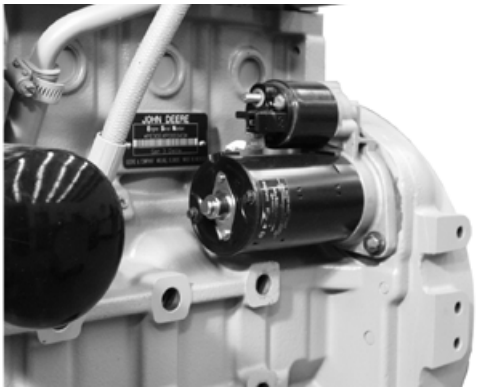
Special Tools:
• None

Consumables:
• None

1. Install starter motor and tighten cap screws to specification.

Specification	
Starter Motor Mounting Screws—Torque	80 N·m (59 lb-ft)

2. Install starter motor wiring and ground strap.



Starter Motor

RG12969 —UN—04JUN03

MK41968,0000359 -19-05JUN09-1/1

Essential, Recommended and Fabricated Tools For This Group

NOTE: Order tools according to information given in the U.S. SERVICEGARD™ Catalog or from the European Microfiche Tool Catalog (MTC).

SERVICEGARD is a trademark of Deere & Company

There are no special tools involved in this group.

MK41968,000000E -19-17JUL09-1/1

Camshaft Position Sensor — Removal

Special Tools:
• None

NOTE: For an expanded component location drawing see Component Location Diagram 1 (B) in Section 03, Group 140 later in this manual.

Disconnect camshaft position sensor connector and remove sensor.

MK41968,000035D -19-10JUL09-1/1

Camshaft Position Sensor — Installation

Spcial Tools:
• None

Consumables:
• None

NOTE: For an expanded component location drawing see Component Location Diagram 1 (B) in Section 03, Group 140 in this manual.

1. Install sensor and tighten to specifications.

Specification	
Camshaft Position Sensor—Torque	14 N·m (10 lb-ft)

2. Connect engine wiring harness connector to camshaft position sensor.

MK41968,000035E -19-10JUL09-1/1

Crankshaft Position Sensor — Removal

Special Tools:
• None

NOTE: For an expanded component location drawing, see Component Location Diagram 4 (I) in Section 03, Group 140 of this manual.

Remove crankshaft position sensor connector and the crankshaft position sensor.

MK41968,000035F -19-10JUL09-1/1

Crankshaft Position Sensor — Installation

Spcial Tools:
• None

Consumables:
• None

NOTE: For an expanded component location drawing, see Component Location Diagram 4 (I) in Section 03, Group 140 of this manual.

1. Install sensor and tighten to specifications.

Specification	
Crankshaft Position Sensor to Cylinder Block—Torque	14 N•m (10 lb-ft)

2. Connect engine wiring harness connector to the crankshaft position sensor.

MK41968,0000360 -19-10JUL09-1/1

Coolant Temperature Sensor — Removal

Special Tools:
• None

NOTE: For an expanded component location drawing, see Component Location Diagram 2 (D) in Section 03, Group 140 of this manual.

Disconnect engine coolant temperature sensor connector and remove sensor.

MK41968,0000361 -19-10JUL09-1/1

Coolant Temperature Sensor — Installation

Special Tools:
• None

Consumables:
• None

NOTE: For an expanded component location drawing, see Component Location Diagram 2 (D) in Section 03, Group 140 of this manual.

1. Install sensor and tighten to specifications.

Specification	
Coolant Temperature Sensor to Thermostat Housing—Torque	10 N•m (7 lb-ft)

2. Connect engine wiring harness connector to engine coolant temperature sensor.

MK41968,0000362 -19-10JUL09-1/1

Engine Control Unit (ECU) — Removal

Special Tools:
• None

IMPORTANT: DO NOT OPEN ENGINE CONTROL UNIT.

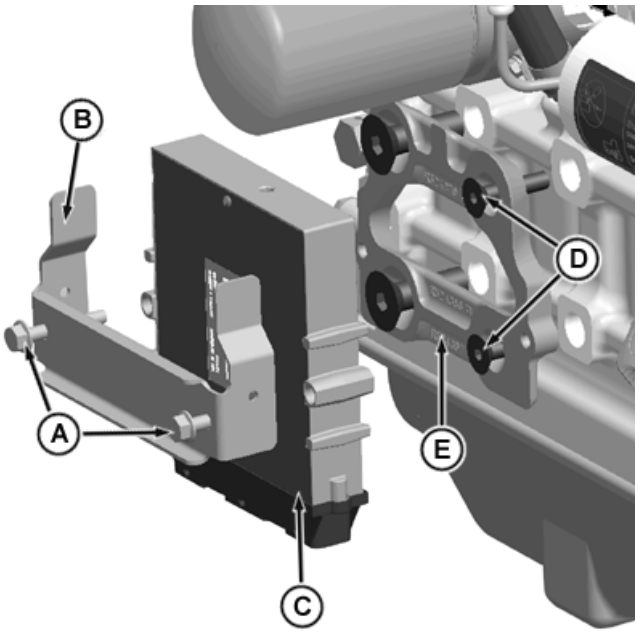
NOTE: The ECU is the system component LEAST likely to fail. Follow proper trouble shooting procedures and isolate the problem before replacing the ECU.

NOTE: For an expanded component location drawing, see Component Location Diagram 4 (J) in Section 03, Group 140 later in this manual.

The ECU is not repairable and must be replaced if found to be defective.

Engine Control Unit (ECU) Removal

1. Disconnect connectors J01 and J02 from the engine control unit.
   Do not force connectors when disconnecting or connecting wire harness to the ECU. For connector locations, see Electronic Control Unit (ECU) System Operation in Section 03, Group 140 later in this manual.
2. Remove two screws (A), mounting strap (B) and the ECU (C).
3. Remove four screws (D), and the ECU hanger plate (E).



RG17403 —UN—14JUL09

Engine Control Unit (ECU) Installation

A—Screws (2)
B—Mounting Strap
C—ECU
D—Hanger Plate Mounting Screws (4)
E—Hanger Plate

MK41968,0000363 -19-01JUN10-1/1

Engine Control Unit (ECU) — Installation

Special Tools:
• None

Consumables:
• None

IMPORTANT: DO NOT OPEN ENGINE CONTROL UNIT.

NOTE: The ECU is the system component LEAST likely to fail. Follow proper trouble shooting procedures and isolate the problem before replacing the ECU.

NOTE: For an expanded component location drawing, see Component Location Diagram 4 (J) in Section 03, Group 140 later in this manual.

ECU Replacement

IMPORTANT: If an ECU is not programmed identically with the original (failed) ECU, misleading diagnostic messages, poor performance, or engine damage can occur.

The ECU is not repairable and must be replaced if found to be defective.
The new ECU has to be programmed for its specific application. See Engine Control Unit (ECU) Reprogramming Instructions in Section 04, group 160 later in this manual.
Do not force connectors when disconnecting or connecting wire harness to the ECU. Observe proper connector and polarity when reconnecting connectors. Make sure the connector is latched properly to its mating connector. For connector locations, see Electronic Control Unit (ECU) System Operation in Section 03, Group 140 later in this manual.

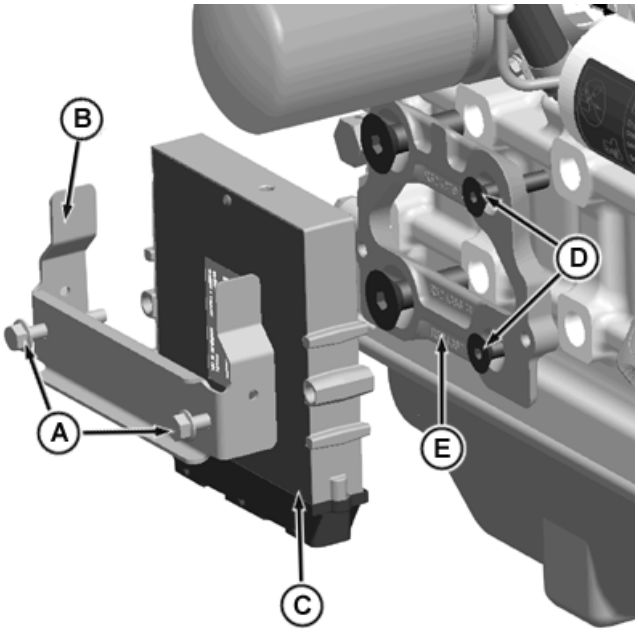
ECU Installation

Normal mounting location for the ECU is to the engine block. The mounting hardware supplied with the ECU provides the required ground connection to the engine block.

1. Install hanger plate (E) to left side of cylinder block. Tighten four screws (D) to specifications.

Specification	
ECU hanger plate 10M cap screws (2)—Torque	40 N·m (30 lb-ft)
ECU hanger plate 16M cap screws (2)—Torque	100 N·m (74 lb-ft)

2. Place strap assembly (B) over ECU (C) with rubber isolators against ECU and side guards covering the air vent. Mount ECU and strap to hanger with ECU connectors pointing down and air vent on right side facing rear of engine block. Tighten screws (A) to specifications.



RG17403 —UN—14JUL09

Engine Control Unit (ECU) Installation

A—Screws (2)
B—Mounting Strap
C—ECU
D—Hanger Plate Mounting Screws (4)
E—Hanger Plate

Specification	
ECU mounting strap cap screws (2)—Torque	30 N·m (22 lb-ft)

3. Connect connectors J01 and J02 to the engine control unit.

   Do not force connectors when connecting wire harness to the ECU. For connector locations, see Engine Control Unit (ECU) System Operation in Section 03, Group 140 in this manual.

If the ECU is mounted in a different fashion, follow the requirements listed below.

- Avoid locations near high temperature areas. Cooling or shielding may have to be provided to keep the ECU within its operating temperature range.
- The ECU must have a ground connection to the engine block. Provide a grounding strap if necessary.
- Avoid high vibration areas.
- Orient the ECU so moisture will not collect on its chassis or into the harness connectors. Keep the vent plug free of dirt and moisture.
- Protect ECU from road splash, foreign debris, and high pressure impact.
- Mount the ECU so the harness exits the chassis in a downward direction.
- If possible, mount the ECU in a vertical orientation, air vent pointing downward (connectors in a vertical plane).

Wiring practices for power to ECU.

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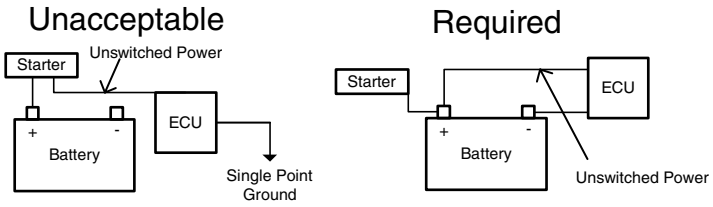
RG15361 —UN—18JUL07



Power Connection to ECU

- Power to the ECU is fused with a 20 Amp fuse.
- Power and ground to the ECU should come directly from the battery. All operating current is drawn from unswitched battery power.
- Switched power input to the ECU draws very little power. It used to signal the ECU that the application has been turned on. Loss of switched input power will cause the application to shutdown.

MK41968,0000364 -19-02JUN10-2/2

Engine Wiring Harness — Removal

Spcial Tools:
• None

The Engine Wire Harness is made up of one main harness that connects to ECU connector J01 and two interconnect harnesses (C34,C35).

NOTE: See application manual for information on Control Panel Harness (J02).

NOTE: Disconnect cable from the negative battery terminal before removing or installing wire harness or any other major electrical components. Secure cable to prevent accidental shorts.

NOTE: For location of sensors and connectors, see Component Location Diagram 6 in Group 03, Section 140 later in this manual.

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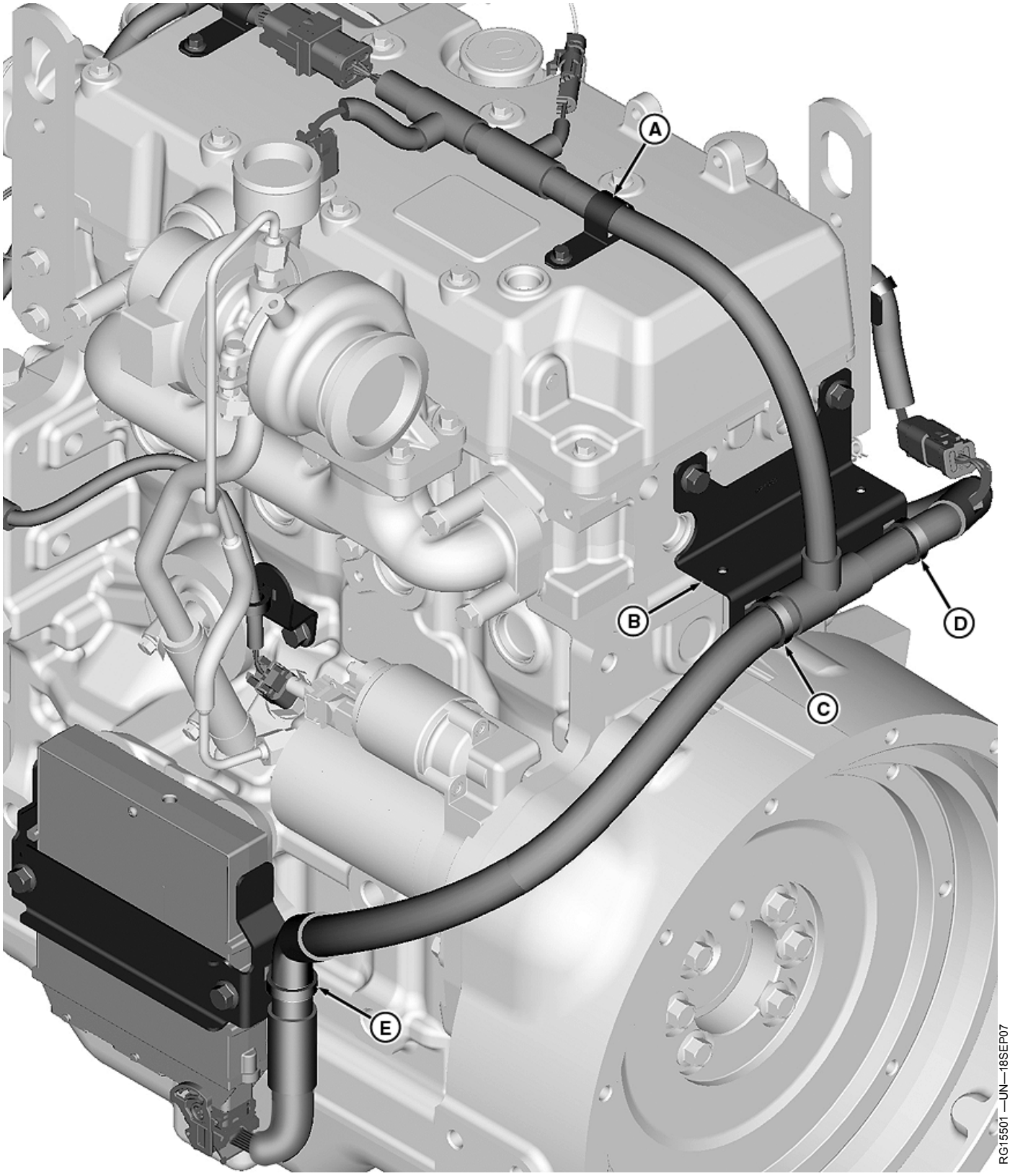

ECU Engine Wiring Harness

A—P-Clamp
B—Harness Support Bracket
C—Harness Clip
D—Harness Clip
E—Harness Clip

ECU Engine Wire Harness Removal

1. Remove the P-Clamp (A) from the top of the rocker arm cover.

Continued on next page

MK41968,0000365 -19-14APR10-2/5

2. Disconnect the front harness interconnect (C35) from the main harness.
3. Disconnect alternator excitation connector (C06) and intake manifold temperature sensor connector (T02).
4. Disconnect electronic unit pump connector (C01).
5. Disconnect fuel system interconnect (C34) from main harness.
6. Remove the 2 harness clips (C,D) from harness support bracket (B) on rear of cylinder head.
7. Disconnect auxiliary power connector (C02) and glow plug connector (C03).
8. Disconnect ECU connector J01.
9. Remove harness clip (E) from ECU support bracket.
10. Remove harness from engine being careful not to snag connectors and hoses.

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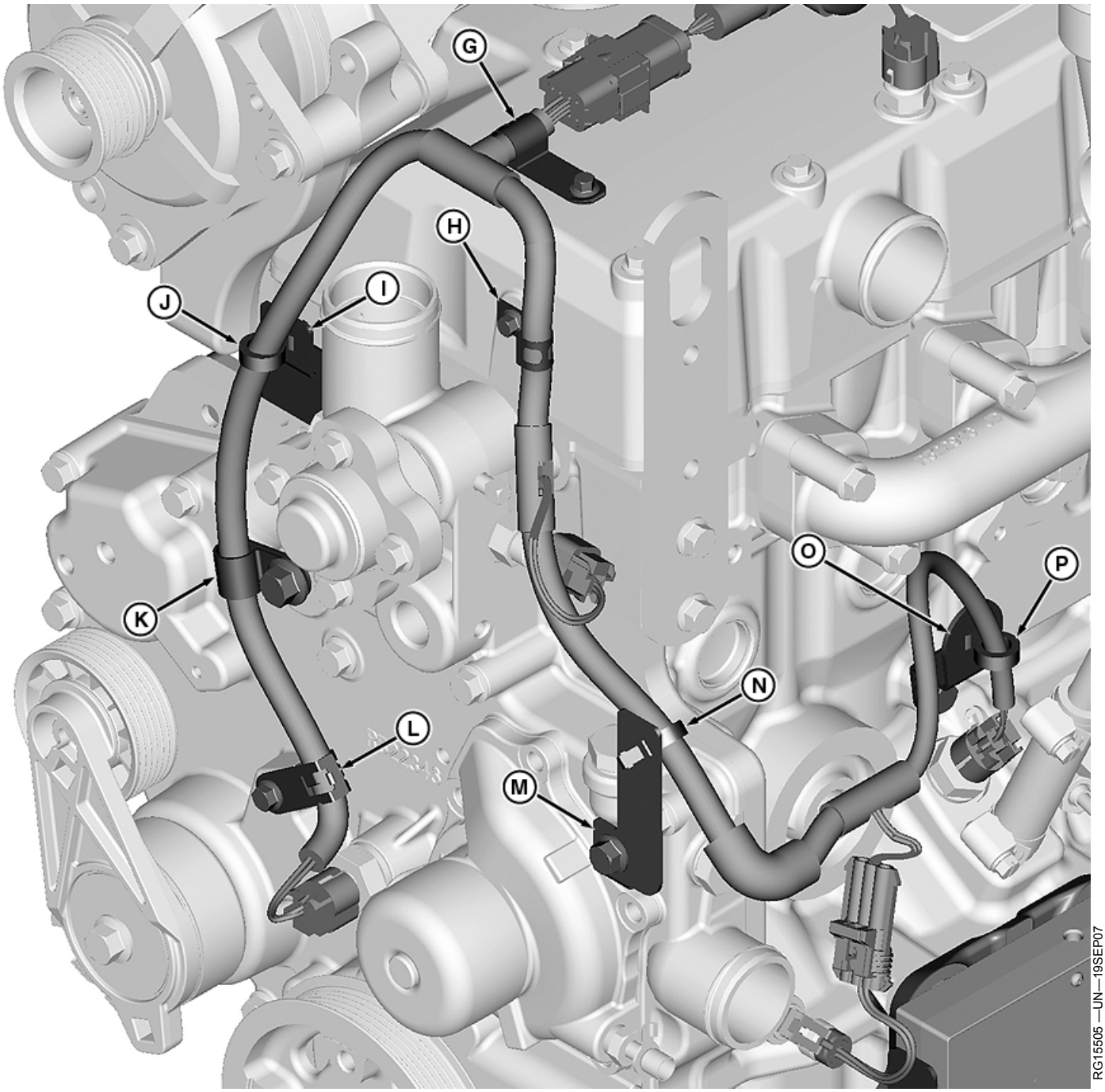

Front Engine Interconnect Harness

G—P-Clamp
H—P-Clamp
I— Harness Support Bracket
J— Harness Clip
K—P-Clamp
L—P-Clamp
M—Harness Support Bracket
N—Harness Clip
O—Harness Support Bracket
P—Harness Clip

Front Engine Interconnect Harness Removal

1. Perform Fan Assembly — Removal

   Spcial Tools:
   • None

2. Perform Fan and Alternator Belt — Removal

   Spcial Tools:
   • None

3. Remove the two P-Clamps (G,H) from the rocker arm cover.
4. Disconnect the front harness interconnect (C35) from the main harness.
5. Remove harness clip (J) from support bracket (I) above timing gear cover.
6. Disconnect camshaft position sensor connector (X02).

Continued on next page

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7. Remove the two P-Clamps (K,L) from the timing gear cover.
8. Disconnect coolant temperature sensor connector (T04).
9. Disconnect oil pressure interconnect (P04B) from interconnect harness if present.
10. Remove harness clip (N) from support bracket (M).
11. Disconnect crankshaft position sensor connector (X01).
12. Remove harness clip (P) from support bracket (O).
13. Remove front engine interconnect harness being careful not to snag connectors and hoses.

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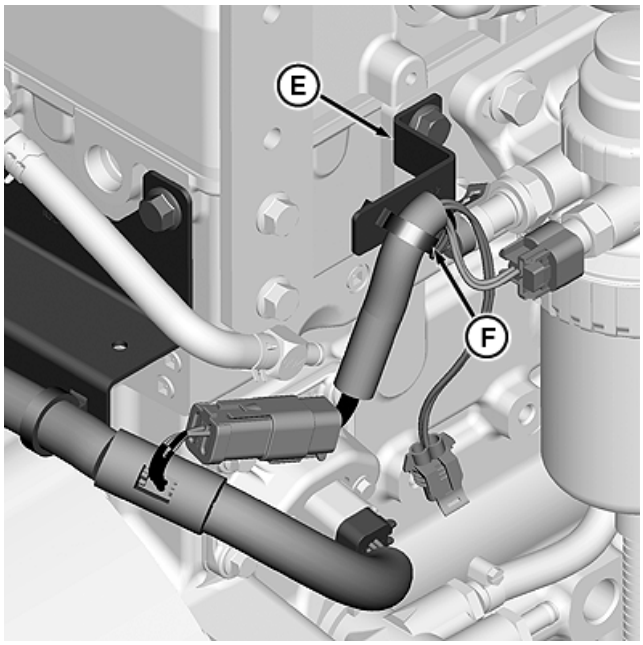
Fuel System Interconnect Harness Removal

1. Disconnect fuel system interconnect (C34) from main harness.
2. Disconnect fuel pressure (P03) and fuel temperature (T05) sensor connectors.
3. Disconnect water in fuel (D01) sensor connector if present.
4. Remove harness clip (F) from support bracket (E).
5. Remove fuel system interconnect harness being careful not to snag connectors and hoses.

E—Harness Support Bracket **F—Harness Clip**



Fuel System Interconnect Harness

MK41968,0000365 -19-14APR10-6/5

Engine Wiring Harness — Installation

The Engine Wire Harness is made up of one main harness that connects to ECU connector J01 and two interconnect harnesses (C34,C35).

NOTE: See application manual for information on Control Panel Harness (J02).

NOTE: Disconnect cable from the negative battery terminal before removing or installing wire harness or any other major electrical components. Secure cable to prevent accidental shorts.

NOTE: For location of sensors and connectors, see COMPONENT LOCATION DIAGRAMS 6 and 7 in Group 03, Section 140 later in this manual.

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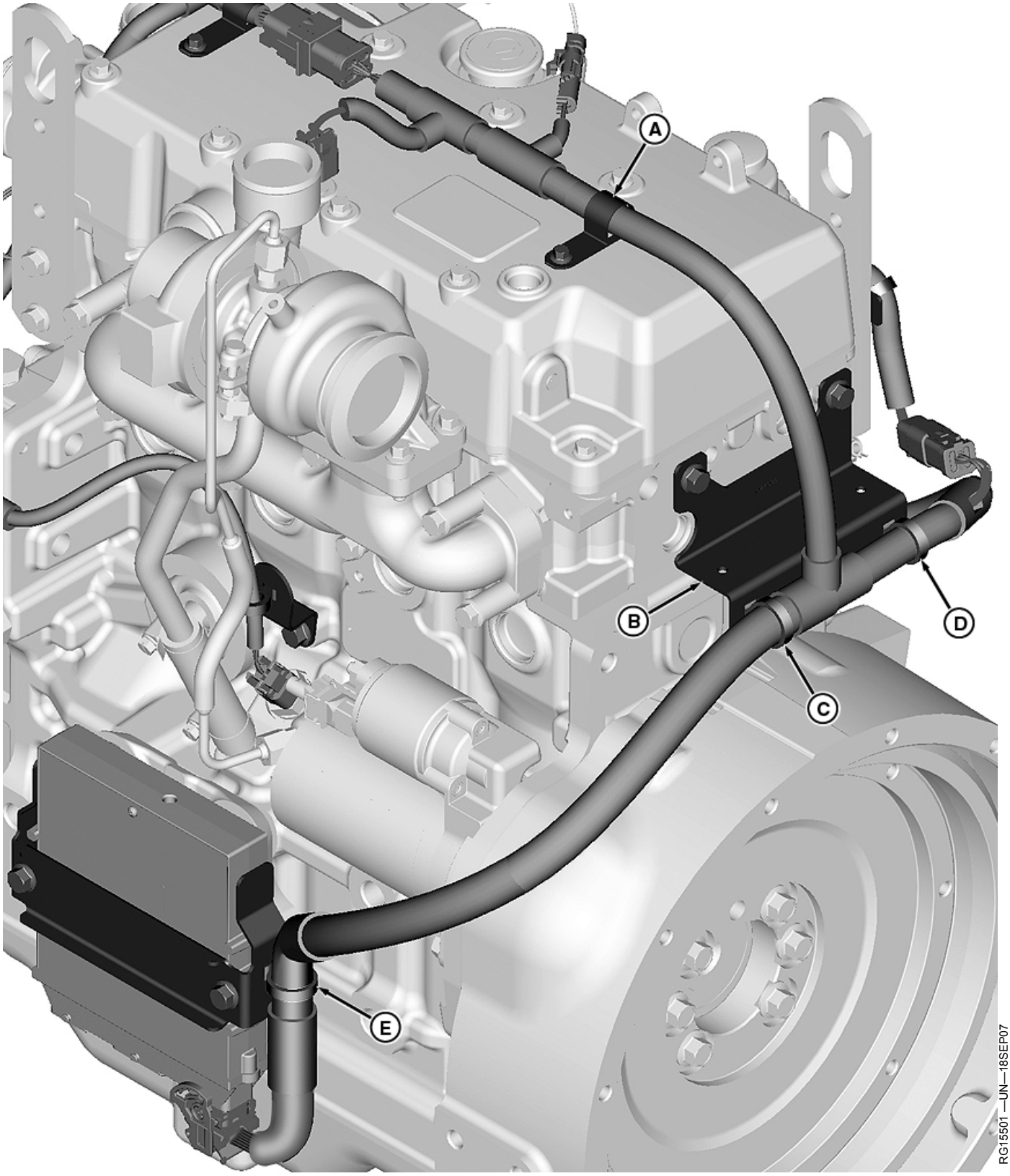

ECU Engine Wiring Harness

A—P-Clamp
B—Harness Support Bracket
C—Harness Clip
D—Harness Clip
E—Harness Clip

ECU Engine Wire Harness — Installation

Spcial Tools:

- None

Continued on next page

MK41968,0000366 -19-16JUL09-2/5

Consumables:
• None

1. If not installed, attach harness support bracket (B) on rear of cylinder head.

Specification	
Harness support bracket to cylinder head (M8 screws)—Torque	30 ±3 N•m (22 lb-ft)

2. Route harness in general area around engine as shown in drawing.
3. Attach the two harness clips (C,D) to harness support bracket (B) on rear of cylinder head.
4. Attach P-Clamp (A) to rocker arm cover using a M6 self tapping screw.

Specification	
P-Clamp to rocker cover—Torque	4 ±1 N•m (3 lb-ft)

5. Connect front engine interconnect connector (C35) if applicable.
6. Connect alternator excitation connector (C06) and intake manifold temperature sensor connector (T02).
7. Connect electronic unit pump connector (C01)
8. Connect fuel system interconnect connector (C34) if applicable.
9. Attach harness clip (E) to ECU support bracket.
10. Connect auxiliary power connector (C02) and glow plug connector (C03).
11. Connect ECU connector J01.

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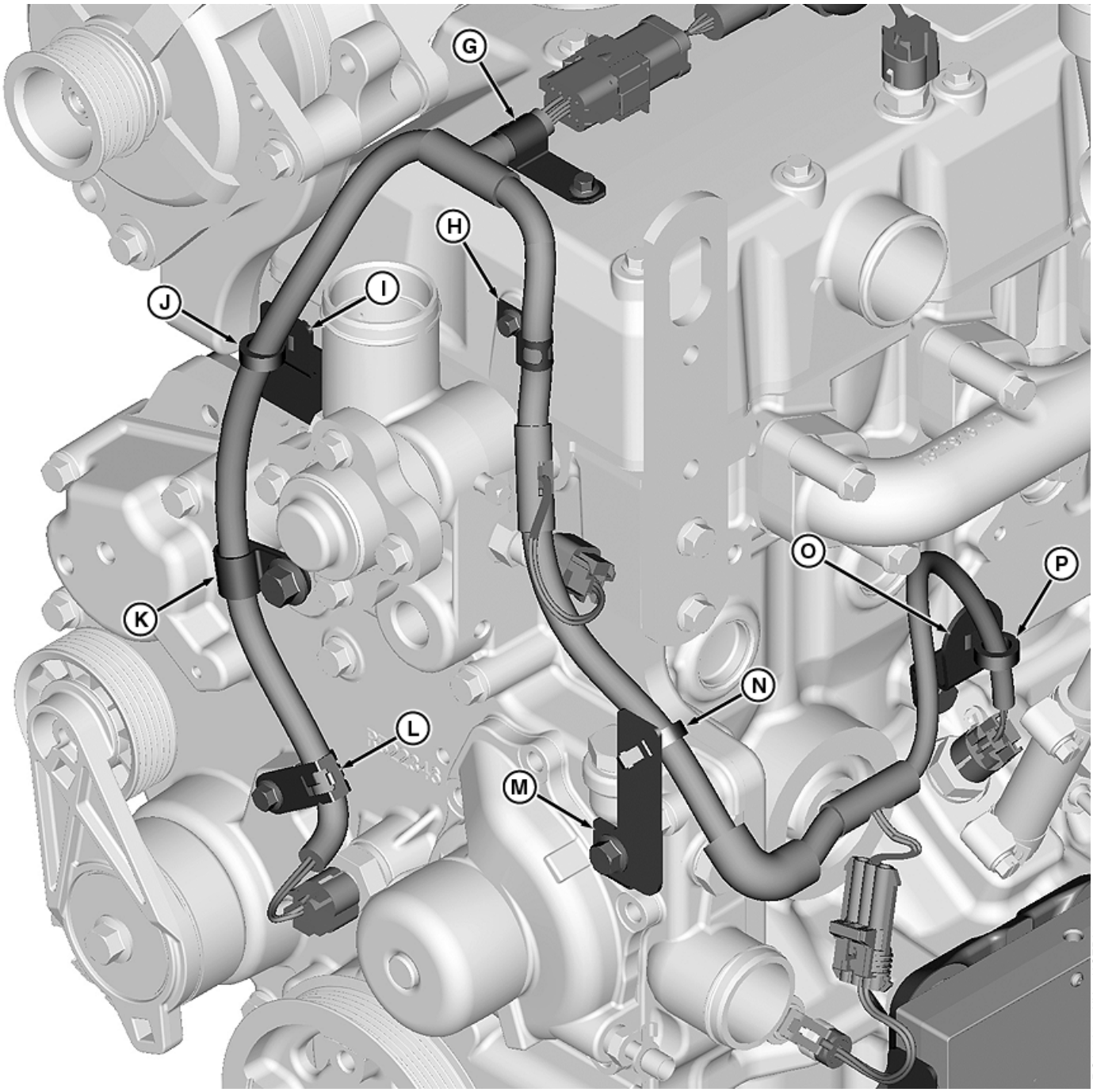


Front Engine Interconnect Harness

G—P-Clamp
H—P-Clamp
I— Harness Support Bracket
J— Harness Clip
K—P-Clamp
L—P-Clamp
M—Harness Support Bracket
N—Harness Clip
O—Harness Support Bracket
P—Harness Clip

Front Engine Interconnect Harness — Installation

Spcial Tools:
• None

Consumables:
• None

1. If not installed, attach two harness support brackets (I,M) to front of cylinder head and timing gear cover.

Specification	
Harness support brackets (M8 screws)—Torque	30 ±3 N•m (22 lb-ft)

2. Position harness as shown in drawing and attach the two harness clips (J,N) to the support brackets.

Continued on next page

MK41968,0000366 -19-16JUL09-4/5

3. Attach two P-Clamps (G,H) to rocker arm cover.

Specification

P-Clamps to rocker cover (M6 self tapping screws)—Torque..... 4 ±1 N•m (3 lb-ft)

4. Connect the front harness interconnect (C35) to main harness.
5. Connect coolant temperature sensor connector (T04).
6. Connect camshaft position sensor connector (X02).
7. If not installed, attach harness support bracket (O) to engine block near crankshaft sensor.

Specification

Harness support brackets (M8 screws)—Torque..... 30 ±3 N•m (22 lb-ft)

8. Attach harness clip (P) to harness support bracket (O).
9. Connect crankshaft position sensor (X01).
10. Connect oil pressure interconnect (P04B) connector if present. Otherwise connected dust cap to P04A.
11. Add P-Clamp (K) to harness at green tape and attach to front cylinder cover. Attach existing P-Clamp (M) to timing gear cover.

Specification

P-Clamps to timing gear cover (M10 screws)—Torque..... 30 ±3 N•m (22 lb-ft)

12. Connect camshaft position sensor (X02).
13. Pull slack in camshaft position sensor wires back through P-Clamps (K.M) to prevent wires from catching on fan belt pulley.
14. Perform Fan Assembly — Installation

    Spcial Tools:
    • None

    Consumables:
    • None

15. Perform Fan and Alternator Belt — Installation

    Spcial Tools:
    • None

    Consumables:
    • None

MK41968,0000366 -19-16JUL09-5/5

Fuel System Interconnect Harness — Installation

Spcial Tools:
• None

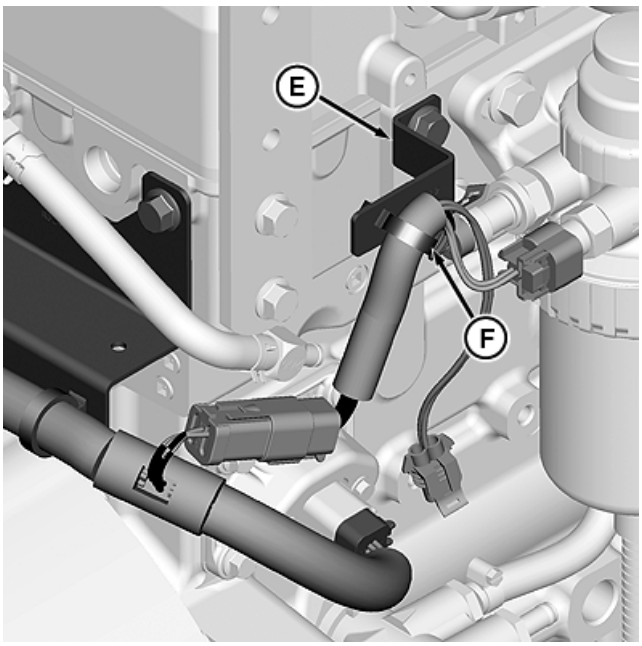
Consumables:
• None

1. If not installed, attach harness support bracket (E) to fuel filter mounting bracket.

Specification

Harness support bracket to fuel filter mounting braqcket—Torque..... 40 ±4 N•m (30 lb-ft)

2. Attach harness clip (F) to support bracket (E).
3. Connect fuel system interconnect (C34) to main harness.
4. Connect fuel pressure (P03) and fuel temperature (T05) sensor connectors.
5. Connect water in fuel (D01) sensor connector if present.



Fuel System Interconnect Harness

E—Harness Support Bracket **F—Harness Clip**

MK41968,0000366 -19-16JUL09-6/5

Fuel Temperature Sensor — Removal (If Equipped)

Special Tools:
• None

NOTE: For an expanded component location drawing see Component Location Diagram 3 (H) in Section 03, Group 140 later in this manual.

Disconnect fuel temperature sensor connector and remove sensor.

MK41968,0000369 -19-10JUL09-1/1

Fuel Temperature Sensor — Installation (IF Equipped)

Special Tools:
• None

Consumables:
• None

NOTE: For an expanded component location drawing see Component Location Diagram 3 (H) in Section 03, Group 140 later in this manual.

1. Install sensor and tighten to specification.

Specification

Fuel Temperature Sensor—Torque..... 10 N•m (7 lb-ft)

2. Connect engine wiring harness connector to fuel temperature sensor.

MK41968,000036A -19-10JUL09-1/1

Intake Manifold Air Temperature Sensor — Removal

Special Tools:
• None

NOTE: For an expanded component location drawing, see Component Location Diagram 1 (A) in Section 03, Group 140 of this manual.

Disconnect manifold air temperature sensor connector and remove sensor.

MK41968,000036B -19-10JUL09-1/1

Intake Manifold Air Temperature Sensor — Installation

Special Tools:
• None

Consumables:
• None

NOTE: For an expanded component location drawing, see Component Location Diagram 1 (A) in Section 03, Group 140 of this manual.

1. Install the manifold air temperature sensor and tighten to specification.

Specification

Manifold Air Temperature Sensor to Intake Manifold—Torque..... 18 N•m (13 lb-ft)

2. Connect engine wiring harness connector to manifold air temperature sensor.

MK41968,000036C -19-10JUL09-1/1

Low Pressure Fuel Pressure Sensor — Removal

Special Tools:
• None

NOTE: For an expanded component location drawing see Component Location Diagram 3 (G) in Section 03, Group 140 later in this manual.

Disconnect low pressure fuel pressure sensor connector and remove sensor.

MK41968,000036D -19-10JUL09-1/1

Low Pressure Fuel Pressure Sensor — Installation

Special Tools:
• None

Consumables:
• JDMH11D7 Sealant

NOTE: For an expanded component location drawing see COMPONENT LOCATION DIAGRAM 3 (G) in Section 03, Group 140 later in this manual.

1. Apply JDMH11D7 Sealant to sensor and install.
2. Tighten low pressure fuel pressure sensor to specification.

Specification	
Low Pressure Fuel Pressure Sensor—Torque	8 N•m (6 lb-ft)

3. Connect engine wiring harness connector to low pressure fuel pressure sensor.

MK41968,000036E -19-10JUL09-1/1

Oil Pressure Sensor — Removal (If Equipped)

Special Tools:
• None

NOTE: For an expanded component location drawing see Component Location Diagram 2 (F) in Section 03, Group 140 later in this manual.

Disconnect oil pressure sensor and remove sensor.

MK41968,000036F -19-10JUL09-1/1

Oil Pressure Sensor — Installation (If Equipped)

Spcial Tools:
• None

Consumables:
• JDMH11D7 Sealant

NOTE: For an expanded component location drawing see Component Location Diagram 2 (F) in Section 03, Group 140 later in this manual.

1. Apply JDMH11D7 Sealant to oil pressure sensor and install.
2. Tighten oil pressure sensor to specification.

Specification	
Oil Pressure Sensor—Torque	8 N·m (6 lb-ft)

3. Connect engine wiring harness connector to oil pressure sensor.

MK41968,0000370 -19-09JUL09-1/1

Water-In-Fuel (WIF) Sensor — Removal (If Equipped)

Special Tools:
• None

NOTE: For an expanded component location drawing, see Component Location Diagram 1 (C) in Section 03, Group 140 of this manual.

Disconnect WIF sensor wiring connector and remove sensor.

MK41968,0000371 -19-09JUL09-1/1

Water-In-Fuel (WIF) Sensor — Installation (If Equipped)

Spcial Tools:
• None

Consumables:
• None

NOTE: For an expanded component location drawing, see COMPONENT LOCATION DIAGRAM 1 (C) in Section 03, Group 140 of this manual.

1. Disconnect WIF sensor wiring connector and remove sensor.
2. Install sensor in fuel filter.
3. Connect engine wiring harness connector to WIF sensor connector.

MK41968,0000372 -19-09JUL09-1/1

Oil Pressure Switch (Optional) — Removal

Special tools:
• None

NOTE: For an expanded component location drawing see Component Location Diagram 2 (E) in Section 03, Group 140 later in this manual.

Disconnect oil pressure switch and remove switch.

JL45346,0000035 -19-10JUL09-1/1

Oil Pressure Switch (Optional) — Installation

NOTE: For an expanded component location drawing see Component Location Diagram 2 (E) in Section 03, Group 140 later in this manual.

Spcial Tools:
• None

Consumables:
• JDMH11D7 Sealant

1. Apply JDMH11D7 Sealant to oil pressure switch and install.
2. Tighten oil pressure switch to specification.

Specification

Oil Pressure Sensor—Torque..... 8 N·m (6 lb-ft)

3. Connect engine wiring harness connector to oil pressure switch.

MK41968,000006E -19-10JUL09-1/1

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Theory of Operation

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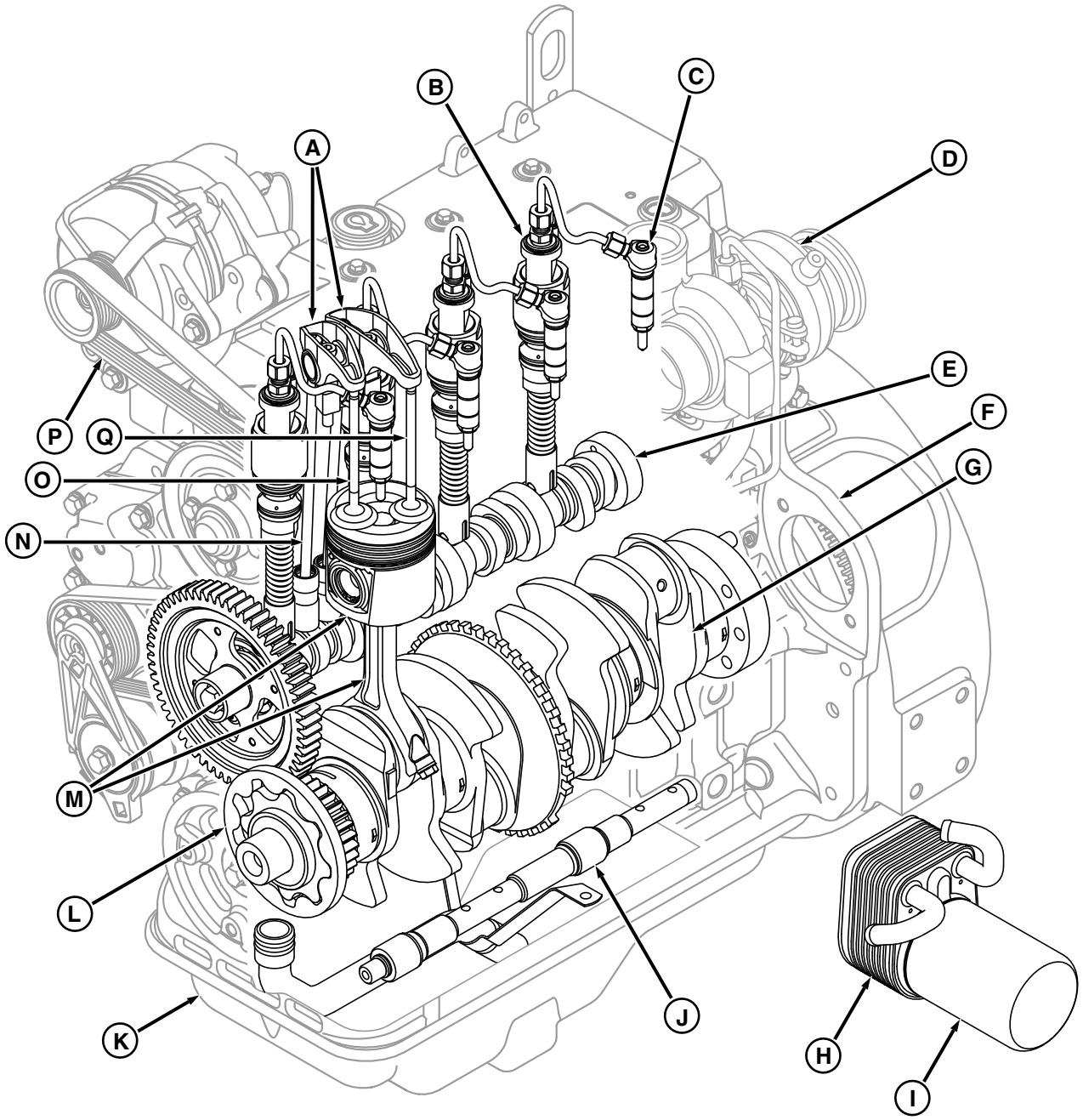
General Engine Operation



General Engine Components

A—Rocker Arm
B—Electronic Unit Pump
C—Injector Nozzle
D—Turbocharger
E—Camshaft
F—Cylinder Block
G—Crankshaft
H—Oil Cooler
I— Oil Filter
J— Balancer Shaft
K—Oil Pan
L—Oil Pump
M—Piston and Connecting Rod
N—Push Rod
O—Intake Valve
P—Poly Vee Fan Belt
Q—Exhaust Valve

The Series 250 engines are vertical, in-line, two valve in head, four cycle (stroke) diesel engines. The 2.4L engine (shown) has four cylinders. The 3.0L version of the Series 250 engine is a five cylinder design.

The fuel system for this engine series uses direct fuel injection provided by an electronically controlled integral pumping unit with a roller hydraulic camshaft follower B), and injector nozzle (C). A fuel transfer pump draws fuel from the tank and provides pressure to and through the fuel filter and cylinder block fuel galley. The fuel gallery, integral with the cylinder block to avoid external fuel lines, supplies fuel to the pumping units and nozzles. The quantity of fuel delivered to each pumping unit is controlled by the engine control unit and the electronic unit pump. The pumping units, driven by hydraulic cam followers, pressurize and deliver fuel to the nozzle.

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RG19661,0000257 -19-01JUN10-1/2

Glow plugs for each cylinder are included in the design as standard equipment to aid during cold weather starts.

Series 250 engines are equipped with a turbocharger (D). The turbocharger uses energy from exhaust gases to compress and deliver intake air to the intake manifold and, subsequently, the combustion chambers. The compressed air means additional air is being delivered to the cylinders. The additional air results in a higher power output by the engine, as well as cleaner emissions.

The cylinder block (F) is a one piece casting with integral cylinder bores.

The camshaft (E) is timed to the crankshaft through the timing gear train. The camshaft rotates in honed bores in the cylinder block. The Series 250 engines use a bearing in the number one camshaft bore, with bushings in the other journals. The camshaft lobe design controls the lift and duration of each intake and exhaust valve opening and closing and also actuate the pumping and injection of fuel within the pumping units and nozzles for each bore. The camshaft intake lobes have a small double lobe which acts as an internal exhaust gas recirculation valve.

The camshaft followers, or lifters, for both the valves and pumping units, are a hydraulic design eliminating the need for regular valve lash adjustment intervals.

Intake (O) and exhaust (Q) valves are actuated by the hydraulic cam followers, or lifters (O), running off the camshaft lobes. Push rods (N) and rocker arms (A) complete the camshaft-to-valve actuation assembly.

The crankshaft (G), is a one piece, nodular iron forging with a integral central timing gear. The crankshaft is dynamically balanced, and the journals are machined with undercut and rolled fillets for additional strength. Each crankshaft journal is encased in a two piece, replaceable, main or rod bearing assembly. Additional two piece main journal thrust bearing inserts are used to control crankshaft end play.

Pistons (M) are manufactured from a high grade, cast aluminum alloy, with internal ribbing. The piston skirt is cam ground to allow for heat expansion during the combustion process. The piston crown has a cut out combustion bowl with a truncated cone center. All piston rings are located above the piston pin. One oil control ring and two compression rings are utilized. The top compression ring is a rectangular, steel, 2 mm thick, barrel face shaped design, and is located close to the top of the piston, by design, for improved starting and engine performance.

The hardened, fully floating piston pins are held in place in the piston bore by snap rings. Piston spray jets, located in the cylinder block, spray pressurized oil to the underside of the piston to lubricate the pins, and cool the piston.

The forged steel connection rods (M) have replaceable bushing inserts to support the piston pin during the combustion process. Rods and caps are manufactured with an angled PRECISION JOINT™

Series 250 engines are designed with a crankshaft driven, gerotor oil pump (L) and a full flow oil filter (I). The oil filter has an internal bypass valve, which opens if the filter element becomes restricted. The filter is mounted on a “donut style” oil cooler (H), which is located on the side of the cylinder block. The Series 250 engines are also designed with a pressure regulating valve, located in the front timing gear cover, to relieve excessive oil pressure that may build up in the lubrication system.

Balancer shafts (J) are used on four cylinder engines to reduce the natural vibration that exists with four cylinder four stroke diesel engine designs. The two shafts, located in integral bores on each side of the crankshaft in the cylinder block, are counter rotating to each other and rotate at twice the engine speed.

The engine has a pressurized cooling system, consisting of a radiator, water pump, multi blade fan, and an intregral thermostat housing in the timing gear cover.

For additional details on fuel, lubrication, cooling, and air systems, see later in this section:

Fuel System Operation

Lubrication System Operation

Cooling System Operation

Intake Air System Operation

Exhaust Air system Operation

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Coolant System Operation

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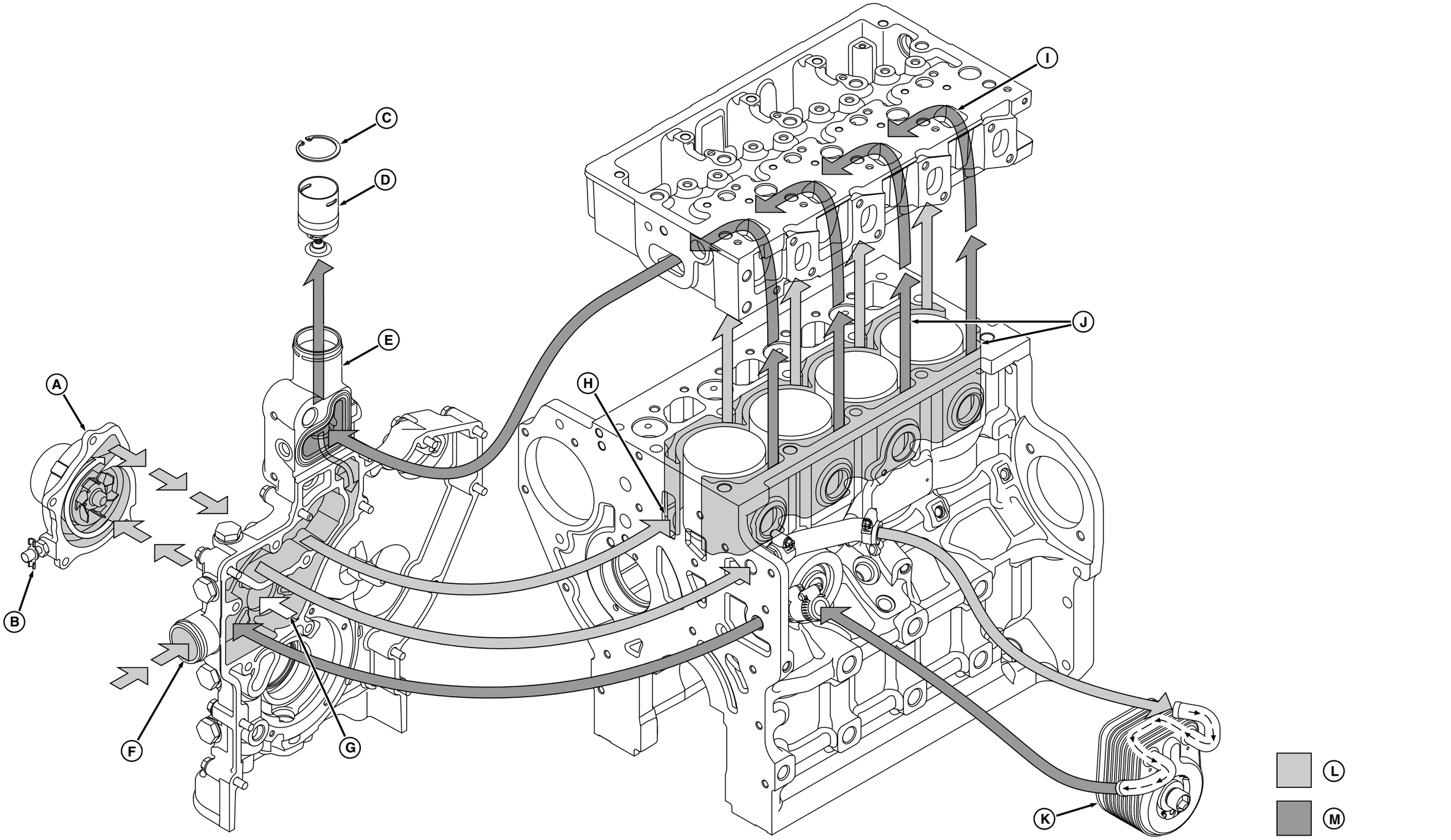

Cooling System

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RG19661,0000279 -19-07SEP09-1/2

A—Water Pump
B—Drain Valve
C—Snap Ring
D—Thermostat
E—Thermostat Housing (Timing Gear Cover)
F—Coolant Return from Radiator
G—Coolant Flow to Water Pump (Suction Side)
H—Coolant Return to Cylinder Block
I—Coolant Flow to Cylinder Head
J—Coolant Flow - Cylinder Block to Cylinder Head
K—Oil Cooler
L—Low Temperature Coolant
M—High Temperature Coolant

NOTE: The 2.4L engine is shown. Cooling of the 3.0L engine is similar.

The coolant system includes the radiator, water pump, thermostat which is secured in the thermostat housing (timing gear cover) with a snap ring (C), and coolant passages.

When the engine is cold, the water pump (A) forces coolant through the engine block, around the cylinders (J), and into the cylinder head (I).

From the cylinder head, the coolant is routed back to the bypass in the thermostat housing (E) which is part of the timing gear cover. Regardless of engine temperature, the water pump also forces coolant through the oil cooler (K).

When the engine is warm, the coolant partially opens the thermostat (D) and the coolant is routed through the radiator and back to the coolant inlet, located in the front timing gear housing.

When the engine is at operating temperature, the coolant fully opens the thermostat, increasing coolant flow through the radiator. Under operating temperature conditions, the bypass port (I) is closed. All of the coolant circulates through both the radiator and oil cooler assembly, and back to the water pump inlet.

Coolant continues flowing through the radiator circuit until the coolant temperature drops below the thermostat opening temperature.

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Lubrication System Operation

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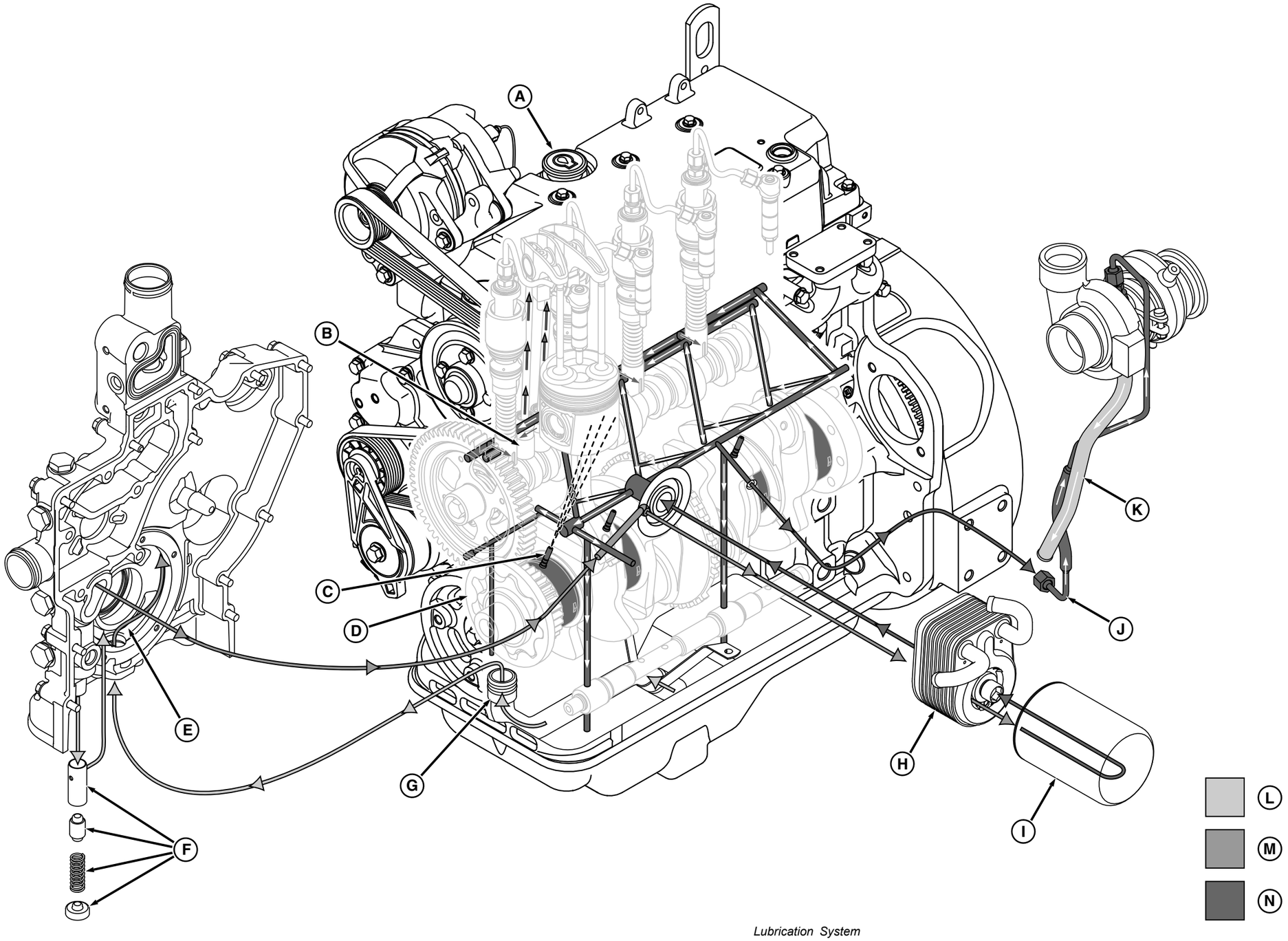

Lubrication System

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Lubrication System

A—Rocker Arm Cover Oil Fill
B—Hydraulic Lifter
C—Piston Cooling Orifice
D—Oil Pump
E—Oil Pump Housing
F—Oil Pressure Regulating Valve
G—Oil Suction Tube
H—Oil Cooler
I— Oil Filter
J— Turbocharger Oil Supply Line
K—Turbocharger Oil Return Tube (Drain)
L—Pressure Free Oil
M—Pressurized Unfiltered Oil
N—Pressurized Filtered Oil

NOTE: The 2.4L engine is shown. Lubrication of the 3.0L engine is similar.

The engine lubrication system consists of a crankshaft driven, gerotor design oil pump (D), a full flow oil filter (I), oil cooler (H) and an oil pressure regulating valve (F).

The gerotor oil pump draws oil from the oil pan sump through a strainer and suction tube (G). The oil pump forces pressurized oil to the main oil galley in the cylinder block through a separate drilled passage. Oil is then routed through the oil cooler and filter, and back into the main oil galley, to be fed to the remainder of the engine.

Oil pressure is regulated by a valve assembly (F) located in the front timing gear cover. Excessive oil is returned to the engine crankcase.

The main oil galley runs the length of the cylinder block and delivers oil to cross-drilled oil passages that feed oil to the camshaft journals, and main bearing bushings. Additional cross-drilled passages intersect with cam and crank oil passages and provide lube oil to the balancer shaft bushings (if equipped). These passages also provide oil for the hydraulic valve lifters (B), and the push rods. The push rods are hollow and allow oil to flow up to the rocker arm area.

From the main bearings, oil flows to the connecting rod bearings through drilled passages in the crankshaft. Oil from the main bearings also supply the piston cooling orifices (C). The piston cooling orifice sprays oil to the underside of the piston to keep the piston crown cool during combustion. The oil spray also provides splash lubrication for the piston pin and bushing via a drilled hole through the top end of the connecting rod.

At the front of the cylinder block, oil flows from the oil passage into a machined groove in the front face of the block. This groove connects with the idler gear shaft to provide oil to the idler gear bushing.

The turbocharger oil supply line (J) supplies oil from the main oil galley to the turbocharger housing to cool and lubricate the turbocharger shaft and bearings. The oil returns to the crankcase from the turbocharger through a separate drain tube (K). Turbocharger components operate at extremely high speeds, so a constant oil supply and an unrestricted return to sump is critical.

The oil fill locations are on left side of the engine, with right side fill optional. Oil can be added through the top of the rocker arm cover (A).

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Electronic Unit Pump and Injector Nozzle Operation

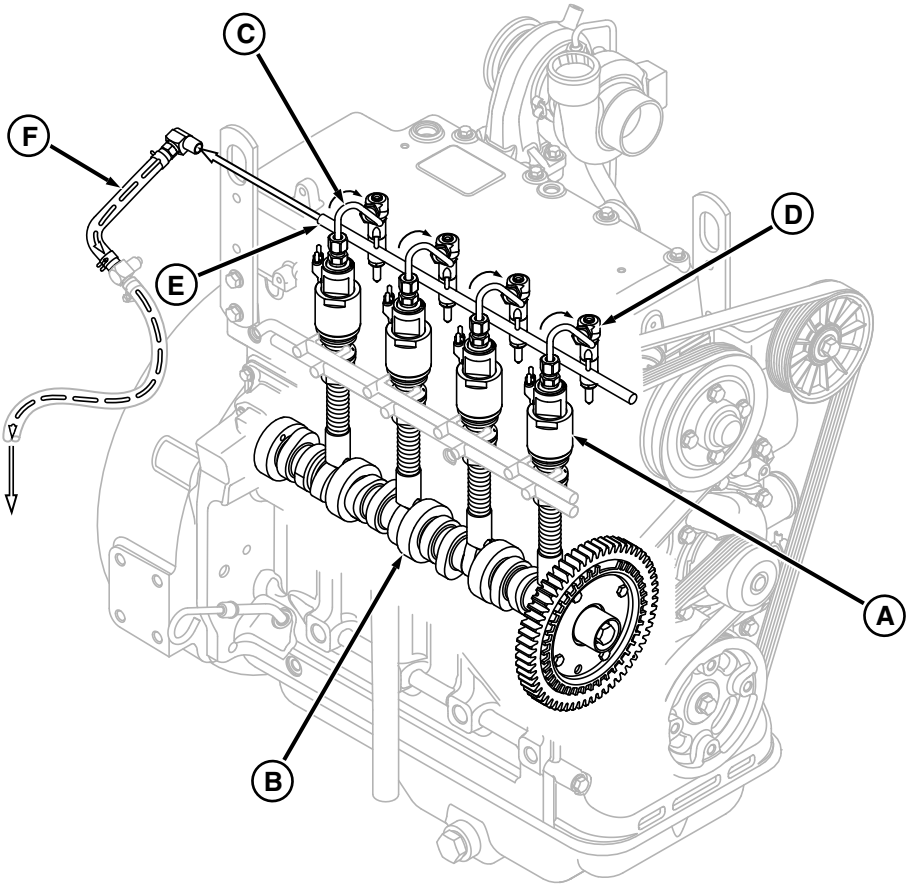

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Figure 1 - Electronic Unit Pump and Injector Nozzle System

A—Electronic Unit Pumps
B—Camshaft
C—High Pressure Fuel Lines
D—Injector Nozzles
E—Injector Nozzle Leak-Off Gallery
F—Injector Nozzle Leak-Off Hose

Basic System Operation

The 2.4L/3.0L electronic unit pump and injector nozzle together are very similar in operation to the 13.5L electronic unit injector. An electronic unit pump (A) for each cylinder is mounted in the engine block and held in place by a hold-down clamp. A roller follower with spring on lower end of the unit pump follows a lobe on the camshaft (B). Camshaft rotation causes the follower and a plunger inside the unit pump to move up and down to produce a pumping action. An electric solenoid inside the unit pump is controlled by the ECU. When the ECU determines that fuel is to be injected, the solenoid is energized. The energized solenoid causes a spill valve inside the unit pump to close resulting in the plunger upward motion applying a high pressure to the fuel. The fuel under high pressure flows through rigid high pressure fuel lines (C) to the injector nozzles (D) mounted in the cylinder head. The tip of the injector nozzle is located in the combustion chamber. When fuel under pressure exceeds the nozzle opening pressure, a needle in the injector nozzle lifts to inject fuel into the combustion chamber. Injection continues until the ECU de-energizes the unit pump solenoid. The injector nozzles are plumbed to a leak-off gallery (E). Leak-off fuel returns to the fuel tank through the injector nozzle leak-off hose (F).

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Electronic Unit Pump Details

The roller mechanical camshaft follower (G) is located on the lower end of the unit pump. A return spring (H) keeps the follower in contact with the camshaft. The unit pump is contained in the engine block (I). A cavity (J) surrounding each unit pump is plumbed to the fuel supply gallery (K) and the fuel return gallery (L). O-rings (M) on the unit pump seal the fuel cavity. There are three openings (N) on the unit pump in area of the fuel cavity which supply fuel to the unit pump and return fuel that has not been injected to the fuel cavity.

Two studded electrical terminals are located at the top of the unit pump (O). The terminals are internally connected to the electric solenoid, which is used to control injection.

The high pressure fuel outlet port (P) is located at the upper end of the unit pump. The high pressure fuel lines are threaded onto the fuel outlet ports.

The electronic unit pumps are marked with a six digit hexadecimal calibration code which identifies unique characteristics of the unit pump. The calibration code must be entered into the ECU using Service ADVISOR if a unit pump is replaced or moved to another cylinder. The electronic unit pump is independent of the injector nozzle. The electronic unit pump or corresponding injector nozzle can be replaced without replacing the other component.

G—Roller Follower
H—Return Spring
I— Engine Block
J— Fuel Cavity
K—Fuel Supply Gallery
L— Fuel Return Gallery
M—O-Rings
N—Fuel Supply and Return Openings
O—Electrical Connections
P—High Pressure Fuel Outlet Port

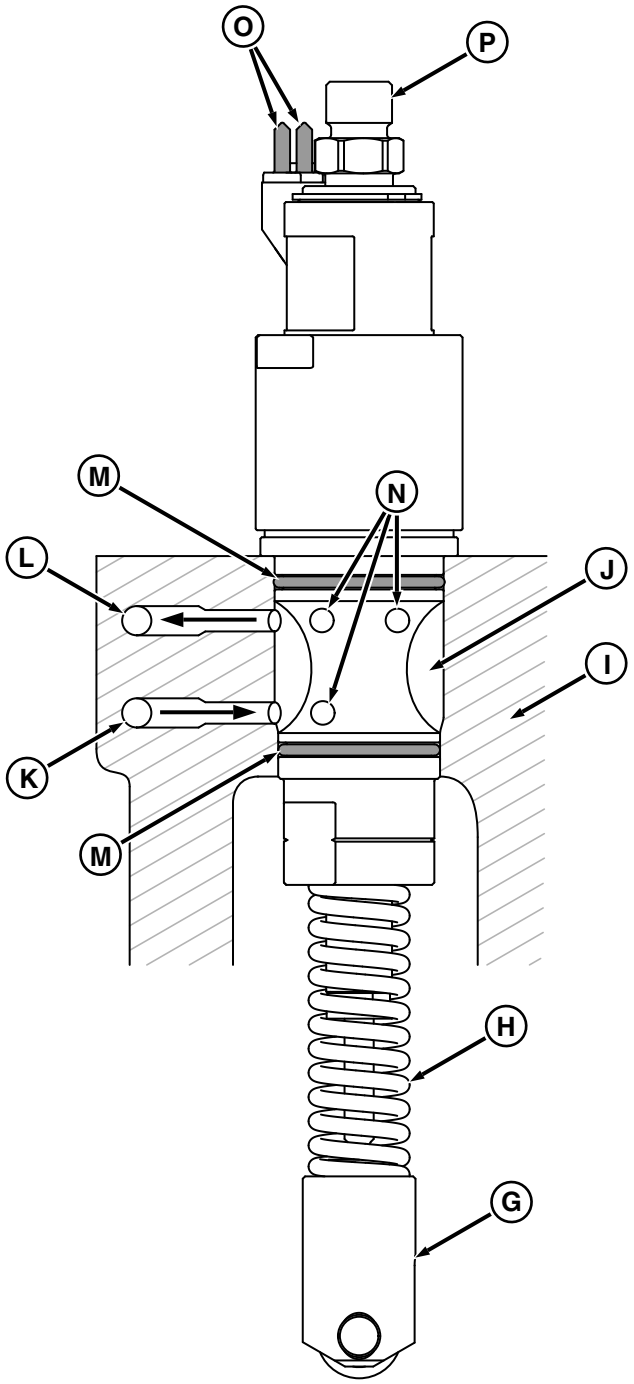

Figure 2 - Electronic Unit Pump

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Injector Nozzle Details

The injector nozzles are mounted in the cylinder head (Q). The fuel inlet port (R) is located at the upper end of the injector nozzle. The high pressure fuel lines are threaded onto the fuel inlet port. A fuel leak-off cavity (S) in the cylinder head surrounds each injector nozzle. The leak-off cavity is plumbed to the leak-off gallery (T). An O-ring (U) at the top of each injector nozzle seals the upper end of the leak-off cavity. A sealing washer (V) at the bottom of each injector nozzle seals the leak-off cavity from the combustion chamber.

Injector nozzles do not have a calibration code. However, the injector nozzle part number is specific to the engine power rating. Installing a nozzle with the wrong part number will result in excessive or insufficient fueling. The injector nozzle part number (W) is stamped on the side of the injector nozzle body and can only be viewed with the injector nozzle removed from the cylinder head.

Fuel Control Details

The electronic unit pump and injector nozzle operation is divided into three cycles. The Fill Cycle, the Pump Cycle, and the Injection Cycle.

Q—Cylinder Head
R—Fuel Inlet Port
S—Leak-Off Cavity
T—Leak-Off Gallery
U—O-Ring
V—Sealing Washer
W—Part Number Location

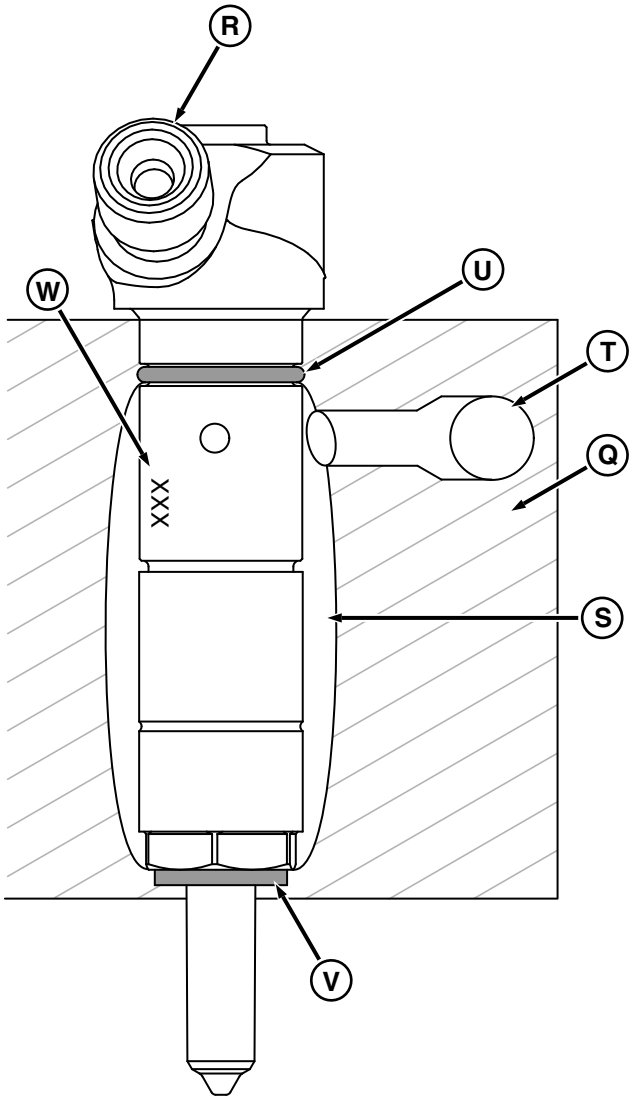

Figure 3 - Injector Nozzle

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Electronic Unit Pump Fill Cycle

The Fill Cycle begins when the plunger (A) shown in Figure 4 is pulled downward by the return spring (B) as the roller follower (C) follows the camshaft lobe. The downward motion of the plunger causes fuel from the fuel supply gallery to be drawn into the unit pump plunger cylinder (D). The unit pump solenoid (E) is not energized during the fill cycle, so the normally-open spill valve (F) is open. Plunger downward motion ceases when the follower reaches the base circle of the camshaft lobe.

A—Plunger
B—Return Spring
C—Roller Follower
D—Plunger Cylinder
E—Solenoid
F—Spill Valve

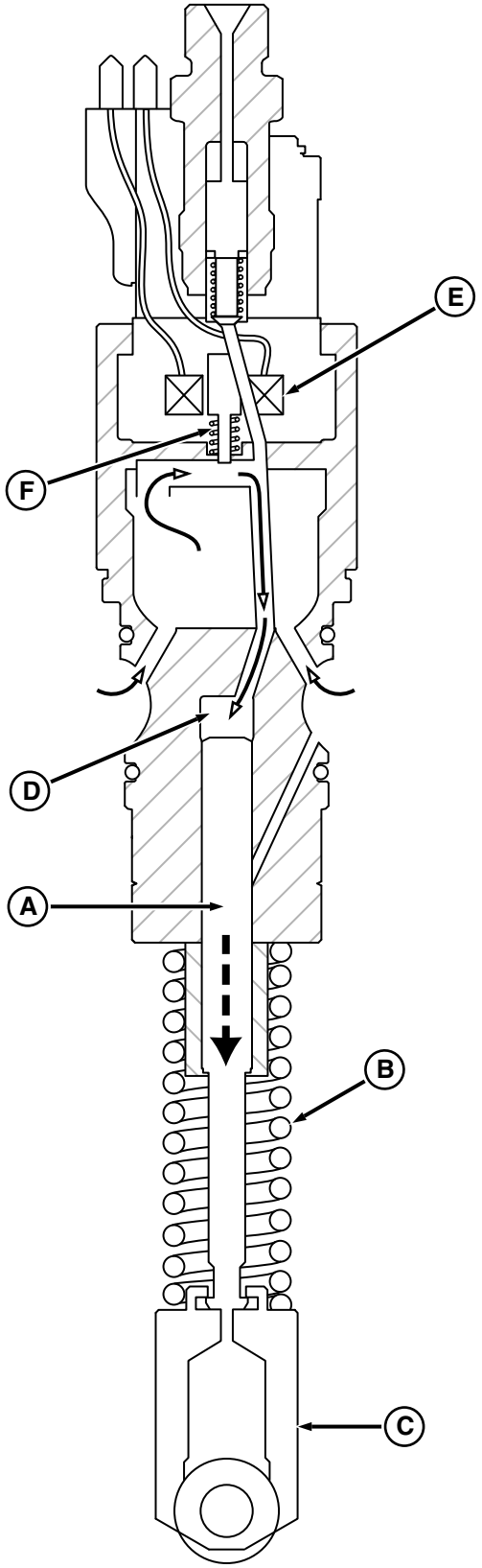

Figure 4 - Electronic Unit Pump Fill Cycle

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Pump Cycle

The Pump Cyclebegins when the camshaft lobe begins lifting the unit pump follower as the corresponding piston is approximately 80 degrees before top dead center of the compression stroke. The upward motion of the follower causes the plunger to also move upwardly. With the spill valve open as shown in Figure 5, fuel in the plunger cylinder is pumped back into the fuel cavity around the unit pump resulting in relatively no pressure being applied to the fuel in the plunger cylinder.

Just prior to the corresponding piston reaching the position where the ECU has determined that fuel should be injected, the ECU provides +90V and ground to the unit pump solenoid coil. The current flow through the coil causes a strong magnetic field to be developed around the coil. The magnetic field causes the spill valve (F) to be pulled closed as shown in Figure 6. With the spill valve closed, pressure is rapidly applied to the fuel in the plunger cylinder as the plunger continues to be pushed upward by the camshaft lobe.

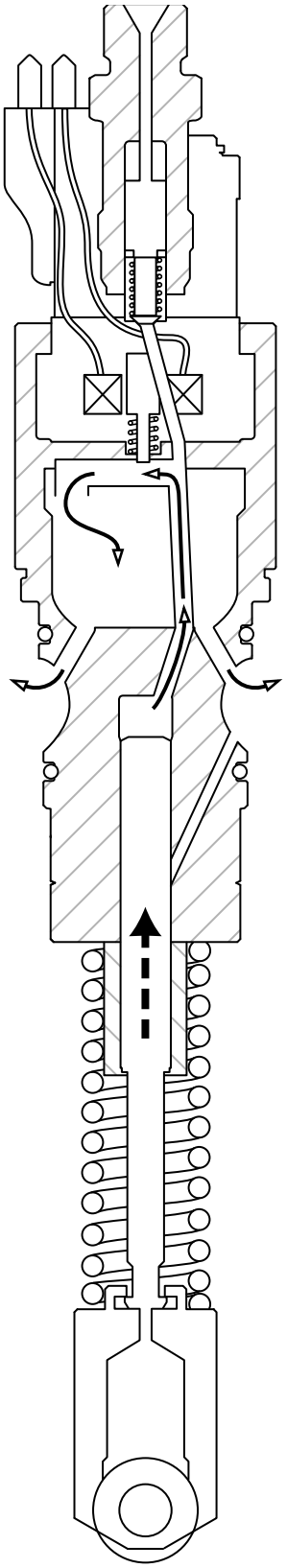

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Figure 5 - Pump Cycle with Spill Valve Open

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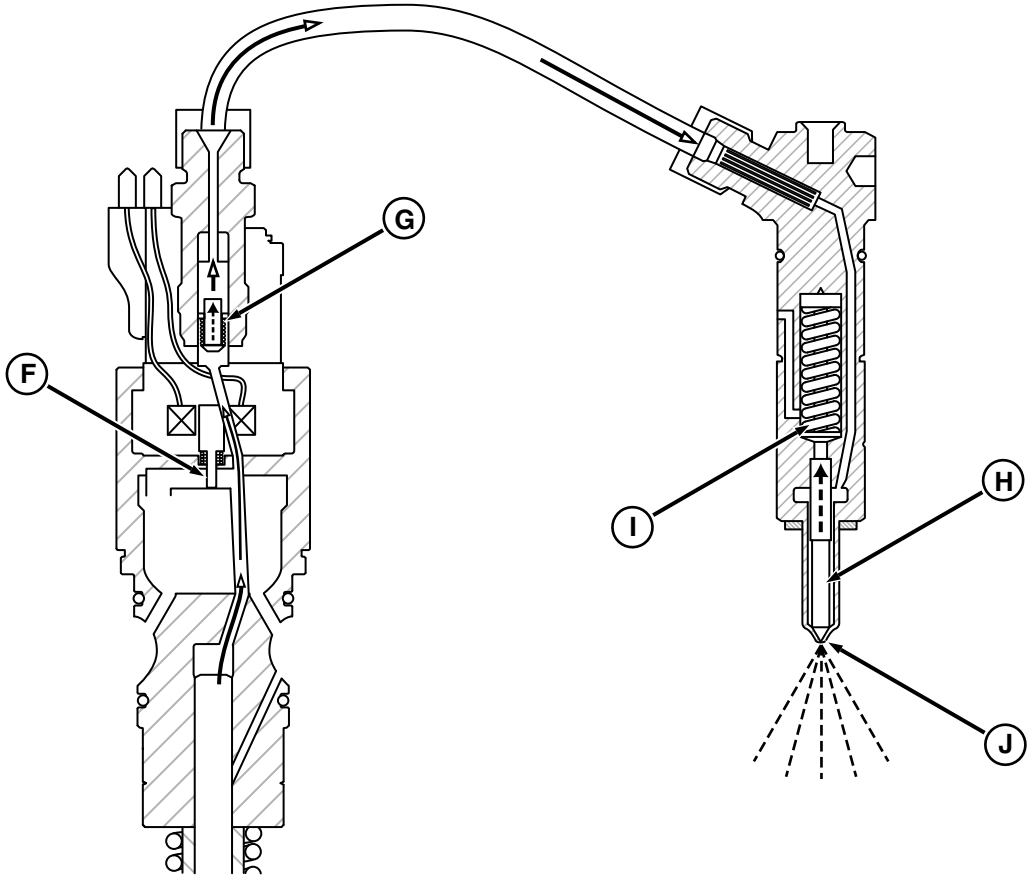

Figure 6 - Spill Valve Closed

F—Spill Valve
G—Check Valve
H—Injector Needle
I— Injector Spring
J— Injector Nozzle Tip

Injection Cycle

When the pressure exceeds 4 MPa (580 psi) a check-valve (G) in the unit pump outlet port opens which causes fuel under pressure to flow through the high pressure fuel line to the injector nozzle. As the plunger continues its upward movement, the pressure applied to the fuel in the injector nozzle increases. When the pressure in the injector nozzle exceeds 25 MPa (3625 psi), the normally-closed injector needle (H) overcomes the injector spring (I) to begin the Injection Cycle. The injector needle lifts and fuel is injected through the tip of the injector nozzle (J) into the combustion chamber. The pressure applied to the fuel in the injector nozzle rapidly rises as high as 120 MPa (17,400 psi) as the plunger upward movement continues.

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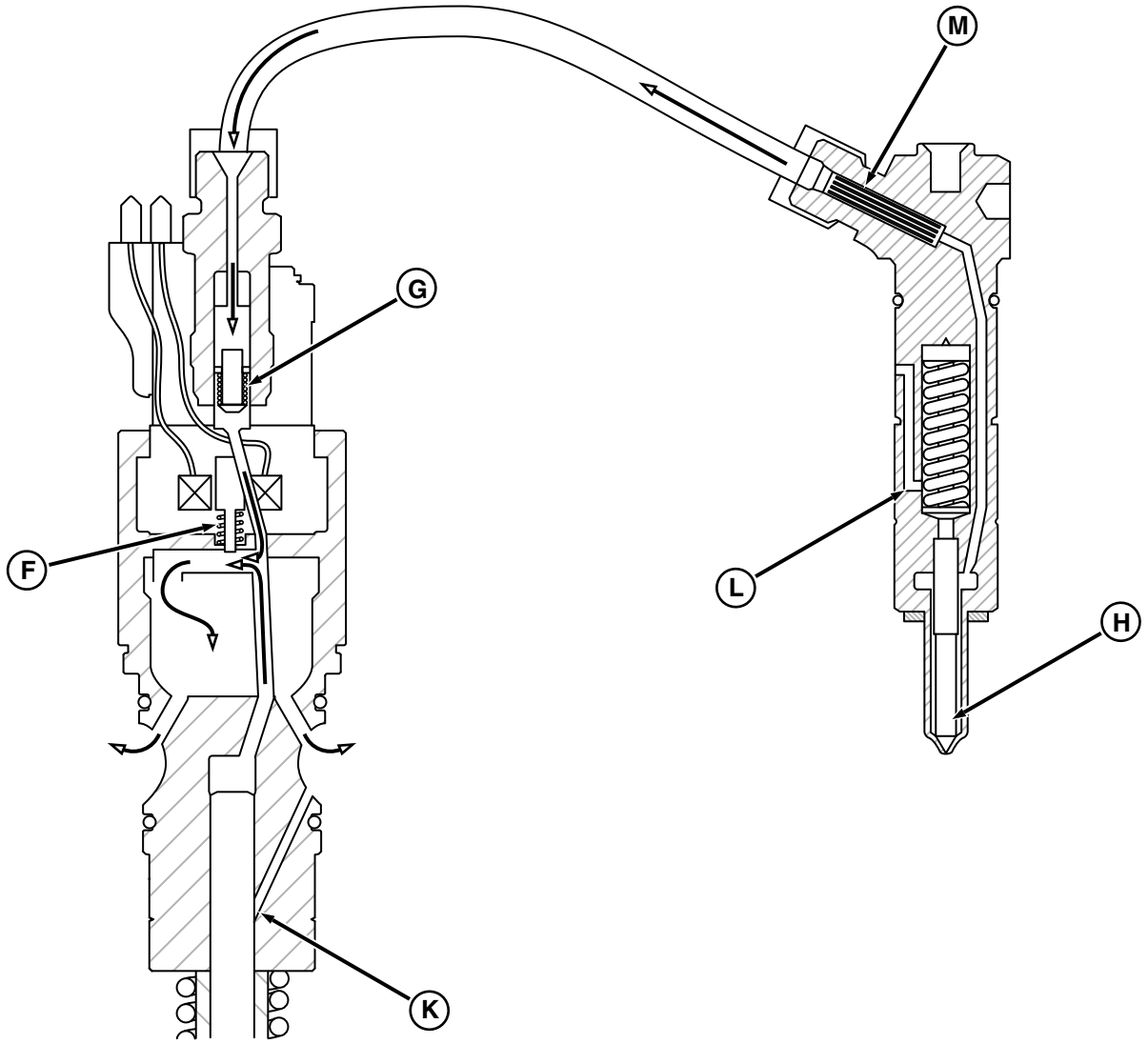

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Figure 7 - End of Injection Cycle

F—Spill Valve
G—Check Valve
H—Needle
K—Unit Pump Leak-Off
L—Injector Nozzle Leak-Off
M—Edge Filter

End of Injection Cycle

The start of injection is determined by when the solenoid is energized in relationship to piston position, based on information from the crankshaft position sensor. The length of time that the electronic unit pump solenoid is energized determines the quantity of fuel injected. When the ECU calculates that the prescribed quantity of fuel has been injected, the ECU de-energizes the solenoid (Figure 7). The magnetic field around the solenoid collapses and the normally-open spill valve (F) is opened. The open spill valve vents the fuel under pressure in the unit pump and injector nozzle into the fuel cavity surrounding the unit pump. The pressure in the injector nozzle rapidly drops which causes the normally-closed injector needle (H) to close and injection then ceases. The check valve (G) at the unit pump outlet closes when pressure drops below 4 MPa (580 psi) to maintain fuel under pressure in the high pressure fuel line and injector nozzle. This reduces the time necessary for pressure in the injector nozzle and high pressure line to rise during the next injection event.

Other Details

The unit pump and injector nozzle have internal leak-off ports (Figure 7). The unit pump leak off (K) returns any fuel that leaks between the plunger and cylinder to the fuel return system. The injector nozzle leak-off (L) returns any fuel that leaks between the injector needle and guide. The injector nozzle inlet also contains a non-servicable edge filter (M).

The fuel system performs pilot injection during engine start-up. The ECU energizes the unit pump solenoid briefly to inject a small amount of fuel prior to main injection. Pilot injection ceases after the engine starts.

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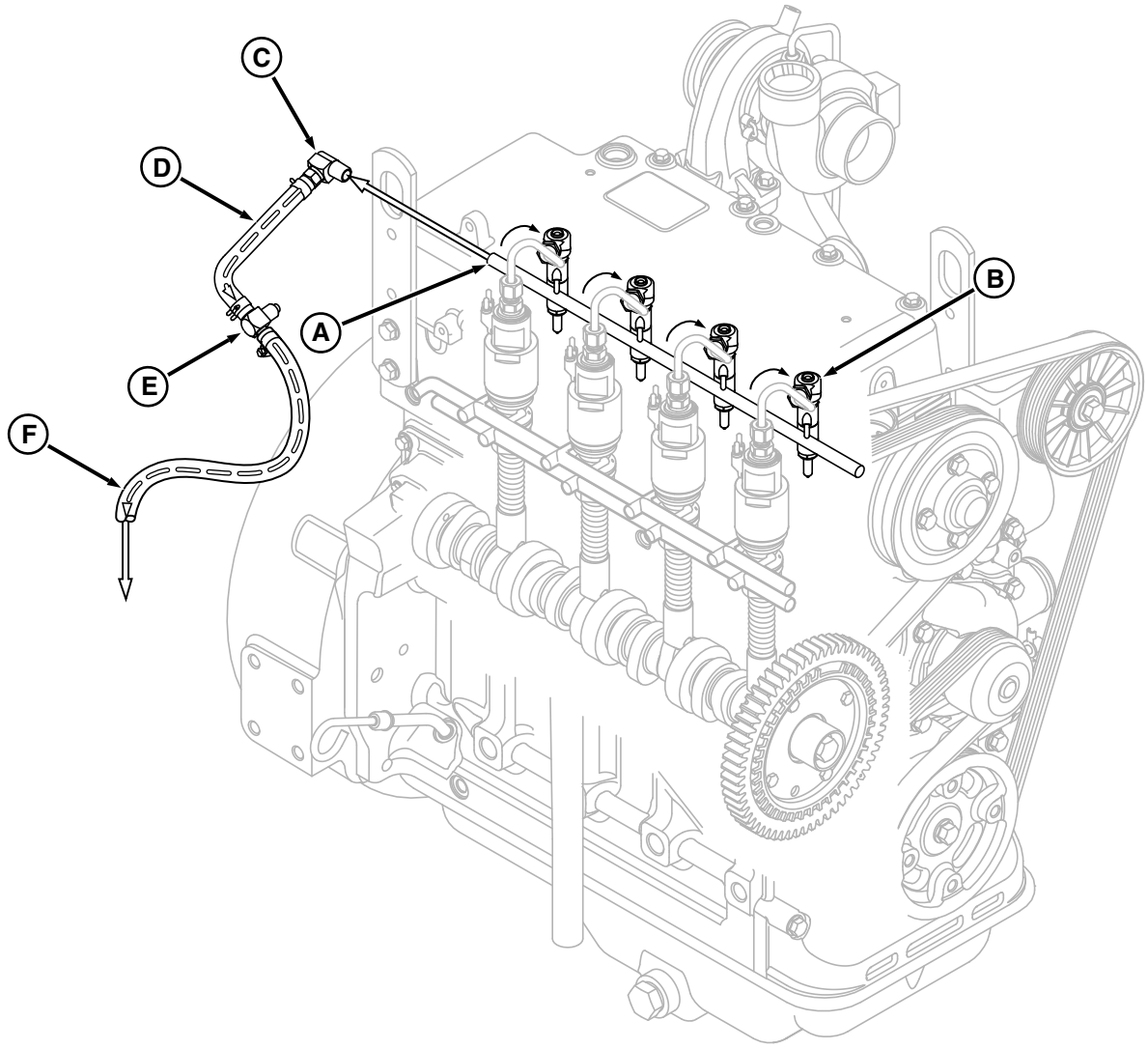
Fuel Leak-Off System



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Fuel Leak-Off System

A—Fuel Leak-Off Gallery
B—Injector Nozzles
C—90 Degree Fitting
D—Fuel Leak-Off Hose
E—Fuel Check Valve Fitting
F—Fuel Return Hose

A fuel leak-off gallery (A) contained in the cylinder head is connected to a leak-off cavity in the cylinder head surrounding each injector nozzle (B). There are no injector sleeves used in the 2.4L/3.0L engines. An O-ring seal at the top of each injector nozzle seals the upper end of the injector nozzle leak-off cavity. A sealing washer at the bottom of each injector nozzle seals the combustion chamber from the leak-off cavity. A 90 degree fitting (C) is threaded into the fuel leak-off gallery at the rear of the cylinder head. The fuel leak-off hose (D) is connected to the 90 degree fitting. The other end of the fuel leak-off hose is connected to the fuel check valve “T” fitting (E). Leak-off fuel flows directly through the fuel check valve fitting to the fuel return hose (F) and back to the fuel tank. Leak-off fuel flowing through the fuel check valve fitting is not subject to the check valve.

Only a small amount of fuel flow is typically present in the fuel leak-off system. Injector nozzle internal wear or damage may result in an increase in leak-off fuel flow.

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Fuel System Operation

The electronically-controlled 2.4L/3.0L fuel system consists of unit pumps operated by the camshaft and has remote-mounted injector nozzles, like the mechanically-controlled 2.4L/3.0L fuel system. However, the mechanical fuel control components including mechanical governor, rack, aneroid, and cold start advance have been eliminated. Instead, an ECU uses information from several sensors to control an electric solenoid inside the electronic unit pump. The operation of the electronic unit pump and injector nozzle together is very similar to the operation of the 13.5L electronic unit injector. The ECU determines when to energize (+90V) the electric coil inside the unit pump primarily based on information from the engine position sensors (crankshaft and camshaft position).

A basic flow diagram of the 2.4L/3.0L fuel system with electronic unit pumps is shown in Figure 1.

For details on the fuel supply system, see Low Pressure Fuel System Operation in Section 3, Group 130.

For details on the electronic unit pump and injector nozzle, see Electronic Unit Pump And Injector Nozzle Operation in Section 3, Group 130.

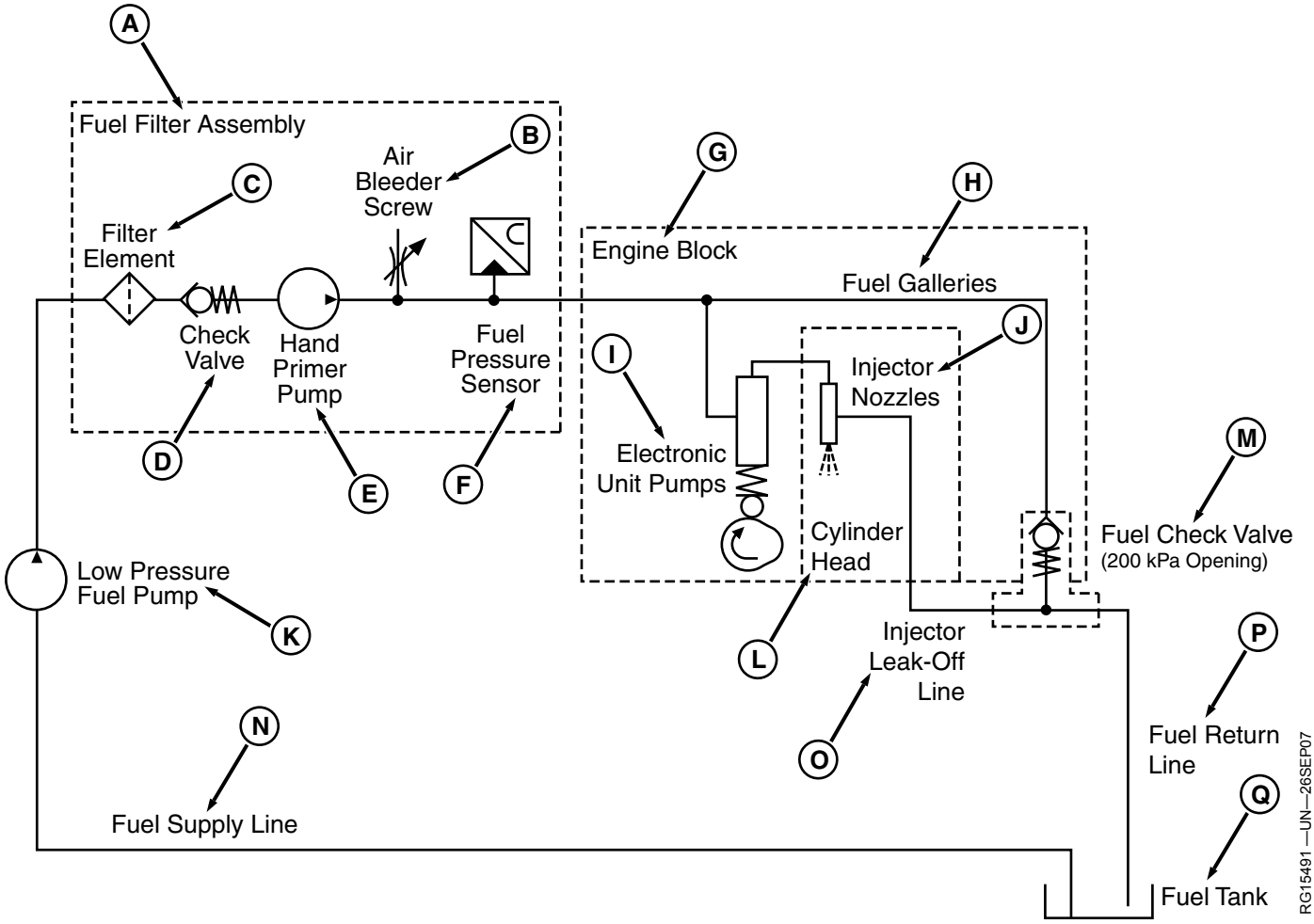

Figure 1 - Fuel System Flow Diagram

A—Fuel Filter Assembly
B—Air Bleeder Screw
C—Filter Element
D—Check Valve
E—Hand Primer Pump
F—Fuel Pressure Sensor
G—Engine Block
H—Fuel Galleries
I— Electronic Unit Pumps
J—Injector Nozzles
K—Low Pressure Fuel Pump
L—Cylinder Head
M—Fuel Check Valve (200 kPa Opening)
N—Fuel Supply Line
O—Injector Leak-Off Line
P—Fuel Return Line
Q—Fuel Tank

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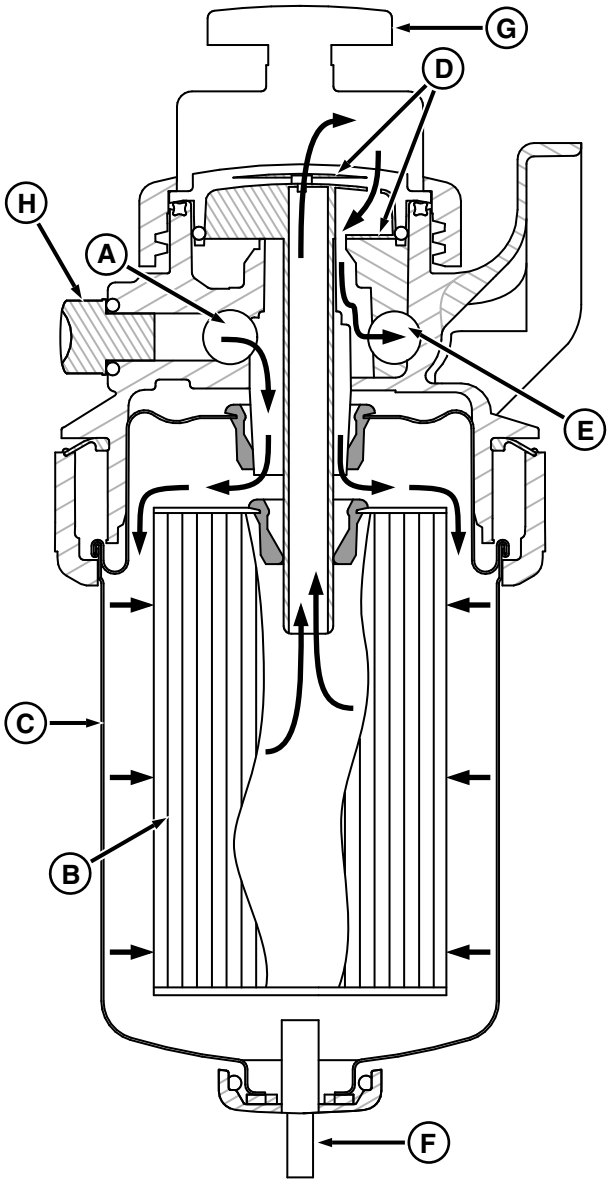
Fuel Filter/Water Separator Operation

Fuel under pressure from the low pressure fuel pump enters the fuel filter header inlet port (A). Fuel then flows through the five micron filter element (B) contained in a disposable housing (C) and passes through a check valve (D) in the filter header. The check valve consists of two flat discs and prevents filtered fuel from draining back into the fuel tank when the engine is not running. Filtered fuel then exits the fuel filter header through the outlet port (E).

A fuel drain (F) on the bottom of the fuel filter housing permit water and contaminants to be drained from the unfiltered fuel.

The hand primer pump (G) and bleeder screw (H) provide a means to pre-fill the filter housing following fuel system service.

A—Fuel Filter Header Inlet Port
B—Filter Element
C—Fuel Filter Element Housing
D—Check Valve
E—Fuel Filter Header Outlet Port
F—Fuel Drain
G—Hand Primer Pump
H—Bleeder Screw



Fuel Flow Through Filter Assembly

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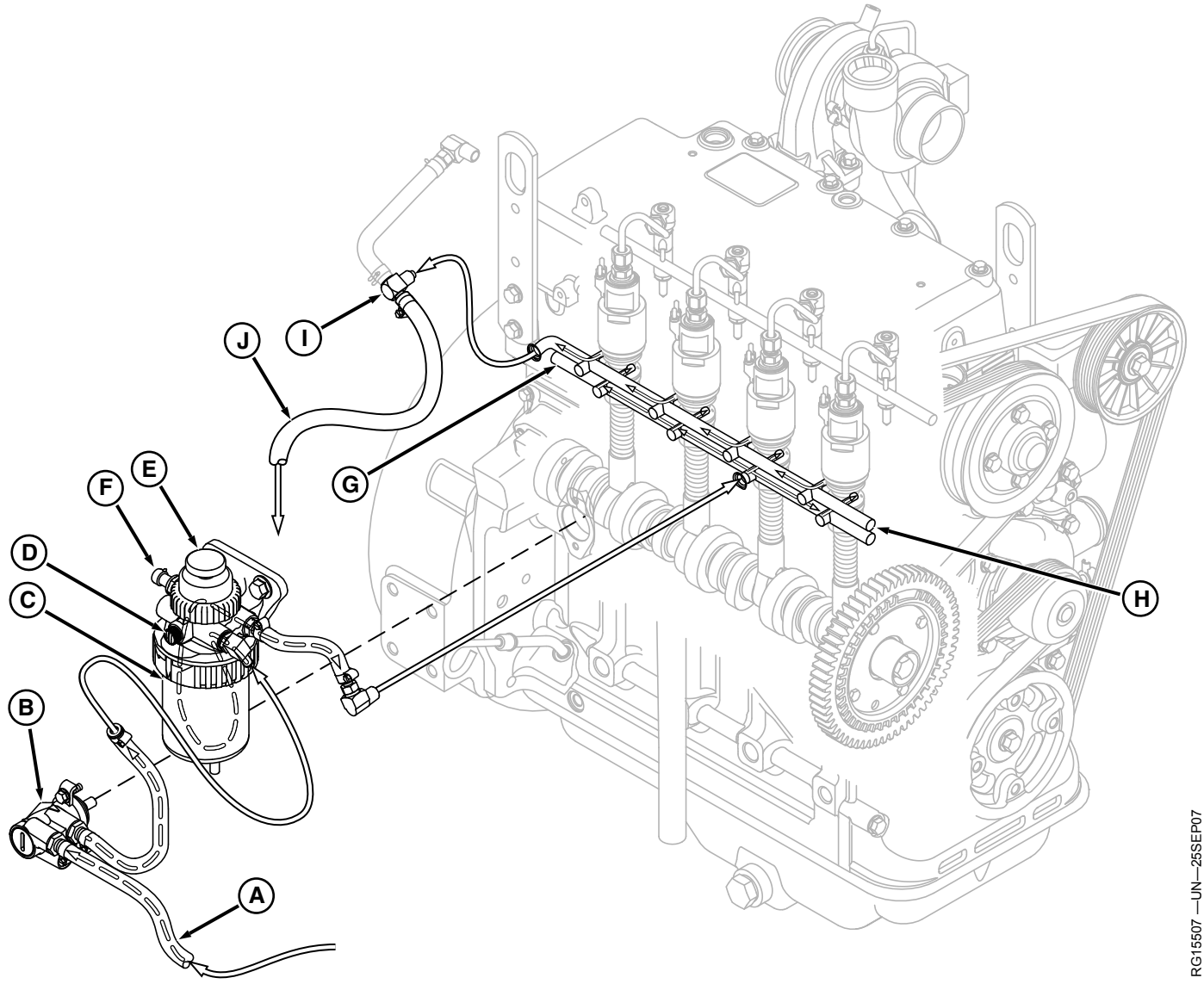
Low Pressure Fuel System Operation



Low Pressure Fuel System

A—Fuel Suction Line from Fuel Tank
B—Low Pressure Fuel Pump
C—Fuel Filter Element and Housing
D—Bleeder Screw
E—Hand Primer Pump
F—Fuel Pressure Sensor
G—Fuel Supply Gallery
H—Fuel Return Gallery
I— Fuel Check Valve
J— Fuel Return Line to Fuel Tank

Basic Low Pressure Fuel System Operation

The low pressure fuel system on the 2.4L/3.0L engines with electronic unit pumps begins at the fuel tank and the fuel suction line (A). The fuel suction line attaches to the mechanical low pressure fuel pump (B) inlet port. The low pressure fuel pump supplies fuel to the inlet port of the fuel filter header. A 5 micron fuel filter element is contained in a disposable filter housing (C). A bleeder screw (D) and hand primer pump (E) are used to prime the fuel system. The fuel filter header also includes a fuel pressure sensor (F) which measures the fuel system pressure after the fuel filter. The outlet port of the fuel filter header is plumbed to the fuel supply gallery (G) in the engine block. This gallery supplies fuel to the electronic unit pumps. The fuel return gallery (H) routes return fuel to the fuel check valve (I). The fuel check valve opens at approximately 200 kPa (29 psi) to regulate fuel pressure in the low pressure fuel system. Fuel flows from the fuel return gallery through the fuel check valve, and back to the fuel tank through the fuel return line (J).

Low Pressure Fuel Pump Details

The low pressure fuel pump (transfer pump) is a mechanical pump driven by a lobe on the camshaft.

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Fuel Filter Assembly Details
The fuel filter assembly includes a 5 micron filter element contained in a disposable filter housing, check valve, fuel bleeder screw, hand primer pump, and fuel pressure sensor. A fuel drain and optional water in fuel sensor are located on the bottom of the fuel filter housing. The flat disc-type check valve in the filter header prevents filtered fuel from draining back to the fuel tank through the fuel suction line when the engine is not running.

Fuel Pressure Sensor Details
The fuel pressure sensor measures the pressure of filtered fuel at the fuel filter outlet port. The three-wire fuel pressure sensor is an input to the ECU. The ECU provides a +5V reference voltage and return (sensor ground) for the fuel pressure sensor. The output voltage signal of the fuel pressure sensor increases as fuel pressure increases. The sensor is an absolute pressure sensor, meaning the measured pressure is referenced to a vacuum inside the sensor. The ECU subtracts the barometric pressure, measured by the barometric pressure sensor inside the ECU, from the pressure measured by the fuel pressure sensor to determine the fuel system pressure with respect to atmospheric pressure (gauge pressure). The low pressure fuel system pressure, expressed as a gauge pressure, is visible as a data point in Service ADVISOR. The fuel system pressure is used by the ECU to determine if the fuel filter is restricted or other fuel system problem exists causing the fuel pressure to be too low.

Fuel Check Valve Details
The fuel check valve is a simple check ball and spring contained in a “T” fitting. The check valve opens at approximately 200 kPa (29 psi) to limit and regulate the low pressure fuel system pressure. The check valve also prevents fuel in the fuel supply and return galleries from draining back to the fuel tank when the engine is shut off. The fuel check valve is threaded into a tapped hole in the engine block which intersects the fuel return gallery. The fuel return line, which returns fuel to the tank, is attached to one port of the “T” fitting. The injector nozzle leak-off line is attached to the other port of the “T” fitting. Leak-off fuel passes directly through the “T” fitting to the fuel return line without passing through the check valve portion of the “T” fitting.

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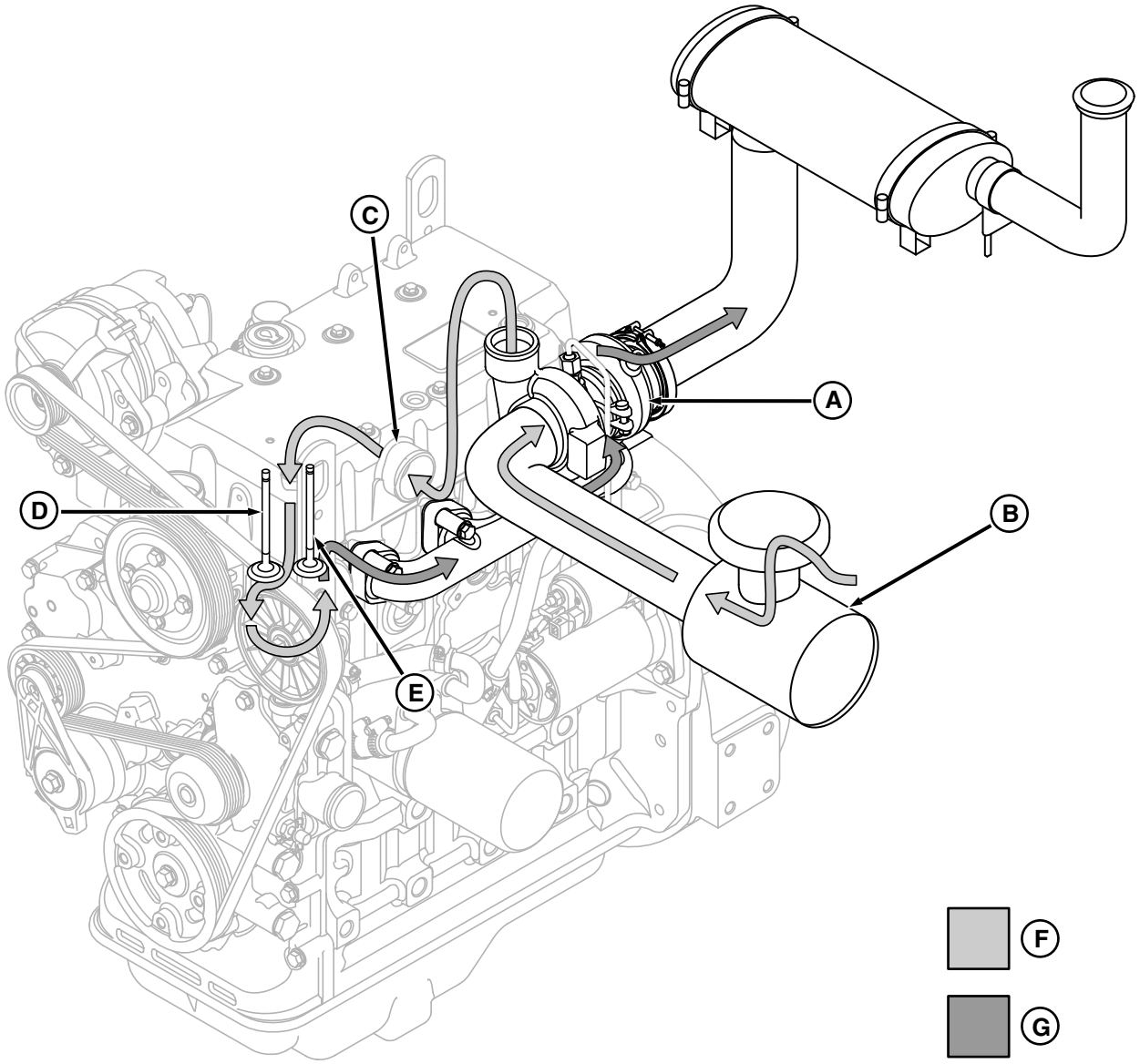
Intake Air System Operation



Air Intake and Exhaust System

A—Turbocharger Turbine Housing
B—Air Cleaner
C—Clean Air Intake
D—Intake Valve
E—Combustion Chamber/Exhaust Valve
F—Intake Air
G—Exhaust Gas

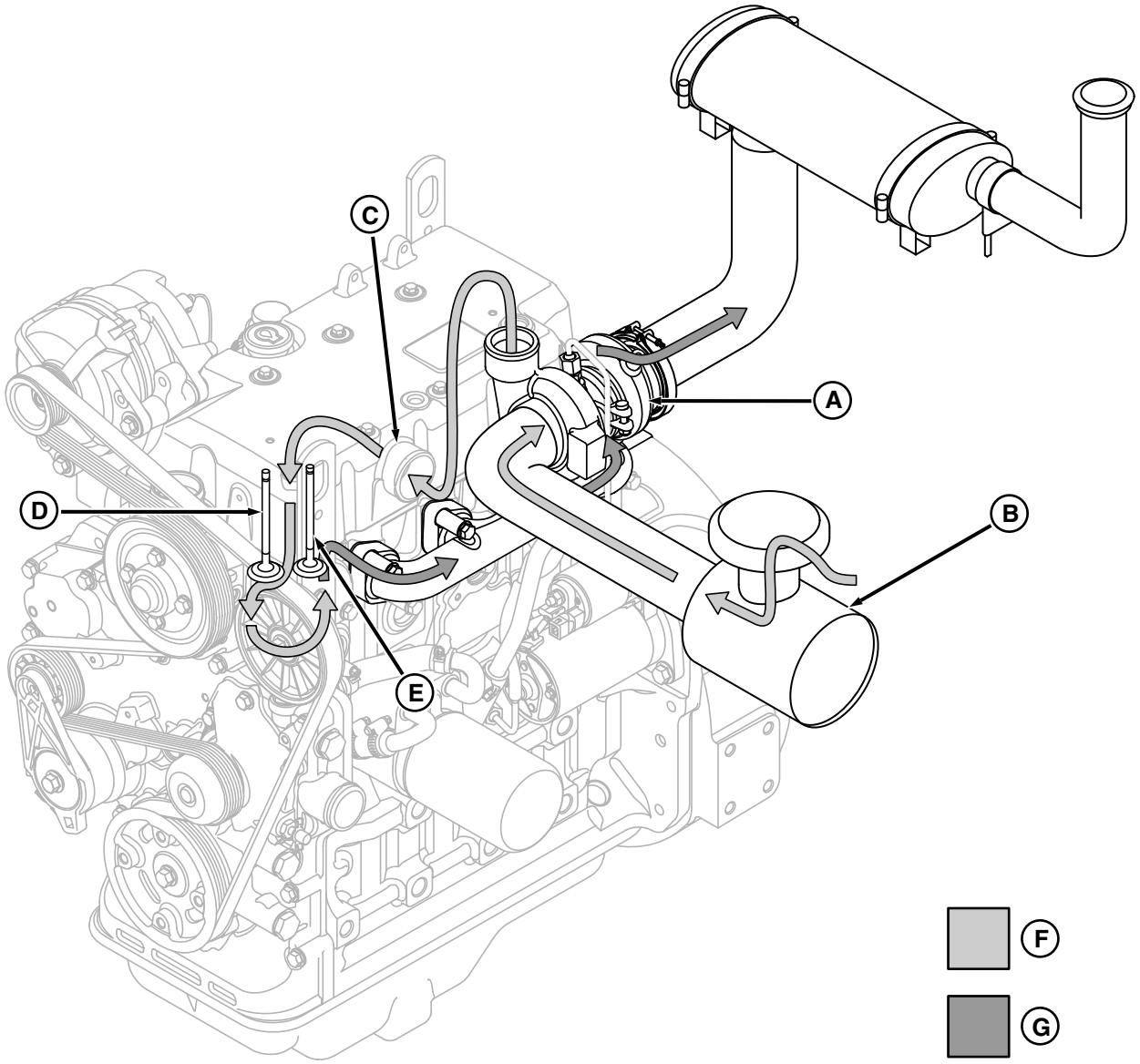
NOTE: The 2.4L engine is shown. The air intake and exhaust of the 3.0L engine is similar.

Engine suction draws dust laden outside air through an air inlet stack into the air cleaner (B). Air is filtered through dry type primary and secondary (safety) filter elements in the air cleaner canister. Clean air travels through the air intake hose to the turbocharger and into the air intake side of the cylinder head (C).

Exhaust gases (G) drive the turbocharger turbine (A), which in turn drives the turbocharger compressor to compress the intake air (F) and thus deliver a larger quantity of air to the combustion chambers (E). The quantity of air delivered to an engine intake by a turbocharger is not possible with naturally aspirated, or non-turbocharged, applications.

MK41968,0000379 -19-16APR08-1/1

Exhaust Air System Operation



Air Intake and Exhaust System

A—Turbocharger Turbine Housing
B—Air Cleaner
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NOTE: The 2.4L engine is shown. The air intake and exhaust of the 3.0L engine is similar.

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Exhaust gases (G) drive the turbocharger turbine (A), which in turn drives the turbocharger compressor to compress the intake air (F) and thus deliver a larger quantity of air to the combustion chambers (E). The quantity of air delivered to an engine intake by a turbocharger is not possible with naturally aspirated, or non-turbocharged, applications.

MK41968,000037A -19-16APR08-1/1

Air Cleaner Operation

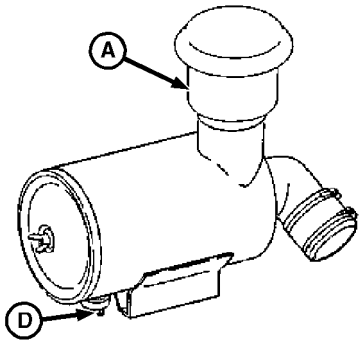
Under suction generated by the engine, unfiltered air flows through the air inlet tube (A) and is forced into a high speed centrifugal motion by tilted fins in the element. By this circulating action, most of the dust and dirt particles are separated from the air and collected in the dust unloading tube (D).

The remaining dirt is removed as the air flows through the primary element (C) and the secondary (safety) filter (B), before being drawn into the engine.

The secondary (safety) filter ensures that, should the primary element fail, no unfiltered air is drawn into the engine.

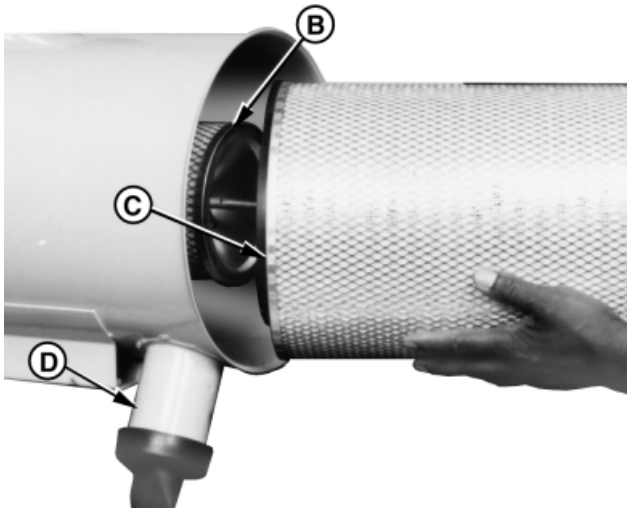
Under normal operating conditions, maximum air intake restriction is 6.25 kPa (0.06 bar) (1.0 psi) (25 in. water). However, a clogged air cleaner element will cause excessive intake restriction and a reduced air supply to the engine. An optional air restriction indicator aides the operator to know when an air cleaner needs servicing.

A—Air Inlet Tube
B—Secondary, or Safety, Filter Element
C—Primary Air Filter Element
D—Dust Unloading Tube



RG9097 —UN—27MAR98

Air Cleaner Assembly



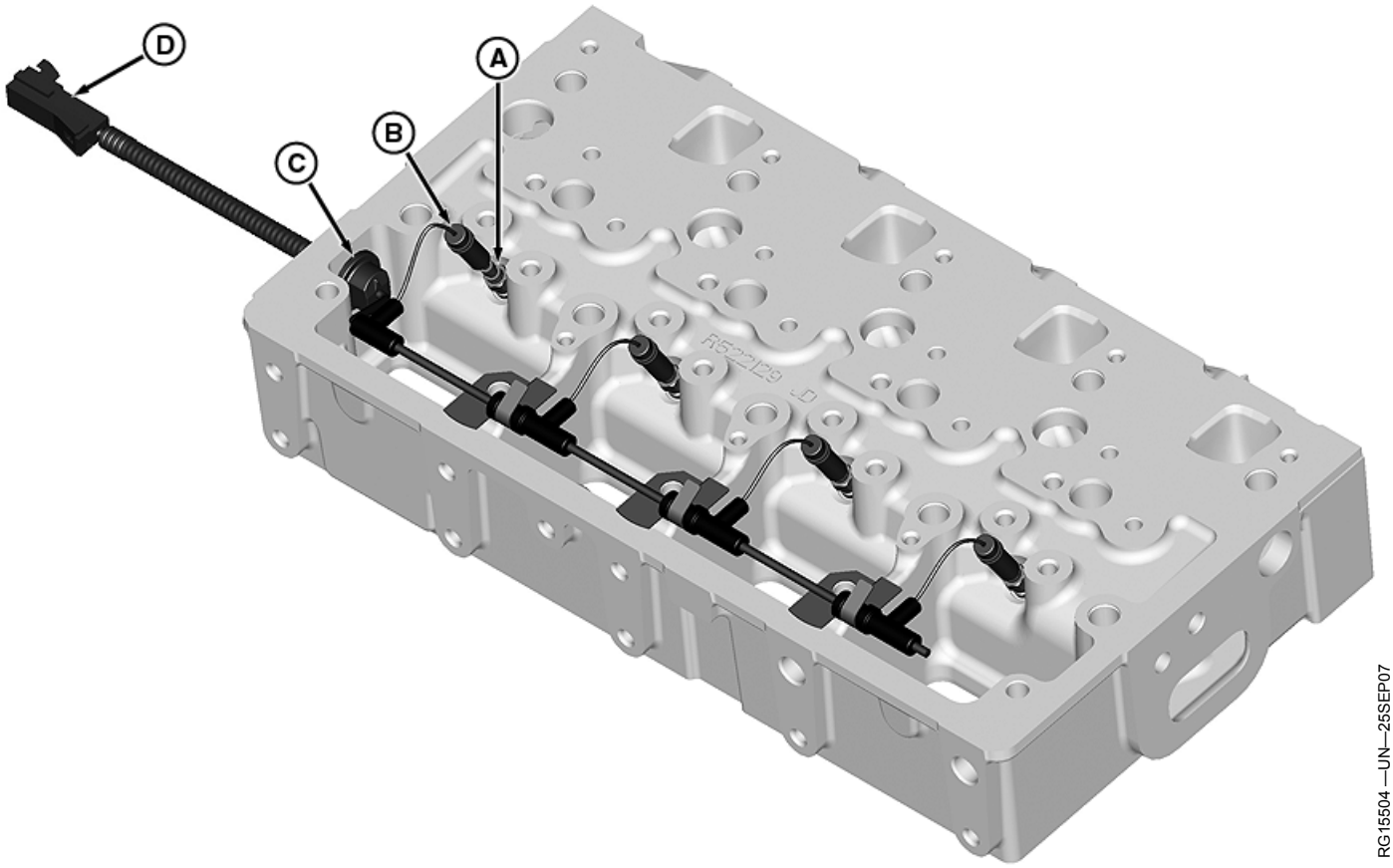
RG7766B —UN—10NOV97

Air Cleaner Primary and Secondary Elements

RE38635,0000011 -19-23AUG07-1/1

Glow Plug Operation

CAUTION: Do NOT use flammable starting aids such as ether on engines equipped with glow plugs.



Glow Plugs (2.4L Shown)

A—Glow Plugs (4) **B—Glow Plug Connectors (4)** **C—Hole in Cylinder Head with Grommet** **D—Glow Plug Harness Connector**

Glow Plugs

Glow plugs are high-power electric heating elements located in each cylinder's combustion chamber. An application-supplied glow plug relay, controlled by the ECU, provides the voltage supply to the parallel connected glow plugs. The ECU supplies a high side output to the glow plug relay coil to energize the glow plug relay.

Glow plugs (A) are installed into a threaded hole in the cylinder head beneath the rocker cover. The tip of each glow plug extends into the corresponding combustion chamber. An engine-supplied glow plug wire harness (B) located beneath the rocker cover is connected to each glow plug. The glow plug wire harness exits the cylinder head through a hole (C) at the rear of the engine as a single cable and a grommet on the glow plug harness acts as a seal. A connector (D) on the glow plug harness is mated with the application's main wire harness.

The glow plugs are internally grounded to the cylinder head through the threaded mounting hole in the cylinder head. Normal resistance to ground of each glow plug is less than 1 ohm with the glow plug at room temperature. The resistance increases significantly when the glow plug is heated.

Preheat Cycle

The ECU uses coolant temperature to determine if the glow plug relay should be energized to preheat the combustion chamber prior to the engine being cranked. Coolant temperature must be below 0°C (32°F) for the ECU to energize the glow plug relay. The length of time that the ECU energizes the glow plug relay to preheat the combustion chamber increases to a programmed maximum value as coolant temperature decreases.

'Wait to Start' Lamp

An application-supplied 'Wait to Start' lamp controlled by the ECU is illuminated to signal the operator to not crank the engine until the ECU has completed the preheating cycle. If the engine does not start, the key switch must be cycled OFF and back ON again to cause the ECU to reset the glow plug preheat cycle and re-energize the glow plug relay for the next attempt to start the engine.

Continued on next page

RE38635,000001B -19-07SEP09-1/2

Reheat and Reheat Cycle
After the engine starts, the ECU may re-energize the glow plug relay for several seconds to reheat the combustion chamber to reduce white smoke and stabilize the engine speed. After the reheat period expires, the ECU may energize the glow plug relay again for a minute or more (reheat cycle) to help stabilize engine speed, if engine speed is fluctuating excessively.

System Diagnostics
The ECU monitors the output of the glow plug relay to determine if the relay is energized for diagnostic purposes. The ECU will generate DTC 000676.05 if the glow plug relay is detected as NOT being energized when commanded and DTC 000675.03 if the glow plug relay is energized when NOT commanded.

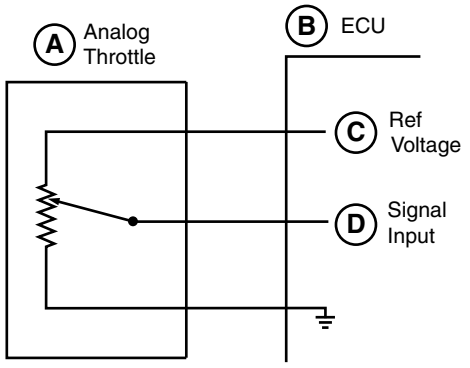
RE38635,000001B -19-07SEP09-2/2

Analog Throttle

An analog throttle uses a variable resistor (potentiometer) to supply voltage to the ECU. A reference voltage is sent to the throttle by the ECU. The resistance changes as the throttle position changes. In turn, input voltage to the ECU will vary according to the throttle position. The input voltage is monitored by the ECU which responds by sending out the appropriate control signals according to its programming.

A second analog throttle can also be enabled with the first (primary) analog throttle if that option has been set in the ECU software.

A—Analog Throttle
B—ECU
C—Reference Voltage
D—Signal Input



Position Sensor

MK41968,00000C1 -19-04JAN10-1/1

Barometric Air Pressure (BAP) Sensor

The BAP sensor is located internal to the ECU. This sensor cannot be repaired or replaced without replacing the entire ECU. This sensor is used to determine the pressure of the ambient air at the mounting location of the ECU. This helps the ECU determine the air density for calculating the correct air/fuel ratio.

For more information on how pressure sensors operate, see Pressure Measurement earlier in this Group.

MK41968,00000AF -19-01JUN10-1/1

Camshaft Position Sensor

It is an inductive type pickup sensor that detects teeth on the upper idler gear. The upper idler gear is composed of 12 evenly-spaced notches with one additional notch offset to tell the ECU that cylinder #1 is approaching Top-Dead-Center.

If there is a problem with the Camshaft Position Sensor, the ECU will use the Crank Position Sensor to determine engine timing. This may require prolonged engine cranking to start the engine.

For more information on how speed sensors operate, see Speed Measurementearlier in this Group.

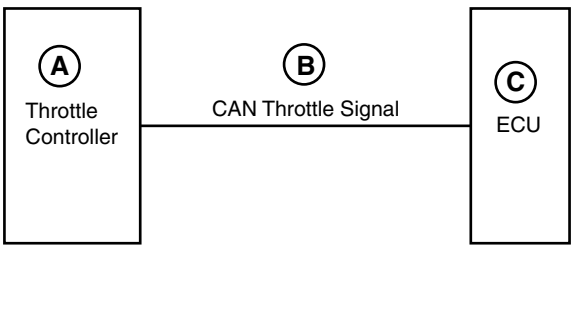
For more information on sensor locations, see COMPONENT LOCATION earlier in this Group.

MK41968,00000B0 -19-01JUN10-1/1

CAN Throttle

CAN (Controller Area Network) throttle is information of the desired throttle position that is sent to the ECU by another controller over the CAN bus.

A—Throttle Controller
B—CAN Throttle Signal
C—ECU



CAN Throttle Schematic

MK41968,00000C2 -19-04JAN10-1/1

Combination Throttle

The combination throttle is the use of two or more throttle controls on an application to give coarse/fine/extra fine control. A maximum of 3 throttles may be combined. Normally, only two are used.

If the combination throttle is enabled, a master and a secondary throttle are selected. An additional third throttle can be selected as part of the combination. Each throttle can only be used once in the combination series (i.e.The Primary Analog Throttle selected as the master throttle cannot be selected as the second or third throttle in the combination).

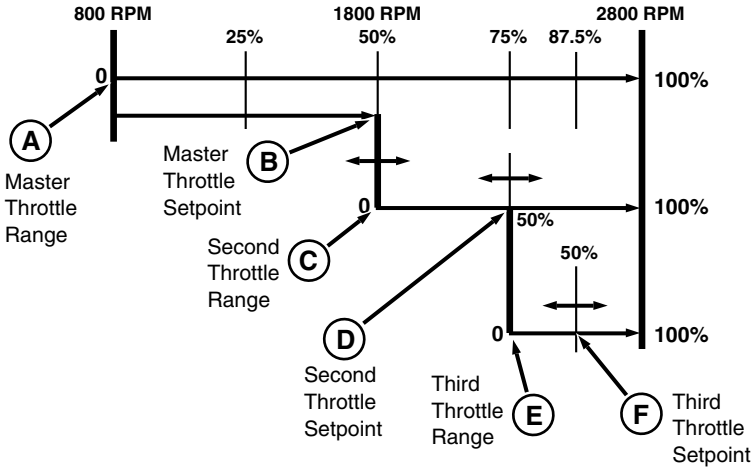
Any type of throttle can be used in the combination. Currently, the only OEM throttle types used are 2-state, 3-state, ramp, and analog. PWM and CAN throttles can be used but are not currently configured for use within the software.

The ECU uses inputs from all enabled throttles to set engine speed. If a combination throttle with 2 throttles is enabled, and a third throttle is enabled, the ECU will look at the input from the combination throttle and compare it to the third throttle. The engine speed will then be set to whichever one is highest.

The basic role of the throttle controls is to act as accelerators. This means that, as the throttle input increases, the engine speed increases. The master throttle always functions in this fashion.

While not common, there are throttle controls that function as decelerators. This means as the throttle input increases, the engine speed decreases. However, this function is not compatible with 3-state throttles.

The combination throttle operates in the following fashion: each throttle has an available throttle range of 0-100% (low idle to high idle speed), and as each throttle is added to the master, a finer resolution in engine speed is defined (see figure below).

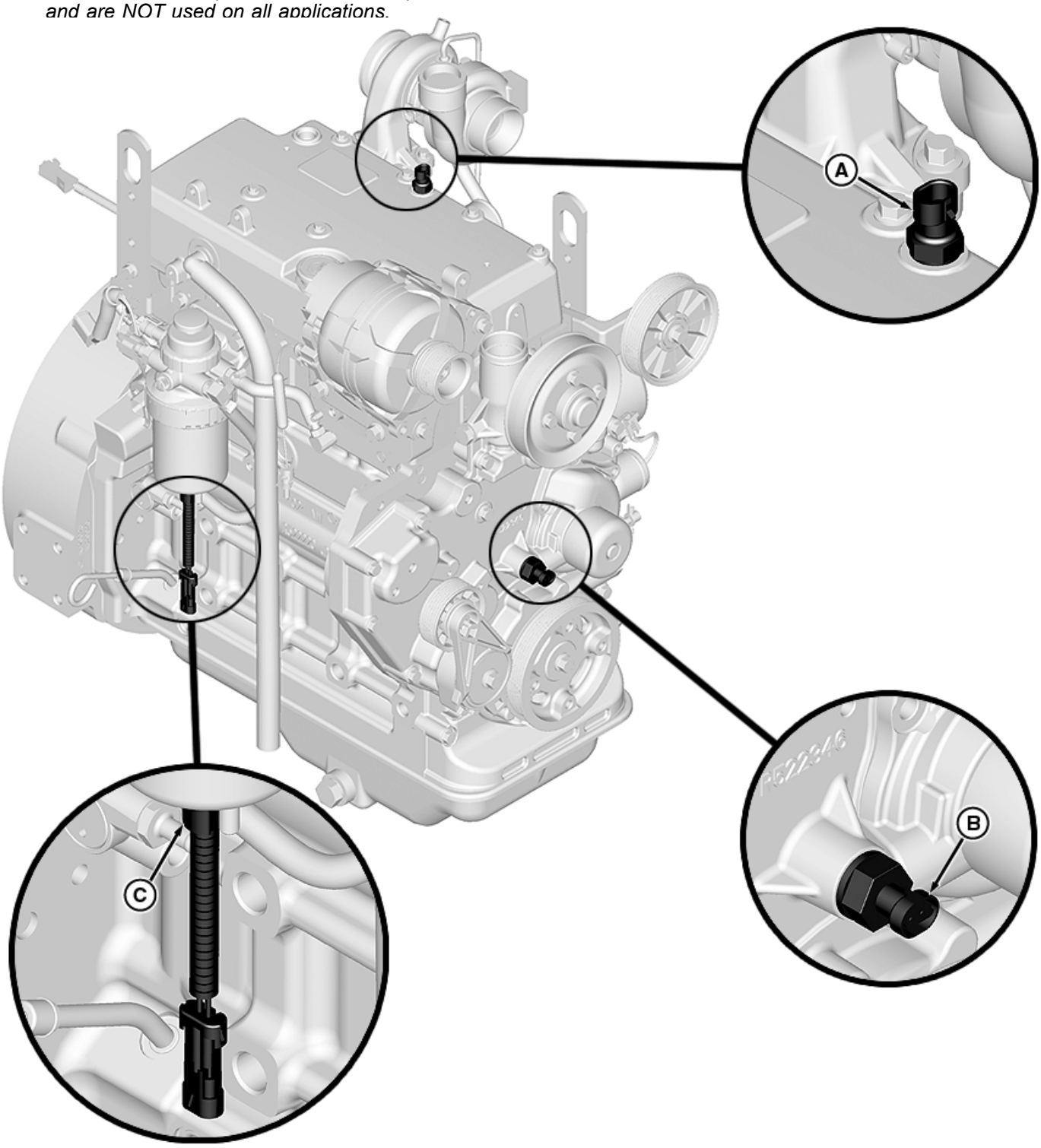


A—Master Throttle Range
B—Master Throttle Setpoint
C—Second Throttle Range
D—Second Throttle Setpoint
E—Third Throttle Range
F—Third Throttle Setpoint

MK41968,00000C4 -19-04JAN10-1/1

Component Location Diagram 1

NOTE: Some of the components shown are optional and are NOT used on all applications.



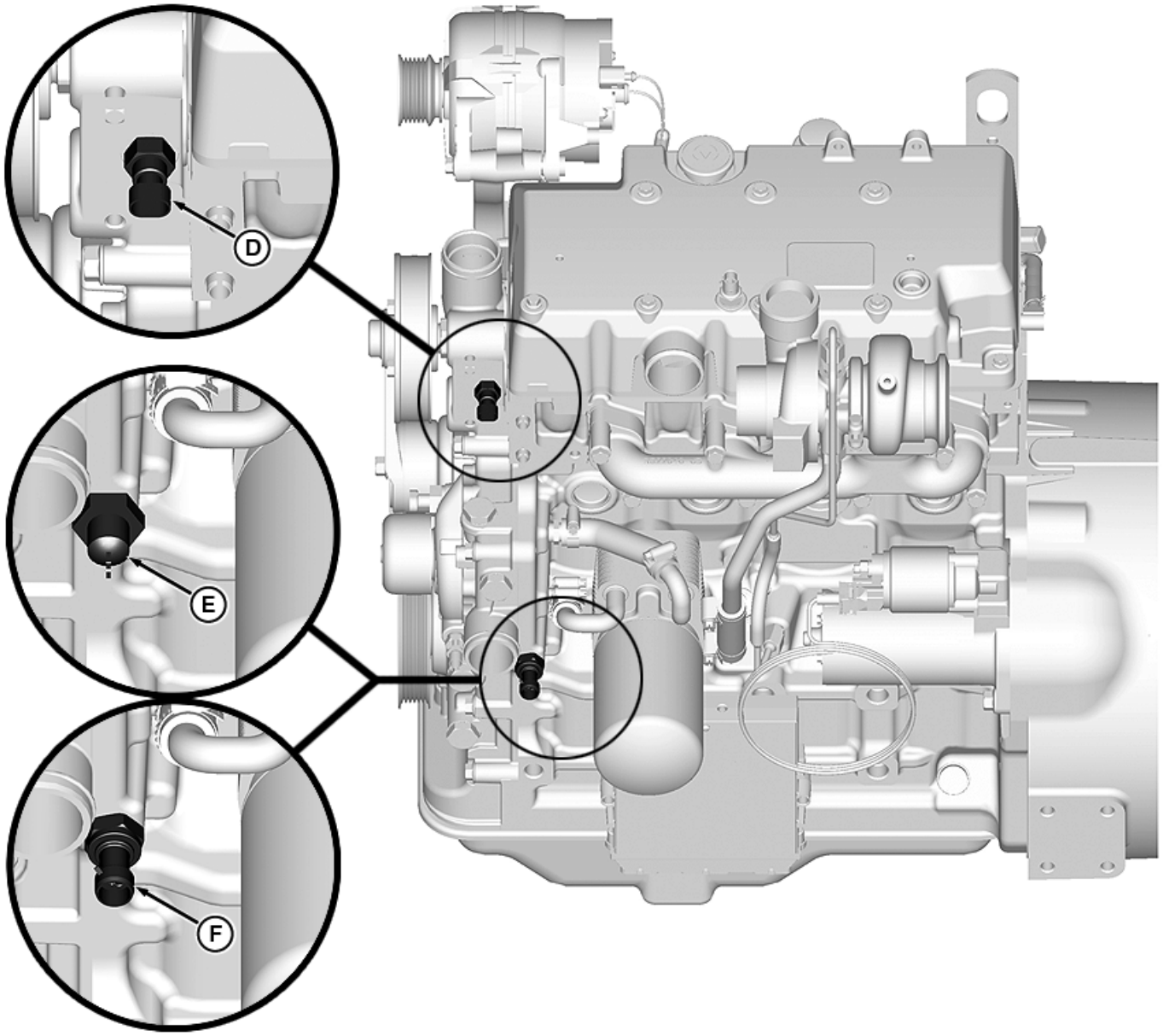
Component Location Diagram 1

A—Manifold Air Temperature (MAT) Sensor **B—Camshaft Position Sensor** **C—Water-In-Fuel (WIF) Sensor**

BK53208,000005E -19-06SEP07-1/1

Component Location Diagram 2

NOTE: Some of the components shown are optional and are NOT used on all applications.



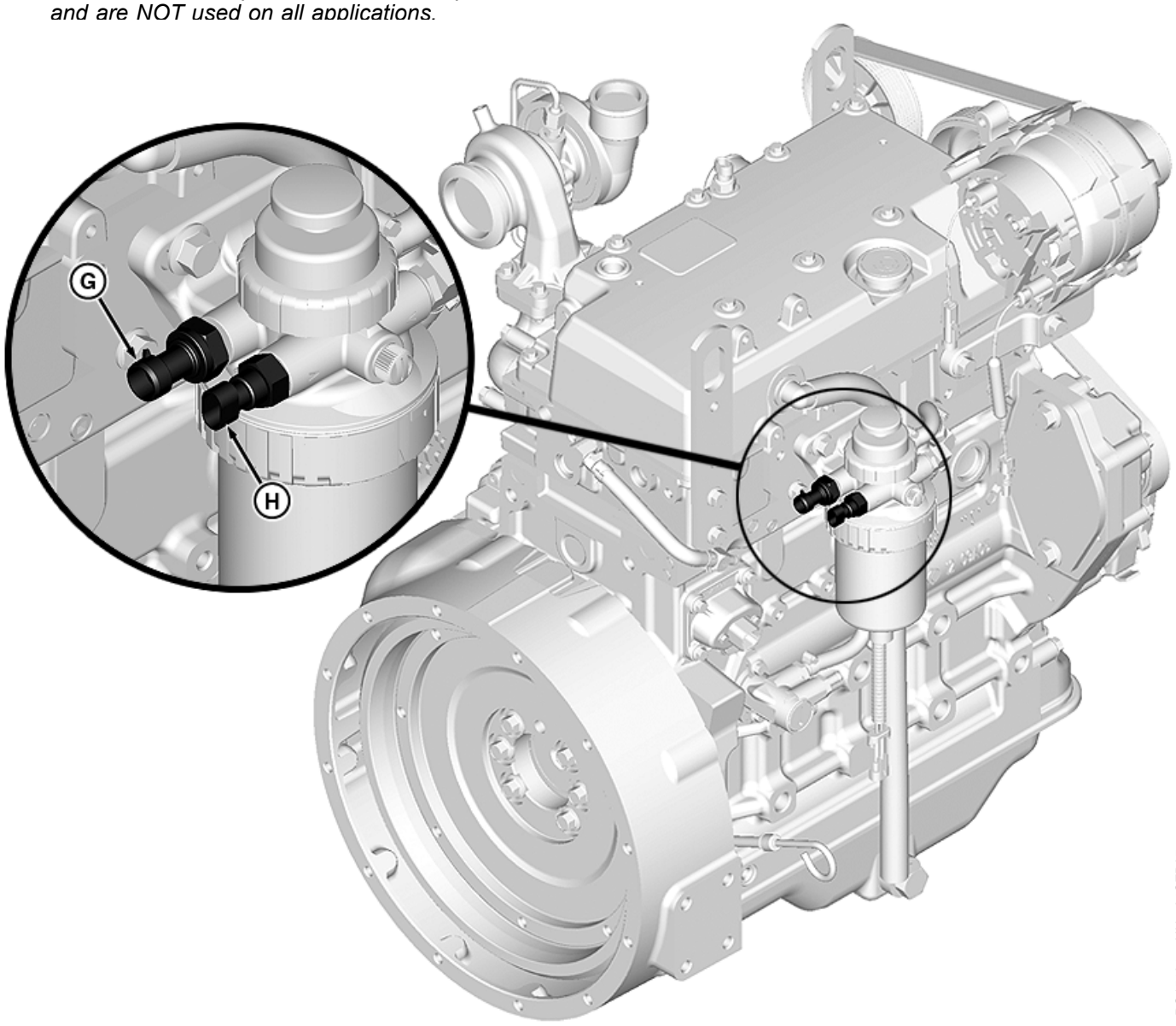
Component Location Diagram 2

D—Engine Coolant Temperature Sensor
E—Oil Pressure Switch (Optional)
F—Oil Pressure Sensor (Optional)

BK53208,000005F -19-06SEP07-1/1

Component Location Diagram 3

NOTE: Some of the components shown are optional and are NOT used on all applications.



Component Location Diagram 3

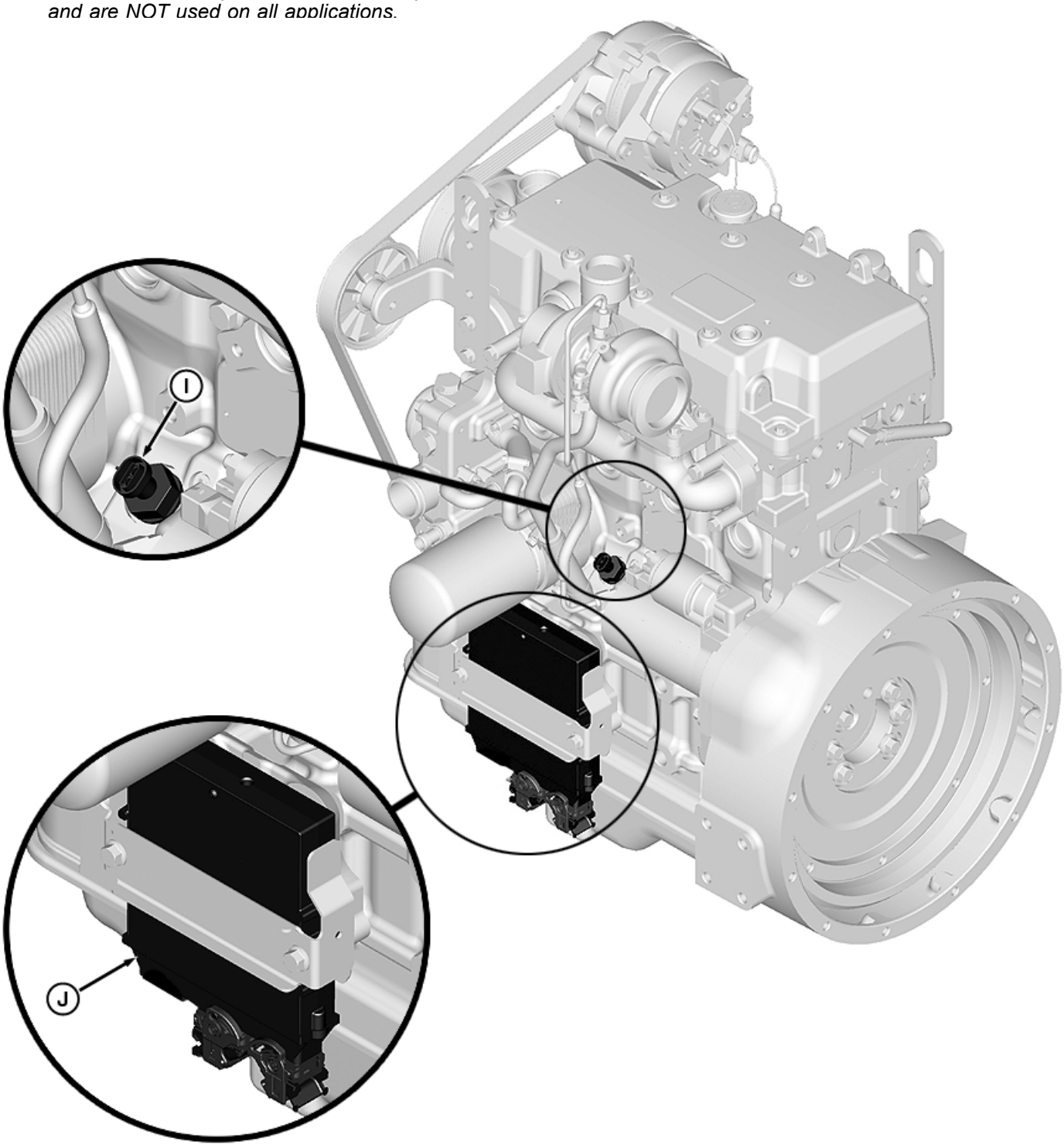
G—Low Pressure Fuel Pressure Sensor

H—Fuel Temperature Sensor (Optional)

BK53208,0000060 -19-06SEP07-1/1

Component Location Diagram 4

NOTE: Some of the components shown are optional and are NOT used on all applications.



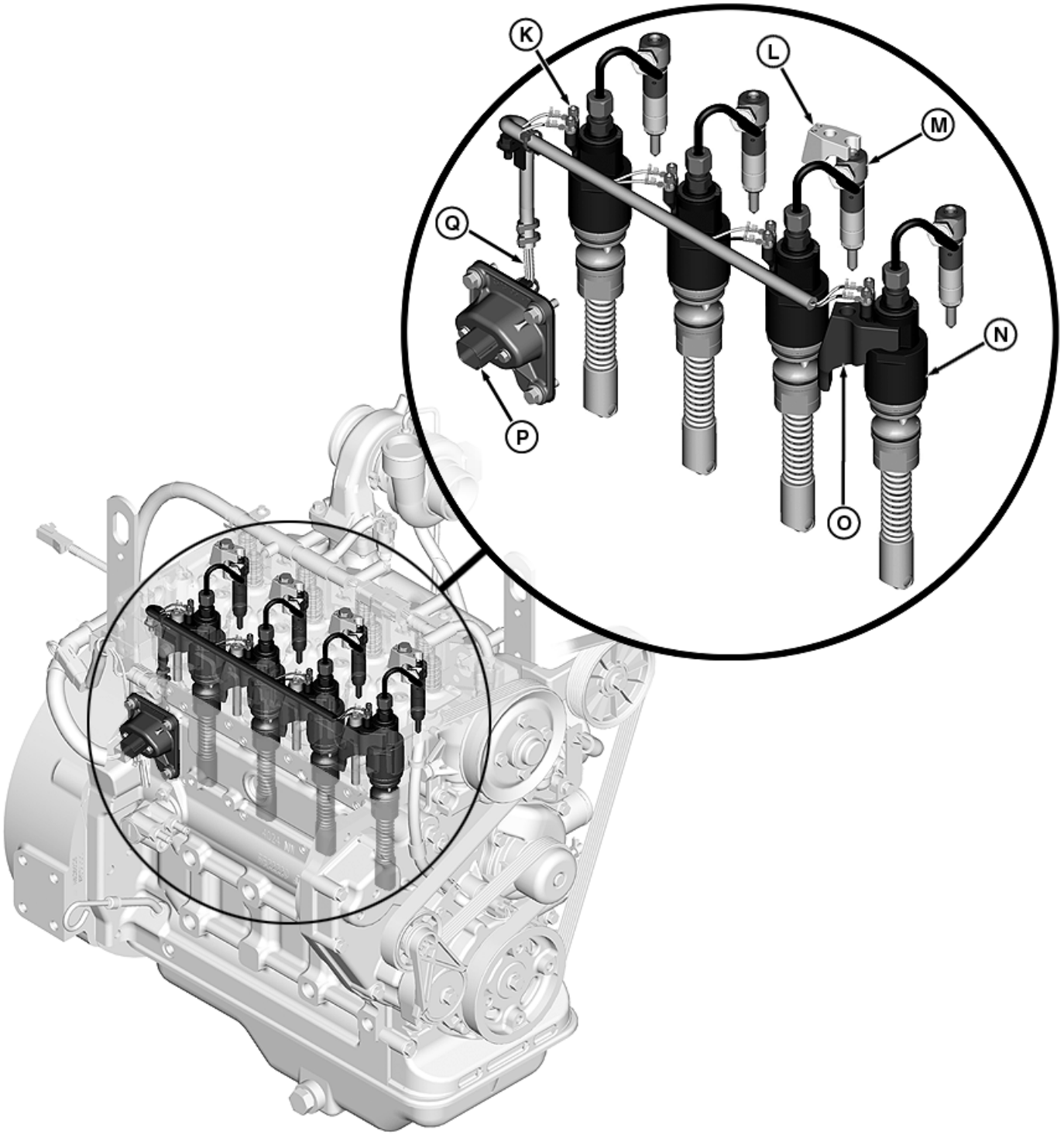
Component Location Diagram 4

I— Crankshaft Position Sensor J— Engine Control Unit (ECU)

BK53208,0000061 -19-06SEP07-1/1

Component Location Diagram 5

NOTE: Some of the components shown are optional and are NOT used on all applications.



RG15481 —UN—04SEP07

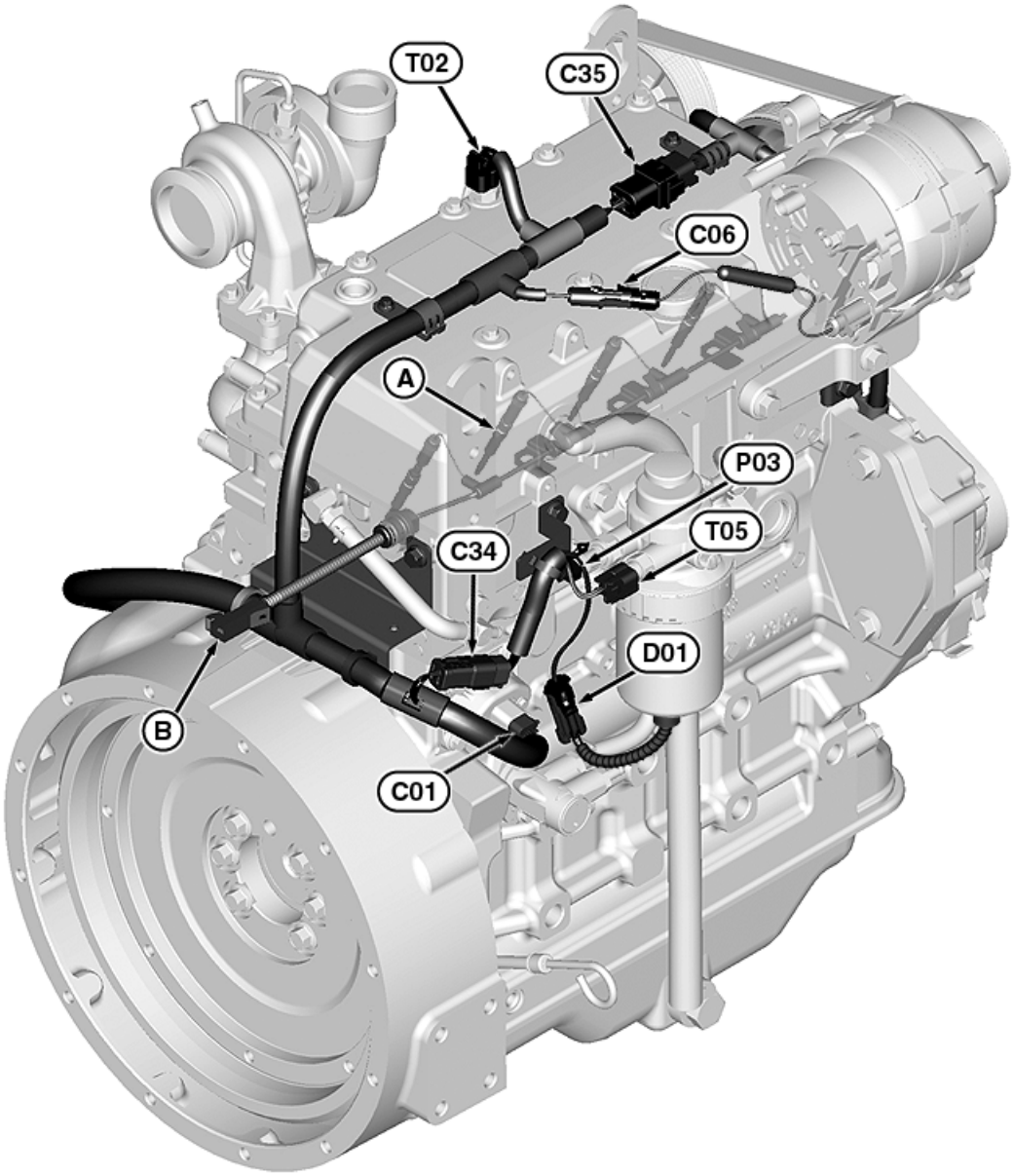
Electronic Unit Pump Wiring Harness

K—Terminal Nut
L—Injector Clamp
M—Injector Nozzle
N—Electronic Unit Pump
O—Electronic Unit Pump Clamp
P—Electronic Unit Pump Connector
Q—Electronic Unit Pump Wiring Harness

BK53208,0000062 -19-20SEP07-1/1

Component Location Diagram 6

NOTE: Some of the components shown are optional and are NOT used on all applications.



Engine Wiring Harness - Filter Side

A—Glow Plugs
B—Connector to Glow Plugs
C01— Electronic Unit Pump Connector
C06— Alternator Excitation Connector
C34— Fuel System Interconnect
C35— Front Engine Interconnect
D01— Water-In-Fuel (WIF) Sensor Connector
P03— Fuel Pressure Sensor Connector
T02— Manifold Air Temperature (MAT) Sensor Connector
T05— Fuel Temperature Sensor Connector

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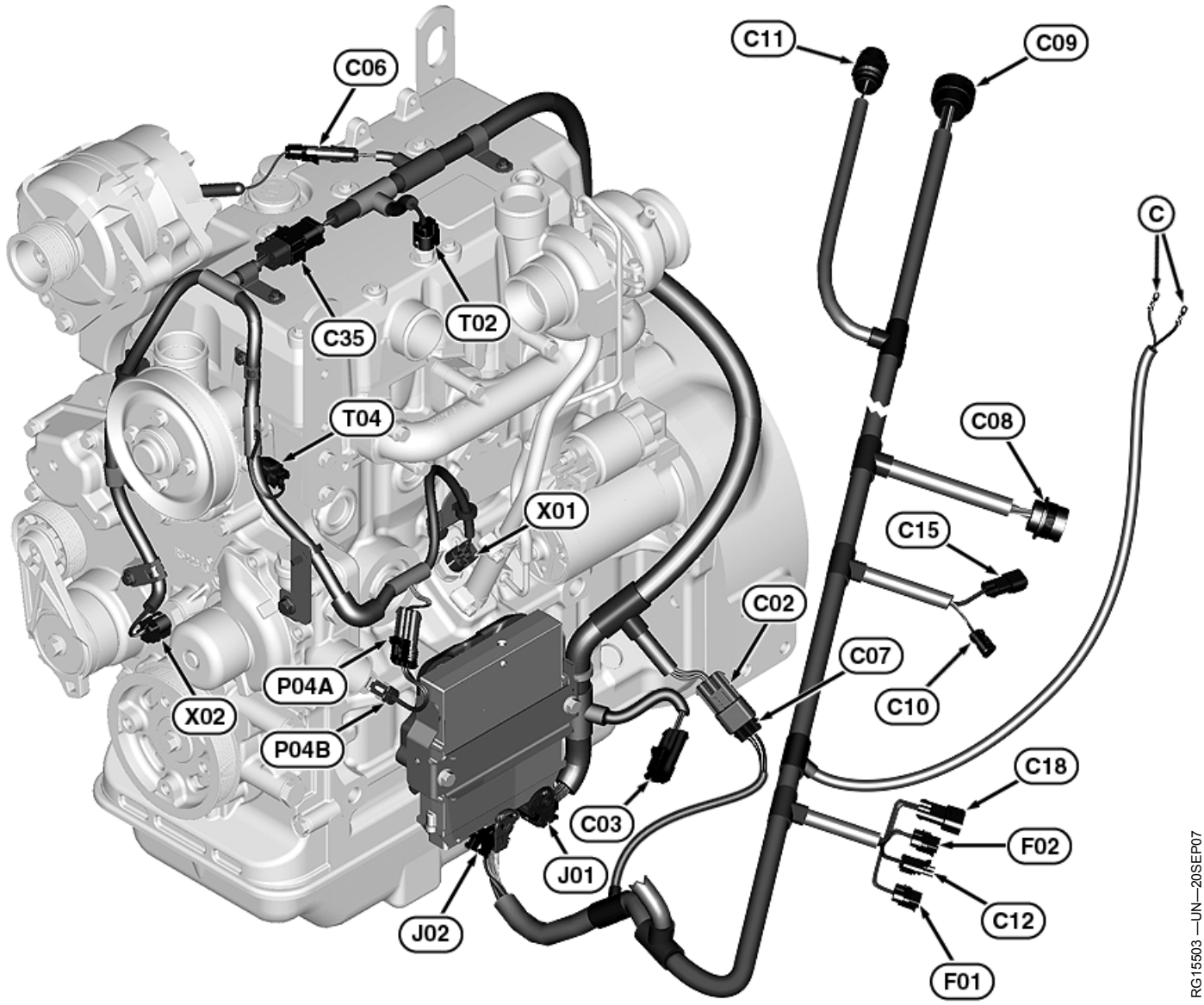
BK53208,0000063 -19-31MAR08-1/2



Engine Wiring Harness - ECU Side

C—Spare Battery Connection
C02— Accessory Connector A
C03— Glow Plug Connector
C06— Alternator Excitation Connector
C07— Accessory Connector B
C08— Auxiliary Connector
C09— Control Panel Connector
C10— CAN Terminator Connector
C11— CAN Diagnostic Connector
C12— Transient Voltage Protector
C15— Remote On/Off
C18— Air Heater Connector
C35— Front Engine Interconnect
F01— Fuse, 30 amp
F02— Fuse, 20 amp
J01— ECU Harness Connector, Black Face
J02— ECU Harness Connector, Red Face
P04A— Oil Pressure Interconnect
P04B— Oil Pressure Sensor Connector
T02— Manifold Air Temperature (MAT) Sensor Connector
T04— Coolant Temperature Sensor Connector
X01— Crankshaft Position Sensor Connector
X02— Camshaft Position Sensor Connector

BK53208,0000063 -19-31MAR08-2/2

Controller Area Network (CAN)

The CAN bus is a high-speed open interconnect network for electronic systems on the vehicle. It allows electronic systems to communicate with each other through a standard architecture of electronic signals over shielded twisted-pair wires. Just about any type of information can be communicated over the CAN Bus. Information such as throttle position, safety systems, engine condition, fuel system information, etc., can be transferred between vehicle controllers. Vehicles can communicate with laptop computers and other accessories. Information on the network can be displayed to the operator on a display panel, or relayed to another location via telemetry. Up to 30 Electronic Control Units or modules can be connected together through a single CAN network segment. A CAN connection (SAE J1939) is provided on the vehicle wiring harness. A round Deutsch 9-pin connector is provided primarily for service/diagnostic purposes. CAN also allows diagnostic software to communicate with the vehicle.

MK41968,00000BE -19-04JAN10-1/1

Crankshaft Position Sensor

It is an inductive type pickup sensor that detects teeth on the crankshaft timing gear. The ECU uses the crank position input to determine engine speed and the angular position of the crankshaft in its 360° field of rotation. The crankshaft timing gear is composed of 45 evenly-spaced teeth. There is a 3-tooth section with no notches. The 3-tooth section helps the ECU determine when cylinder #1 is at Top-Dead-Center (TDC).

The ECU uses the inputs of both the crank position and pump position sensors to precisely control the timing and duration of fuel injection.

If there is a problem with the crank position sensor, the ECU will use the pump position sensor to determine engine timing. This may require prolonged engine cranking to start the engine. The ECU provides engine protection for crank position sensor problems.

For more information on how speed sensors operate, see MEASURING SPEED earlier in this Group.

For more information on engine protection and derate programs, see ENGINE DERATE AND SHUTDOWN PROTECTION later in this Group.

For more information on sensor locations, see COMPONENT LOCATION earlier in this Group.

MK41968,00000B3 -19-04JAN10-1/1

Cruise Control Operation

The ECU is available with and without the cruise control function. It is an off-road cruise control that maintains constant engine speed under varying load conditions. This function is especially intended for field applications where an operator faces the need to turn the vehicle around at the end of each row. This cruise control allows the driver to use the throttle and/or brake to turn the vehicle around. When ready to resume field operations, the operator brings the engine speed above 1300 rpm and activates the Cancel/Resume function again to resume cruise speed. An internal timer gives the operator one minute to complete the turnaround maneuver.

The cruise control has the normal functions of:

- Cruise control power “ON” or “OFF”
- “Set” or “Bump Up” engine speed
- “Resume” or “Bump Down” engine speed
- Vehicle brake or clutch pedal to disengage cruise control

On 12-volt ECUs, the engine speed can be set from two different locations. The primary location would normally be in the cab of the vehicle and is used to set a constant engine speed while the vehicle is being driven. The secondary cruise control is normally used in a location that provides PTO speed control and is used with the engine in “neutral” or out of gear. Both locations have the normal cruise control functions.

JL45346,0000076 -19-17AUG07-1/1

Cruise Control Operation

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JL45346,0000076 -19-17AUG07-1/1

Digital Multi-State Throttle

The multi-state throttle is used when a few fixed engine speeds are desired. There are three types of multi-state throttles:

- Dual-State Throttle - See DUAL-STATE THROTTLE later in this Group.
- Tri-State Throttle - See TRI-STATE THROTTLE later in this Group.
- Ramp Throttle - See RAMP THROTTLE later in this Group.

MK41968,00000C5 -19-04JAN10-1/1

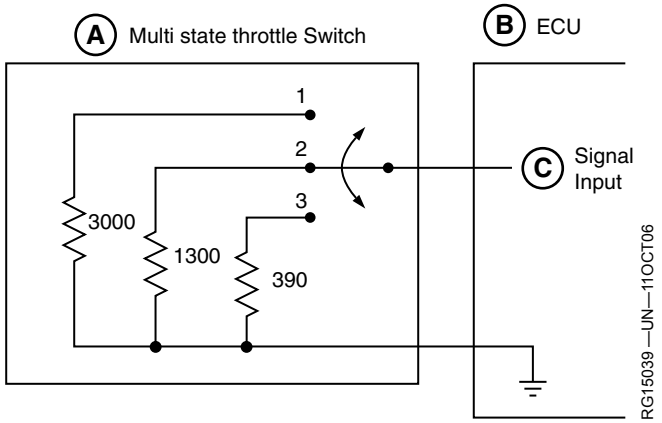
Dual-State Throttle

The dual-state throttle is used on applications that use two fixed engine speeds. The available positions are “Low Idle” (turtle) and “High Idle” (rabbit). The standard tri-state detent switch may be replaced with a 2-position detent switch with only the “turtle/low” and “rabbit/high” position resistance settings.

The switch uses two different resistors to change the voltage returned to the ECU. The ECU uses an internal conversion table to convert the voltage to a specific engine speed. When the switch is in the low idle position, the current is routed through a 390-ohm resistor. High idle position uses a 3000-ohm resistor.

If the panel has an analog throttle then the engine speed can be adjusted when the dual state throttle switch is in the low idle position.

NOTE: The three-position multi-state throttle switch may be used. The middle position is ignored.



Dual-State Throttle Switch Schematic

A—Multi state throttle switch
B—ECU
C—Signal input

MK41968,00000C6 -19-04JAN10-1/1

Electronic Control System Terminology

Actuator	A device controlled by the ECU to perform a certain function.
Analog	Signal which has a continuous range of possible voltages, usually 0 volts (low) to 24 volts (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 etc.
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 vehicles that allows communication between controllers.
Circuit Power	This is power supplied to a device for use by its internal component circuits.
Crank Sensor	Used to determine the angular position and velocity of the crankshaft in the 360° field of rotation.
Digital	A signal which consists of only two levels of voltage — usually 0 volts (low) to 24 volts (high).
DTC	Diagnostic Trouble Code. This is a code that is stored in the ECU's 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.
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.
Input	This identifies a signal as an input to a device or controller.
IFS	Integrated Fuel System. The type of fuel delivery system.
J1939	The Society of Automotive Engineers (SAE) standard for communication between the electronic controllers 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 controllers without removal of the controller 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 multi-meter reads in the ohm position, when the meter lead tips are held together.
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).

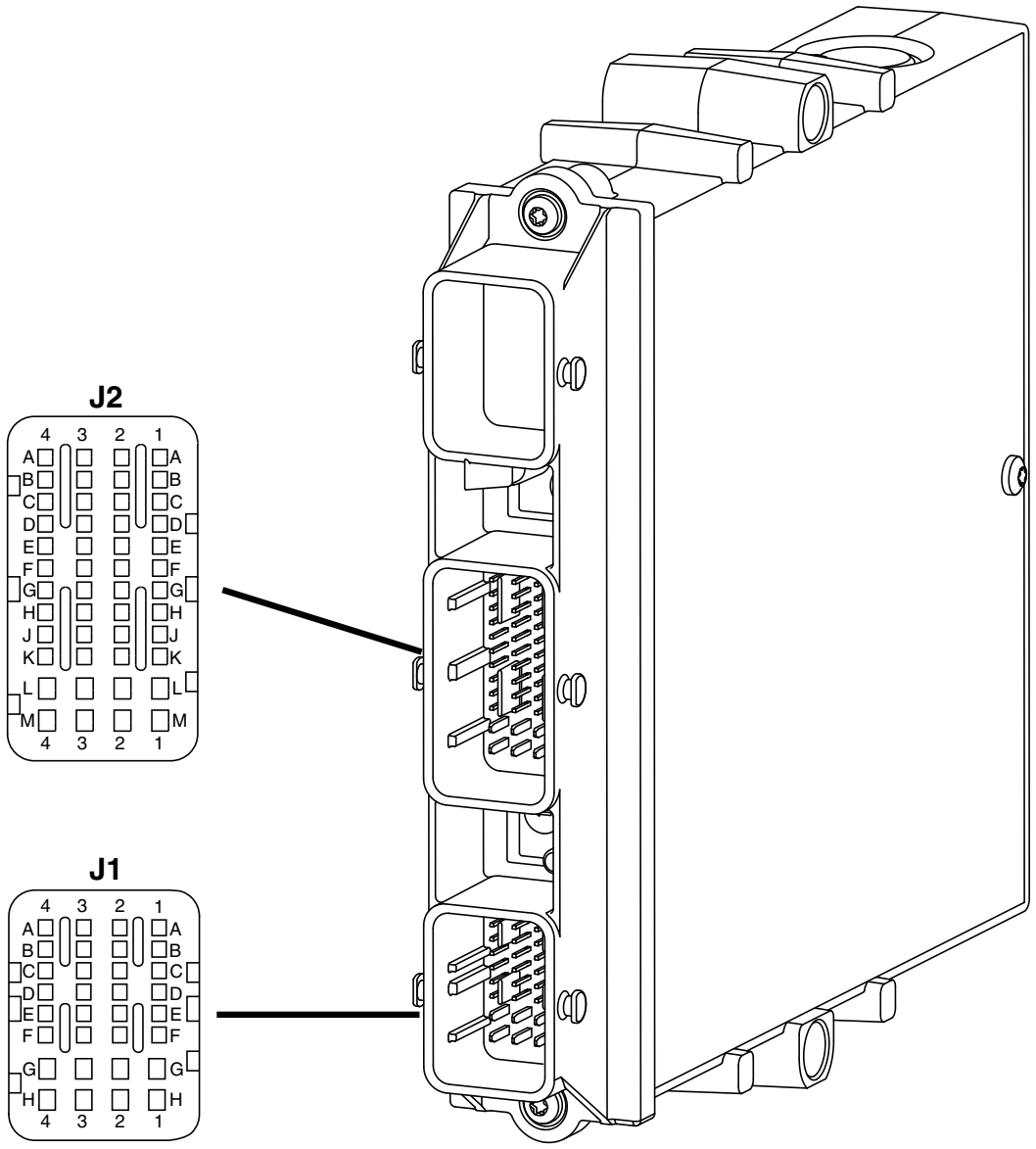
Continued on next page

MK41968,00000B4 -19-04JAN10-1/2

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 controller.
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.
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”.
Suction Control Valve	Suction Control Valve regulates the amount of fuel that the high pressure fuel pump supplies 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.
Trim Options	Options that can be enabled or disabled in the ECU programming, such as throttle selection, torque adjustment, governor gains, derates and shutdowns, etc.
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.

MK41968,00000B4 -19-04JAN10-2/2

Electronic Control Unit (ECU) System Operation



Engine Control Unit (ECU)

J1— 32 Pin Connector - Black Tip J2— 48 Pin Connector - Red Tip

Main Components of the Engine Control Unit (ECU)

The ECU is the controller that follows a defined program to run the engine at the desired operating point while keeping within emissions regulation. This system is made up of input components (i.e. temperature and pressure sensors), and controlled components (i.e. electronic unit pumps and actuators). The ECU consists of:

- Analog-to-digital converters (A/D)
- Digital-to-analog converters (D/A)
- Microprocessor (CPU)
- Memory (storage)
- Internal power supplies for external components

Analog-to-Digital and Digital-to-Analog Converters (A/D and D/A)

The A/D takes the analog input information from the external components and converts it to a digital value that the CPU can understand. The D/A converts the digital information from the CPU to analog information that is used by the external components.

Microprocessor (CPU)

The CPU is considered the “brains” of the ECU. It reads instructions from storage (memory) and interprets them. It receives information from external components, like sensors, through the A/D. It sends outputs to control external components, like actuators. It also performs mathematical computations and logical functions.

Memory

Continued on next page

Memory is a component capable of retaining digital information. This information can be operation code, data files, or fragments of data.

Temporary memory (RAM) is used to hold data for short periods of time. This information is lost when the key is turned to OFF position.

Permanent memory (Flash) stores information for long periods of time. This is where the program and calibration information is stored. The information in this type of memory is not lost when power is completely removed or if the controller is removed from the engine harness.

Internal Power Supplies for External Components

The ECU has several internal power supplies commonly referred to as sensor supplies, that deliver reference voltages to the engine sensors, throttles, and switches. There are OOR high and OOR low voltage diagnostic trouble codes associated with each power supply. Multiple power supplies are used, because there are so many external components. This also keeps critical components from being affected by shorts in other components.

Functions of the ECU

Basic Functions of the Engine Control System

The electronic control system serves as an engine governor by controlling the electronic unit pumps so that the fuel is delivered according to a given set of engine conditions, precise amounts, and at precise time in relation to piston position. In order to achieve this, the control system performs the following functions:

- Constantly monitor engine operating conditions.
- Precisely determines piston position
- Deliver optimum amount of fuel for a given set of operating conditions
- Deliver fuel at optimum piston position
- Provide multiple control modes
- Perform system diagnosis

System Problem Diagnosis

The ECU can detect problems with external components and their associated wiring. There is a Harness Diagnostic Test that can be ran from Service ADVISOR to help diagnose some of the problems (see HARNESS DIAGNOSTIC MODE TEST later this section).

Sensor Monitoring

The ECU monitors its internal temperature to ensure the engine does not overheat and damage components. It monitors the power supplies to ensure they are operating at the proper voltage. Monitors proper running of stored programs. When the key is turned off, it even monitors its shut-down process to ensure it happens properly. If a problem exists, the ECU will generate a Diagnostic Trouble Code (DTC).

The ECU is continuously receiving real-time inputs from temperature, pressure, speed, and position sensors. The ECU compares these values with expected values for the operating conditions. If the ECU detects a problem, it will generate a DTC.

Diagnostic Trouble Codes (DTC)

These are codes that the ECU sends out over the CAN bus to tell the operator or service equipment it sees a problem (See DIAGNOSTIC TROUBLE CODES later in this group). Some of these codes contain a snapshot of certain parameters at the time the codes sets which will be stored in the ECU. There may also be a recording of more data that is stored depending on the DTC (See SNAPSHOT CAPTURE AND RECORDING later this section).

Engine Starting Mode

When the key is turned to the “ON” position, a switched power voltage is sent to the Engine Control Unit (ECU). This energizes the ECU and allows it to “boot-up” and ready itself for engine start.

NOTE: If a wiring problem prevents the key ON signal from getting to the ECU, the engine will not start.

As soon as the ECU determines using the Crank Position Sensor input that the engine is cranking, it will determine using the Pump Position Sensor input when cylinder number 1 is coming to top-dead-center at the end of the compression stroke. It will then start injecting fuel when the next cylinder in the firing order (cylinder number 5) is at the correct position. At this point, the engine will start and the ECU will go into the running mode. To provide cold temperature enrichment, the amount of fuel injected is based on the temperature measured by the Engine Coolant Temperature (ECT) sensor.

Engine Running Mode

In the running mode, both the crank and pump position sensors allow the ECU to precisely determine piston position in relation to top-dead-center. The ECU uses this information to actuate each individual EI of the injection timing and rate. The ECU controls fuel delivery by energizing and de-energizing the two-way valve (TWV), which is located in the EI.

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Engine Control Unit (ECU) Temperature Sensor

The ECU temperature sensor is located internal to the ECU. This sensor cannot be repaired or replaced without replacing the entire ECU. This sensor is used to determine the internal temperature of the ECU. If the temperature exceeds the temperature specification, the ECU will limit the speed of the engine in an attempt to protect the ECU from permanent damage.

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Engine Coolant Level Switch

This sensor provides ECU signal with a path to ground, whenever the engine coolant drops below a certain level.

Loss of coolant switch is used for engine protection purposes and is a trimmable option. The user has the ability to choose a normally open or a normally closed switch. Depending on the switch configuration, diagnostics will vary.

For more information on engine protection and derate programs, see ENGINE DERATE AND SHUTDOWN PROTECTION later in this Group.

For more information on trimmable options, see TRIM OPTIONS INFORMATION in Section 04, Group 160 later in this manual.

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Engine Coolant Temperature (ECT) Sensor

The ECU monitors engine coolant temperature for:

- Engine protection purposes. Depending on the severity of the temperature increase, ECU transmits a diagnostic code for either moderate or extreme levels. The engine is derated correspondingly to each level of severity.
- If the ECU determines the coolant temperature is too low for the current operating conditions it will set an diagnostic trouble code. This normally indicates a thermostat that is stuck open.

For more information on how temperature sensors operate, see Temperature Measurement earlier in this Group.

For more information on engine protection and derate programs, see Engine Derate And Shutdown Protection later in this Group.

For more information on sensor locations, see Component Location Diagram 1 earlier in this Group.

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Engine Derate and Shutdown Protection

The Engine Control Unit (ECU) will decrease the amount of fuel that is delivered to the engine (fuel derate), set the engine to a certain speed (speed derate), or shut the engine down when sensor inputs exceed normal operating ranges. A Diagnostic Trouble Code (DTC) always accompanies a derate.

See Diagnostic Specifications in Section 06, Group 210 later in this manual for derate specifications per application.

There are three ECU engine protection options:

- **No Protection**– Engine ECU's with "No Protection" do not derate or shut down the engine if a fault occurs. The standard fault lamp will illuminate when a "Warning" fault is detected by the ECU, and the standard stop-engine lamp will illuminate when a "Shutdown" fault is detected. The engine operator is responsible for reducing engine speed and power when a "Warning" fault exists and for shutting down the engine when a "Shutdown" fault exists.
- **Engine Derate Protection WITHOUT Shutdown**– In addition to illuminating the standard fault indicating lights, the ECU will derate the engine when certain "Warning" faults are detected (depending on application). It is the responsibility of the operator to decide if it is necessary to shut down the engine.
- **Engine Derate Protection with Shutdown**– In addition to illuminating the standard fault indicating lights, the ECU will derate the engine when certain "Warning" and "Shutdown" faults are detected (depending on application). If a DTC that requires shutdown is set, the ECU will severely derate the engine and shut down the engine either immediately or in 30 seconds, depending on the shutdown timer setting in the ECU. If the fault has a 30-second shutdown delay, and the problem is corrected within the 30-second delay period, the power will increase at a rate determined by the fault, until full power is reached.

NOTE: CAN wait-to-start enables the CAN bus messages for shutdown and for wait-to-start. Disabling this feature disables both the wait-to-start broadcast and the shutdown broadcast.

Shutdown Override

NOTE: Holding the shutdown override switch continuously "ON" will not reset the 30-second timer.

Shutdowns can be overridden for 30 seconds at a time. This can be used to move a vehicle to a safe location. Each time the switch is pushed, the shutdown timer is reset to 30 seconds and the engine will run in a derated power mode.

Similarly, if the key switch is turned off, the engine Shutdown feature will be reset, but when restarted only 30 seconds of running is allowed until the engine will shut down again. Engine will remain in shutdown mode until fault condition has been corrected.

External Derate

Wiring in provided on the engine harness for additional switches that control engine derate. These additional external switches can provide an additional level of engine control. The external switch type and derate rate are selectable:

- **External Derate Enable:** When enabled with an active external derate circuit, the external derate feature will derate the engine when activated by an external device.
- **External Derate Input:** Input can range from ground to 24V, depending on application battery voltage. Either a normally open switch, or normally closed switch is used for the external derate input.
- **External Derate Rate:** Three external derate rates are available: 20% derate over 10 minutes, 20% derate over 1 minute, and 50% derate over 1 minute. Each provides a linear derate of engine power over the time selected. Derates are based on the 100% torque curve value, so operation below the derated power level is still possible.

NOTE: External Derate is not compatible with cruise control.

External Shutdown

Wiring is provided on the engine harness for additional engine shutdown switches. Either a normally-open or normally-closed switch can be used for the external shutdown input. When enabled and the external shutdown circuit is activated, the ECU will shut down the engine. Features include:

- **External Shutdown Timer:** The external shutdown timer can be set for either immediate shutdown, or a 30-second delayed shutdown. If the shutdown switch returns to normal before the end of the 30-second delay, the engine will resume normal running.
- **Override External Shutdown at Engine Start:** Some external shutdowns must be overridden when starting the engine. When enabled, the ECU will disable external shutdowns during engine startup.
- **Override External Shutdown Time:** Once the engine switches to "Run" mode (reaches low idle), the ECU will continue to disengage external shutdown for the time that has been selected. Three override times are available: 5 seconds, 30 seconds, and 1 minute.

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Fuel Temperature Sensor

The ECU uses this sensor input to calculate fuel density and adjust fuel delivery accordingly. The ECU also uses the fuel temperature sensor for engine protection purposes. In addition, the glow plug/air heater (optional) operation is driven off of the fuel temperature. If the temperature of the fuel drops below specification, the glow plugs or air heater (optional) will turn on for a predetermine length of time.

For more information on how temperature sensors operate, see MEASURING TEMPERATURE earlier in this Group.

For more information on engine protection and derate programs, see ENGINE DERATE AND SHUTDOWN PROTECTION later in this Group.

For more information on sensor locations, see COMPONENT LOCATION earlier in this Group.

For more glow plug information, see GLOW PLUG OPERATION later in this Group.

For more air heater information, see AIR HEATER OPERATION later this Group.

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Governor Droop Mode Selection

The electronic control system provides all-speed governing. The Engine Control Unit (ECU) controls the engine speed based on the analog throttle input.

The ECU also has the ability to provide normal and isochronous (0%) droop governing. The normal droop gives a drop in engine speed with an increase in load or an increase in engine speed with a decrease in load. When in isochronous, the droop is set at 0%, and there is a no change in engine speed with changing loads until engine's torque limit is reached. The factory low idle speed is always set for isochronous governing. Droop selection can be determined by engine speed, load, and cruise control depending on the application.

Refer to application manual for information on governor droop parameters.

MK41968,00000CE -19-04JAN10-1/1

Intake Manifold Air Temperature (MAT) Sensor

The ECU uses this sensor to measure the temperature of the air in the intake manifold. The ECU then compares the temperatures of the EGR exhaust, charge air cooler outlet air, and the intake manifold air to determine if proper cooling and mixing has occurred. If the temperature is not correct, the ECU can adjust the signal going to the EGR valve to compensate the mixture accordingly. The MAT sensor helps the ECU calculate the correct fueling for the engine. The intake manifold air is the air that will be used in the cylinder for engine combustion. The ECU also uses this sensor for engine protection purposes.

For more information on how temperature sensors operate, see MEASURING TEMPERATURE earlier in this Group.

For more information on engine protection and derate programs, see ENGINE DERATE AND SHUTDOWN PROTECTION later in this Group.

For more information on sensor locations, see COMPONENT LOCATION DIAGRAM 4 earlier in this Group.

MK41968,00000BD -19-04JAN10-1/1

Low Fuel Pressure Sensor

The fuel pressure sensor sends a pressure equivalent signal to the ECU. The ECU monitors fuel pressure to determine if fuel is continuously passing through the low pressure side of the fuel system, or if there is a leak or blockage in it.

For more information on how pressure sensors operate, see Pressure Measurement earlier in this Group.

For more information on sensor locations, see Component Location Diagram earlier in this Group.

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Marine Throttle

The marine engine has two dual throttle options:

- Dual throttles with transfer control
- Engine synchronization control.

To operate either option requires a variation of the marine transition harness. Which variation depends on feature configuration(s). Both options cannot operate simultaneously. Operation of each option is described as follows:

Dual-Throttle Transfer Control

This feature allows throttle control from one of two locations: the wheelhouse, or a secondary (auxiliary) station. when the ECU is initialized at key ON, throttle control defaults to the station selected via the trim options and is set up in the ECU during programming.

To change throttle control location during engine operation, the station select push-button switch at the requesting throttle is held engaged. The indicator lamp will briefly flash, indicating the throttle control transfer has started. The push-button is held engaged until the station indicator lamp is solid, indicating that throttle control transfer has been successful.

For transfer of throttle control to be successful, the position of the requested throttle must be within 2% of the active throttle position. For example, if the ECU is sampling a throttle command of 55% at the active throttle, then the ECU must receive a throttle command between 53% and 57% at the requesting throttle. If the requesting throttle is not within 2% (approximately 33 rpm) of the active throttle, the lamp flashes on and off. If the station select push-button switch is held engaged and the operator moves the requesting throttle to within 2%, transfer will occur. The lamp will go from flashing to solid and the switch at the requesting throttle can be released.

If the requesting throttle position is outside normal operating range, its lamp momentarily lights, then shuts off and remains off. If the switch contacts of both throttles are simultaneously closed, the ECU selects the “highest priority location”, which has been designated during ECU programming, via trim options.

At key ON, a test of the lamps at the throttle station(s) will occur. If any lamp does not briefly come on, replace the bulb. The lamp test will occur only if the key has been OFF for at least 30 seconds.

Engine Synchronization Control

The Engine Sync feature is selected via trim options and is set up in the ECU during programming. This feature allows the synchronous operation of two engines through a two-throttle, lead-follow system; one ECU is programmed as the Lead, and the other as the Follower. When the system is successfully engaged, the follower ECU runs off the lead ECU’s signal. On engines that also have the dual throttle option described above, auxiliary throttle location input is automatically deselected when the engine synchronization is in operation.

In order to enable this system, the following three criteria must be met and sustained for at least two seconds:

1. Both engines must be running at greater than, or equal to, 975 rpm.
2. The engines must be running to within 100 rpm, or less, of each other.
3. The individual throttle commands of each ECU must be within 5% of each other’s value.

When the synchronous throttle switch is turned on with the initial criteria met, the throttle station lamp comes on. If at least one of the three criteria is not met, the throttle station lamp flashes on and off until the failing condition has been corrected.

When engine synchronization is successful, the ECU will have automatically disabled the tachometer of the follower engine and will have set each engine to isochronous governor operation. When an engine is above or below engine rpm demand, its governor sends a signal back to the engine’s ECU and the ECU makes the appropriate adjustment.

During large demands for acceleration or deceleration, it is normal for the synchronization system to shut down. Synchronous operation may, at any time, be re-enabled, as long as the initial criteria are met.

At key ON, a test of the lamps at the throttle station(s) will occur. If any lamp does not briefly come on, replace the bulb. The lamp test will occur only if the key as been OFF for at least 30 seconds.

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Monitoring Engine Parameters

In order for the electronic control system to deliver fuel according to a given set of operating conditions and, on some applications to provide engine protection, the following engine parameters are monitored by the ECU:

- Crank Position
- Engine Control Unit (ECU) Temperature
- Engine Coolant Temperature (ECT)
- Fuel Rail Pressure
- Fuel Temperature
- Fuel Transfer Pump Pressure
- Manifold Air Pressure (MAP)
- Oil Pressure
- Pump Position
- Throttle Position
- Turbo Compressor Inlet Temperature
- Turbo Speed
- Turbo Turbine Inlet Temperature
- Water In Fuel (WIF)
- Manifold Air Temperature (MAT)
- Barometric Air Pressure (BAP)
- Throttle Position
- Power Supply #1
- Power Supply #2
- Power Supply #3
- External Derate
- External Shutdown
- VGT Valve Position
- EGR Valve Position

MK41968,00000CD -19-04JAN10-1/1

Oil Pressure Sensor

The oil pressure sensor sends an oil pressure equivalent signal to the ECU. The ECU uses this signal to determine if engine oil pressure is adequate for the current operating conditions. The ECU monitors oil pressure for engine protection purposes.

For more information on how pressure sensors operate, see Pressure Measurement earlier in this Group.

For more information on engine protection and derate programs, see Engine Derate And Shutdown Protection later in this Group.

For more information on sensor locations, see Component Location Diagram 2 earlier in this Group.

JL45346,0000060 -19-01JUN10-1/1

Oil Pressure Switch

The oil pressure switch sends an oil pressure equivalent signal to the ECU. The ECU uses this signal to determine if engine oil pressure drops below a certain pressure. The ECU monitors oil pressure for engine protection purposes.

For more information on engine protection and derate programs, see ENGINE DERATE AND SHUTDOWN PROTECTION later in this Group.

For more information on switch locations, see COMPONENT LOCATION DIAGRAM 2 earlier in this Group.

JL45346,0000086 -19-19SEP07-1/1

Pressure Measurement

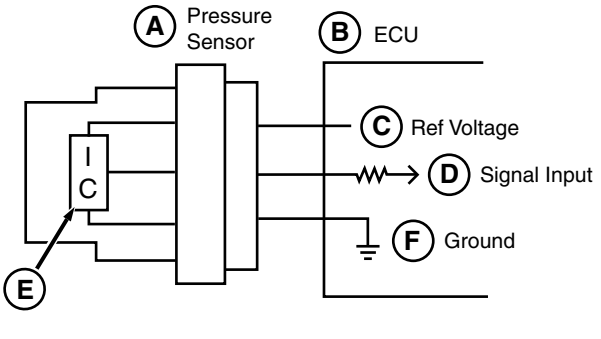
All engine pressure sensors (A) are 3-wire devices. As pressure changes, output changes. The ECU (B) supplies the sensor with a reference voltage (C) and ground (F). It monitors the input voltage from the sensor signal input wire (D). As the pressure changes, it causes the input to the ECU to change. The ECU compares the input value to a pre-programmed value in the ECU's memory.

There are many types of devices, and depending on the circuitry (E) in the device, the ECU determines how to process the input signal.

If the input value is near the expected value, then the ECU assumes everything is functioning properly. If the value is above or below the expected value, the ECU will set the appropriate diagnostic trouble code (DTC).

The ECU has the ability to derate the engine power, engine speed, or shut down the engine in an attempt to protect the engine and its components. If certain pressures exceed the threshold, the ECU will enable the engine protection.

For more information on engine protection and derate programs, see ENGINE DERATE AND SHUTDOWN PROTECTION later in this Group.



Typical Pressure Sensor Schematic

A—Pressure Sensor
B—ECU
C—Ref Voltage
D—Signal Input
E—IC (Integrated Circuit)
F—Ground

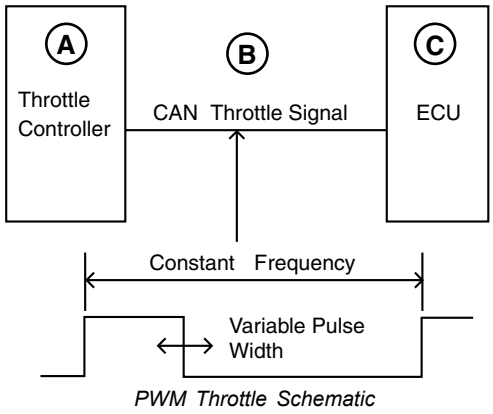
For more information on DTC's, see Diagnostic Trouble Code (DTC) Group Locator in Section 4, Group 160.

MK41968,00000B7 -19-01JUN10-1/1

Pulse-Width-Modulated (PWM) Throttle

The PWM throttle signal is sent to the ECU by another controller. The PWM signal is a square wave signal with a constant frequency. The pulse width of the signal varies to indicate the desired throttle opening.

A—Throttle Controller
B—CAN Bus Throttle Signal
C—ECU



PWM Throttle Schematic

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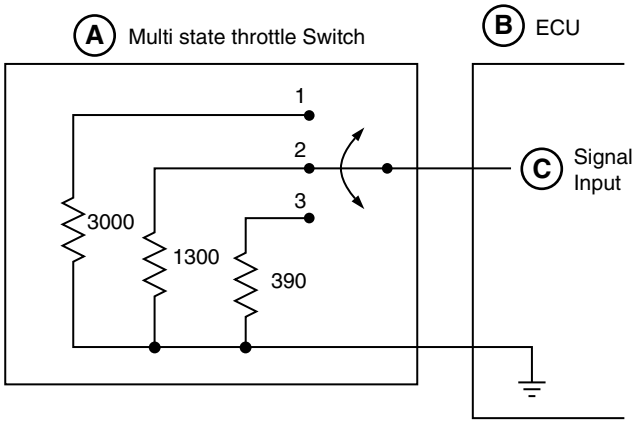
Ramp Throttle



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A—Multi-State throttle **B—ECU** **C—Signal Input**

The digital ramp throttle operates between minimum throttle and fast idle and uses a 3-position “Ramp Throttle” switch. If the switch is held in the “Increase Throttle” (rabbit–1) position, the engine speed will ramp up in small increments. If the switch is held in the “Decrease Throttle” (turtle–3) position, the engine speed will ramp down. As long as this switch is held in a momentary position, the engine continues to ramp up or down until the maximum high or low throttle speed setting is reached. When released, the switch returns to the center “Hold Throttle” position.

This is a 3-position, spring-loaded-to-center switch. The “Increase” speed position (1) uses a 3000-ohm resistor. The “Decrease” speed position (3) uses a 390-ohm resistor, and the “Hold” position (2) uses a 1300-ohm resistor. The ramp throttle settings are reset to the factory settings when the key is turned off and back on.

The ramp rate selection is a trim option and sets the rate of change for engine speed increases or decreases. There are four ramp rate options available.

- **3-Second Exponential:** Engine speed will start to increase/decrease at a slow rate and will accelerate/decelerate at an increasingly faster rate the longer the switch is held. The engine throttle setting will go from 0% to 100% throttle in 3 to 5 seconds.
- **5-Second Linear:** Engine speed will increase/decrease at a constant rate. With this setting the engine throttle setting will go from 0% to 100% throttle in 5 seconds.
- **7-Second Linear:** Engine speed will increase/decrease at a constant rate. With this setting the engine throttle setting will go from 0% to 100% throttle in 7 seconds.
- **9-Second Linear:** Engine speed will increase/decrease at a constant rate. With this setting the engine throttle setting will go from 0% to 100% throttle in 9 seconds.
- **25-Second Linear:** Engine speed will increase/decrease at a constant rate. With this setting the engine throttle setting will go from 0% to 100% throttle in 25 seconds.
- **Custom Linear:**Engine speed will increase/decrease at a rate set by the user. With this setting the engine throttle setting will go from 0% to 100% throttle at a rate between 5 and 30 seconds determined by the user.

Ramp steps or “bumps” are minor increases or decreases, in the engine speed setting. When the ramp throttle switch is momentarily held in the “Increase Throttle” or “Decrease Throttle” positions, the engine speed will increase/decrease a selected percentage of the throttle range. The actual engine RPM speed change for each setting will vary.

Four ramp step rates are available:

- 0.4% of throttle range
- 0.8% of throttle range
- 1.6% of throttle range
- 2.8% of throttle range

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Self-Calibration

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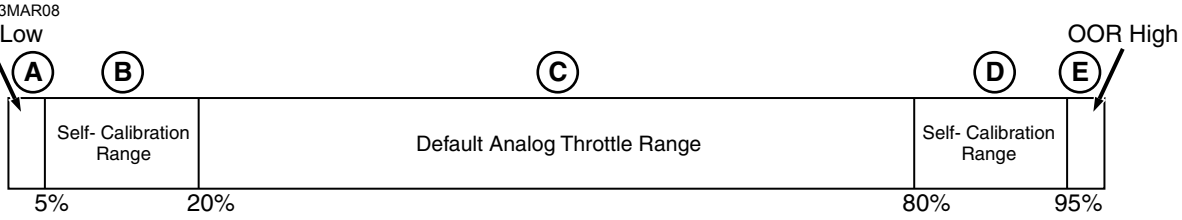

Analog Throttle Input Range

A—OOR (Out Of Range) Low
B—Self-Calibration Range
C—Default Analog Throttle Range
D—Self-Calibration Range
E—OOR (Out Of Range) High

With this feature enabled, it will automatically adjust throttle dead-band on every sweep of the throttle from idle to full throttle position. The Self-Calibration feature can adjust the 0% throttle set point from 20% to 5% of the Analog Throttle Input Range. Similarly, the 100% throttle set point can be adjusted between 80% and 95% of the Analog Throttle Input Range.

If the Self-Calibration feature is disabled, the operating range of the throttle will be limited to the Default Analog Throttle Range.

MK41968,00000CB -19-04JAN10-1/1

Sensor Supply #1

Some engine sensors or devices must have 5 volts and sensor return (ground) supplied to them to function properly. There are too many sensors to for just one power supply and return to handle. For this reason, there are several sets of power supplies.

This power supply has two outputs, Power Supply #1A on J1 and Power Supply #1B on J2.

NOTE: There are not any sensors or devices connected to Power Supply #1A on this application.

The following device is powered by Power Supply #1B:

- Primary Analog Throttle

MK41968,00000BF -19-22JUL10-1/1

Sensor Supply #2

Some engine sensors or devices must have 5 volts and sensor return (ground) supplied to them to function properly. There are too many sensors to for just one power supply and return to handle. For this reason, there are several sets of power supples.

This power supply has two outputs Power Supply #2A on J1 and Power Supply #2B on J2 .

NOTE: Some sensors are not available or are optional for certain applications.

The following devices are powered by Power Supply #2A:

- Fuel Pressure Sensor
- Oil Pressure Sensor
- Manifold Air Pressure Sensor

The following devices are powered by Power Supply #2B:

- Secondary Analog Throttle
- Remote Analog Throttle

MK41968,00000C0 -19-22JUL10-1/1

Speed Measurement

The camshaft position sensor measures engine speed by detecting the rotating teeth of a timing wheel mounted on the front of the camshaft drive gear. It can also measure the position of the rotation of the engine because it can detect a gap in teeth of the timing wheel where two of the teeth have been removed. This gap corresponds to top-dead-center of piston #1.

The sensor uses a coil wound around a magnet to create a voltage signal. As the tooth in the timing wheel passes directly under the sensor, the magnetic field is pulled towards the tooth. As the tooth passes the sensor, the magnetic field moves back toward the sensor. This creates a voltage in the coil that is sent to the ECU. By monitoring the frequency of these signals, the ECU calculates the component speed. When the gap in the teeth of the timing wheel is detected, the ECU interprets this change in the voltage pattern to be top-dead-center.

MK41968,00000B8 -19-04JAN10-1/1

Temperature Measurement

Temperature sensors are generally thermisters–temperature-sensitive variable resistors. The resistance of the sensor decreases as temperature increases (negative temperature coefficient). As the temperature changes it causes the voltage (D) to change. The ECU compares this voltage with values programmed into its memory. If the value measured is near the expected value, the ECU assumes everything is correct. If the value is above or below the expected value, the ECU will set the appropriate diagnostic trouble code (DTC). For more information on DTCs, see Diagnostic Trouble Code (DTC) Group Locator in Section 4, Group 160.

The ECU has the ability to derate the engine power, engine speed, or to shut down the engine in an attempt to protect the engine and its components. If certain temperatures exceed the threshold, the ECU will enable the engine protection. For more information on engine protection and derate programs, see Engine Derate And Shutdown Protection later in this Group.

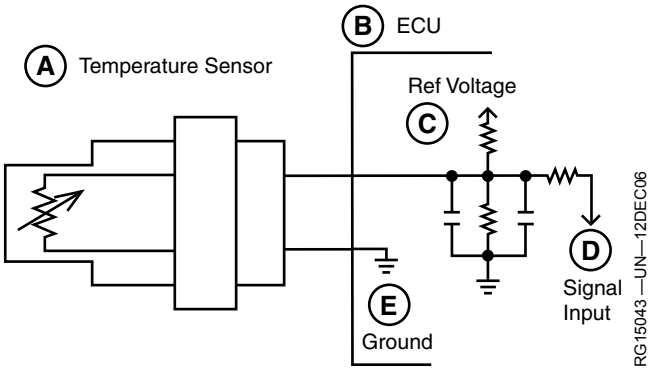

Figure 1

A—Temperature Sensor
B—ECU
C—Reference Voltage
D—Signal Input
E—Ground

MK41968,00000B9 -19-01JUN10-1/1

Throttle Adjustments

Throttle Rate

Throttle rate is how quickly the ECU changes the engine fuel rate in response to a throttle increase signal. Throttle rate has no impact on the deceleration. The ECU is shipped with the Maximum rate selected. Four rates are available: Maximum, Fast, Medium, and Slow.

NOTE: If Ramp Throttle is enabled, the Throttle Rate feature is disabled for all throttles.

Throttle Out-of-Range (OOR) Recovery

A throttle is determined to be Out-of-Range (OOR) when the ECU detects the input signal from that device is outside its expected normal limits (invalid). When the OOR condition is detected the ECU will set an diagnostic trouble code. The ECU will then ignore the input from the OOR throttle until it becomes valid, essentially setting its input to 0%. When the input becomes valid again the ECU will take appropriate action, which is determined by the recovery type programmed into the ECU. Typically, these errors occur when analog throttle endpoints are misaligned, but it can also be caused by faulty wiring.

Recovery types are:

- **Resume Recovery:** When a throttle Out-of-Range Error (OORE) condition is detected, only the OOR throttle input will be considered 0% until a valid input is received. The OOR throttle will immediately operate again as soon as the input is valid.

  IMPORTANT: This setting can cause rapid changes in the throttle if an intermittent OOR condition exists.

- **Idle Recovery:** When a throttle OOR condition is detected, only the OOR throttle input will be considered 0%. If the input becomes valid again after the OOR condition, the OOR throttle must be returned to low idle position (0% throttle) before the output of the throttle is allowed to increase above 0%.
- **Locked Recovery:** When a throttle OOR condition is detected, only the OOR throttle input will be considered 0% and will not be allowed to operate again until the power is reset on the ECU and the throttle input is valid.

The Throttle Out-of-Range (OOR) Recovery applies to all throttles except ramp throttle.Because the ramp throttle resets itself to minimum throttle for any Out-of-Range condition, selecting a different “Throttle Out-of-Range Recovery” will have no effect on the ramp throttle.

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Throttle Descriptions

John Deere engines can accept several types of throttle inputs and in several different connection schemes depending on the application. Types of throttles are:

- Analog
- Digital
- Pulse Width Modulated (PWM)
- CAN (messages on the CAN bus)

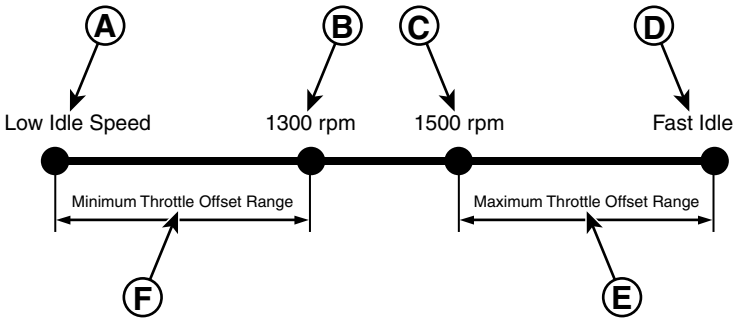
More than one throttle can be enabled at a time in the ECU software. For finer control of engine speed, a combination throttle can be enabled in the ECU software (discussed later in this group).

A description of each type follows later in this group.

JL45346,0000062 -19-17AUG07-1/1

Throttle Offsets

Minimum Throttle Offset



RG15075 —UN—08JUN07

The Minimum Throttle Offset is used to pre-set the low speed idle bump. The number entered into the field on the Trim Page will be the rpm increase from the standard factory setting of the idle speed. This offset will apply to all active throttles. The maximum setting for the Minimum Throttle Offset is the difference between the Low Idle speed and 1300 rpm.

Maximum Throttle Offset (Tri-State Throttle Only)
The Maximum Throttle Offset is used to pre-set the high-speed idle bump. The number entered into the field on the Trim Page will be the amount of rpm below the fast idle speed. The engine will operate in the “mid” position only if the 3-state throttle option is selected. This offset will apply to all active throttles, but only if the 3-state throttle is active. The maximum setting for the Maximum Throttle Offset is the difference between the fast idle speed and 1500 rpm.

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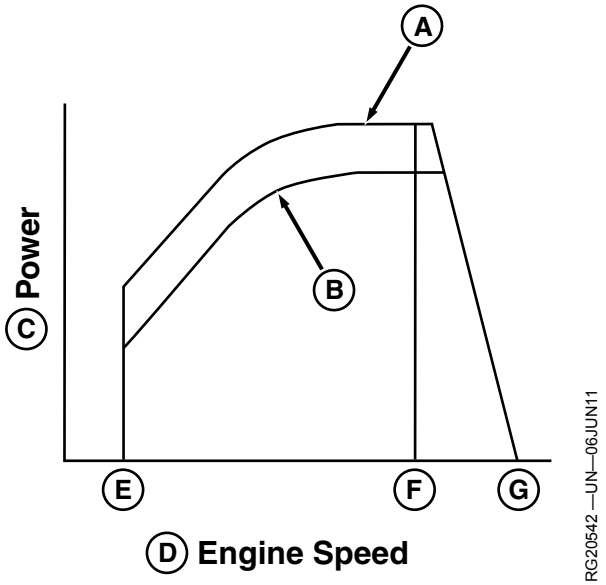
Torque Curve Selection

The ECU has the ability to select one of the multiple torque curves that are stored in its memory. The ECU can switch between torque curves while the engine is running. This provides the proper speed and torque for the current conditions. The other controllers on the vehicle can also send CAN messages to the ECU to change torque curves. There is usually one normal torque curve, and then there are others that reduce power for component protection (i.e. hitches, axles, transmissions). In some instances a power boost for a short period of time is an option (i.e. unloading a combine while still picking).

NOTE: OEM applications have only 1 torque curve.

A—Normal Power Curve
B—Derated Power Curve
C—Power
D—Engine Speed
E—Slow Idle
F—Normal Rated
G—Fast Idle



Torque Curves

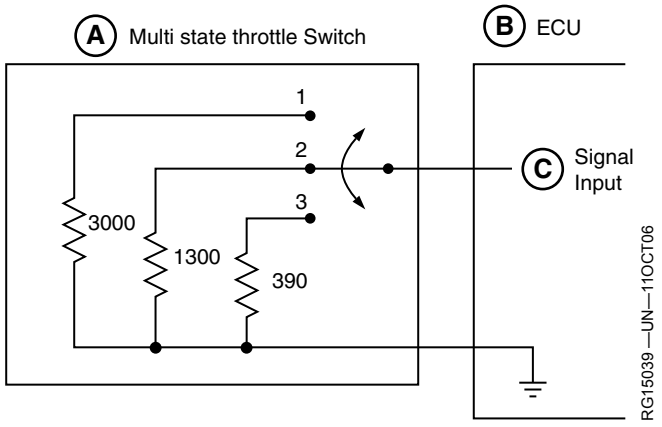
MK41968,00000CC -19-06JUN11-1/1

Tri-State Throttle

The digital tri-state (or “3-state”) throttle works similar to the dual-state throttle. This throttle uses a switch with three positions: minimum throttle (turtle–3), maximum throttle (Adj–2), and fast idle (rabbit–1). In the minimum throttle position, engine RPM defaults to a speed that has been set in the ECU according to the needs of the application. The fast idle (no-load) position speed is set in the ECU according to the needs of the application. In the maximum (Adj–2) throttle position, engine speed can be set within a range programmed into the ECU.

The switch uses three different resistors to change the voltage returned to the ECU. When the switch is in the minimum throttle position, current is routed through a 390-ohm resistor. The maximum throttle position uses a 1300-ohm resistor and the fast idle position uses a 3000-ohm resistor.

To change engine speed, the tri-state throttle must be in the Adj position and the “Bump Enable” switch must be in the “enable up” or “enable down” position while the “Idle Select” switch is held in the increase (+) or the decrease (–) position.



A—Multi-State throttle
B—ECU
C — Signal Input

JL45346,0000068 -19-17AUG07-1/1

Water in Fuel (WIF) Sensor

The water in fuel (WIF) sensor is located on the bottom of the final fuel filter in the water separator bowl. When water is detected in the fuel, a signal is sent to the ECU. The WIF sensor uses the resistance of fuel and water in the fuel system along with the principle that water is a better conductor then fuel. If water is present, the voltage will be lower. The ECU monitors this for engine protection purposes.

For more information on engine protection and derate programs, see ENGINE DERATE AND SHUTDOWN PROTECTION later in this Group.

For more information on sensor locations, see COMPONENT LOCATION DIAGRAM 1 earlier in this Group.

JL45346,0000074 -19-17AUG07-1/1

Glow Plug Operation

Glow plugs are located above each cylinder's combustion chamber. The glow plug heaters are used to increase the intake air temperature to improve cold starting. When the operator turns the key from "OFF" to "ON", the ECU receives fuel temperature information from the fuel temperature sensor, determines if the temperature is below the set point, turns on the "Wait to Start" light on and energizes the coil of the glow plug relay . This closes the normally-open glow plug relay contacts which provide current path to the glow plugs located above each cylinder. The ECU will keep the glow plugs energized for an amount of time that is determined by the measured temperature- colder is longer. When the predetermined time has passed, ECU turns off the "Wait to Start" light and de-energizes the glow plug relay. If the operator turns the ignition from "ON" to "START" at this time, the engine will crank and start.

If the operator turns the key from "START" to "ON" without waiting for the "Wait to Start" light to turn off, the ECU will de-energize the glow plug relay and a key-off/key-on cycle is required before preheating is allowed again.

Anytime the engine cranks but does not start, a key-off/key-on cycle will be required before preheating is allowed again.

For application specific information on glow plug times vs. temperatures, see APPLICATION SPECIFICATIONS in Section 06, Group 210 later in this manual.

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Section 04
Diagnostics

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524235.04 — MFWD Solenoid Circuit Voltage Low.....04-166-20

About This Group of the Manual

This Group of the manual contains necessary information to diagnose some base engine, all lubrication system and all cooling system problems. This section is divided into two areas: diagnosing malfunctions and testing procedures. The diagnosing malfunction areas are further divided into the following headings, containing the following symptoms:

- **(L)** Diagnosing Lubrication System Malfunctions:
  - Excessive Oil Consumption
  - Engine Oil Pressure Low
  - Engine Oil Pressure High
- **(C)** Diagnosing Cooling System Malfunctions:
  - Coolant Temperature Above Normal
  - Coolant Temperature Below Normal
  - Coolant in Oil or Oil in Coolant

Procedures for diagnosing some of the above symptoms are formatted such that a test or repair is recommended, then, based on the results, another test or repair is recommended. Other symptoms are formatted in a symptom - problem - solution format. In these symptoms, the problems are arranged in the most likely or easiest to check first. Symptoms arranged in both formats refer to testing procedures in the second part of this section. The second part of this section contains the following testing procedures:

- Base Engine Testing Procedures:
  - Test Engine Compression Pressure
  - Test Engine Cranking Speed
  - Dynamometer Test
- Lubrications System Testing Procedures:
  - Engine Oil Consumption
  - Check Engine Oil Pressure
  - Check for Excessive Crankcase Pressure (Blow-By)
  - Check for Turbocharger Oil Seal Leak
- Cooling System Testing Procedures:
  - Inspect Thermostat and Test Opening Temperature
  - Pressure Test Cooling System and Radiator Cap
  - Check for Head Gasket Failures
  - Check and Service Cooling System
- Air Supply and Exhaust Systems Testing Procedures:
  - Check Air Intake System
  - Measure Intake Manifold Pressure (Turbo Boost)
  - Check for Intake and Exhaust Restrictions
  - Test for Intake Air Leaks
  - Check for Exhaust Leaks (Turbocharger Engines)
  - Test Turbocharger Wastegate
  - Test Air Filter Restriction Indicator Switch

RG40854,0000019 -19-21JAN10-1/1

Abnormal Engine Noise

Symptom	Problem	Solution
E8 - Abnormal Engine Noise	Worn main or connecting rod bearings	Determine bearing clearance. See Connecting Rod Bearings — Inspection and Measurement (Rods and Crankshaft Removed from Engine) or Crankshaft Main Bearing Oil Clearance — Check in Section 02, Group 030 of this manual.
	Excessive crankshaft end play	Check crankshaft end play. See Crankshaft End Play Check in Section 02, Group 040 of this manual.
	Loose main bearing caps	Check bearing clearance; replace bearings and bearing cap screws as required. See Crankshaft Main Bearing Oil Clearance — Check in Section 02, Group 030 of this manual.
	Worn connecting rod bushings and piston pins	Inspect piston pins and bushings. See Piston Pins and Bushings — Inspection in Section 02, Group 030 of this manual.
	Scored pistons	Inspect pistons. See Piston — Cleaning And Inspection in Section 02, Group 030 of this manual.
	Worn timing gears or excess back lash	Check timing gear back lash. See Timing Gear Backlash Measurement in Section 02, Group 050 of this manual.
	Worn camshaft	Inspect camshaft. See Camshaft — Inspection in Section 02, Group 040 of this manual.
	Worn rocker arm shaft(s)	Inspect rocker arm shafts. See Rocker Arm Assembly — Inspection in Section 02, Group 020 of this manual.
	Insufficient engine lubrication	See Engine Oil Pressure Low in Group 151 of this Section of this manual.
	Turbocharger noise	See Turbocharger — Inspection in Section 02, Group 080 in this manual.

DN22556,00006C6 -19-01JUN10-1/1

Coolant in Oil or Oil in Coolant

Symptom	Problem	Solution
C3 - Coolant in Oil or Oil in Coolant	Faulty cylinder head gasket	Look for signs of head gasket failure. See Head Gasket Failures — Check later in this Group.
	Faulty oil cooler	Remove and inspect engine oil cooler. See Oil Cooler — Removal in Section 02, Group 060 of this manual.
	Cracked cylinder bore(s)	Locate crack; repair/replace components as required.
	Cracked cylinder head or block	Locate crack; repair/replace components as required.

RG41183,00000E4 -19-21JAN10-1/1

ECU Does Not Communicate with Service ADVISOR

JB81757,000004A -19-03JUN11-1/27

ECU Does Not Communicate with Service ADVISOR Diagnostic Procedure

Additional References:
For information on connecting to Service ADVISOR see Connecting To Service Advisor in Section 04, Group 160 later in this manual.

For information on reprogramming ECU see Engine Control Unit (ECU) Reprogramming Instructions in Section 04, Group 160 later in this manual.

For tool identification, see Tools and Other Materials in Section 05, Group 170 later in this manual.

NOTE: The wiring diagrams provided are for a typical John Deere supplied OEM harness. Wire number, colors, and jumper connectors do not apply to all applications.

For wiring information see 2.4L/3.0L ECU WIRING DIAGRAM 4 located in Section 06, Group 210 later in this manual.

Flex probe information:
- ECU large terminal - Orange/Green
- ECU small terminal - Orange/Blue
- 9-pin diagnostic connector C11 - Yellow/Purple
- CAN terminator C10 - Yellow/Purple

For more information on connector and terminal testing or flex probes see Terminal Test in Section 04, Group 160 earlier in this manual.

IMPORTANT: Do not force probes into connector terminals or damage will result. Use JDG10466 Connector Adapter Test Kit to make measurements in connectors. This will ensure that terminal damage does not occur.

Continued on next page

JB81757,000004A -19-03JUN11-2/27

1 Preliminary Checks	Perform as many of these preliminary checks as possible to help determine if problem is related to the PC, cables, or adaptor: **IMPORTANT: Ensure there is no charging equipment in use. This will allow the ECU to detect low input voltage.** • Verify all connections between diagnostic connector and service tool are properly connected and fully seated. • Verify that the adaptor type shown in the Select Readings Option in Service ADVISOR matches the adaptor being used (PDM or EDL) and the type of communication between PC and adaptor (parallel, USB, or Bluetooth). • Close Service ADVISOR and shut down PC. Restart PC, open Service ADVISOR and attempt to connect to ECU. • Attempt to connect to the ECU on a different application, if one is available. • Try to connect using a different USB port (EDL or PDM with USB adaptor). • Try to connect using a different USB or parallel cable, if available. • Try to connect using Bluetooth, if using EDL and PC has Bluetooth capability.	**YES:** Determine which cable or adaptor is defective and replace, if applicable.
	• Try to connect using a different adaptor or different type of adaptor, if available.	**NO:** No other application available to verify equipment. GO TO 2
	• Try to connect using a different PC, if available.	**NO:** Service ADVISOR connected to ECU on a different application. GO TO 2
	Does Service ADVISOR now connect to the original ECU?	**NO:** Service ADVISOR would not connect to ECU on a different application and you have narrowed down problem to PC. Open DTAC case.

JB81757,000004A -19-03JUN11-3/27

2 Check Adaptor Type	Are you using an EDL adaptor?	**YES:** GO TO 3 **NO:** PDM GO TO 5

JB81757,000004A -19-03JUN11-4/27

3 Check for EDL Green Power Light	*NOTE: The EDL will NOT operate unless power and ground are present at the 9-pin diagnostic connector (C11). However, the green power indicator light on the EDL will flash or illuminate steady, depending on EDL firmware level, if the EDL is connected to the PC's USB port and power is NOT present at the 9-pin diagnostic connector.* 1. If using USB cable, disconnect USB cable from EDL. 2. Attach the 26-pin EDL cable to the EDL and application's 9-pin diagnostic connector. 3. Ignition ON, engine OFF.	**YES:** GO TO 4
	Is the EDL green power light ON steady?	**NO:** GO TO 6

Continued on next page

JB81757,000004A -19-03JUN11-5/27

4 Check for Red Error Light - EDL	1. For USB connection, attach the USB cable to the EDL and the PC.	**YES:** Replace EDL. GO TO 25
	2. Open Service ADVISOR and attempt to connect to the ECU.	**NO:** EDL with USB GO TO 8
	Is the EDL red error indicator light ON?	**NO:** EDL with Bluetooth GO TO 9

JB81757,000004A -19-03JUN11-6/27

5 Check for Green Power Light - PDM	a. If using parallel cable, attach the parallel cable to the PDM and the PC. b. If using USB adaptor, connect the adaptor to the PDM and attach the USB cable to the USB adaptor and the PC.	
	1. Attach the 26-pin PDM cable to the PDM and application's 9-pin diagnostic connector.	
	2. Ignition ON engine OFF.	**YES:** GO TO 10
	Is the PDM green power indicator light ON?	**NO:** GO TO 6

JB81757,000004A -19-03JUN11-7/27

6 Check Diagnostic Connector Voltage Supply	*NOTE: Terminal B of the 9-pin diagnostic connector C11 may be supplied by an ignition or unswitched battery source, depending on the application.*	
	1. Disconnect EDL or PDM cable from 9-pin diagnostic connector.	
	2. Ignition ON, engine OFF.	
	3. On the harness, measure the voltage from the 9-pin diagnostic connector C11-B (+) to C11-A (-).	**YES:** GO TO 7
	Is the voltage greater than 10V?	**NO:** Fix problem. GO TO 25

JB81757,000004A -19-03JUN11-8/27

7 Check Cable Power and Ground Circuit Continuity	1. Disconnect 26-pin cable from EDL or PDM.	
	2. Perform Terminal Test on cable.	
	3. On the cable, measure the resistance between the 26-pin connector terminal 9 and the 9-pin connector terminal A.	
	4. On the cable, measure the resistance between the 26-pin connector terminal 8 and the 9-pin connector terminal B.	**YES:** Replace EDL or PDM. GO TO 25
	Were Terminal Test results good and are both resistance measurements less than 10 ohms?	**NO:** Replace cable. GO TO 25

Continued on next page

JB81757,000004A -19-03JUN11-9/27

8 Check for Amber Data Transfer Light - EDL with USB	*NOTE: The EDL amber data transfer light will flash ON briefly while Service ADVISOR attempts to connect to ECU if communication between the EDL and PC is good but there is no response from the ECU.*	
	1. Monitor EDL amber data transfer light closely.	**YES:** Amber light flashed ON briefly. GO TO 11
	2. Reattempt to connect Service ADVISOR to the ECU.	**YES:** Amber light is ON continuous. Service ADVISOR is now connected to the ECU. If data points are not visible, verify correct model was selected.
	Did amber data transfer light flash ON briefly or is the amber light ON continuous?	**NO:** No communication between PC and EDL. Perform checks listed in Step 1 to isolate problem.

JB81757,000004A -19-03JUN11-10/27

9 Check for Amber Data Transfer Light - EDL with Bluetooth	Monitor EDL amber data transfer light closely while attempting to connect Service ADVISOR to the ECU.	**YES:** Amber light flashed ON briefly. GO TO 11
	Did amber data transfer light flash ON briefly or is the amber light ON continuous?	**YES:** Amber light is ON continuous. Service ADVISOR is connected to the ECU. If data points are not visible, verify correct model was selected.
		NO: No communication between PC and EDL. Use USB cable. GO TO 1

JB81757,000004A -19-03JUN11-11/27

10 Check for Red CAN Light - PDM	1. Monitor PDM red CAN light.	**YES:** Red CAN light flashed several times. GO TO 11
	2. Attempt to connect Service ADVISOR to the ECU.	**YES:** Red CAN light is ON continuous. Service ADVISOR is connected to the ECU. If data points are not visible, verify correct model was selected.
	Did red CAN light flash several times or is red CAN light ON continuous?	**NO:** No communication between PC and PDM. Perform checks listed in Step 1 to isolate problem.

JB81757,000004A -19-03JUN11-12/27

11 Check Engine Operation	Attempt to start engine.	**YES:** GO TO 12
	Does engine start?	**NO:** GO TO 13

Continued on next page

JB81757,000004A -19-03JUN11-13/27

12 Test ECU Terminals

1. Ignition OFF, engine OFF.
2. Disconnect ECU connector J2.
3. Perform Terminal Test on J2-A1, J2-B1, and J2-K2.

Were any problems found?

YES: Fix problem. GO TO 25

NO: GO TO 16

JB81757,000004A -19-03JUN11-14/27

13 Check ECU Fuses and Voltages

1. Ignition ON, engine OFF.
2. Check ECU ignition fuse (F01) and ECU battery supply fuse (F02).
3. Measure voltage from ECU ignition fuse F01 (+) to single point ground (-).
4. Measure voltage from ECU battery supply fuse F02 (+) to single point ground (-).

Are both fuses good and are both voltage measurements within 1V of battery voltage?

YES: GO TO 14

NO: Fix problem. GO TO 25

JB81757,000004A -19-03JUN11-15/27

14 Test ECU Terminals

1. Ignition OFF, engine OFF.
2. Disconnect ECU connector J2.
3. Perform Terminal Test on J2.

Were any problems found?

YES: Fix problem. GO TO 25

NO: GO TO 15

JB81757,000004A -19-03JUN11-16/27

15 Check ECU Voltages

1. Ignition ON, engine OFF.
2. On the harness, measure voltage from ECU J2-B2 (+) to J2-L2 (-).
3. On the harness, measure voltage from ECU J2-L1 (+) to J2-L2 (-).

Are both measurements within 1V of battery voltage?

YES: GO TO 16

NO: Fix problem. GO TO 25

JB81757,000004A -19-03JUN11-17/27

16 Check CAN Wiring Continuity

1. Ignition OFF, engine OFF.
2. Disconnect application battery negative cable.
3. On the harness, measure the resistance between ECU J2-A1 and diagnostic connector C11-C.
4. On the harness, measure the resistance between ECU J2-B1 and diagnostic connector C11- D.

NOTE: If BOTH readings are approximately 60 ohms or 120 ohms, CAN High and CAN Low are likely swapped between the ECU and the diagnostic connector.

Were both measurement less than 10 ohms?

YES: Reconnect ECU J2 connector. GO TO 17

NO: Fix problem. GO TO 25

Continued on next page

JB81757,000004A -19-03JUN11-18/27

17 Check CAN for Short to Ground

1. On the harness, measure the resistance between the diagnostic connector C11-C and single point ground.
2. On the harness, measure the resistance between the diagnostic connector C11- D and single point ground.

Were all measurements greater than 1k ohms?

YES: GO TO 18

NO: Repair short to ground of CAN signal wiring. GO TO 25

JB81757,000004A -19-03JUN11-19/27

18 Check CAN Terminator(s)

On the harness, measure the resistance between diagnostic connector C11-C and C11- D.

Is the resistance between 50 and 130 ohms?

YES: GO TO 19

NO: Resistance is greater than 130 ohms. GO TO 20

NO: Resistance is less than 50 ohms: Repair short between CAN High and CAN Low. GO TO 25

JB81757,000004A -19-03JUN11-20/27

19 Check CAN for Short to Voltage

1. Reconnect application battery negative cable.
2. Ignition ON, engine OFF.
3. On the harness, measure the voltage from the application diagnostic connector C11-C (+) to single point ground (-).
4. On the harness, measure the voltage from the application diagnostic connector C11- D (+) to single point ground (-).

Were both measurements less than 4 volts?

YES: GO TO 22

NO: Repair short to power of CAN wiring. GO TO 25

JB81757,000004A -19-03JUN11-21/27

20 Check CAN Wiring Continuity

1. Locate CAN terminator(s) in application wire harness. One terminator is typically located near the ECU J2 connector (C10). A second terminator may be located near the diagnostic gauge or near some other electronic module on the application. Consult application technical information for the location of the second terminator, if applicable.
2. Disconnect the CAN terminator(s).
3. Perform Terminal Test on CAN terminator(s) and connector(s).
4. On the harness, measure the resistance between diagnostic connector C11-C and terminator connector C10-A.
5. On the harness, measure the resistance between diagnostic connector C11- D and terminator connector C10-B.
6. On the harness, measure the resistance between diagnostic connector C11-C and application terminator connector CAN High terminal.
7. On the harness, measure the resistance between diagnostic connector C11- D and application terminator connector CAN Low terminal.

Are all measurements less than 10 ohms and are terminal test results OK?

YES: GO TO 21

NO: Fix problem. GO TO 25

Continued on next page

JB81757,000004A -19-03JUN11-22/27

21 Check Terminator Resistance	On the CAN terminator(s), measure the resistance between terminal A and terminal B. Is the resistance of each terminator between 110 and 130 ohms?	**YES:** Recheck CAN harness resistance and Terminal Tests. Fix problem. GO TO 25 **NO:** Replace defective CAN terminator(s). GO TO 25

JB81757,000004A -19-03JUN11-23/27

22 Disconnect Other Electronic Control Modules	1. Ignition OFF, engine OFF. 2. If applicable, disconnect diagnostic gauge and all other devices that are connected to CAN, except ECU. 3. Ignition ON, engine OFF. 4. Attempt to connect Service ADVISOR to ECU. Did Service ADVISOR connect to ECU?	 **YES:** Determine which device is causing CAN communication problem. GO TO 25 **NO:** GO TO 23

JB81757,000004A -19-03JUN11-24/27

23 Reprogram ECU	1. Download payload for the ECU. 2. Attempt to reprogram the ECU. Was Service ADVISOR able to reprogram ECU?	 **YES:** GO TO 25 **NO:** GO TO 24

JB81757,000004A -19-03JUN11-25/27

24 Replace ECU	*NOTE: Verify that Service ADVISOR connects to the ECU on a different application with the equipment you are using prior to replacing ECU.* 1. Replace ECU and program with payload. 2. Attempt to connect Service ADVISOR to ECU. Did Service ADVISOR connect to ECU?	 **YES:** Problem fixed. **NO:** Open DTAC case.

JB81757,000004A -19-03JUN11-26/27

25 Verification	1. Ignition OFF, engine OFF. 2. Reconnect all connectors and negative battery cable, if removed 3. Ignition ON, engine OFF. 4. Attempt to connect Service ADVISOR to ECU. Did Service ADVISOR connect to the ECU?	 **YES:** Problem fixed. **NO:** GO TO 1

JB81757,000004A -19-03JUN11-27/27

ECU Does Not Communicate with Diagnostic Gauge or Gauge Displays CAN Bus Error

JB81757,0000057 -19-15APR10-1/8

ECU Does Not Communicate with Diagnostic Gauge or Gauge Displays CAN Bus Error Diagnostic Procedure

Additional References:
For information on connecting to Service ADVISOR see Connecting To Service Advisor in Section 04, Group 160 later in this manual

NOTE: The wiring diagrams provided are for a typical John Deere supplied OEM harness. Wire number, colors, and jumper connectors do not apply to all applications.

For wiring information see 2.4L/3.0L ECU WIRING DIAGRAM 4 located in Section 06, Group 210 later in this manual.

Flex probe information:
• Diagnostic gauge 6-way connector - Yellow/Purple

For more information on connector and terminal testing or flex probes see Terminal Test in Section 04, Group 160 earlier in this manual.

IMPORTANT: Do not force probes into connector terminals or damage will result. Use JDG10466 Connector Adapter Test Kit to make measurements in connectors. This will ensure that terminal damage does not occur.

JB81757,0000057 -19-15APR10-2/8

1 Check for Blank Diagnostic Gauge	1. Ignition ON, engine OFF.	
	2. View diagnostic gauge display.	**YES:** GO TO 2
	Is diagnostic gauge display blank?	**NO:** GO TO 3

JB81757,0000057 -19-15APR10-3/8

2 Check Diagnostic Gauge Voltage Supply	*NOTE: The diagnostic gauge has two identical 6-way connectors identified as "A" and "B". The diagnostic gauge left-side connector "A", as viewed from the rear of the gauge, should be connected to the wire harness containing the CAN wires, ignition, and ground.*	
	1. Ignition OFF, engine OFF.	
	2. Disconnect diagnostic gauge left side 6-way connector (as viewed from rear of gauge) identified as "A".	
	3. Perform Terminal Test on connector.	
	4. Ignition ON, engine OFF.	
	5. On the harness, measure the voltage from the diagnostic gauge 6-way connector terminal 1 (+) to terminal 6 (-).	**YES:** Replace diagnostic gauge. GO TO 6
	Are terminal test results good and is voltage within 1V of battery terminal voltage?	**NO:** Fix problem. GO TO 6

Continued on next page

JB81757,0000057 -19-15APR10-4/8

❸ **Check ECU Communication**	1. Ignition ON, engine OFF. 2. Attempt to connect Service ADVISOR to ECU. Does Service ADVISOR connect to the ECU?	**YES:** GO TO 4 **NO:** Discontinue this test and perform diagnostic procedure ECU Does Not Communicate With Service ADVISOR.

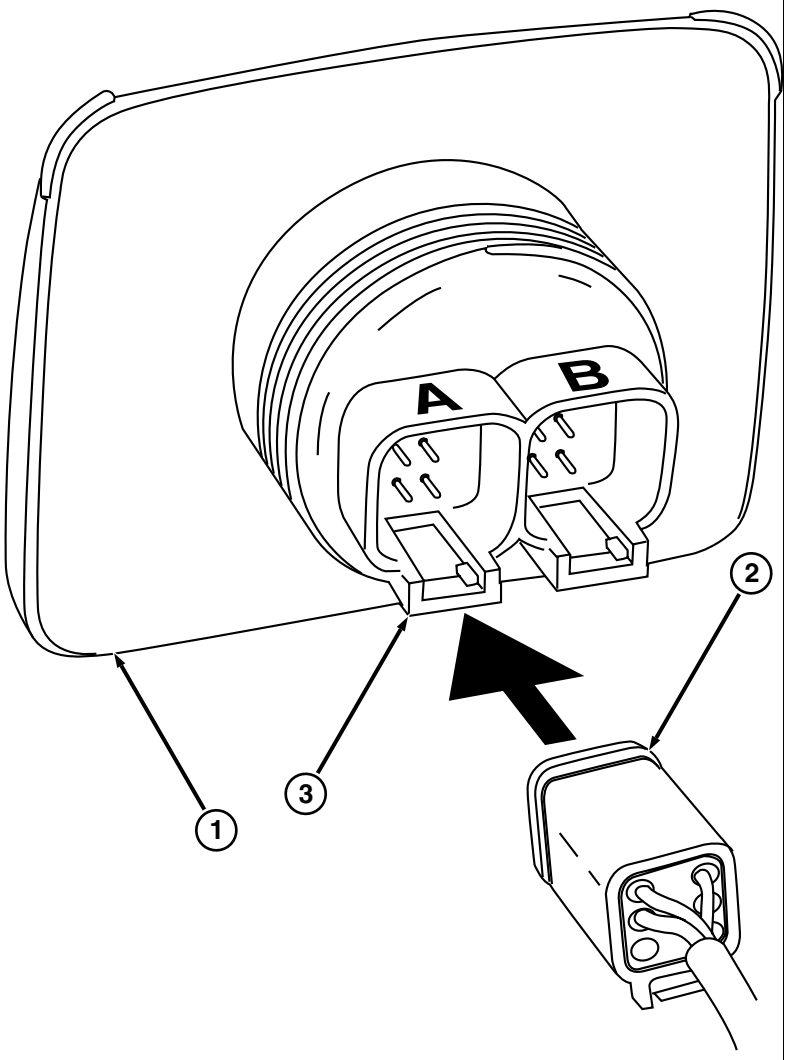
Continued on next page

JB81757,0000057 -19-15APR10-5/8

4 Check for Correct Connection

NOTE: The diagnostic gauge has two identical 6-way connectors identified as "A" and "B". The diagnostic gauge left-side connector "A", as viewed from the rear of the gauge, should be connected to the wire harness containing the CAN wires, ignition, and ground.

1. Ignition OFF, engine OFF.
2. Access view of rear of diagnostic gauge (1) and verify that the wire harness containing the CAN wires (2) is mated to connector "A" (3).



RG15515 —UN—21SEP07

Diagnostic Gauge Connectors

1— Rear View of Diagnostic Gauge
2— Wire Harness Connector with CAN Wiring
3— Left-Side Connector Identified as "A"

Is application wire harness 6-way connector containing the CAN wires connected to the diagnostic gauge left-side connector "A", as viewed from the rear of the gauge?

YES: GO TO 5

NO: Connect to the left-side connector. GO TO 6

Continued on next page

JB81757,0000057 -19-15APR10-6/8

5 Check CAN Wiring Continuity to Diagnostic Connector	1. Disconnect diagnostic gauge 6-way connector containing the CAN wires. 2. On the harness, measure the resistance between the diagnostic gauge 6-way connector terminal 2 and 9-pin diagnostic connector C11-C. 3. On the harness, measure the resistance between the diagnostic gauge 6-way connector terminal 3 and 9-pin diagnostic connector C11-D. Are both resistance measurements less than 10 ohms?	**YES:** Replace diagnostic gauge. GO TO 6 **NO:** Fix CAN wiring. GO TO 6

JB81757,0000057 -19-15APR10-7/8

6 Verification	1. Ignition OFF, engine OFF. 2. Reconnect all electrical connectors. 3. Ignition ON, engine ON. 4. Check diagnostic gauge operation. Does diagnostic gauge display engine information?	**YES:** Problem fixed. **NO:** GO TO 1

JB81757,0000057 -19-15APR10-8/8

ECU Does Not Program with Service ADVISOR

JB81757,000004B -19-15APR10-1/7

ECU Does Not Program with Service ADVISOR Diagnostic Procedure

Additional References:
For information on connecting to Service ADVISOR see Connecting To Service ADVISOR in Section 04, Group 160 later in this manual.

For information on reprogramming ECU see Engine Control Unit (ECU) Reprogramming Instructions in Section 04, Group 160 later in this manual.

JB81757,000004B -19-15APR10-2/7

1 Preliminary Checks	Perform these checks: • Verify all connections between diagnostic connector and service tool are properly connected and fully seated. • Verify that the adaptor type shown in the Available Adapters menu in Service ADVISOR matches the adaptor being used (PDM or EDL) and the type of communication between PC and adaptor (parallel or USB). • Close Service ADVISOR and shut down PC. Restart PC, open Service ADVISOR and attempt to reprogram the ECU. • Check engine payload file name for correct engine serial number. Download the correct payload if engine serial number does not match payload file name. • If replacing the ECU, verify that the new ECU serial number was correctly entered when downloading the payload. Were you able to reprogram the ECU?	**YES:** Problem solved. **NO:** GO TO 2

JB81757,000004B -19-15APR10-3/7

2 Communication Error Message	Does an error message appear in Service ADVISOR indicating “Error Communicating and Programming the ECU?	**YES:** GO TO 3 **NO:** Perform steps indicated in error message. Consult WebHelpR in Service ADVISOR help menu.

JB81757,000004B -19-15APR10-4/7

3 Check for New ECU	Are you attempting to program a new replacement ECU?	**YES:** GO TO 4 **NO:** Attempting to reprogram the original ECU. GO TO 5

Continued on next page

JB81757,000004B -19-15APR10-5/7

4 Parameters	Were you able to successfully retrieve the parameters from the old ECU when prompted in Service ADVISOR?	**YES:** Consult WebHelpR in Service ADVISOR help menu. **NO:** Old ECU is available and operational. GO TO 5 **NO:** Old ECU is not available or is not operational. Consult WebHelpR in Service ADVISOR help menu.

JB81757,000004B -19-15APR10-6/7

5 Check for Service Advisor Communication	*NOTE: A live connection in Service ADVISOR cannot be obtained with a new ECU until it has been programmed.* 1. Ignition OFF, engine OFF. 2. Connect old or original ECU to wire harness. 3. Ignition ON, engine OFF.	**YES:** Attempting to reprogram original ECU. Replace original ECU.
	4. Attempt to connect to ECU (live connection) using Service ADVISOR.	**YES:** Attempting to program a new ECU. Consult WebHelpR in Service ADVISOR help menu.
	Does Service ADVISOR connect to the old or original ECU?	**NO:** Perform procedure Ecu Does Not Communicate With Service ADVISOR.

JB81757,000004B -19-15APR10-7/7

Engine Cranks But Will Not Start

MK41968,000009C -19-01JUN10-1/17

Engine Cranks/Won't Start Diagnostic Procedure

Additional References:

NOTE: This procedure should be followed if engine cranks, but will not start. If the engine will not crank, see Engine Will Not Crank to diagnose the cranking system.

IMPORTANT: When directed to run the Harness Diagnostic Mode Test the engine temperature should be above freezing. It is recommended that the engine temperature be at least room temperature 20° C (68° F). This test is located in Service ADVISOR.

MK41968,000009C -19-01JUN10-2/17

1 Preliminary Checks	1. Verify sufficient fuel in fuel tank. 2. Verify that any remote switch used to shut down engine is in the RUN position. 3. Check for major intake air restriction. 4. Check for major exhaust restriction. 5. Check battery state of charge. 6. Verify engine cranking speed is adequate to start engine. 7. Verify glow plugs are functional if temperature is below 0°C (32°F). Does engine start?	**YES:** Problem fixed. **NO:** GO TO 2

MK41968,000009C -19-01JUN10-3/17

2 Attempt to Connect to ECU with Service ADVISOR	1. Ignition ON, engine OFF. 2. Attempt to connect to ECU with Service ADVISOR. Were you able to connect to ECU with Service ADVISOR?	**YES:** GO TO 3 **NO:** Discontinue this test and perform procedure ECU Does Not Communicate With Service ADVISOR.

MK41968,000009C -19-01JUN10-4/17

3 Check for Active DTCs	Are there any active DTCs?	**YES:** Discontinue this test and perform test for the active DTC. **NO:** GO TO 4

MK41968,000009C -19-01JUN10-5/17

4 Read DTCs and Store Snapshot Information	1. Write down any stored DTCs and their occurrence count. If any DTCs have snapshot capture or snapshot recording information, save the information. For instructions on saving and using snapshot information, see Snapshot Instructions earlier in this Group. *NOTE: When DTCs are cleared Snapshot information for ALL DTCs will also be cleared.* 2. Clear stored DTCs. 3. Crank engine for 15 seconds. Are there any stored or active DTCs after cranking engine?	**YES:** Discontinue this test and perform test for the stored or active DTC. **NO:** GO TO 5

Continued on next page

MK41968,000009C -19-01JUN10-6/17

5 Harness Diagnostic Mode Test	1. Ignition ON, engine OFF.	
	2. Perform Harness Diagnostic Mode Test in Service ADVISOR.	**YES:** Discontinue this test and perform test for the DTC.
	Were any DTCs generated during Harness Diagnostic Mode Test?	**NO:** GO TO 6

MK41968,000009C -19-01JUN10-7/17

6 Low Pressure Fuel System Test	Perform Low Pressure Fuel System Test, found later in this group.	**YES:** Problem fixed.
	Did engine start?	**NO:** GO TO 7

MK41968,000009C -19-01JUN10-8/17

7 Check Fuel Quality	Perform procedure Fuel Supply Quality Check, found later in this group.	**YES:** Problem fixed.
	Did engine start?	**NO:** GO TO 8

MK41968,000009C -19-01JUN10-9/17

8 Camshaft Position and Crankshaft Position Signal Test	*NOTE: See DTC procedures 000636.02 and 000637.02 in Section 04, Group 160 later in this manual for more information on position sensor data points.*	
	1. Monitor and record the following data points in Service ADVISOR: • Crankshaft Position Status • Camshaft Position Status • Crankshaft Position Speed • Camshaft Position Speed • Crankshaft Position Improper Pattern Indicator • Camshaft Position Improper Pattern Indicator • Crankshaft Position Noise Indicator • Camshaft Position Noise Indicator	
	2. Crank engine for 15 seconds.	
	3. Replay recording and review the recorded data points.	
	Did the data points indicate the following while the engine is cranking at a steady speed?	
	NOTE: When engine first begins cranking, the data points may not indicate these values. Ignore data point values until engine has rotated at least two full revolutions.	
	• Crankshaft Position Status – 63 for speeds below 400 rpm, 47 for speeds above 400 rpm.	
	• Camshaft Position Status – 63 for speeds below 400 rpm, 47 for speeds above 400 rpm.	
	• Crankshaft Position Speed - The actual cranking speed (nearly same as camshaft position sensor speed).	
	• Camshaft Position Speed - The actual cranking speed (nearly same as crankshaft position sensor speed).	
	• Crankshaft Position Improper Pattern Indicator - 0	
	• Camshaft Position Improper Pattern Indicator - 0	
	• Crankshaft Position Noise Indicator - 0	**YES:** GO TO 11
	• Camshaft Position Noise Indicator - 0	**NO:** GO TO 9

Continued on next page

MK41968,000009C -19-01JUN10-10/17

9 Check for Crankshaft Position Signal Problem

1. Ignition OFF, engine OFF.
2. Disconnect crankshaft position sensor and secure connector away from rotating components.

NOTE: Ignore DTC 000637.08 which may be set due to the disconnected sensor.

3. Ignition ON, engine OFF.
4. Crank engine for 20 seconds.
5. Ignition OFF, engine OFF.
6. Reconnect crankshaft position sensor.

Did engine start?

YES: Perform diagnostic procedure for 000637.02 as though DTC were active.

NO: GO TO 10

MK41968,000009C -19-01JUN10-11/17

10 Check for Camshaft Position Signal Problem

1. Verify crankshaft position sensor is reconnected.
2. Disconnect camshaft position sensor and secure connector away from rotating components.

NOTE: Ignore DTC 000636.08 which may be set due to the disconnected sensor.

3. Ignition ON, engine OFF.
4. Crank engine for 20 seconds.
5. Clear DTCs.
6. Ignition OFF, engine OFF.
7. Reconnect camshaft position sensor.

Did engine start?

YES: Perform diagnostic procedure for 000636.02 as though DTC were active.

NO: GO TO 11

MK41968,000009C -19-01JUN10-12/17

11 Check Engine Oil Pressure

NOTE: Camshaft followers for valves are hydraulic. A lack of oil pressure can cause inadequate valve opening.

With oil pressure sensor:

1. Monitor Engine Oil Pressure data point in Service ADVISOR.
2. Crank engine for 15 seconds.

Without oil pressure sensor:

3. Remove oil pressure switch or oil gallery plug.
4. Install pressure gauge.
5. Crank engine for 15 seconds.

Is engine oil pressure at least 6 psi with engine cranking?

YES: GO TO 12

NO: Determine cause of low oil pressure.

MK41968,000009C -19-01JUN10-13/17

12 Reprogram ECU

1. Ignition OFF, engine OFF.
2. Download latest ECU payload and reprogram ECU.

Did engine start?

YES: Problem fixed.

NO: GO TO 13

Continued on next page

MK41968,000009C -19-01JUN10-14/17

13 Inspect Valve Train	1. Ignition OFF, engine OFF. 2. Remove rocker arm cover. 3. Inspect valve train for damage. 4. Rotate engine using JDG1704 or JDG10221 Engine Turning Tool while observing valve train for proper operation. Were any problems found?	**YES:** Fix problem. Attempt to start engine. **NO:** GO TO 14

MK41968,000009C -19-01JUN10-15/17

14 Check Compression and Approximate Camshaft Timing	*NOTE: This step verifies that camshaft timing is close enough for engine to start. The camshaft timing procedure in Section 02, Group 050 should be followed for precise camshaft timing adjustment.* 1. Perform procedure Mechanical Compression Test found in Section 04, Group 150. Ignore requirement for engine to be at operating temperature for the test. 2. Remove #1 cylinder rocker arms and electronic unit pump. 3. Install JDG1700-5-1 Timing Gauge in #1 unit pump bore and secure gauge in the cylinder block using the injection pump hold-down clamp and cap screw. 4. Slowly rotate engine using JDG1704 or JDG10221 Engine Turning Tool until significant turning resistance is met indicating the timing gauge is contacting camshaft lobe. 5. Determine if crankshaft is near TDC #1 by attempting to insert JDE81-4 Timing Pin. Is compression pressure at least 1700 kPa (250 psi) in each cylinder and can timing pin be inserted?	**YES:** Reassemble engine. GO TO 15 **NO:** Fix mechanical problem.

MK41968,000009C -19-01JUN10-16/17

15 Replace ECU	Replace ECU. Did engine start?	**YES:** Problem fixed. **NO:** Open DTAC case.

MK41968,000009C -19-01JUN10-17/17

Engine Does Not Develop Full Power

MK41968,000009D -19-01JUN10-1/18

Engine Does Not Develop Full Power Diagnostic Procedure

Additional References:

IMPORTANT: When directed to run the Harness Diagnostic Mode Test the engine temperature should be above freezing. It is recommended that the engine temperature be at least room temperature 20° C (68° F). This test is located in Service ADVISOR.

MK41968,000009D -19-01JUN10-2/18

1 Check for Active DTCs	Were you referred to this test while performing the diagnostic procedures for a diagnostic trouble code (DTC)?	**YES:** GO TO 2 **NO:** Check for and resolve any active DTCs prior to performing this test.

MK41968,000009D -19-01JUN10-3/18

2 Harness Diagnostic Mode Test	1. Write down any stored DTCs and their occurrence count. If any DTCs have snapshot capture or snapshot recording information, save the information. For instructions on saving and using snapshot information, see Snapshot Instructions earlier in this Group. *NOTE: When DTCs are cleared Snapshot information for ALL DTCs will also be cleared.* 2. Perform Harness Diagnostic Mode Test in Service ADVISOR. Were any active DTCs generated during Harness Diagnostic Mode Test?	**YES:** Discontinue this test and perform test for the active DTC. **NO:** GO TO 3

MK41968,000009D -19-01JUN10-4/18

3 Preliminary Checks	*NOTE: Low engine power complaints are often due to the operator's expectations, rather than the engine not actually developing rated power. Compare the suspect engine's performance to another identical application, if possible.* Check for the following, if applicable, on the application. • Air filter element restricted. • Large amount of contamination present in fuel drained from fuel filter drain indicated a restricted fuel filter. • Transmission problems, overheating or slipping. • Driven load has changed. • Auxiliary drives with abnormally high loads. • Hydraulic system problems causing high engine loads. • Engine is otherwise overloaded. Is engine performance restored?	**YES:** Problem fixed. **NO:** GO TO 4

Continued on next page

MK41968,000009D -19-01JUN10-5/18

4 Exhaust Check	Operate engine under the conditions where the low power complaint occurs. Does the engine produce excessive blue, white, or black exhaust smoke?	**YES:** Blue smoke - Check for internal engine damage. Perform Crankcase Pressure Blow-By Test in Section 4 Group 155. **YES:** White smoke - Perform procedure Engine Emits Excessive White Exhaust Smoke. **YES:** Black smoke - Perform procedure Engine Emits Excessive Black or Gray Exhaust Smoke. **NO:** GO TO 5

MK41968,000009D -19-01JUN10-6/18

5 Check for Misfire	Does engine misfire or run irregularly?	**YES:** Perform procedure Engine Misfires or Runs Irregularly **NO:** GO TO 6

MK41968,000009D -19-01JUN10-7/18

6 Throttle Test	*NOTE: Some applications may have a limit on maximum throttle percentage by design. Consult engine distributor for more information.* 1. Ignition ON, engine OFF. 2. Monitor Throttle Position data point in Service ADVISOR. 3. Fully advance throttle lever. Is Throttle Position 97% or higher?	**YES:** GO TO 7 **NO:** Check for throttle circuit problem.

MK41968,000009D -19-01JUN10-8/18

7 Low Pressure Fuel Supply System Test	Perform procedure Low Pressure Fuel System — Check, found later in this group. Is engine performance restored?	**YES:** Problem fixed. **NO:** GO TO 8

MK41968,000009D -19-01JUN10-9/18

8 Check Fuel Quality	Perform procedure Fuel Supply Quality Check, found later in this group. Is engine performance restored?	**YES:** Problem fixed. **NO:** GO TO 9

MK41968,000009D -19-01JUN10-10/18

9 Check for Air in Fuel	Perform procedure Air In Fuel — Check found late in this group. Is engine performance restored?	**YES:** Problem fixed. **NO:** GO TO 10

Continued on next page

MK41968,000009D -19-01JUN10-11/18

10 Charge Air System Analysis	Perform Charge Air System — Test found later in this group. Is engine performance restored?	**YES:** Problem fixed. **NO:** GO TO 11

MK41968,000009D -19-01JUN10-12/18

11 Intake and Exhaust Restriction and Air Leak Test	Check for intake and exhaust restrictions and leaks. See Air Intake System — Check and Exhaust System — Check in Section 04 of the base engine manual. Was a problem found?	**YES:** Fix problem, recheck engine performance. **NO:** GO TO 12

MK41968,000009D -19-01JUN10-13/18

12 Check Manifold Pressure	Check intake manifold pressure with engine under load. See Intake Manifold — Pressure Measurement in Section 04, Group 150. Is manifold pressure within specification?	**YES:** Fix problem. Recheck engine performance. **NO:** GO TO 13

MK41968,000009D -19-01JUN10-14/18

13 Reprogram ECU	1. Download latest ECU payload. 2. Modify Custom Performance trimmable options to values specified by the engine distributor, if applicable. 3. Reprogram ECU. Is engine performance restored?	 **YES:** Problem fixed. **NO:** GO TO 14

MK41968,000009D -19-01JUN10-15/18

14 Check Engine Load	1. Monitor Engine Load at Current Speed data point in Service ADVISOR. 2. Operate engine at speed and load where low power complaint occurs. Does Engine Load at Current Speed data point indicate a value of 95 percent or more?	 **YES:** GO TO 15 **NO:** ECU is limiting engine power. Open DTAC case.

MK41968,000009D -19-01JUN10-16/18

15 Check on Dynamometer	Check engine power on a certified dynamometer, if possible. Does engine develop rated power on dynamometer?	**YES:** Engine is operating as designed. **NO:** GO TO 16 **NO:** Engine cannot be tested on a dynamometer. Open DTAC case.

MK41968,000009D -19-01JUN10-17/18

16 Replace Injector Nozzles	*NOTE: There are two different injector nozzle part numbers which have different flow rates. Installing the lower flow rate injector nozzles in an engine designed for the higher flow rate nozzles will decrease engine power.* Replace injector nozzles. Does engine develop rated power on dynamometer?	 **YES:** Problem fixed. **NO:** Open DTAC case.

MK41968,000009D -19-01JUN10-18/18

Engine Emits Excessive White Exhaust Smoke

RG40854,0000006 -19-01JUN10-1/11

Engine Emits Excessive White Exhaust Smoke Diagnostic Procedure

RG40854,0000006 -19-01JUN10-2/11

1 Check for Active DTCs	Were you referred to this test while performing the diagnostic procedures for a diagnostic trouble code (DTC)?	**YES:** GO TO 2 **NO:** Check for and resolve any active DTCs prior to performing this test.

RG40854,0000006 -19-01JUN10-3/11

2 Check for Type of White Smoke	*NOTE: White exhaust smoke is caused by condensing liquid in the exhaust system. The liquid is typically diesel fuel or coolant. Unburned diesel fuel in the exhaust has an strong diesel fuel odor and causes a severe burning sensation in the eyes. Unburned diesel fuel is caused by a misfire or incomplete combustion. Too low of a coolant temperature may result in white smoke due to incomplete combustion. Poor quality fuel or fuel not blended for the operating conditions may also cause incomplete combustion. Coolant in the exhaust causes an odor that can be described as sweet. White smoke accompanied with coolant loss and overheating indicates that the white smoke is likely due to coolant in the exhaust.* Are you able to determine if the white smoke is caused by fuel or coolant?	**YES:** White smoke is due to fuel in exhaust. GO TO 3 **YES:** White smoke is due to coolant in exhaust. GO TO 9 **NO:** Not sure if fuel or coolant. Perform steps 3-9. Open DTAC case if no problem found.

RG40854,0000006 -19-01JUN10-4/11

3 Check Engine Performance	Is engine idle quality and engine performance good?	**YES:** Reprogram ECU with latest payload. If white smoke still present, GO TO 4 **NO:** Engine performance is not acceptable. GO TO 4

RG40854,0000006 -19-01JUN10-5/11

4 Misfire and Cut-Out Test	*NOTE: If white smoke is decreased substantially when a cylinder is cut-out, the white smoke is likely caused by a misfire of that cylinder.* 1. Perform **Cylinder Misfire Test** in Service ADVISOR. 2. Perform **Cylinder Cut-Out Test in Service ADVISOR** with engine at low idle. Is each cylinder's contribution within 10 percent of the others during the **Cylinder Misfire Test** and does the sound of the engine change equally when each injector is disabled during the Cylinder Cut-Out Test?	**YES:** GO TO 6 **NO:** GO TO 5

Continued on next page

RG40854,0000006 -19-01JUN10-6/11

5 Check Compression Pressure	Perform procedure Mechanical Compression Test found in Section 04, Group 150.	**YES:** Replace electronic unit pump and injector nozzle in the cylinders with low contribution identified in previous step. Recheck for white smoke.
	Is compression pressure and variation between cylinders within specification?	**NO:** Fix cause of low compression in the affected cylinder. Recheck for white smoke.

RG40854,0000006 -19-01JUN10-7/11

6 Fuel Quality	Perform Fuel Supply Quality Check procedure found later in this section.	**YES:** GO TO 7
	Is white smoke still present?	**NO:** Problem fixed.

RG40854,0000006 -19-01JUN10-8/11

7 Check Cooling System	1. Operate engine, under load if possible, until coolant temperature is above 88°C (190°F).	
	2. Return engine to low idle, no load for 10 minutes.	**YES:** GO TO 8
	Were you able to cause coolant temperature to increase to 88°C (190°F) and is coolant temperature greater than 80°C (175°F) after 10 minutes at low idle?	**NO:** Replace thermostat and check for sources of excessive cooling system heat loss.

RG40854,0000006 -19-01JUN10-9/11

8 Reprogram ECU	Reprogram ECU with latest payload, if not already performed during this procedure.	**YES:** Perform step 9. Open DTAC case if no problem found.
	Is white smoke still present?	**NO:** Problem fixed.

RG40854,0000006 -19-01JUN10-10/11

9 Check for Head Gasket Failure	Check for failed head gasket. See Head Gasket Failures — Check in Section 04 Group 150.	**YES:** Fix problem.
	Was problem found?	**NO:** Locate source of coolant leakage into combustion chamber.

RG40854,0000006 -19-01JUN10-11/11

Engine Emits Excessive Black or Gray Exhaust Smoke

RG40854,0000008 -19-15APR10-1/10

Engine Emits Excessive Black or Gray Exhaust Smoke Diagnostic Procedure

RG40854,0000008 -19-15APR10-2/10

1 Check for Active DTCs	Were you referred to this test while performing the diagnostic procedures for a diagnostic trouble code (DTC)?	**YES:** GO TO 2 **NO:** Check for and resolve any active DTCs prior to performing this test, then GO TO 2.

RG40854,0000008 -19-15APR10-3/10

2 Check Charge Air System	Perform Charge Air System — Test. Is black smoke still present when engine is operated under conditions where black smoke was observed?	**YES:** GO TO 3 **NO:** Problem fixed.

RG40854,0000008 -19-15APR10-4/10

3 Intake and Exhaust Restriction and Air Leak Test	Check for intake and exhaust restrictions and leaks. See Air Intake System — Check and Exhaust System — Check Is black smoke still present when engine is operated under conditions where black smoke was observed?	**YES:** GO TO 4 **NO:** Problem fixed.

RG40854,0000008 -19-15APR10-5/10

4 Check Intake Manifold Pressure	Perform Intake Manifold — Pressure Measurement. Is intake manifold pressure within specifications?	**YES:** GO TO 5 **NO:** Fix cause of low intake manifold pressure.

RG40854,0000008 -19-15APR10-6/10

5 Cut-Out Test	Perform Cylinder Cut-Out Test in Service ADVISOR and watch for a decease in exhaust smoke when each cylinder is cut out. Did smoke decrease substantially when a cylinder was cut-out?	**YES:** Replace injector nozzle in the affected cylinder and recheck for black smoke. **NO:** GO TO 6

RG40854,0000008 -19-15APR10-7/10

6 Fuel Quality	Perform Fuel Supply Quality Check procedure found later in this section. Is black smoke still present when engine is operated under conditions where black smoke was observed?	**YES:** GO TO 7 **NO:** Problem fixed.

Continued on next page

RG40854,0000008 -19-15APR10-8/10

7 Reprogram ECU	Reprogram ECU with latest payload, if not already performed during this procedure. Is black smoke still present when engine is operated under conditions where black smoke was observed?	**YES:** GO TO 8 **NO:** Problem fixed.

RG40854,0000008 -19-15APR10-9/10

8 Check Injector Nozzles	*NOTE: There are two different injector nozzle part numbers which have different flow rates. Installing the higher flow rate injector nozzle in an engine designed for the lower flow rate injector nozzle will result in black smoke.* 1. Remove injector nozzles. 2. Verify injector nozzle part number shown on each injector nozzle is correct for the engine. Are each of the injector nozzles the correct part for the engine?	**YES:** Open DTAC case. **NO:** Replace injector nozzles with the correct part number. Recheck for black smoke.

RG40854,0000008 -19-15APR10-10/10

Engine Misfires or Runs Irregularly

Additional References:

NOTE: The wiring diagrams provided are for a typical John Deere supplied OEM harness. Wire number, colors, and jumper connectors do not apply to all applications.

For wiring information see 2.4L ECU WIRING DIAGRAM 1 or 3.0L ECU WIRING DIAGRAM 2 located in Section 06, Group 210 later in this manual.

MK41968,000009E -19-01JUN10-1/15

Engine Misfires/Runs Irregularly Diagnostic Procedure

MK41968,000009E -19-01JUN10-2/15

1 Check for Active DTCs	Were you referred to this test while performing the diagnostic procedures for a diagnostic trouble code (DTC)?	**YES:** GO TO 2 **NO:** Check for and resolve any active DTCs prior to performing this test, then GO TO 2.

MK41968,000009E -19-01JUN10-3/15

2 Items Possibly Mistaken As Misfire or Irregular Running Engine	Check for the following items which may be mistaken for a misfire: • Engine accessories such as A/C clutch or fan drives cycling on and off. • Alterations to the engine and/or machine harness such as radios or non-John Deere accessories. Does disabling or switching off these devices temporarily restore engine performance?	 **YES:** Problem fixed. **NO:** GO TO 3

MK41968,000009E -19-01JUN10-4/15

3 Misfire and Cut-Out Test	1. Perform Cylinder Misfire Test in Service ADVISOR. 2. Perform Cylinder Cut-Out Test in Service ADVISOR with engine at low idle. Is each cylinder's contribution within 10 percent of the others during the Cylinder Misfire Test and does the sound of the engine change equally when each injector is disabled during the Cylinder Cut-Out Test?	**YES:** GO TO 5 **NO:** Only one cylinder has low contribution. GO TO 4 **NO:** Two or more cylinders have low contribution. GO TO 13

MK41968,000009E -19-01JUN10-5/15

4 Check Compression Pressure	Perform procedure Mechanical Compression Test found in Section 04, Group 150. Is compression pressure and variation between cylinders within specification?	**YES:** Replace electronic unit pump and injector nozzle in the cylinders with low contribution identified in previous step. GO TO 16 **NO:** Fix cause of low compression in the affected cylinder. GO TO 16

Continued on next page

MK41968,000009E -19-01JUN10-6/15

5 Check for Air in Fuel	Perform Air In Fuel — Check procedure, found later in this group. Is engine performance restored?	**YES:** Problem fixed. **NO:** GO TO 6

MK41968,000009E -19-01JUN10-7/15

6 Low Pressure Fuel Supply System Test	Perform Low Pressure Fuel System — Check, found later in this group. Is engine performance restored?	**YES:** Problem fixed. **NO:** GO TO 7

MK41968,000009E -19-01JUN10-8/15

7 Check Fuel Quality	Perform procedure Fuel Supply Quality Check, found later in this group. Is engine performance restored?	**YES:** Problem fixed. **NO:** GO TO 8

MK41968,000009E -19-01JUN10-9/15

8 Camshaft Position and Crankshaft Position Signal Test	*NOTE: See DTC procedures 000636.02 and 000637.02 in Group 04, Section 160 later in this manual for more information on speed sensor data points.* 1. Monitor and record the following data points in Service ADVISOR: • Crankshaft Position Status • Camshaft Position Status • Crankshaft Position Speed • Camshaft Position Speed • Crankshaft Position Improper Pattern Indicator • Camshaft Position Improper Pattern Indicator • Crankshaft Position Noise Indicator • Camshaft Position Noise Indicator 2. Operate engine at speed and load where problem occurs. 3. Replay recording and review the recorded data points. Did the data points indicate the following with engine running? • Crankshaft Position Status – 47 for speeds above 400 rpm. • Camshaft Position Status – 47 for speeds above 400 rpm. • Crankshaft Position Speed - The actual engine speed (nearly same as camshaft position sensor speed). • Camshaft Position Speed - The actual engine speed (nearly same as crankshaft position sensor speed). • Crankshaft Position Improper Pattern Indicator - 0 • Camshaft Position Improper Pattern Indicator - 0 • Crankshaft Position Noise Indicator - 0 • Camshaft Position Noise Indicator - 0	**YES:** GO TO 11 **NO:** GO TO 9

Continued on next page

MK41968,000009E -19-01JUN10-10/15

9 Check for Crankshaft Position Signal Problem	1. Ignition OFF, engine OFF. 2. Disconnect crankshaft position sensor and secure connector away from rotating components. *NOTE: Ignore DTC 000637.08 which may be set due to the disconnected sensor.* 3. Ignition ON, engine OFF. 4. Operate engine at speed and load where problem occurs. 5. Ignition OFF, engine OFF. 6. Reconnect crankshaft position sensor. Was engine performance restored?	**YES:** Perform diagnostic procedure for 000637.02 as though DTC were active. **NO:** GO TO 10

MK41968,000009E -19-01JUN10-11/15

10 Check for Camshaft Position Signal Problem	1. Verify crankshaft position sensor is reconnected. 2. Disconnect camshaft position sensor and secure connector away from rotating components. *NOTE: Ignore DTC 000636.08 which may be set due to the disconnected sensor.* 3. Ignition ON, engine OFF. 4. Operate engine at speed and load where problem occurs. 5. Clear DTCs. 6. Ignition OFF, engine OFF. 7. Reconnect camshaft position sensor. Was engine performance restored?	**YES:** Perform diagnostic procedure for 000636.02 as though DTC were active. **NO:** GO TO 11

MK41968,000009E -19-01JUN10-12/15

11 Check Throttle	1. Engine running at speed where misfire or irregular running occurs. 2. Throttle held at a steady position. 3. Monitor Throttle Position data point in Service ADVISOR. Does Throttle Position data point indicate throttle signal is changing by more than 3 percent?	**YES:** Check for throttle circuit problem. **NO:** GO TO 12

MK41968,000009E -19-01JUN10-13/15

12 Reprogram ECU	Download latest payload and reprogram ECU. Is engine performance restored?	**YES:** Problem fixed. **NO:** Open DTAC case.

Continued on next page

MK41968,000009E -19-01JUN10-14/15

13 Check Unit Pump Circuits for Swapped Terminals	Using 2.4L ECU WIRING DIAGRAM 1 or 3.0L ECU WIRING DIAGRAM 2, verify wire harness continuity for unit pumps in cylinders with low contribution (verify terminals are not swapped in one of the connectors). Are all unit pump circuits wired correctly?	**YES:** GO TO 4 **NO:** Correct wiring problem and retest engine performance.

MK41968,000009E -19-01JUN10-15/15

Engine Oil Consumption

All engines consume some oil. The consumption rate depends on loading, design of key parts and engine condition. Since fuel consumption is an indicator of operating power levels, fuel used versus oil consumed is a critical factor in analyzing oil consumption. Oil consumption should be measured over a 100-hour period.

Long-term oil consumption (three oil drain intervals after the engine is broken in) with consumption rates poorer than 400:1 (100 gallons of fuel and 1 quart of oil) indicates a need to monitor/investigate. Suggested steps would be:

- Check for signs of ingested dust or perform an OILSCAN® test to check for silicon.
- Check for proper crankcase oil fill level.
- Perform compression test to find low compression cylinders.
- Remove head and inspect for glazed or worn cylinder bores.
- Inspect pistons for carbon deposits in the ring land grooves.
- Measure valve stem OD and valve guide ID to determine clearance.

NOTE: Ring gap alignment does not identify the leak source.

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Intake valves do not have valve stem seals, and some oil deposits on the valve stem tulip are normal.

When changing to a premium oil such as TORQ-GARD SUPREME® PLUS-50®, little oil consumption change is expected, although a small percentage of engines may experience a noticeable change in consumption rates. This may be due to the following:

- The previous oil may have left deposits on internal components. Use of PLUS-50® oil will cause different chemical reactions in those deposits. The time required for the engine to regain the previous oil consumption rate will vary from one to three normal drain intervals.
- TORQ-GARD SUPREME® PLUS-50® contains a high-performance anti-oxidant along with other additives resulting in the oil remaining in the specified viscosity grade throughout the recommended drain interval. API oil grades CD, CE, and CF-4 universal engine oils do not provide this oxidation resistance which results in more rapid thickening. Increased oil viscosity can reduce oil consumption.

Excessive Oil Consumption

MK41968,00000A1 -19-01JUN10-1/7

Excessive Oil Consumption

MK41968,00000A1 -19-01JUN10-2/7

1 Preliminary Check	1. Check for too low or too high engine oil level. 2. Check for too low viscosity, or coolant- or fuel-diluted engine oil. 3. Check for excessive external oil leaks.	 **No problems found:** GO TO 2 **Problem found:** Repair and retest.

Continued on next page

MK41968,00000A1 -19-01JUN10-3/7

2 Check Oil in Coolant	Check the coolant for signs of oil.	**No oil found in coolant:** GO TO 3 **Oil found in coolant:** See Coolant in Oil or Oil in Coolant in this Group.

MK41968,00000A1 -19-01JUN10-4/7

3 Check for Excessive Crankcase Pressure (Blow-By)	Check for excessive crankcase pressure. See Crankcase Pressure Blow-By Test later in this Group.	**No fumes and no dripping oil observed:** GO TO 4 **Excessive fumes or dripping oil observed; appears to be caused by boost pressure (if equipped with turbocharger):** Check the turbocharger, repair/replace as needed. See Turbocharger Failure Analysis in Section 02, Group 080 of this manual. **Excessive fumes or dripping oil observed; does not appear to be caused by boost pressure (if equipped with turbocharger):** Excessive blow-by, not caused by boost pressure is most likely caused by faulty piston rings/cylinder bores not providing an adequate combustion seal. Perform a compression test to verify this is the case. See Engine Compression Pressure Test later in this Group.

MK41968,00000A1 -19-01JUN10-5/7

4 Turbocharger Oil Seal Leak Check	*NOTE: This check is not needed for non-turbocharged ("D" engines). For these engines, GO TO 5.* Check for turbocharger oil seal leaks. See Turbocharger Oil Seal — Leak Check later in this group.	**No signs of oil leakage:** GO TO 5 **Signs of oil leakage present:** Investigate problems associated with oil leakage as outlined in the test procedure, perform necessary repairs, and retest.

Continued on next page

MK41968,00000A1 -19-01JUN10-6/7

5 Pistons, Rings, Cylinder Bores Check	At this point, the most likely cause of excessive oil consumption is one of the following failures in the pistons, rings, and/or cylinder bores or in the valve guides. Check the most likely items as needed. • Oil control rings worn or broken • Scored cylinder bores or pistons • Piston ring grooves excessively worn • Insufficient piston ring tension • Piston ring gaps not staggered • Cylinder bores glazed (insufficient load during engine break-in) • Worn valve guides or stems	Problem found with pistons, rings, and/or bores or valve guides. Repair problem as necessary.

MK41968,00000A1 -19-01JUN10-7/7

Engine Oil Pressure Low

Symptom	Problem	Solution
Engine Oil Pressure Low	Low crankcase oil level	Fill crankcase to proper oil level.
	Clogged oil cooler or filter	Remove and inspect oil cooler. See Oil Cooler — Removal in Section 02, Group 060 of this manual. Replace oil filter.
	Excessive oil temperature	Remove and inspect oil cooler. See Oil Cooler — Removal in Section 02, Group 060 of this manual.
	Incorrect oil	Drain crankcase and refill with correct oil.
	Defective oil pump	Remove and inspect oil pump. See Oil Pump — Inspection in Section 02, Group 060 of this manual.
	Oil pressure regulating valve failure	Inspect oil pressure regulating valve. See Oil Pressure Regulating Valve — Removal in Section 02, Group 060 of this manual.
	Broken piston spray jet	Replace piston spray jet. See Piston Cooling Orifices — Removal andPiston Cooling Orifices — Installation in Section 02, Group 030 of this manual.
	Clogged oil pump screen or cracked pick-up tube	Remove oil pan and clean screen. Replace pick-up tube. See Oil Pick-up Tube Assembly — Inspection in Section 02, Group 060 of this manual.
	Excessive main or connecting rod bearing clearance	Determine bearing clearance. See Cylinder Block, Liners, Pistons, and Rods Specifications in Section 06, Group 200 or Crankshaft, Main Bearings, and Flywheel Specifications in Section 06, Group 200 of this manual.

MK41968,00000A2 -19-22JAN10-1/1

Engine Overheating

Symptom	Problem	Solution
C1 - Engine Coolant Temperature Above Normal	Lack of coolant in cooling system	Fill cooling system to proper level.
	Radiator core and/or side screens dirty	Clean radiator as required.
	Engine overloaded	Reduce engine load.
	Too low crankcase oil level	Fill crankcase to proper oil level.
	Loose or defective fan belt	Replace/tighten fan belt as required.
	Premature belt wear or belt flies off pulley	Check pulley alignment.
	Defective thermostat(s)	Test thermostat opening temperature; replace thermostat as required. See Thermostat Operation Test in Section 4 Group 155.
	Damaged cylinder head gasket	Replace cylinder head gasket. See Head Gasket Failures — Check later in this Group.
	Defective coolant pump	Replace coolant pump. See Coolant Pump — Removal and Coolant pump — Installation in Section 02, Group 070 of this manual.
	Defective radiator cap	Replace radiator cap as required. See Cooling System and Radiator Cap — Pressure Test in Section 4 Group 155.

RG41183,00000E5 -19-01JUN10-1/1

Engine Will Not Crank

MK41968,000009F -19-23DEC09-1/15

Engine Will Not Crank Diagnostic Procedure

Control Unit Response:
The ECU is not part of the engine cranking circuit.

Additional References:

NOTE: The wiring diagrams provided are for a typical John Deere supplied OEM harness. Wire number, colors, and jumper connectors do not apply to all applications.

For wiring information:
- see 2.4/3.0L WIRING DIAGRAM 4 located in Section 06, Group 210 later in this manual.

For more information on connector and terminal testing see TERMINAL TEST in Section 04, Group 160 earlier in this manual.

IMPORTANT: Do not force probes into connector terminals or damage will result. Use JDG10466 Connector Adapter Test Kit to make measurements in connectors. This will ensure that terminal damage does not occur.

MK41968,000009F -19-23DEC09-2/15

1 Preliminary Checks	1. Inspect batteries, stater motor, starter solenoid, starter relay, and single point ground for loose connections, corroded terminals, or cables that are not connected.	
	2. Check fuse F01.	
	3. Verify that any remote switch used to shut down engine is in the RUN position.	
	4. If application has no remote switches, verify that remote switch jumper at connector C15 is present.	**YES:** Fix problem. GO TO 13
	Were any problems found?	**NO:** GO TO 2

MK41968,000009F -19-23DEC09-3/15

2 Check Battery State of Charge	1. Ignition OFF, engine OFF.	
	2. Measure battery terminal voltage.	**YES:** GO TO 3
	Is the voltage greater than 12.2V for 12V systems or 24.4V for 24V systems?	**NO:** Recharge or replace batteries. GO TO 13

MK41968,000009F -19-23DEC09-4/15

3 Check Battery Voltage While Attempting Crank	1. Ignition ON, engine OFF for 30 seconds.	
	2. Monitor battery terminal voltage.	
	3. Hold key switch in start position for 3 seconds.	**YES:** GO TO 5
	Is the voltage greater than 11V for 12V systems or 22V for 24V systems while attempting to crank engine?	**NO:** GO TO 4

Continued on next page

MK41968,000009F -19-23DEC09-5/15

4 Load Test Batteries	1. Ignition OFF, engine OFF.	
	2. Load test batteries.	**YES:** Check for internal starter problem Check for hydro locked or seized engine, or load not disengaged.
	Do batteries pass load test?	**NO:** Recharge or replace batteries. GO TO 13

MK41968,000009F -19-23DEC09-6/15

5 Check Starter Relay Battery Supply Voltage	1. Ignition OFF, engine OFF.	
	2. Measure the voltage from the starter relay battery voltage supply terminal to single point ground.	**YES:** GO TO 6
	Is the voltage within 1V of battery terminal voltage?	**NO:** Fix problem. GO TO 13

MK41968,000009F -19-23DEC09-7/15

6 Check Voltage at Starter Relay Coil	*NOTE: Some applications may have safety switches or other interlocks which interrupt the starter relay control circuit (high side or ground). Consult equipment manufacturer's information to determine if application has any starter interlocks.*	
	1. Monitor the voltage between the starter relay coil high side terminal (wire between key switch and relay) and single point ground.	
	2. Hold key switch in start position for 3 seconds.	**YES:** GO TO 7
	Is the voltage within 2V of battery terminal voltage while attempting to crank engine?	**NO:** GO TO 11

MK41968,000009F -19-23DEC09-8/15

7 Check Starter Relay Coil Ground	1. Monitor the voltage between the starter relay coil high side terminal and starter relay coil ground terminal.	
	2. Hold key switch in start position for 3 seconds.	**YES:** GO TO 8
	Is the voltage within 2V of battery terminal voltage while attempting to crank engine?	**NO:** Fix open ground circuit. GO TO 13

MK41968,000009F -19-23DEC09-9/15

8 Check Starter Relay Output Voltage	1. Monitor the voltage between the starter relay output terminal and single point ground.	
	2. Hold key switch in start position for 3 seconds.	**YES:** GO TO 9
	Is the voltage within 2V of battery terminal voltage while attempting to crank engine?	**NO:** Replace starter relay. GO TO 13

Continued on next page

MK41968,000009F -19-23DEC09-10/15

9 Check Starter Solenoid Control Circuit	*NOTE: Some gear-reduction type starter motors may have an additional starter relay located near the starter motor which controls the voltage supplied to the starter solenoid. Consult stater motor manufacturer for more information.* 1. Monitor the voltage between the starter solenoid "S" terminal and single point ground. 2. Hold key switch in start position for 3 seconds. Is the voltage within 2V of battery terminal voltage while attempting to crank engine?	**YES:** GO TO 10 **NO:** Fix open circuit between starter relay output and starter solenoid. GO TO 13

MK41968,000009F -19-23DEC09-11/15

10 Check Starter Cables	1. Monitor the voltage between the starter solenoid battery terminal and starter ground terminal (large cable connections). 2. Hold key switch in start position for 3 seconds. Is the voltage within 2V of battery terminal voltage while attempting to crank engine?	**YES:** Remove and bench test stater motor and starter solenoid. **NO:** Check starter cables for poor connections or high resistance. GO TO 13

MK41968,000009F -19-23DEC09-12/15

11 Check Key Switch Voltage Supply	1. Ignition OFF, engine OFF. 2. Measure the voltage between the key switch battery supply terminal and single point ground. Is the voltage within 2V of battery terminal voltage?	**YES:** GO TO 12 **NO:** Fix open circuit between key switch and battery positive terminal. GO TO 13

MK41968,000009F -19-23DEC09-13/15

12 Check Key Switch	1. Monitor the voltage between the key switch start terminal and single point ground. 2. Hold key switch in start position for 3 seconds. Is the voltage within 2V of battery terminal voltage while attempting to crank engine?	**YES:** Fix open circuit between key switch and starter relay coil high side terminal. GO TO 13 **NO:** Replace key switch. GO TO 13

MK41968,000009F -19-23DEC09-14/15

13 Verification	Attempt to crank engine. Does engine crank?	**YES:** Problem fixed. **NO:** GO TO 1

MK41968,000009F -19-23DEC09-15/15

Fuel in Oil

Additional Information
Possible sources of fuel in oil:

- Low pressure fuel pump
- Unit pumps and O-rings
- Loose or damaged high pressure fuel lines
- Injector nozzles and O-rings
- Cylinder head or block casting porosity or cracks

RG40854,0000012 -19-01JUN10-1/12

Fuel in Oil Diagnostic Procedure

RG40854,0000012 -19-01JUN10-2/12

1 Oil Contamination Test	*NOTE: Hydraulic oil leaking into the engine crankcase from a hydraulic pump may be mistaken as fuel in the oil. Laboratory analysis can be used to determine if the contaminate is fuel or hydraulic oil.* 1. Check for an increase in engine oil level and a decrease in oil viscosity (oil is too thin). 2. Submit oil sample to laboratory to identify contaminant, if uncertain. Is the contaminant fuel?	**YES:** GO TO 2 **NO:** Perform test for identified contaminant.

RG40854,0000012 -19-01JUN10-3/12

2 Check for Black Smoke	Does engine emit black or gray exhaust smoke?	**YES:** Perform procedure Engine Emits Excessive Black or Gray Exhaust Smoke. **NO:** GO TO 3

RG40854,0000012 -19-01JUN10-4/12

3 Check for Restricted Fuel Return Lines	Perform Restricted Fuel Leak-Off Line Check in this group. Did return fuel system pass test?	**YES:** GO TO 4 **NO:** Repair problem. GO TO 4

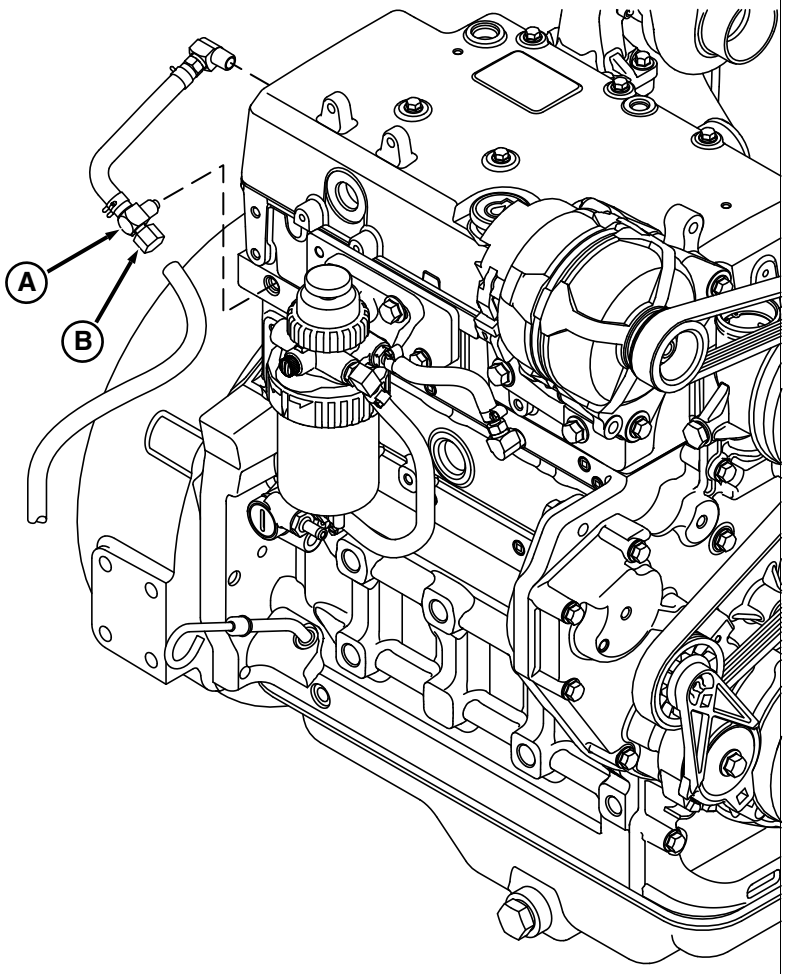
Continued on next page

RG40854,0000012 -19-01JUN10-5/12

4 Check For Internal Fuel Leak

CAUTION: Do NOT operate engine with the fuel return system blocked.

1. Ignition OFF, engine OFF.
2. Remove fuel return line from fuel check valve (A) and install a cap (B) on the fuel check valve.



RG15493 —UN—12SEP07

Temporarily Block Fuel Return

A—Fuel Check Valve
B—Cap

3. Pressurize fuel system to 35 kPa (5 psi) using primer pump.
4. Ignition ON, engine OFF. DO NOT START ENGINE!
5. Monitor Fuel Supply Pressure data point in Service ADVISOR for 1 minute or until pressure drops below 20 kPa (3 psi).

Does fuel pressure remain above 20 kPa (3 psi) for 10 minute?

YES: GO TO 10

NO: GO TO 5

Continued on next page

RG40854,0000012 -19-01JUN10-6/12

5 Check For Internal Fuel Leak

NOTE: The source of an internal fuel leak can often be found by looking for places inside the engine that are cleaner than the surrounding area. The leaking fuel tends to wash away lubrication oil and deposits.

1. Remove rocker cover.
2. Inspect internal fuel system components for evidence of fuel leakage.
3. Pressurize fuel system to 35 kPa (5 psi) using hand primer pump.
4. Check for internal fuel leaks.

Was internal fuel leak found?

YES: Fix problem. Recheck for fuel leak.

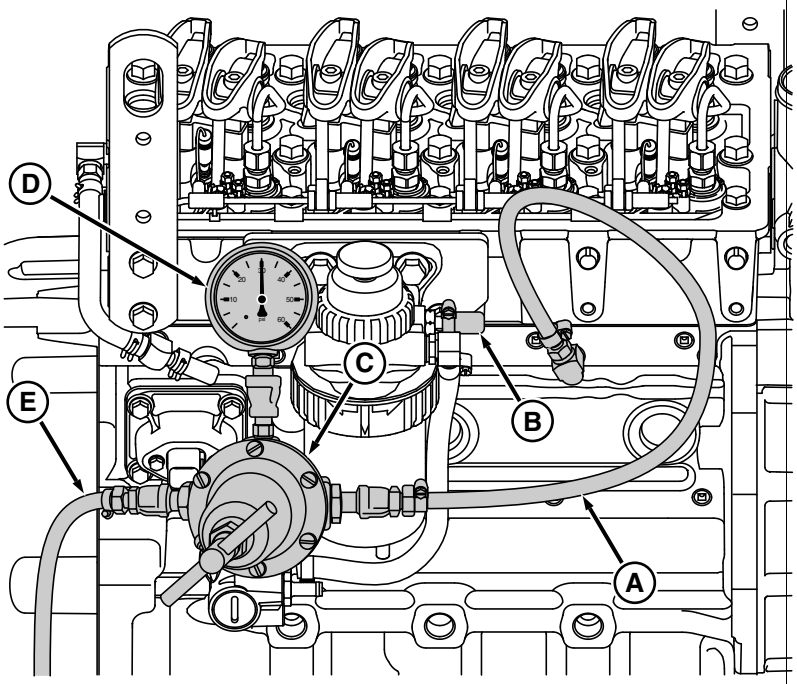
NO: GO TO 6

RG40854,0000012 -19-01JUN10-7/12

6 Pressurize Fuel Supply System with Air and Check for Leaks

NOTE: This test will pressurize the fuel supply and return galleries, the unit pump internal components, and the area between the unit pump O-rings. This test will not pressurize the high pressure lines between the unit pumps and injector nozzles.

1. Remove fuel supply line (A) at fuel filter outlet fitting and install a cap (B) on the fitting.



RG15499 —UN—25SEP07

Testing for Internal Fuel Leaks with Regulated Compressed Air

A—Fuel Supply Line
B—Cap on Fuel Filter Outlet Fitting
C—Pressure Regulator
D—Pressure Gauge
E—Compressed Air Supply

2. Install an air pressure regulator (C) with gauge (D) to the fuel supply line (A).
3. Connect regulator to a compressed air supply (E) and regulate air pressure to 200 kPa (29 psi).
4. Slowly rotate engine using JDG1704 or JDG10221 Engine Turning Tool.
5. Look and listen for air leaks around the unit pumps as engine is rotated. Use a mirror to check for leaks at the lower unit pump O-rings and around the unit pump camshaft follower.

Were any leaks found?

YES: Fix problem. Retest for leaks.

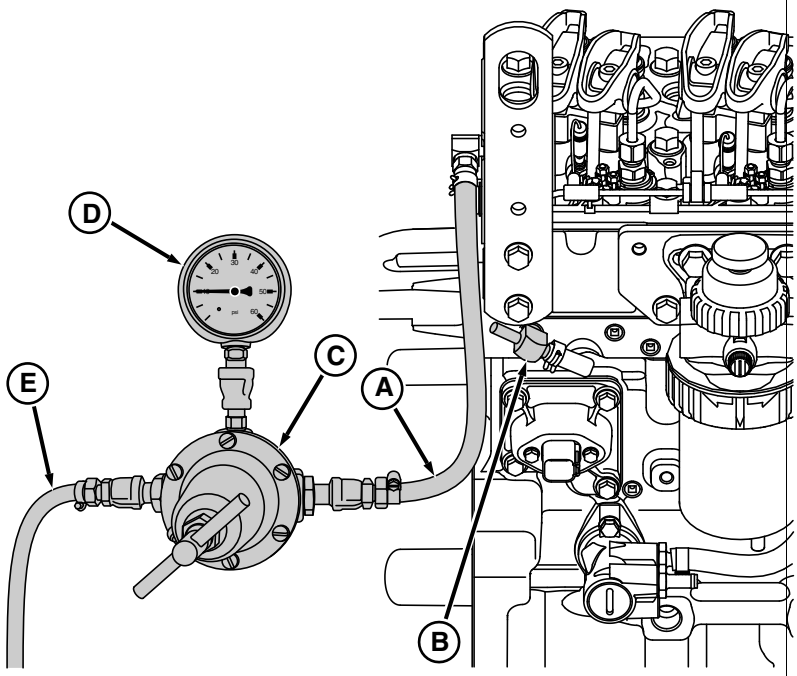
NO: GO TO 7

Continued on next page

RG40854,0000012 -19-01JUN10-8/12

7 Pressurize Injector Nozzle Leak-Off with Compressed Air and Check for Leaks

1. Remove injector nozzle leak-off line (A) at fuel check valve (B).



RG15514 —UN—21SEP07

Testing Injector Leak Off System with Regulated Compressed Air

A—Injector Nozzle Leak-Off Line
B—Fuel Check Valve
C—Pressure Regulator
D—Pressure Gauge
E—Compressed Air Supply

2. Install the air pressure regulator (C) with gauge (D) to the injector nozzle leak-off line.
3. Regulate air pressure to 200 kPa (29 psi).
4. Look and listen for air leaks around the injector nozzles.

Were any leaks found?

YES: Fix problem. Retest for leaks.

NO: GO TO 8

RG40854,0000012 -19-01JUN10-9/12

8 Check High Pressure Fuel Line Fitting Torque

NOTE: For high pressure fuel line torque specifications and procedure, see Electronic Unit Pump — Installation and Injection Nozzle — Installation. Rocker arm and push rod removal may be necessary to access injector nozzle ends of the high pressure fuel lines.

Check high pressure fuel line fitting torque at unit pump and injector nozzle ends.

Were any high pressure fuel line fittings loose?

YES: Torque fittings. Retest for leaks.

NO: GO TO 9

Continued on next page

RG40854,0000012 -19-01JUN10-10/12

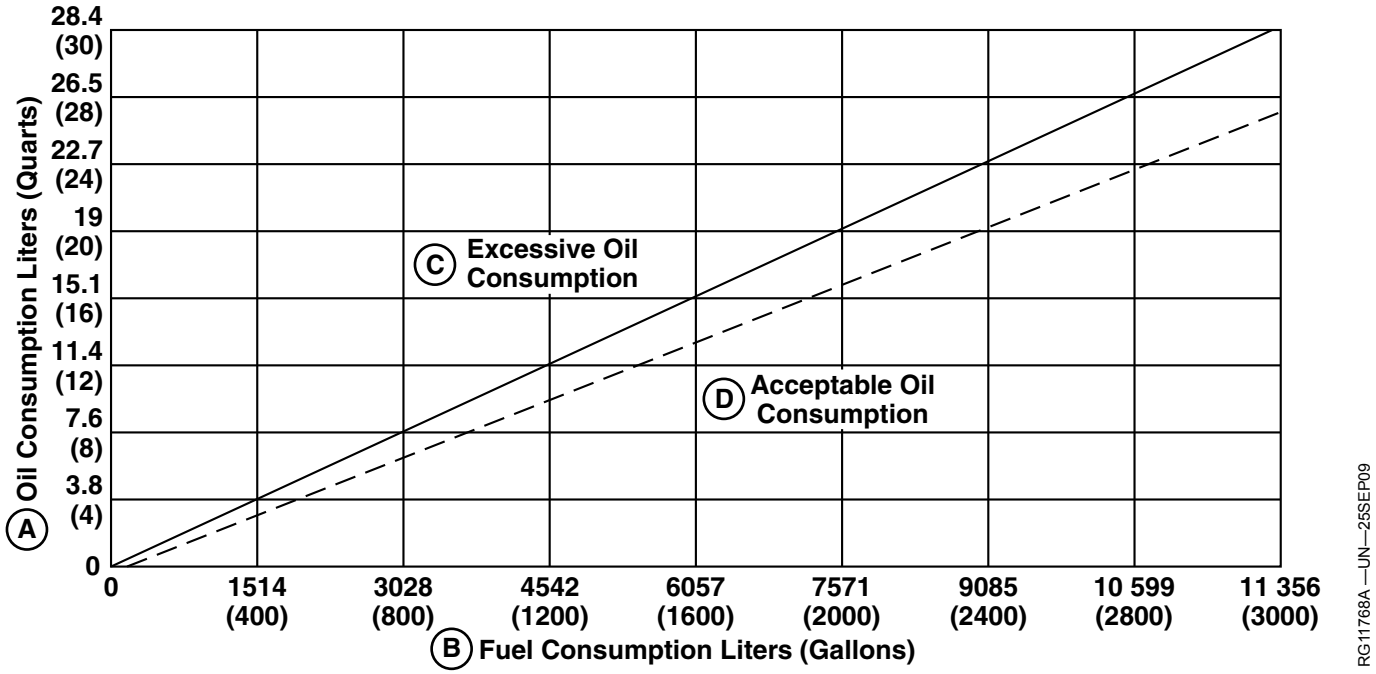
9 Remove and Inspect Fuel System Components	*NOTE: For removal procedures, see Electronic Unit Pump — Removal and Injection Nozzle — Removal.* 1. Remove unit pumps and inspect O-rings and unit pump bores in engine block. 2. Remove injector nozzles and inspect O-rings and injector bores in cylinder head. 3. Inspect high pressure fuel lines. Was cause of fuel leakage found?	**YES:** Fix problem. Retest for leaks. **NO:** Low pressure fuel pump has NOT been tested. GO TO 10 **NO:** Low pressure fuel pump has been tested. Open DTAC case.

RG40854,0000012 -19-01JUN10-11/12

10 Bench Test Low Pressure Fuel Pump	1. Remove low pressure fuel pump. 2. Install a regulated compressed air supply with pressure gauge to the low pressure fuel pump inlet fitting. 3. Install a cap on the low pressure fuel pump outlet fitting. 4. Regulate air pressure to 70 kPa (10 psi). 5. Submerge the low pressure fuel pump in a container of diesel fuel. 6. Check for air bubbles. Are air bubbles present in the fuel?	**YES:** Replace low pressure fuel pump. **NO:** Steps 5-9 have NOT been performed. Reinstall low pressure fuel pump. GO TO 5 **NO:** Steps 5-9 have been performed. Open DTAC case.

RG40854,0000012 -19-01JUN10-12/12

Guideline for Acceptable Oil Consumption



Engine Oil/Fuel Consumption Ratio

A—Oil Consumption Liters (Quarts) **B—Fuel Consumption Liters (Gallons)** **C—Excessive Oil Consumption** **D—Acceptable Oil Consumption**

Oil consumption complaints are usually reported as how many liters (quarts) are used per day. This information is not very specific. Two questions to consider are:

- How long is a day?
- How hard did the engine work in this day?

A much better method of checking oil consumption is based on oil usage compared to the amount of fuel burned (see chart). Long-term oil consumption (three oil drain intervals after engine break-in) should not exceed 0.95 L (1 qt) of oil for every 379 L (100 gal) of fuel burned.

IMPORTANT: If the engine fuel/oil consumption ratio falls below the dashed line, oil consumption is acceptable. If the ratio is between the solid and dashed line, oil consumption is still acceptable but the oil level and usage should be monitored closely. If the ratio is above the solid line, oil consumption is excessive and action should be taken to determine the cause.

For example, if an engine uses less than 0.95 L (1 qt) of oil for every 379 L (100 gal) of fuel burned, it is within acceptable operating parameters. If the engine begins to use 0.95 L (1 qt) of oil or more for every 379 L (100 gal) of fuel burned, you should investigate to determine the cause of the excess oil consumption.

MK41968,000004B -19-13NOV09-1/1

Head Gasket Failures — Check

Head gasket failures generally fall into three categories:

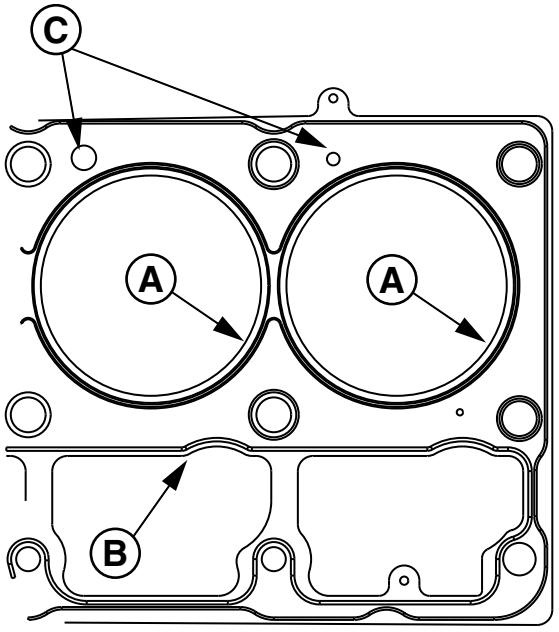
- Combustion seal failures.
- Coolant seal failures.
- Oil seal failures.

Combustion seal failures occur when combustion gases escape between cylinder head and head gasket combustion flange, or between combustion flange and cylinder bore. Leaking combustion gases may vent to an adjacent cylinder, to a coolant or oil passage, or externally.

Coolant or oil seal failures occur when oil or coolant escapes between cylinder head and gasket body, or between cylinder block and gasket body. The oil or coolant may leak to an adjacent coolant or oil passage, or externally. Since oil and coolant passages are primarily on right-hand (camshaft) side of engine, fluid leaks are most likely to occur in that area.

Follow these diagnostic procedures when a head gasket joint failure occurs or is suspected.

1. Before starting or disassembling engine, conduct a visual inspection of machine and note any of the following:
   - Oil or coolant in head gasket seam, or on adjacent surfaces.
   - Displacement of gasket from normal position.
   - Discoloration or soot from combustion gas leakage.
   - Leaking radiator, overflow tank, or hoses.
   - Leaking coolant from coolant pump weep hole.
   - Damaged or incorrect radiator, fan, or shroud.
   - Obstructed air flow or coolant flow.
   - Worn or slipping belts.
   - Damaged or incorrect pressure cap.
   - Presence of oil in coolant.
   - Low coolant levels or Improper coolant.
   - Unusually high or low oil levels.
   - Oil degradation, dilution, or contamination.
   - Incorrectly specified injection pump.
   - Indications of fuel or timing adjustments.
   - Unburned fuel or coolant in exhaust system.
2. Obtain coolant and oil samples for further analysis.
3. Start and warm up engine if it can be safely operated. Examine all potential leakage areas again as outlined previously. Using appropriate test and measurement equipment, check for the following:
   - White smoke, excessive raw fuel, or moisture in exhaust system.
   - Rough, irregular exhaust sound, or misfiring.
   - Air bubbles, gas trapped in radiator/overflow tank.
   - Loss of coolant from overflow.
   - Excessive cooling system pressure.
   - Coolant overheating.
   - Low coolant flow.
   - Loss of cab heating (air lock).



RG12815A —UN—12MAY03

Diagnosing Head Gasket Joint Failures

A—Combustion Sealing Area **C—Coolant Sealing Areas**
B—Oil Sealing Areas

4. Shut engine down. Recheck crankcase, radiator, and overflow tank for any significant differences in fluid levels, viscosity, or appearance.
5. Compare your observations from above steps with the diagnostic charts earlier in this group. If diagnostic evaluations provide conclusive evidence of combustion gas, coolant, or oil leakage from head gasket joint, the cylinder head must be removed for inspection and repair of gasket joint components.

COMBUSTION SEAL LEAKAGE

Symptoms:

- Exhaust from head gasket crevice
- Air bubbles in radiator/overflow tank
- Coolant discharge from overflow tube
- Engine overheating
- Power loss
- Engine runs rough
- White exhaust smoke
- Loss of cab heat
- Gasket section dislodged, missing (blown)
- Coolant in cylinder
- Coolant in crankcase oil
- Low coolant level

Possible Causes:

- Low head bolt clamping loads
- Cracked/deformed gasket combustion flange
- Out-of-flat/damaged/rough cylinder head surface
- Missing/mislocated gasket fire ring
- Excessive fuel delivery
- Advanced injection pump timing

Continued on next page

MK41968,000004C -19-13NOV09-1/2

- Hydraulic or mechanical disturbance of combustion seal

NOTE: Cracked cylinder head or cylinder bores may also allow combustion gas leakage into coolant.

COOLANT SEAL LEAKAGE

Symptoms:

- Coolant discharge from head gasket crevice
- Coolant in crankcase oil
- Low coolant level
- High oil level
- Coolant discharge from crankcase vent

Possible Causes:

- Low head bolt clamping loads
- Out-of-flat/damaged/rough block surface
- Out-of-flat/damaged/rough cylinder head surface
- Oil or coolant overheating
- Cracks/creases in gasket body surfaces
- Damage/voids in elastomer beading

OIL SEAL LEAKAGE

Symptoms:

- Oil discharge from head gasket crevice
- Oil in coolant
- Low crankcase oil level
- Reduced oil to rocker arms (noisy)

Possible Causes:

- Low head bolt clamping loads
- Out-of-flat/damaged/rough block surface
- Out-of-flat/damaged/rough cylinder head surface
- Oil or coolant overheating
- Cracks/creases in gasket body surfaces
- Damage/voids in elastomer beading

NOTE: Defective oil cooler may also allow oil leakage into coolant.

MK41968,000004C -19-13NOV09-2/2

Primary Analog Throttle Does Not Respond

Additional References:
This procedure should only be used if the primary throttle type is analog and if advancing the primary throttle does not cause the engine speed to increase above low idle.

NOTE: The wiring diagrams provided are for a typical John Deere supplied OEM harness. Wire number, colors, and jumper connectors do not apply to all applications.

For wiring information see 2.4L/3.0L ECU WIRING DIAGRAM 6 located in Section 06, Group 210 later in this manual.

Flex probe information:
• ECU small terminal - Orange/Blue

For more information on connector and terminal testing or flex probes see Terminal Test in Section 04, Group 160 earlier in this manual.

IMPORTANT: Do not force probes into connector terminals or damage will result. Use JDG10466 Connector Adapter Test Kit to make measurements in connectors. This will ensure that terminal damage does not occur.

JB81757,0000075 -19-15APR10-1/8

Primary Analog Throttle Does Not Respond Diagnostic Procedure

JB81757,0000075 -19-15APR10-2/8

1 Read DTCs and Store Snapshot Information	1. Ignition ON, engine OFF.	
	NOTE: When DTCs are cleared Snapshot information for ALL DTCs will be cleared.	
	2. Connect Service ADVISOR, see Connecting To Service Advisor earlier in this Group.	
	3. Write down all DTCs and their occurrence count. If any DTCs have snapshot capture or snapshot recording information, save the information. For instructions on saving and using snapshot information, see Snapshot Instructions earlier in this Group.	
	4. Refresh Codes.	
	5. Advance primary analog throttle from low idle position to fully advanced position.	**YES:** Perform DTC procedure first, then GO TO 2.
	Are there any active DTCs?	**NO:** GO TO 2

JB81757,0000075 -19-15APR10-3/8

2 Check Throttle Position Data Point In Service ADVISOR	1. Ignition ON, engine running, primary throttle at low idle position.	
	2. Monitor Throttle Position data point in Service ADVISOR.	**YES:** Perform procedure Engine Does Not Develop Full Power.
	3. Slowly advance primary throttle.	**NO:** Throttle Position data point indicates some percentage less than 25%. GO TO 3
	Does Throttle Position data point increase to at least 25% as primary throttle is fully advanced?	**NO:** Throttle Position data point indicates NA. GO TO 6

Continued on next page

JB81757,0000075 -19-15APR10-4/8

3 Inspect Primary Throttle Position Linkage	*NOTE: Throttle position sensor is supplied by the application manufacturer. Consult application service manual for specific throttle position sensor information.*	
	Check for loose linkage or other problem, if applicable, which would permit the throttle control device to move while the throttle position sensor movable contact (wiper) remains stationary.	**YES:** GO TO 4
	Does throttle position sensor movable contact move when throttle control is advanced?	**NO:** Fix linkage or sensor problem. Recheck throttle performance.

JB81757,0000075 -19-15APR10-5/8

4 Check for Short to Voltage Source	*NOTE: Ignore DTC 000091.04 which may be set during this step.*	
	1. Disconnect primary analog throttle position sensor connector. 2. Ignition ON, engine OFF. 3. On the throttle position sensor connector, measure the voltage between the throttle position sensor signal (+) and single point ground (-).	**YES:** Locate and repair short to voltage source of the throttle position sensor signal circuit between ECU and sensor.
	Is the voltage greater than 0.5V?	**NO:** GO TO 5

JB81757,0000075 -19-15APR10-6/8

5 Check Primary Analog Throttle Circuits	*NOTE: Consult application service manual for throttle position sensor connector and circuit information.*	
	1. Ignition OFF, engine OFF. 2. Disconnect ECU J2 connector. 3. Perform Terminal Test on J2. 4. On the harness, measure the resistance between ECU J2-A3 and the throttle position sensor 5V supply terminal. 5. On the harness, measure the resistance between ECU J2-C3 and the throttle position sensor return (ground) terminal. 6. On the harness, measure the resistance between ECU J2-A4 and the throttle position sensor signal terminal.	**YES:** GO TO 5
	Are Terminal Test results good and all resistance measurements less than 10 ohms?	**NO:** Fix problem. Recheck throttle.

JB81757,0000075 -19-15APR10-7/8

6 Reprogram ECU	1. Download latest ECU software payload file and reprogram ECU.	
	2. Verify primary analog throttle is enabled (check box) when the trimmable options page appears during the reprogramming process.	**YES:** Problem fixed.
	Does primary analog throttle respond?	**NO:** Open DTAC case.

JB81757,0000075 -19-15APR10-8/8

Secondary Analog Throttle Does Not Respond

Additional References:
This procedure should only be used if the secondary throttle type is analog and if advancing the secondary throttle does not cause the engine speed to increase above low idle.

NOTE: The wiring diagrams provided are for a typical John Deere supplied OEM harness. Wire number, colors, and jumper connectors do not apply to all applications.

For wiring information see 2.4L/3.0L ECU WIRING DIAGRAM 6 located in Section 06, Group 210 later in this manual.

Flex probe information:
• ECU small terminal - Orange/Blue

For more information on connector and terminal testing or flex probes see Terminal Test in Section 04, Group 160 earlier in this manual.

IMPORTANT: Do not force probes into connector terminals or damage will result. Use JDG10466 Connector Adapter Test Kit to make measurements in connectors. This will ensure that terminal damage does not occur.

JB81757,0000076 -19-21APR10-1/9

Secondary Analog Throttle Does Not Respond Diagnostic Procedure

JB81757,0000076 -19-21APR10-2/9

1 Read DTCs and Store Snapshot Information	1. Ignition ON, engine OFF. *NOTE: When DTCs are cleared Snapshot information for ALL DTCs will be cleared.* 2. Connect Service ADVISOR, see Connecting To Service Advisor earlier in this Group. 3. Write down all DTCs and their occurrence count. If any DTCs have snapshot capture or snapshot recording information, save the information. For instructions on saving and using snapshot information, see Snapshot Instructions earlier in this Group. 4. Refresh Codes. 5. Advance secondary analog throttle from low idle position to fully advanced position. Are there any active DTCs?	**YES:** Perform DTC procedure first, then GO TO 2. **NO:** GO TO 2

JB81757,0000076 -19-21APR10-3/9

2 Check Throttle Position Data Point In Service ADVISOR	1. Ignition ON, engine running, secondary throttle at low idle position. 2. Monitor Throttle Position data point in Service ADVISOR. 3. Slowly advance secondary throttle. Does Throttle Position data point increase to at least 25% as secondary throttle is fully advanced?	**YES:** GO TO 7 **NO:** Throttle Position data point indicates some percentage less than 25%. GO TO 3 **NO:** Throttle Position data point indicates NA. GO TO 6

Continued on next page

JB81757,0000076 -19-21APR10-4/9

3 Inspect Secondary Throttle Position Linkage

NOTE: Throttle position sensor is supplied by the application manufacturer. Consult application service manual for specific throttle position sensor information.

Check for loose linkage or other problem, if applicable, which would permit the throttle control device to move while the throttle position sensor movable contact (wiper) remains stationary.

Does throttle position sensor movable contact move when throttle control is advanced?

YES: GO TO 4

NO: Fix linkage or sensor problem. Recheck throttle performance.

JB81757,0000076 -19-21APR10-5/9

4 Check for Short to Voltage Source

NOTE: Ignore DTC 000029.04 which may be set during this step.

1. Disconnect secondary analog throttle position sensor connector.
2. Ignition ON, engine OFF.
3. On the throttle position sensor connector, measure the voltage between the throttle position sensor signal (+) and single point ground (-).

Is the voltage greater than 0.5V?

YES: Locate and repair short to voltage source of the throttle position sensor signal circuit between ECU and sensor.

NO: GO TO 5

JB81757,0000076 -19-21APR10-6/9

5 Check Secondary Analog Throttle Circuits

NOTE: Consult application service manual for throttle position sensor connector and circuit information.

1. Ignition OFF, engine OFF.
2. Disconnect ECU J2 connector.
3. Perform Terminal Test on J2.
4. On the harness, measure the resistance between ECU J2-G2 and the throttle position sensor 5V supply terminal.
5. On the harness, measure the resistance between ECU J2-G3 and the throttle position sensor return (ground) terminal.
6. On the harness, measure the resistance between ECU J2-F3 and the throttle position sensor signal terminal.

Are Terminal Test results good and all resistance measurements less than 10 ohms?

YES: GO TO 5

NO: Fix problem. Recheck throttle.

JB81757,0000076 -19-21APR10-7/9

6 Reprogram ECU

1. Download latest ECU software payload file and reprogram ECU.
2. Verify secondary analog throttle is enabled (check box) when the trimmable options page appears during the reprogramming process.

Does secondary analog throttle respond?

YES: Problem fixed.

NO: Open DTAC case.

Continued on next page

JB81757,0000076 -19-21APR10-8/9

7 Check for Primary Throttle Response	Does engine respond to primary throttle?	**YES:** GO TO 6. **NO:** Perform procedure Engine Does Not Develop Full Power

JB81757,0000076 -19-21APR10-9/9

Air in Fuel — Check

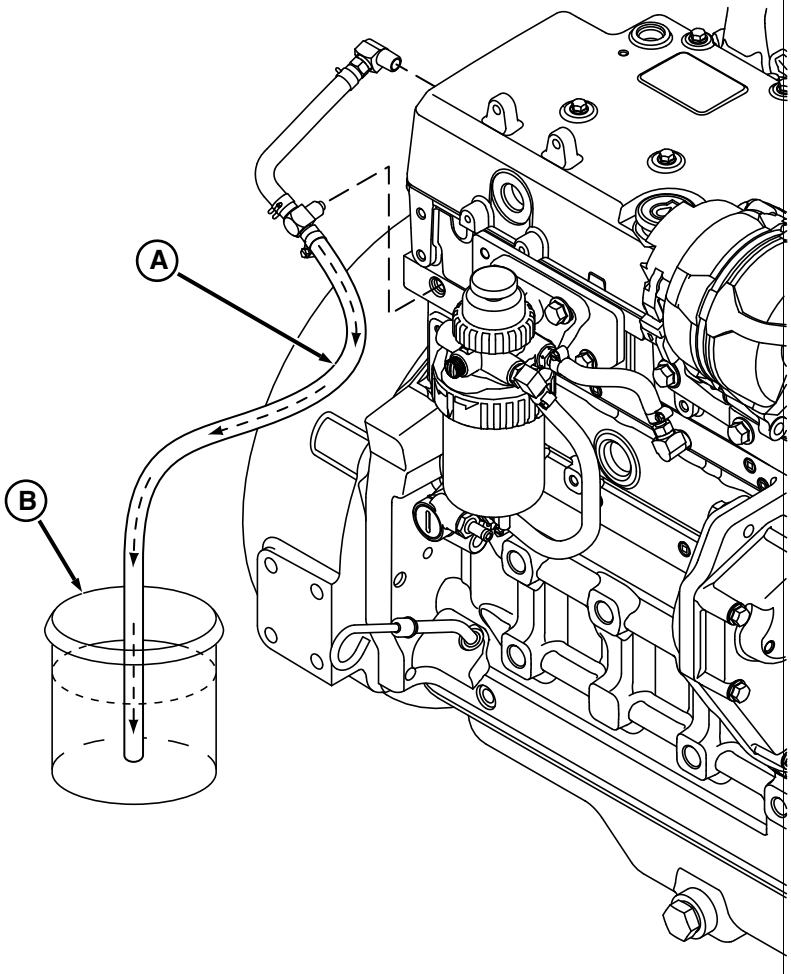
MK41968,0000050 -19-15APR10-1/7

Check for Air in Fuel Diagnostic Procedure

MK41968,0000050 -19-15APR10-2/7

1 Check for Air in Fuel Return Line

1. Disconnect the fuel return line from the fuel check valve T-fitting in the engine block.
2. Install a hose (A) to the fuel check valve T-fitting and place the other end of the hose in a container of clean diesel fuel (B). Alternatively, a section of clear vinyl hose can be inserted in the fuel return line.



RG15495 —UN—12SEP07

Check for Air in Return Fuel

A—Temporary Fuel Return Hose
B—Container of Clean Fuel

3. Run engine for 1 minute at 1500 rpm.
4. Observe hose in container or clear vinyl hose for air bubbles.

Is air present in the fuel return line?

YES: GO TO 2

NO: Air is not present in the fuel system. Return to DTC or other diagnostic procedure.

Continued on next page

MK41968,0000050 -19-15APR10-3/7

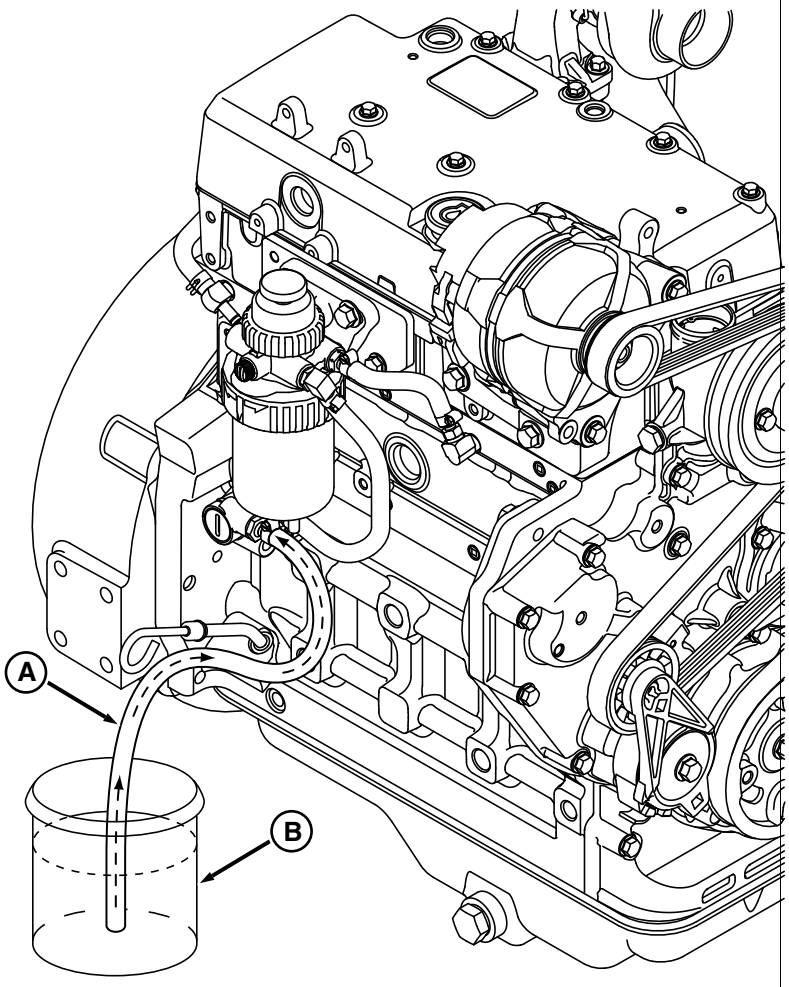
❷ Preliminary Checks	1. Check for the following: • Fuel leaks. • Loose or cracked fittings between fuel tank and low pressure fuel pump. • Loose fuel line clamps. • Loose fuel filter element or damaged filter gasket. • Damaged fuel supply line between fuel tank and low pressure fuel pump. • Low fuel level in tank.	
	2. Repair fuel system problem, if found, and recheck for air in return fuel.	**YES:** GO TO 3
	Is air still present in return fuel?	**NO:** Problem fixed.

Continued on next page

MK41968,0000050 -19-15APR10-4/7

❸ Check for Air Leak in Fuel Supply Line

1. Disconnect fuel supply line from low pressure fuel pump inlet fitting.
2. Install a 10 mm (3/8 inch) hose (A) to the low pressure fuel pump inlet fitting and place the other end of the hose in a container of clean diesel fuel (B).



RG15492 —UN—12SEP07

Temporary Fuel Supply

A—Temporary Fuel Supply Hose
B—Container of Clean Fuel

3. Operate primer pump to prime fuel system.
4. Run engine for 1 minute at 1500 rpm.
5. Recheck for air in return fuel.

Is air still present in the return fuel?

YES: GO TO 4

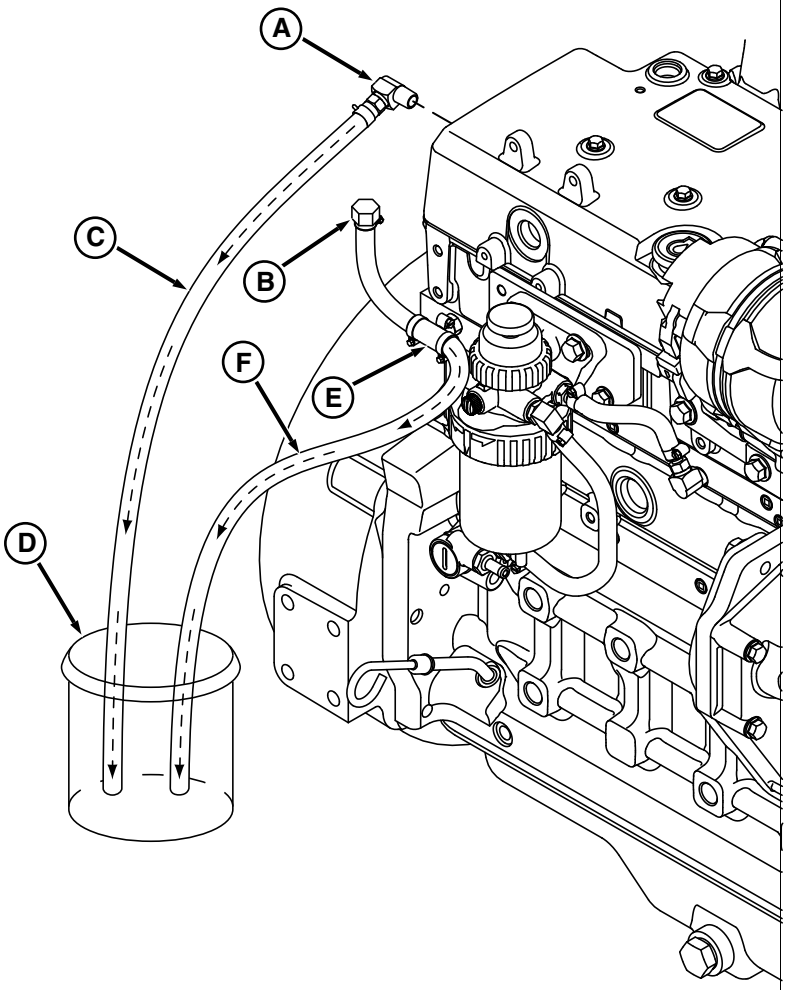
NO: Fix air leak in fuel supply line between fuel tank and low pressure fuel pump.

Continued on next page

MK41968,0000050 -19-15APR10-5/7

4 Check for Combustion Gas Leaking into Injector Nozzle Leak-Off

1. Disconnect the injector nozzle leak-off hose from the injector nozzle leak-off fitting (A) at rear of cylinder head.
2. Install a plug (B) in the end of the disconnected injector leak-off hose.
3. Install a 10 mm (3/8 inch) hose (C) to the injector nozzle leak-off fitting (A) and place the other end of the hose in the container of fuel (D).



RG15498 —UN—25SEP07

Check for Air in Injector Nozzle Leak-Off System

A—Injector Nozzle Leak-Off Fitting
B—Plug
C—Temporary Injector Nozzle Leak-Off Hose
D—Container of Fuel
E—Fuel Check Valve
F—Temporary Fuel Return Hose

4. Verify fuel return hose (F) that is connected to the fuel check valve (E) is still in the container of fuel (D).
5. Run engine for 1 minute at 1500 rpm.
6. Observe temporary fuel return hose (F) and temporary injector nozzle leak-off hose (C) in container (D) for air bubbles.

Are air bubbles only coming from the temporary injector nozzle leak-off hose (C)?

YES: Check for loose injector nozzle clamps or damaged injector nozzle sealing washers.

NO: Air is present in the fuel return hose (F) GO TO 5

Continued on next page

MK41968,0000050 -19-15APR10-6/7

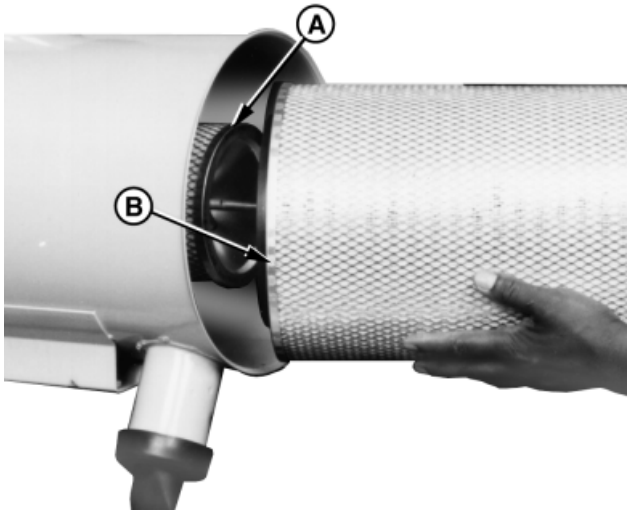
5 Check for Other Sources of Air Leaks	Check for other possible causes of air in fuel: • Leaking primer pump diaphragm. • Leaking low pressure fuel pump. • Fuel in engine oil indicating an internal fuel leak. If present, see FUEL IN OIL diagnostic procedure. • Check valve in fuel filter header permitting filtered fuel to drain back to tank with engine not running. Is air still present in return fuel?	**YES:** Open DTAC case. **NO:** Problem fixed.

MK41968,0000050 -19-15APR10-7/7

Air Intake System — Check

1. Replace air cleaner primary filter element (B). Replace secondary element (A) if primary element has holes in it.
2. Check condition of air intake hose(s) (C). Replace hoses that are cracked, split, or otherwise in poor condition.
3. Check hose clamps (D) for tightness. Replace clamps that cannot be properly tightened. This will help prevent dust from entering the air intake system which could cause serious engine damage.

A—Secondary Filter Element
B—Primary Filter Element
C—Air Intake Hose(s)
D—Hose Clamps



RG7766A —UN—10NOV97

Check Air Cleaner Elements

RG7618C —UN—06NOV97

Check Turbocharger Air Intake Hoses

Continued on next page

MK41968,000004F -19-21DEC09-1/3

Intake Air Leaks — Test

Loose connections or cracks in the suction side of the air intake pipe can allow debris to be ingested into the engine causing rapid wear in the cylinders. Additionally, on turbocharged engines, compressor damage may occur and cause an imbalance resulting in bearing failure.

Air leaking from loose connections or cracks on the pressure side of the turbocharger can cause excessive smoke and low power.

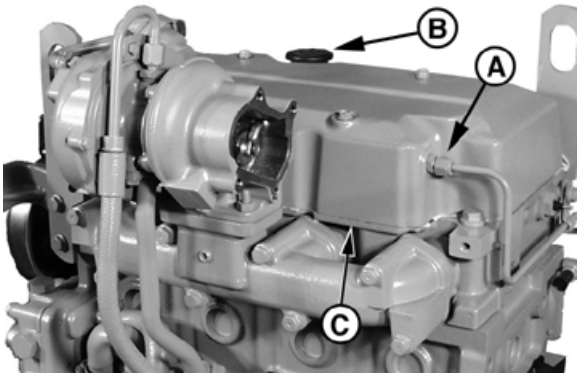
NOTE: The following test procedure requires that the air intake be sealed off to pressurize the system. Using a plastic bag to seal the air intake filter is used as an example.

CAUTION: Do not start engine during this test procedure. Plastic bag (or whatever material/object used to seal intake) can be sucked into the engine.

1. Remove air cleaner cover and main filter element.
2. Put a plastic bag over secondary filter element and install main element and cover.
3. Remove aneroid line (A) from the intake manifold.
4. Using a adapter, connect a regulated air source.
5. Pressurize air intake system to 13.8—20.7 kPa (0.13-0.21 bar) (2—3 psi).
6. Remove oil fill cap (B) and feel for air passing through the rocker arm cover.
7. Spray soap and water solution over all connections from the air cleaner to the turbocharger or air inlet, and rocker arm cover (C) to check for leaks. Repair all leaks.

T5906AP —UN—23FEB89

Air Intake Leak Test



RG12667 —UN—29MAY03

Air Intake Leak Test

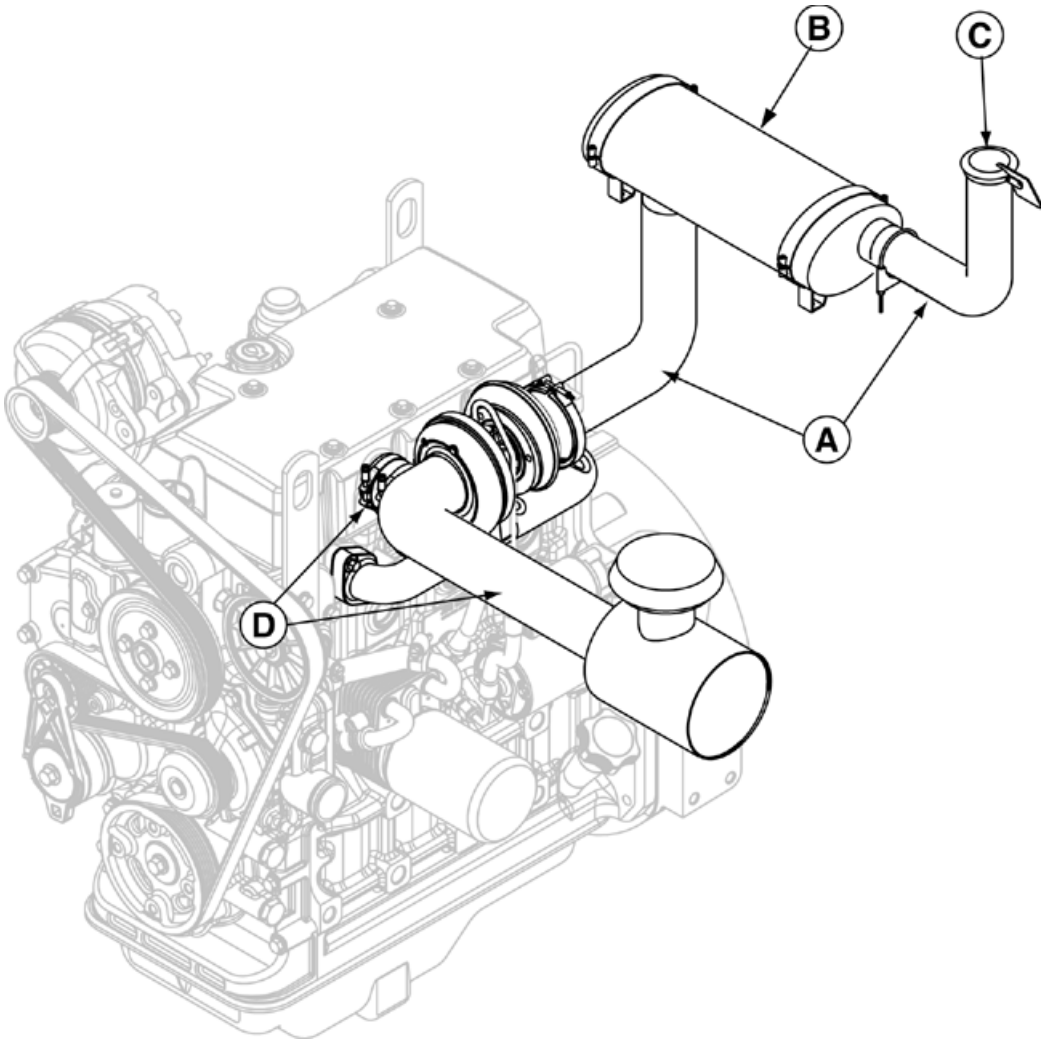
A—Aneroid Line

8. Reconnect aneroid line (A).
9. Remove plastic bag from filter element and reinstall element and cover.

Continued on next page

MK41968,000004F -19-21DEC09-2/3

Air Intake Restrictions — Check



RG12912 —UN—28MAY03

Air Intake Restriction Check

A—Exhaust Piping **B—Muffler** **C—Rain Cap** **D—Intake Piping**

Low power, low boost pressure, and excessive black exhaust smoke can be caused by an intake air or exhaust restriction.

Inspect the intake piping (D). Look for collapsed pipes, dented pipes, cracked hose, and loose connections. Replace components as needed.

MK41968,000004F -19-21DEC09-3/3

Charge Air System — Test

MK41968,0000051 -19-15APR10-1/7

Charge Air System Diagnostic

MK41968,0000051 -19-15APR10-2/7

1 Visual Inspection	1. Check for loose hose clamps. 2. Inspect air filter for damage or blockage that would restrict air flow or permit unfiltered air to flow into the engine. 3. Remove inlet air pipes and check for dirt tracks from unfiltered air. 4. Check for soft inlet air hoses which may collapse between air cleaner and turbo compressor inlet. 5. Inspect charge air cooler for debris or other blockage which would reduce the external cooling air flow through the cooling fins. 6. Check engine cooling fan and fan drive. Was a problem found?	**YES:** Fix problem. GO TO 2. **NO:** GO TO 2.

MK41968,0000051 -19-15APR10-3/7

2 Check for Internal Air Flow Restriction	Check for evidence of oil or other or other contamination in charge air cooler which would reduce internal air flow through the cooler's tubes. Is oil or other contamination present in the charge air cooler?	**YES:** GO TO 3. **NO:** GO TO 4.

MK41968,0000051 -19-15APR10-4/7

3 Clean Charge Air Cooler	1. Remove charge air cooler. 2. Use John Deere Coolant System Cleaner PMCC2638, or equivalent, per the cleaner instructions to clean the oil residue from the charge air cooler. 3. Use compressed air to completely dry the inside of the charge air cooler. Could oil or other contamination be removed from the charge air cooler?	**YES:** Reinstall charge air cooler. GO TO 4. **NO:** Replace charge air cooler. GO TO 4.

MK41968,0000051 -19-15APR10-5/7

4 Charge Air System Leak Check	*NOTE: This procedure requires fabrication of caps for the inlet and outlet of charge air cooler outlet. Constructions of one of the caps requires the ability to receive and seal a supply air line,* 1. At the intake manifold, remove charge air cooler outlet tube, and cap outlet tube. 2. At the turbocharger, remove charge air cooler inlet tube, and cap inlet tube. 3. Install a regulated compressed air supply line to the charge air system. 4. Slowly pressurize the charge air system to 206.85 kPa (30 psi) and maintain this pressure. 5. Using soapy water, check the charge air cooler and hose connections for air leaks. Were any joint leaks found?	**YES:** Repair or replace leaking components. Retest for leak. **NO:** Keep air supply line connected. GO TO 6.

Continued on next page

MK41968,0000051 -19-15APR10-6/7

5 Charge Air Cooler Leak Check	1. With air supply line to charge air cooler still connected, shut off the air supply.	
	2. Measure how much time elapses for air pressure to reach 0 kPa (0 psi).	**YES:** Charge air system is operating correctly.
	Was the time to reach 0 kPa (0 psi) greater than 60 seconds?	**NO:** Replace charge air cooler.

MK41968,0000051 -19-15APR10-7/7

Coolant System — Bleeding

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.

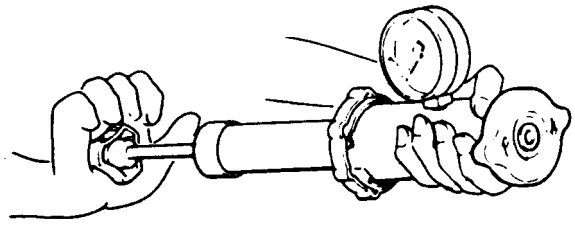
TS281 —UN—23AUG88

High-Pressure Fluids

1. Loosen one of the following components:
   - Coolant temperature sensor
   - Plug in thermostat housing
2. Allow air to escape while filling coolant system.
3. Retighten loosened component.
4. Start and warm engine to normal operating temperature.
5. Visually check entire cooling system for leaks.

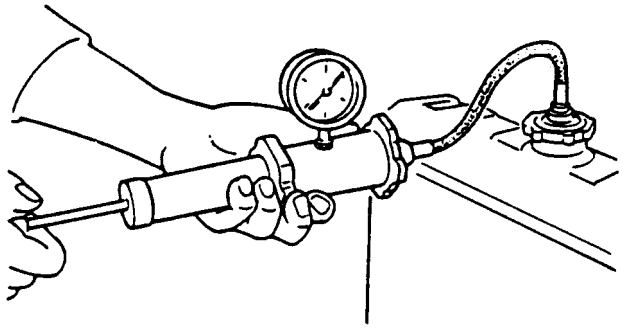
MK41968,0000052 -19-17DEC09-1/1

Cooling System and Radiator Cap — Pressure Test



Pressure Testing Radiator Cap

RG6557 —UN—20JAN93



RG6558 —UN—20JAN93

Pressure Testing Radiator

⚠ CAUTION: Explosive released 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 Radiator Cap:

1. Remove radiator cap and attach to D05104ST Pressure Pump as shown.
2. Pressurize cap to the following specification[1].

2.4 L & 3.0 L Diesel Engines—Specification

Radiator Cap—Holding Pressure (10 Second Minimum Hold).....70 kPa (0.7 bar) (10 psi) Minimum

Gauge should hold pressure for 10 seconds within the normal range if cap is acceptable.

If gauge does not hold pressure, replace radiator cap.

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

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

Test Cooling System:

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

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

IMPORTANT: DO NOT apply excessive pressure to cooling system. Doing so may damage radiator and hoses.

3. Connect gauge and adapter to radiator filler neck. Pressurize cooling system to specification listed for radiator cap.[2], using D05104ST Pressure Pump.
4. With pressure applied, check all cooling system hose connections, radiator, and overall engine for leaks.

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

   If no leakage is detected, but the gauge indicated a drop in pressure, coolant may be leaking internally within the system or at the block-to-head gasket.

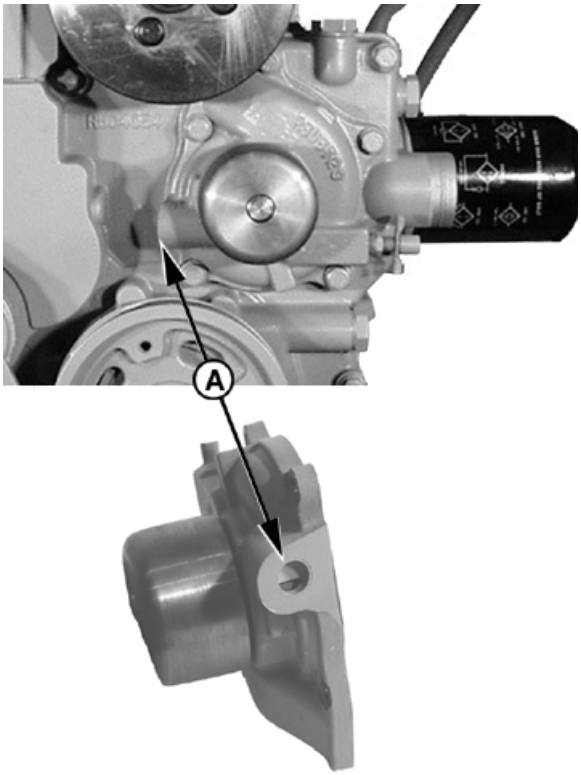
[2] Test pressures recommended are for all Deere OEM cooling systems. On specific vehicle applications, test cooling system and pressure cap according to the recommended pressure for that vehicle.

MK41968,00000AD -19-23DEC09-1/1

Cooling System — Test

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. (Belt removed for illustration)
3. Inspect radiator hoses for signs of leakage or rot. Replace hoses as necessary.
4. Inspect the coolant pump weep hole (A) for any restrictions.
5. Insert a heavy gauge wire deep into weep hole to make sure hole is open.

A—Weep Hole



RG12663 —UN—09JUN03

Weep Hole

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MK41968,00000A3 -19-22JAN10-1/2

CAUTION: Do not drain coolant until it has cooled below operating temperature. Always loosen pump drain valve slowly to relieve any excess pressure.

6. Remove and check thermostat (B). See Thermostat — Removal in Section 02, Group 070.

IMPORTANT: Whenever the aluminum timing gear cover or coolant pump are replaced, the radiator should be completely drained by opening the radiator petcock and removing the lower radiator hose.

When removing the coolant pump, inspect the coolant pump cavity in the timing gear cover for excessive cavitation.

7. Drain coolant at drain valve (A) and flush cooling system. (See Service Cooling System Safely in Section 01, Group 002.)

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 (A) to allow air to escape when filling system. Retighten fitting or plug when all the air has been expelled.

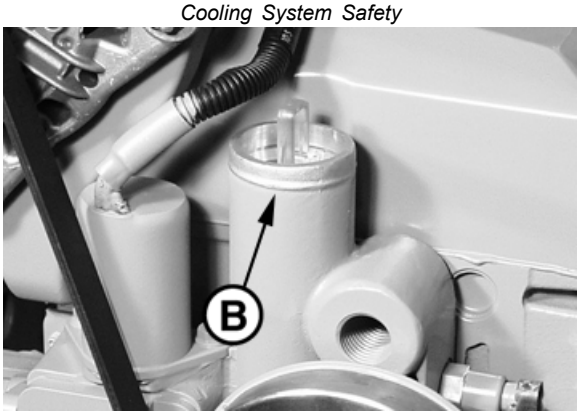
8. Fill cooling system with recommended concentration of coolant, clean soft water, and inhibitors. (See Diesel Engine Coolant in Section 01, Group 002.)
9. Run engine until it reaches operating temperature. Check entire cooling system for leaks.
10. After engine cools, check coolant level.

NOTE: Coolant level should be even with bottom of radiator filler neck.

11. Check system for holding pressure. (See Cooling System And Radiator Cap — Pressure Test in this group.)

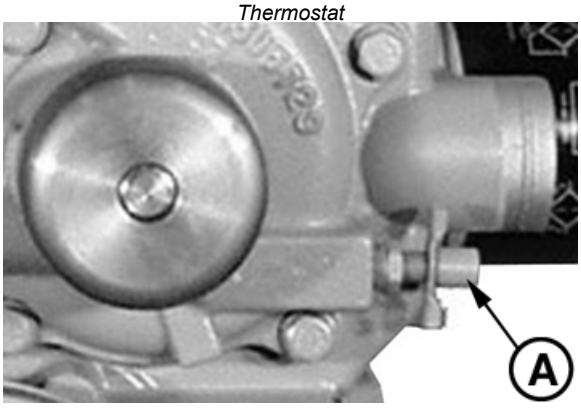
TS281 —UN—23AUG88

Cooling System Safety



RG12789A —UN—07MAY03

Thermostat



RG12534 —UN—12DEC02

Drain Valve

A—Drain Valve **B—Thermostat**

MK41968,00000A3 -19-22JAN10-2/2

Crankcase Pressure Blow-By Test

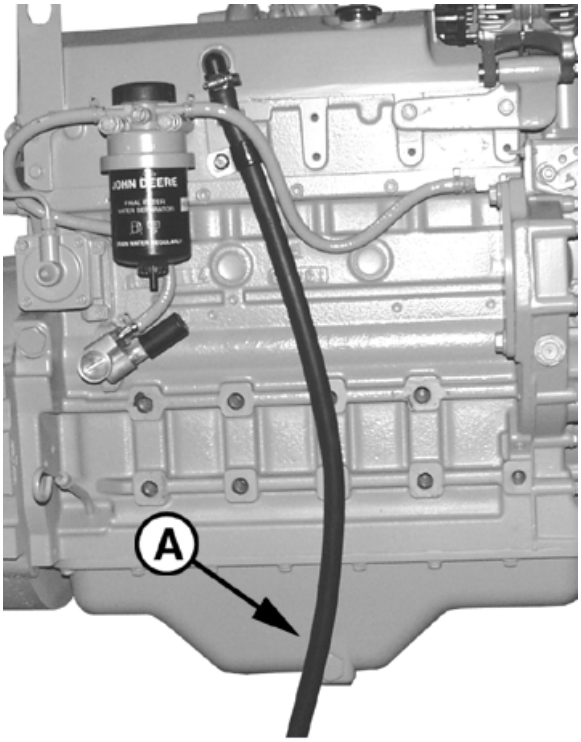
Excessive blow-by coming out of the crankcase breather tube (A) indicates that either the turbocharger (if equipped) seals are faulty or the piston rings and cylinder bores are not adequately sealing off the combustion chamber. This is a comparative check that requires some experience to determine when blow-by is excessive.

Run engine at high idle and check crankcase breather tube. Look for significant fumes and/or dripping oil coming out of the breather tube at fast idle, with no load.

If excessive blow-by is observed, perform the following to determine if the turbocharger (if equipped) is causing the blow-by:

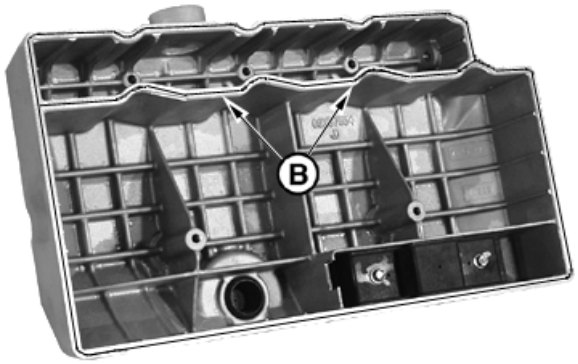
1. Remove the turbocharger oil drain line where it connects to the engine block and run line into a bucket.
2. Run engine at high idle, slightly loaded, and determine if boost pressure is forcing oil through the drain line. Check crankcase breather tube to determine if blow-by has decreased.
3. If it appears that boost pressure is forcing oil through the drain line, and/or blow-by decreases with the drain line disconnected from block, replace the turbocharger, and retest.
4. Remove rocker arm cover and inspect sealant path (B) for areas showing possible blow-by. Clean ssurface and apply sealant as shown and and reinstall. Allow sealant to completely cure. Run engine at high idle and check crankcase breather tube.

A—Breather Tube **B—Sealant Path**



RG12659 —UN—29MAY03

Blow-By Check

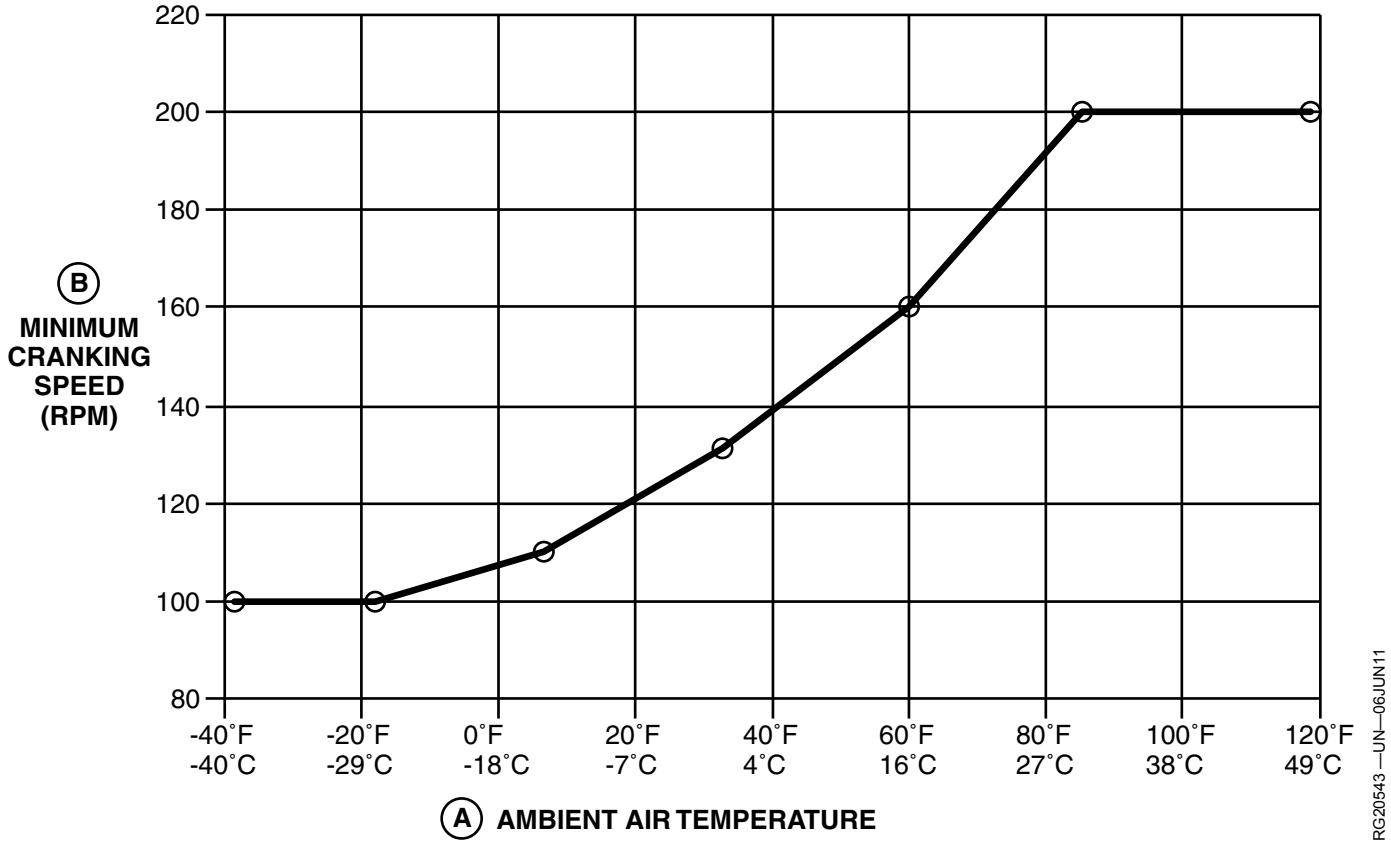


RG12530B —UN—13APR04

Sealant Path

MK41968,0000054 -19-15APR10-1/1

Cranking Speed Test



Engine Cranking Speed Test

A—Ambient Air Temperature **B—Minimum Cranking Speed (RPM)**

IMPORTANT: Cranking speed specifications above are for OEM engines only. See Machine Technical Manual for other applications.

Make sure that batteries are fully charged before performing this test.

1. Disable the fuel supply system at the injection pump so fuel delivery is in the OFF position.
2. If not using the machine tachometer, install a photo tach.
3. Crank the engine for 15 seconds and record engine speed.
4. Compare recorded engine speed to chart above.

   Cranking speed should meet or exceed specified engine rpm for a given ambient air temperature. For example, at 29°C (85°F) ambient air temperature, cranking speed should be at least 200 rpm.

   If cranking speed is below specifications, check the following:

   - Starting system problems (low battery, loose or defective wiring, defective starter, etc.).
   - Excessive engine loads (hydraulic pumps/thick oil, thick engine oil, etc.).

MK41968,0000055 -19-06JUN11-1/1

Engine Oil Consumption

All engines consume some oil. The consumption rate depends on loading, design of key parts and engine condition. Since fuel consumption is an indicator of operating power levels, fuel used versus oil consumed is a critical factor in analyzing oil consumption. Oil consumption should be measured over a 100-hour period.

Long-term oil consumption (three oil drain intervals after the engine is broken in) with consumption rates poorer than 400:1 (100 gallons of fuel and 1 quart of oil) indicates a need to monitor/investigate. Suggested steps would be:

- Check for signs of ingested dust or perform an OILSCAN® test to check for silicon.
- Check for proper crankcase oil fill level.
- Perform compression test to find low compression cylinders.
- Remove head and inspect for glazed or worn cylinder bores.
- Inspect pistons for carbon deposits in the ring land grooves.
- Measure valve stem OD and valve guide ID to determine clearance.

NOTE: Ring gap alignment does not identify the leak source.

Intake valves do not have valve stem seals, and some oil deposits on the valve stem tulip are normal.

When changing to a premium oil such as TORQ-GARD SUPREME® PLUS-50®, little oil consumption change is expected, although a small percentage of engines may experience a noticeable change in consumption rates. This may be due to the following:

- The previous oil may have left deposits on internal components. Use of PLUS-50® oil will cause different chemical reactions in those deposits. The time required for the engine to regain the previous oil consumption rate will vary from one to three normal drain intervals.
- TORQ-GARD SUPREME® PLUS-50® contains a high-performance anti-oxidant along with other additives resulting in the oil remaining in the specified viscosity grade throughout the recommended drain interval. API oil grades CD, CE, and CF-4 universal engine oils do not provide this oxidation resistance which results in more rapid thickening. Increased oil viscosity can reduce oil consumption.

Excessive Oil Consumption

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TORQ-GARD SUPREME is a registered trademark of Deere & Company
PLUS-50 is a registered trademark of Deere & Company

MK41968,00000A6 -19-01JUN10-1/7

Excessive Oil Consumption

MK41968,00000A6 -19-01JUN10-2/7

1 Preliminary Check	1. Check for too low or too high engine oil level. 2. Check for too low viscosity, or coolant- or fuel-diluted engine oil. 3. Check for excessive external oil leaks.	**No problems found:** GO TO 2 **Problem found:** Repair and retest.

MK41968,00000A6 -19-01JUN10-3/7

2 Check Oil in Coolant	Check the coolant for signs of oil.	**No oil found in coolant:** GO TO 3 **Oil found in coolant:** See Coolant In Oil Or Oil In Coolant later in this Group.

Continued on next page

MK41968,00000A6 -19-01JUN10-4/7

3 Check for Excessive Crankcase Pressure (Blow-By)	Check for excessive crankcase pressure. See Crankcase Pressure Blow-By Test later in this Group.	**No fumes and no dripping oil observed:** GO TO 4 **Excessive fumes or dripping oil observed; appears to be caused by boost pressure (if equipped with turbocharger):** Check the turbocharger, repair/replace as needed. See Turbocharger Failure Analysis in Section 02, Group 080 of this manual. **Excessive fumes or dripping oil observed; does not appear to be caused by boost pressure (if equipped with turbocharger):** Excessive blow-by, not caused by boost pressure is most likely caused by faulty piston rings/cylinder bores not providing an adequate combustion seal. Perform a compression test to verify this is the case. See Mechanical Compression Test later in this Group.

MK41968,00000A6 -19-01JUN10-5/7

4 Turbocharger Oil Seal Leak Check	*NOTE: This check is not needed for non-turbocharged ("D" engines). For these engines, GO TO 5.* Check for turbocharger oil seal leaks. See Turbocharger Oil Seal — Leak Check later in this group.	**No signs of oil leakage:** GO TO 5 **Signs of oil leakage present:** Investigate problems associated with oil leakage as outlined in the test procedure, perform necessary repairs, and retest.

Continued on next page

MK41968,00000A6 -19-01JUN10-6/7

5 Pistons, Rings, Cylinder Bores Check	At this point, the most likely cause of excessive oil consumption is one of the following failures in the pistons, rings, and/or cylinder bores or in the valve guides. Check the most likely items as needed. • Oil control rings worn or broken • Scored cylinder bores or pistons • Piston ring grooves excessively worn • Insufficient piston ring tension • Piston ring gaps not staggered • Cylinder bores glazed (insufficient load during engine break-in) • Worn valve guides or stems	Problem found with pistons, rings, and/or bores or valve guides. Repair problem as necessary.

MK41968,00000A6 -19-01JUN10-7/7

Engine Oil Pressure Check

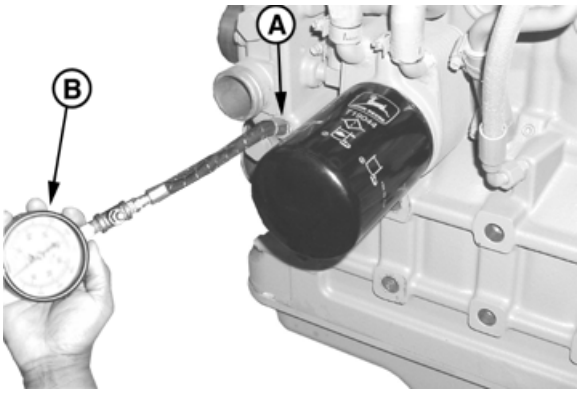
CAUTION: Engine oil pressure MUST be taken from the left side of the engine. The oil gallery on the right side is for cold start advance and will give false readings when engine reached operating temperature.

1. Remove main oil gallery plug from left side of engine.
2. Attach pressure gauge (B) from JT05470 Universal Pressure Test Kit to oil gallery.

IMPORTANT: To achieve an accurate oil pressure reading, warm up engine crankcase oil to 105°C (220°F) or high oil pressure readings will occur.

3. Start engine and run at speeds given below.
4. Measure oil pressure and compare readings.

Specification	
Minimum Oil Pressure—No Load at Slow Idle and 93°C (200°F) Oil Temperature—Minimum Pressure	105 kPa (1.05 bar) (15 psi)
Minimum Oil Pressure—Full Load at Rated Speed and 105°C (220°F) Oil Temperature—Minimum Pressure	275 kPa (2.75 bar) (40 psi)



RG13033 —UN—02JUL03

Oil Gallery Plug

A—Oil Gallery Port **B—Pressure Gauge**

NOTE: Tolerance extremes and gauge fluctuations can result in the gauge reading up to 586 kPa (5.86 bar) 85 psi. This is not detrimental to the engine.

The oil pressure regulating valve is designed so that adjustment of oil pressure should not be required.

5. Replace oil pressure regulating valve if oil pressure is not within specified range.

MK41968,00000A4 -19-23DEC09-1/1

Excessive Fuel Consumption

Symptom	Problem	Solution
Excessive Fuel Consumption	Diagnostic trouble codes	Resolve active diagnostic trouble codes.
	Check for engine smoke	Perform test for white smoke or black smoke, if observed.
	Poor fuel quality	Drain fuel and replace with quality fuel of the proper grade.
	Engine overloaded	Reduce engine load
	Air cleaner restricted or dirty	Replace air cleaner element.
	Engine oil overfilled or incorrect viscosity	Fill engine oil to the correct level with the prescribed oil.
	Leaks in fuel supply system	Locate source of leak and repair as required. Check for fuel in oil indicating an internal engine fuel leak.
	Low engine temperature.	Check thermostat. See Thermostat Operation Test in Section 4 Group 155.
	Check for ECU software updates	Reprogram ECU with latest payload.
	Compression too low	Determine cause of low compression and repair as required.
	Camshaft timing incorrect	Set camshaft timing.
	Injector nozzles or unit pumps defective, incorrect injector nozzles are installed or calibration codes not entered correctly for unit pumps	Verify calibration codes in ECU memory match unit pump calibration codes. Replace defective or incorrect parts.

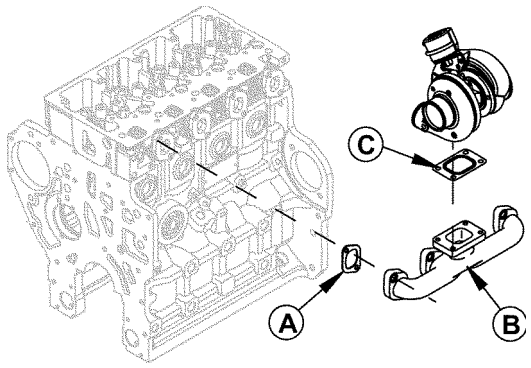
MK41968,00000A9 -19-22JAN10-1/1

Exhaust System — Check

Exhaust leaks, upstream of the turbocharger, will cause the turbocharger turbine to rotate at a reduced speed resulting in low boost pressure, low power, and excessive black smoke.

Inspect the exhaust manifold gasket (A), the exhaust manifold (B), and the turbocharger gasket (C) for damage and any signs of leakage. Replace components as needed.

A—Exhaust Manifold Gasket
B—Exhaust Manifold
C—Turbocharger Gasket

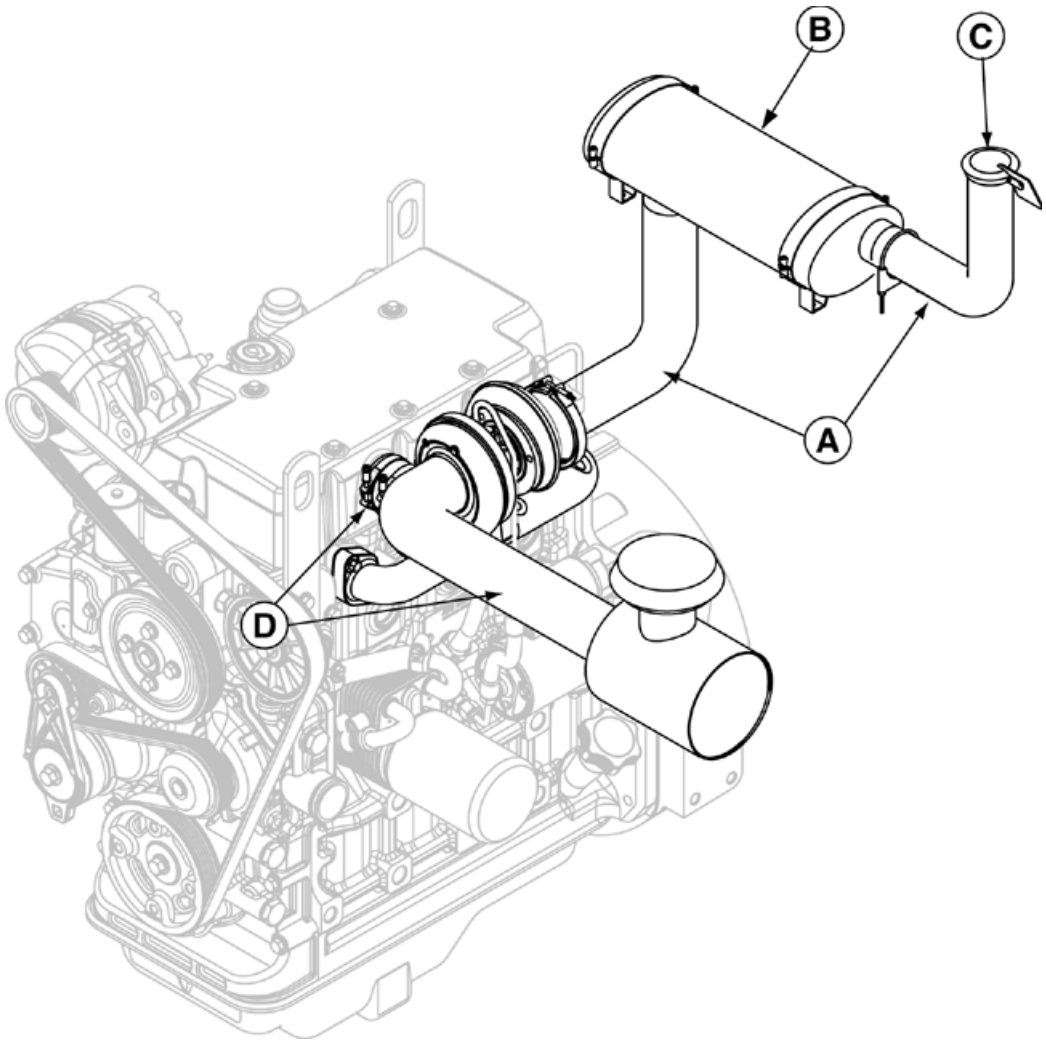


RG12911 —UN—09MAY03

Exhaust Leak Check

MK41968,0000064 -19-21DEC09-1/2

Exhaust Restriction — Check



RG12912 —UN—28MAY03

Intake/Exhaust Restriction Check

A—Exhaust Piping **B—Muffler** **C—Rain Cap** **D—Intake Piping**

Low power, low boost pressure, and excessive black exhaust smoke can be caused by an exhaust restriction.

Inspect the exhaust piping (A), the muffler (B), and the rain cap (C) for damage or any possible restrictions.

MK41968,0000064 -19-21DEC09-2/2

Fuel Shutoff Solenoid Test

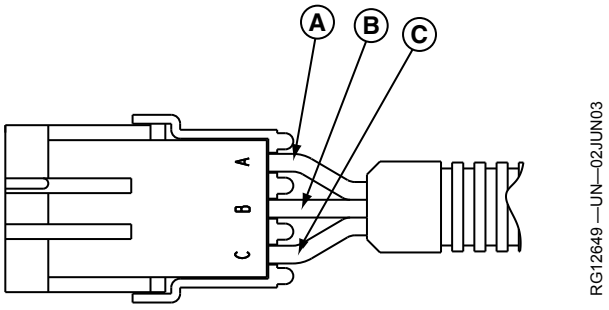
Disconnect shut-of solenoid 3-way WEATHER PACK™ connector.

1. Measure “PULL” coil resistance between black lead wire (C) and white lead wire (B).
2. Measure “HOLD” coil resistance between black lead wire (C) and red lead wire (A).

Replace solenoid if resistance is not within specification.

Specification

Pull Coil—Resistance.....5 Ohms
Hold Coil—Resistance.....14 Ohms



Fuel Shut-Off Solenoid Resistance Check

A—Hold Coil - Red
B—Pull Coil - White
C—Common Ground - Black

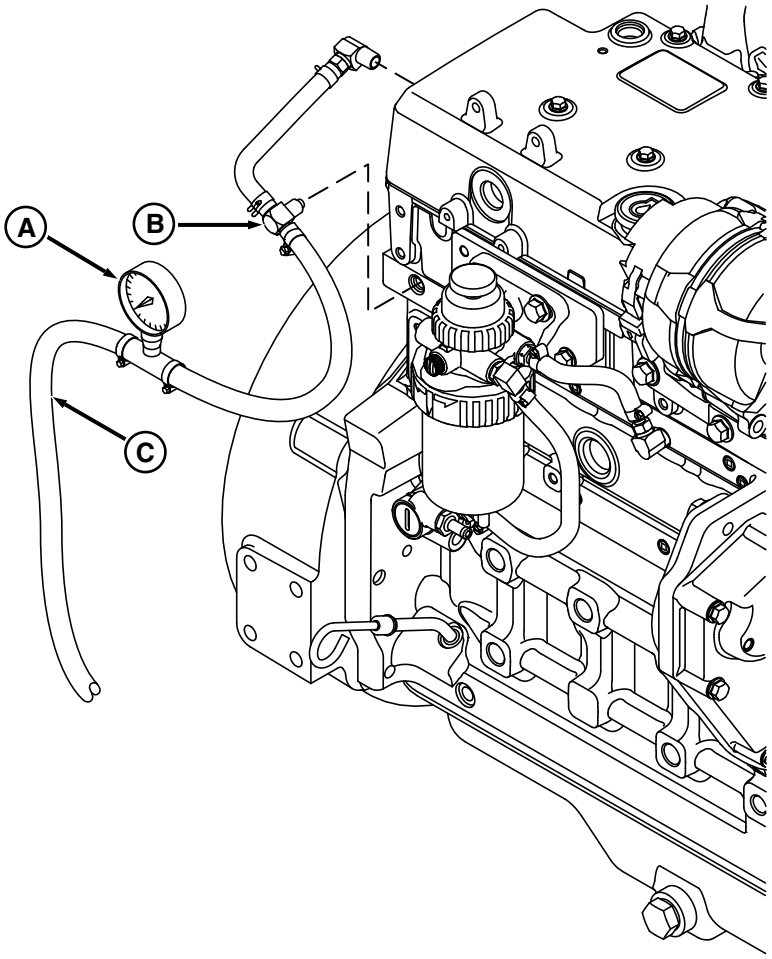
WEATHER PACK is a trademark of Packard Electric

MK41968,00000AB -19-23DEC09-1/1

Fuel Return Line (Leak-off) — Restriction Check

This check will determine if the fuel return line is restricted or not designed correctly for the application.

1. Check all return lines and ensure there are no kinked or pinched lines.
2. Install a pressure gauge (A) capable of accurately reading 20 kPa (2.9 psi) between fuel check valve (B) and fuel return line (C).



RG15502 —UN—25SEP07

Checking Fuel Return Pressure

A—Pressure Gauge **B—Fuel Check Valve** **C—Fuel Return Line**

3. Do NOT remove fuel tank cap.
4. Monitor pressure gauge.
5. Operate engine under various conditions from low idle to governed rpm under load.
6. Determine if pressure gauge exceeds 20 kPa (2.9 psi) at any time.
7. Remove fuel tank cap if pressure gauge exceeds 20 kPa (2.9 psi) and recheck return pressure.
8. If return pressure is less than 20 kPa (2.9 psi) with fuel cap removed, inspect tank vent. If pressure does not decrease with fuel cap removed, locate source of restriction in fuel return line. If no restrictions are found, fuel return line diameter may be too small for the application.

MK41968,0000056 -19-17DEC09-1/1

Fuel Supply Quality Check

MK41968,0000065 -19-01JUN10-1/8

Check Fuel Supply Quality Diagnostic Procedure

Additional References:
Fuel samples can be analyzed in a laboratory for contamination and ratings. See Testing Diesel Fuel in Group 01, Section 002, for more information.

MK41968,0000065 -19-01JUN10-2/8

1 Low Pressure Fuel System Check	Has Low Pressure Fuel System — Check been performed?	**YES:** GO TO 5 **NO:** GO TO 2

MK41968,0000065 -19-01JUN10-3/8

2 Check Fuel in Filters	1. Ignition OFF, engine OFF. 2. Drain fuel filter into a clean container. 3. Check for water, dirt, or other contaminants in the drained fuel. Is an abnormal amount of water or contaminants present in the drained fuel?	**YES:** GO TO 3 **NO:** GO TO 4

MK41968,0000065 -19-01JUN10-4/8

3 Check Fuel Supply	Check fuel in tank for water or contaminants. Is an abnormal amount of water or contaminants present in the fuel?	**YES:** Inspect fuel tank for cause of contamination. Drain and replace fuel in tank with known good fuel. GO TO 4 **NO:** GO TO 4

MK41968,0000065 -19-01JUN10-5/8

4 Replace Fuel Filters	*NOTE: For fuel filter replacement and priming instructions, see Fuel Filter — Removal and Fuel Filter — Installation in Group 02, Section 90 earlier in this manual.* 1. Replace fuel filter. 2. Prime fuel system using primer pump on filter housing. 3. Start engine and check performance. Does engine start and have good performance?	**YES:** Problem solved. **NO:** Fuel in tank was NOT replaced. GO TO 5 **NO:** Fuel in tank was replaced. GO TO 6

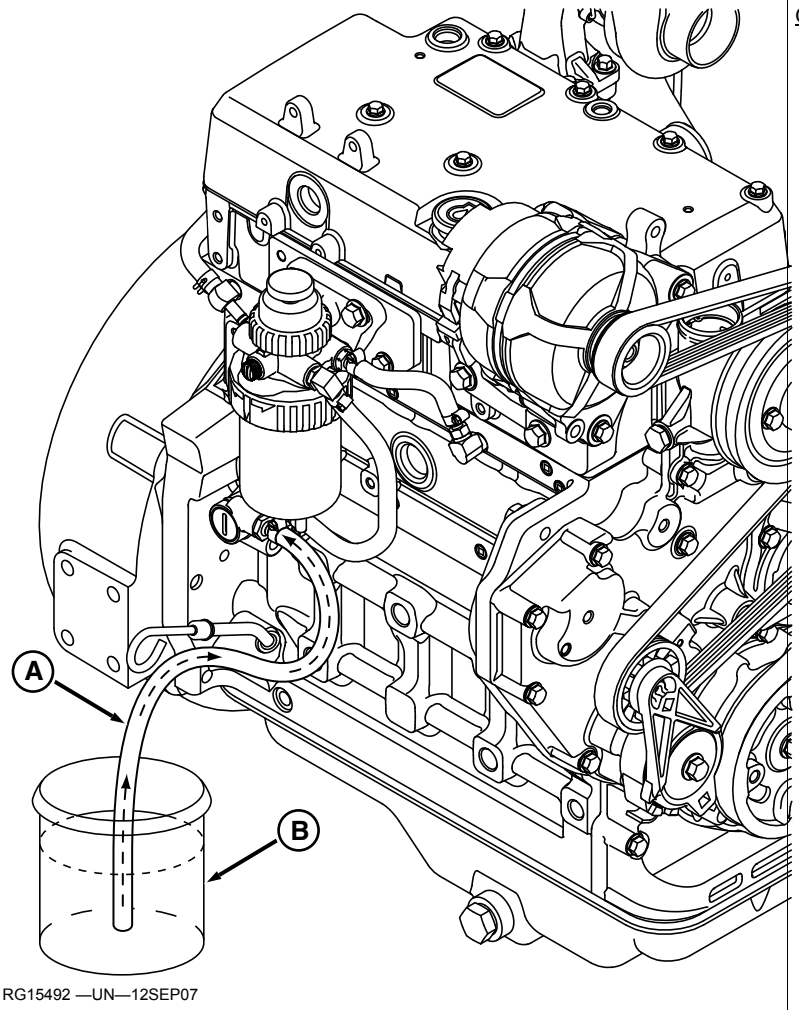
Continued on next page

MK41968,0000065 -19-01JUN10-6/8

5 Temporary Known Good Fuel Supply Installation

NOTE: Use a clean hose and fresh fuel that has known-good quality in a clean container for this step. Do not use fuel from the fuel tank.

1. Ignition OFF, engine OFF.
2. Disconnect fuel inlet line from the low pressure fuel pump.
3. Install a hose (A) on low pressure fuel pump inlet port and place other end of hose in a container of at least 3.8L (1 gal) of clean fuel (B).



RG15492 —UN—12SEP07

Temporary Fuel Supply

A—Temporary Fuel Supply Hose
B—Container of Known-Good Diesel Fuel

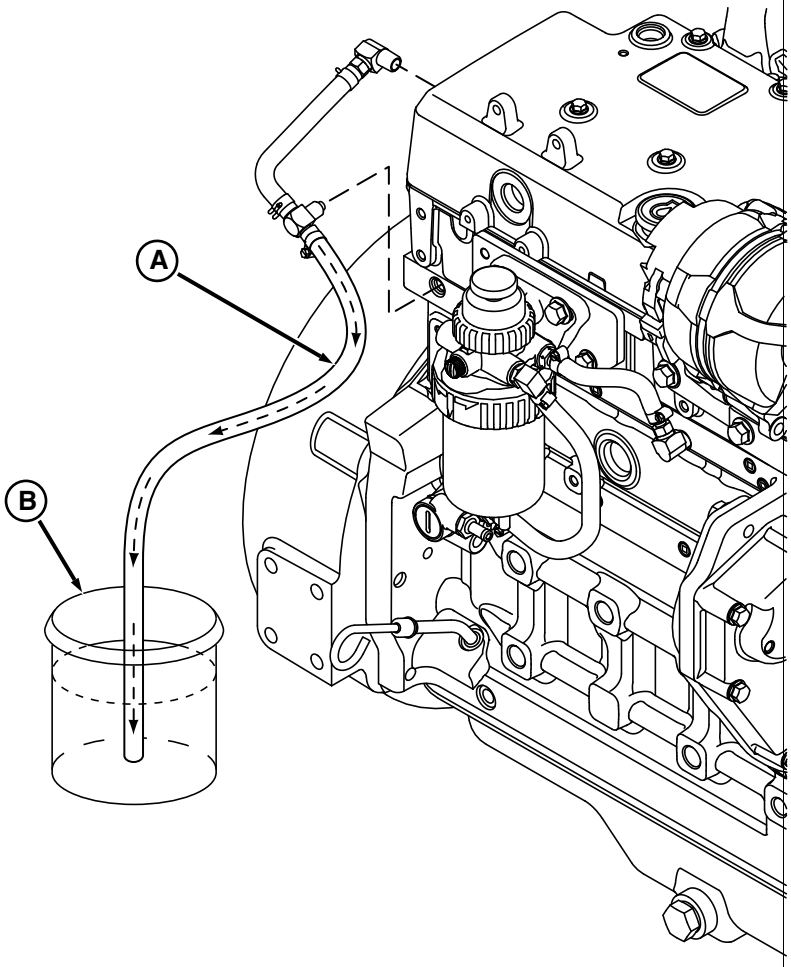
IF OK: Once temporary fuel supply has been installed, GO TO 6

Continued on next page

MK41968,0000065 -19-01JUN10-7/8

6 Purge Fuel in Engine

1. Disconnect fuel return line at fuel check valve.
2. Connect a hose (A) to the fuel check valve and place the other end of the hose in an empty container suitable for diesel fuel (B).



RG15495 —UN—12SEP07

Collecting Return Fuel

A—Temporary Fuel Return Hose
B—Empty Container

   a. If engine starts, start engine and operate at low idle until at least 1.9L (1/2 gal) of return fuel is present in container.

   b. If engine does not start, crank engine for 20 second intervals with 2 minutes between intervals. Repeat until at least 1.9L (1/2 gal) of return fuel is present in the container or until engine starts.

3. Ignition OFF, engine OFF.
4. Reconnect fuel lines.

Does engine start and have good performance?

YES: Problem fixed. Replace fuel in tank, if not already performed.

NO: Fuel quality is not the cause of the problem. Return to DTC or other procedure.

MK41968,0000065 -19-01JUN10-8/8

Fuel System Bleeding

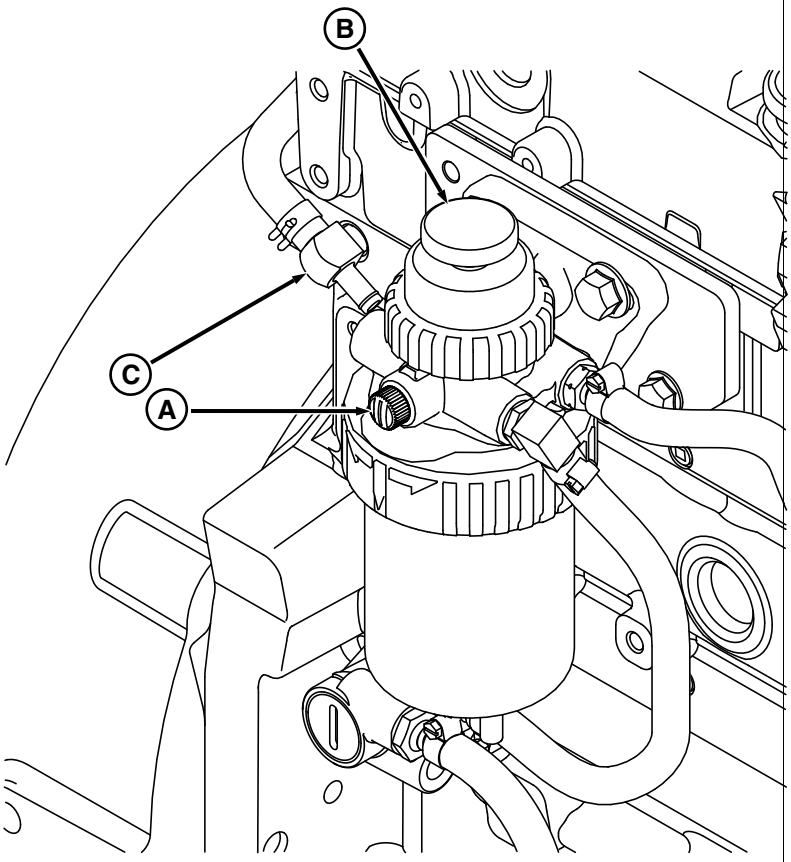
MK41968,0000057 -19-01JUN10-1/4

Bleed the Fuel System Procedure

MK41968,0000057 -19-01JUN10-2/4

1 Fill Fuel Filter Using Hand Primer Pump

1. Place a container suitable for diesel fuel beneath fuel filter assembly.
2. Loosen bleeder screw (A) located on filter header.



RG15509 —UN—25SEP07

Bleed the Fuel System

A—Bleeder Screw
B—Hand Primer Pump
C—Fuel Check Valve

3. Operate hand primer pump (B) by pushing down and releasing the pump handle until a continuous stream of fuel exits the bleeder screw.
4. Tighten bleeder screw.

NOTE: Do NOT crank engine longer than 30 seconds. Provide two minutes between start attempts to permit starter motor to cool.

5. Attempt to start engine. If engine starts, run engine until performance is acceptable.
6. Dispose of fuel in container in an approved manner.

Did engine start?

YES: Engine starts and performance is acceptable. Procedure complete.

YES: Engine starts but performance indicates air is still present in fuel. GO TO 2.

NO: GO TO 2.

Continued on next page

MK41968,0000057 -19-01JUN10-3/4

❷ **Purge Fuel Gallery**	1. Place a container suitable for diesel fuel beneath the fuel check valve (C).	
	2. Remove fuel return line and injector leak-off line from fuel check valve.	
	3. Remove fuel check valve.	
	4. Operate hand primer pump until a continuous stream of fuel exits the tapped hole in engine block for the fuel check valve.	
	5. Reinstall the fuel check valve and the fuel lines.	
	6. Attempt to start engine. If engine starts, run engine until performance is acceptable.	**YES:** Engine starts and performance is acceptable. Procedure complete.
	7. Dispose of fuel in container in an approved manner.	**YES:** Engine starts but performance indicates air is still present in fuel. Perform procedure Air In Fuel — Check located in Section 04, Group 151.
	Did engine start?	**NO:** Perform procedure Engine Cranks But Will Not Start located in Section 04, Group 151.

MK41968,0000057 -19-01JUN10-4/4

Glow Plug Check

JB81757,000004F -19-15APR10-1/14

Glow Plug Check Diagnostic Procedure

Related Information:
The ECU supplies a high side output to control the application-supplied glow plug relay coil to energize the relay. The ECU monitors the output of the relay to determine if the relay is energized.
The ECU will generate DTC 000676.05 if the glow plug relay is detected as not being energized when commanded and DTC 000675.03 if the glow plug relay is energized when not commanded.
Note that the ECU does not monitor actual glow plug current. Open circuits after the glow plug relay output terminal will NOT result in a DTC.
The ECU uses coolant temperature to determine if the glow plug relay should be energized.

Control Unit Response:
The engine may not start or may require extended crank times in cold weather if glow plugs do not preheat the combustion chamber.

Additional References:
For further glow plug information, see Glow Plug Operation in Section 03, Group 140 earlier in this manual.

NOTE: The wiring diagrams provided are for a typical John Deere supplied OEM harness. Wire number, colors, and jumper connectors do not apply to all applications.

For wiring information see 2.4L/3.0L ECU WIRING DIAGRAM 7 located in Section 06, Group 210 later in this manual.

JB81757,000004F -19-15APR10-2/14

1 Read DTCs and Store Snapshot Information	1. Ignition ON, engine OFF. *NOTE: When DTCs are cleared Snapshot information for ALL DTCs will also be cleared.* 2. Connect Service ADVISOR, see Connecting To Service ADVISOR earlier in this Group. 3. Write down all DTCs and their occurrence count. If any DTCs have snapshot capture or snapshot recording information, save the information. For instructions on saving and using snapshot information, see Snapshot Instructions earlier in this Group. Is any DTC with SPN 000110 an active DTC?	**YES:** Discontinue Glow Plug Check. Perform test for DTC with SPN 000110. **NO:** GO TO 2

JB81757,000004F -19-15APR10-3/14

2 Check for Glow Plug Relay DTCs	1. Disconnect coolant temperature sensor connector to cause the ECU to attempt to energize the glow plug relay at next key cycle. *NOTE: Ignore DTC 000110.03 which will be generated due to coolant temperature sensor being disconnected.* 2. Clear DTCs. 3. Ignition OFF, engine OFF for 10 seconds. 4. Ignition ON, engine OFF for 30 seconds. 5. Refresh DTCs. Did 000676.03 or 000676.05 appear as active or stored DTCs?	**YES:** Discontinue Glow Plug Check. Perform diagnostic test for DTC 000676.03 or 000676.05. **NO:** GO TO 3

Continued on next page

JB81757,000004F -19-15APR10-4/14

3 Check Wait to Start Lamp (if Applicable)

1. Verify coolant temperature sensor is still disconnected.
2. Ignition OFF, engine OFF for 10 seconds.
3. Ignition ON, engine OFF for 30 seconds.
4. Observe if wait to start lamp is illuminated for several seconds and is then extinguished.

Does the wait to start lamp illuminate and then go out?

YES: GO TO 4

NO: Diagnose lamp circuit. GO TO 4

NO: Application does not have a wait to start lamp. GO TO 4

JB81757,000004F -19-15APR10-5/14

4 Check Glow Plug Circuit

1. Ignition OFF, engine OFF.
2. Disconnect the engine glow plug harness connector (1-way) at rear of cylinder head from the application's wire harness glow plug connector.
3. On the application's wire harness, measure the resistance between the glow plug relay output terminal and the glow plug connector terminal.

Is resistance less than 2 ohms?

YES: GO TO 5

NO: Fix open circuit. GO TO 5

JB81757,000004F -19-15APR10-6/14

5 Check Glow Plug Resistance

NOTE: Normal resistance of each glow plug is less than 1 ohm with the glow plug at room temperature. The resistance increases significantly when the glow plug is heated. For glow plug replacement instructions, see Glow Plugs — Removal and Glow Plugs — Installation in Section 02, Group 110 earlier in this manual.

1. Remove rocker cover.
2. Disconnect each glow plug from the glow plug harness.
3. On each glow plug, measure the resistance between the glow plug terminal and single point ground.

Is the resistance of each glow plug less than 2 ohms?

YES: GO TO 6.

NO: Replace glow plugs with high resistance. GO TO 6.

JB81757,000004F -19-15APR10-7/14

6 Check Glow Plug Harness

On the glow plug harness, measure the resistance between the terminal in the connector at rear of cylinder head to the terminal in each glow plug connector.

Are all resistance measurements less than 2 ohms?

YES: Replace glow plug harness. See Glow Plug Wiring Harness — Removal and Glow Plug Wiring Harness — Installation in Section 02, Group 110 earlier in this manual.GO TO 7.

NO: Reinstall glow plug connectors and rocker cover. Rocker Arm Cover — Installation. **GO TO 7**.

Continued on next page

JB81757,000004F -19-15APR10-8/14

7 Coolant Temperature Accuracy Check	1. Reconnect coolant temperature sensor connector. 2. Ignition ON, engine OFF 3. Monitor Coolant Temperature data point in Service ADVISOR. 4. Measure coolant temperature using a thermometer with known-good accuracy. Does the Coolant Temperature data point indicate actual coolant temperature within 5°C (9°F)?	**YES:** GO TO 12 **NO:** GO TO 8

JB81757,000004F -19-15APR10-9/14

8 Check Coolant Temperature Circuit	*NOTE: For coolant temperature sensor replacement instructions, see Coolant Temperature Sensor — Removal and Coolant Temperature Sensor — Installation in Section 02, Group 110 earlier in this manual.* 1. Ignition OFF, engine OFF. 2. Disconnect ECU J1 connector and coolant temperature sensor connector T04. 3. Perform Terminal Test on J1 and coolant temperature sensor connector T04. 4. On the harness, measure the resistance between ECU J1-C4 and the coolant temperature sensor connector T04-A. 5. On the harness, measure the resistance between ECU J1-D2 and the coolant temperature sensor connector T04-B. Are Terminal Test results good and are both resistance measurements less than 10 ohms?	**YES:** Replace coolant temperature sensor. GO TO 9 **NO:** Fix problem. GO TO 12

JB81757,000004F -19-15APR10-10/14

9 Recheck Coolant Temperature Accuracy	1. Reconnect coolant temperature sensor connector. 2. Ignition ON, engine OFF 3. Monitor Coolant Temperature data point in Service ADVISOR. Does the Coolant Temperature data point indicate actual coolant temperature within 5°C (9°F)?	**YES:** GO TO 12 **NO:** GO TO 10

JB81757,000004F -19-15APR10-11/14

10 Reprogram ECU	1. Ignition OFF, engine OFF. 2. Reconnect all electrical connectors. 3. Download latest ECU payload and reprogram ECU. 4. Ignition ON, engine OFF 5. Monitor Coolant Temperature data point in Service ADVISOR. Does the Coolant Temperature data point indicate actual coolant temperature within 5°C (9°F)?	**YES:** GO TO 12 **NO:** GO TO 11

Continued on next page

JB81757,000004F -19-15APR10-12/14

11 Replace ECU	1. Ignition OFF, engine OFF.	
	2. Replace ECU.	
	3. Ignition ON, engine OFF	
	4. Monitor Coolant Temperature data point in Service ADVISOR.	**YES:** GO TO 12
	Does the Coolant Temperature data point indicate actual coolant temperature within 5°C (9°F)?	**NO:** Open DTAC case.

JB81757,000004F -19-15APR10-13/14

12 Verification	1. Reconnect glow plug wiring harness and reinstall rocker cover, if applicable.	
	2. Ignition OFF, engine OFF.	
	3. Disconnect coolant temperature sensor connector if the actual coolant temperature is above -5°C (23°F).	
	4. Monitor the battery terminal voltage.	
	5. Ignition ON, engine OFF for 30 seconds.	**YES:** Reconnect coolant temperature sensor if applicable. Glow plug system is operating correctly.
	Does battery terminal voltage drop for several seconds	**NO:** GO TO 2

JB81757,000004F -19-15APR10-14/14

Head Gasket — Leak Check

Head gasket failures generally fall into three categories:

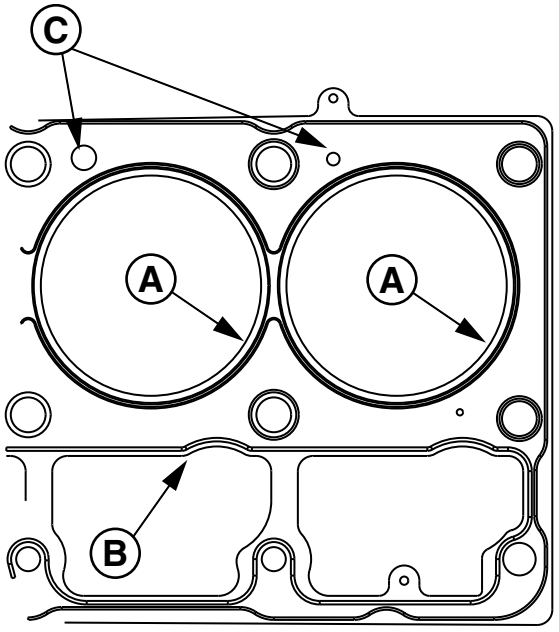
- Combustion seal failures.
- Coolant seal failures.
- Oil seal failures.

Combustion seal failures occur when combustion gases escape between cylinder head and head gasket combustion flange, or between combustion flange and cylinder bore. Leaking combustion gases may vent to an adjacent cylinder, to a coolant or oil passage, or externally.

Coolant or oil seal failures occur when oil or coolant escapes between cylinder head and gasket body, or between cylinder block and gasket body. The oil or coolant may leak to an adjacent coolant or oil passage, or externally. Since oil and coolant passages are primarily on right-hand (camshaft) side of engine, fluid leaks are most likely to occur in that area.

Follow these diagnostic procedures when a head gasket joint failure occurs or is suspected.

1. Before starting or disassembling engine, conduct a visual inspection of machine and note any of the following:
   - Oil or coolant in head gasket seam, or on adjacent surfaces.
   - Displacement of gasket from normal position.
   - Discoloration or soot from combustion gas leakage.
   - Leaking radiator, overflow tank, or hoses.
   - Leaking coolant from coolant pump weep hole.
   - Damaged or incorrect radiator, fan, or shroud.
   - Obstructed air flow or coolant flow.
   - Worn or slipping belts.
   - Damaged or incorrect pressure cap.
   - Presence of oil in coolant.
   - Low coolant levels or Improper coolant.
   - Unusually high or low oil levels.
   - Oil degradation, dilution, or contamination.
   - Incorrectly specified injection pump.
   - Indications of fuel or timing adjustments.
   - Unburned fuel or coolant in exhaust system.
2. Obtain coolant and oil samples for further analysis.
3. Start and warm up engine if it can be safely operated. Examine all potential leakage areas again as outlined previously. Using appropriate test and measurement equipment, check for the following:
   - White smoke, excessive raw fuel, or moisture in exhaust system.
   - Rough, irregular exhaust sound, or misfiring.
   - Air bubbles, gas trapped in radiator/overflow tank.
   - Loss of coolant from overflow.
   - Excessive cooling system pressure.
   - Coolant overheating.
   - Low coolant flow.
   - Loss of cab heating (air lock).



RG12815A —UN—12MAY03

Diagnosing Head Gasket Joint Failures

A—Combustion Sealing Area **C—Coolant Sealing Areas**
B—Oil Sealing Areas

4. Shut engine down. Recheck crankcase, radiator, and overflow tank for any significant differences in fluid levels, viscosity, or appearance.
5. Compare your observations from above steps with the diagnostic charts earlier in this group. If diagnostic evaluations provide conclusive evidence of combustion gas, coolant, or oil leakage from head gasket joint, the cylinder head must be removed for inspection and repair of gasket joint components.

COMBUSTION SEAL LEAKAGE

Symptoms:

- Exhaust from head gasket crevice
- Air bubbles in radiator/overflow tank
- Coolant discharge from overflow tube
- Engine overheating
- Power loss
- Engine runs rough
- White exhaust smoke
- Loss of cab heat
- Gasket section dislodged, missing (blown)
- Coolant in cylinder
- Coolant in crankcase oil
- Low coolant level

Possible Causes:

- Low head bolt clamping loads
- Cracked/deformed gasket combustion flange
- Out-of-flat/damaged/rough cylinder head surface
- Missing/mislocated gasket fire ring
- Excessive fuel delivery
- Advanced injection pump timing

Continued on next page

MK41968,0000058 -19-17DEC09-1/2

- Hydraulic or mechanical disturbance of combustion seal

NOTE: Cracked cylinder head or cylinder bores may also allow combustion gas leakage into coolant.

COOLANT SEAL LEAKAGE

Symptoms:

- Coolant discharge from head gasket crevice
- Coolant in crankcase oil
- Low coolant level
- High oil level
- Coolant discharge from crankcase vent

Possible Causes:

- Low head bolt clamping loads
- Out-of-flat/damaged/rough block surface
- Out-of-flat/damaged/rough cylinder head surface
- Oil or coolant overheating
- Cracks/creases in gasket body surfaces
- Damage/voids in elastomer beading

OIL SEAL LEAKAGE

Symptoms:

- Oil discharge from head gasket crevice
- Oil in coolant
- Low crankcase oil level
- Reduced oil to rocker arms (noisy)

Possible Causes:

- Low head bolt clamping loads
- Out-of-flat/damaged/rough block surface
- Out-of-flat/damaged/rough cylinder head surface
- Oil or coolant overheating
- Cracks/creases in gasket body surfaces
- Damage/voids in elastomer beading

NOTE: Defective oil cooler may also allow oil leakage into coolant.

MK41968,0000058 -19-17DEC09-2/2

Intake Manifold — Pressure Measurement

This test of turbocharger boost is also a good indicator of whether the engine is performing at full rated power.

IMPORTANT: If testing the engine with the air filter system removed, install JDG576 Turbocharger Shield to inlet of turbocharger.

1. Disconnect line (A) from intake manifold and install the appropriate fitting from JDE147 Manifold Pressure Test Kit or FKM10002 Universal Pressure Test Kit.

   Connect gauge (B) and hose assembly to fitting. Be sure all connections are tight.

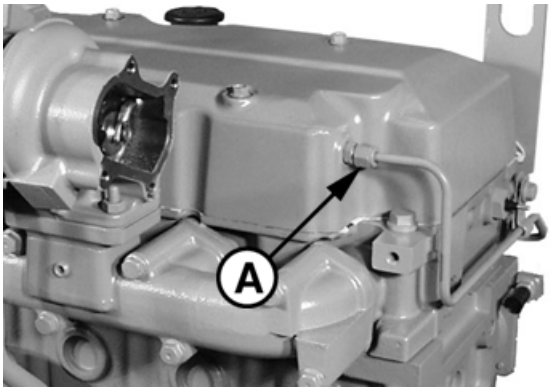
IMPORTANT: Engine speed and load should be stabilized before taking a gauge reading. Be sure that gauge works properly and familiarize yourself with the use of the gauge.

Turbo-boost pressure checks are only a guide to determine if there is an engine problem (valve leakage, faulty nozzles, etc.).

2. Before checking boost pressure, warm up engine to allow the lubricating oil to reach operating temperature.

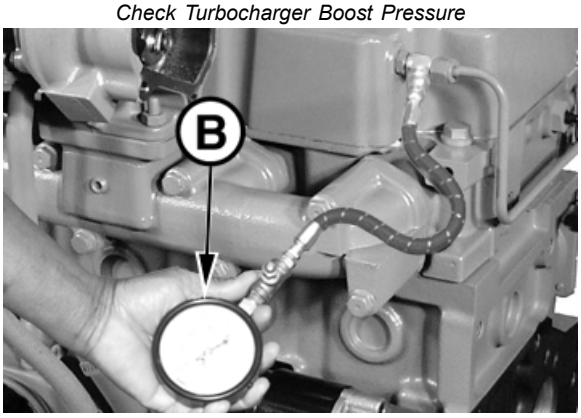
IMPORTANT: In some applications, it may not be possible to meet the turbo boost pressure due to inability to get full load rated speed. In these cases, see Machine Operation and Test Manual for the appropriate test method and pressure.

3. Place engine under full load at rated speed to make test.
4. Observe pressure reading on gauge. Compare readings with charts in Section 06, Group 210. Boost pressure should be within ranges shown in charts when engine is developing rated power at full load rated speed.
5. If boost pressure is too low, check the following:
   - Restricted air filter elements.
   - Restricted fuel filter elements.
   - Incorrect fast idle adjustment.
   - Exhaust manifold leaks.
   - Intake manifold leaks.
   - Faulty fuel supply pump.
   - Low compression pressure.
   - Faulty fuel injection nozzles.
   - Carbon build-up in turbocharger.
   - Turbocharger compressor or turbine wheel rubbing housing.
   - Faulty unit injection pump.
   - Restricted exhaust.
6. After completing test, remove test equipment and fitting and reconnect line to intake manifold. Tighten securely.



RG12667A —UN—23JUN03

Check Turbocharger Boost Pressure



RG12665 —UN—23JUN03

Check Turbocharger Boost Pressure

A—Intake Manifold Line **B—Pressure Gauge**

MK41968,000005B -19-17DEC09-1/1

Low Pressure Fuel System — Check

Additional References:
For fuel system information and flow diagram, see Fuel System Operation located in Section 02, Group 130 earlier in this manual.

NOTE: The wiring diagrams provided are for a typical John Deere supplied OEM harness. Wire number, colors, and jumper connectors do not apply to all applications.

For wiring information see 2.4L/3.0L ECU WIRING DIAGRAM 3 located in Section 06, Group 210 later in this manual.

Flex probe information:
- ECU small terminal - Orange/Blue
- Fuel pressure sensor connector P03 - Purple/Red

For more information on connector and terminal testing or flex probes see Terminal Test in Section 04, Group 160 earlier in this manual.

IMPORTANT: Do not force probes into connector terminals or damage will result. Use JDG10466 Connector Adapter Test Kit to make measurements in connectors. This will ensure that terminal damage does not occur.

MK41968,00000A5 -19-15APR10-1/19

Low Pressure Fuel System Check Diagnostic Procedure

MK41968,00000A5 -19-15APR10-2/19

1 Check for Active DTCs	Were you referred to this Low Pressure Fuel System Check while performing the diagnostic procedures for a diagnostic trouble code (DTC)?	**YES:** GO TO 2 **NO:** Check for and resolve any active DTCs prior to performing this test, then GO TO 2

MK41968,00000A5 -19-15APR10-3/19

2 Preliminary Checks	1. Check for adequate fuel level in fuel tank. 2. Check for restricted vent in fuel tank or fuel cap. 3. Check for loose or misaligned fuel filter housing. 4. Check for ruptured fuel lines. 5. Check for pinched or kinked fuel lines. 6. Check for loose, broken, or cracked fuel line fittings. 7. Verify fuel lines at low pressure fuel pump are installed correctly. The fuel suction line from the fuel tank should be connected to outermost fitting of the low pressure fuel pump. 8. Verify fuel lines at fuel filter header are installed correctly. The fuel supply line from the low pressure fuel pump should be connected to one of the outermost fittings of the fuel filter header. *NOTE: The fuel filter header for the 2.4L/3.0L engine is similar in appearance to the filter header used on many other John Deere engines. However, the fuel inlet and outlet port locations (inboard or outboard) for the 2.4L/3.0L filter header are reversed compared to the filter header for many other John Deere engines.* Was a problem found?	**YES:** Fix problem. If performance problem or DTC still exists, GO TO 3 **NO:** GO TO 3

Continued on next page

MK41968,00000A5 -19-15APR10-4/19

3 Replace Fuel Filter	1. Ignition OFF, engine OFF.	
	2. Drain fuel filter into a clean container.	
	3. Check for water, dirt, or other contaminants in the drained fuel.	
	4. Replace fuel filter element.	**YES:** Inspect fuel tank for cause of contamination. If contaminated, drain and replace fuel in tank with known good fuel. GO TO 4
	Was an abnormal amount of water or contaminants present in the drained fuel?	**NO:** GO TO 4

MK41968,00000A5 -19-15APR10-5/19

4 Check Low Pressure Fuel - Actual Pressure in Service ADVISOR	1. Prime fuel system using primer pump.	
	2. Ignition ON, engine OFF.	
	3. Monitor Low Pressure Fuel - Actual Pressure data point.	
	4. Ignition ON, engine cranking or running.	**YES:** GO TO 11
	Does the Low Pressure Fuel - Actual Pressure data point indicate greater than 170 kPa (25 psi) with engine running or greater than 50 kPa (7 psi) with engine cranking?	**NO:** GO TO 5

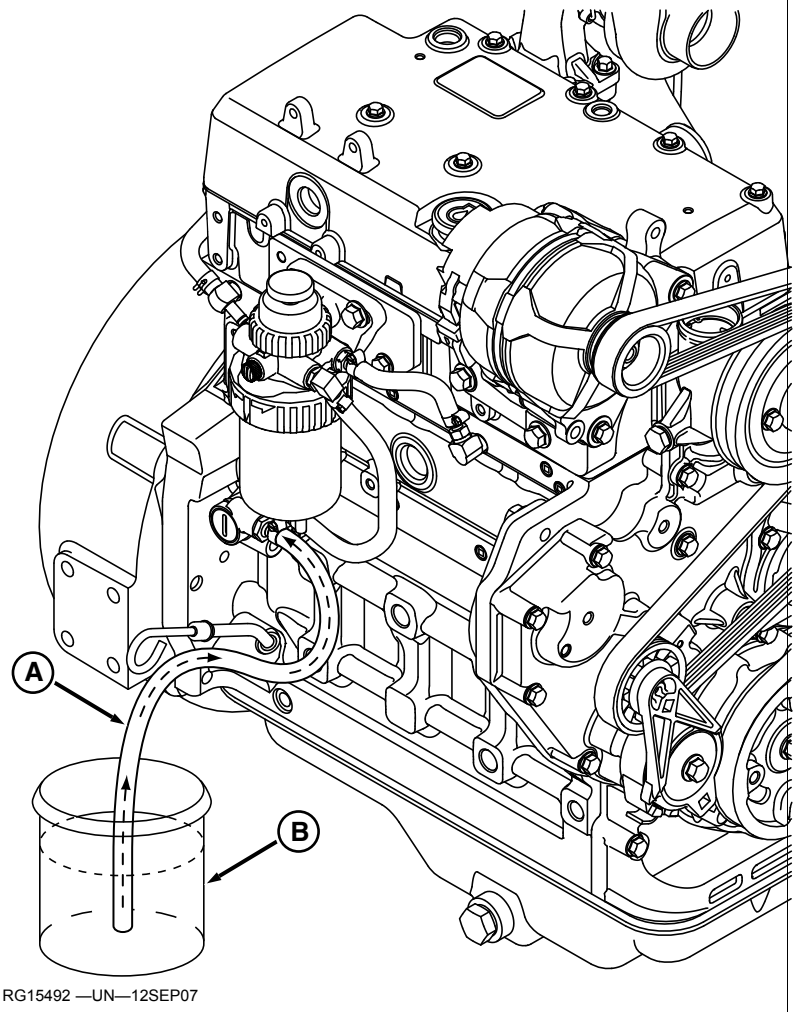
Continued on next page

MK41968,00000A5 -19-15APR10-6/19

5 Temporary Fuel Supply Check

NOTE: Use a clean hose and fuel that has known-good quality in a clean container suitable for diesel fuel for this step.

1. Ignition OFF, engine OFF.
2. Disconnect fuel line at the low pressure fuel pump inlet fitting.
3. Install a hose (A) on low pressure fuel pump inlet fitting and place other end of hose in a container of clean diesel fuel (B).



RG15492 —UN—12SEP07

Temporary Fuel Supply

A—Temporary Fuel Supply Hose
B—Container of Diesel Fuel

4. Purge air from fuel system using primer pump.
5. Monitor Low Pressure Fuel - Actual Pressure in Service ADVISOR.
6. Ignition ON, engine cranking or running.

Does the Low Pressure Fuel - Actual Pressure data point indicate greater than 170 kPa (25 psi) with engine running or greater than 50 kPa (7 psi) with engine cranking?

YES: Repair restriction or air leak between fuel tank and low pressure fuel pump. GO TO 17

NO: GO TO 6

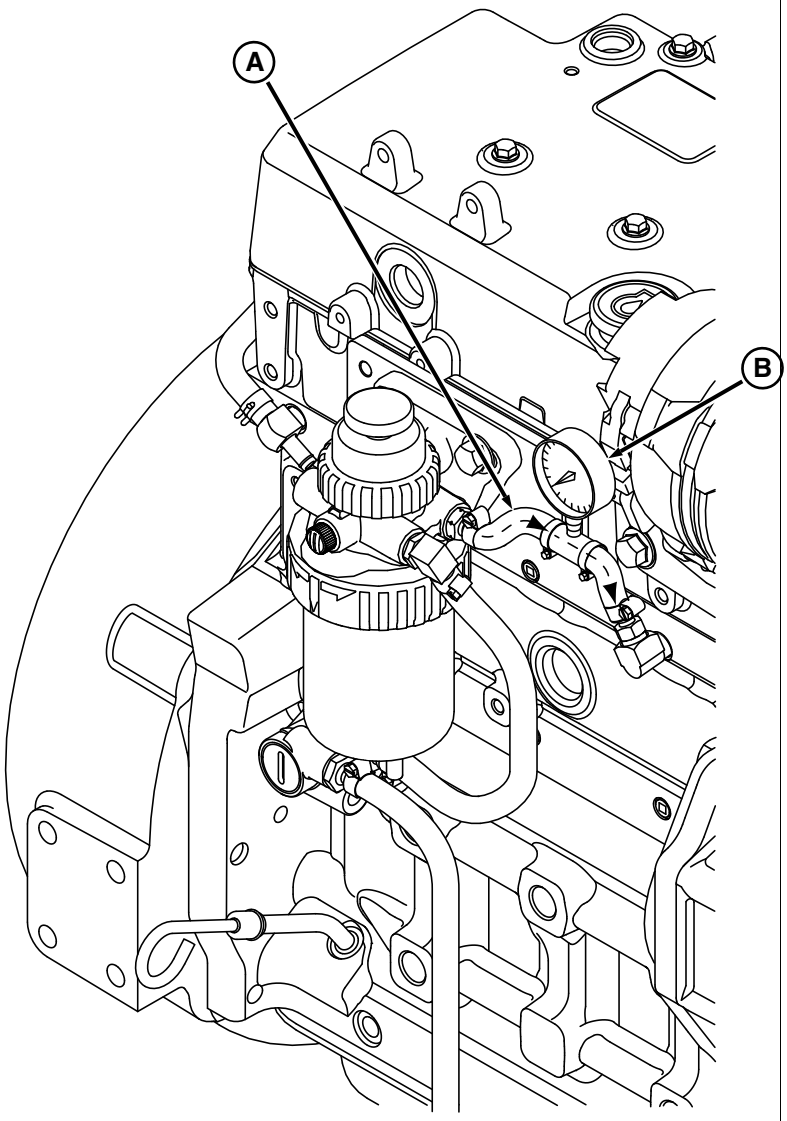
Continued on next page

MK41968,00000A5 -19-15APR10-7/19

6 Check Fuel Pressure Measurement Accuracy

1. Ignition OFF, engine OFF.

2. Disconnect the fuel supply line (A) at fuel filter outlet and install a 350 kPa (50 psi) gauge (B) into the fuel supply line.



RG15494 —UN—12SEP07

A—Fuel Supply Line at Fuel Filter Outlet
B—Fuel Pressure Gauge

3. Monitor Low Pressure Fuel - Actual Pressure in Service ADVISOR.
4. Ignition ON, engine cranking or running.

Is the gauge reading within 35 kPa (5 psi) of the Low Pressure Fuel - Actual Pressure data point?

YES: Remove gauge and reinstall fuel supply line.
GO TO 7

NO: GO TO 12

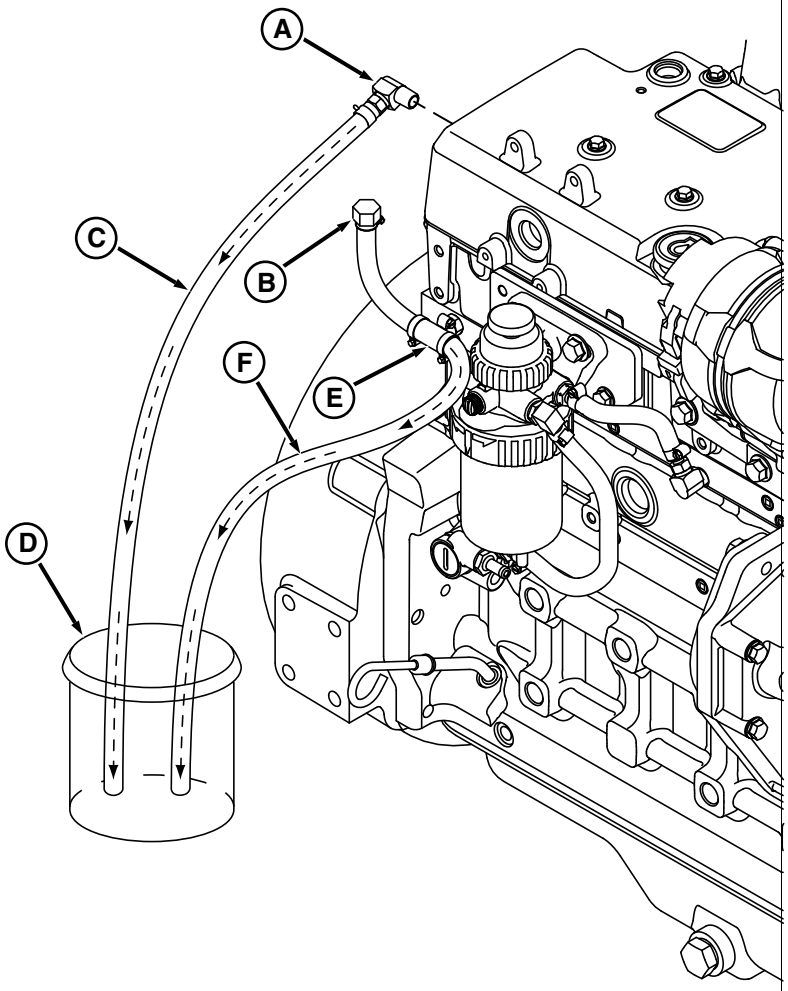
Continued on next page

MK41968,00000A5 -19-15APR10-8/19

❼ Check for Stuck Open Fuel Check Valve

NOTE: The fuel check valve is contained in a "T" fitting threaded into a tapped hole in the engine block. The check valve opens at approximately 200 kPa (29 psi) to regulate fuel supply system pressure. See Theory of Operation for more information on the fuel check valve.

1. Ignition OFF, engine OFF.
2. Remove injector nozzle leak-off hose from injector nozzle leak-off fitting (A) at rear of cylinder head.
3. Install a plug (B) in the injector nozzle leak-off hose.
4. Install a 10 mm (3/8 inch) hose (C) to the injector nozzle leak-off fitting and place the other end of the line in an empty container suitable for diesel fuel (D).



RG15498 —UN—25SEP07

Check for Flow Through Fuel Check Valve

A—Injector Nozzle Leak-Off Fitting
B—Plug
C—Temporary Injector Leak-Off Hose
D—Empty Container
E—Fuel Check Valve
F—Temporary Fuel Return Hose

5. Remove the fuel return line from the fuel check valve (E).
6. Install a 10 mm (3/8 inch) hose (F) to the fuel check valve fitting and place the other end of the line in the empty container (D).
7. Ignition ON, engine cranking or running.

Is fuel flow present through the temporary fuel return hose (F) with engine cranking or running?

YES: Replace fuel check valve. GO TO 17

NO: Reinstall fuel return lines. GO TO 8

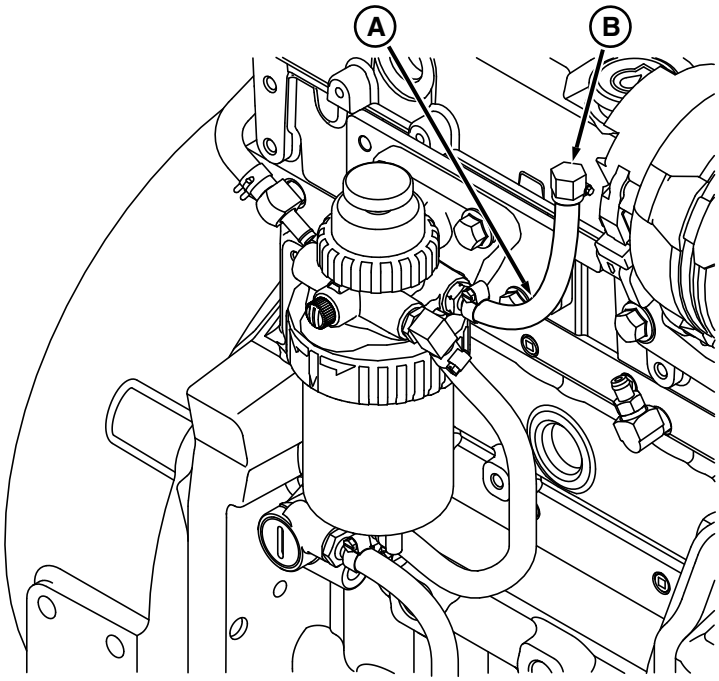
Continued on next page

MK41968,00000A5 -19-15APR10-9/19

8 Check Fuel Pump

1. Ignition OFF, engine OFF.

2. Remove fuel line (A) from fuel gallery inlet fitting and install a plug (B) in the fuel line.



RG15497 —UN—12SEP07

Checking Fuel Pressure with Pump Dead-Headed

A—Fuel Line at Filter Outlet
B—Plug

YES: Check for internal engine fuel leak. See Fuel in Oil in Section 4 Group 150.

3. Ignition ON, engine cranking or running.

NO: Engine does not start. GO TO 9

Does the Low Pressure Fuel - Actual Pressure data point indicate greater than 170 kPa (25 psi) with engine running or greater than 50 kPa (7 psi) with engine cranking?

NO: Engine runs. GO TO 10

MK41968,00000A5 -19-15APR10-10/19

9 Check for Camshaft Rotation

1. Remove engine oil fill cap from rocker cover.

2. Check for push rod movement by viewing through the oil cap opening in rocker cover as engine is cranked.

YES: Reinstall oil fill cap. GO TO 10

Do push rods move up and down when engine is cranked?

NO: Check for internal engine problem causing camshaft to not rotate.

Continued on next page

MK41968,00000A5 -19-15APR10-11/19

10 Replace Low Pressure Fuel Pump

1. Ignition OFF, engine OFF.
2. Replace low pressure fuel pump. Verify pump push rod is installed.
3. Purge air from fuel system using primer pump.
4. Monitor Low Pressure Fuel - Actual Pressure in Service ADVISOR.
5. Ignition ON, engine cranking or running.

Does the Low Pressure Fuel - Actual Pressure data point indicate greater than 170 kPa (25 psi) with engine running or greater than 50 kPa (7 psi) with engine cranking?

YES: Fuel supply system is operating correctly. Return to DTC or other procedure.

NO: Check for damaged fuel pump lobe on camshaft. Open DTAC case if no problem found.

MK41968,00000A5 -19-15APR10-12/19

11 Check Fuel Pressure Measurement Accuracy

1. Ignition OFF, engine OFF.
2. Install a 350 kPa (50 psi) gauge in the fuel line between the fuel filter outlet fitting and the fuel gallery inlet fitting.
3. Monitor Low Pressure Fuel - Actual Pressure in Service ADVISOR.
4. Ignition ON, engine cranking or running.

Is the gauge reading within 35 kPa (5 psi) of the Low Pressure Fuel - Actual Pressure data point?

YES: GO TO 14

NO: GO TO 12

MK41968,00000A5 -19-15APR10-13/19

12 Fuel Pressure Sensor Circuit Checks

1. Ignition OFF, engine OFF.
2. Disconnect ECU J1 connector and fuel pressure sensor P03 connector.
3. Perform Terminal Test on J1 and P03 connectors.
4. On the harness, measure the resistance between ECU J1-B3 and fuel pressure sensor connector P03-C.
5. On the harness, measure the resistance between ECU J1-F3 and fuel pressure sensor connector P03-B.
6. On the harness, measure the resistance between ECU J1-D2 and fuel pressure sensor connector P03-A.

Were Terminal Test results good and were all resistance measurements less than 10 ohms?

YES: Replace low pressure fuel sensor. GO TO 13

NO: Fix problem. GO TO 17

MK41968,00000A5 -19-15APR10-14/19

13 Recheck Fuel Pressure Measurement Accuracy

1. Ignition OFF, engine OFF.
2. Monitor Low Pressure Fuel - Actual Pressure in Service ADVISOR.
3. Ignition ON, engine cranking or running.

Is the gauge reading within 35 kPa (5 psi) of the Low Pressure Fuel - Actual Pressure data point?

YES: GO TO 17

NO: Replace ECU. GO TO 17

Continued on next page

MK41968,00000A5 -19-15APR10-15/19

14 Check for Fuel Pressure Too High

Does the Low Pressure Fuel - Actual Pressure data point indicate greater than 230 kPa (33 psi) with engine running or cranking?

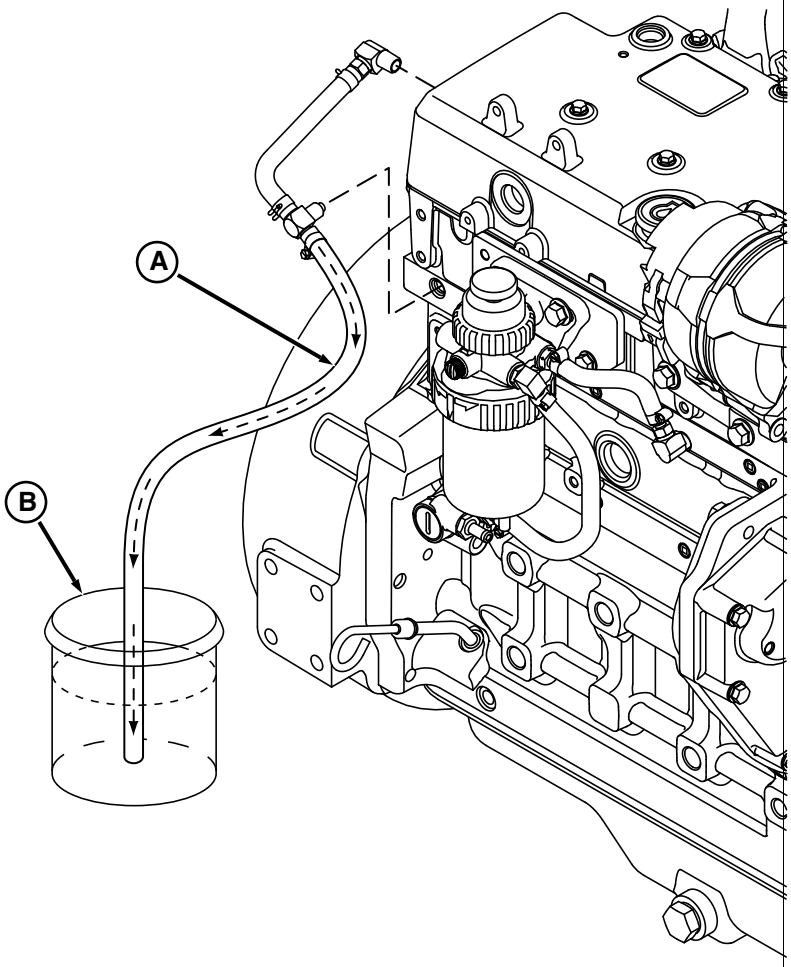
YES: GO TO 15

NO: Fuel supply system is operating correctly. Return to DTC or other procedure.

MK41968,00000A5 -19-15APR10-16/19

15 Check for Restricted Fuel Return Line

1. Ignition OFF, engine OFF.
2. Disconnect fuel return line at fuel check valve fitting located in engine block.
3. Install a hose (A) to the fuel check valve fitting and place the other end of the hose in a container suitable for diesel fuel (B).



RG15495 —UN—12SEP07

Check for Restricted Fuel Return Line

A—Temporary Fuel Return Hose
B—Container

Does the Low Pressure Fuel - Actual Pressure data point indicate greater than 230 kPa (33 psi) with engine running or cranking?

YES: GO TO 16

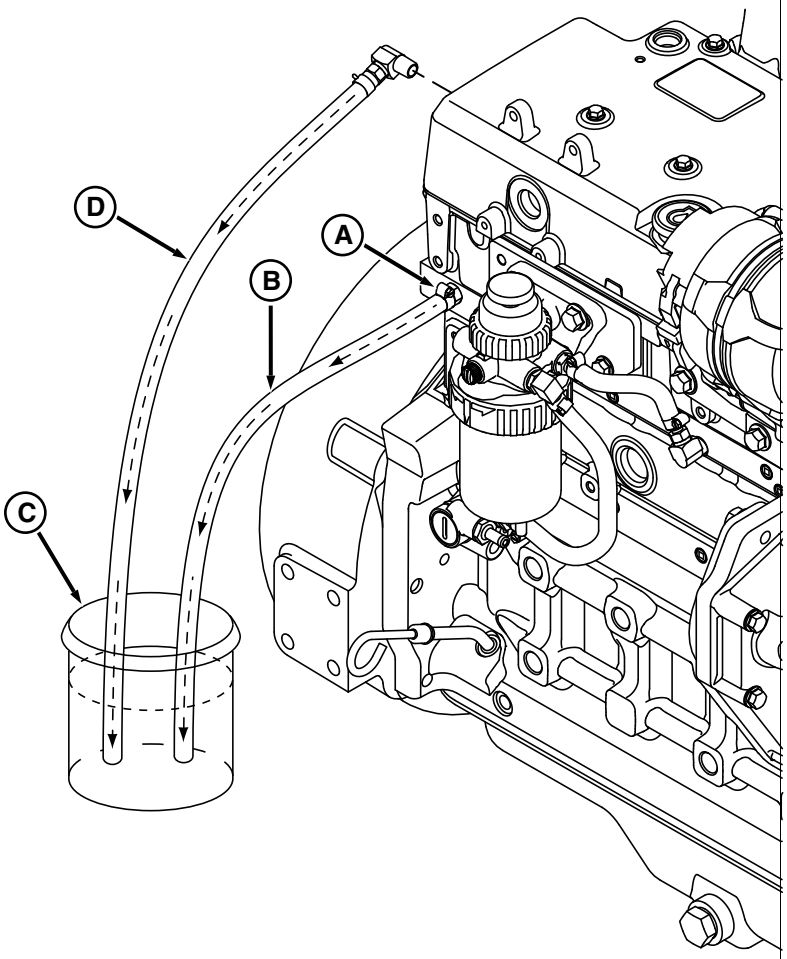
NO: Repair restriction in fuel return line. GO TO 17

Continued on next page

MK41968,00000A5 -19-15APR10-17/19

16 Test for Fuel Check Valve Stuck Closed

1. Ignition OFF, engine OFF.
2. Remove fuel return line and injector nozzle leak off line from the fuel check valve fitting.
3. Remove fuel check valve from engine block.
4. Install a 1/4 inch NPTF barbed hose fitting (A) in the tapped hole where fuel check valve was removed.



RG15496 —UN—25SEP07

Check Fuel Pressure with Fuel Check Valve Removed

A—1/4 inch NPTF Barbed Fitting
B—Temporary Fuel Return Hose
C—Container
D—Injector Nozzle Leak-Off Return Line

5. Install a hose (B) on the fitting (A) and place the other end of the hose in a container suitable for diesel fuel (C).
6. Place the end of the disconnected injector nozzle leak off line (D) in the container.
7. Monitor Low Pressure Fuel - Actual Pressure data point.
8. Ignition ON, engine cranking or running.

Does the Low Pressure Fuel - Actual Pressure data point indicate greater than 230 kPa (33 psi) with engine running or cranking?

YES: Check for restriction between fuel filter outlet and the fuel check valve, including the fuel galleries in the engine block.

NO: Replace fuel check valve. GO TO 17

Continued on next page

MK41968,00000A5 -19-15APR10-18/19

17 Verification	1. Ignition OFF, engine OFF. 2. Reconnect all fuel lines. 3. Monitor Low Pressure Fuel - Actual Pressure data point. 4. Ignition ON, engine running or cranking. Does the Low Pressure Fuel - Actual Pressure data point indicate between 170 kPa (25 psi) to 230 kPa (33 psi) with engine running or greater than 50 kPa (7 psi) with engine cranking?	**YES:** Fuel supply system is operating correctly. Return to DTC or other procedure. **NO:** GO TO 1

MK41968,00000A5 -19-15APR10-19/19

Mechanical Compression Test

IMPORTANT: Compression pressures are affected by the cranking speed of the engine. Before beginning test, ensure that batteries are fully charged.

1. Start engine and run at rated speed until it warms up to normal operating temperature. (From a cold start, operate engine 10—15 minutes at slow idle.)
2. Shut off engine and remove the rocker arm cover. See Rocker Arm Cover — Installation and Removal in Group 20.
3. Shut off fuel supply and remove glow plugs. See Glow Plugs — Removal in Section 20.
4. Install JDG1687 into glow plug bore in the cylinder head and tighten to specification. Attach 45° quick disconnect fitting to compression adapter and install compression gauge to adapter. Do not tighten adapter to more than glow plug torque specification.

Specification	
Glow Plug—Torque	13 N·m (10 lb-ft)

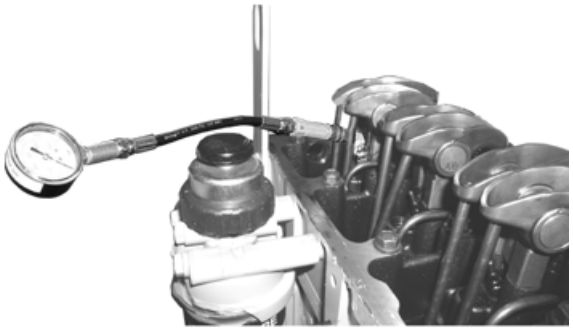
5. Set rocker arm cover on top of cylinder head to reduce oil spray from push rods.

Compression Test

1. Push throttle lever to “STOP” position. Turn crankshaft for 10—15 seconds with starter motor (minimum cranking speed—150 rpm cold/200 rpm hot).
2. Compare readings from all cylinders. Compression pressure must be within specification.

Specification	
Engine Compression Pressure Test—Engine Compression Pressure	2379—2792 kPa (24—28 bar) (345—405 psi)
Maximum Difference between Cylinders	350 kPa (3.5 bar) (50 psi)

NOTE: Pressure given was taken at 183 m (600 ft) above sea level. A 3.6 percent reduction in gauge pressure will result for each additional 300 m (1000 ft) rise in altitude.



RG13030 —UN—01JUL03

Engine Compression Test

All cylinders within an engine should have approximately the same pressure. There should be less than 340 kPa (3.4 bar) (50 psi) difference between cylinders.

3. If pressure is much lower than shown, remove gauge and apply oil to ring area of piston through injection nozzle or glow plug bore. Do not use too much oil. Do not get oil on the valves.
4. Test compression pressure again.

   If pressure is high, worn or stuck rings are indicated, replace piston rings or install new piston set as needed. See Piston Rings — Installation, Piston and Connecting Rod — Reassemble and Piston and Connecting Rod Assembly — Installation in Section 02, Group 030.

   If pressure is low, valves could be worn or sticking. Recondition cylinder head as required. (See Cylinder Head — Thickness Check in Section 02, Group 020.)
5. Measure compression pressure in all remaining cylinders and compare readings. Recondition cylinders and valves as required.

IMPORTANT: When testing is completed, use a clean lint free rag to clean all oil from intake manifold ports.

MK41968,00000A8 -19-01JUN10-1/1

Restarting Engine that has Ran Out of Fuel

See procedure Fuel System Bleeding in this group.

JB81757,0000053 -19-23JAN10-1/1

Thermostat Operation Test

Visually inspect thermostat for corrosion or damage. Replace as necessary.

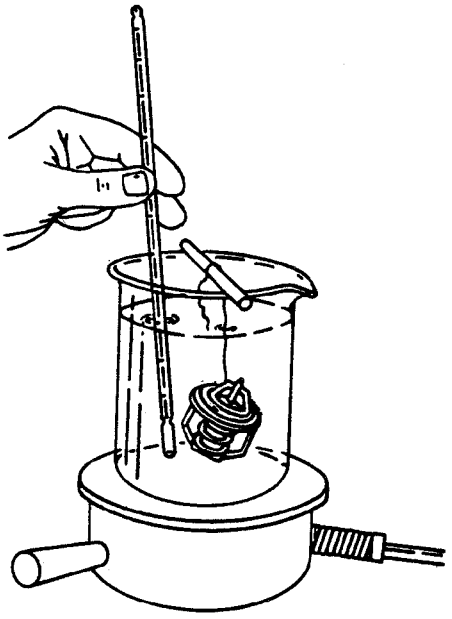
Test thermostat as follows:

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

1. Remove thermostats. (See Thermostat — Removal in Section 02, Group 070.)
2. Suspend thermostat and a thermometer in a container of water.
3. Stir the water as it heats. Observe opening action of thermostat and compare temperatures with specification given in chart below.

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

THERMOSTAT TEST SPECIFICATIONS		
Rating	**Initial Opening (Range)**	**Full Open (Nominal)**
71°C (160°F)	69—72°C (156—162°F)	84°C (182°F)
77°C (170°F)	74—78°C (166—172°F)	89°C (192°F)
82°C (180°F)	80—84°C (175—182°F)	94°C (202°F)
89°C (192°F)	86—90°C (187—194°F)	101°C (214°F)
90°C (195°F)	89—93°C (192—199°F)	103°C (218°F)
92°C (197°F)	89—93°C (193—200°F)	105°C (221°F)
96°C (205°F)	94—97°C (201—207°F)	100°C (213°F)
99°C (210°F)	96—100°C (205—212°F)	111°C (232°F)



RG5971 —UN—23NOV97

Test Thermostat Opening Temperature

4. 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.
5. If thermostat is defective, replace thermostat.

MK41968,000005D -19-23JAN10-1/1

Turbocharger Oil Seal — Leak Check

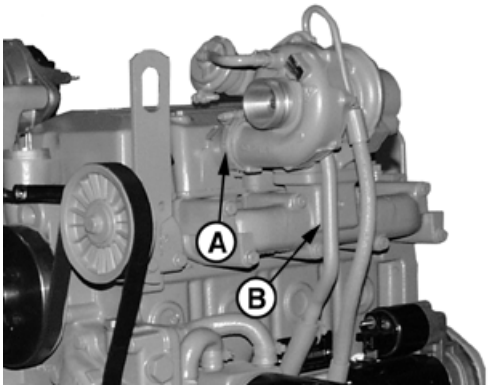
Seals are used on both sides of the turbocharger rotor assembly. The seals are used to prevent exhaust gasses and air from entering the turbocharger housing. Oil leakage past the seals is uncommon but can occur.

A restricted or damaged turbocharger oil return line can cause the housing to pressurize, causing oil to leak by the seals. Additionally, intake or exhaust restrictions can cause a vacuum between the compressor and turbocharger housing, causing oil to leak by the seals.

1. Remove exhaust pipe (shown removed) and inlet hose (A).
2. Inspect the turbine casing and inlet hose for evidence of oil leakage.

   If oil leakage is present, perform the following:

   - Inspect turbocharger oil return line (B) for kinks or damage. Replace if necessary.
   - Check the air intake filter, hoses, and inlet hose for restrictions.
   - Check the exhaust system for restrictions to include position of exhaust outlet.
3. Perform necessary repairs and repeat test.



RG12656 —UN—29MAY03

Turbocharger Oil Seal Leak Test

A—Inlet Hose **B—Oil Return Line**

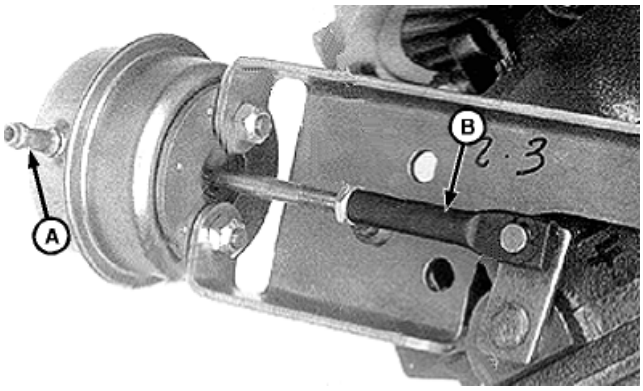
MK41968,000005E -19-17DEC09-1/1

Wastegate Turbocharger Test

1. Check hose to wastegate actuator for kinks or cracks. Replace if damaged.
2. Disconnect hose from wastegate actuator.
3. Connect a regulated air source to actuator fitting (A).
4. Vary pressure to wastegate actuator from 83—103 kPa (.83—1.03 bar) (12—15 psi).

   Actuator rod (B) should move in and out freely as pressure is varied.

   If rod does not move freely, check wastegate adjustment. (See ADJUST TURBOCHARGER WASTEGATE ACTUATOR in Section 02, Group 080.)



RG9147 —UN—23JUL98

Wastegate Check

A—Actuator Fitting **B—Actuator Rod**

MK41968,00000AC -19-23DEC09-1/1

Dynamometer Test

IMPORTANT: Dynamometers should be periodically checked for accuracy and calibrated as necessary.

1. Connect engine to dynamometer using manufacturer's instructions.
2. Operate engine at one-half load until coolant and crankcase oil temperatures are up to normal operating range.
3. Run engine at fast idle.
4. Gradually increase load on engine until speed is reduced to rated speed rpm.

NOTE: Refer to appropriate machine technical manual for average power ratings of specific applications. Allow ±5% for minimum and maximum power.

5. Read horsepower on dynamometer and record reading over a period of several minutes after engine stabilizes.
6. Compare readings taken with power rating level for your engine application, as listed in Section 06, Group 200.

MK41968,00000AA -19-23DEC09-1/1

Control Unit Information and Overview Test

This test gathers specific information from the ECU and puts it into a printable format. The test automatically starts and gathers all of the information listed below. When all the information has been gathered, it is displayed on the screen. The following options are then displayed: Refresh, Exit, and Print.

Refresh:
Selecting this option gathers the information again and displays the new data.

Exit:
Selecting this option exits the test.

Print:
Selecting this option allows the user to print the data now or save it to a file and print it later. For more information, see Interactive Tests and Calibration Results — Printing, Exporting, or Saving Instructions in this group.

The information gathered is:

- Date tested
- Engine Serial number
- Engine Hourmeter
- ECU serial number
- ECU software assembly part number
- Engine model number
- ECU configuration file part number
- ECU software part number
- Vehicle option part number
- Performance option part number
- Operating code compatibility code
- EOL compatibility code
- Option assembly part number
- ECU part number
- Injector number
- Injector part number
- Injector serial number
- Injector calibration code
- See, **Other data that can be collected** below to collect additional data points.
- Active and Stored trouble codes at the time test data is taken

Other data that can be collected:
This test can be set up to collect other static data. Any data point that is available to view can be setup to get sent with this report. The ControlUnitInformation.ini file located in the “C:\Documents and Settings\All Users\Application Data\Service ADVISOR\CAL\Connectivity Applications\AEA Data Files\Procedure Files” folder just needs to be modified. To modify the file see below:

1. Open the ControlUnitInformation.ini using a text editor like Notepad.
2. Scan down to the text that starts with “[Level”.
3. Insert your ECU level under the one(s) listed or replace the number with the controller you are connecting to.
4. The first item under the Level is NumberofDPs. This is the number of data points you want to list. You MUST match the number of data points and this number for the test to run properly.
5. The first data point is DP1= “the data point name you want to record”
6. Continue adding data points using the format in step 5 above.
7. When finished adding the data points simply save the file and close the text editor.

To perform the test:

1. In Service ADVISOR, select Tests and calibrations from the shortcut bar.
2. Select Control Unit Information and Overview.
3. The test automatically starts to gather information, then displays it on the screen.
4. At the end of the data gathering, the following options are available: Refresh, Exit, or Print.

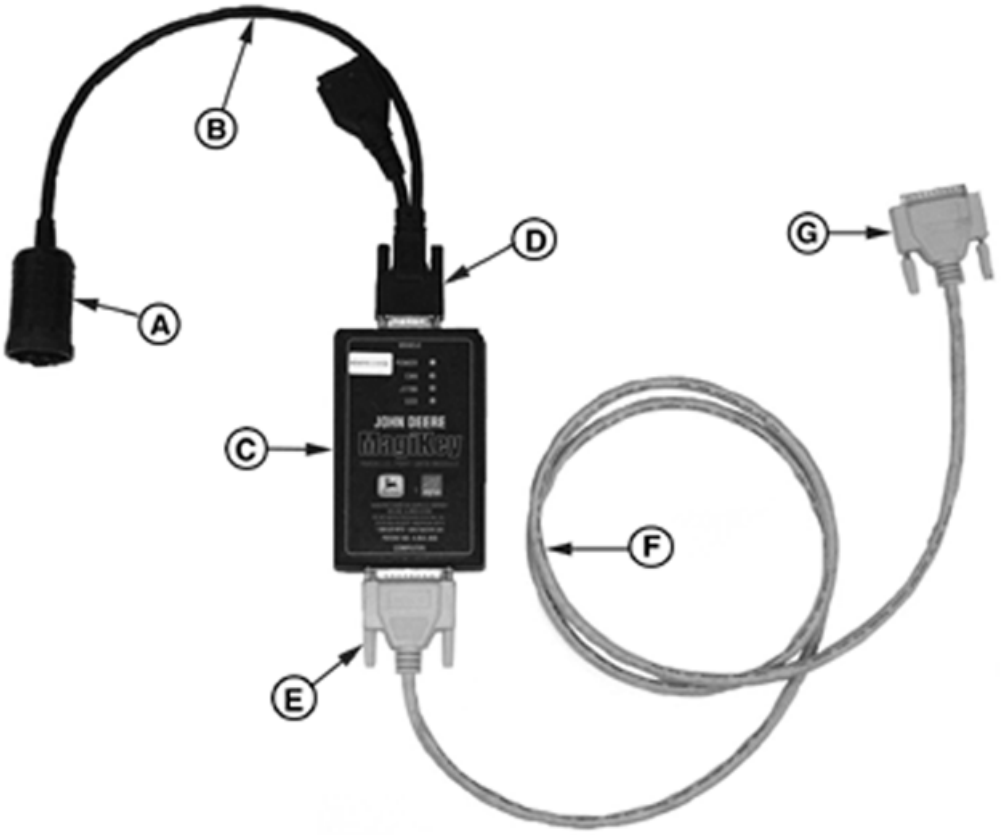
DN22556,00006A8 -19-28MAR11-1/1

Connecting to Service ADVISOR

Refer to the appropriate section below for instructions on connecting Service ADVISOR to your application.

Connecting to Service ADVISOR with PDM Adapter

The Parallel Data Module (PDM) Adaptor is used to provide communication between the PC and the ECU.



RG11737A —UN—18MAY01

Connecting to Service ADVISOR

A—Diagnostic Connector Mate
B—John Deere Controller Cable
C—PDM (Parallel Data Module)
D—26 Pin PDM Connector
E—25 Pin PDM Connector
F—Parallel Cable
G—PC Connector

The PDM is connected to the engine ECU through the diagnostic connector. The diagnostic connector is a 9-pin circular connector with a square mounting flange and a dust cap. The location of the diagnostic connector varies depending on application. On OEM engines, the connector is located near the ECU on the engine wiring harness.

DS10023 ECU Communication Hardware Kit or JDIS121 ECU Communication Hardware Kit is required to connect Service ADVISOR to the ECU.

IMPORTANT: The PDM Adapter is no longer supported. The EDL (Electronic Data Link) is the current hardware available for order. The PDM adapter will still communicate with the ECU.

Instructions for connecting to Service ADVISOR with PDM:

1. Locate diagnostic connector on engine and remove dust cap.
2. Connect John Deere Controller Cable (B) to the diagnostic connector on the engine harness using the diagnostic connector mate (A).
3. Connect the other end of the John Deere Controller Cable to the PDM (C) module at the 26 pin PDM connector (D).
4. Connect the parallel cable (F) to the PDM module at the 25 pin PDM connector (E).
5. Connect the other end of the parallel cable to the PC with Service ADVISOR installed.
6. Key ON, engine off or running.

Continued on next page

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7. Start Service ADVISOR and select Connect to Model(s) from the Readings menu, or press the connect icon on the toolbar.
8. Select Parallel Data Module (PDM) as the current Adapter in the Select Readings Adapter box.
9. Select the engine model. Press the Change Models button in this box to see a list of engine models if the engine model is not listed.
10. Press the Connect button after selecting the engine model.
11. If Service ADVISOR does not connect, see ECU Does Not Communicate With Service ADVISOR diagnostic procedure in Group 150 of this manual.
12. If power to the PDM is lost while cranking the engine for the Mechanical Compression Test, use the Power Adapter. The Power Adapter connects between the PDM and the 26 pin PDM connector.
13. When finished, replace the dust cap on the diagnostic connector.

RG12277 —UN—22APR02

Power Adapter

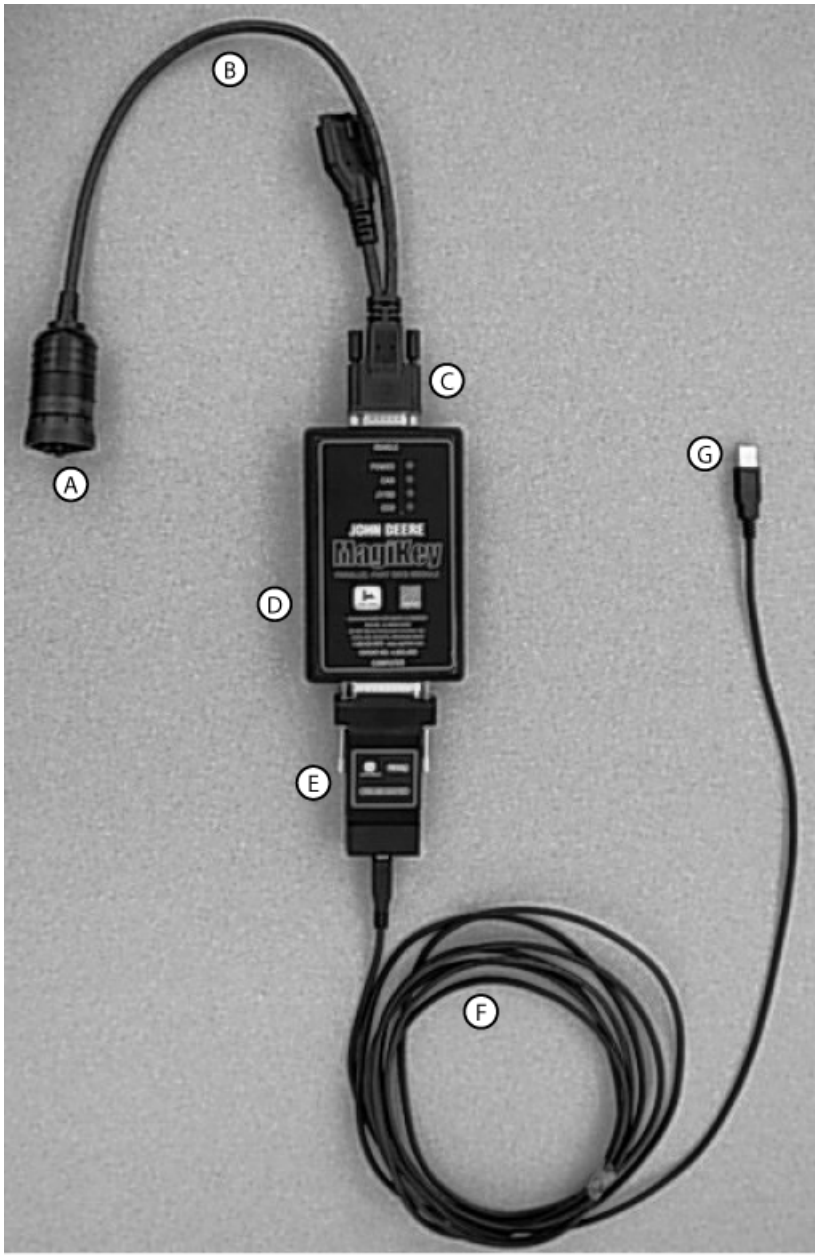
Continued on next page

DM59778,000007B -19-23JAN10-2/5

Connecting to Service ADVISOR with PDM Adapter and USB Adapter

The Parallel Data Module (PDM) Adapter is used to provide communication between the PC and the ECU.

The USB Adapter is used to permit the PDM to connect to a USB port on the PC.



RG16524 —UN—20OCT08

A—Diagnostic Connector Mate
B—John Deere Controller Cable
C—26 Pin PDM Connector
D—Parallel Data Module (PDM)
E—USB Adapter
F—USB Cable
G—PC Connector

The PDM is connected to the engine ECU through the diagnostic connector. The diagnostic connector is a 9-pin circular connector with a square mounting flange and a dust cap. The location of the diagnostic connector varies depending on application. On OEM engines, the connector is located near the ECU on the engine wiring harness.

DS10023 ECU Communication Hardware Kit or JDIS121 ECU Communication Hardware Kit is required to connect Service ADVISOR to the ECU.

IMPORTANT: The PDM Adapter is no longer supported. The EDL (Electronic Data Link) is the current hardware available for order. The PDM adapter will still communicate with the ECU.

Instructions for connecting Service ADVISOR:

1. Locate diagnostic connector on engine and remove dust cap.

Continued on next page

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2. Connect John Deere Controller Cable (B) to the diagnostic connector on the engine harness using the diagnostic connector mate (A).
3. Connect the other end of the John Deere Controller Cable to the PDM (D) module at the 26 pin PDM connector (C).
4. Connect the USB Adapter (E) to the PDM module.
5. Connect the USB cable (F) to the USB Adapter.
6. Connect the USB cable PC connector (G) to the USB port on the PC.
7. Key ON, engine off or running.
8. Start Service ADVISOR and select Connect to Model(s) from the Readings menu, or press the connect icon on the toolbar.
9. Select Parallel Data Module (PDM) with USB Adapter as the current Adapter in the Select Readings Adapter box.
10. Select the engine model. Press the Change Models button in this box to see a list of engine models if the engine model is not listed.
11. Press the Connect button after selecting the engine model.
12. If Service ADVISOR does not connect, see ECU Does Not Communicate With Service ADVISOR diagnostic procedure in Group 150 of this manual.
13. When finished, replace the dust cap on the diagnostic connector.

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DM59778,000007B -19-23JAN10-4/5

Connecting to Service ADVISOR with EDL Adapter using USB Cable

The Electronic Data Link (EDL) Adapter is used to provide communication between the PC and the ECU.

The EDL is connected to the engine ECU through the diagnostic connector. The diagnostic connector is a 9-pin circular connector with a square mounting flange and a dust cap. The location of the diagnostic connector varies depending on application. On OEM engines, the connector is located near the ECU on the engine wiring harness.

SA1001 ECU Communication Hardware Kit contains the EDL and cables necessary to connect Service ADVISOR to the ECU. This kit replaces the DS10117 ECU Communication Hardware Kit. Either kit allows communication with the ECU.

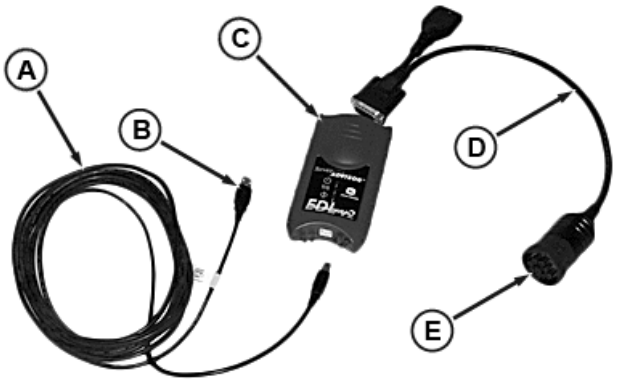
Instructions for connecting Service ADVISOR to the ECU:

1. Locate diagnostic connector on engine and remove dust cap.
2. Connect John Deere Controller Cable (B) to the diagnostic connector on the engine harness.
3. Connect the other end of the John Deere Controller Cable to the EDL (C).
4. Connect the USB cable (D) to the EDL.
5. Connect the other end of the USB cable to the PC with Service ADVISOR installed.
6. Key ON, engine off or running.
7. Start Service ADVISOR and select Connect to Model(s) from the Readings menu, or press the connect icon on the toolbar.
8. Select Electronic Data Link (EDL) Stand-alone USB Device as the current Adapter in the Select Readings Adapter box.
9. Select the engine model. Press the Change Models button in this box to see a list of engine models if the engine model is not listed.
10. Press the Connect button after selecting the engine model.
11. If Service ADVISOR does not connect, see ECU Does Not Communicate With Service ADVISOR diagnostic procedure in Group 150 of this manual.
12. When finished, replace the dust cap on the diagnostic connector.

Connecting to Service ADVISOR with EDL Adapter using Bluetooth

The Electronic Data Link (EDL) Adapter is used to provide communication between the PC and the ECU using Bluetooth wireless communications. The PC must have a Bluetooth Adapter or be Bluetooth capable for this feature to work.

The EDL is connected to the engine ECU through the diagnostic connector. The diagnostic connector is a 9-pin circular connector with a square mounting flange and a dust cap. The location of the diagnostic connector varies depending on application. On OEM engines, the connector is located near the ECU on the engine wiring harness.



A—USB Cable
B—to PC with Service ADVISOR
C—EDL (Electronic Data Link)
D—John Deere Controller Cable
E—to 9-Pin Diagnostic Connector on Engine

SA1001 ECU Communication Hardware Kit contains the EDL and cables necessary to connect Service ADVISOR to the ECU. This kit replaces the DS10117 ECU Communication Hardware Kit. Either kit allows communication with the ECU.

Instructions for connecting Service ADVISOR to the ECU using Bluetooth wireless:

1. Locate diagnostic connector on engine and remove dust cap.
2. Connect John Deere Controller Cable to the diagnostic connector on the engine harness.
3. Connect the other end of the John Deere Controller Cable to the EDL.
4. Key ON, engine off or running.
5. Start Service ADVISOR and select Connect to Model(s) from the Readings menu, or press the connect icon on the toolbar.
6. Select Electronic Data Link (EDL) using Bluetooth as the current Adapter in the Select Readings Adapter box.
7. Select the engine model. Press the Change Models button in this box to see a list of engine models if the engine model is not listed.
8. Press the Connect button after selecting the engine model.
9. If Service ADVISOR does not connect, see ECU Does Not Communicate With Service ADVISOR diagnostic procedure in Group 150 of this manual.
10. When finished, replace the dust cap on the diagnostic connector.

DM59778,000007B -19-23JAN10-5/5

Cylinder Cutout Test Instructions

For instructions on connecting to Service ADVISOR, see Connecting To Service ADVISOR earlier in this Group.

The Cylinder Cutout Test is used to aid in identifying a cylinder that is having a problem or to help in diagnosing mechanical or intermittent problems. During the test, the Engine Control Unit (ECU) will disable the cylinder that the technician selects. The test can be performed while operating the vehicle under the conditions that the problem occurs.

The Cylinder Cutout Test can not determine if an engine is developing low power. The test is only a guide to help determine if there is a problem in a cylinder. The results alone should not be used as a conclusive reason for replacing parts. Other information such as the results of a Engine Test Instructions - Compression Test, Cylinder Misfire Test, and other engine diagnostic procedures should be used along with this test information to accurately determine the source of the engine problem.

Before executing the Cylinder Cutout Test

- Warm engine to normal operating temperature.
- Repair the cause of any Diagnostic Trouble Codes (DTCs) if possible.

  NOTE: The ECU will not allow the test to run if there is an active engine timing error code (any 637 code), an active engine position error code (any 636 code), coolant temperature is below 40° C (104° F) or above 110° C (230° F). If the engine goes into an overspeed condition while running test, the test will stop.

- Ensure that the battery and starter are in good working condition

Performing the Cylinder Cutout Test

1. Engine idling or under the conditions that the problem occurred.
2. Select Cylinder Cutout Test in Service ADVISOR.
3. Follow instructions given by Service ADVISOR.
4. Observe engine operation and the parameters displayed on the Service ADVISOR screen. These parameters include: engine load at current speed, engine speed, and manifold air pressure.
5. Use this data and observations to help in the diagnosis of the problem.

NOTE: Run this test at least 3 times to ensure repeatable, accurate results.

Analysis

A contribution below 70% means that the cylinder is probably not working at all. If a switched-off cylinder does not make any difference to the engine sound, this cylinder is probably not working at all.

A contribution between 70%-90% means that the cylinder does not give its full potential. If the sound slightly changes when the cylinder is cutout the cylinder is working but not to the full potential. To confirm this diagnostic, perform a Cylinder Misfire Test and Compression Test; See Cylinder Electronic Compression Test Instructions and Cylinder Misfire Test Instructions to help confirm the cylinder has a problem.

If the sound is better with a cylinder cutoff, this cylinder is probably firing at the wrong time. This may be due to a damaged injector, electronic unit pump, or a bad electrical connection between ECU and electronic unit pump. If the results of the Cylinder Cutout Test and Cylinder Misfire Test lead to the same cylinder, and the Engine Test Instructions - Compression Test checks good for that cylinder, then the electronic unit pump wiring or injector is probably bad. First check the electrical connections, looking for shorts to the chassis especially, then if no problems are found, replace faulty electronic unit pump and injector.

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Cylinder Electronic Compression Test Instructions

For instructions on connecting to Service ADVISOR, see Connecting To Service ADVISOR earlier in this Group.

The Compression Test is used to compare the compression of each cylinder to the average compression of all cylinders. The test will help determine if a cylinder has low compression compared to all other cylinders. During the test, the Engine Control Unit (ECU) will disable the engine from starting, then measure the time it takes the piston of each cylinder to accelerate through and past TDC. A piston that accelerated faster than the rest would indicate that cylinder has lower compression than the other cylinders.

The Compression Test cannot determine the true compression pressure of any cylinder, it can only compare each cylinder to the average. The test results are only a guide to help determine if a cylinder has low average compression. The results alone should not be used as a conclusive reason for performing any major engine work. Other information such as the results of the Cylinder Misfire Test, Cylinder Cutout Test, and other engine diagnostic procedures should be used to accurately determine the source of an engine problem.

Before executing the Compression Test

- Warm engine to normal operating temperature.
- Repair the cause of any Diagnostic Trouble Codes (DTCs) if possible.

NOTE: The ECU will not allow the test to run if there is an active engine timing error code (any 637 code), the engine cranking speed is below 100 rpm, coolant temperature is below -30° C (-22° F) or above 200° C (392° F).

- Ensure that the battery and starter are in good working condition

Performing the Engine Test Instructions - Compression Test

1. Engine OFF.
2. Select Engine Test Instructions - Compression Test in the Service ADVISOR.
3. Follow instruction given by the diagnostic software. The software will instruct that the engine be cranked for up to 15 seconds. Typically, it should take less than 5 seconds. Service ADVISOR should be observed carefully for instructions during the test.

   Error messages and test results will be displayed on the Service ADVISOR screen.

   Results shown will represent each cylinders' compression as a percentage in relation to the average of all cylinders.

   Any cylinder reading that is more than 10% below the rest indicates the cylinder's compression is possibly low.

   Any cylinder reading that is more than 10% greater than the rest indicates a possible injector leaking fuel into the cylinder.

NOTE: Run this test at least 3 times to ensure repeatable, accurate results.

Further engine diagnostics should be performed to determine the cause of low compression.

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Cylinder Misfire Test

1. With engine running and at normal operating temperature use a noncontact thermometer, inspect the temperature of each exhaust port.
2. Compare readings and investigate cylinders that are low or high from other cylinders.

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Cylinder Misfire Test Instructions

For instructions on connecting to Service ADVISOR, see earlier in this Group.

The Cylinder Misfire Test is used to compare the performance of each cylinder relative to each of the other cylinders. The test will help identify problems such as an engine misfire or irregularly running engine. During the test, the Engine Control Unit (ECU) will disable a cylinder, then accelerate the engine with a fixed amount of fuel and measure the time taken to accelerate the engine from one speed to the next with that cylinder disabled. The ECU will then repeat the procedure for the remaining cylinders.

The Cylinder Misfire Test cannot determine if an engine is delivering low power. The test results are only a guide to help determine if there is a problem in a cylinder. The results alone should not be used as a conclusive reason for replacing parts. Other information such as the results of a Compression Test, Cylinder Cutout Test, and other engine diagnostic procedures should be used along with this test information to accurately determine the source of an engine problem.

Before executing the Cylinder Misfire Test

- Warm engine to normal operating temperature.
- Repair the cause of any Diagnostic Trouble Codes (DTCs) if possible.

NOTE: The ECU will not allow the test to run if there is an active engine timing error code (any 637 code), an active engine position error code (any 636 code), coolant temperature is below 40° C (104° F) or above 110° C (230° F). If the engine goes into an overspeed condition while running test, the test will stop.

- Remove any load to the engine that may change during the test. For example, turn the air conditioner off.

Performing the Cylinder Misfire Test

1. Engine idling.
2. Select Engine Test Instructions - Cylinder Misfire Test in Service ADVISOR.
3. Follow instruction given by the diagnostic software. The software will instruct users that the throttle lever be moved from low idle position to wide open throttle position, then back to low idle position once for each cylinder tested.

The diagnostic software will inform the test operator if the test was not successfully completed. If the test was successfully completed, the results will be displayed on the screen.

Results shown will represent each cylinders' performance as a percentage in relation to the average of all cylinders. If any cylinder is above or below the average by more than 10%, it indicates the cylinder is contributing either too much (above average) or not enough (below average) in relation to the average engine performance.

NOTE: Run this test at least 3 times to ensure repeatable, accurate results.

The Engine Test Instructions - Compression Test and Engine Test Instructions - Cylinder Cutout Test should also be performed to help determine that there is a problem in a specific cylinder.

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Data Parameters Descriptions As Used in Service ADVISOR

Following is a list of the data parameters that can be read in Service ADVISOR. Included in the list is a brief description of each parameter and each parameter's unit of measurement.

Parameter	Units Metric (Eng)	Description
Air Heater Status		Indicates if air heater relay is on.
Air Heater Time Remaining	sec	Amount of time the air heater remains on.
Air Heater Wait Lamp		Indicates if the air heater wait lamp is turned on.
Analog Throttle A Input Voltage	Volts	Voltage from analog throttle (A) position sensor.
Analog Throttle B Input Voltage	Volts	Voltage from analog throttle (B) position sensor.
Analog Throttle C Input Voltage	Volts	Voltage from analog throttle (C) position sensor.
Barometric Air Pressure (Absolute)	kPa (psi)	Barometric Air Pressure (BAP) sensor value. Sensor is located inside of ECU.
Battery Voltage	Volts	Unswitched battery voltage to ECU .
Charge Air Cooler Outlet Temperature	degC (degF)	Charge air cooler outlet temperature sensor value.
Charge Air Cooler Outlet Temperature Input Voltage	Volts	Charge air cooler outlet temperature sensor voltage to ECU.
Crank Position Sensor Improper Pattern Indicator		Value of 0 indicates proper operation.
Crank Position Sensor Input Noise Indicator		Value of 0 indicates proper operation.
Crank Position Sensor Speed	rev/m	The speed the crank sensor detects the crank timing wheel to be rotating.
Crank Position Sensor Status		Value of 16 (engine off) or 47 (engine on) indicates proper operation. Value of 63 indicates engine cranking.
Cruise Accelerate		Indicates the status of the cruise accelerator switch.
Cruise Brake Switch		Indicates the status of the cruise brake switch.
Cruise Clutch Switch		Indicates the status of the cruise clutch switch.
Cruise Coast Switch		Indicates the status of the cruise coast switch.
Cruise Control Active		Indicates if the cruise control is active.
Cruise Control On/Off		Indicates if the cruise control is ON or OFF.
Cruise Control State		
Cruise Resume Switch		Indicates the status of the cruise resume switch.
Cruise Set Switch		Indicates the status of the cruise set switch.
Desired Speed Governor Curve		The mode selected is dependent on the application.
ECU Boot Block Part Number		File name of the Engine Control Unit (ECU) boot block.
ECU Configuration File Part Number		File name of the configuration file in the ECU.
ECU EOL Data Part Number		File name of the data programmed into the ECU at the End of the Assembly Line (EOL).
ECU Part Number		Part number for the Engine Control Unit (ECU) hardware.
ECU Serial Number		Serial number of the Engine Control Unit (ECU).
ECU Software Assembly Part Number		Revision number of the Engine Control Unit (ECU) software.
ECU Software Part Number		File name of the Engine Control Unit (ECU) software.
ECU Temperature	degC (degF)	The internal temperature of the ECU. Sensor is located inside of ECU.
EGR Temperature	degC (degF)	Exhaust gas temperature between EGR cooler and EGR valve.
EGR Temperature Input Voltage	Volts	EGR temperature sensor voltage to ECU.
EGR Valve Control Position	%	Position of EGR valve.
EGR Valve Learned Closed Position	%	EGR valve closed position from current learn cycle.
EGR Valve Learned Open Position	%	EGR valve full open position from current learn cycle.
EGR Valve Measured Position	%	Position of EGR valve.
EGR Valve Original Learned Closed Position	%	Closed position value of EGR valve after calibration. Updates after key cycle.
EGR Valve Original Learned Open Position	%	Open position value of EGR valve after calibration. Updates after key cycle.
EGR Valve Stored Closed Position	%	Stored value from last learn cycle of EGR valve closed position.
EGR Valve Stored Open Position	%	Stored value from last learn cycle of EGR valve open position.
EGR Valve Successful Learn Cycles	Count	Number of learn cycles after a calibration. Increments after harness diagnostic is run.

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Parameter	Units Metric (Eng)	Description
EGR Valve Position - Actual	%	Actual position ECU is able to drive EGR valve to.
EGR Valve Position - Desired	%	Position the ECU wants to drive the EGR valve to. (May be off by two decimal places).
EGR Valve Position Input Voltage	Volts	EGR valve position voltage to ECU.
Engine Coolant Temperature	degC (degF)	Engine coolant temperature value.
Engine Coolant Temperature Input Voltage	Volts	Engine coolant temperature sensor voltage to ECU.
Engine Hours	hr	Total hours run with this ECU.
Engine Load at Current Speed	%	Percentage of load on the engine at a given speed.
Engine Model Number		The model number for the engine.
Engine Oil Pressure	kPa (psi)	Engine oil pressure value.
Engine Oil Pressure Input Voltage	Volts	Engine oil pressure sensor voltage to the ECU.
Engine Serial Number		Serial number of the engine.
Engine Speed	rev/m	The speed the crank sensor detects the crank timing wheel to be rotating.
Fan Speed - Actual	rev/m	Actual fan speed.
Fan Speed - Desired	rev/m	Desired fan speed.
Fuel Mode		
Fan State		
Fuel Rail Pressure (Absolute) - Actual	MPa (psi)	The fuel rail pressure value.
Fuel Rail Pressure (Absolute) - Desired	MPa (psi)	The desired fuel rail pressure calculated by the ECU.
Fuel Rail Pressure Input Voltage	Volts	Fuel rail pressure sensor voltage to the ECU.
Fuel System Part Number		The part number for the fuel system used on the engine.
Fuel System Serial Number		The serial number for the fuel system used on the engine.
Fuel Temperature	degC (degF)	Fuel temperature value.
Fuel Temperature Input Voltage	Volts	Fuel temperature sensor voltage to the ECU.
Fuel Usage Rate	L/hr (gal/hr)	Rate of fuel used calculated by the ECU.
Ignition Voltage	Volts	Switched voltage from ignition switch to ECU.
Inject Start Time	microseconds	
Inject ion Pulse Time	Count	
Intake Manifold Absolute Pressure	kPa (psi)	Intake manifold absolute pressure value.
Intake Manifold Absolute Pressure Input Voltage	Volts	Intake manifold pressure sensor voltage to the ECU.
Intake Manifold Air Temperature	degC (degF)	Intake manifold air temperature value.
Low Fuel Pressure Fuel Transfer Pump Current	Amps	Not implemented.
Low Fuel Pressure Fuel Transfer Pump Duty Cycle	%	Duty cycle of PWM signal to low pressure fuel pump.
Low Pressure Fuel Transfer Pump Enable	%	Indicates if low pressure fuel pump is enabled by ECU.
Low Pressure Fuel Transfer Pump Priming Time	Sec	Length of fuel priming time.
Low Fuel Pressure Fuel Transfer Pump Status		Indicates if low pressure fuel pump is on or off.
Low Pressure Fuel Transfer Pump Pressure - (Absolute) - Actual	kPa (psi)	Measured fuel transfer pump pressure. The actual pressure reading is displayed in gauge.
Low Pressure Fuel Transfer Pump Pressure - (Absolute) - Desired	kPa (psi)	The desired fuel transfer pump pressure calculated by the ECU. The actual pressure reading is displayed in gauge.
Intake Manifold Air Temperature Input Voltage	Volts	Intake manifold air temperature sensor voltage to the ECU.
Maximum Speed Governor Curve		The mode selected is dependent on the application. See APPLICATION SPECIFICATIONS in Section 06, Group 210 of this manual.
Option Assembly Part Number		Part number of application options programmed into the ECU.
Performance Option Part Number		Part number relating to engine performance.
Pump Position Sensor Improper Pattern Indicator	%	Value of 0 indicates proper operation.
Pump Position Sensor Input Noise Indicator		Value of 0 indicates proper operation.

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JL45346,000007F -19-20SEP07-2/3

Parameter	Units Metric (Eng)	Description
Pump Position Sensor Speed	rev/m	Engine RPM.
Pump Position Sensor Status		Value of 16 (engine off) or 47 (engine on) indicates proper operation. Value of 63 indicates engine cranking.
Sensor Supply #1 Voltage	Volts	Voltage of ECU 5 volt power supply #1.
Sensor Supply #2 Voltage	Volts	Voltage of ECU 5 volt power supply #2.
Sensor Supply #3 Voltage	Volts	Voltage of ECU 5 volt power supply #3.
Sensor Supply #4 Voltage	Volts	Voltage of ECU 5 volt power supply #4.
Sensor Supply #5 Voltage	Volts	Voltage of ECU 5 volt power supply #5.
Start of Injection Position	DEG	Position of crank when ECU sends signal to electronic unit pump.
Throttle Position	%	Percent of the throttle being used.
Throttle Type		Type of throttle being used on this application.
Torque Curve Number		Torque curve the ECU is currently using to limit fuel. For definition of the possible torque curves, see APPLICATION SPECIFICATIONS in Section 06, Group 210 of this manual.
Total Fuel Consumption	L gal	The amount of fuel consumed calculated by the ECU.
Turbo Compressor Inlet Air Temperature	degC (degF)	Turbo Compressor Inlet Air Temperature value.
Turbo Compressor Inlet Air Temperature Input Voltage	Volts	Turbo compressor inlet air temperature sensor voltage to the ECU.
Vehicle Driveshaft Speed	rev/m	The speed of the vehicle drive shaft.
Vehicle Option Part Number		Part number of payload options programmed into the ECU.
Vehicle Serial Number		The serial number of the vehicle that this engine is located in.
Vehicle Speed - Calculated	km/h (mph)	Vehicle speed calculated by ECU from wheel speed PWM signal.
Vehicle Speed - CAN	km/h (mph)	Vehicle speed ECU detects over CAN.
Water In Fuel Sensor		Indicates if water level in fuel is too high.
Water In Fuel Sensor Input Voltage	Volts	Water in fuel sensor voltage to the ECU.

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Diagnostic Gauge Active DTC Viewing Instructions

NOTE: For complete Power View operating instructions, refer to the Operator's Manual, associated with this application.

NOTE: The engine does not need to be running to navigate the diagnostic gauge screens.

NOTE: For more information fault codes, see Diagnostic Trouble Code (DTC) Group Locator later in this section of the manual.

IMPORTANT: Ignoring active trouble codes can result in severe engine damage. Refer to the trouble shooting procedures later in this section for fixing active DTCs.

A Diagnostic Trouble Code (DTCs) is set when an operating condition is not within a specified range. This is an indicator to the operator that a problem area needs to be corrected. The diagnostic gauge alerts the operator when a DTC is active by turning on a warning light and changing to the WARNING screen showing information about the DTC. The warning screen is described below.

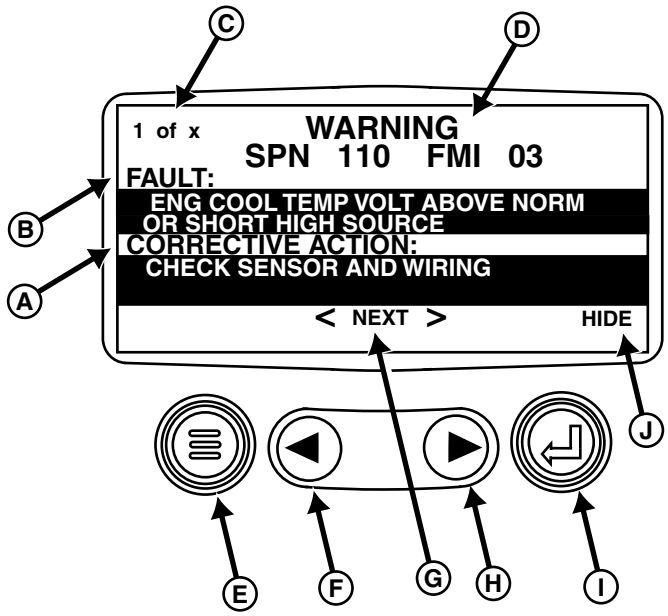

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Figure 1. Active Code Diagnostic Screen

A—Corrective Action
B—Diagnostic Code Description
C—Current and Total number of Active Codes
D—SPN (Suspect Parameter Number) FMI (Failure Mode Identifier) Diagnostic Code
E—Menu Key
F—Left/Up Scroll Key
G—Next
H—Right/Down Scroll Key
I— Enter Key
J— Hide

1. When the diagnostic gauge receives a diagnostic trouble code, the engine parameter screen is replaced with the "Warning" screen. See figure 1.
2. Display features for the Active Codes Diagnostic Screen are described below:
   - SPN/FMI code (D). Refers to the trouble shooting diagnostic procedure.
   - Name of diagnostic code (B) referenced in manual.
   - A brief description for corrective action (A).
   - The word "NEXT" (G) indicates there are more fault codes to be viewed.
   - Two SCROLL KEYS (F,H) are used to cycle through the codes.
   - "1 of x" (C) indicates the current diagnostic code displayed of the total number.
   - To hide (J) this screen and return to the parameter display screen, press the "Enter" Key (I). Pressing the Enter Key again returns to the warning screen.

NOTE: To refresh active DTCs, you must return to the 1-UP or 4-UP screen.

3. To return to the Main Menu screen, press the menu button (E), shown in figure 4.

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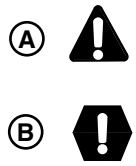
4. The parameter display screen displays one of the following icons when a DTC is active. See figure 2. An amber light sets when a DTC becomes active and a red light sets when the engine has derated or shutdown.

RG14795 —UN—14MAY07



A—Warning **B—Engine Derate or Shutdown**

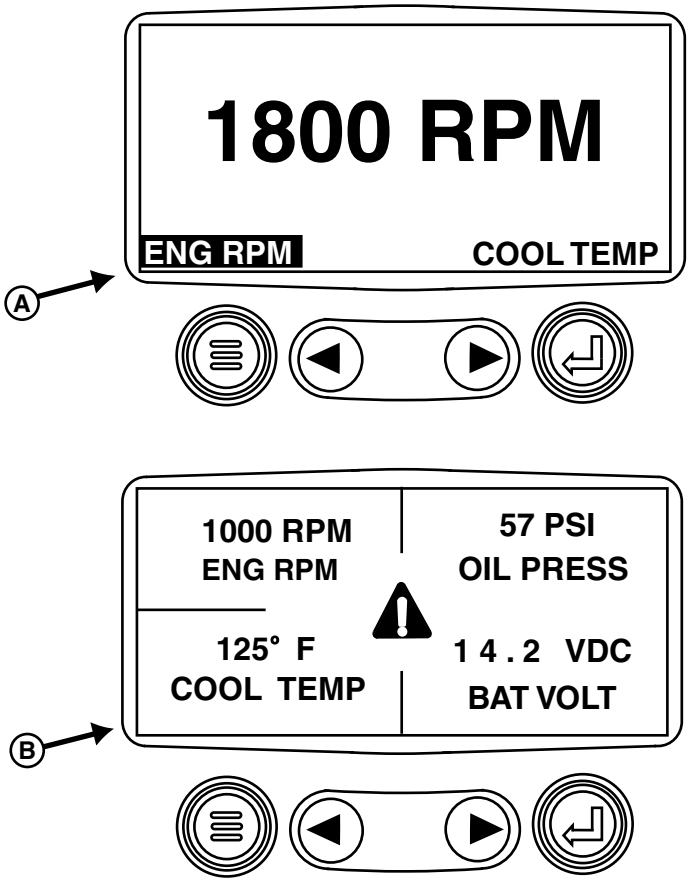
Figure 2. Icons Indicates a Fault Warning, Engine Derate, or Shutdown

DB92450,000005F -19-31MAY10-2/2

Diagnostic Gauge Data Parameters Viewing Instructions

NOTE: For complete Power View operating instructions, refer to the Operator's Manual, associated with this application.

NOTE: The engine does not need to be running to navigate the diagnostic gauge screens.



RG14784 —UN—14MAY07

Figure 1. One and Four Parameter Displays

A—1-Up Display **B—4-Up Display**

The Power View diagnostic gauge can be used for displaying engine parameters. Two display modes can be selected, one showing a single parameter, called 1-Up Display (A), and the other showing 4 selectable parameters, called 4-Up Display (B). At power up, the gauge defaults to the mode that was last used. Examples of both are shown in figure 1.

NOTE: When the one-parameter display is selected, main menu shows "GO TO 4-UP DISPLAY", and when the four-parameter display is selected, main menu shows "GO TO 1-UP DISPLAY" in the top line.

Continued on next page

DM59778,000001C -19-18APR08-1/2

1. Changing to the 4 parameter display. See figure 2.
   a. Press the MENU KEY (F). Main Menu is displayed.
   b. With the SCROLL KEYS (G,H), select “GO TO 4-UP DISPLAY” (B).
   c. Press the ENTER KEY (I).
   d. The 4-Up Display will be shown.
2. Selecting engine parameters for 4-UP Dispaly.
   a. Press the MENU KEY (F). Main menu is displayed.
   b. Using the SCROLL KEYS (G,H), select SETUP 4-UP DISPLAY (B). Press ENTER KEY (I).
   c. In the next screen, select CUSTOM SETUP and press ENTER KEY (I). The 4-Up Display appears.
   d. With the SCROLL KEYS (G,H), select the window on the display you want to change. Press ENTER KEY (I).
   e. Scroll through the parameter list and select the parameter you want to display. Press ENTER KEY (I).
   f. The number of the display window will appear next to the selected parameter.
   g. Press MENU KEY (F) to return to the 4-Up Display. The new parameter should be displayed on the screen.

NOTE: The same method is used for selecting the default parameter for the 1-UP Display.

3. Changing units of measure.
   a. Press the MENU KEY (F). Main menu is displayed.

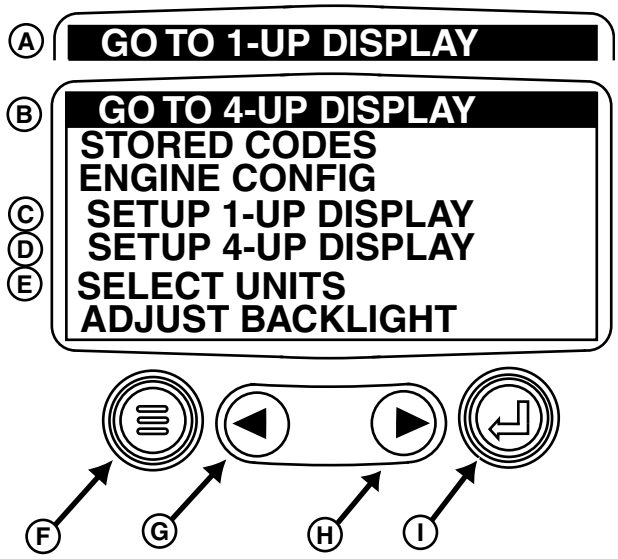


Figure 2. Main Menu.

A—Go To 1-Up Display
B—Go To 4-Up Display
C—Setup 1-Up Display
D—Setup 4-Up Display
E—Select Units
F—Menu Key
G—Left/Up Scroll Key
H—Right/DownScroll Key
I— Enter Key

   b. Scroll through the menu to SELECT UNITS (E). Press ENTER KEY (I).
   c. With the SCROLL KEYS (G,H), select the desired unit of measure. Press ENTER KEY (I).
   d. Press MENU KEY (F) to return to the parameter display.

DM59778,000001C -19-18APR08-2/2

Diagnostic Gauge Stored DTC Clearing Instructions

NOTE: For complete Power View operating instructions, refer to the Operator's Manual, associated with this application.

NOTE: The engine does not need to be running to navigate the diagnostic gauge screens.

NOTE: For more information fault codes, see Diagnostic Trouble Code (DTC) Group Locator later in this section of the manual.

Procedure for clearing stored diagnostic codes on Power View diagnostic gauge.

1. Turn power to diagnostic gauge OFF.
2. Turn power to diagnostic gauge ON. As soon as screen backlight comes on, simultaneously press and hold MENU (C) and ENTER (F) keys. See figure 1.
3. If successful, the screen shown in figure 1 will appear.

NOTE: If the screen in figure 1 does not appear, repeat step 2. This may take several attempts due to the short timing window.

4. Select CLEAR FAULT CODES (A). Press ENTER (F) key.

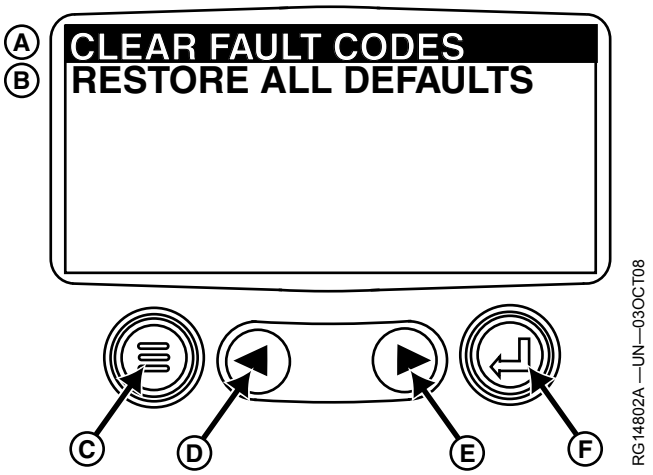


Figure 1. Clear Stored Fault Codes Screen

A—Clear Fault Codes
B—Restore All Defaults
C—Menu Key
D—Left/Up Scroll Key
E—Right/Down Scroll Key
F—Enter Key

MK41968,00000AE -19-31MAY10-1/2

5. Screen shows stored fault codes have been cleared. See figure 2.
6. Cycle power to the diagnostic gauge again for normal operation.

A—Cleared All Fault Codes

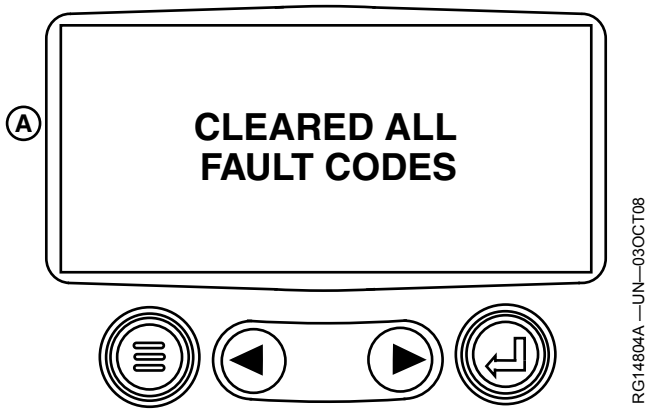


Figure 2. Clear All Fault Codes Screen

MK41968,00000AE -19-31MAY10-2/2

Diagnostic Gauge Stored DTC Viewing Instructions

NOTE: For complete Power View operating instructions, refer to the Operator's Manual, associated with this application.

NOTE: The engine does not need to be running to navigate the diagnostic gauge screens.

NOTE: For more information fault codes, see Diagnostic Trouble Code (DTC) Group Locator later in this section of the manual.

Stored Diagnostic Trouble Codes (DTCs) are a history of DTCs that were once active. When a DTC becomes inactive, it is saved as a 'STORED' code. Stored codes can be reviewed and used as a trouble shooting aid in diagnosing intermittent problems and in range operating conditions. A count is kept of how many times a code has been active. Stored codes can be cleared from the diagnostic gauge. See Diagnostic Gauge Stored Dtc Clearing Instructions later in this section of the manual. Instructions for viewing stored codes are described below.

1. Press MENU KEY (B). Main menu is displayed. See figure 1.
2. Using the SCROLL KEYS (C,D), navigate the menu until STORED CODES (A) is highlighted. Press the ENTER KEY (E).
3. REQUESTING FAULT CODES will momentarily be displayed on the display screen.
4. A new screen showing stored code information appears. See figure 2. If there are no stored fault codes, "No Stored Fault Codes" screen is momentarily displayed. Power View then returns to main menu display. Press the MENU KEY (E) to get back to the parameter display screen.

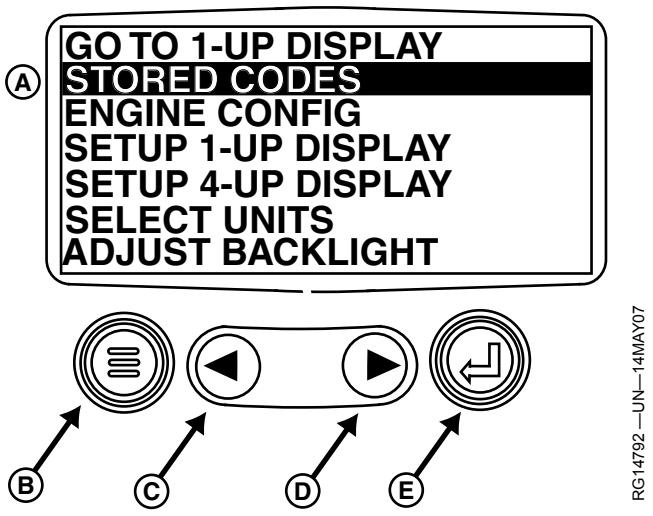


Figure 1. Main Menu

A—Stored Codes
B—Menu Key
C—Left/Up Scroll Key
D—Right/Down Scroll Key
E—Enter Key

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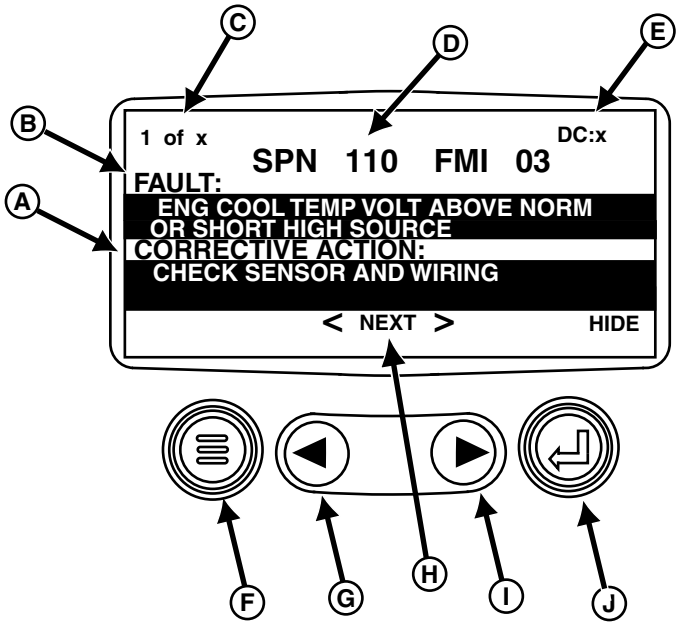

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Figure 2. Stored Code Diagnostic Screen

A—Corrective Action
B—Diagnostic Code Description
C—Current and Total number of Stored Codes
D—SPN (Suspect Parameter Number) FMI (Failure Mode Identifier) Diagnostic Code
E—Diagnostic Count
F—Menu Key
G—Left/Up Scroll Key
H—Next
I— Right/Down Scroll Key
J— Enter Key

5. Display features for the Stored Codes Diagnostic Screen are described below:
   - SPN/FMI code (D). Refers to the trouble shooting diagnostic procedure.
   - Name of diagnostic code (B) referenced in manual.
   - A brief corrective action (A).
   - The word “NEXT” (H) indicates there are more stored codes to can be viewed.
   - The two ARROW KEYS (G,I) are used to cycle through the codes.
   - “1 of x” (C) indicates the current diagnostic code displayed of the total number.
   - Diagnostic Count (E) indicates how many times the code has been active since it was lasted cleared.
6. Press the MENU KEY (F) to return to the main menu. Press the MENU KEY (E) again to return to the parameter screen.

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Diagnostic Trouble Code Designations

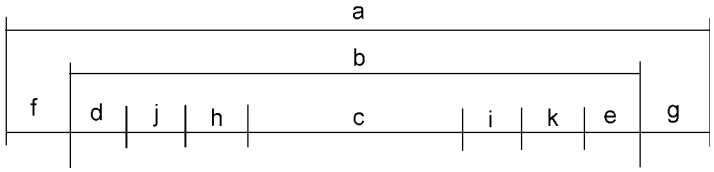
SPN/FMI CODES

SPN/FMI codes are written as a two-part code derived from the SAE J1939 standard. The first part is called the Suspect Parameter Number (SPN). The SPN can contain up to 6 digits. The SPN identifies the system or the component that has the failure; for example SPN 110 indicates a failure in the engine coolant temperature circuit. The second part of the code is called the Failure Mode Identifier (FMI) code. The FMI contains 2 digits and identifies the type of failure that has occurred. For example, FMI 03 indicates value Out of Range High (OORH). In order to determine the exact failure, both the SPN and FMI are required. Combining SPN 110 with FMI 03 yields “engine coolant temperature input voltage out of range high.”

On these applications the ECU transmits SPN/FMI codes over the Controller Area Network (CAN). This allows for service tools such as Service ADVISOR to display active and stored DTCs. When using Service ADVISOR, the codes will be displayed in a 000000.00 format. For example, code 110.03 will be displayed as 000110.03.

RG14537 —UN—31OCT05

FMI Designators



Relationship of FMI Designations and Range of Sensor Input

Region a: Total signal input range possible that can be seen by an electronic module.

Region b: Total signal range physically possible as defined by an application.

Region c: Range defined as normal for a given real world measurement.

Region d: Range defined as Extremely below normal, of what is considered normal for the given real world measurement. Associated with FMI 01.

Region e: Range defined as Extremely above normal, of what is considered normal for the given real world measurement. Associated with FMI 00.

Region f: Range which is low outside the range of what is considered physically possible for a given system. Associated with FMI 04 (Out Of Range Low, OORL).

Region g: Range which is high outside the range of what is considered physically possible for a given system. Associated with FMI 03 (Out Of Range High, OORH), 05, 06.

Region h: Range defined as Slightly below normal, of what is considered normal for a given real-world measurement. Associated with FMI 17.

Region i: Range defined as Slightly above normal, of what is considered normal for a given real-world measurement. Associated with FMI 15.

Region j: Range defined as Moderately below normal, of what is considered normal for a given real-world measurement. Associated with FMI 18.

Region k: Range defined as Moderately above normal, of what is considered normal for a given real-world measurement. Associated with FMI 16.

FMI	Description
00	**Data Valid but Above Normal Operational Range—Extreme Level.** The signal communicating information is within a defined acceptable and valid range, but the real world condition is above what would be considered normal as determined by the predefined extreme level limits for that particular measure of the real world condition. Broadcast of data values is continued as normal.
01	**Data Valid but Below Normal Operational Range—Extreme Level** The signal communicating information is within a defined acceptable and valid range, but the real world condition is below what would be considered normal as determined by the predefined extreme level limits for that particular measure of the real world condition. Broadcast of data values is continued as normal.
02	**Data Erratic, Intermittent or Incorrect** Measurements that change at a rate that is not considered possible in the real world condition and caused by improper operation of the measuring device or its connection to the module. Broadcast of data value is substituted with the "error indicator" value. Incorrect data includes any data not received and any data that is exclusive of the situations covered by FMIs 3, 4, 5 and 6 below. Data may also be considered incorrect if it is inconsistent with other information collected or known about the system.
03	**Value Out of Range High (OORH)** A voltage signal, data or otherwise, is above the predefined limits that bound the range. Broadcast of data value is substituted with the "error indicator" value. Any signal external to an electronic control module whose voltage remains at a high level when the controller commands it to low. Broadcast of data value is substituted with the "error indicator" value.

Continued on next page

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04	**Value Out of Range Low (OORL)** A voltage signal, data or otherwise, is below the predefined limits that bound the range. Broadcast of data value is substituted with the "error indicator" value. Any signal external to an electronic control module whose voltage remains at a low level when the controller commands it to high. Broadcast of data value is substituted with the "error indicator" value.
05	**Current Below Normal** A current signal, data or otherwise, is below the predefined limits that bound the range. Broadcast of data value is substituted with the "error indicator" value. Any signal external to an electronic control module whose current remains off when the controller commands it on. Broadcast of data value is substituted with the "error indicator" value.
06	**Current Above Normal** A current signal, data or otherwise, is above the predefined limits that bound the range. Broadcast of data value is substituted with the "error indicator" value. Any signal external to an electronic control module whose current remains on when the controller commands it off. Broadcast of data value is substituted with the "error indicator" value.
07	**Mechanical System not Responding or Out of Adjustment** Any fault that is detected as the result of an improper mechanical adjustment or an improper response or action of a mechanical system that, with a reasonable confidence level, is not caused by an electronic or electrical system failure. This type of fault may or may not be directly associated with the value of general broadcast information.
08	**Abnormal Frequency or Pulse Width or Period**To be considered in cases of FMI 4 and 5. Any frequency or PWM signal that is outside the predefined limits which bound the signal range for frequency or duty cycle (outside region b of the signal range). Also if the signal is an controller output, any signal whose frequency or duty cycle is not consistent with the signal which is emitted. Broadcast of data value is substituted with the "error indicator" value.
09	**Abnormal Update Rate**Any failure that is detected when receipt of data via the data link or as input from a smart actuator or smart sensor is not at the update rate expected or required by the controller (outside region c of the signal range). Also any error that causes the controller not to send information at the rate required by the system. This type of fault may or may not be directly associated with the value of general broadcast information.
10	**Abnormal Rate of Change**Any data, exclusive of the abnormalities covered by FMI 2, that is considered valid but whose data is changing at a rate that is outside the predefined limits that bound the rate of change for a properly functioning system (outside region c of the signal range). Broadcast of data values is continued as normal.
11	**Root Cause Not Known**It has been detected that a failure has occurred in a particular subsystem but the exact nature of the fault is not known. Broadcast of data value is substituted with the "error indicator" value.
12	**Bad Intelligent Device or Component**Inconsistency of data indicates that a device with some internal intelligence, such as a controller, module, smart sensor or smart actuator, is not properly functioning. This data may be internal to a module or external from a data link message or from various system responses. Broadcast of data value is substituted with the "error indicator" value. This error is to include all internal controller trouble codes that cannot be caused by connections or systems external to the controller.
13	**Out of Calibration**A failure that can be identified to be the result of not being properly calibrated. This may be the case for a subsystem which can identify that the calibration attempting to be used by the controller is out of date. Or it may be the case that the mechanical subsystem is determined to be out of calibration. This failure mode does not relate to a signal range.
14	**Special Instructions**SPNs 611 through 615 are defined as "System Diagnostic Codes" and are used to identify failures that cannot be tied to a specific field-replaceable component. Specific subsystem fault isolation is the goal of any diagnostic system, but for various reasons this cannot always be accomplished. These SPNs allow the manufacturer some flexibility to communicate non-"specific component" diagnostic information. Because SPN 611-615 use the standard SPN/FMI format, it allows the use of standard diagnostic tools, electronic dashboards, satellite systems and other advanced devices that scan Parameter Groups containing the SPN/FMI formats. Because manufacturer-defined codes are not desirable in terms of standardization, the use of these codes should only occur when diagnostic information cannot be communicated as a specific component and failure mode. This failure mode does not relate to the signal range, and may or may not be directly associated with the value of general broadcast information.
15	**Data Valid but Above Normal Operating Range—Slight Level**The signal communicating information is within a defined acceptable and valid range, but the real world condition is above what would be considered normal as determined by the predefined slight level limits for that particular message of the real world condition. Broadcast of data values is continued as normal.
16	**Data Valid but Above Normal Operating Range—-Moderate Level**The signal communicating information is within a defined acceptable and valid range, but the real world condition is above what would be considered normal as determined by the predefined moderate level limits for that particular message of the real world condition. Broadcast of data values is continued as normal.
17	**Data Valid but Below Normal Operating Range—Slight Level**The signal communicating information is within a defined acceptable and valid range, but the real world condition is below what would be considered normal as determined by the predefined slight level limits for that particular message of the real world condition. Broadcast of data values is continued as normal.
18	**Data Valid but Below Normal Operating Range—Moderate Level**The signal communicating information is within a defined acceptable and valid range, but the real world condition is below what would be considered normal as determined by the predefined moderate level limits for that particular message of the real world condition. Broadcast of data values is continued as normal.

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19	**Received Network Data In Error**Any failure that is detected when the data received via the network is found substituted with the "error indicator" value (i.e. FE (16), see J1939/71). This type of failure is associated with received network data. The component used to measure the real world signal is wired directly to the module sourcing the data to the network and not to the module receiving the data via the network. This type of fault may or may not be directly associated with the value of general broadcast information.
20-30	**Reserved for SAE Assignment**
31	**Not Available or Condition Exists**Used to indicate that the FMI is not available or that the condition that is identified by the SPN exists. When no applicable FMI exists for the reported SPN, FMI 31 can be used. Also in cases when the reported SPN name has the failure information in it, FMI 31 can be used to indicated that the condition reported by the SPN exists. This type of fault may or may not be directly associated with the value of general broadcast information.

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Diagnostic Trouble Code (DTC) Group Locator

SPN.FMI	Description	Group
000028.03	Digital Throttle Signal Out of Range High	165
000028.04	Digital Throttle Signal Out of Range Low	165
000029.03	Throttle #2 Signal Out of Range High	165
000029.04	Throttle #2 Signal Out of Range Low	165
000091.03	Throttle #1 Signal Out of Range High	165
000091.04	Throttle #1 Signal Out of Range Low	165
000091.07	Throttle #1 Not Responding	165
000091.13	Throttle #1 Out of Calibration	165
000094.03	Low Pressure Fuel Signal Out of Range High	164
000094.04	Low Pressure Fuel Signal Out of Range Low	164
000094.17	Low Pressure Fuel Signal Slightly Low	164
000100.01	Engine Oil Pressure Signal Extremely Low	163
000100.04	Engine Oil Pressure Signal Out of Range Low	163
000105.00	Intake Manifold Air Temperature Signal Extremely High	162
000105.03	Intake Manifold Air Temperature Signal Out of Range High	162
000105.04	Intake Manifold Air Temperature Signal Out of Range Low	162
000105.15	Intake Manifold Air Temperature Signal Slightly High	162
000105.16	Intake Manifold Air Temperature Signal Moderately High	162
000108.02	Barometric Pressure Signal Invalid	165
000110.00	Engine Coolant Temperature Signal Extremely High	163
000110.03	Engine Coolant Temperature Signal Out of Range High	163
000110.04	Engine Coolant Temperature Signal Out of Range Low	163
000110.15	Engine Coolant Temperature Signal Slightly High	163
000110.16	Engine Coolant Temperature Signal Moderately High	163
000158.17	ECU Power Down Error	165
000174.03	Fuel Temperature Signal Out of Range High	164
000174.04	Fuel Temperature Signal Out of Range Low	164
000189.00	Engine Speed Derate Condition Exists	164
000569.03	Rear Axle differential Lock Signal Out of Range High	166
000569.04	Rear Axle differential Lock Signal Out of Range Low	166
000611.03	Injector Shorted to Power	164
000611.04	Injector Shorted to Ground	164
000627.18	Battery Voltage Moderately Low	165
000629.12	ECU EEPROM Error	165
000629.13	ECU Boot Block Error	165
000636.02	Engine Position Sensor Signal Invalid	161
000636.05	Engine Position Sensor Circuit Has High Resistance	161
000636.06	Engine Position Sensor Circuit Has Low Resistance	161
000636.08	Engine Position Sensor Signal Missing	161
000636.10	Engine Position Signal Rate of Change Abnormal	161
000637.02	Engine Timing Sensor Signal Invalid	161
000637.05	Engine Position Sensor Circuit Has High Resistance	161
000637.06	Engine Position Sensor Circuit Has Low Resistance	161
000637.07	Engine Timing and Position Signals Out of Sync	161
000637.08	Engine Timing Sensor Signal Missing	161
000637.10	Engine Timing Signal Rate of Change Abnormal	161
000651.05	Injector #1 Circuit Has High Resistance	164
000651.06	Injector #1 Circuit Has Low Resistance	164
000651.13	Injector #1 Calibration Fault	164

Continued on next page

000652.05	Injector #2 Circuit Has High Resistance	164
000652.06	Injector #2 Circuit Has Low Resistance	164
000652.13	Injector #2 Calibration Fault	164
000653.05	Injector #3 Circuit Has High Resistance	164
000653.06	Injector #3 Circuit Has Low Resistance	164
000653.13	Injector #3 Calibration Fault	164
000654.05	Injector #4 Circuit Has High Resistance	164
000654.06	Injector #4 Circuit Has Low Resistance	164
000654.13	Injector #4 Calibration Fault	164
000655.05	Injector #5 Circuit Has High Resistance	164
000655.06	Injector #5 Circuit Has Low Resistance	164
000655.13	Injector #5 Calibration Fault	164
000676.03	Glow Plugs Signal Received When Not Expected	162
000676.05	Glow Plugs Signal Not Received When Expected	162
001136.00	ECU Temperature Signal Extremely High	165
001136.16	ECU Temperature Signal Moderately High	165
001569.31	Engine in Derate Condition	165
002003.09	No CAN Message Received From Source Address 17 Within Time Out Period	166
002023.09	Message ETCP 1 from ICC is timed out	166
003509.03	Sensor Supply #1 Voltage Out of Range High	165
003509.04	Sensor Supply #1 Voltage Out of Range Low	165
003510.03	Sensor Supply #2 Voltage Out of Range High	165
003510.04	Sensor Supply #2 Voltage Out of Range Low	165
003597.01	Injector Power Supply Voltage Extremely Low	166
003597.18	Injector Power Supply Voltage Moderately Low	166
524037.02	MFWD Switch Circuit Fault	166
524223.03	Rear Axle Differential Lock Circuit Fault	166
524225.31	Engine Start Protection Bypass Detected	166
524235.03	MFWD Solenoid Circuit Voltage High	166
524235.04	MFWD Solenoid Circuit Voltage Low	166

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Electronic Unit Pump Calibration File Downloading Instructions

NOTE: This procedure requires an internet connection.

Electronic unit pumps in this engine have specific settings for optimum performance. To maintain this performance when any of the electronic unit pumps are replaced or swapped the ECU will need to be reprogrammed with the correct setting for each cylinder. This is done by using the Electronic Unit Pump Calibration Tool in Service ADVISOR.

1. Connect to the John Deere Custom Performance web site.
2. On the Fuel System Search page, enter in the Sequence number from the parts label or from the sheet included with the part. If there is no sequence number available, then enter in the part number and serial number of the electronic unit pump and click on submit.
3. Verify the information about the electronic unit pump and click in the check box if the information matches the electronic unit pump. If the information does not match then go back to step 2 and re-enter the electronic unit pump information.
4. When the search is complete click in the check box to select the electronic unit pump to be downloaded.
5. Click on Download Selected button and the electronic unit pump payload will be copied to the local computer.

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Electronic Unit Pump Calibration Information

A connection with must be made with Service ADVISOR. In the Calibrations tab select Electronic Unit Pump Calibration.

The screen will show a table of the existing electronic unit pump information that is stored in the ECU.

Options to perform:

- Swap Electronic Unit Pumps
- Change Electronic Unit Pumps
- View Calibration History

Swapping Electronic Unit Pumps:

Swapping electronic unit pumps is used for testing suspected electronic unit pump problems only. This is used for moving electronic unit pumps from one cylinder to another to see if the symptom moves cylinders with the electronic unit pump. Information in the ECU is specific for each electronic unit pump and the cylinder that it is installed in. When electronic unit pumps are moved to different cylinders, then the ECU needs to be updated with this information also. Since the information for the existing electronic unit pumps is already in the ECU and just needs to be moved to a different cylinder number, there are pull down menus that allow the electronic unit pump information to be transferred from one cylinder to the other. Service ADVISOR will display the original electronic unit pump information, and the new electronic unit pump information and ask for confirmation before actually moving the electronic unit pump information.

Changing Electronic Unit Pumps

If an electronic unit pump is being replaced, then the information for that electronic unit pump must be loaded into the ECU. This is done by selecting the Change electronic unit pump button in Service ADVISOR. The screen will display a table showing the existing information that is stored in the ECU and will have pull down menus available in the serial number field if there are electronic unit pump calibration files available on the Service ADVISOR computer. For downloading electronic unit pump calibration files, see Electronic Unit Pump Calibration File Downloading Instructions earlier in this group. If the electronic unit pump calibration file is available, then selecting the file that corresponds with the electronic unit pump serial number installed in the cylinder will automatically populate all information fields for that cylinder. If there are no calibration files available on the Service ADVISOR computer, then the information for each field can be entered manually. If the specific calibration file for the electronic unit pump was not downloaded then select Unlisted and the data fields will allow the information to be entered manually. Once all the electronic unit pump information has been updated, click the Next button, verify that the data entered is correct, and then click on the Submit button.

View Calibration History

Anytime a electronic unit pump calibration is performed with Service ADVISOR a history is kept for reviewing any electronic unit pump changes in the past. This information is only kept on the computer that performed the electronic unit pump calibration procedure. So if multiple computers are used, not all information will be in one history report.

JL45346,000007E -19-27JAN10-1/1

Engine Control Unit (ECU) Reprogramming Instructions

The ECU may be reprogrammed using Service ADVISOR. See E-LEARNING under the Service ADVISOR help section. Also, refer to the training material provided with your Service ADVISOR training course. All authorized Service ADVISOR users have received this training. On-line training is available at John Deere University, which is an internet-based distance-learning application.

RG41221,00001EA -19-18APR08-1/1

Engine Hours — Updating Instructions

This procedure explains how to update the engine hours in the ECU. The opening screen displays the current operating hours and asks you to enter the new engine hours value.

NOTE: The new hours cannot be less than the current hours displayed.

You can use whole and tenths of hours. You can change the value before you save it to the ECU, if you have made a mistake, or you can change it after you save it.

1. From the Short Cut bar select “Tests and Calibrations”.
2. Select “Connected Calibrations”.
3. Select “Data Input Calibrations”.

   NOTE: On applications that have more than one ECU you need to select that ECU from the list.

4. From the list select “ECU-Engine Serial Number”.
5. Select “Engine Hourmeter”.
6. On the first screen enter the new engine hours then click “Send”.
7. The next screen asks if you want to proceed. Select the “Yes” button to continue and “No” button to return to the first screen.
8. The next screen displays the value you entered. If correct select the “OK” button. If not select the “Not OK” button to return to the first screen.

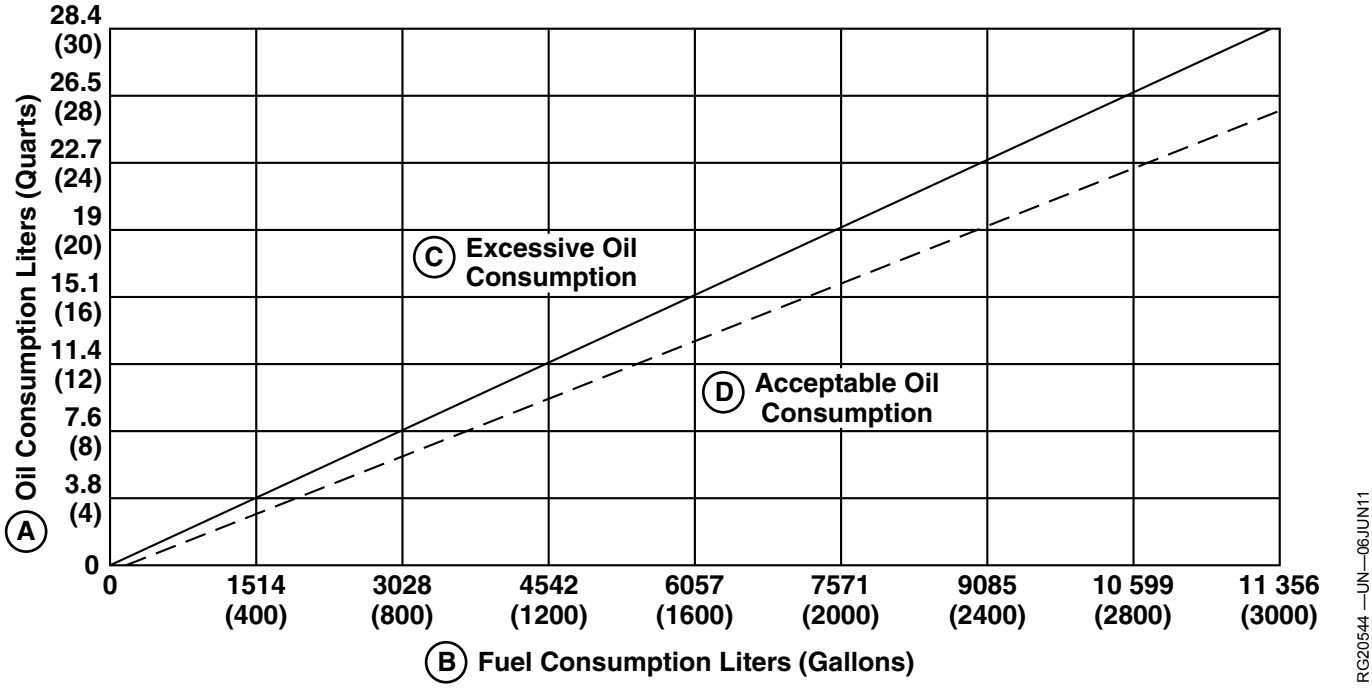
   IMPORTANT: Be sure to cycle the key before selecting OK. If you do not cycle the key the screen displays “Calibration was successfully completed” even though it was not.

9. Next screen says to turn the Ignition OFF for 90 seconds then back ON. Wait 10 seconds, then press “OK” button.
10. The Next screen says “Calibration was successfully completed”, if it was. If you want to run it again select “Yes”. Select “No” to exit the calibration. Select the “Print” button to print the test results.

For more information on printing see, Interactive Tests and Calibration Results — Printing, Exporting, or Saving Instructions in Section 04, Group160.

SS01820,00002DF -19-28MAR11-1/1

Guideline for Acceptable Oil Consumption



Engine Oil/Fuel Consumption Ratio

A—Oil Consumption Liters (Quarts) **B—Fuel Consumption Liters (Gallons)** **C—Excessive Oil Consumption** **D—Acceptable Oil Consumption**

Oil consumption complaints are usually reported as how many liters (quarts) are used per day. This information is not very specific. Two questions to consider are:

- How long is a day?
- How hard did the engine work in this day?

A much better method of checking oil consumption is based on oil usage compared to the amount of fuel burned (see chart). Long-term oil consumption (three oil drain intervals after engine break-in) should not exceed 0.95 L (1 qt) of oil for every 379 L (100 gal) of fuel burned.

IMPORTANT: If the engine fuel/oil consumption ratio falls below the dashed line, oil consumption is acceptable. If the ratio is between the solid and dashed line, oil consumption is still acceptable but the oil level and usage should be monitored closely. If the ratio is above the solid line, oil consumption is excessive and action should be taken to determine the cause.

For example, if an engine uses less than 0.95 L (1 qt) of oil for every 379 L (100 gal) of fuel burned, it is within acceptable operating parameters. If the engine begins to use 0.95 L (1 qt) of oil or more for every 379 L (100 gal) of fuel burned, you should investigate to determine the cause of the excess oil consumption.

MK41968,0000061 -19-06JUN11-1/1

Harness Diagnostic Mode Test

NOTE: Before running this test, ensure you have saved all Snapshot Captures and Recordings. For more information see Snapshot Instructions earlier in this group.

Purpose:
This procedure is designed to test the engine wiring harness and associated components for numerous types of errors. Including opens, shorts, actuator communication, and cycling.

Test Conditions:
This test can only be run when the engine is not running. Cylinder fueling is disabled for all cylinders when the test is initiated. If the ECU senses an engine start request, the Harness Diagnostic Mode Test will be aborted and the engine will start. Test Operation: The ECU continuously monitors all the sensors for normal operation while power is applied to the ECU. During the Harness Diagnostic Mode Test, the ECU will set up and trigger some special tests, also. These are tests that the ECU can not perform while the engine is running. When the test starts, all codes and related Snapshot information is erased from the ECU memory. The test starts and checks are made of various components. You may hear various actuators move, as the actuators do a learn cycle. The ECU compares these new learned values with the original values that were created when the part was new. If the ECU determines the values are good, it will store them as the last good values, but not change the original values. The ECU gathers test information as it runs the various tests. If it finds any problems during the test, it will store the code and display it at the end of the test.

Test Procedures:

1. Select Harness Diagnostic Mode Test in Service ADVISOR. A screen appears with a list of all the ECU codes (active and stored).
2. Press “Next” to start the test, “Cancel” to exit the test, or “Print” to print a list of the codes. After pressing “Next” follow the directions on the screen.
3. At the end of the test, another list of codes will be presented. **Currently this screen does not update properly**. Do NOT compare this list with the initial list to see if there are any additional codes.
4. Go the Diagnostic Trouble Codes tab in Service ADVISOR and select the “Refresh” button. Compare these codes to the original list going into the Harness Diagnostic Mode Test.
5. Go to those DTC(s) displayed and troubleshoot them to fix the problem(s), starting with the active codes.

NOTE: If a stored code does not show back up after the test, it may be a bad or intermittent connection. You may want to run the test again and manipulate the wiring harness to see if the code reappears. If it does, check the harness and connector for problems.

DN22556,000005C -19-27JAN10-1/1

Interactive Tests and Calibration Results Printing Instructions

In Service ADVISOR to print the result screen of interactive tests and calibrations the printer preferences need to be changed. The following steps show you how to do this while performing the test or how to print this information later from a saved Job.

NOTE: Note: If these instructions are not followed, the print out of this information may not include all information from the test or calibration.

From a live connection:

Perform your selected test or calibration then after it has completed perform the steps below.

1. Click on the “Print” button in the lower frame.
2. On the Print popup window:
   a. Click on the “Options” tab of the popup window.
   b. From the Menu bar click on the drop down menu and select “All frames individually”.

      NOTE: This will display the entire report with multiple pages if needed.

   c. Click “Print”.

From a saved Job:

1. From the “Menu” bar click on “File”:
   a. Select “Job” from the drop down list.
   b. From the Job drop down menu select “Open / Manage Jobs”.
2. From the Open / Manage Jobs popup window:
   a. Select the Job ID that corresponds to the one you want to print.
   b. Click on the “Open Job” button.
3. In the Session Logs popup window:
   a. Select the “Session ID” you wan to open.
   b. Click on the “Reading Logs” button.
4. In the Reading Events window:
   a. Click on the “Started Procedure” event for the interactive tests or calibration you are trying to print.
   b. Click on the “Details” button.
5. From the Service ADVISOR main screen Menu bar:
   a. Click on File and select “Print Preview”.
6. In the Print Preview popup window:
   a. From the Menu bar click on the drop down list and select “All frames individually”.

      NOTE: This will display the entire report with multiple pages if needed.

   b. Click Print to print the report.

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Intermittent DTC Diagnostics

Intermittent DTCs are problems that periodically “go away”. A problem such as a loose terminal that intermittently does not make contact with its mating terminal is a likely cause of an intermittent fault. Other intermittent DTCs may only be set only under certain operating conditions such as heavy load, extended idle, etc. When diagnosing intermittent DTCs, take special note of the condition of wiring and connectors since a high percentage of intermittent problems originate here. Check for loose, dirty, or partially disconnected connectors. Inspect the wiring routing looking for possible intermittent shorts to ground caused by contact with external parts (for example, rubbing against sharp sheet metal edges). Inspect the connector vicinity looking for wires that are partially pulled out of connector terminals, damaged connectors, poorly positioned terminals, and corroded or damaged terminals. Look for broken wires, damaged splices, and wire-to-wire shorts.

NOTE: The ECU is the component LEAST likely to fail. Only replace the ECU if the diagnostic procedure indicates that ECU replacement is necessary.

Suggestions for diagnosing intermittent DTCs:

- If the diagnostic procedure indicates that the problem is intermittent, try to reproduce the operating conditions that were present when the DTC set. Service ADVISOR can be used to help locate intermittent problems, as it includes a function called Recording. The Recording function permits the recording of data parameter values during a diagnostic session. If a DTC sets during a certain diagnostic session, the parameters can be played back and observed to see what each applicable parameter’s value was when the DTC occurred.
- If a faulty connection or wire is suspected to be the cause of the intermittent problem: clear DTCs, then check the connection or wire by wiggling it while watching Service ADVISOR to see if the fault resets.
- The voltage measured at the ECU input for most sensors can be monitored in Service ADVISOR as a data point. The minimum and maximum value of voltage measured since the data point was selected is displayed along with the current value of voltage. An intermittent open or shorted circuit will cause the voltage value to momentarily become approximately 5V or 0V, depending on the circuit and the type of failure. If computer screen cannot be seen while performing the test, have an assistant monitor the voltage while the harness is wiggled to help determine where the intermittent connection is located. If an assistant is not available, check the minimum and maximum voltage columns in the data points screen after each section of the harness is wiggled to help isolate the problem location.

Possible Causes of Intermittent DTCs:

- Faulty connection between sensor or actuator and harness.
- Faulty contact between terminals in connector.
- Faulty terminal/wire connection.
- Electromagnetic interference (EMI) from an improperly installed 2-way radio, etc. can cause erroneous signals to be sent to the ECU.

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Internal Data Monitor Instructions

Internal Data Monitor (IDM) is a feature in Service ADVISOR that is for recording multiple data points monitored by the Engine Control Unit (ECU) at a selectable sample rate. Depending on the number of data points selected to record and the sample rate that is selected determines the length of the recording in memory. These recording are completed internally in the ECU and then uploaded to Service ADVISOR.

Configuration Options:

- **One Time** - This recording method will record the data points selected until the memory buffer in the ECU is full and then end the recording. To select more than one data point hold down the Ctrl key on the keyboard and click on the data points to be recorded.
- **Continuous** - This recording method will record the selected data points until the user stops the recording session. The memory space for this data is limited and depending on the number of data points selected to record, determines the length of the recording. This uses the first in first out (FIFO) method with the data in memory.
- **Internal** – This recording method will record the selected data points based on selected data point value as a trigger. There are three options for setting the trigger and they are equal too, greater than, and less than the entered threshold value. It allows up to two different data points to be triggered off of. Example is that trigger one is Engine RPM greater than 1000 rpm and engine load greater than 50%. The recording will begin when both data points are greater than the specified value.

NOTE: To select more than one data point hold down the Ctrl key on the keyboard and click on the data points to be recorded.

Recordings made with IDM are created in the ECU memory, so if there is a power interruption while the recording is being made or downloaded to Service ADVISOR, the recording will be lost.

1. Make a live connection with Service ADVISOR to the ECU.
2. Go to Interactive Tests and select Internal Data Monitor.
3. Select the data points that are to be recorded. Hold the Ctrl key done when selecting more than one data point.
4. Select the sample rate that the data points are to be recorded at. The number of data points selected and the sample rate will determine the length of the recording.
5. Select the Start Trigger mode. There are three options, One Time, Continuous, and Internal. For rest of the procedure refer to the option that was selected.

One Time

1. Validate the IDM setup Information for the correct number of parameters selected and sample rate. Note that it will estimate the length of the recording. Click “Next”.
2. Validate that the correct Start Trigger Mode has been selected and click “Next”.
3. Click “Start” when you want the recording to begin. The recording will automatically stop when completed and begin to upload the information from the ECU to the PC.
4. Once Service ADVISOR has completed the upload of the recording select “Yes” or “No” to create another recording.

See “RECORDING PLAYBACK” later in this procedure to play recording.

Continuous

1. Validate the IDM setup Information for the correct number of parameters selected and sample rate. Note that it will estimate the length of the recording. Click “Next”.
2. Validate that the correct Start Trigger Mode has been selected and click “Next”.
3. Click “Start” when you want the recording to begin.
4. The recording will continue to record until the “Abort” button is selected. Once the recording is stopped then Service ADVISOR with begin to upload the information from the ECU to the PC.
5. Once Service ADVISOR has completed the upload of the recording select “Yes” or “No” to create another recording.

See “RECORDING PLAYBACK” later in this procedure to play recording.

Internal

1. In the pull down menu select Data Point for Start Trigger.
2. In the Data Point pull down menu select the data point that is to be designated as trigger 1.
3. Select the Comparison Operator for this trigger. Note: When triggering off of engine speed it is recommended to use “>” or “<” for a comparison operator.
4. Enter the comparison value for this trigger.
5. Set up Trigger 2. If a second start trigger is not required then select “None” and click on “Next”. If a second start trigger is desired then in the pull down menu select “Data Point”.

Continued on next page

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6. In the Data Point pull down menu select the data point that is to be designated as trigger 2.
7. Select the Comparison Operator for this trigger.
8. Enter the comparison value for this trigger. Click “Next”.
9. If a stop trigger is not desired then click “Next”. If the stop trigger is desired select the type of stop trigger in the pull down menu. If the stop trigger is with a data point then setup is similar to start trigger setup. A second stop trigger can be used. If a second stop trigger is desired then repeat this step to setup Stop Trigger 2.
10. Confirm recording setup and click “Back” to make changes or “Next”.
11. When ready to arm the recording triggers click “Start”. When all triggers that were configured are met then the recording will begin and it will record until the stop trigger setting is met.
12. Once the recording is complete, Service ADVISOR will automatically begin to upload the recording from the ECU to the PC.
13. Once Service ADVISOR has completed the upload of the recording select “Yes” or “No” to create another recording.

See “RECORDING PLAYBACK” later in this procedure to play recording.

Recording Playback

The IDM recording is stored in c:\program files\Service ADVISOR\xvds\tierIII\recs. The folder name for the recording is created using a date and time format. The IDM extension means that it is an IDM recording. Example:
“Rec_01252007_113025.IDM” was created on January 25, 2007 at 11:30:25 AM.

To playback recording disconnect “Live” connection to the ECU. In the menu bar, click on Readings, Recordings, and Open / Manage Recordings. The Open / Manage Recordings window will appear, select Import. Go to c:\program files\Service ADVISOR\xvds\tierIII\recs and select the recording that is to be imported into the available recordings window. The recording can be played immediately or at a later time.

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Payload File Downloading Instructions

NOTE: An Internet connection will be needed.

See E-LEARNING under the Service ADVISOR help section. Also, refer to the training material provided with your Service ADVISOR training course. All authorized Service ADVISOR users have received this training. On-line training is available at John Deere University, which is an internet-based distance-learning application.

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Snapshot Instructions

NOTE: To view Snapshot information Service ADVISOR is required.

Snapshot information is categorized in two types, Snapshot Capture, and Snapshot Recording. Snapshot information is generated when an engine DTC is set.

- **Snapshot Capture** - Is a snapshot of specific parameters at the exact instant in time that the DTC was set. All engine DTCs will have a Snapshot Capture associated with it. This information will also contain the engine hours for the first and latest occurrence of the DTC.
- **Snapshot Recording** - Is a short recording of specific parameters when certain DTCs are set. The recording will include parameter readings for a short period before and after the DTC was set. These are normally two to five seconds long, depending on the DTC that was set. Only specific DTCs will have a Snapshot Recordings associated with it when the DTC is set. If the DTC Count is greater than one then the snapshot recording could contain playbacks of the first and latest occurrences and can be played back by selecting the occurrence to be viewed.

IMPORTANT: It is important to save all Snapshot information before clearing DTCs or running the HARNESS DIAGNOSTIC MODE TEST. Once codes have been cleared then the Snapshot information is also cleared. For help in troubleshooting engine DTCs it is recommended not to clear codes until the problem has been resolved.

Viewing a Snapshot Capture

1. With a live connection already established with Service ADVISOR, click on the icon to get codes.
2. The window will display all active and stored codes. In this window there is a column for Snapshot Capture. If there is a “Yes” in the Snapshot Capture column then there is Snapshot Capture data available for that DTC.
3. Click once on the DTC to highlight that row and then click on the “Snapshot Capture” button below to view the information. At the same time the information is being displayed in the Service ADVISOR window it is downloading this information for viewing off-line.

Viewing a Snapshot Recordings

1. With a live connection already established with Service ADVISOR, click on the icon to get codes.
2. The window will display all active and stored codes. In this window there is a column for Snapshot Recordings. If there is a “Yes” in the Snapshot Recording column then there is Snapshot Recording available for that DTC.
3. Click once on the DTC to highlight that row and then click on the “Snapshot Recording” button below to view the information. At the same time the information is being displayed in the Service ADVISOR window it is downloading this information for viewing off-line.
4. Click on the play button to start the playback of the recording. Refer to the online help in Service ADVISOR for more information about playing a recording and other options available.

Importing a Snapshot Recording for playback when off-line can be found in “C:|Program Files|Service ADVISOR|xvds|TierIII|recs”.

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Terminal Test

The purpose of this test is to check for electrical terminal and connector problems.

Terminal Basics

Terminals are typically made from a base metal that is plated with tin or an alloy. The plating material helps protect the base metal of the terminal from corroding. There are two main varieties of terminals; pins (male) and sockets (female). The male pins are inserted into the female sockets to provide the electrical connection between wires or electrical devices. The female socket terminals typically contain one or more contact springs which provide firm contact points with the male pin terminal.

Terminal Problems

The five main types of terminal problems are corrosion, loose fit, bent terminals, pushed out terminals, and crimp problems.

Corrosion or foreign material on terminals acts as a series resistance between the contact spring and the mating terminal. This series resistance can decrease the voltage measured by the ECU at its inputs. Corrosion, liquids, or other foreign material in a connector may also provide a parallel resistance that permits current to flow between other terminals in the connector. This parallel path can increase or decrease the voltage measured by the ECU at its inputs. Once terminals are corroded, they must be replaced. Scraping the layer of corrosion from the terminal will also remove any remaining plating material resulting in a rapid reappearance of the corrosion.

A loose fit between the pin and the socket terminals may result in an intermittent open circuit. The loose fit is usually due to a damaged or worn contact spring inside the female socket terminal. Loose fitting terminals may be caused by misaligned terminals or by previous troubleshooting procedures where a probe was inserted into the female socket terminal to obtain a measurement.

Bent male pin terminals may cause an open circuit and possibly a short circuit with adjacent pins in the connector. Bent terminals are often caused by connector alignment or improper terminal crimping techniques.

Terminals that are partially pushed out of the connector may cause an open circuit or an intermittent connection if the tip of the partially pushed out terminal makes electrical contact with the tip of the mating terminal. Pushed out terminals are caused by misaligned terminals or by terminals that were not fully seated in the connector during assembly.

Terminals are crimped to wire ends to provide electrical and mechanical connection to the wire. The wire end may pull out of the terminal if not crimped correctly or if the wire has been pulled on with too much force. This results in an open circuit or an intermittent open circuit if the wire end makes contact with the terminal.

Terminal Test Visual Inspection

Inspect the terminals on both sides of the connection including the ECU or sensor for the following problems:

- Corrosion on the terminals or in the connector.
- Water or other foreign material in the connector.
- Bent terminals.
- Pushed out terminals.

Replace or reinsert terminals. Replace connector if damaged.

Terminal Test Loose Fit Check

- Select the proper terminal adapter, Flex Probe, from JDG10466 that matches the terminal you are testing.
- Gently insert the male pin terminal fully into the female socket terminal without twisting or bending.
- Slowly pull the male pin terminal out of the female socket terminal. There should be a noticeable tension as terminal probe is withdrawn.

Replace terminals that have a loose fit.

Terminal Test Crimp Check

- Remove connector back shell to gain access to wire insertion end of connector, if applicable.
- Gently pull on each wire in the connector.

Replace terminal if wire end pulls out of the terminal.

Terminal Tips

- Use the specified extraction tools to remove terminals.
- Always use the specified terminal as a replacement. The plating on mating terminals must be compatible or corrosion could occur.
- Always use the specified seals for those connectors that require them.
- Always use the correct crimping tool to attach replacement terminals.
- After crimping a terminal to the wire end, pull gently on the terminal to make sure it is securely crimped.

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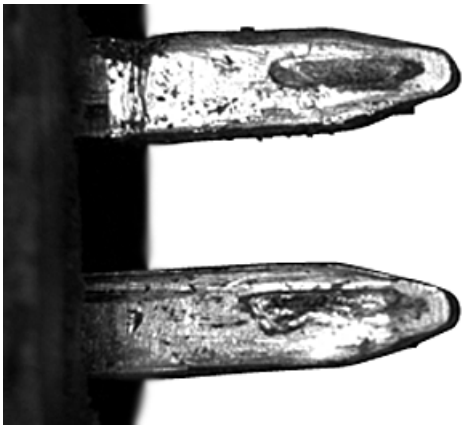

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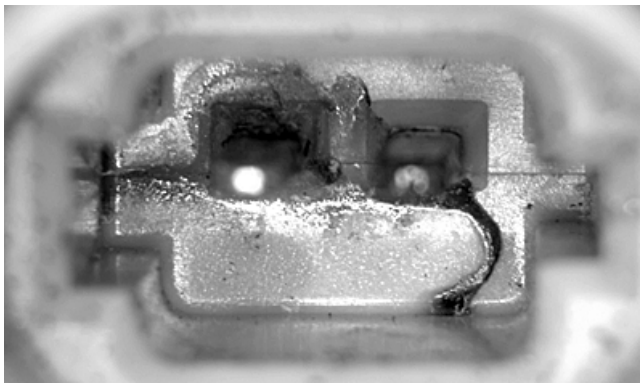

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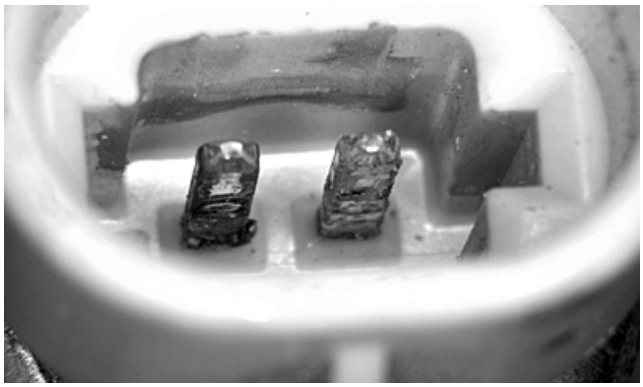

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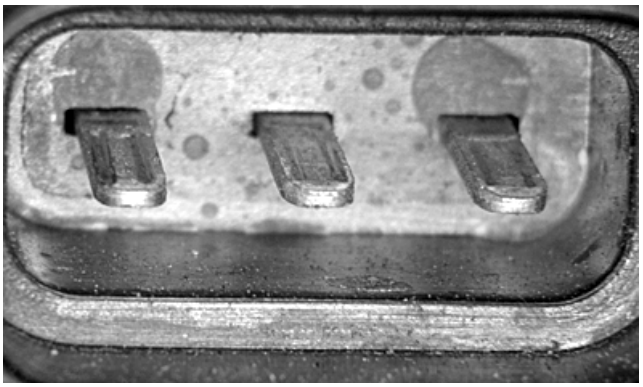

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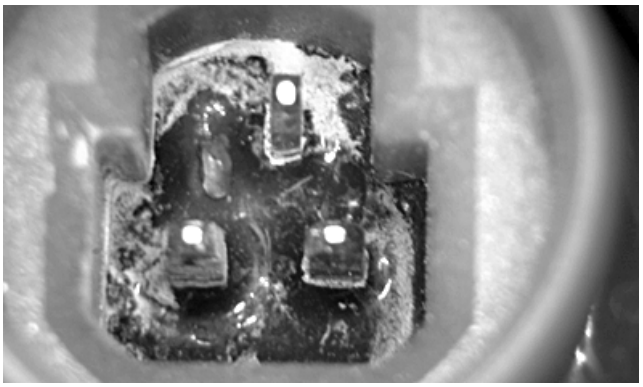

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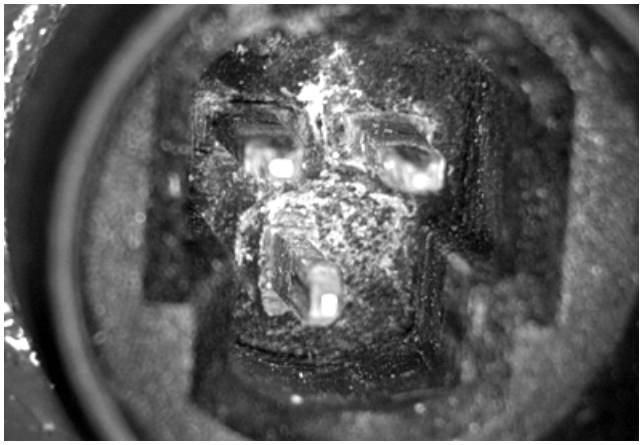

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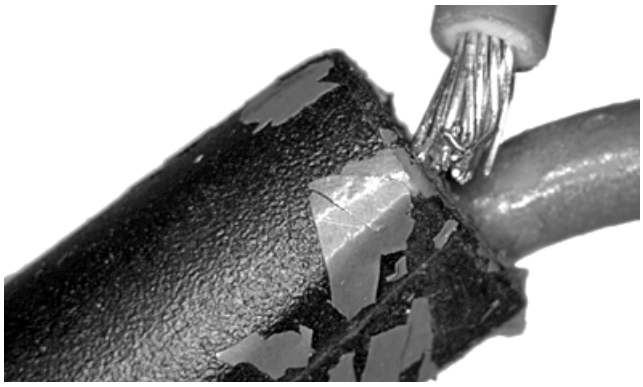

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Trim Options Information

Trimmable options are features that can be turned ON or Off during an ECU programming cycle. These features will customize an engine for each individual customer. Not all engines have the trim feature.

To update trimmable features, download the software payload file and start the programming sequence through the service tool. The trim page automatically appears if the payload has trim incorporated.

For more information to help select the correct option, use the help documentation available in each section of the trim page.

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000636.02 — Camshaft Position Signal Invalid

The ECU detects excessive electrical noise (extra pulses) in the camshaft position signal.

DN22556,00006BA -19-24SEP10-1/22

000636.02 — Camshaft Position Signal Invalid Diagnostic Procedure

Troubleshooting Sequence:
000636.08
000636.02

When DTC is Displayed:
The engine is cranking or running and the error condition is active.

Related Information:
The ECU detects extra pulses (electrical noise) in the camshaft position signal.
The extra pulses may be caused by electromagnetic interference or by a camshaft position sensor signal wire that is shorted to some other signal wire.
Wiring problems such as loose terminals or water in connectors may also cause this DTC.

Alarm Level:
Warning

Control Unit Response:
Prolonged cranking time may be required to start the engine.
The ECU will use the crankshaft position signal to determine camshaft position.
If a crankshaft position 000637 DTC accompanies 000636.02, the engine cannot be started and will stall if running until at least one of the two codes is repaired.

Additional References:
For more camshaft position sensor information, see Camshaft Position Sensor in Section 03, Group 140 earlier in this manual.

For more information on speed sensors, see Speed Measurement in Section 03, Group 140 earlier in this manual.

NOTE: The wiring diagrams provided are for a typical John Deere supplied OEM harness. Wire number, colors, and jumper connectors do not apply to all applications.

For wiring information see 2.4L/3.0L ECU WIRING DIAGRAM 7 located in Section 06, Group 210 later in this manual.

Flex probe information:
- ECU large terminal - Orange/Green
- ECU small terminal - Orange/Blue
- Camshaft position sensor X02 - Purple/Red
- Front Engine Interconnect X07 - Yellow/Purple

For more information on connector and terminal testing or flex probes see Terminal Test in Section 04, Group 160 earlier in this manual.

IMPORTANT: Do not force probes into connector terminals or damage will result. Use JDG10466 Connector Adapter Test Kit to make measurements in connectors. This will ensure that terminal damage does not occur.

Continued on next page

DN22556,00006BA -19-24SEP10-2/22

1 Read DTCs and Store Snapshot Information

1. Ignition ON, engine OFF.

NOTE: When DTCs are cleared Snapshot information for ALL DTCs will also be cleared.

2. Connect Service ADVISOR, see Connecting To Service ADVISOR earlier in this Group.
3. Write down all DTCs and their occurrence count. If any DTCs have snapshot capture or snapshot recording information, save the information. For instructions on saving and using snapshot information, see Snapshot Instructions earlier in this Group.
4. Start or crank engine.
5. Refresh DTCs.

Did 000636.02 reappear active with engine running or cranking?

YES: GO TO 2

NO: GO TO 20

DN22556,00006BA -19-24SEP10-3/22

2 Check Camshaft Position Data Points

1. Monitor the following Data Points in Service ADVISOR:
   - Camshaft Position Signal Noise Indicator
   - Camshaft Position Signal Improper Pattern Indicator
   - Camshaft Position Signal Status
   - Camshaft Position Speed
2. Operate engine through normal speed and load ranges.
3. Switch ON and OFF any electrical devices on the application.

CAUTION: Use caution when working near rotating components.

4. Gently wiggle wire harness between camshaft position sensor and ECU.

NOTE: The Camshaft Position Noise Indicator has a value of 0 if the camshaft position signal is good. The value will temporarily increase if noise is detected in the camshaft position signal. The Camshaft Position Improper Pattern Indicator is 0% if recent camshaft position signal patterns were good. The percentage will increase if errors in the signal pattern are detected and will count down to 0% once the signal pattern is error-free. The Camshaft Position Status has a value of 47 if the camshaft position signal is good with engine speed above 400 rpm. The value will be something other than 47 if a signal problem is detected. These data points can be used to locate intermittent problems with the camshaft position signal which are too brief to cause a DTC to become active.

YES: Found engine wiring problem. Repair problem. GO TO 19

NOTE: Internal Data Monitor in Service ADVISOR may also be used to locate intermittent speed sensor circuit problems. See Internal Data Monitor Instructions earlier in this group for more information on using this feature. Select the data points defined earlier in this step and set sample rate to 5 ms.

YES: Some device on application causes the electrical noise. Open DTAC case.

Were you able to find some mode of operation or an intermittent wiring problem which causes the camshaft position data points to indicate a signal problem?

NO: GO TO 3

DN22556,00006BA -19-24SEP10-4/22

3 Test Sensor Terminals

NOTE: Verify that the camshaft position sensor is connected to harness connector X02 and the crankshaft position sensor is connected to harness connector X01. If engine wire harness is routed incorrectly, connector X02 can be connected to the crankshaft position sensor and connector X01 can be connected to the camshaft position sensor. Inadvertently swapping these connectors may cause DTCs 000636.02, 000636.10, 00637.02, and/or 000637.10.

1. Ignition OFF, engine OFF.
2. Disconnect camshaft position sensor connector X02.
3. Perform Terminal Test on camshaft position sensor and connector.

YES: Fix problem. GO TO 19

Were any problems found?

NO: GO TO 4

Continued on next page

DN22556,00006BA -19-24SEP10-5/22

4 Inspect Target	1. Remove camshaft position sensor.	
	2. Inspect camshaft target through sensor mounting hole as engine is rotated. Look for burs, chips, or debris on target.	**YES:** Fix problem. GO TO 19
	Were any problems found?	**NO:** GO TO 5

DN22556,00006BA -19-24SEP10-6/22

5 Inspect Camshaft Position Sensor	*NOTE: See Camshaft Position Sensor — Removal and Camshaft Position Sensor — Installation in Section 02, Group 110 earlier in this manual for sensor replacement instructions.*	
	Examine tip of camshaft position sensor for damage due to contact with target.	**YES:** Replace camshaft position sensor. Determine cause if replacement sensor also becomes damaged. GO TO 19
	Does sensor appear damaged due to contact with target?	**NO:** GO TO 6

DN22556,00006BA -19-24SEP10-7/22

6 Check Sensor Resistance	On the camshaft position sensor, measure the resistance between terminals A and B.	**YES:** Reinstall camshaft position sensor. Do not reconnect to harness. GO TO 7
	Is the resistance between 2500 ohms and 3500 ohms?	**NO:** Replace camshaft position sensor. GO TO 19

DN22556,00006BA -19-24SEP10-8/22

7 Test ECU Terminals	1. Disconnect ECU J01 connector.	
	2. Perform Terminal Test on J01.	**YES:** Fix problem. GO TO 19
	Were any problems found?	**NO:** GO TO 8

DN22556,00006BA -19-24SEP10-9/22

8 Check for Camshaft Position Return Shorted to Ground	On the harness, measure the resistance between ECU J01-E4 and single point ground.	**YES:** GO TO 9
	Is the resistance greater than 1k ohms?	**NO:** Fix problem. GO TO 19

Continued on next page

DN22556,00006BA -19-24SEP10-10/22

9 Check Camshaft Position Circuit Continuity

NOTE: Verify that camshaft position signal and return wires are in the specified connector cavities (not swapped).

1. On the harness, measure the resistance between ECU J01-A4 and camshaft position sensor X02-B.
2. On the harness, measure the resistance between ECU J01-E4 and camshaft position sensor X02-A.
3. Disconnect front engine interconnect 8-way connector X07.
4. Perform Terminal Test on X07.

Are both resistance measurements less than 10 ohms and are Terminal Test results good?

YES: Reconnect X07 connector. GO TO 10

NO: Fix problem. GO TO 19

DN22556,00006BA -19-24SEP10-11/22

10 Test ECU Terminals

1. Disconnect ECU J02 connector.
2. Perform Terminal Test on J02.

Were any problems found?

YES: Fix problem. GO TO 19

NO: GO TO 11

DN22556,00006BA -19-24SEP10-12/22

11 Check for Intermittent ECU Power Supply Problem

1. Ignition ON, engine OFF.
2. On the harness, measure the voltage from ECU J02-L1 (+) to J02-L2 (-) while gently wiggling wire harness.
3. On the harness, measure the voltage from ECU J02-B2 (+) to J02-L2 (-) while gently wiggling wire harness.

Were any intermittent wiring problems found?

YES: Fix problem. GO TO 19

NO: GO TO 12

DN22556,00006BA -19-24SEP10-13/22

12 Check for Wire-to-Wire Short

1. Ignition OFF, engine OFF.
2. Verify camshaft position sensor is still disconnected.
3. On the harness, measure the resistance between ECU J01-A4 and all other terminals in the J01 and J02 connectors.

Are all resistance measurements greater than 1k ohms?

YES: GO TO 13

NO: Fix problem. GO TO 19

Continued on next page

DN22556,00006BA -19-24SEP10-14/22

13 Check Camshaft Position Wiring	Examine camshaft position wiring between the camshaft position sensor and the ECU. Check for the following: • Verify that camshaft position signal and return wires are twisted together throughout the harness. • Verify that no physical damage to camshaft position signal and return wires is evident. Were any problems found?	**YES:** Replace camshaft position wiring with twisted pair or repair problem. GO TO 19 **NO:** GO TO 14

DN22556,00006BA -19-24SEP10-15/22

14 Check Wire Harness Routing	Examine routing of camshaft position wiring between camshaft position sensor and ECU. Is camshaft position wiring routed near sources of strong electric or magnetic fields such as 2-way radio antenna, alternator, inverter, a.c. generator, or other similar device on the application?	**YES:** Reroute camshaft position wires away from device. GO TO 19 **NO:** GO TO 15

DN22556,00006BA -19-24SEP10-16/22

15 Check for Alternator Noise	1. Disconnect negative battery cable. 2. Disconnect alternator positive output cable and insulate cable terminal. 3. Disconnect all other alternator connectors. 4. Reconnect negative battery cable. 5. Reconnect ECU and sensor connectors. 6. Ignition ON, engine ON. Did DTC 000636.02 reappear active with engine running?	**YES:** GO TO 16 **NO:** Repair alternator problem. GO TO 19

DN22556,00006BA -19-24SEP10-17/22

16 Replace Camshaft Position Sensor	Has camshaft position sensor been replaced during this procedure?	**YES:** GO TO 17 **NO:** Replace camshaft position sensor. GO TO 19

DN22556,00006BA -19-24SEP10-18/22

17 Reprogram ECU	Download latest ECU payload and reprogram ECU. Did DTC 000636.02 reappear active with engine running?	**YES:** GO TO 18 **NO:** Problem fixed.

DN22556,00006BA -19-24SEP10-19/22

18 Replace ECU	1. Ignition OFF, engine OFF. 2. Replace ECU. Did DTC 000636.02 reappear active with engine running?	**YES:** Open DTAC case. **NO:** Problem fixed.

Continued on next page

DN22556,00006BA -19-24SEP10-20/22

19 Verification	1. Ignition OFF, engine OFF.	
	2. Reconnect all connectors (disconnect battery negative cable prior to reinstalling alternator positive cable, if applicable).	
	3. Ignition ON, engine ON.	
	4. Monitor DTCs in Service ADVISOR.	
	5. Refresh DTCs.	
	6. Operate engine through normal speed and load.	**YES:** GO TO 1
	Did DTC 000636.02 reappear active with engine running?	**NO:** Problem fixed.

DN22556,00006BA -19-24SEP10-21/22

20 Review Snapshot Information	1. Retrieve snapshot information, see Snapshot Instructions earlier in this Group.	**YES:** Found a possible problem. Repair possible problem. Retest.
	2. Review information to see if you can determine a possible problem or the operating point that causes the code to become active.	**YES:** Found operating point at which the code becomes active. Try to determine cause. Repair and retest.
	Did you find a possible problem or the operating point at which the code becomes active?	**NO:** GO TO 2

DN22556,00006BA -19-24SEP10-22/22

000636.05 — Camshaft Position Circuit has High Resistance

The ECU detects low current on the camshaft position wiring.

JB81757,0000067 -19-15APR10-1/14

000636.05 — Camshaft Position Circuit Has High Resistance Diagnostic Procedure

Troubleshooting Sequence:
000636.05

Related Information:
The ECU detects high resistance or an open circuit in the camshaft position circuit during the Harness Diagnostic Mode Test in Service ADVISOR.

Alarm Level:
Warning

Control Unit Response:
DTC 000636.08 may also be active when engine is running.

Additional References:
For more camshaft position sensor information, see Camshaft Position Sensor in Section 03, Group 140 earlier in this manual.

For more information on speed sensors, see Speed Measurement in Section 03, Group 140 earlier in this manual.

NOTE: The wiring diagrams provided are for a typical John Deere supplied OEM harness. Wire number, colors, and jumper connectors do not apply to all applications.

For wiring information see 2.4L/3.0L ECU WIRING DIAGRAM 6 located in Section 06, Group 210 later in this manual.

Flex probe information:
- ECU large terminal - Orange/Green
- ECU small terminal - Orange/Blue
- Camshaft position sensor X02 - Purple/Red
- Front Engine Interconnect X07 - Yellow/Purple

For more information on connector and terminal testing or flex probes see Terminal Test in Section 04, Group 160 earlier in this manual.

IMPORTANT: When directed to run the Harness Diagnostic Mode Test the engine temperature should be above freezing. It is recommended that the engine temperature be at least room temperature 20° C (68° F). This test is located in Service ADVISOR.

IMPORTANT: Do not force probes into connector terminals or damage will result. Use JDG10466 Connector Adapter Test Kit to make measurements in connectors. This will ensure that terminal damage does not occur.

JB81757,0000067 -19-15APR10-2/14

1 Test Sensor Terminals	1. Ignition OFF, engine OFF.	
	2. Disconnect camshaft position sensor connector X02.	
	3. Perform Terminal Test on camshaft position sensor and connector.	**YES:** Fix problem. GO TO 12
	Were any problems found?	**NO:** GO TO 2

Continued on next page

JB81757,0000067 -19-15APR10-3/14

2 Check Sensor Resistance	On the camshaft position sensor, measure the resistance between terminals A and B.	**YES:** GO TO 3
	Is the resistance between 2500 ohms and 3500 ohms?	**NO:** Remove camshaft position sensor. GO TO 11

JB81757,0000067 -19-15APR10-4/14

3 Test ECU Terminals	1. Disconnect ECU J01 connector.	
	2. Perform Terminal Test on J01.	**YES:** Fix problem. GO TO 12
	Were any problems found?	**NO:** GO TO 4

JB81757,0000067 -19-15APR10-5/14

4 Check Camshaft Position Circuit Continuity	1. On the harness, measure the resistance between ECU J01-A4 and camshaft position sensor X02-B.	
	2. On the harness, measure the resistance between ECU J01-E4 and camshaft position sensor X02-A.	
	3. Disconnect front engine interconnect 8-way connector X07.	
	4. Perform Terminal Test on X07.	**YES:** Reconnect X07 connector. GO TO 5
	Are both resistance measurements less than 10 ohms and are Terminal Test results good?	**NO:** Fix problem. GO TO 12

JB81757,0000067 -19-15APR10-6/14

5 Check for Camshaft Position Signal Wire-to-Wire Short	1. Disconnect ECU J01 and J02 connectors.	
	2. Verify camshaft position sensor is still disconnected.	
	3. On the harness, measure the resistance between ECU J01-A4 and all other terminals in the J01 and J02 connectors.	**YES:** GO TO 6
	Are all resistance measurements greater than 1k ohms?	**NO:** Fix problem. GO TO 12

JB81757,0000067 -19-15APR10-7/14

6 Check for Camshaft Position Signal Shorted to Voltage	1. Ignition ON, engine OFF.	
	2. On the harness, measure the voltage between ECU J01-A4 (+) and single point ground (-).	**YES:** GO TO 7
	Is voltage less than 0.5V?	**NO:** Fix problem.. GO TO 12

Continued on next page

JB81757,0000067 -19-15APR10-8/14

7 Check for Intermittent Open Circuit	1. Ignition OFF, engine OFF. 2. Reconnect all electrical connectors. 3. Ignition ON, engine OFF. 4. Perform Harness Diagnostic Mode Test in Service ADVISOR. Did 000636.05 reappear active?	**YES:** GO TO 8 **NO:** Recheck for intermittent open circuit. GO TO 1

JB81757,0000067 -19-15APR10-9/14

8 Replace Camshaft Position Sensor	Has camshaft position sensor been replaced during this diagnostic procedure?	**YES:** GO TO 9 **NO:** Remove camshaft position sensor. GO TO 11

JB81757,0000067 -19-15APR10-10/14

9 Reprogram ECU	1. Download latest ECU payload and reprogram ECU. 2. Ignition ON, engine OFF. 3. Perform Harness Diagnostic Mode Test in Service ADVISOR. Did 000636.05 reappear active?	**YES:** GO TO 10 **NO:** Problem fixed.

JB81757,0000067 -19-15APR10-11/14

10 Replace ECU	1. Ignition OFF, engine OFF. 2. Replace ECU. 3. Ignition ON, engine OFF. 4. Perform Harness Diagnostic Mode Test in Service ADVISOR. Did 000636.05 reappear active?	**YES:** Open DTAC case. **NO:** Problem fixed.

JB81757,0000067 -19-15APR10-12/14

11 Inspect Camshaft Position Sensor	Examine tip of camshaft position sensor for damage due to contact with target. Does sensor appear damaged due to contact with target?	**YES:** Replace camshaft position sensor. Determine cause if replacement sensor also becomes damaged. GO TO 12 **NO:** Replace camshaft position sensor. GO TO 12

JB81757,0000067 -19-15APR10-13/14

12 Verification	1. Ignition OFF, engine OFF. 2. Reconnect all electrical connectors. 3. Ignition ON, engine OFF. 4. Perform Harness Diagnostic Mode Test in Service ADVISOR. Did 000636.05 reappear active?	**YES:** GO TO 1 **NO:** Problem fixed.

JB81757,0000067 -19-15APR10-14/14

000636.06 — Camshaft Position Circuit has Low Resistance

The ECU detects high current on the camshaft position wiring.

JB81757,0000068 -19-15APR10-1/16

000636.06 — Camshaft Position Circuit Has Low Resistance Diagnostic Procedure

Troubleshooting Sequence:
000636.06

Related Information:
The ECU detects low resistance or a short to ground in the camshaft position circuit during the Harness Diagnostic Mode Test in .

Alarm Level:
Warning

Control Unit Response:
DTC 000636.08 may also be active when engine is running.

Additional References:
For more camshaft position sensor information, see Camshaft Position Sensor in Section 03, Group 140 earlier in this manual.

For more information on speed sensors, see Speed Measurement in Section 03, Group 140 earlier in this manual.

NOTE: The wiring diagrams provided are for a typical John Deere supplied OEM harness. Wire number, colors, and jumper connectors do not apply to all applications.

For wiring information see 2.4L/3.0L ECU WIRING DIAGRAM 6 located in Section 06, Group 210 later in this manual.

Flex probe information:
- ECU large terminal - Orange/Green
- ECU small terminal - Orange/Blue
- Camshaft position sensor X02 - Purple/Red
- Front Engine Interconnect X07 - Yellow/Purple

For more information on connector and terminal testing or flex probes see Terminal Test in Section 04, Group 160 earlier in this manual.

IMPORTANT: When directed to run the Harness Diagnostic Mode Test the engine temperature should be above freezing. It is recommended that the engine temperature be at least room temperature 20° C (68° F). This test is located in Service ADVISOR.

IMPORTANT: Do not force probes into connector terminals or damage will result. Use JDG10466 Connector Adapter Test Kit to make measurements in connectors. This will ensure that terminal damage does not occur.

JB81757,0000068 -19-15APR10-2/16

1 Check for DTC Change with Sensor Disconnected	1. Ignition ON, engine OFF. 2. Disconnect camshaft position sensor connector X02. 3. Perform Harness Diagnostic Mode Test in Service ADVISOR. Is 000636.05, Camshaft Position Circuit has High Resistance, now an active DTC?	**YES:** Remove camshaft position sensor. GO TO 13 **NO:** GO TO 2

Continued on next page

JB81757,0000068 -19-15APR10-3/16

2 Test Sensor Terminals	1. Ignition OFF, engine OFF.	
	2. Perform Terminal Test on camshaft position sensor and connector.	**YES:** Fix problem. GO TO 14
	Were any problems found?	**NO:** GO TO 3

JB81757,0000068 -19-15APR10-4/16

3 Check Sensor Resistance	On the camshaft position sensor, measure the resistance between terminals A and B.	**YES:** Do not reconnect sensor to harness. GO TO 4
	Is the resistance between 2500 ohms and 3500 ohms?	**NO:** Remove camshaft position sensor. GO TO 13

JB81757,0000068 -19-15APR10-5/16

4 Test ECU Terminals	1. Disconnect ECU J01 connector.	
	2. Perform Terminal Test on connector J01.	**YES:** Fix problem. GO TO 14
	Were any problems found?	**NO:** GO TO 5

JB81757,0000068 -19-15APR10-6/16

5 Check Camshaft Position Circuit Continuity	1. On the harness, measure the resistance between ECU J01-A4 and camshaft position sensor X02-B.	
	2. On the harness, measure the resistance between ECU J01-E4 and camshaft position sensor X02-A.	**YES:** GO TO 6
	Are both resistance measurements less than 10 ohms?	**NO:** Fix problem. GO TO 14

JB81757,0000068 -19-15APR10-7/16

6 Check for Camshaft Position Wire-to-Wire Short	1. Verify camshaft position sensor is disconnected.	
	2. On the harness, measure the resistance between ECU J01-A4 and J01-E4.	**YES:** GO TO 7
	Is the resistance greater than 10k ohms?	**NO:** Fix problem. GO TO 14

JB81757,0000068 -19-15APR10-8/16

7 Check for Camshaft Position Signal Shorted to Ground	On the harness, measure the resistance between ECU J01-A4 and single point ground.	**YES:** GO TO 8
	Is the resistance greater than 10k ohms?	**NO:** Fix problem. GO TO 14

Continued on next page

JB81757,0000068 -19-15APR10-9/16

8 Check for Camshaft Position Signal Wire-to-Wire Short

1. Disconnect ECU J01 and J02 connectors.
2. On the harness, measure the resistance between ECU J01-A4 and all other terminals in the J01 and J02 connectors.

Are all resistance measurements greater than 10k ohms?

YES: GO TO 9

NO: Fix problem. GO TO 14

JB81757,0000068 -19-15APR10-10/16

9 Check for Intermittent Shorted Circuit

1. Ignition OFF, engine OFF.
2. Reconnect all electrical connectors.
3. Ignition ON, engine OFF.
4. Perform Harness Diagnostic Mode Test in Service ADVISOR.

Did 000636.06 reappear active?

YES: GO TO 10

NO: Recheck for intermittent shorted circuit. GO TO 1

JB81757,0000068 -19-15APR10-11/16

10 Replace Camshaft Position Sensor

Has camshaft position sensor been replaced during this diagnostic procedure?

YES: GO TO 11

NO: Remove camshaft position sensor. GO TO 13

JB81757,0000068 -19-15APR10-12/16

11 Reprogram ECU

1. Download latest ECU payload and reprogram ECU.
2. Ignition ON, engine OFF.
3. Perform Harness Diagnostic Mode Test in Service ADVISOR.

Did 000636.06 reappear active?

YES: GO TO 12

NO: Problem fixed.

JB81757,0000068 -19-15APR10-13/16

12 Replace ECU

1. Ignition OFF, engine OFF.
2. Replace ECU.
3. Ignition ON, engine OFF.
4. Perform Harness Diagnostic Mode Test in Service ADVISOR.

Did 000636.06 reappear active?

YES: Open DTAC case.

NO: Problem fixed.

JB81757,0000068 -19-15APR10-14/16

13 Inspect Camshaft Position Sensor

Examine tip of camshaft position sensor for damage due to contact with target.

Does sensor appear damaged due to contact with target?

YES: Replace camshaft position sensor. Determine cause if replacement sensor also becomes damaged. GO TO 14

NO: Replace camshaft position sensor. GO TO 14

Continued on next page

JB81757,0000068 -19-15APR10-15/16

14 Verification	1. Ignition OFF, engine OFF. 2. Reconnect all electrical connectors. 3. Ignition ON, engine OFF. 4. Perform Harness Diagnostic Mode Test in Service ADVISOR. Did 000636.06 reappear active?	**YES:** GO TO 1 **NO:** Problem fixed.

JB81757,0000068 -19-15APR10-16/16

000636.08 — Camshaft Position Signal Missing

The ECU does not detect a camshaft position signal.

JB81757,0000069 -19-16APR10-1/20

000636.08 — Camshaft Position Signal Missing Diagnostic Procedure

Troubleshooting Sequence:
000636.05 or 000636.06
000636.08

When DTC is Displayed:
The engine is cranking or running and the error condition is active.

Related Information:
The ECU does not detect a camshaft position signal when engine is cranking or running.
This DTC can be caused by an open or shorted camshaft position circuit.

Alarm Level:
Warning

Control Unit Response:
Prolonged cranking time may be required to start the engine.
The ECU will use the crankshaft position signal to determine camshaft position.
If a crankshaft position 000637 DTC accompanies 000636.08, the engine cannot be started and will stall if running until at least one of the two codes is repaired.

Additional References:
For more camshaft position sensor information, see Camshaft Position Sensor in Section 03, Group 140 earlier in this manual.

For more information on speed sensors, see Speed Measurement in Section 03, Group 140 earlier in this manual.

NOTE: The wiring diagrams provided are for a typical John Deere supplied OEM harness. Wire number, colors, and jumper connectors do not apply to all applications.

For wiring information see 2.4L/3.0L ECU WIRING DIAGRAM 6 located in Section 06, Group 210 later in this manual.

Flex probe information:
- ECU large terminal - Orange/Green
- ECU small terminal - Orange/Blue
- Camshaft position sensor X02 - Purple/Red
- Front Engine Interconnect X07 - Yellow/Purple

For more information on connector and terminal testing or flex probes see Terminal Test in Section 04, Group 160 earlier in this manual.

IMPORTANT: When directed to run the Harness Diagnostic Mode Test the engine temperature should be above freezing. It is recommended that the engine temperature be at least room temperature 20° C (68° F). This test is located in Service ADVISOR.

IMPORTANT: Do not force probes into connector terminals or damage will result. Use JDG10466 Connector Adapter Test Kit to make measurements in connectors. This will ensure that terminal damage does not occur.

Continued on next page

JB81757,0000069 -19-16APR10-2/20

1 Read DTCs and Store Snapshot Information	1. Ignition ON, engine OFF. *NOTE: When DTCs are cleared Snapshot information for ALL DTCs will also be cleared.* 2. Connect Service ADVISOR, see Connecting To Service ADVISOR earlier in this Group. 3. Write down all DTCs and their occurrence count. If any DTCs have snapshot capture or snapshot recording information, save the information. For instructions on saving and using snapshot information, see Snapshot Instructions earlier in this Group. 4. Start or crank engine. 5. Refresh DTCs. Did 000636.08 reappear active with engine running or cranking?	**YES:** GO TO 2 **NO:** GO TO 18

JB81757,0000069 -19-16APR10-3/20

2 Check for Open or Shorted Camshaft Position Circuit	1. Ignition ON, engine OFF. 2. Perform Harness Diagnostic Mode Test in Service ADVISOR. Is 000636.05 or 000636.06 active?	**YES:** Discontinue test for 000636.08 and perform test for 000636.05 or 000636.06. **NO:** GO TO 3

JB81757,0000069 -19-16APR10-4/20

3 Check for Loose Sensor	*NOTE: See Camshaft Position Sensor — Removal and Camshaft Position Sensor — Installation in Section 02, Group 110 earlier in this manual for sensor torque specifications.* 1. Ignition OFF, engine OFF. 2. Disconnect camshaft position sensor connector X02. 3. Verify camshaft position sensor installation torque. Was camshaft position sensor fully threaded into mounting hole?	**YES:** GO TO 4 **NO:** Torque sensor to specified value. GO TO 17

JB81757,0000069 -19-16APR10-5/20

4 Test Sensor Terminals	Perform Terminal Test on camshaft position sensor and connector. Were any problems found?	**YES:** Fix problem. GO TO 17 **NO:** GO TO 5

JB81757,0000069 -19-16APR10-6/20

5 Check Sensor Resistance	On the camshaft position sensor, measure the resistance between terminals A and B. Is the resistance between 2500 ohms and 3500 ohms?	**YES:** GO TO 6 **NO:** Remove camshaft position sensor. GO TO 16

Continued on next page

JB81757,0000069 -19-16APR10-7/20

6 Inspect Timing Wheel

1. Remove camshaft position sensor.
2. Rotate crankshaft using JDG1704 or JDG10221 Engine Turning Tool and inspect camshaft timing wheel for damage and rotation through sensor mounting hole as engine is rotated.

NOTE: Camshaft timing wheel has two teeth missing by design.

Is camshaft timing wheel intact and rotating when engine is rotated?

YES: GO TO 7

NO: Fix mechanical problem, GO TO 17

JB81757,0000069 -19-16APR10-8/20

7 Test ECU Terminals

1. Disconnect ECU J01 connector.
2. Perform Terminal Test on J01.

Were any problems found?

YES: Fix problem. GO TO 17

NO: GO TO 8

JB81757,0000069 -19-16APR10-9/20

8 Check Sensor Circuit Continuity

NOTE: Verify that camshaft position signal and return wires are in the specified connector cavities (not swapped).

1. On the harness, measure the resistance between ECU J01-A4 and camshaft position sensor X02-B.
2. On the harness, measure the resistance between ECU J01-E4 and camshaft position sensor X02-A.
3. Disconnect front engine interconnect 8-way connector X07.
4. Perform Terminal Test on X07.

Are both resistance measurements less than 10 ohms and are Terminal Test results good?

YES: Reconnect X07 connector. GO TO 9

NO: Fix problem. GO TO 17

JB81757,0000069 -19-16APR10-10/20

9 Check for Camshaft Position Wire-to-Wire Short

1. Verify camshaft position sensor is disconnected.
2. On the harness, measure the resistance between ECU J01-A4 and J01-E4.

Is the resistance greater than 10k ohms?

YES: GO TO 10

NO: Fix problem. GO TO 17

JB81757,0000069 -19-16APR10-11/20

10 Check for Camshaft Position Signal Shorted to Ground

On the harness, measure the resistance between ECU J01-A4 and single point ground.

Is the resistance greater than 10k ohms?

YES: GO TO 11

NO: Fix problem. GO TO 17

Continued on next page

JB81757,0000069 -19-16APR10-12/20

11 Check for Camshaft Position Signal Wire-to-Wire Short	1. Disconnect ECU J01 and J02 connectors.	
	2. On the harness, measure the resistance between ECU J01-A4 and all other terminals in the J01 and J02 connectors.	**YES:** GO TO 12
	Are all resistance measurements greater than 10k ohms?	**NO:** Fix problem. GO TO 17

JB81757,0000069 -19-16APR10-13/20

12 Check for Camshaft Position Signal Circuit Shorted to Voltage Source	1. Ignition ON, engine OFF.	
	2. On the harness, measure the voltage between ECU J01-A4 (+) and single point ground (-).	**YES:** GO TO 13
	Is the voltage less than 0.5V?	**NO:** Fix problem. GO TO 17

JB81757,0000069 -19-16APR10-14/20

13 Replace Camshaft Position Sensor	Has camshaft position sensor been replaced during this diagnostic procedure?	**YES:** GO TO 14 **NO:** Remove camshaft position sensor. GO TO 16

JB81757,0000069 -19-16APR10-15/20

14 Reprogram ECU	1. Ignition OFF, engine OFF.	
	2. Reconnect all electrical connectors.	
	3. Download latest ECU payload and reprogram ECU.	**YES:** GO TO 15
	Did 000636.08 reappear active with engine running?	**NO:** Problem fixed.

JB81757,0000069 -19-16APR10-16/20

15 Replace ECU	1. Ignition OFF, engine OFF.	
	2. Replace ECU.	**YES:** Open DTAC case.
	Did DTC 000636.08 reappear active with engine running?	**NO:** Problem fixed.

JB81757,0000069 -19-16APR10-17/20

16 Inspect Camshaft Position Sensor	Examine tip of camshaft position sensor for damage due to contact with target.	**YES:** Replace camshaft position sensor. Determine cause if replacement sensor also becomes damaged. GO TO 17
	Does sensor appear damaged due to contact with target?	**NO:** Replace camshaft position sensor. GO TO 17

Continued on next page

JB81757,0000069 -19-16APR10-18/20

17 Verification		
	1. Ignition OFF, engine OFF.	
	2. Reconnect all electrical connectors.	
	3. Ignition ON, engine ON.	**YES:** GO TO 1
	Did 000636.08 reappear active with engine running?	**NO:** Problem fixed.

JB81757,0000069 -19-16APR10-19/20

18 Review Snapshot Information		
	1. Retrieve snapshot information, see Snapshot Instructions earlier in this Group.	**YES:** Found a possible problem. Repair possible problem. Retest.
	2. Review information to see if you can determine a possible problem or the operating point that causes the code to become active.	**YES:** Found operating point at which the code becomes active. Try to determine cause. Repair and retest.
	Did you find a possible problem or the operating point at which the code becomes active?	**NO:** GO TO 2

JB81757,0000069 -19-16APR10-20/20

000636.10 — Camshaft Position Signal Rate of Change Abnormal

The ECU detects an improper pattern on the camshaft position input.

JB81757,0000070 -19-21APR10-1/25

000636.10 — Camshaft Position Signal Rate of Change Abnormal Diagnostic Procedure

Troubleshooting Sequence:
000636.08
Any DTC with SPN 000637
000636.10

When DTC is Displayed:
The engine is cranking or running and the error condition is active.

Related Information:
The ECU detects an improper pattern (pulses missing) on the camshaft position input.
This DTC may be caused by intermittent open or shorted camshaft or crankshaft position circuits, loose terminals, or water in connectors.
Problems with the crankshaft position signal may cause this DTC to be falsely generated.

Alarm Level:
Warning

Control Unit Response:
Prolonged cranking time may be required to start the engine.
The ECU will use the crankshaft position signal to determine camshaft position.
If a crankshaft position 000637 DTC accompanies 000636.10, the engine cannot be started and will stall if running until at least one of the two codes is repaired.

Additional References:
For more camshaft position sensor information, see Camshaft Position Sensor in Section 03, Group 140 earlier in this manual.

For more information on speed sensors, see Speed Measurement in Section 03, Group 140 earlier in this manual.

NOTE: The wiring diagrams provided are for a typical John Deere supplied OEM harness. Wire number, colors, and jumper connectors do not apply to all applications.

For wiring information see 2.4L/3.0L ECU WIRING DIAGRAM 6 located in Section 06, Group 210 later in this manual.

Flex probe information:
- ECU large terminal - Orange/Green
- ECU small terminal - Orange/Blue
- Camshaft position sensor X02 - Purple/Red
- Front Engine Interconnect X07 - Yellow/Purple

For more information on connector and terminal testing or flex probes see Terminal Test in Section 04, Group 160 earlier in this manual.

IMPORTANT: When directed to run the Harness Diagnostic Mode Test the engine temperature should be above freezing. It is recommended that the engine temperature be at least room temperature 20° C (68° F). This test is located in Service ADVISOR.

IMPORTANT: Do not force probes into connector terminals or damage will result. Use JT07328 Connector Adapter Test Kit to make measurements in connectors. This will ensure that terminal damage does not occur.

Continued on next page

JB81757,0000070 -19-21APR10-2/25

1 Read DTCs and Store Snapshot Information	1. Ignition ON, engine OFF. *NOTE: When DTCs are cleared Snapshot information for ALL DTCs will also be cleared.* 2. Connect Service ADVISOR, see Connecting To Service ADVISOR earlier in this Group. 3. Write down all DTCs and their occurrence count. If any DTCs have snapshot capture or snapshot recording information, save the information. For instructions on saving and using snapshot information, see Snapshot Instructions earlier in this Group. 4. Start or crank engine. 5. Refresh DTCs. Did 000636.10 reappear active with engine running or cranking?	**YES:** GO TO 2 **NO:** GO TO 23

JB81757,0000070 -19-21APR10-3/25

2 Check for Open or Shorted Sensor Circuit	1. Ignition ON, engine OFF. 2. Perform Harness Diagnostic Mode Test in Service ADVISOR. Is 000636.05, 000636.06, or any DTC with SPN 000637 now active?	**YES:** Discontinue test for 000636.10 and perform test for 000636.05, 000636.06, or DTC with SPN 000637. **NO:** GO TO 3

JB81757,0000070 -19-21APR10-4/25

3 Check for Crankshaft Position Signal Problem	*NOTE: Verify that the camshaft position sensor is connected to harness connector X02 and the crankshaft position sensor is connected to harness connector X01. If engine wire harness is routed incorrectly, connector X02 can be connected to the crankshaft position sensor and connector X01 can be connected to the camshaft position sensor. Inadvertently swapping these connectors may cause DTCs 000636.02, 000636.10, 00637.02, and/or 000637.10.* 1. Ignition OFF, engine OFF. 2. Disconnect crankshaft position sensor X01 and secure connector away from rotating components. Ignore DTC 000637.08 which will be generated for the disconnected crankshaft position sensor. 3. Ignition ON, engine OFF. 4. Refresh DTCs. 5. Attempt to start engine. 6. Operate engine for one minute through rpm range and monitor DTCs, if engine started. 7. Ignition OFF, engine OFF. 8. Reconnect crankshaft position sensor X01. Did engine start and run without generating 000636.10?	**YES:** Perform checks for DTC 000637.02 as though DTC were active. **NO:** GO TO 4

Continued on next page

JB81757,0000070 -19-21APR10-5/25

4 Check Camshaft Position Data Points

1. Monitor the following Data Points in Service ADVISOR:
   - Camshaft Position Noise Indicator
   - Camshaft Position Improper Pattern Indicator
   - Camshaft Position Status
   - Camshaft Position Speed
2. Operate engine through normal speed and load ranges.
3. Switch ON and OFF any electrical devices on the application.

CAUTION: Use caution when working near rotating components.

4. Gently wiggle wire harness between crank sensor and ECU.

NOTE: The Camshaft Position Noise Indicator has a value of 0 if the camshaft position signal is good. The value will temporarily increase if noise is detected in the signal. The Camshaft Position Improper Pattern Indicator is 0% if recent camshaft position signal patterns were good. The percentage will increase if errors in the signal pattern are detected and will count down to 0% once the signal pattern is error-free. The Camshaft Position Status has a value of 47 with engine speed above 400 rpm if the camshaft position signal is good. The value will be something other than 47 if a signal problem is detected. These data points can be used to locate intermittent problems with the camshaft position signal which are too brief to cause a DTC to become active.

NOTE: Internal Data Monitor in Service ADVISOR may also be used to locate intermittent speed sensor circuit problems. See Internal Data Monitor Instructions earlier in this group for more information on using this feature. Select the data points defined earlier in this step and set sample rate to 5 ms.

Were you able to find some mode of operation or an intermittent wiring problem which causes the camshaft position data points to indicate a signal problem?

YES: Engine wiring problem. Repair problem. GO TO 22

YES: Some device on application causes the noise. Open DTAC case.

NO: GO TO 5

JB81757,0000070 -19-21APR10-6/25

5 Check for Loose Sensor

NOTE: See Camshaft Position Sensor — Removal and Camshaft Position Sensor — Installation in Section 02, Group 110 earlier in this manual for sensor torque specifications.

1. Ignition OFF, engine OFF.
2. Disconnect camshaft position sensor connector X02.
3. Verify camshaft position sensor installation torque.

Was camshaft position sensor fully threaded into mounting hole?

YES: GO TO 6

NO: Torque sensor to specified value. GO TO 22

JB81757,0000070 -19-21APR10-7/25

6 Test Sensor Terminals

Perform Terminal Test on camshaft position sensor and connector.

Were any problems found?

YES: Fix problem. GO TO 22

NO: GO TO 7

JB81757,0000070 -19-21APR10-8/25

7 Inspect Target

1. Remove camshaft position sensor. See Camshaft Position Sensor — Removal in Section 2 Group 110.
2. Visually inspect camshaft target for damage or debris through sensor mounting hole as engine is rotated.

Were any problems found?

YES: Fix problem. GO TO 22

NO: GO TO 8

Continued on next page

JB81757,0000070 -19-21APR10-9/25

8 Inspect Sensor	Examine tip of camshaft position sensor for damage due to contact with target.	**YES:** Replace camshaft position sensor. Determine cause if replacement sensor also becomes damaged. GO TO 22
	Does sensor appear damaged due to contact with target?	**NO:** GO TO 9

JB81757,0000070 -19-21APR10-10/25

9 Check Sensor Resistance	On the camshaft position sensor, measure the resistance between terminals A and B.	**YES:** Reinstall camshaft position sensor. Do not reconnect to harness. GO TO 10
	Is the resistance between 2500 ohms and 3500 ohms?	**NO:** Replace camshaft position sensor. GO TO 22

JB81757,0000070 -19-21APR10-11/25

10 Test ECU Terminals	1. Disconnect ECU J01 connector.	
	2. Perform Terminal Test on J01.	**YES:** Fix problem. GO TO 22
	Were any problems found?	**NO:** GO TO 11

JB81757,0000070 -19-21APR10-12/25

11 Check for Shorted Return Circuit	On the harness, measure the resistance between ECU J01-E4 and single point ground.	**YES:** GO TO 12
	Is the resistance greater than 10k ohms?	**NO:** Fix problem. GO TO 22

JB81757,0000070 -19-21APR10-13/25

12 Check Sensor Circuit Resistance	*NOTE: Verify that camshaft position sensor signal and return wires are in the specified connector cavities (not swapped).*	
	1. On the harness, measure the resistance between ECU J01-A4 and camshaft position sensor X02-B. 2. On the harness, measure the resistance between ECU J01-E4 and camshaft position sensor X02-A. 3. Disconnect front engine interconnect 8-way connector X07. 4. Perform Terminal Test on X07.	**YES:** Reconnect X07 connector. GO TO 13
	Are both resistance measurements less than 10 ohms and are Terminal Test results good?	**NO:** Fix problem. GO TO 22

JB81757,0000070 -19-21APR10-14/25

13 Check for Intermittent Short Between Signal and Return	1. Verify camshaft position sensor is disconnected.	
	2. On the harness, measure the resistance between the ECU J01-A4 and J01-E4 while gently moving wire harness.	**YES:** GO TO 14
	Does resistance remain greater than 10k ohms?	**NO:** Fix problem. GO TO 22

Continued on next page

JB81757,0000070 -19-21APR10-15/25

14 Test ECU Terminals	1. Disconnect ECU J02 connector.	
	2. Perform Terminal Test on J02.	**YES:** Fix problem. GO TO 22
	Were any problems found?	**NO:** GO TO 15

JB81757,0000070 -19-21APR10-16/25

15 Check for Intermittent ECU Power Supply Problem	1. Ignition ON, engine OFF.	
	2. On the harness, measure the voltage from ECU J02-L1 (+) to J02-L2 (-) while gently wiggling wire harness.	
	3. On the harness, measure the voltage from ECU J02-B2 (+) to J02-L2 (-) while gently wiggling wire harness.	**YES:** Fix problem. GO TO 22
	Were any intermittent wiring problems found?	**NO:** GO TO 16

JB81757,0000070 -19-21APR10-17/25

16 Check for Camshaft Position Signal Wire-to-Wire Short	1. Ignition OFF, engine OFF.	
	2. Verify camshaft position sensor is still disconnected.	
	3. On the harness, measure the resistance between ECU J01-A4 and all other terminals in the J01 and J02 connectors.	**YES:** GO TO 17
	Are all resistance measurements greater than 10k ohms?	**NO:** Fix problem. GO TO 22

JB81757,0000070 -19-21APR10-18/25

17 Check for Intermittent Open Camshaft Position Circuit	1. Reconnect camshaft position sensor connector.	
	2. On the harness, measure the resistance between ECU J01-A4 and J01-E4 while gently wiggling wire harness between J01 and camshaft position sensor.	**YES:** GO TO 18
	Does resistance remain between 2500 ohms and 3500 ohms?	**NO:** Fix problem. GO TO 22

JB81757,0000070 -19-21APR10-19/25

18 Inspect Sensor Wiring	Examine camshaft position sensor wiring between the camshaft position sensor and the ECU. Check for the following:	
	• Verify that camshaft position signal and return wires are twisted together throughout the harness.	
	• Verify that no physical damage to camshaft position signal and return wires is evident.	**YES:** Replace camshaft position wiring with twisted pair or repair problem. GO TO 22
	Were any problems found?	**NO:** GO TO 19

Continued on next page

JB81757,0000070 -19-21APR10-20/25

19 Replace Camshaft Position Sensor	Has camshaft position sensor been replaced during this procedure?	**YES:** GO TO 20 **NO:** Replace camshaft position sensor. GO TO 22

JB81757,0000070 -19-21APR10-21/25

20 Reprogram ECU	1. Ignition OFF, engine OFF.	
	2. Reinstall ECU connectors.	
	3. Download latest ECU payload and reprogram ECU. See Payload File Downloading Instructions and Engine Control Unit (ECU) Reprogramming Instructions in Section 4 Group 160.	**YES:** GO TO 21
	Did DTC 000636.10 reappear active with engine running?	**NO:** Problem fixed.

JB81757,0000070 -19-21APR10-22/25

21 Replace ECU	1. Ignition OFF, engine OFF.	
	2. Replace ECU.	**YES:** Open DTAC case.
	Did DTC 000636.10 reappear active with engine running?	**NO:** Problem fixed.

JB81757,0000070 -19-21APR10-23/25

22 Verification	1. Ignition OFF, engine OFF.	
	2. Reconnect all connectors.	
	3. Ignition ON, engine ON.	
	4. Monitor DTCs in Service ADVISOR.	
	5. Refresh DTCs.	
	6. Operate engine through normal speed and load.	**YES:** GO TO 1
	Did DTC 000636.10 reappear active with engine running?	**NO:** Problem fixed.

JB81757,0000070 -19-21APR10-24/25

23 Review Snapshot Information	1. Retrieve snapshot information, see Snapshot Instructions earlier in this Group.	**YES:** Found a possible problem. Repair possible problem. Retest.
	2. Review information to see if you can determine a possible problem or the operating point that causes the code to become active.	**YES:** Found operating point at which the code becomes active. Try to determine cause. Repair and retest.
	Did you find a possible problem or the operating point at which the code becomes active?	**NO:** GO TO 4

JB81757,0000070 -19-21APR10-25/25

000637.02 — Crankshaft Position Signal Invalid

The ECU detects excessive noise (extra pulses) on the crankshaft position input.

JB81757,000006A -19-21APR10-1/22

000637.02 — Crankshaft Position Signal Invalid Diagnostic Procedure

Troubleshooting Sequence:
000637.08
000637.02

When DTC is Displayed:
The engine is cranking or running and the error condition is active.

Related Information:
The ECU detects extra pulses (electrical noise) in the crankshaft position signal.
The extra pulses may be caused by electromagnetic interference or by a crankshaft position signal wire that is shorted to some other signal wire.
Wiring problems such as loose terminals or water in connectors may also cause this DTC.

Alarm Level:
Warning

Control Unit Response:
The ECU will use the camshaft position signal to determine crankshaft position.
Prolonged cranking time may be required to start the engine.
If a camshaft position 000636 DTC accompanies 000637.02, the engine cannot be started and will stall if running until at least one of the two codes is repaired.
Maximum engine power is derated up to 50 percent.

Additional References:
For more crankshaft position sensor information, see Crankshaft Position Sensor in Section 03, Group 140 earlier in this manual.

For more information on speed sensors, see Speed Measurement in Section 03, Group 140 earlier in this manual.

For more information on engine protection, see Engine Derate And Shutdown Protection in Section 03, Group 140 earlier in this manual.

NOTE: The wiring diagrams provided are for a typical John Deere supplied OEM harness. Wire number, colors, and jumper connectors do not apply to all applications.

For wiring information see 2.4L/3.0L ECU WIRING DIAGRAM 6 located in Section 06, Group 210 later in this manual.

Flex probe information:
- ECU large terminal - Orange/Green
- ECU small terminal - Orange/Blue
- Crankshaft position sensor X01 - Purple/Red
- Front Engine Interconnect X07 - Yellow/Purple

For more information on connector and terminal testing or flex probes see Terminal Test in Section 04, Group 160 earlier in this manual.

IMPORTANT: Do not force probes into connector terminals or damage will result. Use JDG10466 Connector Adapter Test Kit to make measurements in connectors. This will ensure that terminal damage does not occur.

Continued on next page

JB81757,000006A -19-21APR10-2/22

1 Read DTCs and Store Snapshot Information

1. Ignition ON, engine OFF.

NOTE: When DTCs are cleared Snapshot information for ALL DTCs will also be cleared.

2. Connect Service ADVISOR, see Connecting To Service ADVISOR earlier in this Group.
3. Write down all DTCs and their occurrence count. If any DTCs have snapshot capture or snapshot recording information, save the information. For instructions on saving and using snapshot information, see Snapshot Instructions earlier in this Group.
4. Start or crank engine.
5. Refresh DTCs.

Did 000637.02 reappear active with engine running or cranking?

YES: GO TO 2

NO: GO TO 20

JB81757,000006A -19-21APR10-3/22

2 Check Crankshaft Position Data Points

1. Monitor the following Data Points in Service ADVISOR:
   - Crankshaft Position Input Noise Indicator
   - Crankshaft Improper Pattern Indicator
   - Crankshaft Position Status
   - Crankshaft Position Speed
2. Operate engine through normal speed and load ranges.
3. Switch ON and OFF any electrical devices on the application.

CAUTION: Use caution when working near rotating components.

4. Gently wiggle wire harness between crankshaft position sensor and ECU.

NOTE: The Crankshaft Position Input Noise Indicator has a value of 0 if the crankshaft position signal is good. The value will temporarily increase if noise is detected in the crankshaft position signal. The Crankshaft Improper Pattern Indicator is 0% if recent crankshaft position signal patterns were good. The percentage will increase if errors in the signal pattern are detected and will count down to 0% once the signal pattern is error-free. The Crankshaft Position Status has a value of 47 with engine speed above 400 rpm if the crankshaft position signal is good. The value will be something other than 47 if a signal problem is detected. These data points can be used to locate intermittent problems with the crankshaft position signal which are too brief to cause a DTC to become active.

YES: Engine wiring problem. Fix problem. GO TO 19

NOTE: Internal Data Monitor in Service ADVISOR may also be used to locate intermittent speed sensor circuit problems. See Internal Data Monitor Instructions in section 4 group 161 for more information on using this feature. Select the data points defined earlier in this step and set sample rate to 5 ms.

YES: Some device on application causes the noise. Open DTAC case.

Were you able to find some mode of operation or an intermittent wiring problem which causes the crankshaft position data points to indicate a signal problem?

NO: GO TO 3

JB81757,000006A -19-21APR10-4/22

3 Test Sensor Terminals

NOTE: Verify that the camshaft position sensor is connected to harness connector X02 and the crankshaft position sensor is connected to harness connector X01. If engine wire harness is routed incorrectly, connector X02 can be connected to the crankshaft position sensor and connector X01 can be connected to the camshaft position sensor. Inadvertently swapping these connectors may cause DTCs 000636.02, 000636.10, 00637.02, and/or 000637.10.

1. Ignition OFF, engine OFF.
2. Disconnect crankshaft position sensor connector X01.
3. Perform Terminal Test on crankshaft position sensor and connector.

YES: Fix problem. GO TO 19

Were any problems found?

NO: GO TO 4

Continued on next page

JB81757,000006A -19-21APR10-5/22

4 Inspect Target	1. Remove crankshaft position sensor.	
	2. Inspect crankshaft target through sensor mounting hole for damage or debris as engine is rotated.	**YES:** Fix problem. GO TO 19
	Were any problems found?	**NO:** GO TO 5

JB81757,000006A -19-21APR10-6/22

5 Inspect Sensor	*NOTE: See Crankshaft Position Sensor — Removal and Crankshaft Position Sensor — Installation in Section 02, Group 110 earlier in this manual for sensor replacement instructions.*	
	Examine tip of crankshaft position sensor for damage due to contact with target.	**YES:** Replace crankshaft position sensor. Determine cause if replacement sensor also becomes damaged. GO TO 19
	Does sensor appear damaged due to contact with target	a **NO:** GO TO 6

JB81757,000006A -19-21APR10-7/22

6 Check Sensor Resistance	On the crankshaft position sensor, measure the resistance between the terminals A and B.	**YES:** Reinstall crankshaft position sensor. Do not reconnect to harness. GO TO 7
	Is the resistance between 2500 ohms and 3500 ohms?	**NO:** Replace crankshaft position sensor. GO TO 19

JB81757,000006A -19-21APR10-8/22

7 Test ECU Terminals	1. Disconnect ECU J01 connector.	
	2. Perform Terminal Test on J01.	**YES:** Fix problem. GO TO 19
	Were any problems found?	**NO:** GO TO 8

JB81757,000006A -19-21APR10-9/22

8 Check for Shorted Crankshaft Position Return	On the harness, measure the resistance between ECU J01-D4 and single point ground.	**YES:** GO TO 9
	Is the resistance greater than 10k ohms?	**NO:** Fix problem. GO TO 19

Continued on next page

JB81757,000006A -19-21APR10-10/22

9 Check Crankshaft Position Circuit Continuity

NOTE: Verify that crankshaft position signal and return wires are in the specified connector cavities (not swapped).

1. On the harness, measure the resistance between ECU J01-B4 and crankshaft position sensor X01-B.
2. On the harness, measure the resistance between ECU J01-D4 and crankshaft position sensor X01-A.
3. Disconnect front engine interconnect 8-way connector X07.
4. Perform Terminal Test on X07.

YES: Reconnect X07 connector. GO TO 10

Are both resistance measurements less than 10 ohms and are Terminal Test results good?

NO: Fix problem. GO TO 19

JB81757,000006A -19-21APR10-11/22

10 Test ECU Terminals

1. Disconnect ECU J02 connector.
2. Perform Terminal Test on J02.

YES: Fix problem. GO TO 19

Were any problems found?

NO: GO TO 11

JB81757,000006A -19-21APR10-12/22

11 Check for Intermittent ECU Power Supply Problem

1. Ignition ON, engine OFF.
2. On the harness, measure the voltage from ECU J02-L1 (+) to J02-L2 (-) while gently wiggling wire harness.
3. On the harness, measure the voltage from ECU J02-B2 (+) to J02-L2 (-) while gently wiggling wire harness.

YES: Fix problem. GO TO 19

Were any intermittent wiring problems found?

NO: GO TO 12

JB81757,000006A -19-21APR10-13/22

12 Check for Crankshaft Position Signal Wire-to-Wire Short

1. Ignition OFF, engine OFF.
2. On the harness, measure the resistance between ECU J01-B4 and all other terminals in the J01 and J02 connectors.

YES: GO TO 13

Are all resistance measurements greater than 10k ohms?

NO: Fix problem. GO TO 19

Continued on next page

JB81757,000006A -19-21APR10-14/22

13 Check Crankshaft Position Wiring	Examine crankshaft position wiring between the crankshaft position sensor and the ECU. Check for the following: • Verify that crankshaft position signal and return wires are twisted together throughout the harness. • Verify that no physical damage to crankshaft position signal and return wires is evident. Were any problems found?	**YES:** Replace crankshaft position wiring with twisted pair or repair problem. GO TO 19 **NO:** GO TO 14

JB81757,000006A -19-21APR10-15/22

14 Check Wire Harness Routing	Examine routing of crankshaft position wiring between crankshaft position sensor and ECU. Is crankshaft position wiring routed near sources of strong electric or magnetic fields such as 2-way radio antenna, alternator, inverter, a.c. generator, or other similar device on the application?	**YES:** Reroute crankshaft position wires away from device. GO TO 19 **NO:** GO TO 15

JB81757,000006A -19-21APR10-16/22

15 Check for Alternator Noise	1. Disconnect negative battery cable. 2. Disconnect alternator positive output cable and insulate cable terminal. 3. Disconnect all other alternator connectors. 4. Reconnect negative battery cable. 5. Reconnect ECU and sensor connectors. 6. Ignition ON, engine ON. Did DTC 000637.02 reappear active with engine running?	**YES:** GO TO 16 **NO:** Repair alternator problem. GO TO 19

JB81757,000006A -19-21APR10-17/22

16 Replace Crankshaft Position Sensor	Has crankshaft position sensor been replaced during this procedure?	**YES:** GO TO 17 **NO:** Replace crankshaft position sensor. GO TO 19

JB81757,000006A -19-21APR10-18/22

17 Reprogram ECU	Download latest ECU payload and reprogram ECU. Did DTC 000637.02 reappear active with engine running?	**YES:** GO TO 18 **NO:** Problem fixed.

JB81757,000006A -19-21APR10-19/22

18 Replace ECU	1. Ignition OFF, engine OFF. 2. Replace ECU. Did DTC 000637.02 reappear active with engine running?	**YES:** Open DTAC case. **NO:** Problem fixed.

Continued on next page

JB81757,000006A -19-21APR10-20/22

19 Verification	1. Ignition OFF, engine OFF.	
	2. Reconnect all connectors (disconnect battery negative cable prior to reinstalling alternator positive cable, if applicable).	
	3. Ignition ON, engine ON.	
	4. Monitor DTCs in Service ADVISOR.	
	5. Refresh DTCs.	
	6. Operate engine through normal speed and load.	**YES:** GO TO 2
	Did DTC 000637.02 reappear active with engine running?	**NO:** Problem fixed.

JB81757,000006A -19-21APR10-21/22

20 Review Snapshot Information	1. Retrieve snapshot information, see Snapshot Instructions earlier in this Group.	**YES:** Found a possible problem. Repair possible problem. Retest.
	2. Review information to see if you can determine a possible problem or the operating point that causes the code to become active.	**YES:** Found operating point at which the code becomes active. Try to determine cause. Repair and retest.
	Did you find a possible problem or the operating point at which the code becomes active?	**NO:** GO TO 2

JB81757,000006A -19-21APR10-22/22

000637.05 — Crankshaft Position Circuit has High Resistance

The ECU detects low current on the crankshaft position wiring.

JB81757,000006B -19-16APR10-1/14

000637.05 — Crankshaft Position Circuit Has High Resistance Diagnostic Procedure

Troubleshooting Sequence:
000637.05

Related Information:
The ECU detects high resistance or an open circuit in the crankshaft position circuit during the Harness Diagnostic Mode Test in Service ADVISOR.

Alarm Level:
Warning

Control Unit Response:
DTC 000637.08 may also be active when engine is running.

Additional References:
For more crankshaft position sensor information, see Crankshaft Position Sensor in Section 03, Group 140 earlier in this manual.
For more information on speed sensors, see Speed Measurement in Section 03, Group 140 earlier in this manual.

NOTE: The wiring diagrams provided are for a typical John Deere supplied OEM harness. Wire number, colors, and jumper connectors do not apply to all applications.

For wiring information see 2.4L/3.0L ECU WIRING DIAGRAM 6 located in Section 06, Group 210 later in this manual.

Flex probe information:
- ECU large terminal - Orange/Green
- ECU small terminal - Orange/Blue
- Crankshaft position sensor X01 - Purple/Red
- Front Engine Interconnect X07 - Yellow/Purple

For more information on connector and terminal testing or flex probes see Terminal Test in Section 04, Group 160 earlier in this manual.

IMPORTANT: When directed to run the Harness Diagnostic Mode Test the engine temperature should be above freezing. It is recommended that the engine temperature be at least room temperature 20° C (68° F). This test is located in Service ADVISOR.

IMPORTANT: Do not force probes into connector terminals or damage will result. Use JDG10466 Connector Adapter Test Kit to make measurements in connectors. This will ensure that terminal damage does not occur.

JB81757,000006B -19-16APR10-2/14

1 Test Sensor Terminals	1. Ignition OFF, engine OFF.	
	2. Disconnect crankshaft position sensor connector X01.	
	3. Perform Terminal Test on crankshaft position sensor and connector.	**YES:** Fix problem. GO TO 12
	Were any problems found?	**NO:** GO TO 2

Continued on next page

JB81757,000006B -19-16APR10-3/14

2 Check Sensor Resistance	On the crankshaft position sensor, measure the resistance between terminals A and B.	**YES:** GO TO 3
	Is the resistance between 2500 ohms and 3500 ohms?	**NO:** Remove crankshaft position sensor. GO TO 11

JB81757,000006B -19-16APR10-4/14

3 Test ECU Terminals	1. Disconnect ECU J01 connector.	
	2. Perform Terminal Test on J01.	**YES:** Fix problem. GO TO 12
	Were any problems found?	**NO:** GO TO 4

JB81757,000006B -19-16APR10-5/14

4 Check Crankshaft Position Circuit Continuity	1. On the harness, measure the resistance between ECU J01-B4 and crankshaft position sensor X01-B.	
	2. On the harness, measure the resistance between ECU J01-D4 and crankshaft position sensor X01-A.	
	3. Disconnect front engine interconnect 8-way connector X07.	
	4. Perform Terminal Test on X07.	**YES:** Reconnect X07 connector. GO TO 5
	Are both resistance measurements less than 10 ohms and are Terminal Test results good?	**NO:** Fix problem. GO TO 12

JB81757,000006B -19-16APR10-6/14

5 Check for Crankshaft Position Signal Wire-to-Wire Short	1. Disconnect ECU J02 connector.	
	2. On the harness, measure the resistance between ECU J01-B4 and all other terminals in the J01 and J02 connectors.	**YES:** GO TO 6
	Are all resistance measurements greater than 10k ohms?	**NO:** Fix problem. GO TO 12

JB81757,000006B -19-16APR10-7/14

6 Check for Crankshaft Position Signal Shorted to Voltage	1. Ignition ON, engine OFF.	
	2. On the harness, measure the voltage between ECU J01-B4 (+) and single point ground (-).	**YES:** GO TO 7
	Is voltage less than 0.5V?	**NO:** Fix problem. GO TO 12

Continued on next page

JB81757,000006B -19-16APR10-8/14

7 Check for Intermittent Open Circuit	1. Ignition OFF, engine OFF. 2. Reconnect all electrical connectors. 3. Ignition ON, engine OFF. 4. Perform Harness Diagnostic Mode Test in Service ADVISOR. Did 000637.05 reappear active?	**YES:** GO TO 8 **NO:** Recheck for intermittent open circuit. GO TO 1

JB81757,000006B -19-16APR10-9/14

8 Replace Crankshaft Position Sensor	Has crankshaft position sensor been replaced during this diagnostic procedure?	**YES:** GO TO 9 **NO:** Remove crankshaft position sensor. See Crankshaft Position Sensor — Removal in Section 2 Group 110.GO TO 11

JB81757,000006B -19-16APR10-10/14

9 Reprogram ECU	1. Download latest ECU payload and reprogram ECU. 2. Ignition ON, engine OFF. 3. Perform Harness Diagnostic Mode Test in Service ADVISOR. Did 000637.05 reappear active?	**YES:** GO TO 10 **NO:** Problem fixed.

JB81757,000006B -19-16APR10-11/14

10 Replace ECU	1. Ignition OFF, engine OFF. 2. Replace ECU. 3. Ignition ON, engine OFF. 4. Perform Harness Diagnostic Mode Test in Service ADVISOR. Did 000637.05 reappear active?	**YES:** Open DTAC case. **NO:** Problem fixed.

JB81757,000006B -19-16APR10-12/14

11 Inspect Crankshaft Position Sensor	Examine tip of crankshaft position sensor for damage due to contact with target Does sensor appear damaged due to contact with target?	**YES:** Replace crankshaft position sensor. Determine cause if replacement sensor also becomes damaged. GO TO 12 **NO:** Replace crankshaft position sensor. GO TO 12

Continued on next page

JB81757,000006B -19-16APR10-13/14

12 Verification	1. Ignition OFF, engine OFF. 2. Reconnect all electrical connectors. 3. Ignition ON, engine OFF. 4. Perform Harness Diagnostic Mode Test in Service ADVISOR. Did 000637.05 reappear active?	**YES:** GO TO 1 **NO:** Problem fixed.

JB81757,000006B -19-16APR10-14/14

000637.06 — Crankshaft Position Circuit has Low Resistance

The ECU detects high current on the crankshaft position wiring.

JB81757,000006C -19-16APR10-1/16

000637.06 — Crankshaft Position Circuit Has Low Resistance Diagnostic Procedure

Troubleshooting Sequence:
000637.06

Related Information:
The ECU detects low resistance or a short to ground in the crankshaft position circuit during the Harness Diagnostic Mode Test in Service ADVISOR.

Alarm Level:
Warning

Control Unit Response:
DTC 000637.08 may also be active when engine is running.

Additional References:
For more crankshaft position sensor information, see Crankshaft Position Sensor in Section 03, Group 140 earlier in this manual.

For more information on speed sensors, see Speed Measurementin Section 03, Group 140 earlier in this manual.

NOTE: The wiring diagrams provided are for a typical John Deere supplied OEM harness. Wire number, colors, and jumper connectors do not apply to all applications.

For wiring information see 2.4L/3.0L ECU WIRING DIAGRAM 6 located in Section 06, Group 210 later in this manual.

Flex probe information:
- ECU large terminal - Orange/Green
- ECU small terminal - Orange/Blue
- Crankshaft position sensor X01 - Purple/Red
- Front Engine Interconnect X07 - Yellow/Purple

For more information on connector and terminal testing or flex probes see Terminal Test in Section 04, Group 160 earlier in this manual.

IMPORTANT: When directed to run the Harness Diagnostic Mode Test the engine temperature should be above freezing. It is recommended that the engine temperature be at least room temperature 20° C (68° F). This test is located in Service ADVISOR.

IMPORTANT: Do not force probes into connector terminals or damage will result. Use JDG10466 Connector Adapter Test Kit to make measurements in connectors. This will ensure that terminal damage does not occur.

JB81757,000006C -19-16APR10-2/16

1 Check for DTC Change with Sensor Disconnected	1. Ignition ON, engine OFF. 2. Disconnect crankshaft position sensor connector X01. 3. Perform Harness Diagnostic Mode Test in Service ADVISOR. Is 000637.05, crankshaft position sensor circuit has high resistance, now an active DTC?	**YES:** Remove crankshaft position sensor. GO TO 13 **NO:** GO TO 2

Continued on next page

JB81757,000006C -19-16APR10-3/16

2 Test Sensor Terminals	1. Ignition OFF, engine OFF.	
	2. Perform Terminal Test on crankshaft position sensor and connector.	**YES:** Fix problem. GO TO 14
	Were any problems found?	**NO:** GO TO 3

JB81757,000006C -19-16APR10-4/16

3 Check Sensor Resistance	On the crankshaft position sensor, measure the resistance between terminals A and B.	**YES:** Do not reconnect sensor to harness. GO TO 4
	Is the resistance between 2500 ohms and 3500 ohms?	**NO:** Remove crankshaft position sensor. GO TO 13

JB81757,000006C -19-16APR10-5/16

4 Test ECU Terminals	1. Disconnect ECU J01 connector.	
	2. Perform Terminal Test on J01.	**YES:** Fix problem. GO TO 14
	Were any problems found?	**NO:** GO TO 5

JB81757,000006C -19-16APR10-6/16

5 Check Sensor Circuit Continuity	1. On the harness, measure the resistance between ECU J01-B4 and crankshaft position sensor X01-B.	
	2. On the harness, measure the resistance between ECU J01-D4 and crankshaft position sensor X01-A.	
	3. Disconnect front engine interconnect 8-way connector X07.	
	4. Perform Terminal Test on X07.	**YES:** Reconnect X07 connector. GO TO 6
	Are both resistance measurements less than 10 ohms and are Terminal Test results good?	**NO:** Fix problem. GO TO 14

JB81757,000006C -19-16APR10-7/16

6 Check for Crankshaft Position Wire-to-Wire Short	1. Verify crankshaft position sensor is disconnected.	
	2. On the harness, measure the resistance between ECU J01-B4 and J01-D4.	**YES:** GO TO 7
	Is the resistance greater than 10k ohms?	**NO:** Fix problem. GO TO 14

JB81757,000006C -19-16APR10-8/16

7 Check for Crankshaft Position Signal Shorted to Ground	On the harness, measure the resistance between ECU J01-B4 and single point ground.	**YES:** GO TO 8
	Is the resistance greater than 10k ohms?	**NO:** Fix problem. GO TO 14

Continued on next page

JB81757,000006C -19-16APR10-9/16

8 Check for Crankshaft Position Signal Wire-to-Wire Short	1. Disconnect ECU J02 connector.	
	2. On the harness, measure the resistance between ECU J01-B4 and all other terminals in the J01 and J02 connectors.	**YES:** GO TO 9
	Are all resistance measurements greater than 10k ohms?	**NO:** Fix problem. GO TO 14

JB81757,000006C -19-16APR10-10/16

9 Check for Intermittent Shorted Circuit	1. Ignition OFF, engine OFF.	
	2. Reconnect all electrical connectors.	
	3. Ignition ON, engine OFF.	
	4. Perform Harness Diagnostic Mode Test in Service ADVISOR.	**YES:** GO TO 10
	Did 000637.06 reappear as active?	**NO:** Recheck for intermittent shorted circuit. GO TO 1

JB81757,000006C -19-16APR10-11/16

10 Replace Crankshaft Position Sensor	Has crankshaft position sensor been replaced during this diagnostic procedure?	**YES:** GO TO 11 **NO:** Remove crankshaft position sensor. GO TO 13

JB81757,000006C -19-16APR10-12/16

11 Reprogram ECU	1. Download latest ECU payload and reprogram ECU.	
	2. Ignition ON, engine OFF.	
	3. Perform Harness Diagnostic Mode Test in Service ADVISOR.	**YES:** GO TO 12
	Did 000637.06 reappear active?	**NO:** Problem fixed. GO TO 14

JB81757,000006C -19-16APR10-13/16

12 Replace ECU	1. Ignition OFF, engine OFF.	
	2. Replace ECU.	
	3. Ignition ON, engine OFF.	
	4. Perform Harness Diagnostic Mode Test in Service ADVISOR.	**YES:** Open DTAC case.
	Did 000637.06 reappear active?	**NO:** Problem fixed.

Continued on next page

JB81757,000006C -19-16APR10-14/16

13 Inspect Crankshaft Position Sensor	Examine tip of crankshaft position sensor for damage due to contact with target.	**YES:** Replace crankshaft position sensor. Determine cause if replacement sensor also becomes damaged. GO TO 14
	Does sensor appear damaged due to contact with target?	**NO:** Replace crankshaft position sensor. GO TO 14

JB81757,000006C -19-16APR10-15/16

14 Verification	1. Ignition OFF, engine OFF. 2. Reconnect all electrical connectors. 3. Ignition ON, engine OFF. 4. Perform Harness Diagnostic Mode Test in Service ADVISOR.	**YES:** GO TO 1
	Did 000637.06 reappear active?	**NO:** Problem fixed.

JB81757,000006C -19-16APR10-16/16

000637.07 — Crankshaft Position and Camshaft Position Signals Out of Sync

The ECU detects that the crankshaft position and camshaft position signals are not in sync with each other.

JB81757,000006F -19-21APR10-1/17

000637.07 — Crankshaft Position and Camshaft Position Signals Out of Sync Diagnostic Procedure

Troubleshooting Sequence:
000636.08 or 000637.08
000636.10, 000637.10, 000636.02 or 000637.02
000637.07

When DTC is Displayed:
The engine is running above 400 rpm and the error condition is active.

Related Information:
The ECU detects that the camshaft position signal is not correctly timed relative to the crankshaft position signal. This DTC may be caused by incorrect camshaft timing or by camshaft or crankshaft position sensor target problems. Wiring problems such as loose terminals or water in connectors may also cause this DTC to be active intermittently.

Alarm Level:
Warning

Control Unit Response:
Prolonged cranking time may be required to start the engine.

Additional References:
For more crankshaft position sensor information, see Crankshaft Position Sensor in Section 03, Group 140 earlier in this manual.

For more information on speed sensors, see Speed Measurement in Section 03, Group 140 earlier in this manual.

NOTE: The wiring diagrams provided are for a typical John Deere supplied OEM harness. Wire number, colors, and jumper connectors do not apply to all applications.

For wiring information see 2.4L/3.0L ECU WIRING DIAGRAM 6 located in Section 06, Group 210 later in this manual.

Flex probe information:
- ECU large terminal - Orange/Green
- ECU small terminal - Orange/Blue
- Crankshaft position sensor X01 - Purple/Red
- Camshaft position sensor X02 - Purple/Red
- Front Engine Interconnect X07 - Yellow/Purple

For more information on connector and terminal testing or flex probes see Terminal Test in Section 04, Group 160 earlier in this manual.

IMPORTANT: Do not force probes into connector terminals or damage will result. Use JDG10466 Connector Adapter Test Kit to make measurements in connectors. This will ensure that terminal damage does not occur.

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JB81757,000006F -19-21APR10-2/17

1 Read DTCs and Store Snapshot Information	1. Ignition ON, engine OFF. *NOTE: When DTCs are cleared Snapshot information for ALL DTCs will also be cleared.* 2. Connect Service ADVISOR, see Connecting To Service ADVISOR earlier in this Group. 3. Write down all DTCs and their occurrence count. If any DTCs have snapshot capture or snapshot recording information, save the information. For instructions on saving and using snapshot information, see Snapshot Instructions earlier in this Group. 4. Start engine. 5. Refresh DTCs. Did 000637.07 reappear active with engine running?	**YES:** GO TO 2 **NO:** GO TO 15

JB81757,000006F -19-21APR10-3/17

2 Check for Recent Mechanical Repair	Has an internal engine repair requiring camshaft or crankshaft removal been performed just prior to DTC 000637.07 appearing and does the DTC reappear repeatedly after refreshing active DTCs with engine running?	**YES:** Check camshaft timing. GO TO 14 **NO:** GO TO 3

JB81757,000006F -19-21APR10-4/17

3 Check for Crankshaft Position Signal Problem	1. Ignition OFF, engine OFF. 2. Disconnect crankshaft position sensor and secure connector away from rotating components. Ignore DTC 000637.08 which will be generated for the disconnected crankshaft position sensor. 3. Ignition ON, engine OFF. 4. Refresh DTCs. 5. Attempt to start engine. 6. Operate engine for one minute through rpm range and monitor DTCs, if engine started. 7. Ignition OFF, engine OFF. 8. Reconnect crankshaft position sensor. Did engine start and run with good performance?	**YES:** Perform checks for DTC 000637.02 as though DTC were active. **NO:** GO TO 4

Continued on next page

JB81757,000006F -19-21APR10-5/17

4 Check Crankshaft and Camshaft Position Data Points

1. Monitor the following Data Points in Service ADVISOR:
   - Camshaft Position Noise Indicator
   - Camshaft Position Improper Pattern Indicator
   - Camshaft Position Status
   - Camshaft Position Speed
   - Crankshaft Position Input Noise Indicator
   - Crankshaft Improper Pattern Indicator
   - Crankshaft Position Status
   - Crankshaft Position Speed
2. Operate engine through normal speed and load.
3. Switch ON and OFF any electrical devices on the application.

CAUTION: Use caution when working near rotating components.

4. Gently wiggle wire harness between speed sensors and ECU.

NOTE: The Crankshaft Position Input Noise Indicator and Camshaft Position Noise Indicator have a value of 0 if the signal is good. The value will temporarily increase if noise is detected in the signals. The Crankshaft Improper Pattern Indicator and Camshaft Position Improper Pattern Indicator are 0 if recent signal patterns were good. The value will increase if errors in the signal pattern are detected and will count down to 0 once the signal pattern is error-free. The Camshaft Position Status and Crankshaft Position Status has a value of 47 with engine speed above 400 rpm if the crankshaft position signal is good. The value will be something other than 47 if a signal problem is detected. These data points can be used to locate intermittent problems with the crankshaft or camshaft position signals which are too brief to cause a DTC to become active.

YES: Engine wiring problem. Repair problem. GO TO 14

NOTE: Internal Data Monitor in Service ADVISOR may also be used to locate intermittent speed sensor circuit problems. See Internal Data Monitor Instructions earlier in this group for more information on using this feature. Select the data points defined earlier in this step and set sample rate to 5 ms.

YES: Some device on application causes the noise. Open DTAC case.

Were you able to find some mode of operation or an intermittent wiring problem which causes the crankshaft and camshaft position data points to indicate a signal problem?

NO: GO TO 5

JB81757,000006F -19-21APR10-6/17

5 Test Crankshaft Position Sensor Terminals

1. Ignition OFF, engine OFF.
2. Disconnect crankshaft position sensor connector X01.
3. Perform Terminal Test on crankshaft position sensor and connector.

YES: Fix problem. GO TO 14

Were any problems found?

NO: Do not reconnect sensor. GO TO 6

JB81757,000006F -19-21APR10-7/17

6 Test Camshaft Position Sensor Terminals

1. Ignition OFF, engine OFF.
2. Disconnect camshaft position sensor connector X02.
3. Perform Terminal Test on camshaft position sensor and connector.

YES: Fix problem. GO TO 14

Were any problems found?

NO: Do not reconnect sensor. GO TO 7

Continued on next page

JB81757,000006F -19-21APR10-8/17

7 Test ECU Terminals	1. Disconnect ECU J01 connector.	
	2. Perform Terminal Test on J01.	**YES:** Fix problem. GO TO 14
	Were any problems found?	**NO:** GO TO 8

JB81757,000006F -19-21APR10-9/17

8 Check Camshaft Position Circuit Continuity	*NOTE: Verify that camshaft position signal and return wires are in the specified connector cavities (not swapped).*	
	1. On the harness, measure the resistance between ECU J01-A4 and camshaft position sensor connector X02-B.	
	2. On the harness, measure the resistance between ECU J01-E4 and camshaft position sensor connector X02-A.	**YES:** GO TO 9
	Are both resistance measurements less than 10 ohms?	**NO:** Fix problem. GO TO 14

JB81757,000006F -19-21APR10-10/17

9 Check Crankshaft Position Circuit Continuity	*NOTE: Verify that crankshaft position signal and return wires are in the specified connector cavities (not swapped).*	
	1. On the harness, measure the resistance between ECU J01-B4 and crankshaft position sensor connector X01-B.	
	2. On the harness, measure the resistance between ECU J01-D4 and crankshaft position sensor connector X01-A.	
	3. Disconnect front engine interconnect 8-way connector X07.	
	4. Perform Terminal Test on X07.	**YES:** Reconnect X07 connector. GO TO 10
	Are both resistance measurements less than 10 ohms and are Terminal Test results good?	**NO:** Fix problem. GO TO 14

JB81757,000006F -19-21APR10-11/17

10 Check for Intermittent Short Between Signal and Return	1. Crankshaft position sensor and camshaft position sensor are disconnected.	
	2. On the harness, measure the resistance between the ECU J01-B4 and J01-D4 while gently wiggling harness.	
	3. On the harness, measure the resistance between the ECU J01-A4 and J01-E4 while gently wiggling harness.	**YES:** GO TO 11
	Does resistance remain greater than 10k ohms?	**NO:** Fix problem. GO TO 14

Continued on next page

JB81757,000006F -19-21APR10-12/17

11 Check for Intermittent Short Between Signal and Ground	1. On the harness, measure the resistance between the ECU J01-B4 and single point ground while gently wiggling harness.	
	2. On the harness, measure the resistance between the ECU J01-A4 and single point ground while gently wiggling harness .	**YES:** GO TO 12
	Does resistance remain greater than 10k ohms?	**NO:** Fix problem. GO TO 14

JB81757,000006F -19-21APR10-13/17

12 Reprogram ECU	1. Reinstall all connectors.	
	2. Download latest ECU payload and reprogram ECU.	**YES:** GO TO 13
	Did 000637.07 reappear active with engine running?	**NO:** Problem fixed.

JB81757,000006F -19-21APR10-14/17

13 Replace ECU	1. Ignition OFF, engine OFF.	
	2. Replace ECU.	**YES:** Open DTAC case.
	Did 000637.07 reappear active with engine running?	**NO:** Problem fixed.

JB81757,000006F -19-21APR10-15/17

14 Verification	1. Ignition OFF, engine OFF.	
	2. Reconnect all connectors.	
	3. Ignition ON, engine ON.	
	4. Monitor DTCs in Service ADVISOR.	
	5. Refresh DTCs.	
	6. Operate engine through normal speed and load.	**YES:** GO TO 1
	Did 000637.07 reappear active with engine running?	**NO:** Problem fixed.

JB81757,000006F -19-21APR10-16/17

15 Review Snapshot Information	1. Retrieve snapshot information, see Snapshot Instructions earlier in this Group.	**YES:** Found a possible problem. Repair possible problem. Retest.
	2. Review information to see if you can determine a possible problem or the operating point that causes the code to become active.	**YES:** Found operating point at which the code becomes active. Try to determine cause. Repair and retest.
	Did you find a possible problem or the operating point at which the code becomes active?	**NO:** GO TO 4

JB81757,000006F -19-21APR10-17/17

000637.08 — Crankshaft Position Signal Missing

The ECU does not detect a crankshaft position signal.

JB81757,000006D -19-16APR10-1/19

000637.08 — Crankshaft Position Signal Missing Diagnostic Procedure

Troubleshooting Sequence:
000637.05 or 000637.06
000637.08

When DTC is Displayed:
The engine is cranking or running and the error condition is active.

Related Information:
The ECU does not detect a crankshaft position sensor signal when engine is cranking or running.
This DTC can be caused by an open or shorted crankshaft position circuit.

Alarm Level:
Warning

Control Unit Response:
The ECU will use the camshaft position signal to determine crankshaft position.
Prolonged cranking time may be required to start the engine.
If a camshaft position DTC 000636 accompanies 000637.08, the engine cannot be started and will stall if running until at least one of the two codes is repaired.
Maximum engine power is derated up to 50 percent.

Additional References:
For more crankshaft position sensor information, see Crankshaft Position Sensor in Section 03, Group 140 earlier in this manual.

For more information on speed sensors, see Speed Measurement in Section 03, Group 140 earlier in this manual.

For more information on engine protection, see Engine Derate And Shutdown Protection in Section 03, Group 140 earlier in this manual.

NOTE: The wiring diagrams provided are for a typical John Deere supplied OEM harness. Wire number, colors, and jumper connectors do not apply to all applications.

For wiring information see 2.4L/3.0L ECU WIRING DIAGRAM 6 located in Section 06, Group 210 later in this manual.

Flex probe information:
- ECU large terminal - Orange/Green
- ECU small terminal - Orange/Blue
- Crankshaft position sensor X01 - Purple/Red
- Front Engine Interconnect X07 - Yellow/Purple

For more information on connector and terminal testing or flex probes see Terminal Test in Section 04, Group 160 earlier in this manual.

IMPORTANT: When directed to run the HARNESS DIAGNOSTIC MODE TEST the engine temperature should be above freezing. It is recommended that the engine temperature be at least room temperature 20° C (68° F). This test is located in Service ADVISOR.

IMPORTANT: Do not force probes into connector terminals or damage will result. Use JDG10466 Connector Adapter Test Kit to make measurements in connectors. This will ensure that terminal damage does not occur.

Continued on next page

JB81757,000006D -19-16APR10-2/19

1 Read DTCs and Store Snapshot Information	1. Ignition ON, engine OFF. *NOTE: When DTCs are cleared Snapshot information for ALL DTCs will also be cleared.* 2. Connect Service ADVISOR, see Connecting To Service ADVISOR earlier in this Group. 3. Write down all DTCs and their occurrence count. If any DTCs have snapshot capture or snapshot recording information, save the information. For instructions on saving and using snapshot information, see Snapshot Instructions earlier in this Group. 4. Start or crank engine. 5. Refresh DTCs. Did 000637.08 reappear active with engine running or cranking?	**YES:** GO TO 2 **NO:** GO TO 17

JB81757,000006D -19-16APR10-3/19

2 Check for Open or Shorted Crankshaft Position Circuit	1. Ignition ON, engine OFF. 2. Perform Harness Diagnostic Mode Test in Service ADVISOR. Is DTC 000637.05 or 000637.06 now an active DTC?	**YES:** Discontinue test for 000637.08 and perform test for 000637.05 or 000637.06. **NO:** GO TO 3

JB81757,000006D -19-16APR10-4/19

3 Check for Loose Sensor	*NOTE: See Crankshaft Position Sensor — Installation in Section 02, Group 110 earlier in this manual for sensor torque specifications.* 1. Ignition OFF, engine OFF. 2. Disconnect crankshaft position sensor connector X01. 3. Verify crankshaft position sensor installation torque. Was crankshaft position sensor fully threaded into mounting hole?	**YES:** GO TO 4 **NO:** Torque sensor to specified value. GO TO 16

JB81757,000006D -19-16APR10-5/19

4 Test Sensor Terminals	Perform Terminal Test on crankshaft position sensor and connector. Were any problems found?	**YES:** Fix problem. GO TO 16 **NO:** GO TO 5

JB81757,000006D -19-16APR10-6/19

5 Check Sensor Resistance	On the crankshaft position sensor, measure the resistance between terminals A and B. Is the resistance between 2500 ohms and 3500 ohms?	**YES:** Do not reconnect sensor to harness. GO TO 6 **NO:** Remove crankshaft position sensor. GO TO 15

Continued on next page

JB81757,000006D -19-16APR10-7/19

6 Test ECU Terminals	1. Disconnect ECU J01 connector.	
	2. Perform Terminal Test on J01.	**YES:** Fix problem. GO TO 16
	Were any problems found?	**NO:** GO TO 7

JB81757,000006D -19-16APR10-8/19

7 Check Crankshaft Position Circuit Resistance	*NOTE: Verify that crankshaft position signal and return wires are in the specified connector cavities (not swapped).*	
	1. On the harness, measure the resistance between ECU J01-B4 and crankshaft position sensor X01-B.	
	2. On the harness, measure the resistance between ECU J01-D4 and crankshaft position sensor X01-A.	
	3. Disconnect front engine interconnect 8-way connector X07.	
	4. Perform Terminal Test on X07.	**YES:** Reconnect X07 connector. GO TO 8
	Are both resistance measurements less than 10 ohms and are Terminal Test results good?	**NO:** Fix problem. GO TO 16

JB81757,000006D -19-16APR10-9/19

8 Check Crankshaft Position Circuits for Wire-to-Wire Short	1. Verify crankshaft position sensor is disconnected.	
	2. On the harness, measure the resistance between ECU J01-B4 and J01-D4.	**YES:** GO TO 9
	Is the resistance greater than 10k ohms?	**NO:** Fix problem. GO TO 16

JB81757,000006D -19-16APR10-10/19

9 Check for Crankshaft Position Signal Shorted to Ground	On the harness, measure the resistance between ECU J01-B4 and single point ground.	**YES:** GO TO 10
	Is the resistance greater than 10k ohms?	**NO:** Fix problem. GO TO 16

JB81757,000006D -19-16APR10-11/19

10 Check for Crankshaft Position Signal Wire-to-Wire Short	1. Disconnect ECU J02 connector.	
	2. On the harness, measure the resistance between the ECU J01-B4 and all other terminals in the J01 and J02 connectors.	**YES:** GO TO 11
	Are all resistance measurements greater than 10k ohms?	**NO:** Fix problem. GO TO 16

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JB81757,000006D -19-16APR10-12/19

11 Check for Crankshaft Position Signal Shorted to Voltage Source	1. Ignition ON, engine OFF.	
	2. On the harness, measure the voltage between the ECU J01-B4 (+) and single point ground (-).	**YES:** GO TO 12
	Is the voltage less than 0.5V?	**NO:** Fix problem. GO TO 16

JB81757,000006D -19-16APR10-13/19

12 Replace Crankshaft Position Sensor	Has crankshaft position sensor been replaced during this diagnostic procedure?	**YES:** GO TO 13
		NO: Remove crankshaft position sensor. GO TO 15

JB81757,000006D -19-16APR10-14/19

13 Reprogram ECU	1. Ignition OFF, engine OFF.	
	2. Reconnect all electrical connectors.	
	3. Download latest ECU payload and reprogram ECU.	**YES:** GO TO 14
	Did DTC 000637.08 reappear active with engine running?	**NO:** Problem fixed.

JB81757,000006D -19-16APR10-15/19

14 Replace ECU	1. Ignition OFF, engine OFF.	
	2. Replace ECU.	**YES:** Open DTAC case.
	Did DTC 000637.08 reappear active with engine running?	**NO:** Problem fixed.

JB81757,000006D -19-16APR10-16/19

15 Inspect Crankshaft Position Sensor	Examine tip of crankshaft position sensor for damage due to contact with crankshaft target.	**YES:** Replace crankshaft position sensor. Determine cause if replacement sensor also becomes damaged. GO TO 16
	Does sensor appear damaged due to contact with target?	**NO:** Replace crankshaft position sensor. GO TO 16

JB81757,000006D -19-16APR10-17/19

16 Verification	1. Ignition OFF, engine OFF.	
	2. Reconnect all electrical connectors.	
	3. Ignition ON, engine ON.	**YES:** GO TO 1
	Did DTC 000637.08 reappear active with engine running?	**NO:** Problem fixed.

Continued on next page

JB81757,000006D -19-16APR10-18/19

17 Review Snapshot Information	1. Retrieve snapshot information, see Snapshot Instructions earlier in this Group.	**YES:** Found a possible problem. Repair possible problem. Retest.
	2. Review information to see if you can determine a possible problem or the operating point that causes the code to become active.	**YES:** Found operating point at which the code becomes active. Try to determine cause. Repair and retest.
	Did you find a possible problem or the operating point at which the code becomes active?	**NO:** GO TO 2

JB81757,000006D -19-16APR10-19/19

000637.10 — Crankshaft Position Signal Rate of Change Abnormal

The ECU detects an improper pattern on the crankshaft position input.

JB81757,000006E -19-16APR10-1/24

000637.10 — Crankshaft Position Signal Rate of Change Abnormal Diagnostic Procedure

Troubleshooting Sequence:
000637.08
000637.10

When DTC is Displayed:
The engine is cranking or running and the error condition is active.

Related Information:
The ECU detects an improper pattern (pulses missing) on the crankshaft position input.
This DTC may be caused by intermittent open or shorted crankshaft position wiring, loose terminals or water in connectors.

Alarm Level:
Warning

Control Unit Response:
Prolonged cranking time may be required to start the engine.
The ECU will use the camshaft position signal to determine crankshaft position.
If a camshaft position 000636 DTC accompanies 000637.10, the engine cannot be started and will stall if running until at least one of the two codes is repaired.
Maximum engine power is derated up to 50 percent.

Additional References:
For more crankshaft position sensor information, see Crankshaft Position Sensor in Section 03, Group 140 earlier in this manual.

For more information on speed sensors, see Speed Measurement in Section 03, Group 140 earlier in this manual.

For more information on engine protection, see Engine Derate And Shutdown Protection in Section 03, Group 140 earlier in this manual.

NOTE: The wiring diagrams provided are for a typical John Deere supplied OEM harness. Wire number, colors, and jumper connectors do not apply to all applications.

For wiring information see 2.4L/3.0L ECU WIRING DIAGRAM 6 located in Section 06, Group 210 later in this manual.

Flex probe information:
- ECU large terminal - Orange/Green
- ECU small terminal - Orange/Blue
- Crankshaft position sensor X01 - Purple/Red
- Front Engine Interconnect X07 - Yellow/Purple

For more information on connector and terminal testing or flex probes see Terminal Test in Section 04, Group 160 earlier in this manual.

IMPORTANT: When directed to run the Harness Diagnostic Mode Test the engine temperature should be above freezing. It is recommended that the engine temperature be at least room temperature 20° C (68° F). This test is located in Service ADVISOR.

IMPORTANT: Do not force probes into connector terminals or damage will result. Use JDG10466 Connector Adapter Test Kit to make measurements in connectors. This will ensure that terminal damage does not occur.

Continued on next page

JB81757,000006E -19-16APR10-2/24

1 Read DTCs and Store Snapshot Information	1. Ignition ON, engine OFF. *NOTE: When DTCs are cleared Snapshot information for ALL DTCs will also be cleared.* 2. Connect Service ADVISOR, see Connecting To Service ADVISOR earlier in this Group. 3. Write down all DTCs and their occurrence count. If any DTCs have snapshot capture or snapshot recording information, save the information. For instructions on saving and using snapshot information, see Snapshot Instructions earlier in this Group. 4. Start or crank engine. 5. Refresh DTCs. Did 000637.10 reappear active with engine running or cranking?	**YES:** GO TO 2 **NO:** GO TO 22

JB81757,000006E -19-16APR10-3/24

2 Check for Open or Shorted Crank Position Circuit	1. Ignition ON, engine OFF. 2. Perform Harness Diagnostic Mode Test in Service ADVISOR. Is DTC 000637.05 or 000637.06 now an active DTC?	**YES:** Discontinue test for 000637.10 and perform test for 000637.05 or 000637.06. **NO:** GO TO 3

JB81757,000006E -19-16APR10-4/24

3 Check Crankshaft Position Data Points	1. Monitor the following Data Points in Service ADVISOR: • Crankshaft Position Input Noise Indicator • Crankshaft Improper Pattern Indicator • Crankshaft Position Status • Crankshaft Position Speed 2. Operate engine through normal speed and load ranges. 3. Switch ON and OFF any electrical devices on the application. **CAUTION: Use caution when working near rotating components.** 4. Gently wiggle wire harness between crankshaft position sensor and ECU. *NOTE: The Crankshaft Position Input Noise Indicator has a value of 0 if the crankshaft position signal is good. The value will temporarily increase if noise is detected in the crankshaft position signal. The Crankshaft Improper Pattern Indicator is 0% if recent crankshaft position signal patterns were good. The percentage will increase if errors in the signal pattern are detected and will count down to 0% once the signal pattern is error-free. The Crankshaft Position Status has a value of 47 with engine speed above 400 rpm if the crankshaft position signal is good. The value will be something other than 47 if a signal problem is detected. These data points can be used to locate intermittent problems with the crankshaft position signal which are too brief to cause a DTC to become active.* *NOTE: Internal Data Monitor in Service ADVISOR may also be used to locate intermittent speed sensor circuit problems. See Internal Data Monitor Instructions earlier in this group for more information on using this feature. Select the data points defined earlier in this step and set sample rate to 5 ms.* Were you able to find some mode of operation or an intermittent wiring problem which causes the crankshaft position data points to indicate a signal problem?	**YES:** Engine wiring problem. Fix problem. GO TO 21 **YES:** Some device on application causes the noise. Open DTAC case. **NO:** GO TO 4

Continued on next page

JB81757,000006E -19-16APR10-5/24

4 Check for Loose Sensor	*NOTE: Verify that the camshaft position sensor is connected to harness connector X02 and the crankshaft position sensor is connected to harness connector X01. If engine wire harness is routed incorrectly, connector X02 can be connected to the crankshaft position sensor and connector X01 can be connected to the camshaft position sensor. Inadvertently swapping these connectors may cause DTCs 000636.02, 000636.10, 00637.02, and/or 000637.10.* *NOTE: See Crankshaft Position Sensor — Installation in Section 02, Group 110 earlier in this manual for sensor torque specifications.* 1. Ignition OFF, engine OFF. 2. Disconnect crankshaft position sensor connector X01. 3. Verify crankshaft position sensor installation torque. Was crankshaft position sensor fully threaded into mounting hole?	**YES:** GO TO 5 **NO:** Torque sensor to specified value. GO TO 21

JB81757,000006E -19-16APR10-6/24

5 Test Sensor Terminals	Perform Terminal Test on crankshaft position sensor and connector. Were any problems found?	**YES:** Fix problem. GO TO 21 **NO:** GO TO 6

JB81757,000006E -19-16APR10-7/24

6 Inspect Target	1. Remove crankshaft position sensor. 2. Visually inspect crankshaft target for damage or debris through sensor mounting hole as engine is rotated. Were any problems found?	**YES:** Fix problem. GO TO 21 **NO:** GO TO 7

JB81757,000006E -19-16APR10-8/24

7 Inspect Sensor	Examine tip of crankshaft position sensor for damage due to contact with crankshaft target. Does sensor appear damaged due to contact with target?	**YES:** Replace crankshaft position sensor. Determine cause if replacement sensor also becomes damaged. GO TO 21 **NO:** GO TO 8

JB81757,000006E -19-16APR10-9/24

8 Check Crankshaft Position Sensor Resistance	On the crankshaft position sensor, measure the resistance between terminals A and B. Is the resistance between 2500 ohms and 3500 ohms?	**YES:** Reinstall crankshaft position sensor. Do not reconnect to harness. GO TO 9 **NO:** Replace crankshaft position sensor. GO TO 21

JB81757,000006E -19-16APR10-10/24

9 Test ECU Terminals	1. Disconnect ECU J01 connector. 2. Perform Terminal Test on J01. Were any problems found?	**YES:** Fix problem. GO TO 21 **NO:** GO TO 10

Continued on next page

JB81757,000006E -19-16APR10-11/24

10 Check for Crankshaft Position Return Shorted to Ground

On the harness, measure the resistance between the ECU J01-D4 and single point ground.

Is the resistance greater than 10k ohms?

YES: GO TO 11

NO: Fix problem. GO TO 21

JB81757,000006E -19-16APR10-12/24

11 Check Crankshaft Position Circuit Continuity

NOTE: Verify that crankshaft position sensor signal and return wires are in the specified connector cavities (not swapped).

1. On the harness, measure the resistance between ECU J01-B4 and crankshaft position sensor X01-B.
2. On the harness, measure the resistance between ECU J01-D4 and crankshaft position sensor X01-A.
3. Disconnect front engine interconnect 8-way connector X07.
4. Perform Terminal Test on X07.

YES: Reconnect X07 connector. GO TO 12

Are both resistance measurements less than 10 ohms and are Terminal Test results good?

NO: Fix problem. GO TO 21

JB81757,000006E -19-16APR10-13/24

12 Check for Intermittent Short Between Crankshaft Position Signal and Return

1. Verify crankshaft position sensor is disconnected.
2. On the harness, measure the resistance between ECU J01-B4 and J01-D4 while gently wiggling wire harness between J01 and crankshaft position sensor connector X01.

YES: GO TO 13

Does resistance remain greater than 10k ohms?

NO: Fix problem. GO TO 21

JB81757,000006E -19-16APR10-14/24

13 Test Terminals

1. Disconnect ECU J02 connector.
2. Perform Terminal Test on J02.

YES: Fix problem. GO TO 21

Were any problems found?

NO: GO TO 14

JB81757,000006E -19-16APR10-15/24

14 Check for Intermittent ECU Power Supply Problem

1. Ignition ON, engine OFF.
2. On the harness, measure the voltage from ECU J02-L1 (+) to J02-L2 (-) while gently wiggling wire harness.
3. On the harness, measure the voltage from ECU J02-B2 (+) to J02-L2 (-) while gently wiggling wire harness.

YES: Fix problem. GO TO 21

Were any intermittent wiring problems found?

NO: GO TO 15

Continued on next page

JB81757,000006E -19-16APR10-16/24

15 Check for Crankshaft Position Signal Wire-to-Wire Short	1. Ignition OFF, engine OFF.	
	2. On the harness, measure the resistance between ECU J01-B4 and all other terminals in the J01 and J02 connectors.	**YES:** GO TO 16
	Are all resistance measurements greater than 10k ohms?	**NO:** Fix problem. GO TO 21

JB81757,000006E -19-16APR10-17/24

16 Check Sensor Resistance at ECU	1. Reconnect crankshaft position sensor connector X01.	
	2. On the harness, measure the resistance between ECU J01-B4 and J01-D4 while gently wiggling wire harness between J01 and crankshaft position sensor.	**YES:** GO TO 17
	Does resistance remain between 2500 ohms and 3500 ohms?	**NO:** Fix problem. GO TO 21

JB81757,000006E -19-16APR10-18/24

17 Inspect Crankshaft Position Wiring	Examine crankshaft position wiring between the crankshaft position sensor and the ECU. Check for the following:	
	• Verify that crankshaft position signal and return wires are twisted together throughout the harness. • Verify that no physical damage to crankshaft position signal and return wires is evident.	**YES:** Replace crankshaft position wiring with twisted pair or repair problem. GO TO 21
	Were any problems found?	**NO:** GO TO 18

JB81757,000006E -19-16APR10-19/24

18 Replace Crankshaft Position Sensor	Has crankshaft position sensor been replaced during this procedure?	**YES:** GO TO 19 **NO:** Replace crankshaft position sensor. GO TO 21

JB81757,000006E -19-16APR10-20/24

19 Reprogram ECU	1. Ignition OFF, engine OFF.	
	2. Reinstall ECU connectors.	
	3. Download latest ECU payload and reprogram ECU.	**YES:** GO TO 20
	Did DTC 000637.10 reappear active with engine running?	**NO:** Problem fixed.

JB81757,000006E -19-16APR10-21/24

20 Replace ECU	1. Ignition OFF, engine OFF.	
	2. Replace ECU.	**YES:** Open DTAC case.
	Did DTC 000637.10 reappear active with engine running?	**NO:** Problem fixed.

Continued on next page

JB81757,000006E -19-16APR10-22/24

21 Verification		
	1. Ignition OFF, engine OFF.	
	2. Reconnect all connectors.	
	3. Ignition ON, engine ON.	
	4. Monitor DTCs in Service ADVISOR.	
	5. Refresh DTCs.	
	6. Operate engine through normal speed and load.	**YES:** GO TO 2
	Did DTC 000637.10 reappear as active with engine running?	**NO:** Problem fixed.

JB81757,000006E -19-16APR10-23/24

22 Review Snapshot Information		
	1. Retrieve snapshot information, see Snapshot Instructions earlier in this Group.	**YES:** Found a possible problem. Repair possible problem. Retest.
	2. Review information to see if you can determine a possible problem or the operating point that causes the code to become active.	**YES:** Found operating point at which the code becomes active. Try to determine cause. Repair and retest.
	Did you find a possible problem or the operating point at which the code becomes active?	**NO:** GO TO 3

JB81757,000006E -19-16APR10-24/24

000105.00 — Intake Manifold Air Temperature Signal Extremely High

The ECU senses the Intake Manifold Air Temperature to be extremely high.

DM59778,0000082 -19-31MAY10-1/16

000105.00 — Intake Manifold Air Temperature Signal Extremely High Diagnostic Procedure

Trouble Shooting Sequence:
000110.00, 000110.16, or 000110.15
000105.00

When DTC is Displayed:
When the engine is on and the error is active.

Related Information:

NOTE: OEM engines are programmed using trimmable features. The customer had the option to choose an engine shutdown feature. If this feature was programmed into the ECU , the ECU will shut the engine down if this code sets. If the shutdown feature was not selected, a standard derate will be activated.

The ECU senses an intake manifold air temperature at or above 91° C (196° F) on OEM engines.
The engine has to be running for the code to be set.
001569.31 is set when this code is active and engine has not shut down.
001110.31 is set if the shutdown feature is enabled. The engine has to be running for 3 minutes before the code is set.
001109.31 is set 30 seconds before the ECU shuts down the engine.

Alarm Level:
STOP

Control Unit Response:
Maximum engine power is derated up to 60 percent.

Additional References:
For more intake manifold air temperature sensor information, see Intake Manifold Air Temperature (MAT) Sensor in Section 03, Group 140 earlier in this manual.
For more temperature sensor information, see Temperature Measurement in Section 03, Group 140 earlier in this manual.
For more information on air intake system, see Intake Air System Operation in section 03, Group 120 earlier in this manual.
For more information on engine protection, see Engine Derate And Shutdown Protection in Section 03, Group 140 earlier in this manual.

NOTE: The wiring diagrams provided are for a typical John Deere supplied OEM harness. Wire number, colors and jumper connectors do not apply to all applications.

For wiring information see 2.4L-3.0L ECU WIRING DIAGRAM 3 located in Section 06, Group 210 later in this manual.

Flex probe information:
- ECU large terminal - Orange/Green
- ECU small terminal - Orange/Blue
- Intake Manifold Air Temperature Sensor T02 - Purple/Red

For further information on connector and terminal testing or flex probes see Terminal Test in Section 04, Group 160 earlier in this manual.

IMPORTANT: Do not force probes into connector terminals or damage will result. Use JDG10466 Flex Probe Kit to make measurements in connectors. This will ensure that terminal damage does not occur.

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DM59778,0000082 -19-31MAY10-2/16

1 Read DTCs and Store Snapshot Information	1. Ignition ON, Engine OFF. *NOTE: When DTCs are cleared Snapshot information for ALL DTCs will be cleared.* 2. Connect Service ADVISOR, see Connecting To Service ADVISOR earlier in this Group. 3. Ignition ON, Engine ON. 4. Let engine idle for 3 minutes before proceeding. 5. Write down all DTCs and their occurrence count. If any DTCs have snapshot capture or snapshot recording information, save the information. For instructions on saving and using snapshot information, see Snapshot Instructions earlier in this Group. 6. Refresh Codes. Did 000105.00 reappear active?	**YES:** GO TO 2 **NO:** GO TO 14

DM59778,0000082 -19-31MAY10-3/16

2 Preliminary Check of Air Intake System	Visually inspect components related to air intake system. • Restricted air intake plumbing. • Restricted, dirty, or damaged charge air cooler. Refer to Vehicle Maintenance Manual for more information. • Loose cooling fan belt. See Belt Tensioner — Spring Tension and Belt Wear (Automatic Tensioner) Check in Section 02, Group 070. • Damaged cooling fan shroud. • Excessively high ambient air temperature. Were any problems found?	**YES:** Fix problem(s). GO TO 13 **NO:** GO TO 3

DM59778,0000082 -19-31MAY10-4/16

3 Terminal Test on Sensor Connector	*NOTE: From here on through the manual, the intake manifold air temperature will be referred to as MAT* 1. Ignition OFF, Engine OFF. 2. Disconnect the MAT sensor connector T02. 3. Perform Terminal Test on the harness and sensor connectors. 4. Inspect surrounding area for pinched or melted wires. Are there any problems with the wiring or connectors?	**YES:** Repair problem. GO TO 13 **NO:** GO TO 4

DM59778,0000082 -19-31MAY10-5/16

4 Check Intake Manifold Air Temperature Sensor	1. Remove MAT sensor. See Intake Intake Manifold Air Temperature Sensor — Removal in Section 02, Group 110 earlier in this manual. 2. Inspect engine housing, sensor housing, and O-ring for defects. Were any defects found?	**YES:** Replace defective part. GO TO 13 **NO:** GO TO 5

Continued on next page

DM59778,0000082 -19-31MAY10-6/16

5 Check Intake Manifold Air Temperature Sensor Operation	1. With MAT sensor removed from engine, reconnect MAT sensor to its harness connector T02. 2. Ignition ON, Engine OFF. 3. Monitor the intake manifold air temperature from within Service ADVISOR. 4. If necessary, let the sensor cool down to the ambient temperature. Does the sensor reading closely match the ambient temperature?	**YES:** MAT sensor is OK. Diagnose engine air intake cooling system. GO TO 6 **NO:** Check harness. GO TO 8

DM59778,0000082 -19-31MAY10-7/16

6 Check for Engine Related Causes	Check the following items that can cause high intake manifold air temperature: • Check air intake operation. See Air Cleaner Operation in Section 03, Group 120 earlier in this manual. • Check air intake manifold. See Intake Manifold — Inspection in Section 02, Group 080 earlier in this manual. • Check turbocharger operation. See Turbocharger Operation in Section 03, Group 135 earlier in this manual. Was cause of high intake manifold air temperature determined?	**YES:** Repair problem. GO TO 13 **NO:** ECU has not been reprogrammed. GO TO 7 **NO:** Problem not fixed. Verify air intake system and related parameters are functioning properly. GO TO 1

DM59778,0000082 -19-31MAY10-8/16

7 Reprogram ECU	1. Ignition OFF, Engine OFF. 2. Reconnect all connectors and sensors. 3. Download latest ECU software payload and reprogram ECU. See Payload File Downloading Instructions and Engine Control Unit (ECU) — Reprogramming Instructions in Group 04, Section 160 earlier in this manual. 4. Monitor DTCs in SERVICE ADVISOR™. 5. Let engine run for 3 minutes and refresh codes. Is 000105.00 still active?	**YES:** Problem not fixed. Verify air intake system and related parameters are functioning properly. GO TO 1 **NO:** Verify problem is fixed. GO TO 13

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DM59778,0000082 -19-31MAY10-9/16

8 Terminal Test on ECU Connector	1. Ignition OFF, Engine OFF. 2. Disconnect ECU connector J01. 3. Perform Terminal Test on harness and ECU connectors. 4. Inspect surrounding area for pinched or melted wires. Are there any problems with the wiring or connectors?	**YES:** Repair problem. GO TO 13 **NO:** GO TO 9

DM59778,0000082 -19-31MAY10-10/16

9 Check Harness	*NOTE: Several new DTCs will appear in this step. Ignore all DTCs except for 000105.03* 1. ECU connector J01 still disconnected from ECU. 2. Ignition ON, Engine OFF. 3. Monitor DTCs from within Service ADVISOR. Did 105.03 become active?	**YES:** Check for short in harness. GO TO 10 **NO:** Check ECU. GO TO 12

DM59778,0000082 -19-31MAY10-11/16

10 Check For Short in Harness	1. Ignition OFF, Engine OFF. 2. Disconnect ECU connector J02. 3. Disconnect MAT connector T02 from MAT sensor. 4. On harness, measure resistance between ECU connector J01-C2 and all other terminals on ECU connectors J01 and J02. Were any measurements less than 100 ohms?	**YES:** Fix shorted wires in harness. GO TO 13 **NO:** GO TO 11

DM59778,0000082 -19-31MAY10-12/16

11 Replace Sensor	Has MAT sensor been replaced?	**YES:** Check ECU. GO TO 12 **NO:** Replace MAT sensor. GO TO 13

Continued on next page

DM59778,0000082 -19-31MAY10-13/16

12 Reprogram ECU	*NOTE: Several new DTCs will appear in this step. Ignore all DTCs except for 000105.03*	
	1. Ignition OFF, Engine OFF.	
	2. Reconnect ECU connector J02. Leave ECU connector J01 disconnected.	
	3. Download latest ECU software payload and reprogram ECU. See Engine Control Unit (ECU) Reprogramming Instructionsand Payload File Downloading Instructions in Group 04, Section 160 earlier in this manual.	
	4. Ignition ON, Engine OFF.	
	5. Monitor DTCs in Service ADVISOR.	**YES:** Problem not fixed. Verify air intake system and related parameters are functioning properly. GO TO 1
	Is 000105.03 active?	**NO:** Replace ECU. See Engine Control Unit (ECU) — Removal in Group 02, Section 110 earlier in this manual. GO TO 13

DM59778,0000082 -19-31MAY10-14/16

13 Verification	1. Ignition OFF, Engine OFF.	
	2. Reconnect all connectors, hoses, sensors, etc.	
	3. Ignition ON, Engine ON.	
	4. Monitor DTCs in Service ADVISOR.	
	5. Let engine run for 3 minutes.	
	6. Refresh DTCs.	
	7. Operate engine through normal speed and load.	**YES:** Problem not fixed. Recheck connectors and air intake system. GO TO 1
	Did DTC 000105.00 reappear as active with engine running?	**NO:** Problem fixed.

DM59778,0000082 -19-31MAY10-15/16

14 Review Snapshot Information	1. Retrieve snapshot information, see Snapshot Instructions earlier in this Group.	
	2. Review all stored codes. Does information relate to a possible intermittent or operating condition causing the code to become active.	**YES:** Found a possible problem. Repair possible problem. Retest.
	3. Review information to see if you can determine a possible problem or the operating point that causes the code to become active.	**YES:** Found operating point at which the code becomes active. GO TO 2
	Did you find a possible problem or the operating point at which the code becomes active?	**NO:** Start DTAC case.

DM59778,0000082 -19-31MAY10-16/16

000105.03 — Intake Manifold Air Temperature Signal Out of Range High

The intake manifold air temperature input voltage exceeds the sensor's high voltage specification.

JL45346,0000052 -19-16APR10-1/19

000105.03 — Intake Manifold Air Temperature Signal Out of Range High Diagnostic Procedure

Troubleshooting Sequence:
000105.03

When DTC is Displayed:
When ever the ignition is on and the error is active.

Related Information:
The intake manifold air temperature input voltage increases above the sensor's high voltage specification. This corresponds to a temperature that is lower than what is physically possible for intake manifold air temperature.

Alarm Level:
Warning

Control Unit Response:
The ECU uses a default intake manifold air temperature of 60° C (140° F). The ECU will try to maintain the engine operating envelope.

Additional References:
For more temperature sensor information, see Temperature Measurement in Section 03, Group 140 earlier in this manual.

For more intake manifold air temperature sensor information, see Intake Manifold Air Temperature (MAT) Sensor in Section 03, Group 140 earlier in this manual.

NOTE: The wiring diagrams provided are for a typical John Deere supplied OEM harness. Wire number, colors, and jumper connectors do not apply to all applications.

For wiring information:
- see 2.4L 12V ECU WIRING DIAGRAM 3
- see 2.4L 24V ECU WIRING DIAGRAM 3
- see 3.0L 12V ECU WIRING DIAGRAM 3
- see 3.0L 24V ECU WIRING DIAGRAM 3

located in Section 06, Group 210 later in this manual.

For more information on connector and terminal testing see Terminal Test in Section 04, Group 160 earlier in this manual.

IMPORTANT: When directed to run the Harness Diagnostic Mode Test the engine temperature should be above freezing. It is recommended that the engine temperature be at least room temperature 20° C (68° F). This test is located in Service ADVISOR.

IMPORTANT: Do not force probes into connector terminals or damage will result. Use JT07328 Connector Adapter Test Kit to make measurements in connectors. This will ensure that terminal damage does not occur.

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JL45346,0000052 -19-16APR10-2/19

1 Read DTCs and Store Snapshot Information	1. Ignition ON, engine OFF. *NOTE: When DTCs are cleared Snapshot information for ALL DTCs will be cleared.* 2. Connect Service ADVISOR, see Connecting To Service ADVISOR earlier in this Group. 3. Write down all DTCs and their occurrence count. If any DTCs have snapshot capture or snapshot recording information, save the information. For instructions on saving and using snapshot information, see Snapshot Instructions earlier in this Group. 4. Refresh Codes. Did 000105.03 reappear active?	**YES:** GO TO 2 **NO:** GO TO 10

JL45346,0000052 -19-16APR10-3/19

2 Terminal Test	1. Ignition OFF, Engine OFF 2. Perform Terminal Test on intake manifold air temperature sensor harness connector. 3. Inspect harness for melted or pinched areas near the intake manifold air temperature sensor. Were any problems found?	**YES:** Repair problem. Run Harness Diagnostic Mode Test in Service ADVISOR. **NO:** GO TO 3

JL45346,0000052 -19-16APR10-4/19

3 Sensor Open Test	Measure the resistance between terminal A and terminal B on the intake manifold air temperature sensor. Was the resistance value greater than 7.5M ohms?	**YES:** Replace sensor. Run Harness Diagnostic Mode Test in Service ADVISOR. **NO:** GO TO 4

JL45346,0000052 -19-16APR10-5/19

4 Harness Resistance Check	Measure the resistance between the return (terminal B) and signal (terminal A) in the intake manifold air temperature sensor harness connector. Was the resistance between 1k and 3k ohms?	**YES:** GO TO 5 **NO:** GO TO 6.

JL45346,0000052 -19-16APR10-6/19

5 Terminal to Terminal Resistance Check	1. Disconnect all ECU connectors. 2. Measure the resistance between the signal (terminal J1-C2) and all other ECU connector terminals in the ECU harness connectors. Was any resistance less than 100 ohms?	**YES:** Look for pinched or melted harness and repair wiring. Run Harness Diagnostic Mode Test in Service ADVISOR **NO:** Reconnect all connectors. Run Harness Diagnostic Mode Test in Service ADVISOR

Continued on next page

JL45346,0000052 -19-16APR10-7/19

6 **Harness Return Wire Resistance Check**	Measure the resistance between the return (terminal B) in the intake manifold air temperature sensor harness connector and application single point ground. Was the resistance less than 5 ohms?	**YES:** GO TO 7 **NO:** GO TO 8.

JL45346,0000052 -19-16APR10-8/19

7 **Harness Signal Wire Resistance Check ECU Disconnected**	Measure the resistance between the signal (terminal J1-C2) in the ECU connector and the signal (terminal A) in the intake manifold air temperature sensor harness connector. Was the resistance less than 5 ohms?	**YES:** GO TO 9 **NO:** Repair open wiring. Run Harness Diagnostic Mode Test in SERVICE ADVISOR™

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JL45346,0000052 -19-16APR10-9/19

8 **Harness Return Wire Resistance Check ECU Disconnected**	Measure the resistance between the return (terminal J1-D2) in the ECU connector and the return (terminal B) in the intake manifold air temperature sensor harness connector. Was the resistance less than 5 ohms?	**YES:** GO TO 9 **NO:** Repair open wiring. Run Harness Diagnostic Mode Test in Service ADVISOR

JL45346,0000052 -19-16APR10-10/19

9 **ECU Resistance Check**	Measure the resistance between the return (terminal J1-D2) and signal (terminal J1-C2) in the ECU connector. Was the resistance between 1k and 3k ohms?	**YES:** Problem not found, reconnect all connectors. GO TO 2 and confirm your findings. Look closely at connectors, wiring and terminal numbers where measurements were made. **NO:** Replace ECU. Run Harness Diagnostic Mode Test in Service ADVISOR.

JL45346,0000052 -19-16APR10-11/19

10 **Occurrence Count Check**	Review stored information and look at occurrence count for 000105.03. Is occurrence recorded in step 1 greater than 5?	**YES:** GO TO 11 **NO:** GO TO 12

JL45346,0000052 -19-16APR10-12/19

11 **Terminal Test**	1. Ignition OFF, Engine OFF 2. Perform Terminal Test on the intake manifold air temperature sensor harness connector. Were any problems found?	 **YES:** Repair problem. Run Harness Diagnostic Mode Test in Service ADVISOR. **NO:** GO TO 12

Continued on next page

JL45346,0000052 -19-16APR10-13/19

12 Further Review of Snapshot Information	Review stored information collected in step 1	**YES:** Repair problem if found.
	Does stored information lead to a possible problem or is there a certain operating point where error occurs?	**YES:** If a certain operating point exists when error occurs then GO TO 13 **NO:** GO TO 15

JL45346,0000052 -19-16APR10-14/19

13 Engine Error Operating Point Test	1. Ignition ON, Engine ON	
	2. Set engine to operating point of failure and refresh codes	**YES:** GO TO 14
	Did 000105.03 reappear when engine operating point was reached?	**NO:** GO TO 12 and confirm the operating point.

JL45346,0000052 -19-16APR10-15/19

14 Sensor Temperature Test	1. Ignition OFF, Engine OFF	
	2. Check temperature of the intake manifold air temperature sensor and surrounding ares.	**YES:** Replace manifold air temperature sensor. Run Harness Diagnostic Mode Test in Service ADVISOR.
	Is everything hot?	**NO:** GO TO 15

JL45346,0000052 -19-16APR10-16/19

15 Terminal Test	1. Ignition OFF, Engine OFF	
	2. Perform Terminal Test on the intake manifold air temperature sensor harness connector and ECU J1 connector.	**YES:** Repair problem, Run Harness Diagnostic Mode Test in Service ADVISOR.
	Were any problems found?	**NO:** GO TO 16

JL45346,0000052 -19-16APR10-17/19

16 Reconnect and Retest	1. Reconnect all connectors.	
	2. Ignition ON, Engine OFF.	
	3. Run Harness Diagnostic Mode Test in Service ADVISOR.	
	4. Refresh codes.	**YES:** GO TO 17.
	Is 000105.03 active?	**NO:** GO TO 15.

Continued on next page

JL45346,0000052 -19-16APR10-18/19

17 Software Updates	1. Download latest ECU software payload and reprogram ECU using Service ADVISOR. See Payload File Downloading Instructions and Engine Control Unit (ECU) Reprogramming Instructions in Section 4 Group 160. 2. Run Harness Diagnostic Mode Test in Service ADVISOR. Is 000105.03 active?	**YES:** Replace Sensor, Run Harness Diagnostic Mode Test in Service ADVISOR. **NO:** Problem fixed, bad ECU program.

JL45346,0000052 -19-16APR10-19/19

000105.04 — Intake Manifold Air Temperature Signal Out of Range Low

The intake manifold air temperature input voltage drops below the sensor's low voltage specification.

JL45346,0000053 -19-16APR10-1/19

000105.04 — Intake Manifold Air Temperature Signal Out of Range Low Diagnostic Procedure

Troubleshooting Sequence:
000105.04

When DTC is Displayed:
When ever the ignition is on and the error is active.

Related Information:
The intake manifold air temperature input voltage drops below the sensor's low voltage specification. This corresponds to a temperature that is higher than what is physically possible for intake manifold air temperature.

Alarm Level:
Warning

Control Unit Response:
The ECU uses a default intake manifold air temperature of 60° C (140° F).

Additional References:
For further temperature sensor information, see Temperature Measurement in Section 03, Group 140 earlier in this manual.

For further intake manifold air temperature sensor information, see Intake Manifold Air Temperature (MAT) Sensor in Section 03, Group 140 earlier in this manual.

NOTE: The wiring diagrams provided are for a typical John Deere supplied OEM harness. Wire number, colors, and jumper connectors do not apply to all applications.

For wiring information:
- see 2.4L 12V ECU WIRING DIAGRAM 3
- see 2.4L 24V ECU WIRING DIAGRAM 3
- see 3.0L 12V ECU WIRING DIAGRAM 3
- see 3.0L 24V ECU WIRING DIAGRAM 3

located in Section 06, Group 210 later in this manual.

For further information on connector and terminal testing see Terminal Test earlier in this Group.

IMPORTANT: When directed to run the Harness Diagnostic Mode Test the engine temperature should be above freezing. It is recommended that the engine temperature be at least room temperature 20° C (68° F). This test is located in Service ADVISOR.

IMPORTANT: Do not force probes into connector terminals or damage will result. Use JT07328 Connector Adapter Test Kit to make measurements in connectors. This will ensure that terminal damage does not occur.

Continued on next page

JL45346,0000053 -19-16APR10-2/19

1 Read DTCs and Store Snapshot Information

1. Ignition ON, engine OFF.

NOTE: When DTCs are cleared Snapshot information for ALL DTCs will be cleared.

2. Connect Service ADVISOR; see Connecting to Service ADVISOR earlier in this Group.
3. Write down all DTCs and their occurrence count. If any DTCs have snapshot capture or snapshot recording information, save the information. For instructions on saving and using snapshot information, see Snapshot Instructions earlier in this Group.
4. Refresh Codes.

Did 000105.04 reappear active?

YES: GO TO 2

NO: GO TO 10

JL45346,0000053 -19-16APR10-3/19

2 Monitor Code Test

1. Ignition OFF, Engine OFF.
2. Disconnect the intake manifold air temperature sensor connector.
3. Ignition ON, Engine OFF
4. Refresh codes.

Did 000105.03 become active and 000105.04 move to stored?

YES: GO TO 3

NO: GO TO 4

JL45346,0000053 -19-16APR10-4/19

3 Terminal Test

1. Ignition OFF, Engine OFF
2. Perform Terminal Test on intake manifold air temperature sensor harness connector.
3. Inspect harness for melted or pinched areas near the intake manifold air temperature sensor.

Were any problems found?

YES: Repair problem. Run Harness Diagnostic Mode Test in Service ADVISOR.

NO: GO TO 4

JL45346,0000053 -19-16APR10-5/19

4 Sensor Short to Ground Test

Measure the resistance from terminal A to chassis ground and terminal B to chassis ground on the intake manifold air temperature sensor.

Was either resistance value less than 1k ohm?

YES: Replace sensor. Run Harness Diagnostic Mode Test in Service ADVISOR.

NO: Problem not found. GO TO 2 and confirm your findings. Look closely at connectors, wiring and terminal numbers where measurements were made.

JL45346,0000053 -19-16APR10-6/19

5 Terminal Test

1. Ignition OFF, Engine OFF
2. Perform Terminal Test on the intake manifold air temperature sensor harness connector.

Were any problems found?

YES: Repair problem. Run Harness Diagnostic Mode Test in Service ADVISOR.

NO: GO TO 6

Continued on next page

JL45346,0000053 -19-16APR10-7/19

6 Harness Resistance Check	Measure the resistance between the return (terminal B) and signal (terminal A) in the intake manifold air temperature sensor harness connector. Was the resistance less than 100 ohms?	**YES:** GO TO 7 **NO:** Problem not found, reconnect all connectors. GO TO 2 and confirm your findings. Look closely at connectors, wiring and terminal numbers where measurements were made.

JL45346,0000053 -19-16APR10-8/19

7 Harness Resistance Check ECU Disconnected	1. Disconnect ECU connector J1. 2. Measure the resistance between the return (terminal B) and signal (terminal A) in the intake manifold air temperature sensor harness connector. Was the resistance less than 100 ohms?	 **YES:** GO TO 8 **NO:** GO TO 9.

JL45346,0000053 -19-16APR10-9/19

8 Harness Physical Check	Terminal A has low resistance to ground, check for: • Melted harness and wiring • Pinched harness and wiring. Was the problem found?	 **YES:** Repair problem. Run Harness Diagnostic Mode Test in Service ADVISOR. **NO:** Problem not found. GO TO 5 and confirm your findings. Look closely at connectors, wiring and terminal numbers where measurements were made.

JL45346,0000053 -19-16APR10-10/19

9 ECU Resistance Check	Measure the resistance between the return (terminal J1-D2) and signal (terminal J1-C2) in the ECU connector. Was the resistance less than 100 ohms?	**YES:** Replace ECU. Run Harness Diagnostic Mode Test in Service ADVISOR. **NO:** Problem not found, reconnect all connectors. GO TO 2 and confirm your findings. Look closely at connectors, wiring and terminal numbers where measurements were made.

JL45346,0000053 -19-16APR10-11/19

10 Occurrence Count Check	Review stored information and look at occurrence count for 000105.04. Is occurrence recorded in step 1 greater than 5?	**YES:** GO TO 11 **NO:** GO TO 12

Continued on next page

JL45346,0000053 -19-16APR10-12/19

11 Terminal Test	1. Ignition OFF, Engine OFF	
	2. Perform Terminal Test on the intake manifold air temperature sensor harness connector.	**YES:** Repair problem, Run Harness Diagnostic Mode Test in Service ADVISOR.
	Were any problems found?	**NO:** GO TO 12

JL45346,0000053 -19-16APR10-13/19

12 Further Review of Snapshot Information	Review stored information collected in step 1	**YES:** Repair problem if found.
	Does stored information lead to a possible problem or is there a certain operating point where error occurs?	**YES:** If a certain operating point exists when error occurs then GO TO 13 **NO:** GO TO 15

JL45346,0000053 -19-16APR10-14/19

13 Engine Error Operating Point Test	1. Ignition ON, Engine ON	
	2. Set engine to operating point of failure and refresh codes	**YES:** GO TO 14
	Did 000105.04 reappear when engine operating point was reached?	**NO:** GO TO 12 and confirm operating point.

JL45346,0000053 -19-16APR10-15/19

14 Sensor Temperature Test	1. Ignition OFF, Engine OFF	
	2. Check temperature of the intake manifold air temperature sensor and surrounding ares.	**YES:** Replace Sensor, Run Harness Diagnostic Mode Test in Service ADVISOR.
	Is everything hot?	**NO:** GO TO 15

JL45346,0000053 -19-16APR10-16/19

15 Terminal Test	1. Ignition OFF, Engine OFF	
	2. Perform Terminal Test on the intake manifold air temperature sensor harness connector and ECU J1 connector.	**YES:** Repair problem, Run Harness Diagnostic Mode Test in Service ADVISOR.
	Were any problems found?	**NO:** GO TO 16

JL45346,0000053 -19-16APR10-17/19

16 Reconnect and Retest	1. Reconnect all connectors.	
	2. Ignition ON, Engine OFF.	
	3. Run Harness Diagnostic Mode Test in Service ADVISOR.	
	4. Refresh codes.	**YES:** GO TO 17.
	Is 000105.04 active?	**NO:** GO TO 15.

Continued on next page

JL45346,0000053 -19-16APR10-18/19

17 Software Updates	1. Download latest ECU software payload and reprogram ECU using Service ADVISOR. 2. Run Harness Diagnostic Mode Test in Service ADVISOR. Is 000105.04 active?	**YES:** Replace Sensor, Run Harness Diagnostic Mode Test in Service ADVISOR. **NO:** Problem fixed, bad ECU program.

JL45346,0000053 -19-16APR10-19/19

000105.15 — Intake Manifold Air Temperature Signal Slightly High

The ECU senses the Intake Manifold Air Temperature is above specification.

DM59778,0000083 -19-31MAY10-1/16

000105.15 — Intake Manifold Air Temperature Signal Slightly High Diagnostic Procedure

Trouble Shooting Sequence:
000110.00, 000110.16, or 000110.15
000105.15

When DTC is Displayed:
When the engine has been running 3 minutes and the error is active

Related Information:
The ECU senses an intake manifold air temperature at or above 88° C (190° F) on OEM engines.

Alarm Level:
Warning

Control Unit Response:
The ECU will continue to operate normally.

Additional References:
For further intake manifold air temperature sensor information, see Intake Manifold Air Temperature (Mat) Sensor in Section 03, Group 140 earlier in this manual.
For further temperature sensor information, see Temperature Measurementin Section 03, Group 140 earlier in this manual.
For more information on air intake system, see Intake Air System Operation in section 03, Group 135 earlier in this manual.
For more information on engine protection, see Engine Derate And Shutdown Protection in Section 03, Group 140 earlier in this manual.

NOTE: The wiring diagrams provided are for a typical John Deere supplied OEM harness. Wire number, colors and jumper connectors do not apply to all applications.

For wiring information see 2.4L-3.0L ECU WIRING DIAGRAM 3 located in Section 06, Group 210 later in this manual.

Flex probe information:
- ECU large terminal - Orange/Green
- ECU small terminal - Orange/Blue
- Intake Manifold Air Temperature Sensor T02 - Purple/Red

For further information on connector and terminal testing or flex probes see Terminal Test in Section 04, Group 160 earlier in this manual.

IMPORTANT: Do not force probes into connector terminals or damage will result. Use JDG10466 Flex Probe Kit to make measurements in connectors. This will ensure that terminal damage does not occur.

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DM59778,0000083 -19-31MAY10-2/16

1 Read DTCs and Store Snapshot Information	1. Ignition ON, Engine OFF. *NOTE: When DTCs are cleared Snapshot information for ALL DTCs will be cleared.* 2. Connect Service ADVISOR, see Connecting To Service ADVISOR earlier in this Group. 3. Ignition ON, Engine ON. 4. Let engine idle for 3 minutes before proceeding. 5. Write down all DTCs and their occurrence count. If any DTCs have snapshot capture or snapshot recording information, save the information. For instructions on saving and using snapshot information, see Snapshot Instructions earlier in this Group. 6. Refresh Codes. Did 000105.15 reappear active?	**YES:** GO TO 2 **NO:** GO TO 14

DM59778,0000083 -19-31MAY10-3/16

2 Preliminary Check of Air Intake System	Visually inspect components related to air intake system. • Restricted air intake plumbing. • Restricted, dirty, or damaged charge air cooler. Refer to **Vehicle Maintenance Manual** for more information. • Loose cooling fan belt. See Belt Tensioner — Spring Tension and Belt Wear (Automatic Tensioner) Check in Section 02, Group 070. • Damaged cooling fan shroud. • Excessively high ambient air temperature. Were any problems found?	**YES:** Fix problem(s). GO TO 13 **NO:** GO TO 3

DM59778,0000083 -19-31MAY10-4/16

3 Terminal Test on Sensor Connector	*NOTE: From here on through the manual, the intake manifold air temperature will be referred to as MAT* 1. Ignition OFF, Engine OFF. 2. Disconnect the MAT sensor connector T02. 3. Perform Terminal Test on the harness and sensor connector. 4. Inspect surrounding area for pinched or melted wires. Are there any problems with the wiring or connectors?	**YES:** Repair problem. GO TO 13 **NO:** GO TO 4

DM59778,0000083 -19-31MAY10-5/16

4 Check Intake Manifold Air Temperature Sensor	1. Remove MAT sensor. See Intake Manifold Air Temperature Sensor — Removal in Section 02, Group 110 earlier in this manual. 2. Inspect engine housing, sensor housing, and O-ring for defects. Were any defects found?	**YES:** Replace defective part. GO TO 13 **NO:** GO TO 5

Continued on next page

DM59778,0000083 -19-31MAY10-6/16

5 Check Intake Manifold Air Temperature Sensor Operation	1. With MAT sensor removed from engine, reconnect MAT sensor to its harness connector T02. 2. Ignition ON, Engine OFF. 3. Monitor the intake manifold air temperature from within Service ADVISOR. 4. If necessary, let the sensor cool down to the ambient temperature. Does the sensor reading closely match the ambient temperature?	**YES:** MAT sensor is OK. Diagnose engine air intake cooling system. GO TO 6 **NO:** Check harness. GO TO 8

DM59778,0000083 -19-31MAY10-7/16

6 Check for Engine Related Causes	Check the following items that can cause high intake manifold air temperature: • Check air intake operation. See Air Cleaner Operation in Section 03, Group 120 earlier in this manual. • Check air intake manifold. See Intake Manifold — Inspection in Section 02, Group 080 earlier in this manual. • Check turbocharger operation. See Turbocharger Operation in Section 03, Group 135 earlier in this manual. Was cause of high intake manifold air temperature determined?	**YES:** Repair problem. GO TO 13 **NO:** ECU has not been reprogrammed. GO TO 7 **NO:** Problem not fixed. Verify air intake system and related parameters are functioning properly. GO TO 1

DM59778,0000083 -19-31MAY10-8/16

7 Reprogram ECU	1. Ignition OFF, Engine OFF. 2. Reconnect all connectors and sensors. 3. Download latest ECU software payload and reprogram ECU. See Payload File Downloading Instructions and Engine Control Unit (ECU) — Reprogramming Instructions in Group 04, Section 160 earlier in this manual. 4. Monitor DTCs in SERVICE ADVISOR™. 5. Let engine run for 3 minutes and refresh codes. Is 000105.15 still active?	**YES:** Problem not fixed. Verify air intake system and related parameters are functioning properly. GO TO 1 **NO:** Verify problem is fixed. GO TO 13

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DM59778,0000083 -19-31MAY10-9/16

8 Terminal Test on ECU Connector	1. Ignition OFF, Engine OFF. 2. Disconnect ECU connector J01. 3. Perform Terminal Test on harness and ECU connectors. 4. Inspect surrounding area for pinched or melted wires. Are there any problems with the wiring or connectors?	**YES:** Repair problem. GO TO 13 **NO:** GO TO 9

DM59778,0000083 -19-31MAY10-10/16

9 Check Harness	*NOTE: Several new DTCs will appear in this step. Ignore all DTCs except for 000105.03* 1. ECU connector J01 disconnected from ECU. 2. Ignition ON, Engine OFF. 3. Monitor DTCs from within Service ADVISOR. Did 105.03 become active?	**YES:** Check for short in harness. GO TO 10 **NO:** Check ECU. GO TO 12

DM59778,0000083 -19-31MAY10-11/16

10 Check For Short in Harness	1. Ignition OFF, Engine OFF. 2. Disconnect ECU connector J02. 3. Disconnect MAT connector T02 from MAT sensor. 4. On harness, measure resistance between ECU connector J01-C2 and all other terminals on ECU connectors J01 and J02. Were any measurements less than 100 ohms?	**YES:** Fix shorted wires in harness. GO TO 13 **NO:** GO TO 11

DM59778,0000083 -19-31MAY10-12/16

11 Replace Sensor	Has MAT sensor been replaced?	**YES:** Check ECU. GO TO 12 **NO:** Replace MAT sensor. GO TO 13

Continued on next page

DM59778,0000083 -19-31MAY10-13/16

12 Reprogram ECU	*NOTE: Several new DTCs will appear in this step. Ignore all DTCs except for 000105.03*	
	1. Ignition OFF, Engine OFF.	
	2. Reconnect ECU connector J02. Leave ECU connector J01 disconnected.	
	3. Download latest ECU software payload and reprogram ECU. See Payload File Downloading Instructions and Engine Control Unit (ECU) — Reprogramming Instructions in Group 04, Section 160 earlier in this manual.	
	4. Ignition ON, Engine OFF.	
	5. Monitor DTCs in Service ADVISOR.	**YES:** Problem not fixed. Verify air intake system and related parameters are functioning properly. GO TO 1
	Is 000105.03 active?	**NO:** Replace ECU. See Engine Control Unit (ECU) — Removal in Group 02, Section 110 earlier in this manual. GO TO 13

DM59778,0000083 -19-31MAY10-14/16

13 Verification	1. Ignition OFF, Engine OFF.	
	2. Reconnect all connectors, hoses, sensors, etc.	
	3. Ignition ON, Engine ON.	
	4. Monitor DTCs in Service ADVISOR.	
	5. Let engine run for 3 minutes.	
	6. Refresh DTCs.	
	7. Operate engine through normal speed and load.	**YES:** Problem not fixed. Recheck connectors and air intake system. GO TO 1
	Did DTC 000105.15 reappear as active with engine running?	**NO:** Problem fixed.

DM59778,0000083 -19-31MAY10-15/16

14 Review Snapshot Information	1. Retrieve snapshot information, see Snapshot Instructions earlier in this Group.	
	2. Review all stored codes. Does information relate to a possible intermittent or operating condition causing the code to become active.	**YES:** Found a possible problem. Repair possible problem. Retest.
	3. Review information to see if you can determine a possible problem or the operating point that causes the code to become active.	**YES:** Found operating point at which the code becomes active. GO TO 2
	Did you find a possible problem or the operating point at which the code becomes active?	**NO:** Start DTAC case.

DM59778,0000083 -19-31MAY10-16/16

000105.16 — Intake Manifold Air Temperature Signal Moderately High

The ECU senses the Intake Manifold Air Temperature to be moderately high.

DM59778,0000084 -19-31MAY10-1/16

000105.16 — Intake Manifold Air Temperature Signal Moderately High Diagnostic Procedure

Trouble Shooting Sequence:
000110.00, 000110.16, or 000110.15
000105.16

When DTC is Displayed:
When the engine is on and the error is active.

Related Information:

The ECU senses an intake manifold air temperature at or above 89.5° C (193° F) on OEM engines.
The engine has to be running for 3 minutes for the code to be set.
001569.31 is set when this code is active and the ECU has derated the engine.
Alarm Level:
Warning

Control Unit Response:
Maximum engine power is derated up to 20 percent.

Additional References:
For further intake manifold air temperature sensor information, see Intake Manifold Air Temperature (MAT) Sensor in Section 03, Group 140 earlier in this manual.
For further temperature sensor information, see Temperature Measurement in Section 03, Group 140 earlier in this manual.
For more information on air intake system, see Intake Air System Operation in section 03, Group 120 earlier in this manual.
For more information on engine protection, see Engine Derate And Shutdown Protection in Section 03, Group 140 earlier in this manual

NOTE: The wiring diagrams provided are for a typical John Deere supplied OEM harness. Wire number, colors and jumper connectors do not apply to all applications.

For wiring information see 2.4L-3.0L ECU WIRING DIAGRAM 3 located in Section 06, Group 210 later in this manual.

Flex probe information:
- ECU large terminal - Orange/Green
- ECU small terminal - Orange/Blue
- Intake Manifold Air Temperature Sensor T02 - Purple/Red

For further information on connector and terminal testing or flex probes see Terminal Test in Section 04, Group 160 earlier in this manual.

IMPORTANT: Do not force probes into connector terminals or damage will result. Use JDG10466 Flex Probe Kit to make measurements in connectors. This will ensure that terminal damage does not occur.

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DM59778,0000084 -19-31MAY10-2/16

1 Read DTCs and Store Snapshot Information

1. Ignition ON, Engine OFF.

NOTE: When DTCs are cleared Snapshot information for ALL DTCs will be cleared.

2. Connect Service ADVISOR, see Connecting To Service ADVISOR earlier in this Group.
3. Ignition ON, Engine ON.
4. Let engine idle for 3 minutes before proceeding.
5. Write down all DTCs and their occurrence count. If any DTCs have snapshot capture or snapshot recording information, save the information. For instructions on saving and using snapshot information, see Snapshot Instructions earlier in this Group.
6. Refresh Codes.

Did 000105.16 reappear active?

YES: GO TO 2

NO: GO TO 14

DM59778,0000084 -19-31MAY10-3/16

2 Preliminary Check of Air Intake System

Visually inspect components related to air intake system.

- Restricted air intake plumbing.
- Restricted, dirty, or damaged charge air cooler. Refer to **Vehicle Maintenance Manual** for more information.
- Loose cooling fan belt. See Belt Tensioner — Spring Tension and Belt Wear (Automatic Tensioner) Check in Section 02, Group 070.
- Damaged cooling fan shroud.
- Excessively high ambient air temperature.

Were any problems found?

YES: Fix problem(s). GO TO 13

NO: GO TO 3

DM59778,0000084 -19-31MAY10-4/16

3 Terminal Test on Sensor Connector

NOTE: From here on through the manual, the intake manifold air temperature will be referred to as MAT

1. Ignition OFF, Engine OFF.
2. Disconnect the MAT sensor connector T02.
3. Perform Terminal Test on the harness and sensor connectors.
4. Inspect surrounding area for pinched or melted wires.

Are there any problems with the wiring or connectors?

YES: Repair problem. GO TO 13

NO: GO TO 4

DM59778,0000084 -19-31MAY10-5/16

4 Check Intake Manifold Air Temperature Sensor

1. Remove MAT sensor. See Intake Manifold Air Temperature Sensor — Removal in Section 02, Group 110 earlier in this manual.
2. Inspect engine housing, sensor housing, and O-ring for defects.

Were any defects found?

YES: Replace defective part. GO TO 13

NO: GO TO 5

Continued on next page

DM59778,0000084 -19-31MAY10-6/16

5 Check Intake Manifold Air Temperature Sensor Operation

1. With MAT sensor removed from engine, reconnect MAT sensor to its harness connector T02.
2. Ignition ON, Engine OFF.
3. Monitor the intake manifold air temperature from within Service ADVISOR.
4. If necessary, let the sensor cool down to the ambient temperature.

Does the sensor reading closely match the ambient temperature?

YES: MAT sensor is OK. Diagnose engine air intake cooling system. GO TO 6

NO: Check harness. GO TO 8

DM59778,0000084 -19-31MAY10-7/16

6 Check for Engine Related Causes

Check the following items that can cause high intake manifold air temperature:

- Check air intake operation. See Air Cleaner Operation in Section 03, Group 120 earlier in this manual.
- Check air intake manifold. See Intake Manifold — Inspection in Section 02, Group 080 earlier in this manual.
- Check turbocharger operation. See Turbocharger Operation in Section 03, Group 120 earlier in this manual.

Was cause of high intake manifold air temperature determined?

YES: Repair problem. GO TO 13

NO: ECU has not been reprogrammed. GO TO 7

NO: Problem not fixed. Verify air intake system and related parameters are functioning properly. GO TO 1

DM59778,0000084 -19-31MAY10-8/16

7 Reprogram ECU

1. Ignition OFF, Engine OFF.
2. Reconnect all connectors and sensors.
3. Download latest ECU software payload and reprogram ECU. See Payload File Downloading Instructions and Engine Control Unit (ECU) — Reprogramming Instructions in Group 04, Section 160 earlier in this manual.
4. Monitor DTCs in Service ADVISOR.
5. Let engine run for 3 minutes and refresh codes.

Is 000105.00 still active?

YES: Problem not fixed. Verify air intake system and related parameters are functioning properly. GO TO 1

NO: Verify problem is fixed. GO TO 13

DM59778,0000084 -19-31MAY10-9/16

8 Terminal Test on ECU Connector

1. Ignition OFF, Engine OFF.
2. Disconnect ECU connector J01.
3. Perform Terminal Test on harness and ECU connectors.
4. Inspect surrounding area for pinched or melted wires.

Are there any problems with the wiring or connectors?

YES: Repair problem. GO TO 13

NO: GO TO 9

Continued on next page

DM59778,0000084 -19-31MAY10-10/16

9 Check Harness	*NOTE: Several new DTCs will appear in this step. Ignore all DTCs except for 000105.03* 1. ECU connector J01 disconnected from ECU. 2. Ignition ON, Engine OFF. 3. Monitor DTCs from within Service ADVISOR. Did 105.03 become active?	**YES:** Check for short in harness. GO TO 10 **NO:** Check ECU. GO TO 12

DM59778,0000084 -19-31MAY10-11/16

10 Check For Short in Harness	1. Ignition OFF, Engine OFF. 2. Disconnect ECU connector J02. 3. Disconnect MAT connector T02 from MAT sensor. 4. On harness, measure resistance between ECU connector J01-C2 and all other terminals on ECU connectors J01 and J02. Were any measurements less than 100 ohms?	**YES:** Fix shorted wires in harness. GO TO 13 **NO:** GO TO 11

DM59778,0000084 -19-31MAY10-12/16

11 Replace Sensor	Has MAT sensor been replaced?	**YES:** Check ECU. GO TO 12 **NO:** Replace MAT sensor. GO TO 13

DM59778,0000084 -19-31MAY10-13/16

12 Reprogram ECU	*NOTE: Several new DTCs will appear in this step. Ignore all DTCs except for 000105.03* 1. Ignition OFF, Engine OFF. 2. Reconnect ECU connector J02. Leave ECU connector J01 disconnected. 3. Download latest ECU software payload and reprogram ECU. See Payload File Downloading Instructions and Engine Control Unit (ECU) Reprogramming Instructions in Group 04, Section 160 earlier in this manual. 4. Ignition ON, Engine OFF. 5. Monitor DTCs in Service ADVISOR. Is 000105.03 active?	**YES:** Problem not fixed. Verify air intake system and related parameters are functioning properly. GO TO 1 **NO:** Replace ECU. See Engine Control Unit (ECU) — Removal in Group 02, Section 110 earlier in this manual. GO TO 13

Continued on next page

DM59778,0000084 -19-31MAY10-14/16

13 Verification	1. Ignition OFF, Engine OFF.	
	2. Reconnect all connectors, hoses, sensors, etc.	
	3. Ignition ON, Engine ON.	
	4. Monitor DTCs in Service ADVISOR.	
	5. Let engine run for 3 minutes.	
	6. Refresh DTCs.	
	7. Operate engine through normal speed and load.	**YES:** Problem not fixed. Recheck connectors and air intake system.
	Did DTC 000105.16 reappear as active with engine running?	**NO:** Problem fixed.

DM59778,0000084 -19-31MAY10-15/16

14 Review Snapshot Information	1. Retrieve snapshot information, see Snapshot Instructions earlier in this Group.	
	2. Review all stored codes. Does information relate to a possible intermittent or operating condition causing the code to become active.	**YES:** Found a possible problem. Repair possible problem. Retest.
	3. Review information to see if you can determine a possible problem or the operating point that causes the code to become active.	**YES:** Found operating point at which the code becomes active. GO TO 2
	Did you find a possible problem or the operating point at which the code becomes active?	**NO:** Start DTAC case.

DM59778,0000084 -19-31MAY10-16/16

000676.03 — Glow Plug Relay Output Signal Received When Not Expected

The ECU detects the glow plug relay output is high when the ECU is not energizing the relay.

JB81757,0000071 -19-19APR10-1/18

000676.03 — Glow Plug Signal Received When Not Expected Diagnostic Procedure

Troubleshooting Sequence:
000676.03

When DTC is Displayed:
The ECU is commanding the glow plug relay OFF but is detecting that the glow plug relay is energized.

Related Information:
The ECU supplies a high side output to the glow plug relay coil to energize the relay. The ECU monitors the output of the relay to determine if the relay is energized.
The ECU uses coolant temperature to determine the length of time to energize glow plug relay.

Alarm Level:
Warning

Control Unit Response:
The ECU will attempt to control the engine in a normal manner.

Additional References:
For further glow plug information, see Glow Plug Operation in Section 03, Group 140 earlier in this manual.

NOTE: The wiring diagrams provided are for a typical John Deere supplied OEM harness. Wire number, colors, and jumper connectors do not apply to all applications.

For wiring information see 2.4L/3.0L ECU WIRING DIAGRAM 6 located in Section 06, Group 210 later in this manual.

Flex probe information:
- ECU large terminal - Orange/Green
- ECU small terminal - Orange/Blue
- Glow Plug Interconnect C03 - Purple/Gray

For more information on connector and terminal testing or flex probes see Terminal Test in Section 04, Group 160 earlier in this manual.

IMPORTANT: Do not force probes into connector terminals or damage will result. Use JDG10466 Connector Adapter Test Kit to make measurements in connectors. This will ensure that terminal damage does not occur.

JB81757,0000071 -19-19APR10-2/18

1 Read DTCs and Store Snapshot Information	1. Ignition ON, engine OFF for at least 30 seconds to permit glow plug relay to be switched off. *NOTE: When DTCs are cleared Snapshot information for ALL DTCs will also be cleared.* 2. Connect Service ADVISOR, see Connecting To Service ADVISOR earlier in this Group. 3. Write down all DTCs and their occurrence count. If any DTCs have snapshot capture or snapshot recording information, save the information. For instructions on saving and using snapshot information, see Snapshot Instructions earlier in this Group. 4. Refresh DTCs. Did 000676.03 reappear active?	**YES:** GO TO 2 **NO:** GO TO 12

Continued on next page

JB81757,0000071 -19-19APR10-3/18

2 Check Glow Plug Relay Output Voltage	*NOTE: The glow plug relay and the wire harness between engine harness connector C03 and the glow plug relay are supplied by the application manufacturer. The relay typically has four stud-type connections. The two smaller studs are connected to the relay control coil. One of the large studs is connected to the battery voltage supply. The other large stud is the relay output which is connected to the glow plugs.* 1. Ignition ON, engine OFF for at least 30 seconds. 2. Measure the voltage from the glow plug relay output terminal (+) to single point ground (-). Is the voltage greater than 1V?	**YES:** GO TO 3 **NO:** GO TO 5

JB81757,0000071 -19-19APR10-4/18

3 Check for Energized Glow Plug Relay	Measure voltage from glow plug relay coil high side terminal (+) to single point ground (-). Is voltage greater than 1V?	**YES:** GO TO 6 **NO:** GO TO 4

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4 Check for Stuck Glow Plug Relay Contacts	*NOTE: See application manufacturer's service information for fuse location.* 1. Remove glow plug fuse. 2. Measure the voltage from the glow plug relay output terminal (+) to single point ground (-). Is voltage greater than 1V?	**YES:** Repair short to voltage source in glow plug relay output wiring. GO TO 11 **NO:** Replace glow plug relay. GO TO 11

JB81757,0000071 -19-19APR10-6/18

5 Check Glow Plug Relay Output Sense Wiring for Correct Pin-Out	1. Ignition OFF, engine OFF. 2. Disconnect ECU J01 connector. 3. Perform Terminal Test on J01. 4. Measure the resistance between ECU J01-A2 and glow plug relay output terminal. Are Terminal Test results good and is resistance less than 10 ohms?	**YES:** GO TO 9 **NO:** Fix problem. GO TO 11

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6 Check Glow Plug Relay Control Circuit	1. Ignition OFF, engine OFF. 2. Disconnect ECU J01 connector. 3. Perform Terminal Test on J01. 4. Measure the resistance between ECU J01-H4 and glow plug relay coil high side terminal. Are Terminal Test results good and is resistance less than 10 ohms?	**YES:** Do not reconnect J01. GO TO 7 **NO:** Fix problem. GO TO 11

Continued on next page

JB81757,0000071 -19-19APR10-8/18

7 Check Glow Plug Relay Control Circuit for Short to Voltage

1. Ignition ON, engine OFF for at least 30 seconds.
2. Measure the voltage from glow plug relay coil high side terminal (+) to single point ground (-).

Is the voltage greater than 1V?

YES: Repair short to voltage of glow plug control circuit. GO TO 11

NO: GO TO 8

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8 Check Glow Plug Relay Control Circuit for Wire to Wire Short

1. Ignition OFF, engine OFF.
2. Remove glow plug relay coil high side terminal from glow plug relay.
3. Measure resistance between ECU J01-H4 and all other terminals in the J01 connector.

Are all resistance values greater than 1k ohms?

YES: GO TO 9

NO: Fix problem. GO TO 11

JB81757,0000071 -19-19APR10-10/18

9 Reprogram ECU

1. Ignition OFF, engine OFF.
2. Reconnect all connectors.
3. Download latest ECU payload and reprogram ECU.
4. Ignition ON, engine OFF for at least 30 seconds.
5. Refresh DTCs.

Did DTC 000676.03 reappear active?

YES: GO TO 10

NO: Problem fixed.

JB81757,0000071 -19-19APR10-11/18

10 Replace ECU

1. Ignition OFF, engine OFF.
2. Replace ECU.
3. Ignition ON, engine OFF for at least 30 seconds.
4. Refresh DTCs.

Did DTC 000676.03 reappear active?

YES: Open DTAC case.

NO: Problem fixed.

JB81757,0000071 -19-19APR10-12/18

11 Verification

1. Ignition OFF, engine OFF for 10 seconds.
2. Reconnect all connectors.
3. Ignition ON, engine OFF for at least 30 seconds.
4. Refresh DTCs.

Did DTC 000676.03 reappear active?

YES: GO TO 2

NO: Problem fixed.

Continued on next page

JB81757,0000071 -19-19APR10-13/18

12 Further Review of Snapshot Information	Review stored information collected in step 1	**YES:** Fix problem if found. GO TO 11
	Does stored information lead to a possible problem or is there a certain operating point where error occurs?	**YES:** If a certain operating point exists when error occurs then GO TO 13 **NO:** GO TO 14

JB81757,0000071 -19-19APR10-14/18

13 Engine Error Operating Point Test	1. Ignition ON, engine ON	
	2. Set engine to operating point of failure and refresh DTCs.	**YES:** GO TO 2
	Did 000676.03 reappear active when engine operating point was reached?	**NO:** GO TO 14

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14 Terminal Test and Harness Inspection	1. Ignition OFF, engine OFF.	
	2. Perform Terminal Test on the ECU J01 and C03 connectors and the glow plug relay.	
	3. Inspect wiring harness for damage which could cause intermittent short to voltage source or wire to wire shorts.	**YES:** Fix problem. GO TO 11
	Were any problems found?	**NO:** Reconnect all connectors. GO TO 15

JB81757,0000071 -19-19APR10-16/18

15 Check for Intermittent Stuck Relay Contacts	1. Disconnect coolant temperature sensor to cause ECU to energize glow plug relay at next key cycle.	
	NOTE: Ignore DTC 000110.03 which will be generated due to coolant temperature sensor being disconnected.	
	2. Ignition ON, engine OFF for at least 30 seconds.	
	3. Refresh DTCs.	
	Did 000676.03 reappear active?	**YES:** Relay contacts may be stuck. GO TO 2
	NOTE: Cycle ignition OFF for 10 seconds and repeat sub-steps 2-3 several times to cycle relay contacts, if 000676.03 does not reappear active.	**NO:** GO TO 16

JB81757,0000071 -19-19APR10-17/18

16 Reprogram ECU	1. Download latest ECU payload and reprogram ECU.	
	2. Ignition ON, engine ON for at least 30 seconds.	
	3. Refresh DTCs.	**YES:** GO TO 2
	Did 000676.03 reappear active?	**NO:** Problem fixed or conditions necessary to duplicate 000676.03 not met.

JB81757,0000071 -19-19APR10-18/18

000676.05 — Glow Plug Relay Output Signal Not Received

The ECU detects the glow plug relay output is low when the ECU is energizing the relay.

JB81757,0000072 -19-21APR10-1/18

000676.05 — Glow Plug Relay Output Signal Not Received Diagnostic Procedure

Troubleshooting Sequence:
000676.05

When DTC is Displayed:
The ECU is commanding the glow plug relay ON but is detecting that the glow plug relay is not energized.
This DTC will become stored when the ECU commands the glow plug relay OFF.
The brief length of time that DTC is active may cause DTC to only be shown as stored.

Related Information:
The ECU uses coolant temperature to determine if glow plug relay should be energized.
The ECU supplies a high side control to the glow plug relay to energize the relay. The ECU monitors the output of the relay to determine if glow plug relay is energized.
This DTC may be caused by wiring problems including an open glow plug relay control circuit or an open circuit between the relay output and the ECU.
This DTC may also be caused by a defective glow plug relay or a blown or missing glow plug fuse.

Alarm Level:
Warning

Control Unit Response:
The ECU will attempt to control the engine in a normal manner.
The engine may require extended crank time or may not start in low ambient temperatures if glow plugs are not powered.

Additional References:
For further glow plug information, see Glow Plug Operation in Section 03, Group 140 earlier in this manual.

NOTE: The wiring diagrams provided are for a typical John Deere supplied OEM harness. Wire number, colors, and jumper connectors do not apply to all applications.

For wiring information see 2.4L/3.0L ECU WIRING DIAGRAM 6 located in Section 06, Group 210 later in this manual.

Flex probe information:
- ECU large terminal - Orange/Green
- ECU small terminal - Orange/Blue
- Glow Plug Interconnect C03 - Purple/Gray

For more information on connector and terminal testing or flex probes see Terminal Test in Section 04, Group 160 earlier in this manual.

IMPORTANT: Do not force probes into connector terminals or damage will result. Use JDG10466 Connector Adapter Test Kit to make measurements in connectors. This will ensure that terminal damage does not occur.

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1 Read DTCs and Store Snapshot Information	1. Ignition ON, engine OFF. *NOTE: When DTCs are cleared Snapshot information for ALL DTCs will also be cleared.* 2. Connect Service ADVISOR, see Connecting To Service ADVISOR earlier in this Group. 3. Write down all DTCs and their occurrence count. If any DTCs have snapshot capture or snapshot recording information, save the information. For instructions on saving and using snapshot information, see Snapshot Instructions earlier in this Group. 4. Disconnect coolant temperature sensor connector to cause the ECU to attempt to energize the glow plug relay at next key cycle. *NOTE: Ignore DTC 000110.03 which will be generated due to coolant temperature sensor being disconnected.* 5. Clear DTCs. 6. Ignition OFF, engine OFF for 10 seconds. 7. Ignition ON, engine OFF. 8. Refresh DTCs. Did 000676.05 reappear active or stored?	**YES:** GO TO 2 **NO:** GO TO 12

JB81757,0000072 -19-21APR10-3/18

2 Check Glow Plug Relay Voltage Supply	*NOTE: The glow plug relay and the wire harness between engine harness connector C03 and the glow plug relay are supplied by the application manufacturer. The relay typically has four stud-type connections. The two smaller studs are connected to the relay control coil. One of the large studs is connected to the battery voltage supply. The other large stud is the relay output which is connected to the glow plugs. Consult application manufacturer's service information for details.* 1. Ignition OFF, engine OFF. 2. Measure the voltage from the glow plug relay battery voltage supply terminal (+) to single point ground (-). Is voltage within 1V of battery terminal voltage?	**YES:** GO TO 3 **NO:** Check for blown or missing glow plug fuse, loose connections, or open circuit. Fix problem. GO TO 11

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3 Check Glow Plug Circuits in Application Wire Harness	1. Disconnect Glow Plug Interconnect connector C03. 2. Perform Terminal Test on C03 connector. 3. On the application wire harness, measure the resistance between C03-A to the glow plug relay coil high side terminal. 4. On the application wire harness, measure the resistance between C03-B to the glow plug relay output terminal. 5. On the application wire harness, measure the resistance between C03-C to the glow plug relay coil low side terminal. Were Terminal Test results good and all resistance measurement less than 10 ohms?	**YES:** Reconnect C03. GO TO 4 **NO:** Fix problem. GO TO 11

Continued on next page

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4 Check Glow Plug Relay Output Voltage	1. Verify coolant temperature sensor is still disconnected.	
	2. Ignition ON, engine OFF. Glow plug relay should be energized for approximately 15 seconds.	
	3. Measure voltage from glow plug relay output terminal (+) to single point ground (-) while ECU is attempting to energize relay.	**YES:** GO TO 5
	Is voltage within 5V of battery terminal voltage?	**NO:** GO TO 6

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5 Check Relay Output Sense Wiring	1. Ignition OFF, engine OFF.	
	2. Disconnect ECU J01 connector.	
	3. Perform Terminal Test on J01-A2.	
	4. On the harness, measure the resistance between ECU J01-A2 and glow plug relay output sense terminal.	**YES:** GO TO 9
	Are Terminal Test results good and is resistance less than 10 ohms?	**NO:** Fix problem. GO TO 11

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6 Check Glow Plug Relay Coil Ground Circuit	1. Ignition OFF, engine OFF.	
	2. Measure the resistance between the glow plug relay control coil low side terminal and single point ground.	**YES:** GO TO 7
	Is resistance less than 2 ohms?	**NO:** Fix problem. GO TO 11

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7 Check Glow Plug Relay Operation	1. Ignition OFF, engine OFF.	
	2. Disconnect relay high side control terminal from relay stud.	
	3. Attach a fused jumper wire between the glow plug relay battery supply terminal and the relay high side control stud.	
	4. Measure voltage from glow plug relay output terminal to single point ground.	**YES:** Remove jumper wire. GO TO 8
	Is the voltage at relay output within 5V of battery terminal voltage?	**NO:** Replace glow plug relay. GO TO 11

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8 Check Relay Control Wiring	1. Disconnect ECU J01 connector.	
	2. Perform Terminal Test on J01-H4.	
	3. Measure the resistance between ECU J01-H4 and glow plug relay coil high side control terminal.	**YES:** GO TO 9
	Are Terminal Test results good and is resistance less than 2 ohms?	**NO:** Fix problem. GO TO 11

Continued on next page

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9 Reprogram ECU	1. Ignition OFF, engine OFF. 2. Reconnect all connectors except coolant temperature sensor. 3. Download latest ECU payload and reprogram ECU. 4. Clear DTCs. 5. Ignition OFF, engine OFF for 10 seconds. 6. Ignition ON, engine OFF. 7. Refresh DTCs. Did DTC 000676.05 reappear active or stored?	**YES:** GO TO 10 **NO:** Problem fixed. Reconnect coolant temperature sensor and clear DTCs.

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10 Replace ECU	1. Ignition OFF, engine OFF. 2. Replace ECU. 3. Ignition ON, engine OFF. 4. Clear DTCs. 5. Ignition OFF, engine OFF for 10 seconds. 6. Ignition ON, engine OFF. 7. Refresh DTCs. Did DTC 000676.05 reappear active or stored?	**YES:** Open DTAC case. **NO:** Problem fixed. Reconnect coolant temperature sensor and clear DTCs.

JB81757,0000072 -19-21APR10-12/18

11 Verification	1. Ignition OFF, engine OFF. 2. Reconnect all connectors except coolant temperature sensor. 3. Ignition ON, engine OFF. 4. Clear DTCs. 5. Ignition OFF, engine OFF for 10 seconds. 6. Ignition ON, engine OFF. 7. Refresh DTCs. Did DTC 000676.05 reappear active or stored?	**YES:** GO TO 2 **NO:** Problem fixed. Reconnect coolant temperature sensor and clear DTCs.

JB81757,0000072 -19-21APR10-13/18

12 Further Review of Snapshot Information	Review stored information collected in step 1	**YES:** Fix problem if found. GO TO 10
	Does stored information lead to a possible problem or is there a certain operating point where error occurs?	**YES:** If a certain operating point exists when error occurs then GO TO 12 **NO:** GO TO 13

Continued on next page

JB81757,0000072 -19-21APR10-14/18

13 Engine Error Operating Point Test		
	1. Ignition ON, engine ON	
	2. Set engine to operating point of failure and refresh DTCs.	**YES:** GO TO 2
	Did 000676.05 reappear active when engine operating point was reached?	**NO:** GO TO 14

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14 Terminal Test		
	1. Ignition OFF, engine OFF	
	2. Perform Terminal Test on the ECU J01 connector, glow plug relay, and glow plug voltage supply circuit including fuse.	**YES:** Fix problem. GO TO 11
	Were any problems found?	**NO:** GO TO 15

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15 Reconnect and Retest		
	1. Reconnect all connectors except coolant temperature sensor.	
	2. Ignition ON, engine OFF.	
	3. Clear DTCs.	
	4. Ignition OFF, engine OFF for 10 seconds.	
	5. Ignition ON, engine OFF.	
	6. Refresh DTCs.	**YES:** GO TO 2.
	Did 000676.05 reappear active or stored?	**NO:** GO TO 16.

JB81757,0000072 -19-21APR10-17/18

16 Reprogram ECU		
	1. Download latest ECU payload and reprogram ECU.	
	2. Ignition ON, engine OFF.	
	3. Clear DTCs.	
	4. Ignition OFF, engine OFF for 10 seconds.	
	5. Ignition ON, engine OFF.	
	6. Refresh DTCs.	**YES:** GO TO 2
	Did 000676.05 reappear active or stored?	**NO:** Problem fixed or conditions necessary to duplicate 000676.05 not met. Reconnect coolant temperature sensor and clear DTCs.

JB81757,0000072 -19-21APR10-18/18

000100.01 — Engine Oil Pressure Signal Extremely Low

The ECU senses the Engine Oil Pressure to be extremely low.

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000100.01 — Engine Oil Pressure Signal Extremely Low Diagnostic Procedure

Trouble Shooting Sequence:
000100.01
When DTC is Displayed:
When the engine is on and the error is active.

Related Information:

NOTE: The engine oil pressure sensor is an option and must be enabled from the trim option page at the time the ECU is programmed.

NOTE: OEM engines are programmed using trimmable features. The customer had the option to choose an engine shutdown feature. If this feature was programmed into the ECU , the ECU will shut the engine down if this code sets. If the shutdown feature was not selected, a standard derate will be activated.

NOTE: Some applications may be equipped with a oil pressure switch (2 wire device) in place of a sensor (3 wire device). If your application has an oil pressure switch, refer to your applications manual for the troubleshooting procedure for this code.

NOTE: For information on oil pressure values that trigger this fault, see OEM Engines - Derate Specifications in Section 210, later in this manual.

The ECU senses a lower than expected engine oil pressure.
The engine must be running for the code to be set.
The warning value set point is dependent on engine speed.
001569.31 is set when this code is active and engine has not shut down.
001110.31 is set if the shutdown feature is enabled.
001109.31 code is set 30 seconds before the ECU shuts down the engine.

Alarm Level:
STOP

Control Unit Response:
Maximum engine power is derated up to 60 percent.

Additional references:
For further oil pressure sensor information, see Oil Pressure Sensor in Section 03, Group 140, earlier in this manual.
For further pressure sensor information, see Pressure Measurement in Section 03, Group 140 earlier in this manual.
For more information on engine protection, see Engine Derate And Shutdown Protection in Section 03, Group 140 earlier in this manual.

NOTE: The wiring diagrams provided are for a typical John Deere supplied OEM harness. Wire number, colors and jumper connectors do not apply to all applications.

For wiring information see 2.4L-3.0L ECU WIRING DIAGRAM 3 located in Section 06, Group 210 later in this manual.

Flex probe information:
- ECU large terminal - Orange/Green
- ECU small terminal - Orange/Blue
- Oil Pressure Sensor P04B - Purple/Red
- Oil Pressure Interconnect P04A - Purple/Red
- Front Engine Interconnect C35 - Yellow/Purple

For further information on connector and terminal testing or flex probes see Terminal Test in Section 04, Group 160 earlier in this manual.

IMPORTANT: Do not force probes into connector terminals or damage will result. Use JDG10466 Flex Probe Kit to make measurements in connectors. This will ensure that terminal damage does not occur.

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1 Read DTCs and Store Snapshot Information	1. Ignition ON, Engine OFF. *NOTE: When DTCs are cleared Snapshot information for ALL DTCs will also be cleared.* 2. Connect Service ADVISOR, see Connecting To Service ADVISOR in Section 160 earlier in this Group. 3. Write down all DTCs and their occurrence count. If any DTCs have snapshot capture or snapshot recording information, save the information. For instructions on saving and using snapshot information, see Snapshot Instructions in section 160 earlier in this Group. 4. Refresh Codes. Did 000100.01 reappear active?	**YES:** GO TO 2 **NO:** GO TO 16

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2 Measure Engine Oil Pressure With External Gauge	1. Ignition OFF, Engine OFF 2. Attach a pressure gauge to an available gallery hole on the engine. See Engine Oil Pressure Checkin Section 04, Group 150 earlier in this manual. 3. Ignition ON, Engine ON. 4. Record pressure reading from pressure gauge. 5. Monitor the Engine Oil Pressure using Service ADVISOR. *NOTE: Pressure readings can be indicated in Atmosphere or Absolute. To convert from Atmosphere to Absolute, add 14 PSI (100kPa)* Is the pressure gauge value approximately the same as the Service ADVISOR value?	**YES:** Engine oil pressure sensor is OK. Diagnose problem why engine has low oil pressure. Refer to Engine Oil Pressure Low in Section 04, Group 150 earlier in this manual. **YES:** ECU has not been reprogrammed. GO TO 3 **NO:** GO TO 4

DM59778,0000088 -19-31MAY10-4/18

3 Reprogram ECU	1. Ignition OFF, Engine OFF. 2. Download latest ECU software payload and reprogram ECU. See Payload File Downloading Instructions and Engine Control Unit (ECU) — Reprogramming Instructions in Group 04, Section 160 earlier in this manual. 3. Reconnect all connectors and sensors. 4. Monitor DTCs in SERVICE ADVISOR™. 5. Let engine run for 3 minutes and refresh codes. Is 000100.01 still active?	**YES:** Problem not fixed. Diagnose problem why engine has low oil pressure. Refer to Engine Oil Pressure Low in Section 04, Group 150 earlier in this manual. **NO:** Verify problem is fixed. GO TO 15

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4 Terminal Test on Sensor Connector	1. Ignition OFF, Engine OFF.	
	2. Disconnect the engine oil sensor connector P04B.	
	3. Perform Terminal Test on the harness and sensor connector.	
	4. Inspect surrounding area for pinched or melted wires.	
	5. Verify mating terminals do not have loose connections.	**YES:** Repair problem. GO TO 15
	Are there any problems with the wiring or connectors?	**NO:** GO TO 5

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5 Check Oil Pressure Sensor	1. Remove engine oil sensor. See Oil Pressure Sensor — Removal (If Equipped) in Section 02, Group 110 earlier in this manual.	
	2. Inspect engine housing, sensor, and O-ring for defects.	**YES:** Replace defective part. GO TO 15
	Were any defects found?	**NO:** GO TO 6

DM59778,0000088 -19-31MAY10-7/18

6 Oil Pressure Sensor Operation	1. Ignition OFF, Engine OFF.	
	2. With engine oil pressure sensor still removed from engine, reconnect sensor to its harness connector P04B.	
	3. Ignition ON, Engine OFF.	
	4. Monitor the Engine Oil Pressure Input Voltage using Service ADVISOR.	**YES:** Wire harness and sensor OK. Retest application for cause of low engine oil pressure. GO TO 1
	Is the voltage between 0.4 and 0.7 volts?	**NO:** Check harness for high resistance connection. GO TO 7

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7 Terminal Test on Jumper Harness	1. Disconnect oil jumper interconnect harness connectors P04A.	
	2. Perform Terminal Test on both connectors.	
	3. Inspect surrounding area for pinched or melted wires.	
	4. Verify mating terminals do not have loose connections.	**YES:** Repair problem. GO TO 15
	Are there any problems with the wiring or connectors?	**NO:** GO TO 8

Continued on next page

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8 Terminal Test on Interconnect Connector

1. Disconnect front engine interconnect harness connectors C35.
2. Perform Terminal Test on the both connectors.
3. Inspect surrounding area for pinched or melted wires.
4. Verify mating terminals do not have loose connections.

Are there any problems with the wiring or connectors?

YES: Repair problem. GO TO 15

NO: GO TO 9

DM59778,0000088 -19-31MAY10-10/18

9 Terminal Test on ECU Connector

1. Disconnect ECU connector J01.
2. Perform Terminal Test on harness and ECU connectors.
3. Inspect surrounding area for pinched or melted wires.
4. Verify mating terminals do not have loose connections.

Are there any problems with the wiring or connectors?

YES: Repair problem. GO TO 15

NO: GO TO 10

DM59778,0000088 -19-31MAY10-11/18

10 Check ECU

NOTE: Several new DTCs will appear in this step. Ignore all DTCs except for 000100.04

1. Leave ECU connector J01 disconnected from ECU.
2. Ignition ON, Engine OFF.
3. Monitor DTCs from within Service ADVISOR.

Did 000100.04 become active?

YES: Check harness. GO TO 11

NO: Reprogram ECU. GO TO 13

DM59778,0000088 -19-31MAY10-12/18

11 Check For High Resistance in Harness

1. Ignition OFF, Engine OFF.
2. Reconnect harness interconnect connectors C35 and P04A. Disconnect oil pressure connector P04B from oil pressure sensor.
3. On the harness, make the following resistance measurements between ECU connector J01 and the oil pressure sensor connector P04.
   - Return signal form J01-D2 to P04-A.
   - 5 volt power supply signal form J01-F3 to P04-B.
   - Sensor signal form J01-A3 to P04-C.

Were any measurements greater than 10 ohms?

YES: Fix problem in harness. GO TO 15

NO: GO TO 12

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12 Check For Short in Harness

1. Disconnect ECU connector J02.
2. Measure resistance between ECU harness connector J01-A3 and all other terminals on ECU harness connectors J01 and J02.

Were any measurements less than 100 ohms?

YES: Fix shorted wires in harness. GO TO 15

NO: GO TO 13

Continued on next page

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13 Replace Sensor	Has oil pressure sensor been replaced?	**YES:** Check ECU. GO TO 14 **NO:** Replace oil pressure sensor. GO TO 15

DM59778,0000088 -19-31MAY10-15/18

14 Reprogram ECU	*NOTE: Several new DTCs will appear in this step. Ignore all DTCs except for 000100.04* 1. Ignition OFF, Engine OFF. 2. Reconnect ECU connector J02. Leave ECU connector J01 disconnected. 3. Download latest ECU software payload and reprogram ECU. See Payload File Downloading Instructions and Engine Control Unit (ECU) — Reprogramming Instructions in Group 04, Section 160 earlier in this manual. 4. Ignition ON, Engine OFF. 5. Monitor DTCs in Service ADVISOR. Is 000100.04 active?	 **YES:** Verify problem is fixed. GO TO 15 **NO:** Replace ECU. See Engine Control Unit (ECU) — Removal in Group 02, Section 110 earlier in this manual. GO TO 15

DM59778,0000088 -19-31MAY10-16/18

15 Verification	1. Ignition OFF, Engine OFF. 2. Reconnect all connectors, hoses, sensors, etc. 3. Ignition ON, Engine ON. 4. Monitor DTCs in Service ADVISOR. 5. Refresh DTCs. 6. Operate engine through normal speed and load. Did DTC 000100.01 reappear as active with engine running?	 **YES:** Problem not found. Recheck wiring, connectors, and engine operation. GO TO 1 **NO:** Problem fixed.

DM59778,0000088 -19-31MAY10-17/18

16 Review Snapshot Information	1. Retrieve snapshot information, see Snapshot Instructions in Section 160 earlier in this Group. 2. Review all stored codes. Does information relate to a possible intermittent or operating condition causing the code to become active. 3. Review information to see if you can determine a possible problem or the operating point that causes the code to become active. Did you find a possible problem or the operating point at which the code becomes active?	 **YES:** Found a possible problem. Repair possible problem. Retest. **YES:** Found operating point at which the code becomes active. GO TO 2 **NO:** Start DTAC case.

DM59778,0000088 -19-31MAY10-18/18

000100.04 — Engine Oil Pressure Signal Out of Range Low

The engine oil pressure input voltage drops below the sensor's low voltage specification.

DN22556,00006C1 -19-24SEP10-1/20

000100.04 — Engine Oil Pressure Signal Out of Range Low Diagnostic Procedure

Troubleshooting Sequence:
003510.04
000100.04

When DTC is Displayed:
When ever the ignition is on and the error is active.

Related Information:
The oil pressure input voltage drops below the sensor's low voltage specification. The voltage corresponds to a pressure that is lower than what is physically possible for oil pressure.

Alarm Level:
Warning

Control Unit Response:
The ECU will try to maintain the engine operating envelope.

Additional References:
For more engine oil pressure sensor information, see Oil Pressure Sensor in Section 03, Group 140 earlier in this manual.

For more pressure sensor information, see Pressure Measurement in Section 03, Group 140 earlier in this manual.

NOTE: The wiring diagrams provided are for a typical John Deere supplied OEM harness. Wire number, colors, and jumper connectors do not apply to all applications.

For wiring information:
- see 2.4L/3.0L ECU WIRING DIAGRAM 3
located in Section 06, Group 210 later in this manual.

IMPORTANT: Do not force probes into connector terminals or damage will result. Use JDG10466 Connector Adapter Test Kit to make measurements in connectors. This will ensure that terminal damage does not occur.

Flex probe information:
- ECU large terminal - Orange/Green
- ECU small terminal - Orange/Blue
- Oil pressure sensor P04B - Purple/Red
- Oil pressure interconnect P04A - Purple/Red
- Front engine interconnect C35- Yellow/Purple

For more information on connector and terminal testing see Terminal Test in Section 04, Group 150 earlier in this manual.

IMPORTANT: When directed to run the Harness Diagnostic Mode Test the engine temperature should be above freezing. It is recommended that the engine temperature be at least room temperature 20° C (68° F). This test is located in Service ADVISOR.

IMPORTANT: If you are working on an application with an oil pressure switch see the application manual for troubleshooting procedures.

Continued on next page

DN22556,00006C1 -19-24SEP10-2/20

1 Read DTCs and Store Snapshot Information	1. Ignition ON, engine OFF. *NOTE: When DTCs are cleared Snapshot information for ALL DTCs will be cleared.* 2. Connect Service ADVISOR, see Connecting To Service ADVISOR in Group 160 earlier in this Section. 3. Write down all DTCs and their occurrence count. If any DTCs have snapshot capture or snapshot recording information, save the information. For instructions on saving and using snapshot information, see Snapshot Instructions in Group 160 earlier in this Section. 4. Refresh Codes. Did 000100.04 reappear active?	**YES:** GO TO 2 **NO:** GO TO 12

DN22556,00006C1 -19-24SEP10-3/20

2 Test Sensor Connector	1. Ignition OFF, Engine OFF 2. Disconnect the engine oil pressure harness connector P04B. 3. Perform Terminal Test on P04B. Were any problems found?	**YES:** Repair problem. Run Harness Diagnostic Mode Test. **NO:** GO TO 3

DN22556,00006C1 -19-24SEP10-4/20

3 Test Sensor for Signal Terminal Short to Ground	On the oil pressure sensor make the following resistance checks: • between P04B-C and chassis ground. • between P04B-A and P04B-C. Was either resistance value less than 100 ohms?	**YES:** Replace sensor. Run Harness Diagnostic Mode Test. **NO:** GO TO 4

DN22556,00006C1 -19-24SEP10-5/20

4 Test for Harness Wire-to-Wire Short	On the harness, measure the resistance between oil pressure sensor P04B-A and P04B-C. Was the resistance less than 100 ohms?	**YES:** GO TO 5 **NO:** GO TO 12

DN22556,00006C1 -19-24SEP10-6/20

5 Test Oil Pressure Interconnect Connector	1. Disconnect the oil pressure interconnect connector P04A. 2. Perform Terminal Test on P04A. Were any problems found?	**YES:** Repair problem. Run Harness Diagnostic Mode Test. **NO:** GO TO 6

Continued on next page

DN22556,00006C1 -19-24SEP10-7/20

6 Test for Harness Wire-to-Wire Short With Oil Pressure Interconnect Disconnected	On the harness connector with male terminals, measure the resistance between oil pressure interconnect P04A-A and P04A-C.	**YES:** GO TO 7
	Was the resistance less than 100 ohms?	**NO:** Repair short in wiring between oil pressure interconnect P04A and oil pressure sensor connector P04B. Run Harness Diagnostic Mode Test.

DN22556,00006C1 -19-24SEP10-8/20

7 Test Front Engine Interconnect Connector	1. Disconnect the front engine interconnect connector C35.	
	2. Perform Terminal Test on C35.	**YES:** Repair short in wiring between the oil pressure interconnect P04A and front engine interconnect C35. Run Harness Diagnostic Mode Test.
	Were any problems found?	**NO:** GO TO 8

DN22556,00006C1 -19-24SEP10-9/20

8 Test for Harness Wire-to-Wire Short With Front Engine Interconnect Disconnected	On the harness connector with male terminals, measure the resistance between front engine interconnect C35-4 and C35-8.	**YES:** GO TO 9
	Was the resistance less than 100 ohms?	**NO:** Repair short in wiring between the oil pressure interconnect P04A and front engine interconnect C35. Run Harness Diagnostic Mode Test.

DN22556,00006C1 -19-24SEP10-10/20

9 Test ECU Connector	1. Disconnect ECU J01 connector.	
	2. Perform Terminal Test on J01.	**YES:** Repair problem. Run Harness Diagnostic Mode Test.
	Were any problems found?	**NO:** GO TO 10

Continued on next page

DN22556,00006C1 -19-24SEP10-11/20

10 Test for Harness Wire-to-Wire Short With ECU Disconnected	On the harness connector with male terminals, measure the resistance between front engine interconnect C35-8 and C35-4..	**YES:** Repair wiring between ECU J01 and front engine interconnect C35. Run Harness Diagnostic Mode Test.
	Was the resistance less than 100 ohms?	**NO:** GO TO 11

DN22556,00006C1 -19-24SEP10-12/20

11 ECU Circuit Check	On the ECU, measure the resistance between J01-A3 and J01-D2.	**YES:** Reconnect all connectors, GO TO 2, verify measurements looking closely at the wiring and connectors.
	Was the value between 128k and 172k ohms.	**NO:** Replace ECU. GO TO 1

DN22556,00006C1 -19-24SEP10-13/20

12 Occurrence Count Check	Review stored information and look at occurrence count for 000100.04.	**YES:** GO TO 13
	Is occurrence recorded in step 1 greater than 5?	**NO:** GO TO 14

DN22556,00006C1 -19-24SEP10-14/20

13 Terminal Test	1. Ignition OFF, Engine OFF	
	2. Disconnect engine oil pressure sensor connector P04A, P04B, and C35.	
	3. Perform Terminal Test on P04A, P04B, and C35.	**YES:** Repair problem. Run Harness Diagnostic Mode Test.
	Were any problems found?	**NO:** GO TO 14

DN22556,00006C1 -19-24SEP10-15/20

14 Further Review of Snapshot Information	Review stored information collected in step 1.	**YES:** Repair problem if found.
	Does stored information lead to a possible problem or is there a certain operating point where error occurs?	**YES:** If a certain operating point exists when error occurs GO TO 15 **NO:** GO TO 16

DN22556,00006C1 -19-24SEP10-16/20

15 Engine Error Operating Point Test	1. Reconnect all connectors.	
	2. Ignition ON, Engine ON	
	3. Set engine to operating point of failure and refresh codes	**YES:** GO TO 1
	Did 000100.04 reappear when engine operating point was reached?	**NO:** GO TO 14 and confirm operating point.

Continued on next page

DN22556,00006C1 -19-24SEP10-17/20

16 Terminal Test		
	1. Ignition OFF, Engine OFF	
	2. Perform Terminal Test on the ECU J01 connector.	**YES:** Repair problem, Run Harness Diagnostic Mode Test in Service ADVISOR.
	Were any problems found?	**NO:** GO TO 17

DN22556,00006C1 -19-24SEP10-18/20

17 Reconnect and Retest		
	1. Reconnect all connectors.	
	2. Ignition ON, Engine OFF.	
	3. Run Harness Diagnostic Mode Test.	
	4. Refresh codes.	**YES:** GO TO 1
	Is 000100.04 active?	**NO:** GO TO 18

DN22556,00006C1 -19-24SEP10-19/20

18 Software Updates		
	1. Download latest ECU software payload and reprogram ECU using Service ADVISOR.	
	2. Run Harness Diagnostic Mode Test.	**YES:** Replace oil pressure sensor, Run Harness Diagnostic Mode Test.
	Is 000100.04 active?	**NO:** Problem fixed, bad ECU program.

DN22556,00006C1 -19-24SEP10-20/20

000100.18 — Engine Oil Pressure Signal Moderately Low

The ECU senses an oil pressure below the warning value set point in the ECU.

DN22556,00006C4 -19-24SEP10-1/12

000100.18 — Engine Oil Pressure Signal Moderately Low Diagnostic Procedure

Trouble Shooting Sequence:
000100.18

When DTC is Displayed:
When the engine is running and the error is active.

Related Information:
The ECU senses a lower than expected engine oil pressure.
The warning value set point is dependent on engine speed.
001569.31 is also set when this code is active.

Alarm Level:
Warning

Control Unit Response:
Maximum engine power is derated up to 20 percent.

Additional references:
For more oil pressure sensor information, see Oil Pressure Sensor in Section 03, Group 140, earlier in this manual.
For more pressure sensor information, see Pressure Measurement in Section 03, Group 140 earlier in this manual.
For more information on engine protection, see Engine Derate And Shutdown Protection in Section 03, Group 140 earlier in this manual.

NOTE: The wiring diagrams provided are for a typical John Deere supplied OEM harness. Wire number, colors and jumper connectors do not apply to all applications.

For wiring information:
- see 2.0L/3.0L ECU WIRING DIAGRAM 3
located in Section 06, Group 210 later in this manual.

IMPORTANT: Do not force probes into connector terminals or damage will result. Use JDG10466 Connector Adapter Test Kit to make measurements in connectors. This will ensure that terminal damage does not occur.

Flex probe information:
- ECU large terminal - Orange/Green
- ECU small terminal - Orange/Blue

For more information on connector and terminal testing see Terminal Test in Section 04, Group 150 earlier in this manual.

IMPORTANT: When directed to run the Harness Diagnostic Mode Test the engine temperature should be above freezing. It is recommended that the engine temperature be at least room temperature 20° C (68° F). This test is located in Service ADVISOR.

IMPORTANT: If you are working on an application with an oil pressure switch see the application manual for troubleshooting procedures.

Continued on next page

DN22556,00006C4 -19-24SEP10-2/12

1 Read DTCs and Store Snapshot Information

1. Ignition ON, Engine OFF.

NOTE: When DTCs are cleared Snapshot information for ALL DTCs will be cleared.

2. Connect Service ADVISOR, see Connecting To Service ADVISOR in Group 160 earlier in this Section.
3. Write down all DTCs and their occurrence count. If any DTCs have snapshot capture or snapshot recording information, save the information. For instructions on saving and using snapshot information, see Snapshot Instructions in Group 160 earlier in this Section.
4. Refresh Codes.

Did 000100.18 reappear active?

YES: GO TO 2

NO: GO TO 10

DN22556,00006C4 -19-24SEP10-3/12

2 Measure Engine Oil Pressure With External Gauge

1. Ignition OFF, Engine OFF.
2. Attach a pressure gauge to an available gallery hole on the engine. See Engine Oil Pressure Check in Group 155 earlier in this Section.
3. Ignition ON, Engine ON.
4. Record pressure reading from pressure gauge.
5. Monitor the Engine Oil Pressure data point.

Is the pressure gauge value within ±34 kPa (5 psi) of the data point reading?

YES: Engine oil pressure sensor is OK. See Engine Oil Pressure Low in Group 155 earlier in this Section.

NO: GO TO 3

DN22556,00006C4 -19-24SEP10-4/12

3 Terminal Test

1. Ignition OFF, Engine OFF.
2. Disconnect the engine oil pressure sensor connector.
3. Perform Terminal Test on the harness and sensor connector.

Were any problems found?

YES: Repair problem. GO TO 9

NO: GO TO 4

DN22556,00006C4 -19-24SEP10-5/12

4 Check Oil Pressure Sensor

1. Remove engine oil pressure sensor. See Oil Pressure Sensor — Removal (If Equipped) in Section 02, Group 110.
2. Inspect engine housing, sensor housing, and O-ring for defects.

Were any defects found?

YES: Replace defective part. GO TO 9

NO: GO TO 5

Continued on next page

DN22556,00006C4 -19-24SEP10-6/12

5 Oil Pressure Sensor Operation	1. Ignition OFF, Engine OFF.	
	2. With engine oil pressure sensor still removed from engine, reconnect connector.	
	3. Ignition ON, Engine OFF.	**YES:** Wire harness and sensor OK. Reinstall oil pressure sensor. GO TO 1
	4. Monitor the Engine Oil Pressure Input Voltage data point.	**NO:** Engine oil pressure sensor already been replaced. GO TO 6
	Is voltage between 0.3 and 0.7 volts?	**NO:** Replace engine oil pressure sensor. GO TO 9

DN22556,00006C4 -19-24SEP10-7/12

6 Check Harness	*NOTE: Several new DTCs will appear in this step. Ignore all DTCs except for 000100.04*	
	1. Ignition OFF, Engine OFF.	
	2. Disconnect ECU connector J01.	
	3. Ignition ON, Engine OFF.	
	4. Monitor the DTC codes from within Service ADVISOR.	**YES:** Problem in harness. Perform Terminal Test on ECU connector J01. Diagnose and fix harness problem. GO TO 8
	Did 000100.04 become active?	**NO:** Problem with ECU. GO TO 8

DN22556,00006C4 -19-24SEP10-8/12

7 Test ECU Terminals	1. Ignition OFF, Engine OFF.	
	2. Disconnect ECU J01 connector.	
	3. Perform Terminal Test on J01.	**YES:** Repair problem. GO TO 9
	Were any problems found?	**NO:** GO TO 8

DN22556,00006C4 -19-24SEP10-9/12

8 Reprogram ECU	1. Download latest ECU software payload and reprogram ECU. See Engine Control Unit (ECU) — Reprogramming Instructions in Group 160 earlier in this Section.	
	2. Reconnect all connectors and sensors.	
	3. Monitor DTCs in Service ADVISOR.	
	4. Ignition ON, Engine ON.	**YES:** Replace ECU. GO TO 9
	Is 000100.18 still active?	**NO:** Verify problem is fixed. GO TO 9

Continued on next page

DN22556,00006C4 -19-24SEP10-10/12

9 Verification	1. Ignition OFF, Engine OFF.	
	2. Reconnect all connectors, hoses, sensors, etc.	
	3. Ignition ON, Engine ON.	
	4. Monitor DTCs in Service ADVISOR.	
	5. Refresh DTCs.	
	6. Operate engine through normal speed and load (if possible).	**YES:** Problem not found. Recheck wiring, connectors, and engine operation. GO TO 1
	Did DTC 000100.18 reappear as active with engine running?	**NO:** Problem fixed.

DN22556,00006C4 -19-24SEP10-11/12

10 Review Snapshot Information	1. Retrieve snapshot information, see Snapshot Instructions earlier in this Group.	
	2. Review all stored codes. Does information relate to a possible intermittent or operating condition causing the code to become active.	**YES:** Found a possible problem. Repair possible problem. GO TO 1.
	3. Review information to see if you can determine a possible problem or the operating point that causes the code to become active.	**YES:** Found operating point at which the code becomes active. GO TO 2
	Did you find a possible problem or the operating point at which the code becomes active?	**NO:** Start DTAC case.

DN22556,00006C4 -19-24SEP10-12/12

000100.31 — Engine Oil Pressure is not Zero with Engine Stopped

The ECU receives an engine oil pressure when engine speed is zero.

DN22556,00006C2 -19-24SEP10-1/14

000100.31 — Engine Oil Pressure is not Zero with Engine Stopped Diagnostic Procedure

Trouble Shooting Sequence:
000100.31

When DTC is Displayed:
When the ignition is on, engine off, and the error is active.

Related Information:
The ECU senses an engine oil pressure when engine is not running.

Alarm Level:
Warning

Control Unit Response:
The ECU will try to maintain the engine operating envelope.

Additional references:
For more oil pressure sensor information, see Oil Pressure Sensor in Section 03, Group 140, earlier in this manual.
For more pressure sensor information, see Pressure Measurement in Section 03, Group 140 earlier in this manual.

NOTE: The wiring diagrams provided are for a typical John Deere supplied OEM harness. Wire number, colors and jumper connectors do not apply to all applications.

For wiring information:
- see 2.4L/3.0L ECU WIRING DIAGRAM 3
located in Section 06, Group 210 later in this manual.

IMPORTANT: Do not force probes into connector terminals or damage will result. Use JDG10466 Connector Adapter Test Kit to make measurements in connectors. This will ensure that terminal damage does not occur.

Flex probe information:
- ECU large terminal - Orange/Green
- ECU small terminal - Orange/Blue
- Oil pressure sensor P04B - Purple/Red
- Oil pressure interconnect P04A - Purple/Red
- Front engine interconnect C35- Yellow/Purple

For more information on connector and terminal testing see Terminal Test in Section 04, Group 150 earlier in this manual.

IMPORTANT: When directed to run the Harness Diagnostic Mode Test the engine temperature should be above freezing. It is recommended that the engine temperature be at least room temperature 20° C (68° F). This test is located in Service ADVISOR.

IMPORTANT: If you are working on an application with an oil pressure switch see the application manual for troubleshooting procedures.

Continued on next page

DN22556,00006C2 -19-24SEP10-2/14

1 Read DTCs and Store Snapshot Information

1. Ignition ON, Engine OFF.

NOTE: When DTCs are cleared Snapshot information for ALL DTCs will be cleared.

2. Connect Service ADVISOR, see Connecting To Service ADVISOR earlier in this Group.
3. Write down all DTCs and their occurrence count. If any DTCs have snapshot capture or snapshot recording information, save the information. For instructions on saving and using snapshot information, see Snapshot Instructions in Group 160 earlier in this Section.
4. Refresh Codes.

Did 000100.31 reappear active?

YES: GO TO 2
NO: GO TO 11

DN22556,00006C2 -19-24SEP10-3/14

2 Test Engine Oil Pressure Sensor Connector

1. Ignition OFF, Engine OFF.
2. Disconnect the engine oil pressure sensor connector P04B.
3. Perform Terminal Test on P04B.

Were any problems found?

YES: Repair problem. GO TO 11
NO: GO TO 3

DN22556,00006C2 -19-24SEP10-4/14

3 Check Oil Pressure Sensor Ground Wire

1. Ignition OFF, Engine OFF.
2. Measure the resistance from oil pressure sensor P04B-A to single point ground.

Is the resistance less than 5 ohms?

YES: GO TO 11
NO: GO TO 4

DN22556,00006C2 -19-24SEP10-5/14

4 Test Engine Oil Pressure Interconnect Connector

1. Disconnect the oil pressure interconnect connector P04A.
2. Perform Terminal Test on both sides of P04A.

Were any problems found?

YES: Repair problem. GO TO 11
NO: GO TO 5

DN22556,00006C2 -19-24SEP10-6/14

5 Ground Wire-to-Wire Check, Oil Pressure Interconnect to Oil Pressure Sensor Connector

On harness, measure resistance between female P04A-A and Female P04B-A.

Is the resistance less than 5 ohms?

YES: GO TO 6
NO: Repair open wire between P04A-A and P04B-4. GO TO 11

Continued on next page

DN22556,00006C2 -19-24SEP10-7/14

6 Test Front Engine Interconnect Connector	1. Disconnect the front engine interconnect connector C35.	
	2. Perform Terminal Test on both sides of C35.	**YES:** Repair problem. GO TO 11
	Were any problems found?	**NO:** GO TO 7

DN22556,00006C2 -19-24SEP10-8/14

7 Ground Wire-to-Wire Check, Oil Pressure Interconnect to Front Engine Interconnect	On harness, measure resistance between male P04A-A and Female C35-4.	**YES:** GO TO 8
	Is the resistance less than 5 ohms?	**NO:** Repair open wire between P04A-A and C35-4. GO TO 11

DN22556,00006C2 -19-24SEP10-9/14

8 Test ECU Connector Terminals	1. Disconnect the ECU connector J01.	
	2. Perform Terminal Test on J01.	**YES:** Repair problem. GO TO 11
	Were any problems found?	**NO:** GO TO 9

DN22556,00006C2 -19-24SEP10-10/14

9 Ground Wire-to-Wire Check, Front Engine Interconnect to ECU	On harness, measure resistance between male C35-4 and J01-D2.	**YES:** GO TO 10
	Is the resistance less than 5 ohms?	**NO:** Repair open wire between P04A-A and C35-4. GO TO 11

DN22556,00006C2 -19-24SEP10-11/14

10 ECU Circuit Check	1. Disconnect ECU J02.	
	2. On the ECU, measure the resistance between J01-D2 and J02-L2.	**YES:** GO TO 11
	Is the resistance less than 5 ohms?	**NO:** Replace and Reprogram ECU. GO TO 11

Continued on next page

DN22556,00006C2 -19-24SEP10-12/14

11 Verification	1. Ignition OFF, Engine OFF.	
	2. Reconnect all connectors.	
	3. Ignition ON, Engine OFF.	
	4. Monitor DTCs in Service ADVISOR, see Connecting To Service ADVISOR.	
	5. Refresh DTCs.	**YES:** Problem not found or caused another problem. Recheck wiring and connectors. GO TO 1
	Did DTC 000100.31 reappear as active or did any codes that were not recorded in step 1 become active?	**NO:** Problem fixed.

DN22556,00006C2 -19-24SEP10-13/14

12 Review Snapshot Information	1. Retrieve snapshot information, see Snapshot Instructions earlier in this Group.	
	2. Review all stored codes. Does information relate to a possible intermittent or operating condition causing the code to become active.	**YES:** Found a possible problem. Repair possible problem. Retest.
	3. Review information to see if you can determine a possible problem or the operating point that causes the code to become active.	**YES:** Found operating point at which the code becomes active. GO TO 1
	Did you find a possible problem or the operating point at which the code becomes active?	**NO:** Start DTAC case.

DN22556,00006C2 -19-24SEP10-14/14

000110.00 — Engine Coolant Temperature Signal Extremely High

The ECU senses a coolant temperature that is extremely high.

DM59778,0000085 -19-31MAY10-1/17

000110.00 — Engine Coolant Temperature Signal Extremely High Diagnostic Procedure

Troubleshooting Sequence:
000110.00

When DTC is Displayed:
When the engine has been running 3 minutes and the error is active

Related Information:

NOTE: OEM engines are programmed using trimmable features. The customer had the option to choose an engine shutdown feature. If this feature was programmed into the ECU , the ECU will shut the engine down if this code sets. If the shutdown feature was not selected, a standard derate will be activated.

NOTE: For information on temperature values that trigger this fault, see OEM Engines - Derate Specifications in Group 06, Section 210 later in this manual.

The engine has to be running for 3 minutes before the code is set.
001569.31 is set when this code is active and engine has not shut down.
001109.31 is set 30 seconds before the ECU shuts down the engine.
001110.31 is set if the shutdown feature is enabled.

Alarm Level:
STOP

Control Unit Response:
Maximum engine power is derated up to 60 percent.

Additional References:
For further temperature sensor information, see Temperature Measurement in Section 03, Group 140 earlier in this manual.
For further coolant temperature sensor information, see Engine Coolant Temperature (ECT) Sensor in Section 03, Group 140 earlier in this manual
For more information on engine protection, see Engine Derate And Shutdown Protection in Section 03, Group 140 earlier in this manual.

NOTE: The wiring diagrams provided are for a typical John Deere supplied OEM harness. Wire number, colors and jumper connectors do not apply to all applications.

For wiring information see 2.4L/3.0L ECU WIRING DIAGRAM 3 located in Section 06, Group 210 later in this manual.

Flex probe information:
- ECU large terminal - Orange/Green
- ECU small terminal - Orange/Blue
- Coolant temperature sensor T04 - Purple/Red
- Front Engine Interconnect C35 - Yellow/Purple

For further information on connector and terminal testing or flex probes see Terminal Test in Section 04, Group 160 earlier in this manual.

IMPORTANT: Do not force probes into connector terminals or damage will result. Use JDG10466 Flex Probe Kit to make measurements in connectors. This will ensure that terminal damage does not occur.

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DM59778,0000085 -19-31MAY10-2/17

1 Read DTCs and Store Snapshot Information

1. Ignition ON, Engine OFF.

NOTE: When DTCs are cleared Snapshot information for ALL DTCs will be cleared.

2. Connect Service ADVISOR, see Connecting To Service ADVISOR in Section 160 earlier in this Group.
3. Ignition ON, Engine ON.
4. Let engine idle for 3 minutes before proceeding.
5. Write down all DTCs and their occurrence count. If any DTCs have snapshot capture or snapshot recording information, save the information. For instructions on saving and using snapshot information, see Snapshot Instructions in Section 160 earlier in this Group.
6. Refresh Codes.

Did 000110.00 reappear active?

YES: GO TO 2

NO: GO TO 15

DM59778,0000085 -19-31MAY10-3/17

2 Preliminary Check of Cooling System

Visually inspect cooling system components.

- Remove any blockage on or near radiator.
- Inspect radiator hoses for signs of leakage or cracks.
- Check radiator coolant is filled to proper level.
- Inspect cooling fan shroud for damage.
- Inspect radiator cap for failure.
- Loose cooling fan belt. See Belt Tensioner — Spring Tension And Belt Wear (Automatic Tensioner) Check in Section 02, Group 070 earlier in this manual.
- Malfunctioning cooling fan. See Fan Assembly — Inspection in Section 02, Group 070 earlier in this manual.
- Inspect Thermostat. See Thermostat — Removal in Section 02, Group 070 earlier in this manual.
- Excessively high ambient air temperature.

Were any problems found?

YES: Fix problem(s). GO TO 14

NO: GO TO 3

DM59778,0000085 -19-31MAY10-4/17

3 Terminal Test on Sensor Connector

1. Ignition OFF, Engine OFF.
2. Disconnect coolant temperature sensor connector T04.
3. Perform Terminal Test on the harness and sensor connectors.
4. Inspect surrounding area for pinched or melted wires.

Are there any problems with the wiring or connectors?

YES: Repair problem. GO TO 14

NO: GO TO 4

DM59778,0000085 -19-31MAY10-5/17

4 Check Coolant Temperature Sensor

1. Remove coolant temperature sensor. See Coolant Temperature Sensor — Removal in Section 02, Group 110 earlier in this manual.
2. Inspect engine housing, sensor, and O-ring for defects.

Were any defects found?

YES: Replace defective part. GO TO 14

NO: GO TO 5

Continued on next page

DM59778,0000085 -19-31MAY10-6/17

5 Check Coolant Temperature Sensor Operation

1. With coolant sensor removed from engine, reconnect coolant temperature sensor to its harness connector T04.
2. Ignition ON, Engine OFF.
3. Place senor in water to cool it down to ambient temperature.
4. Record the coolant temperature value from within Service ADVISOR.
5. Place the sensor in hot water and record the temperature with a thermometer.
6. Record the coolant temperature value from within Service ADVISOR.

Does the sensor reading closely match the ambient temperature and that of the thermometer?

YES: Coolant temperature sensor is OK. Diagnose engine cooling system. GO TO 6

NO: Check harness. GO TO 8

DM59778,0000085 -19-31MAY10-7/17

6 Check for Engine Related Causes

Check the following items that can cause high coolant temperature:

- Inspect cooling system. See CHECK AND SERVICE COOLING SYSTEM in Section 04, Group 150 earlier in this manual.
- Inspect cooling system components. See Engine Overheating in Section 04, Group 150 earlier in this manual.

Was cause of high coolant temperature determined?

YES: Repair problem. GO TO 13

NO: ECU has not been reprogrammed. GO TO 7

NO: Problem not fixed. Verify cooling system and related parameters are functioning properly. GO TO 1

DM59778,0000085 -19-31MAY10-8/17

7 Reprogram ECU

1. Ignition OFF, Engine OFF.
2. Reconnect all connectors and sensors.
3. Download latest ECU software payload and reprogram ECU. See Payload File Downloading Instructions and Engine Control Unit (ECU) — Reprogramming Instructions in Group 04, Section 160 earlier in this manual.
4. Monitor DTCs in Service ADVISOR.
5. Let engine run for 3 minutes and refresh codes.

Is 000110.00 still active?

YES: Problem not fixed. Verify cooling system and related parameters are functioning properly. GO TO 1

NO: Verify problem is fixed. GO TO 14

Continued on next page

DM59778,0000085 -19-31MAY10-9/17

8 Terminal Test on Interconnect Connector

1. Ignition OFF, Engine OFF.
2. Disconnect front engine interconnect harness connector C35.
3. Perform Terminal Test on the front engine interconnect connectors.
4. Inspect surrounding area for pinched or melted wires.

Are there any problems with the wiring or connectors?

YES: Repair problem. GO TO 14

NO: GO TO 9

DM59778,0000085 -19-31MAY10-10/17

9 Terminal Test on ECU Connector

1. Disconnect ECU J01 connector.
2. Perform Terminal Test on harness and ECU connector J01.
3. Inspect surrounding area for pinched or melted wires.

Are there any problems with the wiring or connectors?

YES: Repair problem. GO TO 14

NO: GO TO 10

DM59778,0000085 -19-31MAY10-11/17

10 Check Harness

NOTE: Several new DTCs will appear in this step. Ignore all DTCs except for 000110.03

1. ECU connector J01 disconnected from ECU.
2. Ignition ON, Engine OFF.
3. Monitor the DTC codes from within Service ADVISOR.

Did 000110.03 become active?

YES: Check for short in harness. GO TO 11

NO: Replace Sensor. GO TO 12

DM59778,0000085 -19-31MAY10-12/17

11 Check For Short in Harness

1. Ignition OFF, Engine OFF.
2. Disconnect ECU connector J02.
3. Disconnect coolant temperature sensor connector T04 from coolant temperature sensor.
4. Reconnect harness interconnect connectors C35.
5. On harness, measure resistance between ECU connector J01-C4 and all other terminals on ECU harness connectors J01 and J02.

Were any measurements less than 100 ohms?

YES: Fix shorted wires in harness. GO TO 14

NO: GO TO 12

DM59778,0000085 -19-31MAY10-13/17

12 Replace Sensor

Has coolant temperature sensor been replaced?

YES: Check ECU. GO TO 13

NO: Replace coolant temperature sensor. GO TO 14

Continued on next page

DM59778,0000085 -19-31MAY10-14/17

13 Reprogram ECU	*NOTE: Several new DTCs will appear in this step. Ignore all DTCs except for 000110.03*	
	1. Ignition OFF, Engine OFF.	
	2. Reconnect ECU connector J02. Leave ECU connector J01 disconnected.	
	3. Download latest ECU software payload and reprogram ECU. See Payload File Downloading Instructions and Engine Control Unit (ECU) — Reprogramming Instructions in Group 04, Section 160 earlier in this manual.	
	4. Ignition ON, Engine OFF.	
	5. Monitor DTCs in SERVICE ADVISOR™.	**YES:** Verify problem is fixed. GO TO 14
	Is 000110.03 active?	**NO:** Replace ECU. See Engine Control Unit (ECU) — Removall and Engine Control Unit (ECU) — Installation in Group 02, Section 110 earlier in this manual. GO TO 14

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DM59778,0000085 -19-31MAY10-15/17

14 Verification	1. Ignition OFF, Engine OFF.	
	2. Reconnect all connectors, hoses, sensors, etc.	
	3. Ignition ON, Engine ON.	
	4. Monitor DTCs in Service ADVISOR.	
	5. Let engine run for 5 minutes.	
	6. Operate engine through normal speed and load.	
	7. Refresh DTCs.	**YES:** GO TO 1
	Did DTC 000110.00 reappear as active with engine running?	**NO:** Problem fixed.

DM59778,0000085 -19-31MAY10-16/17

15 Review Snapshot Information	1. Retrieve snapshot information, see Snapshot Instructions in Section 160 earlier in this Group.	
	2. Review all stored codes. Does information relate to a possible intermittent or operating condition causing the code to become active.	**YES:** Found a possible problem. Repair possible problem. Retest.
	3. Review information to see if you can determine a possible problem or the operating point that causes the code to become active.	**YES:** Found operating point at which the code becomes active. GO TO 2
	Did you find a possible problem or the operating point at which the code becomes active?	**NO:** Start DTAC case.

DM59778,0000085 -19-31MAY10-17/17

000110.03 — Engine Coolant Temperature Signal Out of Range High

The engine coolant temperature input voltage exceeds the sensor's high voltage specification.

JL45346,0000049 -19-31MAY10-1/18

000110.03 — Engine Coolant Temperature Signal Out of Range High Diagnostic Procedure

Troubleshooting Sequence:
000110.03

When DTC is Displayed:
When ever the ignition is on and the error is active.

Related Information:
The engine coolant temperature input voltage increases above the sensor's high voltage specification. This corresponds to a temperature that is lower than what is physically possible for engine coolant temperature.

Alarm Level:
Warning

Control Unit Response:
The ECU uses a default engine coolant temperature of 90° C (194° F).
The ECU will try to maintain the engine operating envelope.

Additional References:
For more engine coolant temperature sensor information, see Engine Coolant Temperature (ECT) Sensor in Section 03, Group 140 earlier in this manual.

For more temperature sensor information, see Temperature Measurement in Section 03, Group 140 earlier in this manual.

NOTE: The wiring diagrams provided are for a typical John Deere supplied OEM harness. Wire number, colors, and jumper connectors do not apply to all applications.

For wiring information:
- see 2.4L 12V ECU WIRING DIAGRAM 3
- see 2.4L 24V ECU WIRING DIAGRAM 3
- see 3.0L 12V ECU WIRING DIAGRAM 3
- see 3.0L 24V ECU WIRING DIAGRAM 3

located in Section 06, Group 210 later in this manual.

For more information on connector and terminal testing see Terminal Test in Section 04, Group 160 earlier in this manual.

IMPORTANT: When directed to run the Harness Diagnostic Mode Test the engine temperature should be above freezing. It is recommended that the engine temperature be at least room temperature 20° C (68° F). This test is located in Service ADVISOR.

IMPORTANT: Do not force probes into connector terminals or damage will result. Use JT07328 Connector Adapter Test Kit to make measurements in connectors. This will ensure that terminal damage does not occur.

Continued on next page

JL45346,0000049 -19-31MAY10-2/18

1 Read DTCs and Store Snapshot Information	1. Ignition ON, engine OFF. *NOTE: When DTCs are cleared Snapshot information for ALL DTCs will be cleared.* 2. Connect Service ADVISOR, see Connecting To Service ADVISOR earlier in this Group. 3. Write down all DTCs and their occurrence count. If any DTCs have snapshot capture or snapshot recording information, save the information. For instructions on saving and using snapshot information, see Snapshot Instructions earlier in this Group. 4. Refresh Codes. Did 000110.03 reappear active?	**YES:** GO TO 2 **NO:** GO TO 10

JL45346,0000049 -19-31MAY10-3/18

2 Terminal Test	1. Ignition OFF, Engine OFF 2. Perform Terminal Test on coolant sensor harness connector. 3. Inspect harness for melted or pinched areas near the coolant sensor. Were any problems found?	**YES:** Fix problem. Run Harness Diagnostic Mode Test in Service ADVISOR. **NO:** GO TO 3

JL45346,0000049 -19-31MAY10-4/18

3 Sensor Open Test	Measure the resistance between terminal A and terminal B on the coolant sensor. Was the resistance value greater than 7.5M ohms?	**YES:** Replace sensor. Run Harness Diagnostic Mode Test in Service ADVISOR. **NO:** GO TO 4

JL45346,0000049 -19-31MAY10-5/18

4 Harness Resistance Check	Measure the resistance between the return (terminal B) and signal (terminal A) in the coolant sensor harness connector. Was the resistance between 1k and 3k ohms?	**YES:** GO TO 5 **NO:** GO TO 6.

JL45346,0000049 -19-31MAY10-6/18

5 Terminal to Terminal Resistance Check	1. Disconnect all ECU connectors. 2. Measure the resistance between the signal (terminal J1-C4) and all other ECU connector terminals in the ECU harness connectors. Was any resistance less than 100 ohms?	**YES:** Look for pinched or melted harness and repair wiring. Run Harness Diagnostic Mode Test in Service ADVISOR **NO:** Reconnect all connectors. Run Harness Diagnostic Mode Test in Service ADVISOR

Continued on next page

JL45346,0000049 -19-31MAY10-7/18

6	**Harness Return Wire Resistance Check**	Measure the resistance between the return (terminal B) in the coolant sensor harness connector and application single point ground. Was the resistance less than 5 ohms?	**YES:** GO TO 7 **NO:** GO TO 8.

JL45346,0000049 -19-31MAY10-8/18

7	**Harness Signal Wire Resistance Check ECU Disconnected**	Measure the resistance between the signal (terminal J1-C4) in the ECU connector and the signal (terminal A) in the coolant sensor harness connector. Was the resistance less than 5 ohms?	**YES:** GO TO 9 **NO:** Repair open wiring. Run Harness Diagnostic Mode Test in Service ADVISOR

JL45346,0000049 -19-31MAY10-9/18

8	**Harness Return Wire Resistance Check ECU Disconnected**	Measure the resistance between the return (terminal J1-D2) in the ECU connector and the return (terminal B) in the coolant sensor harness connector. Was the resistance less than 5 ohms?	**YES:** GO TO 9 **NO:** Repair open wiring. Run Harness Diagnostic Mode Test in Service ADVISOR

JL45346,0000049 -19-31MAY10-10/18

9	**ECU Resistance Check**	Measure the resistance between the return (terminal J1-D2) and signal (terminal J1-C4) in the ECU connector. Was the resistance between 1k and 3k ohms?	**YES:** Reconnect all connectors and GO TO 2. **NO:** Replace ECU. Run Harness Diagnostic Mode Test in Service ADVISOR.

JL45346,0000049 -19-31MAY10-11/18

10	**Occurrence Count Check**	Review stored information and look at occurrence count for 000110.03. Is occurrence recorded in step 1 greater than 5?	**YES:** GO TO 11 **NO:** GO TO 12

JL45346,0000049 -19-31MAY10-12/18

11	**Terminal Test**	1. Ignition OFF, Engine OFF 2. Perform Terminal Test on the coolant sensor harness connector. Were any problems found?	 **YES:** Fix problem. Run Harness Diagnostic Mode Test in Service ADVISOR. **NO:** GO TO 12

Continued on next page

JL45346,0000049 -19-31MAY10-13/18

12 Further Review of Snapshot Information	Review stored information collected in step 1	**YES:** Repair problem if found.
	Does stored information lead to a possible problem or is there a certain operating point where error occurs?	**YES:** If a certain operating point exists when error occurs then GO TO 13 **NO:** GO TO 14

JL45346,0000049 -19-31MAY10-14/18

13 Engine Error Operating Point Test	1. Ignition ON, Engine ON	
	2. Set engine to operating point of failure and refresh codes	**YES:** GO TO 1
	Did 000110.03 reappear when engine operating point was reached?	**NO:** GO TO 12 and confirm the operating point

JL45346,0000049 -19-31MAY10-15/18

14 Terminal Test	1. Ignition OFF, Engine OFF	
	2. Perform Terminal Test on the coolant sensor harness connector and ECU J1 connector.	**YES:** Fix problem. Run Harness Diagnostic Mode Test in Service ADVISOR.
	Were any problems found?	**NO:** GO TO 15

JL45346,0000049 -19-31MAY10-16/18

15 Reconnect and Retest	1. Reconnect all connectors.	
	2. Ignition ON, Engine OFF.	
	3. Run Harness Diagnostic Mode Test in Service ADVISOR.	
	4. Refresh codes.	**YES:** GO TO 1
	Is 000110.03 active?	**NO:** GO TO 16

JL45346,0000049 -19-31MAY10-17/18

16 Software Updates	1. Download latest ECU software payload and reprogram ECU using Service ADVISOR.	
	2. Run Harness Diagnostic Mode Test in Service ADVISOR.	**YES:** Replace Sensor, Run Harness Diagnostic Mode Test in Service ADVISOR.
	Is 000110.03 active?	**NO:** Problem fixed, bad ECU program.

JL45346,0000049 -19-31MAY10-18/18

000110.04 — Engine Coolant Temperature Signal Out of Range Low

The engine coolant temperature input voltage drops below the sensor's low voltage specification.

JL45346,000004A -19-31MAY10-1/19

000110.04 — Engine Coolant Temperature Signal Out of Range Low Diagnostic Procedure

Troubleshooting Sequence:
000110.04

When DTC is Displayed:
When ever the ignition is on and the error is active.

Related Information:
The engine coolant temperature input voltage drops below the sensor's low voltage specification. This corresponds to a temperature that is higher than what is physically possible for engine coolant temperature.

Alarm Level:
Warning

Control Unit Response:
The ECU uses a default engine coolant temperature of 90° C (194° F).

Additional References:
For further temperature sensor information, see Temperature Measurement in Section 03, Group 140 earlier in this manual.

For further engine coolant temperature sensor information, see Engine Coolant Temperature (ECT) Sensor in Section 03, Group 140 earlier in this manual.

NOTE: The wiring diagrams provided are for a typical John Deere supplied OEM harness. Wire number, colors, and jumper connectors do not apply to all applications.

For wiring information:
- see 2.4L 12V ECU WIRING DIAGRAM 3
- see 2.4L 24V ECU WIRING DIAGRAM 3
- see 3.0L 12V ECU WIRING DIAGRAM 3
- see 3.0L 24V ECU WIRING DIAGRAM 3

located in Section 06, Group 210 later in this manual.

For further information on connector and terminal testing see Terminal Test earlier in this Group.

IMPORTANT: When directed to run the Harness Diagnostic Mode Test the engine temperature should be above freezing. It is recommended that the engine temperature be at least room temperature 20° C (68° F). This test is located in Service ADVISOR.

IMPORTANT: Do not force probes into connector terminals or damage will result. Use JT07328 Connector Adapter Test Kit to make measurements in connectors. This will ensure that terminal damage does not occur.

Continued on next page

JL45346,000004A -19-31MAY10-2/19

1 Read DTCs and Store Snapshot Information

1. Ignition ON, engine OFF.

NOTE: When DTCs are cleared Snapshot information for ALL DTCs will be cleared.

2. Connect SERVICE ADVISOR™, see Connecting To Service ADVISOR earlier in this Group.
3. Write down all DTCs and their occurrence count. If any DTCs have snapshot capture or snapshot recording information, save the information. For instructions on saving and using snapshot information, see Snapshot Instructions earlier in this Group.
4. Refresh Codes.

Did 000110.04 reappear active?

YES: GO TO 2

NO: GO TO 10

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JL45346,000004A -19-31MAY10-3/19

2 Monitor Code Test

1. Ignition OFF, Engine OFF.
2. Disconnect the engine coolant temperature sensor connector.
3. Ignition ON, Engine OFF
4. Refresh codes.

Did 000110.03 become active and 000110.04 move to stored?

YES: GO TO 3

NO: GO TO 4

JL45346,000004A -19-31MAY10-4/19

3 Terminal Test

1. Ignition OFF, Engine OFF
2. Perform Terminal Test on engine coolant temperature sensor harness connector.
3. Inspect harness for melted or pinched areas near the engine coolant temperature sensor.

Were any problems found?

YES: Repair problem. Run Harness Diagnostic Mode Test in Service ADVISOR.

NO: GO TO 4

JL45346,000004A -19-31MAY10-5/19

4 Sensor Short to Ground Test

Measure the resistance from terminal A to chassis ground and terminal B to chassis ground on the engine coolant temperature sensor.

Was either resistance value less than 1k ohm?

YES: Replace sensor. Run Harness Diagnostic Mode Test in Service ADVISOR.

NO: Problem not found, reconnect all connectors. GO TO 2 and confirm your findings. Look closely at connectors, wiring and terminal numbers where measurements were made.

JL45346,000004A -19-31MAY10-6/19

5 Terminal Test

1. Ignition OFF, Engine OFF
2. Perform Terminal Test on the engine coolant temperature sensor harness connector.

Were any problems found?

YES: Repair problem. Run Harness Diagnostic Mode Test in Service ADVISOR.

NO: GO TO 6

Continued on next page

JL45346,000004A -19-31MAY10-7/19

6 Harness Resistance Check	Measure the resistance between the return (terminal B) and signal (terminal A) in the engine coolant temperature sensor harness connector. Was the resistance less than 100 ohms?	**YES:** GO TO 7 **NO:** Problem not found, reconnect all connectors. GO TO 2 and confirm your findings. Look closely at connectors, wiring and terminal numbers where measurements were made.

JL45346,000004A -19-31MAY10-8/19

7 Harness Resistance Check ECU Disconnected	1. Disconnect ECU connector J1. 2. Measure the resistance between the return (terminal B) and signal (terminal A) in the engine coolant temperature sensor harness connector. Was the resistance less than 100 ohms?	 **YES:** GO TO 8 **NO:** GO TO 9.

JL45346,000004A -19-31MAY10-9/19

8 Harness Physical Check	Terminal A has low resistance to ground, check for: • Melted harness and wiring • Pinched harness and wiring. Was the problem found?	 **YES:** Repair problem. Run Harness Diagnostic Mode Test in Service ADVISOR. **NO:** Problem not found, reconnect all connectors. GO TO 5 and confirm your findings. Look closely at connectors, wiring and terminal numbers where measurements were made.

JL45346,000004A -19-31MAY10-10/19

9 ECU Resistance Check	Measure the resistance between the return (terminal J1-D2) and signal (terminal J1-C4) in the ECU connector. Was the resistance less than 100 ohms?	**YES:** Replace ECU. Run Harness Diagnostic Mode Test in Service ADVISOR. **NO:** Problem not found, reconnect all connectors. GO TO 2 and confirm your findings. Look closely at connectors, wiring and terminal numbers where measurements were made.

JL45346,000004A -19-31MAY10-11/19

10 Occurrence Count Check	Review stored information and look at occurrence count for 000110.04. Is occurrence recorded in step 1 greater than 5?	**YES:** GO TO 11 **NO:** GO TO 12

Continued on next page

JL45346,000004A -19-31MAY10-12/19

11 Terminal Test	1. Ignition OFF, Engine OFF	
	2. Perform Terminal Test on the engine coolant temperature sensor harness connector.	**YES:** Repair problem, Run Harness Diagnostic Mode Test in Service ADVISOR.
	Were any problems found?	**NO:** GO TO 12

JL45346,000004A -19-31MAY10-13/19

12 Further Review of Snapshot Information	Review stored information collected in step 1	**YES:** Repair problem if found.
	Does stored information lead to a possible problem or is there a certain operating point where error occurs?	**YES:** If a certain operating point exists when error occurs then GO TO 13 **NO:** GO TO 15

JL45346,000004A -19-31MAY10-14/19

13 Engine Error Operating Point Test	1. Ignition ON, Engine ON	
	2. Set engine to operating point of failure and refresh codes	**YES:** GO TO 14
	Did 000110.04 reappear when engine operating point was reached?	**NO:** GO TO 12 and confirm operating point.

JL45346,000004A -19-31MAY10-15/19

14 Sensor Temperature Test	1. Ignition OFF, Engine OFF	
	2. Check temperature of the engine coolant temperature sensor and surrounding ares.	**YES:** Replace Sensor, Run Harness Diagnostic Mode Test in Service ADVISOR.
	Is everything hot?	**NO:** GO TO 15

JL45346,000004A -19-31MAY10-16/19

15 Terminal Test	1. Ignition OFF, Engine OFF	
	2. Perform terminal test on the engine coolant temperature sensor harness connector and ECU J1 connector.	**YES:** Repair problem, Run Harness Diagnostic Mode Test in Service ADVISOR.
	Were any problems found?	**NO:** GO TO 16

JL45346,000004A -19-31MAY10-17/19

16 Reconnect and Retest	1. Reconnect all connectors.	
	2. Ignition ON, Engine OFF.	
	3. Run Harness Diagnostic Mode Test in Service ADVISOR.	
	4. Refresh codes.	**YES:** GO TO 17.
	Is 000110.04 active?	**NO:** GO TO 15.

Continued on next page

JL45346,000004A -19-31MAY10-18/19

17 Software Updates	1. Download latest ECU software payload and reprogram ECU using Service ADVISOR. 2. Run Harness Diagnostic Mode Test in Service ADVISOR. Is 000110.04 active?	**YES:** Replace Sensor, Run Harness Diagnostic Mode Test in Service ADVISOR. **NO:** Problem fixed, bad ECU program.

JL45346,000004A -19-31MAY10-19/19

000110.15 — Engine Coolant Temperature Signal Slightly High

The ECU senses a coolant temperature above specification.

DM59778,0000086 -19-31MAY10-1/17

000110.15 — Engine Coolant Temperature Signal Slightly High Diagnostic Procedure

Troubleshooting Sequence:
000110.15

When DTC is Displayed:
When the engine has been running 3 minutes and the error is active

Related Information:

NOTE: For information on temperature values that trigger this fault, see OEM Engines - Derate Specifications in Group 06, Section 210 later in this manual.

The engine has to be running for 3 minutes before the code is set.

Alarm Level:
Warning

Control Unit Response:
The ECU will continue to operate normally.

Additional References:
For further temperature sensor information, see Temperature Measurement in Section 03, Group 140 earlier in this manual.
For further coolant temperature sensor information, see Engine Coolant Temperature (ECT) Sensor in Section 03, Group 140 earlier in this manual
For more information on engine protection, see Engine Derate And Shutdown Protection in Section 03, Group 140 earlier in this manual.

NOTE: The wiring diagrams provided are for a typical John Deere supplied OEM harness. Wire number, colors and jumper connectors do not apply to all applications.

For wiring information see 2.4L/3.0L ECU WIRING DIAGRAM 3 located in Section 06, Group 210 later in this manual.

Flex probe information:
- ECU large terminal - Orange/Green
- ECU small terminal - Orange/Blue
- Coolant temperature sensor T04 - Purple/Red
- Front Engine Interconnect X07 - Yellow/Purple

For further information on connector and terminal testing or flex probes see a in Section 04, Group 160 earlier in this manual.

IMPORTANT: Do not force probes into connector terminals or damage will result. Use JDG10466 Flex Probe Kit to make measurements in connectors. This will ensure that terminal damage does not occur.

Continued on next page

DM59778,0000086 -19-31MAY10-2/17

1 Read DTCs and Store Snapshot Information

1. Ignition ON, Engine OFF.

NOTE: When DTCs are cleared Snapshot information for ALL DTCs will be cleared.

2. Connect Service ADVISOR, see Connecting To Service ADVISOR in Section 160 earlier in this Group.
3. Ignition ON, Engine ON.
4. Let engine idle for 3 minutes before proceeding.
5. Write down all DTCs and their occurrence count. If any DTCs have snapshot capture or snapshot recording information, save the information. For instructions on saving and using snapshot information, see Snapshot Instructions in Section 160 earlier in this Group.
6. Refresh Codes.

Did 000110.15 reappear active?

YES: GO TO 2
NO: GO TO 15

DM59778,0000086 -19-31MAY10-3/17

2 Preliminary Check of Cooling System

Visually inspect cooling system components.

- Remove any blockage on or near radiator.
- Inspect radiator hoses for signs of leakage or cracks.
- Check radiator coolant is filled to proper level.
- Inspect cooling fan shroud for damage.
- Inspect radiator cap for failure.
- Loose cooling fan belt. See Belt Tensioner — Spring Tension and Belt Wear (Automatic Tensioner) Check in Section 02, Group 070 earlier in this manual.
- Malfunctioning cooling fan. See Fan Assembly — Inspection in Section 02, Group 070 earlier in this manual.
- Inspect Thermostat. See Thermostat — Removal in Section 02, Group 070 earlier in this manual.
- Excessively high ambient air temperature.

Were any problems found?

YES: Fix problem(s). GO TO 14
NO: GO TO 3

DM59778,0000086 -19-31MAY10-4/17

3 Terminal Test

1. Ignition OFF, Engine OFF.
2. Disconnect the coolant temperature sensor connector T04.
3. Perform Terminal Test on the harness and sensor connectors.
4. Inspect surrounding area for pinched or melted wires.

Are there any problems with the wiring or connectors?

YES: Repair problem. GO TO 14
NO: GO TO 4

DM59778,0000086 -19-31MAY10-5/17

4 Check Coolant Temperature Sensor

1. Remove coolant temperature sensor. See Coolant Temperature Sensor — Removal in Section 02, Group 110 earlier in this manual.
2. Inspect engine housing, sensor, and O-ring for defects.

Were any defects found?

YES: Replace defective part. GO TO 14
NO: GO TO 5

Continued on next page

DM59778,0000086 -19-31MAY10-6/17

5 Check Coolant Temperature Sensor Operation

1. With coolant sensor removed from engine, reconnect coolant temperature sensor to its harness connector T04.
2. Ignition ON, Engine OFF.
3. Place senor in water to cool it down to ambient temperature.
4. Record the coolant temperature value from within Service ADVISOR.
5. Place the sensor in hot water and record the temperature with a thermometer.
6. Record the coolant temperature value from within Service ADVISOR.

Does the sensor reading closely match the ambient temperature and that of the thermometer?

YES: Coolant temperature sensor is OK. Diagnose engine cooling system. GO TO 6

NO: Check harness. GO TO 8

DM59778,0000086 -19-31MAY10-7/17

6 Check for Engine Related Causes

Check the following items that can cause high coolant temperature:

- Inspect cooling system. See Cooling System — Test in Section 04, Group 150 earlier in this manual.
- Inspect cooling system components. See Engine Overheating in Section 04, Group 150 earlier in this manual.

Was cause of high coolant temperature determined?

YES: Repair problem. GO TO 14

NO: ECU has not been reprogrammed. GO TO 7

NO: Problem not fixed. Verify cooling system and related parameters are functioning properly. GO TO 1

DM59778,0000086 -19-31MAY10-8/17

7 Reprogram ECU

1. Ignition OFF, Engine OFF.
2. Reconnect all connectors and sensors.
3. Download latest ECU software payload and reprogram ECU. See Payload File Downloading Instructions and Engine Control Unit (ECU) — Reprogramming Instructions in Group 04, Section 160 earlier in this manual.
4. Monitor DTCs in Service ADVISOR.
5. Let engine run for 3 minutes and refresh codes.

Is 000110.15 still active?

YES: Problem not fixed. Verify cooling system and related parameters are functioning properly. GO TO 1

NO: Verify problem is fixed. GO TO 14

Continued on next page

DM59778,0000086 -19-31MAY10-9/17

8 Terminal Test on Interconnect Connector

1. Ignition OFF, Engine OFF.
2. Disconnect front engine interconnect harness connector X07.
3. Perform Terminal Test on the front engine interconnect connectors.
4. Inspect surrounding area for pinched or melted wires.

Are there any problems with the wiring or connectors?

YES: Repair problem. GO TO 14

NO: GO TO 9

DM59778,0000086 -19-31MAY10-10/17

9 Terminal Test on ECU Connector

1. Disconnect ECU connector J01.
2. Perform Terminal Test on harness and ECU connector J01.
3. Inspect surrounding area for pinched or melted wires.

Are there any problems with the wiring or connectors?

YES: Repair problem. GO TO 14

NO: GO TO 10

DM59778,0000086 -19-31MAY10-11/17

10 Check Harness

NOTE: Several new DTCs will appear in this step. Ignore all DTCs except for 000110.03

1. ECU connector J01 disconnected from ECU.
2. Ignition ON, Engine OFF.
3. Monitor the DTC codes from within Service ADVISOR.

Did 000110.03 become active?

YES: Check for short in harness. GO TO 11

NO: Check ECU. GO TO 12

DM59778,0000086 -19-31MAY10-12/17

11 Check For Short in Harness

1. Ignition OFF, Engine OFF.
2. Disconnect ECU connector J02.
3. Disconnect coolant temperature sensor connector T04 from coolant temperature sensor.
4. Reconnect harness interconnect connectors X07.
5. On harness, measure resistance between ECU connector J01-C4 and all other terminals on ECU harness connectors J01 and J02.

Were any measurements less than 100 ohms?

YES: Fix shorted wires in harness. GO TO 14

NO: GO TO 12

DM59778,0000086 -19-31MAY10-13/17

12 Replace Sensor

Has coolant temperature sensor been replaced?

YES: GO TO 13

NO: Replace coolant temperature sensor. GO TO 14

Continued on next page

DM59778,0000086 -19-31MAY10-14/17

13 Reprogram ECU	*NOTE: Several new DTCs will appear in this step. Ignore all DTCs except for 000110.03* 1. Ignition OFF, Engine OFF. 2. Reconnect ECU connector J02. Leave ECU connector J01 disconnected. 3. Download latest ECU software payload and reprogram ECU. See Payload File Downloading Instructions and Engine Control Unit (ECU) — Reprogramming Instructions in Group 04, Section 160 earlier in this manual. 4. Ignition ON, Engine OFF. 5. Monitor DTCs in Service ADVISOR. Did 000110.03 become active?	**YES:** Verify problem is fixed. GO TO 14 **NO:** Replace ECU. GO TO 14

DM59778,0000086 -19-31MAY10-15/17

14 Verification	1. Ignition OFF, Engine OFF. 2. Reconnect all connectors, hoses, sensors, etc. 3. Ignition ON, Engine ON. 4. Monitor DTCs in Service ADVISOR. 5. Let engine run for 5 minutes. 6. Operate engine through normal speed and load. 7. Refresh DTCs. Did DTC 000110.15 reappear as active with engine running?	**YES:** GO TO 1 **NO:** Problem fixed.

DM59778,0000086 -19-31MAY10-16/17

15 Review Snapshot Information	1. Retrieve snapshot information, see Snapshot Instructions earlier in this Group. 2. Review all stored codes. Does information relate to a possible intermittent or operating condition causing the code to become active. 3. Review information to see if you can determine a possible problem or the operating point that causes the code to become active. Did you find a possible problem or the operating point at which the code becomes active?	**YES:** Found a possible problem. Repair possible problem. Retest. **YES:** Found operating point at which the code becomes active. GO TO 2 **NO:** Start DTAC case.

DM59778,0000086 -19-31MAY10-17/17

000110.16 — Engine Coolant Temperature Signal Moderately High

The ECU senses a coolant temperature above specification.

DM59778,0000087 -19-31MAY10-1/17

000110.16 — Engine Coolant Temperature Signal Moderately High Diagnostic Procedure

Troubleshooting Sequence:
000110.16

When DTC is Displayed:
When the engine is on and the error is active.

Related Information:

NOTE: For information on temperature values that trigger this fault, see OEM Engines - Derate Specifications in Section 210, later in this manual.

The engine has to be running for 3 minutes before the code is set.
001569.31 is set when this code is active and the ECU has derated the engine.

Alarm Level:
Warning

Control Unit Response:
Maximum engine power is derated up to 20 percent.

Additional References:
For further temperature sensor information, see Temperature Measurement in Section 03, Group 140 earlier in this manual.
For further coolant temperature sensor information, see Engine Coolant Temperature (ECT) Sensor in Section 03, Group 140 earlier in this manual
For more information on engine protection, see Engine Derate And Shutdown Protection in Section 03, Group 140 earlier in this manual.

NOTE: The wiring diagrams provided are for a typical John Deere supplied OEM harness. Wire number, colors and jumper connectors do not apply to all applications.

For wiring information see 2.4L-3.0L ECU WIRING DIAGRAM 3 located in Section 06, Group 210 later in this manual.

Flex probe information:
- ECU large terminal - Orange/Green
- ECU small terminal - Orange/Blue
- Coolant temperature sensor T04 - Purple/Red
- Front Engine Interconnect C35 - Yellow/Purple

For further information on connector and terminal testing or flex probes see Terminal Test in Section 04, Group 160 earlier in this manual.

IMPORTANT: Do not force probes into connector terminals or damage will result. Use JDG10466 Flex Probe Kit to make measurements in connectors. This will ensure that terminal damage does not occur.

Continued on next page

DM59778,0000087 -19-31MAY10-2/17

1 Read DTCs and Store Snapshot Information	1. Ignition ON, Engine OFF. *NOTE: When DTCs are cleared Snapshot information for ALL DTCs will be cleared.* 2. Connect Service ADVISOR, see Connecting To Service ADVISOR earlier in this Group. 3. Ignition ON, Engine ON. 4. Let engine idle for 3 minutes before proceeding. 5. Write down all DTCs and their occurrence count. If any DTCs have snapshot capture or snapshot recording information, save the information. For instructions on saving and using snapshot information, see Snapshot Instructions earlier in this Group. 6. Refresh Codes. Did 000110.16 reappear active?	**YES:** GO TO 2 **NO:** GO TO 15

DM59778,0000087 -19-31MAY10-3/17

2 Preliminary Check of Cooling System	Visually inspect cooling system components. • Remove any blockage on or near radiator. • Inspect radiator hoses for signs of leakage or cracks. • Check radiator coolant is filled to proper level. • Inspect cooling fan shroud for damage. • Inspect radiator cap for failure. • Loose cooling fan belt. See Belt Tensioner — Spring Tension and Belt Wear (Automatic Tensioner) Check in Section 02, Group 070 earlier in this manual. • Malfunctioning cooling fan. See Fan Assembly — Inspection in Section 02, Group 070 earlier in this manual. • Inspect Thermostat. See Thermostat — Removal in Section 02, Group 070 earlier in this manual. • Excessively high ambient air temperature. Were any problems found?	**YES:** Fix problem(s). GO TO 14 **NO:** GO TO 3

DM59778,0000087 -19-31MAY10-4/17

3 Terminal Test on Sensor Connector	1. Ignition OFF, Engine OFF. 2. Disconnect the coolant temperature sensor connector T04. 3. Perform Terminal Test on the harness and sensor connectors. 4. Inspect surrounding area for pinched or melted wires. Are there any problems with the wiring or connectors?	**YES:** Repair problem. GO TO 14 **NO:** GO TO 4

DM59778,0000087 -19-31MAY10-5/17

4 Check Coolant Temperature Sensor	1. Remove coolant temperature sensor. See Coolant Temperature Sensor — Removal in Section 02, Group 110 earlier in this manual. 2. Inspect engine housing, sensor, and O-ring for defects. Were any defects found?	**YES:** Replace defective part. GO TO 14 **NO:** GO TO 5

Continued on next page

DM59778,0000087 -19-31MAY10-6/17

5 Check Coolant Temperature Sensor Operation

1. With coolant sensor removed from engine, reconnect coolant temperature sensor to its harness connector T04.
2. Ignition ON, Engine OFF.
3. Place senor in water to cool it down to ambient temperature.
4. Record the coolant temperature value from within Service ADVISOR.
5. Place the sensor in hot water and record the temperature with a thermometer.
6. Record the coolant temperature value from within Service ADVISOR.

Does the sensor reading closely match the ambient temperature and that of the thermometer?

YES: Coolant temperature sensor is OK. Diagnose engine cooling system. GO TO 6

NO: Check harness. GO TO 8

DM59778,0000087 -19-31MAY10-7/17

6 Check for Engine Related Causes

Check the following items that can cause high coolant temperature:

- Inspect cooling system. See Cooling System — Test in Section 04, Group 150 earlier in this manual.
- Inspect cooling system components. See Engine Overheating in Section 04, Group 150 earlier in this manual.

Was cause of high coolant temperature determined?

YES: Repair problem. GO TO 14

NO: ECU has not been reprogrammed. GO TO 7

NO: Problem not fixed. Verify cooling system and related parameters are functioning properly. GO TO 1

DM59778,0000087 -19-31MAY10-8/17

7 Reprogram ECU

1. Ignition OFF, Engine OFF.
2. Reconnect all connectors and sensors.
3. Download latest ECU software payload and reprogram ECU. See Payload File Downloading Instructions and Engine Control Unit (ECU) — Reprogramming Instructions in Group 04, Section 160 earlier in this manual.
4. Monitor DTCs in Service ADVISOR.
5. Let engine run for 3 minutes and refresh codes.

Is 000110.16 still active?

YES: Problem not fixed. Verify cooling system and related parameters are functioning properly. GO TO 1

NO: Verify problem is fixed. GO TO 14

Continued on next page

DM59778,0000087 -19-31MAY10-9/17

8 Terminal Test on Interconnect Connector

1. Ignition OFF, Engine OFF.
2. Disconnect front engine interconnect harness connectors C35.
3. Perform Terminal Test on the front engine interconnect connectors.
4. Inspect surrounding area for pinched or melted wires.

Are there any problems with the wiring or connectors?

YES: Repair problem. GO TO 14

NO: GO TO 9

DM59778,0000087 -19-31MAY10-10/17

9 Terminal Test on ECU Connector

1. Disconnect ECU connector J01 at ECU.
2. Perform Terminal Test on harness and ECU connector J01.
3. Inspect surrounding area for pinched or melted wires.

Are there any problems with the wiring or connectors?

YES: Repair problem. GO TO 14

NO: GO TO 10

DM59778,0000087 -19-31MAY10-11/17

10 Check Harness

NOTE: Several new DTCs will appear in this step. Ignore all DTCs except for 000110.03

1. ECU connector J01 disconnected from ECU.
2. Ignition ON, Engine OFF.
3. Monitor the DTC codes from within Service ADVISOR.

Did 000110.03 become active?

YES: Check for short in harness. GO TO 11

NO: Replace sensor. GO TO 12

DM59778,0000087 -19-31MAY10-12/17

11 Check For Short in Harness

1. Ignition OFF, Engine OFF.
2. Disconnect ECU connector J02.
3. Disconnect coolant temperature sensor connector T04 from coolant temperature sensor.
4. Reconnect harness interconnect connectors C35.
5. On harness, measure resistance between ECU connector J01-C4 and all other terminals on ECU harness connectors J01 and J02.

Were any measurements less than 100 ohms?

YES: Fix shorted wires in harness. GO TO 14

NO: GO TO 12

DM59778,0000087 -19-31MAY10-13/17

12 Replace Sensor

Has coolant temperature sensor been replaced?

YES: Check ECU. GO TO 13

NO: Replace coolant temperature sensor. GO TO 14

Continued on next page

DM59778,0000087 -19-31MAY10-14/17

13 Reprogram ECU

NOTE: Several new DTCs will appear in this step. Ignore all DTCs except for 000110.03

1. Ignition OFF, Engine OFF.
2. Reconnect ECU connector J02.
3. Download latest ECU software payload and reprogram ECU. See Payload File Downloading Instructions and Engine Control Unit (ECU) — Reprogramming Instructions in Group 04, Section 160 earlier in this manual.
4. Ignition ON, Engine OFF.
5. Monitor DTCs in Service ADVISOR.

Is 000110.03 active?

YES: Verify problem is fixed. GO TO 14

NO: Replace ECU. See Engine Control Unit (ECU) — Removal in Group 02, Section 110 earlier in this manual. GO TO 14

DM59778,0000087 -19-31MAY10-15/17

14 Verification

1. Ignition OFF, Engine OFF.
2. Reconnect all connectors, hoses, sensors, etc.
3. Ignition ON, Engine ON.
4. Monitor DTCs in Service ADVISOR.
5. Let engine run for 5 minutes.
6. Operate engine through normal speed and load.
7. Refresh DTCs.

Did DTC 000110.16 reappear as active with engine running?

YES: GO TO 1

NO: Problem fixed.

DM59778,0000087 -19-31MAY10-16/17

15 Review Snapshot Information

1. Retrieve snapshot information, see Snapshot Instructions earlier in this Group.
2. Review all stored codes. Does information relate to a possible intermittent or operating condition causing the code to become active.

YES: Found a possible problem.
Repair possible problem.
Retest.

3. Review information to see if you can determine a possible problem or the operating point that causes the code to become active.

YES: Found operating point at which the code becomes active. GO TO 2

Did you find a possible problem or the operating point at which the code becomes active?

NO: Start DTAC case.

DM59778,0000087 -19-31MAY10-17/17

000094.03 — Low Pressure Fuel Signal Out of Range High

The low pressure fuel pressure input voltage exceeds the sensor's high voltage specification.

DN22556,00006BE -19-31MAY10-1/15

000094.03 — Low Pressure Fuel Signal Out of Range High Diagnostic Procedure

Troubleshooting Sequence:
003510.03
000094.03

When DTC is Displayed:
When ever the ignition is on and the error is active.

Related Information:
The low pressure fuel signal input voltage rises above the sensor's high voltage specification. The voltage corresponds to a pressure that is higher than what is physically possible for the low pressure fuel pressure signal.

Alarm Level:
Warning

Control Unit Response:
The ECU will try to maintain the engine operating envelope.

Additional References:
For sensor location see COMPONENT LOCATION in Section 3 Group 140.

For more engine low pressure fuel sensor information, see Low Fuel Pressure Sensor in Section 03, Group 140 earlier in this manual.

For more pressure sensor information, see Pressure Measurement in Section 03, Group 140 earlier in this manual.

NOTE: The wiring diagrams provided are for a typical John Deere supplied OEM harness. Wire number, colors, and jumper connectors do not apply to all applications.

For wiring information:
- see 2.4/3.0L ECU WIRING DIAGRAM 3
located in Section 06, Group 210 later in this manual.

IMPORTANT: Do not force probes into connector terminals or damage will result. Use JDG10466 Flex Probe Kit to make measurements in connectors. This will ensure that terminal damage does not occur.

Flex probe information:
- ECU large terminal - Orange/Green
- ECU small terminal - Orange/Blue
- Fuel temperature sensor- Purple/Red
- Fuel system interconnect C34- Yellow/Purple

For more information on connector and terminal testing see Terminal Test in Group 160 earlier in this Section.

IMPORTANT: When directed to run the Harness Diagnostic Mode Test the engine temperature should be above freezing. It is recommended that the engine temperature be at least room temperature 20° C (68° F). This test is located in Service ADVISOR.

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DN22556,00006BE -19-31MAY10-2/15

1 Read DTCs and Store Snapshot Information	1. Ignition ON, engine OFF. *NOTE: When DTCs are cleared Snapshot information for ALL DTCs will be cleared.* 2. Connect Service ADVISOR, see Connecting To Service ADVISOR in Group 160 earlier in this Section. 3. Write down all DTCs and their occurrence count. If any DTCs have snapshot capture or snapshot recording information, save the information. For instructions on saving and using snapshot information, see Snapshot Instructions in Group 160 earlier in this Section. 4. Refresh Codes. Did 000094.03 reappear active?	**YES:** GO TO 2 **NO:** GO TO 7

DN22556,00006BE -19-31MAY10-3/15

2 Sensor Disconnected Test	1. Ignition OFF, Engine OFF 2. Disconnect low pressure fuel sensor connector. 3. Ignition ON, Engine OFF 4. Refresh codes. Did 000094.03 go to stored and 000094.04 become active?	**YES:** GO TO 3 **NO:** GO TO 4

DN22556,00006BE -19-31MAY10-4/15

3 Terminal Test	1. Ignition OFF, Engine OFF 2. Disconnect low pressure fuel pressure sensor connector P03. 3. Perform a Terminal Test on P03. Were any problems found?	**YES:** Repair problem. Run Harness Diagnostic Mode Test. **NO:** GO TO 4

DN22556,00006BE -19-31MAY10-5/15

4 Sensor Short to Ground Test	On the harness, measure the resistance between low pressure fuel pressure sensor connector, female sockets P03-C and P03-B. Was the resistance value between 120k and 180k ohms?	**YES:** GO TO 5 **NO:** Repair short in harness. Run Harness Diagnostic Mode Test.

DN22556,00006BE -19-31MAY10-6/15

5 Harness Resistance Check ECU Disconnected	1. Disconnect ECU connectors J01 and J02. 2. Perform Terminal Test on J01 and J02. 3. Measure the resistance between ECU J01-B3 and all other female sockets in J01 and J02. Was any resistance measurement less than 100 ohms?	**YES:** Repair short in wiring. Run Harness Diagnostic Mode Test. **NO:** GO TO 6

Continued on next page

DN22556,00006BE -19-31MAY10-7/15

6 ECU Resistance Check	Measure the resistance between ECU female sockets J01-B3 and signal J01-D2. Was the resistance between 120k and 180k ohms?	**YES:** Problem not found, reconnect all connectors. GO TO 2 and confirm your findings. Look closely at connectors, wiring and terminal numbers where measurements were made. **NO:** Replace ECU. Run Harness Diagnostic Mode Test.

DN22556,00006BE -19-31MAY10-8/15

7 Occurrence Count Check	Review stored information and look at occurrence count for 000094.03. Is occurrence recorded in step 1 greater than 5?	**YES:** GO TO 8 **NO:** GO TO 9

DN22556,00006BE -19-31MAY10-9/15

8 Terminal Test	1. Ignition OFF, Engine OFF 2. Disconnect low pressure fuel pressure sensor P03 and fuel system interconnect C34. 3. Perform Terminal Test on P03 and C34. Were any problems found?	 **YES:** Repair problem, Run Harness Diagnostic Mode Test. **NO:** GO TO 9

DN22556,00006BE -19-31MAY10-10/15

9 Further Review of Snapshot Information	Review stored information collected in step 1. Does stored information lead to a possible problem or is there a certain operating point where error occurs?	**YES:** Repair problem if found. **YES:** If a certain operating point exists when error occurs GO TO 10 **NO:** GO TO 12

DN22556,00006BE -19-31MAY10-11/15

10 Engine Error Operating Point Test	1. Ignition ON, Engine ON 2. Set engine to operating point of failure and refresh codes Did 000094.03 reappear when engine operating point was reached?	 **YES:** GO TO 11 **NO:** GO TO 12 and confirm the operating point.

Continued on next page

DN22556,00006BE -19-31MAY10-12/15

11 Sensor Temperature Test	1. Ignition ON, Engine OFF	
	2. Refresh codes.	**YES:** GO TO 1
	Is 000094.03 active?	**NO:** Replace low pressure fuel pressure sensor. Run Harness Diagnostic Mode Test.

DN22556,00006BE -19-31MAY10-13/15

12 Terminal Test	1. Ignition OFF, Engine OFF.	
	2. Disconnect low pressure fuel pressure sensor P03, fuel system interconnect C34 and ECU J01.	
	3. Perform Terminal Test on P03, C34, J01.	**YES:** Repair problem, Run Harness Diagnostic Mode Test in Service ADVISOR.
	Were any problems found?	**NO:** GO TO 13

DN22556,00006BE -19-31MAY10-14/15

13 Software Updates	1. Download the latest ECU software payload and reprogram ECU using Service ADVISOR.	
	2. Run Harness Diagnostic Mode Test.	**YES:** Replace Sensor, Run Harness Diagnostic Mode Test.
	Is 000094.03 active?	**NO:** Problem fixed, bad ECU program.

DN22556,00006BE -19-31MAY10-15/15

000094.04 — Low Pressure Fuel Signal Out of Range Low

The low pressure fuel pressure input voltage drops below the sensor's low voltage specification.

DN22556,00006BF -19-19APR10-1/20

000094.04 — Low Pressure Fuel Signal Out of Range Low Diagnostic Procedure

Troubleshooting Sequence:
003510.04
000094.04

When DTC is Displayed:
When ever the ignition is on and the error is active.

Related Information:
The low pressure fuel signal input voltage drops below the sensor's low voltage specification. The voltage corresponds to a pressure that is lower than what is physically possible for the low pressure fuel signal.

Alarm Level:
Warning

Control Unit Response:
ECU's will operate normally.

Additional References:
For sensor location see COMPONENT LOCATION in Section 3 Group 140.

For more engine low pressure fuel signal sensor information, see Low Fuel Pressure Sensor in Section 03, Group 140 earlier in this manual.

For more pressure sensor information, see Pressure Measurement in Section 03, Group 140 earlier in this manual.

NOTE: The wiring diagrams provided are for a typical John Deere supplied OEM harness. Wire number, colors, and jumper connectors do not apply to all applications.

For wiring information:
- see 2.4L/3.0L ECU WIRING DIAGRAM 3
located in Section 06, Group 210 later in this manual.

IMPORTANT: Do not force probes into connector terminals or damage will result. Use JDG10466 Connector Adapter Test Kit to make measurements in connectors. This will ensure that terminal damage does not occur.

Flex probe information:
- ECU large terminal - Orange/Green
- ECU small terminal - Orange/Blue
- Fuel temperature sensor- Purple/Red
- Fuel system interconnect C34- Yellow/Purple

For more information on connector and terminal testing see Terminal Test in Section 04, Group 160 earlier in this manual.

IMPORTANT: When directed to run the Harness Diagnostic Mode Test the engine temperature should be above freezing. It is recommended that the engine temperature be at least room temperature 20° C (68° F). This test is located in Service ADVISOR.

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DN22556,00006BF -19-19APR10-2/20

1 Read DTCs and Store Snapshot Information	1. Ignition ON, engine OFF. *NOTE: When DTCs are cleared Snapshot information for ALL DTCs will be cleared.* 2. Connect Service ADVISOR, see Connecting To Service ADVISOR in Group 160 earlier in this manual. 3. Write down all DTCs and their occurrence count. If any DTCs have snapshot capture or snapshot recording information, save the information. For instructions on saving and using snapshot information, see Snapshot Instructions in Group 160 earlier in this manual. 4. Refresh Codes. Did 000094.04 reappear active?	**YES:** GO TO 2 **NO:** GO TO 12

DN22556,00006BF -19-19APR10-3/20

2 Terminal Test	1. Ignition OFF, Engine OFF 2. Disconnect the low pressure fuel pressure sensor connector P03. 3. Perform a Terminal Test on P03. Were any problems found?	**YES:** Repair problem. Run Harness Diagnostic Mode Test. **NO:** GO TO 3

DN22556,00006BF -19-19APR10-4/20

3 Sensor Short to Ground Test	On the low pressure fuel sensor, measure the resistance between P03-C and application single point ground. Was the resistance value less than 100 ohms?	**YES:** Replace sensor. Run Harness Diagnostic Mode Test. **NO:** GO TO 4

DN22556,00006BF -19-19APR10-5/20

4 Sensor Internal Short Test	On the low pressure fuel sensor, measure the resistance between P03-A and P03-C. Was the resistance value less than 100 ohms?	**YES:** Replace sensor. Run Harness Diagnostic Mode Test. **NO:** GO TO 5

DN22556,00006BF -19-19APR10-6/20

5 Harness Resistance Check	On the harness, measure the resistance between P03-A and P03-C. Was the resistance less than 100 ohms?	**YES:** GO TO 6 **NO:** GO TO 9

DN22556,00006BF -19-19APR10-7/20

6 Harness Resistance Check ECU Disconnected	1. Disconnect ECU connector J01. 2. Perform Terminal Test on J01. 3. On the harness, measure the resistance between the low pressure fuel pressure sensor connector P03-A and P03-C. Was the resistance less than 100 ohms?	**YES:** GO TO 7 **NO:** GO TO 8

Continued on next page

DN22556,00006BF -19-19APR10-8/20

7 Harness Physical Check	P03-C has low resistance to ground, check for: • Melted harness and wiring • Pinched harness and wiring. Was the problem found?	**YES:** Repair problem. Run Harness Diagnostic Mode Test in Service ADVISOR. **NO:** Problem not found, reconnect all connectors. GO TO 2 and confirm your findings. Look closely at connectors, wiring and terminal numbers where measurements were made.

DN22556,00006BF -19-19APR10-9/20

8 ECU Resistance Check	On the ECU, measure the resistance between J01-B3 and J01-D2. Was the resistance less than 100 ohms?	**YES:** Replace ECU. Run Harness Diagnostic Mode Test. **NO:** Problem not found, reconnect all connectors. GO TO 2 and confirm your findings. Look closely at connectors, wiring and terminal numbers where measurements were made.

DN22556,00006BF -19-19APR10-10/20

9 Harness Resistance Check	On the harness, measure the resistance between the low pressure fuel signal sensor harness connector P03-A and P03-B. Was the resistance between 50k and 150k ohms?	**YES:** Reconnect all connectors and GO TO 2. **NO:** GO TO 2

DN22556,00006BF -19-19APR10-11/20

10 Harness Resistance Check ECU Disconnected	1. Disconnect ECU connector J01. 2. Perform Terminal Test on J01. 3. On the harness, measure the resistance between low pressure fuel signal sensor connector P03-B and ECU J01-F3. Was the resistance less than 5 ohms?	**YES:** GO TO 11 **NO:** Check for pinched or melted wiring, repair problem. Run Harness Diagnostic Mode Test

DN22556,00006BF -19-19APR10-12/20

11 ECU Resistance Check	On the ECU, measure the resistance between J01-D2 and J01-F3. Was the resistance between 50k and 150k ohms?	**YES:** Reconnect ECU connector and GO TO 2. **NO:** Replace ECU. Run Harness Diagnostic Mode Test.

Continued on next page

DN22556,00006BF -19-19APR10-13/20

12 Occurrence Count Check	Review stored information and look at occurrence count for 000094.04. Is occurrence recorded in step 1 greater than 5?	**YES:** GO TO 13 **NO:** GO TO 14

DN22556,00006BF -19-19APR10-14/20

13 Terminal Test	1. Ignition OFF, Engine OFF 2. Disconnect low pressure fuel pressure sensor P03. 3. Perform Terminal Test on P03. Were any problems found?	 **YES:** Repair problem, Run Harness Diagnostic Mode Test. **NO:** GO TO 14

DN22556,00006BF -19-19APR10-15/20

14 Further Review of Snapshot Information	Review stored information collected in step 1. Does stored information lead to a possible problem or is there a certain operating point where error occurs?	**YES:** Repair problem if found. **YES:** If a certain operating point exists when error occurs, GO TO 15 **NO:** GO TO 17

DN22556,00006BF -19-19APR10-16/20

15 Engine Error Operating Point Test	1. Ignition ON, Engine ON 2. Set engine to operating point of failure and refresh codes Did 000094.04 reappear when engine operating point was reached?	 **YES:** GO TO 1 **NO:** GO TO 14 and confirm the operating point.

DN22556,00006BF -19-19APR10-17/20

16 Terminal Test	1. Ignition OFF, Engine OFF 2. Disconnect low pressure fuel sensor P03, fuel system interconnect C34 and ECU J01. 3. Perform Terminal Test on P03, C34 and J01. Were any problems found?	 **YES:** Repair problem, Run Harness Diagnostic Mode Test. **NO:** GO TO 17

DN22556,00006BF -19-19APR10-18/20

17 Reconnect and Retest	1. Reconnect all connectors. 2. Ignition ON, Engine OFF. 3. Run Harness Diagnostic Mode Test. 4. Refresh codes. Is 000094.04 active?	 **YES:** GO TO 1 **NO:** GO TO 18

Continued on next page

DN22556,00006BF -19-19APR10-19/20

18 Software Updates	1. Download the latest ECU software payload and reprogram ECU using Service ADVISOR. 2. Run Harness Diagnostic Mode Test. Is 000094.04 active?	**YES:** GO TO 1 **NO:** Replace low pressure fuel sensor. Run Harness Diagnostic Mode Test.

DN22556,00006BF -19-19APR10-20/20

000094.18 — Low Pressure Fuel Signal Moderately Low

The ECU senses that the low pressure fuel is below specification.

JB81757,000009E -19-24SEP10-1/6

000094.18 — Low Pressure Fuel Signal Moderately Low Procedure

Troubleshooting Sequence:
003510.04
000094.04
000094.18

When DTC is Displayed:
When the engine is running and the error is active.

Related Information
The ECU detects low pressure fuel pressure is less than 160 kPa with engine speed above 1700 rpm, or some other programmable values.

Alarm Level:
Warning

Control Unit Response:
Maximum engine power is derated up to 50%.

Additional References:
For more low pressure fuel pressure sensor information, see Low Fuel Pressure Sensor in Section 03, Group 140 earlier in this manual.

For more pressure sensor information, see Pressure Measurement in Section 03, Group 140 earlier in this manual.

For more low pressure fuel system information, see Low Pressure Fuel System Operation in Section 03, Group 130 earlier in this manual.

NOTE: The wiring diagrams provided are for a typical John Deere supplied OEM harness. Wire number, colors, and jumper connectors do not apply to all applications.

For wiring information:
- see 2.4/3.0L ECU WIRING DIAGRAM 3
located in Section 06, Group 210 later in this manual.

IMPORTANT: Do not force probes into connector terminals or damage will result. Use JDG10466 Flex Probe Kit to make measurements in connectors. This will ensure that terminal damage does not occur.

Flex probe information:
- ECU large terminal - Orange/Green
- ECU small terminal - Orange/Blue
- Fuel temperature sensor- Purple/Red
- Fuel system interconnect C34- Yellow/Purple

For more information on connector and terminal testing see Terminal Test in Group 160 earlier in this Section.

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JB81757,000009E -19-24SEP10-2/6

1 Read DTCs and Store Snapshot Information	*NOTE: When DTCs are cleared Snapshot information for ALL DTCs will be cleared.* 1. Ignition ON, engine OFF. 2. Connect Service ADVISOR, see Connecting To Service ADVISOR in Group 160 earlier in this Section. 3. Write down all DTCs and their occurrence count. If any DTCs have Snapshot Capture or Snapshot Recording information save the information. For instructions on saving and using Snapshot Information, see Snapshot Instructions in Group 160 earlier in this Section. 4. Ignition ON, engine running above 1700 rpm. 5. Refresh DTC list. Is 000094.18 active?	**YES:** GO TO 2 **NO:** GO TO 4

JB81757,000009E -19-24SEP10-3/6

2 Low Pressure Fuel System Check	Check fuel system, see Low Pressure Fuel System — Check in Group 155 earlier in this Section. Were any problems found?	**YES:** Fix problem, recheck for DTC 000094.18 **NO:** GO TO 3

JB81757,000009E -19-24SEP10-4/6

3 Diagnostic Code Check	1. Ignition OFF, engine OFF. 2. Connect Service ADVISOR, see Connecting To Service ADVISOR in Group 160 earlier in this Section. 3. Ignition ON, engine running above 1700 rpm. 4. Refresh codes. Is 000094.18 active?	**YES:** Check for applicable DTAC solutions. If none found, open a DTAC case. **NO:** Problem fixed or conditions to duplicate DTC 000094.18 have not been met.

JB81757,000009E -19-24SEP10-5/6

4 Review Snapshot Information	1. Retrieve snapshot information, see Snapshot Instructions earlier in this Group. 2. Review all stored codes. Does information relate to a possible intermittent or operating condition causing the code to become active. 3. Review information to see if you can determine a possible problem or the operating point that causes the code to become active. Did you find a possible problem or the operating point at which the code becomes active?	**YES:** Found a possible problem. Repair possible problem. Retest. **YES:** Found operating point at which the code becomes active. GO TO 2 **NO:** Check for applicable DTAC solutions. If none found, open a DTAC case.

JB81757,000009E -19-24SEP10-6/6

000097.03 — Water In Fuel Signal Out of Range High

The Water In Fuel input voltage exceeds the sensor's high voltage specification.

DN22556,0000056 -19-23JUL10-1/19

000097.03 — Water In Fuel Signal Out of Range High Diagnostic Procedure

Troubleshooting Sequence:
000097.03

When DTC is Displayed:
When ever the ignition is on and the error is active.

Related Information:
The Water In Fuel Input Voltage increases above the sensor's high voltage specification.

Alarm Level:
Warning

Control Unit Response:
The ECU will try to operate in a normal manner.

Additional References:
For more Water In Fuel sensor information, see WATER IN FUEL (WIF) SENSOR in Section 03, Group 140 earlier in this manual.

NOTE: The wiring diagrams provided are for a typical John Deere supplied OEM harness. Wire number, colors, and jumper connectors do not apply to all applications.

For wiring information:
- see 2.4L-3.0L ECU WIRING DIAGRAM 3
located in Section 06, Group 210 later in this manual.

For more information on connector and terminal testing see TERMINAL TEST in Section 04, Group 160 earlier in this manual.

IMPORTANT: When directed to run the HARNESS DIAGNOSTIC MODE TEST the engine temperature should be above freezing. It is recommended that the engine temperature be at least 20° C (68° F). This test is located in Service ADVISOR.

IMPORTANT: Do not force probes into connector terminals or damage will result. Use JDG10466 Connector Adapter Test Kit to make measurements in connectors. This will ensure that terminal damage does not occur.

Flex probe information:
- ECU small terminal - Orange/Blue
- ECU large terminal - Orange/Green
- Water In Fuel Sensor D01 - Purple/Red

DN22556,0000056 -19-23JUL10-2/19

1 Read DTCs and Store Snapshot Information	1. Ignition ON, engine OFF. *NOTE: When DTCs are cleared Snapshot information for ALL DTCs will also be cleared.* 2. Connect Service ADVISOR, see CONNECTING TO SERVICE ADVISOR earlier in this Group. 3. Write down all DTCs and their occurrence count. If any DTCs have snapshot capture or snapshot recording information, save the information. For instructions on saving and using snapshot information, see SNAPSHOT INSTRUCTIONS earlier in this Group. 4. Refresh Codes. Did 000097.03 reappear active?	**YES:** GO TO 2 **NO:** GO TO 12

Continued on next page

DN22556,0000056 -19-23JUL10-3/19

❷ Short to Voltage Check	1. Ignition OFF, Engine OFF.	
	2. Disconnect WIF sensor connector.	
	3. On the harness, measure the voltage between the WIF sensor connector signal (terminal A) and return (terminal B).	**YES:** GO TO 3
	Was the voltage measurement less than 0.5 volts?	**NO:** Repair shorted wiring. Run HARNESS DIAGNOSTIC MODE TEST in Service ADVISOR.

DN22556,0000056 -19-23JUL10-4/19

❸ Terminal Test	1. Ignition OFF, Engine OFF.	
	2. Perform TERMINAL TEST on Water In Fuel sensor harness connector.	**YES:** Repair problem. Run HARNESS DIAGNOSTIC MODE TEST in Service ADVISOR.
	Were any problems found?	**NO:** GO TO 4

DN22556,0000056 -19-23JUL10-5/19

❹ Sensor Resistance Check	On the WIF sensor, measure the resistance between signal (terminal A) and return (terminal B).	**YES:** GO TO 5
	Was the resistance between 200k and 240k ohms?	**NO:** Replace WIF sensor. Run HARNESS DIAGNOSTIC MODE TEST in Service ADVISOR.

DN22556,0000056 -19-23JUL10-6/19

❺ WIF Sensor Circuit Resistance Check	On the harness, measure the resistance between the WIF sensor connector signal (terminal A) and return (terminal B).	**YES:** GO TO 6
	Was the resistance between 6M and 7M ohms?	**NO:** GO TO 8.

DN22556,0000056 -19-23JUL10-7/19

❻ Terminal Test	1. Disconnect ECU connector J1.	
	2. Perform TERMINAL TEST on ECU connector J1.	**YES:** Repair problem. Run HARNESS DIAGNOSTIC MODE TEST in Service ADVISOR.
	Were any problems found?	**NO:** GO TO 7

Continued on next page

DN22556,0000056 -19-23JUL10-8/19

7 Terminal to Terminal Resistance Check	On the harness, measure the resistance between the ECU connector signal (terminal J1-B2) and all other ECU harness connector terminals. Were any resistance less than 100 ohms?	**YES:** Look for pinched or melted harness and repair wiring. Run HARNESS DIAGNOSTIC MODE TEST in Service ADVISOR **NO:** Reconnect all connectors. Run HARNESS DIAGNOSTIC MODE TEST in Service ADVISOR

DN22556,0000056 -19-23JUL10-9/19

8 Harness Return Wire Resistance Check	On the harness, measure the resistance between the WIF sensor connector return (terminal B) and application single point ground. Was the resistance less than 5 ohms?	**YES:** GO TO 9 **NO:** GO TO 10.

DN22556,0000056 -19-23JUL10-10/19

9 Harness Return Wire Resistance Check	On the harness, measure the resistance between the WIF sensor harness connector return (terminal B) and ECU J1 connector return (terminal J1-D2). Was the resistance less than 5 ohms?	**YES:** GO TO 10 **NO:** Repair open wiring. Run HARNESS DIAGNOSTIC MODE TEST in Service ADVISOR

DN22556,0000056 -19-23JUL10-11/19

10 Harness Signal Wire Resistance Check	On the harness, measure the resistance between the WIF sensor harness connector signal (terminal A) and ECU connector J1 signal (terminal J1-B2). Was the resistance less than 5 ohms?	**YES:** GO TO 11 **NO:** Repair open wiring. Run HARNESS DIAGNOSTIC MODE TEST in Service ADVISOR

DN22556,0000056 -19-23JUL10-12/19

11 ECU Resistance Check	On the ECU, measure the resistance between return (terminal J1-D2) and signal (terminal J1-B2). Was the resistance between 6M and 7M ohms?	**YES:** Reconnect all connectors and GO TO 2. **NO:** Replace ECU. Run HARNESS DIAGNOSTIC MODE TEST in Service ADVISOR.

DN22556,0000056 -19-23JUL10-13/19

12 Occurrence Count Check	Review stored information and look at occurrence count for 000097.03. Is occurrence recorded in step 1 greater than 5?	**YES:** GO TO 13 **NO:** GO TO 14

Continued on next page

DN22556,0000056 -19-23JUL10-14/19

13 Terminal Test		
	1. Ignition OFF, Engine OFF	
	2. Disconnect WIF sensor connector.	
	3. Perform TERMINAL TEST on the WIF sensor harness connector.	**YES:** Repair problem. Run HARNESS DIAGNOSTIC MODE TEST in Service ADVISOR.
	Were any problems found?	**NO:** GO TO 14

DN22556,0000056 -19-23JUL10-15/19

14 Further Review of Snapshot Information		
	Review stored information collected in step 1	**YES:** Repair problem if found.
	Does stored information lead to a possible problem or is there a certain operating point where error occurs?	**YES:** If a certain operating point exists when error occurs then GO TO 15 **NO:** GO TO 16

DN22556,0000056 -19-23JUL10-16/19

15 Engine Error Operating Point Test		
	1. Ignition ON, Engine ON	
	2. Set engine to operating point of failure and refresh codes	**YES:** Replace WIF sensor. Run HARNESS DIAGNOSTIC MODE TEST in Service ADVISOR.
	Did 000097.03 reappear when engine operating point was reached?	**NO:** GO TO 14

DN22556,0000056 -19-23JUL10-17/19

16 Terminal Test		
	1. Ignition OFF, Engine OFF	
	2. Disconnect WIF sensor connector and ECU connector J1.	
	3. Perform TERMINAL TEST on the WIF sensor harness connector and ECU connector J1.	**YES:** Repair problem. Run HARNESS DIAGNOSTIC MODE TEST in Service ADVISOR.
	Were any problems found?	**NO:** GO TO 17

DN22556,0000056 -19-23JUL10-18/19

17 Software Updates		
	1. Download latest ECU software payload.	
	2. Reprogram ECU using Service ADVISOR.	
	3. Run HARNESS DIAGNOSTIC MODE TEST in Service ADVISOR.	**YES:** Replace WIF sensor. Run HARNESS DIAGNOSTIC MODE TEST in Service ADVISOR.
	Is 000097.03 active?	**NO:** Problem fixed.

DN22556,0000056 -19-23JUL10-19/19

000097.04 — Water In Fuel Signal Out of Range Low

The Water In Fuel Input Voltage drops below the sensor's low voltage specification.

DN22556,0000057 -19-23JUL10-1/19

000097.04 — Water In Fuel Signal Out of Range Low Diagnostic Procedure

Troubleshooting Sequence:
000097.04

When DTC is Displayed:
When ever the ignition is on and the error is active.

Related Information:
The Water In Fuel Input Voltage drops below the minimum threshold. The voltage is lower than what is physically possible for the Water In Fuel sensor to achieve.

Alarm Level:
Warning

Control Unit Response:
The ECU's will continue to work normally.

Additional References:
For further Water In Fuel sensor information, see WATER IN FUEL (WIF) SENSOR in Section 03, Group 140 earlier in this manual.

NOTE: The wiring diagrams provided are for a typical John Deere supplied OEM harness. Wire number, colors, and jumper connectors do not apply to all applications.

For wiring information:
- see 2.4L-3.0L ECU WIRING DIAGRAM 3
located in Section 06, Group 210 later in this manual.

For more information on connector and terminal testing see TERMINAL TEST in Section 04, Group 160 earlier in this manual.

IMPORTANT: When directed to run the HARNESS DIAGNOSTIC MODE TEST the engine temperature should be above freezing. It is recommended that the engine temperature be at least 20° C (68° F). This test is located in Service ADVISOR.

IMPORTANT: Do not force probes into connector terminals or damage will result. Use JDG10466 Connector Adapter Test Kit to make measurements in connectors. This will ensure that terminal damage does not occur.

Flex probe information:
- ECU small terminal - Orange/Blue
- ECU large terminal - Orange/Green
- Water In Fuel sensor D01 - Purple/Red

Continued on next page

DN22556,0000057 -19-23JUL10-2/19

1 Read DTCs and Store Snapshot Information

1. Ignition ON, engine OFF.

NOTE: When DTCs are cleared Snapshot information for ALL DTCs will also be cleared.

2. Connect Service ADVISOR, see CONNECTING TO SERVICE ADVISOR earlier in this Group.
3. Write down all DTCs and their occurrence count. If any DTCs have snapshot capture or snapshot recording information, save the information. For instructions on saving and using snapshot information, see SNAPSHOT INSTRUCTIONS earlier in this Group.
4. Refresh Codes.

Did 000097.04 reappear active?

YES: GO TO 2

NO: GO TO 10

DN22556,0000057 -19-23JUL10-3/19

2 Monitor Code Test

1. Ignition OFF, Engine OFF.
2. Disconnect the Water In Fuel sensor connector.
3. Ignition ON, Engine OFF
4. Refresh codes.

Did 000097.03 become active and 000097.04 move to stored?

YES: GO TO 3

NO: GO TO 5

DN22556,0000057 -19-23JUL10-4/19

3 Terminal Test

1. Ignition OFF, Engine OFF
2. Perform TERMINAL TEST on Water In Fuel sensor harness connector.
3. Inspect harness for melted or pinched areas near the Water In Fuel sensor.

Were any problems found?

YES: Repair problem. Run HARNESS DIAGNOSTIC MODE TEST in Service ADVISOR.

NO: GO TO 4

DN22556,0000057 -19-23JUL10-5/19

4 Sensor Short to Ground Test

Measure the resistance from each terminal on the sensor to chassis ground.

Specification

Check for short to ground—Resistance..... Greater than 1k ohm

Measure the resistance between the two sensor terminals.

Specification

Check for internal short—Resistance..... Greater than 50 ohms

Is either measurement out of specification?

YES: Replace sensor. Run HARNESS DIAGNOSTIC MODE TEST in Service ADVISOR.

NO: GO TO 2 and confirm your findings. Look closely at connectors, wiring and terminal numbers where measurements were made.

DN22556,0000057 -19-23JUL10-6/19

5 Terminal Test

1. Ignition OFF, Engine OFF
2. Perform TERMINAL TEST on the WIF sensor harness connector.

Were any problems found?

YES: Repair problem. Run HARNESS DIAGNOSTIC MODE TEST in Service ADVISOR.

NO: GO TO 6

Continued on next page

DN22556,0000057 -19-23JUL10-7/19

6 Harness Resistance Check	Measure the resistance between the return (terminal B) and signal (terminal A) in the WIF sensor harness connector. Was the resistance less than 100 ohms?	**YES:** GO TO 7 **NO:** Reconnect all connectors and GO TO 2.

DN22556,0000057 -19-23JUL10-8/19

7 Harness Resistance Check ECU Disconnected	1. Disconnect ECU connector J1. 2. Measure the resistance between the return (terminal B) and signal (terminal A) in the Water In Fuel sensor harness connector. Was the resistance less than 100 ohms?	 **YES:** GO TO 8 **NO:** GO TO 9.

DN22556,0000057 -19-23JUL10-9/19

8 Harness Physical Check	Terminal A has low resistance to ground, check for: • Melted harness and wiring • Pinched harness and wiring. Was the problem found?	 **YES:** Repair problem. Run HARNESS DIAGNOSTIC MODE TEST in Service ADVISOR. **NO:** GO TO 5.

DN22556,0000057 -19-23JUL10-10/19

9 ECU Resistance Check	Measure the resistance between the return (terminal J1-D2) and signal (terminal J1-B2) in the ECU connector. Was the resistance less than 100 ohms?	**YES:** Replace ECU. Run HARNESS DIAGNOSTIC MODE TEST in Service ADVISOR. **NO:** Reconnect all connectors and GO TO 2.

DN22556,0000057 -19-23JUL10-11/19

10 Occurrence Count Check	Review stored information and look at occurrence count for 000097.04. Is occurrence recorded in step 1 greater than 5?	**YES:** GO TO 11 **NO:** GO TO 12

DN22556,0000057 -19-23JUL10-12/19

11 Terminal Test	1. Ignition OFF, Engine OFF 2. Perform TERMINAL TEST on the Water In Fuel sensor harness connector. Were any problems found?	 **YES:** Repair problem, Run HARNESS DIAGNOSTIC MODE TEST in Service ADVISOR. **NO:** GO TO 12

Continued on next page

DN22556,0000057 -19-23JUL10-13/19

12 Further Review of Snapshot Information	Review stored information collected in step 1	**YES:** Repair problem if found.
	Does stored information lead to a possible problem or is there a certain operating point where error occurs?	**YES:** If a certain operating point exists when error occurs then GO TO 13 **NO:** GO TO 15

DN22556,0000057 -19-23JUL10-14/19

13 Engine Error Operating Point Test	1. Ignition ON, Engine ON	
	2. Set engine to operating point of failure and refresh codes	**YES:** GO TO 14
	Did 000097.04 reappear when engine operating point was reached?	**NO:** GO TO 12

DN22556,0000057 -19-23JUL10-15/19

14 Sensor Temperature Test	1. Ignition OFF, Engine OFF	
	2. Check temperature of the Water In Fuel sensor and surrounding areas.	**YES:** Replace Sensor, Run HARNESS DIAGNOSTIC MODE TEST in Service ADVISOR.
	Is everything hot?	**NO:** GO TO 15

DN22556,0000057 -19-23JUL10-16/19

15 Terminal Test	1. Ignition OFF, Engine OFF	
	2. Perform TERMINAL TEST on the Water In Fuel sensor harness connector and ECU J1 connector.	**YES:** Repair problem, Run HARNESS DIAGNOSTIC MODE TEST in Service ADVISOR.
	Were any problems found?	**NO:** GO TO 16

DN22556,0000057 -19-23JUL10-17/19

16 Reconnect and Retest	1. Reconnect all connectors.	
	2. Ignition ON, Engine OFF.	
	3. Run HARNESS DIAGNOSTIC MODE TEST in Service ADVISOR.	
	4. Refresh codes.	**YES:** GO TO 17.
	Is 000097.04 active?	**NO:** GO TO 15.

Continued on next page

DN22556,0000057 -19-23JUL10-18/19

17 Software Updates	1. Check custom performance for possible software updates. If new software is available, reprogram ECU using Service ADVISOR.	
	2. Run HARNESS DIAGNOSTIC MODE TEST in Service ADVISOR.	**YES:** Replace Sensor, Run HARNESS DIAGNOSTIC MODE TEST in Service ADVISOR.
	Is 000097.04 active?	**NO:** Problem fixed, bad ECU program.

DN22556,0000057 -19-23JUL10-19/19

000097.16 — Water In Fuel Detected

The ECU detects water in the fuel.

DN22556,0000058 -19-23JUL10-1/13

000097.16 — Water In Fuel Detected Diagnostic Procedure

Troubleshooting Sequence:
000097.16

Related Information:
The ECU detects water in fuel.

Alarm Level:
Warning

Control Unit Response:
Maximum engine power is derated up to 50 percent.

Additional References:
For more water in fuel sensor information, see WATER IN FUEL (WIF) SENSOR in Section 03, Group 140 earlier in this manual.

For more information on engine protection, see ENGINE DERATE AND SHUTDOWN PROTECTION in Section 03, Group 140 earlier in this manual.

NOTE: The wiring diagrams provided are for a typical John Deere supplied OEM harness. Wire number, colors, and jumper connectors do not apply to all applications.

For wiring information:
- see 2.4L-3.0L ECU WIRING DIAGRAM 3
located in Section 06, Group 210 later in this manual.

For more information on connector and terminal testing see TERMINAL TEST in Section 04, Group 160 earlier in this manual.

IMPORTANT: When directed to run the HARNESS DIAGNOSTIC MODE TEST the engine temperature should be above freezing. It is recommended that the engine temperature be at least 20° C (68° F). This test is located in Service ADVISOR.

IMPORTANT: Do not force probes into connector terminals or damage will result. Use JDG10466 Connector Adapter Test Kit to make measurements in connectors. This will ensure that terminal damage does not occur.

Flex probe information:
- ECU small terminal - Orange/Blue
- ECU large terminal - Orange/Green
- Water In Fuel sensor D01 - Purple/Red

DN22556,0000058 -19-23JUL10-2/13

1 Read DTCs and Store Snapshot Information	1. Ignition ON, engine OFF. *NOTE: When DTCs are cleared Snapshot information for ALL DTCs will be cleared.* 2. Connect Service ADVISOR, see CONNECTING TO SERVICE ADVISOR earlier in this Group. 3. Write down all DTCs and their occurrence count. If any DTCs have snapshot capture or snapshot recording information, save the information. For instructions on saving and using snapshot information, see SNAPSHOT INSTRUCTIONS earlier in this Group. 4. Refresh Codes. Did 000097.16 reappear active?	**YES:** GO TO 2 **NO:** GO TO 6

Continued on next page

DN22556,0000058 -19-23JUL10-3/13

2 Terminal Test	1. Ignition OFF, Engine OFF. 2. Disconnect the water in fuel sensor connector. 3. Perform TERMINAL TEST on the harness and sensor connector. Are there any problems with the wiring or connectors?	**YES:** Repair problem. GO TO 1 **NO:** GO TO 3

DN22556,0000058 -19-23JUL10-4/13

3 WIF Sensor Check	1. Drain all fuel and water from the water separator bowl on the bottom of the final fuel filter into a suitable container for fuel. 2. Wipe off the end of the WIF sensor with a clean dry rag. 3. On the WIF sensor, measure resistance between signal (terminal A) and return (terminal B). Is the resistance between 200k and 240k ohms?	**YES:** GO TO 4 **NO:** Replace WIF sensor. GO TO 1

DN22556,0000058 -19-23JUL10-5/13

4 Check for Engine Related Causes	Check the following items that can cause the water in fuel sensor to trip: • Water and debris in the filter water separator bowl. • Dirty tip of sensor, clean with clean dry cloth. • Water in fuel tank. • Loose fuel tank cap. • Missing or damaged fuel tank cap seal. • Water in fuel source. • If application was washed with a high pressure washer be sure to let connector sit and dry off. Was cause of water in fuel determined?	**YES:** Repair problem. GO TO 1. **NO:** GO TO 5

DN22556,0000058 -19-23JUL10-6/13

5 Fuel Quality Check	Preform fuel quality check, see CHECK FUEL SUPPLY QUALITY in Section 4 Group 150. Did the fuel pass the quality check?	**YES:** GO TO 8 **NO:** See CHECK FUEL SUPPLY QUALITY in Section 4 Group 150.

DN22556,0000058 -19-23JUL10-7/13

6 Occurrence Count Check	Review stored information and look at occurrence count for 0000097.16. Is occurrence recorded in step 1 greater than 5?	**YES:** GO TO 7 **NO:** GO TO 8

Continued on next page

DN22556,0000058 -19-23JUL10-8/13

7 Terminal Test	1. Ignition OFF, Engine OFF	
	2. Perform TERMINAL TEST on the coolant sensor harness connector.	**YES:** Repair problem, Run HARNESS DIAGNOSTIC MODE TEST in Service ADVISOR.
	Were any problems found?	**NO:** GO TO 8

DN22556,0000058 -19-23JUL10-9/13

8 Further Review of Snapshot Information	Review stored information collected in step 1	**YES:** Repair problem if found.
	Does stored information lead to a possible problem or is there a certain operating point where error occurs?	**YES:** If a certain operating point exists when error occurs then GO TO 9 **NO:** GO TO 10

DN22556,0000058 -19-23JUL10-10/13

9 Engine Error Operating Point Test	1. Ignition ON, Engine ON	
	2. Set engine to operating point of failure and refresh codes	**YES:** Replace WIF sensor. GO TO 1
	Did 000097.16 reappear when engine operating point was reached?	**NO:** GO TO 8

DN22556,0000058 -19-23JUL10-11/13

10 Terminal Test	1. Ignition OFF, Engine OFF	
	2. Disconnect coolant temperature sensor connector and ECU connector J1.	
	3. Perform TERMINAL TEST on the coolant sensor harness connector and ECU J1 connector.	**YES:** Repair problem, Run HARNESS DIAGNOSTIC MODE TEST in Service ADVISOR.
	Were any problems found?	**NO:** GO TO 11

DN22556,0000058 -19-23JUL10-12/13

11 Software Updates	1. Download latest ECU software payload, reprogram ECU using Service ADVISOR.	
	2. Run HARNESS DIAGNOSTIC MODE TEST in Service ADVISOR.	**YES:** Replace WIF sensor, Run HARNESS DIAGNOSTIC MODE TEST in Service ADVISOR.
	Is 000097.16 active?	**NO:** Problem fixed, return to service.

DN22556,0000058 -19-23JUL10-13/13

000174.03 — Fuel Temperature Signal Out of Range High

The fuel temperature input voltage exceeds the sensor's high voltage specification.

DN22556,00006BC -19-21APR10-1/24

000174.03 — Fuel Temperature Signal Out of Range High Diagnostic Procedure

Troubleshooting Sequence:
000174.03

When DTC is Displayed:
When ever the ignition is on and the error is active.

Related Information:
The fuel temperature input voltage increases above the sensor's high voltage specification. This corresponds to a temperature that is lower than what is physically possible for fuel temperature.

Alarm Level:
Warning

Control Unit Response:
The ECU uses a default fuel temperature of 40° C (104° F). The ECU will try to maintain the engine operating envelope.

Additional References:
For more fuel temperature sensor information, see Fuel Temperature Sensor in Section 03, Group 140 earlier in this manual.

For more temperature sensor information, see Temperature Measurement in Section 03, Group 140 earlier in this manual.

NOTE: The wiring diagrams provided are for a typical John Deere supplied OEM harness. Wire number, colors, and jumper connectors do not apply to all applications.

For wiring information:
- see 2.4L/3.0L ECU WIRING DIAGRAM 3
located in Section 06, Group 210 later in this manual.

IMPORTANT: Do not force probes into connector terminals or damage will result. Use JDG10466 Connector Adapter Test Kit to make measurements in connectors. This will ensure that terminal damage does not occur.

Flex probe information:
- ECU large terminal - Orange/Green
- ECU small terminal - Orange/Blue
- Fuel temperature sensor- Purple/Red
- Fuel system interconnect C34- Yellow/Purple

For more information on connector and terminal testing see Terminal Test in Section 04, Group 160 earlier in this manual.

IMPORTANT: When directed to run the Harness Diagnostic Mode Test the engine temperature should be above freezing. It is recommended that the engine temperature be at least room temperature 20° C (68° F). This test is located in Service ADVISOR.

Continued on next page

DN22556,00006BC -19-21APR10-2/24

1 Read DTCs and Store Snapshot Information	1. Ignition ON, engine OFF. *NOTE: When DTCs are cleared Snapshot information for ALL DTCs will be cleared.* 2. Connect Service ADVISOR, see Connecting To Service ADVISOR in Group 160 earlier in this Section. 3. Write down all DTCs and their occurrence count. If any DTCs have snapshot capture or snapshot recording information, save the information. For instructions on saving and using snapshot information, see Snapshot Instructions in Group 160 earlier in this Section. 4. Refresh Codes. Did 000174.03 reappear active?	**YES:** GO TO 2 **NO:** GO TO 10

DN22556,00006BC -19-21APR10-3/24

2 Test Fuel Temperature Sensor Connector	Perform Terminal Test on fuel temperature sensor connector T05. Were any problems found?	**YES:** Repair problem. Run Harness Diagnostic Mode Test. **NO:** GO TO 3

DN22556,00006BC -19-21APR10-4/24

3 Check for Short to Power	1. Ignition OFF, Engine OFF. 2. Disconnect fuel temperature sensor T05. 3. On the harness, measure the voltage between fuel temperature sensor connector female socket T05-A and application single point ground. Is voltage less than 0.5 volts	**YES:** GO TO 4 **NO:** Check wiring harness for pinched or melted spot where wires are shorted together. Repair. GO TO 1

DN22556,00006BC -19-21APR10-5/24

4 Sensor Open Test	On the fuel temperature sensor, measure the resistance between male pin T05-A and male pin T05-B. *NOTE: Be sure your fingers are not touching the meter probe tips.* Was the resistance value greater than 7.5M ohms?	**YES:** Replace sensor. Run Harness Diagnostic Mode Test. **NO:** GO TO 5

DN22556,00006BC -19-21APR10-6/24

5 Harness Resistance Check	On the harness, measure the resistance between fuel temperature sensor female socket T05-A and female socket T05-B. Was the resistance between 1k and 3k ohms?	**YES:** GO TO 13 **NO:** GO TO 6

DN22556,00006BC -19-21APR10-7/24

6 Harness Return Wire Resistance Check	On the harness, measure the resistance between fuel temperature sensor connector female socket T05-B and application single point ground. Was the resistance less than 5 ohms?	**YES:** GO TO 11 **NO:** GO TO 7

Continued on next page

DN22556,00006BC -19-21APR10-8/24

7 Test Fuel System Interconnect Connectors	1. Disconnect fuel system interconnect C34.	
	2. Perform Terminal Test on C34.	**YES:** Repair problem. Run Harness Diagnostic Mode Test.
	Were any problems found?	**NO:** GO TO 8

DN22556,00006BC -19-21APR10-9/24

8 Return Wire Resistance Check With Fuel System Interconnect Disconnected	On the harness, measure the resistance between fuel system interconnect male pin C34-2 to application single point ground.	**YES:** Repair open wiring between fuel system interconnect and sensor. Run Harness Diagnostic Mode Test.
	Was the resistance less than 5 ohms?	**NO:** GO TO 9

DN22556,00006BC -19-21APR10-10/24

9 Test ECU Connectors	1. Disconnect ECU J01.	
	2. Perform Terminal Test on J01.	**YES:** Repair problem. Run Harness Diagnostic Mode Test.
	Were any problems found?	**NO:** GO TO 10

DN22556,00006BC -19-21APR10-11/24

10 Harness Return Wire Resistance Check ECU Disconnected	On the harness, measure the resistance between ECU female socket J01-D2 and fuel system interconnect connector male pin C34-2.	**YES:** GO TO 15
	Was the resistance less than 5 ohms?	**NO:** Repair open wiring between ECU J01 and fuel system interconnect C34. Run Harness Diagnostic Mode Test.

DN22556,00006BC -19-21APR10-12/24

11 Test ECU Connector	1. Disconnect ECU connector J01.	
	2. Perform Terminal Test on J01.	**YES:** Repair problem. Run Harness Diagnostic Mode Test.
	Were any problems found?	**NO:** GO TO 12

Continued on next page

DN22556,00006BC -19-21APR10-13/24

12 Harness Signal Wire Resistance Check	On the harness, measure the resistance between ECU J01-F4 and fuel temperature sensor connector T05-A. Was the resistance less than 5 ohms?	**YES:** GO TO 15 **NO:** Repair open wiring between ECU J01 and fuel system interconnect C34. Run Harness Diagnostic Mode Test.

DN22556,00006BC -19-21APR10-14/24

13 Test ECU J01 Connector	1. Disconnect ECU connectors J01 and J02. 2. Perform Terminal Test on J01 and J02. Were any problems found?	 **YES:** Repair problem. Run Harness Diagnostic Mode Test. **NO:** GO TO 14

DN22556,00006BC -19-21APR10-15/24

14 Terminal to Terminal Resistance Check	On the harness, measure the resistance between ECU J01-F4 and all other terminals in connectors J01 and J02. Was any resistance less than 100 ohms?	**YES:** Look for pinched or melted harness and repair wiring. Run Harness Diagnostic Mode Test. **NO:** Reconnect all connectors. Run Harness Diagnostic Mode Test.

DN22556,00006BC -19-21APR10-16/24

15 ECU Resistance Check	On the ECU, measure the resistance between J01-F4 and J01-D2. Was the resistance between 1k and 3k ohms?	**YES:** Problem not found, reconnect all connectors. GO TO 1 and confirm your findings. Look closely at connectors, wiring and terminal numbers where measurements were made. **NO:** Replace and reprogram ECU. Run Harness Diagnostic Mode Test.

DN22556,00006BC -19-21APR10-17/24

16 Occurrence Count Check	Review stored information and look at occurrence count for 000174.03. Is occurrence recorded in step 1 greater than 5?	**YES:** GO TO 17 **NO:** GO TO 18

Continued on next page

DN22556,00006BC -19-21APR10-18/24

17 Terminal Test	1. Ignition OFF, Engine OFF	
	2. Disconnect fuel temperature sensor connector.	
	3. Perform Terminal Test on fuel temperature sensor, harness and connector.	**YES:** Repair problem. Run Harness Diagnostic Mode Test.
	Were any problems found?	**NO:** GO TO 18

DN22556,00006BC -19-21APR10-19/24

18 Further Review of Snapshot Information	Review stored information collected in step 1	**YES:** Repair problem if found.
	Does stored information lead to a possible problem or is there a certain operating point where error occurs?	**YES:** If a certain operating point exists when error occurs then GO TO 19 **NO:** GO TO 20

DN22556,00006BC -19-21APR10-20/24

19 Engine Error Operating Point Test	1. Ignition ON, Engine ON	
	2. Set engine to operating point of failure and refresh codes	**YES:** GO TO 1
	Did 000174.03 reappear when engine operating point was reached?	**NO:** GO TO 18 and confirm operating point information.

DN22556,00006BC -19-21APR10-21/24

20 Terminal Test	1. Ignition OFF, Engine OFF	
	2. Perform Terminal Test on the fuel temperature sensor, harness and connector T05 also ECU J01 connector.	**YES:** Repair problem, Run Harness Diagnostic Mode Test.
	Were any problems found?	**NO:** GO TO 21

DN22556,00006BC -19-21APR10-22/24

21 Reconnect and Retest	1. Reconnect all connectors.	
	2. Ignition ON, Engine OFF.	
	3. Run Harness Diagnostic Mode Test.	
	4. Refresh codes.	**YES:** GO TO 1
	Is 000174.03 active?	**NO:** GO TO 22

Continued on next page

DN22556,00006BC -19-21APR10-23/24

22 Software Updates	1. Download latest ECU software payload and reprogram ECU using SERVICE ADVISOR™.	
	2. Run Harness Diagnostic Mode Test.	**YES:** Replace Sensor, Run Harness Diagnostic Mode Test.
	Is 000174.03 active?	**NO:** Problem fixed, bad ECU program.

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DN22556,00006BC -19-21APR10-24/24

000174.04 — Fuel Temperature Signal Out of Range Low

The fuel temperature input voltage drops below the sensor's low voltage specification.

DN22556,00006BD -19-19APR10-1/18

000174.04 — Fuel Temperature Signal Out of Range Low Diagnostic Procedure

Troubleshooting Sequence:
000174.04

When DTC is Displayed:
When ever the ignition is on and the error is active.

Related Information:
The fuel temperature input voltage drops below the sensor's low voltage specification. This corresponds to a temperature that is higher than what is physically possible for fuel temperature.

Alarm Level:
Warning

Control Unit Response:
The ECU uses a default fuel temperature of 40° C (104° F).

Additional References:
For more temperature sensor information, see Temperature Measurement in Section 03, Group 140 earlier in this manual.

For more fuel temperature sensor information, see Fuel Temperature Sensor in Section 03, Group 140 earlier in this manual.

NOTE: The wiring diagrams provided are for a typical John Deere supplied OEM harness. Wire number, colors, and jumper connectors do not apply to all applications.

For wiring information:
- see 2.4L/3.0L ECU WIRING DIAGRAM 3
located in Section 06, Group 210 later in this manual.

IMPORTANT: Do not force probes into connector terminals or damage will result. Use JDG10466 Connector Adapter Test Kit to make measurements in connectors. This will ensure that terminal damage does not occur.

Flex probe information:
- ECU large terminal - Orange/Green
- ECU small terminal - Orange/Blue
- Fuel temperature sensor- Purple/Red
- Fuel system interconnect C34- Yellow/Purple

For more information on connector and terminal testing see Terminal Test in Section 04, Group 160 earlier in this manual.

IMPORTANT: When directed to run the Harness Diagnostic Mode Test the engine temperature should be above freezing. It is recommended that the engine temperature be at least room temperature 20° C (68° F). This test is located in Service ADVISOR.

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DN22556,00006BD -19-19APR10-2/18

1 Read DTCs and Store Snapshot Information

1. Ignition ON, engine OFF.

NOTE: When DTCs are cleared Snapshot information for ALL DTCs will be cleared.

2. Connect Service ADVISOR, see Connecting To Service ADVISOR in Group 160 earlier in this Section.
3. Write down all DTCs and their occurrence count. If any DTCs have snapshot capture or snapshot recording information, save the information. For instructions on saving and using snapshot information, see Snapshot Instructions in Group 160 earlier in this Section.
4. Refresh Codes.

Did 000174.04 reappear active?

YES: GO TO 2
NO: GO TO 10

DN22556,00006BD -19-19APR10-3/18

2 Test Fuel Temperature Sensor Connector

1. Ignition OFF, Engine OFF
2. Disconnect fuel temperature sensor connector T05.
3. Perform Terminal Test on T05.

Were any problems found?

YES: Repair problem. Run Harness Diagnostic Mode Test.
NO: GO TO 3

DN22556,00006BD -19-19APR10-4/18

3 Monitor Diagnostic Code With Sensor Disconnected

1. Ignition ON, Engine OFF
2. Refresh codes.

Did 000174.03 become active and 000174.04 move to stored?

YES: GO TO 9
NO: GO TO 4

DN22556,00006BD -19-19APR10-5/18

4 Test Fuel System Interconnect Connector

1. Ignition OFF, Engine OFF
2. Disconnect fuel system interconnect connector C34.
3. Perform Terminal Test on C34.

Were any problems found?

YES: Repair problem. Run Harness Diagnostic Mode Test.
NO: GO TO 5

DN22556,00006BD -19-19APR10-6/18

5 Monitor Diagnostic Code With Fuel System Interconnect Disconnected

1. Ignition ON, Engine OFF
2. Refresh codes.

Did 000174.03 become active and 000174.04 move to stored?

YES: Repair short in wiring harness between fuel system interconnect C34 and sensor T05
NO: GO TO 6

Continued on next page

DN22556,00006BD -19-19APR10-7/18

6 Test ECU J01 Connector	1. Ignition OFF, Engine OFF	
	2. Disconnect ECU connector J01.	
	3. Perform Terminal Test on J01.	**YES:** Repair problem. Run Harness Diagnostic Mode Test.
	Were any problems found?	**NO:** GO TO 7

DN22556,00006BD -19-19APR10-8/18

7 Monitor Diagnostic Code With ECU J01 Disconnected	1. Ignition ON, Engine OFF	
	2. Refresh codes.	**YES:** Repair short in wiring between fuel system interconnect C34 and ECU J01
	Did 000174.03 become active and 000174.04 move to stored?	**NO:** GO TO 8

DN22556,00006BD -19-19APR10-9/18

8 ECU Resistance Check	On the ECU, measure the resistance between male pin J01-D2 and male pin J01-F4.	**YES:** Problem not found, reconnect all connectors. GO TO 2 and confirm your findings. Look closely at connectors, wiring and terminal numbers where measurements were made.
	Was the resistance between 1k and 3k ohms?	**NO:** Replace and reprogram ECU. Run Harness Diagnostic Mode Test.

DN22556,00006BD -19-19APR10-10/18

9 Sensor Short to Ground Test	On the fuel temperature sensor, measure the resistance from:	
	• male pin A to chassis ground.	
	• male pin B to chassis ground.	**YES:** Replace sensor. Run Harness Diagnostic Mode Test.
	Was either resistance value less than 100 ohms?	**NO:** Problem not found, reconnect all connectors. GO TO 2 and confirm your findings. Look closely at connectors, wiring and terminal numbers where measurements were made.

Continued on next page

DN22556,00006BD -19-19APR10-11/18

10 Occurrence Count Check	Review stored information and look at occurrence count for 000174.04. Is occurrence recorded in step 1 greater than 5?	**YES:** GO TO 11 **NO:** GO TO 12

DN22556,00006BD -19-19APR10-12/18

11 Test Connectors	1. Ignition OFF, Engine OFF 2. Disconnect fuel temperature sensor T05, fuel system interconnect C34. 3. Perform Terminal Test on T05 and C34. Were any problems found?	 **YES:** Repair problem. Run Harness Diagnostic Mode Test. **NO:** Reconnect all connectors. GO TO 12

DN22556,00006BD -19-19APR10-13/18

12 Further Review of Snapshot Information	Review stored information collected in step 1. Does stored information lead to a possible problem or is there a certain operating point where error occurs?	**YES:** Repair problem if found. **YES:** If a certain operating point exists when error occurs, GO TO 13 **NO:** GO TO 15

DN22556,00006BD -19-19APR10-14/18

13 Engine Error Operating Point Test	1. Ignition ON, Engine ON. 2. Set engine to operating point of failure and refresh codes. Did 000174.04 reappear when engine operating point was reached?	 **YES:** GO TO 14 **NO:** GO TO 12 and confirm operating point.

DN22556,00006BD -19-19APR10-15/18

14 Terminal Test	1. Ignition OFF, Engine OFF 2. Disconnect fuel temperature sensor T05, fuel system interconnect C34 and ECU J01 connector. 3. Perform Terminal Test on T05, C34 and J01. Were any problems found?	 **YES:** Repair problem. Run Harness Diagnostic Mode Test. **NO:** GO TO 15

DN22556,00006BD -19-19APR10-16/18

15 Reconnect and Retest	1. Reconnect all connectors. 2. Ignition ON, Engine OFF. 3. Run Harness Diagnostic Mode Test. 4. Refresh codes. Is 000174.04 active?	 **YES:** GO TO 1 **NO:** GO TO 16

Continued on next page

DN22556,00006BD -19-19APR10-17/18

16 Software Updates	1. Download latest ECU software payload and reprogram ECU using Service ADVISOR. 2. Run Harness Diagnostic Mode Test. 3. Refresh codes. Is 000174.04 active?	**YES:** GO TO 1 **NO:** Replace fuel temperature sensor. Run Harness Diagnostic Mode Test.

DN22556,00006BD -19-19APR10-18/18

000611.03 — Electronic Unit Pump Circuit Shorted to Voltage Source

The ECU detects that electronic unit pump wiring is shorted to a voltage source.

JB81757,0000062 -19-21APR10-1/18

000611.03 — Electronic Unit Pump Circuit Shorted to Voltage Source Diagnostic Procedure

Troubleshooting Sequence:
000611.03

When DTC is Displayed:
The engine is cranking or running and the error condition is active. The DTC may also be displayed during the Harness Diagnostic Mode Test in Service ADVISOR.

Related Information:
The ECU detects that unit pump wiring is shorted to a voltage source.
The ECU has two internally-connected terminals which provide a shared high voltage supply (+90V) to all the unit pumps. The ECU switches the low side (ground) to control each individual unit pump.
This DTC can be caused by either the unit pump high side wiring or unit pump low side wiring being shorted to a voltage source.

Alarm Level:
Stop

Control Unit Response:
The ECU will attempt to control the engine in a normal manner. Engine may run poorly or stall, depending on the location of short.

Additional References:
For further electronic unit pump information, see Electronic Unit Pump and Injector Nozzle Operation in Section 03, Group 130 earlier in this manual.

NOTE: The wiring diagrams provided are for a typical John Deere supplied OEM harness. Wire number, colors, and jumper connectors do not apply to all applications.

For wiring information see 2.4L ECU WIRING DIAGRAM 1 or 3.0L ECU WIRING DIAGRAM 2 located in Section 06, Group 210 later in this manual.

Flex probe information:
- ECU large terminal - Orange/Green
- ECU small terminal - Orange/Blue
- Unit pump connector C01 - Yellow/Purple

For more information on connector and terminal testing see Terminal Test in Section 04, Group 160 earlier in this manual.

IMPORTANT: When directed to run the Harness Diagnostic Mode Test the engine temperature should be above freezing. It is recommended that the engine temperature be at least room temperature 20° C (68° F). This test is located in Service ADVISOR.

IMPORTANT: Do not force probes into connector terminals or damage will result. Use JDG10466 Connector Adapter Test Kit to make measurements in connectors. This will ensure that terminal damage does not occur.

Continued on next page

JB81757,0000062 -19-21APR10-2/18

1 Read DTCs and Store Snapshot Information	1. Ignition ON, engine OFF. *NOTE: When DTCs are cleared Snapshot information for ALL DTCs will also be cleared.* 2. Connect Service ADVISOR, see Connecting To Service ADVISOR earlier in this Group. 3. Write down all DTCs and their occurrence count. If any DTCs have snapshot capture or snapshot recording information, save the information. For instructions on saving and using snapshot information, see Snapshot Instructions earlier in this Group. 4. Refresh DTCs. 5. Perform Harness Diagnostic Mode Test in SERVICE ADVISOR™. Did 000611.03 reappear active?	**YES:** GO TO 2 **NO:** GO TO 12

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JB81757,0000062 -19-21APR10-3/18

2 Check for DTC Change with Unit Pump Harness Disconnected	**⚠ CAUTION: Unit pumps are supplied with 90V. Electric shock hazard if ignition is ON!** *NOTE: See FUEL SYSTEM COMPONENTS located in Section 02, Group 90 earlier in this manual for component locations.* 1. Ignition OFF, engine OFF. 2. Disconnect 6-way connector C01 between engine harness and unit pump harness. 3. Ignition ON, engine OFF. 4. Refresh DTCs 5. Perform Harness Diagnostic Mode Test in Service ADVISOR. Is DTC 000611.03 still active? *NOTE: Ignore DTCs for high resistance in all unit pump circuits that may now be active because of this test.*	**YES:** GO TO 5 **NO:** GO TO 3

JB81757,0000062 -19-21APR10-4/18

3 Terminal Test	1. Ignition OFF, engine OFF. 2. Perform Terminal Test on unit pump harness connector C01. Were any problems found?	**YES:** Fix problem. GO TO 11 **NO:** GO TO 4

JB81757,0000062 -19-21APR10-5/18

4 Inspect Unit Pump Harness	1. Remove rocker cover. 2. Inspect unit pump harness for damage that would cause a short to a voltage source. *NOTE: Check for contact between unit pump terminals and the non-insulated glow plug bus bar. Such contact could cause DTC 000611.03 to only be active when glow plugs are energized and DTC 000611.04 to be active when glow plugs are NOT energized.* Were any problems found?	**YES:** Fix problem. GO TO 11 **NO:** Reconnect C01 and check for intermittent wiring problem. GO TO 1

Continued on next page

JB81757,0000062 -19-21APR10-6/18

5 ECU Terminal Test

1. Ignition OFF, engine OFF.
2. Disconnect ECU J01 connector.
3. Perform Terminal Test on J01.

Were any problems found?

YES: Fix problem. GO TO 11

NO: GO TO 6

JB81757,0000062 -19-21APR10-7/18

6 Check Engine Harness for Correct Pin Out

NOTE: Two parallel circuits in the engine harness provide the 90V supply to the unit pumps. The two circuits are spliced together approximately 250 mm (10 inches) from the C01 connector and pass through connector C01-6 as a single circuit.

On the engine harness, measure the resistance between the following unit pump circuit terminals in the J01 connector and the 6-way unit pump connector C01:

- Terminal J01-G1 to C01-6
- Terminal J01-G2 to C01-6
- Terminal J01-B1 to C01-3 (with 3.0L).
- Terminal J01-C1 to C01-5
- Terminal J01-D1 to C01-4
- Terminal J01-E1 to C01-1
- Terminal J01-F1 to C01-2

Are all resistance readings less than 10 ohms?

YES: GO TO 7

NO: Fix problem. GO TO 11

JB81757,0000062 -19-21APR10-8/18

7 Check 90V Supply Circuit for Short to Voltage

1. Reconnect engine harness to unit pump harness connector C01.
2. Ignition ON, engine OFF.
3. On the harness, measure the voltage from ECU J01-G1 (+) to single point ground (-).

Is voltage greater than 0.5V?

YES: Fix problem. GO TO 11

NO: GO TO 8

JB81757,0000062 -19-21APR10-9/18

8 Check 90V Supply Circuit for Wire-to-Wire Short

1. Ignition OFF, engine OFF.
2. On the harness, measure the resistance between ECU J01-G1 and all other terminals in the J01 connector EXCEPT the following terminals:
   - J01-G2
   - J01-B1
   - J01-C1
   - J01-D1
   - J01-E1
   - J01-F1

Are all resistance readings greater than 10k ohms?

YES: GO TO 9

NO: Fix problem. GO TO 11

Continued on next page

JB81757,0000062 -19-21APR10-10/18

9 Reprogram ECU	1. Ignition OFF, engine OFF. 2. Reconnect all connectors. 3. Download latest ECU payload and reprogram ECU. 4. Ignition ON, engine OFF. 5. Refresh DTCs. 6. Perform Harness Diagnostic Mode Test in Service ADVISOR. Did DTC 000611.03 reappear active?	**YES:** GO TO 10 **NO:** Problem fixed.

JB81757,0000062 -19-21APR10-11/18

10 Replace ECU	1. Ignition OFF, engine OFF. 2. Replace ECU. 3. Ignition ON, engine OFF. 4. Refresh DTCs. 5. Perform Harness Diagnostic Mode Test in Service ADVISOR. Did DTC 000611.03 reappear active?	**YES:** Open DTAC case. **NO:** Problem fixed.

JB81757,0000062 -19-21APR10-12/18

11 Verification	1. Ignition OFF, engine OFF. 2. Reconnect all connectors. 3. Ignition ON, engine OFF. 4. Refresh DTCs. 5. Perform Harness Diagnostic Mode Test in Service ADVISOR. Did DTC 000611.03 reappear active?	**YES:** GO TO 2 **NO:** Problem fixed.

JB81757,0000062 -19-21APR10-13/18

12 Further Review of Snapshot Information	Review stored information collected in step 1 Does stored information lead to a possible problem or is there a certain operating point where error occurs?	**YES:** Fix problem if found. **YES:** If a certain operating point exists when error occurs then GO TO 13 **NO:** GO TO 14

JB81757,0000062 -19-21APR10-14/18

13 Engine Error Operating Point Test	1. Ignition ON, engine ON 2. Set engine to operating point of failure and refresh codes. Did 000611.03 reappear active when engine operating point was reached?	**YES:** GO TO 2 **NO:** GO TO 14

Continued on next page

JB81757,0000062 -19-21APR10-15/18

14 Terminal Test and Harness Inspection

CAUTION: Unit pumps are supplied with 90V. Electric shock hazard if ignition is ON!

1. Ignition OFF, engine OFF
2. Perform Terminal Test on the ECU J01 connector and unit pump harness connector C01.
3. Remove rocker cover.
4. Inspect engine wire harness and unit pump harness carefully for damage which may cause an intermittent short to a voltage source.

NOTE: Check for contact between unit pump terminals and the non-insulated glow plug bus bar. Such contact could cause DTC 000611.03 to only be active when glow plugs are energized and DTC 000611.04 to be active when glow plugs are NOT energized.

Were any problems found?

YES: Fix problem. GO TO 11

NO: GO TO 15

JB81757,0000062 -19-21APR10-16/18

15 Reconnect and Retest

1. Reconnect all connectors and reinstall rocker cover.
2. Ignition ON, engine ON.
3. Refresh DTCs.
4. Gently wiggle wire harness between ECU and connector C01.

CAUTION: Use caution when working near rotating components.

Is 000611.03 active with engine running?

YES: GO TO 2.

NO: GO TO 16.

JB81757,0000062 -19-21APR10-17/18

16 Reprogram ECU

1. Download latest ECU payload and reprogram ECU.
2. Ignition ON, engine ON.
3. Refresh DTCs.

Is 000611.03 active with engine running?

YES: GO TO 2

NO: Problem fixed or conditions to generate 000611.03 have not been duplicated.

JB81757,0000062 -19-21APR10-18/18

000611.04 — Electronic Unit Pump Circuit Shorted to Ground

The ECU detects that electronic unit pump wiring is shorted to ground.

JB81757,0000063 -19-31MAY10-1/20

000611.04 — Unit Pump Shorted to Ground Diagnostic Procedure

Troubleshooting Sequence:
000611.04

When DTC is Displayed:
The engine is cranking or running and the error condition is active. The DTC may also displayed during the Harness Diagnostic Mode Test in Service ADVISOR.

Related Information:
The ECU detects that unit pump wiring is shorted to ground.
The ECU has two internally-connected terminals which provide a shared high voltage supply to all the unit pumps. The ECU switches the low side (ground) to control each individual unit pump.
This DTC can be caused by a short to ground of unit pump high side or low side wiring, or by a unit pump coil that is shorted to ground.

Alarm Level:
Stop

Control Unit Response:
The ECU will attempt to control the engine in a normal manner. Engine may run poorly or stall, depending on the location of short.

Additional References:
For further electronic unit pump information, see Electronic Unit Pump and Injector Nozzle Operation in Section 03, Group 130 earlier in this manual.

NOTE: The wiring diagrams provided are for a typical John Deere supplied OEM harness. Wire number, colors, and jumper connectors do not apply to all applications.

For wiring information see 2.4L ECU WIRING DIAGRAM 1 or 3.0L ECU WIRING DIAGRAM 2 located in Section 06, Group 210 later in this manual.

Flex probe information:
- ECU large terminal - Orange/Green
- ECU small terminal - Orange/Blue
- Unit pump connector C01 - Yellow/Purple

For more information on connector and terminal testing or flex probes see Terminal Test in Section 04, Group 160 earlier in this manual.

IMPORTANT: When directed to run the Harness Diagnostic Mode Test the engine temperature should be above freezing. It is recommended that the engine temperature be at least room temperature 20° C (68° F). This test is located in Service ADVISOR.

IMPORTANT: Do not force probes into connector terminals or damage will result. Use JDG10466 Connector Adapter Test Kit to make measurements in connectors. This will ensure that terminal damage does not occur.

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JB81757,0000063 -19-31MAY10-2/20

1 Read DTCs and Store Snapshot Information	1. Ignition ON, engine OFF. *NOTE: When DTCs are cleared Snapshot information for ALL DTCs will also be cleared.* 2. Connect Service ADVISOR, see Connecting To Service ADVISOR earlier in this Group. 3. Write down all DTCs and their occurrence count. If any DTCs have snapshot capture or snapshot recording information, save the information. For instructions on saving and using snapshot information, see Snapshot Instructions earlier in this Group. 4. Refresh DTCs. 5. Perform Harness Diagnostic Mode Test in Service ADVISOR. Did 000611.04 reappear active?	**YES:** GO TO 2 **NO:** GO TO 14

JB81757,0000063 -19-31MAY10-3/20

2 Check for DTC Change with Unit Pump Harness Disconnected	**⚠ CAUTION: Unit pumps are supplied with 90V. Electric shock hazard if ignition is ON!** *NOTE: See FUEL SYSTEM COMPONENTS located in Section 02, Group 90 earlier in this manual for component locations.* 1. Ignition OFF, engine OFF. 2. Disconnect 6-way connector C01 between engine harness and unit pump harness. 3. Ignition ON, engine OFF. 4. Refresh DTCs 5. Perform Harness Diagnostic Mode Test in Service ADVISOR. *NOTE: Ignore DTCs for high resistance in all unit pump circuits that may now be active because of this test.* Is DTC 000611.04 still active?	**YES:** GO TO 7 **NO:** GO TO 3

JB81757,0000063 -19-31MAY10-4/20

3 Terminal Test	1. Ignition OFF, engine OFF. 2. Perform Terminal Test on unit pump harness connector C01. Were any problems found?	**YES:** Fix problem. GO TO 13 **NO:** GO TO 4

JB81757,0000063 -19-31MAY10-5/20

4 Check Unit Pump Harness for Short to Ground	On the unit pump harness (male pin terminals), measure the resistance between each terminal of the unit pump harness connector and single point ground. Are all resistance readings greater than 10k ohms?	**YES:** Reconnect C01. Check for intermittent wiring problem. GO TO 1 **NO:** GO TO 5

Continued on next page

JB81757,0000063 -19-31MAY10-6/20

5 Inspect Unit Pump Harness

1. Remove rocker cover.
2. Inspect unit pump harness for damage that would cause a short to ground.

NOTE: Check for contact between unit pump terminals and the non-insulated glow plug bus bar. Such contact could cause DTC 000611.03 to be active when glow plugs are energized and DTC 000611.04 to be active when glow plugs are NOT energized.

Were any problems found?

YES: Replace unit pump harness. GO TO 13

NO: GO TO 6

JB81757,0000063 -19-31MAY10-7/20

6 Check Unit Pump Coils for Short to Ground

1. Loosen all unit pump terminal nuts.
2. Lift unit pump terminals away from unit pump studs.
3. On each of the unit pumps, measure the resistance between each unit pump stud and single point ground.

Are all resistance readings greater than 10k ohms?

YES: Recheck for intermittent short of pump wire harness or pump coils to ground.

NO: Replace unit pump(s) having less than 10k ohms of resistance to ground. GO TO 13

JB81757,0000063 -19-31MAY10-8/20

7 ECU Terminal Test

1. Ignition OFF, engine OFF.
2. Disconnect ECU J01 connector.
3. Perform Terminal Test on J01

Were any problems found?

YES: Fix problem. GO TO 13

NO: GO TO 8

JB81757,0000063 -19-31MAY10-9/20

8 Check Engine Harness for Correct Pin Out

NOTE: Two parallel circuits in the engine harness provide the 90V supply to the unit pumps. The two circuits are spliced together approximately 250 mm (10 inches) from the C01 connector and pass through connector C01-6 as a single circuit.

On the engine harness, measure the resistance between the following unit pump circuit terminals in the J01 connector and the 6-way unit pump connector:

- Terminal J01-G1 to C01-6
- Terminal J01-G2 to C01-6
- Terminal J01-B1 to C01-3 (with 3.0L).
- Terminal J01-C1 to C01-5
- Terminal J01-D1 to C01-4
- Terminal J01-E1 to C01-1
- Terminal J01-F1 to C01-2

Are all resistance readings less than 10 ohms?

YES: GO TO 9

NO: Fix problem. GO TO 13

Continued on next page

JB81757,0000063 -19-31MAY10-10/20

9 Check 90V Supply Circuit for Short to Ground	1. Reconnect engine harness to unit pump harness connector. 2. On the harness, measure the resistance between ECU J01-G1 and single point ground. Is resistance greater than 10k ohms?	**YES:** GO TO 10 **NO:** Fix problem. GO TO 13

JB81757,0000063 -19-31MAY10-11/20

10 Check 90V Supply Circuit for Wire-to-Wire Short	On the harness, measure the resistance between ECU J01-G1 and all other terminals in the J01 connector EXCEPT the following terminals: • J01-G2 • J01-B1 • J01-C1 • J01-D1 • J01-E1 • J01-F1 Are all resistance readings greater than 10k ohms?	**YES:** GO TO 11 **NO:** Fix problem. GO TO 13

JB81757,0000063 -19-31MAY10-12/20

11 Reprogram ECU	*NOTE: See INSTALL ELECTRONIC UNIT PUMP (EUP) in Section 02, Group 90 earlier in this manual for unit pump terminal torque specification.* 1. Ignition OFF, engine OFF. 2. Reconnect all connectors and reinstall rocker cover, if removed. 3. Download latest ECU payload and reprogram ECU. 4. Ignition ON, engine OFF. 5. Refresh DTCs. 6. Perform Harness Diagnostic Mode Test in Service ADVISOR. Did DTC 000611.04 reappear active?	**YES:** GO TO 12 **NO:** Problem fixed.

JB81757,0000063 -19-31MAY10-13/20

12 Replace ECU	1. Ignition OFF, engine OFF. 2. Replace ECU. 3. Ignition ON, engine OFF. 4. Refresh DTCs. 5. Perform Harness Diagnostic Mode Test in Service ADVISOR. Did DTC 000611.04 reappear active?	**YES:** Open DTAC case. **NO:** Problem fixed.

Continued on next page

JB81757,0000063 -19-31MAY10-14/20

13 Verification

NOTE: See Electronic Unit Pump — Installation in Section 02, Group 90 earlier in this manual for unit pump terminal torque specification.

1. Ignition OFF, engine OFF.
2. Reconnect all connectors and reinstall rocker cover, if removed.
3. Ignition ON, engine OFF.
4. Monitor DTCs in Service ADVISOR.
5. Refresh DTCs.
6. Perform Harness Diagnostic Mode Test in Service ADVISOR.

Did DTC 000611.04 reappear active?

YES: GO TO 2
NO: Problem fixed.

JB81757,0000063 -19-31MAY10-15/20

14 Further Review of Snapshot Information

Review stored information collected in step 1

YES: Fix problem if found.

Does stored information lead to a possible problem or is there a certain operating point where error occurs?

YES: If a certain operating point exists when error occurs then GO TO 15
NO: GO TO 16

JB81757,0000063 -19-31MAY10-16/20

15 Engine Error Operating Point Test

1. Ignition ON, engine ON
2. Set engine to operating point of failure and refresh codes.

Did 000611.04 reappear active when engine operating point was reached?

YES: GO TO 2
NO: GO TO 16

JB81757,0000063 -19-31MAY10-17/20

16 Terminal Test and Harness Inspection

CAUTION: Unit Pumps are supplied with 90V. Electric shock hazard if ignition is ON!

1. Ignition OFF, engine OFF
2. Perform Terminal Test on the ECU J01 connector and unit pump harness connector.
3. Remove rocker cover.
4. Inspect engine wire harness and unit pump harness carefully for damage which may cause an intermittent short to ground.

YES: Fix problem. GO TO 13

NOTE: Check for contact between unit pump terminals and the non-insulated glow plug bus bar. Such contact could cause DTC 000611.03 to be active when glow plugs are energized and DTC 000611.04 to be active when glow plugs are NOT energized.

Were any problems found?

NO: GO TO 17

JB81757,0000063 -19-31MAY10-18/20

17 Reconnect and Retest

1. Reconnect all connectors.
2. Ignition ON, engine OFF.
3. Refresh DTCs.
4. Gently wiggle wire harness between ECU and connector C01.

YES: GO TO 2.

CAUTION: Use caution when working near rotating components.

Is 000611.04 active with engine running?

NO: GO TO 18.

Continued on next page

JB81757,0000063 -19-31MAY10-19/20

18 Reprogram ECU	1. Download latest ECU payload and reprogram ECU. 2. Ignition ON, engine OFF. 3. Refresh DTCs. Is 000611.04 active with engine running?	**YES:** GO TO 2 **NO:** Problem fixed or conditions to generate 000611.04 have not been duplicated.

JB81757,0000063 -19-31MAY10-20/20

003597.01 — All Electronic Unit Pump Circuits Have High Resistance

The ECU detects that all electronic unit pump circuits have high resistance.

JB81757,0000064 -19-20APR10-1/18

003597.01— All Electronic Unit Pump Circuits Have High Resistance Diagnostic Procedure

Troubleshooting Sequence:
003597.18
003597.01

When DTC is Displayed:
The engine is cranking or running and the error condition is active. The DTC may also be generated during Harness Diagnostic Mode Test in Service ADVISOR.

Related Information:
The ECU detects high resistance in all unit pump circuits.
The ECU has two internally-connected terminals which provide a shared high voltage supply to all the unit pumps. The ECU switches the low side (ground) to control each individual unit pump.
This DTC can be caused by an open circuit or by a few additional ohms of resistance in the unit pump circuits.
This DTC can also be caused by a low ECU voltage supply.

Alarm Level:
Warning

Control Unit Response:
The ECU will attempt to control the engine in a normal manner, but the engine may not run due to low unit pump current.

Additional References:
For further electronic unit pump information, see Electronic Unit Pump and Injector Nozzle Operation in Section 03, Group 130 earlier in this manual.

NOTE: The wiring diagrams provided are for a typical John Deere supplied OEM harness. Wire number, colors, and jumper connectors do not apply to all applications.

For wiring information see 2.4L ECU WIRING DIAGRAM 1 or 3.0L ECU WIRING DIAGRAM 2 located in Section 06, Group 210 later in this manual.

Flex probe information:
- ECU large terminal - Orange/Green
- ECU small terminal - Orange/Blue
- Unit pump connector C01 - Yellow/Purple

For more information on connector and terminal testing or flex probes see Terminal Test in Section 04, Group 160 earlier in this manual.

IMPORTANT: When directed to run the Harness Diagnostic Mode Test the engine temperature should be above freezing. It is recommended that the engine temperature be at least room temperature 20° C (68° F). This test is located in Service ADVISOR.

IMPORTANT: Do not force probes into connector terminals or damage will result. Use JDG10466 Connector Adapter Test Kit to make measurements in connectors. This will ensure that terminal damage does not occur.

Continued on next page

JB81757,0000064 -19-20APR10-2/18

1 Read DTCs and Store Snapshot Information

1. Ignition ON, engine OFF.

NOTE: When DTCs are cleared Snapshot information for ALL DTCs will also be cleared.

2. Connect Service ADVISOR, see Connecting To Service ADVISOR earlier in this Group.
3. Write down all DTCs and their occurrence count. If any DTCs have snapshot capture or snapshot recording information, save the information. For instructions on saving and using snapshot information, see Snapshot Instructions earlier in this Group.
4. Refresh DTCs.
5. Perform Harness Diagnostic Mode Test in Service ADVISOR.

Did 003597.01 reappear active?

YES: GO TO 2

NO: GO TO 12

JB81757,0000064 -19-20APR10-3/18

2 Check ECU Battery Voltage Supply

NOTE: High resistance in the ECU battery supply or ground circuits may cause DTC 003597.01.

1. Ignition ON, engine OFF.
2. Measure battery terminal voltage.
3. Monitor Battery Voltage data point in Service ADVISOR.

Is battery terminal voltage greater than 12.2V (12V system) or 24.4V (24V system) and is Battery Voltage data point within 0.5V of battery terminal voltage?

YES: GO TO 3

NO: Recharge application batteries or determine cause of low ECU voltage. GO TO 11

JB81757,0000064 -19-20APR10-4/18

3 Check Connectors

CAUTION: Electronic Unit Pumps are supplied with 90V. Electric shock hazard if ignition is ON!

1. Ignition OFF, engine OFF.
2. Verify engine harness 6-way connector C01 in engine block is fully attached to unit pump harness connector.
3. Verify ECU J01 connector is fully attached to ECU.

Were any problems found?

YES: Fix problem. GO TO 11

NO: GO TO 4

JB81757,0000064 -19-20APR10-5/18

4 Terminal Test

1. Disconnect engine harness 6-way connector C01 from unit pump harness connector.
2. Perform Terminal Test on connector C01.

Were any problems found?

YES: Fix problem. GO TO 11

NO: GO TO 5

JB81757,0000064 -19-20APR10-6/18

5 Check Unit Pump #1 Circuit for High Resistance

NOTE: DTC 003597.01 will only be set if all unit pumps have high resistance. This check used to verify that at least one unit pump circuit has continuity.

On the unit pump harness 6-way connector C01 in engine block (male pin terminals), measure the resistance between C01-6 and C01-1.

Is resistance less than 8 ohms?

YES: GO TO 6

NO: Fix problem. GO TO 11

Continued on next page

JB81757,0000064 -19-20APR10-7/18

6 ECU Terminal Test and Power Supply Resistance Check

1. Disconnect application battery negative cable.
2. Disconnect ECU J01 and J02 connectors.
3. Perform Terminal Test on J01 and J02.
4. On the harness, measure the resistance between the ECU J02-L1 and the battery positive cable.
5. On the harness, measure the resistance between the ECU J02-L1 and the disconnected battery negative cable terminal.

Are Terminal Test results good and are both resistance measurements less than 2 ohms?

YES: GO TO 7

NO: Fix problem. GO TO 11

JB81757,0000064 -19-20APR10-8/18

7 Check Engine Harness for High Resistance

NOTE: Two parallel circuits in the engine harness provide the 90V supply to the unit pumps. The two circuits are spliced together approximately 250 mm (10 inches) from the C01 connector and pass through connector C01-6 as a single circuit. A poor connection at the splice may cause an intermittent open circuit.

On the engine harness, measure the resistance between the following unit pump circuit terminals in the J01 connector and the 6-way unit pump connector:

- Terminal J01-G1 to C01-6
- Terminal J01-G2 to C01-6
- Terminal J01-B1 to C01-3 (with 3.0L).
- Terminal J01-C1 to C01-5
- Terminal J01-D1 to C01-4
- Terminal J01-E1 to C01-1
- Terminal J01-F1 to C01-2

Are all resistance readings less than 2 ohms?

YES: GO TO 8

NO: Fix problem. GO TO 11

JB81757,0000064 -19-20APR10-9/18

8 Check Electronic Unit Pump Circuits for High Resistance

1. Reconnect engine harness to unit pump harness 6-way connector C01.
2. On the engine harness, measure the resistance between the following unit pump circuit terminals in the J01 connector:

- Terminal J01-G1 to J01-B1 (with 3.0L)
- Terminal J01-G1 to J01-C1
- Terminal J01-G1 to J01-D1
- Terminal J01-G1 to J01-E1
- Terminal J01-G1 to J01-F1

Are all resistance readings less than 8 ohms?

YES: GO TO 9

NO: Fix problem. GO TO 11

Continued on next page

JB81757,0000064 -19-20APR10-10/18

9 Reprogram ECU	1. Reconnect all connectors and battery negative cable. 2. Ignition ON, engine OFF. 3. Download latest ECU payload and reprogram ECU. 4. Refresh DTCs. 5. Perform Harness Diagnostic Mode Test in Service ADVISOR. Did DTC 003597.01 reappear active?	**YES:** GO TO 10 **NO:** Problem fixed.

JB81757,0000064 -19-20APR10-11/18

10 Replace ECU	1. Ignition OFF, engine OFF. 2. Replace ECU. 3. Ignition ON, engine OFF. 4. Refresh DTCs. 5. Perform Harness Diagnostic Mode Test in Service ADVISOR. Did DTC 003597.01 reappear active?	**YES:** Open DTAC case. **NO:** Problem fixed.

JB81757,0000064 -19-20APR10-12/18

11 Verification	1. Ignition OFF, engine OFF. 2. Reconnect all connectors. 3. Ignition ON, engine OFF. 4. Refresh DTCs. 5. Perform Harness Diagnostic Mode Test in Service ADVISOR. Did DTC 003597.01 reappear active?	**YES:** GO TO 2 **NO:** Problem fixed.

JB81757,0000064 -19-20APR10-13/18

12 Further Review of Snapshot Information	Review stored information collected in step 1 Does stored information lead to a possible problem or is there a certain operating point where error occurs?	**YES:** Fix problem if found. **YES:** If a certain operating point exists when error occurs then GO TO 13 **NO:** GO TO 14

JB81757,0000064 -19-20APR10-14/18

13 Engine Error Operating Point Test	1. Ignition ON, engine ON 2. Set engine to operating point of failure and refresh codes. Did 003597.01 reappear active when engine operating point was reached?	**YES:** GO TO 2 **NO:** GO TO 14

Continued on next page

JB81757,0000064 -19-20APR10-15/18

14 Terminal Test and Harness Inspection

CAUTION: Electronic Unit Pumps are supplied with 90V. Electric shock hazard if ignition is ON!

NOTE: Two parallel circuits in the engine harness provide the 90V supply to the unit pumps. The two circuits are spliced together approximately 250 mm (10 inches) from the C01 connector and pass through connector C01-6 as a single circuit. A poor connection at the splice may cause an intermittent open circuit.

1. Ignition OFF, engine OFF
2. Perform Terminal Test on the ECU J01 connector and unit pump harness 6-way connector C01.
3. Remove rocker cover. See Rocker Arm Cover — Removal
4. Inspect engine wire harness and unit pump harness carefully for damage which may cause an intermittent open circuit.

Were any problems found?

YES: Fix problem. GO TO 11

NO: GO TO 15

JB81757,0000064 -19-20APR10-16/18

15 Reconnect and Retest

1. Reconnect all connectors.
2. Ignition ON, engine running.
3. Refresh DTCs.
4. Gently wiggle wire harness between ECU J01 connector and connector C01.

CAUTION: Use caution when working near rotating components.

5. Gently wiggle wire harness between ECU J02 connector and battery to check for intermittent high resistance in ECU power supply.

Did 003597.01 become active at any time with engine running?

YES: Locate intermittent open or high resistance circuit. GO TO 2.

NO: GO TO 16.

JB81757,0000064 -19-20APR10-17/18

16 Reprogram ECU

1. Download latest ECU payload and reprogram ECU.
2. Ignition ON, engine running.
3. Refresh DTCs.

Is 003597.01 active with engine running?

YES: GO TO 2

NO: Problem fixed or conditions to generate 003597.01 have not been duplicated.

JB81757,0000064 -19-20APR10-18/18

000651.05 — Electronic Unit Pump #1 Circuit Has High Resistance

The ECU detects high resistance in the cylinder #1 electronic unit pump circuit.

JB81757,0000058 -19-31MAY10-1/18

000651.05 — Electronic Unit Pump #1 Circuit Has High Resistance Diagnostic Procedure

Troubleshooting Sequence:
003597.01
000651.05

When DTC is Displayed:
The engine is cranking or running and the error condition is active. The DTC may also be displayed during Harness Diagnostic Mode Test in Service ADVISOR.

Related Information:
The ECU detects high resistance in the cylinder #1 unit pump circuit.
The ECU has two internally-connected terminals which provide a shared high voltage supply to all the unit pump coils.
The ECU switches the low side (ground) to control each individual unit pump.
This DTC can be caused by an open circuit or by a few ohms of additional series resistance anywhere in the unit pump #1 circuit.
An open circuit in the unit pump high voltage supply may also cause active DTCs indicating high resistance in this and all other unit pump circuits.

Alarm Level:
Warning

Control Unit Response:
The ECU will attempt to control the engine in a normal manner.

Additional References:
For further electronic pump information, see Electronic Unit Pump and Injector Nozzle Operation in Section 03, Group 130 earlier in this manual.

NOTE: The wiring diagrams provided are for a typical John Deere supplied OEM harness. Wire number, colors, and jumper connectors do not apply to all applications.

For wiring information see 2.4L ECU WIRING DIAGRAM 1 or 3.0L ECU WIRING DIAGRAM 2 located in Section 06, Group 210 later in this manual.

Flex probe information:
- ECU large terminal - Orange/Green
- ECU small terminal - Orange/Blue
- Unit pump connector C01 - Yellow/Purple

For more information on connector and terminal testing or flex probes see Terminal Test in Section 04, Group 160 earlier in this manual.

IMPORTANT: When directed to run the Harness Diagnostic Mode Test the engine temperature should be above freezing. It is recommended that the engine temperature be at least room temperature 20° C (68° F). This test is located in Service ADVISOR.

IMPORTANT: Do not force probes into connector terminals or damage will result. Use JDG10466 Connector Adapter Test Kit to make measurements in connectors. This will ensure that terminal damage does not occur.

Continued on next page

JB81757,0000058 -19-31MAY10-2/18

1 Read DTCs and Store Snapshot Information

1. Ignition ON, engine OFF.

NOTE: When DTCs are cleared Snapshot information for ALL DTCs will also be cleared.

2. Connect Service ADVISOR, see Connecting To Service ADVISOR earlier in this Group.
3. Write down all DTCs and their occurrence count. If any DTCs have snapshot capture or snapshot recording information, save the information. For instructions on saving and using snapshot information, see Snapshot Instructions earlier in this Group.
4. Refresh DTCs.
5. Perform Harness Diagnostic Mode Test in Service ADVISOR.

Did 000651.05 reappear active?

YES: GO TO 2

NO: GO TO 11

JB81757,0000058 -19-31MAY10-3/18

2 Terminal Test

CAUTION: Unit pumps are supplied with 90V. Electric shock hazard if ignition is ON!

NOTE: See FUEL SYSTEM COMPONENTS located in Section 02, Group 90 earlier in this manual for component locations.

1. Ignition OFF, engine OFF.
2. Disconnect 6-way connector C01 at engine block between engine harness and unit pump harness.
3. Perform Terminal Test on connector C01.

Were any problems found?

YES: Fix problem. GO TO 10

NO: GO TO 3

JB81757,0000058 -19-31MAY10-4/18

3 Check Unit Pump Circuit Resistance

NOTE: Nominal unit pump coil resistance is approximately 4 ohms at 20°C (68°F). Resistance will be higher if unit pump temperature is above 20°C (68°F).

On the unit pump harness 6-way connector C01 in engine block (male pin terminals), measure the resistance between C01-6 and C01-1.

Is resistance less than 8 ohms?

YES: GO TO 5

NO: GO TO 4

JB81757,0000058 -19-31MAY10-5/18

4 Check Unit Pump Coil Resistance

1. Remove rocker arm cover.
2. On the #1 unit pump, measure the resistance between the two unit pump studs.

Is the resistance less than 8 ohms?

YES: Replace unit pump wire harness. GO TO 10

NO: Replace #1 unit pump. GO TO 10

JB81757,0000058 -19-31MAY10-6/18

5 ECU Terminal Test

1. Disconnect ECU J01 connector.
2. Perform Terminal Test on J01-G1, J01-G2, and J01-E1.

Were any problems found?

YES: Fix problem. GO TO 10

NO: GO TO 6

Continued on next page

JB81757,0000058 -19-31MAY10-7/18

6 Check Engine Harness Continuity	1. On the harness, measure the resistance between ECU J01-E1 and unit pump connector C01-1. 2. On the harness, measure the resistance between ECU J01-G1 and unit pump connector C01-6. Are both resistance readings less than 2 ohms?	**YES:** GO TO 7 **NO:** Fix problem. GO TO 10

JB81757,0000058 -19-31MAY10-8/18

7 Reprogram ECU	1. Ignition OFF, engine OFF. 2. Reconnect all connectors. 3. Download latest ECU payload and reprogram ECU. 4. Ignition ON, engine OFF. 5. Refresh DTCs. 6. Perform Harness Diagnostic Mode Test in Service ADVISOR. Did DTC 000651.05 reappear active?	**YES:** GO TO 8 **NO:** Problem fixed.

JB81757,0000058 -19-31MAY10-9/18

8 Replace Unit Pump #1	*NOTE: For unit pump replacement instructions, see Electronic Unit Pump — Installation in Section 02, Group 90 earlier in this manual.* 1. Ignition OFF, engine OFF. 2. Replace unit pump #1. 3. Ignition ON, engine OFF. 4. Refresh DTCs. 5. Perform Harness Diagnostic Mode Test in Service ADVISOR. Did DTC 000651.05 reappear active?	**YES:** GO TO 9 **NO:** Problem fixed.

JB81757,0000058 -19-31MAY10-10/18

9 Replace ECU	1. Ignition OFF, engine OFF. 2. Replace ECU. 3. Ignition ON, engine OFF. 4. Refresh DTCs. 5. Perform Harness Diagnostic Mode Test in Service ADVISOR. Did DTC 000651.05 reappear active?	**YES:** Open DTAC case. **NO:** Problem fixed.

JB81757,0000058 -19-31MAY10-11/18

10 Verification	*NOTE: For unit pump terminal torque specifications, see Electronic Unit Pump — Installation in Section 02, Group 90 earlier in this manual.* 1. Ignition OFF, engine OFF. 2. Reconnect all connectors and reinstall rocker cover, if removed. 3. Ignition ON, engine OFF. 4. Refresh DTCs. 5. Perform Harness Diagnostic Mode Test in Service ADVISOR. Did DTC 000651.05 reappear active?	**YES:** GO TO 2 **NO:** Problem fixed.

Continued on next page

JB81757,0000058 -19-31MAY10-12/18

11 Further Review of Snapshot Information	Review stored information collected in step 1	**YES:** Fix problem if found. GO TO 10
	Does stored information lead to a possible problem or is there a certain operating point where error occurs?	**YES:** If a certain operating point exists when error occurs then GO TO 12 **NO:** GO TO 13

JB81757,0000058 -19-31MAY10-13/18

12 Engine Error Operating Point Test	1. Ignition ON, engine ON	
	2. Set engine to operating point of failure and refresh DTCs.	**YES:** GO TO 2
	Did 000651.05 reappear active when engine operating point was reached?	**NO:** GO TO 13

JB81757,0000058 -19-31MAY10-14/18

13 Terminal Test	**CAUTION: Unit pumps are supplied with 90V. Electric shock hazard if ignition is ON!** *NOTE: For unit pump terminal torque specifications, see Electronic Unit Pump — Installation in Section 02, Group 90 earlier in this manual.* 1. Ignition OFF, engine OFF 2. Remove rocker cover. 3. Check for loose terminal studs on unit pump #1.	
	4. Perform Terminal Test on the ECU J01 connector, unit pump #1, and unit pump harness connector C01.	**YES:** Fix problem. GO TO 10
	Were any problems found?	**NO:** GO TO 14

JB81757,0000058 -19-31MAY10-15/18

14 Check for Intermittent Open Circuit	1. Reconnect all connectors except J01 connector.	
	2. On the harness, measure the resistance between ECU J01-E1 and J01-G1 while gently wiggling wire harness between ECU and unit pump #1.	**YES:** GO TO 15.
	Does resistance value remain below 8 ohms while wiggling harness?	**NO:** Repair cause of intermittent open circuit. GO TO 10.

JB81757,0000058 -19-31MAY10-16/18

15 Reconnect and Retest	1. Reconnect J01 connector.	
	2. Ignition ON, engine ON. 3. Refresh DTCs.	
	4. Gently wiggle wire harness between ECU and connector C01.	**YES:** Repair cause of intermittent open circuit. GO TO 10.
	CAUTION: Use caution when working near rotating components. Did 000651.05 reappear active at any time with engine running?	**NO:** GO TO 16.

Continued on next page

JB81757,0000058 -19-31MAY10-17/18

16 Reprogram ECU	1. Download latest ECU payload and reprogram ECU. 2. Ignition ON, engine ON. 3. Refresh DTCs. Did 000651.05 reappear active with engine running?	**YES:** GO TO 2. **NO:** Replace unit pump #1. GO TO 10.

JB81757,0000058 -19-31MAY10-18/18

000651.06 — Electronic Unit Pump #1 Circuit Has Low Resistance

The ECU detects low resistance in the cylinder #1 electronic unit pump circuit.

JB81757,0000059 -19-20APR10-1/18

000651.06 — Electronic Unit Pump #1 Circuit Has Low Resistance Diagnostic Procedure

Troubleshooting Sequence:
000611.03
000651.06

When DTC is Displayed:
The engine is cranking or running and the error condition is active. The DTC may also be displayed during Harness Diagnostic Mode Test in Service ADVISOR.

Related Information:
The ECU detects low resistance in the cylinder #1 electronic unit pump circuit.
The ECU has two internally-connected terminals which provide a shared high voltage supply to all the unit pumps. The ECU switches the low side (ground) to control each individual unit pump.
This DTC is NOT caused by a short to ground of the unit pump circuit. This DTC can be caused by a unit pump that has low coil resistance (internal coil windings are shorted together).
This DTC can also be caused by a wire-to-wire short. A short between the low side wiring of two unit pumps will cause active DTCs indicating low resistance in both unit pumps.

Alarm Level:
Warning

Control Unit Response:
The ECU will attempt to control the engine in a normal manner.

Additional References:
For further electronic unit pump information, see Electronic Unit Pump and Injector Nozzle Operation in Section 03, Group 130 earlier in this manual.

NOTE: The wiring diagrams provided are for a typical John Deere supplied OEM harness. Wire number, colors, and jumper connectors do not apply to all applications.

For wiring information see 2.4L ECU WIRING DIAGRAM 1 or 3.0L ECU WIRING DIAGRAM 2 located in Section 06, Group 210 later in this manual.

Flex probe information:
- ECU large terminal - Orange/Green
- ECU small terminal - Orange/Blue
- Unit pump connector C01 - Yellow/Purple

For more information on connector and terminal testing or flex probes see Terminal Test in Section 04, Group 160 earlier in this manual.

IMPORTANT: When directed to run the Harness Diagnostic Mode Test the engine temperature should be above freezing. It is recommended that the engine temperature be at least room temperature 20° C (68° F). This test is located in Service ADVISOR.

IMPORTANT: Do not force probes into connector terminals or damage will result. Use JDG10466 Connector Adapter Test Kit to make measurements in connectors. This will ensure that terminal damage does not occur.

Continued on next page

JB81757,0000059 -19-20APR10-2/18

1 Read DTCs and Store Snapshot Information

1. Ignition ON, engine OFF.

NOTE: When DTCs are cleared Snapshot information for ALL DTCs will also be cleared.

2. Connect Service ADVISOR, see Connecting To Service ADVISOR earlier in this Group.
3. Write down all DTCs and their occurrence count. If any DTCs have snapshot capture or snapshot recording information, save the information. For instructions on saving and using snapshot information, see Snapshot Instructions earlier in this Group.
4. Refresh DTCs.
5. Perform Harness Diagnostic Mode Test in Service ADVISOR.

Did 000651.06 reappear active?

YES: GO TO 2

NO: GO TO 12

JB81757,0000059 -19-20APR10-3/18

2 Check for DTC Change with Open Unit Pump Harness

CAUTION: Unit pumps are supplied with 90V. Electric shock hazard if ignition is ON!

NOTE: See FUEL SYSTEM COMPONENTS located in Section 02, Group 90 earlier in this manual for component locations.

1. Ignition OFF, engine OFF.
2. Disconnect 6-way connector C01 at engine block between engine harness and unit pump harness.
3. Ignition ON, engine OFF.
4. Refresh DTCs
5. Perform Harness Diagnostic Mode Test in Service ADVISOR.

Did DTC 000651.05, high unit pump #1 resistance, become active?

NOTE: Ignore DTCs for high resistance in the other unit pump circuits that may now be active because of this test.

YES: GO TO 3

NO: Do not reconnect unit pump harness connector. GO TO 5

JB81757,0000059 -19-20APR10-4/18

3 Unit Pump Harness Terminal Test and Inspection

1. Ignition OFF, engine OFF.
2. Perform Terminal Test on unit pump connector C01.
3. Remove rocker cover.
4. Inspect unit pump harness for damage.

Were any problems found?

YES: Fix problem. GO TO 10

NO: GO TO 4

JB81757,0000059 -19-20APR10-5/18

4 Check Unit Pump Harness for Wire to Wire Short

1. Loosen unit pump #1 terminal nuts.
2. Lift unit pump #1 connector away from unit pump studs.
3. On the unit pump harness connector C01 in engine block (male pin terminals), measure the resistance between C01-1 and all other terminals in the unit pump harness connector C01.

Are all resistance readings greater than 10k ohms?

YES: Replace unit pump #1. GO TO 10

NO: Replace unit pump harness. GO TO 10

Continued on next page

JB81757,0000059 -19-20APR10-6/18

5 ECU Terminal Test

1. Ignition OFF, engine OFF.
2. Disconnect ECU J01 connector.
3. Perform Terminal Test on J01-G1, J01-G2, and J01-E1.

Were any problems found?

YES: Fix problem. GO TO 10

NO: GO TO 6

JB81757,0000059 -19-20APR10-7/18

6 Check Engine Harness for Wire-to-Wire Short

1. Disconnect ECU J02 connector.
2. Verify unit pump harness connector C01 is still disconnected.
3. On the harness, measure the resistance between ECU J01-E1 and all terminals in the J01 and J02 connectors.

Are all resistance measurements greater than 10k ohms?

YES: GO TO 7

NO: Fix problem. GO TO 10

JB81757,0000059 -19-20APR10-8/18

7 Check Engine Harness for Short to Voltage Source

1. Ignition ON, engine OFF.
2. On the harness, measure the voltage between ECU J01-E1 (+) and single point ground (-).

Is voltage greater than 0.5V?

YES: Fix problem. GO TO 10

NO: GO TO 8

JB81757,0000059 -19-20APR10-9/18

8 Reprogram ECU

1. Ignition OFF, engine OFF.
2. Reconnect all connectors.
3. Download latest ECU payload and reprogram ECU.
4. Ignition ON, engine OFF.
5. Refresh DTCs.
6. Perform Harness Diagnostic Mode Test in Service ADVISOR.

Did DTC 000651.06 reappear active?

YES: GO TO 9

NO: Problem fixed.

JB81757,0000059 -19-20APR10-10/18

9 Replace ECU

1. Ignition OFF, engine OFF.
2. Replace ECU.
3. Ignition ON, engine OFF.
4. Refresh DTCs.
5. Perform Harness Diagnostic Mode Test in Service ADVISOR.

Did DTC 000651.06 reappear active?

YES: Open DTAC case.

NO: Problem fixed.

Continued on next page

JB81757,0000059 -19-20APR10-11/18

10 Verification

NOTE: See Electronic Unit Pumps — Installation in Section 02, Group 90 earlier in this manual for unit pump terminal torque specification.

1. Ignition OFF, engine OFF.
2. Reconnect all connectors and reinstall rocker cover, if removed.
3. Ignition ON, engine OFF.
4. Refresh DTCs.
5. Perform Harness Diagnostic Mode Test in Service ADVISOR.

Did DTC 000651.06 reappear active?

YES: GO TO 2
NO: Problem fixed.

JB81757,0000059 -19-20APR10-12/18

11 Further Review of Snapshot Information

Review stored information collected in step 1

YES: Fix problem if found. GO TO 10

Does stored information lead to a possible problem or is there a certain operating point where error occurs?

YES: If a certain operating point exists when error occurs then GO TO 12
NO: GO TO 13

JB81757,0000059 -19-20APR10-13/18

12 Engine Error Operating Point Test

1. Ignition ON, engine ON
2. Set engine to operating point of failure and refresh DTCs.

Did 000651.06 reappear active when engine operating point was reached?

YES: GO TO 2
NO: GO TO 13

JB81757,0000059 -19-20APR10-14/18

13 Terminal Test and Harness Inspection

CAUTION: Unit pumps are supplied with 90V. Electric shock hazard if ignition is ON!

1. Ignition OFF, engine OFF
2. Remove rocker cover.
3. Inspect unit pump wire harness for damage which would result in an intermittent wire-to-wire short circuit.
4. Perform Terminal Test on the ECU J01 connector, unit pump #1, and unit pump connector C01.

Were any problems found?

YES: Fix problem. GO TO 10
NO: GO TO 14

JB81757,0000059 -19-20APR10-15/18

14 Check for Intermittent Shorted Circuit

NOTE: Nominal unit pump coil resistance is approximately 4 ohms at 20°C (68°F). A wire-to-wire short of two unit pump low side control circuits will cause resistance readings of approximately 2 ohms. Resistance values will be higher if unit pump temperature is greater than 20°C (68°F).

1. Reconnect all connectors except J01 connector.
2. On the harness, measure the resistance between ECU J01-E1 and J01-G1 while gently wiggling wire harness between ECU and unit pump #1.

Does resistance value decrease below 3 ohms while wiggling harness?

YES: Repair cause of intermittent shorted circuit. GO TO 10
NO: GO TO 15

Continued on next page

JB81757,0000059 -19-20APR10-16/18

15 Reconnect and Retest	1. Reconnect J01 connector. 2. Ignition ON, engine ON. 3. Refresh DTCs. 4. Gently wiggle wire harness between ECU and unit pump connector C01. **CAUTION: Use caution when working near rotating components.** Did 000651.06 reappear active at any time with engine running?	**YES:** Repair cause of intermittent shorted circuit. GO TO 10 **NO:** GO TO 16

JB81757,0000059 -19-20APR10-17/18

16 Reprogram ECU	1. Download latest ECU payload and reprogram ECU. 2. Ignition ON, engine ON. 3. Refresh DTCs. Did 000651.06 reappear active with engine running?	**YES:** GO TO 2 **NO:** Replace unit pump #1. GO TO 10

JB81757,0000059 -19-20APR10-18/18

000651.13 — Electronic Unit Pump #1 Calibration Fault

The ECU detects an incorrect Electronic Unit Pump Calibration Code was calibrated into the ECU.

DN22556,00006B2 -19-24SEP10-1/9

000651.13 — Electronic Unit Pump #1 Calibration Fault Diagnostic Procedure

Troubleshooting Sequence:
000651.13

When DTC is Displayed:
During an electronic unit pump programming event.

Alarm Level:
Warning

Control Unit Response:
The ECU will attempt to run the engine normally.

Related Information:
The ECU detects an incorrect Electronic Unit Pump Calibration Code was programmed into the ECU. The engine performance may be drastically effected. The engine will also be out of compliance with Tier 3 emission requirements.

Additional References:
For more electronic unit pump information, see Electronic Unit Pump And Injector Nozzle Operation in Section 03, Group 130 earlier in this manual.

For more information on the fuel system, see Fuel System Operation in Section 03, Group 130 earlier in this manual.

DN22556,00006B2 -19-24SEP10-2/9

❶	**Electronic Unit Pump Calibration Code Input Method Check**	Was the Electronic Unit Pump Calibration code typed in manually?	**YES:** GO TO 2 **NO:** GO TO 3

DN22556,00006B2 -19-24SEP10-3/9

❷	**Verification and Reentry of Electronic Unit Pump Calibration Code**	1. Perform Electronic Unit Pump Calibration in Service ADVISOR. 2. Select the electronic unit pump to calibrate. 3. Check the written code against the one displayed. 4. Type it back in again. Did the ECU accept the Electronic Unit Pump Calibration code?	**YES:** Problem fixed. **NO:** GO TO 3

DN22556,00006B2 -19-24SEP10-4/9

❸	**Automatic Input of Electronic Unit Pump Data**	1. Perform Electronic Unit Pump Calibration in Service ADVISOR. See Electronic Unit Pump Calibration Information 2. Select the electronic unit pump to calibrate. 3. Select the sequence number of the electronic unit pump installed from the list. Did the ECU accept the Electronic Unit Pump Calibration code?	**YES:** Problem fixed. **NO:** GO TO 4

Continued on next page

DN22556,00006B2 -19-24SEP10-5/9

4 Retrieve New Electronic Unit Pump Calibration File	Download a new electronic unit pump calibration file, see Electronic Unit Pump Calibration File Downloading Instructions earlier in this goup. Were you able to get a new calibration file?	**YES:** GO TO 5 **NO:** GO TO 6

DN22556,00006B2 -19-24SEP10-6/9

5 Automatic Input of Electronic Unit Pump Data	1. Perform Electronic Unit Pump Calibration in Service ADVISOR. See Electronic Unit Pump Calibration Information 2. Select the electronic unit pump to calibrate. 3. Select the serial number of the electronic unit pump file downloaded from the list of electronic unit pumps. Did the ECU accept the Electronic Unit Pump Calibration code?	 **YES:** Problem fixed. **NO:** GO TO 6

DN22556,00006B2 -19-24SEP10-7/9

6 ECU Programming	1. Download the latest ECU software. 2. Reprogram ECU. Was the ECU programming successful?	 **YES:** GO TO 7 **NO:** Replace ECU. GO TO 3

DN22556,00006B2 -19-24SEP10-8/9

7 Automatic Input of Electronic Unit Pump Data	1. Perform Electronic Unit Pump Calibration in Service ADVISOR. See Electronic Unit Pump Calibration Information 2. Select the electronic unit pump to calibrate. 3. Select the serial number of the electronic unit pump file downloaded from the list of electronic unit pumps. Did the ECU accept the Electronic Unit Pump Calibration code?	 **YES:** Problem fixed. **NO:** Start a DTAC case.

DN22556,00006B2 -19-24SEP10-9/9

000652.05 — Electronic Unit Pump #2 Circuit Has High Resistance

The ECU detects high resistance in the cylinder #2 electronic unit pump circuit.

JB81757,000005A -19-20APR10-1/18

000652.05 — Electronic Unit Pump #2 Circuit Has High Resistance Diagnostic Procedure

Troubleshooting Sequence:
003597.01
000652.05

When DTC is Displayed:
The engine is cranking or running and the error condition is active. The DTC may also be displayed during Harness Diagnostic Mode Test in Service ADVISOR.

Related Information:
The ECU detects high resistance in the cylinder #2 unit pump circuit.
The ECU has two internally-connected terminals which provide a shared high voltage supply to all the unit pump coils.
The ECU switches the low side (ground) to control each individual unit pump.
This DTC can be caused by an open circuit or by a few ohms of additional series resistance anywhere in the unit pump #2 circuit.
An open circuit in the unit pump high voltage supply may also cause active DTCs indicating high resistance in this and all other unit pump circuits.

Alarm Level:
Warning

Control Unit Response:
The ECU will attempt to control the engine in a normal manner.

Additional References:
For further electronic pump information, see Electronic Unit Pump and Injector Nozzle Operation in Section 03, Group 130 earlier in this manual.

NOTE: The wiring diagrams provided are for a typical John Deere supplied OEM harness. Wire number, colors, and jumper connectors do not apply to all applications.

For wiring information see 2.4L ECU WIRING DIAGRAM 1 or 3.0L ECU WIRING DIAGRAM 2 located in Section 06, Group 210 later in this manual.

Flex probe information:
- ECU large terminal - Orange/Green
- ECU small terminal - Orange/Blue
- Unit pump connector C01 - Yellow/Purple

For more information on connector and terminal testing or flex probes see Terminal Test in Section 04, Group 160 earlier in this manual.

IMPORTANT: When directed to run the Harness Diagnostic Mode Test the engine temperature should be above freezing. It is recommended that the engine temperature be at least room temperature 20° C (68° F). This test is located in Service ADVISOR.

IMPORTANT: Do not force probes into connector terminals or damage will result. Use JDG10466 Connector Adapter Test Kit to make measurements in connectors. This will ensure that terminal damage does not occur.

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JB81757,000005A -19-20APR10-2/18

1 Read DTCs and Store Snapshot Information

1. Ignition ON, engine OFF.

NOTE: When DTCs are cleared Snapshot information for ALL DTCs will also be cleared.

2. Connect Service ADVISOR, see Connecting To Service ADVISOR earlier in this Group.
3. Write down all DTCs and their occurrence count. If any DTCs have snapshot capture or snapshot recording information, save the information. For instructions on saving and using snapshot information, see Snapshot Instructions earlier in this Group.
4. Refresh DTCs.
5. Perform Harness Diagnostic Mode Test in Service ADVISOR.

Did 000652.05 reappear active?

YES: GO TO 2

NO: GO TO 11

JB81757,000005A -19-20APR10-3/18

2 Terminal Test

CAUTION: Unit pumps are supplied with 90V. Electric shock hazard if ignition is ON!

NOTE: See FUEL SYSTEM COMPONENTS located in Section 02, Group 90 earlier in this manual for component locations.

1. Ignition OFF, engine OFF.
2. Disconnect 6-way connector C01 at engine block between engine harness and unit pump harness.
3. Perform Terminal Test on connector C01.

Were any problems found?

YES: Fix problem. GO TO 10

NO: GO TO 3

JB81757,000005A -19-20APR10-4/18

3 Check Unit Pump Circuit Resistance

NOTE: Nominal unit pump coil resistance is approximately 4 ohms at 20°C (68°F). Resistance will be higher if unit pump temperature is above 20°C (68°F).

With 3.0L - On the unit pump harness 6-way connector C01 in engine block (male pin terminals), measure the resistance between C01-6 and C01-2.

With 2.4L - On the unit pump harness 6-way connector C01 in engine block (male pin terminals), measure the resistance between C01-6 and C01-5.

Is resistance less than 8 ohms?

YES: GO TO 5

NO: GO TO 4

JB81757,000005A -19-20APR10-5/18

4 Check Unit Pump Coil Resistance

1. Remove rocker arm cover.
2. On the #2 unit pump, measure the resistance between the two unit pump studs.

Is the resistance less than 8 ohms?

YES: Replace unit pump wire harness. GO TO 1

NO: Replace #2 unit pump. GO TO 10

JB81757,000005A -19-20APR10-6/18

5 ECU Terminal Test

1. Disconnect ECU J01 connector.
2. Perform Terminal Test on J01.

Were any problems found?

YES: Fix problem. GO TO 10

NO: GO TO 6

Continued on next page

JB81757,000005A -19-20APR10-7/18

6 Check Engine Harness Continuity	With 3.0L: 1. On the harness, measure the resistance between ECU J01-F1 and unit pump connector C01-2. 2. On the harness, measure the resistance between ECU J01-G1 and unit pump connector C01-6. With 2.4L: 3. On the harness, measure the resistance between ECU J01-C1 and unit pump connector C01-5. 4. On the harness, measure the resistance between ECU J01-G1 and unit pump connector C01-6. Are both resistance readings less than 2 ohms?	**YES:** GO TO 7 **NO:** Fix problem. GO TO 10

JB81757,000005A -19-20APR10-8/18

7 Reprogram ECU	1. Ignition OFF, engine OFF. 2. Reconnect all connectors. 3. Download latest ECU payload and reprogram ECU. 4. Ignition ON, engine OFF. 5. Refresh DTCs. 6. Perform Harness Diagnostic Mode Test in Service ADVISOR. Did DTC 000652.05 reappear active?	**YES:** GO TO 8 **NO:** Problem fixed.

JB81757,000005A -19-20APR10-9/18

8 Replace Unit Pump #2	*NOTE: For unit pump replacement instructions, see Electronic Unit Pump — Installation in Section 02, Group 90 earlier in this manual.* 1. Ignition OFF, engine OFF. 2. Replace unit pump #2. 3. Ignition ON, engine OFF. 4. Refresh DTCs. 5. Perform Harness Diagnostic Mode Test in Service ADVISOR. Did DTC 000652.05 reappear active?	**YES:** GO TO 9 **NO:** Problem fixed.

JB81757,000005A -19-20APR10-10/18

9 Replace ECU	1. Ignition OFF, engine OFF. 2. Replace ECU. 3. Ignition ON, engine OFF. 4. Refresh DTCs. 5. Perform Harness Diagnostic Mode Test in Service ADVISOR. Did DTC 000652.05 reappear active?	**YES:** Open DTAC case. **NO:** Problem fixed.

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JB81757,000005A -19-20APR10-11/18

10 Verification	*NOTE: For unit pump terminal torque specifications, see Electronic Unit Pump — Installation in Section 02, Group 90 earlier in this manual.* 1. Ignition OFF, engine OFF. 2. Reconnect all connectors and reinstall rocker cover, if removed. 3. Ignition ON, engine OFF. 4. Refresh DTCs. 5. Perform Harness Diagnostic Mode Test in Service ADVISOR. Did DTC 000652.05 reappear active?	**YES:** GO TO 2 **NO:** Problem fixed.

JB81757,000005A -19-20APR10-12/18

11 Further Review of Snapshot Information	Review stored information collected in step 1 Does stored information lead to a possible problem or is there a certain operating point where error occurs?	**YES:** Fix problem if found. GO TO 10 **YES:** If a certain operating point exists when error occurs then GO TO 12 **NO:** GO TO 13

JB81757,000005A -19-20APR10-13/18

12 Engine Error Operating Point Test	1. Ignition ON, engine ON 2. Set engine to operating point of failure and refresh DTCs. Did 000652.05 reappear active when engine operating point was reached?	**YES:** GO TO 2 **NO:** GO TO 13

JB81757,000005A -19-20APR10-14/18

13 Terminal Test	**CAUTION: Unit pumps are supplied with 90V. Electric shock hazard if ignition is ON!** *NOTE: For unit pump terminal torque specifications, see Electronic Unit Pump — Installation in Section 02, Group 90 earlier in this manual.* 1. Ignition OFF, engine OFF 2. Remove rocker cover. 3. Check for loose terminal studs on unit pump #2. 4. Perform Terminal Test on the ECU J01 connector, unit pump #2, and unit pump harness connector C01. Were any problems found?	**YES:** Fix problem. GO TO 10 **NO:** GO TO 14

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JB81757,000005A -19-20APR10-15/18

14 Check for Intermittent Open Circuit	With 3.0L: 1. Reconnect all connectors except J01 connector. 2. On the harness, measure the resistance between ECU J01-F1 and J01-G1 while gently wiggling wire harness between ECU and unit pump #2. With 2.4L: 3. Reconnect all connectors except J01 connector. 4. On the harness, measure the resistance between ECU J01-C1 and J01-G1 while gently wiggling wire harness between ECU and unit pump #2. Does resistance value remain below 8 ohms while wiggling harness?	**YES:** GO TO 15 **NO:** Repair cause of intermittent open circuit. GO TO 10

JB81757,000005A -19-20APR10-16/18

15 Reconnect and Retest	1. Reconnect J01 connector. 2. Ignition ON, engine ON. 3. Refresh DTCs. 4. Gently wiggle wire harness between ECU and connector C01. **CAUTION: Use caution when working near rotating components.** Did 000652.05 reappear active at any time with engine running?	**YES:** Repair cause of intermittent open circuit. GO TO 10 **NO:** GO TO 16

JB81757,000005A -19-20APR10-17/18

16 Reprogram ECU	1. Download latest ECU payload and reprogram ECU. 2. Ignition ON, engine ON. 3. Refresh DTCs. Did 000652.05 reappear active with engine running?	**YES:** GO TO 2 **NO:** Replace unit pump #2. GO TO 10

JB81757,000005A -19-20APR10-18/18

000652.06 — Electronic Unit Pump #2 Circuit Has Low Resistance

The ECU detects low resistance in the cylinder #2 electronic unit pump circuit.

JB81757,000005B -19-21APR10-1/18

000652.06 — Electronic Unit Pump #2 Circuit Has Low Resistance Diagnostic Procedure

Troubleshooting Sequence:
000611.03
000652.06

When DTC is Displayed:
The engine is cranking or running and the error condition is active. The DTC may also be displayed during Harness Diagnostic Mode Test in Service ADVISOR.

Related Information:
The ECU detects low resistance in the cylinder #2 electronic unit pump circuit.
The ECU has two internally-connected terminals which provide a shared high voltage supply to all the unit pumps. The ECU switches the low side (ground) to control each individual unit pump.
This DTC is NOT caused by a short to ground of the unit pump circuit. This DTC can be caused by a unit pump that has low coil resistance (internal coil windings are shorted together).
This DTC can also be caused by a wire-to-wire short. A short between the low side wiring of two unit pumps will cause active DTCs indicating low resistance in both unit pumps.

Alarm Level:
Warning

Control Unit Response:
The ECU will attempt to control the engine in a normal manner.

Additional References:
For further electronic unit pump information, see Electronic Unit Pump and Injector Nozzle Operation in Section 03, Group 130 earlier in this manual.

NOTE: The wiring diagrams provided are for a typical John Deere supplied OEM harness. Wire number, colors, and jumper connectors do not apply to all applications.

For wiring information see 2.4L ECU WIRING DIAGRAM 1 or 3.0L ECU WIRING DIAGRAM 2 located in Section 06, Group 210 later in this manual.

Flex probe information:
- ECU large terminal - Orange/Green
- ECU small terminal - Orange/Blue
- Unit pump connector C01 - Yellow/Purple

For more information on connector and terminal testing or flex probes see Terminal Test in Section 04, Group 160 earlier in this manual.

IMPORTANT: When directed to run the Harness Diagnostic Mode Test the engine temperature should be above freezing. It is recommended that the engine temperature be at least room temperature 20° C (68° F). This test is located in Service ADVISOR.

IMPORTANT: Do not force probes into connector terminals or damage will result. Use JDG10466 Connector Adapter Test Kit to make measurements in connectors. This will ensure that terminal damage does not occur.

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JB81757,000005B -19-21APR10-2/18

1 Read DTCs and Store Snapshot Information	1. Ignition ON, engine OFF. *NOTE: When DTCs are cleared Snapshot information for ALL DTCs will also be cleared.* 2. Connect Service ADVISOR, see Connecting To Service ADVISOR earlier in this Group. 3. Write down all DTCs and their occurrence count. If any DTCs have snapshot capture or snapshot recording information, save the information. For instructions on saving and using snapshot information, see Snapshot Instructions earlier in this Group. 4. Refresh DTCs. 5. Perform Harness Diagnostic Mode Test in Service ADVISOR. Did 000652.06 reappear active?	**YES:** GO TO 2 **NO:** GO TO 12

JB81757,000005B -19-21APR10-3/18

2 Check for DTC Change with Open Unit Pump Harness	**⚠ CAUTION: Unit pumps are supplied with 90V. Electric shock hazard if ignition is ON!** *NOTE: See FUEL SYSTEM COMPONENTS located in Section 02, Group 90 earlier in this manual for component locations.* 1. Ignition OFF, engine OFF. 2. Disconnect 6-way connector C01 at engine block between engine harness and unit pump harness. 3. Ignition ON, engine OFF. 4. Refresh DTCs 5. Perform Harness Diagnostic Mode Test in Service ADVISOR. Did DTC 000652.05, high unit pump #2 resistance, become active? *NOTE: Ignore DTCs for high resistance in the other unit pump circuits that may now be active because of this test.*	**YES:** GO TO 3 **NO:** Do not reconnect unit pump harness connector. GO TO 5

JB81757,000005B -19-21APR10-4/18

3 Unit Pump Harness Terminal Test and Inspection	1. Ignition OFF, engine OFF. 2. Perform Terminal Test on unit pump connector C01. 3. Remove rocker cover See Rocker Arm Cover — Removal in Section 2, Group 20 4. Inspect unit pump harness for damage. Were any problems found?	**YES:** Fix problem. GO TO 10 **NO:** GO TO 4

Continued on next page

JB81757,000005B -19-21APR10-5/18

4 Check Unit Pump Harness for Wire to Wire Short	With 3.0L: 1. Loosen unit pump #2 terminal nuts. 2. Lift unit pump #2 connector away from unit pump studs. 3. On the unit pump harness connector C01 in engine block (male pin terminals), measure the resistance between C01-2 and all other terminals in the unit pump harness connector C01. With 2.4L: 4. Loosen unit pump #2 terminal nuts. 5. Lift unit pump #2 connector away from unit pump studs. 6. On the unit pump harness connector C01 in engine block (male pin terminals), measure the resistance between C01-5 and all other terminals in the unit pump harness connector C01. Are all resistance readings greater than 10k ohms?	**YES:** Replace unit pump #2. GO TO 10 **NO:** Replace unit pump harness. GO TO 10

JB81757,000005B -19-21APR10-6/18

5 ECU Terminal Test	1. Ignition OFF, engine OFF. 2. Disconnect ECU J01 connector. 3. Perform Terminal Test on J01. Were any problems found?	**YES:** Fix problem. GO TO 10 **NO:** GO TO 6

JB81757,000005B -19-21APR10-7/18

6 Check Engine Harness for Wire-to-Wire Short	With 3.0L: 1. Disconnect ECU J02 connector. 2. Verify unit pump harness connector C01 is still disconnected. 3. On the harness, measure the resistance between ECU J01-F1 and all terminals in the J01 and J02 connectors. With 2.4L: 4. Disconnect ECU J02 connector. 5. Verify unit pump harness connector C01 is still disconnected. 6. On the harness, measure the resistance between ECU J01-C1 and all terminals in the J01 and J02 connectors. Are all resistance measurements greater than 10k ohms?	**YES:** GO TO 7 **NO:** Fix problem. GO TO 10

Continued on next page

JB81757,000005B -19-21APR10-8/18

7 Check Engine Harness for Short to Voltage Source	With 3.0L: 1. Ignition ON, engine OFF. 2. On the harness, measure the voltage between ECU J01-F1 (+) and single point ground (-). With 2.4L: 3. Ignition ON, engine OFF. 4. On the harness, measure the voltage between ECU J01-C1 (+) and single point ground (-). Is voltage greater than 0.5V?	**YES:** Fix problemGO TO 10 **NO:** GO TO 8

JB81757,000005B -19-21APR10-9/18

8 Reprogram ECU	1. Ignition OFF, engine OFF. 2. Reconnect all connectors. 3. Download latest ECU payload and reprogram ECU. 4. Ignition ON, engine OFF. 5. Refresh DTCs. 6. Perform Harness Diagnostic Mode Test in Service ADVISOR. Did DTC 000652.06 reappear active?	**YES:** GO TO 9 **NO:** Problem fixed.

JB81757,000005B -19-21APR10-10/18

9 Replace ECU	1. Ignition OFF, engine OFF. 2. Replace ECU. 3. Ignition ON, engine OFF. 4. Refresh DTCs. 5. Perform Harness Diagnostic Mode Test in Service ADVISOR. Did DTC 000652.06 reappear active?	**YES:** Open DTAC case. **NO:** Problem fixed.

JB81757,000005B -19-21APR10-11/18

10 Verification	*NOTE: See INSTALL ELECTRONIC UNIT PUMP (EUP) in Section 02, Group 90 earlier in this manual for unit pump terminal torque specification.* 1. Ignition OFF, engine OFF. 2. Reconnect all connectors and reinstall rocker cover, if removed. 3. Ignition ON, engine OFF. 4. Refresh DTCs. 5. Perform Harness Diagnostic Mode Test in Service ADVISOR. Did DTC 000652.06 reappear active?	**YES: GO TO 2** **NO:** Problem fixed.

Continued on next page

JB81757,000005B -19-21APR10-12/18

11 Further Review of Snapshot Information

Review stored information collected in step 1	**YES:** Fix problem if found. GO TO 10
Does stored information lead to a possible problem or is there a certain operating point where error occurs?	**YES:** If a certain operating point exists when error occurs then GO TO 12 **NO:** GO TO 13

JB81757,000005B -19-21APR10-13/18

12 Engine Error Operating Point Test

1. Ignition ON, engine ON	
2. Set engine to operating point of failure and refresh DTCs.	**YES:** GO TO 2
Did 000652.06 reappear active when engine operating point was reached?	**NO:** GO TO 13

JB81757,000005B -19-21APR10-14/18

13 Terminal Test and Harness Inspection

CAUTION: Unit pumps are supplied with 90V. Electric shock hazard if ignition is ON!

1. Ignition OFF, engine OFF	
2. Remove rocker cover. See Rocker Arm Cover — Removal in Section 2 Group 20	
3. Inspect unit pump wire harness for damage which would result in an intermittent wire-to-wire short circuit.	
4. Perform Terminal Test on the ECU J01 connector, unit pump #2, and unit pump connector C01.	**YES:** Fix problem. GO TO 10
Were any problems found?	**NO:** GO TO 14

JB81757,000005B -19-21APR10-15/18

14 Check for Intermittent Shorted Circuit

NOTE: Nominal unit pump coil resistance is approximately 4 ohms at 20°C (68°F). A wire-to-wire short of two unit pump low side control circuits will cause resistance readings of approximately 2 ohms. Resistance values will be higher if unit pump temperature is greater than 20°C (68°F).

With 3.0L:	
1. Reconnect all connectors except J01 connector.	
2. On the harness, measure the resistance between ECU J01-F1 and J01-G1 while gently wiggling wire harness between ECU and unit pump #2.	
With 2.4L:	
3. Reconnect all connectors except J01 connector.	
4. On the harness, measure the resistance between ECU J01-C1 and J01-G1 while gently wiggling wire harness between ECU and unit pump #2.	**YES:** Repair cause of intermittent shorted circuit. GO TO 10.
Does resistance value decrease below 3 ohms while wiggling harness?	**NO:** GO TO 15.

Continued on next page

JB81757,000005B -19-21APR10-16/18

15 Reconnect and Retest	1. Reconnect J01 connector. 2. Ignition ON, engine ON. 3. Refresh DTCs. 4. Gently wiggle wire harness between ECU and unit pump connector C01. **CAUTION: Use caution when working near rotating components.** Did 000652.06 reappear active at any time with engine running?	**YES:** Repair cause of intermittent shorted circuit. GO TO 10. **NO:** GO TO 16.

JB81757,000005B -19-21APR10-17/18

16 Reprogram ECU	1. Download latest ECU payload and reprogram ECU. 2. Ignition ON, engine ON. 3. Refresh DTCs. Did 000652.06 reappear active with engine running?	**YES:** GO TO 2 **NO:** Replace unit pump #2. GO TO 10

JB81757,000005B -19-21APR10-18/18

000652.13 — Electronic Unit Pump #2 Calibration Fault

The ECU detects an incorrect Electronic Unit Pump Calibration Code was calibrated into the ECU.

DN22556,00006B3 -19-24SEP10-1/9

000652.13 — Electronic Unit Pump #2 Calibration Fault Diagnostic Procedure

Troubleshooting Sequence:
000652.13

When DTC is Displayed:
During an electronic unit pump programming event.

Alarm Level:
Warning

Control Unit Response:
The ECU will attempt to run the engine normally.

Related Information:
The ECU detects an incorrect Electronic Unit Pump Calibration Code was programmed into the ECU. The engine performance may be drastically effected. The engine will also be out of compliance with Tier 3 emission requirements.

Additional References:
For more electronic unit pump information, see Electronic Unit Pump and Injector Nozzle Operation in Section 03, Group 130 earlier in this manual.

For more information on the fuel system, see FUEL SYSTEM OPERATION in Section 03, Group 130 earlier in this manual.

DN22556,00006B3 -19-24SEP10-2/9

1	**Electronic Unit Pump Calibration Code Input Method Check**	Was the Electronic Unit Pump Calibration code typed in manually?	**YES:** GO TO 2 **NO:** GO TO 3

DN22556,00006B3 -19-24SEP10-3/9

2	**Verification and Reentry of Electronic Unit Pump Calibration Code**	1. Perform Electronic Unit Pump Calibration in Service ADVISOR. See Electronic Unit Pump Calibration Information. 2. Select the electronic unit pump to calibrate. 3. Check the written code against the one displayed. 4. Type it back in again. Did the ECU accept the Electronic Unit Pump Calibration code?	**YES:** Problem fixed. **NO:** GO TO 3

DN22556,00006B3 -19-24SEP10-4/9

3	**Automatic Input of Electronic Unit Pump Data**	1. Perform Electronic Unit Pump Calibration in Service ADVISOR. See Electronic Unit Pump Calibration Information 2. Select the electronic unit pump to calibrate. 3. Select the sequence number of the electronic unit pump installed from the list. Did the ECU accept the Electronic Unit Pump Calibration code?	**YES:** Problem fixed. **NO:** GO TO 4

Continued on next page

DN22556,00006B3 -19-24SEP10-5/9

4 Retrieve New Electronic Unit Pump Calibration File	Download a new electronic unit pump calibration file, see Electronic Unit Pump Calibration File Downloading Instructions earlier in this Group. Were you able to get a new calibration file?	**YES:** GO TO 5 **NO:** GO TO 6

DN22556,00006B3 -19-24SEP10-6/9

5 Automatic Input of Electronic Unit Pump Data	1. Perform Electronic Unit Pump Calibration in Service ADVISOR. See Electronic Unit Pump Calibration Information. 2. Select the electronic unit pump to calibrate. 3. Select the serial number of the electronic unit pump file downloaded from the list of electronic unit pumps. Did the ECU accept the Electronic Unit Pump Calibration code?	 **YES:** Problem fixed. **NO:** GO TO 6

DN22556,00006B3 -19-24SEP10-7/9

6 ECU Programming	1. Download the latest ECU software. 2. Reprogram ECU. Was the ECU programming successful?	 **YES:** GO TO 7 **NO:** Replace ECU. GO TO 3

DN22556,00006B3 -19-24SEP10-8/9

7 Automatic Input of Electronic Unit Pump Data	1. Perform Electronic Unit Pump Calibration in Service ADVISOR. See Electronic Unit Pump Calibration Information 2. Select the electronic unit pump to calibrate. 3. Select the serial number of the electronic unit pump file downloaded from the list of electronic unit pumps. Did the ECU accept the Electronic Unit Pump Calibration code?	 **YES:** Problem fixed. **NO:** Start a DTAC case.

DN22556,00006B3 -19-24SEP10-9/9

000653.05 — Electronic Unit Pump #3 Circuit Has High Resistance

The ECU detects high resistance in the cylinder #3 electronic unit pump circuit.

JB81757,000005C -19-20APR10-1/18

000653.05 — Electronic Unit Pump #3 Circuit Has High Resistance Diagnostic Procedure

Troubleshooting Sequence:
003597.01
000653.05

When DTC is Displayed:
The engine is cranking or running and the error condition is active. The DTC may also be displayed during Harness Diagnostic Mode Test in Service ADVISOR.

Related Information:
The ECU detects high resistance in the cylinder #3 unit pump circuit.
The ECU has two internally-connected terminals which provide a shared high voltage supply to all the unit pump coils.
The ECU switches the low side (ground) to control each individual unit pump.
This DTC can be caused by an open circuit or by a few ohms of additional series resistance anywhere in the unit pump #3 circuit.
An open circuit in the unit pump high voltage supply may also cause active DTCs indicating high resistance in this and all other unit pump circuits.

Alarm Level:
Warning

Control Unit Response:
The ECU will attempt to control the engine in a normal manner.

Additional References:
For further electronic pump information, see Electronic Unit Pump and Injector Nozzle Operation in Section 03, Group 130 earlier in this manual.

NOTE: The wiring diagrams provided are for a typical John Deere supplied OEM harness. Wire number, colors, and jumper connectors do not apply to all applications.

For wiring information see 2.4L ECU WIRING DIAGRAM 1 or 3.0L ECU WIRING DIAGRAM 2 located in Section 06, Group 210 later in this manual.

Flex probe information:
- ECU large terminal - Orange/Green
- ECU small terminal - Orange/Blue
- Unit pump connector C01 - Yellow/Purple

For more information on connector and terminal testing or flex probes see Terminal Test in Section 04, Group 160 earlier in this manual.

IMPORTANT: When directed to run the Harness Diagnostic Mode Test the engine temperature should be above freezing. It is recommended that the engine temperature be at least room temperature 20° C (68° F). This test is located in Service ADVISOR.

IMPORTANT: Do not force probes into connector terminals or damage will result. Use JDG10466 Connector Adapter Test Kit to make measurements in connectors. This will ensure that terminal damage does not occur.

Continued on next page

JB81757,000005C -19-20APR10-2/18

1 Read DTCs and Store Snapshot Information

1. Ignition ON, engine OFF.

NOTE: When DTCs are cleared Snapshot information for ALL DTCs will also be cleared.

2. Connect Service ADVISOR, see Connecting To Service ADVISOR earlier in this Group.
3. Write down all DTCs and their occurrence count. If any DTCs have snapshot capture or snapshot recording information, save the information. For instructions on saving and using snapshot information, see Snapshot Instructions earlier in this Group.
4. Refresh DTCs.
5. Perform Harness Diagnostic Mode Test in SERVICE ADVISOR™.

Did 000653.05 reappear active?

YES: GO TO 2

NO: GO TO 11

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JB81757,000005C -19-20APR10-3/18

2 Terminal Test

CAUTION: Unit pumps are supplied with 90V. Electric shock hazard if ignition is ON!

NOTE: See FUEL SYSTEM COMPONENTS located in Section 02, Group 90 earlier in this manual for component locations.

1. Ignition OFF, engine OFF.
2. Disconnect 6-way connector C01 at engine block between engine harness and unit pump harness.
3. Perform Terminal Test on connector C01.

Were any problems found?

YES: Fix problem. GO TO 10

NO: GO TO 3

JB81757,000005C -19-20APR10-4/18

3 Check Unit Pump Circuit Resistance

NOTE: Nominal unit pump coil resistance is approximately 4 ohms at 20°C (68°F). Resistance will be higher if unit pump temperature is above 20°C (68°F).

With 3.0L - On the unit pump harness 6-way connector C01 in engine block (male pin terminals), measure the resistance between C01-6 and C01-3.

With 2.4L - On the unit pump harness 6-way connector C01 in engine block (male pin terminals), measure the resistance between C01-6 and C01-2.

Is resistance less than 8 ohms?

YES: GO TO 5

NO: GO TO 4

JB81757,000005C -19-20APR10-5/18

4 Check Unit Pump Coil Resistance

1. Remove rocker arm cover.
2. On the #3 unit pump, measure the resistance between the two unit pump studs.

Is the resistance less than 8 ohms?

YES: Replace unit pump wire harness. GO TO 10

NO: Replace #3 unit pump. GO TO 10

JB81757,000005C -19-20APR10-6/18

5 ECU Terminal Test

1. Disconnect ECU J01 connector.
2. Perform Terminal Test on J01.

Were any problems found?

YES: Fix problem. GO TO 10

NO: GO TO 6

Continued on next page

JB81757,000005C -19-20APR10-7/18

6 Check Engine Harness Continuity	With 3.0L: 1. On the harness, measure the resistance between ECU J01-B1 and unit pump connector C01-3. 2. On the harness, measure the resistance between ECU J01-G1 and unit pump connector C01-6. With 2.4L: 3. On the harness, measure the resistance between ECU J01-F1 and unit pump connector C01-2. 4. On the harness, measure the resistance between ECU J01-G1 and unit pump connector C01-6. Are both resistance readings less than 2 ohms?	**YES:** GO TO 7 **NO:** Fix problem. GO TO 10

JB81757,000005C -19-20APR10-8/18

7 Reprogram ECU	1. Ignition OFF, engine OFF. 2. Reconnect all connectors. 3. Download latest ECU payload and reprogram ECU. 4. Ignition ON, engine OFF. 5. Refresh DTCs. 6. Perform Harness Diagnostic Mode Test in Service ADVISOR. Did DTC 000653.05 reappear active?	**YES:** GO TO 8 **NO:** Problem fixed.

JB81757,000005C -19-20APR10-9/18

8 Replace Unit Pump #3	*NOTE: For unit pump replacement instructions, see Electronic Unit Pump — Installation in Section 02, Group 90 earlier in this manual.* 1. Ignition OFF, engine OFF. 2. Replace unit pump #3. 3. Ignition ON, engine OFF. 4. Refresh DTCs. 5. Perform Harness Diagnostic Mode Test in Service ADVISOR. Did DTC 000653.05 reappear active?	**YES:** GO TO 9 **NO:** Problem fixed.

JB81757,000005C -19-20APR10-10/18

9 Replace ECU	1. Ignition OFF, engine OFF. 2. Replace ECU. 3. Ignition ON, engine OFF. 4. Refresh DTCs. 5. Perform Harness Diagnostic Mode Test in Service ADVISOR. Did DTC 000653.05 reappear active?	**YES:** Open DTAC case. **NO:** Problem fixed.

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JB81757,000005C -19-20APR10-11/18

10 Verification	*NOTE: For unit pump terminal torque specifications, see Electronic Unit Pump — Installation in Section 02, Group 90 earlier in this manual.* 1. Ignition OFF, engine OFF. 2. Reconnect all connectors and reinstall rocker cover, if removed. 3. Ignition ON, engine OFF. 4. Refresh DTCs. 5. Perform Harness Diagnostic Mode Test in Service ADVISOR. Did DTC 000653.05 reappear active?	**YES:** GO TO 2 **NO:** Problem fixed.

JB81757,000005C -19-20APR10-12/18

11 Further Review of Snapshot Information	Review stored information collected in step 1 Does stored information lead to a possible problem or is there a certain operating point where error occurs?	**YES:** Fix problem if found. GO TO 10 **YES:** If a certain operating point exists when error occurs then GO TO 12 **NO:** GO TO 13

JB81757,000005C -19-20APR10-13/18

12 Engine Error Operating Point Test	1. Ignition ON, engine ON 2. Set engine to operating point of failure and refresh DTCs. Did 000653.05 reappear active when engine operating point was reached?	**YES:** GO TO 2 **NO:** GO TO 13

JB81757,000005C -19-20APR10-14/18

13 Terminal Test	**CAUTION: Unit pumps are supplied with 90V. Electric shock hazard if ignition is ON!** *NOTE: For unit pump terminal torque specifications, see Electronic Unit Pump — Installation in Section 02, Group 90 earlier in this manual.* 1. Ignition OFF, engine OFF 2. Remove rocker cover. See Rocker Arm Cover — Removalin Section 2 Group 20. 3. Check for loose terminal studs on unit pump #3. 4. Perform Terminal Test on the ECU J01 connector, unit pump #3, and unit pump harness connector C01. Were any problems found?	**YES:** Fix problem. GO TO 10 **NO:** GO TO 14

Continued on next page

JB81757,000005C -19-20APR10-15/18

14 Check for Intermittent Open Circuit	With 3.0L: 1. Reconnect all connectors except J01 connector. 2. On the harness, measure the resistance between ECU J01-B1 and J01-G1 while gently wiggling wire harness between ECU and unit pump #3. With 2.4L: 3. Reconnect all connectors except J01 connector. 4. On the harness, measure the resistance between ECU J01-F1 and J01-G1 while gently wiggling wire harness between ECU and unit pump #3. Does resistance value remain below 8 ohms while wiggling harness?	**YES:** GO TO 15. **NO:** Repair cause of intermittent open circuit. GO TO 10.

JB81757,000005C -19-20APR10-16/18

15 Reconnect and Retest	1. Reconnect J01 connector. 2. Ignition ON, engine ON. 3. Refresh DTCs. 4. Gently wiggle wire harness between ECU and connector C01. **CAUTION: Use caution when working near rotating components.** Did 000653.05 reappear active at any time with engine running?	**YES:** Repair cause of intermittent open circuit. GO TO 10. **NO:** GO TO 16.

JB81757,000005C -19-20APR10-17/18

16 Reprogram ECU	1. Download latest ECU payload and reprogram ECU. 2. Ignition ON, engine ON. 3. Refresh DTCs. Did 000653.05 reappear active with engine running?	**YES:** GO TO 2. **NO:** Replace unit pump #3. GO TO 10.

JB81757,000005C -19-20APR10-18/18

000653.06 — Electronic Unit Pump #3 Circuit Has Low Resistance

The ECU detects low resistance in the cylinder #3 electronic unit pump circuit.

JB81757,000005D -19-20APR10-1/18

000653.06 — Electronic Unit Pump #3 Circuit Has Low Resistance Diagnostic Procedure

Troubleshooting Sequence:
000611.03
000653.06

When DTC is Displayed:
The engine is cranking or running and the error condition is active. The DTC may also be displayed during Harness Diagnostic Mode Test in Service ADVISOR.

Related Information:
The ECU detects low resistance in the cylinder #3 electronic unit pump circuit.
The ECU has two internally-connected terminals which provide a shared high voltage supply to all the unit pumps. The ECU switches the low side (ground) to control each individual unit pump.
This DTC is NOT caused by a short to ground of the unit pump circuit. This DTC can be caused by a unit pump that has low coil resistance (internal coil windings are shorted together).
This DTC can also be caused by a wire-to-wire short. A short between the low side wiring of two unit pumps will cause active DTCs indicating low resistance in both unit pumps.

Alarm Level:
Warning

Control Unit Response:
The ECU will attempt to control the engine in a normal manner.

Additional References:
For further electronic unit pump information, see Electronic Unit Pump and Injector Nozzle Operation in Section 03, Group 130 earlier in this manual.

NOTE: The wiring diagrams provided are for a typical John Deere supplied OEM harness. Wire number, colors, and jumper connectors do not apply to all applications.

For wiring information see 2.4L ECU WIRING DIAGRAM 1 or 3.0L ECU WIRING DIAGRAM 2 located in Section 06, Group 210 later in this manual.

Flex probe information:
- ECU large terminal - Orange/Green
- ECU small terminal - Orange/Blue
- Unit pump connector C01 - Yellow/Purple

For more information on connector and terminal testing or flex probes see Terminal Test in Section 04, Group 160 earlier in this manual.

IMPORTANT: When directed to run the Harness Diagnostic Mode Test the engine temperature should be above freezing. It is recommended that the engine temperature be at least room temperature 20° C (68° F). This test is located in Service ADVISOR.

IMPORTANT: Do not force probes into connector terminals or damage will result. Use JDG10466 Connector Adapter Test Kit to make measurements in connectors. This will ensure that terminal damage does not occur.

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JB81757,000005D -19-20APR10-2/18

1 Read DTCs and Store Snapshot Information	1. Ignition ON, engine OFF. *NOTE: When DTCs are cleared Snapshot information for ALL DTCs will also be cleared.* 2. Connect Service ADVISOR, see Connecting To Service ADVISOR earlier in this Group. 3. Write down all DTCs and their occurrence count. If any DTCs have snapshot capture or snapshot recording information, save the information. For instructions on saving and using snapshot information, see Snapshot Instructions earlier in this Group. 4. Refresh DTCs. 5. Perform Harness Diagnostic Mode Test in Service ADVISOR. Did 000653.06 reappear active?	**YES:** GO TO 2 **NO:** GO TO 12

JB81757,000005D -19-20APR10-3/18

2 Check for DTC Change with Open Unit Pump Harness	**⚠ CAUTION: Unit pumps are supplied with 90V. Electric shock hazard if ignition is ON!** *NOTE: See FUEL SYSTEM COMPONENTS located in Section 02, Group 90 earlier in this manual for component locations.* 1. Ignition OFF, engine OFF. 2. Disconnect 6-way connector C01 at engine block between engine harness and unit pump harness. 3. Ignition ON, engine OFF. 4. Refresh DTCs 5. Perform Harness Diagnostic Mode Test in Service ADVISOR. Did DTC 000653.05, high unit pump #3 resistance, become active? *NOTE: Ignore DTCs for high resistance in the other unit pump circuits that may now be active because of this test.*	**YES:** GO TO 3 **NO:** Do not reconnect unit pump harness connector. GO TO 5

JB81757,000005D -19-20APR10-4/18

3 Unit Pump Harness Terminal Test and Inspection	1. Ignition OFF, engine OFF. 2. Perform Terminal Test on unit pump connector C01. 3. Remove rocker cover. See Rocker Arm Cover — Removal in Section 2 Group 20. 4. Inspect unit pump harness for damage. Were any problems found?	**YES:** Fix problem. GO TO 10 **NO:** GO TO 4

Continued on next page

JB81757,000005D -19-20APR10-5/18

4 Check Unit Pump Harness for Wire to Wire Short	With 3.0L: 1. Loosen unit pump #3 terminal nuts. 2. Lift unit pump #3 connector away from unit pump studs. 3. On the unit pump harness connector C01 in engine block (male pin terminals), measure the resistance between C01-3 and all other terminals in the unit pump harness connector C01. With 2.4L: 4. Loosen unit pump #3 terminal nuts. 5. Lift unit pump #3 connector away from unit pump studs. 6. On the unit pump harness connector C01 in engine block (male pin terminals), measure the resistance between C01-2 and all other terminals in the unit pump harness connector C01. Are all resistance readings greater than 10k ohms?	**YES:** Replace unit pump #3. GO TO 10 **NO:** Replace unit pump harness. GO TO 10

JB81757,000005D -19-20APR10-6/18

5 ECU Terminal Test	1. Ignition OFF, engine OFF. 2. Disconnect ECU J01 connector. 3. Perform Terminal Test on J01. Were any problems found?	**YES:** Fix problem. GO TO 10 **NO:** GO TO 6

JB81757,000005D -19-20APR10-7/18

6 Check Engine Harness for Wire-to-Wire Short	With 3.0L: 1. Disconnect ECU J02 connector. 2. Verify unit pump harness connector C01 is still disconnected. 3. On the harness, measure the resistance between ECU J01-B1 and all terminals in the J01 and J02 connectors. With 2.4L: 4. Disconnect ECU J02 connector. 5. Verify unit pump harness connector C01 is still disconnected. 6. On the harness, measure the resistance between ECU J01-F1 and all terminals in the J01 and J02 connectors. Are all resistance measurements greater than 10k ohms?	**YES:** GO TO 7 **NO:** Fix problem. GO TO 10

Continued on next page

JB81757,000005D -19-20APR10-8/18

7 Check Engine Harness for Short to Voltage Source	With 3.0L: 1. Ignition ON, engine OFF. 2. On the harness, measure the voltage between ECU J01-B1 (+) and single point ground (-). With 2.4L: 3. Ignition ON, engine OFF. 4. On the harness, measure the voltage between ECU J01-F1 (+) and single point ground (-). Is voltage greater than 0.5V?	**YES:** Fix problem. GO TO 10 **NO:** GO TO 8

JB81757,000005D -19-20APR10-9/18

8 Reprogram ECU	1. Ignition OFF, engine OFF. 2. Reconnect all connectors. 3. Download latest ECU payload and reprogram ECU. 4. Ignition ON, engine OFF. 5. Refresh DTCs. 6. Perform Harness Diagnostic Mode Test in SERVICE ADVISOR™. Did DTC 000653.06 reappear active?	**YES:** GO TO 9 **NO:** Problem fixed.

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JB81757,000005D -19-20APR10-10/18

9 Replace ECU	1. Ignition OFF, engine OFF. 2. Replace ECU. 3. Ignition ON, engine OFF. 4. Refresh DTCs. 5. Perform Harness Diagnostic Mode Test in Service ADVISOR. Did DTC 000653.06 reappear active?	**YES:** Open DTAC case. **NO:** Problem fixed.

JB81757,000005D -19-20APR10-11/18

10 Verification	*NOTE: See Electronic Unit Pump — Installation in Section 02, Group 90 earlier in this manual for unit pump terminal torque specification.* 1. Ignition OFF, engine OFF. 2. Reconnect all connectors and reinstall rocker cover, if removed. 3. Ignition ON, engine OFF. 4. Refresh DTCs. 5. Perform Harness Diagnostic Mode Test in Service ADVISOR. Did DTC 000653.06 reappear active?	**YES:** GO TO 2 **NO:** Problem fixed.

Continued on next page

JB81757,000005D -19-20APR10-12/18

11 Further Review of Snapshot Information

Review stored information collected in step 1	**YES:** Fix problem if found. GO TO 10
Does stored information lead to a possible problem or is there a certain operating point where error occurs?	**YES:** If a certain operating point exists when error occurs then GO TO 12 **NO:** GO TO 13

JB81757,000005D -19-20APR10-13/18

12 Engine Error Operating Point Test

1. Ignition ON, engine ON	
2. Set engine to operating point of failure and refresh DTCs.	**YES:** GO TO 2
Did 000653.06 reappear active when engine operating point was reached?	**NO:** GO TO 13

JB81757,000005D -19-20APR10-14/18

13 Terminal Test and Harness Inspection

CAUTION: Unit pumps are supplied with 90V. Electric shock hazard if ignition is ON!

1. Ignition OFF, engine OFF	
2. Remove rocker arm cover. See Rocker Arm Cover Cover — Removal	
3. Inspect unit pump wire harness for damage which would result in an intermittent wire-to-wire short circuit.	
4. Perform Terminal Test on the ECU J01 connector, unit pump #3, and unit pump connector C01.	**YES:** Fix problem. GO TO 10
Were any problems found?	**NO:** GO TO 14

JB81757,000005D -19-20APR10-15/18

14 Check for Intermittent Shorted Circuit

NOTE: Nominal unit pump coil resistance is approximately 4 ohms at 20°C (68°F). A wire-to-wire short of two unit pump low side control circuits will cause resistance readings of approximately 2 ohms. Resistance values will be higher if unit pump temperature is greater than 20°C (68°F).

With 3.0L:	
1. Reconnect all connectors except J01 connector.	
2. On the harness, measure the resistance between ECU J01-B1 and J01-G1 while gently wiggling wire harness between ECU and unit pump #3.	
With 2.4L:	
3. Reconnect all connectors except J01 connector.	
4. On the harness, measure the resistance between ECU J01-F1 and J01-G1 while gently wiggling wire harness between ECU and unit pump #3.	**YES:** Repair cause of intermittent shorted circuit. GO TO 10.
Does resistance value decrease below 3 ohms while wiggling harness?	**NO:** GO TO 15.

Continued on next page

JB81757,000005D -19-20APR10-16/18

15 Reconnect and Retest	1. Reconnect J01 connector. 2. Ignition ON, engine ON. 3. Refresh DTCs. 4. Gently wiggle wire harness between ECU and unit pump connector C01. **CAUTION: Use caution when working near rotating components.** Did 000653.06 reappear active at any time with engine running?	**YES:** Repair cause of intermittent shorted circuit. GO TO 10. **NO:** GO TO 16.

JB81757,000005D -19-20APR10-17/18

16 Reprogram ECU	1. Download latest ECU payload and reprogram ECU. 2. Ignition ON, engine ON. 3. Refresh DTCs. Did 000653.06 reappear active with engine running?	**YES:** GO TO 2 **NO:** Replace unit pump #3. GO TO 10

JB81757,000005D -19-20APR10-18/18

000653.13 — Electronic Unit Pump #3 Calibration Fault

The ECU detects an incorrect Electronic Unit Pump Calibration Code was calibrated into the ECU.

DN22556,00006B4 -19-24SEP10-1/9

000653.13 — Electronic Unit Pump #3 Calibration Fault Diagnostic Procedure

Troubleshooting Sequence:
000653.13

When DTC is Displayed:
During an electronic unit pump programming event.

Alarm Level:
Warning

Control Unit Response:
The ECU will attempt to run the engine normally.

Related Information:
The ECU detects an incorrect Electronic Unit Pump Calibration Code was programmed into the ECU. The engine performance may be drastically effected. The engine will also be out of compliance with Tier 3 emission requirements.

Additional References:
For more electronic unit pump information, see Electronic Unit Pump and Injector Nozzle Operation in Section 03, Group 130 earlier in this manual.

For more information on the fuel system, see Fuel System Operation in Section 03, Group 130 earlier in this manual.

DN22556,00006B4 -19-24SEP10-2/9

1	**Electronic Unit Pump Calibration Code Input Method Check**	Was the Electronic Unit Pump Calibration code typed in manually?	**YES:** GO TO 2 **NO:** GO TO 3

DN22556,00006B4 -19-24SEP10-3/9

2	**Verification and Reentry of Electronic Unit Pump Calibration Code**	1. Perform Electronic Unit Pump Calibration in Service ADVISOR. 2. Select the electronic unit pump to calibrate. 3. Check the written code against the one displayed. 4. Type it back in again. Did the ECU accept the Electronic Unit Pump Calibration code?	**YES:** Problem fixed. **NO:** GO TO 3

DN22556,00006B4 -19-24SEP10-4/9

3	**Automatic Input of Electronic Unit Pump Data**	1. Perform Electronic Unit Pump Calibration in Service ADVISOR. See Electronic Unit Pump Calibration Information in Section 4 Group 160. 2. Select the electronic unit pump to calibrate. 3. Select the sequence number of the electronic unit pump installed from the list. Did the ECU accept the Electronic Unit Pump Calibration Code?	**YES:** Problem fixed. **NO:** GO TO 4

Continued on next page

DN22556,00006B4 -19-24SEP10-5/9

4 Retrieve New Electronic Unit Pump Calibration File	Download a new electronic unit pump calibration file, see Electronic Unit Pump Calibration File Downloading Instructions earlier in this Group. Were you able to get a new calibration file?	**YES:** GO TO 5 **NO:** GO TO 6

DN22556,00006B4 -19-24SEP10-6/9

5 Automatic Input of Electronic Unit Pump Data	1. Perform Electronic Unit Pump Calibration in Service ADVISOR. See Electronic Unit Pump Calibration Information in Section 4 Group 160. 2. Select the electronic unit pump to calibrate. 3. Select the serial number of the electronic unit pump file downloaded from the list of electronic unit pumps. Did the ECU accept the Electronic Unit Pump Calibration code?	 **YES:** Problem fixed. **NO:** GO TO 6

DN22556,00006B4 -19-24SEP10-7/9

6 ECU Programming	1. Download the latest ECU software. 2. Reprogram ECU. Was the ECU programming successful?	 **YES:** GO TO 7 **NO:** Replace ECU. GO TO 3

DN22556,00006B4 -19-24SEP10-8/9

7 Automatic Input of Electronic Unit Pump Data	1. Perform Electronic Unit Pump Calibration in Service ADVISOR. See Electronic Unit Pump Calibration Information in Section 4 Group 160. 2. Select the electronic unit pump to calibrate. 3. Select the serial number of the electronic unit pump file downloaded from the list of electronic unit pumps. Did the ECU accept the Electronic Unit Pump Calibration code?	 **YES:** Problem fixed. **NO:** Start a DTAC case.

DN22556,00006B4 -19-24SEP10-9/9

000654.05 — Electronic Unit Pump #4 Circuit Has High Resistance

The ECU detects high resistance in the cylinder #4 electronic unit pump circuit.

JB81757,000005E -19-20APR10-1/18

000654.05 — Electronic Unit Pump #4 Circuit Has High Resistance Diagnostic Procedure

Troubleshooting Sequence:
003597.01
000654.05

When DTC is Displayed:
The engine is cranking or running and the error condition is active. The DTC may also be displayed during Harness Diagnostic Mode Test in Service ADVISOR.

Related Information:
The ECU detects high resistance in the cylinder #4 unit pump circuit.
The ECU has two internally-connected terminals which provide a shared high voltage supply to all the unit pump coils.
The ECU switches the low side (ground) to control each individual unit pump.
This DTC can be caused by an open circuit or by a few ohms of additional series resistance anywhere in the unit pump #4 circuit.
An open circuit in the unit pump high voltage supply may also cause active DTCs indicating high resistance in this and all other unit pump circuits.

Alarm Level:
Warning

Control Unit Response:
The ECU will attempt to control the engine in a normal manner.

Additional References:
For further electronic pump information, see Electronic Unit Pump and Injector Nozzle Operation in Section 03, Group 130 earlier in this manual.

NOTE: The wiring diagrams provided are for a typical John Deere supplied OEM harness. Wire number, colors, and jumper connectors do not apply to all applications.

For wiring information see 2.4L ECU WIRING DIAGRAM 1 or 3.0L ECU WIRING DIAGRAM 2 located in Section 06, Group 210 later in this manual.

Flex probe information:
- ECU large terminal - Orange/Green
- ECU small terminal - Orange/Blue
- Unit pump connector C01 - Yellow/Purple

For more information on connector and terminal testing or flex probes see Terminal Test in Section 04, Group 160 earlier in this manual.

IMPORTANT: When directed to run the Harness Diagnostic Mode Test the engine temperature should be above freezing. It is recommended that the engine temperature be at least room temperature 20° C (68° F). This test is located in Service ADVISOR.

IMPORTANT: Do not force probes into connector terminals or damage will result. Use JDG10466 Connector Adapter Test Kit to make measurements in connectors. This will ensure that terminal damage does not occur.

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JB81757,000005E -19-20APR10-2/18

1 Read DTCs and Store Snapshot Information

1. Ignition ON, engine OFF.

NOTE: When DTCs are cleared Snapshot information for ALL DTCs will also be cleared.

2. Connect Service ADVISOR, see Connecting To Service ADVISOR earlier in this Group.
3. Write down all DTCs and their occurrence count. If any DTCs have snapshot capture or snapshot recording information, save the information. For instructions on saving and using snapshot information, see Snapshot Instructions earlier in this Group.
4. Refresh DTCs.
5. Perform Harness Diagnostic Mode Test in Service ADVISOR.

Did 000654.05 reappear active?

YES: GO TO 2

NO: GO TO 11

JB81757,000005E -19-20APR10-3/18

2 Terminal Test

CAUTION: Unit pumps are supplied with 90V. Electric shock hazard if ignition is ON!

NOTE: See FUEL SYSTEM COMPONENTS located in Section 02, Group 90 earlier in this manual for component locations.

1. Ignition OFF, engine OFF.
2. Disconnect 6-way connector C01 at engine block between engine harness and unit pump harness.
3. Perform Terminal Test on connector C01.

Were any problems found?

YES: Fix problem. GO TO 10

NO: GO TO 3

JB81757,000005E -19-20APR10-4/18

3 Check Unit Pump Circuit Resistance

NOTE: Nominal unit pump coil resistance is approximately 4 ohms at 20°C (68°F). Resistance will be higher if unit pump temperature is above 20°C (68°F).

On the unit pump harness 6-way connector C01 in engine block (male pin terminals), measure the resistance between C01-6 and C01-4.

Is resistance less than 8 ohms?

YES: GO TO 5

NO: GO TO 4

JB81757,000005E -19-20APR10-5/18

4 Check Unit Pump Coil Resistance

1. Remove rocker arm cover.
2. On the #4 unit pump, measure the resistance between the two unit pump studs.

Is the resistance less than 8 ohms?

YES: Replace unit pump wire harness. GO TO 10

NO: Replace #4 unit pump. GO TO 10

JB81757,000005E -19-20APR10-6/18

5 ECU Terminal Test

1. Disconnect ECU J01 connector.
2. Perform Terminal Test on J01-G1, J01-G2, and J01-D1.

Were any problems found?

YES: Fix problem. GO TO 10

NO: GO TO 6

Continued on next page

JB81757,000005E -19-20APR10-7/18

6 Check Engine Harness Continuity

1. On the harness, measure the resistance between ECU J01-D1 and unit pump connector C01-4.
2. On the harness, measure the resistance between ECU J01-G1 and unit pump connector C01-6.

Are both resistance readings less than 2 ohms?

YES: GO TO 7

NO: Fix problem. GO TO 10

JB81757,000005E -19-20APR10-8/18

7 Reprogram ECU

1. Ignition OFF, engine OFF.
2. Reconnect all connectors.
3. Download latest ECU payload and reprogram ECU.
4. Ignition ON, engine OFF.
5. Refresh DTCs.
6. Perform Harness Diagnostic Mode Test in Service ADVISOR.

Did DTC 000654.05 reappear active?

YES: GO TO 8

NO: Problem fixed.

JB81757,000005E -19-20APR10-9/18

8 Replace Unit Pump #4

NOTE: For unit pump replacement instructions, see Electronic Unit Pump — Installation in Section 02, Group 90 earlier in this manual.

1. Ignition OFF, engine OFF.
2. Replace unit pump #4.
3. Ignition ON, engine OFF.
4. Refresh DTCs.
5. Perform Harness Diagnostic Mode Test in Service ADVISOR.

Did DTC 000654.05 reappear active?

YES: GO TO 9

NO: Problem fixed.

JB81757,000005E -19-20APR10-10/18

9 Replace ECU

1. Ignition OFF, engine OFF.
2. Replace ECU.
3. Ignition ON, engine OFF.
4. Refresh DTCs.
5. Perform Harness Diagnostic Mode Test in Service ADVISOR.

Did DTC 000654.05 reappear active?

YES: Open DTAC case.

NO: Problem fixed.

JB81757,000005E -19-20APR10-11/18

10 Verification

NOTE: For unit pump terminal torque specifications, see Electronic Unit Pump — Installation in Section 02, Group 90 earlier in this manual.

1. Ignition OFF, engine OFF.
2. Reconnect all connectors and reinstall rocker cover, if removed. See Rocker Arm Cover — Installation in Section 2 Group 20
3. Ignition ON, engine OFF.
4. Refresh DTCs.
5. Perform Harness Diagnostic Mode Test in Service ADVISOR.

Did DTC 000654.05 reappear active?

YES: GO TO 2

NO: Problem fixed.

Continued on next page

JB81757,000005E -19-20APR10-12/18

11 Further Review of Snapshot Information

Review stored information collected in step 1	**YES:** Fix problem if found. GO TO 10
Does stored information lead to a possible problem or is there a certain operating point where error occurs?	**YES:** If a certain operating point exists when error occurs then GO TO 12 **NO:** GO TO 13

JB81757,000005E -19-20APR10-13/18

12 Engine Error Operating Point Test

1. Ignition ON, engine ON	
2. Set engine to operating point of failure and refresh DTCs.	**YES:** GO TO 2
Did 000654.05 reappear active when engine operating point was reached?	**NO:** GO TO 13

JB81757,000005E -19-20APR10-14/18

13 Terminal Test

CAUTION: Unit pumps are supplied with 90V. Electric shock hazard if ignition is ON!

NOTE: For unit pump terminal torque specifications, see Electronic Unit Pump — Installation in Section 02, Group 90 earlier in this manual.

1. Ignition OFF, engine OFF	
2. Remove rocker cover. See Rocker Arm Cover — Removal in Section 2 Group 20	
3. Check for loose terminal studs on unit pump #4.	
4. Perform Terminal Test on the ECU J01 connector, unit pump #4, and unit pump harness connector C01.	**YES:** Fix problem. GO TO 10
Were any problems found?	**NO:** GO TO 14

JB81757,000005E -19-20APR10-15/18

14 Check for Intermittent Open Circuit

1. Reconnect all connectors except J01 connector.	
2. On the harness, measure the resistance between ECU J01-D1 and J01-G1 while gently wiggling wire harness between ECU and unit pump #4.	**YES:** GO TO 15.
Does resistance value remain below 8 ohms while wiggling harness?	**NO:** Repair cause of intermittent open circuit. GO TO 10.

JB81757,000005E -19-20APR10-16/18

15 Reconnect and Retest

1. Reconnect J01 connector.	
2. Ignition ON, engine ON.	
3. Refresh DTCs.	
4. Gently wiggle wire harness between ECU and connector C01.	**YES:** Repair cause of intermittent open circuit. GO TO 10.
CAUTION: Use caution when working near rotating components.	
Did 000654.05 reappear active at any time with engine running?	**NO:** GO TO 16.

Continued on next page

JB81757,000005E -19-20APR10-17/18

16 Reprogram ECU	1. Download latest ECU payload and reprogram ECU. 2. Ignition ON, engine ON. 3. Refresh DTCs. Did 000654.05 reappear active with engine running?	**YES:** GO TO 2. **NO:** Replace unit pump #4. GO TO 10.

JB81757,000005E -19-20APR10-18/18

000654.06 — Electronic Unit Pump #4 Circuit Has Low Resistance

The ECU detects low resistance in the cylinder #4 electronic unit pump circuit.

JB81757,000005F -19-31MAY10-1/18

000654.06 — Electronic Unit Pump #4 Circuit Has Low Resistance Diagnostic Procedure

Troubleshooting Sequence:
000611.03
000654.06

When DTC is Displayed:
The engine is cranking or running and the error condition is active. The DTC may also be displayed during Harness Diagnostic Mode Test in Service ADVISOR.

Related Information:
The ECU detects low resistance in the cylinder #4 electronic unit pump circuit.
The ECU has two internally-connected terminals which provide a shared high voltage supply to all the unit pumps. The ECU switches the low side (ground) to control each individual unit pump.
This DTC is NOT caused by a short to ground of the unit pump circuit. This DTC can be caused by a unit pump that has low coil resistance (internal coil windings are shorted together).
This DTC can also be caused by a wire-to-wire short. A short between the low side wiring of two unit pumps will cause active DTCs indicating low resistance in both unit pumps.

Alarm Level:
Warning

Control Unit Response:
The ECU will attempt to control the engine in a normal manner.

Additional References:
For further electronic unit pump information, see Electronic Unit Pump and Injector Nozzle Operation in Section 03, Group 130 earlier in this manual.

NOTE: The wiring diagrams provided are for a typical John Deere supplied OEM harness. Wire number, colors, and jumper connectors do not apply to all applications.

For wiring information see 2.4L ECU WIRING DIAGRAM 1 or 3.0L ECU WIRING DIAGRAM 2 located in Section 06, Group 210 later in this manual.

Flex probe information:
- ECU large terminal - Orange/Green
- ECU small terminal - Orange/Blue
- Unit pump connector C01 - Yellow/Purple

For more information on connector and terminal testing or flex probes see Terminal Test in Section 04, Group 160 earlier in this manual.

IMPORTANT: When directed to run the Harness Diagnostic Mode Test the engine temperature should be above freezing. It is recommended that the engine temperature be at least room temperature 20° C (68° F). This test is located in Service ADVISOR.

IMPORTANT: Do not force probes into connector terminals or damage will result. Use JDG10466 Connector Adapter Test Kit to make measurements in connectors. This will ensure that terminal damage does not occur.

Continued on next page

JB81757,000005F -19-31MAY10-2/18

1 Read DTCs and Store Snapshot Information

1. Ignition ON, engine OFF.

NOTE: When DTCs are cleared Snapshot information for ALL DTCs will also be cleared.

2. Connect Service ADVISOR, see Connecting To Service ADVISOR earlier in this Group.
3. Write down all DTCs and their occurrence count. If any DTCs have snapshot capture or snapshot recording information, save the information. For instructions on saving and using snapshot information, see Snapshot Instructions earlier in this Group.
4. Refresh DTCs.
5. Perform Harness Diagnostic Mode Test in Service ADVISOR.

Did 000654.06 reappear active?

YES: GO TO 2

NO: GO TO 12

JB81757,000005F -19-31MAY10-3/18

2 Check for DTC Change with Open Unit Pump Harness

CAUTION: Unit pumps are supplied with 90V. Electric shock hazard if ignition is ON!

NOTE: See FUEL SYSTEM COMPONENTS located in Section 02, Group 90 earlier in this manual for component locations.

1. Ignition OFF, engine OFF.
2. Disconnect 6-way connector C01 at engine block between engine harness and unit pump harness.
3. Ignition ON, engine OFF.
4. Refresh DTCs
5. Perform Harness Diagnostic Mode Test in Service ADVISOR.

Did DTC 000654.05, high unit pump #4 resistance, become active?

YES: GO TO 3

NOTE: Ignore DTCs for high resistance in the other unit pump circuits that may now be active because of this test.

NO: Do not reconnect unit pump harness connector. GO TO 5

JB81757,000005F -19-31MAY10-4/18

3 Unit Pump Harness Terminal Test and Inspection

1. Ignition OFF, engine OFF.
2. Perform Terminal Test on unit pump connector C01.
3. Remove rocker cover.
4. Inspect unit pump harness for damage.

Were any problems found?

YES: Fix problem. GO TO 10

NO: GO TO 4

JB81757,000005F -19-31MAY10-5/18

4 Check Unit Pump Harness for Wire to Wire Short

1. Loosen unit pump #4 terminal nuts.
2. Lift unit pump #4 connector away from unit pump studs.
3. On the unit pump harness connector C01 in engine block (male pin terminals), measure the resistance between C01-4 and all other terminals in the unit pump harness connector C01.

Are all resistance readings greater than 10k ohms?

YES: Replace unit pump #4. GO TO 10

NO: Replace unit pump harness. GO TO 10

Continued on next page

JB81757,000005F -19-31MAY10-6/18

5 ECU Terminal Test

1. Ignition OFF, engine OFF.
2. Disconnect ECU J1 connector.
3. Perform Terminal Test on J1-G1, J1-G2, and J1-D1.

Were any problems found?

YES: Fix problem. GO TO 10

NO: GO TO 6

JB81757,000005F -19-31MAY10-7/18

6 Check Engine Harness for Wire-to-Wire Short

1. Disconnect ECU J2 connector.
2. Verify unit pump harness connector C01 is still disconnected.
3. On the harness, measure the resistance between the ECU unit pump #4 control (terminal J1-D1) and all terminals in the J1 and J2 connectors.

Are all resistance measurements greater than 10k ohms?

YES: GO TO 7

NO: Fix problem. GO TO 10

JB81757,000005F -19-31MAY10-8/18

7 Check Engine Harness for Short to Voltage Source

1. Ignition ON, engine OFF.
2. On the harness, measure the voltage between ECU J1-D1 (+) and single point ground (-).

Is voltage greater than 0.5V?

YES: Fix problem. GO TO 10

NO: GO TO 8

JB81757,000005F -19-31MAY10-9/18

8 Reprogram ECU

1. Ignition OFF, engine OFF.
2. Reconnect all connectors.
3. Download latest ECU payload and reprogram ECU.
4. Ignition ON, engine OFF.
5. Refresh DTCs.
6. Perform Harness Diagnostic Mode Test in Service ADVISOR.

Did DTC 000654.06 reappear active?

YES: GO TO 9

NO: Problem fixed.

JB81757,000005F -19-31MAY10-10/18

9 Replace ECU

1. Ignition OFF, engine OFF.
2. Replace ECU.
3. Ignition ON, engine OFF.
4. Refresh DTCs.
5. Perform Harness Diagnostic Mode Test in Service ADVISOR.

Did DTC 000654.06 reappear active?

YES: Open DTAC case.

NO: Problem fixed.

Continued on next page

JB81757,000005F -19-31MAY10-11/18

10 Verification

NOTE: See Electronic Unit Pump — Installation in Section 02, Group 90 earlier in this manual for unit pump terminal torque specification.

1. Ignition OFF, engine OFF.
2. Reconnect all connectors and reinstall rocker cover, if removed.
3. Ignition ON, engine OFF.
4. Refresh DTCs.
5. Perform Harness Diagnostic Mode Test in Service ADVISOR.

Did DTC 000654.06 reappear active?

YES: GO TO 2
NO: Problem fixed.

JB81757,000005F -19-31MAY10-12/18

11 Further Review of Snapshot Information

Review stored information collected in step 1

YES: Fix problem if found. GO TO 10

Does stored information lead to a possible problem or is there a certain operating point where error occurs?

YES: If a certain operating point exists when error occurs then GO TO 12
NO: GO TO 13

JB81757,000005F -19-31MAY10-13/18

12 Engine Error Operating Point Test

1. Ignition ON, engine ON
2. Set engine to operating point of failure and refresh DTCs.

Did 000654.06 reappear active when engine operating point was reached?

YES: GO TO 2
NO: GO TO 13

JB81757,000005F -19-31MAY10-14/18

13 Terminal Test and Harness Inspection

CAUTION: Unit pumps are supplied with 90V. Electric shock hazard if ignition is ON!

1. Ignition OFF, engine OFF
2. Remove rocker cover.
3. Inspect unit pump wire harness for damage which would result in an intermittent wire-to-wire short circuit.
4. Perform Terminal Test on the ECU J1 connector, unit pump #4, and unit pump connector C01.

Were any problems found?

YES: Fix problem. GO TO 10
NO: GO TO 14

JB81757,000005F -19-31MAY10-15/18

14 Check for Intermittent Shorted Circuit

NOTE: Nominal unit pump coil resistance is approximately 4 ohms at 20°C (68°F). A wire-to-wire short of two unit pump low side control circuits will cause resistance readings of approximately 2 ohms. Resistance values will be higher if unit pump temperature is greater than 20°C (68°F).

1. Reconnect all connectors except J1 connector.
2. On the harness, measure the resistance between ECU J1-D1 and J1-G1 while gently wiggling wire harness between ECU and unit pump #4.

Does resistance value decrease below 3 ohms while wiggling harness?

YES: Repair cause of intermittent shorted circuit. GO TO 10.
NO: GO TO 15.

Continued on next page

JB81757,000005F -19-31MAY10-16/18

15 Reconnect and Retest	1. Reconnect J1 connector. 2. Ignition ON, engine ON. 3. Refresh DTCs. 4. Gently wiggle wire harness between ECU and unit pump connector C01. **CAUTION: Use caution when working near rotating components.** Did 000654.06 reappear active at any time with engine running?	**YES:** Repair cause of intermittent shorted circuit. GO TO 10. **NO:** GO TO 16.

JB81757,000005F -19-31MAY10-17/18

16 Reprogram ECU	1. Download latest ECU payload and reprogram ECU. 2. Ignition ON, engine ON. 3. Refresh DTCs. Did 000654.06 reappear active with engine running?	**YES:** GO TO 2 **NO:** Replace unit pump #4. GO TO 10

JB81757,000005F -19-31MAY10-18/18

000654.13 — Electronic Unit Pump #4 Calibration Fault

The ECU detects an incorrect Electronic Unit Pump Calibration Code was calibrated into the ECU.

DN22556,00006B5 -19-24SEP10-1/9

000654.13 — Electronic Unit Pump #4 Calibration Fault Diagnostic Procedure

Troubleshooting Sequence:
000654.13

When DTC is Displayed:
During an electronic unit pump programming event.

Alarm Level:
Warning

Control Unit Response:
The ECU will attempt to run the engine normally.

Related Information:
The ECU detects an incorrect Electronic Unit Pump Calibration Code was programmed into the ECU. The engine performance may be drastically effected. The engine will also be out of compliance with Tier 3 emission requirements.

Additional References:
For more electronic unit pump information, see Electronic Unit Pump — Installation in Section 03, Group 130 earlier in this manual.

For more information on the fuel system, see Fuel System Operation in Section 03, Group 130 earlier in this manual.

DN22556,00006B5 -19-24SEP10-2/9

1 Electronic Unit Pump Calibration Code Input Method Check	Was the Electronic Unit Pump Calibration code typed in manually?	**YES:** GO TO 2 **NO:** GO TO 3

DN22556,00006B5 -19-24SEP10-3/9

2 Verification and Reentry of Electronic Unit Pump Calibration Code	1. Perform Electronic Unit Pump Calibration in Service ADVISOR. See Electronic Unit Pump Calibration Information 2. Select the electronic unit pump to calibrate. 3. Check the written code against the one displayed. 4. Type it back in again. Did the ECU accept the Electronic Unit Pump Calibration code?	**YES:** Problem fixed. **NO:** GO TO 3

DN22556,00006B5 -19-24SEP10-4/9

3 Automatic Input of Electronic Unit Pump Data	1. Perform Electronic Unit Pump Calibration in Service ADVISOR. See Electronic Unit Pump Calibration Information. 2. Select the electronic unit pump to calibrate. 3. Select the sequence number of the electronic unit pump installed from the list. Did the ECU accept the Electronic Unit Pump Calibration Code?	**YES:** Problem fixed. **NO:** GO TO 4

Continued on next page

DN22556,00006B5 -19-24SEP10-5/9

4 Retrieve New Electronic Unit Pump Calibration File	Download a new electronic unit pump calibration file, see Electronic Unit Pump Calibration File Downloading Instructions earlier in this Group. Were you able to get a new calibration file?	**YES:** GO TO 5 **NO:** GO TO 6

DN22556,00006B5 -19-24SEP10-6/9

5 Automatic Input of Electronic Unit Pump Data	1. Perform Electronic Unit Pump Calibration in Service ADVISOR. See Electronic Unit Pump Calibration Information 2. Select the electronic unit pump to calibrate. 3. Select the serial number of the electronic unit pump file downloaded from the list of electronic unit pumps. Did the ECU accept the Electronic Unit Pump Calibration code?	 **YES:** Problem fixed. **NO:** GO TO 6

DN22556,00006B5 -19-24SEP10-7/9

6 ECU Programming	1. Download the latest ECU software. 2. Reprogram ECU. Was the ECU programming successful?	 **YES:** GO TO 7 **NO:** Replace ECU. GO TO 3

DN22556,00006B5 -19-24SEP10-8/9

7 Automatic Input of Electronic Unit Pump Data	1. Perform Electronic Unit Pump Calibration in Service ADVISOR. See Electronic Unit Pump Calibration Information 2. Select the electronic unit pump to calibrate. 3. Select the serial number of the electronic unit pump file downloaded from the list of electronic unit pumps. Did the ECU accept the Electronic Unit Pump Calibration code?	 **YES:** Problem fixed. **NO:** Start a DTAC case.

DN22556,00006B5 -19-24SEP10-9/9

000655.05 — Electronic Unit Pump #5 Circuit Has High Resistance

The ECU detects high resistance in the cylinder #5 electronic unit pump circuit.

JB81757,0000060 -19-31MAY10-1/18

000655.05 — Electronic Unit Pump #5 Circuit Has High Resistance Diagnostic Procedure

Troubleshooting Sequence:
003597.01
000655.05

When DTC is Displayed:
The engine is cranking or running and the error condition is active. The DTC may also be displayed during Harness Diagnostic Mode Test in Service ADVISOR.

Related Information:
The ECU detects high resistance in the cylinder #5 unit pump circuit.
The ECU has two internally-connected terminals which provide a shared high voltage supply to all the unit pump coils.
The ECU switches the low side (ground) to control each individual unit pump.
This DTC can be caused by an open circuit or by a few ohms of additional series resistance anywhere in the unit pump #5 circuit.
An open circuit in the unit pump high voltage supply may also cause active DTCs indicating high resistance in this and all other unit pump circuits.

Alarm Level:
Warning

Control Unit Response:
The ECU will attempt to control the engine in a normal manner.

Additional References:
For further electronic pump information, see Electronic Unit Pump and Injector Nozzle Operation in Section 03, Group 130 earlier in this manual.

NOTE: The wiring diagrams provided are for a typical John Deere supplied OEM harness. Wire number, colors, and jumper connectors do not apply to all applications.

For wiring information see 3.0L ECU WIRING DIAGRAM 2 located in Section 06, Group 210 later in this manual.

Flex probe information:
- ECU large terminal - Orange/Green
- ECU small terminal - Orange/Blue
- Unit pump connector C01 - Yellow/Purple

For more information on connector and terminal testing or flex probes see Terminal Test in Section 04, Group 160 earlier in this manual.

IMPORTANT: When directed to run the Harness Diagnostic Mode Test the engine temperature should be above freezing. It is recommended that the engine temperature be at least room temperature 20° C (68° F). This test is located in Service ADVISOR.

IMPORTANT: Do not force probes into connector terminals or damage will result. Use JDG10466 Connector Adapter Test Kit to make measurements in connectors. This will ensure that terminal damage does not occur.

Continued on next page

JB81757,0000060 -19-31MAY10-2/18

1 Read DTCs and Store Snapshot Information

1. Ignition ON, engine OFF.

NOTE: When DTCs are cleared Snapshot information for ALL DTCs will also be cleared.

2. Connect Service ADVISOR, see Connecting To Service ADVISOR earlier in this Group.
3. Write down all DTCs and their occurrence count. If any DTCs have snapshot capture or snapshot recording information, save the information. For instructions on saving and using snapshot information, see Snapshot Instructionsearlier in this Group.
4. Refresh DTCs.
5. Perform Harness Diagnostic Mode Test in Service ADVISOR.

Did 000655.05 reappear active?

YES: GO TO 2

NO: GO TO 11

JB81757,0000060 -19-31MAY10-3/18

2 Terminal Test

CAUTION: Unit pumps are supplied with 90V. Electric shock hazard if ignition is ON!

NOTE: See FUEL SYSTEM COMPONENTS located in Section 02, Group 90 earlier in this manual for component locations.

1. Ignition OFF, engine OFF.
2. Disconnect 6-way connector C01 at engine block between engine harness and unit pump harness.
3. Perform Terminal Test on connector C01.

Were any problems found?

YES: Fix problem. GO TO 10

NO: GO TO 3

JB81757,0000060 -19-31MAY10-4/18

3 Check Unit Pump Circuit Resistance

NOTE: Nominal unit pump coil resistance is approximately 4 ohms at 20°C (68°F). Resistance will be higher if unit pump temperature is above 20°C (68°F).

On the unit pump harness 6-way connector C01 in engine block (male pin terminals), measure the resistance between C01-6 and C01-5.

Is resistance less than 8 ohms?

YES: GO TO 5

NO: GO TO 4

JB81757,0000060 -19-31MAY10-5/18

4 Check Unit Pump Coil Resistance

1. Remove rocker arm cover.
2. On the #5 unit pump, measure the resistance between the two unit pump studs.

Is the resistance less than 8 ohms?

YES: Replace unit pump wire harness. GO TO 10

NO: Replace #5 unit pump. GO TO 10

JB81757,0000060 -19-31MAY10-6/18

5 ECU Terminal Test

1. Disconnect ECU J01 connector.
2. Perform Terminal Test on J01-G1, J01-G2, and J01-C1.

Were any problems found?

YES: Fix problem. GO TO 10

NO: GO TO 6

Continued on next page

JB81757,0000060 -19-31MAY10-7/18

6 Check Engine Harness Continuity	1. On the harness, measure the resistance between ECU J01-C1 and unit pump connector C01-5. 2. On the harness, measure the resistance between ECU J01-G1 and unit pump connector C01-6. Are both resistance readings less than 2 ohms?	**YES:** GO TO 7 **NO:** Fix problem. GO TO 10

JB81757,0000060 -19-31MAY10-8/18

7 Reprogram ECU	1. Ignition OFF, engine OFF. 2. Reconnect all connectors. 3. Download latest ECU payload and reprogram ECU. 4. Ignition ON, engine OFF. 5. Refresh DTCs. 6. Perform Harness Diagnostic Mode Test in Service ADVISOR. Did DTC 000655.05 reappear active?	**YES:** GO TO 8 **NO:** Problem fixed.

JB81757,0000060 -19-31MAY10-9/18

8 Replace Unit Pump #5	*NOTE: For unit pump replacement instructions, see Electronic Unit Pump — Installation in Section 02, Group 90 earlier in this manual.* 1. Ignition OFF, engine OFF. 2. Replace unit pump #5. 3. Ignition ON, engine OFF. 4. Refresh DTCs. 5. Perform Harness Diagnostic Mode Test in Service ADVISOR. Did DTC 000655.05 reappear active?	**YES:** GO TO 9 **NO:** Problem fixed.

JB81757,0000060 -19-31MAY10-10/18

9 Replace ECU	1. Ignition OFF, engine OFF. 2. Replace ECU. 3. Ignition ON, engine OFF. 4. Refresh DTCs. 5. Perform Harness Diagnostic Mode Test in Service ADVISOR. Did DTC 000655.05 reappear active?	**YES:** Open DTAC case. **NO:** Problem fixed.

JB81757,0000060 -19-31MAY10-11/18

10 Verification	*NOTE: For unit pump terminal torque specifications, see Electronic Unit Pump — Installation in Section 02, Group 90 earlier in this manual.* 1. Ignition OFF, engine OFF. 2. Reconnect all connectors and reinstall rocker cover, if removed. 3. Ignition ON, engine OFF. 4. Refresh DTCs. 5. Perform Harness Diagnostic Mode Test in Service ADVISOR. Did DTC 000655.05 reappear active?	**YES:** GO TO 2 **NO:** Problem fixed.

Continued on next page

JB81757,0000060 -19-31MAY10-12/18

11 Further Review of Snapshot Information	Review stored information collected in step 1	**YES:** Fix problem if found. GO TO 10
	Does stored information lead to a possible problem or is there a certain operating point where error occurs?	**YES:** If a certain operating point exists when error occurs then GO TO 12 **NO:** GO TO 13

JB81757,0000060 -19-31MAY10-13/18

12 Engine Error Operating Point Test	1. Ignition ON, engine ON	
	2. Set engine to operating point of failure and refresh DTCs.	**YES:** GO TO 2
	Did 000655.05 reappear active when engine operating point was reached?	**NO:** GO TO 13

JB81757,0000060 -19-31MAY10-14/18

13 Terminal Test	**CAUTION: Unit pumps are supplied with 90V. Electric shock hazard if ignition is ON!** *NOTE: For unit pump terminal torque specifications, see Electronic Unit Pump — Installation in Section 02, Group 90 earlier in this manual.* 1. Ignition OFF, engine OFF 2. Remove rocker cover. 3. Check for loose terminal studs on unit pump #5.	
	4. Perform Terminal Test on the ECU J01 connector, unit pump #5, and unit pump harness connector C01.	**YES:** Fix problem. GO TO 10
	Were any problems found?	**NO:** GO TO 14

JB81757,0000060 -19-31MAY10-15/18

14 Check for Intermittent Open Circuit	1. Reconnect all connectors except J01 connector.	
	2. On the harness, measure the resistance between ECU J01-C1 and J01-G1 while gently wiggling wire harness between ECU and unit pump #5.	**YES:** GO TO 15.
	Does resistance value remain below 8 ohms while wiggling harness?	**NO:** Repair cause of intermittent open circuit. GO TO 10.

JB81757,0000060 -19-31MAY10-16/18

15 Reconnect and Retest	1. Reconnect J01 connector.	
	2. Ignition ON, engine ON. 3. Refresh DTCs.	
	4. Gently wiggle wire harness between ECU and connector C01.	**YES:** Repair cause of intermittent open circuit. GO TO 10.
	CAUTION: Use caution when working near rotating components. Did 000655.05 reappear active at any time with engine running?	**NO:** GO TO 16.

Continued on next page

JB81757,0000060 -19-31MAY10-17/18

16 Reprogram ECU	1. Download latest ECU payload and reprogram ECU. 2. Ignition ON, engine ON. 3. Refresh DTCs. Did 000655.05 reappear active with engine running?	**YES:** GO TO 2. **NO:** Replace unit pump #5. GO TO 10.

JB81757,0000060 -19-31MAY10-18/18

000655.06 — Electronic Unit Pump #5 Circuit Has Low Resistance

The ECU detects low resistance in the cylinder #5 electronic unit pump circuit.

JB81757,0000061 -19-20APR10-1/18

000655.06 — Electronic Unit Pump #5 Circuit Has Low Resistance Diagnostic Procedure

Troubleshooting Sequence:
000611.03
000655.06

When DTC is Displayed:
The engine is cranking or running and the error condition is active. The DTC may also be displayed during Harness Diagnostic Mode Test in Service ADVISOR.

Related Information:
The ECU detects low resistance in the cylinder #5 electronic unit pump circuit.
The ECU has two internally-connected terminals which provide a shared high voltage supply to all the unit pumps. The ECU switches the low side (ground) to control each individual unit pump.
This DTC is NOT caused by a short to ground of the unit pump circuit. This DTC can be caused by a unit pump that has low coil resistance (internal coil windings are shorted together).
This DTC can also be caused by a wire-to-wire short. A short between the low side wiring of two unit pumps will cause active DTCs indicating low resistance in both unit pumps.

Alarm Level:
Warning

Control Unit Response:
The ECU will attempt to control the engine in a normal manner.

Additional References:
For further electronic unit pump information, see Electronic Unit Pump and Injector Nozzle Operation in Section 03, Group 130 earlier in this manual.

NOTE: The wiring diagrams provided are for a typical John Deere supplied OEM harness. Wire number, colors, and jumper connectors do not apply to all applications.

For wiring information see 3.0L ECU WIRING DIAGRAM 2 located in Section 06, Group 210 later in this manual.

Flex probe information:
- ECU large terminal - Orange/Green
- ECU small terminal - Orange/Blue
- Unit pump connector C01 - Yellow/Purple

For more information on connector and terminal testing or flex probes see Terminal Test in Section 04, Group 160 earlier in this manual.

IMPORTANT: When directed to run the Harness Diagnostic Mode Test the engine temperature should be above freezing. It is recommended that the engine temperature be at least room temperature 20° C (68° F). This test is located in Service ADVISOR.

IMPORTANT: Do not force probes into connector terminals or damage will result. Use JDG10466 Connector Adapter Test Kit to make measurements in connectors. This will ensure that terminal damage does not occur.

Continued on next page

JB81757,0000061 -19-20APR10-2/18

1 Read DTCs and Store Snapshot Information

1. Ignition ON, engine OFF.

NOTE: When DTCs are cleared Snapshot information for ALL DTCs will also be cleared.

2. Connect Service ADVISOR, see Connecting To Service ADVISOR earlier in this Group.
3. Write down all DTCs and their occurrence count. If any DTCs have snapshot capture or snapshot recording information, save the information. For instructions on saving and using snapshot information, see Snapshot Instructions earlier in this Group.
4. Refresh DTCs.
5. Perform Harness Diagnostic Mode Test in Service ADVISOR.

Did 000655.06 reappear active?

YES: GO TO 2

NO: GO TO 12

JB81757,0000061 -19-20APR10-3/18

2 Check for DTC Change with Open Unit Pump Harness

CAUTION: Unit pumps are supplied with 90V. Electric shock hazard if ignition is ON!

NOTE: See FUEL SYSTEM COMPONENTS located in Section 02, Group 90 earlier in this manual for component locations.

1. Ignition OFF, engine OFF.
2. Disconnect 6-way connector C01 at engine block between engine harness and unit pump harness.
3. Ignition ON, engine OFF.
4. Refresh DTCs
5. Perform Harness Diagnostic Mode Test in Service ADVISOR.

Did DTC 000655.05, high unit pump #5 resistance, become active?

NOTE: Ignore DTCs for high resistance in the other unit pump circuits that may now be active because of this test.

YES: GO TO 3

NO: Do not reconnect unit pump harness connector. GO TO 5

JB81757,0000061 -19-20APR10-4/18

3 Unit Pump Harness Terminal Test and Inspection

1. Ignition OFF, engine OFF.
2. Perform Terminal Test on unit pump connector C01.
3. Remove rocker cover. See Rocker Arm Cover — Removal in Section 2 Group 20.
4. Inspect unit pump harness for damage.

Were any problems found?

YES: Fix problem. GO TO 10

NO: GO TO 4

JB81757,0000061 -19-20APR10-5/18

4 Check Unit Pump Harness for Wire to Wire Short

1. Loosen unit pump #5 terminal nuts.
2. Lift unit pump #5 connector away from unit pump studs.
3. On the unit pump harness connector C01 (male pin terminals), measure the resistance between C01-5 and all other terminals in the unit pump harness connector C01.

Are all resistance readings greater than 10k ohms?

YES: Replace unit pump #5. GO TO 10

NO: Replace unit pump harness. GO TO 10

Continued on next page

JB81757,0000061 -19-20APR10-6/18

5 ECU Terminal Test	1. Ignition OFF, engine OFF.	
	2. Disconnect ECU J01 connector.	
	3. Perform Terminal Test on J01-G1, J01-G2, and J01-C1.	**YES:** Fix problem. GO TO 10
	Were any problems found?	**NO:** GO TO 6

JB81757,0000061 -19-20APR10-7/18

6 Check Engine Harness for Wire-to-Wire Short	1. Disconnect ECU J02 connector.	
	2. Verify unit pump harness connector C01 is still disconnected.	
	3. On the harness, measure the resistance between J01-C1 and all terminals in the J01 and J02 connectors.	**YES:** GO TO 7
	Are all resistance measurements greater than 10k ohms?	**NO:** Fix problem. GO TO 10

JB81757,0000061 -19-20APR10-8/18

7 Check Engine Harness for Short to Voltage Source	1. Ignition ON, engine OFF.	
	2. On the harness, measure the voltage between ECU J01-C1 (+) and single point ground (-).	**YES:** Fix problem. GO TO 10
	Is voltage greater than 0.5V?	**NO:** GO TO 8

JB81757,0000061 -19-20APR10-9/18

8 Reprogram ECU	1. Ignition OFF, engine OFF.	
	2. Reconnect all connectors.	
	3. Download latest ECU payload and reprogram ECU.	
	4. Ignition ON, engine OFF.	
	5. Refresh DTCs.	
	6. Perform Harness Diagnostic Mode Test in Service ADVISOR.	**YES:** GO TO 9
	Did DTC 000655.06 reappear active?	**NO:** Problem fixed.

JB81757,0000061 -19-20APR10-10/18

9 Replace ECU	1. Ignition OFF, engine OFF.	
	2. Replace ECU.	
	3. Ignition ON, engine OFF.	
	4. Refresh DTCs.	
	5. Perform Harness Diagnostic Mode Test in Service ADVISOR.	**YES:** Open DTAC case.
	Did DTC 000655.06 reappear active?	**NO:** Problem fixed.

Continued on next page

JB81757,0000061 -19-20APR10-11/18

10 Verification

NOTE: See Electronic Unit Pump — Installation in Section 02, Group 90 earlier in this manual for unit pump terminal torque specification.

1. Ignition OFF, engine OFF.
2. Reconnect all connectors and reinstall rocker cover, if removed.
3. Ignition ON, engine OFF.
4. Refresh DTCs.
5. Perform Harness Diagnostic Mode Test in Service ADVISOR.

Did DTC 000655.06 reappear active?

YES: GO TO 2

NO: Problem fixed.

JB81757,0000061 -19-20APR10-12/18

11 Further Review of Snapshot Information

Review stored information collected in step 1

YES: Fix problem if found. GO TO 10

Does stored information lead to a possible problem or is there a certain operating point where error occurs?

YES: If a certain operating point exists when error occurs then GO TO 12

NO: GO TO 13

JB81757,0000061 -19-20APR10-13/18

12 Engine Error Operating Point Test

1. Ignition ON, engine ON
2. Set engine to operating point of failure and refresh DTCs.

Did 000655.06 reappear active when engine operating point was reached?

YES: GO TO 2

NO: GO TO 13

JB81757,0000061 -19-20APR10-14/18

13 Terminal Test and Harness Inspection

CAUTION: Unit pumps are supplied with 90V. Electric shock hazard if ignition is ON!

1. Ignition OFF, engine OFF
2. Remove rocker cover. See Rocker Arm Cover — Removal in Section 2 Group 20.
3. Inspect unit pump wire harness for damage which would result in an intermittent wire-to-wire short circuit.
4. Perform Terminal Test on the ECU J01 connector, unit pump #5, and unit pump connector C01.

Were any problems found?

YES: Fix problem. GO TO 10

NO: GO TO 14

JB81757,0000061 -19-20APR10-15/18

14 Check for Intermittent Shorted Circuit

NOTE: Nominal unit pump coil resistance is approximately 4 ohms at 20°C (68°F). A wire-to-wire short of two unit pump low side control circuits will cause resistance readings of approximately 2 ohms. Resistance values will be higher if unit pump temperature is greater than 20°C (68°F).

1. Reconnect all connectors except J01 connector.
2. On the harness, measure the resistance between ECU J01-C1 and J01-G1 while gently wiggling wire harness between ECU and unit pump #5.

Does resistance value decrease below 3 ohms while wiggling harness?

YES: Repair cause of intermittent shorted circuit. GO TO 10.

NO: GO TO 15.

Continued on next page

JB81757,0000061 -19-20APR10-16/18

15 Reconnect and Retest	1. Reconnect J01 connector. 2. Ignition ON, engine ON. 3. Refresh DTCs. 4. Gently wiggle wire harness between ECU and unit pump connector C01. **CAUTION: Use caution when working near rotating components.** Did 000655.06 reappear active at any time with engine running?	**YES:** Repair cause of intermittent shorted circuit. GO TO 10. **NO:** GO TO 16.

JB81757,0000061 -19-20APR10-17/18

16 Reprogram ECU	1. Download latest ECU payload and reprogram ECU. 2. Ignition ON, engine ON. 3. Refresh DTCs. Did 000655.06 reappear active with engine running?	**YES:** GO TO 2 **NO:** Replace unit pump #5. GO TO 10

JB81757,0000061 -19-20APR10-18/18

000655.13 — Electronic Unit Pump #5 Calibration Fault

The ECU detects an incorrect Electronic Unit Pump Calibration Code was calibrated into the ECU.

DN22556,00006B6 -19-24SEP10-1/9

000655.13 — Electronic Unit Pump #5 Calibration Fault Diagnostic Procedure

Troubleshooting Sequence:
000655.13

When DTC is Displayed:
During an electronic unit pump programming event.

Alarm Level:
Warning

Control Unit Response:
The ECU will attempt to run the engine normally.

Related Information:
The ECU detects an incorrect Electronic Unit Pump Calibration Code was programmed into the ECU. The engine performance may be drastically effected. The engine will also be out of compliance with Tier 3 emission requirements.

Additional References:
For more electronic unit pump information, see Electronic Unit Pump and Injector Nozzle Operation in Section 03, Group 130 earlier in this manual.

For more information on the fuel system, see Fuel System Operation in Section 03, Group 130 earlier in this manual.

DN22556,00006B6 -19-24SEP10-2/9

❶	**Electronic Unit Pump Calibration Code Input Method Check**	Was the Electronic Unit Pump Calibration code typed in manually?	**YES:** GO TO 2 **NO:** GO TO 3

DN22556,00006B6 -19-24SEP10-3/9

❷	**Verification and Reentry of Electronic Unit Pump Calibration Code**	1. Perform Electronic Unit Pump Calibration in Service ADVISOR. See Electronic Unit Pump Calibration Information in Section 4 Group 160 2. Select the electronic unit pump to calibrate. 3. Check the written code against the one displayed. 4. Type it back in again. Did the ECU accept the Electronic Unit Pump Calibration code?	**YES:** Problem fixed. **NO:** GO TO 3

DN22556,00006B6 -19-24SEP10-4/9

❸	**Automatic Input of Electronic Unit Pump Data**	1. Perform Electronic Unit Pump Calibration in Service ADVISOR. 2. Select the electronic unit pump to calibrate. 3. Select the sequence number of the electronic unit pump installed from the list. Did the ECU accept the Electronic Unit Pump Calibration code?	**YES:** Problem fixed. **NO:** GO TO 4

Continued on next page

DN22556,00006B6 -19-24SEP10-5/9

4 Retrieve New Electronic Unit Pump Calibration File	Download a new electronic unit pump calibration file, see Electronic Unit Pump Calibration File Downloading Instructionsearlier in this Group. Were you able to get a new calibration file?	**YES:** GO TO 5 **NO:** GO TO 6

DN22556,00006B6 -19-24SEP10-6/9

5 Automatic Input of Electronic Unit Pump Data	1. Perform Electronic Unit Pump Calibration in Service ADVISOR. 2. Select the electronic unit pump to calibrate. 3. Select the serial number of the electronic unit pump file downloaded from the list of electronic unit pumps. Did the ECU accept the Electronic Unit Pump Calibration code?	 **YES:** Problem fixed. **NO:** GO TO 6

DN22556,00006B6 -19-24SEP10-7/9

6 ECU Programming	1. Download the latest ECU software. 2. Reprogram ECU. Was the ECU programming successful?	 **YES:** GO TO 7 **NO:** Replace ECU. GO TO 3

DN22556,00006B6 -19-24SEP10-8/9

7 Automatic Input of Electronic Unit Pump Data	1. Perform Electronic Unit Pump Calibration in Service ADVISOR. 2. Select the electronic unit pump to calibrate. 3. Select the serial number of the electronic unit pump file downloaded from the list of electronic unit pumps. Did the ECU accept the Electronic Unit Pump Calibration code?	 **YES:** Problem fixed. **NO:** Start a DTAC case.

DN22556,00006B6 -19-24SEP10-9/9

000028.03 — Digital Throttle Signal Out of Range High

Digital throttle signal is above the high voltage specification.

DN22556,00000B3 -19-07OCT10-1/15

000028.03 — Digital Throttle Signal Out of Range High Diagnostic Procedure

Troubleshooting Sequence:
000028.03

When DTC is Displayed:
When ever the ignition is on and the error is active.

Related Information:
The digital throttle signal increases above the high voltage specification.

Alarm Level:
Warning

Control Unit Response:
The ECU will try to maintain the engine operating envelope if there are more than one throttle set up in the Trim Options.

Additional References:
For more information, see DIGITAL MULTI-STATE THROTTLE, see DUAL-STATE THROTTLE, see TRI-STATE THROTTLE , or see RAMP THROTTLE in Section 03, Group 140 earlier in this manual, depending on the type of multi-state throttle employed on the application.

NOTE: The wiring diagrams provided are for a typical John Deere supplied OEM harness. Wire number, colors, and jumper connectors do not apply to all applications.

For wiring information:
- see 2.4L - 3.0L ECU Wiring Diagram 6
located in Section 06, Group 210 later in this manual.

For more information on connector and terminal testing see TERMINAL TEST in Section 04, Group 160 earlier in this manual.

IMPORTANT: When directed to run the HARNESS DIAGNOSTIC MODE TEST the engine temperature should be above freezing. It is recommended that the engine temperature be at least 20° C (68° F). This test is located in Service ADVISOR.

IMPORTANT: Do not force probes into connector terminals or damage will result. Use JDG10466 Connector Adapter Test Kit to make measurements in connectors. This will ensure that terminal damage does not occur.

Flex probe information:
- ECU small terminal - Orange/Blue
- ECU large terminal - Orange/Green
- Control Panel small terminal C09 - Yellow/Purple
- Control Panel large terminal C09 - Yellow/Blue

Continued on next page

DN22556,00000B3 -19-07OCT10-2/15

1 Read DTCs and Store Snapshot Information	1. Ignition ON, engine OFF. *NOTE: When DTCs are cleared Snapshot information for ALL DTCs will be cleared.* 2. Connect Service ADVISOR, see CONNECTING TO SERVICE ADVISOR earlier in this Group. 3. Write down all DTCs and their occurrence count. If any DTCs have snapshot capture or snapshot recording information, save the information. For instructions on saving and using snapshot information, see SNAPSHOT INSTRUCTIONS earlier in this Group. 4. Refresh Codes. Did 000028.03 reappear active?	**YES:** GO TO 2 **NO:** GO TO 8

DN22556,00000B3 -19-07OCT10-3/15

2 Terminal Test	1. Ignition OFF, Engine OFF. 2. Check wiring connections at digital throttle. 3. Disconnect connector C09 on the control panel. 4. Perform TERMINAL TEST on C09 harness connector and panel connector. Were any problems found?	**YES:** Repair problem. Run HARNESS DIAGNOSTIC MODE TEST in Service ADVISOR. **NO:** GO TO 3

DN22556,00000B3 -19-07OCT10-4/15

3 Harness Resistance Check	On the harness C09 connector, measure the resistance between signal (terminal B4) and return (terminal G3). Is resistance greater than 4k ohms?	**YES:** GO TO 4 **NO:** GO TO 5

DN22556,00000B3 -19-07OCT10-5/15

4 Return Wire Check	On the harness C09 connector, measure the resistance between return (terminal G3) and application single point ground. Is resistance less than 10 ohms?	**YES:** Repair open signal wire terminal B4 on C09. **NO:** GO TO 6

DN22556,00000B3 -19-07OCT10-6/15

5 Control Panel Resistance Check	1. Set the multi-state throttle switch to the rabbit position. 2. On the control panel C09 connector, measure the resistance between signal (terminal B4) and return (terminal G3). Is resistance greater than 10k ohms?	**YES:** GO TO 6 **NO:** GO TO 8

DN22556,00000B3 -19-07OCT10-7/15

6 Signal Wire Check	On the control panel C09 connector, measure the resistance between signal (terminal B4) and the corresponding wire on the switch. Is resistance greater than 10 ohms?	**YES:** Repair open signal wire. **NO:** GO TO 7

Continued on next page

DN22556,00000B3 -19-07OCT10-8/15

7 **Return Wire Check**	On the control panel C09 connector, measure the resistance between return (terminal G3) and the corresponding wire on the switch. Is resistance greater than 10 ohms?	**YES:** Repair open return wire. **NO:** GO TO 13

DN22556,00000B3 -19-07OCT10-9/15

8 **Occurrence Count Check**	Review stored information and look at occurrence count for 000028.03. Is occurrence recorded in step 1 greater than 5?	**YES:** GO TO 9 **NO:** GO TO 10

DN22556,00000B3 -19-07OCT10-10/15

9 **Terminal Test**	1. Ignition OFF, Engine OFF 2. Perform TERMINAL TEST on the digital throttle harness connector. Were any problems found?	 **YES:** Repair problem, Run HARNESS DIAGNOSTIC MODE TEST in Service ADVISOR. **NO:** GO TO 10

DN22556,00000B3 -19-07OCT10-11/15

10 **Further Review of Snapshot Information**	1. Ignition ON, Engine OFF 2. Review stored information collected in step 1 Does stored information lead to a possible problem or is there a certain operating point where error occurs?	**YES:** Repair problem if found. **YES:** If a certain operating point exists when error occurs then GO TO 11 **NO:** GO TO 12

DN22556,00000B3 -19-07OCT10-12/15

11 **Engine Error Operating Point Test**	1. Ignition ON, Engine ON 2. Set engine to operating point of failure and refresh codes. Did 000028.03 reappear when engine operating point was reached?	 **YES:** GO TO 2 **NO:** GO TO 10 and confirm operating point.

DN22556,00000B3 -19-07OCT10-13/15

12 **Terminal Test**	1. Ignition OFF, Engine OFF 2. Disconnect digital throttle connector and ECU connector J2. 3. Perform TERMINAL TEST on the digital throttle harness connector and ECU J2 connector. Were any problems found?	 **YES:** Repair problem, Run HARNESS DIAGNOSTIC MODE TEST in Service ADVISOR. **NO:** GO TO 13

Continued on next page

DN22556,00000B3 -19-07OCT10-14/15

13 Software Updates	1. Download latest ECU payload and reprogram ECU using Service ADVISOR. 2. Run HARNESS DIAGNOSTIC MODE TEST in Service ADVISOR. Is 000028.03 active?	**YES:** Replace digital throttle. Run HARNESS DIAGNOSTIC MODE TEST in Service ADVISOR. **NO:** Problem fixed, bad ECU program.

DN22556,00000B3 -19-07OCT10-15/15

000028.04 — Digital Throttle Signal Out of Range Low

Digital throttle signal is below the low voltage specification.

DN22556,00000B4 -19-07OCT10-1/13

000028.04 — Digital Throttle Signal Out of Range Low Diagnostic Procedure

Troubleshooting Sequence:
000028.04

When DTC is Displayed:
When ever the ignition is on and the error is active.

Related Information:
The digital throttle signal decreases below the low voltage specification.

Alarm Level:
Warning

Control Unit Response:
The ECU will try to maintain the engine operating envelope if there are more than one throttle set up in the Trim Options.

Additional References:
For more digital throttle information, see DIGITAL MULTI-STATE THROTTLE, see DUAL-STATE THROTTLE, see TRI-STATE THROTTLE , or see RAMP THROTTLE in Section 03, Group 140 earlier in this manual, depending on the type of multi-state throttle employed on the application.

NOTE: The wiring diagrams provided are for a typical John Deere supplied OEM harness. Wire number, colors, and jumper connectors do not apply to all applications.

For wiring information:
- see 2.4L - 3.0L ECU Wiring Diagram 6
located in Section 06, Group 210 later in this manual.

For more information on connector and terminal testing see TERMINAL TEST in Section 04, Group 160 earlier in this manual.

IMPORTANT: When directed to run the HARNESS DIAGNOSTIC MODE TEST the engine temperature should be above freezing. It is recommended that the engine temperature be at least 20° C (68° F). This test is located in Service ADVISOR.

IMPORTANT: Do not force probes into connector terminals or damage will result. Use JDG10466 Connector Adapter Test Kit to make measurements in connectors. This will ensure that terminal damage does not occur.

Flex probe information:
- ECU small terminal - Orange/Blue
- ECU large terminal - Orange/Green
- Control Panel small terminal C09 - Yellow/Purple
- Control Panel large terminal C09 - Yellow/Blue

Continued on next page

DN22556,00000B4 -19-07OCT10-2/13

1 Read DTCs and Store Snapshot Information	1. Ignition ON, engine OFF. *NOTE: When DTCs are cleared Snapshot information for ALL DTCs will be cleared.* 2. Connect Service ADVISOR, see CONNECTING TO SERVICE ADVISOR earlier in this Group. 3. Write down all DTCs and their occurrence count. If any DTCs have snapshot capture or snapshot recording information, save the information. For instructions on saving and using snapshot information, see SNAPSHOT INSTRUCTIONS earlier in this Group. 4. Refresh Codes. Did 000028.04 reappear active?	**YES:** GO TO 2 **NO:** GO TO 8

DN22556,00000B4 -19-07OCT10-3/13

2 Terminal Test	1. Ignition OFF, Engine OFF. 2. Check wiring connections on digital throttle. 3. Disconnect connector C09 on the control panel. 4. Perform TERMINAL TEST on C09 harness connector and panel connector. Were any problems found?	**YES:** Repair problem. Run HARNESS DIAGNOSTIC MODE TEST in Service ADVISOR. **NO:** GO TO 3

DN22556,00000B4 -19-07OCT10-4/13

3 Harness Resistance Check	On the harness C09 connector, measure the resistance between signal (terminal B4) and return (terminal G3). Is resistance less than 10 ohms?	**YES:** Repair short between wires. Run HARNESS DIAGNOSTIC MODE TEST. **NO:** GO TO 4

DN22556,00000B4 -19-07OCT10-5/13

4 Control Panel Resistance Check	1. Set the multi-state throttle switch to the rabbit position. 2. On the control panel C09 connector, measure the resistance between signal (terminal B4) and return (terminal G3). Is resistance less than 500 ohms?	**YES:** GO TO 5 **NO:** GO TO 6

DN22556,00000B4 -19-07OCT10-6/13

5 Switch Check	1. Disconnect the wires on the multi-state throttle. 2. On the control panel C09 connector, measure the resistance between signal (terminal B4) and return (terminal G3). Is resistance less than 500 ohms?	**YES:** Repair shorted between wires. Run HARNESS DIAGNOSTIC MODE TEST. **NO:** Replace multi-state throttle switch. Run HARNESS DIAGNOSTIC MODE TEST.

Continued on next page

DN22556,00000B4 -19-07OCT10-7/13

6 Occurrence Count Check	Review stored information and look at occurrence count for 000028.04.	**YES:** GO TO 7
	Is occurrence recorded in step 1 greater than 5?	**NO:** GO TO 8

DN22556,00000B4 -19-07OCT10-8/13

7 Terminal Test	1. Ignition OFF, Engine OFF	
	2. Perform TERMINAL TEST on the digital throttle harness connector.	**YES:** Repair problem, Run HARNESS DIAGNOSTIC MODE TEST in Service ADVISOR.
	Were any problems found?	**NO:** GO TO 9

DN22556,00000B4 -19-07OCT10-9/13

8 Further Review of Snapshot Information	1. Ignition ON, Engine OFF	**YES:** Repair problem if found.
	2. Review stored information collected in step 1	**YES:** If a certain operating point exists when error occurs then GO TO 10
	Does stored information lead to a possible problem or is there a certain operating point where error occurs?	**NO:** GO TO 11

DN22556,00000B4 -19-07OCT10-10/13

9 Engine Error Operating Point Test	1. Ignition ON, Engine ON	
	2. Set engine to operating point of failure and refresh codes.	**YES:** GO TO 2
	Did 000028.04 reappear when engine operating point was reached?	**NO:** GO TO 8 and confirm operating point.

DN22556,00000B4 -19-07OCT10-11/13

10 Terminal Test	1. Ignition OFF, Engine OFF	
	2. Disconnect digital throttle connector and ECU connector J2.	
	3. Perform TERMINAL TEST on the digital throttle harness connector and ECU J2 connector.	**YES:** Repair problem, Run HARNESS DIAGNOSTIC MODE TEST in Service ADVISOR.
	Were any problems found?	**NO:** GO TO 11

Continued on next page

DN22556,00000B4 -19-07OCT10-12/13

11 Software Updates	1. Download latest ECU payload and reprogram ECU using Service ADVISOR. 2. Run HARNESS DIAGNOSTIC MODE TEST in Service ADVISOR. Is 000028.04 active?	**YES:** Replace digital throttle. Run HARNESS DIAGNOSTIC MODE TEST in Service ADVISOR. **NO:** Problem fixed, bad ECU program.

DN22556,00000B4 -19-07OCT10-13/13

000029.03 — Throttle #2 Signal Out of Range High

Throttle voltage is above the high voltage specification.

JL45346,0000039 -19-21APR10-1/20

000029.03 — Throttle #2 Signal Out of Range High Diagnostic Procedure

Troubleshooting Sequence:
003510.03
000029.03

When DTC is Displayed:
When ever the ignition is on and the error is active.

Related Information:
The throttle #2 input voltage increases above its high voltage specification.

Alarm Level:
Warning

Control Unit Response:
The ECU will try to maintain the engine operating envelope.

Additional References:
For more Throttle #2 information, see Analog Throttle in Section 03, Group 140 earlier in this manual.

NOTE: The wiring diagrams provided are for a typical John Deere supplied OEM harness. Wire number, colors, and jumper connectors do not apply to all applications.

For wiring information:
- see 2.4L 12V ECU WIRING DIAGRAM 5
- see 2.4L 24V ECU WIRING DIAGRAM 5
- see 3.0L 12V ECU WIRING DIAGRAM 5
- see 3.0L 24V ECU WIRING DIAGRAM 5

located in Section 06, Group 210 later in this manual.

For more information on connector and terminal testing see Terminal Test in Section 04, Group 160 earlier in this manual.

IMPORTANT: When directed to run the Harness Diagnostic Mode Test the engine temperature should be above freezing. It is recommended that the engine temperature be at least room temperature 20° C (68° F). This test is located in Service ADVISOR.

IMPORTANT: Do not force probes into connector terminals or damage will result. Use JT07328 Connector Adapter Test Kit to make measurements in connectors. This will ensure that terminal damage does not occur.

JL45346,0000039 -19-21APR10-2/20

1 Read DTCs and Store Snapshot Information	1. Ignition ON, engine OFF. *NOTE: When DTCs are cleared Snapshot information for ALL DTCs will be cleared.* 2. Connect Service ADVISOR, see Connecting To Service ADVISOR earlier in this Group. 3. Write down all DTCs and their occurrence count. If any DTCs have snapshot capture or snapshot recording information, save the information. For instructions on saving and using snapshot information, see Snapshot Instructions earlier in this Group. 4. Refresh Codes. Did 000029.03 reappear active?	**YES:** GO TO 2 **NO:** GO TO 13

Continued on next page

JL45346,0000039 -19-21APR10-3/20

2 Throttle Linkage Check	1. Ignition OFF, Engine OFF	
	2. Check throttle linkage for any slipping. 3. Check throttle linkage for misalignment. *NOTE: Use application manual for linkage and alignment procedures.*	**YES:** Repair problem. Run Harness Diagnostic Mode Test in SERVICE ADVISOR™.
	Were any problems found?	**NO:** GO TO 3

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JL45346,0000039 -19-21APR10-4/20

3 Terminal Test	1. Disconnect throttle #2 connector.	
	2. Perform Terminal Test on Throttle #2 harness connector.	**YES:** Repair problem. Run Harness Diagnostic Mode Test in SERVICE ADVISOR™.
	Were any problems found?	**NO:** GO TO 4

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JL45346,0000039 -19-21APR10-5/20

4 Analog Throttle Disconnected Test	*NOTE: Leave throttle connector disconnected.*	
	1. Ignition ON, Engine OFF. 2. Refresh codes.	**YES:** GO TO 5
	Did 00029.04 appear active and 00029.03 go stored?	**NO:** GO TO 7

JL45346,0000039 -19-21APR10-6/20

5 Throttle potentiometer Resistance Check	1. Ignition OFF, Engine OFF.	
	2. On the throttle potentiometer, measure the resistance between: • power (terminal C) and signal (terminal B). **Specification** Throttle Potentiometer—Resistance..... Between 350 and 550 ohms • power (terminal C) and return (terminal A). **Specification** Throttle Potentiometer—Resistance.....Between 4.2k and 6.2k ohms	**YES:** GO TO 6
	Were the resistance measurements within specifications?	**NO:** Replace throttle #2 potentiometer. Run Harness Diagnostic Mode Test in SERVICE ADVISOR™.

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Continued on next page

JL45346,0000039 -19-21APR10-7/20

6 Harness Resistance Check	1. Ignition OFF, Engine OFF.	
	2. On the harness, measure the resistance between the throttle #2 potentiometer connector return (terminal A) and application single point ground.	**YES:** Repair open terminal A wiring. Run Harness Diagnostic Mode Test in SERVICE ADVISOR™.
	Is resistance greater than 10 ohms?	**NO:** GO TO 7

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JL45346,0000039 -19-21APR10-8/20

7 Throttle #2 Circuit Resistance Check	On the harness, measure the resistance between the throttle #2 potentiometer connector power (terminal C) and signal (terminal B).	**YES:** GO TO 8
	Is resistance less than 10 ohms?	**NO:** GO TO 10

JL45346,0000039 -19-21APR10-9/20

8 Terminal Test	1. Disconnect ECU connector J2.	
	2. Perform Terminal Test on Throttle #2 harness connector.	**YES:** Repair problem. Run Harness Diagnostic Mode Test in SERVICE ADVISOR™.
	Were any problems found?	**NO:** GO TO 9

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JL45346,0000039 -19-21APR10-10/20

9 Terminal to Terminal Resistance Check	1. Disconnect all ECU connectors.	
	2. On the ECU harness, measure the resistance between the throttle #2 potentiometer signal (terminal J2-F3) and all other terminals in all ECU connectors.	**YES:** Repair short to terminal J2-F3 in wiring harness. Run Harness Diagnostic Mode Test in Service ADVISOR.
	were any measurements less than 100 ohms?	**NO:** Reconnect all connectors. Run Harness Diagnostic Mode Test in Service ADVISOR.

JL45346,0000039 -19-21APR10-11/20

10 Terminal Test	1. Disconnect ECU connector J2.	
	2. Perform Terminal Test on Throttle #2 harness connector.	**YES:** Repair problem. Run Harness Diagnostic Mode Test in Service ADVISOR.
	Were any problems found?	**NO:** GO TO 11

Continued on next page

JL45346,0000039 -19-21APR10-12/20

11 Throttle #2 Circuit Resistance Check, ECU Disconnected	*NOTE: Leave throttle connector disconnected.*	
	On the harness, measure the resistance between the throttle #2 connector power (terminal C) and signal (terminal B).	**YES:** GO TO 12
	Is resistance greater than 10M ohms?	**NO:** Repair shorted wiring problem. Run Harness Diagnostic Mode Test in SERVICE ADVISOR™.

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JL45346,0000039 -19-21APR10-13/20

12 ECU Resistance Check	On the ECU, measure the resistance between the power (terminal J2-G2) and signal (terminal J2-F3).	**YES:** Reconnect all connectors. Run Harness Diagnostic Mode Test in Service ADVISOR.
	Was the resistance between 120k and 180k ohms?	**NO:** Replace ECU. Run Harness Diagnostic Mode Test in Service ADVISOR.

JL45346,0000039 -19-21APR10-14/20

13 Occurrence Count Check	Review stored information and look at occurrence count for 000029.03.	**YES:** GO TO 14
	Is occurrence recorded in step 1 greater than 5?	**NO:** GO TO 15

JL45346,0000039 -19-21APR10-15/20

14 Terminal Test	1. Ignition OFF, Engine OFF	
	2. Perform Terminal Test on the Throttle #2 harness connector.	**YES:** Repair problem, Run Harness Diagnostic Mode Test in Service ADVISOR.
	Were any problems found?	**NO:** GO TO 15

JL45346,0000039 -19-21APR10-16/20

15 Further Review of Snapshot Information	1. Ignition ON, Engine OFF	**YES:** Repair problem if found.
	2. Review stored information collected in step 1	**YES:** If a certain operating point exists when error occurs then GO TO 16
	Does stored information lead to a possible problem or is there a certain operating point where error occurs?	**NO:** GO TO 17

Continued on next page

JL45346,0000039 -19-21APR10-17/20

16 Engine Error Operating Point Test	1. Ignition ON, Engine ON	
	2. Set engine to operating point of failure and refresh codes.	**YES:** Replace throttle #2. Run Harness Diagnostic Mode Test in Service ADVISOR.
	Did 000029.03 reappear when engine operating point was reached?	**NO:** GO TO 15

JL45346,0000039 -19-21APR10-18/20

17 Terminal Test	1. Ignition OFF, Engine OFF	
	2. Disconnect throttle #2 connector and ECU connector J2.	
	3. Perform Terminal Test on the Throttle #2 harness connector and ECU J2 connector.	**YES:** Repair problem, Run Harness Diagnostic Mode Test in Service ADVISOR.
	Were any problems found?	**NO:** GO TO 18

JL45346,0000039 -19-21APR10-19/20

18 Software Updates	1. Download latest ECU payload and reprogram ECU using Service ADVISOR.	
	2. Run Harness Diagnostic Mode Test in Service ADVISOR.	**YES:** Replace throttle #2. Run Harness Diagnostic Mode Test in Service ADVISOR.
	Is 000029.03 active?	**NO:** Problem fixed, bad ECU program.

JL45346,0000039 -19-21APR10-20/20

000029.04 — Throttle #2 Signal Out of Range Low

Throttle voltage is below the low voltage specification.

JL45346,000003A -19-20APR10-1/23

000029.04 — Throttle #2 Signal Out of Range Low Diagnostic Procedure

Troubleshooting Sequence:
003510.04
000029.04

When DTC is Displayed:
When ever the ignition is on and the error is active.

Related Information:
The throttle #2 input voltage decreases below its low voltage specification.

Alarm Level:
Warning

Control Unit Response:
The ECU will continue to operate normally.

Additional References:
For more Throttle #2 information, see Analog Throttle in Section 03, Group 140 earlier in this manual.

NOTE: The wiring diagrams provided are for a typical John Deere supplied OEM harness. Wire number, colors, and jumper connectors do not apply to all applications.

For wiring information:
- see 2.4L 12V ECU WIRING DIAGRAM 5
- see 2.4L 24V ECU WIRING DIAGRAM 5
- see 3.0L 12V ECU WIRING DIAGRAM 5
- see 3.0L 24V ECU WIRING DIAGRAM 5

located in Section 06, Group 210 later in this manual.

For more information on connector and terminal testing see Terminal Test in Section 04, Group 160 earlier in this manual.

IMPORTANT: When directed to run the Harness Diagnostic Mode Test the engine temperature should be above freezing. It is recommended that the engine temperature be at least room temperature 20° C (68° F). This test is located in Service ADVISOR.

IMPORTANT: Do not force probes into connector terminals or damage will result. Use JT07328 Connector Adapter Test Kit to make measurements in connectors. This will ensure that terminal damage does not occur.

JL45346,000003A -19-20APR10-2/23

1 Read DTCs and Store Snapshot Information	1. Ignition ON, engine OFF. *NOTE: When DTCs are cleared Snapshot information for ALL DTCs will be cleared.* 2. Connect Service ADVISOR, see Connecting To Service ADVISOR earlier in this Group. 3. Write down all DTCs and their occurrence count. If any DTCs have snapshot capture or snapshot recording information, save the information. For instructions on saving and using snapshot information, see Snapshot Instructions earlier in this Group. 4. Refresh Codes. Did 000029.04 reappear active?	**YES:** GO TO 2 **NO:** GO TO 16

Continued on next page

JL45346,000003A -19-20APR10-3/23

2 Throttle Linkage Check	1. Ignition OFF, Engine OFF 2. Check throttle linkage for any slipping. 3. Check throttle linkage for misalignment. *NOTE: Use application manual for linkage and alignment procedures.* Were any problems found?	**YES:** Repair problem. Run Harness Diagnostic Mode Test in Service ADVISOR. **NO:** GO TO 3

JL45346,000003A -19-20APR10-4/23

3 Terminal Test	1. Disconnect throttle #2 connector. 2. Perform Terminal Test on Throttle #2 harness connector. Were any problems found?	**YES:** Repair problem. Run Harness Diagnostic Mode Test in Service ADVISOR. **NO:** GO TO 4

JL45346,000003A -19-20APR10-5/23

4 Throttle potentiometer Resistance Check	On the throttle potentiometer, measure the resistance between: • power (terminal C) and signal (terminal B). **Specification** Throttle Potentiometer—Resistance..... Between 350 and 550 ohms • power (terminal C) and return (terminal A). **Specification** Throttle Potentiometer—Resistance.....Between 4.2k and 6.2k ohms Were the resistance measurements within specifications?	**YES:** GO TO 5 **NO:** Replace throttle #2 potentiometer. Run Harness Diagnostic Mode Test in Service ADVISOR.

JL45346,000003A -19-20APR10-6/23

5 Throttle #2 Circuit Resistance Check Part 1	On the harness, measure the resistance between the throttle #2 harness connector signal (terminal B) and return (terminal A). Is resistance between 120k and 180k ohms?	**YES:** GO TO 6 **NO:** Measurement is greater than 180k ohms. GO TO 10 **NO:** Measurement is less than 10 ohms. GO TO 12

JL45346,000003A -19-20APR10-7/23

6 Throttle #2 Circuit Resistance Check Part 2	On the harness, measure the resistance between the throttle #2 harness connector power (terminal C) and return (terminal A). Is resistance between 90k and 130k ohms?	**YES:** Reconnect all connectors. Run Harness Diagnostic Mode Test in Service ADVISOR **NO:** GO TO 7

Continued on next page

JL45346,000003A -19-20APR10-8/23

7 Terminal Test	1. Ignition OFF, Engine OFF. 2. Disconnect ECU connector J2. 3. Perform Terminal Test on the ECU harness connector J2. Were any problems found?	**YES:** Repair problem. Run Harness Diagnostic Mode Test in Service ADVISOR. **NO:** GO TO 8

JL45346,000003A -19-20APR10-9/23

8 Terminal to Terminal Resistance Check	On the harness, measure the resistance between the throttle #2 harness connector power (terminal C) and the ECU harness connector power (terminal J2-G2). Is the resistance greater than 10 ohms?	**YES:** Repair open to in wiring harness. Run Harness Diagnostic Mode Test in Service ADVISOR. **NO:** GO TO 9

JL45346,000003A -19-20APR10-10/23

9 ECU Resistance Check	On the ECU, measure the resistance between the power (terminal J2-G2) and return (terminal J2-G3). Was the resistance between 120k and 180k ohms?	**YES:** Problem not found, reconnect all connectors. GO TO 1 and confirm your findings. Look closely at connectors, wiring and terminal numbers where measurements were made. **NO:** Replace ECU. Run Harness Diagnostic Mode Test in Service ADVISOR.

JL45346,000003A -19-20APR10-11/23

10 Terminal to Terminal Resistance Check	1. Disconnect ECU connector J2. 2. On the harness, measure the resistance between the throttle #2 harness connector signal (terminal B) and the ECU harness connector signal (terminal J2-F3). Is the resistance greater than 10 ohms?	**YES:** Repair open to in wiring harness. Run Harness Diagnostic Mode Test in Service ADVISOR. **NO:** GO TO 11

JL45346,000003A -19-20APR10-12/23

11 Terminal Test	Perform Terminal Test on the ECU harness connector J2. Were any problems found?	**YES:** Repair problem. Run Harness Diagnostic Mode Test in Service ADVISOR. **NO:** GO TO 14

JL45346,000003A -19-20APR10-13/23

12 Harness Resistance Check, ECU Disconnected	1. Disconnect ECU connector J2. 2. On the harness, measure the resistance between the throttle #2 harness connector signal (terminal B) and return (terminal A). Is resistance less than 10 ohms?	**YES:** GO TO 13 **NO:** GO TO 14

Continued on next page

JL45346,000003A -19-20APR10-14/23

13 Terminal Test	Perform Terminal Test on the ECU harness connector J2. Were any problems found?	**YES:** Repair problem. Run Harness Diagnostic Mode Test in Service ADVISOR. **NO:** GO TO 15

JL45346,000003A -19-20APR10-15/23

14 ECU Resistance Check	On the ECU, measure the resistance between the signal (terminal J2-F3) and return (terminal J2-G3). Was the resistance between 120k and 180k ohms?	**YES:** Reconnect all connectors. GO TO 1 **NO:** Replace ECU. Run Harness Diagnostic Mode Test in Service ADVISOR.

JL45346,000003A -19-20APR10-16/23

15 Terminal to Terminal Resistance Check	On the harness, measure the resistance between the ECU harness connector J2 signal (terminal J2-F3) and all other ECU connector terminals. Is the resistance less than 100 ohms on any terminal?	**YES:** Repair wiring for all measurements less than 100 ohms. Run Harness Diagnostic Mode Test in Service ADVISOR. **NO:** Reconnect all connectors. GO TO 1

JL45346,000003A -19-20APR10-17/23

16 Occurrence Count Check	Review stored information and look at occurrence count for 000029.04. Is occurrence recorded in step 1 greater than 5?	**YES:** GO TO 17 **NO:** GO TO 18

JL45346,000003A -19-20APR10-18/23

17 Terminal Test	1. Ignition OFF, Engine OFF 2. Perform Terminal Test on the Throttle #2 harness connector. Were any problems found?	 **YES:** Repair problem, Run Harness Diagnostic Mode Test in Service ADVISOR. **NO:** GO TO 18

JL45346,000003A -19-20APR10-19/23

18 Further Review of Snapshot Information	1. Ignition ON, Engine OFF 2. Review stored information collected in step 1 Does stored information lead to a possible problem or is there a certain operating point where error occurs?	**YES:** Repair problem if found. **YES:** If a certain operating point exists when error occurs then GO TO 19 **NO:** GO TO 20

Continued on next page

JL45346,000003A -19-20APR10-20/23

19 Engine Error Operating Point Test	1. Ignition ON, Engine ON	
	2. Set engine to operating point of failure and refresh codes.	**YES:** Replace throttle #2. Run Harness Diagnostic Mode Test in Service ADVISOR.
	Did 000029.04 reappear when engine operating point was reached?	**NO:** GO TO 18 and confirm operating point.

JL45346,000003A -19-20APR10-21/23

20 Terminal Test	1. Ignition OFF, Engine OFF	
	2. Disconnect throttle #2 connector and ECU connector J2.	
	3. Perform Terminal Test on the Throttle #2 harness connector and ECU J2 connector.	**YES:** Repair problem, Run Harness Diagnostic Mode Test in Service ADVISOR.
	Were any problems found?	**NO:** GO TO 21

JL45346,000003A -19-20APR10-22/23

21 Software Updates	1. Download latest payload and reprogram ECU using Service ADVISOR.	
	2. Run Harness Diagnostic Mode Test in Service ADVISOR.	**YES:** Replace throttle #2. Run Harness Diagnostic Mode Test in Service ADVISOR.
	Is 000029.04 active?	**NO:** Problem fixed, bad ECU program.

JL45346,000003A -19-20APR10-23/23

000091.03 — Throttle #1 Signal Out of Range High

Throttle voltage is above the high voltage specification.

JL45346,000003B -19-20APR10-1/20

000091.03 — Throttle #1 Signal Out of Range High Diagnostic Procedure

Troubleshooting Sequence:
003511.03
000091.03

When DTC is Displayed:
When ever the ignition is on and the error is active.

Related Information:
The throttle #1 input voltage increases above its high voltage specification.

Alarm Level:
Warning

Control Unit Response:
The ECU will continue to operate normally.

Additional References:
For more Throttle #1 information, see ANALOG THROTTLE in Section 03, Group 140 earlier in this manual.

NOTE: The wiring diagrams provided are for a typical John Deere supplied OEM harness. Wire number, colors, and jumper connectors do not apply to all applications.

For wiring information:
- see 2.4L 12V ECU WIRING DIAGRAM 6
- see 2.4L 24V ECU WIRING DIAGRAM 6
- see 3.0L 12V ECU WIRING DIAGRAM 6
- see 3.0L 24V ECU WIRING DIAGRAM 6

located in Section 06, Group 210 later in this manual.

For more information on connector and terminal testing see Terminal Test in Section 04, Group 160 earlier in this manual.

IMPORTANT: When directed to run the Harness Diagnostic Mode Test the engine temperature should be above freezing. It is recommended that the engine temperature be at least room temperature 20° C (68° F). This test is located in Service ADVISOR.

IMPORTANT: Do not force probes into connector terminals or damage will result. Use JT07328 Connector Adapter Test Kit to make measurements in connectors. This will ensure that terminal damage does not occur.

JL45346,000003B -19-20APR10-2/20

1 Read DTCs and Store Snapshot Information	1. Ignition ON, engine OFF. *NOTE: When DTCs are cleared Snapshot information for ALL DTCs will be cleared.* 2. Connect Service ADVISOR, see Connecting To Service ADVISOR earlier in this Group. 3. Write down all DTCs and their occurrence count. If any DTCs have snapshot capture or snapshot recording information, save the information. For instructions on saving and using snapshot information, see Snapshot Instructions earlier in this Group. 4. Refresh Codes. Did 000091.03 reappear active?	**YES:** GO TO 2 **NO:** GO TO 13

Continued on next page

JL45346,000003B -19-20APR10-3/20

❷ Throttle Linkage Check

1. Ignition OFF, Engine OFF
2. Check throttle linkage for any slipping.
3. Check throttle linkage for misalignment.

NOTE: Use application manual for linkage and alignment procedures.

Were any problems found?

YES: Repair problem. Run Harness Diagnostic Mode Test in Service ADVISOR.

NO: GO TO 3

JL45346,000003B -19-20APR10-4/20

❸ Terminal Test

1. Disconnect throttle #1 connector.
2. Perform Terminal Test on Throttle #1 harness connector.

Were any problems found?

YES: Repair problem. Run Harness Diagnostic Mode Test in Service ADVISOR.

NO: GO TO 4

JL45346,000003B -19-20APR10-5/20

❹ Analog Throttle Disconnected Test

NOTE: Leave throttle connector disconnected.

1. Ignition ON, Engine OFF.
2. Refresh codes.

Did 00091.04 appear active and 00091.03 go stored?

YES: GO TO 5

NO: GO TO 7

JL45346,000003B -19-20APR10-6/20

❺ Throttle potentiometer Resistance Check

1. Ignition OFF, Engine OFF.
2. On the throttle potentiometer, measure the resistance between:
   - power (terminal C) and signal (terminal B).

Specification

Throttle Potentiometer—Resistance..... Between 350 and 550 ohms

   - power (terminal C) and return (terminal A).

Specification

Throttle Potentiometer—Resistance.....Between 4.2k and 6.2k ohms

Were the resistance measurements within specifications?

YES: GO TO 6

NO: Replace throttle #1 potentiometer. Run Harness Diagnostic Mode Test in Service ADVISOR.

JL45346,000003B -19-20APR10-7/20

❻ Harness Resistance Check

1. Ignition OFF, Engine OFF.
2. On the harness, measure the resistance between the return (terminal A) and application single point ground.

Is resistance greater than 10 ohms?

YES: Repair open terminal A wiring. Run Harness Diagnostic Mode Test in Service ADVISOR.

NO: GO TO 7

Continued on next page

JL45346,000003B -19-20APR10-8/20

7 Throttle #1 Circuit Resistance Check	On the harness, measure the resistance between the throttle #1 connector power (terminal C) and signal (terminal B).	**YES:** GO TO 8
	Is resistance less than 10 ohms?	**NO:** GO TO 10

JL45346,000003B -19-20APR10-9/20

8 Terminal Test	1. Disconnect ECU connector J2.	
	2. Perform Terminal Test on the ECU J2 connector.	**YES:** Repair problem. Run Harness Diagnostic Mode Test in Service ADVISOR.
	Were any problems found?	**NO:** GO TO 9

JL45346,000003B -19-20APR10-10/20

9 Terminal to Terminal Resistance Check	1. Disconnect all ECU connectors.	
	2. On the harness, measure the resistance between the signal (terminal J2-A4) and all other terminals in all ECU connectors.	**YES:** Repair short to terminal J2-A4 in wiring harness. Run Harness Diagnostic Mode Test in Service ADVISOR.
	were any measurements less than 100 ohms?	**NO:** Reconnect all connectors. Run Harness Diagnostic Mode Test in Service ADVISOR.

JL45346,000003B -19-20APR10-11/20

10 Terminal Test	1. Disconnect ECU connector J2.	
	2. Perform Terminal Test on the ECU J2 connector.	**YES:** Repair problem. Run Harness Diagnostic Mode Test in Service ADVISOR.
	Were any problems found?	**NO:** GO TO 11

JL45346,000003B -19-20APR10-12/20

11 Throttle #1 Circuit Resistance Check, ECU Disconnected	*NOTE: Leave throttle connector disconnected.*	
	On the harness, measure the resistance between the throttle #1 connector power (terminal C) and signal (terminal B).	**YES:** GO TO 12
	Is resistance greater than 10M ohms?	**NO:** Repair shorted wiring problem. Run Harness Diagnostic Mode Test in Service ADVISOR.

Continued on next page

JL45346,000003B -19-20APR10-13/20

12 ECU Resistance Check	On the ECU, measure the resistance between the power (terminal J2-A3) and signal (terminal J2-A4). Was the resistance between 120k and 180k ohms?	**YES:** Reconnect all connectors. Run Harness Diagnostic Mode Test in Service ADVISOR. **NO:** Replace ECU. Run Harness Diagnostic Mode Test in Service ADVISOR.

JL45346,000003B -19-20APR10-14/20

13 Occurrence Count Check	Review stored information and look at occurrence count for 000091.03. Is occurrence recorded in step 1 greater than 5?	**YES:** GO TO 14 **NO:** GO TO 15

JL45346,000003B -19-20APR10-15/20

14 Terminal Test	1. Ignition OFF, Engine OFF 2. Perform Terminal Test on the Throttle #1 harness connector. Were any problems found?	 **YES:** Repair problem, Run Harness Diagnostic Mode Test in Service ADVISOR. **NO:** GO TO 15

JL45346,000003B -19-20APR10-16/20

15 Further Review of Snapshot Information	1. Ignition ON, Engine OFF 2. Review stored information collected in step 1 Does stored information lead to a possible problem or is there a certain operating point where error occurs?	**YES:** Repair problem if found. **YES:** If a certain operating point exists when error occurs then GO TO 16 **NO:** GO TO 17

JL45346,000003B -19-20APR10-17/20

16 Engine Error Operating Point Test	1. Ignition ON, Engine ON 2. Set engine to operating point of failure and refresh codes. Did 000091.03 reappear when engine operating point was reached?	 **YES:** Replace throttle #1. Run Harness Diagnostic Mode Test in Service ADVISOR. **NO:** GO TO 15 and confirm operating point.

JL45346,000003B -19-20APR10-18/20

17 Terminal Test	1. Ignition OFF, Engine OFF 2. Disconnect throttle #1 connector and ECU connector J2. 3. Perform Terminal Test on the Throttle #1 harness connector and ECU J2 connector. Were any problems found?	 **YES:** Repair problem, Run Harness Diagnostic Mode Test in Service ADVISOR. **NO:** GO TO 18

Continued on next page

JL45346,000003B -19-20APR10-19/20

18 Software Updates	1. Download latest payload and reprogram ECU using Service ADVISOR.	
	2. Run Harness Diagnostic Mode Test in Service ADVISOR.	**YES:** Replace throttle #1. Run Harness Diagnostic Mode Test in Service ADVISOR.
	Is 000091.03 active?	**NO:** Problem fixed, bad ECU program.

JL45346,000003B -19-20APR10-20/20

000091.04 — Throttle #1 Signal Out of Range Low

Throttle voltage is below the low voltage specification.

JL45346,000003C -19-20APR10-1/23

000091.04 — Throttle #1 Signal Out of Range Low Diagnostic Procedure

Troubleshooting Sequence:
003511.04
000091.04

When DTC is Displayed:
When ever the ignition is on and the error is active.

Related Information:
The throttle #1 input voltage decreases below its low voltage specification.

Alarm Level:
Warning

Control Unit Response:
The ECU will continue to operate normally.

Additional References:
For more Throttle #1 information, see Analog Throttle in Section 03, Group 140 earlier in this manual.

NOTE: The wiring diagrams provided are for a typical John Deere supplied OEM harness. Wire number, colors, and jumper connectors do not apply to all applications.

For wiring information:
- see 2.4L 12V ECU WIRING DIAGRAM 6
- see 2.4L 24V ECU WIRING DIAGRAM 6
- see 3.0L 12V ECU WIRING DIAGRAM 6
- see 3.0L 24V ECU WIRING DIAGRAM 6

located in Section 06, Group 210 later in this manual.

For more information on connector and terminal testing see Terminal Test in Section 04, Group 160 earlier in this manual.

IMPORTANT: When directed to run the Harness Diagnostic Mode Test the engine temperature should be above freezing. It is recommended that the engine temperature be at least room temperature 20° C (68° F). This test is located in Service ADVISOR.

IMPORTANT: Do not force probes into connector terminals or damage will result. Use JT07328 Connector Adapter Test Kit to make measurements in connectors. This will ensure that terminal damage does not occur.

JL45346,000003C -19-20APR10-2/23

1 Read DTCs and Store Snapshot Information	1. Ignition ON, engine OFF. *NOTE: When DTCs are cleared Snapshot information for ALL DTCs will be cleared.* 2. Connect Service ADVISOR, see Connecting To Service ADVISOR earlier in this Group. 3. Write down all DTCs and their occurrence count. If any DTCs have snapshot capture or snapshot recording information, save the information. For instructions on saving and using snapshot information, see Snapshot Instructions earlier in this Group. 4. Refresh Codes. Did 000091.04 reappear active?	**YES:** GO TO 2 **NO:** GO TO 16

Continued on next page

JL45346,000003C -19-20APR10-3/23

2 Throttle Linkage Check	1. Ignition OFF, Engine OFF 2. Check throttle linkage for any slipping. 3. Check throttle linkage for misalignment. *NOTE: Use application manual for linkage and alignment procedures.* Were any problems found?	**YES:** Repair problem. Run Harness Diagnostic Mode Test in Service ADVISOR. **NO:** GO TO 3

JL45346,000003C -19-20APR10-4/23

3 Terminal Test	1. Disconnect throttle #1 connector. 2. Perform Terminal Test on Throttle #1 harness connector. Were any problems found?	**YES:** Repair problem. Run Harness Diagnostic Mode Test in Service ADVISOR. **NO:** GO TO 4

JL45346,000003C -19-20APR10-5/23

4 Throttle potentiometer Resistance Check	On the throttle potentiometer, measure the resistance between: • power (terminal C) and signal (terminal B). **Specification** Throttle Potentiometer—Resistance..... Between 350 and 550 ohms • power (terminal C) and return (terminal A). **Specification** Throttle Potentiometer—Resistance.....Between 4.2k and 6.2k ohms Were the resistance measurements within specifications?	**YES:** GO TO 5 **NO:** Replace throttle #1 potentiometer. Run Harness Diagnostic Mode Test in Service ADVISOR.

JL45346,000003C -19-20APR10-6/23

5 Throttle #1 Circuit Resistance Check Part 1	On the harness, measure the resistance between the throttle #1 harness connector signal (terminal B) and return (terminal A). Is resistance between 120k and 180k ohms?	**YES:** GO TO 6 **NO:** Measurement is greater than 180k ohms. GO TO 10 **NO:** Measurement is less than 10 ohms. GO TO 12

JL45346,000003C -19-20APR10-7/23

6 Throttle #1 Circuit Resistance Check Part 2	On the harness, measure the resistance between the throttle #1 harness connector power (terminal C) and return (terminal A). Is resistance between 90k and 130k ohms?	**YES:** Reconnect all connectors. Run Harness Diagnostic Mode Test in Service ADVISOR **NO:** GO TO 7

Continued on next page

JL45346,000003C -19-20APR10-8/23

7 Terminal Test	1. Ignition OFF, Engine OFF. 2. Disconnect ECU connector J2. 3. Perform Terminal Test on the ECU harness connector J2. Were any problems found?	**YES:** Repair problem. Run Harness Diagnostic Mode Test in Service ADVISOR. **NO:** GO TO 8

JL45346,000003C -19-20APR10-9/23

8 Terminal to Terminal Resistance Check	On the harness, measure the resistance between the throttle #1 harness connector power (terminal C) and the ECU harness connector power (terminal J2-A3). Is the resistance greater than 10 ohms?	**YES:** Repair open to in wiring harness. Run Harness Diagnostic Mode Test in SERVICE ADVISOR™. **NO:** GO TO 9

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JL45346,000003C -19-20APR10-10/23

9 ECU Resistance Check	On the ECU, measure the resistance between the power (terminal J2-A3) and return (terminal J2-C3). Was the resistance between 120k and 180k ohms?	**YES:** Problem not found, reconnect all connectors. GO TO 1 and confirm your findings. Look closely at connectors, wiring and terminal numbers where measurements were made. **NO:** Replace ECU. Run Harness Diagnostic Mode Test in Service ADVISOR.

JL45346,000003C -19-20APR10-11/23

10 Terminal to Terminal Resistance Check	1. Disconnect ECU connector J2. 2. On the harness, measure the resistance between the throttle #1 harness connector signal (terminal B) and the ECU harness connector signal (terminal J2-A4). Is the resistance greater than 10 ohms?	**YES:** Repair open to in wiring harness. Run Harness Diagnostic Mode Test in Service ADVISOR. **NO:** GO TO 11

JL45346,000003C -19-20APR10-12/23

11 Terminal Test	Perform Terminal Test on the ECU harness connector J2. Were any problems found?	**YES:** Repair problem. Run Harness Diagnostic Mode Test in Service ADVISOR. **NO:** GO TO 14

Continued on next page

JL45346,000003C -19-20APR10-13/23

12 Harness Resistance Check, ECU Disconnected	1. Disconnect ECU connector J2. 2. On the harness, measure the resistance between the throttle #1 harness connector signal (terminal B) and return (terminal A). Is resistance less than 10 ohms?	**YES:** GO TO 13 **NO:** GO TO 14

JL45346,000003C -19-20APR10-14/23

13 Terminal Test	Perform Terminal Test on the ECU harness connector J2. Were any problems found?	**YES:** Repair problem. Run Harness Diagnostic Mode Test in Service ADVISOR. **NO:** GO TO 15

JL45346,000003C -19-20APR10-15/23

14 ECU Resistance Check	On the ECU, measure the resistance between the signal (terminal J2-A4) and return (terminal J2-C3). Was the resistance between 120k and 180k ohms?	**YES:** Reconnect all connectors. GO TO 1 **NO:** Replace ECU. Run Harness Diagnostic Mode Test in Service ADVISOR.

JL45346,000003C -19-20APR10-16/23

15 Terminal to Terminal Resistance Check	On the harness, measure the resistance between the ECU harness connector J2 signal (terminal J2-A4) and all other ECU connector terminals. Is the resistance less than 100 ohms on any terminal?	**YES:** Repair wiring for all measurements less than 100 ohms. Run Harness Diagnostic Mode Test in Service ADVISOR. **NO:** Problem not found, reconnect all connectors. GO TO 1 and confirm your findings. Look closely at connectors, wiring and terminal numbers where measurements were made.

JL45346,000003C -19-20APR10-17/23

16 Occurrence Count Check	Review stored information and look at occurrence count for 000091.04. Is occurrence recorded in step 1 greater than 5?	**YES:** GO TO 17 **NO:** GO TO 18

JL45346,000003C -19-20APR10-18/23

17 Terminal Test	1. Ignition OFF, Engine OFF 2. Perform Terminal Test on the Throttle #1 harness connector. Were any problems found?	**YES:** Repair problem, Run Harness Diagnostic Mode Test in Service ADVISOR. **NO:** GO TO 18

Continued on next page

JL45346,000003C -19-20APR10-19/23

18 Further Review of Snapshot Information	1. Ignition ON, Engine OFF	**YES:** Repair problem if found.
	2. Review stored information collected in step 1	**YES:** If a certain operating point exists when error occurs then GO TO 19
	Does stored information lead to a possible problem or is there a certain operating point where error occurs?	**NO:** GO TO 20

JL45346,000003C -19-20APR10-20/23

19 Engine Error Operating Point Test	1. Ignition ON, Engine ON	
	2. Set engine to operating point of failure and refresh codes.	**YES:** Replace throttle #1. Run Harness Diagnostic Mode Test in Service ADVISOR.
	Did 000091.04 reappear when engine operating point was reached?	**NO:** GO TO 18 and confirm operating point.

JL45346,000003C -19-20APR10-21/23

20 Terminal Test	1. Ignition OFF, Engine OFF	
	2. Disconnect throttle #1 connector and ECU connector J2.	
	3. Perform Terminal Test on the Throttle #1 harness connector and ECU J2 connector.	**YES:** Repair problem, Run Harness Diagnostic Mode Test in Service ADVISOR.
	Were any problems found?	**NO:** GO TO 21

JL45346,000003C -19-20APR10-22/23

21 Software Updates	1. Download latest payload and reprogram ECU using Service ADVISOR.	
	2. Run Harness Diagnostic Mode Test in Service ADVISOR.	**YES:** Replace throttle #1. Run Harness Diagnostic Mode Test in Service ADVISOR.
	Is 000091.04 active?	**NO:** Problem fixed, bad ECU program.

JL45346,000003C -19-20APR10-23/23

000091.07 — Throttle #1 Not Responding

ECU received invalid or missing throttle information from the CAN buss. See application manual for troubleshooting procedures.

JL45346,0000083 -19-18SEP07-1/1

000108.02 — Barometric Pressure Signal Invalid

The ECU receives an invalid pressure from the barometric air pressure sensor.

JL45346,000003D -19-31MAY10-1/6

000108.02 — Barometric Pressure Signal Invalid Diagnostic Procedure

Troubleshooting Sequence:
000108.02

Related Information:
The barometric air pressure sensor is an internal ECU sensor and cannot be repaired.

Alarm Level:
Warning

Control Unit Response:
If this code sets, the ECU uses intake manifold air pressure for the barometric pressure value. If the intake manifold air pressure is invalid, a default value of 101 kPA (14.6PSI) is used as barometric air pressure to run the engine.

Additional References:
For further barometric air pressure sensor information, see Barometric Air Pressure (BAP) Sensor in Section 03, Group 140 earlier in this manual.

NOTE: The wiring diagrams provided are for a typical John Deere supplied OEM harness. Wire number, colors and jumper connectors do not apply to all applications.

For wiring information:
- see 2.4L 12V ECU WIRING DIAGRAMS
- see 2.4L 24V ECU WIRING DIAGRAMS
- see 3.0L 12V ECU WIRING DIAGRAMS
- see 3.0L 24V ECU WIRING DIAGRAMS

located in Section 06, Group 210 later in this manual.

For further information on connector and terminal testing see Terminal Test in Section 04, Group 160 earlier in this manual.

IMPORTANT: When directed to run the Harness Diagnostic Mode Test the engine temperature should be above freezing. It is recommended that the engine temperature be at least room temperature 20° C (68° F). This test is located in Service ADVISOR.

IMPORTANT: Do not force probes into connector terminals or damage will result. Use JT07328 Connector Adapter Test Kit to make measurements in connectors. This will ensure that terminal damage does not occur.

JL45346,000003D -19-31MAY10-2/6

1 Read DTCs and Store Snapshot Information	1. Ignition ON, engine OFF *NOTE: When DTCs are cleared Snapshot information for ALL DTCs will be cleared.* 2. Connect Service ADVISOR, see Connecting To Service ADVISOR earlier in this Group. 3. Write down all DTCs and their occurrence count. If any DTCs have snapshot capture or snapshot recording information, save the information. For instructions on saving and using snapshot information, see Snapshot Instructions earlier in this Group. 4. Refresh DTC list. Is 000108.02 error code active?	**YES:** GO TO 2 **NO:** GO TO 4

Continued on next page

JL45346,000003D -19-31MAY10-3/6

2 Preliminary Check	Inspect the air vent located on the side of the ECU. Clear any debris blocking the passage. Is vent free of debris?	**YES:** GO TO 3 **NO:** Clear debris from air vent. Run Harness Diagnostic Mode Test in Service ADVISOR.

JL45346,000003D -19-31MAY10-4/6

3 Reprogram ECU	Download latest ECU software payload and reprogram ECU. See Engine Control Unit (ECU) — Reprogramming Instructions in this section of the manual. Is 000110.00 still active?	**YES:** Problem not fixed. Replace ECU. **NO:** Verify problem is fixed. . Run Harness Diagnostic Mode Test in Service ADVISOR.

JL45346,000003D -19-31MAY10-5/6

4 Review Snapshot Information	1. Retrieve snapshot information, see Snapshot Instructions earlier in this Group.	
	2. Review all stored codes. Does information relate to a possible intermittent or operating condition causing the code to become active.	**YES:** Found a possible problem. Repair possible problem. Retest.
	3. Review information to see if you can determine a possible problem or the operating point that causes the code to become active.	**YES:** Found operating point at which the code becomes active. GO TO 2
	Did you find a possible problem or the operating point at which the code becomes active?	**NO:** If no other active or stored codes exists, clear codes. Return to service and monitor further.

JL45346,000003D -19-31MAY10-6/6

000158.17 — ECU Power Down Error

The ECU is unable to complete proper power down procedures after detecting a key off condition.

JL45346,000003E -19-31MAY10-1/4

000158.17 — ECU Power Down Error Diagnostic Procedure

Troubleshooting Sequence:
000158.17

When DTC is Displayed:
DTC is active 164 seconds after ECU commands an internal electronic switch OFF.

Related Information:
The ECU contains an electronic switch which is commanded OFF several seconds after the ECU detects ignition as being OFF to reduce the amount of current drawn by the ECU.
This DTC is generated if the ECU commands the internal electronic switch OFF but the switch does not respond within 164 seconds.
This DTC is only active when ignition is OFF.

Alarm Level:
Warning

Control Unit Response:
The application battery may be discharged because the ECU will not power down.

Additional References:
For further ECU information, see Electronic Control Unit (ECU) System Operation in Section 03, Group 140 earlier in this manual.

JL45346,000003E -19-31MAY10-2/4

1 Reprogram ECU and Store Snapshot Information	1. Ignition ON, engine OFF. *NOTE: When DTCs are cleared Snapshot information for ALL DTCs will also be cleared.* 2. Connect Service ADVISOR, see Connecting To Service ADVISOR earlier in this Group. 3. Write down all DTCs and their occurrence count. If any DTCs have snapshot capture or snapshot recording information, save the information. For instructions on saving and using snapshot information, see Snapshot Instructions earlier in this Group. 4. Download latest ECU payload and reprogram ECU. 5. Clear DTCs. 6. Disconnect Service ADVISOR. 7. Ignition OFF, engine OFF for 5 minutes. 8. Ignition ON, engine OFF. 9. Connect Service ADVISOR and check for stored or active DTCs Did 000158.17 reappear as an active or stored DTC?	**YES:** GO TO 2 **NO:** Problem fixed.

Continued on next page

JL45346,000003E -19-31MAY10-3/4

❷ **Replace ECU**	1. Ignition OFF, engine OFF. 2. Replace ECU. 3. Clear DTCs. 4. Disconnect Service ADVISOR. 5. Ignition OFF, engine OFF for 5 minutes. 6. Ignition ON, engine OFF. 7. Connect Service ADVISOR and check for stored or active DTCs Did 000158.17 reappear as an active or stored DTC?	**YES:** Open DTAC case. **NO:** Problem fixed.

JL45346,000003E -19-31MAY10-4/4

000189.00 — Engine Speed Derate Condition Exists

The ECU detects a condition that requires an engine speed derate.

Related Information:
The engine speed derate diagnostic trouble code is information to the operator that the ECU has detected a condition and is derating the engine by limiting the maximum amount of engine speed available to the engine. This code will only set as a result of another DTC setting.

Alarm Level:
Warning

Control Unit Response:
The ECU will limit the amount of engine speed in an attempt to protect the engine.

Additional References:
For more information on derates see Engine Derate And Shutdown Protection in Section 3 Group 140 earlier in this manual.

JL45346,000003F -19-18JAN10-1/1

000190.00 — Engine Speed Extremely High

The ECU detects that engine speed exceeds the maximum rpm.

DN22556,00000AE -19-08OCT10-1/12

000190.00 — Engine Speed Extremely High Diagnostic Procedure

Troubleshooting Sequence:
000190.00

When DTC is Displayed:
When ever the ignition is on and the error is active.

Related Information:
The ECU detects that engine speed exceeds the maximum rpm allowed.

Alarm Level:
Warning

Control Unit Response:
The ECU stops fuel flow through the injectors.

Additional References:
For more fuel system information, see FUEL SYSTEM OPERATION in Section 03, Group 130 earlier in this manual.

DN22556,00000AE -19-08OCT10-2/12

❶ **Read DTCs and Store Snapshot Information**	1. Ignition ON, engine OFF. *NOTE: When DTCs are cleared Snapshot information for ALL DTCs will also be cleared.* 2. Connect Service ADVISOR, see CONNECTING TO SERVICE ADVISOR earlier in this Group. 3. Write down all DTCs and their occurrence count. If any DTCs have snapshot capture or snapshot recording information, save the information. For instructions on saving and using snapshot information, see SNAPSHOT INSTRUCTIONS earlier in this Group. 4. Refresh Codes. Did 000190.00 reappear active?	**YES:** GO TO 2 **NO:** GO TO 7

DN22556,00000AE -19-08OCT10-3/12

❷ **Application Check**	For the engine to exceed the maximum allowed engine speed at this level, the application must be mechanically pushing the engine. Check the application for anything that could be pushing the engine to an overspeed condition such as trying to use the engine as a break when going down hill. Problem found to be application related?	**YES:** Repair application problem. **NO:** GO TO 3

DN22556,00000AE -19-08OCT10-4/12

❸ **Oil Level Check**	Check application oil level Is oil level low?	**YES:** GO TO 4 **NO:** GO TO 5

Continued on next page

DN22556,00000AE -19-08OCT10-5/12

4 Turbo Oil Seal Leak Test	1. Check for leaking oil seal on turbocharger, see EXCESSIVE OIL CONSUMPTION in Section 4 Group 150 of the base engine manual. 2. Fill oil to proper level. 3. Ignition ON, Engine ON. 4. Reconnect Service ADVISOR, if disconnected. 5. Run engine to highest load point you can for 5 minutes. 6. Refresh codes. Is 000190.00 still active?	**YES:** GO TO 5 **NO:** Problem fixed.

DN22556,00000AE -19-08OCT10-6/12

5 Cylinder Testing	1. Ignition ON, Engine OFF. 2. Run CYLINDER ELECTRONIC COMPRESSION TEST INSTRUCTIONS and record values. 3. Run CYLINDER MISFIRE TEST INSTRUCTIONS and record values. 4. Run CYLINDER CUTOUT TEST INSTRUCTIONS and record values. Do these tests all point to a problem in a particular cylinder?	**YES:** Replace injector in the suspected cylinder. GO TO 6 **NO:** GO TO 7

DN22556,00000AE -19-08OCT10-7/12

6 Overspeed Test	1. Ignition ON, Engine ON. 2. Reconnect Service ADVISOR, if disconnected. 3. Run engine to highest load point you can for 5 minutes. 4. Refresh codes. Is 000190.00 still active?	**YES:** Start a DTAC case. **NO:** Problem fixed.

DN22556,00000AE -19-08OCT10-8/12

7 Occurrence Count Check	Review stored information and look at occurrence count for 000190.00. Is occurrence recorded in step 1 greater than 5?	**YES:** GO TO 8 **NO:** Return application to service.

DN22556,00000AE -19-08OCT10-9/12

8 Further Review of Snapshot Information	Review stored information collected in step 1 Does stored information lead to a possible problem or is there a certain operating point where error occurs?	**YES:** Repair problem if found. **YES:** If a certain operating point exists when error occurs then GO TO 9 **NO:** GO TO 10

Continued on next page

DN22556,00000AE -19-08OCT10-10/12

9 Engine Error Operating Point Test	1. Ignition ON, Engine ON 2. Set engine to operating point of failure. 3. Refresh codes. Did 000190.00 reappear when engine operating point was reached?	**YES:** GO TO 2 **NO:** GO TO 8 and confirm operating point.

DN22556,00000AE -19-08OCT10-11/12

10 Software Updates	1. Download latest ECU software payload and reprogram ECU using Service ADVISOR. 2. Run HARNESS DIAGNOSTIC MODE TEST in Service ADVISOR. Is 000190.00 active?	**YES:** Start DTAC case. **NO:** Problem fixed, bad ECU program.

DN22556,00000AE -19-08OCT10-12/12

000190.16 — Engine Speed Moderately High

The ECU detects that engine speed exceeds the maximum rpm.

DN22556,00000AF -19-08OCT10-1/12

000190.16 — Engine Speed Moderately High Diagnostic Procedure

Troubleshooting Sequence:
000190.16

When DTC is Displayed:
When ever the ignition is on and the error is active.

Related Information:
The ECU detects that engine speed exceeds the maximum rpm allowed.

Alarm Level:
Warning

Control Unit Response:
The ECU stops fuel flow through the injector.

Additional References:
For more fuel system information, see FUEL SYSTEM OPERATION in Section 03, Group 130 earlier in this manual.

DN22556,00000AF -19-08OCT10-2/12

1 Read DTCs and Store Snapshot Information	1. Ignition ON, engine OFF. *NOTE: When DTCs are cleared Snapshot information for ALL DTCs will be cleared.* 2. Connect Service ADVISOR, see CONNECTING TO SERVICE ADVISOR earlier in this Group. 3. Write down all DTCs and their occurrence count. If any DTCs have snapshot capture or snapshot recording information, save the information. For instructions on saving and using snapshot information, see SNAPSHOT INSTRUCTIONS earlier in this Group. 4. Refresh Codes. Did 000190.16 reappear active?	**YES:** GO TO 2 **NO:** GO TO 7

DN22556,00000AF -19-08OCT10-3/12

2 Application Check	For the engine to exceed the maximum allowed engine speed at this level, the application must be mechanically pushing the engine. Check the application for anything that could be pushing the engine to an overspeed condition such as trying to use the engine as a break when going down hill. Problem found to be application related?	**YES:** Repair application problem. **NO:** GO TO 3

DN22556,00000AF -19-08OCT10-4/12

3 Oil Level Check	Check application oil level Is oil level low?	**YES:** GO TO 4 **NO:** GO TO 5

Continued on next page

DN22556,00000AF -19-08OCT10-5/12

4 Turbo Oil Seal Leak Test	1. Check for leaking oil seal on turbocharger, see EXCESSIVE OIL CONSUMPTION in Section 4 Group 150 of the base engine manual. 2. Fill oil to proper level. 3. Ignition ON, Engine ON. 4. Reconnect Service ADVISOR, if disconnected. 5. Run engine to highest load point you can for 5 minutes. 6. Refresh codes. Is 000190.16 still active?	**YES:** GO TO 5 **NO:** Problem fixed.

DN22556,00000AF -19-08OCT10-6/12

5 Cylinder Testing	1. Ignition ON, Engine OFF. 2. Run CYLINDER ELECTRONIC COMPRESSION TEST INSTRUCTIONS and record values. 3. Run CYLINDER MISFIRE TEST INSTRUCTIONS and record values. 4. Run CYLINDER CUTOUT TEST INSTRUCTIONS and record values. Do these tests all point to a problem in a particular cylinder?	**YES:** Replace injector in the suspected cylinder. GO TO 6 **NO:** GO TO 7

DN22556,00000AF -19-08OCT10-7/12

6 Overspeed Test	1. Ignition ON, Engine ON. 2. Reconnect Service ADVISOR, if disconnected. 3. Run engine to highest load point you can for 5 minutes. 4. Refresh codes. Is 000190.16 still active?	**YES:** Start a DTAC case. **NO:** Problem fixed.

DN22556,00000AF -19-08OCT10-8/12

7 Occurrence Count Check	Review stored information and look at occurrence count for 000190.16. Is occurrence recorded in step 1 greater than 5?	**YES:** GO TO 8 **NO:** Return application to service.

DN22556,00000AF -19-08OCT10-9/12

8 Further Review of Snapshot Information	Review stored information collected in step 1 Does stored information lead to a possible problem or is there a certain operating point where error occurs?	**YES:** Repair problem if found. **YES:** If a certain operating point exists when error occurs then GO TO 9 **NO:** GO TO 10

Continued on next page

DN22556,00000AF -19-08OCT10-10/12

9 Engine Error Operating Point Test	1. Ignition ON, Engine ON 2. Set engine to operating point of failure. 3. Refresh codes. Did 000190.16 reappear when engine operating point was reached?	**YES:** GO TO 2 **NO:** GO TO 8 and confirm operating point.

DN22556,00000AF -19-08OCT10-11/12

10 Software Updates	1. Download latest ECU software payload and reprogram ECU using Service ADVISOR. 2. Run HARNESS DIAGNOSTIC MODE TEST in Service ADVISOR. Is 000190.16 active?	**YES:** Start DTAC case. **NO:** Problem fixed, bad ECU program.

DN22556,00000AF -19-08OCT10-12/12

000627.18 — Battery Voltage Moderately Low

The ECU detects a voltage below specification on ECU battery supply terminals.

DN22556,0000002 -19-21APR10-1/17

000627.18 — Battery Voltage Moderately Low Diagnostic Procedure

Related Information:
The ECU detects that its battery voltage supply is less than a programmable value for more than 1 second with engine speed greater than a programmable value.
The ECU has four internally-connected battery supply terminals and three internally-connected ground terminals.
This DTC may be caused by charging system problems or by high resistance in the ECU battery supply or ground circuits.

Alarm Level:
Warning

Control Unit Response:
The ECU will attempt to control the engine in a normal manner.
If ECU battery voltage supply is too low, injectors may not operate.

Additional References:

NOTE: The wiring diagrams provided are for a typical John Deere supplied OEM harness. Wire number, colors, and jumper connectors do not apply to all applications.

For wiring information see 2.4L/3.0L ECU WIRING DIAGRAM 4 located in Section 06, Group 210 later in this manual.

Flex probe information:
- ECU large terminal - Orange/Green
- ECU small terminal - Orange/Blue

For more information on connector and terminal testing or flex probes see Terminal Test in Section 04, Group 160 earlier in this manual.

IMPORTANT: Do not force probes into connector terminals or damage will result. Use JDG10466 Connector Adapter Test Kit to make measurements in connectors. This will ensure that terminal damage does not occur.

DN22556,0000002 -19-21APR10-2/17

1 Read DTCs and Store Snapshot Information	1. Ignition ON, engine OFF. *NOTE: When DTCs are cleared Snapshot information for ALL DTCs will also be cleared.* 2. Connect Service ADVISOR, see Connecting To Service ADVISOR earlier in this Group. 3. Write down all DTCs and their occurrence count. If any DTCs have snapshot capture or snapshot recording information, save the information. For instructions on saving and using snapshot information, see Snapshot Instructions earlier in this Group. 4. Refresh DTCs. 5. Start engine and operate at speeds above 1200 rpm. Did 003597.18 reappear active?	**YES:** GO TO 2 **NO:** GO TO 10

Continued on next page

DN22556,0000002 -19-21APR10-3/17

2 Check Battery Voltage	1. Ignition ON, engine ON.	
	2. Measure voltage from application battery positive terminal to battery negative terminal for 12V applications or across series connected batteries for 24V applications.	**YES:** GO TO 3
	Is voltage greater than 13V for 12V applications or 26V for 24V applications with engine running?	**NO:** Fix application charging system problem. GO TO 9

DN22556,0000002 -19-21APR10-4/17

3 Check ECU Battery Voltage Data Point	Monitor Battery Voltage data point in Service ADVISOR with engine running.	**YES:** GO TO 7
	Is the voltage greater than 12.5V for 12V systems or 25V for 24V systems?	**NO:** GO TO 4

DN22556,0000002 -19-21APR10-5/17

4 Terminal Test	1. Ignition OFF, engine OFF.	
	2. Disconnect ECU J02 connector.	
	3. Perform Terminal Test on J02.	**YES:** Fix problem. GO TO 9
	Where any problems found?	**NO:** GO TO 5

DN22556,0000002 -19-21APR10-6/17

5 Check ECU Battery Supply	*NOTE: The ECU has four battery supply terminals and three ground terminals. The four battery supply terminals are all connected together inside the ECU, as are the three ground terminals.*	
	1. On the harness, measure voltage from ECU J02-L1 (+) to J02-L2 (-).	
	2. On the harness, measure voltage from ECU J02-L4 (+) to J02-L3 (-).	
	3. On the harness, measure voltage from ECU J02-M1 (+) to J02-M2 (-).	
	4. On the harness, measure voltage from ECU J02-M4 (+) to single point ground (-).	**YES:** GO TO 6
	Are all voltage measurements within 1V of battery terminal voltage?	**NO:** Fix problem in ECU battery supply or ground circuits. GO TO 9

DN22556,0000002 -19-21APR10-7/17

6 Check ECU Battery Voltage Supply Circuit Resistance	1. Disconnect application battery negative cable.	
	2. On the harness, measure resistance between each of the ECU battery supply terminals (J02-L1, J02-L4, J02-M1, J02-M4) and the battery positive terminal.	
	3. On the harness, measure resistance between each of the ECU ground terminals (J02-L2, J02-L3, J02-M2) and the disconnected battery negative cable.	**YES:** GO TO 7
	Are all resistance measurements less than 2 ohms?	**NO:** Fix problem. GO TO 9

Continued on next page

DN22556,0000002 -19-21APR10-8/17

7 Reprogram ECU	1. Ignition OFF, engine OFF. 2. Reconnect all connectors. 3. Download latest ECU payload and reprogram ECU. 4. Start engine and operate at speeds above 1200 rpm. 5. Refresh DTCs. Did DTC 003597.18 reappear active?	**YES:** GO TO 8 **NO:** Problem fixed.

DN22556,0000002 -19-21APR10-9/17

8 Replace ECU	1. Ignition OFF, engine OFF. 2. Replace ECU. 3. Start engine and operate at speeds above 1200 rpm. 4. Refresh DTCs. Did DTC 003597.18 reappear active?	**YES:** Open DTAC case. **NO:** Problem fixed.

DN22556,0000002 -19-21APR10-10/17

9 Verification	1. Ignition OFF, engine OFF. 2. Reconnect all connectors. 3. Start engine and operate at speeds above 1200 rpm. 4. Refresh DTCs. Did DTC 003597.18 reappear active?	**YES:** GO TO 1 **NO:** Problem fixed.

DN22556,0000002 -19-21APR10-11/17

10 Further Review of Snapshot Information	Review stored information collected in step 1 Does stored information lead to a possible problem or is there a certain operating point where error occurs?	**YES:** Fix problem if found. **YES:** If a certain operating point exists when error occurs then GO TO 11 **NO:** GO TO 12

DN22556,0000002 -19-21APR10-12/17

11 Engine Error Operating Point Test	1. Ignition ON, engine ON 2. Set engine to operating point of failure and refresh codes. Did 003597.18 reappear active when engine operating point was reached?	**YES:** GO TO 2 **NO:** GO TO 12

Continued on next page

DN22556,0000002 -19-21APR10-13/17

12 Check for Intermittent Wiring Problem

1. Ignition ON, engine OFF.
2. Monitor Battery Voltage data point in Service ADVISOR.
3. Gently wiggle wiring harness between ECU and battery terminals.

Is the minimum Battery Voltage data point recorded during the check within 1V of battery terminal voltage?

YES: GO TO 13

NO: Repair source of intermittent high resistance in ECU battery supply and ground circuits. GO TO 9

DN22556,0000002 -19-21APR10-14/17

13 Terminal Test and Harness Inspection

1. Ignition OFF, engine OFF
2. Perform Terminal Test of single point ground stud.
3. Perform Terminal Test of ECU battery supply fuse holder and fuse.
4. Perform Terminal Test at battery terminals.
5. Perform Terminal Test on the ECU J02 connector.
6. Inspect engine wire harness for damage which may cause an intermittent open circuit.

Were any problems found?

YES: Fix problem. GO TO 9

NO: GO TO 14

DN22556,0000002 -19-21APR10-15/17

14 Reconnect and Retest

1. Reconnect all connectors.
2. Start engine and operate at speeds above 1200 rpm.
3. Refresh DTCs.
4. Gently wiggle wire harness between ECU and battery positive terminal, between ECU and single point ground, and between single point ground and battery negative terminal.

CAUTION: Use caution when working near rotating components.

Did 003597.18 become active at any time with engine running?

YES: Locate source of intermittent high resistance or open circuit. GO TO 2

NO: GO TO 15

DN22556,0000002 -19-21APR10-16/17

15 Reprogram ECU

1. Download latest ECU payload and reprogram ECU.
2. Start engine and operate at speeds above 1200 rpm.
3. Refresh DTCs.

Is 003597.18 active with engine running?

YES: GO TO 2

NO: Problem fixed or conditions to generate 003597.18 have not been duplicated.

DN22556,0000002 -19-21APR10-17/17

000629.12 — ECU EEPROM Error

The ECU detects an internal problem.

JL45346,0000041 -19-20APR10-1/5

000629.12 — ECU EEPROM Error Diagnostic Procedure

Troubleshooting Sequence:
000629.12

When DTC is Displayed:
The ECU detects an internal memory problem.

Related Information:
This may be generated after ECU has been reprogrammed.

Alarm Level:
Stop

Control Unit Response:
The ECU will attempt to control the engine in a normal manner. Engine may not run or may run poorly.

JL45346,0000041 -19-20APR10-2/5

1 Reprogram ECU and Store Snapshot Information	1. Ignition ON, engine OFF. *NOTE: When DTCs are cleared Snapshot information for ALL DTCs will also be cleared.* 2. Connect Service ADVISOR, see Connecting To Service ADVISOR earlier in this Group. 3. Write down all DTCs and their occurrence count. If any DTCs have snapshot capture or snapshot recording information, save the information. For instructions on saving and using snapshot information, see Snapshot Instructions earlier in this Group. 4. Monitor Battery Voltage data point in Service ADVISOR. Is the voltage greater than 11.7V for 12V systems or 23.5V for 24V systems?	**YES:** GO TO 2 **NO:** Recharge application batteries or determine cause of low ECU voltage. GO TO 2

JL45346,0000041 -19-20APR10-3/5

2 Reprogram ECU	1. Download latest ECU payload and reprogram ECU. 2. Disconnect Service ADVISOR. 3. Ignition OFF, engine OFF for 5 minutes. 4. Ignition ON, engine OFF. 5. Connect Service ADVISOR. See Connecting To Service ADVISOR earlier in this group Did 000629.12 reappear active?	**YES:** GO TO 3 **NO:** Problem fixed.

Continued on next page

JL45346,0000041 -19-20APR10-4/5

❸ **Replace ECU**	1. Ignition OFF, engine OFF. 2. Replace ECU. 3. Disconnect Service ADVISOR. 4. Ignition OFF, engine OFF for 5 minutes. 5. Ignition ON, engine OFF. 6. Connect Service ADVISOR. See Connecting To Service Advisor earlier in this group Did 000629.12 reappear active?	**YES:** Open DTAC case. **NO:** Problem fixed.

JL45346,0000041 -19-20APR10-5/5

000629.13 — ECU Boot Block Error

The ECU detects an internal problem.

JL45346,0000040 -19-20APR10-1/4

000629.13 — ECU Boot Block Error Diagnostic Procedure

Troubleshooting Sequence:
000629.13

When DTC is Displayed:
The ECU detects an internal memory problem.

Related Information:
This DTC may be generated after ECU has been reprogrammed.

Alarm Level:
Stop

Control Unit Response:
The ECU will not permit engine to run.

JL45346,0000040 -19-20APR10-2/4

1 Reprogram ECU	1. Download latest ECU payload and reprogram ECU. 2. Disconnect Service ADVISOR. 3. Ignition OFF, engine OFF for 5 minutes. 4. Ignition ON, engine OFF. 5. Connect Service ADVISOR Did 000629.13 reappear active?	**YES:** GO TO 2 **NO:** Problem fixed.

JL45346,0000040 -19-20APR10-3/4

2 Replace ECU	1. Ignition OFF, engine OFF. 2. Replace ECU. 3. Disconnect Service ADVISOR. 4. Ignition OFF, engine OFF for 5 minutes. 5. Ignition ON, engine OFF. 6. Connect Service ADVISOR Did 000629.13 reappear active?	**YES:** Open DTAC case. **NO:** Problem fixed.

JL45346,0000040 -19-20APR10-4/4

001136.00 — ECU Temperature Signal Extremely High

The ECU detects its internal temperature above specification.

DM59778,0000089 -19-20APR10-1/9

001136.00 — ECU Temperature Signal Extremely High Diagnostic Procedure

Troubleshooting Sequence:
All xxxxxx.06 codes
000611.04
001136.00

Related Information:
The ECU senses its internal temperature above 135° C (275° F) for OEM engines.

NOTE: The ECU temperature sensor is located inside the ECU and is not repairable. If the sensor fails, the ECU has to be replaced.

Alarm Level:
STOP

Control Unit Response:
The ECU limits the engine to 1200 RPM.

Additional References:
For further ECU information, see Electronic Control Unit (ECU) System Operation in Section 03, Group 140 earlier in this manual.
For further ECU temperature sensor information, see Engine Control Unit (ECU) Temperature Sensor in Section 03, Group 140 earlier in this manual.
For more information on engine protection, see Engine Derate And Shutdown Protection in Section 03, Group 140 earlier in this manual.

NOTE: The wiring diagrams provided are for a typical John Deere supplied OEM harness. Wire number, colors and jumper connectors do not apply to all applications.

For wiring information see 2.4/3.0L 12/24V ECU WIRING DIAGRAMS located in Section 06, Group 210 later in this manual.

For further information on connector and terminal testing see Terminal Test in Section 04, Group 160 earlier in this manual.

IMPORTANT: Do not force probes into connector terminals or damage will result. Use JDG10466 Connector Adapter Test Kit to make measurements in connectors. This will ensure that terminal damage does not occur.

DM59778,0000089 -19-20APR10-2/9

1 Read DTCs and Store Snapshot Information	1. Ignition ON, Engine OFF. *NOTE: When DTCs are cleared Snapshot information for ALL DTCs will also be cleared.* 2. Connect Service ADVISOR, see Connecting To Service ADVISOR earlier in this Group. 3. Write down all DTCs and their occurrence count. If any DTCs have snapshot capture or snapshot recording information, save the information. For instructions on saving and using snapshot information, see Snapshot Instructions earlier in this Group. 4. Refresh Codes. Did 001136.00 reappear active?	**YES:** GO TO 2 **NO:** GO TO 7

Continued on next page

DM59778,0000089 -19-20APR10-3/9

2 Check Physical Environment	*NOTE: For Proper ECU installation, see Remove and Install Engine Control Unit (ECU) in Section 02, Group 110 earlier in this manual.* 1. Ignition OFF, Engine OFF. 2. Make the following checks: • Remove any items that are restricting the air flow around the ECU. • Remove dirt and debris from the ECU. Be cautious not to damage the connectors or strike ECU housing. Do not use a pressure wash to clean the ECU. • Verify the ECU is not mounted near high temperature components or in the path of high temperature air flow. Do any of the above conditions exist?	**YES:** Fix environment. GO TO 6 **NO:** GO TO 3

DM59778,0000089 -19-20APR10-4/9

3 Direct Sunlight	Is the ECU in direct sunlight?	**YES:** Shade the ECU. GO TO 6 **NO:** GO TO 4

DM59778,0000089 -19-20APR10-5/9

4 Test ECU	If a Programming Harness is available, perform the following steps. *NOTE: Other DTCs will appear when running this test. Ignore all other DTCs except for 001136.00.* 1. Ignition OFF, Engine OFF. 2. Disconnect all connectors from ECU. 3. Remove ECU from application. 4. Connect ECU to programming harness. 5. Power ECU on from the Programming Harness. 6. Wait for 10 minutes. 7. Refresh codes from within Service ADVISOR. Is 001136.00 still active?	**YES:** Bad temperature sensor. Replace ECU. GO TO 6 **NO:** Programming Harness not available. GO TO 5 **NO:** 001136.00 not active. Recheck physical environment. GO TO 1

Continued on next page

DM59778,0000089 -19-20APR10-6/9

5 Test ECU	*NOTE: Other DTCs will appear when running this test. Ignore all other DTCs except for 001136.00.*	
	1. Ignition OFF, Engine OFF.	
	2. Disconnect all connectors from ECU.	
	3. Remove ECU from application. Isolate ECU from any hot areas.	
	4. Reconnect ECU connector J2.	
	5. Ignition ON, Engine OFF.	
	6. Wait 10 minutes.	
	7. Refresh codes from within Service ADVISOR.	**YES:** Bad temperature sensor. Replace ECU. GO TO 6
	Is 001136.00 still active?	**NO:** 001136.00 not active. Recheck physical environment. GO TO 1

DM59778,0000089 -19-20APR10-7/9

6 Verification	1. Ignition OFF, Engine OFF.	
	2. Reconnect all connectors, hoses, sensors, etc.	
	3. Ignition ON, Engine ON.	
	4. Monitor DTCs in Service ADVISOR.	
	5. Let engine run for 10 minutes.	
	6. Refresh DTCs.	
	7. Operate engine through normal speed and load.	**YES:** GO TO 1
	Did DTC 001136.00 reappear as active with engine running?	**NO:** Problem fixed.

DM59778,0000089 -19-20APR10-8/9

7 Review Snapshot Information	1. Retrieve snapshot information, see Snapshot Instructions earlier in this Group.	**YES:** Found a possible problem. Repair possible problem. Retest.
	2. Review information to see if you can determine a possible problem or the operating point that causes the code to become active.	**YES:** Found operating point at which the code becomes active. GO TO 2
	Did you find a possible problem or the operating point at which the code becomes active?	**NO:** Start DTAC case.

DM59778,0000089 -19-20APR10-9/9

001136.16 — ECU Temperature Signal Moderately High

The ECU detects its internal temperature above specification.

DM59778,000008A -19-20APR10-1/9

001136.16 — ECU Temperature Signal Moderately High Diagnostic Procedure

Troubleshooting Sequence:
All xxxxxx.06 codes
000611.04
001136.00
001136.16

Related Information:
The ECU senses an internal ECU temperature of 125° C (257° F) on OEM engines.

NOTE: The ECU temperature sensor is located inside the ECU and is not repairable. If the sensor fails, the ECU has to be replaced.

Alarm Level:
Warning

Control Unit Response:
The ECU will continue to operate normally.

Additional References:
For further ECU information, see Engine Control Unit (ECU) System Operation in Section 03, Group 140 earlier in this manual.
For further ECU temperature sensor information, see Engine Control Unit (ECU) Temperature Sensor in Section 03, Group 140 earlier in this manual.
For more information on engine protection, see Engine Derate And Shutdown Protection in Section 03, Group 140 earlier in this manual.

NOTE: The wiring diagrams provided are for a typical John Deere supplied OEM harness. Wire number, colors and jumper connectors do not apply to all applications.

For wiring information see 2.4/3.0L 12/24V ECU WIRING DIAGRAMS located in Section 06, Group 210 later in this manual.

For further information on connector and terminal testing see Terminal Test in Section 04, Group 160 earlier in this manual.

IMPORTANT: Do not force probes into connector terminals or damage will result. Use JDG10466 Connector Adapter Test Kit to make measurements in connectors. This will ensure that terminal damage does not occur.

DM59778,000008A -19-20APR10-2/9

1 Read DTCs and Store Snapshot Information	1. Ignition ON, engine OFF. *NOTE: When DTCs are cleared Snapshot information for ALL DTCs will also be cleared.* 2. Connect Service ADVISOR, see Connecting To Service ADVISOR earlier in this Group. 3. Write down all DTCs and their occurrence count. If any DTCs have snapshot capture or snapshot recording information, save the information. For instructions on saving and using snapshot information, see Snapshot Instructions earlier in this Group. 4. Refresh Codes. Did 001136.16 reappear active?	**YES:** GO TO 2 **NO:** GO TO 7

Continued on next page

DM59778,000008A -19-20APR10-3/9

2 Check Physical Environment	*NOTE: For Proper ECU installation, see Remove and Install Engine Control Unit (ECU) in Section 02, Group 110 earlier in this manual.* 1. Ignition OFF, Engine OFF. 2. Make the following checks: • Remove any items that are restricting the air flow around the ECU. • Remove dirt and debris from the ECU. Be cautious not to damage the connectors or strike ECU housing. Do not use a pressure wash to clean the ECU. • Verify the ECU is not mounted near high temperature components or in the path of high temperature air flow. Do any of the above conditions exist?	**YES:** Fix environment. GO TO 6 **NO:** GO TO 3

DM59778,000008A -19-20APR10-4/9

3 Direct Sunlight	Is the ECU in direct sunlight?	**YES:** Shade the ECU. GO TO 6 **NO:** GO TO 4

DM59778,000008A -19-20APR10-5/9

4 Test ECU	If a Programming Harness is available, perform the following steps. *NOTE: Other DTCs will appear when running this test. Ignore all other DTCs except for 001136.00.* 1. Ignition OFF, Engine OFF. 2. Disconnect all connectors from ECU. 3. Remove ECU from application. 4. Connect ECU to programming harness 5. Power ECU on from the Programming Harness. 6. Wait for 10 minutes. 7. Refresh codes from within Service ADVISOR. Is 001136.16 still active?	**YES:** Bad temperature sensor. Replace ECU. GO TO 6 **NO:** Programming Harness not available. GO TO 5 **NO:** 001136.00 not active. Recheck physical environment. GO TO 1

Continued on next page

DM59778,000008A -19-20APR10-6/9

5 Test ECU	*NOTE: Other DTCs will appear when running this test. Ignore all other DTCs except for 001136.00.* 1. Ignition OFF, Engine OFF. 2. Disconnect all connectors from ECU. 3. Remove ECU from application. Isolate ECU from any hot areas. 4. Reconnect ECU connector J2. 5. Ignition ON, Engine OFF. 6. Wait 10 minutes. 7. Refresh codes from within Service ADVISOR. Is 001136.16 still active?	**YES:** Bad temperature sensor. Replace ECU. GO TO 6 **NO:** 001136.00 not active. Recheck physical environment. GO TO 1

DM59778,000008A -19-20APR10-7/9

6 Verification	1. Ignition OFF, Engine OFF. 2. Reconnect all connectors, hoses, sensors, etc. 3. Ignition ON, Engine ON. 4. Monitor DTCs in Service ADVISOR. 5. Let engine run for 10 minutes. 6. Refresh DTCs. 7. Operate engine through normal speed and load. Did DTC 001136.16 reappear as active with engine running?	**YES:** GO TO 1 **NO:** Problem fixed.

DM59778,000008A -19-20APR10-8/9

7 Review Snapshot Information	1. Retrieve snapshot information, see Snapshot Instructions earlier in this Group.	**YES:** Found a possible problem. Repair possible problem. Retest.
	2. Review information to see if you can determine a possible problem or the operating point that causes the code to become active.	**YES:** Found operating point at which the code becomes active. GO TO 2
	Did you find a possible problem or the operating point at which the code becomes active?	**NO:** Start DTAC case.

DM59778,000008A -19-20APR10-9/9

001569.31 — Engine in Derate Condition

Engine in Derate Condition

Related Information:
The engine power derate diagnostic trouble code is information to the operator that the ECU has detected a condition such as high coolant temperature and is derating the engine by limiting the maximum amount of fuel available to the engine. This code will only set as a result of another DTC setting.

Alarm Level:
Warning

Control Unit Response:
The ECU will limit the amount of engine power in an attempt to protect the engine.

Additional References:
For more information on derate specifications, see OEM Engines Derate Specifications in Section 06, Group 205 later in this manual.

For more information on derates see Engine Derate And Shutdown Protection in Section 3 Group 140 earlier in this manual.

JL45346,0000042 -19-18JAN10-1/1

003509.03 — Sensor Supply #1 Voltage Out of Range High

The ECU detects a supply voltage above specification on the ECU 5 volt supply circuit.

JL45346,0000045 -19-08OCT10-1/13

003509.03 — Sensor Supply #1 Voltage Out of Range High Diagnostic Procedure

Troubleshooting Sequence:
003509.03

When DTC is Displayed:
Whenever the ignition is on and the error is active.

Related Information:
The ECU detects a supply voltage greater than 5.26 volts on the Sensor Supply #1 circuit.

The output from this supply comes from both ECU connectors, J1 (black face) and J2 (red face). The outputs on J1 are currently not connected to any components.

Alarm Level:
Warning

Sensors Using Sensor Supply #1 Voltage from ECU connector J1:
Currently None.
Sensors Using Sensor Supply #1 Voltage from ECU connector J2:
Primary Analog Throttle.

Control Unit Response:
The ECU will try to operate normally. Engine performance may be affected.

Additional References:
For more Sensor Supply #1 information, see SENSOR SUPPLY #1 in Section 03, Group 140 earlier in this manual.

NOTE: The wiring diagrams provided are for a typical John Deere supplied OEM harness. Wire number, colors, and jumper connectors do not apply to all applications.

For wiring information see 2.4L-3.0L ECU WIRING DIAGRAM 6 located in Section 06, Group 210 later in this manual.

Flex probe information:
- ECU large terminal - Orange/Green
- ECU small terminal - Orange/Blue

For more information on connector and terminal testing or flex probes see TERMINAL TEST in Section 04, Group 160 earlier in this manual.

IMPORTANT: When directed to run the Harness Diagnostic Mode Test the engine temperature should be above freezing. It is recommended that the engine temperature be at least room temperature 20° C (68° F). This test is located in Service ADVISOR.

IMPORTANT: Do not force probes into connector terminals or damage will result. Use JDG10466 Connector Adapter Test Kit to make measurements in connectors. This will ensure that terminal damage does not occur.

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JL45346,0000045 -19-08OCT10-2/13

1 Read DTCs and Store Snapshot Information

1. Ignition ON, Engine OFF.

NOTE: When DTCs are cleared Snapshot information for ALL DTCs will be cleared.

2. Connect Service ADVISOR, see CONNECTING TO SERVICE ADVISOR in Section 04, Group 160 earlier in this manual.
3. Write down all DTCs and their occurrence count. If any DTCs have snapshot capture or snapshot recording information, save the information. For instructions on saving and using snapshot information, see SNAPSHOT INSTRUCTIONS in Section 04, Group 160 earlier in this manual.
4. Refresh Codes.

Did 003509.03 reappear active?

YES: GO TO 2

NO: GO TO 6

JL45346,0000045 -19-08OCT10-3/13

2 ECU Programming Harness Availability

Is the ECU programming harness available for use?

YES: GO TO 3

NO: GO TO 4

JL45346,0000045 -19-08OCT10-4/13

3 No Load Sensor Supply Voltage Check

1. Ignition OFF, Engine OFF.
2. Disconnect ECU connectors J1 and J2.

NOTE: New error codes will appear in the next step. Disregard all codes except for 003509.03

3. Connect ECU Programming Harness.
4. Turn Programming Harness Key Switch to ON.
5. Refresh codes.

Is 003509.03 still active?

YES: Replace ECU. Run HARNESS DIAGNOSTIC MODE TEST in Service ADVISOR.

NO: GO TO 4

JL45346,0000045 -19-08OCT10-5/13

4 Wiring Harness Short to Battery Check

1. Turn Programming Harness Key Switch to OFF and wait for the red LED to turn OFF.
2. Remove ECU Programming Harness.
3. On the ECU harness connector J2, measure voltage from power supply terminal (J2-A3) to single point ground.

Was the voltage greater than 5.5 volts?

YES: Look for shorted wires in harness and repair wiring. Run HARNESS DIAGNOSTIC MODE TESTin Service ADVISOR.

NO: GO TO 5

Continued on next page

JL45346,0000045 -19-08OCT10-6/13

5 Wiring Harness Check	Look for shorted wire from Sensor Power Supply #1 to other wires in harness. *NOTE: Signals J1-D3 and J2-A3 are internally connected together within the ECU* • Measure resistance from power supply terminal (J1-D3) on the ECU harness connector to all other terminals of J1 and J2 on the ECU harness. • Measure resistance from power supply terminal (J2-A3) on the ECU harness connector to all other terminals of J1 and J2 on the ECU harness. Were any measurements less than 10 ohms?	**YES:** Look for shorted wires in harness and repair wiring. Run HARNESS DIAGNOSTIC MODE TEST in Service ADVISOR. **NO:** Problem not found. Reconnect all connectors. GO TO 1

JL45346,0000045 -19-08OCT10-7/13

6 Occurrence Count Check	Review stored information and look at occurrence count for 003509.03. Is occurrence recorded in step 1 greater than 5?	**YES:** GO TO 7 **NO:** GO TO 8

JL45346,0000045 -19-08OCT10-8/13

7 Harness Check	1. Ignition OFF, Engine OFF. 2. Inspect ECU connectors and harness wiring for pinched or melted wiring. Were any problems found?	**YES:** Repair problem. Run HARNESS DIAGNOSTIC MODE TEST in Service ADVISOR. **NO:** Reconnect all connectors. GO TO 8

JL45346,0000045 -19-08OCT10-9/13

8 Further Review of Snapshot Information	Review stored information collected in step 1. Does stored information lead to a possible problem or is there a certain operating point where error occurs?	**YES:** Repair problem if found. Run HARNESS DIAGNOSTIC MODE TEST in Service ADVISOR. **YES:** If a certain operating point exists when error occurs, GO TO 9 **NO:** GO TO 10

JL45346,0000045 -19-08OCT10-10/13

9 Engine Error Operating Point Test	1. Ignition ON, Engine ON. 2. Set engine to operating point of failure and refresh codes. Did 003509.03 reappear when engine operating point was reached?	**YES:** Repair problem if found. Run HARNESS DIAGNOSTIC MODE TEST in Service ADVISOR. **YES:** GO TO 2 **NO:** GO TO 8 and confirm the operating point.

Continued on next page

JL45346,0000045 -19-08OCT10-11/13

10 Retest	1. Ignition ON, Engine OFF. 2. Run HARNESS DIAGNOSTIC MODE TEST in Service ADVISOR. 3. Refresh codes. Is 003509.03 active?	**YES:** GO TO 2 **NO:** GO TO 11

JL45346,0000045 -19-08OCT10-12/13

11 Software Updates	1. Download latest ECU software payload and reprogram ECU. See PAYLOAD FILE DOWNLOADING INSTRUCTIONS for Service ADVISOR and ENGINE CONTROL UNIT (ECU) — REPROGRAMMING NSTRUCTIONS in Group 04, Section 160 earlier in this manual. 2. Run HARNESS DIAGNOSTIC MODE TEST in Service ADVISOR. Is 003509.03 active?	**YES:** Start a DTAC case. **NO:** Problem fixed, bad ECU program.

JL45346,0000045 -19-08OCT10-13/13

003509.04 — Sensor Supply #1 Voltage Out of Range Low

The ECU detects a supply voltage below specification on the ECU 5 volt supply circuit.

JL45346,0000046 -19-08OCT10-1/16

003509.04 — Sensor Supply #1 Voltage Out of Range Low Diagnostic Procedure

Troubleshooting Sequence:
003509.04

When DTC is Displayed:
When ever the ignition is on and the error is active.

Related Information:
The ECU detects a supply voltage lower than 4.59 volts on the Sensor Supply #1 circuit.

The output from this supply comes from both ECU connectors, J1 (black face) and J2 (red face). Currently there are not components connected to the output on J1.

Alarm Level:
Warning

Sensors Using Sensor Supply #1 Voltage from ECU connector J1:
Currently None.
Sensors Using Sensor Supply #1 Voltage from ECU connector J2:
Primary Analog Throttle..

Control Unit Response:
The ECU will try to maintain the engine operating envelope. Engine performance may be affected.

Additional References:
For more Sensor Supply #1 information, see SENSOR SUPPLY #1 in Section 03, Group 140 earlier in this manual.

NOTE: The wiring diagrams provided are for a typical John Deere supplied OEM harness. Wire number, colors, and jumper connectors do not apply to all applications.

For wiring information see 2.4L-3.0L ECU WIRING DIAGRAM 6 located in Section 06, Group 210 later in this manual.

Flex probe information:
- ECU large terminal - Orange/Green
- ECU small terminal - Orange/Blue

For more information on connector and terminal testing or flex probes see TERMINAL TEST in Section 04, Group 160 earlier in this manual.

IMPORTANT: When directed to run the Harness Diagnostic Mode Test the engine temperature should be above freezing. It is recommended that the engine temperature be at least room temperature 20° C (68° F). This test is located in Service ADVISOR.

IMPORTANT: Do not force probes into connector terminals or damage will result. Use JDG10466 Connector Adapter Test Kit to make measurements in connectors. This will ensure that terminal damage does not occur.

Continued on next page

JL45346,0000046 -19-08OCT10-2/16

1 Read DTCs and Store Snapshot Information	1. Ignition ON, Engine OFF. *NOTE: When DTCs are cleared Snapshot information for ALL DTCs will be cleared.* 2. Connect Service ADVISOR, see CONNECTING TO SERVICE ADVISOR in Section 04, Group 160 earlier in this manual. 3. Write down all DTCs and their occurrence count. If any DTCs have snapshot capture or snapshot recording information, save the information. For instructions on saving and using snapshot information, see SNAPSHOT INSTRUCTIONS in Section 04, Group 160 earlier in this manual. 4. Refresh Codes. Did 003509.04 reappear active?	**YES:** GO TO 2 **NO:** GO TO 9

JL45346,0000046 -19-08OCT10-3/16

2 Disconnect Related Components	*NOTE: New codes will appear as sensors are disconnected. Disregard all codes except 3509.04.* Part 1 1. Ignition OFF, Engine OFF. 2. Disconnect one of the related sensors/components listed below. • *Primary Analog Throttle* 3. Ignition ON, Engine OFF. 4. Monitor Sensor Supply #1 Voltage in Service ADVISOR. 5. Refresh codes. Has 003509.04 moved to the stored list?	**YES:** GO TO 3 **NO:** GO TO Part 2
	Part 2 Have all related sensors from step 1 been disconnected and 003509.04 still active?	**YES:** GO TO 6 **NO:** GO TO Part 1, Step 1

JL45346,0000046 -19-08OCT10-4/16

3 Terminal Test	1. Ignition OFF, Engine OFF. 2. Perform TERMINAL TEST on the connector of the sensor just removed. 3. Perform TERMINAL TEST on any interconnect connectors if applicable. Were any problems found?	**YES:** Repair problem. Run HARNESS DIAGNOSTIC MODE TEST. **NO:** GO TO 4

JL45346,0000046 -19-08OCT10-5/16

4 Check For Shorted Component	Part 1 Measure the resistance between each of the terminals on the component just disconnected and record . Were any measurements less than 10 ohms?	**YES:** Replace sensor. Run HARNESS DIAGNOSTIC MODE TEST. **NO:** GO TO Part 2
	Part 2 Measure the resistance from each terminal on the component to chassis ground Were any measurements less than 10 ohms?	**YES:** Replace sensor. Run HARNESS DIAGNOSTIC MODE TEST. **NO:** GO TO 5

Continued on next page

JL45346,0000046 -19-08OCT10-6/16

5 Wiring Harness Check	Check wiring harness for pinched or melted wiring. Were any problems found?	**YES:** Repair wiring. Run HARNESS DIAGNOSTIC MODE TEST. **NO:** Problem not found. Reconnect all connectors. GO TO 1

JL45346,0000046 -19-08OCT10-7/16

6 ECU Programming Harness Availability	Is the ECU programming harness available for use?	**YES:** GO TO 7 **NO:** GO TO 8

JL45346,0000046 -19-08OCT10-8/16

7 No Load Sensor Supply Voltage Check	1. Ignition OFF, Engine OFF. 2. Disconnect ECU connector J2. 3. Connect ECU Programming Harness. *NOTE: Many new codes will appear in the next step. Disregard all codes except 3509.04.* 4. Turn Programming Harness Key Switch to ON. 5. Refresh codes. Is 003509.04 still active?	 **YES:** Replace ECU. Run HARNESS DIAGNOSTIC MODE TEST. **NO:** GO TO 8

JL45346,0000046 -19-08OCT10-9/16

8 Harness Resistance Check With ECU Disconnected	1. Ignition OFF, Engine OFF. 2. Look for shorted wires from Sensor Supply #1 to other wires in ECU harness. *NOTE: Signals J1-D3 and J2-A3 are internally connected together within the ECU* • Measure resistance from power (terminal J1-D3) of ECU harness connector to all other terminals of harness connectors J1 and J2. • Measure resistance from power (terminal J2-A3) of ECU harness connector to all other terminals of harness connectors J1 and J2. Were any of the measurements less than 10 ohms?	 **YES:** Check for melted or pinched wire in harness and repair. Run HARNESS DIAGNOSTIC MODE TEST. **NO:** Problem not fixed. Reconnect all connectors. GO TO 1

JL45346,0000046 -19-08OCT10-10/16

9 Occurrence Count Check	Review stored information and look at occurrence count for 003509.04. Is occurrence recorded in step 1 greater than 5?	**YES:** GO TO 10 **NO:** GO TO 11

Continued on next page

JL45346,0000046 -19-08OCT10-11/16

10 Harness Check	1. Ignition OFF, Engine OFF.	
	2. Disconnect ECU connectors. Inspect wiring harness for pinched or melted wiring.	**YES:** Repair problem. Run HARNESS DIAGNOSTIC MODE TEST in Service ADVISOR.
	Were any problems found?	**NO:** Reconnect all connectors. GO TO 11

JL45346,0000046 -19-08OCT10-12/16

11 Further Review of Snapshot Information	Review stored information collected in step 1.	**YES:** Repair problem if found. Run HARNESS DIAGNOSTIC MODE TEST in Service ADVISOR.
	Does stored information lead to a possible problem or is there a certain operating point where error occurs?	**YES:** If a certain operating point exists when error occurs, GO TO 12 **NO:** GO TO 13

JL45346,0000046 -19-08OCT10-13/16

12 Engine Error Operating Point Test	1. Ignition ON, Engine ON.	**YES:** Repair problem if found. Run HARNESS DIAGNOSTIC MODE TEST in Service ADVISOR.
	2. Set engine to operating point of failure and refresh codes.	**YES:** GO TO 2
	Did 003509.04 reappear when engine operating point was reached?	**NO:** Confirm operating point. GO TO 10

JL45346,0000046 -19-08OCT10-14/16

13 Retest	1. Ignition ON, Engine OFF.	
	2. Run HARNESS DIAGNOSTIC MODE TEST in Service ADVISOR.	
	3. Refresh codes.	**YES:** GO TO 2
	Is 003509.04 active?	**NO:** GO TO 14

JL45346,0000046 -19-08OCT10-15/16

14 Software Updates	1. Download latest ECU software payload and reprogram ECU. See PAYLOAD FILE DOWNLOADING INSTRUCTIONS and ENGINE CONTROL UNIT (ECU) — REPROGRAMMING NSTRUCTIONS in Group 04, Section 160 earlier in this manual.	
	2. Run HARNESS DIAGNOSTIC MODE TEST in Service ADVISOR.	**YES:** Start a DTAC case.
	Is 003509.04 active?	**NO:** Problem fixed, bad ECU program.

JL45346,0000046 -19-08OCT10-16/16

003510.03 — Sensor Supply #2 Voltage Out of Range High

The ECU detects a supply voltage above specification on the ECU 5 volt supply circuit.

JL45346,0000047 -19-08OCT10-1/13

003510.03 — Sensor Supply #2 Voltage Out of Range High Diagnostic Procedure

Troubleshooting Sequence:
003510.03

When DTC is Displayed:
When ever the ignition is on and the error is active.

Related Information:
The ECU detects a supply voltage greater than 5.26 volts on the Sensor Supply #2 circuit.

The output from this supply comes from both ECU connectors, J1 (black face) and J2 (red face).

Alarm Level:
Warning

Sensors Using Sensor Supply #2 Voltage from ECU connector J1:
Fuel Pressure Sensor.
Oil Pressure Sensor.
Manifold Air Pressure.
Sensors Using Sensor Supply #2 Voltage from ECU connector J2:
Secondary Analog Throttle.
Droop/ISOC Governor Switch.

Control Unit Response:
The ECU will try to maintain the engine operating envelope. Engine performance may be affected.

Additional References:
For more Sensor Supply #2 information, see SENSOR SUPPLY #2 in Section 03, Group 140 earlier in this manual.

NOTE: The wiring diagrams provided are for a typical John Deere supplied OEM harness. Wire number, colors, and jumper connectors do not apply to all applications.

For wiring information:
-see 2.4L-3.0L ECU WIRING DIAGRAM 3 located in Section 06, Group 210 later in this manual.
-see 2.4L-3.0L ECU WIRING DIAGRAM 5 located in Section 06, Group 210 later in this manual.

Flex probe information:
• ECU large terminal - Orange/Green
• ECU small terminal - Orange/Blue

For more information on connector and terminal testing or flex probes see TERMINAL TEST in Section 04, Group 160 earlier in this manual.

IMPORTANT: When directed to run the Harness Diagnostic Mode Test the engine temperature should be above freezing. It is recommended that the engine temperature be at least room temperature 20° C (68° F). This test is located in Service ADVISOR.

IMPORTANT: Do not force probes into connector terminals or damage will result. Use JDG10466 Connector Adapter Test Kit to make measurements in connectors. This will ensure that terminal damage does not occur.

Continued on next page

JL45346,0000047 -19-08OCT10-2/13

1 Read DTCs and Store Snapshot Information

1. Ignition ON, Engine OFF.

NOTE: When DTCs are cleared Snapshot information for ALL DTCs will be cleared.

2. Connect Service ADVISOR, see CONNECTING TO SERVICE ADVISOR in Section 04, Group 160 earlier in this manual.
3. Write down all DTCs and their occurrence count. If any DTCs have snapshot capture or snapshot recording information, save the information. For instructions on saving and using snapshot information, see SNAPSHOT INSTRUCTIONS in Section 04, Group 160 earlier in this manual.
4. Refresh Codes.

Did 003510.03 reappear active?

YES: GO TO 2

NO: GO TO 6

JL45346,0000047 -19-08OCT10-3/13

2 ECU Programming Harness Availability

Is the ECU programming harness available for use?

YES: GO TO 3

NO: GO TO 4

JL45346,0000047 -19-08OCT10-4/13

3 No Load Sensor Supply Voltage Check

1. Ignition OFF, Engine OFF.
2. Disconnect ECU connector J2.

NOTE: New error codes will appear in the next step. Disregard all codes except for 003510.03

3. Connect ECU Programming Harness.
4. Turn Programming Harness Key Switch to ON.
5. Refresh codes.

Is 003510.03 still active?

YES: Replace ECU. Run HARNESS DIAGNOSTIC MODE TEST in Service ADVISOR.

NO: GO TO 4

JL45346,0000047 -19-08OCT10-5/13

4 Wiring Harness Short to Battery Check

1. Turn Programming Harness Key Switch to OFF and wait for the red LED to turn OFF.
2. Remove ECU Programming Harness.
3. On the ECU harness connector J2, measure voltage from power supply terminal (J2-G2) to chassis ground.

Was the voltage greater than 5.5 volts?

YES: Look for shorted wires in harness and repair wiring. Run HARNESS DIAGNOSTIC MODE TEST in Service ADVISOR.

NO: GO TO 5

Continued on next page

JL45346,0000047 -19-08OCT10-6/13

5 Wiring Harness Check	Look for shorted wire from Sensor Power Supply #2 to other wires in harness. *NOTE: Signals J1-F3 and J2-G2 are internally connected together within the ECU* • Measure resistance from power supply terminal (J1-F3) on the ECU harness connector to all other terminals of J1 and J2 on the ECU harness. • Measure resistance from power supply terminal (J2-G2) on the ECU harness connector to all other terminals of J1 and J2 on the ECU harness. Were any measurements less than 10 ohms?	**YES:** Look for shorted wires in harness and repair wiring. Run HARNESS DIAGNOSTIC MODE TEST in Service ADVISOR. **NO:** Problem not found. Reconnect all connectors. GO TO 1

JL45346,0000047 -19-08OCT10-7/13

6 Occurrence Count Check	Review stored information and look at occurrence count for 003510.03. Is occurrence recorded in step 1 greater than 5?	**YES:** GO TO 7 **NO:** GO TO 8

JL45346,0000047 -19-08OCT10-8/13

7 Harness Check	1. Ignition OFF, Engine OFF. 2. Inspect ECU connectors and harness wiring for pinched or melted wiring. If necessary, remove connectors to get a better visual inspection. Were any problems found?	**YES:** Repair problem. Run HARNESS DIAGNOSTIC MODE TEST in Service ADVISOR. **NO:** Reconnect all connectors. GO TO 8

JL45346,0000047 -19-08OCT10-9/13

8 Further Review of Snapshot Information	Review stored information collected in step 1. Does stored information lead to a possible problem or is there a certain operating point where error occurs?	**YES:** Repair problem if found. Run HARNESS DIAGNOSTIC MODE TEST in Service ADVISOR. **YES:** If a certain operating point exists when error occurs, GO TO 9 **NO:** GO TO 10

JL45346,0000047 -19-08OCT10-10/13

9 Engine Error Operating Point Test	1. Ignition ON, Engine ON. 2. Set engine to operating point of failure and refresh codes. Did 003510.03 reappear when engine operating point was reached?	**YES:** Repair problem if found. Run HARNESS DIAGNOSTIC MODE TEST in Service ADVISOR. **YES:** GO TO 2 **NO:** GO TO 8 and confirm the operating point.

Continued on next page

JL45346,0000047 -19-08OCT10-11/13

10 Retest	1. Ignition ON, Engine OFF. 2. Run HARNESS DIAGNOSTIC MODE TEST in Service ADVISOR. 3. Refresh codes. Is 003510.03 active?	**YES:** GO TO 2 **NO:** GO TO 11

JL45346,0000047 -19-08OCT10-12/13

11 Software Updates	1. Download latest ECU software payload and reprogram ECU. See PAYLOAD FILE DOWNLOADING INSTRUCTIONS and ENGINE CONTROL UNIT (ECU) — REPROGRAMMING NSTRUCTIONS in Group 04, Section 160 earlier in this manual. 2. Run HARNESS DIAGNOSTIC MODE TEST in Service ADVISOR. Is 003510.03 active?	**YES:** Start a DTAC case. **NO:** Problem fixed, bad ECU program.

JL45346,0000047 -19-08OCT10-13/13

003510.04 — Sensor Supply #2 Voltage Out of Range Low

The ECU detects a supply voltage below specification on the ECU 5 volt supply circuit.

JL45346,0000048 -19-08OCT10-1/16

003510.04 — Sensor Supply #2 Voltage Out of Range Low Diagnostic Procedure

Troubleshooting Sequence:
003510.04

When DTC is Displayed:
When ever the ignition is on and the error is active.

Related Information:
The ECU detects a supply voltage lower than 4.59 volts on the Sensor Supply #2 circuit.

The output from this supply comes from both ECU connectors, J1 (black face) and J2 (red face).

Alarm Level:
Warning

Sensors Using Sensor Supply #2 Voltage from ECU connector J1:
Fuel Pressure Sensor.
Oil Pressure Sensor.
Sensors Using Sensor Supply #2 Voltage from ECU connector J2:
Secondary Analog Throttle.
Droop/ISOC Governor Switch.

Control Unit Response:
The ECU will try to maintain the engine operating envelope. Engine performance may be affected.

Additional References:
For more Sensor Supply #2 information, see SENSOR SUPPLY #2 in Section 03, Group 140, earlier in this manual.

NOTE: The wiring diagrams provided are for a typical John Deere supplied OEM harness. Wire number, colors, and jumper connectors do not apply to all applications.

For wiring information:
-see 2.4L-3.0L ECU WIRING DIAGRAM 3 located in Section 06, Group 210 later in this manual.
-see 2.4L-3.0L ECU WIRING DIAGRAM 5 located in Section 06, Group 210 later in this manual.

Flex probe information:
• ECU large terminal - Orange/Green
• ECU small terminal - Orange/Blue

For more information on connector and terminal testing or flex probes see Terminal Test in Section 04, Group 160 earlier in this manual.

IMPORTANT: When directed to run the Harness Diagnostic Mode Test the engine temperature should be above freezing. It is recommended that the engine temperature be at least room temperature 20° C (68° F). This test is located in Service ADVISOR.

IMPORTANT: Do not force probes into connector terminals or damage will result. Use JDG10466 Connector Adapter Test Kit to make measurements in connectors. This will ensure that terminal damage does not occur.

Continued on next page

JL45346,0000048 -19-08OCT10-2/16

1 Read DTCs and Store Snapshot Information	1. Ignition ON, Engine OFF. *NOTE: When DTCs are cleared Snapshot information for ALL DTCs will be cleared.* 2. Connect Service ADVISOR, see Connecting To Service ADVISOR in Section 04, Group 160, earlier in this manual. 3. Write down all DTCs and their occurrence count. If any DTCs have snapshot capture or snapshot recording information, save the information. For instructions on saving and using snapshot information, see Snapshot Instructions in Section 04, Group 160, earlier in this manual. 4. Refresh Codes. Did 003510.04 reappear active?	**YES:** GO TO 2 **NO:** GO TO 9

JL45346,0000048 -19-08OCT10-3/16

2 Disconnect Related Components	*NOTE: New codes will appear as sensors are disconnected. Disregard all codes except 3510.04.* Part 1 1. Ignition OFF, Engine OFF. 2. Disconnect one of the related sensors/components listed below. • *Oil Pressure Sensor (optional)* • *Fuel Pressure Sensor*. 3. Ignition ON, Engine OFF. 4. Monitor Sensor Supply #2 Voltage in Service ADVISOR. 5. Refresh codes. Has 003510.04 moved to the stored list?	**YES:** GO TO 3 **NO:** GO TO Part 2
	Part 2 Have all related sensors from step 1 been disconnected and 003510.04 still active?	**YES:** GO TO 6 **NO:** GO TO Part 1, Step 1

JL45346,0000048 -19-08OCT10-4/16

3 Terminal Test	1. Ignition OFF, Engine OFF. 2. Perform Terminal Test on the connector of the sensor just removed. 3. Perform Terminal Test on any interconnect connectors if applicable. Were any problems found?	**YES:** Repair problem. Run Harness Diagnostic Mode Test. **NO:** GO TO 4

JL45346,0000048 -19-08OCT10-5/16

4 Check For Shorted Wires on Related Component	Part 1 Measure the resistance between each of the terminals on the component just disconnected and record . Were any measurements less than 10 ohms?	**YES:** Replace sensor. Run Harness Diagnostic Mode Test. **NO:** GO TO Part 2
	Part 2 Measure the resistance from each terminal on the component to chassis ground Were any measurements less than 10 ohms?	**YES:** Replace sensor. Run Harness Diagnostic Mode Test. **NO:** GO TO 5

Continued on next page

JL45346,0000048 -19-08OCT10-6/16

5 Wiring Harness Check	Check wiring harness for pinched or melted wiring. Were any problems found?	**YES:** Repair wiring. Run Harness Diagnostics Mode Test. **NO:** Problem not found. Reconnect all connectors. GO TO 1

JL45346,0000048 -19-08OCT10-7/16

6 ECU Programming Harness Availability	Is the ECU programming harness available for use?	**YES:** GO TO 7 **NO:** GO TO 8

JL45346,0000048 -19-08OCT10-8/16

7 No Load Sensor Supply Voltage Check	1. Ignition OFF, Engine OFF. 2. Disconnect ECU connector J2. 3. Connect ECU Programming Harness. *NOTE: Many new codes will appear in the next step. Disregard all codes except 3510.04.* 4. Turn Programming Harness Key Switch to ON. 5. Refresh codes. Is 003510.04 still active?	 **YES:** Replace ECU. Run Harness Diagnostics Mode Test. **NO:** GO TO 8

JL45346,0000048 -19-08OCT10-9/16

8 Harness Resistance Check With ECU Disconnected	1. Ignition OFF, Engine OFF. 2. Look for shorted wires from Sensor Supply #2 to other wires in ECU harness. *NOTE: Signals J1-F3 and J2-G2 are internally connected together within the ECU* • Measure resistance from power (terminal J1-F3) of ECU harness connector to all other terminals of harness connectors J1 and J2. • Measure resistance from power (terminal J2-G2) of ECU harness connector to all other terminals of harness connectors J1 and J2. Were any of the measurements less than 10 ohms?	 **YES:** Check for melted or pinched wire in harness and repair. Run Harness Diagnostics Mode Test. **NO:** Problem not fixed. Reconnect all connectors. GO TO 1

JL45346,0000048 -19-08OCT10-10/16

9 Occurrence Count Check	Review stored information and look at occurrence count for 003510.04. Is occurrence recorded in step 1 greater than 5?	**YES:** GO TO 10 **NO:** GO TO 11

Continued on next page

JL45346,0000048 -19-08OCT10-11/16

10 Harness Check	1. Ignition OFF, Engine OFF.	
	2. Disconnect ECU connector J2. Inspect wiring harness for pinched or melted wiring.	**YES:** Repair problem. Run Harness Diagnostic Mode Test in Service ADVISOR.
	Were any problems found?	**NO:** Reconnect all connectors. GO TO 11

JL45346,0000048 -19-08OCT10-12/16

11 Further Review of Snapshot Information	Review stored information collected in step 1.	**YES:** Repair problem if found. Run Harness Diagnostic Mode Test in Service ADVISOR.
	Does stored information lead to a possible problem or is there a certain operating point where error occurs?	**YES:** If a certain operating point exists when error occurs, GO TO 12
		NO: GO TO 13

JL45346,0000048 -19-08OCT10-13/16

12 Engine Error Operating Point Test	1. Ignition ON, Engine ON.	**YES:** Repair problem if found. Run Harness Diagnostic Mode Test in Service ADVISOR.
	2. Set engine to operating point of failure and refresh codes.	**YES:** GO TO 2
	Did 003510.04 reappear when engine operating point was reached?	**NO:** Confirm operating point. GO TO 10

JL45346,0000048 -19-08OCT10-14/16

13 Retest	1. Ignition ON, Engine OFF.	
	2. Run Harness Diagnostic Mode Test in Service ADVISOR.	
	3. Refresh codes.	**YES:** GO TO 2
	Is 003510.04 active?	**NO:** GO TO 14

JL45346,0000048 -19-08OCT10-15/16

14 Software Updates	1. Download latest ECU software payload and reprogram ECU. See Payload File Downloading Instructions and Engine Control Unit (ECU) Reprogramming Instructions in Group 04, Section 160 earlier in this manual.	
	2. Run Harness Diagnostic Mode Test in Service ADVISOR.	**YES:** Start a DTAC case.
	Is 003510.04 active?	**NO:** Problem fixed, bad ECU program.

JL45346,0000048 -19-08OCT10-16/16

003597.18 — Battery Voltage Moderately Low

The ECU detects a voltage below specification on ECU battery supply terminals.

JB81757,0000066 -19-21APR10-1/17

003597.18 — Battery Voltage Moderately Low Diagnostic Procedure

Related Information:
The ECU detects that its battery voltage supply is less than a programmable value for more than 1 second with engine speed greater than a programmable value.
The ECU has four internally-connected battery supply terminals and three internally-connected ground terminals.
This DTC may be caused by charging system problems or by high resistance in the ECU battery supply or ground circuits.

Alarm Level:
Warning

Control Unit Response:
The ECU will attempt to control the engine in a normal manner.
If ECU battery voltage supply is too low, injectors may not operate.

Additional References:

NOTE: The wiring diagrams provided are for a typical John Deere supplied OEM harness. Wire number, colors, and jumper connectors do not apply to all applications.

For wiring information see 2.4L/3.0L ECU WIRING DIAGRAM 4 located in Section 06, Group 210 later in this manual.

Flex probe information:
- ECU large terminal - Orange/Green
- ECU small terminal - Orange/Blue

For more information on connector and terminal testing or flex probes see Terminal Test in Section 04, Group 160 earlier in this manual.

IMPORTANT: Do not force probes into connector terminals or damage will result. Use JDG10466 Connector Adapter Test Kit to make measurements in connectors. This will ensure that terminal damage does not occur.

JB81757,0000066 -19-21APR10-2/17

1 Read DTCs and Store Snapshot Information	1. Ignition ON, engine OFF. *NOTE: When DTCs are cleared Snapshot information for ALL DTCs will also be cleared.* 2. Connect Service ADVISOR, see Connecting To Service ADVISOR earlier in this Group. 3. Write down all DTCs and their occurrence count. If any DTCs have snapshot capture or snapshot recording information, save the information. For instructions on saving and using snapshot information, see Snapshot Instructions earlier in this Group. 4. Refresh DTCs. 5. Start engine and operate at speeds above 1200 rpm. Did 003597.18 reappear active?	**YES:** GO TO 2 **NO:** GO TO 10

Continued on next page

JB81757,0000066 -19-21APR10-3/17

2 Check Battery Voltage	1. Ignition ON, engine ON.	
	2. Measure voltage from application battery positive terminal to battery negative terminal for 12V applications or across series connected batteries for 24V applications.	**YES:** GO TO 3
	Is voltage greater than 13V for 12V applications or 26V for 24V applications with engine running?	**NO:** Fix application charging system problem. GO TO 9

JB81757,0000066 -19-21APR10-4/17

3 Check ECU Battery Voltage Data Point	Monitor Battery Voltage data point in Service ADVISOR with engine running.	**YES:** GO TO 7
	Is the voltage greater than 12.5V for 12V systems or 25V for 24V systems?	**NO:** GO TO 4

JB81757,0000066 -19-21APR10-5/17

4 Terminal Test	1. Ignition OFF, engine OFF.	
	2. Disconnect ECU J02 connector.	
	3. Perform Terminal Test on J02.	**YES:** Fix problem. GO TO 9
	Where any problems found?	**NO:** GO TO 5

JB81757,0000066 -19-21APR10-6/17

5 Check ECU Battery Supply	*NOTE: The ECU has four battery supply terminals and three ground terminals. The four battery supply terminals are all connected together inside the ECU, as are the three ground terminals.*	
	1. On the harness, measure voltage from ECU J02-L1 (+) to J02-L2 (-).	
	2. On the harness, measure voltage from ECU J02-L4 (+) to J02-L3 (-).	
	3. On the harness, measure voltage from ECU J02-M1 (+) to J02-M2 (-).	
	4. On the harness, measure voltage from ECU J02-M4 (+) to single point ground (-).	**YES:** GO TO 6
	Are all voltage measurements within 1V of battery terminal voltage?	**NO:** Fix problem in ECU battery supply or ground circuits. GO TO 9

JB81757,0000066 -19-21APR10-7/17

6 Check ECU Battery Voltage Supply Circuit Resistance	1. Disconnect application battery negative cable.	
	2. On the harness, measure resistance between each of the ECU battery supply terminals (J02-L1, J02-L4, J02-M1, J02-M4) and the battery positive terminal.	
	3. On the harness, measure resistance between each of the ECU ground terminals (J02-L2, J02-L3, J02-M2) and the disconnected battery negative cable.	**YES:** GO TO 7
	Are all resistance measurements less than 2 ohms?	**NO:** Fix problem. GO TO 9

Continued on next page

JB81757,0000066 -19-21APR10-8/17

7 Reprogram ECU	1. Ignition OFF, engine OFF. 2. Reconnect all connectors. 3. Download latest ECU payload and reprogram ECU. 4. Start engine and operate at speeds above 1200 rpm. 5. Refresh DTCs. Did DTC 003597.18 reappear active?	**YES:** GO TO 8 **NO:** Problem fixed.

JB81757,0000066 -19-21APR10-9/17

8 Replace ECU	1. Ignition OFF, engine OFF. 2. Replace ECU. 3. Start engine and operate at speeds above 1200 rpm. 4. Refresh DTCs. Did DTC 003597.18 reappear active?	**YES:** Open DTAC case. **NO:** Problem fixed.

JB81757,0000066 -19-21APR10-10/17

9 Verification	1. Ignition OFF, engine OFF. 2. Reconnect all connectors. 3. Start engine and operate at speeds above 1200 rpm. 4. Refresh DTCs. Did DTC 003597.18 reappear active?	**YES:** GO TO 1 **NO:** Problem fixed.

JB81757,0000066 -19-21APR10-11/17

10 Further Review of Snapshot Information	Review stored information collected in step 1 Does stored information lead to a possible problem or is there a certain operating point where error occurs?	**YES:** Fix problem if found. **YES:** If a certain operating point exists when error occurs then GO TO 11 **NO:** GO TO 12

JB81757,0000066 -19-21APR10-12/17

11 Engine Error Operating Point Test	1. Ignition ON, engine ON 2. Set engine to operating point of failure and refresh codes. Did 003597.18 reappear active when engine operating point was reached?	**YES:** GO TO 2 **NO:** GO TO 12

Continued on next page

JB81757,0000066 -19-21APR10-13/17

12 Check for Intermittent Wiring Problem

1. Ignition ON, engine OFF.
2. Monitor Battery Voltage data point in Service ADVISOR.
3. Gently wiggle wiring harness between ECU and battery terminals.

Is the minimum Battery Voltage data point recorded during the check within 1V of battery terminal voltage?

YES: GO TO 13

NO: Repair source of intermittent high resistance in ECU battery supply and ground circuits. GO TO 9

JB81757,0000066 -19-21APR10-14/17

13 Terminal Test and Harness Inspection

1. Ignition OFF, engine OFF
2. Perform Terminal Test of single point ground stud.
3. Perform Terminal Test of ECU battery supply fuse holder and fuse.
4. Perform Terminal Test at battery terminals.
5. Perform Terminal Test on the ECU J02 connector.
6. Inspect engine wire harness for damage which may cause an intermittent open circuit.

Were any problems found?

YES: Fix problem. GO TO 9

NO: GO TO 14

JB81757,0000066 -19-21APR10-15/17

14 Reconnect and Retest

1. Reconnect all connectors.
2. Start engine and operate at speeds above 1200 rpm.
3. Refresh DTCs.
4. Gently wiggle wire harness between ECU and battery positive terminal, between ECU and single point ground, and between single point ground and battery negative terminal.

CAUTION: Use caution when working near rotating components.

Did 003597.18 become active at any time with engine running?

YES: Locate source of intermittent high resistance or open circuit. GO TO 2

NO: GO TO 15

JB81757,0000066 -19-21APR10-16/17

15 Reprogram ECU

1. Download latest ECU payload and reprogram ECU.
2. Start engine and operate at speeds above 1200 rpm.
3. Refresh DTCs.

Is 003597.18 active with engine running?

YES: GO TO 2

NO: Problem fixed or conditions to generate 003597.18 have not been duplicated.

JB81757,0000066 -19-21APR10-17/17

000091.13 — Throttle #1 Out of Calibration

For troubleshooting procedures please see the application troubleshooting manual.

JL45346,0000082 -19-20SEP07-1/1

000107.31 — Air Filter Restriction Detected

For troubleshooting procedures please see the application troubleshooting manual.

DM59778,00000A5 -19-20SEP07-1/1

000111.01 — Engine Coolant Level Low

For troubleshooting procedures please see the application troubleshooting manual.

DM59778,00000A6 -19-20SEP07-1/1

000237.02 — VIN Security Data Invalid

For troubleshooting procedures please see the application troubleshooting manual.

DN22556,00000AA -19-07OCT10-1/1

000237.13 — VIN Option Code Security Data Conflict

For troubleshooting procedures please see the application troubleshooting manual.

DN22556,00000AB -19-07OCT10-1/1

000237.31 — VIN Security Data Missing

For troubleshooting procedures please see the application troubleshooting manual.

DN22556,00000AC -19-07OCT10-1/1

000569.03 — Rear Axle Differential Lock Signal Out of Range High

For troubleshooting procedures please see the application troubleshooting manual.

JL45346,000001D -19-20SEP07-1/1

000569.04 — Rear Axle Differential Lock Signal Out of Range Low

For troubleshooting procedures please see the application troubleshooting manual.

JL45346,000001E -19-20SEP07-1/1

000970.31 — External Engine Shutdown Switch Active

For troubleshooting procedures please see the application troubleshooting manual.

DM59778,00000A3 -19-20SEP07-1/1

000971.31 — External Fuel Derate Switch Active

For troubleshooting procedures please see the application troubleshooting manual.

DM59778,00000A4 -19-20SEP07-1/1

001110.31 — Engine Protection Shutdown Active

The ECU has shutdown the engine due to a operating condition out of range.

DN22556,00000AD -19-08OCT10-1/3

001110.31 — Engine Protection Shutdown Active Diagnostic Procedure

Troubleshooting Sequence:
All other DTCs that are set.
001110.31

Related Information:

NOTE: OEM applications can be programmed with trim options to disable certain engine parameters from shutting down the engine. For other applications, consult the operators manual for engine shutdown options.

NOTE: When protection shutdown options are over ridden, severe damage can be caused to an application by continuously running the engine. Diagnose the problem as soon as possible.

When 001110.31 is set, an associated DTC is set along with it. The associated DTC is the code that needs to be diagnosed.

Alarm Level:
STOP

Control Unit Response:
f this code sets and the shutdown is enabled, the ECU will shut down the engine.

Additional References:
For more information on engine protection, see ENGINE DERATE AND SHUTDOWN PROTECTION in Section 03, Group 140 earlier in this manual.

For more information on derate specifications, see OEM ENGINES - DERATE SPECIFICATIONS in Section 06, Group 210 later in this manual.

DN22556,00000AD -19-08OCT10-2/3

1 **Engine Protection Shutdown:**	Parameters that can cause the ECU to shutdown the engine. • The ECU detects water in fuel. See diagnostic procedure for DTC 000097.16 • The ECU detects high manifold air temperature. See diagnostic procedure for DTC 000105.00 • The ECU detects low oil pressure. See diagnostic procedure for DTC 000100.01 • The ECU detects high engine coolant temperature. See diagnostic procedure for DTC 000110.00 • The ECU detects coolant level switch is active. See diagnostic procedure for DTC 000111.01 Were any operating conditions found to cause the ECU to shutdown the engine?	**YES:** Diagnose problem. Diagnostic troubleshooting procedures are found in this section of the manual for OEM applications.

DN22556,00000AD -19-08OCT10-3/3

002003.09 — No CAN Message Received From Source Address 17 Within Time Out Period

For troubleshooting procedures please see the application troubleshooting manual.

JL45346,000001F -19-20SEP07-1/1

002023.09 — The ETCP1 Message From ICC Has Not Been Received

For troubleshooting procedures please see the application troubleshooting manual.

JL45346,0000020 -19-21SEP07-1/1

003597.01 — Injector Power Supply Voltage Extremely Low

For troubleshooting procedures please see the application troubleshooting manual.

JL45346,0000021 -19-20SEP07-1/1

003597.18 — Injector Power Supply Voltage Moderately Low

For troubleshooting procedures please see the application troubleshooting manual.

JL45346,0000022 -19-20SEP07-1/1

524037.02 — MFWD Switch Circuit Fault

For troubleshooting procedures please see the application troubleshooting manual.

JL45346,0000023 -19-20SEP07-1/1

524223.03 — Rear Axle Differential Lock Circuit Fault

For troubleshooting procedures please see the application troubleshooting manual.

JL45346,0000024 -19-20SEP07-1/1

524225.31 — Engine Start Protection Bypass Detected

For troubleshooting procedures please see the application troubleshooting manual.

JL45346,0000025 -19-20SEP07-1/1

524235.03 — MFWD Solenoid Circuit Voltage High

For troubleshooting procedures please see the application troubleshooting manual.

JL45346,0000026 -19-20SEP07-1/1

524235.04 — MFWD Solenoid Circuit Voltage Low

For troubleshooting procedures please see the application troubleshooting manual.

JL45346,0000027 -19-20SEP07-1/1

Section 05
Tools and Other Materials

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About This Group

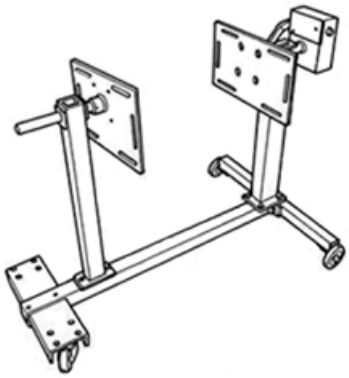
This group contains the list of tools used in this manual.

1. D01003AA — Engine Repair Stand
2. D01168AA — Spring Compression Tester
3. D01200AA — Push Puller
4. D01218AA — Pulling Attachment
5. D05012ST — Precision "Beveled Edge" Straight edge
6. D05058ST — Valve Inspection Center
7. D05104DT — Cooling System Pressure Pump
8. D05223ST — Engine Repair Stand
9. D17024BR — End Brush
10. D17526CI — Dial Indicator (English)
11. D17527CI — Dial Indicator (Metric)
12. DS10023 — PDM Communication Hardware Mini Kit
13. DS10117 — EDL Communication Hardware Mini Kit
14. 170 DS10118 — EDL Communication Hardware Full Kit
15. FKM10002 — Universal Pressure Test Kit
16. JDE81-4 — Timing Pin
17. JDE147 — Manifold Pressure Tester
18. JDE645E — Rear Crankshaft Oil Seal / Wear Sleeve Puller
19. JDG22 — Seal Remover
20. JDG23 — Engine Lifting Sling
21. JDG451 — Piston and Liner Height Gauge
22. JDG578 — Turbocharger Shield
23. JDG698A — Seal and Wear Sleeve Remover
24. JDG1658 — Dipstick Driver
25. 170 11 JDG1660 — Timing Gear Cover Alignment / Front Oil Seal Installer Tool
26. JDG1676 — Engine Mounting Fixture
27. JDG1678 — Hydraulic Lifter Bleed down Tool
28. JDG1687 — Compression Test Adapter
29. JDG1690 — Piston Ring Compressor
30. JDG1691 — Balancer Bushing Drivers
31. JDG1694 — Camshaft Bushing Driver
32. JDG1697 — Spray Jet Installer
33. JDG1700 — Engine Timing Set
34. JDG1702 — Oil Filter Adapter Socket
35. JDG1703 — Rear Seal Housing Alignment Tool
36. JDG1704 — Flywheel Turning Tool
37. 170 JDG1721 — Oil Pressure Regulator Valve Installer
38. JDG1755 — Cold Start Advance Plug Socket Adapter
39. JDG1791 — Aneroid Cap Screw Socket Adapter
40. JDG1822 — Injection Nozzle Puller
41. JDG1854 — Pump Wrench
42. JDG2073 — Fuel Control Rack Measuring Tool
43. JDG10038 — Full Load Stop Screw Socket Wrench
44. JDG10221 — Engine Turning Tool
45. JDG10245 — Fuel Control Rack Tool With Dial Indicator
46. JDG10409 — Wrench Adapter
47. JDG10466 — Flex Probe Kit
48. JT05470 — Universal Pressure Test Kit
49. JT05949 — Valve Guide Knurler Kit
50. JT05993 — Torque Angle Gauge
51. JT07254 — Noncontact Temperature Measuring Gun
52. JT07306 — Digital Multimeter
53. JT30040B — Rear Oil Seal Wear Sleeve Installer Set

MK41968,0000381 -19-09OCT09-1/1

D01003AA — Engine Repair Stand

- Used with JDG1676 Engine Adapter to mount engine.



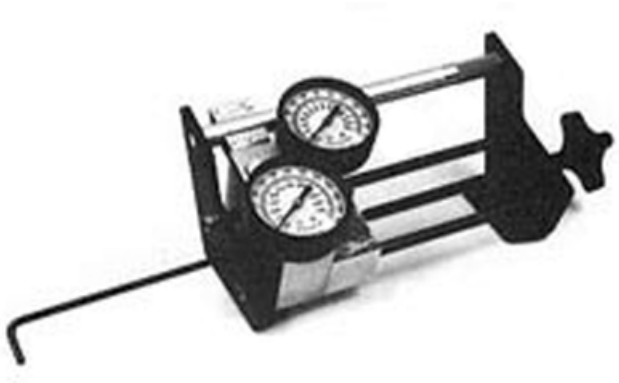
RG16280 —UN—21MAY08

Engine Repair Stand

MK41968,0000384 -19-19JUN08-1/1

D01168AA — Spring Compression Tester

- Test valve spring compression.
- Test oil pressure regulating valve spring compression.



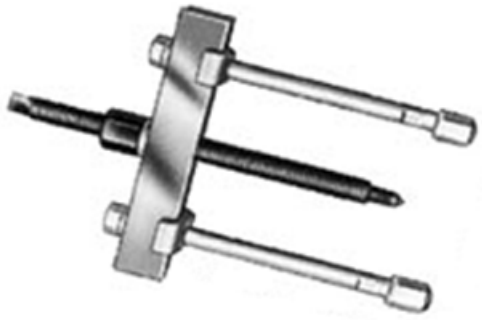
RG16282 —UN—21MAY08

Spring Compression Tester

MK41968,0000385 -19-22MAY08-1/1

D01200AA — Push Puller

• Used with D01218AA to remove crankshaft gear from crankshaft.



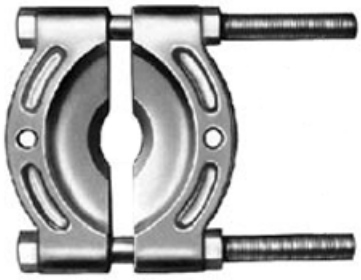
RG16283 —UN—15MAY08

Push Puller

MK41968,0000386 -19-05JUN08-1/1

D01218AA — Pulling Attachment

• Used with D01200AA Push Puller to remove crankshaft gear from crankshaft.



RG16287 —UN—21MAY08

Pulling Attachment

MK41968,000038B -19-05JUN08-1/1

D05012ST — Precision "Beveled Edge" Straight edge

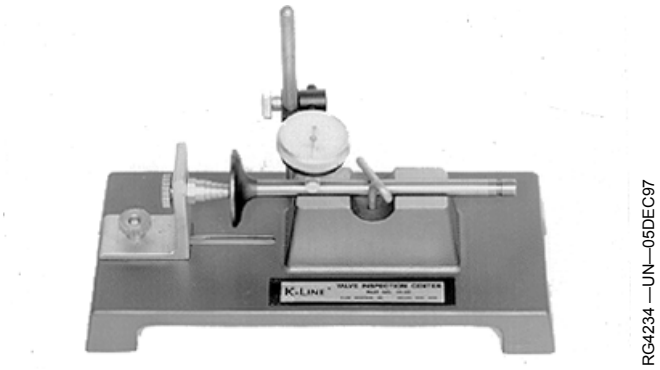
• Check cylinder head flatness.

Precision "Beveled Edge" Straight edge

MK41968,000038C -19-05JUN08-1/1

D05058ST — Valve Inspection Center

• Check valves for out-of-round.



Valve Inspection Center

MK41968,000038D -19-17JUN08-1/1

D05104DT — Cooling System Pressure Pump

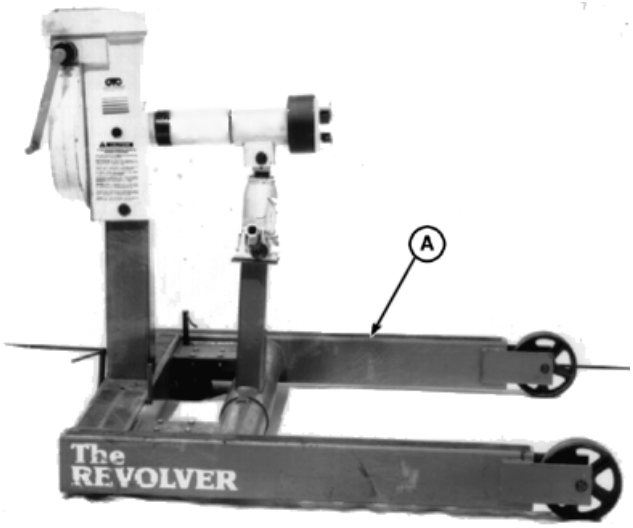
• Used to pressure test radiator cap and cooling system.

Cooling System Pressure Pump

MK41968,000038E -19-17JUN08-1/1

D05223ST — Engine Repair Stand

• Used with JDG1676 Engine Adapter to mount engine.



RG4929 —UN—05DEC97

Engine Repair Stand

MK41968,000038F -19-19JUN08-1/1

D17024BR — End Brush

• Clean valve seat and bores.

RG16289 —UN—15MAY08

End Brush

MK41968,0000390 -19-18JUN08-1/1

D17526CI — Dial Indicator (English)

• Used with magnetic base to measure radial runout (concentricity) and wobble on vibration damper.

RG6246 —UN—05DEC97

RG6246

D17526CI

MK41968,0000391 -19-19JUN08-1/1

D17527CI - Dial Indicator (Metric)

• Used with magnetic base to measure radial runout (concentricity) and wobble on vibration damper.

RG6246 —UN—05DEC97

RG6246

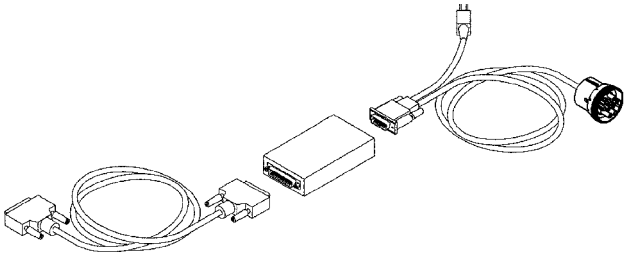
D17527CI

MK41968,0000392 -19-17JUN08-1/1

DS10023 — PDM Communication Hardware Mini Kit

• Used with ECU Communication Software Kit, this kit enables a Windows-compatible computer to read information from the Engine Control Unit (ECU). The computer must be at least a Pentium 1 with 512 of RAM and an IEEE 1284 compliant parallel port. This kit allows communication with applications that use the black 9-pin Deutsch diagnostic connector.

NOTE: ECU Communications Kit DS10023 can no longer be purchased. It will be supported on applications up to and including Tier III.



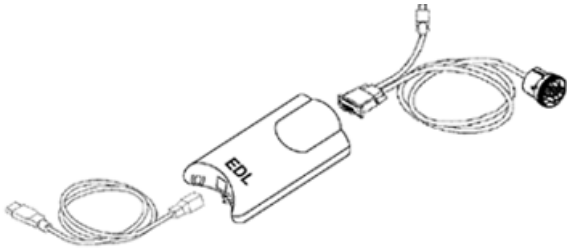
RG11747 —UN—19OCT05

DS10023

MK41968,0000393 -19-19JUN08-1/1

DS10117 — EDL Communication Hardware Mini Kit

• Used with ECU Communication Software Kit, this kit enables a Windows-compatible computer to read information from the Engine Control Unit (ECU). The computer must be at least a Pentium 1 with 512 of RAM and a USB port. This kit allows communication with applications that use the black 9-pin Deutsch diagnostic connector. Kit includes USB cable, Electronic Data Link (EDL), and cable to connect to the 9-pin diagnostic connector on the engine harness. Kit parts may be purchased separately.

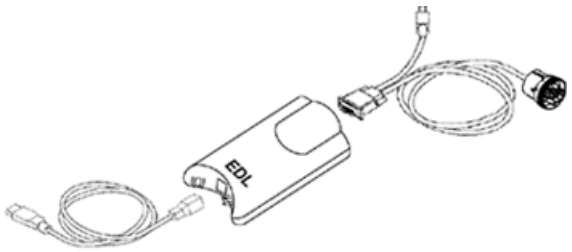


RG11747B —UN—19OCT05

MK41968,0000394 -19-18JUN08-1/1

DS10118 — EDL Communication Hardware Full Kit

• Used with ECU Communication Software Kit, this kit enables a Windows-compatible computer to read information from the Engine Control Unit (ECU). The computer must be at least a Pentium 1 with 512 MB of RAM and a USB port. In addition to the USB cable, Electronic Data Link (EDL), and cable to connect to the 9-pin diagnostic connector on the engine harness, this kit allows communication with applications that use the black 9-pin Deutsch diagnostic connector, gray 9-pin Deutsch diagnostic connector (early 8000 series tractors), and the flat 6-pin Weatherpack diagnostic connector (Lucas controllers). Kit parts may be purchased separately.



RG11747B —UN—19OCT05

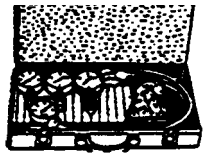
Not all kit components shown

MK41968,0000395 -19-18JUN08-1/1

FKM10002 — Universal Pressure Test Kit

• Used to check engine oil pressure.

RG5162 —UN—23AUG88



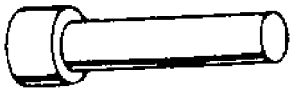
FKM10002

MK41968,00003A5 -19-17JUN08-1/1

JDE81-4 —Timing Pin

• Used to lock engine/flywheel.

RG5068 —UN—05DEC97



RG5068

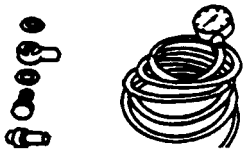
RG5068

MK41968,00003A6 -19-17JUN08-1/1

JDE147 — Manifold Pressure Tester

• Used to test intake manifold pressure on turbocharged engines.

RG5163 —UN—23AUG88



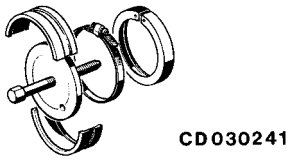
JDE147

MK41968,00003A7 -19-17JUN08-1/1

JDE645E — Rear Crankshaft Oil Seal / Wear Sleeve Puller

• Remove rear oil seal/wear sleeve from crankshaft flange.

CD30241 —UN—08MAR95



CD030241

JDE645E

MK41968,00003A8 -19-18JUN08-1/1

JDG22 — Seal Remover

• Remove crankshaft front oil seal with timing gear cover installed. Also used to remove crankshaft rear oil seal without removing flywheel housing.

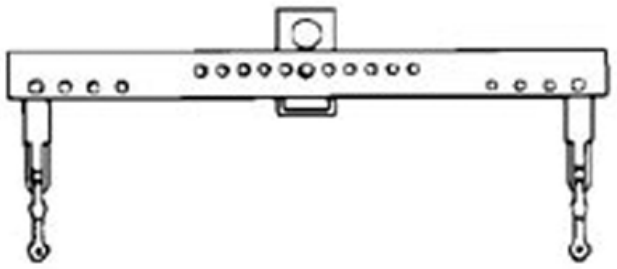
RG5109 —UN—23AUG88

JDG22

MK41968,00003A9 -19-17JUN08-1/1

JDG23 — Engine Lifting Sling

• Lift engine.



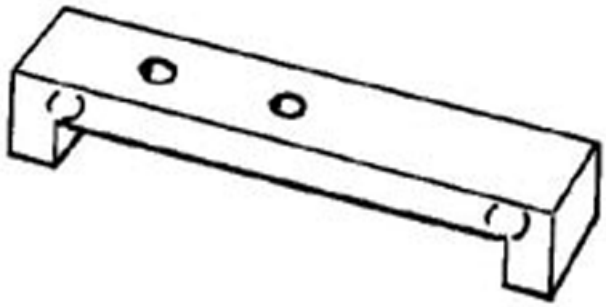
RG16300 —UN—18JUN08

JDG23

MK41968,00003AA -19-17JUN08-1/1

JDG451 — Piston and Liner Height Gauge

• Measure piston height.



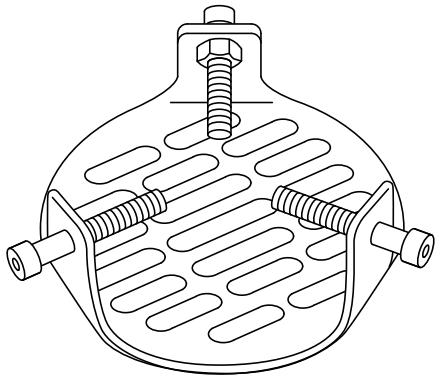
RG16301 —UN—18JUN08

JDG451

MK41968,00003AB -19-17JUN08-1/1

JDG578 — Turbocharger Shield

• Cover turbocharger inlet when testing engine with air filter system removed.



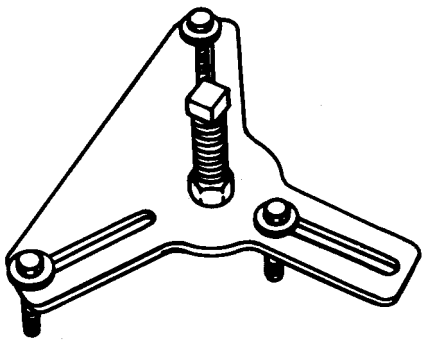
RG15521 —UN—25SEP07

Turbocharger Shield

MK41968,00003AC -19-17JUN08-1/1

JDG698A — Seal and Wear Sleeve Remover

• Remove unitized crankshaft rear oil seal and wear sleeve.



RG5631 —UN—12APR90

JDG698A

MK41968,00003AD -19-17JUN08-1/1

JDG1658 — Dipstick Driver

• Install dipstick tube in block.

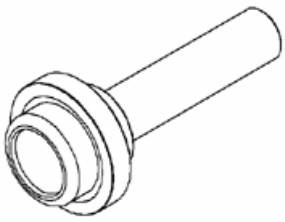
RG12997 —UN—19JUN03

JDG1658

MK41968,00003AE -19-17JUN08-1/1

JDG1660 — Timing Gear Cover Alignment / Front Oil Seal Installer Tool

• Use to install front oil seal into timing gear cover. Also use to center timing gear cover with the crankshaft.



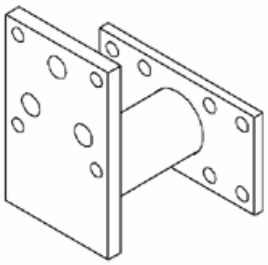
RG12998 —UN—19JUN03

JDG1660

MK41968,00003AF -19-18JUN08-1/1

JDG1676 — Engine Mounting Fixture

• Use to mount engine to engine repair stand.



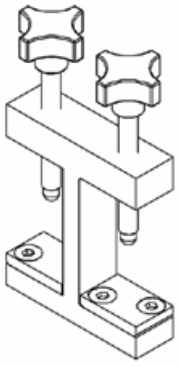
RG13000 —UN—19JUN03

JDG1676

MK41968,00003B0 -19-18JUN08-1/1

JDG1678 — Hydraulic Lifter Bleed down Tool

• Use to bleed-down hydraulic lifters.



RG12995 —UN—19JUN03

JDG1678

MK41968,00003B1 -19-18JUN08-1/1

JDG1687 — Compression Test Adapter

• Used to check cylinder compression pressure. Use adapter with gauge/hose assembly from JT01674 (formerly D14546BA or FKM10021).

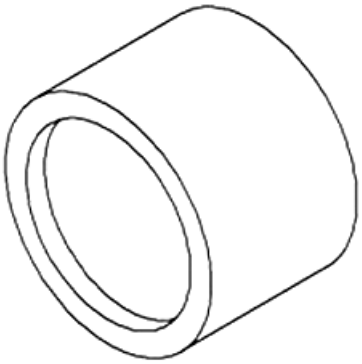
RG12994 —UN—19JUN03

JDG1687

MK41968,00003B2 -19-18JUN08-1/1

JDG1690 — Piston Ring Compressor

• Compress rings while installing pistons.



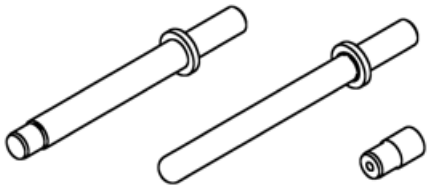
RG16309 —UN—18JUN08

JDG1690

MK41968,00003B3 -19-18JUN08-1/1

JDG1691 — Balancer Bushing Drivers

• Use to remove and install balancer bushings.



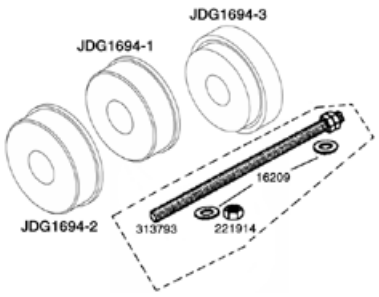
RG13758 —UN—28SEP04

JDG1691

MK41968,00003B4 -19-18JUN08-1/1

JDG1694 — Camshaft Bushing Driver

• Use to remove and install to specification the camshaft bushings. Pilots are designed to protect bushings during installation. 313793 Forcing Screw Assembly can be used from JDG968 or ordered if not available.



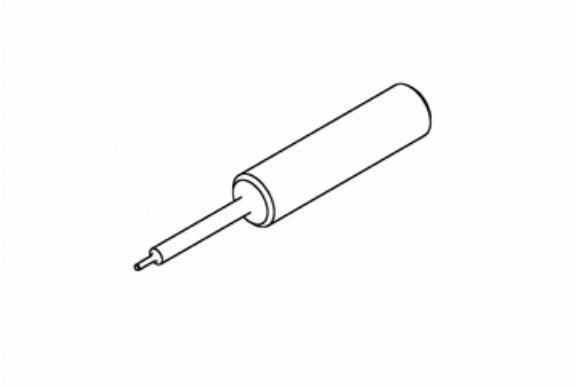
RG13009 —UN—19JUN03

JDG1694

MK41968,00003B5 -19-18JUN08-1/1

JDG1697 — Spray Jet Installer

• Use to install piston oil spray jets.



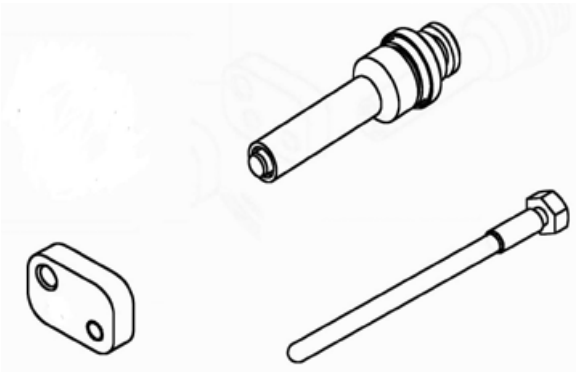
RG13757 —UN—28SEP04

JDG1697

MK41968,00003B6 -19-18JUN08-1/1

JDG1700 — Engine Timing Set

• Used to position camshaft while installing camshaft gear



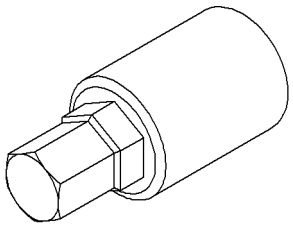
RG13710 —UN—27SEP04

JDG1700

MK41968,00003B7 -19-18JUN08-1/1

JDG1702 — Oil Filter Adapter Socket

• Used to remove oil filter nipple, allowing the oil cooler to be removed.



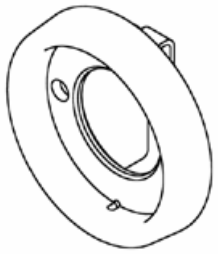
RG13031 —UN—01JUL03

JDG1702

MK41968,00003B8 -19-18JUN08-1/1

JDG1703 — Rear Seal Housing Alignment Tool

• Use to center rear oil seal housing during installation.



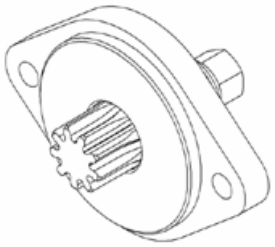
RG13003 —UN—19JUN03

JDG1703

MK41968,00003B9 -19-18JUN08-1/1

JDG1704 — Flywheel Turning Tool

• Used to rotate engine crankshaft and/or camshaft to specific locations.



RG13004 —UN—19JUN03

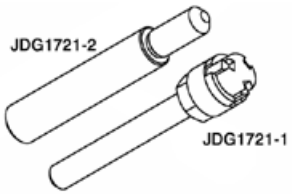
JDG1704

MK41968,00003BA -19-18JUN08-1/1

JDG1721 — Oil Pressure Regulator Valve Installer

• Use to install oil pressure regulating valve body to specification and install cap.

RG13010 —UN—19JUN03

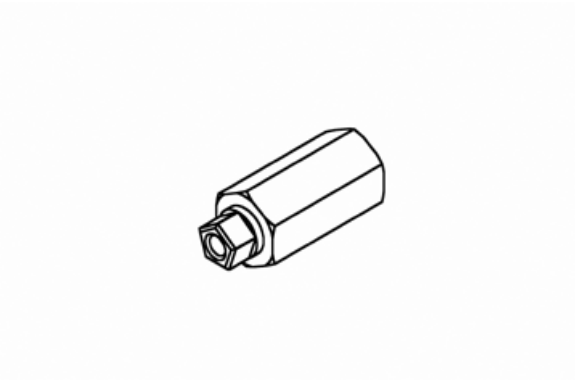


JDG1721

MK41968,00003BB -19-18JUN08-1/1

JDG1755 — Cold Start Advance Plug Socket Adapter

• Use to remove and install tamper-proof cold advance plug.



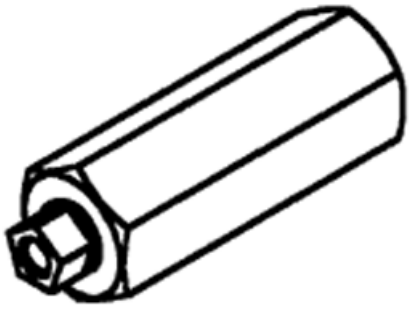
RG13756 —UN—28SEP04

JDG1755

MK41968,00003BC -19-18JUN08-1/1

JDG1791 — Aneroid Cap Screw Socket Adapter

• Use to remove and install the aneroid cap screws on the PowerTech 2.4L and 3.0L engines.



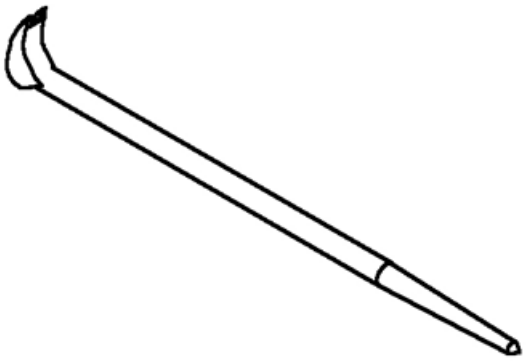
RG16319 —UN—19JUN08

JDG1791

MK41968,00003BD -19-18JUN08-1/1

JDG1822 — Injection Nozzle Puller

• Pull injection nozzle from cylinder head.



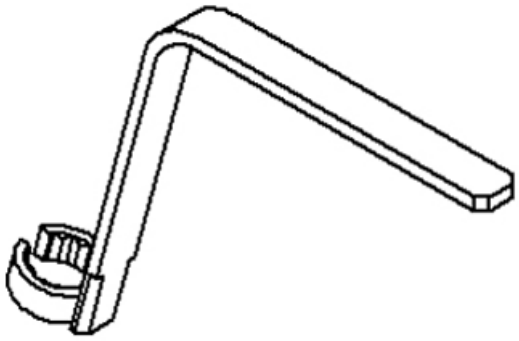
RG13713 —UN—10SEP04

JDG1822

MK41968,00003BE -19-18JUN08-1/1

JDG1854 — Pump Wrench

• Use with standard 15MM hex flare nut socket to hold Injector Pump fitting to loosen or tighten the fuel line nut.



RG13711 —UN—10SEP04

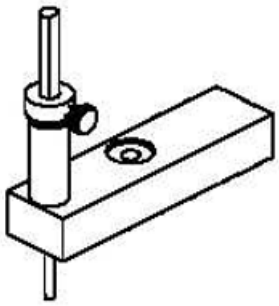
JDG1854

MK41968,00003BF -19-19JUN08-1/1

JDG2073 — Fuel Control Rack Measuring Tool

• Use to transfer measurement of the front and rear position of fuel control rack on the 2.4L and 3.0L engines.

• This tool is included in JDG2PT.



RG16322 —UN—18JUN08

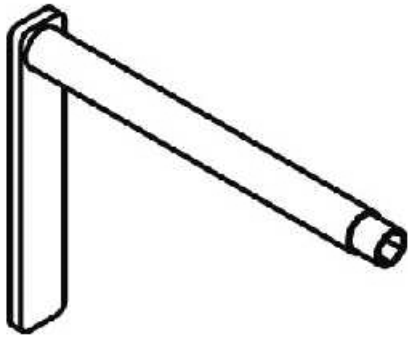
JDG2073

MK41968,00003C0 -19-18JUN08-1/1

JDG10038 — Full Load Stop Screw Socket Wrench

• This tool is used to adjust the power screw on the PowerTech 2.4 & 3.0L Engines. It will work in conjunction with JDG1791 Aneroid Screw Tool

• This tool is included in JDG2PT.



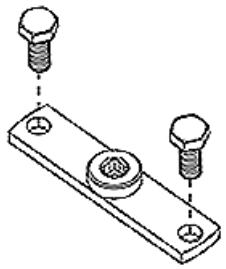
RG16323 —UN—19JUN08

JDG10038

MK41968,00003C1 -19-18JUN08-1/1

JDG10221 — Engine Turning Tool

• Used to rotate engine crankshaft and/or camshaft to specific locations.



RG15105 —UN—01SEP06

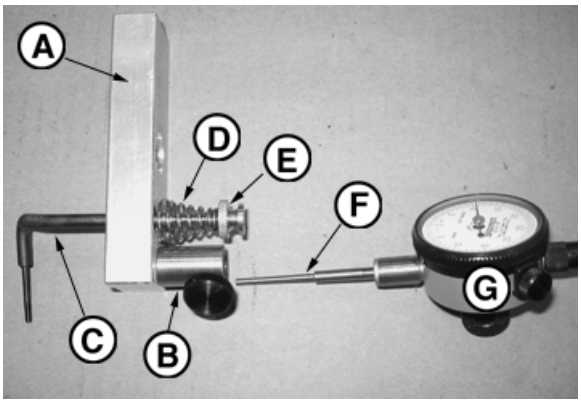
JDG10221

MK41968,00003C2 -19-18JUN08-1/1

JDG10245 — Fuel Control Rack Tool With Dial Indicator

• Used to measure fuel control rack travel when setting and synchronizing fuel injection pumps on the 2.4L and 3.0L engines.

A—Base
B—Gauge Bushing
C—Retaining Pin
D—Tapered Spring
E—Knurled Nut
F—Dial Indicator Extension
G—Dial Indicator



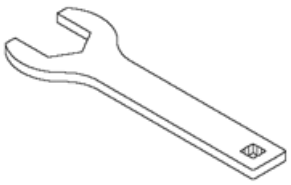
RG14615 —UN—30NOV05

JDG10245

MK41968,00003C3 -19-19JUN08-1/1

JDG10409 — Wrench Adapter

• Use to remove and install the fan bearing bushing assembly to the proper specification.



RG15104 —UN—01SEP06

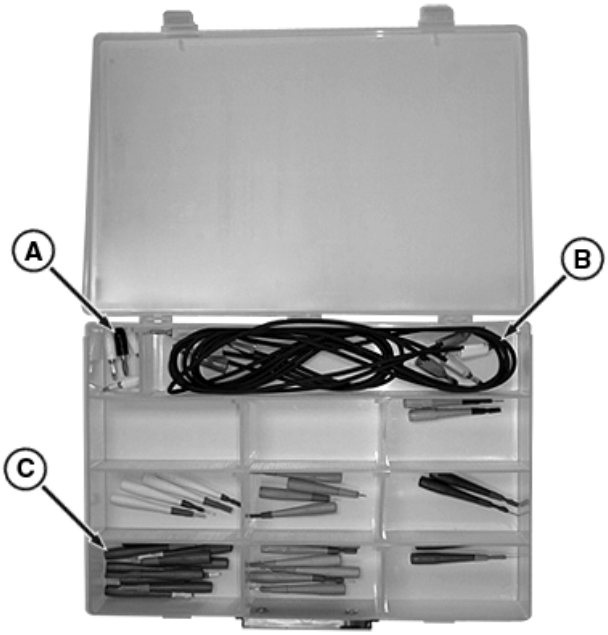
JDG10409

MK41968,00003C4 -19-18JUN08-1/1

JDG10466 — Flex Probe Kit

• Used along with digital multimeter to make measurements on connector and sensor terminals. Kit contains Test Leads, Test Lead Adaptors, and Flex Probes. Flex Probes have mating terminals for harness and sensor connectors and are color coded to identify which terminal they are used for. Can also be used to test terminals for proper fit.

A—Test Lead Adaptors
B—Test Leads
C—Flex Probes



RG15517 —UN—24SEP07

JDG10466

MK41968,00003C5 -19-18JUN08-1/1

JT05470 — Universal Pressure Test Kit

• Used for checking pressure on cotton pickers with diagnostic receptacles and metric test ports.

RG17715 —UN—08OCT09

Universal Pressure Test Kit

MK41968,000002B -19-09OCT09-1/1

JT05949 — Valve Guide Knurler

• Used for knurling valve guides

• Stops oil consumption due to valve guide wear.

• Closer tolerances allow instant valve seating.

• Reduces valve sticking and scoring.

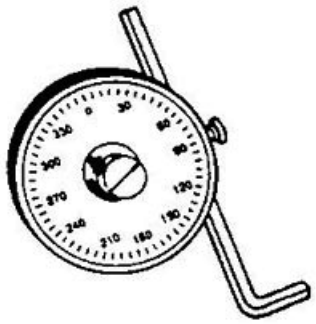
RG17718 —UN—09OCT09

Valve Guide Knurler

MK41968,000002C -19-09OCT09-1/1

JT05993 — Torque Angle Gauge

• Used to stretch cylinder head and connecting rod bolts to obtain optimum clamping load.
• Once the bolt is torqued to the required specification, this tool allows you to accurately control the additional angle of the turn.



RG17713 —UN—08OCT09

Torque Angle Gauge

MK41968,000002D -19-09OCT09-1/1

JT07254 — Non-contact Temperature Measuring Gun

• Spots heat problems early in your electrical and mechanical systems.

• Temperature range is -76 to +932 degree F (-60 to +500 degree C).

RG17717 —UN—08OCT09

Non-contact Temperature Measuring Gun

MK41968,000002E -19-09OCT09-1/1

JT07306 — Digital Multimeter

Used to measure:

• Resistance, continuity and diode test
• Millisecond pulse width measurements for fuel injectors
• Frequency to 200 kHz and % duty cycle
• Up to 1000 V AC and DC
• Current up to 10 A, 20 A for up to 30 seconds
• 4 1/2 digits for precise measurements
• RPN measurements with optional inductive pickup
• Temperature measurements with optional temperature probe

RG17714 —UN—09OCT09

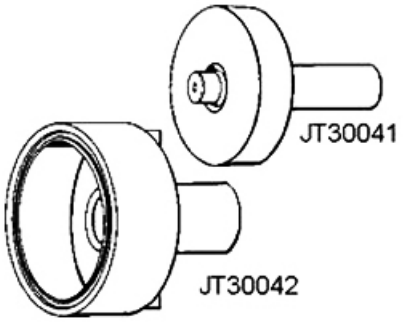
Digital Multimeter

MK41968,000002F -19-09OCT09-1/1

JT30040B — Rear Oil Seal Wear Sleeve Installer Set

• Used to install the rear seal and wear sleeve simultaneously, without removing the flywheel housing.

• Eliminates possible error in the positioning of the seal and wear sleeve.



Rear Oil Seal Wear Sleeve Installer Set

MK41968,0000030 -19-09OCT09-1/1

DT4052 — Petroleum Grease

MK41968,0000025 -19-05OCT09-1/1

DT5446 — Permabond MM115

MK41968,0000026 -19-05OCT09-1/1

DT5189 — Loctite #380-50, 1oz bottle

MK41968,0000027 -19-05OCT09-1/1

LOCTITE® 242 — Thread Lock and Sealer

LOCTITE® 242 locks and seals threaded fasteners which require normal disassembly with standard hand tools.

It cures when confined in the absence of air between close fitting metal surfaces and prevents loosening and leakage from shock and vibration.

RG17832 —UN—21OCT09

LOCTITE® 242

LOCTITE is a trademark of Loctite Corp.

MK41968,0000031 -19-11NOV09-1/1

LOCTITE® 277 — Adhesive & Sealant

LOCTITE® 277 permanently locks and seals threaded fasteners.

It cures when confined in the absence of air between close fitting metal surfaces and prevents loosening and leakage from shock and vibration.

RG17910 —UN—11NOV09

LOCTITE® 277

LOCTITE is a trademark of Loctite Corp.

MK41968,0000032 -19-11NOV09-1/1

LOCTITE® 592 — Adhesive

LOCTITE® 592 prevents galling on pipe threads and fittings.

It provides immediate low pressure sealing and allows the readjustment of fittings shortly after assembly.

RG17914 —UN—11NOV09

LOCTITE® 592

LOCTITE is a trademark of Loctite Corp.

MK41968,0000033 -19-11NOV09-1/1

LOCTITE® 7649 — Clean and Cure Primer

LOCTITE® 7649 is used to increase cure speed of LOCTITE® anaerobic products

It is especially recommended for applications with passive metals or inert surfaces and with large bond gaps.

RG17917 —UN—11NOV09

LOCTITE® 7649

LOCTITE is a trademark of Loctite Corp.

MK41968,0000034 -19-11NOV09-1/1

LOCTITE® 5910 — Silicone Sealant

LOCTITE® 5910 provides good oil resistance and the ability to withstand high joint-movement.

RG17918 —UN—11NOV09

LOCTITE® 5910

LOCTITE is a trademark of Loctite Corp.

MK41968,0000035 -19-11NOV09-1/1

LOCTITE® 5127 — Silicone Sealant

LOCTITE® 5127 has high elongation properties, and is suitable for flexible applications.

LOCTITE is a trademark of Loctite Corp.

MK41968,0000037 -19-11NOV09-1/1

LOCTITE® 609 — Adhesive

LOCTITE®609 is used for the bonding of cylindrical fitting parts.

It cures when confined in the absence of air between close fitting metal surfaces and prevents loosening and leakage from shock and vibration.

RG17919 —UN—11NOV09

LOCTITE® 609

LOCTITE is a trademark of Loctite Corp.

MK41968,0000036 -19-11NOV09-1/1

LOCTITE® 222 — Adhesive (purple)

LOCTITE® 222 is used for locking and sealing of threaded fasteners which require easy disassembly with standard hand tools.

It cures when confined in the absence of air between close fitting metal surfaces and prevents loosening and leakage from shock and vibration.

RG17920 —UN—11NOV09

LOCTITE® 222

LOCTITE is a trademark of Loctite Corp.

MK41968,0000038 -19-11NOV09-1/1

Section 06
Specifications and Wiring Drawings

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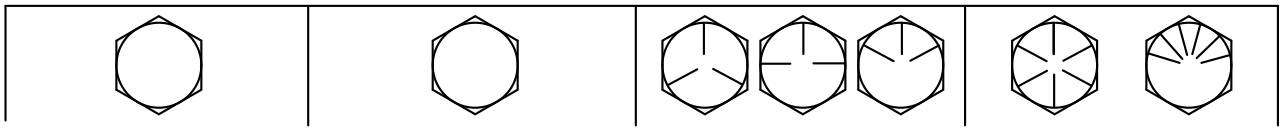
Unified Inch Bolt and Screw Torque Values

TS1671 —UN—01MAY03



Bolt or	SAE Grade 1				SAE Grade 2[a]				SAE Grade 5, 5.1 or 5.2				SAE Grade 8 or 8.2			
Screw	Lubricated[b]		Dry[c]		Lubricated[b]		Dry[c]		Lubricated[b]		Dry[c]		Lubricated[b]		Dry[c]	
Size	N·m	lb-in	N·m	lb-in	N·m	lb-in	N·m	lb-in	N·m	lb-in	N·m	lb-in	N·m	lb-in	N·m	lb-in
1/4	3.7	33	4.7	42	6	53	7.5	66	9.5	84	12	106	13.5	120	17	150
													N·m	lb-ft	N·m	lb-ft
5/16	7.7	68	9.8	86	12	106	15.5	137	19.5	172	25	221	28	20.5	35	26
									N·m	lb-ft	N·m	lb-ft				
3/8	13.5	120	17.5	155	22	194	27	240	35	26	44	32.5	49	36	63	46
			N·m	lb-ft	N·m	lb-ft	N·m	lb-ft								
7/16	22	194	28	20.5	35	26	44	32.5	56	41	70	52	80	59	100	74
	N·m	lb-ft														
1/2	34	25	42	31	53	39	67	49	85	63	110	80	120	88	155	115
9/16	48	35.5	60	45	76	56	95	70	125	92	155	115	175	130	220	165
5/8	67	49	85	63	105	77	135	100	170	125	215	160	240	175	305	225
3/4	120	88	150	110	190	140	240	175	300	220	380	280	425	315	540	400
7/8	190	140	240	175	190	140	240	175	490	360	615	455	690	510	870	640
1	285	210	360	265	285	210	360	265	730	540	920	680	1030	760	1300	960
1-1/8	400	300	510	375	400	300	510	375	910	670	1150	850	1450	1075	1850	1350
1-1/4	570	420	725	535	570	420	725	535	1280	945	1630	1200	2050	1500	2600	1920
1-3/8	750	550	950	700	750	550	950	700	1700	1250	2140	1580	2700	2000	3400	2500
1-1/2	990	730	1250	930	990	730	1250	930	2250	1650	2850	2100	3600	2650	4550	3350

Torque values listed are for general use only, based on the strength of the bolt or screw. DO NOT use these values if a different torque value or tightening procedure is given for a specific application. For plastic insert or crimped steel type lock nuts, for stainless steel fasteners, or for nuts on U-bolts, see the tightening instructions for the specific application. Shear bolts are designed to fail under predetermined loads. Always replace shear bolts with identical grade.

Replace fasteners with the same or higher grade. If higher grade fasteners are used, tighten these to the strength of the original. Make sure fastener threads are clean and that you properly start thread engagement. When possible, lubricate plain or zinc plated fasteners other than lock nuts, wheel bolts or wheel nuts, unless different instructions are given for the specific application.

[a] Grade 2 applies for hex cap screws (not hex bolts) up to 6. in (152 mm) long. Grade 1 applies for hex cap screws over 6 in. (152 mm) long, and for all other types of bolts and screws of any length.

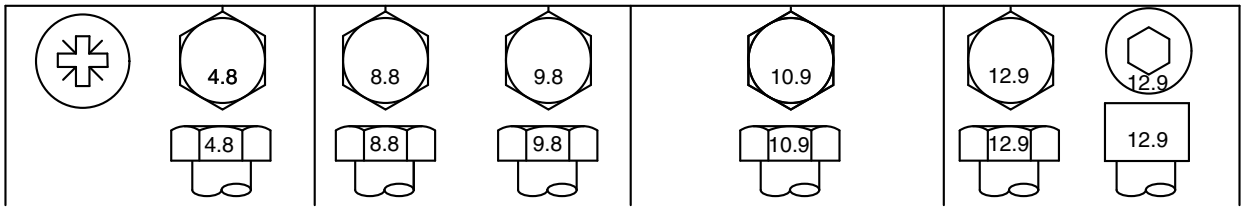
[b] "Lubricated" means coated with a lubricant such as engine oil, fasteners with phosphate and oil coatings, or 7/8 in. and larger fasteners with JDM F13C zinc flake coating.

[c] "Dry" means plain or zinc plated without any lubrication, or 1/4 to 3/4 in. fasteners with JDM F13B zinc flake coating.

DX,TORQ1 -19-24APR03-1/1

Metric Bolt and Screw Torque Values

TS1670 —UN—01MAY03



Bolt or	Class 4.8				Class 8.8 or 9.8				Class 10.9				Class 12.9			
Screw	Lubricated[a]		Dry[b]		Lubricated[a]		Dry[b]		Lubricated[a]		Dry[b]		Lubricated[a]		Dry[b]	
Size	N·m	lb-in	N·m	lb-in	N·m	lb-in	N·m	lb-in	N·m	lb-in	N·m	lb-in	N·m	lb-in	N·m	lb-in
M6	4.7	42	6	53	8.9	79	11.3	100	13	115	16.5	146	15.5	137	19.5	172
									N·m	lb-ft	N·m	lb-ft	N·m	lb-ft	N·m	lb-ft
M8	11.5	102	14.5	128	22	194	27.5	243	32	23.5	40	29.5	37	27.5	47	35
			N·m	lb-ft	N·m	lb-ft	N·m	lb-ft								
M10	23	204	29	21	43	32	55	40	63	46	80	59	75	55	95	70
	N·m	lb-ft														
M12	40	29.5	50	37	75	55	95	70	110	80	140	105	130	95	165	120
M14	63	46	80	59	120	88	150	110	175	130	220	165	205	150	260	190
M16	100	74	125	92	190	140	240	175	275	200	350	255	320	235	400	300
M18	135	100	170	125	265	195	330	245	375	275	475	350	440	325	560	410
M20	190	140	245	180	375	275	475	350	530	390	675	500	625	460	790	580
M22	265	195	330	245	510	375	650	480	725	535	920	680	850	625	1080	800
M24	330	245	425	315	650	480	820	600	920	680	1150	850	1080	800	1350	1000
M27	490	360	625	460	950	700	1200	885	1350	1000	1700	1250	1580	1160	2000	1475
M30	660	490	850	625	1290	950	1630	1200	1850	1350	2300	1700	2140	1580	2700	2000
M33	900	665	1150	850	1750	1300	2200	1625	2500	1850	3150	2325	2900	2150	3700	2730
M36	1150	850	1450	1075	2250	1650	2850	2100	3200	2350	4050	3000	3750	2770	4750	3500

Torque values listed are for general use only, based on the strength of the bolt or screw. DO NOT use these values if a different torque value or tightening procedure is given for a specific application. For stainless steel fasteners or for nuts on U-bolts, see the tightening instructions for the specific application. Tighten plastic insert or crimped steel type lock nuts by turning the nut to the dry torque shown in the chart, unless different instructions are given for the specific application.

Shear bolts are designed to fail under predetermined loads. Always replace shear bolts with identical property class. Replace fasteners with the same or higher property class. If higher property class fasteners are used, tighten these to the strength of the original. Make sure fastener threads are clean and that you properly start thread engagement. When possible, lubricate plain or zinc plated fasteners other than lock nuts, wheel bolts or wheel nuts, unless different instructions are given for the specific application.

[a] *"Lubricated" means coated with a lubricant such as engine oil, fasteners with phosphate and oil coatings, or M20 and larger fasteners with JDM F13C zinc flake coating.*
[b] *"Dry" means plain or zinc plated without any lubrication, or M6 to M18 fasteners with JDM F13B zinc flake coating.*

DX,TORQ2 -19-24APR03-1/1

Engine Rebuild Specifications

Item	Measurement	Specification
D05226ST Special Adapter-to-Mounting Hub SAE Grade 8 Socket Head Cap Screws.	Torque	600 N·m (450 lb-ft)
JDG1676 Engine Adapter-to-Special Adapter SAE Grade 8 Cap Screws.	Torque	135 N·m (100 lb-ft)

RG41183,0000065 -19-26SEP07-1/1

Cylinder Head and Valves Specifications

Item	Measurement	Specification
Unit Pump Clamp	Torque	50 N•m (37 lb-ft)
Glow Plug	Torque	13 N•m (9 lb-ft)
Glow Plug Wire Harness Nut	Torque	3.5 N•m (31 lb-in.)
Cylinder Head Cap Screw/Glow Plug Wire Harness	Torque	28 N•m (21 lb-ft)
Intake Valve	Recess in Cylinder Head	0.72—1.48 mm (0.028—0.058 in.)
Exhaust Valve	Recess in Cylinder Head	0.72—1.48 mm (0.028—0.058 in.)
Spring Free Length 0 N (0 lb-force)[1]	Height	46.2 mm (1.818 in.)
Spring Compressed 166 N (37 lb-force)	Height	37.2 mm (1.46 in.)
Spring Compressed 356 N (80 lb-force)	Height	27.0 mm (1.06 in.)
Intake Valve Head	OD	36.87—37.13 mm (1.452—1.462 in.)
Exhaust Valve Head	OD	33.87—34.13 mm (1.333—1.344 in.)
Intake Valve Stem	OD	6.987—7.013 mm (0.2751—0.2761 in.)
Exhaust Valve Stem	OD	6.974—7.000 mm (0.2746—0.2755 in.)
Valve Face	Maximum Runout (Intake and Exhaust)	0.038 mm (0.0015 in.)
Valves	Face Angle	29.25° ± 0.25°
Initial Cylinder Head Cap Screw (4-cylinder)	Torque	110 N•m (81 ft-lb)
Final Cylinder Head Cap Screws No.1 - No.8 (4-cylinder)	Torque	70 N•m (52 ft-lb) plus 150° +10/-0
Final Cylinder Head Cap Screws No.9 - No.10 (4-cylinder)	Torque	70N•m (52 ft-lb) plus 120° +10°/-0°
Initial Cylinder Head Cap Screw (5-cylinder)	Torque	110 N•m (81 ft-lb)
Final Cylinder Head Cap Screws No.1 - No.10 (5-cylinder)	Torque	70 N•m (52 ft-lb) plus 150° +10°/-0°
Final Cylinder Head Cap Screws No.11 - No.12 (5-cylinder)	Torque	70N•m (52 ft-lb) plus 120° +10°/-0°
Unit Pump Clamp	Torque	50 N•m (37 lb-ft)
Top of valve spring retainer to cylinder head	Height	37.0 mm (1.46 in.) minimum
Rocker Arm Cap Screw	Torque	40 N•m (30 lb-ft)

[1]Free length may vary slightly between valve springs.

RG41183,000005C -19-17FEB10-1/1

Cylinder Block, Liners, Pistons, and Rods Specifications

Item	Measurement	Specification
Piston Ring-to-Groove Clearance—New Piston Ring (First Compression Ring Groove)	Maximum Clearance	0.12 mm (0.005 in.)
Piston Ring-to-Groove Clearance—New Piston Ring (Second Compression Ring Groove)	Maximum Clearance	0.098 mm (0.004 in.)
Piston Ring-to-Groove Clearance—New Piston Ring (Third Oil Control Ring Groove, Standard Ring)	Maximum Clearance	0.09 mm (0.004 in.)
Piston Pin Bore	ID	30.003—30.009 mm (1.1812—1.1815 in.)
Piston Skirt (Measurement Taken at Bottom of Skirt 12 mm (0.5 in.) from Bottom of Piston)	Diameter	85.876—85.908 mm (3.381—3.382 in.)
Piston — Turbocharged Engines	Height	53.415—53.465 mm (2.103—2.105 in.)
Cylinder Bore	ID	85.987—86.013 mm (3.385—3.386 in.)
Piston-to-Cylinder Bore Clearance (Measured at Bottom of Piston Skirt)	Clearance	0.079—0.137 mm (0.003—0.005 in.)
Crankshaft Journal	OD	59.987—60.013 mm (2.361—2.363 in.)
Assembled Rod Bearing	ID	60.030—60.073 mm (2.363—2.365 in.)
Connecting Rod Bearing-to-Journal Minimum	Clearance	0.017 mm (0.001in.)
Maximum	Clearance	0.086 mm (0.003 in.)
Connecting Rod Bore (Without Bearing Inserts)	ID	63.437—63.463 mm (2.498—2.499 in.)
Piston Pin	OD	29.994—30.000 mm (1.1809—1.1811 in.)
	OD Wear Limit	29.980 mm (1.1808 in.)
Piston Pin	Length	67.75—68.00 mm (2.667—2.677 in.)
Rod Bearing Bore-to-Piston Pin Bushing Bore (Center-to-Center)	Measurement	170 mm (6.69 in.)
Plug (Oil Gallery)	Torque	15 N•m (11 lb-ft)
Camshaft Follower Bore in Block	ID	21.428—21.454 mm (0.8436—0.8446 in.)
Camshaft Follower (New)	OD	21.392—21.404 mm (0.8422—0.8427 in.)
Connecting Rod Cap Screws	Initial Torque	35 N•m (18 lb-ft)
Connecting Rod Cap Screws	Torque-Turn	1/4 Turn (90—100°) After Initial Torque

RG41183,000005D -19-17FEB10-1/1

Crankshaft, Main Bearings, and Flywheel Specifications

Item	Measurement	Specification
Damper	Maximum Radial Runout (Concentricity)	1.00 mm (0.040 in.)
Damper Pulley Outer Ring	Wobble (Maximum)	1.50 mm (0.060 in.)
Damper Pulley Inner Ring	Wobble (Maximum)	0.5 mm (0.020 in.)
Starter Motor Mounting Cap Screws	Torque	80 N•m (59 lb-ft)
Initial Pulley Mounting Cap Screw	Torque	100 N•m (74 lb-ft)
Final Pulley Mounting Cap Screw	Torque Turn	50 N•m + 90° (37 lb-ft + 90°)
Crankshaft	End Play	0.089—0.396 mm (0.004—0.016 in.)
Flywheel Face Flatness	Maximum Variation	0.23 mm (0.009 in.)
Flywheel Bearing Bore Concentricity	Maximum Variation	0.127 mm (0.005 in.)
Rear Oil Seal Housing Cap Screws	Torque	17 N•m (13 lb-ft)
Crankshaft Main Bearing Cap Screws	Torque	80 N•m (59 lb-ft)
Crankshaft Main Bearing-to-Journal	Oil Clearance	0.021—0.090 mm (0.0008—0.0035 in.)
Main Bearing Cap Screws	Torque	80 N•m (59 lb-ft)
Crankshaft Main Bearing	ID	75.034—75.077 mm (2.9541—2.9558 in.)
Crankshaft Main Journal	OD	74.987—75.013 mm (2.9522—2.9533 in.)
Crankshaft Rod Journal	OD	59.987—60.013 mm (2.36170—2.3627 in.)
Crankshaft Main or Rod Journal	Maximum Taper	0.010 mm (0.0004 in.)
Crankshaft Main or Rod Journal	Maximum Out-of-Round	0.008 mm (0.0003 in.)
Crankshaft Main Thrust Bearing Journal Width	Width	31.302—31.378 mm (1.2340—1.2350 in.)
Crankshaft Main Thrust Washer	Overall Thickness	2.95—3.05 mm (0.120—0.116 in.)
Crankshaft Main Bearing Bore (Without Bearings)	ID	79.892—79.918 mm (3.1454—3.1464 in.)
Crankshaft Main Bearing Cap Screws	Torque	80 N•m (59 lb-ft)
Crankshaft	End Play	0.089—.396 mm (0.004—0.016 in.)
Initial Flywheel Housing Cap Screws	Torque	35 N•m (26 lb-ft)
Final Flywheel Housing Cap Screws	Torque	140 N•m (105 lb-ft)
Initial Flywheel Mounting Cap Screws	Torque	30 N•m (20 lb-ft)
Final Flywheel Mounting Cap Screws	Torque	110 N•m (80 lb-ft)

Continued on next page

RG41183,000005E -19-17FEB10-1/2

Item	Measurement	Specification
Balancer Shaft Weight Cap Screws	Torque	16.5 N·m (12 lb-ft)

RG41183,000005E -19-17FEB10-2/2

Camshaft, Balancer Shafts and Timing Gear Train Specifications

Item	Measurement	Specification
Camshaft	End Play	0.08—0.23 mm (0.003—0.009 in.)
Balancer Shaft	End Play	0.08—0.38 mm (0.003—0.015 in.)
Camshaft Journal	OD	55.872—55.898 mm (2.1997—2.2007 in.)
Camshaft Bore, Front No. 1(Ball Bearing)	ID	55.961—55.987 mm (2.2031—2.2042 in.)
Camshaft Bore, All Except No. 1	ID	55.986—56.012 mm (2.2042—2.2052 in.)
Camshaft Journal-to-Bushing, No. 1 Bore (With Bushing)	Oil Clearance	0.063—0.115 mm (0.0025—0.0045 in.)
Camshaft Intake Lobe	Height	7.05—7.31 mm (0.278—0.288 in.)
Camshaft Exhaust Lobe	Height	6.89—7.15 mm (0.271—0.281 in.)
Fuel Supply Pump Camshaft Lobe	Diameter	42.67—42.93 mm (1.68—1.69 in.)
Camshaft Follower	OD	31.61—31.64 mm (1.245—1.246 in.)
Camshaft Follower Bore in Block	ID	31.70—31.75 mm (1.248—1.250 in.)
Camshaft Follower-to-Bore	Clearance	0.06—0.13 mm (0.002—0.005 in.)
Balancer Shaft Bushing (New)	ID	30.038—30.104 mm (1.1826—1.1852 in.)
Balancer Shaft Journal	OD	29.987—30.013 mm (1.1806—1.1816 in.)
Balancer Shaft Journal-to-Bushing	Oil Clearance	0.025—0.117 mm (0.0009—0.0046 in.)
Cylinder Block Bore for Balancer Shaft Bushing	ID	33.500—33.526 mm (1.3189—1.3199 in.)
Balancer Shaft Thrust Plate (New)	End Play	Not to Exceed 0.45 mm (0.02 in.)

RG41183,000005F -19-30APR04-1/1

Lubrication System Specifications

Item	Measurement	Specification
Nipple	Torque	37 N•m (27 lb-ft)
Oil Pan Drain Plug	Torque	35 N•m (26 lb-ft)
Oil Pick-up Tube Support Bracket Cap Screws	Torque	28 N•m (21 lb-ft)
Oil Pick-up Tube Hold Down Clamp Cap Screw	Torque	16.5 N•m (12 lb-ft)

RG41183,0000060 -19-17FEB10-1/1

Cooling System Specifications

Item	Measurement	Specification
Coolant Temperature Sensor	Torque	15 N•m (11 lb-ft)
Belt Tensioner-to-Timing Cover and Engine Cap Screws	Torque	50 N•m (37 lb-ft)
Belt Tensioner Pulley Cap Screw	Torque	40 N•m (29 lb-ft)
Belt Tensioner	Spring Tension	18—22 N•m (13—16 lb-ft)
Standard Flow Coolant Pump Impeller Diameter	Diameter	56 mm (2.20 in.)
High Flow Coolant Pump Impeller Diameter	Diameter	70 mm (2.75 in.)
Coolant Pump-to-Timing Cover Cap Screws	Torque	40 N•m (30 lb-ft)
Fan-to-Pulley Hub M8 Cap Screws	Torque	35 N•m (26 lb-ft)
Fan-to-Pulley Hub M10 Cap Screws	Torque	70 N•m (52 lb-ft)
Fan Pulley Cap Screws	Torque	32 N•m (24 lb-ft)

RG41183,0000061 -19-17FEB10-1/1

Fuel System Specifications

Item	Measurement	Specification
Fuel Filter Bracket to Rear of Cylinder Head	Torque	40 ±4 N•m (30 lb-ft)
Fuel Filter Assembly to Fuel Filter Bracket	Torque	40 ±4 N•m (30 lb-ft)
Elbow Fitting to Outlet Port of Fuel Filter (Right Side)	Torque	20 ±2 N•m (15 lb-ft)
Straight Fitting to Inlet Port of Fuel Filter (Right Side)	Loctite	592
	Torque	20 ±2 N•m (15 lb-ft)
Hose Clamps on Fuel Lines	Torque	1.8 ±0.4 N•m (16 lb-in)
Low Pressure Fuel Pump	Torque	15 ±1.5 N•m (11 lb-ft)
Unit Pump Clamp Cap Screw	Torque	70 ±5 N•m (52 lb-ft)
Injector Clamp Cap Screw (Initial)	Torque	20 ±3 N•m (15 lb-ft)
Injector Clamp Cap Screw (Final)	Torque	35 ±3.5 N•m (26 lb-ft)
Injector Line Nut at Injector	Torque	24 ±3 N•m (18 lb-ft)
Injector Line Nut at Electronic Unit Pump	Torque	24 ±3 N•m (18 lb-ft)
Unit Pump Harness Support Bracket at Rear of Cylinder (M6 Cap Screw)	Torque	15 ±1.5 N•m (11 lb-ft)
Unit Pump Harness Connector to Cover (M5 Screws)	Loctite	222 (Purple)
	Torque	2 ±0.25 N•m (17 lb-in)
Unit Pump Harness Connector Cover to Cylinder Block (M6 Screws)	Loctite	222 (Purple)
	Torque	15 ±1.5 N•m (11 lb-ft)
Ring Terminals to Electronic Unit Pump Posts	Torque	3 ±0.5 N•m (27 lb-in)

RG41183,0000064 -19-26SEP07-1/1

Air Intake and Exhaust System Specifications

Item	Measurement	Specification
Turbocharger to Exhaust Manifold Cap Screws	Torque	32 ±3 N•m (24 lb-ft)
Turbocharger Supply Line Adaptors	Loctite	592
	Torque	20 ±2 N•m (15 lb-ft)
Turbocharger Oil Supply Line to Turbocharger and Cylinder Block	Torque	16±1.6 N•m (12 lb-ft)
Drain Line Fitting to Cylinder Block	Loctite	592
	Torque	20 ±2 N•m (15 lb-ft)
Turbocharger Drain Line to Drain Hose	Torque	13 ±1.3 N•m (9.5 lb-ft)
Drain Hose Clamps	Torque	6 ±2 N•m (4.5 lb-ft)
Exhaust Manifold Cap Screws (Cylinders 2 & 3 First)	Torque	32 ±3.2 N•m (24 lb-ft)
Exhaust Manifold Cap Screws (Cylinders 1 & 4 (&5) Second	Torque	32 ±3.2 N•m (24 lb-ft)
Heat Shield for Exhaust Manifold (If Applicable)	Torque	32 ±3.2 N•m (24 lb-ft)
Rocker Arm Cover Cap Screws	Torque	12 ±1.2N•m (9 lb-ft)

RG19661,0000255 -19-11SEP07-1/1

Starting and Charging Systems Specifications

Item	Measurement	Specification
Starter Motor	Torque	80 N•m (59 lb-ft)
Alternator Cap Screws	Torque	40 N•m (29.5 lb-ft)

RG41183,0000063 -19-17FEB10-1/1

Electronic Engine Control Repair and Adjustment Specifications

Item	Measurement	Specification
ECU Harness Support Brackets (M8 Screws)	Torque	30 ±2 N•m (22 lb-ft)
ECU Mounting Bracket to Block (Smaller M10 Screws)	Torque	40 ±4 N•m (30 lb-ft)
ECU Mounting Bracket to Block (Larger M16 Screws)	Torque	100 ±10 N•m (74 lb-ft)
ECU Strap to ECU Mounting Bracket (M8 Screws)	Torque	30 ±3 N•m (22 lb-ft)
Harness P-Clamp to Rocker Arm Cover (M6 Self Tapping Screw)	Torque	4 ±1 N•m (3 lb-ft)
Interconnect Harness P-Clamps to Rocker Arm Cover (M6 Self Tapping Screws)	Torque	4 ±1 N•m (3 lb-ft)
Interconnect Harness P-Clamp to Timing Gear Cover (M6 Screw)	Torque	15 ±1.5 N•m (11 lb-ft)
Interconnect Harness P-Clamp to Timing Gear Cover (M10 Screw)	Torque	30 ±3 N•m (22 lb-ft)
Engine Coolant Temperature Sensor	Torque	10 ±2 N•m (7 lb-ft)
Fuel Pressure Sensor	Torque	8 ±2 N•m (6 lb-ft)
Fuel Temperature Sensor	Torque	10 ±2 N•m (7 lb-ft)
Intake Manifold Air Temperature (MAT) Sensor	Torque	18 ±2 N•m (13 lb-ft)
Oil Pressure Sensor	Torque	8 ±2 N•m (6 lb-ft)
Camshaft Position Sensor	Torque	14 ±3 N•m (10 lb-ft)
Crankshaft Position Sensor	Torque	14 ±3 N•m (10 lb-ft)
Water In Fuel Sensor to Fuel Filter	Torque	Finger Tight
Glow Plugs	Torque	12.5 ±1.5 N•m (9.2 lb-ft)
Head Bolts for Glow Plug Harness	Torque	28 ±3 N•m (21 lb-ft)

DM59778,000009F -19-20SEP07-1/1

Turbocharger Boost Table

Turbocharger Boost Pressure					
Machine Model	**Engine Model**	**Injection Pump Part #**	**Rated Power at Full Load Rated Speed**	**Full Load Rated Speed RPM**	**Turbo Boost Pressure at Full Load Rated Speed kPa (bar) (psi) ±10%**
Augusta					
4120 Tractor	4024TLV04	RE515967	30.5 (41)	2400	52 kPa (.5) (7.5)
4320 Tractor	4024TLV01	RE515967	35 (47)	2400	62 kPa (.6) (9)
4520 Tractor	4024TLV02	RE515968	39 (52)	2400	90 kPa (.9) (13)
4720 Tractor	4024TLV03	RE515968	42 (56)	2400	100.5 kPa (1) (14.5)
Dubuque					
317 Skid Steer	4024TT001	RE515949	45.5 (61)	2800	116 kPa (1.16) (17)
320 Skid Steer	4024TT002	RE515949	49 (66)	2800	121 kPa (1.21) (17.5)
325 Skid Steer	5030TT001	RE509660	57 (76)	2800	115 kPa (1.15) (17)
328 Skid Steer	5030TT002	RE509661	61.5 (82)	2800	120 kPa (1.2) (17)
332 Skid Steer	5030HT001	RE515975	68 (91)	2800	106 kPa (1) (15)

MK41968,000037F -19-24MAY11-1/1

Engine Power Rating and Speed Specifications

NOTE: Specifications are subject to change. Refer to factory DTAC for assistance.

Engine speeds listed are as preset to factory specification. In some cases, slow idle speed will be reset depending upon specific vehicle application requirements. Refer to your machine technical manual for engine speeds that are different from those preset at the factory.

Power ratings specify flywheel power for a bare engine without the drag effect of a cooling fan or other accessories like an air compressor.

POWER RATINGS ON DYNAMOMETER FOR OEM ENGINES						
Engine Model	**Fuel System Option Code**	**Engine Application**	**Slow Idle (rpm)**	**Fast Idle (rpm)**	**Rated Speed at Full Load (rpm)**	**Power Rating kW (HP)[a]**
4024DF270	1602	Industrial	900	3000	2800	37 (49)
4024TF270	1601	Industrial	900	3000	2800	45 (60)
4024TF270	1603	Industrial	900	3000	2800	49 (66)
5030TF270	1604	Industrial	900	3000	2800	56 (75)
5030TF270	1605	Industrial	900	3000	2800	63 (84)
5030HF270	1606	Industrial	900	3000	2800	74 (99)

[a]*Power rating is under full load and at rated speed listed*

RG41183,0000069 -19-30SEP04-1/1

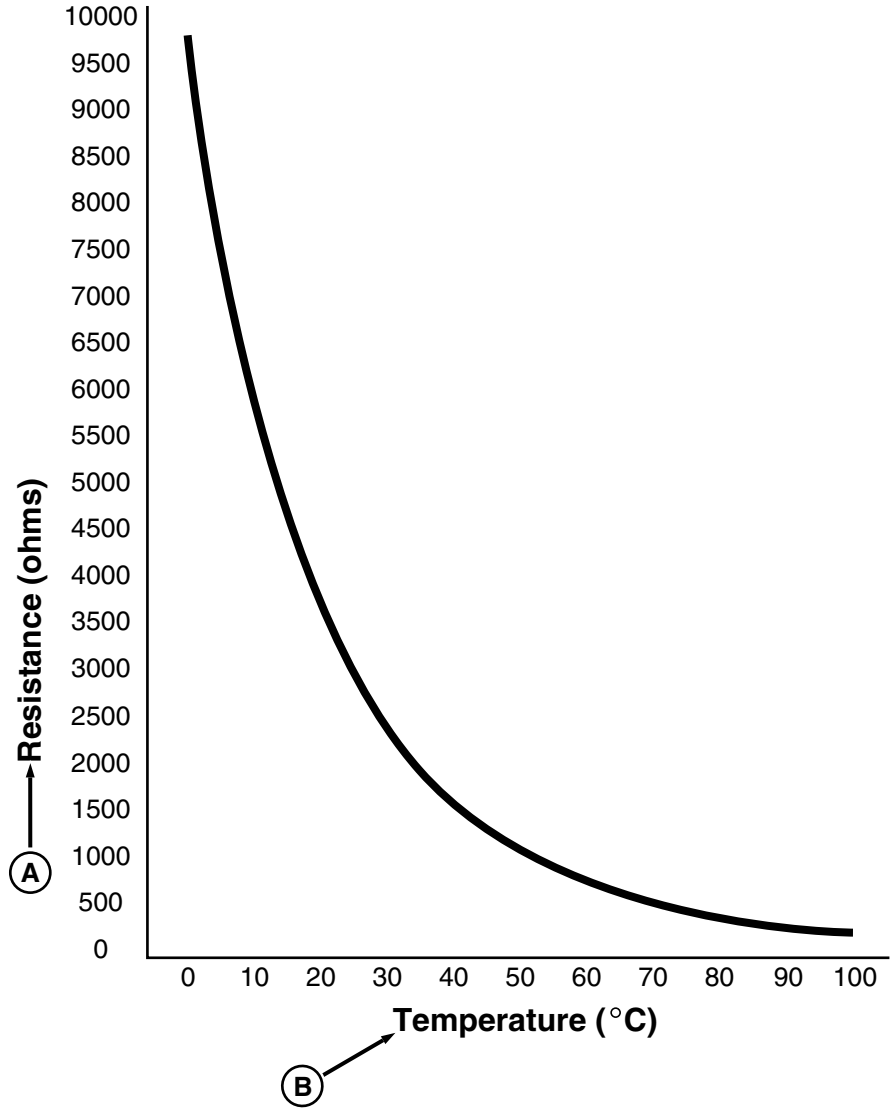
Coolant Temperature Sensor Characteristic Graph

MK41968,0000380 -19-16APR08-1/1

Fuel Temperature Sensor Characteristic Graph

MK41968,000002A -19-05OCT09-1/1

Manifold Air Temperature Sensor Characteristics



B TEMP (°C)	C TEMP (°F)	A RESISTANCE (OHMS)
0	32	9795
5	41	7616
10	50	5970
15	59	4712
20	68	3747
25	77	3000
30	86	2417
35	95	1959
40	104	1598
45	113	1311
50	122	1081
55	131	895.9
60	140	746.4
65	149	624.9
70	158	525.6
75	167	444.4
80	176	377.4
85	185	321.7
90	194	275.3
95	203	236.6
100	212	204.0

RG15347 —UN—28JUN07

A—Resistance (ohms)

B—Temperature (degrees Celsius)

C—Temperature (degrees Fahrenheit)

DM59778,00000A1 -19-19SEP07-1/1

OEM Engines Derate Specifications

NOTE: The option code for PEAK POWER LEVEL of an application is identified on the OEM Engine Option Code Label near the rocker arm cover. See Engine Power Rating and Speed Specifications in Group 06, Section 200 earlier in this manual for an explanation of the code.

Listed below are the parameters that the Engine Control Unit (ECU) uses to derate the engine.

Parameter	SPN-FMI	Value that Triggers Fault	Derate Limit (% Power or RPM)
Air Filter Restriction Switch. (Customer Trim Option)	000107.31	Air Filter Restriction Switch Active.	50%
Crankshaft Sensor Faults.	000637.02 000637.08 000637.10	Noise, Invalid Pattern, or Missing Pulse.	50%
Engine Control Unit (ECU) Temperature.	001136.00	135°C (275°F)	1200 rpm
Engine Coolant Level Switch. (Customer Trim Option)	000111.01	Engine Coolant Level Low Switch Active.	50%
Engine Coolant Temperature (ECT) For 2.4L. Peak Power Level Greater Than or Equal to 37kw (50hp).	000110.15	110°C (230°F)	0%
Engine Coolant Temperature (ECT) For 2.4L .Peak Power Less Than 37kw (50hp).	000110.15	113°C (235°F)	0%
Engine Coolant Temperature (ECT) For 3.0L. Peak Power Level Greater Than or Equal to 56kw (74hp).	000110.15	110°C (230°F)	0%
Engine Coolant Temperature (ECT) For 3.0L.Peak. Power Less Than 56kw (74hp).	000110.15	113°C (235°F)	0%
Engine Coolant Temperature (ECT) For 2.4L. Peak Power Level Greater Than or Equal to 37kw (50hp).	000110.16	111°C (232°F)	20%
Engine Coolant Temperature (ECT) For 2.4L .Peak Power Less Than 37kw (50hp)	000110.16	114°C (237°F)	20%
Engine Coolant Temperature (ECT) For 3.0L. Peak Power Level Greater Than or Equal to 56kw (74hp).	000110.16	111°C (232°F)	20%
Engine Coolant Temperature (ECT) For 3.0L.Peak. Power Less Than 56kw (74hp).	000110.16	114°C (237°F)	20%
Engine Coolant Temperature (ECT) For 2.4L. Peak Power Level Greater Than or Equal to 37kw (50hp)..	000110.00	113°C (235°F)	60%
Engine Coolant Temperature (ECT) For 2.4L.Peak Power Less Than 37kw (50hp).	000110.00	116°C (241°F)	60%
Engine Coolant Temperature (ECT) For 3.0L. Peak Power Level Greater Than or Equal to 56kw (74hp).	000110.00	113°C (235°F)	60%
Engine Coolant Temperature (ECT) For 3.0L.Peak. Power Less Than 56kw (74hp).	000110.00	116°C (241°F)	60%
Manifold Air Temperature (MAT).	000105.16	89.5°C (193°F)	20%
Manifold Air Temperature (MAT).	000105.00	91°C (196°F)	60%
Oil Pressure.	000100.18	Less than 1kPa (0.14psi) @870 rpm Less than 153Pa (22psi) @ 875 rpm Less than 230kPa (33psi) @2800 rpm	20%
Oil Pressure.	000100.01	Less than 1kPa (0.14psi) @870 rpm Less than 103Pa (15psi) @ 875 rpm Less than 180kPa (26psi) @2800 rpm	60%
Water-in-Fuel	000097.16	Water Detected.	50%

DM59778,0000094 -19-27SEP07-1/1

Glow Plug Specifications

NOTE: Preheat time has an additional 5 seconds after the indicator light turns off.

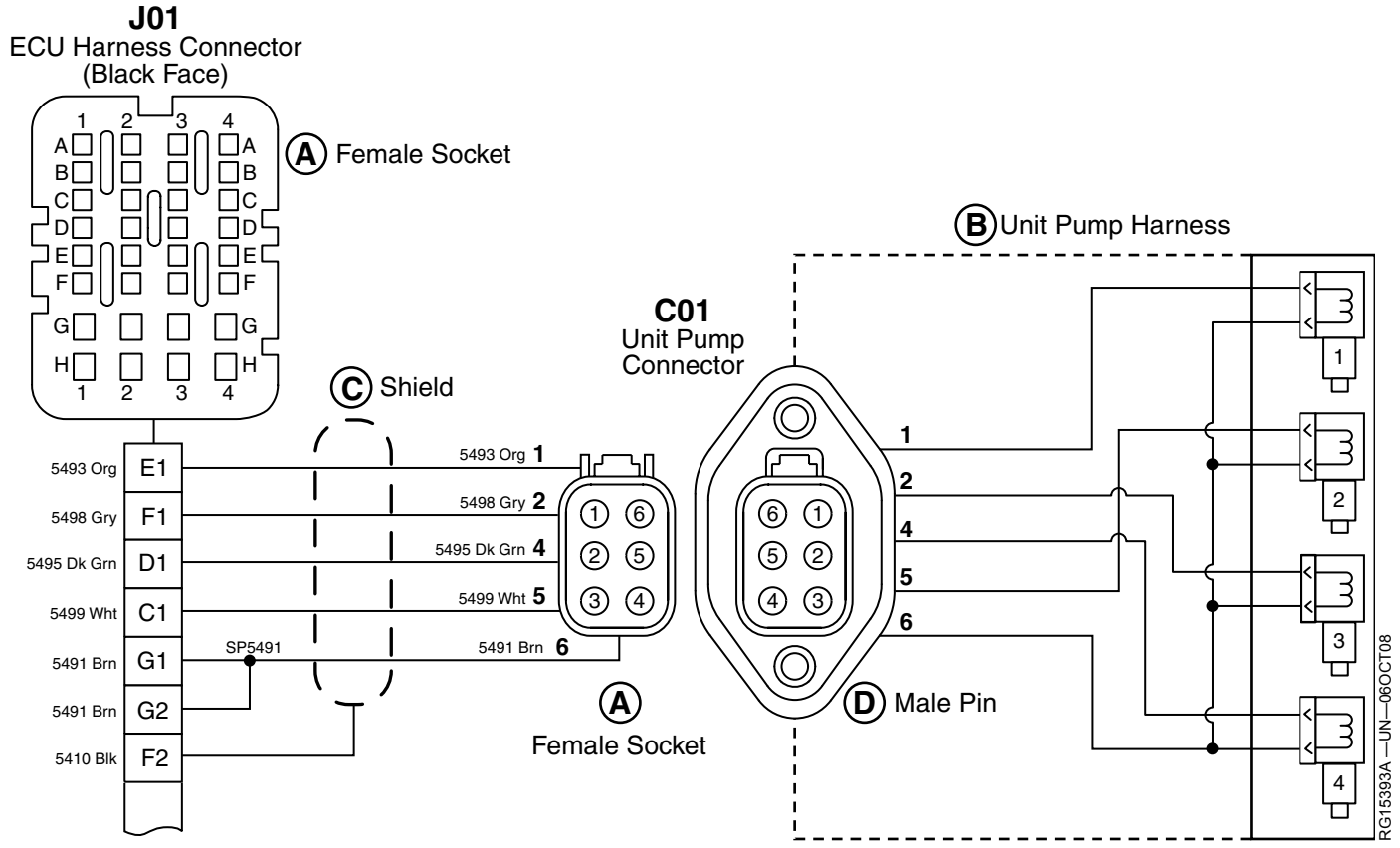
NOTE: If engine is started during preheat time, the glow plugs are turned off. Glow plugs are turned back on after engine reaches idle speed.

	-Glow Plug Operation - OEM	
Fuel Temperature	**Preheat Time**	**Reheat Time**
-20°C (-4°F)	15 seconds	10 seconds
-15°C (5°F)	15 seconds	10 seconds
-10°C (14°F)	10 seconds	10 seconds
-5°C (23°F)	5 seconds	10 seconds
0°C (32°F)	0 seconds	0 seconds

Glow Plug and Air Heater Operating Conditions - OEM

RG41183,000008B -19-19SEP07-1/1

2.4L ECU Wiring Diagram 1



2.4L 12/24 Volt ECU Wiring Diagram 1

A—Female Socket
B—Unit Pump Harness
C—Shield
D—Male Pin

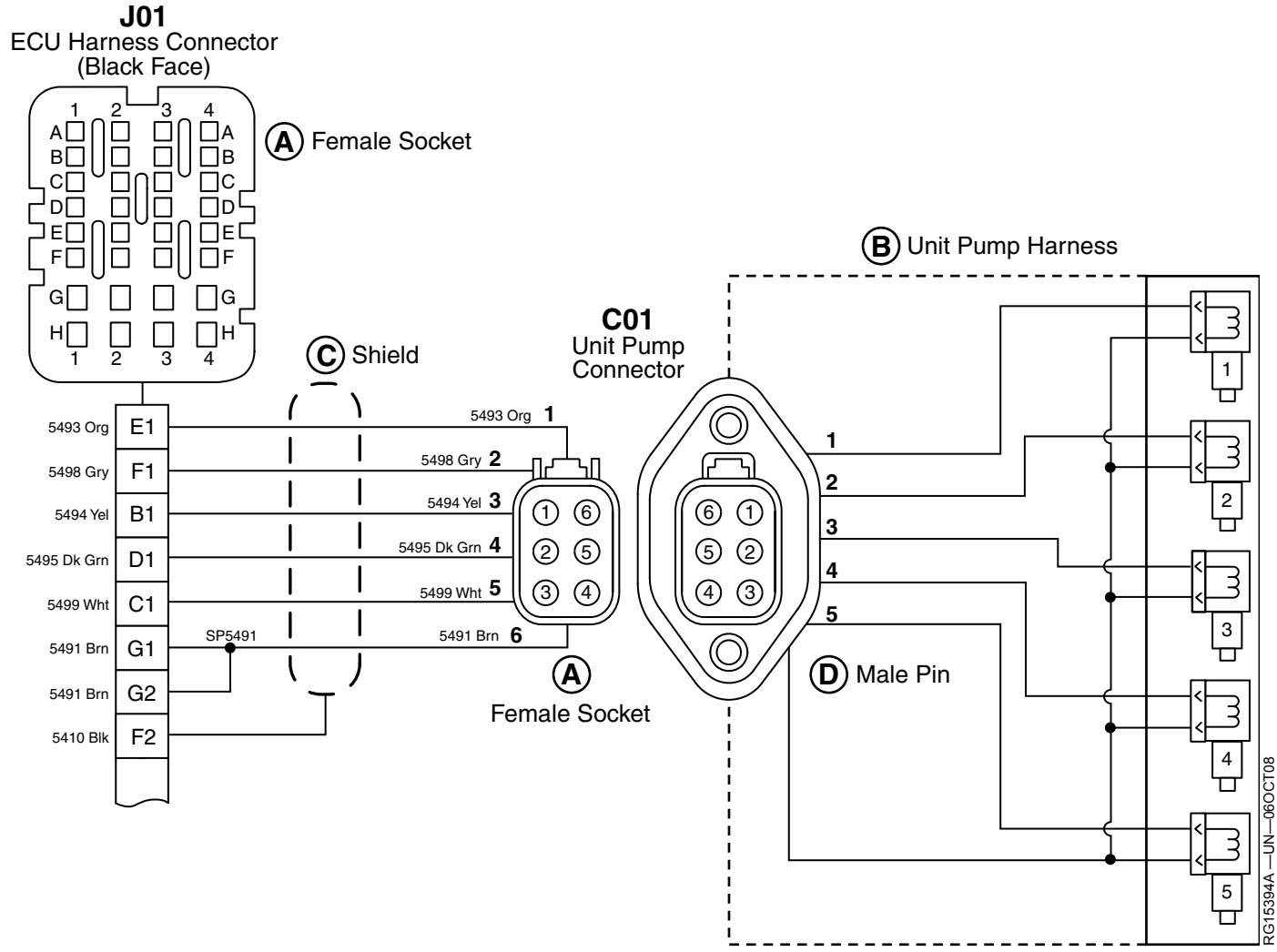
C01— Unit Pump Connector
J01— ECU Harness Connector (Black Face)
J01-C1—[5499 White] Unit Pump #2 Inject Pulse
J01-D1—[5495 Dark Green] Unit Pump #4 Inject Pulse

J01-E1—[5493 Orange] Unit Pump #1 Inject Pulse
J01-F1—[5498 Gray] Unit Pump #3 Inject Pulse
J01-F2—[5410 Black] Wiring Shield
J01-G1—[5491A White] Unit Pump Power

J01-G2—[5491B White] Unit Pump Power

DM59778,000008B -19-06OCT08-1/1

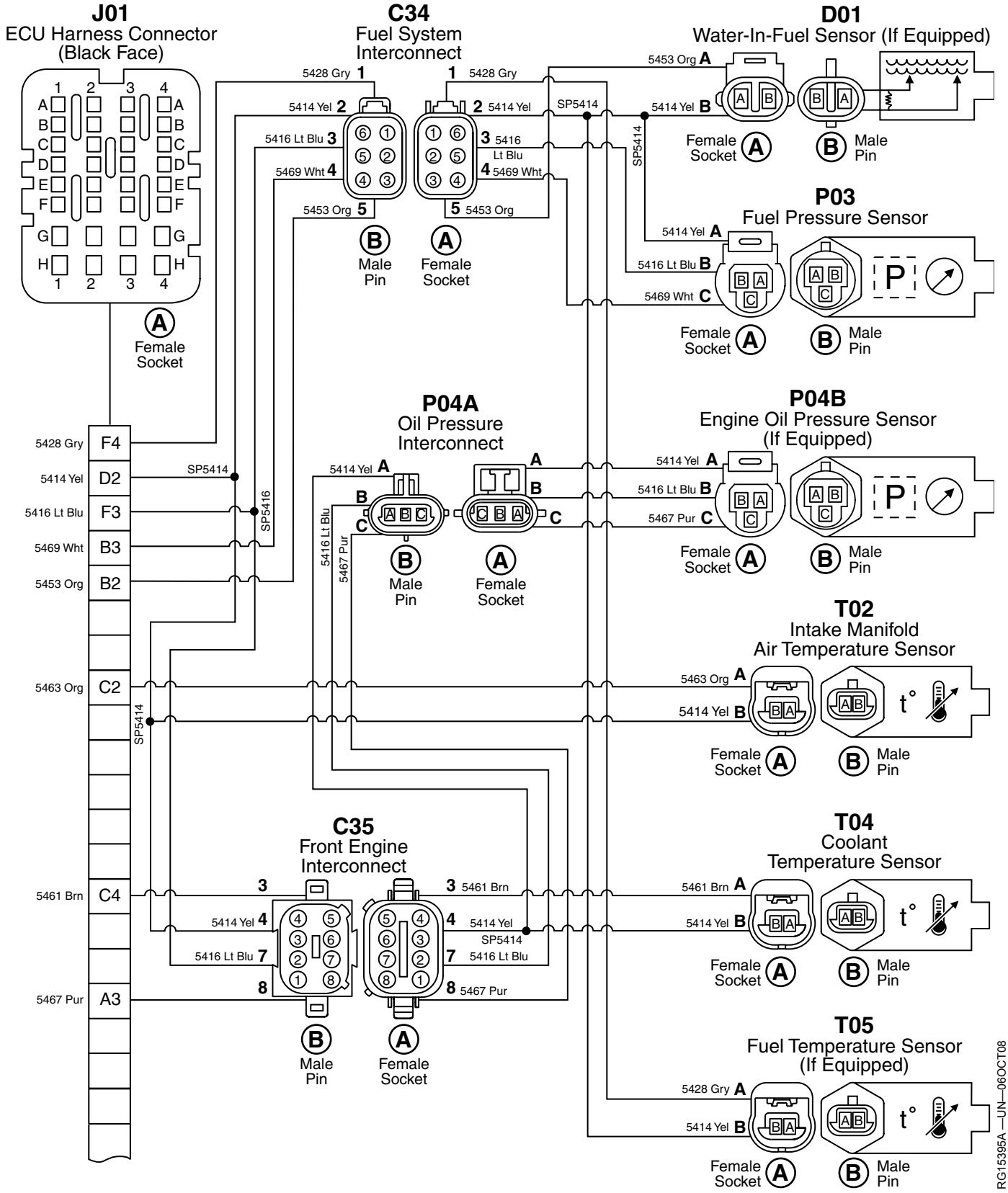
3.0L ECU Wiring Diagram 2



A—Female Socket
B—Unit Pump Harness
C—Shield
D—Male Pin
C01— Unit Pump Connector
J01— ECU Harness Connector (Black Face)
J01-B1—[5494 Yellow] Unit Pump #3 Inject Pulse
J01-C1—[5499 White] Unit Pump #5 Inject Pulse
J01-D1—[5495 Dark Green] Unit Pump #4 Inject Pulse
J01-E1—[5493 Orange] Unit Pump #1 Inject Pulse
J01-F1—[5498 Gray] Unit Pump #2 Inject Pulse
J01-F2—[5410 Black] Wiring Shield
J01-G1—[5491A White] Unit Pump Power
J01-G2—[5491B White] Unit Pump Power

DM59778,000008C -19-06OCT08-1/1

2.4L-3.0L ECU Wiring Diagram 3



2.4L-3.0L 12/24 Volt ECU Wiring Diagram 3

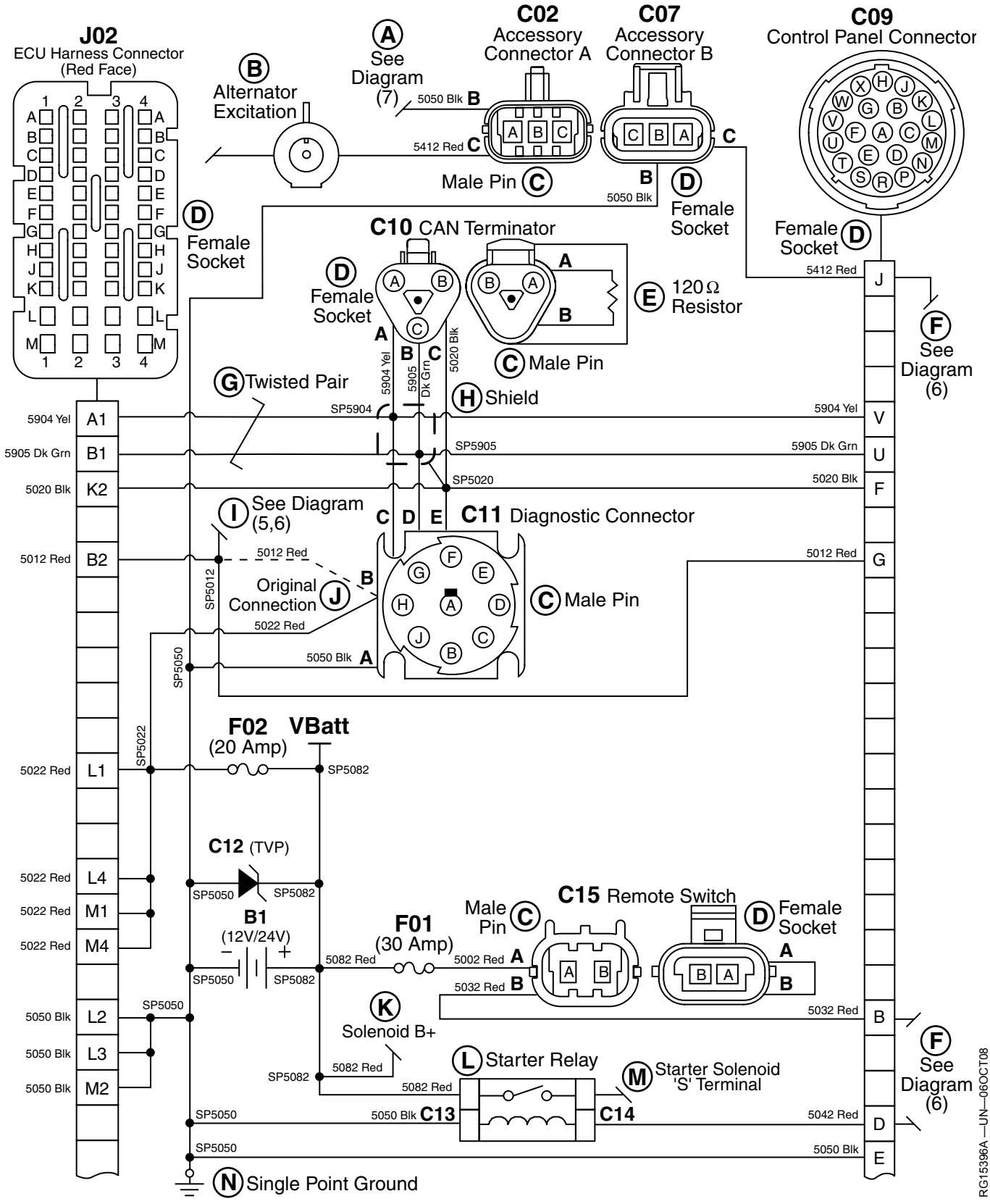
Continued on next page

DM59778,000008D -19-13NOV09-1/2

A—Female Socket
B—Male Pin
C34— Fuel System Interconnect
C35— Front Engine Interconnect
D01— Water-In-Fuel Sensor (Optional)
J01— ECU Harness Connector (Black Face)
J01-A3—[5467 Purple] Engine Oil Pressure Signal
J01-B2—[5453 Orange] Water In Fuel Signal
J01-B3—[5569 White] Fuel Pressure Signal
J01-C2—[5463 Orange] Intake Manifold Air Temperature Signal
J01-C4—[5461 Brown] Coolant Temperature Signal
J01-D2—[5414A Yellow] 5 Volt Power Supply #2A Return
J01-F3—[5416A Light Blue] 5 Volt Power Supply #2A Positive
J01-F4—[5428 Gray] Fuel Temperature Signal
P03— Fuel Pressure Sensor
P04A— Oil Pressure Interconnect
P04B— Oil Pressure Sensor (Optional)
T02— Intake Manifold Air Temperature Sensor
T04— Coolant Temperature Sensor
T05— Fuel Temperature Sensor (Optional)

DM59778,000008D -19-13NOV09-2/2

2.4L/3.0L ECU Wiring Diagram 4



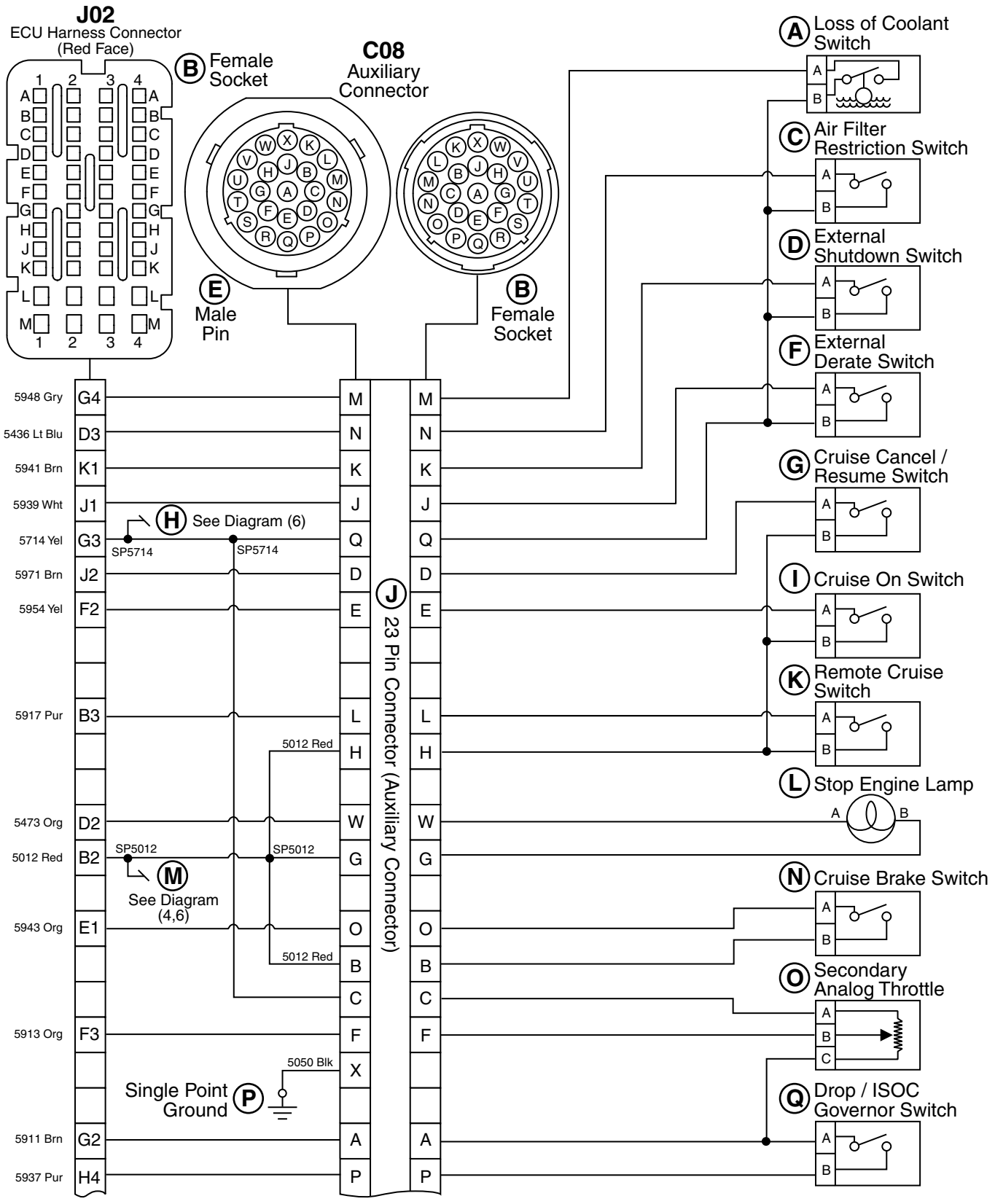
2.4L-3.0L 12/24 Volt ECU Wiring Diagram 4

Continued on next page

A—See Diagram (7)
B—Alternator Excitation
C—Male Pin
D—Female Socket
E—120 Ω Resister
F—See Diagram (6)
G—Twisted Pair
H—Shield
I— See Diagram (5,6)
J— Original Connection. See Instruction for Update
K—Solenoid B+
L—Starter Relay
M—Starter Solenoid 'S' Terminal
N—Single Point Ground
B1—12V/24V
C02— Accessory Connector A
C06— Alternator Excitation Connector
C07— Accessory Connector B
C09— Control Panel Connector
C10— CAN Terminator
C11— Diagnostic Connector
C12— Transient Voltage Protection (TVP)
C13— Starter Relay Coil Return
C14— Starter Relay Coil Control
C15— Remote Switch
F01— 30 Amp
F02— 20 Amp
J02— ECU Harness Connector (Red Face)
J02-A1—[5904A Yellow] CAN High
J02-B1—[5905A Dark Green] CAN Low
J02-B2—[5012A Red] Ignition Key Start/Run Switch
J02-K2—[5020A Black] CAN Shield
J02-L1—[5022A Red] Battery Positive
J02-L2—[5050A Black] Battery Negative
J02-L3—[5050B Black] Battery Negative
J02-L4—[5022B Red] Battery Positive
J02-M1—[5022C Red] Battery Positive
J02-M2—[5050C Black] Battery Negative
J02-M4—[5022D Red] Battery Positive
VBatt—Battery Positive

DM59778,000008E -19-06OCT08-2/2

2.4L-3.0L ECU Wiring Diagram 5



2.4L-3.0L 12/24 Volt ECU Wiring Diagram 5

Continued on next page

DM59778,000008F -19-13NOV09-1/2

A—Loss of Coolant Switch
B—Air Filter Restriction Switch
C—External Shutdown Switch
D—Female Socket
E—Male Pin
F—External Derate Switch
G—Cruise Cancel/Resume Switch
H—See Diagram (6)
I— Cruise On Switch
J— 23 Pin Connector (Auxiliary Connector)
K—Remote Cruise Switch
L—Stop Engine Lamp
M—See Diagram (4,6)
N—Cruise Brake Switch
O—Secondary Analog Throttle
P—Single Point Ground
Q—Droop/Isoc (Isochronous) Governor Switch
C08— Auxiliary Connector
J02— ECU Harness Connector (Red Face)
J02-B2—[5012A Red] Ignition Key Start/Run Switch
J02-B3—[5917 Purple] Remote Cruise On/Off Switch
J02-D2—[5473 Orange] Stop Engine Lamp Return
J02-D3—[5436 Light Blue] Air Filter Restriction Switch
J02-E1—[5943 Orange] Cruise Brake Switch
J02-F2—[5954 Yellow] Cruise On/Off Switch
J02-F3—[5913 Orange] Secondary Analog Throttle Signal
J02-G2—[5911 Brown] 5 Volt Power Supply #2B Positive
J02-G3—[5714A Yellow] 5 Volt Power Supply #2B Return
J02-G4—[5948 Gray] Low Coolant Level Switch
J02-H4—[5937 Purple] Droop/Isochronous Governor Switch
J02-J1—[5939 White] External Derate Switch
J02-J2—[5971 Brown] Cruise Cancel/Resume Switch
J02-K1—[5941 Brown] External Shutdown Switch

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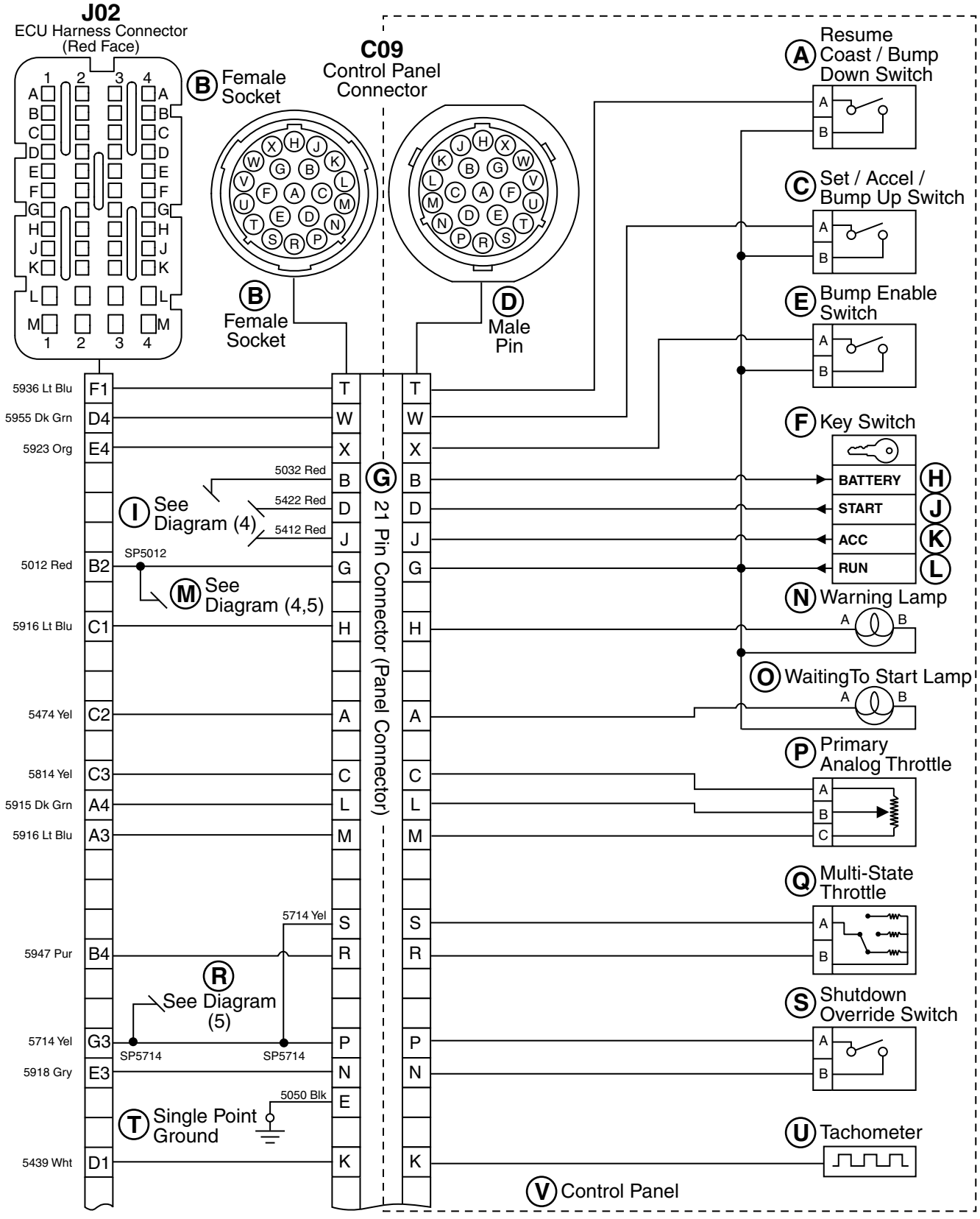
2.4L-3.0L ECU Wiring Diagram 6



2.4L-3.0L 12/24 Volt ECU Wiring Diagram 6

Continued on next page

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A—Resume Coast/Bump Down Switch
B—Set Accel/Bump Up Switch
C—Female Socket
D—Male Pin
E—Bump Enable Switch
F—Key Switch
G—21 Pin Connector (Panel Connector)
H—Battery
I— See Diagram (4)
J—Start
K—Accessory
L—Run
M—See Diagram (4,5)
N—Warning Lamp
O—Wait to Start Lamp
P—Primary Analog Throttle
Q—Multi-State Throttle
R—See Diagram (5)
S—Shutdown Override Switch
T—Single Point Ground
U—Tachometer
V—Control Panel
C09— Control Panel Connector
J02— ECU Harness Connector (Red Face)
J02-A3—[5616 Light Blue] 5 Volt Power Supply #1B Positive
J02-A4—[5915 Dark Green] Primary Analog Throttle Signal
J02-B2—[5012A Red] Ignition Key Start/Run Switch
J02-B4—[5947 Purple] Mulit-state Throttle Signal
J02-C1—[5916 Light Blue] Warning Lamp Drive Return
J02-C2—[5474 Yellow] Wait To Start Lamp Drive Return
J02-C3—[5814 Yellow] 5 Volt Power Supply #1B Return
J02-D1—[5439 White] Tachometer Pulse Output
J02-D4—[5955 Dark green] Set/Accel/Bump Up Switch
J02-E3—[5913 Orange] Secondary Analog Throttle Signal
J02-E4—[5923 Orange] Bump Enable Switch
J02-F1—[5936 Light Blue] Resume Coast/Bump Down Switch
J02-G3—[5714A Yellow] 5 Volt Power Supply #2B Return

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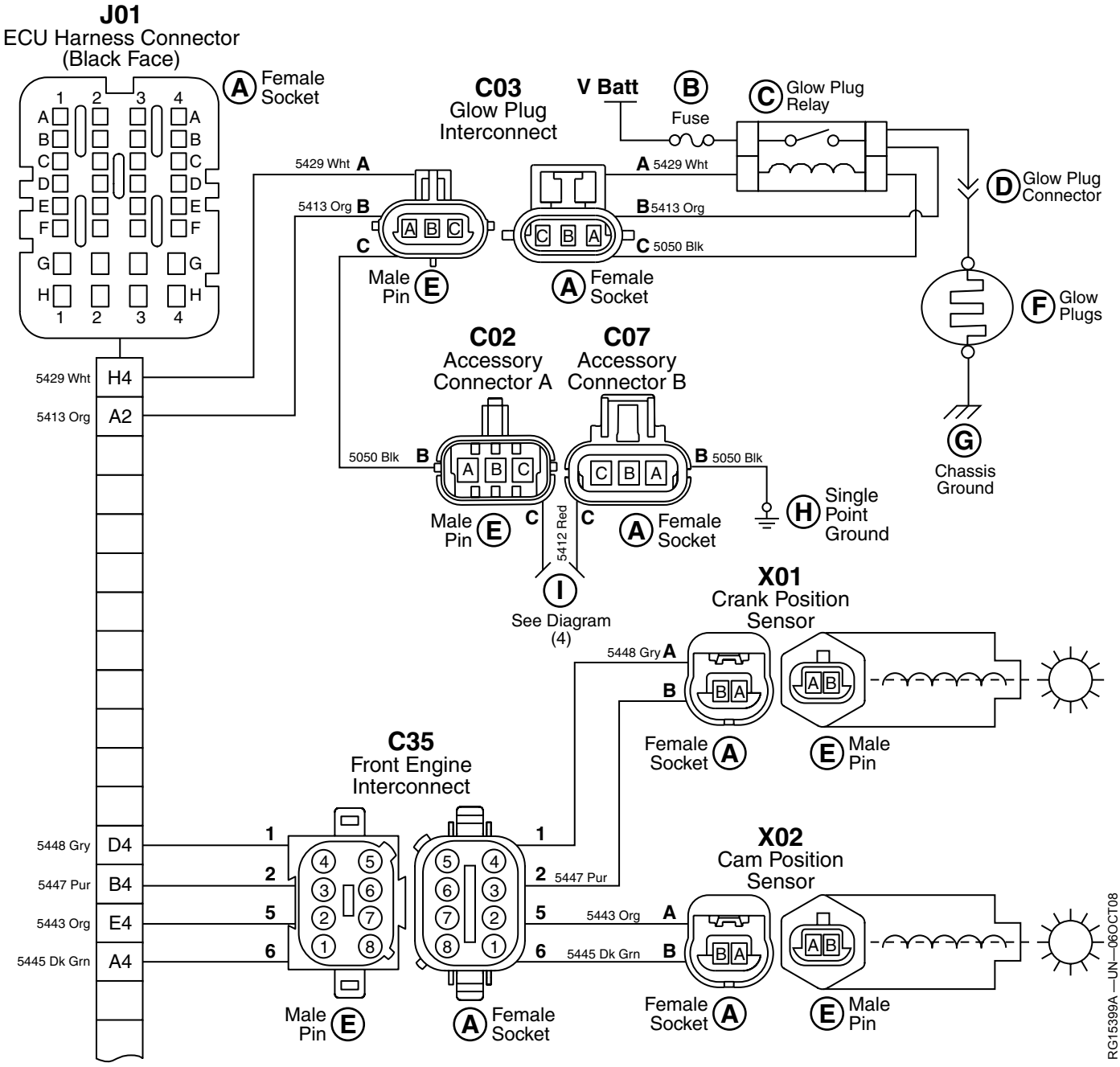
2.4L-3.0L ECU Wiring Diagram 7



2.4L-3.0L 12/24 Volt ECU Wiring Diagram 7

A—Female Socket
B—Fuse
C—Glow Plug Relay
D—Glow Plug Connector
E—Male Pin
F—Glow Plugs
G—Chassis Ground
H—Single Point Ground
I— See Diagram (4)
C02— Accessory Connector A
C03— Glow Plug Interconnect
C07— Accessory Connector B
C35— Front Engine Interconnect
J01— ECU Harness Connector (Black Face)
J01-A2—[5413 Orange] Glow Plug Relay Status
J01-A4—[5445 Dark Green] Camshaft Position Pulse
J01-B4—[5447 Purple] Crankshaft Position Pulse
J01-D4—[5448 Gray] Crankshaft Position Return
J01-E4—[5443 Orange] Camshaft Position Return
J01-H4—[5429 White] Glow Plug Relay Control
X01— Crankshaft Position Sensor
X02— Camshaft Position Sensor

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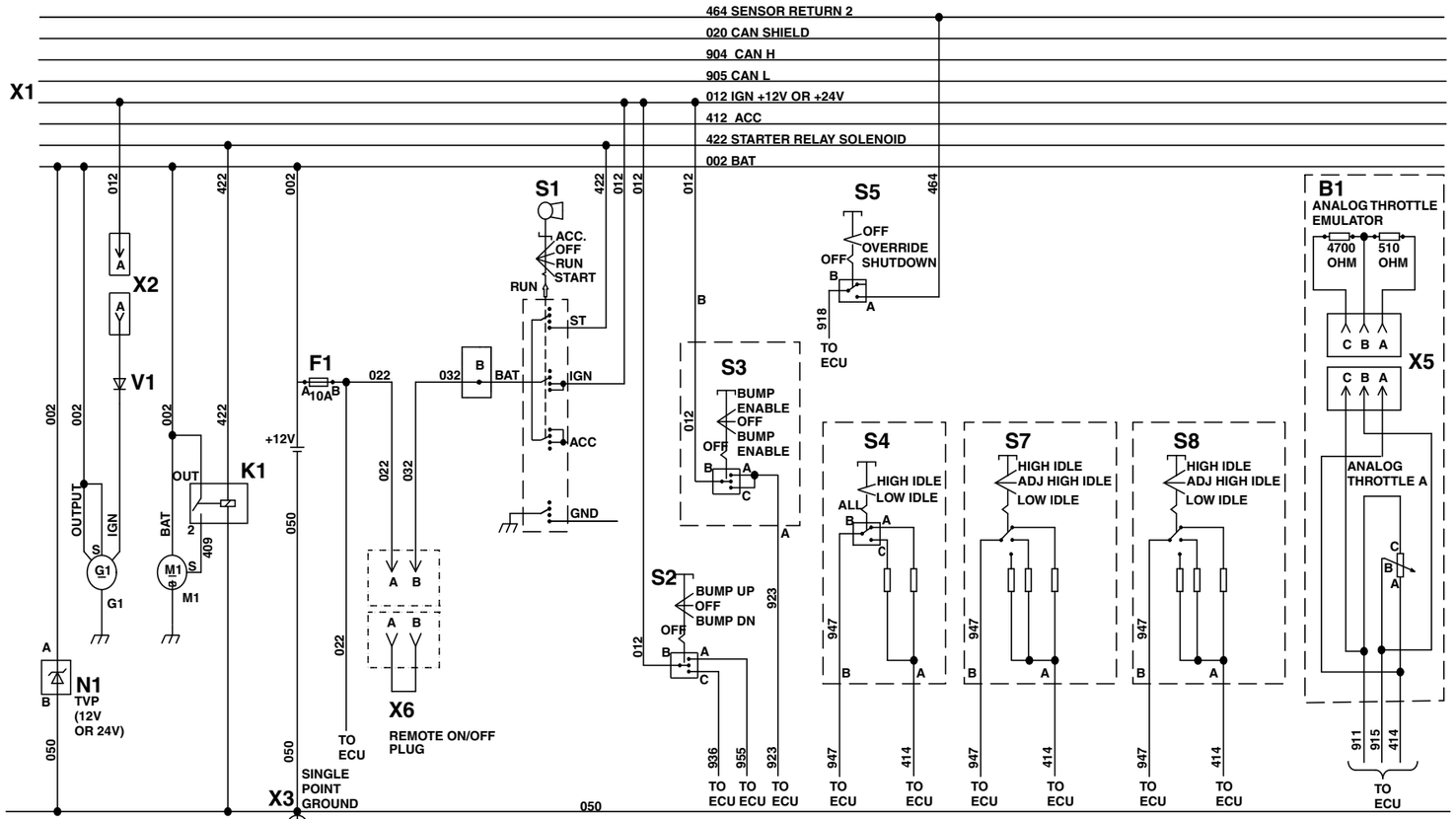
OEM Engine-Instrument Panel Components Wiring Diagram

RG20545 —UN—06JUN11



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B1—Analog Throttle Emulator
F1—Fuse (10 Amp)
F2—Fuse (5 Amp)
G1—Alternator
K1—Starter Relay
M1—Starter Motor
N1—Transient Voltage Protector
N2—Voltage Regulator (for 24V Operation)
S1—Ignition Key Switch
S2—Speed Select Switch (Momentary)
S3—Bump Enable Switch (Momentary
S4—Dual State Throttle Switch
S5—Override Shutdown Switch (Momentary)
S6—Dimmer Control or Jumper Plug
S7—Tri-state Throttle Switch
S8—Ramp Throttle Switch
V1—Diode
X1—Vehicle Harness Connector
X2—Alternator Harness Connector
X3—Single Point Ground
X4—CAN Terminator
X5—Analog Throttle Connector
X6—Remote On/Off Plug

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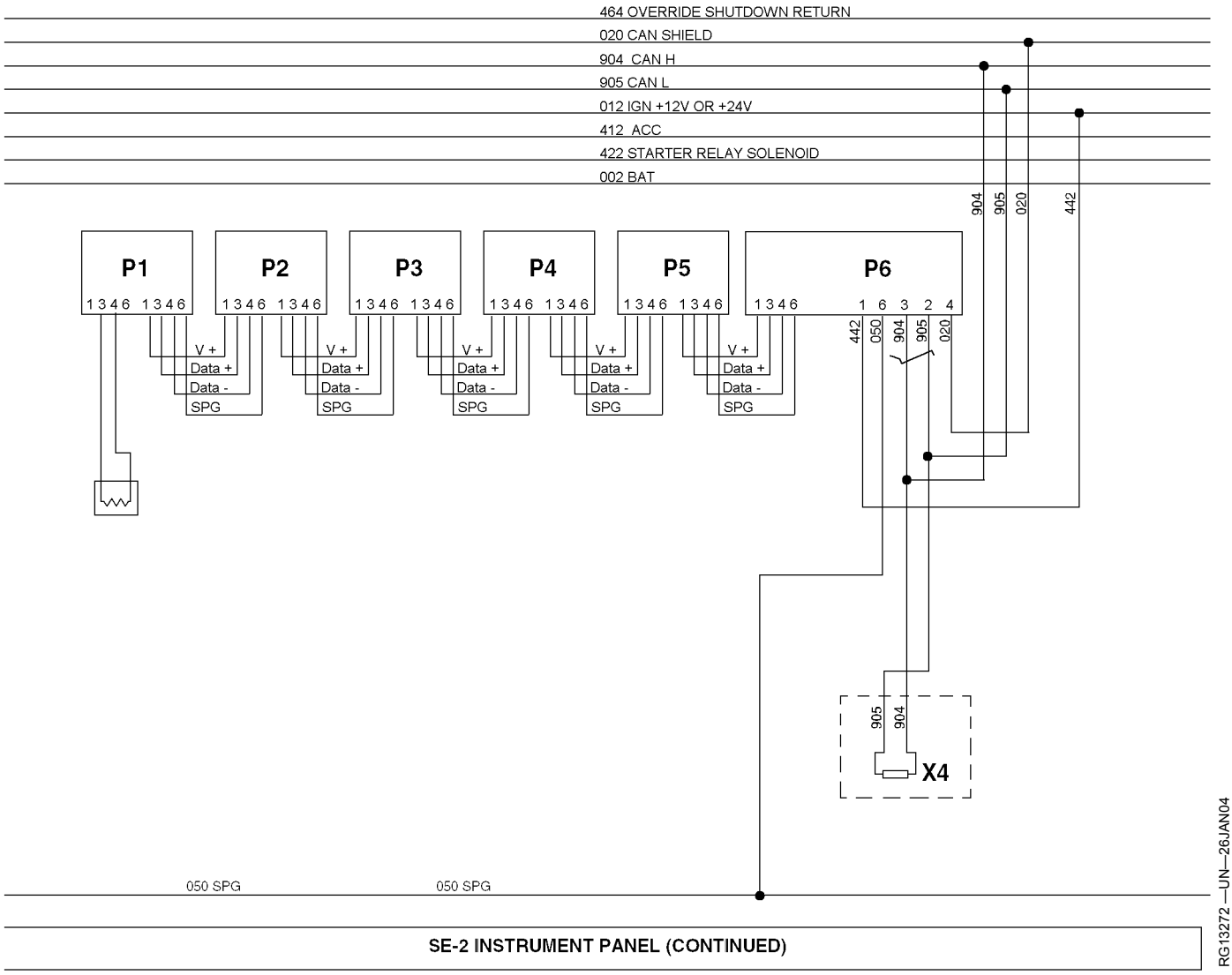
OEM Engine-Instruments Panel/Engine Start Components Wiring Diagram (Cont)



SE-2 INSTRUMENT PANEL (CONTINUED)

OEM Instrument Panel Wiring Diagram

P1—Optional Gauge
P2—Optional Gauge
P3—Oil Pressure Gauge
P4—Coolant Temperature Gauge
P5—Tachometer Display
P6—Hourmeter/Diagnostic Meter
X4—CAN Terminator

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