JOHN DEERE

# COMPONENT TECHNICAL MANUAL

## PowerTech® 4.5 & 6.8 L Diesel Engines Level 4 Electronic Fuel System

CTM170 14MAY03 (English)

TP-6288 5/03

# POWERTECH® 4.5L & 6.8L Diesel Engines

# Level 4 Electronic Fuel Systems With Bosch VP44 Pump

## TECHNICAL MANUAL

## POWERTECH® 4.5 & 6.8 L Diesel Engines Level 4 Electronic Fuel System

**14MAY03 (ENGLISH)**

**For complete service information also see:**




**John Deere Power Systems**

LITHO IN U.S.A.

# Introduction

## Forward

This manual (CTM 170) is written for an experienced technician. Essential tools required in performing certain service work are identified in this manual and are recommended for use.

This manual covers only Level 4 Electronic Fuel Systems with the Bosch VP44 injection pump. It is one of five volumes on 4.5 L and 6.8 L engines. The following four companion manuals cover the base engine and mechanical fuel system repair, operation and diagnostics:

- CTM104—Base Engine
- CTM207—Mechanical Fuel Systems
- CTM220—Level 11 Electronic Fuel System with Denso High Pressure Common Rail
- CTM331—Level 12 electronic Fuel System with DE10 Pump

Other manuals will be added in the future to provide additional information on electronic fuel systems as needed.

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.

Use this component technical manual in conjunction with the machine technical manual. An application listing in Section 01, Group 001 identifies product-model/component type-model relationship. See the machine technical manual for information on component removal and installation, and gaining access to the components.

Information is organized in sections and groups for the various components requiring service instruction. At the beginning of each group are summary listings of all applicable essential tools, service equipment and tools, other materials needed to do the job, service parts kits, specifications, wear tolerances, and torque values.

Before beginning repair on an engine, clean the engine.

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.

Some components of this engine may be serviced without removing the engine from the machine. Refer to the specific machine technical manual for information on components that can be serviced without removing the engine from the machine and for engine removal and installation procedures.

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 engine model number you are working on. If only one procedure is given, that procedure applies to all the engines in the manual.

**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.**

DPSG,OUO1004,2760 –19–17JUL01–1/1

# Contents





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

# Section 01
# General

## Contents

## 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

*Avoid Fires*

DX,FLAME –19–29SEP98–1/1

## 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

## 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

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## 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

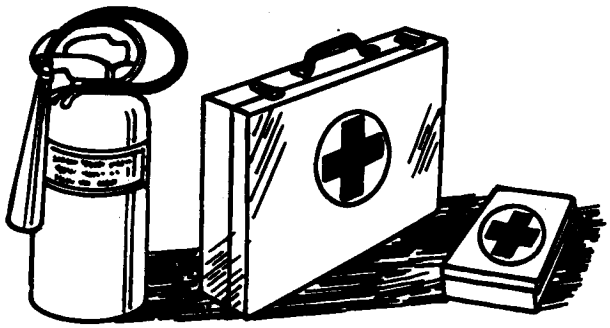
DX,SPARKS –19–03MAR93–1/1

## 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

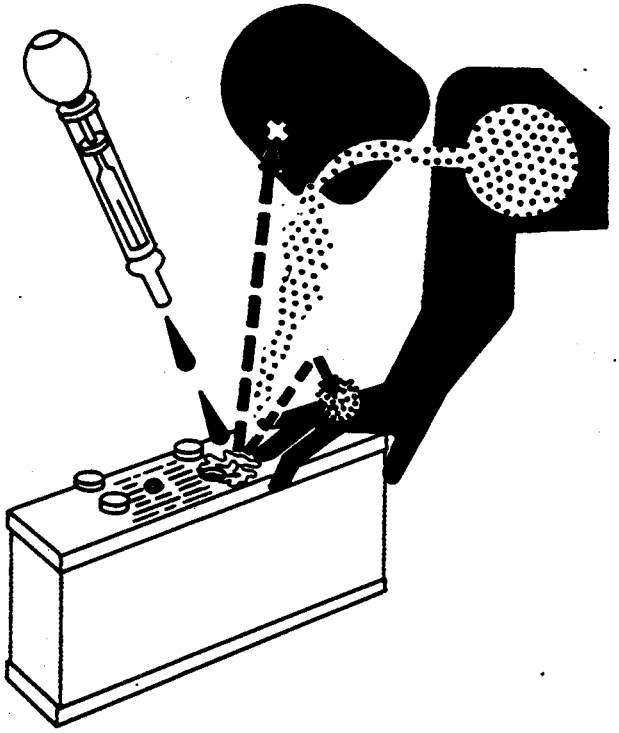
## Handling Batteries Safely

TS204 –UN–23AUG88

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

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

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



TS203 –UN–23AUG88

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

**Avoid the hazard by:**

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

**If you spill acid on yourself:**

1. **Flush your skin with water.**
2. **Apply baking soda or lime to help neutralize the acid.**
3. **Flush your eyes with water for 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.**

**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.**

DPSG,OUO1004,2758 –19–11MAY00–1/1

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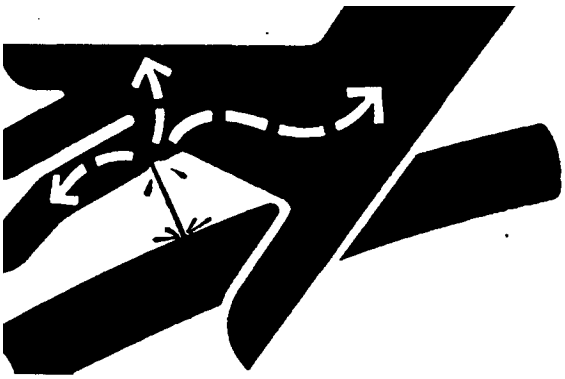
## Avoid High-Pressure Fluids

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

*High-Pressure Fluids*

DX,FLUID –19–03MAR93–1/1

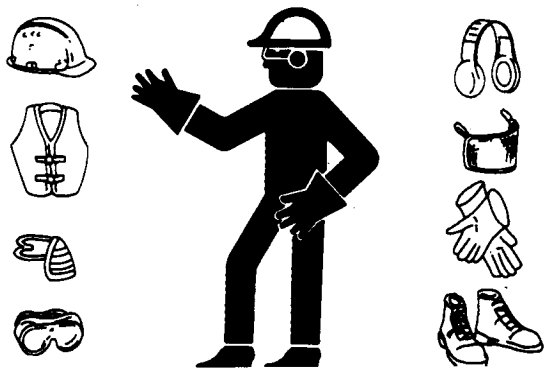
## Wear Protective Clothing

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

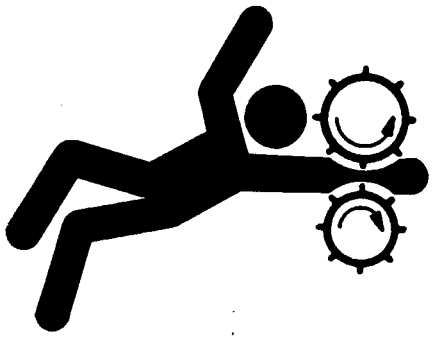
*Protective Clothing*

DX,WEAR –19–10SEP90–1/1

## Service Machines Safely

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

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



TS228 –UN–23AUG88

*Moving Parts*

DX,LOOSE –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

*Engine Exhaust Fumes*

DX,AIR –19–17FEB99–1/1

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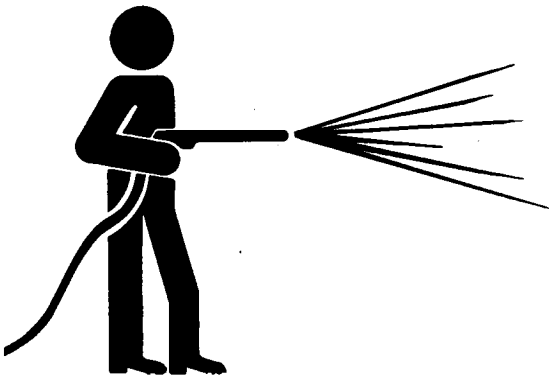
## Work in Clean Area

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

*Clean Work Area*

DX,CLEAN –19–04JUN90–1/1

## Remove Paint Before Welding or Heating

Avoid potentially toxic fumes and dust.

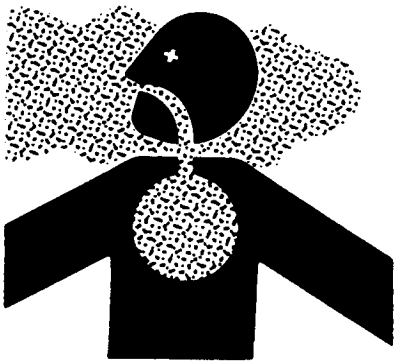
Hazardous fumes can be generated when paint is heated by welding, soldering, or using a torch.

Remove paint before heating:

- Remove paint a minimum of 76 mm (3 in.) from area to be affected by heating.
- 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 all work in an area that is ventilated to carry toxic fumes and dust away.

Dispose of paint and solvent properly.



TS220 –UN–23AUG88

DX,PAINT –19–22OCT99–1/1

## 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 be accidentally cut when heat goes beyond the immediate flame area.

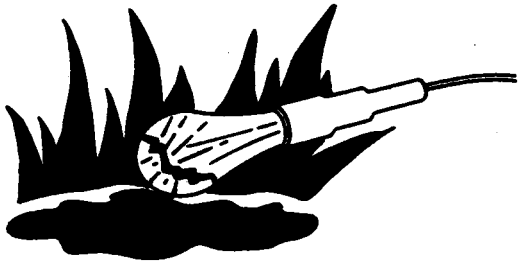
TS953 –UN–15MAY90

*Flammable Spray*

DX,TORCH –19–03MAR93–1/1

## Illuminate Work Area Safely

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



TS223 –UN–23AUG88

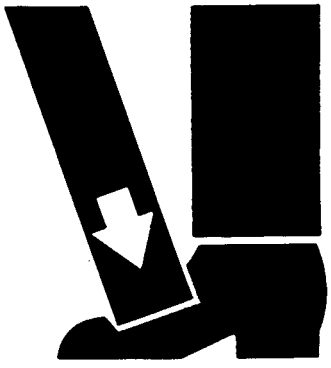
*Illuminate Work Area Safely*

DX,LIGHT –19–04JUN90–1/1

## 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

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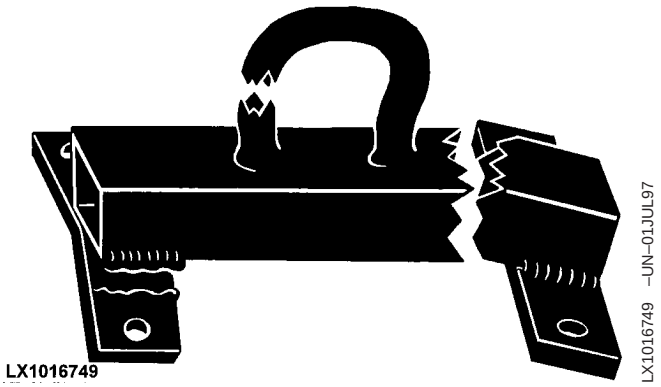
## Construct Dealer-Made Tools Safely

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.




*Construct Dealer-Made Tools Safely*

DPSG,OUO1004,899 –19–19MAY99–1/1

## 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.


*Keep Area Clean*

DX,SERV –19–17FEB99–1/1

## 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

*Use Proper Tools*

DX,REPAIR –19–17FEB99–1/1

## Dispose of Waste Properly

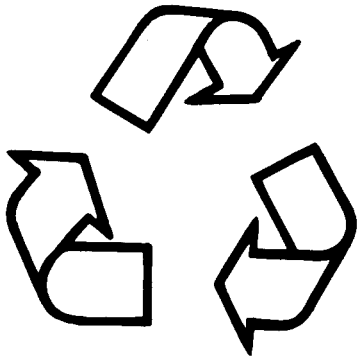
Improperly disposing of waste can threaten the environment and ecology. Potentially harmful waste used with John Deere equipment include such items as oil, fuel, coolant, brake fluid, filters, and batteries.

Use leakproof containers when draining fluids. Do not use food or beverage containers that may mislead someone into drinking from them.

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

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

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



TS1133 –UN–26NOV90

*Recycle Waste*

DX,DRAIN –19–03MAR93–1/1

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## 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

*Safety Systems*

DX,LIVE –19–25SEP92–1/1

## Engine Model Designation

John Deere Engine Model—4045 and 6068 Engines

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

| | |
|---|---|
| **4045TF150 Engine** | |
| 4 ..... | Number of cylinders |
| 4.5 ..... | Liter displacement |
| T ..... | Aspiration code |
| F ..... | User code |
| 1 ..... | Internal engine configuration type |
| 50 ..... | *POWERTECH*® application code |
| **Aspiration Code** | |
| D ..... | Naturally aspirated |
| T ..... | Turbocharged (No aftercooling) |
| A ..... | Turbocharged and Air-to-Coolant Aftercooled |
| H ..... | Turbocharged and Air-to-Air Aftercooled |
| **User Factory Code** | |
| AP ..... | Saltillo (Mexico) |
| CQ ..... | S.L.C. Horizontina (Brazil) |
| DW ..... | John Deere Davenport Works |
| E ..... | John Deere Ottumwa Works |
| F ..... | OEM (Outside Equipment Manufacturers) |
| FF ..... | Kernersville Deere-Hitachi (North Carolina) |
| FG ..... | Goldoni (Italy) |
| FM ..... | Marine Engines |
| H ..... | John Deere Harvester Works |
| KV ..... | John Deere Knoxville (Tennessee) |
| L ..... | John Deere Werke Mannheim (Germany) |
| LA ..... | John Deere Werke Mannheim (Germany) (Engines with Bosch VP44 Injection Pump) |
| LV ..... | John Deere Augusta, Georgia |
| N ..... | John Deere Des Moines Works |
| P ..... | Saltillo/Monterrey (Mexico) |
| RW ..... | John Deere Waterloo Tractor Works |
| T ..... | John Deere Dubuque Works |
| T8 ..... | Cameco (Deere) (Louisiana) |
| YC ..... | John Deere Jialian Harvester Co. Limited (China) |
| Z ..... | John Deere WERKE Zweibrucken (Germany) |
| **Model Designation** | |
| 1 or 2 ..... | Indicates different internal engine components |
| **Application Code** | |
| 50 or above ..... | *POWERTECH*® code for specific application |

## Engine Serial Number Plate Information

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

### 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:

**T04045T000000**

| | |
|---|---|
| T0 ..... | Factory producing engine |
| 4045T ..... | Engine model designation |
| 000000 ..... | Sequential serial number |

**Factory Code (Engine Manufacturer)**

| | |
|---|---|
| T0 ..... | Dubuque, Iowa |
| CD ..... | Saran, France |
| PE ..... | Torreon, Mexico |

**Engine Model Designation**

| | |
|---|---|
| 4045T ..... | Definition explained previously. (See ENGINE MODEL DESIGNATION earlier in this group. |

**Sequential Number**

| | |
|---|---|
| 000000 ..... | 6-digit sequential serial number |

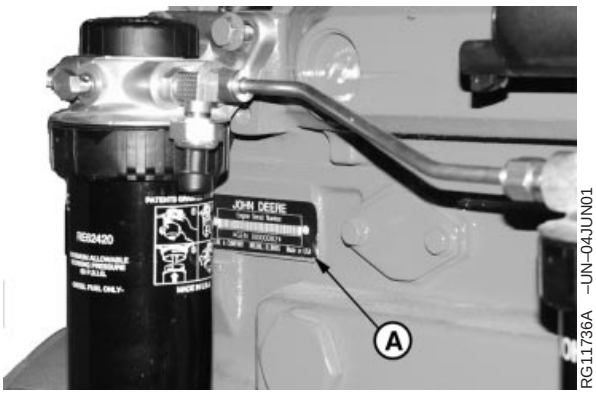
### Engine Application Data (C)

The second line of information on the serial number plate identifies the engine/machine or OEM relationship. See ENGINE APPLICATION CHART later in this group.

### Coefficient of Absorption (D) — (Saran-Built Engines Only)

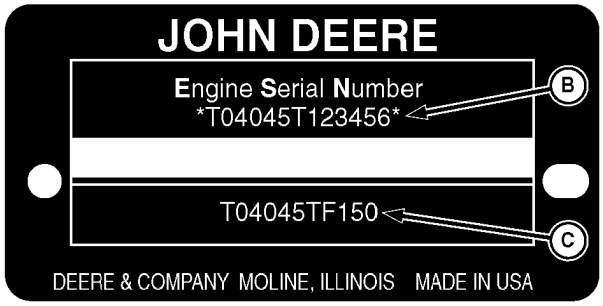
The second line of information on Saran serial number plate also contains the coefficient of absorption value for smoke emissions.

**A—Engine Serial Number Plate**
**B—Engine Serial Number**
**C—Engine Application Data**
**D—Coefficient of Absorption (Saran Engines Only)**



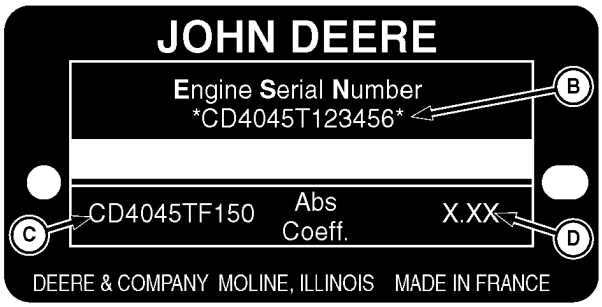

RG11736A –UN–04JUN01

*Engine Serial Number Plate*



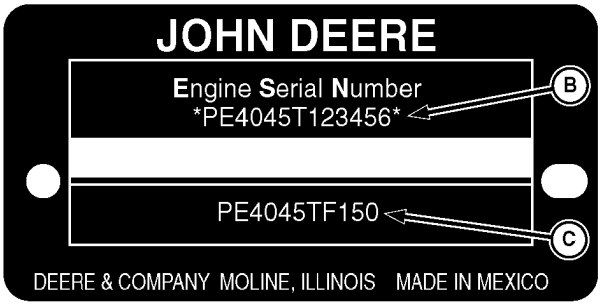

RG9060 –UN–16MAR98

*Dubuque Engine Serial Number Plate*




RG9061 –UN–16MAR98

*Saran Engine Serial Number Plate*




RG9062 –UN–16MAR98

*Torreon Engine Serial Number Plate*

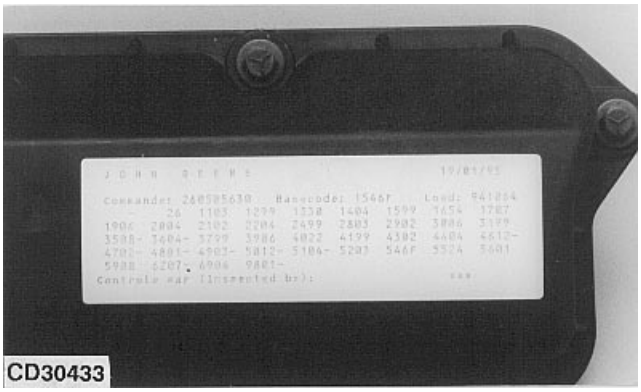
RG,01,DT7029 –19–09MAY01–1/1

## OEM Engine Option Code Label

An option code label is secured to the top of the valve cover and identifies the factory installed options on each OEM engine to ensure correct parts acquisition.

Always provide option code information and engine base code 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. It is recommended to record this information in the spaces provided in the Operation and Maintenance Manual.*




CD30433 –UN–10MAY95

DPSG,OUO1004,482 –19–13AUG01–1/1

## Engine Application Chart

| JOHN DEERE AGRICULTURAL EQUIPMENT | | |
|---|---|---|
| **Machine Model** | **Emission Level** | **Engine Model** |
| **Waterloo - TRACTORS** | | |
| 7320 Tractor | Tier 1 | CD6068HRW01 |
| 7420 Tractor | Tier 1 | CD6068HRW01 |
| 7520 Tractor | Tier 1 | CD6068HRW01 |
| | | |
| **MANNHEIM - TRACTORS** | | |
| 6310 Tractor | Tier 1 | CD4045TLA50 |
| 6410 Tractor | Tier 1 | CD4045TLA51 |
| 6510 Tractor | Tier 1 | |
| 6610 Tractor | Tier 1 | CD6068TLA50 |
| 6810 Tractor | Tier 1 | CD6068TLA51 |
| 6910 Tractor | Tier 1 | CD6068TLA52 |
| 6910S Tractor, Boost) | Tier 1 | CD6068TLA53 |
| 6320 (North America) Tractor | Tier 1 | CD4045HLA71 |
| 6320 Tractor | Tier 1 | CD4045HLA70 |
| 6420 (North America) Tractor | Tier 1 | CD4045HLA72 |
| 6420 Tractor | Tier 1 | CD4045HLA72 |
| 6420S Boost Tractor | Tier 1 | CD4045HLA73 |
| 6620 Tractor | Tier 1 | CD6068HLA70 |
| 6820 Tractor | Tier 1 | CD6068HLA71 |
| 6920 Tractor | Tier 1 | CD6068HLA72 |
| 6920S Boost Tractor | Tier 1 | CD6068HLA73 |
| | | |
| **ZWEIBRUCKEN - COMBINES/TELESCOPIC HANDLERS** | | |
| 9540 Combine | Tier 2 | CD6068HZ060 |
| 9540 HM Combine | Tier 2 | CD6068HZ060 |
| 3800 Telescopic Handler | Tier 1 | CD4045HZ050 |
| | | |
| **HORIZONTINA - COMBINES** | | |
| 1450 CWS Combine | Tier 2 | CD6068HCQ60 |
| 1550 CWS Combine | Tier 2 | CD6068HCQ61 |

| JOHN DEERE CONSTRUCTION EQUIPMENT | | |
|---|---|---|
| **Machine Model** | **Emission Level** | **Engine Model** |
| **DEERE-HITACHI - KERNERSVILLE** | | |
| 200 LC Excavator | Tier 2 | PE6068HT053 |
| 230 LC Excavator | Tier 2 | PE6068HT054 |
| | | |
| **HITACHI - JAPAN** | | |
| 270 LC Excavator | Tier 2 | PE6068HT055 |

| JOHN DEERE OEM (OUTSIDE EQUIPMENT MANUFACTURERS) | | |
|---|---|---|
| **Machine Model** | **Emission Level** | **Engine Model** |
| **OEM** | | |
| OEM | Tier 2 | PE6068HF275 |
| Marine | Tier 2 | T06068SFM50 |
| Marine | Tier 2 | PE6068SFM50 |
| Marine | Tier 2 | CD6068SFM50 |

RG41221,0000134 –19–17OCT02–1/1

## Tier 1 vs. Tier 2

The fuel transfer pump is located on the final fuel filter header on Tier 1 applications and primary fuel filter on Tier 2 applications. Some Tier 2 applications use a remote mounted fuel transfer pump. For more information on Tier 1 vs. Tier 2 applications, see ENGINE APPLICATION CHART in Group 001 earlier in this manual. The transfer pump is electrically controlled by the Electronic Control Unit (ECU).

All Tier 1 engines are equipped with a fuel pressure sensor on the final fuel filter. Some Tier 2 engines use a fuel pressure sensor and some do not.

Tier 1 engines may be equipped with a primary fuel filter/water separator. All Tier 2 engines will have both a primary and final fuel filter.

Tier 1 engines may be equipped with either a 30 micron or 150 micron primary filter. All Tier 2 engines have a 30 micron primary filter.

All engines are equipped with a round final fuel filter.

All engines use 9.5 mm pencil-type nozzles.

Fuel system options include fuel heater and water separator bowl.

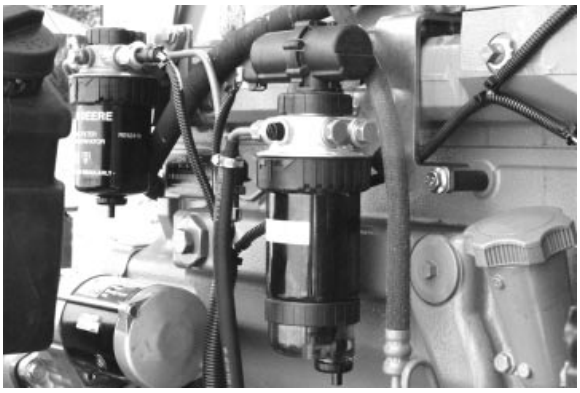
**IMPORTANT: The Bosch VP44 Injection Pump is electronically controlled. All connectors on the pump and the engine control unit (ECU) must be disconnected before any welding is accomplished on the engine, or damage to the electrical system is likely to occur.**


RG11745 –UN–22JUN01

*Tier 1 - Final Fuel Filter*


RG11720 –UN–20JUN01

*Tier 2 - Final Fuel filter*



RG11746 –UN–22JUN01

*Tier 2 - Primary Fuel Filter*

RG41221,0000204 –19–22MAY01–1/1

## Lubricants and Coolant

*NOTE: For information on lubricants and coolants, refer to Section 01, Group 002 of CTM104 Base Engine Manual for information on lubricants and coolants.*

DPSG,OUO1004,2761 –19–16MAY00–1/1

## Diesel Fuel - Tier 1

*NOTE: For information on Tier 1 vs. Tier 2 applications, see ENGINE APPLICATION CHART in Group 001 earlier in this manual.*

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.

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

- **Cetane Number of 40 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)** below the expected low temperature OR Cloud Point at least 5°C (9°F) below the expected low temperature.
- **Fuel Lubricity** should pass a minimum of 3100 gram load level as measured by the BOCLE scuffing test.
- **Sulfur Content**
  - Sulfur content should not exceed 0.5%. Sulfur content less than 0.05% is preferred.
  - If diesel fuel with sulfur content greater than 0.5% is used, reduce the service interval for engine oil and filter by 50%.
  - DO NOT use diesel fuel with sulfur content greater than 1.0%.

Bio-diesel fuels with properties meeting DIN 51606 or equivalent specification may be used.

DO NOT mix used engine oil or any other type of lubricant with diesel fuel.

RG,02,DT7324 –19–17OCT02–1/1

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## Diesel Fuel - Tier 2

*NOTE: For information on Tier 1 vs. Tier 2 applications, see ENGINE APPLICATION CHART in Group 001 earlier in this manual.*

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.

**Required fuel properties**

In all cases, the fuel must 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) below the expected low temperature OR **Cloud Point** at least 5°C (9°F) below the expected low temperature.

**Fuel lubricity** should pass a minimum load level of 3100 grams as measured by ASTM D6078 or, maximum scar diameter of 0.45 mm as measured by ASTM D6079.

**Sulfur content:**

- Diesel fuel quality and fuel sulfur content must comply with all existing regulations for the area in which the engine operates.
- Sulfur content less than 0.05% (500 ppm) is preferred.
- If diesel fuel with sulfur content greater than 0.05% (500 ppm) is used, crankcase oil service intervals may be affected. (See recommendation for Diesel Engine Oil.)
- DO NOT use diesel fuel with sulfur content greater than 1.0%.

**IMPORTANT: DO NOT mix used engine oil or any other type of lubricating oil with diesel fuel.**

RG41221,0000085 –19–23OCT02–1/1

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## Bio-Diesel Fuel

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

Bio-diesel fuels may be used ONLY if the bio-diesel fuel properties meet the latest edition of ASTM PS121, DIN 51606 or equivalent specification.

It has been found that bio-diesel fuels may improve lubricity in concentrations up to a 5% blend in petroleum diesel fuel.

When using a blend of bio-diesel fuel, the engine oil level must be checked daily when the air temperature is -10°C (14°F) or lower. If the oil becomes diluted with fuel, shorten oil change intervals accordingly.

**IMPORTANT: Raw pressed vegetable oils are NOT acceptable for use for fuel in any concentration in John Deere engines.**

**These oils do not burn completely, and will cause engine failure by leaving deposits on injectors and in the combustion chamber.**

A major environmental benefit of bio-diesel fuel is its ability to biodegrade. This makes proper storage and handling of bio-diesel fuel especially important. Areas of concern include:

- Quality of new fuel
- Water content of the fuel
- Problems due to aging of the fuel

Potential problems resulting from deficiencies in the above areas when using bio-diesel fuel in concentrations above 5% may lead to the following symptoms:

- Power loss and deterioration of performance
- Fuel leakage
- Corrosion of fuel injection equipment
- Coked and/or blocked injector nozzles, resulting in engine misfire
- Filter plugging
- Lacquering and/or seizure of internal components
- Sludge and sediments
- Reduced service life of engine components

RG41183,0000046 –19–15NOV01–1/1

## Dieselscan Fuel Analysis

DIESELSCAN™ is a John Deere fuel sampling program to help you monitor the quality of your fuel source. It verifies fuel type, cleanliness, water content, suitability for cold weather operation, and if fuel is within ASTM specifications. Check with your John Deere dealer for availability of DIESELSCAN kits.

*DIESELSCAN is a trademark of Deere & Company*

DX,FUEL6 –19–06DEC00–1/1

## Lubricity of Diesel Fuel

Diesel fuel must have adequate lubricity to ensure proper operation and durability of fuel injection system components.

Diesel fuels for highway use in the United States, Canada, and the European Union require sulfur content less than 0.05%.

Experience shows that some low sulfur diesel fuels may have inadequate lubricity and their use may reduce performance in fuel injection systems due to inadequate lubrication of injection pump components. The lower concentration of aromatic compounds in these fuels also adversely affects injection pump seals and may result in leaks.

Use of low lubricity diesel fuels may also cause accelerated wear, injection nozzle erosion or corrosion, engine speed instability, hard starting, low power, and engine smoke.

Fuel lubricity should pass a minimum of 3100 gram load level as measured by the BOCLE scuffing test.

ASTM D975 and EN 590 specifications do not require fuels to pass a fuel lubricity test.

If fuel of low or unknown lubricity is used, add John Deere PREMIUM DIESEL FUEL CONDITIONER (or equivalent) at the specified concentration.

DX,FUEL5 –19–17FEB99–1/1

# Section 02
# Repair and Adjustments

## Contents

## Fuel System—General Information

For static lock-pin timing of the Bosch VP44 Injection Pump, see BOSCH VP44 INJECTION PUMP STATIC TIMING in this Group.

The fuel transfer pump is located on the final fuel filter header on Tier 1 applications and primary fuel filter, or remote mounted on Tier 2 applications. For more information on Tier 1 vs. Tier 2 applications, see ENGINE APPLICATION CHART in Group 001 earlier in this manual. The transfer pump is electrically controlled by the Electronic Control Unit (ECU).

Tier 1 engines may be equipped with a primary fuel filter/water separator. All Tier 2 engines will have both a primary and final fuel filter.

All engines are equipped with a round final fuel filter.

All engines use 9.5 mm pencil-type nozzles.

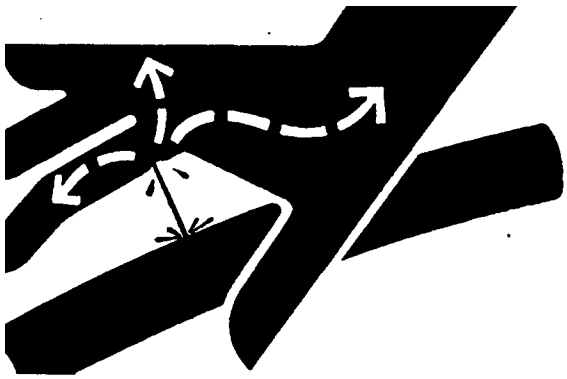
Fuel system options include fuel heater and water separator bowl.

**IMPORTANT: The Bosch VP44 Injection Pump is electronically controlled. All connectors on the pump and the engine control unit (ECU) must be disconnected before any welding is accomplished on the engine, or damage to the electrical system is likely to occur.**



DPSG,OUO1004,2639 –19–09MAY01–1/1

## Relieve Fuel System Pressure



X9811 –UN–23AUG88



**CAUTION: Escaping diesel fuel under pressure can have sufficient force to penetrate the skin, causing serious injury. Before disconnecting lines, be sure to relieve pressure. Before applying pressure to the system, be sure ALL connections are tight and lines, pipes and hoses are not damaged. Keep hands and body away from pinholes and nozzles which eject fluid under pressure. Use a piece of cardboard or wood, rather than hands, to search for suspected leaks.**

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

Any time the fuel system has been opened up for service (lines disconnected or filters removed), it will be necessary to bleed air from the system. See BLEED THE FUEL SYSTEM in Group 150 later in this manual.

RG,35,JW7625 –19–20NOV97–1/1

## Remove and Install Primary Fuel Filter/Water Separator Base - Tier 2

*NOTE: For information on Tier 1 vs. Tier 2 applications, see ENGINE APPLICATION CHART in Group 001 earlier in this manual.*

The primary fuel filter may be equipped with a water separator bowl.

The electronic fuel transfer pump is mounted on top of the filter head.

1. Thoroughly clean primary fuel filter/water separator assembly and surrounding area to keep from getting dirt and debris into fuel system.
2. Connect a fuel line to filter drain (if equipped) on bottom of filter and drain all fuel from the system.
3. Remove primary fuel filter element.

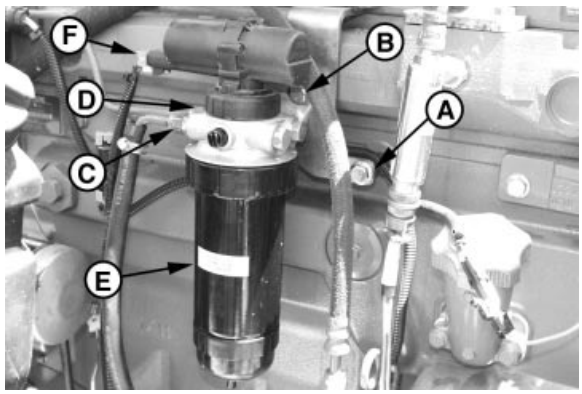
*NOTE: Fuel lines may be connected to different inlet and outlet ports depending on engine application.*

4. Disconnect fuel lines from fuel inlet (C) and fuel outlet (D).
5. Disconnect fuel transfer pump connector (F).
6. Remove filter base cap screws (B) and primary fuel filter base.

*NOTE: Mounting bracket does not need to be removed.*

7. Replace parts as necessary.
8. If removed, install mounting bracket on engine. Install filter base on mounting bracket. Tighten cap screws to specification.

| Specification | |
|---|---|
| Primary Fuel Filter Mounting Bracket-to-Cylinder Head Cap Screws—Torque | 74 N•m (54.5 lb-ft) |
| Primary Fuel Filter Base-to-Bracket Cap Screws—Torque | 60 N•m (44 lb-ft) |




*Primary Fuel Filter - Tier 2*

**A—Filter Bracket to Engine Mounting Cap Screws**
**B—Filter Base to Bracket Mounting Cap Screws**
**C—Fuel Inlet Line (From Fuel Tank)**
**D—Fuel Outlet (To Final Fuel Filter)**
**E—Primary Fuel Filter**
**F—Fuel Transfer Pump Connector**

Continued on next page

9. Install water separator and primary fuel filter element. See REPLACE FINAL FUEL FILTER ELEMENT later in this Group.

10. Connect fuel lines to fuel inlet (C) and fuel outlet (D) and tighten to specification.



| Specification | |
|---|---|
| Primary Fuel Filter Inlet Line— | |
| Torque | 30 N•m (22 lb-ft) |
| Primary Fuel Filter Outlet Line— | |
| Torque | 30 N•m (22 lb-ft) |

11. Reconnect fuel transfer pump electrical connector.

12. Bleed the fuel system. See BLEED THE FUEL SYSTEM in Group 150 later in this manual.

RG41221,00000FB –19–17OCT02–2/2

## Remove and Install Final Fuel Filter/Water Separator Base - Tier 1

*NOTE: For information on Tier 1 vs. Tier 2 applications, see ENGINE APPLICATION CHART in Group 001 earlier in this manual.*

Final fuel filter may be equipped with a water separator bowl.

The electronic fuel transfer pump is mounted on top of the filter header.

1. Thoroughly clean fuel filter/water separator assembly and surrounding area to keep from getting dirt and debris into fuel system.

2. Connect a fuel line to filter drain on bottom of filter and drain all fuel from system.

3. Remove final fuel filter element. See REPLACE FINAL FUEL FILTER ELEMENT, later in this Group.

*NOTE: Fuel lines may be connected to different filter inlet and outlet ports depending on engine application.*

4. Disconnect fuel lines from fuel inlet (B), overflow valve (E), and fuel outlet (F).

5. Disconnect fuel transfer pump connector (G) and fuel pressure sensor connector (C) (both shown disconnected).

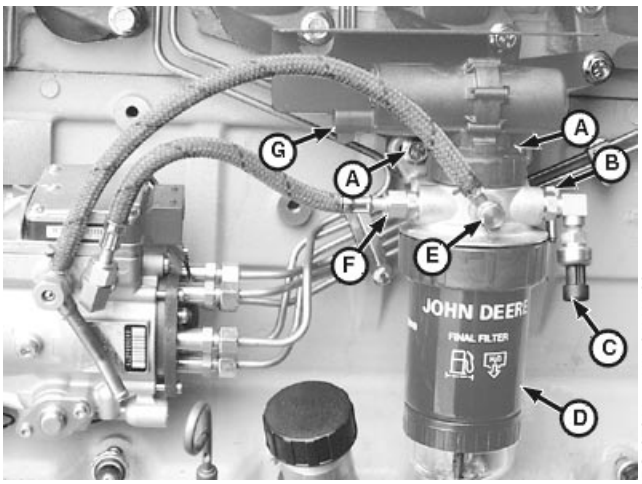
6. Remove cap screws (A) and final fuel filter base.

*NOTE: Mounting bracket does not need to be removed.*

7. Replace parts as necessary.

8. If removed, install filter mounting bracket on engine. Install filter base on mounting bracket. Tighten cap screws to specifications.

| Specification | |
|---|---|
| Final Fuel Filter Mounting Bracket-to-Exhaust Manifold—Torque | 70 N•m (52 lb-ft) |
| Final Fuel Filter Base-to-Bracket Cap Screws—Torque | 70 N•m (52 lb-ft) |




*Final Fuel Filter - Tier 1*

**A—Filter Base Mounting Cap Screws**
**B—Fuel Inlet Line (From Prefilter)**
**C—Fuel Pressure Sensor Connector**
**D—Final Fuel Filter**
**E—Fuel Overflow Line (To Injection Pump Overflow Valve)**
**F—Fuel Outlet Line (To Injection Pump Inlet)**
**G—Fuel Transfer Pump Connector**

**Continued on next page**

9. Install water separator and fuel filter element. See REPLACE FINAL FUEL FILTER ELEMENT later in this Group.

10. Connect fuel lines to fuel inlet (B), overflow valve (E), and fuel outlet (F) and tighten to specification.



| Specification | |
|---|---|
| Final Fuel Filter Inlet Line— Torque | 30 N•m (22 lb-ft) |
| Final Fuel Filter Outlet Line— Torque | 30 N•m (22 lb-ft) |

11. Reconnect fuel transfer pump and fuel pressure sensor electrical connectors.

12. Bleed the fuel system. See BLEED THE FUEL SYSTEM in Group 150 later in this manual.

RG41221,0000105 –19–17OCT02–2/2

## Remove and Install Final Fuel Filter/Water Separator Base - Tier 2

*NOTE: For information on Tier 1 vs. Tier 2 applications, see ENGINE APPLICATION CHART in Group 001 earlier in this manual.*

Final fuel filter may be equipped with a water separator bowl.

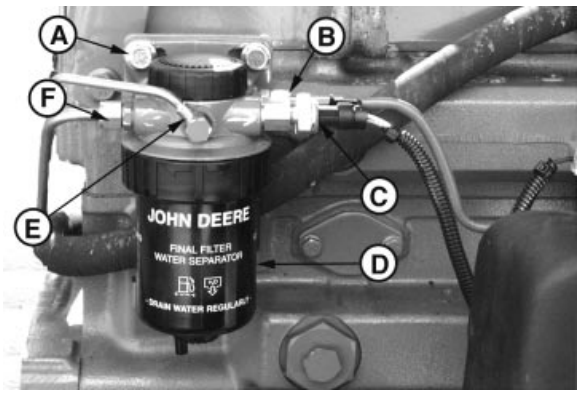
1. Thoroughly clean fuel filter/water separator assembly and surrounding area to keep from getting dirt and debris into fuel system.
2. Connect a fuel line to filter drain and drain all fuel from system.
3. Remove final fuel filter element. See REPLACE FINAL FUEL FILTER ELEMENT later in this Group.

*NOTE: Fuel lines may be connected to different filter inlet and outlet ports depending on engine application.*

4. Disconnect fuel lines from fuel inlet (B), overflow valve (E), and fuel outlet (F).
5. Disconnect fuel pressure sensor connector (C).
6. Remove cap screws (A) and final fuel filter base. Remove final filter.
7. Replace parts as necessary.
8. Install filter base on engine cylinder head. Tighten cap screws to specifications.

| Specification | |
|---|---|
| Final Fuel Filter Base-to-Cylinder Head—Torque | 70 N•m (52 lb-ft) |

9. Install water separator and fuel filter element. See REPLACE FINAL FUEL FILTER ELEMENT later in this Group.
10. Connect fuel lines to fuel inlet (B), overflow valve (E), and fuel outlet (F) and tighten to specification.




*Final Fuel Filter - Tier 2*

**A—Filter Base Mounting Cap Screws**
**B—Fuel Inlet Line (From Prefilter)**
**C—Fuel Pressure Sensor Connector**
**D—Final Fuel Filter**
**E—Fuel Overflow Line (To Injection Pump Overflow Valve)**
**F—Fuel Outlet Line (To Injection Pump Inlet)**

**Continued on next page**

| Specification | |
|---|---|
| Final Fuel Filter Inlet Line— | |
| Torque | 30 N•m (22 lb-ft) |
| Final Fuel Filter Outlet Line— | |
| Torque | 30 N•m (22 lb-ft) |

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11. Reconnect the fuel pressure electrical connector.

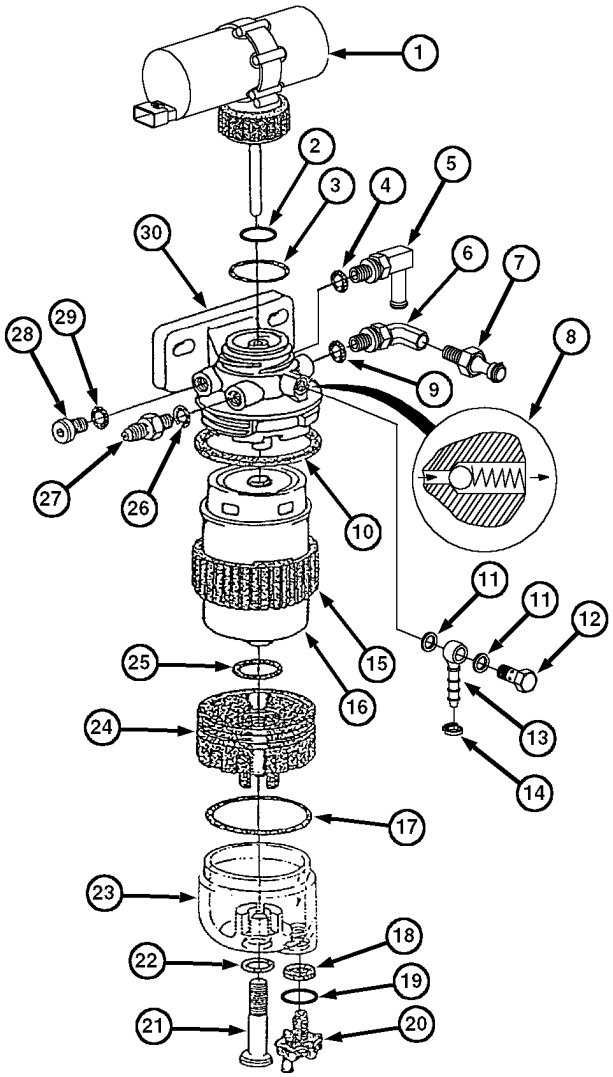
12. Bleed the fuel system. See BLEED THE FUEL SYSTEM in Group 150 later in this manual.

RG41221,00000FC –19–17OCT02–2/2

## Final Fuel Filter Assembly - Tier 1

*NOTE: For information on Tier 1 vs. Tier 2 applications, see ENGINE APPLICATION CHART in Group 001 earlier in this manual.*

**1—Fuel Transfer Pump**
**2—O-Ring**
**3—O-Ring**
**4—O-Ring**
**5—Fitting**
**6—Fitting**
**7—Fuel Pressure Sensor**
**8—Air Bleed Spring and Ball (Non-Serviceable)**
**9—O-Ring**
**10—Dust Seal**
**11—Copper Washer**
**12—Banjo Bolt**
**13—Banjo Fitting**
**14—Hose Clamp**
**15—Retaining Ring**
**16—Filter**
**17—O-Ring**
**18—Gasket**
**19—O-Ring**
**20—Drain Adapter**
**21—Screw**
**22—O-Ring**
**23—Water Separator Bowl**
**24—Adapter**
**25—O-Ring**
**26—O-Ring**
**27—Fitting**
**28—Plug[1]**
**29—O-Ring**
**30—Filter Base**




RG10723 –UN–02MAY00

*Final Fuel Filter - Tier 1*

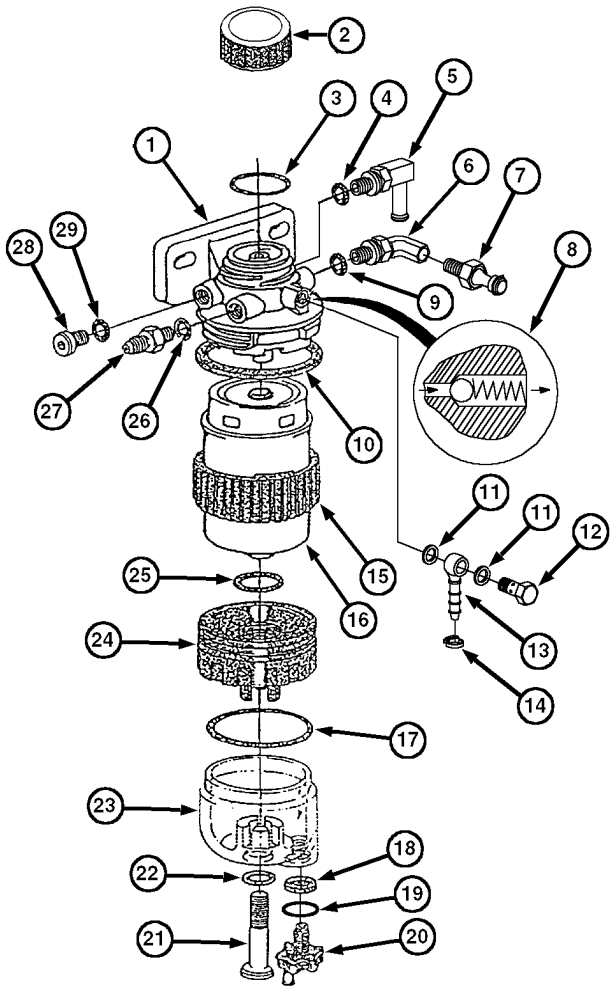
*[1]An optional fuel heater is available for installation in this bore.*

RG41221,0000106 –19–09MAY01–1/1

## Final Fuel Filter Assembly - Tier 2

*NOTE: For information on Tier 1 vs. Tier 2 applications, see ENGINE APPLICATION CHART in Group 001 earlier in this manual.*

**1—Filter Base**
**2—Final Fuel Filter Cover**
**3—O-Ring**
**4—O-Ring**
**5—Fitting**
**6—Fitting**
**7—Fuel Pressure Sensor**
**8—Air Bleed Spring and Ball (Non-Serviceable)**
**9—O-Ring**
**10—Dust Seal**
**11—Copper Washer**
**12—Banjo Bolt**
**13—Banjo Fitting**
**14—Hose Clamp**
**15—Retaining Ring**
**16—Filter**
**17—O-Ring**
**18—Gasket**
**19—O-Ring**
**20—Drain Adapter**
**21—Screw**
**22—O-Ring**
**23—Water Separator Bowl**
**24—Adapter**
**25—O-Ring**
**26—O-Ring**
**27—Fitting**
**28—Plug[1]**
**29—O-Ring**




*Final Fuel Filter - Tier 2*

*[1]An optional fuel heater is available for installation in this bore.*

RG41221,00000FE –19–08MAY01–1/1

## Replace Final Fuel Filter Element

*NOTE: For information on Tier 1 vs. Tier 2 applications, see ENGINE APPLICATION CHART in Group 001 earlier in this manual.*

*NOTE: Refer to operator's manual for proper servicing and (hourly) replacement intervals.*

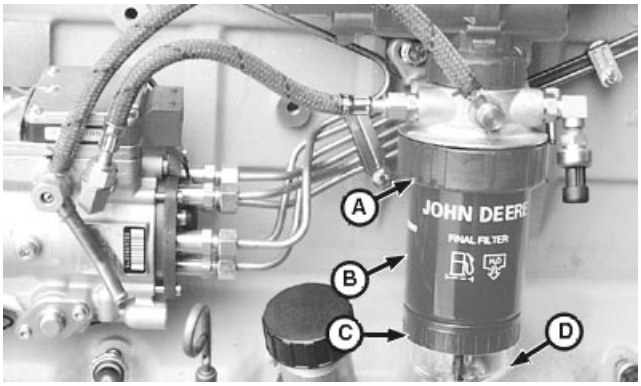
1. Thoroughly clean fuel filter/water separator assembly and surrounding area, if not previously done.
2. Connect a fuel line to filter drain adapter and drain all fuel from filter/water separator.

*NOTE: Lifting up on retaining ring (A) as it is rotated helps to get it past raised locators.*

3. Firmly grasp the retaining ring (A) and loosen it 1/4 turn. Remove retaining ring with filter element (B) and water separator (D) (if equipped).
4. Inspect filter mounting base for cleanliness. Clean as required.
5. Remove water separator bowl (D), if equipped. Drain and clean separator bowl. Dry with compressed air.
6. Install water separator bowl, if equipped, onto new filter element. Tighten adapter (C) securely.
7. Thoroughly inspect filter base seal ring. Replace as needed.

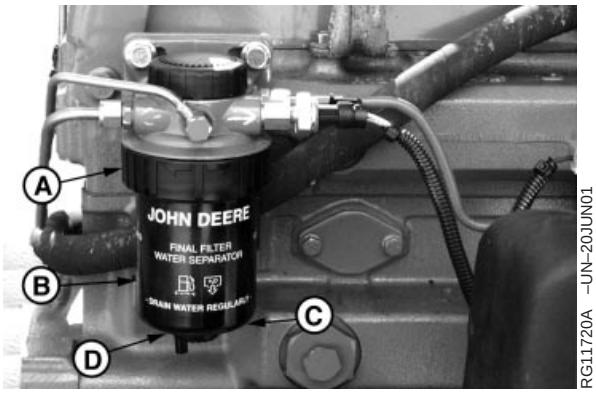
*NOTE: The fuel filter must be indexed properly and the key on canister must be oriented in slot of mounting base for correct installation.*

8. Install new filter element onto mounting base and position element using a slight rocking motion. Be sure element is properly indexed on mounting base.
9. Install retaining ring onto mounting base and tighten about 1/3 turn until ring "snaps" into the detent. DO NOT overtighten the retaining ring.
10. Bleed fuel system. See BLEED THE FUEL SYSTEM in Group 150 later in this manual.




RG10721B –UN–04MAY00

*Final Fuel Filter Element - Tier 1*




RG11720A –UN–20JUN01

*Final Fuel Filter Element - Tier 2*

**A—Retaining Ring**
**B—Filter Element**
**C—Adapter**
**D—Water Separator Bowl**

RG41221,0000107 –19–09MAY01–1/1

## Remove and Install Electronic Fuel Transfer Pump - Filter Mount

*NOTE: For information on Tier 1 vs. Tier 2 applications, see ENGINE APPLICATION CHART in Group 001 earlier in this manual.*

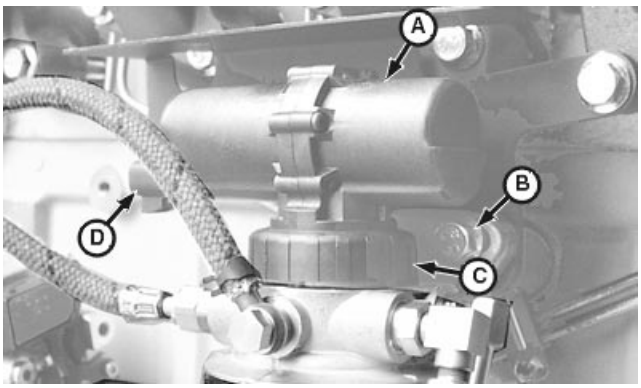
*NOTE: On Tier 1 applications the fuel transfer pump is located on the final fuel filter. Tier 2 applications have the fuel transfer pump on the primary fuel filter.*

1. Disconnect fuel transfer pump connector (D).
2. Remove heat shield above fuel transfer pump (Tier 1 applications only).
3. Unscrew the holding ring (C). If necessary, loosen cap screws (B) holding fuel filter base.
4. Remove electronic fuel transfer pump assembly (A) from filter base. Discard O-rings.
5. Replace complete fuel transfer pump as necessary.
6. Install transfer pump using new O-rings (E) and (F), observing orientation shown. Do not rotate pump after installation.
7. Hand tighten holding ring keeping correct transfer pump orientation.
8. When needed, tighten fuel filter base cap screws to specifications.

**Specification**

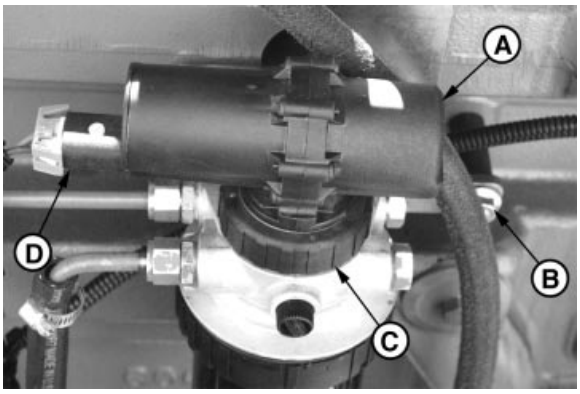
| | |
|---|---|
| Final Fuel Filter Base Mounting Cap Screws—Torque | 70 N•m (52 lb-ft) |
| Primary Fuel Filter Base-to-Bracket Cap Screws—Torque | 60 N•m (44 lb-ft) |

9. Reconnect electrical connection.
10. Install heat shield above fuel transfer pump (Tier 1 applications only).
11. Bleed fuel system. See BLEED THE FUEL SYSTEM in Group 150 later in this manual.



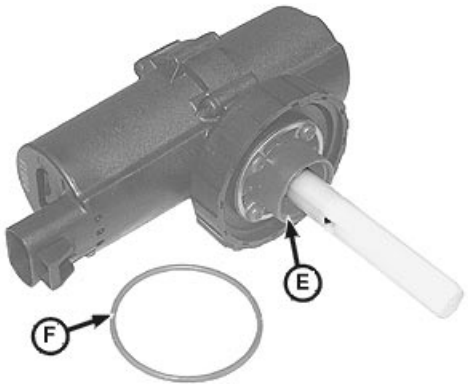

RG10726A –UN–04MAY00

*Electronic Fuel Transfer Pump - Tier 1*




RG11721A –UN–20JUN01

*Electronic Fuel Transfer Pump - Tier 2*




RG10727A –UN–04MAY00

*Electrical Fuel Transfer Pump Details*

**A—Fuel Transfer Pump**
**B—Filter Base Cap Screw (2 used)**
**C—Holding Ring**
**D—Fuel Transfer Pump Connector**
**E—O-Ring**
**F—O-Ring**

RG41221,0000108 –19–13AUG01–1/1

## Remove and Install Electronic Fuel Transfer Pump - Remote Mount

*NOTE: On 24 volt applications the fuel transfer pump is mounted to the engine or remote mounted on the frame of the vehicle.*

1. Disconnect ring terminals from the fuel transfer pump power (A) and ground (B) studs.
2. Remove fuel lines from fuel inlet (D) and outlet (C) on transfer pump.
3. Remove fuel transfer pump.
4. Replace complete fuel transfer pump as necessary.
5. Install fuel transfer pump.
6. Connect fuel inlet and outlet lines.

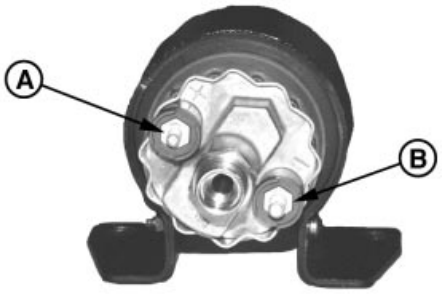
*NOTE: Do not overtighten retaining nuts on power and ground stud. Studs can break off requiring the replacement of the pump.*

7. Reconnect electrical connections. Tighten retaining nuts to specification.

**Specification**

| | |
|---|---|
| Fuel Transfer Pump Wiring Retaining Nut (+)—Torque | 1.2 N•m (0.9 lb-ft) |
| Fuel Transfer Pump Wiring Retaining Nut (-)—Torque | 1.6 N•m (1.2 lb-ft) |

8. Bleed fuel system. See BLEED THE FUEL SYSTEM in Group 150 later in this manual.




RG11757A –UN–20JUL01

*Remote Mount Transfer Pump Wiring*


RG11756A –UN–20JUL01

*Remote Mount Transfer Pump*

**A—Power Stud**
**B—Ground Stud**
**C—Fuel Outlet**
**D—Fuel Inlet**

RG41221,0000214 –19–09JUL01–1/1

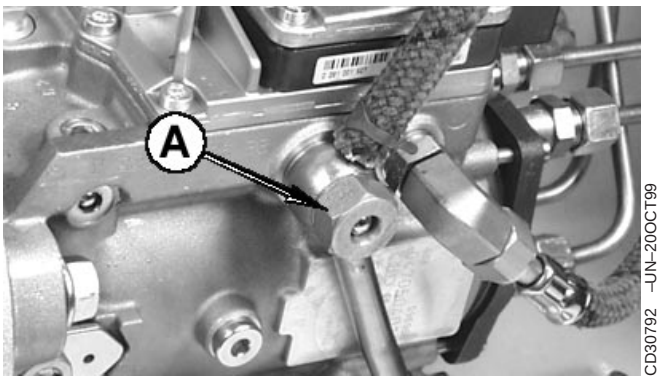
## Service Injection Pump Overflow Valve

The overflow valve (A) cannot be adjusted or serviced. Replace valve as required. Tighten to specifications.

**Specification**

Fuel Injection Pump Overflow Valve (VP44)—Torque ..... 25 N•m (18.5 lb-ft)

**A—Overflow Valve**




CD30792 –UN–20OCT99

*Overflow Valve on VP44 Pump*

DPSG,CD03523,103 –19–17OCT02–1/1

## Bosch VP44 Injection Pump Static Timing

Static lock-pin timing is accomplished during installation of the injection pump with engine locked at No. 1 TDC.

02
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1. Remove plug from block.
2. Rotate engine using JDE820 Flywheel Turning Tool (A) (in normal running direction) until No. 1 piston is at "TDC" of its compression stroke. At this point, JDE81-4 Timing Pin (B) should enter the hole in the flywheel.
3. Remove injection pump driver gear cover and O-ring.
4. Install KJD10233 Timing Pin (E) through drive hub until it bottoms.

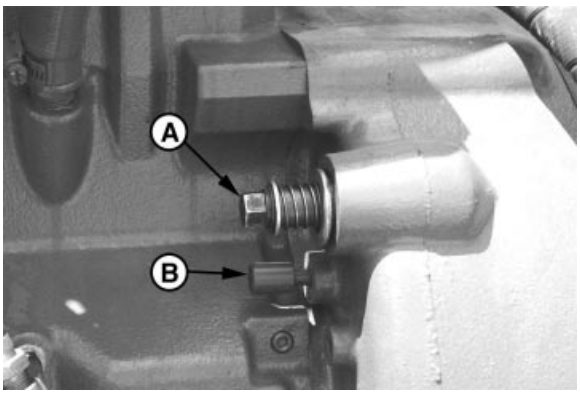
**IMPORTANT: The normal backlash of gears is enough to throw the pump timing off by several degrees, resulting in poor engine performance. It is important that pump timing be rechecked after pump has been installed.**

*NOTE: Normal engine rotation is counterclockwise, viewed from flywheel end.*

5. To check alignment of injection pump and eliminate backlash of timing gear train, remove both timing pins and rotate the flywheel opposite the direction of normal rotation. Install JDE81-4 Timing Pin and rotate flywheel in the direction of normal rotation until timing pin engages in timing pin hole.

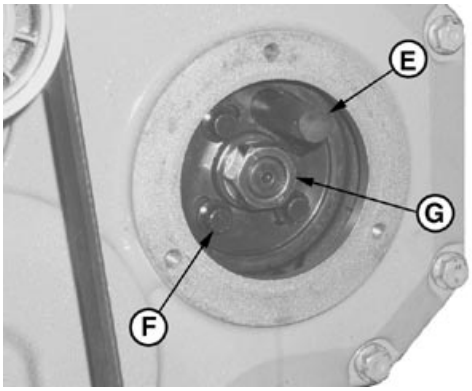
**IMPORTANT: Do not loosen the central nut (G) which must be removed only by a specialized diesel workshop.**

6. If KJD10233 Timing Pin will not install through drive hub and bottom out, loosen drive gear cap screws (F) and rotate hub until timing pin can be installed and locked in place.




RG11752A –UN–12JUL01

*Flywheel Turning Tool and Timing Pin*




RG12805A –UN–16JAN03

*Timing Injection Pump*

**A—JDE820 Flywheel Turning Tool**
**B—JDE81-4 Timing Pin**
**E—KJD10233 Timing Pin**
**F—Drive Gear Screws**
**G—Nut**

**Continued on next page**

*NOTE: When tightening pump drive gear cap screws (F), apply light force (clockwise) to gear to eliminate any backlash with camshaft gear.*

7. Tighten pump drive gear cap screws to specifications.

**Specification**

Bosch VP44 Injection Pump Drive
Gear Cap Screws—Torque ..... 50 N•m (37 lb-ft)

8. Install injection pump drive gear cover and O-ring. Tighten cap screws to specification.

**Specification**

Injection Pump Drive Gear Cover
Cap Screws—Torque ..... 6 N•m (4.4 lb-ft)

9. Remove timing pin and flywheel turning tool from block.



DPSG,OUO1004,2640 –19–17OCT02–2/2

## Remove Bosch VP44 Fuel Injection Pump

02
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**IMPORTANT: Do not bend high pressure fuel lines. Bending can cause failures in the line when high pressure fuel is routed through lines.**

**IMPORTANT: Do not use a high-pressure cleaner. Never steam clean or pour cold water on a fuel injection pump when engine is running or while pump is warm.**

1. Clean fuel injection pump, lines and area around pump with cleaning solvent or a steam cleaner.

2. Rotate engine using JDE820 Flywheel Turning Tool (in normal running direction) until No. 1 piston is at "TDC" of its compression stroke. At this point, JDE81-4 Timing Pin (B) should enter the hole in the flywheel to lock engine at No. 1 TDC compression stroke.

3. Pull connector locking mechanism outward and disconnect electrical connector (A).

**IMPORTANT: Always use a backup wrench when loosening or tightening fuel injection lines at injection pump to prevent rotation of the discharge fitting.**

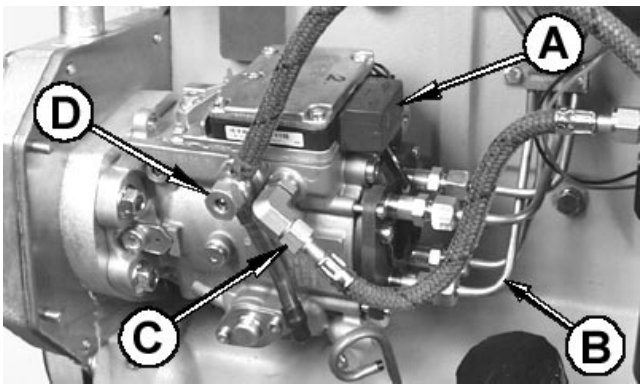
4. Disconnect fuel injection lines (B) at both pump and nozzle ends, to prevent cross-threading of lines when reconnecting.

5. Disconnect supply line (C) and return line (D).

6. Plug all open connections on pump and fuel lines. Do not use fibrous material.

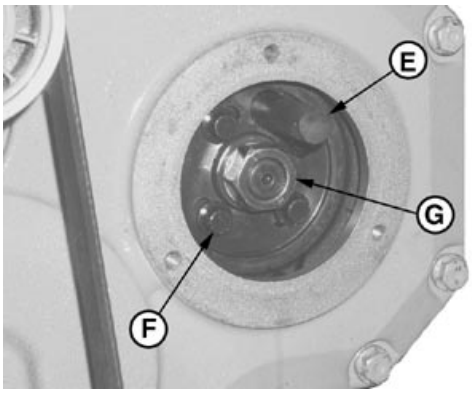
7. Remove injection pump drive gear cover and O-ring.

8. Install KJD10233 VP44 Timing Pin (E) through injection pump drive gear into injection pump hub until it bottoms. Do not leave pin in injection pump if pump is sent out for repair.




CD30782 –UN–19OCT99

*Remove Bosch VP44 Injection Pump*




RG12805A –UN–16JAN03

*Timing Injection Pump*

**A—Electrical Connector**
**B—Injection Lines**
**C—Fuel Supply Line**
**D—Fuel Return Line**
**E—KJD10233 Timing Pin**
**F—Drive Gear Screws**
**G—Nut**

**Continued on next page**

RG41221,00001F7 –19–17OCT02–1/3

**IMPORTANT: Do not loosen the central nut (G) which must be removed only by a specialized diesel service shop.**

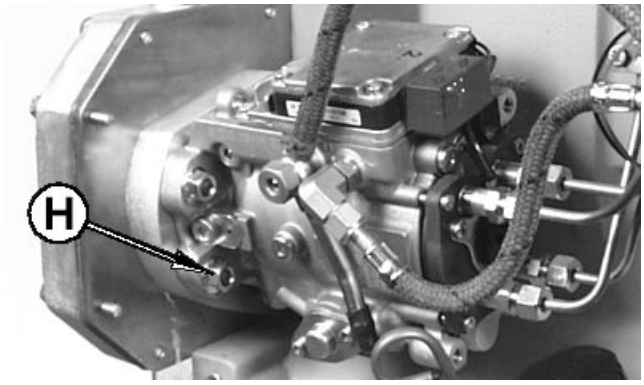
9. Remove the four drive gear screws (F).



RG41221,00001F7 –19–17OCT02–2/3

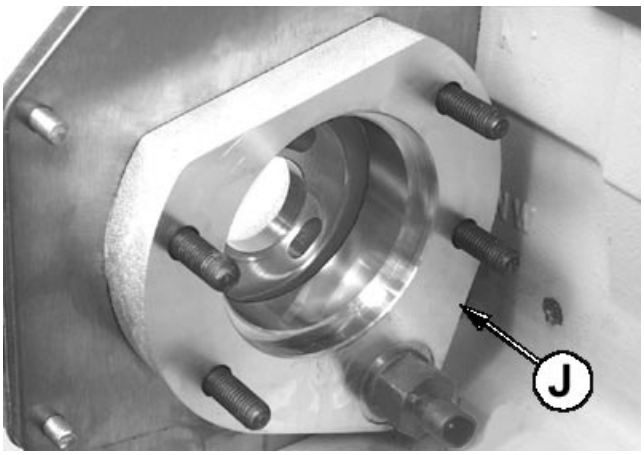
10. Remove the four nuts (H) which secure the pump to the front plate.
11. Carefully remove injection pump from mounting studs and place it on a clean flat surface.
12. Disconnect the pump position sensor's electrical connector.
13. Remove spacer (J) from engine front plate.

**H—Pump-to-Front Plate Nuts**
**J—Spacer**




CD30784 –UN–19OCT99

*Remove Bosch VP44 Injection Pump (3)*




CD30785 –UN–19OCT99

*Remove Bosch VP44 Injection Pump (4)*

RG41221,00001F7 –19–17OCT02–3/3

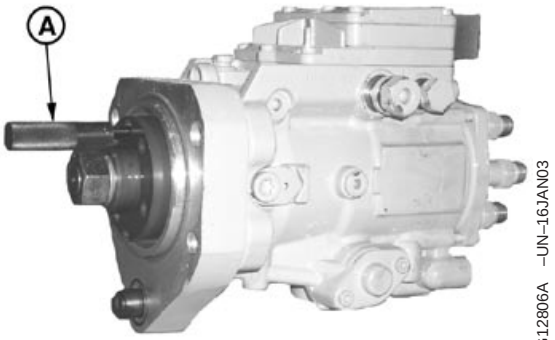
## Repair Bosch VP44 Fuel Injection Pump

**IMPORTANT: Do not disassemble fuel injection pump further than necessary for installing available service parts, not even for cleaning.**

**Be sure that all identification numbers are legible so that pump is set to the correct specifications for its intended use.**

The Bosch VP44 fuel injection pump is only repairable by an authorized Bosch service shop. When diagnostics show evidence of injection pump failure, contact your local Bosch service shop. Unauthorized repairs made to the injection pump will void it's warranty.

*NOTE: Remove KJD10233 Timing Pin (A) before sending injection pump out for repair.*




*Repair Bosch VP44 Injection Pump*

**A—KJD10233 Timing Pin**

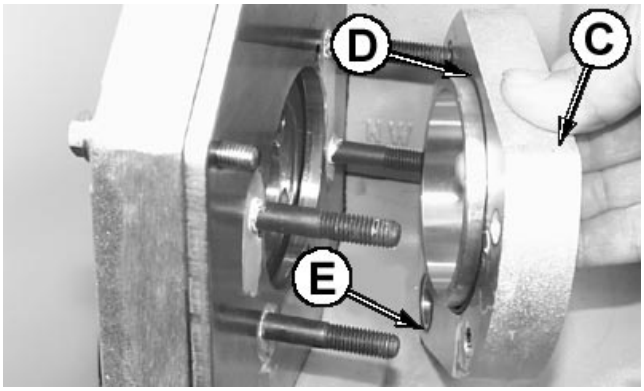
RG41221,00001F8 –19–17MAY01–1/1

## Install Bosch VP44 Fuel Injection Pump

1. Ensure that No. 1 cylinder is at TDC compression stroke.
2. If removed, install KJD10233 Timing Pin (A) into drive hub until it bottoms.
3. Install a new O-ring (B) into the pilot groove. Lightly lubricate O-ring with AR54749 Soap Lubricant.
4. Slide spacer (C) with new O-rings (D) and (E) over studs.
5. Install injection pump over studs, inserting pump shaft and timing pin in drive gear.
6. If removed, install pump position sensor on spacer (C). See REPLACE PUMP POSITION SENSOR in Group 110.

**A—KJD10233 Timing Pin**
**B—O-Ring**
**C—Spacer**
**D—O-Ring**
**E—O-Ring**


*Install Bosch VP44 Injection Pump (1)*




*Install Bosch VP44 Injection Pump (2)*

**Continued on next page**

7. Tighten four nuts (F) on studs to specifications.

| Specification | |
|---|---|
| Bosch VP44 Injection Pump Mounting Nuts—Torque | 70 N•m (52 lb-ft) |

**IMPORTANT: Do not bend high pressure fuel lines. Bending can cause failures in the line when high pressure fuel is routed through lines.**

8. Connect injection lines (G). Begin with outlet (H) and continue around the pump head in counterclockwise direction, attaching lines in same order as engine firing (1-5-3-6-2-4 on 6-cylinder engines and 1-3-4-2 on 4-cylinder engines). Tighten lines to specifications.

| Specification | |
|---|---|
| Bosch VP44 Injection Pump Delivery Lines—Torque | 27 N•m (20 lb-ft) |

**IMPORTANT: Always use a backup wrench when loosening or tightening fuel injection lines at injection pump to prevent rotation of the high pressure discharge fitting.**

9. Connect injection lines to nozzles. Tighten to specification.

| Specification | |
|---|---|
| Bosch VP44 Injection Pump Delivery Lines—Torque | 27 N•m (20 lb-ft) |

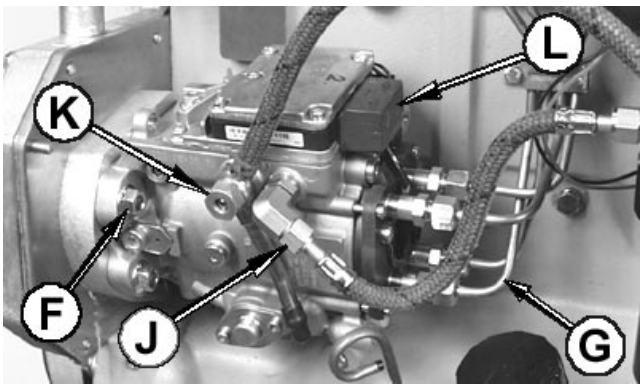
10. Install NEW copper sealing washer and connect fuel supply line (J). Tighten to specifications.

| Specification | |
|---|---|
| Bosch VP44 Injection Pump Supply Line—Torque | 27 N•m (20 lb-ft) |

11. Install NEW copper sealing washer and connect fuel return line (K). Tighten to specifications.

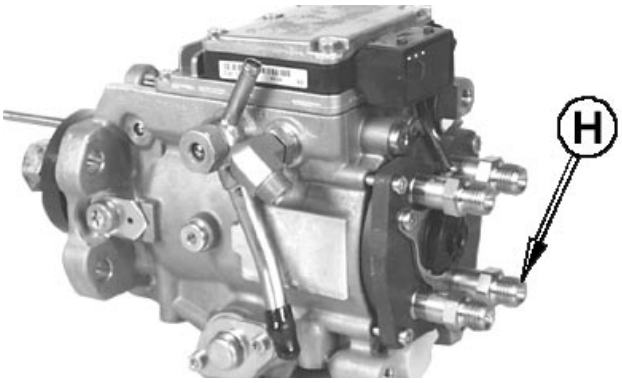
| Specification | |
|---|---|
| Bosch VP44 Injection Pump Return Line—Torque | 27 N•m (20 lb-ft) |

12. Install electrical connector (L). Make sure connector locking mechanism is completely latched in detents.




CD30789 –UN–19OCT99

*Install Bosch VP44 Injection Pump (3)*




CD30790 –UN–19OCT99

*Install Bosch VP44 Injection Pump (4)*

**F—Nuts**
**G—Injection Lines**
**H—Outlet Port**
**J—Supply Line**
**K—Return Line**
**L—Electrical Connector**

**Continued on next page**

*NOTE: The injection pump needs to be properly timed during installation of pump to ensure that gear backlash is removed. See BOSCH VP44 INJECTION PUMP STATIC TIMING earlier in this Group for proper injection pump timing and elimination of backlash with camshaft gear.*

13. Install drive gear-to-pump hub screws (M) and tighten to specifications.

**Specification**

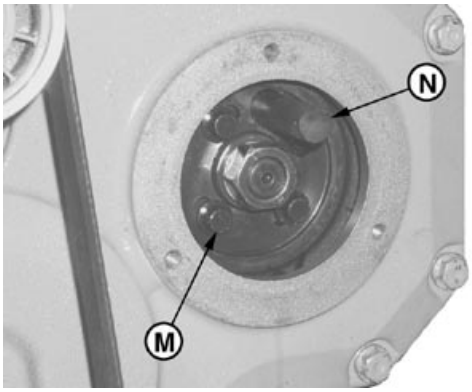
Bosch VP44 Injection Pump Drive Gear-to-Pump Hub Screws—Torque ..... 48 N•m (35 lb-ft)

14. Remove KJD10233 Timing Pin (N), then install cover with a new O-ring. Tighten cover cap screws to specifications.

**Specification**

Bosch VP44 Injection Pump Drive Gear Cover—Torque ..... 6 N•m (4.4 lb-ft)

15. Bleed fuel system. See BLEED THE FUEL SYSTEM in Group 150 later in this manual.




RG12805B –UN–16JAN03

*Timing Injection Pump*

**M—Gear-to-Pump Hub Screws**
**N—KJD10233 Timing Pin**

RG41221,00001F9 –19–17OCT02–3/3

## Remove Fuel Injection Nozzles

### General Nozzle Service Precautions



Before removal, thoroughly clean and remove all dirt from the cylinder head around fuel injection nozzles. Clean with compressed air to prevent dirt from entering the cylinders. Plug the bore in the cylinder head after each nozzle has been removed. Cap fuel line openings as soon as they are disconnected.

Immediately fit protective caps over the nozzle tips and the line connections to avoid handling damage and getting debris in fuel system.

Do not bend the fuel delivery lines, as this may affect their durability. When loosening the fuel pressure lines, hold male union of nozzle line stationary with a backup wrench.

**Continued on next page**

RG41221,00001FA –19–17MAY01–1/2

*NOTE: When all fuel injection nozzles have to be removed, disconnect leak-off line and remove as a complete assembly. For individual nozzle removal, remove only the section of leak-off line necessary for nozzle removal.*

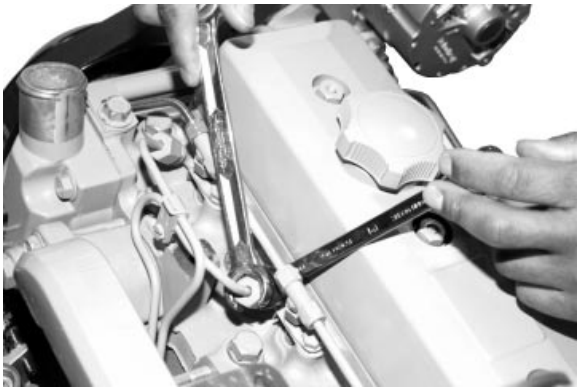
1. Loosen tube nuts at each nozzle to remove leak-off lines and T-fittings as an assembly.
2. Disconnect fuel injection line from nozzle using a backup wrench on nozzle connection as shown.
3. Remove fuel line clamps to allow fuel lines to move enough for the removal of the injectors without bending or damaging lines. If lines still cannot be moved enough, disconnect fuel lines from the fuel injection pump.
4. Remove cap screw securing nozzle in cylinder head nozzle bore.
5. Pull injection nozzle out of cylinder head using JDE38B Injection Nozzle Puller Set (A) or JDG716 Adapter and slide handle from JDE38 or JDE38A Puller Set.

**IMPORTANT: Do not use screwdrivers, pry bars, or similar tools to remove injectors, as they can easily damage the injection nozzle beyond repair.**

**A—Nozzle Puller**

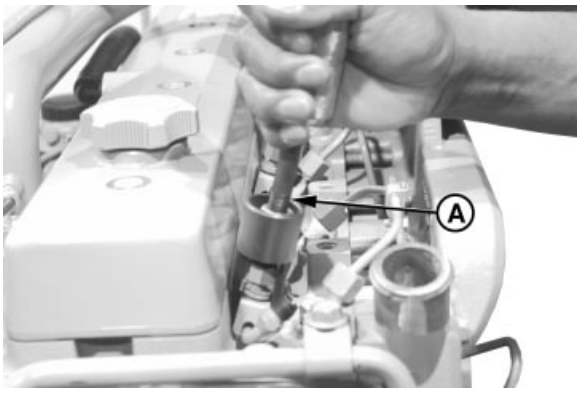
RG7724 –UN–23NOV97

*Fuel Leak-Off Lines*



RG7725 –UN–08JAN97

*Fuel Injection Line at Nozzle*




RG7726 –UN–07NOV97

*Injection Nozzle Puller Set*

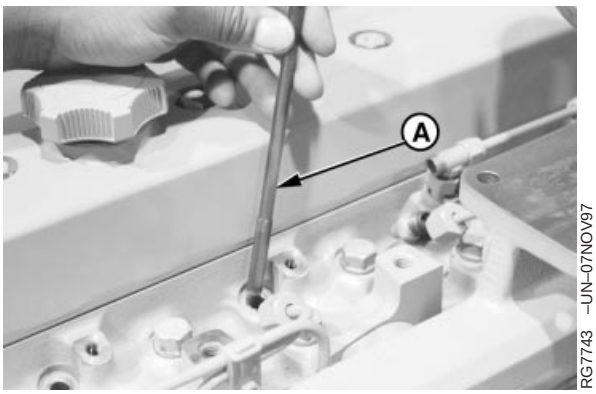
RG41221,00001FA –19–17MAY01–2/2

## Clean Fuel Injection Nozzle Bore

**IMPORTANT: Always turn tool clockwise in bore to prevent dulling of cutting edges, even when removing tool from bore.**

Clean injection nozzle bore using JDE39 Nozzle Bore Cleaning Tool (A). Blow debris from bore using compressed air, and plug the bore to prevent entry of foreign material.

**A—Nozzle Bore Cleaning Tool**




*Clean Injection Nozzle Bore*

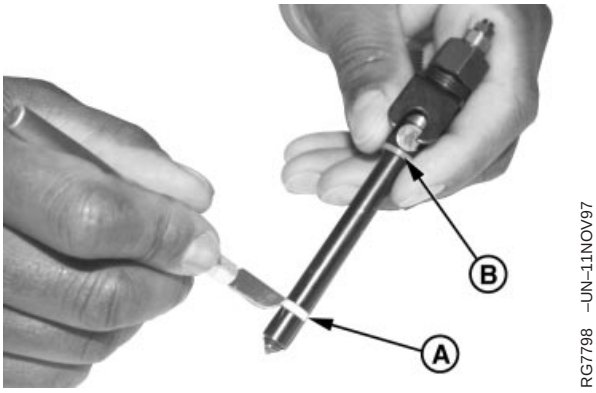
RG,35,JW7596 –19–20NOV97–1/1

## Clean Fuel Injection Nozzles

1. Remove carbon dam seal (A) from groove in nozzle body using razor blade or sharp knife and remove upper sealing washer (B). Discard seal and washer.
2. Place nozzle in solvent or clean diesel fuel, so carbon stop seal groove is submerged, and soak for a while.

**IMPORTANT: Do not scrape or disturb the TEFLON® coating on the nozzle body above the carbon stop seal groove. This coating will become discolored during normal operation, but this is not harmful. Do not use a motor-driven brush to clean nozzle body.**

3. After soaking, clean nozzle tip with brass wire brush. Never use a steel wire brush or scraper.




*Clean Fuel Injection Nozzle*

**A—Carbon Dam Seal**
**B—Upper Sealing Washer**

*TEFLON is a registered trademark of the DuPont Co.*

RG,35,JW7595 –19–20NOV97–1/1

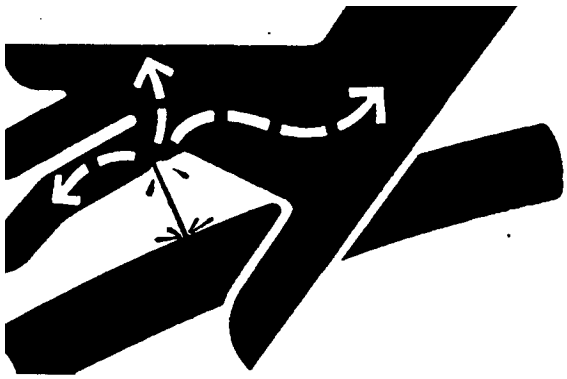
## Test Fuel Injection Nozzles

**CAUTION: The nozzle tip should always be directed away from the operator. Fuel from the spray orifices can penetrate clothing and skin causing serious personal injury. Enclosing the nozzle in a clear glass beaker is recommended.**

**Before applying pressure to the nozzle tester, be sure that all connections are tight, and that the fittings are not damaged. Fluid escaping from a very small hole can be almost invisible. To search for suspected leaks, use a piece of cardboard or wood, rather than hands.**

**If ANY fluid is injected into the skin, it must be surgically removed within a few hours by a doctor familiar with this type of injury or gangrene may result.**

1. Connect injection nozzle to nozzle tester.



X9811 –UN–23AUG88

*High Pressure Fluid*

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**Continued on next page**

RG41221,00001FB –19–14AUG01–1/5

*NOTE: When using the Bosch Tester (JT25510), use the KJD10109 Fuel Line and connect line to tester and nozzle.*

2. Use Y900-3 and Y900-5 Adapters (C) and Y900-2 Fuel Line (B) from D01110AA Adapter Set to connect nozzles to D01109AA Nozzle Tester (A).

3. Position tip of nozzle below top of beaker (D) and back out 30° from vertical. This is necessary to contain all spray in beaker, as nozzle spray pattern is at an angle to the nozzle centerline. Leave connections slightly loose.

*NOTE: Rapid operation of pump handle will result in inaccurate cracking pressure readings and cause undue wear on gauge.*

4. Pump handle several strokes to flush air from lines and to determine the pumping rate required for proper fuel atomization. Tighten all connections securely after all air has been expelled from nozzle and line.

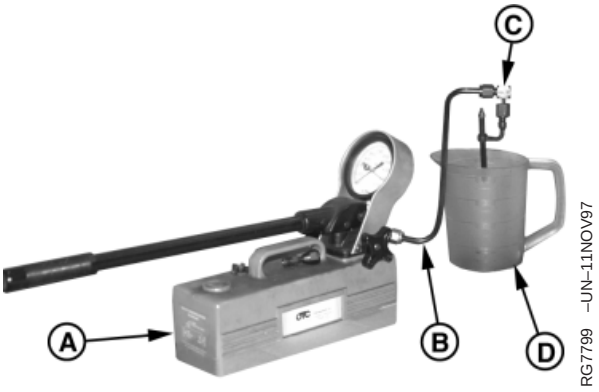
**IMPORTANT: Make sure that nozzle tester is in good condition and that gauge works properly. Service nozzle tester as recommended in the operating instructions provided with tester.**

**Opening Pressure Test**

*NOTE: Actual nozzle opening pressure is less important than equal opening pressure of all nozzles. For maximum variation between nozzles see specifications below.*

1. Actuate the nozzle tester rapidly several times to allow the valve to seat rapidly.

2. Open gauge valve, actuate the tester and raise the pressure to a point where the gauge needle falls rapidly. This is the nozzle opening pressure, and should be as specified for a new or used nozzle.




*Injection Nozzle Tester*

**A—Nozzle Tester**
**B—Fuel Line**
**C—Adapters**
**D—Beaker**

**Continued on next page**

3. Compare readings to the following specifications:

**Fuel Injection Nozzles (RE48786)—Specification**

| | |
|---|---|
| New or Reconditioned Nozzle with New Internal Parts—Opening Pressure for Setting | 25,511—26,062 kPa (255—260 bar) (3700—3780 psi) |
| Opening Pressure for Checking (Minimum) | 24,683 kPa (246 bar) (3580 psi) |
| Used Nozzle—Opening Pressure for Checking (Minimum) | 23,511 kPa (235 bar) (3410 psi) |
| Opening Pressure Difference between Cylinders—Pressure Difference (Maximum) | 700 kPa (7 bar) (101.5 psi) |

**IMPORTANT: If any of the nozzle opening pressures are not within specified range, reset pressure and valve lift BEFORE checking chatter and spray pattern. Otherwise, these characteristics may be affected. See ADJUST FUEL INJECTION NOZZLES later in this Group.**

**Chatter Test**

1. Close gauge shut-off valve and operate nozzle tester at a pumping rate that will cause the nozzle to chatter. Nozzle should chatter softly, and spray pattern should be broad and finely atomized.

   If nozzle fails to chatter, the nozzle valve may be bent or tight in its guide due to accumulated lacquer deposits. To disassemble nozzle and correct as detailed, see DISASSEMBLE FUEL INJECTION NOZZLES later in this Group.

*NOTE: Until the chattering range is reached, fuel will emerge in non-atomized streams.*

2. Using the pumping rate for proper atomization, operate tester for ten strokes. The nozzle must atomize on at least eight of the ten strokes without consecutive misses.

**Continued on next page**

If the nozzle fails to meet this requirement, repeat procedure. Nozzles which do not meet the requirement after second test should be considered unacceptable and should be either repaired or replaced.

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**Spray Pattern Test**

1. Close gauge shut-off valve and operate nozzle tester at a pumping rate that will cause the nozzle to chatter.

*NOTE: Partially clogged, chipped, or eroded orifices will cause the spray to deviate from the correct angle. Spray will be streaky, rather than finely atomized.*

2. Observe spray pattern and check for plugged orifices.

   If nozzle fails to chatter or spray properly, disassemble, clean and recondition, see DISASSEMBLE FUEL INJECTION NOZZLES later in this Group.

| Specification | |
|---|---|
| Fuel Injection Nozzle Tip—Spray Angle | 144° |

**Leakage Test**

1. Check nozzle for fuel leakage past valve seat by positioning nozzle on nozzle tester with nozzle tip down.

2. Operate pump handle rapidly to firmly seat valve. Wipe the nozzle tip dry with a clean, lint-free cloth

3. Slowly raise pressure at nozzle to about 2800—3500 kPa (28—35 bar) (400—500 psi) under specified opening pressure and hold at that pressure. Watch for an accumulation of fuel around the nozzle tip orifices.

   If fuel drips from nozzle within 5 seconds, nozzle must be lapped.

| Specification | |
|---|---|
| Nozzle Valve/Seat Tightness Condition at Pressure Test of 2800—3500 kPa (28—35 bar) (400—500 psi)—Leakage | Nozzle tip dry after 5 seconds. (Slight dampness permissible on used nozzles.) |

Continued on next page

**Valve Stem and Guide Wear Test**

1. Position nozzle with tip slightly above the horizontal plane.

**CAUTION: Completely enclose spray zone in a glass beaker to avoid possible personal injury from spray.**

2. Slowly raise pressure to 10,300 kPa (103 bar) (1500 psi) on test gauge

*NOTE: Leakage rate based on use of No. 2 diesel fuel or an equivalent viscosity of test oil at 18°—24°C (65°—75°F) ambient temperature.*

3. Look for leakage from the return end of nozzle. After one drop, leakage should be within specifications.

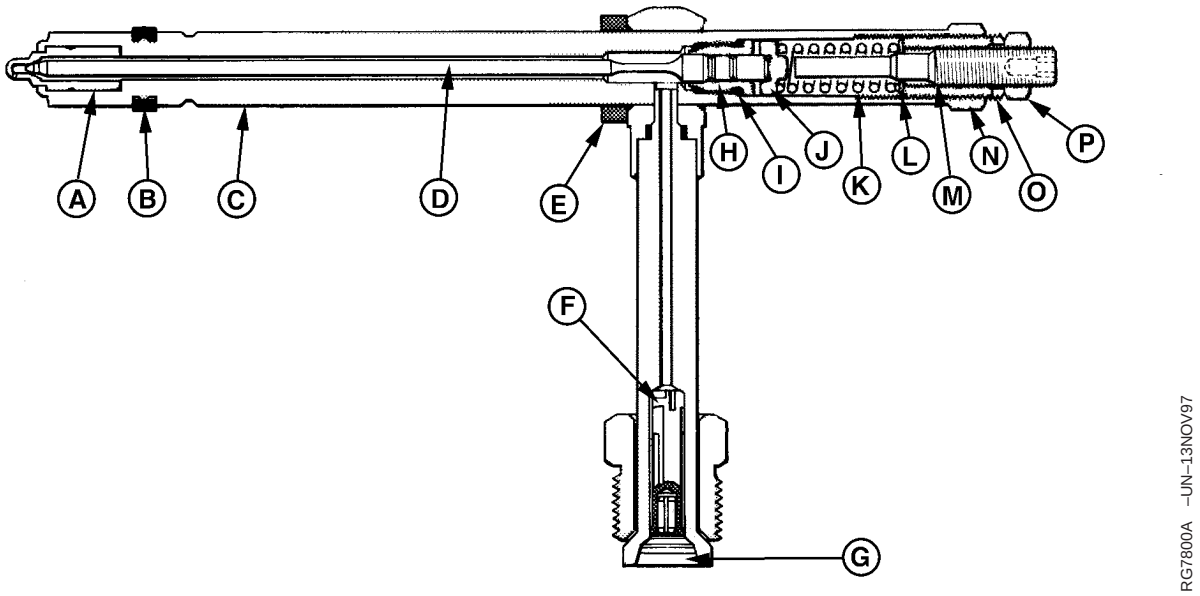
| | Specification |
|---|---|
| Fuel Injection Nozzle Return Leakage at Pressure Test of 10,300 kPa (103 bar) (1494 psi)—Leakage | 3—10 Drops/30 Seconds |

If nozzle leakage is not within specified range, nozzle must be reconditioned. See DISASSEMBLE FUEL INJECTION NOZZLES later in this Group.

RG41221,00001FB –19–14AUG01–5/5

## Disassemble Fuel Injection Nozzles






*Fuel Injection Nozzles*

**A—Nozzle Tip**
**B—Carbon Dam Seal**
**C—Nozzle Body**
**D—Nozzle Valve**
**E—Plastic Sealing Washer**
**F—Edge-Type Filter**
**G—Fuel Inlet**
**H—Upper Guide**
**I—Upper Seal**
**J—Spring Seat**
**K—Spring Screw**
**L—Spring Washer**
**M—Lift Adjusting Screw**
**N—Pressure Adjusting Screw Lock Nut**
**O—Pressure Adjusting Screw**
**P—Lift Adjusting Screw Lock Nut**

### General Nozzle Repair Notes

*NOTE: Disassembly of nozzles is not recommended unless servicing is indicated by nozzle operation and testing.*

Since dirt and water are the worst contaminants in the fuel injection system, the working area, tools and cleaning materials must be kept clean. Whenever possible, work in an isolated, dust-free area.

Cover the work bench with clean paper before beginning disassembly of injection nozzles.

As parts are disassembled, place them in a pan of clean diesel fuel and leave there until needed. Do not permit these parts to strike each other.

Use a separate pan of clean fuel for washing parts before assembly.

**Continued on next page**

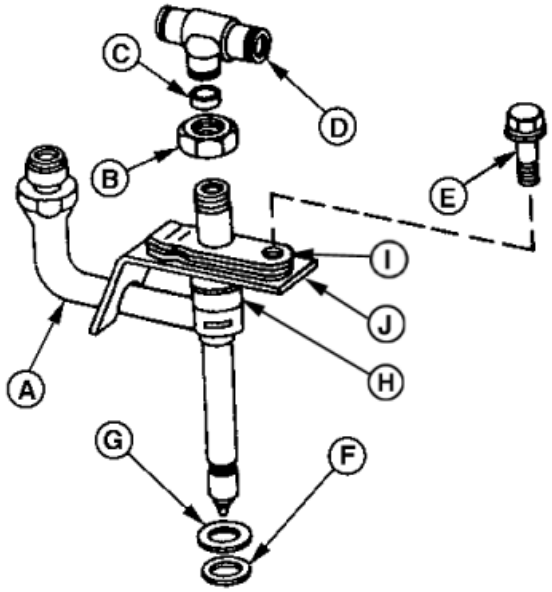
**To Disassemble Fuel Injection Nozzle**

1. Place nozzle in a vice using the indexing clamp (J)[1] to secure in place.
2. Remove leak-off fitting (D) from top of injector if not already removed with leak-off line assembly.
3. Remove lift adjusting screw lock nut (K).
4. Remove pressure adjusting screw lock nut (L).
5. Remove nozzle from vise or holding fixture.
6. Remove tube nut (B) and Packing (C).
7. Remove hold down clamps (I) and Indexing clamp (J).
8. Using JDG949 Injection Nozzle Wrench, remove pressure adjusting screw (N) and lift adjusting screw (M) as an assembly.

*NOTE: If JDG949 does not mate with pressure adjusting screw, turn lift adjusting screw in until wrench mates with pressure adjusting screw.*

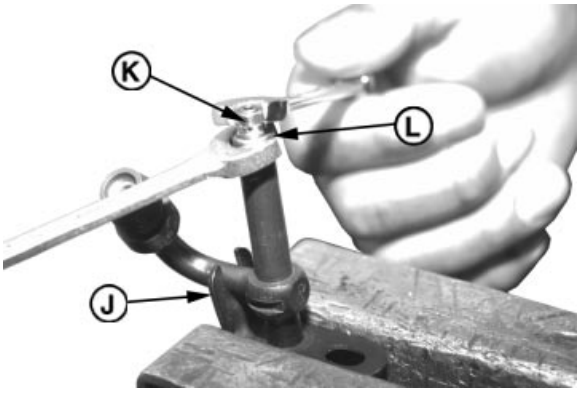
9. Invert nozzle and allow pressure adjusting spring seat and lift adjusting assembly to fall into your hand. Do not bend stem during removal.

**A—Nozzle Assembly**
**B—Tube Nut**
**C—Packing**
**D—Leak-Off Fitting**
**E—Cap Screw**
**F—Carbon Dam Seal**
**G—Plastic Sealing Washer**
**H—Spacer**
**I—Hold Down Clamps**
**J—Indexing Clamp**
**K—Lift Adjusting Screw Lock Nut**
**L—Pressure Adjusting Lock Nut**
**M—Lift Adjusting Screw**
**N—Pressure Adjusting Screw**



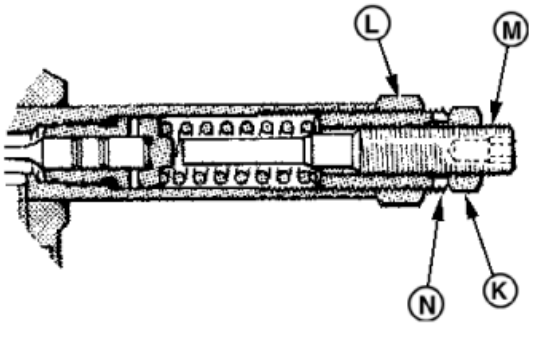

RG9086A –UN–20JUN01

*Nozzle Disassembly*




RG7802A –UN–23MAY01

*Injection Nozzle in Holding Fixture*




RG7810C –UN–20JUN01

*Injection Nozzle Adjustment Components*

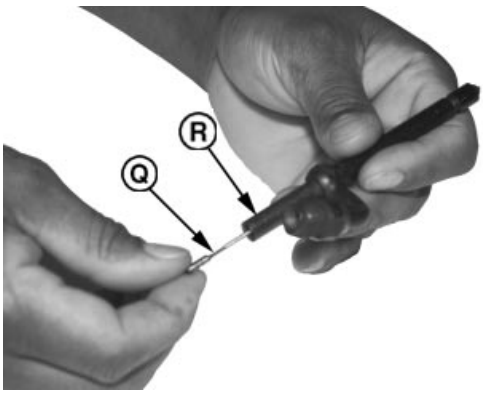
[1]*If available, ROS17787 Holding Fixture (obsolete) can be used.*

**Continued on next page**

10. If valve does not slide freely from body (R), use No. 16481 Valve Retractor[1] (Q) to remove valve.

**R—Valve Body**
**Q—Valve Retractor**






RG7803A –UN–23MAY01

*Injection Nozzle Body and Valve*

*[1]No. 16481 Valve Retractor is a Stanadyne tool.*

RG,35,JW7591 –19–17OCT02–3/3

## Inspect and Clean Fuel Injection Nozzle Body

*NOTE: Unless otherwise indicated, all tools required for nozzle cleaning can be found in the JDF13B Nozzle Cleaning Kit.*

Clean carbon stop seal groove and nozzle tip with a nozzle cleaning wire inserted in holder (A).

Inspect tip for cracks and spray orifices for chipping and erosion using an inspection magnifier (B).[1]

### To Clean Carbon from Nozzle Orifices

*NOTE: Stoning the wire to provide a flat surface on one side will help in reaming carbon from a clogged hole.*

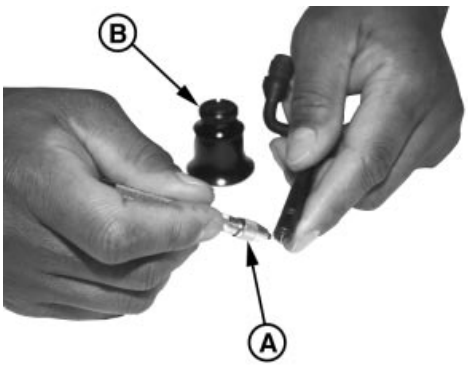
1. Begin with a cleaning wire 0.07—0.10 mm (0.003—0.004 in.) smaller than the nominal orifice size given in specifications below.

| Specification | |
|---|---|
| Fuel Injection Nozzle Tip Orifice—Number of Orifices per Nozzle | 4 |
| Fuel Injection Nozzle Tip Orifice—ID | 0.29 mm (0.0114 in.) |

2. Clamp the wire in pin vise from nozzle cleaning kit. Wire should not protrude from the vise more than 0.8 mm (1/32 in).

3. Insert wire in orifice and rotate.

4. Use scraper from cleaning kit to clean deposits from valve seating area.




RG7804 –UN–11NOV97

*Clean Injection Nozzle Body*

**A—Holder**
**B—Inspection Magnifier**

*[1]If available, ROS16487 Inspection Magnifier (obsolete) can be used.*

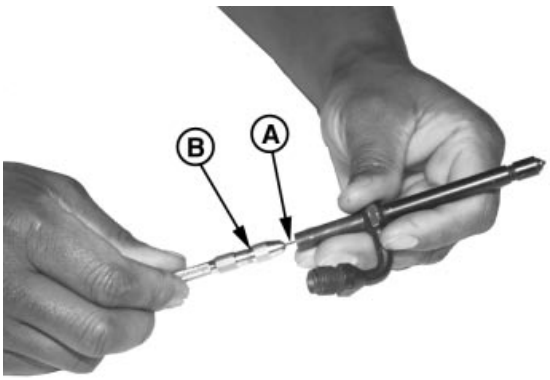
**Continued on next page**

RG41221,00001FC –19–14AUG01–1/2

5. Grasp sac hole drill (A) with valve retractor (B).

6. For final cleaning, use a cleaning wire 0.03 mm (0.001 in.) smaller than the nominal orifice size and repeat steps 2 and 3.

**A—Sac Hole Drill**
**B—Valve Retractor**




*Injection Nozzle Orifices*

RG41221,00001FC –19–14AUG01–2/2

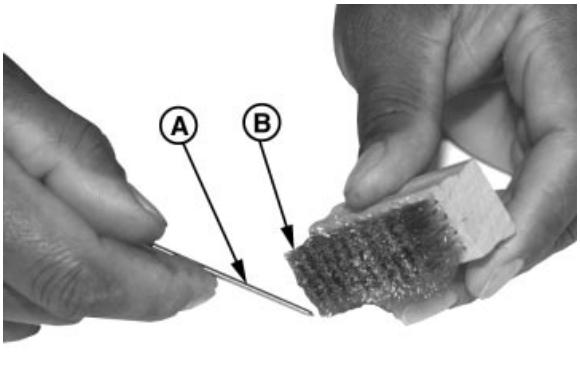
## Inspect and Clean Valve and Valve Seat

**IMPORTANT: NEVER use a steel wire brush on nozzle parts.**

Use brass wire brush (B) to remove deposits from seating area on tip of nozzle valve (A). Use a felt pad to remove varnish deposits.

Inspect guide area for valve scratches which could cause sticking. This area will generally be polished on one side during operation. Visible vertical marks are normal.

**A—Nozzle Valve**
**B—Brass Wire Brush**




*Injection Nozzle Valve and Valve Seat*

**Continued on next page**

RG41221,00001FD –19–17MAY01–1/2

**Inconsistent Chatter or No Chatter**

A nozzle which during test had spotty chatter or showed definite signs of sticking accompanied by low return leakage, may be corrected by polishing the valve guide area as follows:

1. Place a small amount of nozzle lapping compound on the nozzle valve in guide area only. DO NOT use any other compound for this purpose.

2. Slide valve into body (A).

**IMPORTANT: Never attempt to rotate the valve in a motor driven chuck for this purpose.**

3. Grip top of the valve with retractor (B) and rotate valve in the guide by turning retractor. The amount of lapping required can be accomplished in 10—20 turns by hand. The valve should be raised and lowered in the guide every 3—4 revolutions and direction of rotation changed for best results.

4. Wash nozzle body and valve thoroughly in clean fuel before reassembly.

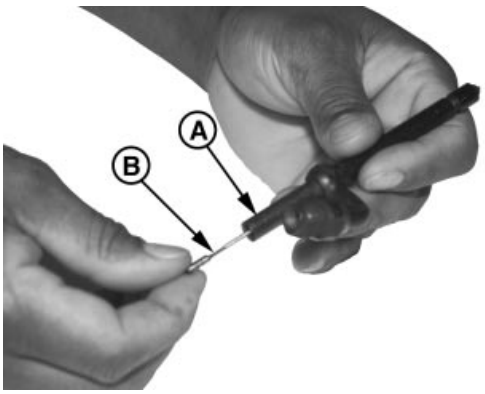
**Seat Leakage**

Seat leakage may be caused by dirt, carbon or fuel deposits in valve area. Inspect valve seat and clean as follows:

1. Apply a small amount of lapping compound to valve tip and insert valve in nozzle body (A).

2. Gripping valve with retractor (B), rotate valve 3—5 turns to clean up seat.

3. Wash valve and nozzle body thoroughly in clean fuel.




RG7803 –UN–11NOV97

*Nozzle Valve in Nozzle Body*

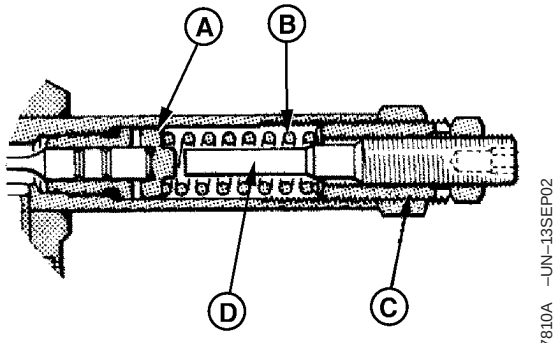
**A—Nozzle Body**
**B—Retractor**

RG41221,00001FD –19–17MAY01–2/2

## Inspect Valve Adjusting Mechanism

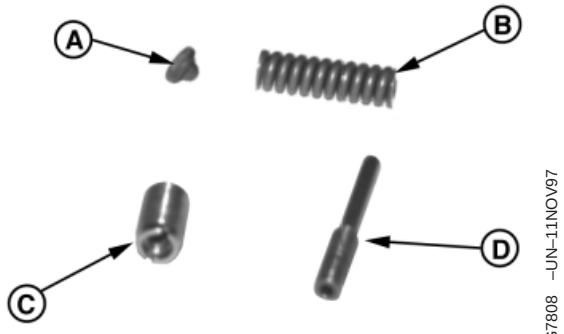
1. Inspect lift adjusting screw (D). Replace if bent or otherwise damaged.
2. Inspect pressure adjusting screw (C). Replace if worn or damaged.
3. Inspect pressure adjusting spring (B). Replace if broken or distorted.
4. Inspect spring seat (A) for wear. Replace as necessary.
5. Replace nozzle clamp if bent.

**A—Spring Seat**
**B—Pressure Adjusting Spring**
**C—Pressure Adjusting Screw**
**D—Lift Adjusting Screw**




RG7810A –UN–13SEP02

*Inspect Nozzle Valve Adjust Mechanism*

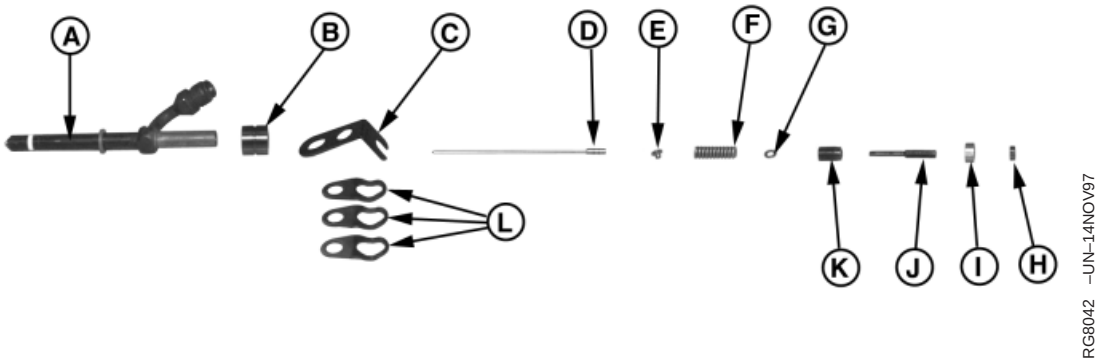



RG7808 –UN–11NOV97

*Inspect Nozzle Valve Adjust Mechanism*

RG41221,00001FE –19–17MAY01–1/1

## Assemble Fuel Injection Nozzles




*Fuel Injection Nozzles*

**A—Nozzle Body**
**B—Spacer**
**C—Indexing Clamp**
**D—Nozzle Valve**
**E—Spring Seat**
**F—Pressure Adjusting Spring**
**G—Washer**
**H—Lift Adjusting Screw Lock Nut**
**I—Pressure Adjusting Screw Lock Nut**
**J—Lift Adjusting Screw**
**K—Pressure Adjusting Screw**
**L—Hold-Down Clamps**

**IMPORTANT: Wear rubber gloves when assembling nozzles.**

1. Install nozzle spacer (B) onto upper nozzle body (A). Position nozzle indexing clamp (C) over upper nozzle body with flanges pointing downward. Install three remaining clamps (L) onto nozzle body.
2. Dip nozzle valve (D) in clean fuel and insert into nozzle body.
3. Thread lift adjusting screw (J) into pressure adjusting screw (K) until top just enters screw.
4. Invert adjusting screw assembly and assemble washer (G), spring (F), and spring seat (E) to adjusting screw.
5. Tilt body, DO NOT allow valve to fall out, and install spring and adjusting screws to body. Be careful not to dislodge spring or seat during initial assembly.
6. Turn pressure adjusting screw (K) down as far as possible by hand, usually about ten full turns.
7. Thread pressure adjusting screw lock nut (I) to pressure adjusting screw finger tight.
8. Thread lift adjusting screw lock nut (H) on lift adjusting screw (J) finger tight.
9. Adjust fuel injection nozzles. See ADJUST FUEL INJECTION NOZZLES later in this Group.

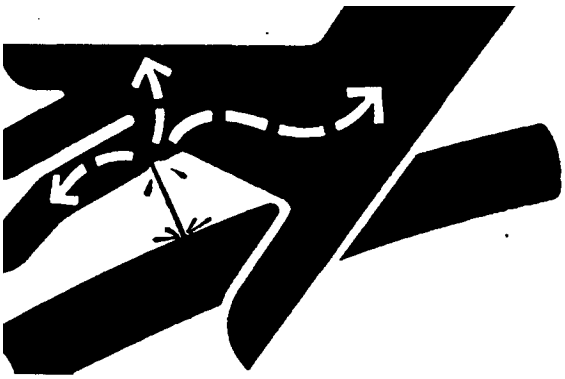
RG41221,00001FF –19–17MAY01–1/1

## Adjust Fuel Injection Nozzles

**CAUTION: Nozzle tip should always be directed away from operator. Fuel from spray orifices can penetrate clothing and skin causing serious personal injury. Enclosing nozzle in a glass beaker is recommended.**

**Before applying pressure to nozzle tester, be sure all connections are tight, and fittings are not damaged. Fluid escaping from a very small hole can be almost invisible. Use a piece of cardboard or wood, rather than hands, to search for suspected leaks.**

**If ANY fluid is injected into the skin, it must be surgically removed within a few hours by a doctor familiar with this type of injury or gangrene may result.**



X9811 –UN–23AUG88

*High Pressure Fluids*

Connect nozzle to nozzle tester. See TEST FUEL INJECTION NOZZLES earlier in this Group.

RG41221,0000200 –19–14AUG01–1/5

### Nozzle Opening Pressure Check

1. Close pressure gauge valve and flush nozzle by operating pump rapidly.
2. Raise pressure on pump until nozzle opens (gauge drops sharply).
3. Refer to nozzle opening pressure specifications below.

**Fuel Injection Nozzles (RE48786)—Specification**

| | |
|---|---|
| New or Reconditioned Nozzle with New Internal Parts—Opening Pressure for Setting | 25,511—26,062 kPa (255—260 bar) (3700—3780 psi) |
| Opening Pressure for Checking (Minimum) | 24,683 kPa (247 bar) (3580 psi) |
| Used Nozzle—Opening Pressure for Checking (Minimum) | 23,511 kPa (235 bar) (3410 psi) |
| Opening Pressure Difference between Cylinders—Pressure Difference (Maximum) | 700 kPa (7 bar) (101.5 psi) |

RG7809 –UN–15JAN98

*Injection Nozzle Tester*

Continued on next page

RG41221,0000200 –19–14AUG01–2/5

**If opening pressure is incorrect:**

1. Remove nozzle from tester and install in holding fixture.
2. Remove lift adjusting lock nut (D).
3. Loosen pressure adjusting screw lock nut (A).
4. Reconnect nozzle to tester with tip pointing downward.
5. Back out lift adjusting screw (B) far enough (two or three turns) to prevent bottoming when pressure adjusting screw (C) is turned.
6. Turn pressure adjusting screw in (clockwise) to increase opening pressure, or out (counterclockwise) to decrease opening pressure using JDG949 Nozzle Wrench.

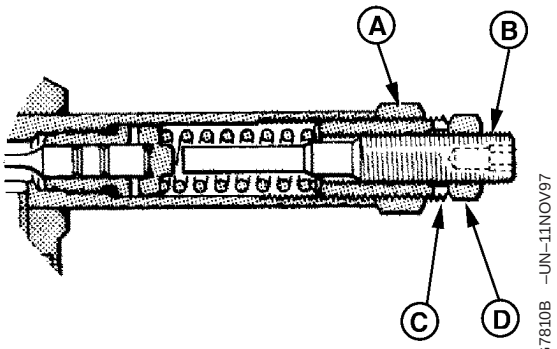
*NOTE: It is desirable to set opening pressure to the high limit of specification. If required, repeat procedure to obtain proper result.*

7. Adjust nozzle opening pressure. See ADJUST FUEL INJECTION NOZZLES earlier in this Group.

   If pressure is still out of specification, repeat steps 5 - 7 until pressure is set to specification.

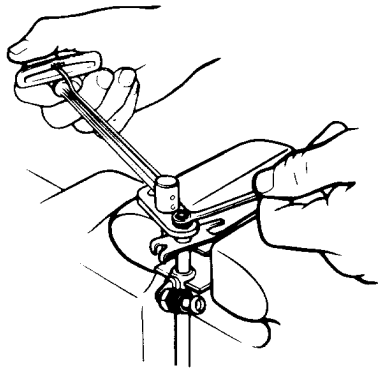
8. Remove nozzle from tester and secure in holding fixture. While holding pressure adjusting screw, tighten pressure adjusting screw lock nut to specifications using a crowsfoot wrench or torque wrench adapter, if available.[1]

| Specification | |
|---|---|
| Injection Nozzle Pressure Adjusting Screw Lock Nut—Torque | 10 N•m (7.4 lb-ft) |




RG7810B –UN–11NOV97

*Adjust Nozzle Pressure*



RG7811 –UN–15JAN98

*Nozzle Pressure Adjusting Screw and Lock Nut*

**A—Pressure Adjusting Screw Lock Nut**
**B—Lift Adjusting Screw**
**C—Pressure Adjusting Screw**
**D—Lift Adjusting Lock Nut**

[1]*If available, ROS18958 (English) or No. 24374 (Stanadyne, Metric) Torque Wrench Adapter (obsolete) can be used.*

**Continued on next page**

**Adjust Nozzle Valve Lift**

1. Reconnect nozzle to tester. While pumping fuel through nozzle, hold pressure adjusting screw and slowly turn lift adjusting screw in (clockwise) until valve ceases to open.

**IMPORTANT: DO NOT manually bottom the valve with excessive force as bending of the valve may result.**

2. Check for valve bottoming by raising opening pressure to 26,063—28,133 kPa (260—280 bar) (3780—4080 psi).

   Although some fuel may collect at nozzle tip, a rapid dribble should not occur.

3. Remove nozzle from tester and install in holding fixture.

4. Carefully turn lift adjusting screw out specified amount. A tolerance of 1/8 turn is permissible.

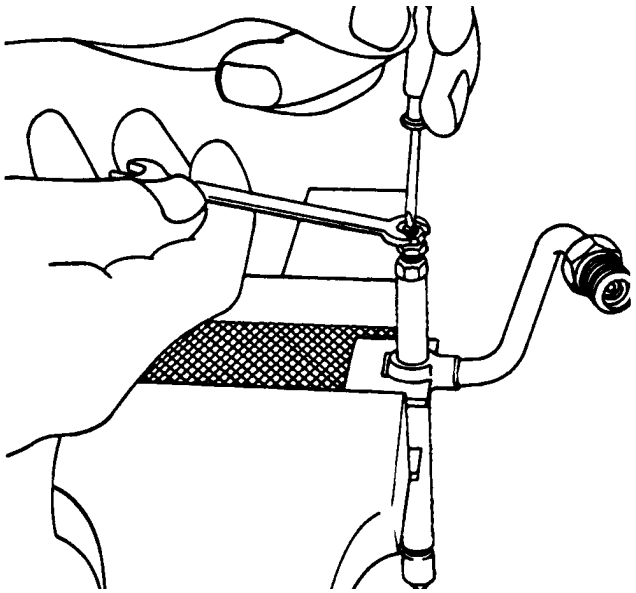
**Specification**

Fuel Injection Nozzle Valve Needle Lift—Needle Lift (Based on Zero Lift) ..... 3/4 Turn Counterclockwise

5. Hold lift adjusting screw stationary and tighten lift adjusting screw lock nut to specifications. Use a crowsfoot wrench or torque wrench adapter, if available.[1]

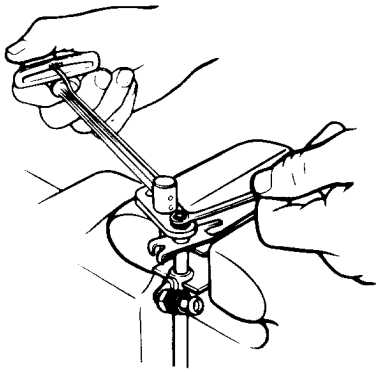
**Specification**

Fuel Injection Nozzle Lift Adjusting Screw Lock Nut—Torque ..... 5 N•m (3.7 lb-ft) (44 lb-in.)



RG9103 –UN–31MAR98

*Injection Nozzle Valve Lift Adjustment*



RG7811 –UN–15JAN98

*Nozzle Pressure Adjusting Screw and Lock Nut*

*[1]If available, ROS18958 (English) or No. 24374 (Stanadyne, Metric) Torque Wrench Adapter (obsolete) can be used.*

**Continued on next page**

6. Recheck nozzle opening pressure.

**Fuel Injection Nozzles (RE48786)—Specification**

| | |
|---|---|
| New or Reconditioned Nozzle with New Internal Parts—Opening Pressure for Setting | 25,511—26,062 kPa (255—260 bar) (3700—3780 psi) |
| Opening Pressure for Checking (Minimum) | 24,683 kPa (246 bar) (3580 psi) |
| Used Nozzle—Opening Pressure for Checking (Minimum) | 23,511 kPa (235 bar) (3410 psi) |
| Opening Pressure Difference between Cylinders—Pressure Difference (Maximum) | 700 kPa (7 bar) (100 psi) |

If nozzle chatter is incorrect after servicing, valve parts may be misaligned. To correct, turn lift adjusting screw through its range of adjustment several times and reset valve lift. Recheck nozzle for chatter.

7. Clean nozzle with brass wire brush.



RG41221,0000200 –19–14AUG01–5/5

## Install Seals on Fuel Injection Nozzle

**IMPORTANT: Each time an injection nozzle is removed from the cylinder head, replace carbon stop seal (B) with a new one.**

1. Position JD258 (JD-258) Nozzle Carbon Stop Seal Installer (A) over nozzle tip.
2. Install a new seal washer (C) onto nozzle body.
3. Position a new carbon stop seal (B) on seal installer. Slide the carbon seal until it seats in its groove on nozzle body.

*NOTE: If nozzle is not going to be installed at this time, install a No. 16189 Nozzle Protector Cap over nozzle tip. Plug all other openings in nozzle to prevent contamination.*


RG9096 –UN–27MAR98

*Fuel Injection Nozzle Seals*

**A—Carbon Stop Seal Installer**
**B—Carbon Stop Seal**
**C—Seal Washer**

RG41221,0000201 –19–17MAY01–1/1

## Install Fuel Injection Nozzles

**IMPORTANT: Before installing injection nozzles, make sure nozzles are clean and free from oil or grease.**

02
090
42

*NOTE: If nozzle bore in cylinder head must be cleaned, use JDE39 Nozzle Bore Cleaning Tool See REMOVE FUEL INJECTION NOZZLES earlier in this Group.*

1. Remove plug (if installed previously) from nozzle bore in cylinder head and blow out bore with compressed air.

*NOTE: Make sure that the sealing surface of the cylinder head (on which the seal washer will be resting) is smooth and free of damage or dirt. This could prevent proper sealing. Dirt and roughness could also cause nozzle to be distorted when the attaching screw is tightened, making the valve stick.*

*NOTE: Never lubricate the nozzle tip. Oil on the tip will create sooting of the injector tip. The teflon carbon dam seal will lubricate the nozzle bore as it is being installed.*

2. Install nozzle with spacer and clamps in cylinder head using a slight twisting motion as nozzle is seated in bore. Illustration shows relationship of parts required for proper installation.

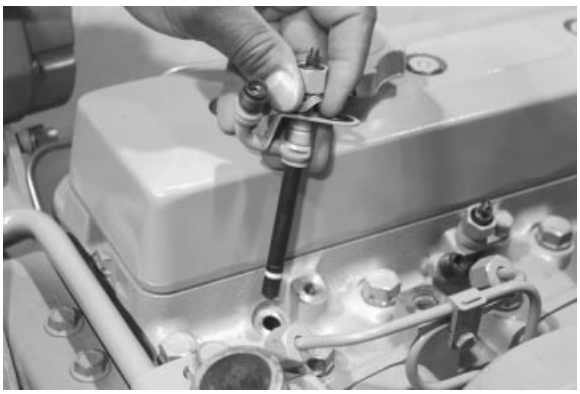
3. Align nozzle clamps and loosely install cap screw. Do not tighten cap screw at this stage.

4. Connect fuel pressure line to nozzle. Leave connection slightly loose until air is bled from system.

5. Tighten nozzle hold-down clamp cap screws to specifications.

**Specification**

Fuel Injection Nozzle Hold-Down
Clamp Cap Screws—Torque..... 40 N•m (30 lb-ft)




*Injection Nozzle in Cylinder Head*

Continued on next page

**IMPORTANT: Do NOT over tighten fuel leak-off hex nut.**

6. Install leak-off line assembly.

**Specification**

Fuel Leak-Off Hex Nut—Torque ..... 5 N•m (3.7 lb-ft) (44 lb-in.)

7. Bleed air from loose injection line connection. See BLEED THE FUEL SYSTEM in Group 150 later in this manual. Tighten connection using two wrenches to the following specifications.

**Specification**

Fuel Injection Nozzle Delivery Line—Torque ..... 27 N•m (20 lb-ft)


*Nozzle Fuel Pressure Line*

RG41221,0000202 –19–17OCT02–2/2

## Engine Control Unit (ECU)

**IMPORTANT: DO NOT pressure wash the Engine Control Unit (ECU).**

**Before welding on engines with ECU, protect the ECU from high-current damage as follows:**

1. **Disconnect ECU-to-vehicle frame ground connection.**
2. **Disconnect all other connectors from ECU. Also disconnect module connector at injector pump.**
3. **Connect welder ground close to welding point and make sure ECU and other electrical components are not in the ground path.**

*NOTE: For diagnosis and testing of the electronic engine control and sensors, refer to Section 04, Group 150 and 160 as required.*

**IMPORTANT: DO NOT OPEN ENGINE CONTROL UNIT.**

*NOTE: The sealed ECU assembly is the system component LEAST likely to fail. Ensure that it is isolated and identified as the defective component before replacing. See operation and test manual for proper troubleshooting procedures.*

The ECU is not repairable. If it is found to be defective, replace it as a unit. Provide the 13-digit engine serial number when ordering a new ECU.

**IMPORTANT: If an ECU is not programmed identically with the original (failed) ECU, misleading diagnostic messages, poor performance, or engine damage can occur.**

The wiring connector for the ECU is repairable. See REPAIR AMP CONNECTORS later in this Group.

*Engine Control Unit (ECU)*

RG10735 –UN–17MAY00

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1

DPSG,OUO1004,1177 –19–17OCT02–1/1

## Remove and Install Engine Coolant Temperature Sensor

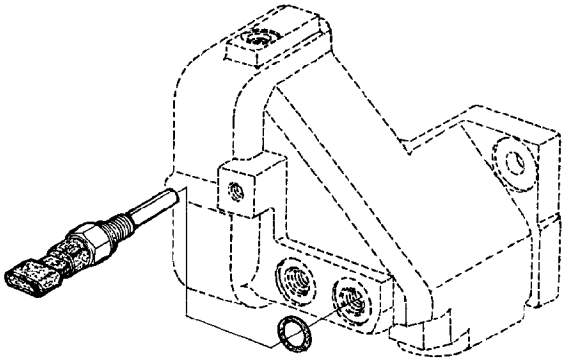


*NOTE: On OEM applications, the ECU uses the ECT sensor in the thermostat housing. Other applications may use the sensor located in the rear of the head.*

1. Disconnect engine coolant temperature sensor wiring connector and remove sensor.
2. Remove engine coolant temperature sensor.
3. Coat sensor O-ring with JDT405 High Temperature Grease and install sensor in thermostat housing or in the rear of the cylinder head. Tighten to specifications.

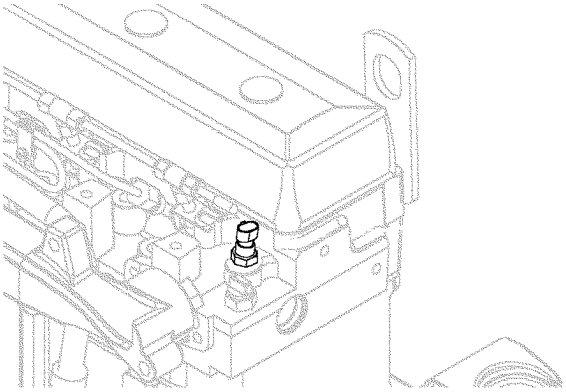
| Specification | |
|---|---|
| Coolant Temperature Sensor (In Thermostat Cover)—Torque | 15 N•m (11 lb-ft) |
| Coolant Temperature Sensor (In Cylinder Head)—Torque | 35 N•m (26 lb-ft) |

4. Install sensor wiring connector.



RG10552 –UN–02DEC99

*Engine Coolant Temperature Sensor in Thermostat Housing*



RG10766A –UN–12JUN01

*Engine Coolant Temperature Sensor in Cylinder Head*

RG,RG34710,269 –19–21MAY01–1/1

## Replace Fuel Pressure Sensor

1. Disconnect electrical connector (B) (shown disconnected).
2. Remove fuel pressure sensor (A).

*NOTE: Plug bore with clean cap plug after removal of sensor.*

3. Replace part as necessary.
4. Install pressure sensor then tighten to specifications.

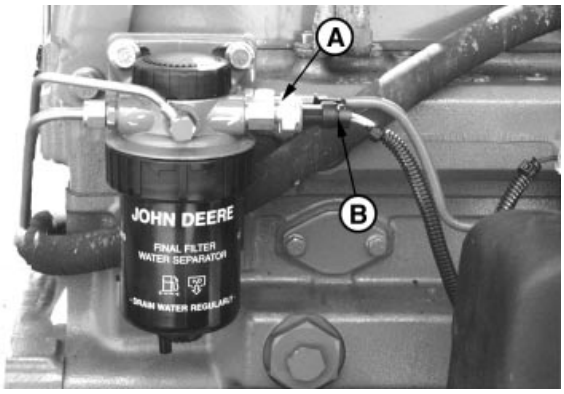
| Specification | |
|---|---|
| Fuel Pressure Sensor (VP44 Pump)—Torque | 8 N•m (6 lb-ft) |

5. Install sensor wiring connector.
6. Bleed fuel system. See BLEED THE FUEL SYSTEM in Group 150 later in this manual.

**A—Pressure Sensor**
**B—Electrical Connector**


RG10721C –UN–04MAY00

*Replace Fuel Pressure Sensor - Tier 1*




RG11720C –UN–20JUN01

*Replace Fuel Pressure Sensor - Tier 2*

RG41221,000010A –19–09MAY01–1/1

## Replace Pump Position Sensor

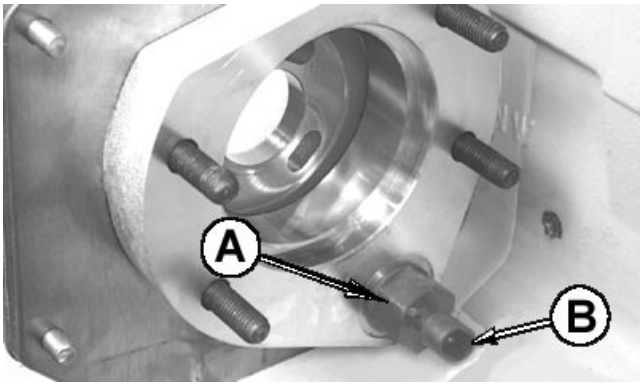
*NOTE: Pump Position sensor (A) can be removed with injection pump installed on engine.*

1. Disconnect wiring harness from electrical connector (B) (shown disconnected).
2. Remove pump position sensor (A). Discard O-ring.
3. Replace part as necessary.
4. Install pump position sensor with a new O-ring and tighten to specifications.

**Specification**

Injection Pump Position Sensor (VP44 Pump)—Torque ..... 14 N•m (10 lb-ft)

5. Install sensor wiring connector.




*Replace Pump Position Sensor*

**A—Pump Position Sensor**
**B—Electrical Connector**

DPSG,OUO1004,2644 –19–10APR00–1/1

## Replace Crankshaft Position Sensor

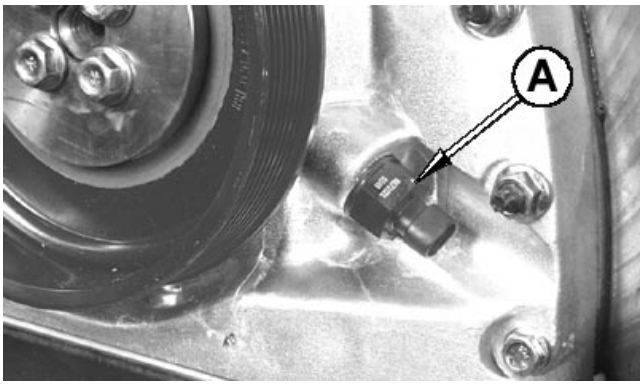
*NOTE: Timing wheel sensor is only used on engines with Bosch VP44 injection pumps.*

1. Disconnect wiring harness connector (shown disconnected).
2. Using a deep well socket, remove crankshaft position sensor (A).
3. Replace sensor and o-ring in timing gear cover. Tighten sensor to specifications.

**Specification**

Crankshaft Position Sensor—Torque ..... 14 N•m (10 lb-ft)

4. Install sensor wiring connector.




*Timing Wheel Sensor (Engines with Bosch VP44 Pumps)*

**A—Timing Wheel Sensor**

DPSG,OUO1004,1127 –19–26OCT99–1/1

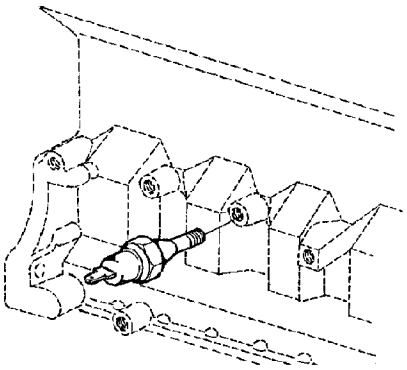
## Remove and Install Oil Pressure Sensor

1. Disconnect oil pressure sensor wiring connector and remove sensor from oil cooler housing.
2. Coat threads of sensor with LOCTITE® 592 Pipe Sealant with TEFLON®. Install sensor in oil cooler housing and tighten to specifications.

**Specification**

Oil Pressure Sensor—Torque ..... 15 N•m (11 lb-ft)

3. Install sensor wiring connector.



RG10550 –UN–02DEC99

*Oil Pressure Sensor*

02
110
5

*LOCTITE is a registered trademark of Loctite Corp.*
*TEFLON is a registered trademark of Du Pont Co.*

DPSG,OUO1004,1178 –19–29NOV99–1/1

## Connectors

Connectors are devices that provide for assembly and disassembly of systems. Connectors should always be serviced using tools designed for that type of connector. A good crimp is important to mechanical and electrical soundness. Repaired connectors should be physically tested by pulling to be sure the contact is firmly attached to the conductor.



**IMPORTANT: If for some reason the connectors are not connected, such as when the fuel injection pump is removed, it is important to protect the connectors from debris.**

Refer to the procedures which follow for repair of various types of connectors.

RG,RG34710,1328 –19–23OCT97–1/1

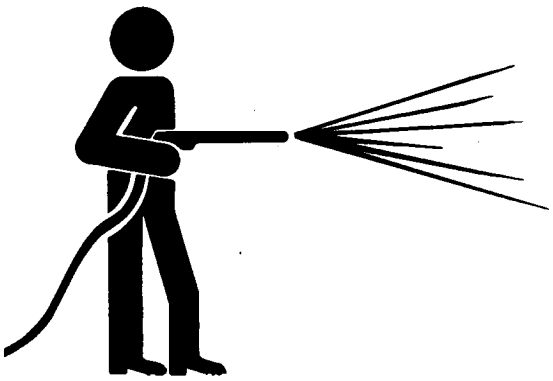
## Use Electrical Insulating Compound

Apply AT66865 Compound directly to the terminals between the wire seal and connector body. This provides a moisture barrier, especially in wet and humid conditions.

RG,RG34710,1335 –19–23OCT97–1/1

## Using High-Pressure Washer

**IMPORTANT: Reduce pressure when directing pressurized water at electronic or electrical components and connectors as this may cause the components to malfunction. Always reduce pressure, and spray at a 45 to 90 degree angle.**



T6642EJ –UN–18OCT88

RG,RG34710,1329 –19–23OCT97–1/1

## Repair WEATHERPACK™ Connector


TS0128 –UN–23AUG88

1. Disconnect WEATHERPACK™ connector. Remove the tie bands and tape.
2. Open the secondary lock on the back of the connector.
3. Identify wire color/number to the connector cavity. Make sure each wire goes back to the correct cavity location.
4. Insert JDG364 Extraction Tool[1] over terminal contact in connector body. Extraction tool needs to be fully seated to unlock terminal tangs from the connector body. When tool is seated, gently pull the wire from the back of the connector. If the wire(s) or terminal(s) are being repaired, go to step 5. If the wires and terminals are OK and only the connector is being replaced, go to step 9.
5. Using JDG145 Universal Electrical Pliers[2], cut off wire directly behind the terminal seal crimp. If any part of the seal is still on the wire, dispose of it.
6. Using JDG145 Universal Electrical Pliers[2], strip 6 mm (1/4 in.) insulation from end of wire.

*WEATHERPACK is a trademark of Packard Electric*

*[1] Included in JT07195B Electrical Repair Kit*

*[2]Included in JDG155 Electrical Repair Tool Kit*

**Continued on next page**

AG,OUOD008,296 –19–06MAR02–1/4

7. Select correct size of seal. Slide the seal over the wire insulation with the smaller diameter side facing the end of the wire. Small diameter side of seal should line up with the outer edge of the insulation.

**IMPORTANT: The seal must fit snug over the cable insulation without a gap between the cable seal and the insulation.**

*NOTE: Cable seals are color coded for three sizes of wire:*

- *Green - 18—20 Gauge Wire*
- *Gray - 14—16 Gauge Wire*
- *Blue - 10—12 Gauge Wire*

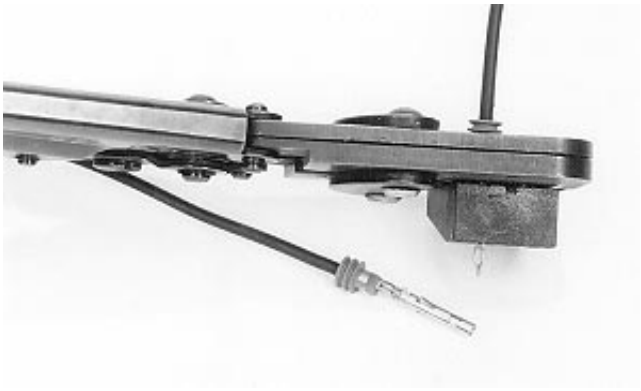
TS0136 –UN–23AUG88

AG,OUOD008,296 –19–06MAR02–2/4

8. Select correct size terminal on wire and crimp in position with a W-type crimp using a JDG783 WEATHER PACK™ Crimping Tool.

*NOTE: Terminals have numbered identification for two sizes of wire:*

- *#15 - 14—16 Gauge Wire*
- *#19 - 18—20 Gauge Wire*



TS1623 –UN–02NOV94

*WEATHER PACK is a trademark of Packard Electric*

**Continued on next page**

AG,OUOD008,296 –19–06MAR02–3/4

9. Insert terminal into connector. Terminal should click when it is fully seated. Make sure the wire is inserted into the correct connector cavity.

**IMPORTANT: Terminal tangs must be carefully spread to ensure good seating on connector body. If terminal is being reused in a new connector, make sure tangs are spread.**

*NOTE: Connector bodies are "keyed" for correct terminals. Be sure terminals are correctly aligned.*

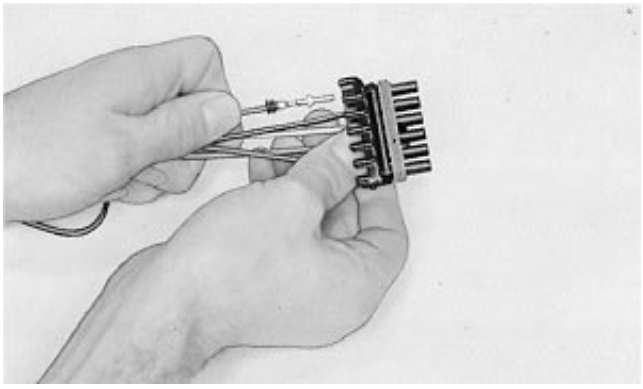
*Correct terminal installation for sleeve (A) and pin (B) is illustrated.*

10. Gently pull on wire to insure that the terminal is locked in position.

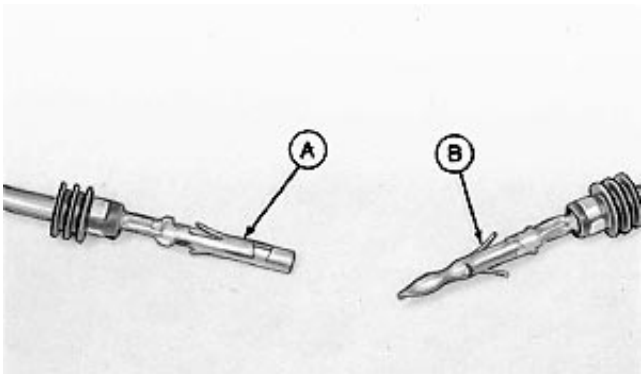
11. Repair or transfer remaining wires.

12. Close the secondary lock on the back of the connector.

13. Retape wires and add the required tie bands to the harness.



TS0130 –UN–23AUG88




TS0139 –UN–02DEC88

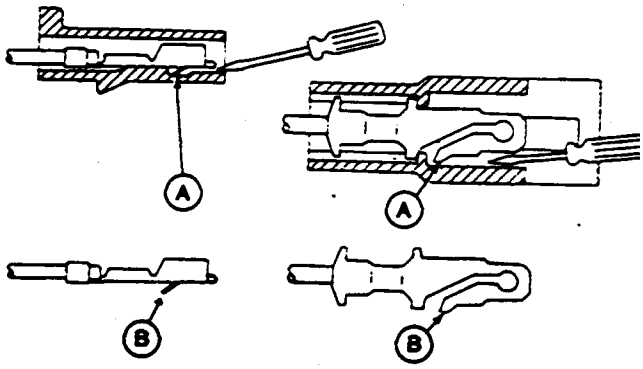
**A—Sleeve**
**B—Pin**

AG,OUOD008,296 –19–06MAR02–4/4

## Remove Blade Terminals from Connector Body

*NOTE: Use JDG776 Extraction Tool with 56, 280, and 630 Series METRI-PACK terminals. Use JDG777 Extraction Tool with 150 Series METRI-PACK terminals.*

1. Insert JDG776 or JDG777 Terminal Extraction Tool[1] into connector body pushing the terminal locking tang inward.
2. Gently pull wire and remove terminal from connector.
3. Adjust the locking tang on the terminal to it's original position before installing into a connector.




RW4218 –UN–23AUG88

**A—Locking Tang**
**B—Original Position**

[1]*Included in JT07195B Electrical Repair Kit*

AG,OUOD008,297 –19–06MAR02–1/1

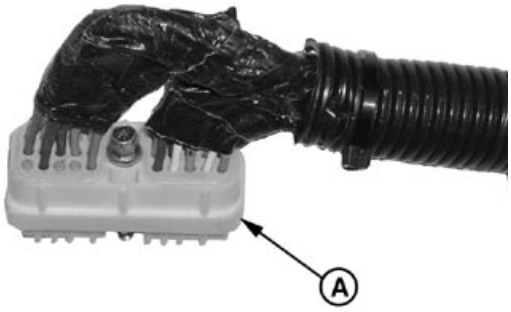
## Repair *(Pull Type)* METRI-PACK™ Connectors

1. Disconnect the METRI-PACK connector (A) from the ECU.
2. Remove tie bands and tape from the wiring harness behind the connector.
3. Identify wire color/number to the connector cavity. Make sure each wire goes back to the correct cavity location.
4. Using JDG776 Terminal Extraction Tool (C)[1], carefully remove the connector seal (B) from the back of the connector.

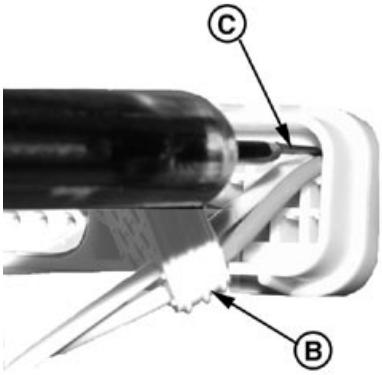
**IMPORTANT: Make sure no damage to the seal occurs or water and contaminants will corrode terminals.**

*NOTE: Extraction tool must be used from the back of the connector.*

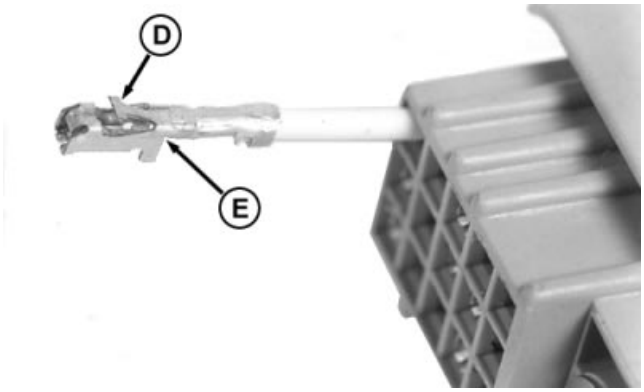
5. Using JDG776 Terminal Extraction Tool (C), angle the tip so it slides along the top edge of the connector. Make sure the extraction tool is centered in the connector cavity and push the tool in until resistance is felt.
6. With extraction tool inserted into the connector, gently rotate tool clockwise and counter-clockwise (no more than 1/8 turn each direction) to depress the terminal locking tang (D).
7. Remove extraction tool from back of connector.
8. Push wire until terminal has extracted from the front of the connector. If terminal does not extract, repeat steps 4-6.




RG12231A –UN–13MAR02




RG12232A –UN–13MAR02




RW16935A –UN–05AUG98

**A—Connector**
**B—Connector Seal**
**C—JDG777 Terminal Extraction Tool**
**D—Terminal Locking Tang**
**E—Terminal**

*METRI-PACK is a trademark of Delphi Packard Electric Systems*

*[1] Included JT07195B Electrical Repair Kit*

**Continued on next page**

9. Using JDG145 Universal Electrical Pliers[1], cut off wire directly behind the terminal.

**IMPORTANT: Save as much wire as possible. If only a couple of wires are shorter than the rest, all of the strain will be placed on them. Damage to the harness may occur.**

10. Using JDG145 Universal Electrical Pliers[1], strip 6 mm (1/4 in.) insulation from end of wire.

11. If wire has been removed from the connector, make sure the wire is fed through the connector (F) and in the correct cavity.

12. Using either JDG783 (G) or JDG707 (H) Crimping Pliers, crimp a new terminal on the wire.

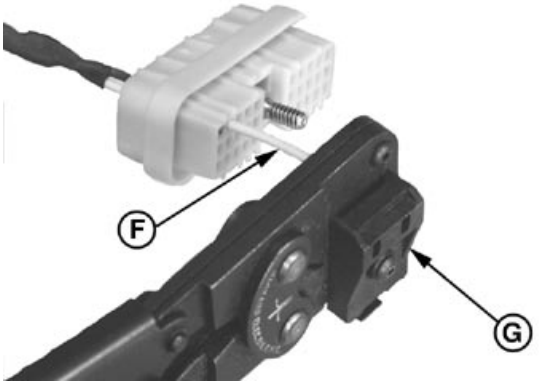
13. Make sure terminal locking tang (D) on new terminal is in outward position. Pull wire back into connector cavity until terminal locks.

*NOTE: Terminal will seat only one way. If terminal does not pull into the connector body socket, check for correct terminal alignment (E).*

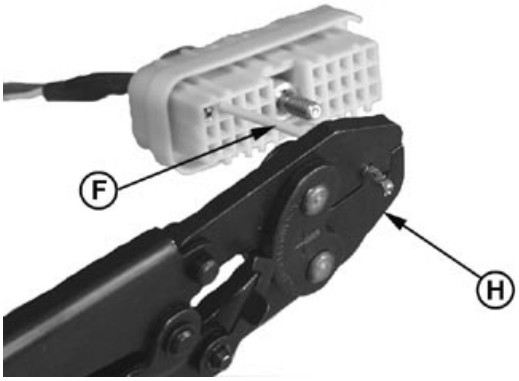
14. Push on the wire to make sure terminal is locked into the connector.

15. Slide the connector seal back into the connector. Make sure seal is in it's original position.

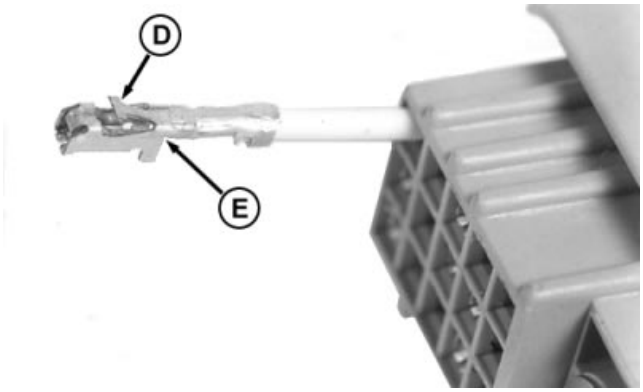
16. Retape the wires and add the required tie bands to the harness.




RG12234A –UN–13MAR02




RG12233A –UN–13MAR02




RW16935A –UN–05AUG98

**D—Terminal Locking Tang**
**E—Correct Terminal Orientation**
**F—Wire**
**G—JDG783 Terminal Crimping Tool**
**H—JDG707 Terminal Crimping Tool**

[1]*Included in JDG155 Electrical Repair Tool Kit*

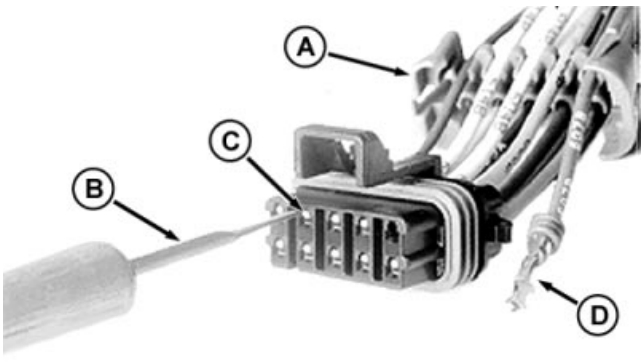
AG,OUOD008,298 –19–06MAR02–2/2

## Repair *(Push Type)* METRI-PACK™ Connectors

1. Disconnect the METRI-PACK connector. Remove the tie bands and tape.
2. Remove secondary lock (A).
3. Identify wire color/number to the connector cavity. Make sure each wire goes back to the correct cavity location.
4. Insert JDG776 or JDG777 Terminal Extraction Tool[1] (B) into connector cavity (C) pushing the terminal locking tab inward.

*NOTE: Use JDG776 Extraction Tool with 56, 280, and 630 Series METRI-PACK terminals. Use JDG777 Extraction Tool with 150 Series METRI-PACK terminals.*

5. Remove extraction tool and pull wire from the back of the connector.
6. Using JDG145 Universal Electrical Pliers[2], cut off wire directly behind the terminal.
7. Using JDG145 Universal Electrical Pliers[2] strip 6 mm (1/4 in.) insulation from end of wire.
8. Select correct size of seal. Slide the seal over the wire insulation with the smaller diameter side facing the end of the wire. Small diameter side of seal should line up with the outer edge of the insulation.




RW77137 –UN–08DEC98

TS0136 –UN–23AUG88

**A—Connector Secondary Lock**
**B—Extraction Tool**
**C—Connector Body Socket**
**D—Terminal**

*METRI-PACK is a trademark of Delphi Packard Electric Systems*

*[1]Included in JT07195B Electrical Repair Kit*

*[2]Included in JDG155 Electrical Repair Tool Kit*

**Continued on next page**

AG,OUOD008,299 –19–06MAR02–1/3

**IMPORTANT: The seal must fit snug over the cable insulation, without a gap between the cable seal and the insulation.**



*NOTE: Cable seals are color coded for three sizes of wire:*

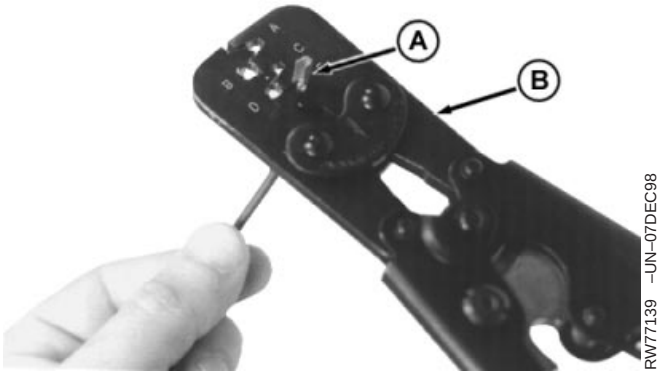
- *Green - 18—20 Gauge Wire*
- *Gray - 14—16 Gauge Wire*
- *Blue - 10—12 Gauge Wire*

9. Select correct size contact for wire.

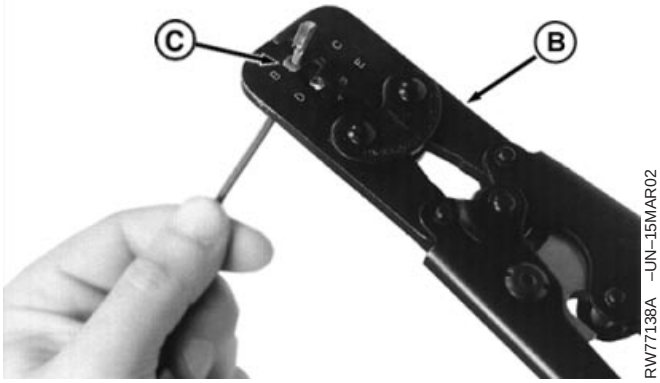
**Continued on next page**

10. Crimp contact (A) on wire with a “W” type crimp using JDG865 Crimping Tool (B).
11. Crimp cable seal (C) on contact using JDG865 Crimping Tool (B).
12. Make sure locking tang (D) on the new terminal is in the outward position.
13. Push terminal into the correct connector cavity until terminal locks.
14. Gently pull on wire to verify terminal is locked into the connector.
15. Place the secondary lock back on the connector.
16. Retape the wires and add the required tie bands to the harness.

**A—Contact**
**B—Tool**
**C—Cable Seal**
**D—Terminal Locking Tang**




RW77139 –UN–07DEC98




RW77138A –UN–15MAR02


RW77140A –UN–15MAR02

AG,OUOD008,299 –19–06MAR02–3/3

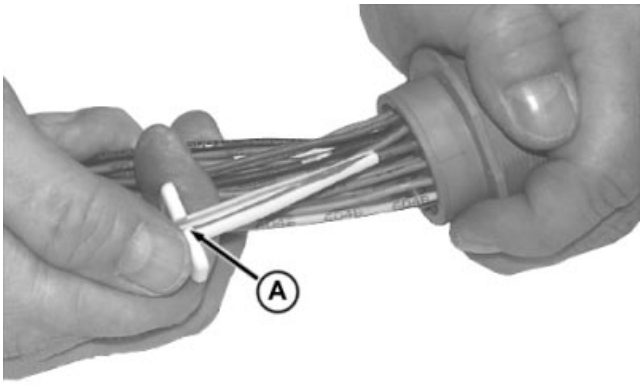
## Repair DEUTSCH™ Connectors



1. Disconnect the Deutsch connector. Remove the tie bands and tape.
2. Identify wire color/number to the connector cavity. Make sure each wire goes back to the correct cavity location.
3. Select correct size extractor tool for size of wire to be removed:
   - JDG361 Extractor Tool - 12—14 Gauge Wire[1]
   - JDG362 Extractor Tool - 16—18 Gauge Wire[1]
   - JDG363 Extractor Tool - 20 Gauge Wire[2]
   - JDG785 Extractor Tool - 6-8 Gauge Wire[3]
4. Start inserting the wire into the handle end (A) of the correct size extraction tool.
5. Slide extraction tool rearward along wire until tool tip snaps onto wire.

**IMPORTANT: DO NOT twist tool when inserting in connector.**

6. Slide extraction tool along wire into connector body until tool is positioned over terminal contact.
7. Pull wire from connector body using extraction tool.
8. Using JDG145 Universal Electrical Pliers[4] cut off wire directly behind the terminal.
9. Using JDG145 Universal Electrical Pliers[4], strip 6 mm (1/4 in.) insulation from end of wire.




RW77142 –UN–07DEC98

**A—Handle**

*DEUTSCH is a trademark of Deutsch Company*

*[1]Included in JT07195B Electrical Repair Tool Kit and JDG359 DEUTSCH Electrical Repair Kit*

*[2]Included in JDG359 DEUTSCH Electrical Repair Kit*

*[3]Included in JT07195B Electrical Repair Tool Kit*

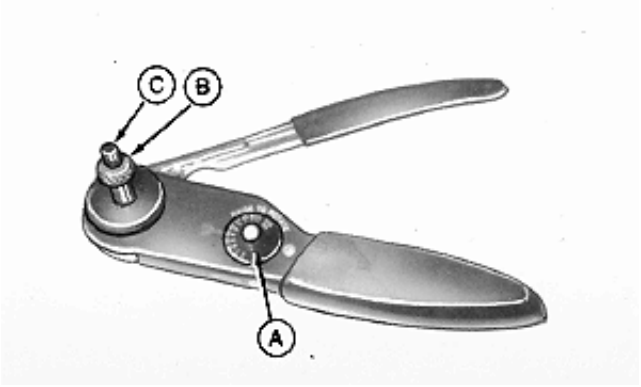
*[4]Included in JDG155 Electrical Repair Tool Kit*

**Continued on next page**

10. Adjust selector (A) on JDG360 Crimping Tool[1] for correct wire size .

11. Loosen lock nut (B) and turn adjusting screw (C) in until screw stops.

**A—Selector**
**B—Lock Nut**
**C—Adjusting Screw**




TS117 –UN–23AUG88

[1]*Included in JDG359 Electrical Repair Kit*

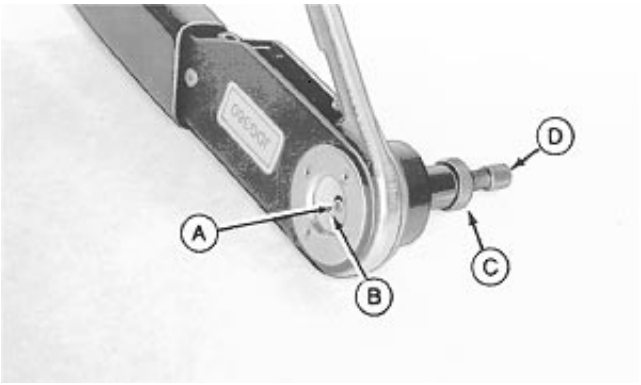
AG,OUOD008,304 –19–26MAR02–2/4

12. Insert terminal (A) and turn adjusting screw (D) until terminal is flush with cover (B).

**IMPORTANT: Select correct size terminal to fit connector body.**

13. Tighten lock nut (C).

**A—Terminal**
**B—Cover**
**C—Lock Nut**
**D—Adjusting Screw**




TS0134 –UN–23AUG88

**Continued on next page**

AG,OUOD008,304 –19–26MAR02–3/4

14. Insert wire in terminal and crimp until handle contacts stop.

**IMPORTANT: Terminal must remain centered between indenters while crimping.**

15. Release handle and remove terminal.

16. Inspect terminals to ensure all wires are in crimped barrel.

**IMPORTANT: If all wire strands are not crimped into terminal, cut off wire at terminal and repeat terminal installation procedures.**

*NOTE: Readjust crimping tool for each crimping procedure.*

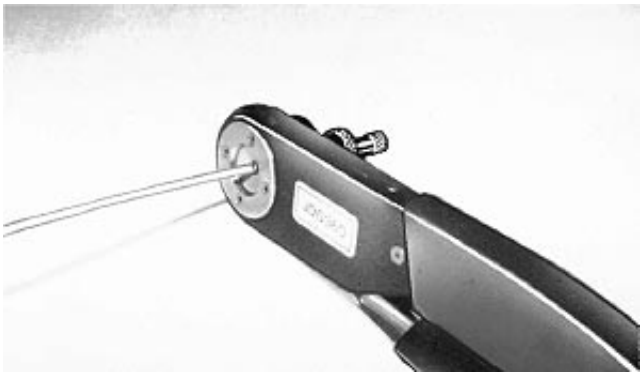
17. Push terminal straight into correct connector cavity until positive stop is felt.

**IMPORTANT: Install terminal in correct connector cavity using correct size grommet.**

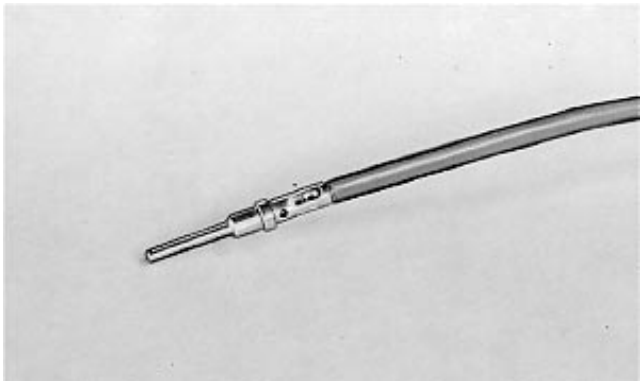
18. Gently pull on wire to verify terminal is locked into the connector.

19. Transfer remaining wires to correct cavity in new connector.

20. Retape the wires and add the required tie bands to the harness.



TS118 –UN–23AUG88

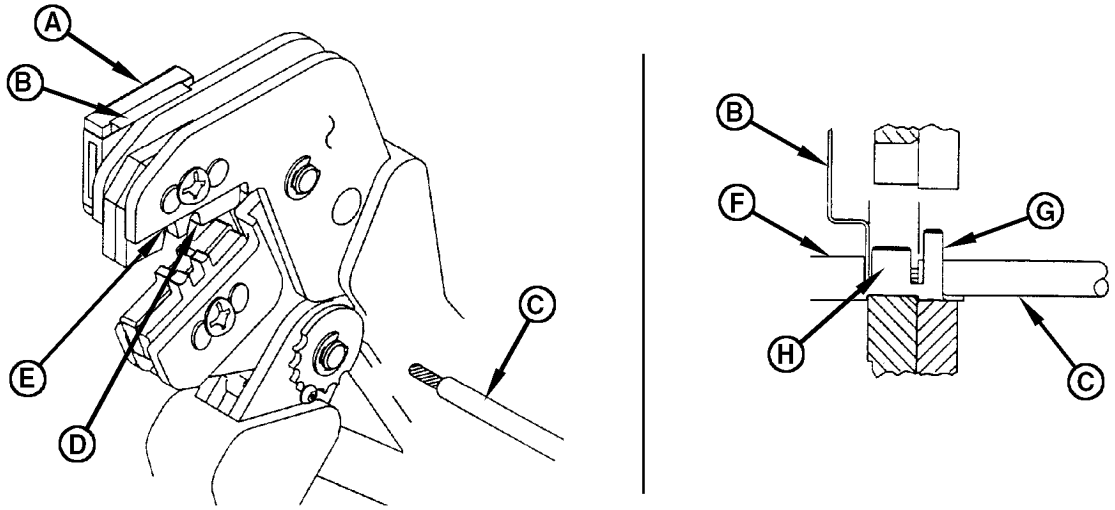


TS0135 –UN–23AUG88

RW77141 –UN–07DEC98

AG,OUOD008,304 –19–26MAR02–4/4

## Repair AMP Connector




RG10742 –UN–31MAY00

**A—Locator Assembly**
**B—Locator**
**C—Wire**
**D—Crimping Slot**
**E—Crimping Slot**
**F—Terminal**
**G—Insulation Barrel**
**H—Wire Barrel**

1. Disconnect AMP connector. Remove the tie bands and tape.

2. Identify wire color/number to the connector cavity. Make sure the each wire goes back into the correct cavity location.

3. Press JDG1369 Terminal Extraction Tool into face of connector and remove wire and terminal from back of connector.

*NOTE: Verify wire stripping length and crimp height before using AMP crimping tool. See instructions provided with tool.*

4. Strip new wire to length indicated in tool instructions. Do not nick or cut wire strands.

5. Hold JDG708 AMP Crimping Tool so that the back (wire side) is facing you. Squeeze tool handles together and allow them to open fully.

*NOTE: See instructions provided with tool to determine which crimping slot (D or E) to use.*

6. Holding the terminal (F) by the mating end, insert the insulation barrel (G) first, through the front of the tool and into the appropriate crimp slot (D or E).

**IMPORTANT: Make sure that both sides of the insulation barrel (G) are started evenly into the crimping section. Do NOT attempt to crimp an improperly positioned terminal.**

7. Position the terminal so that the open “U” of the wire and insulation barrels (H and G) face the top of the tool. Place the terminal up into the nest so that the movable locator (B) drops into the slot in the terminal as shown. Butt the front end of the wire barrel (H) against the movable locator.

8. Hold the terminal (F) in position and squeeze the tool handles together until ratchet engages sufficiently to hold the terminal in position. DO NOT deform insulation barrel or wire barrel.

9. Insert stripped wire (C) into terminal insulation and wire barrels until it is butted against the wire stop.

Continued on next page

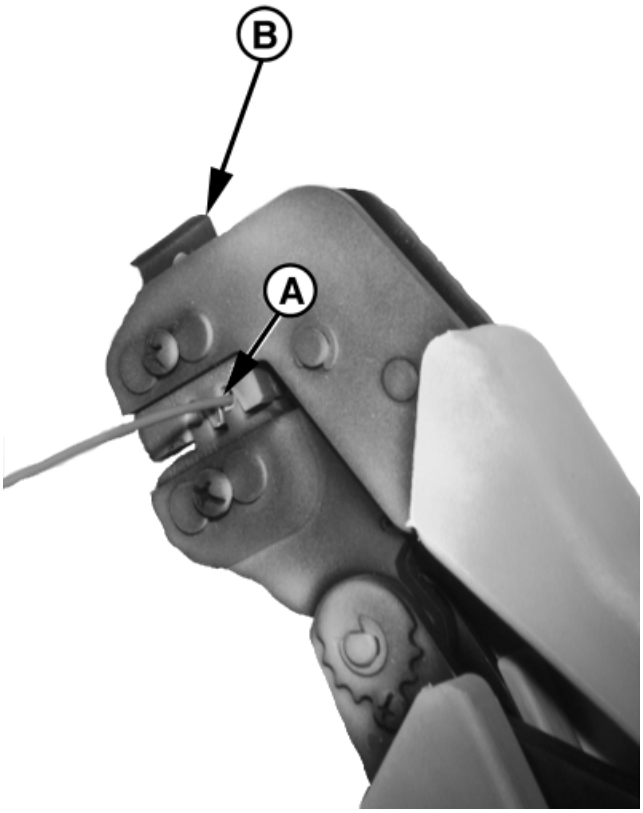
10. Hold the wire and terminal (A) in place. Squeeze tool handles together until ratchet releases. Allow tool handles to open and remove crimped terminal.

*NOTE: The crimped terminal may stick in the crimping area. It can be easily removed by pushing downward on the top of the locator (B).*

11. Install wire in correct connector cavity.

12. Retape the wires and add the required tie bands to the harness.

**A—Wire and Terminal**
**B—Locator**




T112335E –UN–15MAR02

DPSG,OUO1004,2867 –19–06MAR02–2/2

# Section 03
# Theory of Operation

## Contents

# Group 130
# Electronic Fuel System Operation

## About this Group

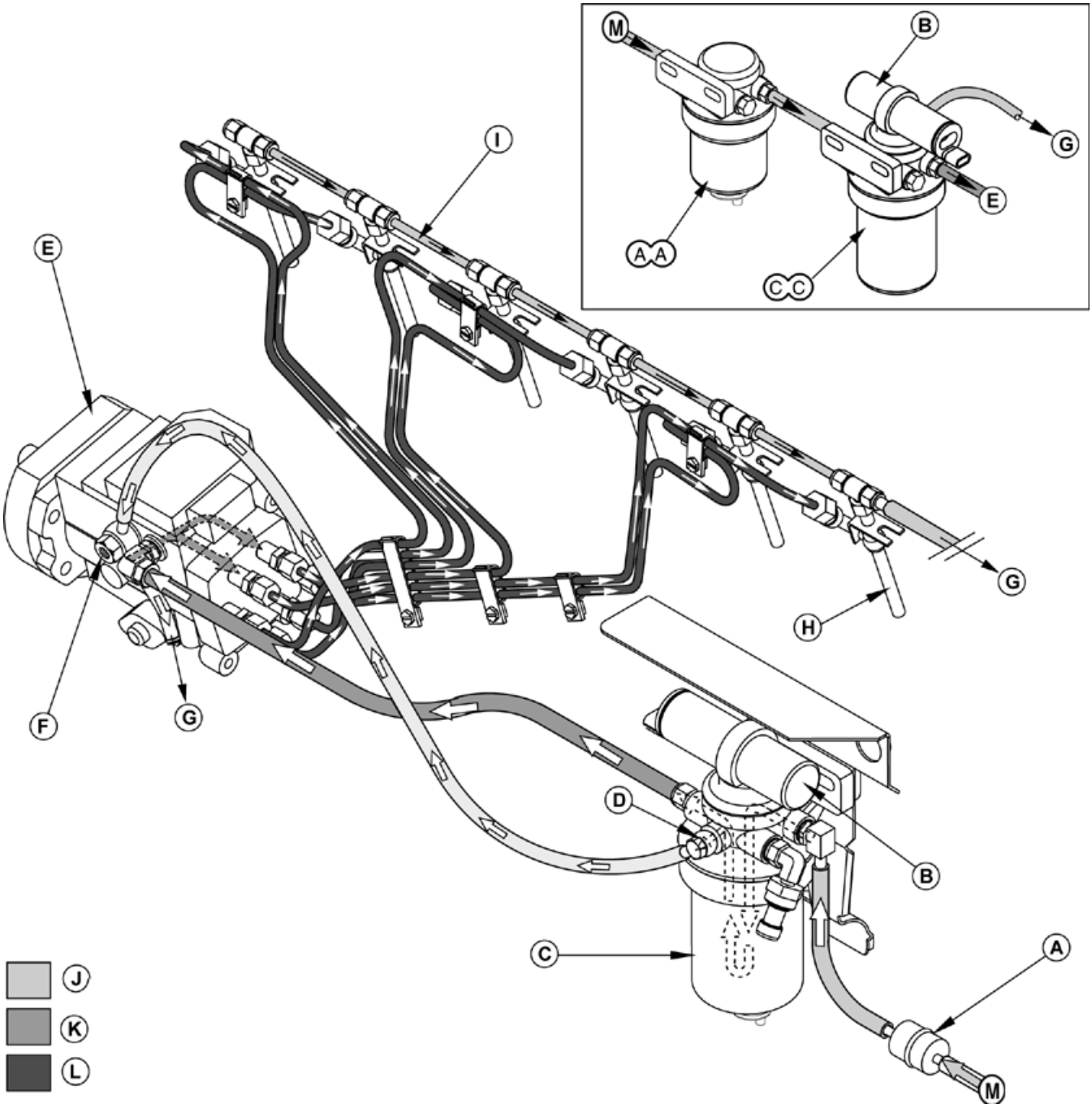
In this group, the fuel system information is described in the following categories:

- Fuel System Operation - Tier 1
- Fuel System Operation - Tier 2
- Primary Fuel Filter Operation - Tier 1
- Primary Fuel Filter Operation - Tier 2
- Final Fuel Filter Operation - Tier 1
- Final Fuel Filter Operation - Tier 2
- Fuel Injection Pump Operation
- Fuel Injection Nozzle Information



DPSG,RG40854,663 –19–25MAY00–1/1

## Fuel System Operation - Tier 1




**A—Primary Filter**
**B—Fuel Transfer Pump**
**C—Final Filter/Water Separator**
**D—Air Bleed-off Valve**
**E—Fuel Injection Pump**
**F— Injection Pump Overflow Valve**
**G—Return to Tank Fuel Line**
**H—Fuel Injection Nozzle**
**I—Fuel Return Leak-off Line**
**J—Return Pressure Fuel**
**K—Transfer Pump Pressure Fuel**
**L—Injection Pump Pressure Fuel**
**M—Inlet From Fuel Tank**
**AA—Primary Filter/Water Separator**
**CC—Final Filter**

**Continued on next page**

RG41221,000010D –19–17OCT02–1/2

*NOTE: For information on Tier 1 vs. Tier 2 applications, see ENGINE APPLICATION CHART in Group 001 earlier in this manual.*

The fuel transfer pump (B) draws fuel from the tank (M) through the primary fuel filter (A) by pressurizing the fuel. Once the fuel is pressurized in the transfer pump, it travels through the final filter with a water separator (C) to the fuel injection pump (E). Air and excess fuel are bled out of the system at the final filter through an air bleed-off valve (D). Fuel is then routed through a fuel return line that is connected to the overflow valve (F) on the injection pump. This fuel returns to the fuel tank (G) after going through a fuel cooler.

On some applications, the fuel transfer pump (B) draws fuel from the tank (M) through the primary fuel filter with a water separator (AA). The fuel travels through the final filter (CC) to the injection pump (E). The transfer pump, primary filter, and final filter are located on the side opposite of the injection pump. An air bleed-off valve (D) is located at the final filter. On these applications, air and excess fuel is routed directly to the fuel tank (G).

The fuel injection pump raises the required fuel pressure for injection. This high pressure fuel is routed through the delivery (pressure) lines to the fuel injection nozzles (H). If there is excess fuel in the injection pump, it is released through an overflow valve and returned to tank. On all applications, this fuel is routed through a fuel cooler before returning to the fuel tank.

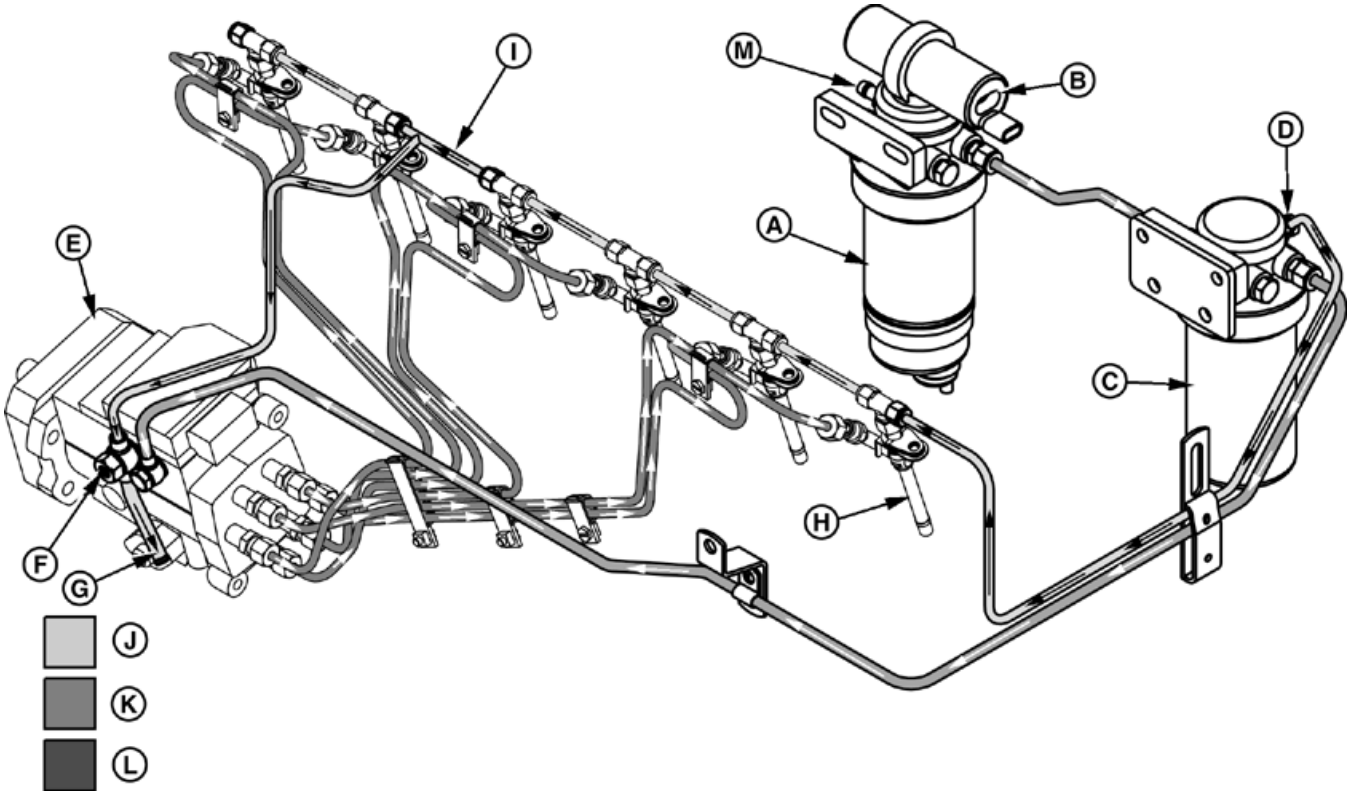
Once fuel enters the injection nozzle (H), it overcomes the nozzle valve, and fuel is forced out a small orifice in the nozzle tip. This allows for fuel to atomize as it enters the combustion chamber. Excess fuel from the nozzles is first routed through the fuel return leak-off line (I) and then through the return to tank fuel line (G).



RG41221,000010D –19–17OCT02–2/2

## Fuel System Operation - Tier 2






RG11709A –UN–24OCT02

**A—Primary Filter**
**B—Fuel Transfer Pump**
**C—Final Filter/Water Separator**
**D—Air Bleed-off Valve**
**E—Fuel Injection Pump**
**F— Injection Pump Overflow Valve**
**G—Return to Tank Fuel Line**
**H—Fuel Injection Nozzle**
**I—Fuel Return Leak-off Line**
**J—Return Pressure Fuel**
**K—Transfer Pump Pressure Fuel**
**L—Injection Pump Pressure Fuel**
**M—Inlet From Fuel Tank**

*NOTE: For information on Tier 1 vs. Tier 2 applications, see ENGINE APPLICATION CHART in Group 001 earlier in this manual.*

The fuel transfer pump (B) draws fuel from the tank (M) through the primary fuel filter (A) by pressurizing the fuel. Once the fuel is pressurized in the transfer pump, it travels through the final filter with a water separator (C) to the fuel injection pump (E). Air and excess fuel are bled out of the system at the final filter through an air bleed-off valve (D). Fuel is then routed through a fuel return line that is connected to the overflow valve (F) on the injection pump. This fuel returns to the fuel tank (G) after going through a fuel cooler.

The fuel injection pump raises the required fuel pressure for injection. This high pressure fuel is routed through the delivery (pressure) lines to the fuel injection nozzles (H). If there is excess fuel in the injection pump, it is released through an overflow valve and returned to tank. On most applications, this fuel is routed through a fuel cooler before returning to the fuel tank. Some applications use a fuel cooler on the supply side of the fuel tank.

Once fuel enters the injection nozzle (H), it overcomes spring pressure in the nozzle valve and is forced out of small orifices in the nozzle tip. This process atomizes the fuel as it enters the combustion chamber. Excess fuel from the nozzles is routed through the fuel return leak-off line (I) and out the return to tank fuel line (G).

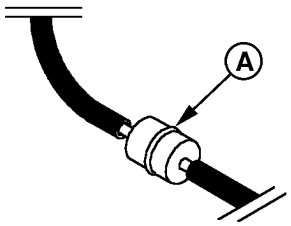
RG41221,0000101 –19–17OCT02–1/1

## Primary Fuel Filter Operation - Tier 1

*NOTE: For information on Tier 1 vs. Tier 2 applications, see ENGINE APPLICATION CHART in Group 001 earlier in this manual.*

The primary filter (A) is a 150 micron filter, which screens particles out of the fuel system before they reach the transfer pump. The filtered fuel is routed through the final fuel filter and then to the injection pump.

**A—Primary Filter**




RG11053A –UN–12JUN01



RG41221,000010F –19–17OCT02–1/1

## Primary Fuel Filter Operation - Tier 2

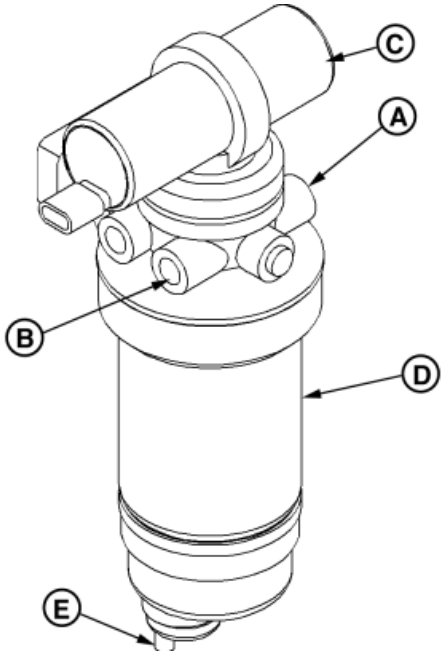
*NOTE: For information on Tier 1 vs. Tier 2 applications, see ENGINE APPLICATION CHART in Group 001 earlier in this manual.*

*NOTE: Some Tier 2 applications use a remote mounted fuel filter.*

The primary filter is a 30 micron filter, which screens particles out of the fuel system. This filter can either be mounted on the engine or on the frame of the machine. The fuel transfer pump (C) draws fuel from the fuel tank, into the primary fuel filter inlet (A), through the filter element (D), and out the filter outlet (B). The filtered fuel is routed through the final fuel filter and then to the injection pump.

A filter drain (E) is located on the bottom of the filter element. This is used to drain excess fuel and water from the filter.

A Water in Fuel (WIF) Sensor is located on the filter header with the probe next to the filter drain on Marine engines only. For more WIF sensor information, see WATER IN FUEL (WIF) SENSOR in Section 03, Group 140 later in this manual.




RG11710A –UN–12JUN01

**A—Primary Fuel Filter Inlet**
**B—Primary Fuel Filter Outlet**
**C—Fuel transfer pump**
**D—Filter element**
**E—Filter drain**

RG41221,0000102 –19–17OCT02–1/1

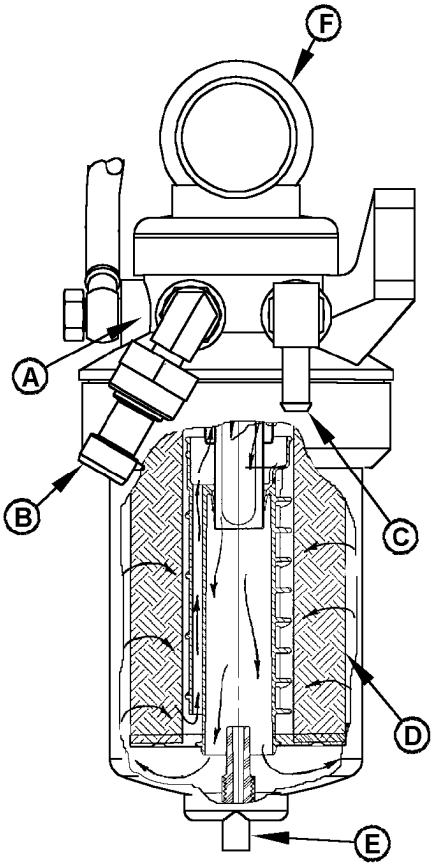
## Final Fuel Filter Operation - Tier 1

*NOTE: For information on Tier 1 vs. Tier 2 applications, see ENGINE APPLICATION CHART in Group 001 earlier in this manual.*

The final fuel filter is a 5 micron filter. The transfer pump (F) draws fuel from the fuel tank through the primary filter. Fuel enters the final filter at inlet (C), then flows through the center filter element (D) and exits through outlet (reverse side, not shown) to the fuel injection pump. Air or excess fuel is expelled through the bleed-off valve (A). Depending on the application, it runs through a fuel line that either connects with the return to tank fuel line from the overflow of the injection pump or it runs directly to the fuel tank.

The filter element is housed in a sediment bowl attached to the base with a threaded retaining ring. Since water and contaminants settle at the bottom of the sediment bowl, a drain plug (E) is provided. Depending on application, a water separator bowl for drainage may be attached to either the final or primary filter.

The final filter base houses the fuel pressure sensor (B). For more information on the fuel pressure sensor, see MEASURING PRESSURE in Group 140, later in this manual.




RG11054A –UN–12JUN01

**A—Bleed Valve**
**B—Fuel Pressure Sensor**
**C—Fuel Inlet**
**D—Filter Element**
**E—Drain Plug**
**F—Transfer Pump**

RG41221,000010E –19–17OCT02–1/1

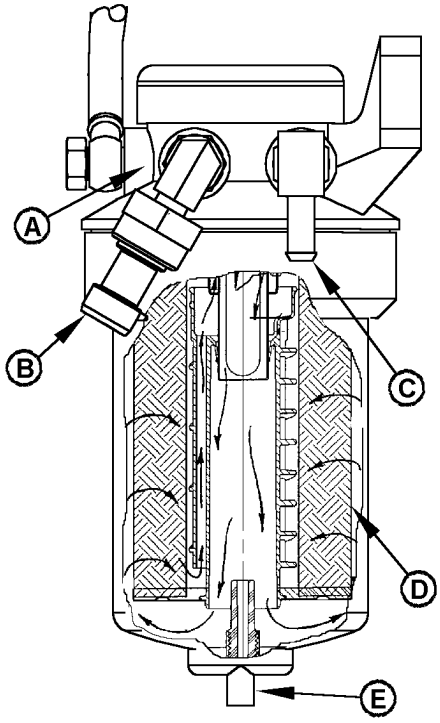
## Final Fuel Filter Operation - Tier 2

*NOTE: For information on Tier 1 vs. Tier 2 applications, see ENGINE APPLICATION CHART in Group 001 earlier in this manual.*

The final fuel filter is a 5 micron filter. The transfer pump draws fuel from the fuel tank through the primary filter. Fuel enters the final filter at inlet (C), then flows through the center filter element (D) and exits through outlet (reverse side, not shown) to the fuel injection pump. Air or excess fuel is expelled through the bleed-off valve (A) routing the fuel back to the fuel tank. Depending on the application, the fuel may route through a fuel cooler prior to the tank.

The filter element is housed in a sediment bowl attached to the base with a threaded retaining ring. Since water and contaminants settle at the bottom of the sediment bowl, a drain plug (E) is provided. Depending on application, a water separator bowl for drainage may be attached to either the final or primary filter.

The final filter base houses the fuel pressure sensor (B). For more information on the fuel pressure sensor, see MEASURING PRESSURE in Group 140, later in this manual.



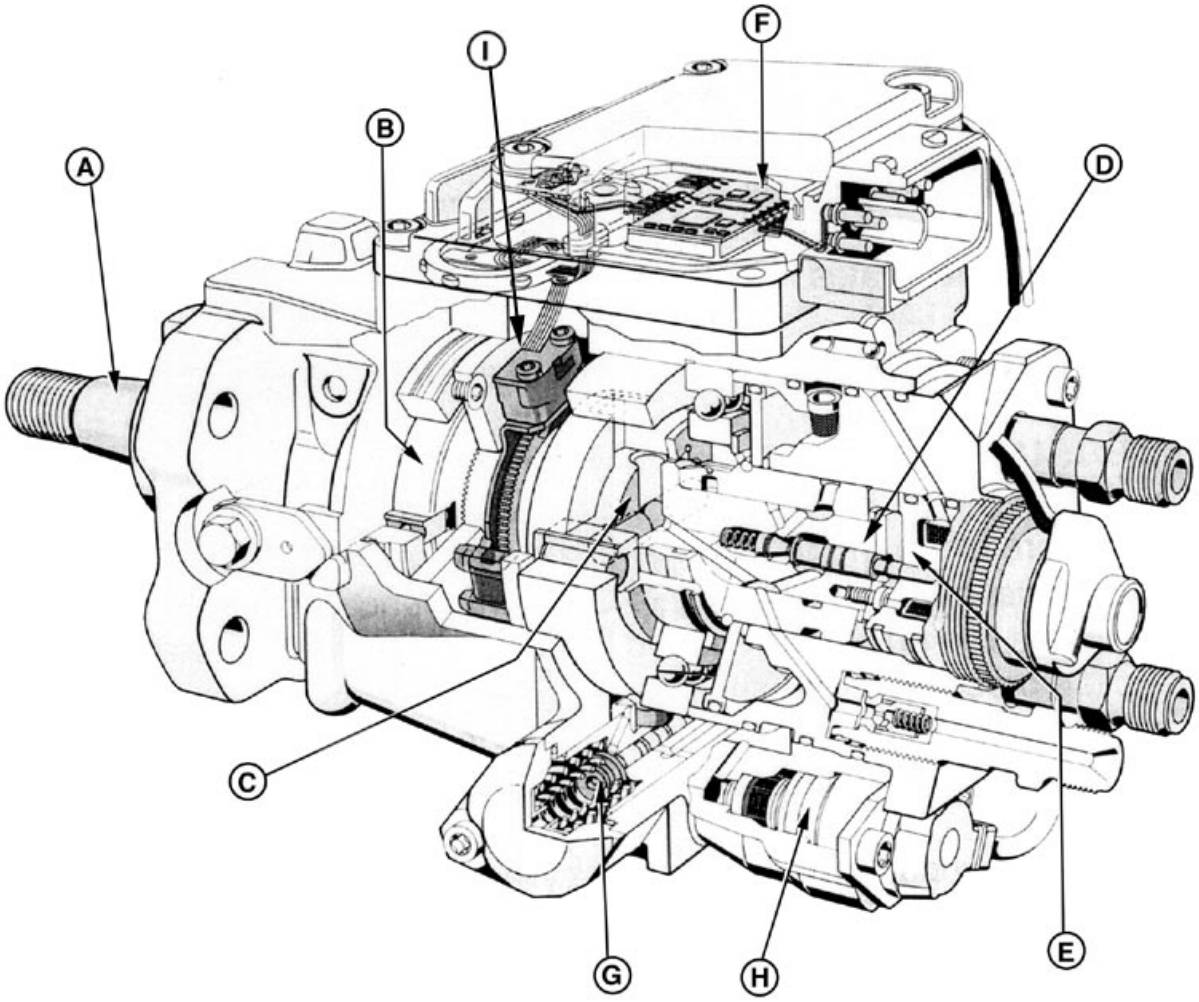

RG11711A –UN–12JUN01

**A—Bleed Valve**
**B—Fuel Pressure Sensor**
**C—Fuel Inlet**
**D—Filter Element**
**E—Drain Plug**

RG41221,0000103 –19–17OCT02–1/1

## Fuel Injection Pump Operation






RG11052 –UN–15AUG01

**A—Driveshaft**
**B—Supply Pump**
**C—Radial Piston High-Pressure Pump**
**D—Distributor Shaft**
**E—High Pressure Solenoid Valve**
**F—Pump Control Unit**
**G—Timing Device**
**H—Timing Solenoid Valve**
**I—Angle of Rotation Sensor**

*NOTE: The above illustration has been reprinted with permission from Robert Bosch Corporation.*

The main components of the Bosch VP44 fuel injection pump are the driveshaft (A), the supply pump (B), radial plunger pump (C), distributor shaft (D), advanced piston timing device (G), and pump control unit (F). The crankshaft drives the driveshaft using gears between the two components. The rotation of the driveshaft moves the supply pump, radial plunger pump, and distributor shaft since all of these components are engaged.

**Continued on next page**

The vane-type fuel supply pump draws fuel from the final filter and with each revolution delivers a constant quantity of fuel to the radial plunger pump. Since the supply pump pressure is a function of pump speed, it is necessary to prevent excessive pressure in the housing at high speeds. A pressure control valve is used to regulate the fuel pressure in the pump housing. If the fuel pressure exceeds the threshold, the valve opens to relieve the excess supply pressure. This fuel is then routed back to the fuel inlet side of the pump.

The radial piston high-pressure pump generates injection pressure for each cylinder. This pump includes a cam ring, plungers, and high pressure solenoid valve (E) to help create the requested high pressure. Fuel at supply pressure enters the radial plunger pump. The amount of fuel entering the radial plunger pump chamber is controlled by the position of the high pressure solenoid valve. Excess fuel is released out of the overflow valve. The plungers are located inside the rotating distributor shaft and move inward and outward by the lobes on the cam ring. When the plungers are forced inward by their rotation within the cam lobes, the fuel reaches injection pressure. The fuel at injection pressure is released when the slot in the distributor shaft is aligned with the high pressure outlet. The fuel travels from the outlet, through the high pressure fitting, to the fuel injection nozzles.

The advanced piston timing device (G) controls when injection pressure is created. The main components associated with the timing device are the timing device piston, control plunger, cam ring, and the timing solenoid valve (H). The cam ring has a small ball pivot at its base that rides within a slot inside the timing device piston. This allows the axial movement of the timing piston to be converted into rotational movement of the cam ring.

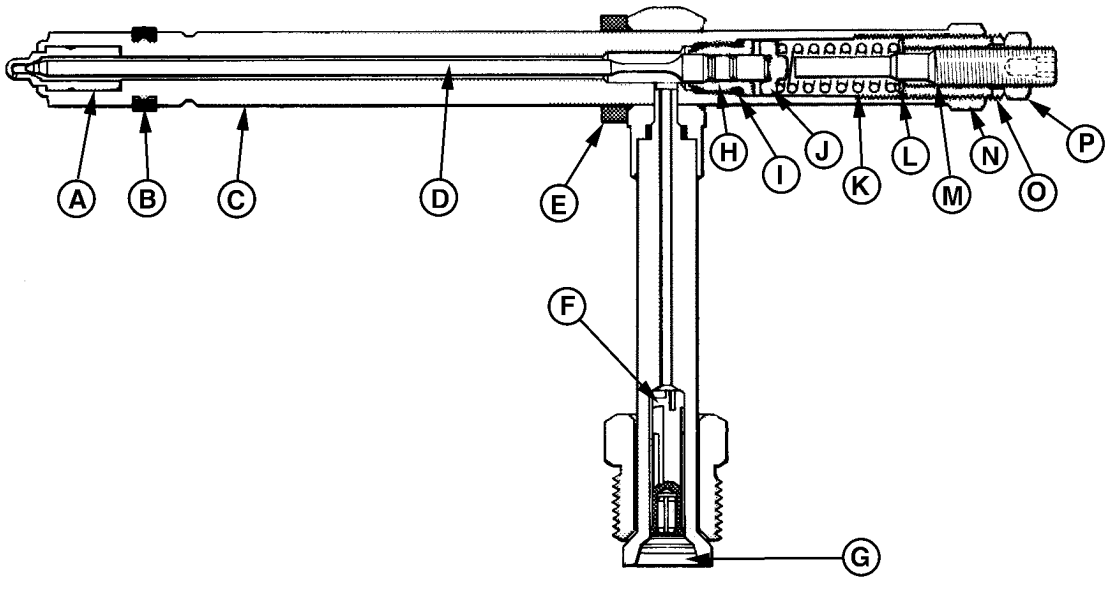
The cam lobes and the timing of the injection pressure are either advanced or retarded by the rotation of the cam ring a few degrees in either direction. A control plunger moves the timing piston through the use of supply pressure fuel, which is controlled by the timing solenoid valve. When the timing solenoid valve is closed, the timing device advances the timing by allowing the supply pressure fuel to buildup and force the control plunger to move in an axial direction. When the timing solenoid valve is open, the timing device retards timing by relieving the pressure behind the control plunger and allowing the same supply pressure fuel to move the control plunger in the opposite direction. The position of the timing solenoid valve is determined by the pump control unit.



The pump control unit (PSG) (F) is located on top of the injection pump. The PSG and the ECU (engine control unit) communicate over a controlled area network (CAN). For more information on CAN, see CONTROLLED AREA NETWORK (CAN) later in this Group. The ECU supplies the desired fuel quantity for injection, the start of injection, and engine speed messages to the PSG. The PSG in return sends the ECU the duration of triggering of the high-pressure solenoid valve, injection pump speed, injection pump fuel temperature, and any injection pump generated fault codes. This information in generated by the following components internal to the PSG: angle of rotation sensor (I), timing device (G), fuel temperature sensor, and the high pressure solenoid valve (E). This communication keeps the pump and engine in time with each other and protects the engine and pump from failures. The pump also has the ability to derate the engine by limiting the amount of fuel supply to the engine if there is a pump related problem.

DPSG,RG34710,118 –19–17OCT02–2/2

## Fuel Injection Nozzle Operation

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**A—Nozzle Tip**
**B—Carbon Dam Seal**
**C—Nozzle Body**
**D—Nozzle Valve**
**E—Plastic Seal Washer**
**F—Edge-Type Filter**
**G—Fuel Inlet**
**H—Upper Guide**
**I—Upper Seal**
**J—Spring Seat**
**K—Valve Spring**
**L—Spring Washer**
**M—Lift Adjusting Screw**
**N—Lock Nut**
**O—Pressure Adjusting Screw**
**P—Lock Nut**

The injection nozzles are secured by a locating clamp in the engine cylinder head. The injectors are spring and valve type, hydraulically operated by fuel delivered from the injection pump.

The nozzle is sealed at the top end by a plastic seal washer (E). A carbon dam seal (B), located on the lower end of the nozzle body (C), prevents carbon build up from collecting around the nozzle and combustion gases from blowing by the nozzle body in the cylinder head. The nozzle tip (A) is pressed into the nozzle body and cannot be separated.

Enclosed in the nozzle body are the valve (D), valve spring (K), and spring seat (J). The nozzle operating pressure is controlled by the pressure adjusting screw (O) in the upper end of the nozzle body. Valve lift is adjusted by the lift adjusting screw (M) located in the pressure adjusting screw.

A leak-off line tee is attached to the upper end of the injection nozzle, secured by a hex nut.

Metered fuel under high pressure, is delivered by the injection pump through the nozzle inlet (G) on the valve body into the area surrounding the valve. When fuel pressure reaches nozzle opening pressure, the valve is forced from its seat against the pressure of the spring, permitting a measured amount of fuel to enter the combustion chamber through four small holes in the nozzle tip.

After fuel has been injected, the spring closes the valve. In actual operation, the valve opens and closes very rapidly, providing a distinct chatter.

A small amount of fuel leaks past the valve into the spring area. This cools and lubricates the nozzle's working parts. This excess fuel is then removed from the nozzle at the top by means of a leak-off line routed back to the fuel tank.

DPSG,RG34710,119 –19–09MAY01–1/1

## About This Group

In this group, the electronic control system is described in the following categories:

- Electronic Control System Terminology
- Electronic Control System Operation
- Monitoring Engine Parameters
- Electronic Control System Overview - Tier 1
- Electronic Control System Overview - Tier 2
- Measuring Temperature
  - – Engine Coolant Temperature (ECT) Sensor
  - – Manifold Air Temperature (MAT) Sensor
- Measuring Pressure
  - – Fuel Pressure Sensor
  - – Oil Pressure Sensor
- Measuring Throttle Position
  - – Analog Throttle
  - – CAN Throttle
  - – Dual State Throttle
  - – Excavator Throttle
  - – Multi-state Throttle
  - – Pulse-Width Modulated (PWM) Throttle
  - – Ramp Throttle
  - – Tri-state Throttle
- Measuring Engine Speed
  - – Crankshaft Position Sensor
  - – Pump Position Sensor
- Electronic Transfer Pump
- Water in Fuel (WIF) Sensor
- Pump Control Unit
- Engine Control Unit (ECU)
- Controlled Area Network (CAN)
- Intake Air Heater Operation
- Cruise Control Operation
- Engine Protection
- Derate Programs
- Multiple Torque Curves Selection
- Governor Droop Mode Selection
- Engine Control Unit (ECU) Self Diagnosis



RG41221,0000110 –19–09MAY01–1/1

## 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 to 5 volt or 0 to 12 volt signals. |
| **Boost** | Air charge pressure in the intake manifold. |
| **CAN** | Controller Area Network. The electronic pathway network on vehicles that allows communication between controllers. |
| **DTC** | Diagnostic Trouble Code. A code which is stored in the ECU's memory when the ECU detects a problem in the electronic control system. |
| **DST** | Diagnostic Scan Tool. This is a diagnostic software that is used to read engine parameters, check DTCs, and run special tests. The DST consists of an Windows ('95, '98, 2000) or NT compatible computer and a hardware kit available from John Deere Distribution Service Center (DSC): JDIS121 - ECU Communication Hardware Kit. The software is available to download from your John Deere home page. |
| **Digital** | A signal which consists of only two-volt levels — usually 0 volts and +5 volts. |
| **ECT** | Engine Coolant Temperature (sensor). Measures the temperature of the engine coolant. See MEASURING TEMPERATURE later in this Group for details. |
| **ECU** | Engine Control Unit. The computer which controls the fuel, air, and ignition systems on the engine. See ENGINE CONTROL UNIT (ECU) later in this Group for details. |
| **FMI** | Failure Mode Identifier. The second part of a two-part code that identifies control system trouble codes according to the SAE J1939 standard. The FMI identifies the type of failure that has occurred. The first half of the code is the Suspect Parameter Number (SPN). |
| **J1587/J1708** | The Society of Automotive Engineers (SAE) standard for the electronic components of heavy duty vehicles. J1587 is the software standard. J1708 is the hardware standard. |
| **MAT** | Manifold Air Temperature (sensor). Measures the temperature of the air in the intake manifold. See MEASURING TEMPERATURE later in this Group for details. |
| **PDM** | Parallel Data Module. Device used as part of the DST that allows communication with the ECU. |
| **PROM** | Programmable, Read-Only Memory. The computer chip which contains the calibration information for the engine control system. See ENGINE CONTROL UNIT (ECU) later in this Group for details. |
| **PSG** | Pump Control Unit. The controller for the Bosch VP44 rotary injection pump. This is located on top of the injection pump. The acronym PSG derives from the German word Pumpensteuergerat. |
| **PWM** | Pulse Width Modulation. A digital signal (not analog) which consists of a pulse generated at a fixed frequency. When an actuator is controlled by a PWM signal, the on time of the signal is increased or decreased (modulated) to increase or decrease the output of the actuator. |
| **RAM** | Random Access Memory. The portion of computer memory within the ECU which changes as the engine is running and is stored while the engine is off. See ENGINE CONTROL UNIT (ECU) later in this Group for details. |
| **SAE** | Society of Automotive Engineers. Working with society to promote vehicle safety and maintenance and energy resource conservation. |
| **Sensor** | Device used by the ECU to monitor various engine parameters. |

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| | |
|---|---|
| **SPN** | Suspect Parameter Number. The first half of a two-part code that identifies control system fault codes according to the SAE 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). |
| **VBAT** | Battery voltage or unswitched voltage. |
| **VSW** | Switched voltage |

RG,RG34710,1528 –19–17OCT02–2/2

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## Electronic Control System Operation

### Engine Starting Mode

When the key is turned to the “ON” position, a switched power voltage is sent to the Electronic 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 receives an input from the crankshaft position sensor that the engine is cranking, it will determine using the pump position sensor input when cylinder number 1 is coming to top-dead-center (TDC) 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 before TDC at the end of its compression stroke. To provide cold temperature enrichment, the amount of fuel injected is based on the temperature measured by the Engine Coolant Temperature (ECT) sensor. At this point, the engine will start and the ECU will go into the running mode.

### Engine Running Mode

In the running mode, both the pump and crankshaft position sensors allow the ECU to precisely determine piston position in relation to top-dead-center so that the ECU can inform the pump control unit (PSG) of the operating conditions of the engine. Given the information from the ECU and the sensors internal to the pump, the PSG controls fuel delivery by energizing and de-energizing the high pressure solenoid valve. When the PSG energizes the high pressure solenoid valve, the valve needle closes and injection begins. When the correct amount of fuel has been injected, the PSG de-energizes the high pressure solenoid valve, causing the valve needle to open, and fuel injection to stop.

RG,RG34710,1530 –19–17OCT02–1/1

## Monitoring Engine Parameters

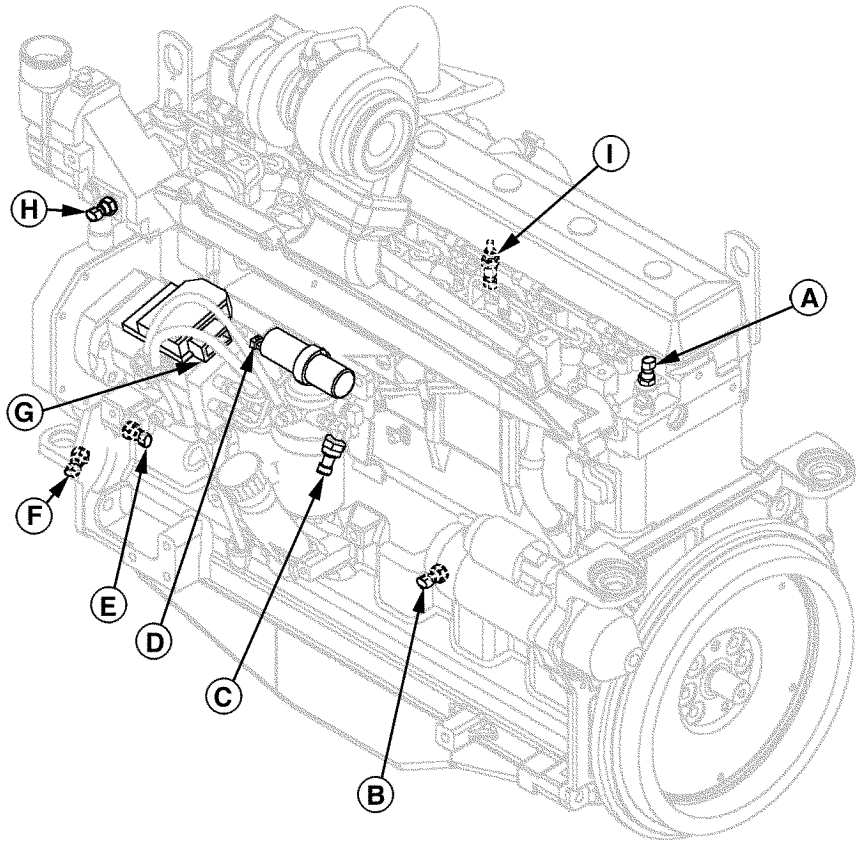
In order for the electronic control system to deliver fuel according to a given set of operating conditions, the following parameters are monitored by the ECU:

- Engine Coolant Temperature (ECT)
- Manifold Air Temperature (MAT)
- Fuel Pressure
- Oil Pressure
- Throttle Position
- Crankshaft Position Sensor
- Pump Position Sensor
- Transfer Pump
- Pump Control Unit



RG,RG34710,1531 –19–09MAY01–1/1

## Electronic Control System Overview - Tier 1




**A—ECT Sensor (Rear of Cylinder Head)**
**B—Oil Pressure Sensor**
**C—Fuel Pressure Sensor**
**D—Electronic Transfer Pump Connector**
**E—Pump Position Sensor**
**F—Crankshaft Position Sensor**
**G—PSG Connector**
**H—ECT Sensor (Thermostat Housing)**
**I—MAT Sensor**

*NOTE: For information on Tier 1 vs. Tier 2 applications, see ENGINE APPLICATION CHART in Group 001 earlier in this manual.*

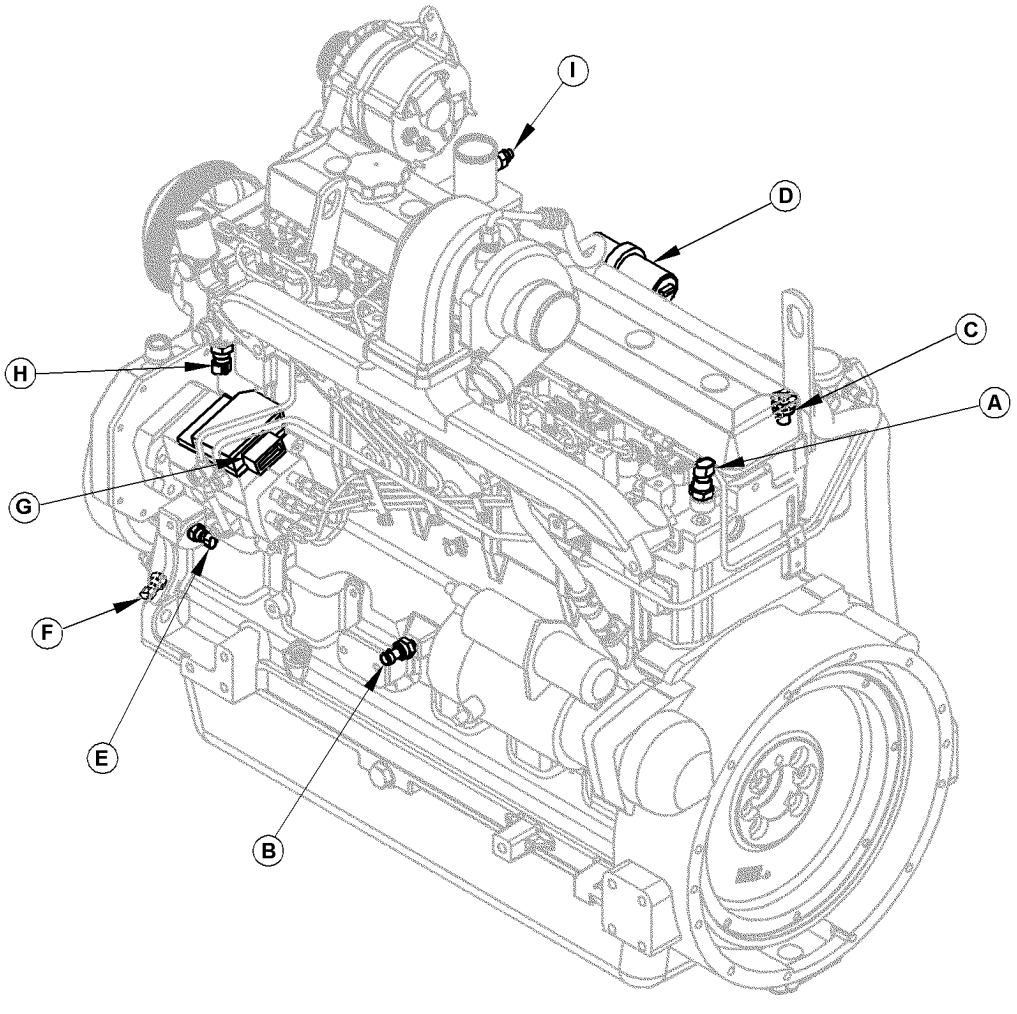
*NOTE: Some of the components shown are optional and not used on all applications.*

The electronic control system sends the PSG (pump control unit) fuel delivery quantity information. In order to achieve this, the engine control system encompasses the following performance functions:

- Constantly monitors engine operating conditions
- Precisely determines piston position
- Informs the PSG of desired fuel quantity
- Provides multiple control modes
- Performs self-diagnosis

RG41221,0000111 –19–17OCT02–1/1

## Electronic Control System Overview - Tier 2




**A—ECT Sensor (Rear of Cylinder Head)**
**B—Oil Pressure Sensor**
**C—Fuel Pressure Sensor**
**D—Electronic Transfer Pump Connector**
**E—Pump Position Sensor**
**F—Crankshaft Position Sensor**
**G—PSG Connector**
**H—ECT Sensor (Thermostat Housing)**
**I—MAT Sensor**

*NOTE: For information on Tier 1 vs. Tier 2 applications, see ENGINE APPLICATION CHART in Group 001 earlier in this manual.*

*NOTE: Some of the components shown are optional and not used on all applications.*

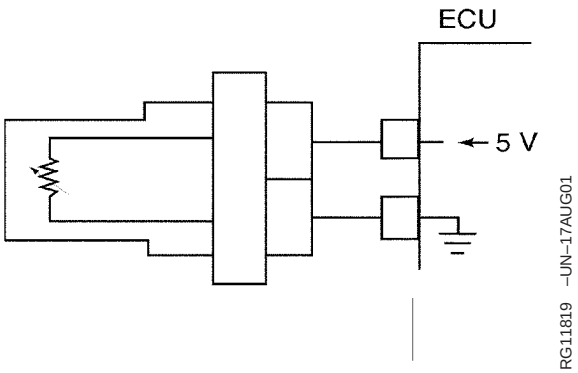
The electronic control system sends the PSG (pump control unit) fuel delivery quantity information. In order to achieve this, the engine control system encompasses the following performance functions:

- Constantly monitors engine operating conditions
- Precisely determines piston position
- Informs the PSG of desired fuel quantity
- Provides multiple control modes
- Performs self-diagnosis

RG41221,0000112 –19–17OCT02–1/1

## Measuring Temperature

The Engine Coolant Temperature (ECT) sensor and the Manifold Air Temperature (MAT) sensor are thermistors (temperature sensitive variable resistors). The sensors' resistance goes down as the temperature that it is exposed to goes up (negative temperature coefficient). Higher temperatures result in lower voltages and lower temperatures result in higher voltages. The Engine Control Unit (ECU) sends 5 volts to the sensor, monitors the voltage drop across the sensor, and compares the voltage drop to preprogrammed values in the ECU's memory in order to determine temperature. In addition to temperature sensors, some applications use temperature switches. The loss of coolant temperature switch is an example. Temperature switches close when a specific temperature is reached.




*Temperature Sensor Schematic*

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RG41221,0000113 –19–17OCT02–1/3

**Engine Coolant Temperature (ECT) Sensor**

The Engine Coolant Temperature (ECT) sensor is located in the rear of the cylinder head (A) or in the thermostat housing (H) depending on the application using this engine.

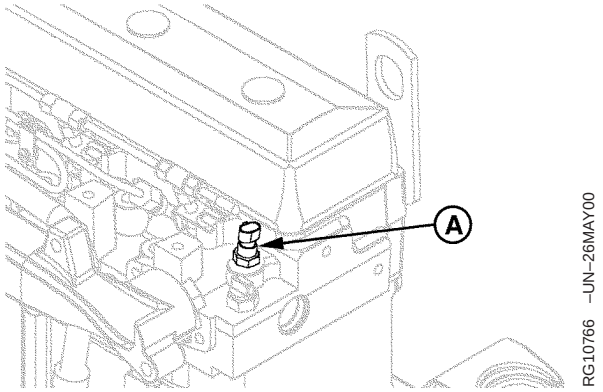
*NOTE: On OEM applications, the ECU uses the ECT sensor in the thermostat housing. Other applications may use the sensor located in the rear of the head.*



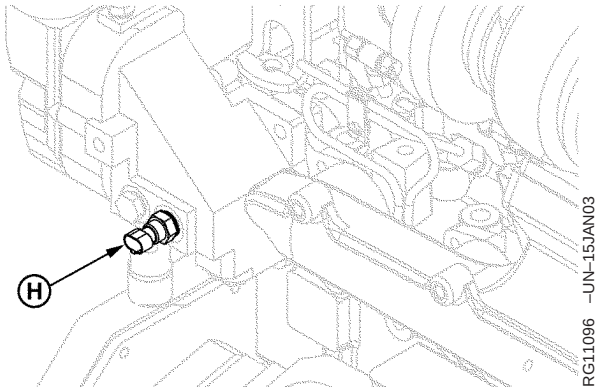
The ECU monitors coolant temperature for:

- Engine protection purposes. For more information on engine protection and derate programs see, ENGINE PROTECTION or DERATE PROGRAMS later in this Group.
- Starting fuel quantity determination — The ECU will adjust the amount of fuel delivered during start-up based on initial ECT readings.
- Idle speed determination — In order to speed engine warm-up, the ECU will increase idle speed after start-up if a low coolant temperature is measured.

**A—ECT Sensor (Rear of Cylinder Head)**
**H—ECT Sensor (Thermostat Housing)**




*ECT Sensor (Rear of Cylinder Head)*



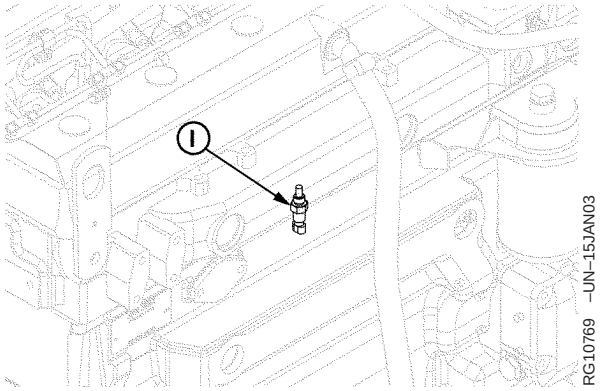

*ECT Sensor (Thermostat Housing)*

**Continued on next page**

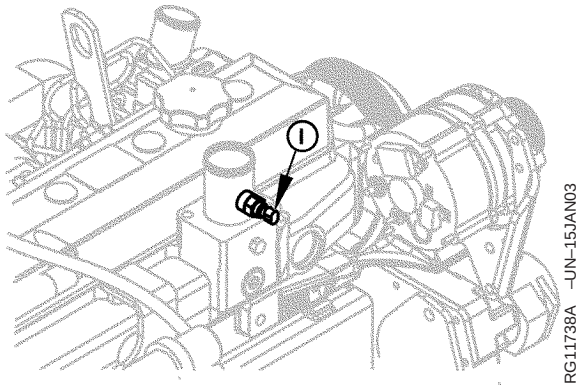
### Manifold Air Temperature (MAT) Sensor

The Manifold Air Temperature (MAT) sensor is located in the intake manifold (I) or in the cross over tube (I). The MAT sensor measures intake air temperature to help the ECU calculate the correct fueling. The ECU also monitors manifold air temperature for engine protection purposes. For more information on engine protection and derate programs see, ENGINE PROTECTION or DERATE PROGRAMS later in this Group. This sensor is optional and is not included on all applications.

**I—MAT Sensor Intake Manifold**
**I—MAT Sensor Crossover Tube**




*MAT Sensor - Tier 1*

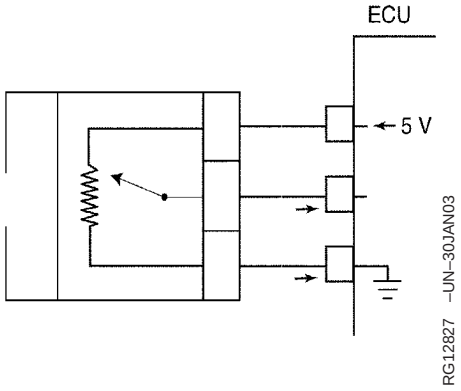



*MAT Sensor - Tier 2*

RG41221,0000113 –19–17OCT02–3/3

## Measuring Pressure

The system's pressure sensors are 3 wire variable resistors. As the pressure changes, sensor resistance changes. The ECU sends a 5 volt reference voltage to the sensor, monitors the voltage returning on the sensor signal wire, and compares the voltage drop to preprogrammed values in the ECU's memory to determine pressure. In addition to pressure sensors, some applications use pressure switches. Pressure switches close when a specific pressure is reached.



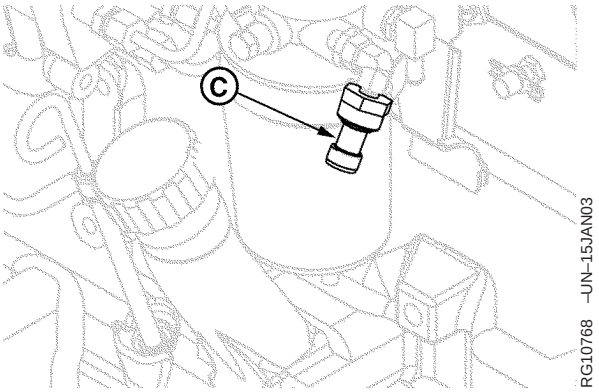

*Pressure Sensor Schematic*



RG,RG34710,1533 –19–17OCT02–1/3

### Fuel Pressure Sensor

The fuel pressure sensor (C) is an optional sensor located in the final fuel filter housing. This sensor measures the fuel pressure on the clean side of the filter. The ECU uses the input from the sensor to control the electronic fuel transfer pump and to provide engine protection. For more information on engine protection and derate programs see, ENGINE PROTECTION or DERATE PROGRAMS later in this Group.



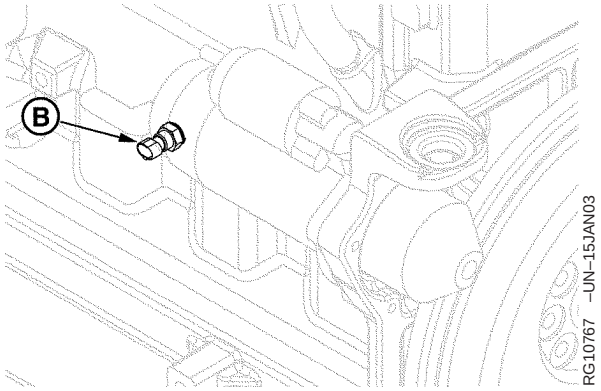

*Fuel Pressure Sensor*

**Continued on next page**

RG,RG34710,1533 –19–17OCT02–2/3

**Oil Pressure Sensor**

The oil pressure sensor is an optional sensor located in the main engine galley (B). The ECU monitors oil pressure for engine protection purposes. For more information on engine protection and derate programs see, ENGINE PROTECTION or DERATE PROGRAMS later in this Group.




*Oil Pressure Sensor*



RG,RG34710,1533 –19–17OCT02–3/3

## Measuring Throttle Position

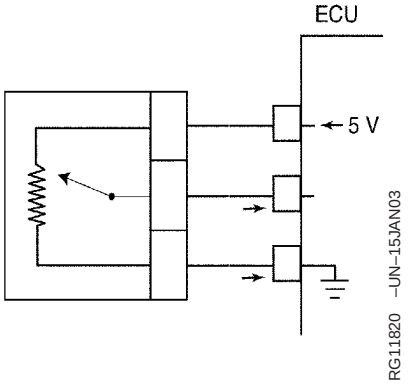
The 4.5L & 6.8L engines have the option of operating with a pulse-width-modulated (PWM) throttle signal, an analog throttle position sensor output signal, multi-state throttle, or a CAN throttle. On some applications, multiple throttles are used.



RG41221,0000029 –19–23APR03–1/9

### Analog Throttle

An analog throttle uses a variable resistor (potentiometer) sensor to measure the position of the throttle. The ECU sends a 5 volt reference voltage to the sensor, monitors the voltage drop across the resistor, and compares the voltage drop to preprogrammed values in the ECU's memory. The analog throttle input voltage normally varies between 1.0 volts and 4.0 depending on throttle position. Analog throttle voltage at low idle is approximately 1.0 volt and 4.0 volts at high idle. The ECU has the ability to learn different voltages for low and high idle, so the voltages above may change depending on application.

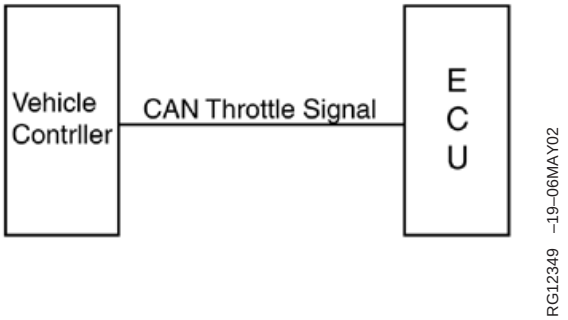



*Position Sensor*

RG41221,0000029 –19–23APR03–2/9

### CAN Throttle

CAN throttle is information sent to the ECU by another controller over the CAN bus of the desired throttle position.



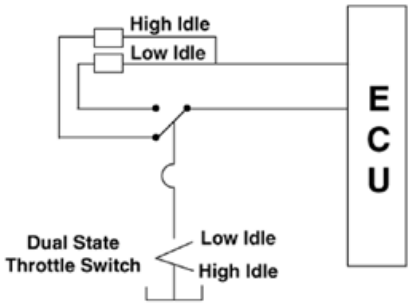

*CAN Throttle Schematic*

Continued on next page

RG41221,0000029 –19–23APR03–3/9

### Dual State Throttle

The dual state throttle is used on applications that use a few fixed engine speeds. There are two available positions, Low Idle and High Idle. 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 1300 ohm resistor. These speeds can be adjusted and saved depending on the needs of the application.




RG12284 –19–26APR02

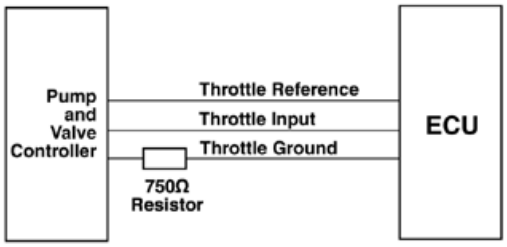
*Dual State Throttle*

03
140
13

RG41221,0000029 –19–23APR03–4/9

### Excavator Throttle

The Excavator uses an analog throttle to measure throttle position. This throttle is connected to the Pump and Valve controller, which sends throttle input information to the ECU through a dedicated wire. Since the ECU uses and Pump and Valve controller do not share a common ground, a throttle voltage reference wire and a throttle ground wire accompany the throttle input wire. The ECU calculates the differences in controller grounds in order to determine the throttle request by the Pump and Valve controller.




RG12287 –19–26APR02

*Excavator Throttle*

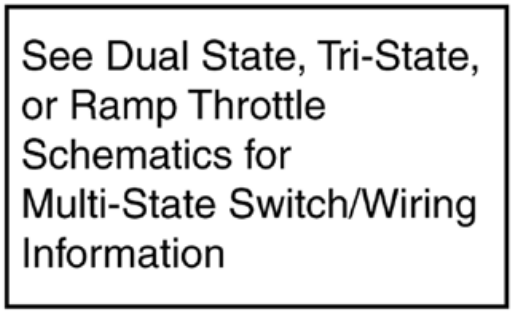
**Continued on next page**

RG41221,0000029 –19–23APR03–5/9

**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, Tri-state, and Ramp. All of these throttles are wired exactly the same. The only difference is the actual switch that is used to control the engine speed. For information on each of these throttles, see DUAL STATE THROTTLE, TRI-STATE THROTTLE, or RAMP THROTTLE later in this Measuring Throttle Position section.





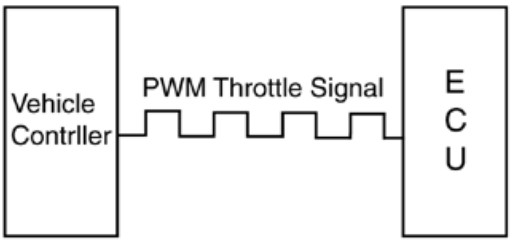

RG12348 –19–06MAY02

*Multi-state Throttle Schematic*

RG41221,0000029 –19–23APR03–6/9

**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.




RG12347 –19–06MAY02

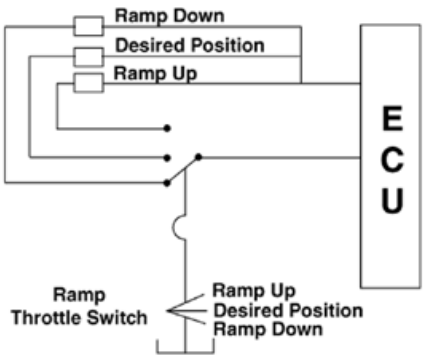
*PWM Throttle Schematic*

**Continued on next page**

RG41221,0000029 –19–23APR03–7/9

### Ramp Throttle

The ramp throttle allows the operator slowly increase or decrease the engine speed through a three position momentary (spring back to center position) switch. If the switch is held in the upward position, the engine speed will increase in small increments. If the switch is held in the downward position, the engine speed will decrease. Once the desired speed is selected, release the switch into the center position. The switch uses three different resistors to change the voltage returned to the ECU. When the switch is in the desired position (center), the current is routed through a 1300 ohm resistor. When changing engine speed, a 390 ohm resistor to reduce the engine speed and a 3000 ohm resistor to ramp up the engine speed. Speed will remain the same until key cycle or operator change.



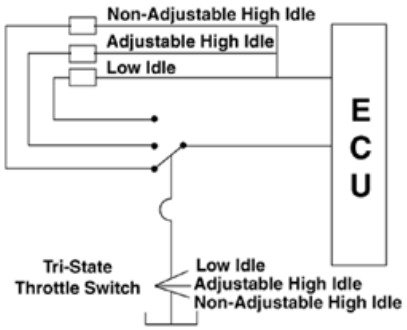

RG12286 –19–26APR02

*Ramp Throttle*

RG41221,0000029 –19–23APR03–8/9

### Tri-State Throttle

The tri-state throttle works very similar to the dual state throttle. This throttle uses a three position switch, Low Idle, Adjustable High Idle, and Non-Adjustable High Idle. The switch uses three 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, adjustable high idle position uses a 1300 ohm resistor, and non-adjustable high idle position uses a 3000 ohm resistor. These adjustable speeds can be saved depending on the needs of the applications. The non-adjustable high idle is set at the factory to the engine's high idle speed and can not be changed. This position will always set the engine speed to the factory high idle value. The other two positions are adjustable and work exactly like the dual state throttle.




RG12285 –19–26APR02

*Tri-State Throttle*

RG41221,0000029 –19–23APR03–9/9

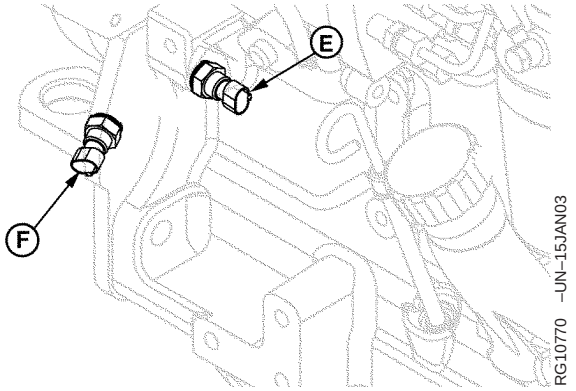
## Measuring Engine Speed

Both the crank position sensor and the pump position sensor operate by detecting notches on their corresponding gear/timing wheel. When a notch on the gear/timing wheel is directly under the sensor, a voltage is induced. The sensors use an internal magnet to create this voltage signal from the teeth on their respective gear/timing wheel. The magnet is pulled towards the gear/timing wheel as the teeth pass directly under the sensor. As the root diameter (area between teeth) pass the sensor, the magnet returns inside the sensor. This creates the voltage signal that the ECU monitors for timing and speed. When a notch (one or more missing teeth) passes under the sensor, the pattern of the signal changes. By monitoring these changes in the signal, the ECU calculates the speed and the cylinder number that is ready for injection. The ECU monitors both of these sensors to verify that they are in time with each other.



### Crankshaft Position Sensor

The crankshaft position sensor (F) is located on the front of the crank, behind the pressed-on crank gear. It is an inductive type pickup sensor that detects teeth on the crank timing wheel. The ECU uses the crankshaft position input to determine engine speed and precise piston position in relation to the firing order. The crank timing wheel is composed of 48 evenly spaced teeth and 2 gaps between the teeth missing. The missing gaps help the ECU to determine Top-Dead-Center (TDC).




*Speed Sensors*

**E—Pump Position Sensor**
**F—Crankshaft Position Sensor**

**Continued on next page**

RG,RG34710,1536 –19–17OCT02–1/2

**Pump Position Sensor**

The pump position sensor (E) is located behind the injection pump. It is an inductive type pickup sensor that detects notches in the injection pump gear. The ECU uses the pump position input to determine cylinder identification. The ECU uses this sensor to determine engine speed and to determine when each cylinder is at TDC at the end of the compression stroke. The ECU needs this information in order to deliver the correct amount of fuel to the correct cylinder, at the correct time. The ECU monitors the voltage that is created by the pump position sensor when the slots of the injection pump gear passes. The injection pump gear is composed of 12 evenly spaced slots with one additional notch offset to tell the ECU that cylinder #1 is approaching Top-Dead-Center.



RG,RG34710,1536 –19–17OCT02–2/2

## Electronic Fuel Transfer Pump

*NOTE: For information on Tier 1 vs. Tier 2 applications, see ENGINE APPLICATION CHART in Group 001 earlier in this manual.*

*NOTE: On Tier 1 applications the fuel transfer pump is located on the final fuel filter. Tier 2 applications have the fuel transfer pump on the primary fuel filter or remote mounted inside the engine compartment.*

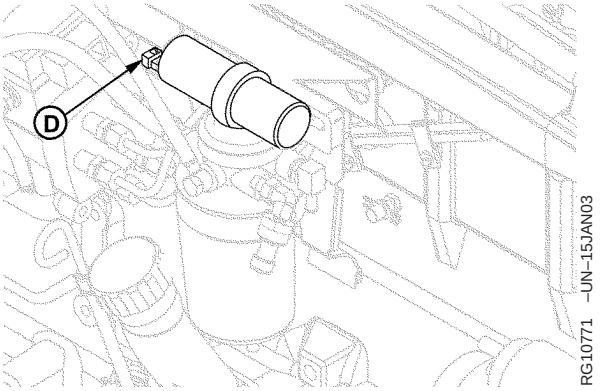


### Electronic Transfer Pump - Closed Loop

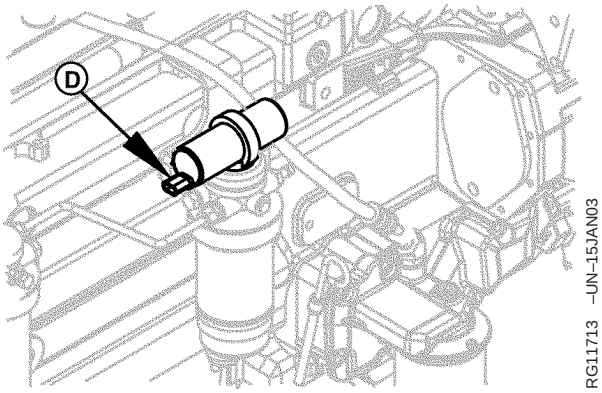
- Closed loop pumps can be either mounted on the primary fuel filter (Tier 2), on the final fuel filter (Tier 1), or remote mounted (Tier 2). All closed loop pumps use a fuel pressure sensor at the outlet of the final fuel filter to communicate the pressure to the ECU.
- The ECU maintains a constant fuel pressure for a given speed by controlling the duty cycle of the Pulse Width Modulated (PWM) signal between the ECU and transfer pump. When fuel pressure increases, the ECU decreases the duty cycle. When fuel pressure decreases, the ECU increases the duty cycle. Transfer pump duty cycle and fuel pressure can be monitored on the Diagnostic Scan Tool (DST) or SERVICE ADVISOR™.
- In addition to helping to maintain a constant fuel pressure, the transfer pump is also used to aid in bleeding air out of the fuel system through the air bleed-off valve in the final fuel filter housing. When the key is ON, the transfer pump works to purge air, and the ECU will let the pump run for up to 40 seconds.

### Electronic Transfer Pump - Open Loop

- All open loop pumps are remote mounted on Tier 2 engines only.
- The ECU uses a Pulse Width Modulated (PWM) signal during priming and cranking. When the engine is running, the ECU sends a constant voltage to the pump. There is a mechanical regulator in the filter header to regulate the fuel pressure prior to the final fuel filter.




*Electronic Transfer Pump - Tier 1*




*Electronic Transfer Pump - Tier 2*

**D—Electronic Transfer Pump Connector**

*SERVICE ADVISOR is a trademark of Deere & Company*

Continued on next page

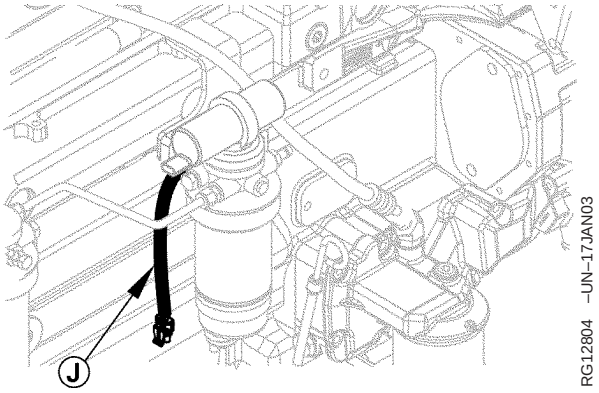
- The transfer pump is also used to aid in bleeding air out of the fuel system through the air bleed-off valve in the final fuel filter housing. When the key is ON, the transfer pump works to purge air, and the ECU will let the pump run for up to 40 seconds.



RG41221,0000115 –19–17OCT02–2/2

## Water in Fuel (WIF) Sensor

The WIF sensor (J) is located inside the water separating bowl of the primary fuel filter. The ECU compares the resistance of the sensor probe to the water separator bowl housing and the resistance of the sensor ground to the fuel filter header. When water is present, the resistance between the sensor probe and the water separator bowl increases. This shorts the sensor input to ground to let the ECU know that water has been detected. The ECU monitors this for engine protection purposes. For more information on engine protection and derate programs see, ENGINE PROTECTION or DERATE PROGRAMS later in this Group.




*WIF Sensor*

**J—Water in Fuel Sensor**

RG41221,00000AC –19–02JAN03–1/1

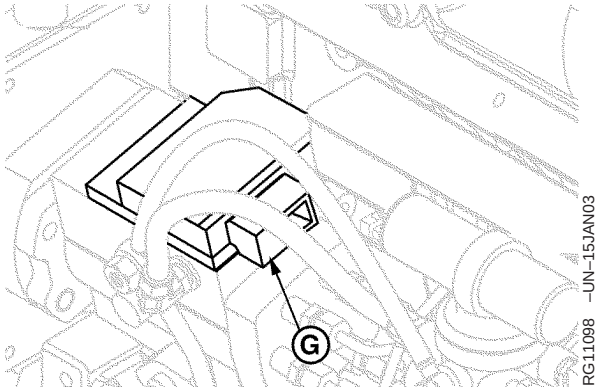
## Pump Control Unit

Located on top of the injection pump, the pump control unit monitors a few different sensors inside the injection pump and acquires information from the ECU. This helps the pump control unit to determine how to control the high pressure solenoid valve and the timing solenoid valve, which help to provide for accurate quantity and timing of fuel delivery to the engine.



The pump control unit (PSG) is mounted to the top of the fuel injection pump. The PSG is cooled by fuel which runs through a passage under the PSG housing.

The PSG contains a nine pin connector that houses all necessary wiring for the ECU (engine control unit) to communication with the pump. The PSG and the ECU (engine control unit) communicate over a controlled area network (CAN). For more information on CAN, see CONTROLLED AREA NETWORK (CAN) later in this Group. The ECU supplies inputs for desired fuel quantity for injection, the start of injection, and engine speed messages to the PSG. The PSG in return sends the ECU the duration of triggering of the high-pressure solenoid valve, injection pump speed, injection pump temperature, and any injection pump generated fault codes. This information in generated by the following components internal to the PSG: angle of rotation sensor, timing device, fuel temperature sensor, and the high pressure solenoid valve. This communication keeps the pump and engine in time with each other and protects the engine and pump from failures. The PSG is an intelligent injection pump. It can adjust fuel quantity by triggering a timing device so that the correct state of delivery is met.

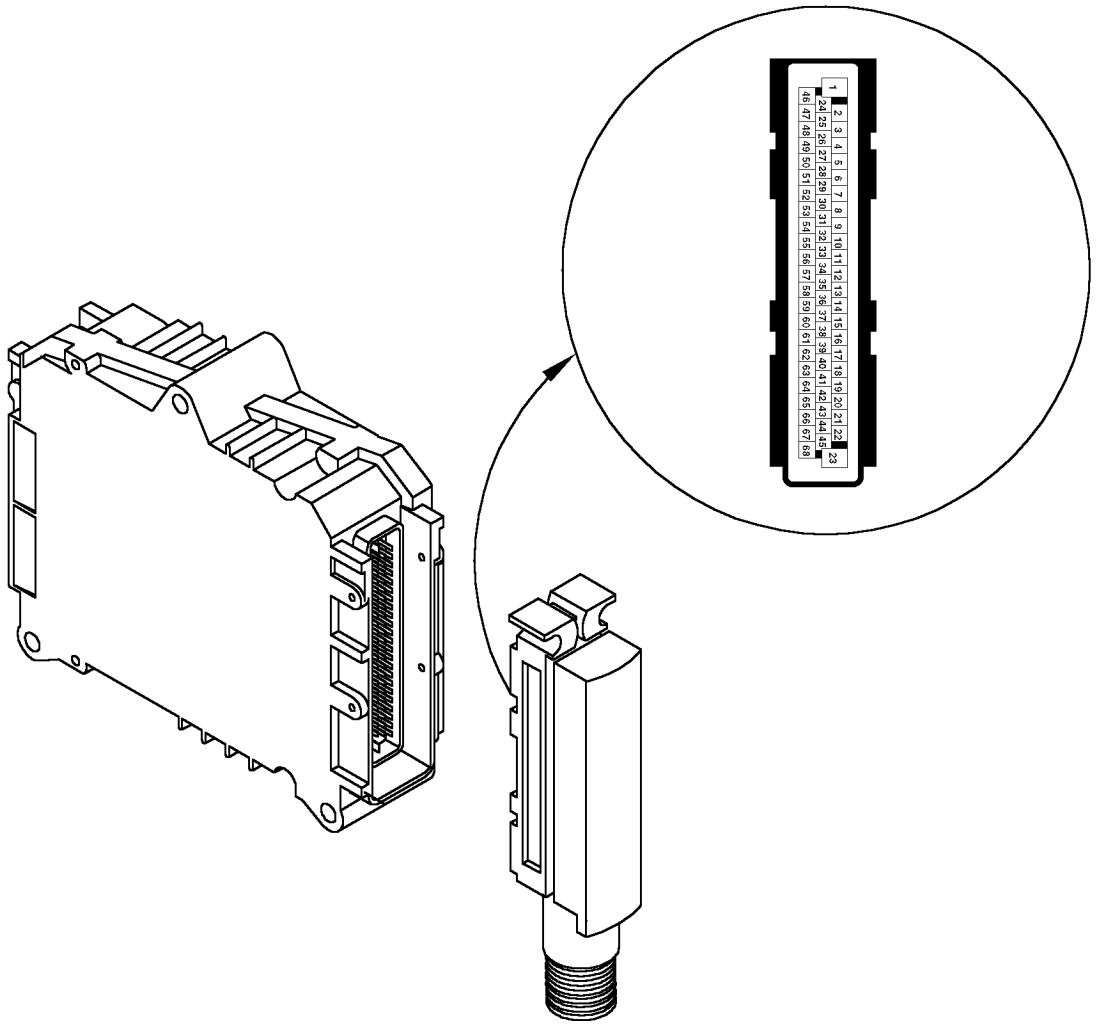



*Pump Control Unit*

**G—Pump Control Unit Connector**

DPSG,RG40854,665 –19–17OCT02–1/1

## Engine Control Unit (ECU)




*John Deere Level 4 ECU*

The Engine Control Unit (ECU) is the “brains” of the Electronic Control System. The ECU is a self-contained unit containing electronic circuitry and computer software which together perform the following functions:

- Converts the electrical signals from the various sensors into digital signals
- Makes decisions of optimum fuel quantity and injection timing based on information from various sensors
- Limits maximum fuel for operation on multiple power curves
- Informs pump control unit (PSG) of desired fuel delivery
- Provides all-speed governing
- Performs self diagnosis on the control system
- Stores trouble codes in memory

The ECU connects to the wiring harness through a 68-way ECU connector. This connector is marked by terminal numbers.

The ECU is composed of the following subsystems:

**Analog/Digital Converters**

This portion of the ECU converts the analog voltage signals from the various sensors into digital signals that the central processing unit can “understand”.

**Continued on next page**

**Central Processing Unit (CPU)**

The central processing unit performs the mathematical computations and logical functions that are necessary in controlling injection fuel quantity and injection timing. The CPU communicates its desired fuel quantity and timing to the pump control unit (PSG), and it controls the self diagnostic system.

**Memory**



The ECU contains 3 different types of memory:

— Random Access Memory - RAM

The RAM is like the working desk top of the ECU. Data from the various sensors and the results of various calculations are temporarily stored in RAM. Information in RAM is lost when battery voltage to the ECU is removed.

— Read Only Memory - ROM

The ROM contains programmed information. Information in ROM can only be read, not changed. ROM information is retained when battery voltage is removed.

— Electrical Erasable Programmable Read Only Memory - EEPROM

The EEPROM contains information programmed in at the factory including engine specific data, and application data. Information in the EEPROM is retained when battery voltage is removed.

RG,RG34710,1537 –19–30SEP97–2/2

## Controlled Area Network (CAN)

Controlled Area Network (CAN) is used to allow communication between other controllers on the engine or vehicle and for connecting to diagnostic software. All of the controllers that are required to communicate over CAN are connected together using wires forming a bus. J1939 is an SAE standard that utilizes CAN.

Just about any type of information can be communicated over the CAN Bus. Depending on the application, information like part numbers, serial numbers, engine speed, throttle position, application requested derates and shutdowns, ect. The Level 4 control system uses the bus for communication between the Pump Control Unit (PSG) and the Engine Control Unit (ECU). The ECU supplies inputs for desired fuel quantity for injection, the start of injection, and engine speed messages to the PSG. The PSG in return sends the ECU the duration of triggering of the high-pressure solenoid valve, injection pump speed, injection pump temperature, and any injection pump generated fault codes.

The engine also uses CAN to talk to other vehicle controllers. Depending on the application, information like throttle position, application requested derates and or engine protection, displaying diagnostic fault codes on vehicle displays, ect.

CAN also allows diagnostic software like the Diagnostic Scan Tool (DST) and SERVICE ADVISOR™ to communicate with our engine controller. All of the information viewed through the diagnostic software and diagnostic gauge is transferred via the CAN Bus.

*SERVICE ADVISOR is a trademark of Deere & Company*

RG41221,0000248 –19–17OCT02–1/1

## Intake Air Heater Operation

An optional function not included in all ECUs, the intake air heater is used to increase intake manifold air temperature to improve cold starting. When the operator turns the key from “OFF” to “ON”, the ECU uses the fuel temperature sensor to determine engine temperature and ambient air temperature, turns on the “Air Heater Indicator” light on the dash, and energizes the air heater relay.

The air heater relay will in turn energize the air heater coils located in the intake manifold. The ECU will keep the air heater relay energized for an amount of time that is determined by the measured temperatures. When the ECU has determined that the preheat time is adequate, it will turn off the “Air Heater Indicator” light and de-energize the air heater 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 “Air Heater Indicator” light to turn off, the ECU will de-energize the air heater 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.



DPSG,RG34710,8 –19–03DEC98–1/1

## 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.

DPSG,RG40854,457 –19–14OCT99–1/1

## Engine Protection

Engine protection is necessary to prevent damage to an engine. There are three different engine protection programs available in Engine Control Units (ECUs):

- **No Protection** — The ECU does not have the software to derate or shut the engine down. It is the responsibility of the operator to react to warning light(s) on their application. Derating or shutting the engine down may be necessary depending on the Diagnostic Trouble Code (DTC) that is set. Refer to the operator's manual to identify this information for a given application.
- **Engine Protection WITHOUT Shutdown** — The ECU has the capability to derate an engine. It is the responsibility of the operator to react to warning light(s) on their application to identify if it is necessary to shut the engine down. Refer to the operator's manual to retrieve this information for a given application.
- **Engine Protection with Shutdown** — The ECU will derate the engine for given DTCs. If a DTC that requires shutdown is set, the ECU will severely derate the engine and shut the engine down in 30 seconds. If the problem is corrected within the 30 second delay period, the power will increase at a particular rate until full power is reached.

There are two levels of engine protection:

**SHUTDOWN OVERRIDE**

*NOTE: Holding the shutdown override switch continuously "ON" will not reset the 30 second timer.*

The engine protection 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.

RG41221,0000116 –19–17OCT02–1/1

## Derate Programs

The Electronic Control Unit (ECU) will derate the amount of fuel that is delivered to the engine when sensor inputs exceed normal operating ranges. A Diagnostic Trouble Code (DTC) always accompanies a fuel derate. See APPLICATION SPECIFICATIONS in Section 06, Group 210 later in this manual for derate specifications per application.

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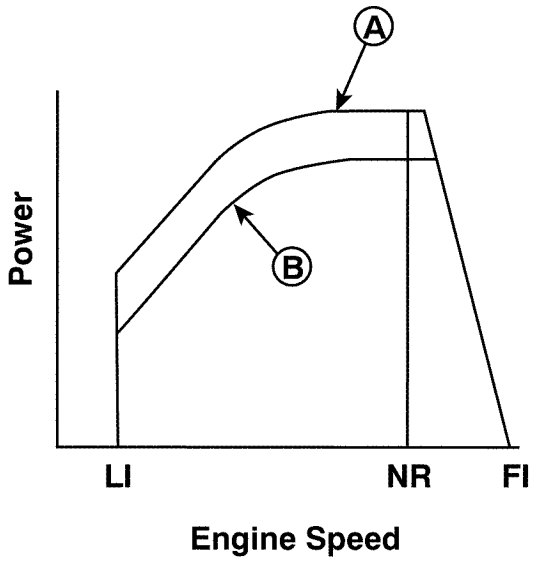
## Multiple Torque Curve Selection

The ECU has the ability to limit the maximum fuel quantity through the pump control unit (PSG) such that multiple torque curves can be individually selected while the engine is running. The selection of multiple torque curves is determined by either switch inputs into the ECU's torque curve select terminal, or by messages from other controllers on the machine's Controller Area Network (CAN). In most applications, one torque curve is used for "normal" operation. Several other derated torque curves will be used to protect vehicle axles, hitches, and transmissions, etc. under certain operating conditions.

For example: a machine can choose multiple torque curves using simple switching arrangement. A simple on/off toggle switch and resistor can be used to switch between torque curve 1 (maximum power), and any of the other torque curves. When the switch is open, the ECU will command torque curve 1. When the switch is closed, the ECU will command one of the other curves depending on the resistance in the line. See APPLICATION SPECIFICATIONS in Section 6, Group 210 of this manual for torque curve selection specifications.




**A–Normal Power Curve**
**B–Derated Power Curve**
**LI–Low (Slow) Idle**
**NR–Normal Rated**
**FI–Fast Idle**

RG8552 –19–18SEP98

*Torque Curves*

DPSG,RG40854,460 –19–23APR03–1/1

## 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. 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. See APPLICATION SPECIFICATIONS in Section 6, Group 210 of this manual for governor droop mode specifications.

DPSG,RG40854,461 –19–23APR03–1/1

## Engine Control Unit (ECU) Self-Diagnosis

The Engine Control Unit (ECU) has the ability to detect problems internally and in the electronic control system. This includes determining if any sensor input voltages are too high or too low. If the ECU detects a problem with the electronic control system, a Diagnostic Trouble Code (DTC) specific to the failed system will be stored in the ECU's memory.



There are two types of DTCs:

- Active
- Stored

Active DTCs indicate that the failure is occurring. These type of failures are sometimes called "hard" failures.

Stored DTCs indicate that a failure has occurred in the past, but is not currently occurring. This type of DTC can be caused by an "intermittent" failure. These could be problems such as a bad connection or a wire intermittently shorting to ground.

There are several different methods for displaying both stored and active DTCs from the ECU.

*NOTE: If the Diagnostic Scan Tool (DST) or SERVICE ADVISOR™ is used to read a sensor voltage and calculated value, and there is an active DTC for that sensor, the calculated value for that sensor will be the "limp home" value and the voltage will be the actual sensor voltage. Use the voltage during diagnostics unless otherwise directed by a diagnostic chart.*

### SPN/FMI CODES

SPN/FMI codes are written from the SAE J1939 standard as a two part code. The first part is called the Suspect Parameter Number (SPN). Typically, it contains between 2 and 4 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. The FMI identifies the type of failure that has occurred; for example FMI 3 indicates value above normal. In order to determine the exact failure, both the SPN and FMI are required. Combining SPN 110 with FMI 3 yields engine coolant temperature input voltage high.

On all applications with the Level 4 Engine Control Unit (ECU), the ECU transmits SPN/FMI codes over the Controller Area Network (CAN). This allows for service tools such as the DST, SERVICE ADVISOR™, and the Diagnostic Gauge to display active and stored DTCs. When using DST or SERVICE ADVISOR™ the codes will be displayed in a 000000.00 format. For example, SPN 110 FMI 3 will be displayed as 000110.03.

### 2-DIGIT CODES

Some John Deere applications display DTCs as 2-digit codes read from an on-board display.

### WARNING LAMP

On some applications, there is a warning lamp (also referred to as the "Air Heater Indicator" light) that is used when a code becomes active. When a code is active, this lamp will either blink or stay on solid. A solid light indicates that the ECU is taking extreme measures to protect the engine. A blinking light indicates that the ECU has detected a fault and engine performance may be affected.

### CLEARING STORED DTCS

Stored DTCs can be cleared through the Diagnostic Scan Tool (DST) or SERVICE ADVISOR™. Refer to the vehicle machine manual or see CLEARING STORED DTCS ON DIAGNOSTIC GAUGE in Group 160 later in this manual to determine how to clear the code reader.

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*SERVICE ADVISOR*

# Section 04
# Diagnostics

## Contents



**Continued on next page**

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## About This Group of the Manual

This section of the manual contains necessary information for observable diagnostics and fuel-related test procedures. Use this information in conjunction with the 4.5 L & 6.8 L Diesel Engines Base Engine Manual (CTM 104). Group 150 is divided into two areas: diagnosing malfunctions and test procedures. The diagnosing malfunctions area is further divided into the following headings, containing the following observable symptoms:

*NOTE: Follow the diagnostic procedure of an active or stored DTC before pursuing any observable diagnostic procedure.*

*NOTE: To diagnose observable symptoms on engines with a mechanical fuel system, see 4.5 L & 6.8 L Diesel Engines Mechanical Fuel Systems Manual (CTM 207).*

- **(E)** Diagnosing General Engine Malfunctions:
  - E1 - Engine Cranks/Won't Start
  - E2 - Engine Misfires/Runs Irregularly
  - E3 - Engine Does Not Develop Full Power
  - E4 - Engine Emits Excessive White Exhaust Smoke
  - E5 - Engine Emits Excessive Black Or Gray Smoke
  - E6 - Engine Will Not Crank
  - E7 - Engine Idles Poorly
  - E8 - Abnormal Engine Noise
  - E10 - Analog Throttle (B) Does Not Respond
- **(F)** Diagnosing Fuel System Malfunctions:
  - F1 - Fuel Supply System Check - Tier 1
  - F2 - Excessive Fuel Consumption
  - F3 - Fuel In Oil
  - F4 - Fuel Supply System Check - Tier 2
  - F5 - Fuel Injection Nozzle Check
- **(D)** Diagnosing Diagnostic Software Malfunctions:
  - D1 - ECU Does Not Communicate With DST or SERVICE ADVISOR™
  - D2 - Diagnostic Gauge Does Not Communicate With ECU
- **(A)** Diagnosing Intake Air Heater Malfunctions:
  - A1 - Intake Air Heater Check

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 manual contains the following testing procedures:

- Fuel System Testing Procedures:
  - Check Fuel Supply Quality - Tier 1
  - Check Fuel Supply Quality - Tier 2
  - Test for Fuel Drain Back
  - Test for Air in Fuel - Tier 1
  - Test for Air in Fuel - Tier 2
  - Check Fuel Supply Pressure
  - Bleed the Fuel System
  - Test For Cylinder Misfire (Engine Running)

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## E1 - Engine Cranks/Won't Start

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### E1 - Engine Cranks/Won't Start Diagnostic Procedure

*NOTE: This procedure applies to engines with John Deere Engine Control Units (ECUs). This procedure should be used if engine cranking speed is OK, but engine will not start, or only starts after prolonged cranking. If engine will not crank, determine problem in the starting/charging system.*



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| ❶ **E1 - Preliminary Check** | Before using this diagnostic procedure, ensure that:<br>1. Ensure that fuel quality and quantity are OK. See CHECK FUEL SUPPLY QUALITY - TIER 1 or CHECK FUEL SUPPLY QUALITY - TIER 2 later in this Group.<br>2. Ensure that engine cranking speed is OK. See TEST ENGINE CRANKING SPEED in Group 150 of 4.5 L & 6.8 L Diesel Engines Base Engine Manual (CTM 104).<br>3. Ensure that oil viscosity is correct.<br>4. Verify air heater operation in cold temperatures. See A1 - INTAKE AIR HEATER CHECK later in this Group. | **No problems found:**<br>GO TO ❷<br><br>**Problem found:**<br>Repair and retest |

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| ❷ **Active DTC Test** | 1. Connect the DST or SERVICE ADVISOR™. For instructions on connecting to the DST or SERVICE ADVISOR™, see CONNECTING TO DIAGNOSTIC SCAN TOOL (DST) OR SERVICE ADVISOR™ in Group 160 later in this manual.<br>2. Ignition ON, engine OFF<br>3. Start the ECU diagnostic software<br>4. Crank engine for 15 seconds<br>5. Read DTCs using DST or SERVICE ADVISOR™. | **No active DTCs present:**<br>GO TO ❸<br><br>**Active DTC(s) present:**<br>Diagnose active DTCs first.<br>If any of the DTCs have a SPN of 636 or 637 go to those first.<br><br>**Can't communicate with ECU:**<br>See diagnostic chart D1 - ECU DOES NOT COMMUNICATE WITH DST OR SERVICE ADVISOR™ later in this Group. |

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| ❸ **Pump Position and Crankshaft Position Indicators Test** | 1. Start cranking engine<br>2. While cranking observe pump position noise, crank noise, and crank status. See Pump Position/Crankshaft Position parameters. For an explanation of these parameters, see DATA PARAMETER DESCRIPTION in Group 160. | **No pump position or crankshaft position noise and crank status reaches 15:**<br>GO TO ❺<br><br>**Pump position or crank noise or crank status does not reach 15:**<br>GO TO ❹<br><br>– – –1/1 |

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| ❹ **Vehicle Wiring Inspection Check** | Inspect the vehicle for possible failures that can cause either of the following:<br>1. Bad electrical connections<br>2. Damaged engine speed sensors<br>3. EMI from improperly install radio equipment, or other electronic devices<br>4. Once problem is found, repair and retest. | – – –1/1 |



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| ❺ **Air Heater Check** | Verify that the air heater is functioning properly. See A1 - INTAKE AIR HEATER CHECK later in this Group. | **Air heater functions correctly:**<br>GO TO ❻<br><br>**Air heater does not functions correctly:**<br>Repair air heater and retest.<br><br>– – –1/1 |

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| ❻ **Fuel Present at Injection Nozzles Check** | Perform following procedure to check for fuel at injection nozzle:<br><br>**CAUTION: Escaping fluid under pressure can penetrate the skin causing serious injury. Keep hands and body away from pinholes and nozzles which could inject fluids under high pressure.**<br><br>**If ANY fluid is injected into the skin, it must be surgically removed within a few hours by a doctor familiar with this type of injury or gangrene may result. Doctors unfamiliar with this type of injury may call the Deere and Company Medical Department in Moline, Illinois, or other knowledgeable medical source.**<br><br>1. Using two open-end wrenches, loosen fuel line connection at one of the injection nozzles.<br><br>2. Crank engine while monitoring loosened connection for consistent squirts of fuel.<br><br>3. Retighten connection at nozzle to specification.<br><br>**Specification**<br>Fuel Injection Nozzle Delivery Lines—<br>Torque ..... 27 N•m (20 lb-ft) | **Consistent squirts of fuel observed:**<br>GO TO ❽<br><br>**Don't observe consistent squirts of fuel:**<br>GO TO ❼<br><br>– – –1/1 |
| ❼ **Fuel Supply System Check** | Check the fuel supply system. See F1 - FUEL SUPPLY SYSTEM CHECK - TIER 1 or F4 - FUEL SUPPLY SYSTEM CHECK - TIER 2 later in this Group. Repair problem and retest | **Fuel supply system is OK:**<br>GO TO ❽<br><br>**Fuel supply system problem found:**<br>Repair fuel supply system problem and retest.<br><br>– – –1/1 |
| ❽ **Intake and Exhaust Restrictions Test** | Check for intake and exhaust restrictions. See CHECK FOR INTAKE AND EXHAUST RESTRICTIONS in Group 150 of 4.5 L & 6.8 L Diesel Engines Base Engine Manual (CTM 104). | **All components operating correctly:**<br>GO TO ❾<br><br>**Restrictions are found:**<br>Repair faulty component and retest.<br><br>– – –1/1 |

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| **9 Compression Test** | 1. Perform the Compression Test. For instructions, see ENGINE TEST INSTRUCTIONS - COMPRESSION TEST in Group 160 of this manual.<br><br>2. Make note of the results. | **All cylinders scored within 10% of each other:**<br>GO TO 10<br><br>**One or more cylinders scored 10% or lower than the rest:**<br>GO TO 11<br><br>– – –1/1 |

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| **10 Fuel Injection Nozzles Check** | Test fuel injection nozzles. See F5 - FUEL INJECTION NOZZLE CHECK later in this Group. | **Injection nozzles test good:**<br>Faulty injection pump. Have injection pump repaired by an authorized diesel repair station or replace pump.<br><br>**Faulty injection nozzle(s) found:**<br>Repair or replace injection nozzles. See REMOVE FUEL INJECTION NOZZLES in Section 02, Group 090 earlier in this manual.<br><br>– – –1/1 |



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| **11 Piston Ring Check** | *NOTE: DO NOT use too much oil. DO NOT get oil on the valves.*<br><br>1. Apply oil to the ring area of the piston through injection nozzle bore. See REMOVE FUEL INJECTION NOZZLES in Section 02, Group 090 of this manual.<br><br>2. Retest the compression pressure. | **Compression pressure is within specification:**<br>GO TO 14<br><br>**Compression pressure is not within specification:**<br>GO TO 12<br><br>– – –1/1 |

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| **12 Valve Lash Check** | Check valve lash. See CHECK AND ADJUST VALVE CLEARANCE in Section 02, Group 020 of 4.5 L & 6.8 L Diesel Engines Base Engine Manual (CTM104). | **Valve lash is within specification:**<br>GO TO 13<br><br>**Valve lash on one or more valves is out of specification:**<br>Adjust valve lash and retest.<br><br>– – –1/1 |

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| **13 Valve Lift Check** | Check valve lift. See MEASURE VALVE LIFT in Section 02, Group 020 of 4.5 L & 6.8 L Diesel Engines Base Engine Manual (CTM104). | **Lift on all valves within specification:**<br>GO TO 14<br><br>**Lift on one or more valves is out of specification:**<br>Reset clearance to specification after measuring lift. See CHECK AND ADJUST VALVE CLEARANCE in Section 02, Group 020 of 4.5 L & 6.8 L Diesel Engines Base Engine Manual (CTM104).<br><br>– – –1/1 |

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| **14 Pistons, Rings, Cylinder Liners Check** | At this point, the most likely cause of the low engine compression pressure is one of the following failures in the piston, rings, and/or cylinder liners or in the valve guides. Check the most likely items as needed:<br><br>• Oil control rings worn or broken<br>• Scored cylinder liners or pistons<br>• Piston ring grooves excessively worn<br>• Piston rings sticking in ring grooves<br>• Insufficient piston ring tension<br>• Piston ring gaps not staggered<br>• Cylinder liners glazed (insufficient load during engine break-in)<br>• Worn valve guides or stems<br>• Cylinder head may need reconditioning | **Problem found with pistons, rings, and/or liners or valve guides:**<br>Repair problems as necessary.<br><br>– – –1/1 |

## E2 - Engine Misfires/Runs Irregularly

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### E2 - Engine Misfires/Runs Irregularly Diagnostic Procedure

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| ❶ **E2 - Preliminary Check** | Before using this diagnostic procedure, make the following checks that could cause or be mistaken as miss/rough running:<br>1. Check for intake manifold air leaks<br>2. Check for mechanical problems<br>3. Check for transmission problems<br>4. Check for engine Accessories, such as A/C, cycling on and off<br>5. Check for electromagnetic interference (EMI) from improperly installed radios etc. | **No problems found:** GO TO ❷<br>**Problem found:** Repair and retest<br>– – –1/1 |
| ❷ **Active DTC Test** | 1. Connect the DST or SERVICE ADVISOR™. For instructions on connecting to the DST or SERVICE ADVISOR™, see CONNECTING TO DIAGNOSTIC SCAN TOOL (DST) OR SERVICE ADVISOR™ in Group 160 later in this manual.<br>2. Ignition ON, engine OFF<br>3. Start the ECU diagnostic software<br>4. Ignition ON, engine idling<br>5. Read DTCs using DST or SERVICE ADVISOR™. | **No active DTCs:** GO TO ❸<br>**Active DTCs present:** Diagnose DTCs. If any of the DTCs have a SPN of 636 or 637, diagnose those first |

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| ❸ **Engine Performance Test** | 1. Ignition ON, engine idling.<br>2. Observe engine performance. | **Not running rough:** GO TO ❹<br>**Running rough:** GO TO ❻<br>– – –1/1 |

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| ❹ **Recreate Conditions** | Operate engine under conditions where the miss/rough running complaint occurs. | **Running rough:**<br>GO TO ❺<br><br>**Not running rough:**<br>No problem found, verify complaint and try to reproduce conditions of miss/rough running complaint.<br><br>– – –1/1 |

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| ❺ **Active DTC Test** | 1. Ignition ON, engine idling<br><br>2. Read DTCs | **No active DTCs:**<br>GO TO ❻<br><br>**Active DTCs present:**<br>Diagnose DTCs. If any of the DTCs have a SPN of 636 or 637, diagnose those first.<br><br>– – –1/1 |



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| ❻ **Head Gasket Failure Test** | Check for head gasket joint failures. See CHECK FOR HEAD GASKET FAILURES in Group 150 of 4.5 L & 6.8 L Diesel Engines Base Engine Manual (CTM 104). | **No sign of head gasket failure:**<br>GO TO ❼<br><br>**Signs of head gasket failure found:**<br>Replace head gasket and retest.<br><br>– – –1/1 |

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| ❼ **Cylinder Misfire Check** | Perform the Cylinder Misfire Test. For instructions, see ENGINE TEST INSTRUCTIONS - CYLINDER MISFIRE TEST in Section 04, Group 160 earlier in this manual. | **Single cylinder misfires:**<br>GO TO ❽<br><br>**Random or all cylinder misfire:**<br>See F1 - FUEL SUPPLY SYSTEM CHECK - TIER 1 or F4 - FUEL SUPPLY SYSTEM CHECK - TIER 2 in this Group.<br><br>– – –1/1 |

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| ❽ **Compression Pressure Check** | Check the compression pressure. See ENGINE TEST INSTRUCTIONS - COMPRESSION TEST in Section 04, Group 160 later in this manual. | **Compression pressure within specification:** GO TO ❾<br><br>**Compression pressure is not within specification:** GO TO ⓬<br><br>– – –1/1 |

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| ❾ **Fuel Supply System Check** | Check the fuel supply system. See F1 - FUEL SUPPLY SYSTEM CHECK - TIER 1 or F4 - FUEL SUPPLY SYSTEM CHECK - TIER 2 in this Group. | **Fuel supply system OK:** GO TO ❿<br><br>**Fuel supply system problem found:** Repair fuel supply system problem and retest.<br><br>– – –1/1 |



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| ❿ **Fuel Delivery Line Check** | **Perform the following steps to determine if fuel delivery lines are restricted:**<br><br>1. Disconnect the suspected fuel delivery line on the injection nozzle end and the injection pump end.<br><br>2. Force air through one end of the delivery line.<br><br>3. If the delivery line is not restricted, the compressed air should flow freely out the other side.<br><br>4. If air does not flow freely, there are restriction in the fuel line. | **Lines are not restricted:** GO TO ⓫<br><br>**Lines are restricted:** Repair or replace lines and retest.<br><br>– – –1/1 |

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| **11 Fuel Injection Nozzle Check** | Test fuel injection nozzles. See F5 - FUEL INJECTION NOZZLE CHECK later in this Group. | **Injection nozzles test OK:**<br>Faulty injection pump. Have injection pump repaired by an authorized diesel repair station or replace pump.<br><br>**Faulty injection nozzle(s) found:**<br>Repair or replace injection nozzle(s). See REMOVE FUEL INJECTION NOZZLES in Section 02, Group 090 earlier in this manual.<br><br>– – –1/1 |



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| **12 Piston Ring Check** | *NOTE: DO NOT use too much oil. DO NOT get oil on the valves.*<br><br>1. Apply oil to the ring area of the piston through injection nozzle bore. See REMOVE FUEL INJECTION NOZZLES in Section 02, Group 090 of this manual.<br><br>2. Retest the compression pressure. | **Compression pressure is within specification:**<br>GO TO 15<br><br>**Compression pressure is not within specification:**<br>GO TO 13<br><br>– – –1/1 |

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| **13 Valve Lash Check** | Check valve lash. See CHECK AND ADJUST VALVE CLEARANCE in Section 02, Group 020 of 4.5 L & 6.8 L Diesel Engines Base Engine Manual (CTM 104). | **Valve clearance within specification:**<br>GO TO 14<br><br>**Valve clearance out of specification:**<br>Adjust valves to specification and retest.<br><br>– – –1/1 |

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| **14 Valve Lift Test** | Check valve lift. See MEASURE VALVE LIFT in Section 02, Group 020 of 4.5 L & 6.8 L Diesel Engines Base Engine Manual (CTM104). | **Lift on all valves within specification:**<br>GO TO 15<br><br>**Lift on one or more valves is out of specification:**<br>Reset clearance to specification after measuring lift. See CHECK AND ADJUST VALVE CLEARANCE in Section 02, Group 020 of 4.5 L & 6.8 L Diesel Engines Base Engine Manual (CTM104).<br><br>– – –1/1 |

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| **15 Piston, Rings, Cylinder Liner Check** | At this point, the most likely cause of the low engine compression pressure is one of the following failures in the piston, rings, and/or cylinder liners or in the valve guides. Check the most likely items as needed:<br><br>• Oil control rings worn or broken<br>• Scored cylinder liners or pistons<br>• Piston ring grooves excessively worn<br>• Piston rings sticking in ring grooves<br>• Insufficient piston ring tension<br>• Piston ring gaps not staggered<br>• Cylinder liners glazed (insufficient load during engine break-in)<br>• Worn valve guides or stems<br>• Cylinder head may need reconditioning | **Problem found with pistons, rings, and/or liners or valve guides:**<br>Repair problems as necessary.<br><br>– – –1/1 |

## E3 - Engine Does Not Develop Full Power

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## E3 - Engine Does Not Develop Full Power Diagnostic Procedure

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| ❶ **E3 - Preliminary Check** | Before using the diagnostic procedure, ensure that:<br>1. There are no problems with transmission<br>2. There are no engine mechanical problems<br>3. There is not an excessive load on the engine<br>4. There is no unbalanced ballast<br>5. The air and fuel filters are not restricted or plugged<br>6. Fuel quality is OK | **No problems found:**<br>GO TO ❷<br>**Problem found:**<br>Repair and retest |

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| ❷ **Active DTC Test** | 1. Connect the DST or SERVICE ADVISOR™. For instructions on connecting to the DST or SERVICE ADVISOR™, see CONNECTING TO DIAGNOSTIC SCAN TOOL (DST) OR SERVICE ADVISOR™in Group 160 later in this manual.<br>2. Ignition ON, engine OFF<br>3. Start the ECU diagnostic software<br>4. Ignition ON, engine OFF<br>5. Read DTCs using DST or SERVICE ADVISOR™.<br>*NOTE: Look for DTCs that indicate a fuel derate is or has been in effect.* | **No DTCs present:**<br>GO TO ❸<br>**DTCs present:**<br>Go to appropriate diagnostic procedure. |

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| ❸ **Exhaust Emission Test** | 1. Operate engine at full load rated speed.<br><br>2. Under these conditions, determine type of exhaust emitted. | **Small amount or no exhaust smoke:**<br>GO TO ❹<br><br>**Heavy white exhaust smoke:**<br>See E4 - ENGINE EMITS EXCESSIVE WHITE EXHAUST SMOKE diagnostic procedure later in this Group.<br><br>**Heavy black or gray exhaust smoke:**<br>See E5 - ENGINE EMITS EXCESSIVE BLACK or GRAY EXHAUST SMOKE diagnostic procedure later in this Group.<br><br>– – –1/1 |



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| ❹ **Torque Curve Selection Check** | The ECU on 4.5/6.8L engines has the ability to operate on multiple torque curves. To check that the engine is operating on the correct torque curve under the operating conditions where there is a low power complaint:<br><br>1. Recreate the conditions of the low power complaint.<br><br>2. Read the Torque Curve Parameter<br><br>*NOTE: For explanation of this parameter, see DATA PARAMETER DESCRIPTION in Section 04, Group 160 later in this manual.*<br><br>3. Compare the Torque Curve Parameter to the appropriate torque curve chart. See APPLICATION SPECIFICATIONS in Section 06, Group 210 of this manual. | **Correct torque curve number displayed for corresponding operating conditions:**<br>GO TO ❺<br><br>**Incorrect torque curve number displayed for corresponding operating conditions:**<br>Refer to machine manual to determine components that if faulty could prevent the correct torque curve from being selected<br>OR<br>Faulty torque curve select wiring<br><br>– – –1/1 |

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| ❺ **Governor Droop Mode Selection Check** | 1. Operate engine and attempt to recreate the low power condition.<br><br>2. Read the Desired Speed Governor parameter and the Maximum Speed Governor parameter.<br><br>*NOTE: For explanation of this parameter, see DATA PARAMETER DESCRIPTION in Section 04, Group 160 later in this manual.*<br><br>3. Compare governor selection to the appropriate governor mode chart. See APPLICATION SPECIFICATIONS in Section 06, Group 210 of this manual. | **Correct governor selection:**<br>GO TO ❻<br><br>**Incorrect governor selection:**<br>Refer to machine manual to determine components that if faulty could prevent the correct governor from being selected<br>OR<br>Faulty governor select wiring<br><br>– – –1/1 |

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|---|---|---|
| ❻ **Throttle Test** | 1. Operate engine at full load rated speed.<br>2. At these operating conditions, read the Throttle Position data parameter.<br>*NOTE: For explanation of this parameter, see DATA PARAMETER DESCRIPTION in Section 04, Group 160 later in this manual.* | **97% or above:**<br>GO TO ❼<br>**Below 97%:**<br>Refer to machine manual and perform the throttle calibration procedure; then retest.<br>– – –1/1 |
| ❼ **Turbocharger Boost Pressure Check** | Check the Turbo Boost pressure. See MEASURE INTAKE MANIFOLD PRESSURE (TURBO BOOST) in Group 150 of 4.5 L & 6.8 L Diesel Engines Base Engine Manual (CTM 104). | **Intake manifold pressure within range or above, compared to boost specification:**<br>GO TO ❽<br>**Intake manifold pressure below range compared to boost specification:**<br>GO TO ❾<br>– – –1/1 |
| ❽ **Fuel Supply System Check** | Check the fuel supply system by referring to chart F1 - FUEL SUPPLY SYSTEM CHECK - TIER 1 or F4 - FUEL SUPPLY SYSTEM CHECK - TIER 2 in this Group. | **Fuel supply system is OK:**<br>Engine appears to be delivering full power. Check for vehicle problems that could cause an excessive load on the engine.<br>**Fuel supply system problem found:**<br>Repair fuel supply system problem and retest.<br>– – –1/1 |
| ❾ **Cylinder Misfire Check** | Perform the Cylinder Misfire Test. For instructions, see ENGINE TEST INSTRUCTIONS - CYLINDER MISFIRE TEST in Section 04, Group 160 earlier in this manual. | **All cylinders within specification:**<br>GO TO ❿<br>**Random or all cylinder misfire:**<br>See E2 - ENGINE MISFIRES/RUNS IRREGULARLY earlier in this Group.<br>– – –1/1 |

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| **10 Compression and Misfire Test** | Check the compression pressure. See ENGINE TEST INSTRUCTIONS - COMPRESSION TEST in Section 04, Group 160 later in this manual. | **Compression pressure within specification:**<br>GO TO 11<br><br>**Compression pressure is not within specification:**<br>GO TO 14<br><br>– – –1/1 |

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| **11 Checking Potential Causes of Low Boost Pressure** | **Check for the following that can cause reduced boost pressure:**<br>1. Restricted air cleaner<br>2. Intake air leak<br>3. Exhaust air leak<br>4. Restriction in exhaust<br>5. Faulty turbocharger. See TURBOCHARGER SEVEN-STEP INSPECTION in Group 080 of 4.5 L & 6.8 L Diesel Engines Base Engine Manual (CTM 104). | **None of the above problems found:**<br>GO TO 12<br><br>**Problem found:**<br>Repair problem and retest.<br><br>– – –1/1 |



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| **12 Fuel Supply System Check** | Check the fuel supply system by referring to chart F1 - FUEL SUPPLY SYSTEM CHECK - TIER 1 or F4 - FUEL SUPPLY SYSTEM CHECK - TIER 2 in this Group. | **Fuel supply system is OK:**<br>GO TO 13<br><br>**Fuel supply system problem found:**<br>Repair fuel supply system problem and retest.<br><br>– – –1/1 |

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| **13 Fuel Injection Nozzles Test** | Test fuel injection nozzles. See TEST FUEL INJECTION NOZZLES in Group 090 of this manual. | **Injection nozzles test good:**<br>Faulty injection pump<br>OR<br>Faulty ECU<br><br>**Faulty injection nozzle(s) found:**<br>Repair or replace faulty injection nozzles.<br><br>– – –1/1 |

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| **14 Piston Ring Check** | *NOTE: DO NOT use too much oil. DO NOT get oil on the valves.*<br><br>1. Apply oil to the ring area of the piston through injection nozzle bore. See REMOVE FUEL INJECTION NOZZLES in Section 02, Group 090 of this manual.<br><br>2. Retest the compression pressure. | **Compression pressure is within specification:**<br>GO TO 17<br><br>**Compression pressure is not within specification:**<br>GO TO 15<br><br>– – –1/1 |

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| **15 Valve Lash Check** | 1. Ensure there are no engine mechanical problems and that there isn't something drawing excessive engine power<br><br>2. Ensure that valve lash is correctly adjusted. See CHECK AND ADJUST VALVE CLEARANCE in Group 020 of 4.5 L & 6.8 L Diesel Engines Base Engine Manual (CTM 104). | **Valve clearance within specification:**<br>GO TO 16<br><br>**Valve clearance out of specification:**<br>Adjust valves to specification and retest.<br><br>– – –1/1 |



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| **16 Valve Lift Test** | Check valve lift. See MEASURE VALVE LIFT in Section 02, Group 020 of 4.5 L & 6.8 L Diesel Engines Base Engine Manual (CTM104). | **Lift on all valves within specification:**<br>GO TO 17<br><br>**Lift on one or more valves is out of specification:**<br>Reset clearance to specification after measuring lift. See CHECK AND ADJUST VALVE CLEARANCE in Section 02, Group 020 of 4.5 L & 6.8 L Diesel Engines Base Engine Manual (CTM104).<br><br>– – –1/1 |

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| **17 Piston, Rings, Cylinder Liner Check** | At this point, the most likely cause of the low engine compression pressure is one of the following failures in the piston, rings, and/or cylinder liners or in the valve guides. Check the most likely items as needed:<br><br>• Oil control rings worn or broken<br>• Scored cylinder liners or pistons<br>• Piston ring grooves excessively worn<br>• Piston rings sticking in ring grooves<br>• Insufficient piston ring tension<br>• Piston ring gaps not staggered<br>• Cylinder liners glazed (insufficient load during engine break-in)<br>• Worn valve guides or stems<br>• Cylinder head may need reconditioning | **Problem found with pistons, rings, and/or liners or valve guides:** Repair problems as necessary.<br><br>– – –1/1 |

## E4 - Engine Emits Excessive White Exhaust Smoke

RG41221,000011B –19–18OCT02–1/1

### E4 - Engine Emits Excessive White Exhaust Smoke Diagnostic Procedure

*NOTE: This procedure should be used if the engine emits excessive white exhaust smoke. This type of smoke causes a burning sensation to the eyes. If engine emits a less heavy, bluish exhaust smoke see L1 - EXCESSIVE OIL CONSUMPTION in Section 04, Group 150 of 4.5 L & 6.8 L Diesel Engines Base Engine Manual (CTM 104).*



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| ❶ **E4 - Preliminary Check** | Before using this diagnostic procedure, ensure that:<br>1. Ensure fuel quantity and quality are OK. See CHECK FUEL SUPPLY QUALITY or CHECK FUEL SUPPLY QUALITY - TIER 2 later in this Group.<br>2. Ensure engine coolant temperature is not extremely low. | **No problems found:** GO TO ❷<br>**Problem found:** Repair and retest<br>– – –1/1 |
| ❷ **Head Gasket Failure Test** | Check for a failed head gasket. See CHECK FOR HEAD GASKET FAILURES in Group 150 of 4.5 L & 6.8 L Diesel Engines Base Engine Manual (CTM 104). | **No signs of head gasket failure:** GO TO ❸<br>**Signs of head gasket failure are found:** See HEAD GASKET INSPECTION AND REPAIR SEQUENCE in Group 020 of 4.5 L & 6.8 L Diesel Engines Base Engine Manual (CTM 104).<br>– – –1/1 |

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| ❸ **Compression Pressure Test** | Check compression pressure. See ENGINE TEST INSTRUCTIONS - COMPRESSION TEST in Section 04, Group 160 later in this manual. | **All cylinders score within 10% of each other:**<br>GO TO ❹<br><br>**One or more cylinders scored 10% or lower than the rest:**<br>Test low cylinder(s) to verify low compression. See TEST ENGINE COMPRESSION PRESSURE in Group 150 of 4.5 L & 6.8 L Diesel Engines Base Engine Manual (CTM 104). Investigate problems related to low compression on low cylinder(s).<br><br>– – –1/1 |



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| ❹ **Fuel Supply Pressure Check** | Check fuel pressure. See CHECK FUEL SUPPLY PRESSURE later in this Group. | **Fuel pressure within specification:**<br>GO TO ❺<br><br>**Fuel pressure below specification:**<br>Check fuel supply system. See F1 - FUEL SUPPLY SYSTEM CHECK - TIER 1 or F4 - FUEL SUPPLY SYSTEM CHECK - TIER 2 later in this Group.<br><br>– – –1/1 |

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| ❺ **Fuel Injection Nozzle Check** | Test fuel injection nozzles. See F5 - FUEL INJECTION NOZZLE CHECK later in this Group. | **Injection nozzles test OK:**<br>Faulty injection pump.<br><br>**Faulty injection nozzle(s) found:**<br>Repair or replace injection nozzle(s). See REMOVE FUEL INJECTION NOZZLES in Section 02, Group 090 earlier in this manual.<br><br>– – –1/1 |

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| **❻ Piston Ring Check** | *NOTE: DO NOT use too much oil. DO NOT get oil on the valves.*<br><br>1. Apply oil to the ring area of the piston through injection nozzle bore. See REMOVE FUEL INJECTION NOZZLES in Section 02, Group 090 of this manual.<br><br>2. Retest the compression pressure. | **Compression pressure is within specification:** GO TO ❾<br><br>**Compression pressure is not within specification:** GO TO ❼<br><br>– – –1/1 |

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|---|---|---|
| **❼ Valve Lash Check** | Check Valve Lash. See CHECK AND ADJUST VALVE CLEARANCE in Group 020 of 4.5 L and 6.8 L Diesel Engines Repair Manual (CTM 104). | **Valve clearance within specification:** GO TO ❽<br><br>**Valve clearance out of specification:** Adjust valves to specification and retest.<br><br>– – –1/1 |



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|---|---|---|
| **❽ Valve Lift Check** | Check valve lift. See MEASURE VALVE LIFT in Section 02, Group 020 of 4.5 L & 6.8 L Diesel Engines Base Engine Manual (CTM104). | **Lift on all valves within specification:** GO TO ❾<br><br>**Lift on one or more valves is out of specification:** Reset clearance to specification after measuring lift. See CHECK AND ADJUST VALVE CLEARANCE in Section 02, Group 020 of 4.5 L & 6.8 L Diesel Engines Base Engine Manual (CTM104).<br><br>– – –1/1 |

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| ❾ **Piston, Rings, Cylinder Liners Check** | At this point, the most likely cause of the low engine compression pressure is one of the following failures in the piston, rings, and/or cylinder liners or in the valve guides. Check the most likely items as needed:<br><br>• Oil control rings worn or broken<br>• Scored cylinder liners or pistons<br>• Piston ring grooves excessively worn<br>• Piston rings sticking in ring grooves<br>• Insufficient piston ring tension<br>• Piston ring gaps not staggered<br>• Cylinder liners glazed (insufficient load during engine break-in)<br>• Worn valve guides or stems<br>• Cylinder head may need reconditioning | **Problem found with pistons, rings, and/or liners or valve guides:** Repair problems as necessary.<br><br>– – –1/1 |

# E5 - Engine Emits Excessive Black Or Gray Smoke

RG41221,000011C –19–18OCT02–1/1

## E5 - Engine Emits Excessive Black Or Gray Smoke Diagnostic Procedure

*NOTE: This procedure should be used if the engine emits excessive black or gray smoke. If engine emits a less heavy, bluish exhaust smoke see L1 - EXCESSIVE OIL CONSUMPTION in Section 04, Group 150 of 4.5 L & 6.8 L Diesel Engines Base Manual (CTM 104).*



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| ❶ **E5 - Preliminary Check** | Before using this diagnostic procedure, ensure that:<br>1. Ensure fuel quantity and quality are OK. See CHECK FUEL SUPPLY QUALITY or CHECK FUEL SUPPLY QUALITY - TIER 2 later in this Group.<br>2. Ensure engine is not excessively loaded<br>3. Ensure air filter is not restricted or plugged | **No problem found:**<br>GO TO ❷<br><br>**Problems found:**<br>Repair and retest |

– – –1/1

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| ❷ **Torque Curve Check** | *NOTE: This check is only required for Excavators. For all other applications, GO TO ❸.*<br>1. Connect the DST or SERVICE ADVISOR™. For instructions on connecting to the DST or SERVICE ADVISOR™, see CONNECTING TO DIAGNOSTIC SCAN TOOL (DST) OR SERVICE ADVISOR™ in Group 160 later in this manual.<br>*NOTE: For explanation of this parameter, see DATA PARAMETER DESCRIPTION in Section 04, Group 160 later in this manual.*<br>2. Using the ECU diagnostic software, read the Torque Curve Parameter with the engine running.<br>3. Compare the Torque Curve Parameter to the appropriate torque chart. See EXCAVATORS - TORQUE CURVE SELECTION in Section 06, Group 210 later in this manual. | **Correct torque curve number displayed:**<br>GO TO ❸<br><br>**Incorrect torque curve number displayed:**<br>Adjust the torque curve using the diagnostic software. See ENGINE TEST INSTRUCTIONS - EXCAVATOR TORQUE CURVE CHANGE TEST in Section 04, Group 160 later in this manual. |

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| ❸ **Air Intake and Exhaust Test** | Check for intake and exhaust restrictions and air leaks. See CHECK FOR INTAKE AND EXHAUST RESTRICTIONS and TEST FOR INTAKE AIR LEAKS and CHECK FOR EXHAUST AIR LEAKS in Group 150 of 4.5 L & 6.8 L Diesel Engines Base Engine Manual (CTM 104). | **No restrictions or leaks found:**<br>GO TO ❹<br><br>**Restrictions or leaks found:**<br>Repair or replace components as necessary.<br><br>– – –1/1 |
| ❹ **Turbocharger Check** | Check for turbocharger failure. See TURBOCHARGER SEVEN-STEP INSPECTION in Group 080 of 4.5 L & 6.8 L Diesel Engines Base Engine Manual (CTM 104). | **No turbocharger failure found:**<br>GO TO ❺<br><br>**Turbocharger failure found:**<br>Follow appropriate repair procedure in Group 080 of 4.5 L & 6.8 L Diesel Engines Base Engine Manual (CTM104).<br><br>– – –1/1 |
| ❺ **Valve Lash Check** | Check valve lash. See CHECK AND ADJUST VALVE CLEARANCE in Group 020 of 4.5 L & 6.8 L Diesel Engines Base Engine Manual (CTM104). | **Valve lash on all valves within specification:**<br>GO TO ❻<br><br>**Valve lash on one or more valves out of specification:**<br>Adjust valve lash and retest<br><br>– – –1/1 |
| ❻ **Fuel Return Line Check** | Check for restricted fuel return line and fittings. | **No restriction found:**<br>GO TO ❼<br><br>**Restriction found:**<br>Repair and retest<br><br>– – –1/1 |

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|---|---|---|
| ❼ **Fuel Injection Nozzle Check** | Test fuel injection nozzles. See F5 - FUEL INJECTION NOZZLE CHECK later in this Group. | **Injection nozzles test OK:**<br>Faulty injection pump.<br><br>**Faulty injection nozzle(s) found:**<br>Repair or replace injection nozzle(s). See REMOVE FUEL INJECTION NOZZLES in Section 02, Group 090 earlier in this manual.<br><br>– – –1/1 |

## E6 - Engine Will Not Crank

| Symptom | Problem | Solution |
|---|---|---|
| **Engine Will Not Crank** | Weak battery | Replace battery. |
| | Corroded or loose battery connections | Clean battery terminals and connections. |
| | Defective main switch or start safety switch | Repair switch as required. |
| | Starter solenoid defective | Replace solenoid. |
| | Starter defective | Replace starter. |
| | Start circuit defective | Check wiring, fuses, and relays. |
| | Engine is seized up | Check by rotating engine by hand. |



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## E7 - Engine Idles Poorly

| Symptom | Problem | Solution |
|---|---|---|
| **E7 - Engine Idles Poorly** | Poor fuel quality | Drain fuel and replace with quality fuel of the proper grade. |
| | Air leak on suction side of air intake system | Check hose and pipe connections for tightness; repair as required. See AIR INTAKE AND EXHAUST SYSTEM SPECIFICATIONS in Section 6, Group 200 of 4.5 L & 6.8 L Diesel Engines Base Engine Manual (CTM 104). |
| | Electronic control system problem or basic engine problem | See E2 - ENGINE MISFIRES/RUNS IRREGULARLY earlier in this Group. |

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## E8 - Abnormal Engine Noise

| Symptom | Problem | Solution |
|---|---|---|
| **E8 - Abnormal Engine Noise** | Worn main or connecting rod bearings | Determine bearing clearance. See CYLINDER BLOCK, LINERS, PISTONS, AND RODS SPECIFICATIONS in Section 6, Group 200 or CRANKSHAFT , MAIN BEARINGS, AND FLYWHEEL SPECIFICATIONS in Section 6, Group 200 of 4.5 L & 6.8 L Diesel Engines Base Engine Manual (CTM 104). |
| | Excessive crankshaft end play | Check crankshaft end play. See CHECK CRANKSHAFT END PLAY in Section 2, Group 040 of 4.5 L & 6.8 L Diesel Engines Base Engine Manual (CTM 104). |
| | Loose main bearing caps | Check bearing clearance; replace bearings and bearing cap screws as required. See CRANKSHAFT , MAIN BEARINGS, AND FLYWHEEL SPECIFICATIONS in Section 6, Group 200 of 4.5 L & 6.8 L Diesel Engines Base Engine Manual (CTM 104). |
| | Worn connecting rod bushings and piston pins | Inspect piston pins and bushings. See INSPECT PISTON PINS AND BUSHINGS in Section 2, Group 030 of 4.5 & 6.8 L Diesel Engines Base Engine Manual (CTM 104). |
| | Scored pistons | Inspect pistons. See PRELIMINARY LINER, PISTON, AND ROD CHECKS in Section 2, Group 030 of 4.5 L & 6.8 L Diesel Engines Base Engine Manual (CTM 104). |



Continued on next page

| Symptom | Problem | Solution |
|---|---|---|
| | Worn timing gears or excess back lash | Check timing gear back lash. See MEASURE TIMING GEAR BACKLASH in Section 2, Group 050 of 4.5 L & 6.8 L Diesel Engines Base Engine Manual (CTM 104). |
| | Excessive valve clearance | Check and adjust valve clearance. See CHECK AND ADJUST VALVE CLEARANCE in Section 2, Group 020 of 4.5 L & 6.8 L Diesel Engines Base Engine Manual (CTM 104). |
| | Worn camshaft | Inspect camshaft. See VISUALLY INSPECT CAMSHAFT in Section 2, Group 050 of 4.5 & 6.8 L Diesel Engines Base Engine Manual (CTM 104). |
| | Worn rocker arm shaft(s) | Inspect rocker arm shafts. See DISASSEMBLE AND INSPECT ROCKER ARM SHAFT ASSEMBLY in Section 2, Group 020 of 4.5 L & 6.8 L Diesel Engines Base Engine Manual (CTM 104). |
| | Insufficient engine lubrication | See L2 - ENGINE OIL PRESSURE LOW in Section 4, Group 150 of 4.5 & 6.8 L Diesel Engines Base Engine Manual (CTM 104). |
| | Turbocharger noise | See TURBOCHARGER SEVEN-STEP INSPECTION in Section 2, Group 080 of 4.5 L & 6.8 L Diesel Engines Base Engine Manual (CTM 104). |



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## E10 - Analog Throttle (B) Does Not Respond

*NOTE: This procedure is necessary for OEM applications only. For other applications, check for Diagnostic Trouble Codes (DTCs) and follow the corresponding procedure.*

| Symptom | Problem | Solution |
|---|---|---|
| **E10 - Analog Throttle (B) Does Not Respond** | Active DTC Check | Read DTCs on DST or SERVICE ADVISOR™. Go to the diagnostic procedure for the corresponding DTC. |
| | Analog Throttle (B) Check | See T6 - ANALOG THROTTLE (B) INPUT LOW DIAGNOSTIC PROCEDURE in Group 160 of this manual. |

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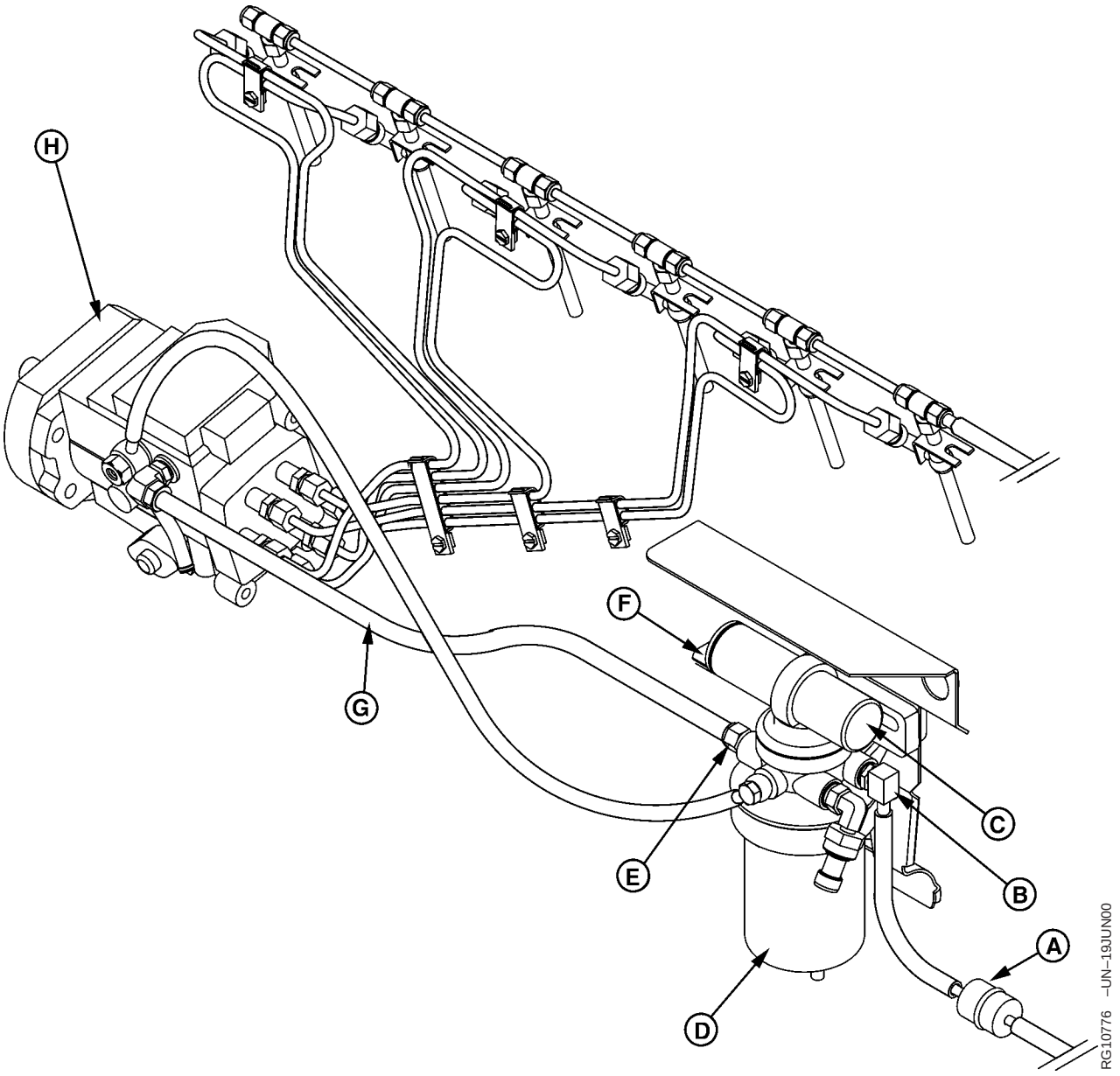
## F1 - Fuel Supply System Check - Tier 1

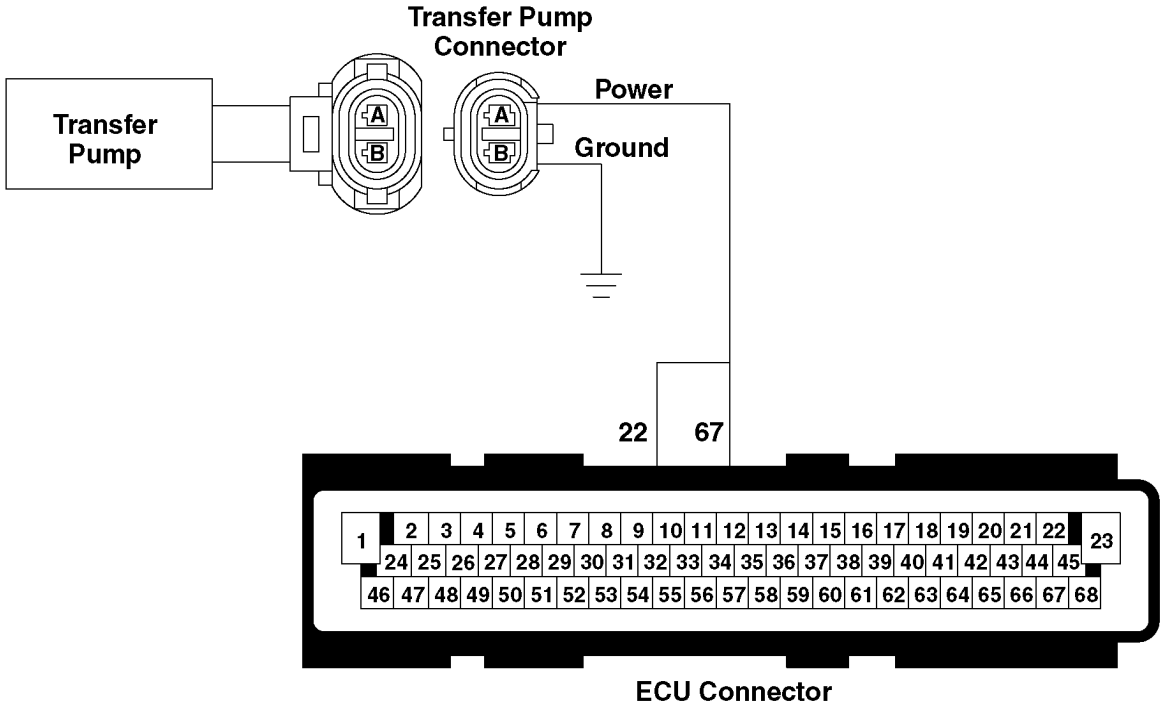





**A—Primary Filter**
**B—Final Filter Inlet**
**C—Transfer Pump**
**D—Final Filter**
**E—Final Filter Outlet**
**F—Transfer Pump Connector**
**G—Fuel Line Between Final Filter and Injection Pump**
**H—Injection Pump**

The callouts in this illustration are referred to throughout F1-FUEL SUPPLY CHECK - TIER 1 diagnostic procedure to clearly identify various locations on the fuel system. For fuel system theory of operation information, see FUEL SYSTEM OPERATION - TIER 1 in Section 03, Group 130 earlier in this manual.

**Continued on next page**

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**Electronic Transfer Pump**

- The ECU maintains a constant fuel pressure for a given speed by controlling the duty cycle of the Pulse Width Modulated (PWM) signal between the ECU and transfer pump. When fuel pressure increases, the ECU decreases the duty cycle. When fuel pressure decreases, the ECU increases the duty cycle. Transfer pump duty cycle and fuel pressure can be monitored on the ECU diagnostic software.

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## F1 - Fuel Supply System Check - Tier 1

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## F1 - Fuel Supply System Check - Tier 1 Diagnostic Procedure

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| ❶ **Preliminary Check** | *NOTE: For wiring and theory of operation information, see F1 - FUEL SUPPLY SYSTEM CHECK - TIER 1 supporting information*<br><br>Before using this diagnostic procedure, check the following:<br><br>1. If fuel system has been recently opened (filter changed, line removed etc.) perform fuel system bleed procedure. See BLEED THE FUEL SYSTEM later in this Group and retest.<br><br>2. Check for air leaks from loose or damaged fuel lines and fittings.<br><br>3. Check for ruptured fuel lines.<br><br>4. Ensure fuel quantity and quality are OK. See CHECK FUEL SUPPLY QUALITY - TIER 1 later in this Group.<br><br>5. Check for air in the fuel system. See TEST FOR AIR IN FUEL - TIER 1 later in this Group. | **No problem found:**<br>GO TO ❷<br><br>**Problem found:**<br>Repair and retest<br><br>– – –1/1 |
| ❷ **Engine Performance Check** | *NOTE: For wiring and theory of operation information, see F1 - FUEL SUPPLY SYSTEM CHECK - TIER 1 supporting information*<br><br>1. Ignition ON, engine running<br><br>2. Observe engine performance. | **Engine runs:**<br>GO TO ❹<br><br>**Engine cranks but won't start:**<br>GO TO ❸<br><br>– – –1/1 |

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| ❸ **Fuel Pressure Check During Prime Cycle** | *NOTE: For wiring and theory of operation information, see F1 - FUEL SUPPLY SYSTEM CHECK - TIER 1 supporting information*<br><br>1. Connect the DST or SERVICE ADVISOR™. For instructions on connecting to the DST or SERVICE ADVISOR™, see CONNECTING TO DIAGNOSTIC SCAN TOOL (DST) OR SERVICE ADVISOR™in Group 160 later in this manual.<br><br>2. Ignition ON, engine OFF<br><br>3. Start the ECU diagnostic software<br><br>4. Read the fuel pressure parameter using DST or SERVICE ADVISOR™.<br><br>*NOTE: The electronic transfer pump runs for 40 seconds at key ON to prime the fuel system. Fuel pressure must be read within the first 40 seconds after key ON.* | **Consistently above 150 kPa (1.50 bar) (22 psi):**<br>GO TO ❽<br><br>**Consistently below 150 kPa (1.50 bar) (22 psi):**<br>GO TO ❺ |

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| ❹ **Fuel Pressure Check (Running)** | *NOTE: For wiring and theory of operation information, see F1 - FUEL SUPPLY SYSTEM CHECK - TIER 1 supporting information*<br><br>1. Ignition ON, engine running<br><br>2. Read the fuel pressure parameter using DST or SERVICE ADVISOR™. | **Between 70-90 kPa (0.7-0.9 bar) (10.1-13.0 psi):**<br>GO TO ❽<br><br>**Consistently below 70 kPa (0.7 bar) (10.1 psi):**<br>GO TO ❺<br><br>**Consistently above 90 kPa (0.9 bar) (13.0 psi):**<br>GO TO ⓮ |

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| ❺ **Restricted Fuel Supply Line Check** | *NOTE: For wiring and theory of operation information, see F1 - FUEL SUPPLY SYSTEM CHECK - TIER 1 supporting information*<br><br>Remove the fuel supply lines between the fuel tank and the primary filter (A) and the line between the primary filter and the final filter (D) and determine if there are any restrictions. | **No restrictions found:**<br>GO TO ❻<br><br>**Restrictions found:**<br>Repair or replace components as needed. |

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| ❻ **Primary Fuel Filter Check** | *NOTE: For wiring and theory of operation information, see F1 - FUEL SUPPLY SYSTEM CHECK - TIER 1 supporting information*<br><br>Check for damaged, dirty, or plugged primary fuel filter. | **Primary fuel filter OK:**<br>GO TO ❼<br><br>**Primary fuel filter dirty or damaged:**<br>Clean or replace primary fuel filter and retest. |

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| ❼ **Final Fuel Filter Check** | *NOTE: For wiring and theory of operation information, see F1 - FUEL SUPPLY SYSTEM CHECK - TIER 1 supporting information*<br><br>Check for damaged, dirty, or plugged final fuel filter. | **Final fuel filter OK:**<br>GO TO ⓬<br><br>**Final fuel filter dirty or damaged:**<br>Replace final fuel filter and retest.<br><br>– – –1/1 |

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| ❽ **Restricted Injection Pump Fuel Supply Line Check** | *NOTE: For wiring and theory of operation information, see F1 - FUEL SUPPLY SYSTEM CHECK - TIER 1 supporting information*<br><br>Remove the fuel supply line (G) between the final filter and the fuel injection pump and determine if there are any restrictions. | **No restrictions found:**<br>GO TO ❾<br><br>**Restrictions found:**<br>Repair and replace components as needed.<br>– – –1/1 |

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|---|---|---|
| ❾ **Fuel at Injectors Check** | *NOTE: For wiring and theory of operation information, see F1 - FUEL SUPPLY SYSTEM CHECK - TIER 1 supporting information*<br><br>1. Ignition OFF<br>2. Using two open ended wrenches, loosen fuel line connections at the fuel inlet of the injector.<br>3. Place shop rag around the fuel line fitting at the injector.<br>4. Ignition ON, engine cranking or running<br>5. Observe fuel line at open fitting for fuel flow. | **Fuel flow is present:**<br>GO TO ⓫<br><br>**No or little fuel flow is present:**<br>GO TO ❿<br><br>– – –1/1 |

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| ❿ **Fuel Injection Lines Check** | *NOTE: For wiring and theory of operation information, see F1 - FUEL SUPPLY SYSTEM CHECK - TIER 1 supporting information*<br><br>Check all fuel injection lines for damage or restrictions. | **No damaged or restricted fuel injection line(s) found:**<br>Faulty fuel injection pump.<br><br>**Damaged or restricted fuel injection line(s) found:**<br>Repair or replace fuel line(s) as needed.<br><br>– – –1/1 |

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|---|---|---|
| **11 Fuel Injection Nozzle Check** | *NOTE: For wiring and theory of operation information, see F1 - FUEL SUPPLY SYSTEM CHECK - TIER 1 supporting information*<br><br>Test fuel injection nozzles. See F5 - FUEL INJECTION NOZZLE CHECK later in this Group. | **Injection nozzles test OK:**<br>Faulty injection pump. Have injection pump repaired by an authorized diesel repair station or replace pump.<br><br>**Faulty injection nozzle(s) found:**<br>Repair or replace injection nozzle(s). See REMOVE FUEL INJECTION NOZZLES in Section 02, Group 090 earlier in this manual. |

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|---|---|---|
| **12 Transfer Pump Power Wire Check** | *NOTE: For wiring and theory of operation information, see F1 - FUEL SUPPLY SYSTEM CHECK - TIER 1 supporting information*<br><br>1. Ignition OFF<br><br>2. Disconnect transfer pump connector (F)<br><br>3. Ignition ON, engine OFF<br><br>4. Using a multimeter, measure voltage between the power terminal (terminal A) of the transfer pump connector on the engine harness and a good chassis ground.<br><br>*NOTE: Voltage must be read within the first 40 seconds after key ON*<br><br>*NOTE: This voltage does NOT need to be battery voltage.* | **Positive voltage:**<br>GO TO 13<br><br>**NO voltage:**<br>Open or short in transfer pump power wire. |

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| **13 Transfer Pump Ground Wire Check** | *NOTE: For wiring and theory of operation information, see F1 - FUEL SUPPLY SYSTEM CHECK - TIER 1 supporting information*<br><br>1. Transfer pump connector still disconnected.<br><br>2. Ignition ON, engine OFF<br><br>3. Using a multimeter, measure voltage between the ground terminal (terminal B) of the transfer pump connector and battery voltage. | **At or near battery voltage:**<br>Faulty transfer pump connector<br>OR<br>Faulty transfer pump.<br><br>**Below battery voltage:**<br>Open in ground transfer pump ground wire. |

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| 14 **Transfer Pump Wiring Check** | *NOTE: For wiring and theory of operation information, see F1 - FUEL SUPPLY SYSTEM CHECK - TIER 1 supporting information*<br><br>1. Ignition OFF<br><br>2. Disconnect ECU connector<br><br>3. Using a multimeter, measure resistance between:<br><br>• Terminal 22 and all other terminals in the ECU connector (except 67).<br>• Terminal 67 and all other terminals in the ECU connector (except 22). | **Greater than 20k ohms:** Restriction in fuel line (G) between final filter and injection pump.<br><br>**Less than 20k ohms:** Short to voltage in transfer pump wiring<br><br>– – –1/1 |

## F2 - Excessive Fuel Consumption

| Symptom | Problem | Solution |
|---|---|---|
| **Excessive Fuel Consumption** | 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 as required. |
| | Compression too low | Determine cause of low compression and repair as required. |
| | Leaks in fuel supply system | Locate source of leak and repair as required. |

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## F3 - Fuel in Oil

| Symptom | Problem | Solution |
|---|---|---|
| **Fuel in Oil** | Faulty injection pump front seal | Replace front seal. |

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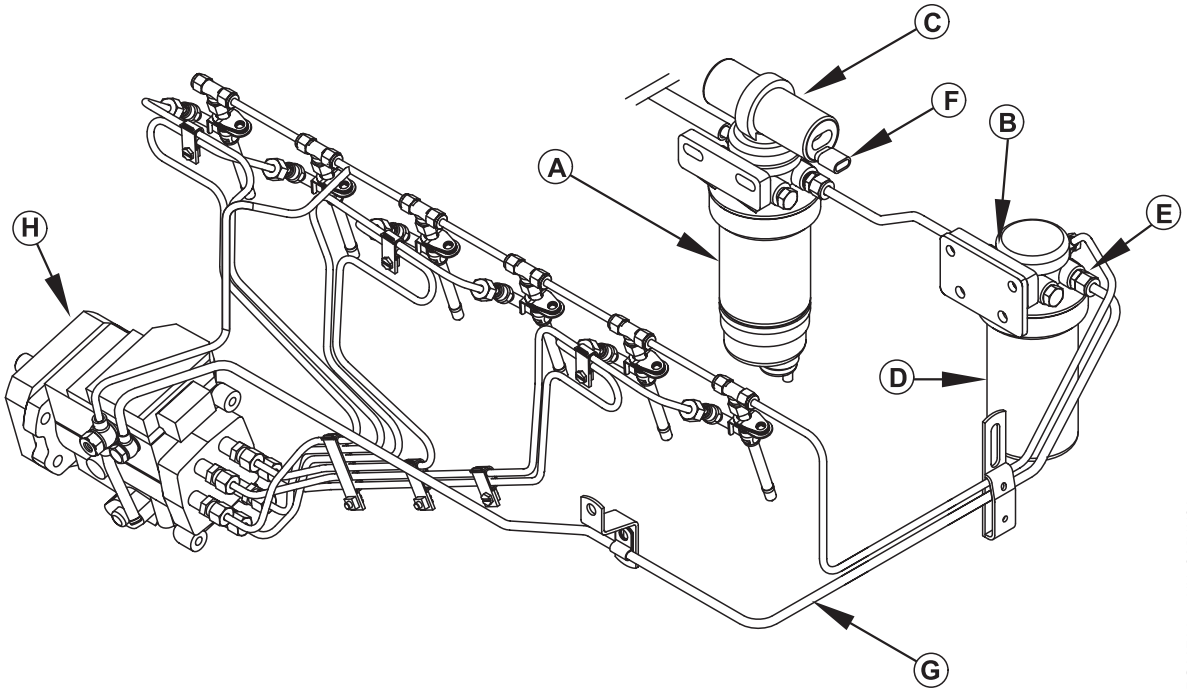
## F4 - Fuel Supply System Check - Tier 2




**A—Primary Filter**
**B—Final Filter Inlet**
**C—Transfer Pump**
**D—Final Filter**
**E—Final Filter Outlet**
**F—Transfer Pump Connector**
**G—Fuel Line Between Final Filter and Injection Pump**
**H—Injection Pump**

The callouts in this illustration are referred to throughout F4 - FUEL SUPPLY CHECK - TIER 2 diagnostic procedure to clearly identify various locations on the fuel system. For fuel system theory of operation information, see FUEL SYSTEM OPERATION - TIER 2 in Group 130 of this manual.

**Continued on next page**

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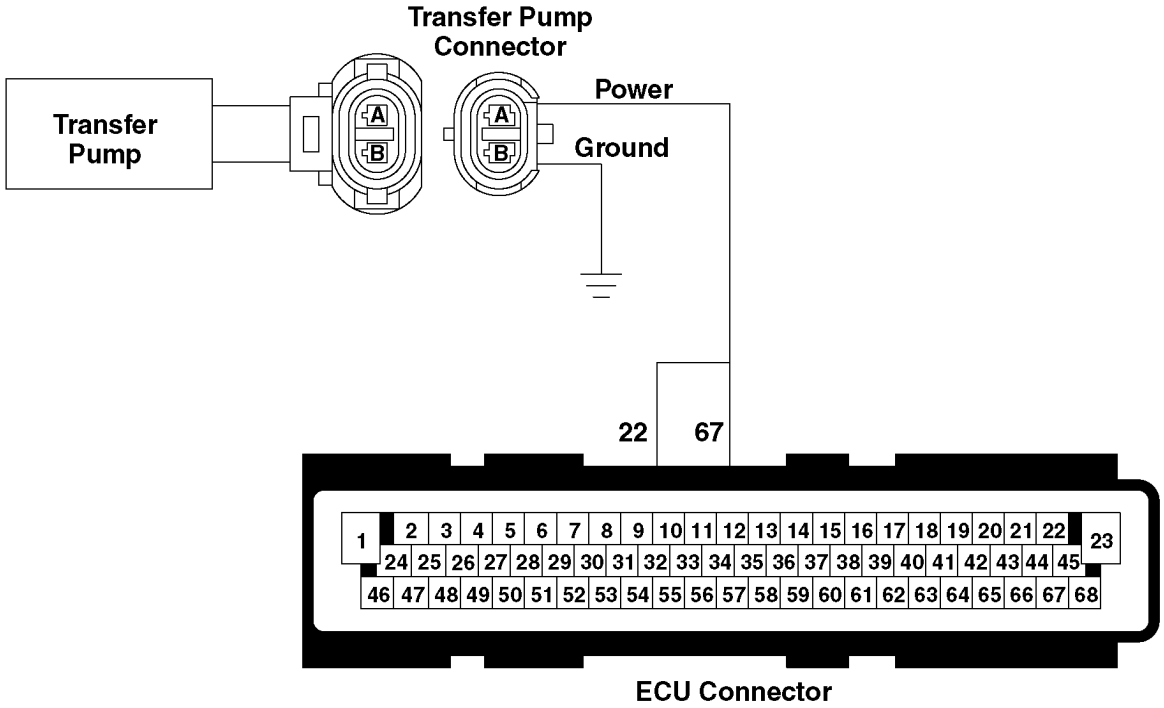


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**Electronic Transfer Pump**

- There are two types of fuel transfer pumps available on the tier 2 engines; Closed Loop and Open Loop. The Closed Loop pump uses the ECU and a fuel pressure sensor to control the fuel pressure at any give speed or load. The Open Loop pump does not have a fuel pressure sensor. This system uses a constant voltage to the transfer pump and a pressure regulating device. For more information on Closed Loop versus Open Loop systems, see ELECTRONIC FUEL TRANSFER PUMP in Section 03, Group 140 earlier in this manual.
- Some Applications use a remote mounted fuel transfer pump. These applications use ring terminals foe the electrical connections on the pump. The power still originates from the same terminals on the ECU connector.

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## F4 - Fuel Supply System Check - Tier 2

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## F4 - Fuel Supply System Check - Tier 2 Diagnostic Procedure

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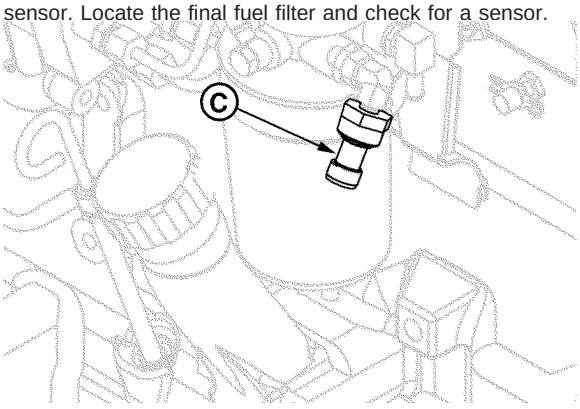
| ❶ **Preliminary Check** | *NOTE: For wiring and theory of operation information, see F4 - FUEL SUPPLY SYSTEM CHECK - TIER 2 supporting information*<br><br>Before using this diagnostic procedure, check the following:<br><br>1. If fuel system has been recently opened (filter changed, line removed etc.) perform fuel system bleed procedure. See BLEED THE FUEL SYSTEM later in this Group and retest.<br><br>2. Check for air leaks from loose or damaged fuel lines and fittings.<br><br>3. Check for ruptured fuel lines.<br><br>4. Ensure fuel quantity and quality are OK. See CHECK FUEL SUPPLY QUALITY - TIER 2 later in this Group.<br><br>5. Check for air in the fuel system. See TEST FOR AIR IN FUEL - TIER 2 later in this Group. | **No problem found:**<br>GO TO ❷<br><br>**Problem found:**<br>Repair and retest<br><br>– – –1/1 |
| ❷ **Fuel Control System Check** | *NOTE: For wiring and theory of operation information, see F4 - FUEL SUPPLY SYSTEM CHECK - TIER 2 supporting information*<br><br>Decide if this application is using a Closed Loop or Open Loop fuel control system. All closed loop systems use a fuel pressure sensor (C) to control the amount of fuel provided by the fuel transfer pump. Open loop systems do not use a fuel pressure sensor. Locate the final fuel filter and check for a sensor.<br><br>  <br><br>RG10768 –UN–15JAN03<br>*Fuel Pressure Sensor on Final Fuel Filter* | **No fuel pressure sensor found:**<br>GO TO ❸<br><br>**Fuel pressure sensor found:**<br>GO TO ❸<br><br>– – –1/1 |

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| ❸ **Engine Performance Check** | *NOTE: For wiring and theory of operation information, see F4 - FUEL SUPPLY SYSTEM CHECK - TIER 2 supporting information*<br><br>1. Ignition ON, engine running<br><br>2. Observe engine performance. | **Engine runs on Closed Loop System:**<br>GO TO ❻<br><br>**Engine runs on Open Loop System:**<br>GO TO ❼<br><br>**Engine cranks but won't start on Closed Loop System:**<br>GO TO ❹<br><br>**Engine cranks but won't start on Open Loop System:**<br>GO TO ❺ |



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| ❹ **Fuel Pressure Check During Prime Cycle on Closed Loop Systems** | *NOTE: For wiring and theory of operation information, see F4 - FUEL SUPPLY SYSTEM CHECK - TIER 2 supporting information*<br><br>1. Connect the DST or SERVICE ADVISOR™. For instructions on connecting to the DST or SERVICE ADVISOR™, see CONNECTING TO DIAGNOSTIC SCAN TOOL (DST) OR SERVICE ADVISOR™in Group 160 later in this manual.<br><br>2. Ignition ON, engine OFF<br><br>3. Start the ECU diagnostic software<br><br>4. Read the fuel pressure parameter using DST or SERVICE ADVISOR™.<br><br>*NOTE: The electronic transfer pump runs for 40 seconds at key ON to prime the fuel system. Fuel pressure must be read within the first 40 seconds after key ON.* | **Consistently above 150 kPa (1.50 bar) (22 psi):**<br>GO TO ⓫<br><br>**Consistently below 150 kPa (1.50 bar) (22 psi):**<br>GO TO ❽ |

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| ❺ **Fuel Pressure Check During Prime Cycle on Open Loop Systems** | *NOTE: For wiring and theory of operation information, see F4 - FUEL SUPPLY SYSTEM CHECK - TIER 2 supporting information*<br><br>1. Ignition OFF<br><br>2. Connect proper pressure gauge from Universal Pressure Kit JT05412 to spare outlet port on the final fuel filter.<br><br>3. Ignition ON, engine cranking<br><br>4. Using gauge, read pressure. | **Positive Pressure:**<br>GO TO ⓫<br><br>**Negative or NO Pressure:**<br>GO TO ❽ |

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| ❻ **Fuel Pressure Check (Running) on Closed Loop Systems** | *NOTE: For wiring and theory of operation information, see F4 - FUEL SUPPLY SYSTEM CHECK - TIER 2 supporting information*<br><br>1. Ignition ON, engine running<br><br>2. Read the fuel pressure parameter using DST or SERVICE ADVISOR™. | **Between 70-90 kPa (0.7-0.9 bar) (10.1-13.0 psi):**<br>GO TO ⓫<br><br>**Consistently below 70 kPa (0.7 bar) (10.1 psi):**<br>GO TO ❽<br><br>**Consistently above 90 kPa (0.9 bar) (13.0 psi):**<br>GO TO ⓱ |

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| ❼ **Fuel Pressure Check (Running) on Open Loop Systems** | *NOTE: For wiring and theory of operation information, see F4 - FUEL SUPPLY SYSTEM CHECK - TIER 2 supporting information*<br><br>1. Ignition OFF<br><br>2. Connect proper pressure gauge from Universal Pressure Kit JT05412 to spare outlet port on the final fuel filter.<br><br>3. Ignition ON, engine running at fast idle.<br><br>4. Using gauge, read pressure. | **Between 1-83 kPa (0.01-0.8 bar) (0.15-12.0 psi):**<br>GO TO ⓫<br><br>**Consistently below 1 kPa (0.01 bar) (0.15 psi):**<br>GO TO ❽ |

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| ❽ **Restricted Fuel Supply Line Check** | *NOTE: For wiring and theory of operation information, see F4 - FUEL SUPPLY SYSTEM CHECK - TIER 2 supporting information*<br><br>Remove the fuel supply lines between the fuel tank and the primary filter (A) and the line between the primary filter and the final filter (D) and determine if there are any restrictions. | **No restrictions found:**<br>GO TO ❾<br><br>**Restrictions found:**<br>Repair or replace components as needed. |

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| ❾ **Primary Fuel Filter Check** | *NOTE: For wiring and theory of operation information, see F4 - FUEL SUPPLY SYSTEM CHECK - TIER 2 supporting information*<br><br>Check for damaged, dirty, or plugged primary fuel filter. | **Primary fuel filter OK:**<br>GO TO ⓾<br><br>**Primary fuel filter dirty or damaged:**<br>Clean or replace primary fuel filter and retest. |

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| **10 Final Fuel Filter Check** | *NOTE: For wiring and theory of operation information, see F4 - FUEL SUPPLY SYSTEM CHECK - TIER 2 supporting information*<br><br>Check for damaged, dirty, or plugged final fuel filter. | **Final fuel filter OK:**<br>GO TO 15<br><br>**Final fuel filter dirty or damaged:**<br>Replace final fuel filter and retest.<br><br>– – –1/1 |
| **11 Restricted Injection Pump Fuel Supply Line Check** | *NOTE: For wiring and theory of operation information, see F4 - FUEL SUPPLY SYSTEM CHECK - TIER 2 supporting information*<br><br>Remove the fuel supply line (G) between the final filter and the fuel injection pump and determine if there are any restrictions. | **No restrictions found:**<br>GO TO 12<br><br>**Restrictions found:**<br>Repair and replace components as needed.<br>– – –1/1 |
| **12 Fuel at Injectors Check** | *NOTE: For wiring and theory of operation information, see F4 - FUEL SUPPLY SYSTEM CHECK - TIER 2 supporting information*<br><br>1. Ignition OFF<br>2. Using two open ended wrenches, loosen fuel line connections at the fuel inlet of the injector.<br>3. Place shop rag around the fuel line fitting at the injector.<br>4. Ignition ON, engine cranking or running<br>5. Observe fuel line at open fitting for fuel flow. | **Fuel flow is present:**<br>GO TO 14<br><br>**No or little fuel flow is present:**<br>GO TO 13<br><br>– – –1/1 |
| **13 Fuel Injection Lines Check** | *NOTE: For wiring and theory of operation information, see F4 - FUEL SUPPLY SYSTEM CHECK - TIER 2 supporting information*<br><br>Check all fuel injection lines for damage or restrictions. | **No damaged or restricted fuel injection line(s) found:**<br>Faulty fuel injection pump.<br><br>**Damaged or restricted fuel injection line(s) found:**<br>Repair or replace fuel line(s) as needed.<br><br>– – –1/1 |

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| **14 Fuel Injection Nozzle Check** | *NOTE: For wiring and theory of operation information, see F4 - FUEL SUPPLY SYSTEM CHECK - TIER 2 supporting information*<br><br>Test fuel injection nozzles. See F5 - FUEL INJECTION NOZZLE CHECK later in this Group. | **Injection nozzles test OK:**<br>Faulty injection pump. Have injection pump repaired by an authorized diesel repair station or replace pump.<br><br>**Faulty injection nozzle(s) found:**<br>Repair or replace injection nozzle(s). See REMOVE FUEL INJECTION NOZZLES in Section 02, Group 090 earlier in this manual.<br><br>– – –1/1 |



| | | |
|---|---|---|
| **15 Transfer Pump Power Wire Check** | *NOTE: For wiring and theory of operation information, see F4 - FUEL SUPPLY SYSTEM CHECK - TIER 2 supporting information*<br><br>1. Ignition OFF<br><br>2. Disconnect transfer pump connector (F)<br><br>3. Ignition ON, engine OFF<br><br>4. Using a multimeter, measure voltage between the power terminal of the transfer pump connector on the engine harness and a good chassis ground.<br><br>*NOTE: Voltage must be read within the first 40 seconds after key ON* | **Positive voltage:**<br>GO TO 16<br><br>**NO voltage:**<br>Open or short in transfer pump power wire.<br><br>– – –1/1 |

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|---|---|---|
| **16 Transfer Pump Ground Wire Check** | *NOTE: For wiring and theory of operation information, see F4 - FUEL SUPPLY SYSTEM CHECK - TIER 2 supporting information*<br><br>1. Transfer pump connector still disconnected.<br><br>2. Ignition ON, engine OFF<br><br>3. Using a multimeter, measure voltage between the ground terminal (terminal B) of the transfer pump connector and battery voltage. | **At or near battery voltage:**<br>Faulty transfer pump connector<br>OR<br>Faulty transfer pump.<br><br>**Below battery voltage:**<br>Open in transfer pump ground wire.<br><br>– – –1/1 |

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|---|---|---|
| **17 Transfer Pump Wiring Check** | *NOTE: For wiring and theory of operation information, see F4 - FUEL SUPPLY SYSTEM CHECK - TIER 2 supporting information*<br><br>1. Ignition OFF<br><br>2. Disconnect ECU connector<br><br>3. Using a multimeter, measure resistance between:<br><br>• Terminal 22 and all other terminals in the ECU connector (except 67).<br>• Terminal 67 and all other terminals in the ECU connector (except 22). | **Greater than 20k ohms:** Restriction in fuel line (G) between final filter and injection pump.<br><br>**Less than 20k ohms:** Short to voltage in transfer pump wiring<br><br>– – –1/1 |

## F5 - Fuel Injection Nozzle Check

The F5 - Fuel Injection Nozzle Check provides a list of possible failures and there solutions. This list below provides references to assist in the diagnosis and repair of the nozzle.

- Operation - See FUEL INJECTION NOZZLE OPERATION in Section 03, Group 130 earlier in this manual.
- Removal - See REMOVE FUEL INJECTION NOZZLES in Section 02, Group 090 earlier in this manual.
- Cleaning - See CLEAN FUEL INJECTION NOZZLES and CLEAN FUEL INJECTION NOZZLE BORE in Section 02, Group 090 earlier in this manual.
- Performance Tests - See TEST FUEL INJECTION NOZZLE in Section 02, Group 090 earlier in this manual.
- Disassembly - See DISASSEMBLE FUEL INJECTION NOZZLES in Section 02, Group 090 earlier in this manual.
- Adjusting - See ADJUST FUEL INJECTION NOZZLES in Section 02, Group 090 earlier in this manual.
- Installing Seals - See INSTALL SEALS ON FUEL INJECTION NOZZLE in Section 02, Group 090 earlier in this manual.
- Installation - See INSTALL FUEL INJECTION NOZZLES in Section 02, Group 090 earlier in this manual.

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| Symptom | Problem | Solution |
|---|---|---|
| **Failed Carbon Stop Seal Washer** | Nozzle replaced without using new seal or washer | Clean groove and install new seal and washer. |
| | Carbon stop seal groove not cleaned when new seal was installed. | Clean groove and install new seal. |
| **Incorrect Opening Pressure** | Improper adjustment | Adjust opening pressure. See TEST FUEL INJECTION NOZZLE in Section 02, Group 090 of this manual. |
| | Broken spring | Replace spring |
| **Nozzle Will Not Open** | Plugged orifices | Clean orifices. |
| | Chipped orifices | Replace injection nozzle |
| | Bottomed lift screw | Adjust lift screw. |
| **Poor Spray Pattern** | Plugged orifices | Clean orifices. |
| | Chipped orifices | Replace injection nozzle |
| | Cracked nozzle tip | Replace injection nozzle. |
| **Poor Atomization** | Plugged orifice | Clean orifice. |

Continued on next page

| Symptom | Problem | Solution |
|---|---|---|
| | Chipped orifice | Replace injection nozzle |
| | Cracked nozzle tip | Replace injection nozzle. |
| **Inconsistent Chatter** | Spring components misaligned | Adjust opening pressure. |
| | Varnish on valve | Clean guide area. |
| | Deposit in seat area | Clean seat. |
| | Bent valve | Replace nozzle. |
| | Distorted body | Replace nozzle. |
| **No Chatter** | Spring components misaligned | Adjusting opening pressure. |
| | Varnish on valve | Clean guide area. |
| | Deposit in seat area | Clean seat. |
| | Bent valve | Replace nozzle. |
| | Valve seat eroded or pitted | Lap valve to seat. Replace nozzle as necessary. |
| | Tip seat pitted | Lap valve to seat. Replace nozzle as necessary. |
| | Seat interference angle worn | Replace nozzle. |
| | Distorted body | Replace nozzle. |
| **Seat Leakage** | Deposits in seat area | Clean seat. |
| | Valve seat eroded or pitted | Lap valve to seat. Replace nozzle as necessary. |
| | Tip seat pitted | Lap tip to seat. Replace nozzle as necessary. |
| | Valve not free | See TEST FUEL INJECTION NOZZLE in Section 02, Group 090 of this manual. |
| | Distorted body | Replace injection nozzle |
| | Cracked tip | Replace injection nozzle |

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Continued on next page

| Symptom | Problem | Solution |
|---|---|---|
| **High Leak-Off** | Wear or scratched at guide | Lap valve to guide. Replace nozzle as necessary. |
| **Low Leak-Off** | Varnish on valve | Clean Guide Area |
| | Insufficient clearance | Clean nozzle. Lap valve to guide. Replace injection nozzle as necessary. |

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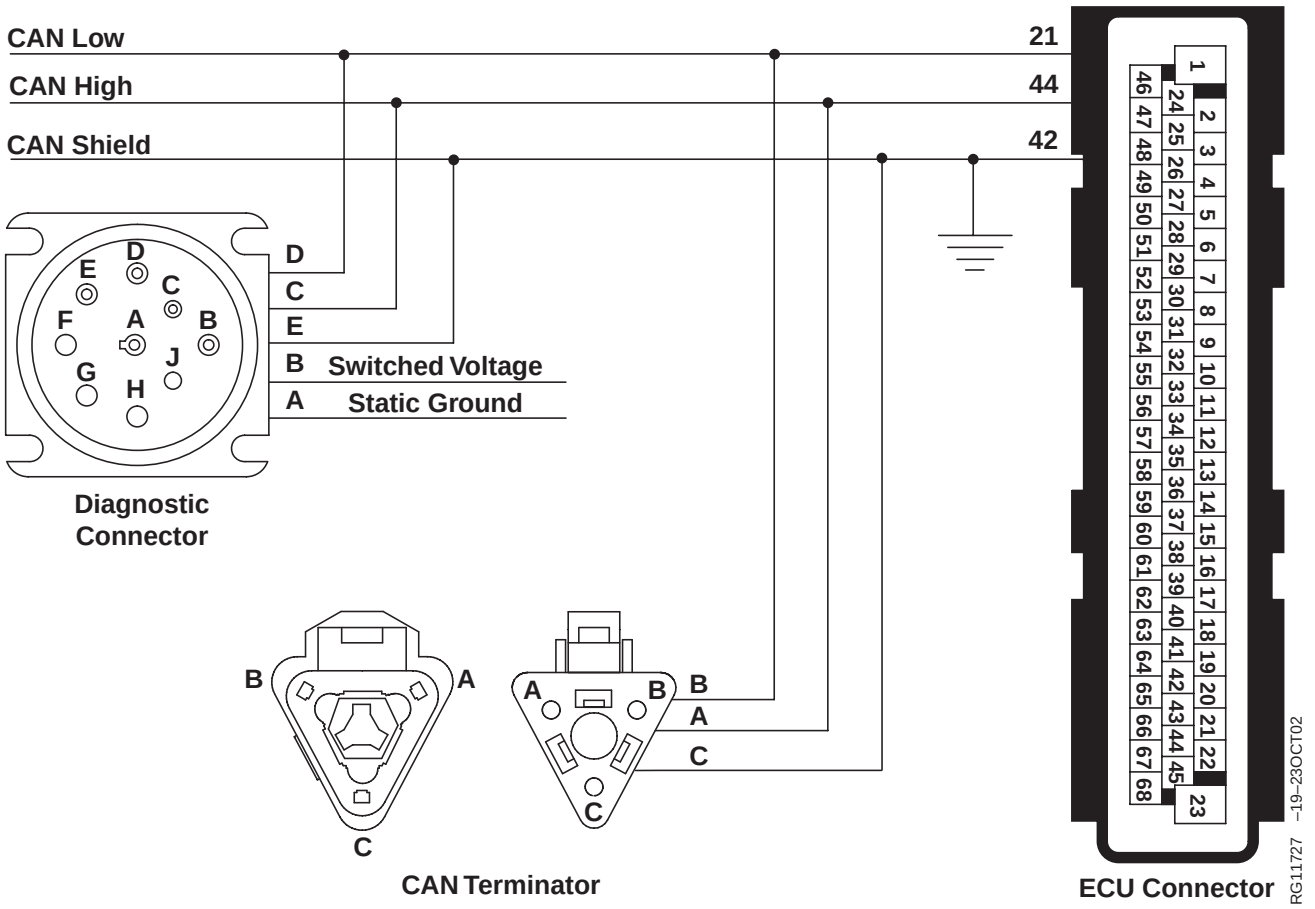
## D1 - ECU Does Not Communicate With DST or SERVICE ADVISOR™




This diagnostic procedure should be used if communication between the Diagnostic Scan Tool (DST) or SERVICE ADVISOR™ and the Engine Control Unit (ECU) cannot be established. For more information on CAN, see CONTROLLED AREA NETWORK (CAN) in Section 03, Group 130 earlier in this manual.

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## D1 - ECU Does Not Communicate With DST or SERVICE ADVISOR™

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## D1 - ECU Does Not Communicate with DST or SERVICE ADVISOR™ Diagnostic Procedure

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| ❶ **Connection Check** | **IMPORTANT: Do not force probes into connector terminals or damage will result. Use the JT07328 Connector Adapter Test Kit to make measurements in connectors. This will ensure that terminal damage does not occur.**<br><br>*NOTE: For wiring and theory of operation information, see D1 - ECU DOES NOT COMMUNICATE WITH DST OR SERVICE ADVISOR™ supporting information*<br><br>Before using this diagnostic procedure, perform a preliminary inspection of the ECU connector, diagnostic connector, and the CAN terminator looking for dirty, damaged, or poorly positioned terminals. | **No faulty connection(s):** GO TO ❷<br><br>**Faulty connection(s):** Repair connection and retest. |

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| ❷ **Intermittent Fault Test** | *NOTE: For wiring and theory of operation information, see D1 - ECU DOES NOT COMMUNICATE WITH DST OR SERVICE ADVISOR™ supporting information*<br><br>1. Connect the DST or SERVICE ADVISOR™. For instructions on connecting to the DST or SERVICE ADVISOR™, see CONNECTING TO DIAGNOSTIC SCAN TOOL (DST) OR SERVICE ADVISOR™in Group 160 later in this manual.<br><br>2. Make sure all communication cables are properly connected<br><br>3. Ignition ON, engine OFF<br><br>4. Start the ECU diagnostic software | **Can't communicate with ECU:** GO TO ❸<br><br>**Communicates with ECU:** Problem is intermittent. If no other codes are present, see INTERMITTENT FAULT DIAGNOSTICS earlier in this Group. |

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| **❸ Sensor Voltage Test** | *NOTE: For wiring and theory of operation information, see D1 - ECU DOES NOT COMMUNICATE WITH DST OR SERVICE ADVISOR™ supporting information*<br><br>1. Ignition OFF<br><br>2. Disconnect ECT sensor<br><br>For sensor location, see ELECTRONIC CONTROL SYSTEM OVERVIEW - TIER 1 or ELECTRONIC CONTROL SYSTEM OVERVIEW - TIER 2 in Section 03, Group 140 earlier in this manual.<br><br>3. Ignition ON<br><br>4. Using a multimeter, measure the voltage between both terminals of the selected sensor harness connector | **4.5 V or above:**<br>GO TO ❺<br><br>**Below 4.5 V:**<br>GO TO ❹ |



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| **❹ Power Supply Test** | *NOTE: For wiring and theory of operation information, see D1 - ECU DOES NOT COMMUNICATE WITH DST OR SERVICE ADVISOR™ supporting information*<br><br>1. Ignition OFF<br><br>2. Disconnect ECU connector<br><br>3. Ignition ON<br><br>4. Using a multimeter, measure the voltage between a good chassis ground and terminal 19 in the harness end of the ECU connector | **10.0 V or above:**<br>Faulty ECU power wiring<br>OR<br>Faulty ECU<br><br>**Below 10.0 V:**<br>Faulty ECU power fuse<br>OR<br>Key-on signal wire open or shorted to ground<br>OR<br>Faulty ignition switch<br>OR<br>Faulty key-on power fuse |

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| **❺ PDM Power Light Test** | *NOTE: For wiring and theory of operation information, see D1 - ECU DOES NOT COMMUNICATE WITH DST OR SERVICE ADVISOR™ supporting information*<br><br>1. Ignition ON<br><br>2. Note the power light on the Parallel Port Data Module (PDM) | **Power light is Green:**<br>GO TO ❽<br><br>**Power light is Red or OFF:**<br>GO TO ❻ |

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| ❻ **Open in Diagnostic Ground Connector Wire Test** | *NOTE: For wiring and theory of operation information, see D1 - ECU DOES NOT COMMUNICATE WITH DST OR SERVICE ADVISOR™ supporting information*<br><br>1. Ignition OFF<br><br>2. Disconnect the diagnostic cable from the diagnostic connector<br><br>3. Using a multimeter, measure the voltage between the ground terminal and the power terminal (terminals A and B) in the diagnostic connector on the main harness. | **Substantially less than battery voltage:**<br>GO TO ❼<br><br>**At or near battery voltage:**<br>Faulty diagnostic cable between diagnostic connector and PDM<br>OR<br>Faulty Parallel Port Data Module (PDM) |

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| ❼ **Harness Power and Ground Wire Test** | *NOTE: For wiring and theory of operation information, see D1 - ECU DOES NOT COMMUNICATE WITH DST OR SERVICE ADVISOR™ supporting information*<br><br>1. Ignition OFF<br><br>2. Disconnect the diagnostic cable from the diagnostic connector on main harness.<br><br>3. Probe terminal A in diagnostic connector with test light connected to battery voltage. | **Light ON:**<br>Faulty diagnostic connector<br>OR<br>Open or short to ground in diagnostic connector power wire.<br><br>**Light OFF:**<br>Faulty diagnostic connector<br>OR<br>Open in diagnostic connector ground wire. |

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| ❽ **Open in Harness Circuit Test** | *NOTE: For wiring and theory of operation information, see D1 - ECU DOES NOT COMMUNICATE WITH DST OR SERVICE ADVISOR™ supporting information*<br><br>1. Ignition OFF<br><br>2. Disconnect ECU connector and diagnostic cable from the diagnostic connector<br><br>3. Using a multimeter, measure resistance on the harness end of both connectors between:<br><br>• CAN low terminal D in the diagnostic connector and terminal 21 in the ECU connector<br>• CAN high terminal C in the diagnostic connector and terminal 44 in the ECU connector | **Both measurements 5 ohms or less:**<br>GO TO ❾<br><br>**One or more measurements greater than 5 ohms:**<br>Open in harness circuit<br>OR<br>Connector terminals in wrong position |

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|---|---|---|
| **9 CAN Resistance Test** | *NOTE: For wiring and theory of operation information, see D1 - ECU DOES NOT COMMUNICATE WITH DST OR SERVICE ADVISOR™ supporting information*<br><br>1. Ignition OFF<br><br>2. ECU and diagnostic connector still disconnected.<br><br>3. Using a multimeter, measure resistance between terminals C and D in the harness end of the diagnostic connector. | **Between 45 - 75 ohms:**<br>GO TO 10<br><br>**Less than 45 or greater than 75 ohms:**<br>Faulty or missing CAN terminator connector<br>OR<br>Open or short in CAN wiring harness |

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|---|---|---|
| **10 CAN High and Low Voltage Test** | *NOTE: For wiring and theory of operation information, see D1 - ECU DOES NOT COMMUNICATE WITH DST OR SERVICE ADVISOR™ supporting information*<br><br>1. Ignition OFF<br><br>2. Reconnect ECU connector<br><br>3. Ignition ON, engine OFF<br><br>4. Using a multimeter, measure voltage between a good chassis ground and :<br><br>• Terminal C in the diagnostic connector<br>• Terminal D in the diagnostic connector | **Both measurements between 1.5 - 3.5 volts:**<br>Faulty ECU/Cab Harness connection<br>OR<br>Faulty diagnostic cable<br>OR<br>Faulty diagnostic connector<br>OR<br>Faulty Parallel Port Data Module (PDM)<br>OR<br>Faulty diagnostic software/computer configuration<br>OR<br>Faulty ECU<br><br>**Either measurement less than 1.5 or greater than 3.5 volts:**<br>CAN wiring shorted to ground or voltage<br>OR<br>Faulty ECU |

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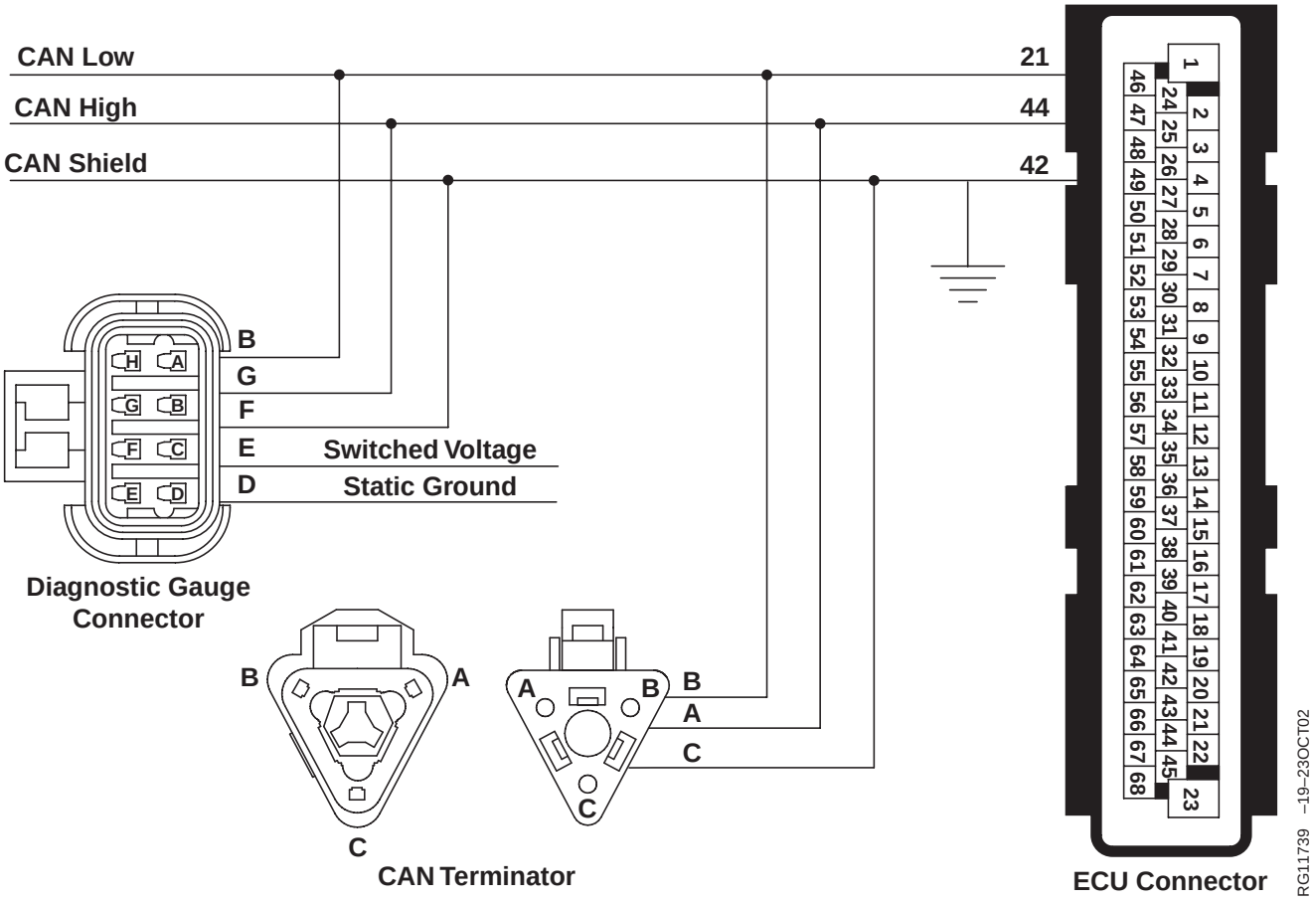
## D2 - Diagnostic Gauge Does Not Communicate With ECU




*NOTE: For more information on CAN, see CONTROLLED AREA NETWORK (CAN) in Group 130 earlier in this manual.*

**Internal Diagnostic Gauge Errors**

- The D2 - Diagnostic Gauge Does Not Communicate With ECU diagnostic procedure should be followed if the diagnostic gauge shows the following error codes or it can not communicate with the ECU:
  - EE-error
  - ACP-Err/No Addr
  - ACP-Err/Bus EP
  - ACP-Err/Bus Error

RG41221,000020B –19–18OCT02–1/1

## D2 - Diagnostic Gauge Does Not Communicate With ECU

RG41221,000020D –19–18OCT02–1/1

## D2 - Diagnostic Gauge Does Not Communicate With ECU Diagnostic Procedure

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| ❶ **Connection Check** | **IMPORTANT: Do not force probes into connector terminals or damage will result. Use the JT07328 Connector Adapter Test Kit to make measurements in connectors. This will ensure that terminal damage does not occur.**<br><br>*NOTE: For wiring information, see D2 - DIAGNOSTIC GAUGE DOES NOT COMMUNICATE WITH ECU supporting information.*<br><br>Before using this diagnostic procedure, perform a preliminary inspection of the ECU connectors, diagnostic gauge connector, and the CAN terminator connector looking for dirty damaged, or poorly positioned terminals. | **No faulty connection(s):** GO TO ❷<br><br>**Faulty connection(s):** Repair connection and retest. |

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|---|---|---|
| ❷ **Intermittent Fault Test** | *NOTE: For wiring information, see D2 - DIAGNOSTIC GAUGE DOES NOT COMMUNICATE WITH ECU supporting information.*<br><br>1. Ignition OFF<br><br>2. Ignition ON | **Error or no power found in diagnostic gauge:** GO TO ❸<br><br>**No error found and power present in diagnostic gauge:** Problem is intermittent. If no other codes are present, see INTERMITTENT FAULT DIAGNOSTICS earlier in this Group. |

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|---|---|---|
| ❸ **Sensor Voltage Test** | *NOTE: For wiring information, see D2 - DIAGNOSTIC GAUGE DOES NOT COMMUNICATE WITH ECU supporting information.*<br><br>1. Ignition OFF<br><br>2. Disconnect any of the following:<br><br>• MAT sensor<br>• ECT sensor<br><br>3. Ignition ON<br><br>4. Using a multimeter, measure the voltage between both terminals of the selected sensor harness connector. | **4.5 V or above:** GO TO ❺<br><br>**Below 4.5 V:** GO TO ❹ |

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|---|---|---|
| ❹ **Power Supply Test** | *NOTE: For wiring information, see D2 - DIAGNOSTIC GAUGE DOES NOT COMMUNICATE WITH ECU supporting information.*<br>1. Ignition OFF<br>2. Disconnect ECU connector.<br>3. Ignition ON<br>4. Using a multimeter, measure the voltage between a good ground and terminal 19 in the harness end of the ECU connector. | **10.0 V or above:**<br>Faulty ECU power wiring<br>OR<br>Faulty ECU<br>**Below 10.0 V:**<br>Faulty ECU power fuse<br>OR<br>Key-on signal wire open or short to ground<br>OR<br>Faulty ignition switch<br>OR<br>Faulty key-on power fuse<br>– – –1/1 |

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|---|---|---|
| ❺ **Diagnostic Gauge Power Test** | *NOTE: For wiring information, see D2 - DIAGNOSTIC GAUGE DOES NOT COMMUNICATE WITH ECU supporting information.*<br>1. Ignition ON<br>2. View diagnostic gauge | **Gauge has power:**<br>GO TO ❽<br>**Gauge does not have power:**<br>GO TO ❻<br>– – –1/1 |

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|---|---|---|
| ❻ **Open in Diagnostic Gauge Connector Ground Wire Test** | *NOTE: For wiring information, see D2 - DIAGNOSTIC GAUGE DOES NOT COMMUNICATE WITH ECU supporting information.*<br>1. Ignition OFF<br>2. Disconnect the diagnostic gauge from the diagnostic gauge connector.<br>3. Ignition ON<br>4. Using a multimeter, measure voltage between the switched voltage terminal and the ground terminal (terminals D and E) of the harness end of the diagnostic gauge connector. | **Substantially less than battery voltage:**<br>GO TO ❼<br>**At or near battery voltage:**<br>Open in diagnostic gauge ground wire.<br>– – –1/1 |

| | | |
|---|---|---|
| ❼ **Open in Diagnostic Gauge Connector Power Wire Test** | *NOTE: For wiring information, see D2 - DIAGNOSTIC GAUGE DOES NOT COMMUNICATE WITH ECU supporting information.*<br>1. Ignition OFF<br>2. Disconnect the diagnostic gauge connector.<br>3. Probe terminal D in the diagnostic gauge connector with a test light connected to battery voltage. | **Light ON:**<br>Open or short to ground in diagnostic gauge power wire.<br>**Light OFF:**<br>Open in diagnostic gauge connector ground wire.<br>– – –1/1 |

| | | |
|---|---|---|
| ❽ **Open in Harness Circuit Test** | *NOTE: For wiring information, see D2 - DIAGNOSTIC GAUGE DOES NOT COMMUNICATE WITH ECU supporting information.*<br><br>1. Ignition OFF<br><br>2. Disconnect the ECU connector and the diagnostic cable from the diagnostic connector.<br><br>3. Using a multimeter, measure resistance on the harness end of both connectors between:<br><br>• Terminal B in the diagnostic gauge connector and terminal 21 in the ECU connector.<br>• Terminal G in the diagnostic gauge connector and terminal 44 in the ECU connector. | **All measurements 5 ohms or less:**<br>GO TO ❾<br><br>**One or more measurements greater than 5 ohms:**<br>Open in harness circuit<br>OR<br>Connector terminals in wrong position |

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| | | |
|---|---|---|
| ❾ **CAN Resistance Test** | *NOTE: For wiring information, see D2 - DIAGNOSTIC GAUGE DOES NOT COMMUNICATE WITH ECU supporting information.*<br><br>1. Ignition OFF<br><br>2. ECU and diagnostic connectors still disconnected.<br><br>3. Using a multimeter, measure resistance between terminals B and G in the harness end of the diagnostic connector. | **Between 45-75 ohms:**<br>GO TO ❿<br><br>**Less than 45 or greater than 75 ohms:**<br>Faulty or missing CAN terminator connector(s)<br>OR<br>Open or short in CAN wiring harness |

– – –1/1

| | | |
|---|---|---|
| ❿ **CAN High and Low Voltage Test** | *NOTE: For wiring information, see D2 - DIAGNOSTIC GAUGE DOES NOT COMMUNICATE WITH ECU supporting information.*<br><br>1. Ignition OFF<br><br>2. Reconnect the ECU connector.<br><br>3. Ignition ON<br><br>4. Using a multimeter, measure voltage between a good chassis ground and:<br><br>• Terminal B in the diagnostic gauge connector<br>• Terminal G in the diagnostic gauge connector | **Both measurements between 1.5 - 3.5 V:**<br>Faulty ECU connection<br>OR<br>Faulty diagnostic gauge connection<br>OR<br>Faulty diagnostic software/computer configuration<br>OR<br>Faulty ECU<br><br>**Either measurement less than 1.5 V or greater than 3.5 V:**<br>CAN wiring shorted to ground or power<br>OR<br>Faulty ECU |

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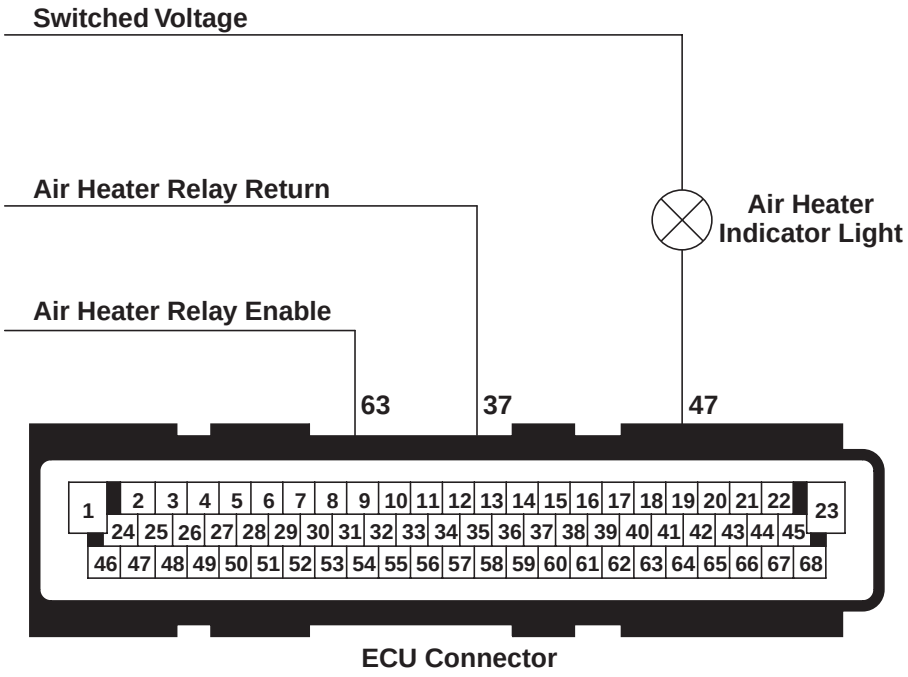
## A1 - Intake Air Heater Check




RG11111 –19–08JUN00

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*NOTE: For further wiring information on the air heater and air heater relay, refer to machine manual.*

**Intake Air Heater**

The intake air heater is located between the intake pipe and intake manifold. Its function is to heat the intake air during cold starting conditions. Its operation time is dependent on the fuel temperature for most applications (some applications use manifold air temperature) when the ECU detects at key-on. The table below explains this relationship.

When the ECU sends battery voltage out of terminal 63 to the air heater relay, the solenoid in the relay activates, and the air heater turns ON. At this time, the ECU will illuminate the air heater indicator light. When the ECU stops sending battery voltage out of terminal 63, the solenoid deactivates, and the air heater turns OFF. At this time, the ECU will turn the air heater indicator light OFF.

To ensure full utilization of the intake air heater, the operator should wait until the light goes out before starting the engine. Anytime the engine cranks but does not start, a key-off/key-on cycle will be required before preheating is allowed again.

DPSG,RG40854,677 –19–18OCT02–1/1

## A1 - Intake Air Heater Check

*NOTE: The air heater indicator light is the same light that trouble codes are displayed on. The air heater will run for 5 additional seconds after the light turns OFF.*

| Intake Air Heater Operation - Combines | |
|---|---|
| **Fuel Temperature** | **Light ON Time** |
| -1°C (30.2°F) | 5 seconds |
| -5°C (23°F) | 10 seconds |
| -10°C (14°F) | 15 seconds |
| -15°C (5°F) | 20 seconds |
| -20°C (-4°F) and below | 25 seconds |

| Intake Air Heater Operation - Marine | |
|---|---|
| **Manifold Air Temperature** | **Light ON Time** |
| 5°C (41°F) | 5 seconds |
| 0°C (32°F) | 10 seconds |
| -5°C (23°F) | 20 seconds |
| -10°C (14°F) and below | 30 seconds |

| Intake Air Heater Operation - OEM | |
|---|---|
| **Fuel Temperature** | **Light ON Time** |
| -1°C (30.2°F) | 5 seconds |
| -5°C (23°F) | 10 seconds |
| -10°C (14°F) | 15 seconds |
| -15°C (5°F) | 20 seconds |
| -20°C (-4°F) and below | 25 seconds |

| Intake Air Heater Operation - Telehandler | |
|---|---|
| **Fuel Temperature** | **Light ON Time** |
| 5°C (41°F) | 5 seconds |
| 0°C (32°F) | 10 seconds |
| -5°C (23°F) | 15 seconds |
| -10°C (14°F) | 20 seconds |
| -15°C (5°F) | 25 seconds |
| -20°C (-4°F) and below | 30 seconds |
| -25°C (-13°F) and below | 45 seconds |

| Intake Air Heater Operation - Tractors | |
|---|---|
| **Fuel Temperature** | **Light ON Time** |
| -1°C (30.2°F) | 5 seconds |
| -2°C (28.4°F) | 10 seconds |
| -3°C (26.6°F) | 15 seconds |
| -4°C (24.8°F) | 20 seconds |
| -5°C (23°F) and below | 25 seconds |

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RG41221,0000125 –19–09MAY01–1/1

## A1 - Intake Air Heater Check Diagnostic Procedure

– – –1/1

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|---|---|---|
| ❶ **Connection Check** | **IMPORTANT: Do not force probes into connector terminals or damage will result. Use the JT07328 Connector Adapter Test Kit to make measurements in connectors. This will ensure that terminal damage does not occur.**<br><br>*NOTE: For wiring and theory of operation information, see A1 - INTAKE AIR HEATER CHECK supporting information*<br><br>Before using this diagnostic procedure, perform a preliminary inspection of the ECU connector, air heater relay connector, and air heater connector looking for dirty, damaged, or poorly positioned terminals. | **No faulty connection(s):**<br>GO TO ❷<br><br>**Faulty connection(s):**<br>Repair faulty connection(s)<br><br>– – –1/1 |

| | | |
|---|---|---|
| ❷ **Air Heater Indicator Light Check** | *NOTE: Do not run engine during this diagnostic procedure.*<br><br>*NOTE: For wiring and theory of operation information, see A1 - INTAKE AIR HEATER CHECK supporting information*<br><br>1. Key ON, engine OFF<br><br>2. Verify that the air heater indicator light is working | **Light works:**<br>GO TO ❸<br><br>**Light does not work:**<br>Faulty air heater indicator light wiring<br>OR<br>Faulty air heater indicator light<br><br>– – –1/1 |

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|---|---|---|
| ❸ **Active DTC Test** | *NOTE: For wiring and theory of operation information, see A1 - INTAKE AIR HEATER CHECK supporting information*<br><br>1. Connect the DST or SERVICE ADVISOR™. For instructions on connecting to the DST or SERVICE ADVISOR™, see CONNECTING TO DIAGNOSTIC SCAN TOOL (DST) OR SERVICE ADVISOR™in Group 160 later in this manual.<br><br>2. Ignition ON, engine OFF<br><br>3. Start the ECU diagnostic software<br><br>4. Key ON, engine OFF<br><br>5. Read DTCs using DST or SERVICE ADVISOR™. | **No active DTC(s) present:**<br>GO TO ❹<br><br>**Active DTC(s) present:**<br>Go to appropriate diagnostic procedure |

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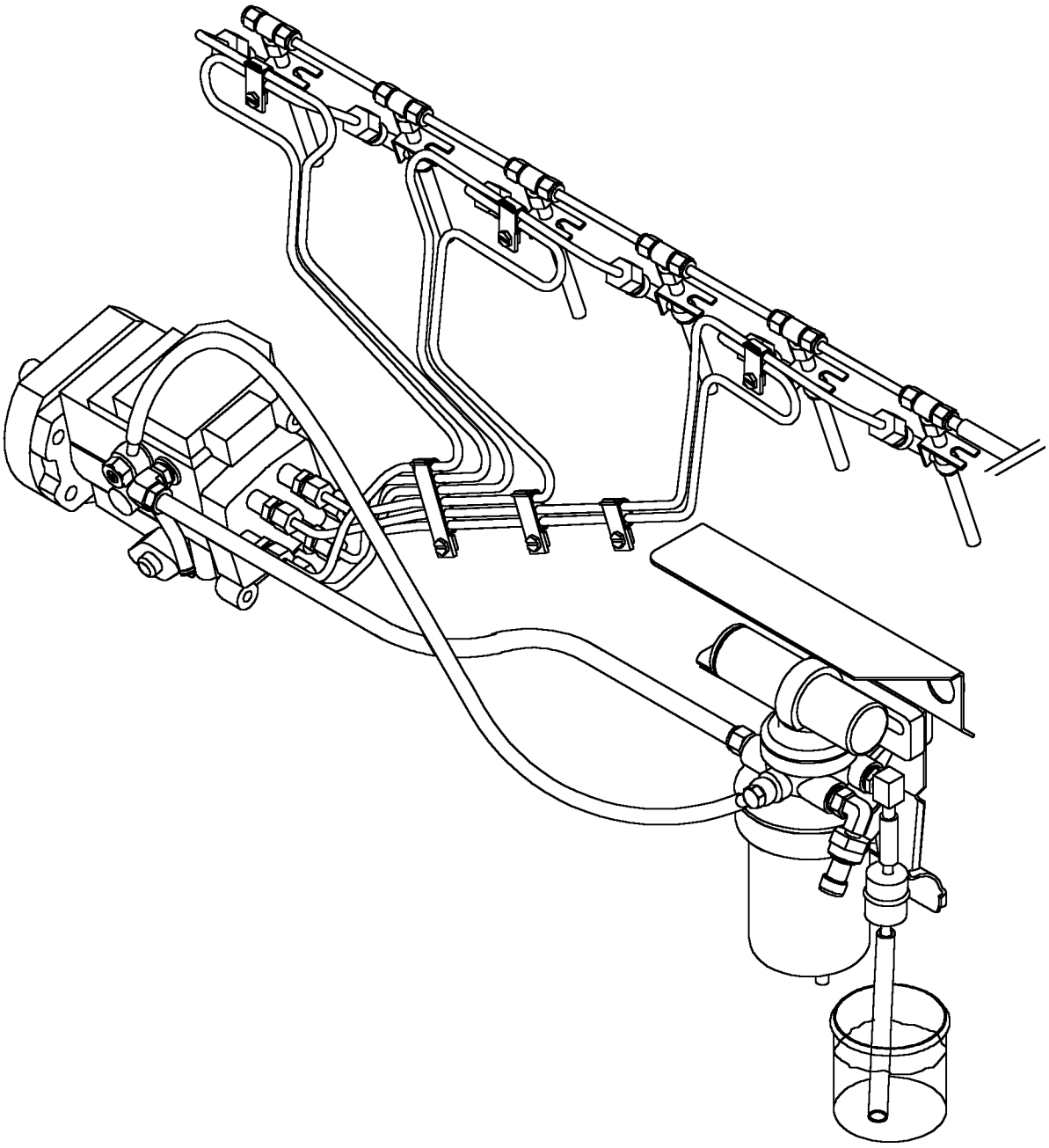
|---|---|---|
| ❹ **Engine Coolant Temperature Check** | *NOTE: For wiring and theory of operation information, see A1 - INTAKE AIR HEATER CHECK supporting information*<br><br>1. Key ON, engine OFF<br><br>2. Read the fuel temperature parameter. On Marine applications, read the manifold air temperature parameter.<br><br>3. Compare the temperature to the corresponding temperature specification table. See A1 - INTAKE AIR HEATER CHECK earlier in this Group. | **Temperature is below the specification to turn the air heater ON:**<br>GO TO ❺<br><br>**Temperature is above the specification to turn the air heater ON:**<br>No air heater-related problem found<br><br>– – –1/1 |
| ❺ **Voltage at Air Heater Check** | *NOTE: For wiring and theory of operation information, see A1 - INTAKE AIR HEATER CHECK supporting information*<br><br>1. Key OFF<br><br>2. Using a multimeter, measure the voltage between the air heater power stud and a good chassis ground while turning key ON (engine OFF)<br><br>*NOTE: Voltage must be read as key is turned ON* | **At or near battery voltage:**<br>GO TO ❻<br><br>**No voltage detected:**<br>GO TO ❼<br><br>– – –1/1 |
| ❻ **Air Heater Check** | *NOTE: For wiring and theory of operation information, see A1 - INTAKE AIR HEATER CHECK supporting information*<br><br>1. Key OFF<br><br>2. Using a multimeter, measure the temperature of air heater housing with temperature probes.<br><br>3. Key ON, engine OFF<br><br>4. Continue to monitor temperature of air heater housing | **Temperature increases:**<br>No air heater related problem found<br><br>**Temperature does not increase**<br>Faulty air heater<br><br>– – –1/1 |

| | | |
|---|---|---|
| ❼ **Air Heater Relay Check** | *NOTE: For wiring and theory of operation information, see A1 - INTAKE AIR HEATER CHECK supporting information*<br><br>1. Key OFF<br><br>2. Listen for air heater relay to click while turning key ON (engine OFF) | **Relay clicks:**<br>Faulty power wire to relay<br>OR<br>Faulty wire between relay and heater<br>OR<br>Faulty air heater relay<br><br>**Relay does not click:**<br>Faulty air heater enable wire<br>OR<br>Faulty relay ground<br>OR<br>Faulty relay<br><br>– – –1/1 |

## Check Fuel Supply Quality - Tier 1



RG10778 –UN–22MAY00



*NOTE: For information on Tier 1 vs. Tier 2 applications, see ENGINE APPLICATION CHART in Group 001 earlier in this manual.*

The quality of diesel fuel affects engine performance. Check your operators manual for correct fuel specifications.

Poor quality or contaminated fuel will make the engine hard to start, misfire, run rough or produce low power.

If poor quality or contaminated fuel is suspected, perform the following:

**Continued on next page**

RG41221,0000127 –19–18OCT02–1/2

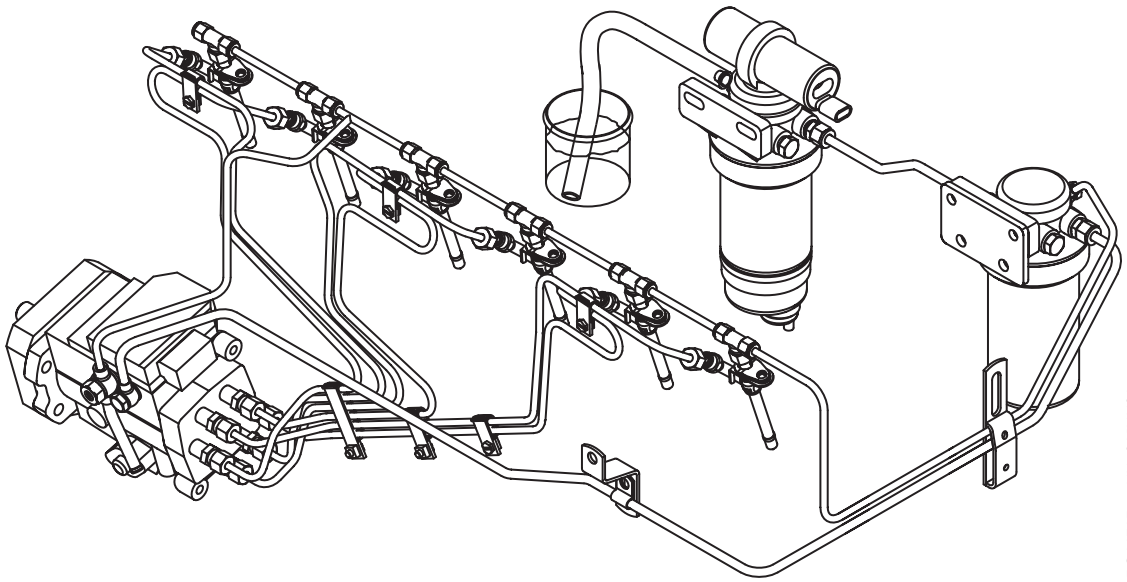
1. Check primary (if equipped) and final fuel filters for serviceability. If filter is equipped with a water separator, empty and clean separator bowl.
2. Start engine and operate under load, observing engine performance.
3. Reduce engine speed to idle and shutdown engine.
4. Disconnect fuel line from inlet side of primary fuel filter (if equipped) or inlet side of final filter on engines without primary filter.
5. Connect a hose to inlet port.
6. Submerge hose in a container of clean, good quality fuel meeting engine specifications.
7. Operate engine under load and observe performance.

   If performance improves, fuel is contaminated or not of the proper grade. Check fuel source.



RG41221,0000127 –19–18OCT02–2/2

## Check Fuel Supply Quality - Tier 2






*NOTE: For information on Tier 1 vs. Tier 2 applications, see ENGINE APPLICATION CHART in Group 001 earlier in this manual.*

The quality of diesel fuel affects engine performance. Check your operators manual for correct fuel specifications.

Poor quality or contaminated fuel will make the engine hard to start, misfire, run rough or produce low power.

If poor quality or contaminated fuel is suspected, perform the following:

1. Check primary and final fuel filters for serviceability. If filter is equipped with a water separator, empty and clean separator bowl.
2. Start engine and operate under load, observing engine performance.
3. Reduce engine speed to idle and shutdown engine.
4. Disconnect fuel line from inlet side of primary fuel filter.
5. Connect a hose to inlet port.
6. Submerge hose in a container of clean, good quality fuel meeting engine specifications.
7. Operate engine under load and observe performance.

   If performance improves, fuel is contaminated or not of the proper grade. Check fuel source.

RG41221,0000128 –19–20OCT02–1/1

## Test for Fuel Drain Back

Fuel draining back through the fuel system may cause hard starting. This procedure will determine if air is entering the system at connections and allowing fuel to siphon back to the fuel tank.

1. Disconnect fuel supply and return lines at fuel tank.

**IMPORTANT: Fuel return line MUST extend below fuel level in fuel tank before performing this test. Fill fuel tank if necessary.**

2. Drain all fuel from the system, including the fuel transfer pump, fuel injection pump, fuel filters, and water separator (if equipped).



3. Securely plug off the end of the fuel return pipe.

**CAUTION: Maximum air pressure should be 100 kPa (1 bar) (14.5 psi) when performing this test.**

4. Using a low pressure air source, pressurize the fuel system at the fuel supply line.

5. Apply liquid soap and water solution to all joints and connections in the fuel system and inspect for leaks.

*NOTE: Connections may allow air to enter the system without allowing fuel to leak out.*

6. If any leaks are found, take necessary steps to repair.

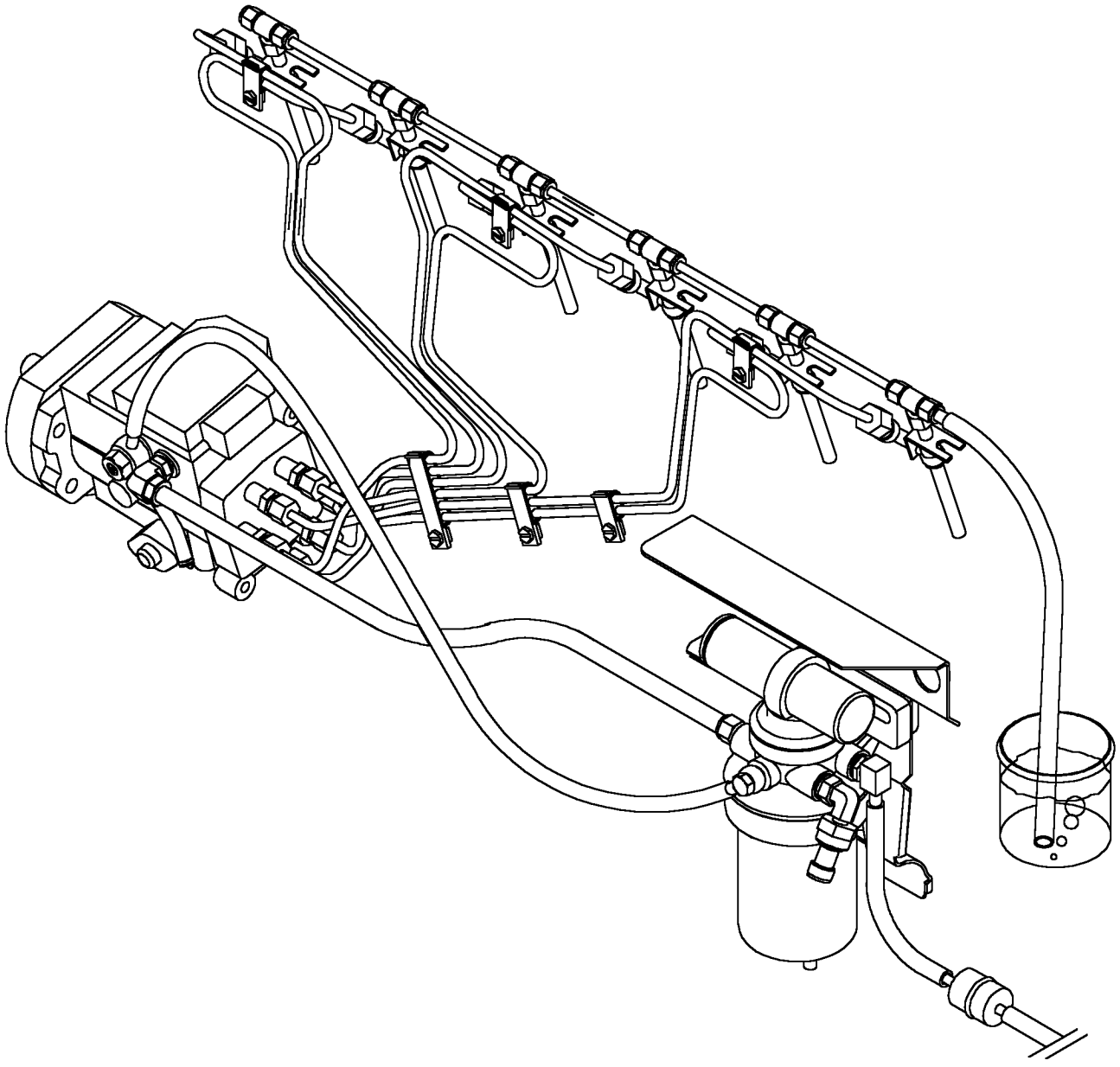
7. Reconnect supply and return lines and prime system.

8. Start engine and run for approximately 10 minutes.

9. Allow engine to sit overnight and try starting the following morning.

RG41221,0000129 –19–09MAY01–1/1

## Test for Air in Fuel - Tier 1






*NOTE: For information on Tier 1 vs. Tier 2 applications, see ENGINE APPLICATION CHART in Group 001 earlier in this manual.*

*NOTE: If engine cranks but won't start, see BLEED THE FUEL SYSTEM later in this Group.*

Air in the fuel system will make the engine hard to start, run rough, misfire or produce low power. Additionally, it can cause excessive smoke and knocking.

Whenever the fuel system is opened for repair, it must be bled to remove any air that has entered the system.

1. Disconnect fuel return line end of fuel leak-off line assembly. Connect a clear plastic hose to end of leak-off line assembly and place opposite end of hose in a suitable container filled with fuel as shown.

**Continued on next page**

2. Operate engine and check for air bubbles in container. If bubbles are present, bleed the fuel system and repeat test. See BLEED THE FUEL SYSTEM later in this Group.

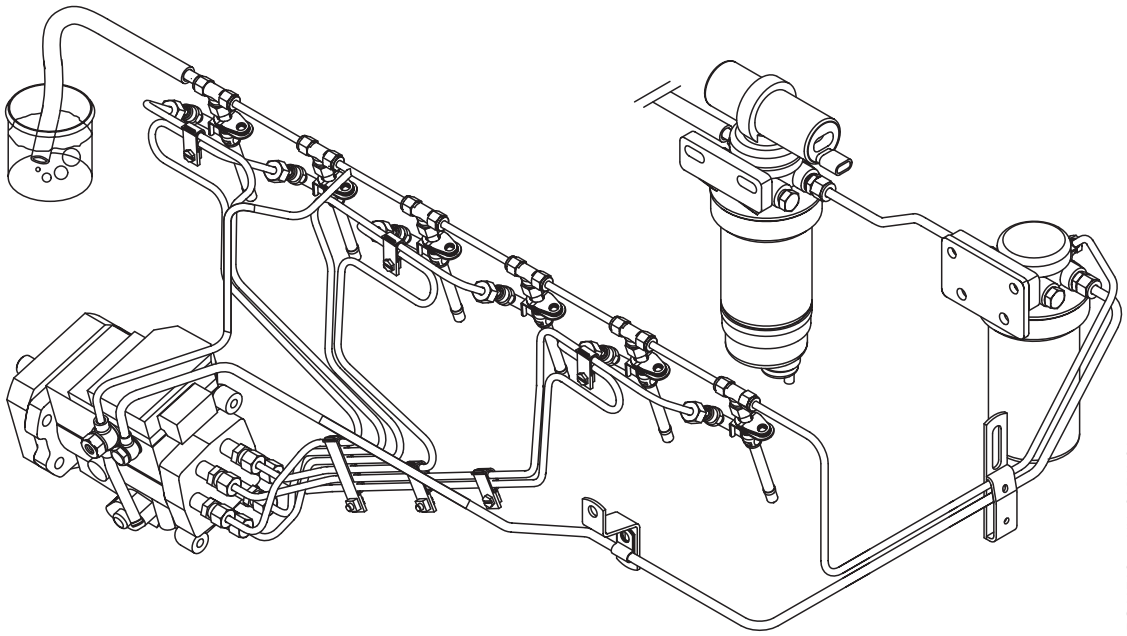
3. If bubbles are still present, check the following:

- Check for loose fuel fittings from the suction side of the fuel supply pump to the fuel tank to include all lines and filters.
- Check fuel tank suction tube (if equipped) and welded joints for cracks or holes.

Perform any necessary repairs, bleed fuel system and repeat test.

RG41221,000012A –19–20OCT02–2/2

## Test for Air in Fuel - Tier 2






*NOTE: For information on Tier 1 vs. Tier 2 applications, see ENGINE APPLICATION CHART in Group 001 earlier in this manual.*

*NOTE: If engine cranks but won't start, see BLEED THE FUEL SYSTEM later in this Group.*

Air in the fuel system will make the engine hard to start, run rough, misfire or produce low power. Additionally, it can cause excessive smoke and knocking.

Whenever the fuel system is opened for repair, it must be bled to remove any air that has entered the system.

1. Disconnect fuel return line end of fuel leak-off line assembly. Connect a hose to end of leak-off line assembly and place opposite end of hose in a suitable container filled with fuel as shown.
2. Operate engine and check for air bubbles in container. If bubbles are present, bleed the fuel system and repeat test. See BLEED THE FUEL SYSTEM later in this Group.
3. If bubbles are still present, check the following:

- Check for loose fuel fittings from the suction side of the fuel supply pump to the fuel tank to include all lines and filters.
- Check fuel tank suction tube (if equipped) and welded joints for cracks or holes.

Perform any necessary repairs, bleed fuel system and repeat test.

RG41221,000012B –19–20OCT02–1/1

## Check Fuel Supply Pressure

**IMPORTANT: Before disconnecting any fuel line, completely clean any debris from around the fitting. DO NOT allow debris to enter fuel line.**

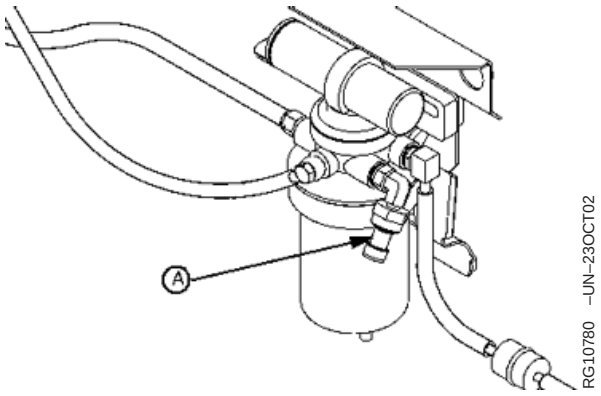
1. Remove the fuel pressure sensor (A) from the final fuel filter base. See REPLACE FUEL PRESSURE SENSOR in Section 02, Group 110 earlier in this manual.
2. Connect a 0-1000 kPa (0-150 psi) gauge to the sensor port on the filter base.
3. Start engine. Fuel transfer pump should maintain minimum pressure shown in specification.

**Specification**

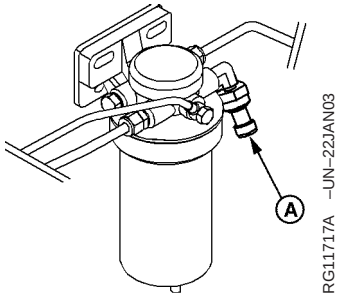
Tier 1 - Fuel Transfer Pump
Pressure—Running ..... 70—90 kPa (0.7—0.9 bar) (10.1—13.0 psi)

Tier 2- Fuel Transfer Pump
Pressure—Running ..... 100—110 kPa (1.0—1.1 bar) (14.5—16.0 psi)

4. If engine can not be started, perform bleed procedure. See BLEED THE FUEL SYSTEM later in this Group.
5. Reinstall the fuel pressure sensor. See REPLACE FUEL PRESSURE SENSOR in Section 02 Group 110 earlier in this manual.




*Check Fuel Supply Pressure - Tier 1*




*Check Fuel Supply Pressure - Tier 2*

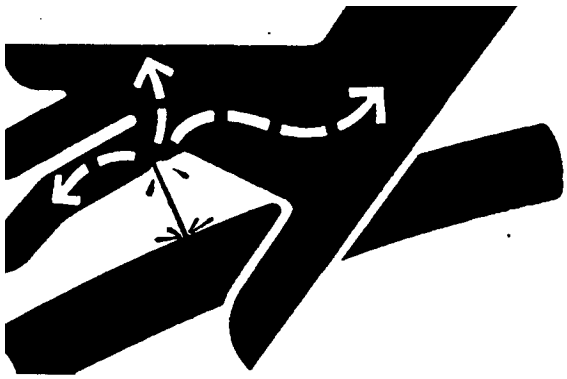
**A—Fuel Pressure Sensor**

RG,115,JW7707 –19–20OCT02–1/1

## Bleed the Fuel System

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

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



X9811 –UN–23AUG88

*High Pressure Fluids*

Any time the fuel system has been opened up for service (lines disconnected, filters removed, pump or nozzles replace, or after the engine has run out of fuel), it will be necessary to bleed air from the system.

This fuel system can only be bled by the electronic transfer pump or at the injection nozzles. **BLEEDING SHOULD NOT BE PERFORMED** at any location on the Bosch VP44 injection pump.

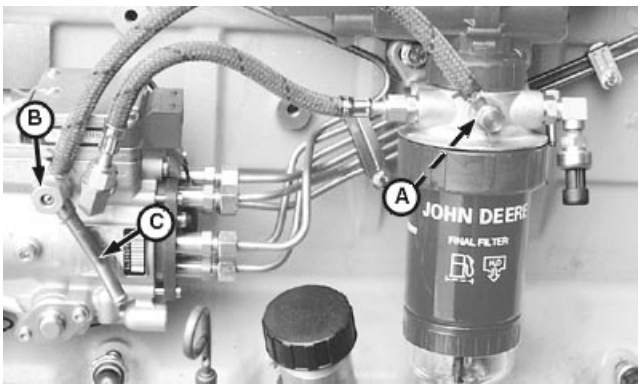
Continued on next page

*NOTE: For information on Tier 1 vs. Tier 2 applications, see ENGINE APPLICATION CHART in Group 001 earlier in this manual.*

**Bleed Using Electronic Transfer Pump - Tier 1**

The bleed is automatically performed by a small orifice (A) inside the filter base connected to the overflow valve (B) on injection pump. This system allows air to escape continually through the fuel return line (C) when ignition is ON.

1. Ignition ON
2. Allow 40 seconds for electronic transfer pump to complete priming
3. If additional system bleeding is required, bleed the circuit by loosening fuel line connections at injection nozzles. See procedure, BLEED FUEL SYSTEM AT FUEL INJECTION NOZZLES later in this Group.




RG10721D –UN–04MAY00

*Bleed Fuel System (VP44 Pump) - Tier 1*

**A—Bleed Orifice in Final Fuel Filter Base**
**B—Overflow Valve**
**C—Fuel Return Line**

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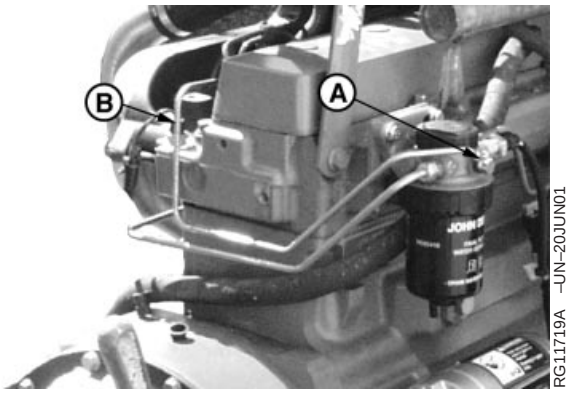
RG41221,0000109 –19–20OCT02–2/4

**Bleed Using Electronic Transfer Pump - Tier 2**

The bleed is automatically performed by a small orifice (A) inside the filter base connected to the overflow valve (B) on injection pump. This system allows air to escape continually through the fuel return line (C) when ignition is ON.

1. Ignition ON
2. Allow 40 seconds for the electronic transfer pump to complete priming
3. If additional system bleeding is required, bleed the circuit by loosening fuel line connections at injection nozzles. See procedure, BLEED FUEL SYSTEM AT FUEL INJECTION NOZZLES later in this Group.




RG11719A –UN–20JUN01

*Bleed Fuel System (VP44) - Tier 2*

**A—Bleed Orifice in Final Fuel Filter Base**
**B—Fuel Return Line**

**Continued on next page**

RG41221,0000109 –19–20OCT02–3/4

**Bleed Fuel System at Fuel Injection Nozzles**

1. Place throttle lever in half-throttle position.

   On engines equipped with electronic fuel shut-off solenoid, energize solenoid.

**IMPORTANT: Always use a backup wrench when loosening or tightening fuel lines at nozzles and/or injection pump to avoid damage.**

2. Using two open-end wrenches, loosen two fuel line connections at injection nozzles.

3. Crank engine for 15 seconds (but do not start engine) until fuel free from bubbles flows out of loosened connection. Retighten connection to specifications.

**Specification**

Fuel Injection Nozzle Delivery Lines—Torque ..... 27 N•m (20 lb-ft)

4. Repeat procedure for remaining injection nozzles (if necessary) until all air has been removed from fuel system.


*Nozzle Fuel Pressure Line*

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RG41221,0000109 –19–20OCT02–4/4

## Test for Cylinder Misfire (Engine Running)

*NOTE: Use this procedure only if DST or SERVICE ADVISOR™ is not available.*

**CAUTION: Escaping fluid under pressure can penetrate the skin causing serious injury. Keep hands and body away from pinholes and nozzles which could inject fluids under high pressure.**

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



1. Operate engine at intermediate speed with no load.
2. Place a shop towel around nozzle-to-line connection to absorb escaping fuel.
3. Slowly loosen the fuel pressure line at one of the nozzles until fuel escapes at the connection (fuel not opening nozzle valve).
   - If engine speed changes, the cylinder is probably working satisfactory.
   - If engine speed does not change, a cylinder is faulty.
4. Tighten fuel lines to specifications.

| Specification | |
|---|---|
| FUEL INJECTION NOZZLE DELIVERY LINES—Torque | 27 N•m (20 lb-ft) |

5. Repeat test for each remaining cylinder.
6. Remove faulty injection nozzles and repair as required. See REMOVE FUEL INJECTION NOZZLES in Group 090 earlier in this manual.

*SERVICE ADVISOR is a trademark of Deere & Company*

DPSG,RG40854,23 –19–25NOV98–1/1

## About this Group of the Manual

This section of the manual contains necessary information to diagnose the electronic control system. Use this information in conjunction with the 4.5 L & 6.8 L Diesel Engines Base Engine Manual (CTM104).

See the 4.5 L & 6.8 L Diesel Engines Base Engine Manual (CTM 104) for:

- Removal of base engine components
- Base engine repair procedures
- Base engine disassembly
- Base engine inspection
- Base engine assembly

Parts such as sensors, actuators, connectors, and wiring harnesses are serviceable and available.

To help diagnose electronic control system problems, Section 6, Group 210 DIAGNOSTIC

SPECIFICATIONS contains useful information, such as ECU terminal identification and a system wiring schematic.

**IMPORTANT: Under NO circumstances, should the Engine Control Unit (ECU) be opened.**

*NOTE: Instruction is given throughout the diagnostic charts to make resistance and voltage measurements in the ECU connector. Note that these measurements are always made in the harness end of the connector. Measurements should never be made in the ECU end of the connection.*

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RG,RG34710,1552 –19–30SEP97–1/1

## Electrical Concepts

Tests will include making measurements of voltage and resistance and making checks for open circuits and short circuits. An understanding of the following concepts is required to use the diagnostic procedures:

- Voltage (volts)
- Current (amps)
- Resistance (ohms)
- Open Circuit
- Short Circuit

RG,RG34710,1553 –19–30SEP97–1/1

## Using a Digital Multimeter

It is recommended that a digital multimeter (JT07306 or equivalent with an analog display) be used to make the required measurements in the diagnostic procedures. A knowledge of the operation of the particular meter used is assumed.

Instructions for measuring voltages take the following form:

- Measure voltage from Point A (+) to Point (B) (-)

In this example, the positive test lead from the volt-ohm input of the meter should be connected to Point A and the negative test lead from the common input of the meter should be connected to Point B.

Unless otherwise stated, all voltage measurements are direct current (D.C.).

In making a resistance measurement, be careful to use the correct resistance range on the meter. Disconnect appropriate connectors or turn off key switch, as directed by diagnostic procedures later in this group.

RG11126 –UN–19JUN00

*Digital Multimeter*

RG,RG34710,1554 –19–30SEP97–1/1

## Electrical Circuit Malfunctions

### Circuit Malfunctions

There are four major circuit malfunctions. They are:

1. High-resistance circuit
2. Open circuit
3. Grounded circuit
4. Shorted circuit

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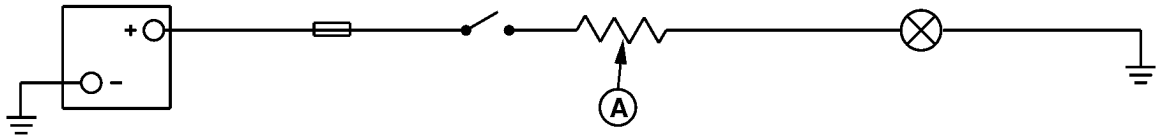
DPSG,RG40854,37 –19–15DEC98–1/6

RG9891 –UN–06JAN99




*High Resistance Circuit*

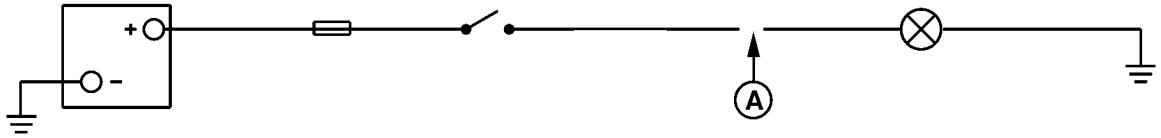
**A—Unwanted Resistance**

**Definition of Circuit Malfunctions**

1. **High Resistance Circuit:**
   A circuit having unwanted resistance (A) that causes a voltage drop and reduces current flow.

DPSG,RG40854,37 –19–15DEC98–2/6

RG9892 –UN–06JAN99



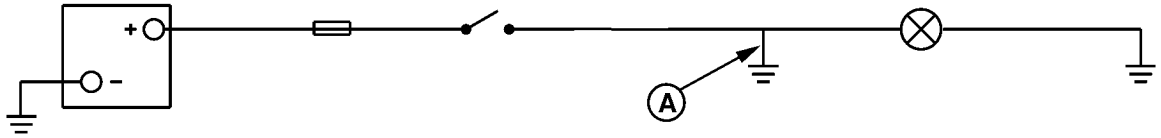

*Open Circuit*

**A—Break or Separation in Circuit**

2. **Open Circuit:**
   A circuit having a break or a separation (A) that prevents current from flowing in the circuit.

DPSG,RG40854,37 –19–15DEC98–3/6

RG9893 –UN–06JAN99




*Grounded Circuit*

**A—Voltage Wire in Contact with Machine Frame**

3. **Grounded Circuit:**
   A voltage wire in contact with the machine frame (A), providing continuity with the battery ground terminal.

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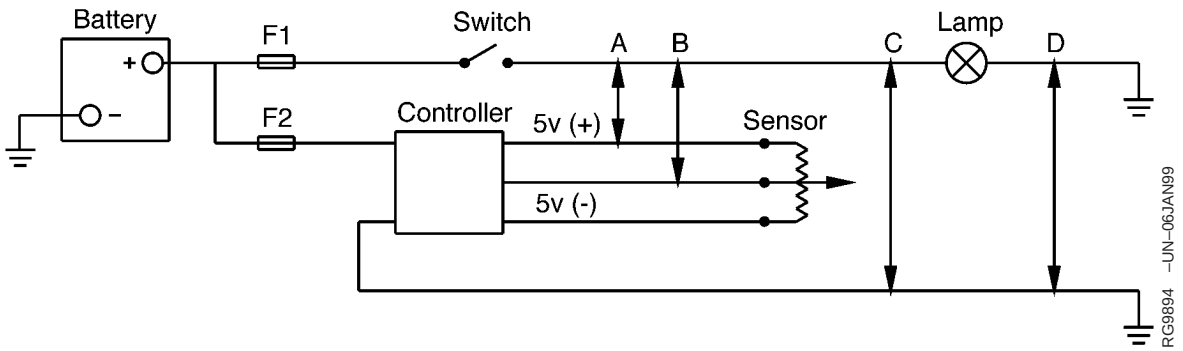
DPSG,RG40854,37 –19–15DEC98–4/6




*Shorted Circuit*

4. **Shorted Circuit:**
   A wire-to-wire contact of two adjacent wires that provides unwanted continuity between the two wires. The following are types of short circuits:
   - Voltage wire shorted to another voltage wire (wires of equal or unequal voltage).
   - Voltage wire shorted to a sensor signal wire (wires of unequal voltage).
   - Voltage wire shorted to a ground wire (wires of battery voltage or regulated voltage, shorted to a ground wire connecting a component to the battery negative terminal).
   - Ground wire shorted to another ground wire (wires of zero voltage).

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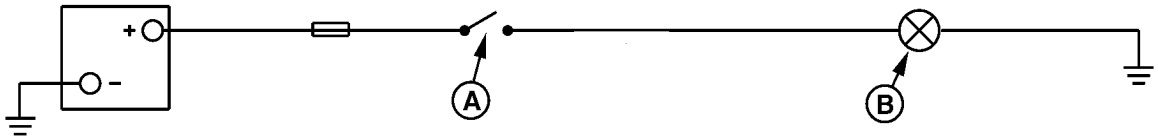
*NOTE: This type of short does not create an observable malfunction. Therefore, no further explanation for trouble shooting is necessary.*

DPSG,RG40854,37 –19–15DEC98–5/6

RG9895 –UN–06JAN99




*Locations of Circuit Malfunctions*

**A—Controlling Switch** **B—Load**

**Locations of Circuit Malfunctions:**

In a “Simple Electrical Circuit” the circuit malfunctions occur at only three locations. They are:

1. Before the controlling switch (A).

2. Between the controlling switch (A) and the load (B).

3. After the load (B).

Electrical components can become faulty with the same four circuit malfunctions. Sometimes component malfunctions can easily be confused with circuit malfunctions. Therefore, care must be exercised when isolating the cause of the problem.

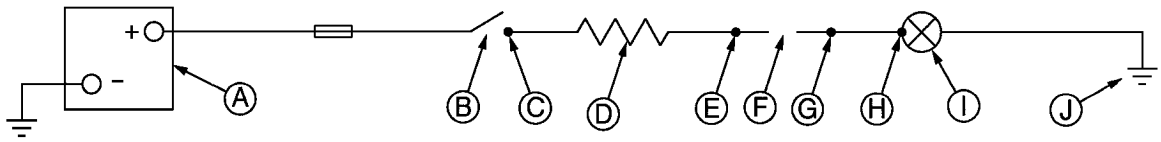
**Example:** A component may not operate before disconnecting an electrical connection, but it operates after reconnecting the connector.

**Reason:** Oxidation of the terminals created “High Resistance” and a voltage drop that prevents the proper amount of current flow to the component. Disconnecting and reconnecting the connector, removed some oxidation and re-established good continuity through the connector.

DPSG,RG40854,37 –19–15DEC98–6/6

## Troubleshooting Circuit Malfunctions

RG9896 –UN–06JAN99




*Troubleshooting Circuit Malfunctions*

**A—Battery**
**B—Switch**
**C—Component Terminal**
**D—Unwanted Resistance**
**E—Circuit Connector**
**F—Open Circuit**
**G—Circuit Connector**
**H—Component Terminal**
**I—Load (Lamp)**
**J—Ground**

1. **High Resistance Circuit:**

   A “High Resistance” circuit can result in slow, dim or no component operation (for example: loose, corroded, dirty or oily terminals, gauge of wire too small or broken strands of wire).

2. **Open Circuit:**

   An “Open” circuit results in no component operation because the circuit is incomplete (for example: broken wire, terminals disconnected, open protective device or open switch).

   Do the following to isolate the location of a “High Resistance” or “Open” circuit:

   a. With the controlling switch (B) closed (on) and the load (I) connected into the circuit, check for proper voltage at a location easily accessible between (C) and (H).

      - If voltage is low, move toward the voltage source (A) to locate the point of voltage drop.
      - If voltage is correct, move toward the load (I) and ground terminal (J) to locate the voltage drop.

      *NOTE: The example shows high resistance (D) between (C) and (E) and the open circuit (F) between (E) and (G).*

   b. Repair the circuit as required.

   c. Perform an operational check-out on the component after completing the repair.

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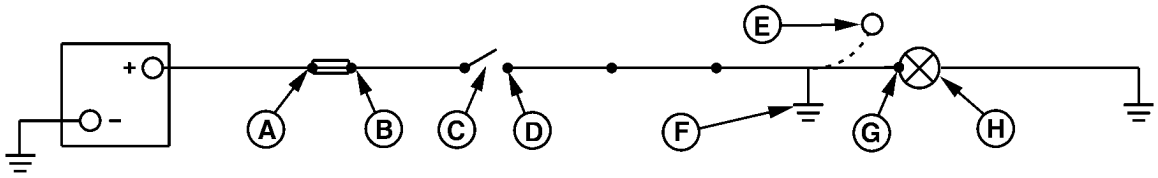
DPSG,RG40854,38 –19–15DEC98–1/4

RG9897 –UN–06JAN99




*Ground Circuit*

**A—Fuse “A” Terminal**
**B—Fuse “B” Terminal**
**C—Switch**
**D—Component Terminal**
**E—Wire Terminal**
**F—Grounded Circuit**
**G—Component Terminal**
**H—Load (Lamp)**

3. **Ground Circuit:**

   A “Grounded” circuit (F) results in no component operation and the fuse or circuit breaker opens (for example: a power wire contacting the machine frame, chassis or component housing).

   Do the following to isolate the location of a “Grounded” circuit:

   a. Switch (C) must be open (off). Check for continuity to ground between (B) and (C).

      - If there is continuity, there is a grounded circuit between (B) and (C). Repair the circuit.
      - No continuity, go to step b.

   b. Disconnect the load (H) at component terminal (G).

   c. With the controlling switch (C) open (off), check for continuity to ground between (D) and (E).

      - If there is continuity, there is a grounded circuit between (D) and (E). Repair the circuit.

   *NOTE: The example is grounded between (D) and (E) at (F).*

      - Perform an operational check-out on the component after completing the repair.

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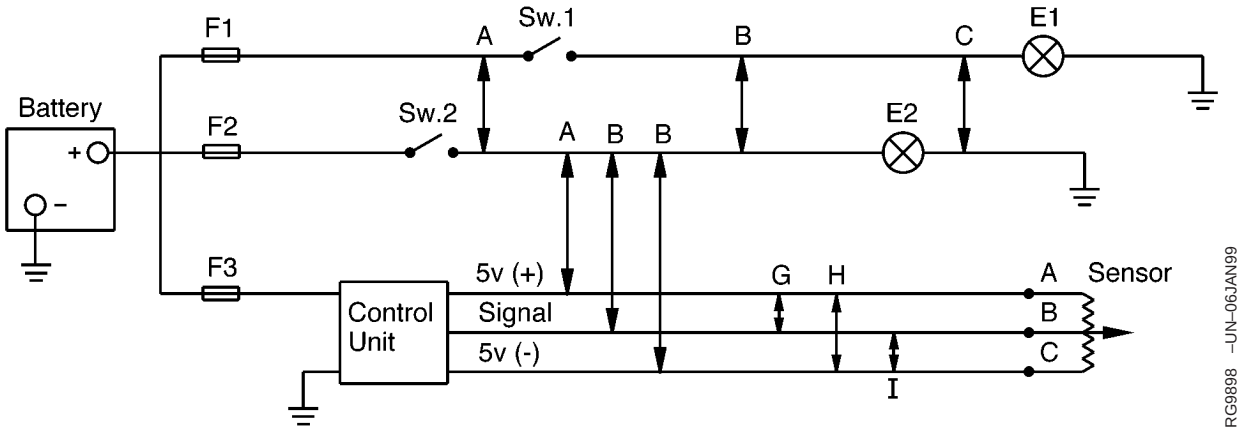
DPSG,RG40854,38 –19–15DEC98–2/4




*Shorted Circuit*

4. **Shorted Circuit:**

   Machines equipped with several electronic control devices contain wiring harnesses that can become shorted by one of the following ways shown above.

   1. Battery wire from fuse (F1) is shorted at (A) to another battery wire after switch (Sw.2).
      - Result: Lamp (E1) is on all of the time.

   2. Battery wire from fuse (F1) is shorted at (B) to another battery wire after switches (Sw.1 & 2).
      - Result: Both lamps (E1 & E2) operate on either switch (Sw. 1 or 2).

   3. Battery wire from fuse (F1) is shorted at (C) to a ground wire.
      - Result: Fuse (F1) opens after closing switch (Sw. 1)

   4. Battery wire from switch (Sw. 2) is shorted at (D) to a regulated voltage wire.
      - Result: The sensor signal voltage is distorted.[1]

   5. Battery wire from switch (Sw. 2) is shorted at (E) to the sensor signal voltage wire.
      - Result: The sensor signal is distorted.[1]

   6. Battery wire from switch (Sw. 2) is shorted at (F) to the sensor ground wire.
      - Result: Fuse (F2) opens after closing switch (Sw. 2) and the sensor signal is distorted.[1]

   7. Controller regulated voltage wire is shorted at (G) to the sensor signal voltage wire.
      - Result: The sensor signal is distorted.

   8. Controller regulated voltage wire is shorted at (H) to the sensor ground wire.
      - Result: The sensor signal is distorted.[1]

   9. Sensor voltage wire is shorted at (I) to the sensor ground wire.
      - Result: The sensor signal is distorted.[1]

   **Do the following to isolate a "Shorted Circuit:"**

   a. Review the machine electrical schematic to identify the circuits for the component that does not operate.

   b. Disconnect the components at each end of the circuits, to single out the affected wires.

   c. To prevent damage to connector terminals, obtain mating connector terminals from repair parts. DO NOT force meter probes into connector terminals.

*[1]The sensor signal voltage goes out of range and a fault code may be restored. The controller may shut down or provide limited operation for its function.*

Continued on next page

d. Connect the meter leads across two of the affected circuits. The meter should show no continuity between the two circuits. Repeat the check across another combination of two circuits until all affected circuits have been checked.

e. Then, connect a meter lead to each affected circuit one at a time and touch the other meter leads to all terminals in the connector. The meter should show no continuity between any two circuits.

   Example: A 37 pin connector contains three wires to a sensor. With one meter probe attached to each of the three wires, one at a time, touch the other meter probe to the remaining 36 wires. If there is continuity between any two wires, the circuit is shorted. Repair the circuit.



f. Alternate Method to Check for Shorted Circuit.

   With the components disconnected at each end of the suspected circuits, turn the key switch on.

   Connect one meter lead to a good frame ground. With the other meter probe, touch each of the suspected circuits one at a time. If there is a voltage reading, the circuit is shorted to another voltage wire. Repair the circuit.

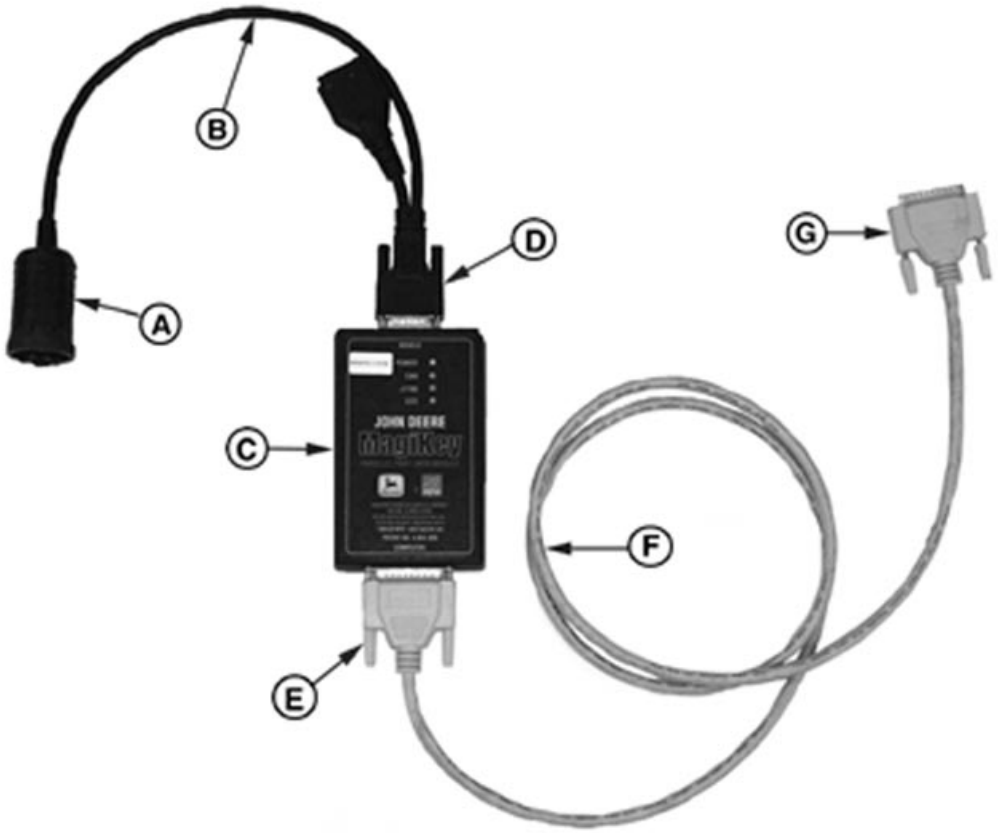
g. Repair the “Shorted Circuit” as follows:

   - Wires not in a loom: Wrap individual wires with electrical tape or replace the damaged wire and band as required.
   - Wires in a loom: If hot spots exist in shorted area of the harness, replace the harness. If hot sports are not noticeable, install a new wire of proper gauge between the last two connections. Use tie bands to secure the wire to outside of the harness.

h. Perform an operational check-out on the component after completing the repair.

DPSG,RG40854,38 –19–15DEC98–4/4

## Connecting to Diagnostic Scan Tool (DST) or SERVICE ADVISOR™




RG11737A –UN–18MAY01

**A—Diagnostic Connector Mate**
**B—John Deere Controller Cable**
**C—MagiKey**
**D—26 Pin MagiKey Connector**
**E—25 Pin MagiKey Connector**
**F—PC Cable**
**G—PC Connector**

DS10023 ECU Communication Hardware Kit or JDIS121 - ECU Communication Hardware Kit is required to connect the DST or SERVICE ADVISOR™ to the ECU. Please refer to your John Deere Dealer website for obtaining the latest version of software.

The diagnostic connector is a black, circular connector with a square mounting flange and a dust cap. There are nine available pins. Depending on application, the location of the diagnostic connector may vary. On OEM the connector is located near the ECU on the engine wiring harness.

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 (B) to the MagiKey (C) module at the 26 pin MagiKey connector (D).
4. Connect the PC cable (F) to the MagiKey (C) module at the 25 pin MagiKey connector (E).
5. Connect the PC cable (F) to the computer with the Diagnostic Scan Tool (DST) or SERVICE ADVISOR™ installed through the PC connector (G).
6. Key ON, engine off or running, verify that power light on MagiKey is illuminated green.

*SERVICE ADVISOR is a trademark of Deere & Company*

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RG41221,000020E –19–20OCT02–1/2

7. Start the diagnostic software and select the appropriate application.
8. Connect to the application. The CAN light on the MagiKey should illuminate red when the connection to the ECU is made.
9. If DST or SERVICE ADVISOR™ does not connect see D1 - ECU DOES NOT COMMUNICATE WITH DST OR SERVICE ADVISOR™ DIAGNOSTIC PROCEDURE in Group 150 of this manual.
10. If power to the PDM is lost during cranking the engine for the Compression Test, use the Power Adapter. The Power Adapter connects between the PDM and the 26 pin MagiKey connector.
11. When finished, replace the dust cap on the diagnostic connector.

RG12277 –UN–22APR02

*Power Adapter*

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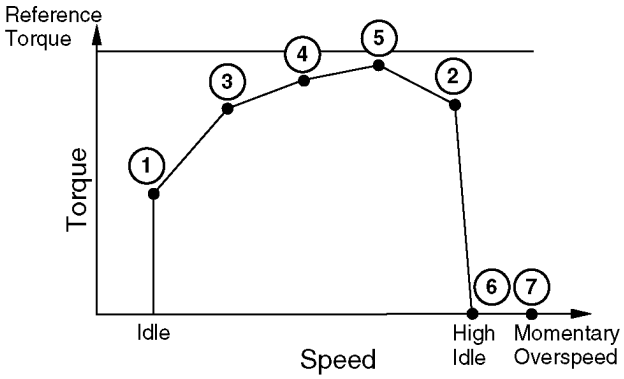
## Engine Configuration Data Parameters on Diagnostic Gauge

**Accessing Engine Configuration Data Parameters:**

1. Scroll through the main menu of engine parameters by pressing ***either*** the right or the left touch switch
2. Select “E-Config” sub-menu by ***simultaneously*** pressing the right and the left touch switch.
3. Scroll through the “E-Config”sub-menu to view Engine Configuration Parameters by pressing ***either*** the right or the left touch switch until desired parameter is found. The numbers next to the parameters correspond to the number on the graph.
4. In order to exit “E-Config” sub-menu, ***simultaneously*** press the right and left touch switch

**A—Diagnostic Gauge**
**B—Touch Switches**
**C—Lights**

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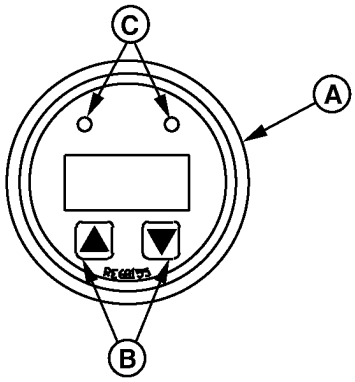


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DPSG,OUOD007,2840 –19–21OCT99–1/2

| Engine Configuration Parameter Description | | |
|---|---|---|
| **Parameter Displayed on Diagnostic Gauge** | **Units** | **Description** |
| Speed 1 | RPM | Stationary low idle speed of engine which includes influences due to engine temperature and other stationary changes. This is point 1 on the engine configuration map. |
| Torque 1 | % | Torque 1 equals the desired torque of the ECU divided by the reference torque. |
| Speed 2 | RPM | Engine speed at point 2 of the engine configuration map. This is defined as the kick-in point for which torque is reduced to zero. |
| Torque 2 | % | Torque 2 equals the desired torque of the ECU divided by the reference torque. |
| Speed 3 | RPM | Engine speed at point 3 of the engine configuration map. Points 3, 4, and 5 are optional and can be located anywhere between points 1 and 2. |
| Torque 3 | % | Torque 3 equals the desired torque of the ECU divided by the reference torque. |
| Speed 4 | RPM | Engine speed at point 4 of the engine configuration map. Points 3, 4, and 5 are optional and can be located anywhere between points 1 and 2. |
| Torque 4 | % | Torque 4 equals the desired torque of the ECU divided by the reference torque. |
| Speed 5 | RPM | Engine speed at point 5 of the configuration map. Points 3, 4, and 5 are optional and can be located anywhere between points 1 and 2. |
| Torque 5 | % | Torque 5 equals the desired torque of the ECU divided by the reference torque. |
| Speed 6 | RPM | Engine speed of high idle. |
| Torque 6 | % | Torque 6 equals the desired torque of the ECU divided by the reference torque. |
| Gov Gain | % | Equals the change of torque between points 2 and 6 divided by the change of engine speed between points 2 and 6. |
| Ref Torque | Nm (ft-lbs) | This parameter is the 100% reference value for all defined indicated engine torque parameters. It is only defined once and doesn't change if a difference engine torque map becomes valid. |
| Speed 7 | RPM | The maximum engine speed above point 6 allowed by the engine control during a momentary high idle override. This duration is limited by the maximum momentary override time limit. |
| Time Limit | sec | The maximum time limit allowed to override the engine's high idle speed. |
| Lo Limit | RPM | The minimum engine speed that the engine will allow when operating in a speed control/limit mode |
| Hi Limit | RPM | The maximum engine speed that the engine will allow when operating in a speed control/limit mode. |
| Low Limit | % | The minimum engine torque that the engine will allow when operating in a torque control/limit mode. |
| Hi Limit | % | The maximum engine torque that the engine will allow when operating in a torque control/limit mode. |

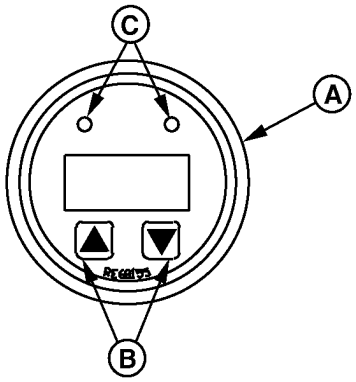


DPSG,OUOD007,2840 –19–21OCT99–2/2

## Viewing Active DTCs on Diagnostic Gauge

**Accessing Active Diagnostic Trouble Codes (DTCs):**

1. Scroll through the main menu of engine parameters by pressing ***either*** the right or the left touch switch
2. Select “SrvcCodes” sub-menu by ***simultaneously*** pressing the right and the left touch switch.
3. Scroll through the “Srvc Codes ”sub-menu to view active DTCs by pressing ***either*** the right or the left touch switch until all codes are found.
4. In order to exit “SrvcCodes” sub menu, ***simultaneously*** press the right and left touch switch




RG10031 –UN–28OCT99

**A—Diagnostic Gauge**
**B—Touch Switches**
**C—Lights**

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DPSG,OUOD007,2842 –19–15NOV00–1/1

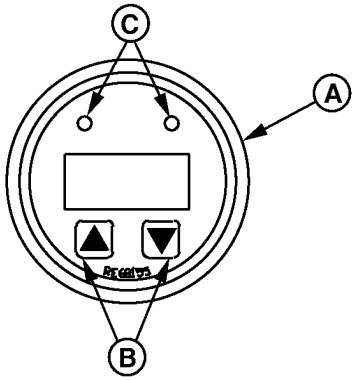
## Viewing Stored DTCs on Diagnostic Gauge

**Accessing Stored Diagnostic Trouble Codes (DTCs):**

1. Scroll through the main menu of engine parameters by pressing ***either*** the right or the left touch switch
2. Select “DM2Codes” sub-menu by ***simultaneously*** pressing the right and the left touch switch.
3. Scroll through the “DM2Codes”sub-menu to view stored DTCs by pressing ***either*** the right or the left touch switch until all codes are found.

*NOTE: If “No Data” is on the gauge, there are no stored codes.*

4. In order to exit “DM2Codes” sub menu, ***simultaneously*** press the right and left touch switch




RG10031 –UN–28OCT99

**A—Diagnostic Gauge**
**B—Touch Switches**
**C—Lights**

DPSG,OUOD007,2842 –19–21OCT99–1/1

## Clearing Stored DTCs on Diagnostic Gauge

**Clearing Stored Diagnostic Trouble Codes (DTCs):**

1. Scroll through the main menu of engine parameters by pressing ***either*** the right or the left touch switch
2. Select “DM2Codes” sub-menu by ***simultaneously*** pressing the right and the left touch switch.
3. Scroll through the “DM2Codes”sub-menu to view stored DTCs by pressing ***either*** the right or the left touch switch until all codes are found.

*NOTE: If “No Data” is on the gauge, there are no stored codes.*

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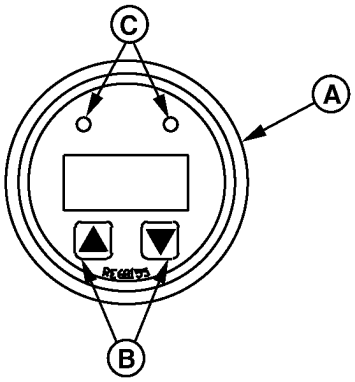
4. In order to clear codes, ***simultaneously*** press the right and left switch for at least 8 seconds

*NOTE: If the switches are held for less than 8 seconds, the sub menu will be exited.*

5. If display reads “**********”, press the right switch for at least 8 seconds.

*NOTE: If the switch is held for less than 8 seconds, the sub menu will be exited.*

6. If the display reads “*Send* **DM3 *”, the codes are now cleared. In order to exit “DM2Codes” sub menu, ***simultaneously*** press the right and left touch switch




RG10031 –UN–28OCT99

**A—Diagnostic Gauge**
**B—Touch Switches**
**C—Lights**

RG40854,000006A –19–23JAN01–1/1

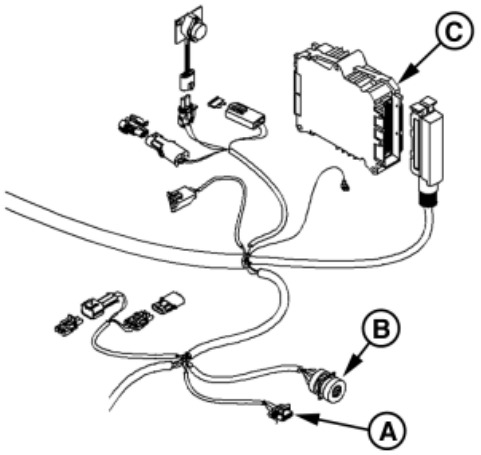
## Blinking DTCs Using Diagnostic Blink Code Connector

*NOTE: Illustration shows location of connectors on OEM applications. For location information on non-OEM applications, refer to machine manual.*

On OEM applications that have a Fault Lamp, the ECU has the ability to display DTCs using blinking sequence of the fault lamp. To retrieve DTCs from the ECU using the “blink code” method:

*NOTE: The ECU blinks the codes in 2-digit codes only. In order to convert the codes to SPN/FMI codes, see LISTING OF DIAGNOSTIC TROUBLE CODES (DTCS) ON ECU later in this Group.*

1. Locate and uncap the 4–way METRI-PACK™ diagnostic blink code connector (A).
2. Using a short piece of wire, jump terminals A and B in the diagnostic blink code connector together.
3. Turn the ignition switch “ON”.
4. The Fault Lamp will begin to flash a code number. For example, flash three times...short pause...flash two times...long pause. This example is code 32.
5. The ECU begins the flashing sequence by flashing a code 32, this indicates the start of blinking active codes. If there are any active DTCs, the ECU will flash it’s 2–digit number. If there is more than one active DTC, the ECU will flash each code in numerical order. If there are no active DTCs, the Fault Lamp will flash a code 88.
6. Following the active codes, the Fault Lamp will flash a code 33, this indicates the start of blinking stored codes. If there are any stored DTCs, the Fault Lamp will flash it’s 2–digit number. If there is more than one stored DTC, the ECU will flash each code in numerical order. If there are no stored DTCs, the Fault Lamp will flash a code 88.
7. Once complete, the above sequence will be repeated.




RG11754A –UN–13JUL01

**A—Diagnostic Blink Code Connector**
**B—Diagnostic Connector**
**C—ECU**

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Continued on next page

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8. When complete, turn ignition “OFF”, remove jumper wire, and recap the diagnostic reader connector.

As an example, if an engine had an active DTC 18 and stored DTC 53, the flashing sequence would be:

- flash three times...short pause
- flash two times...long pause
- flash one time...short pause
- flash eight times...long pause
- flash three times...short pause
- flash three times...long pause
- flash five times...short pause
- flash three times



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## Data Parameter Description

Following is a list of the data parameters that can be read on the Diagnostic Scan Tool (DST). The DST consists of a Windows ('95 or '98) or NT compatible computer, DS10023 ECU Communication Hardware Kit or JDIS121 - ECU Communication Hardware Kit, and JDIS122 ECU Communication Software Kit, available from John Deere. Included in the list below is a brief description of each parameter, the range of possible readings, and each parameter's unit of measurement.

| Parameter | Units | Description |
|---|---|---|
| Air Heater Time Remaining | sec | Amount of time the air heater will continue to heat the air prior to starting. |
| Analog Throttle (A) Input Voltage | volts | Optional component, not included on all applications. The voltage from the analog throttle (A) position sensor (potentiometer). |
| Analog Throttle (B) Input Voltage | volts | Optional component, not included on all applications. The voltage from analog throttle (B) position sensor (potentiometer). |
| Analog Throttle (C) Input Voltage | volts | Optional component, not included on all applications. The voltage from analog throttle (C) position sensor (potentiometer). |
| Battery Voltage | volts | Switched battery voltage may vary depending on application |
| Commanded Power | kW (HP) | ECU calculates power based on engine fueling. |
| Commanded Torque | Nm (lb-ft) | ECU calculates torque based on engine fueling. |
| Crank Improper Pattern Indicator | % | "0" reading means that there is NO improper pattern. Between 0—100, the crankshaft position sensor signal pattern becomes progressively more improper. When 100 is reached, a trouble code is thrown. |
| Crank Position Input Noise Indicator | % | "0" reading means that there is NO noise. Between 0—100, the noise on the crankshaft position sensor signal becomes progressively worse. When 100 is reached, a trouble code is thrown. |
| Crank Position Sensor Speed | rpm | The speed of the crank timing wheel. |
| Crank Position Status | N/A[a] | When status is 15, the ECU is receiving ALL of the signal. When the status is below 15, it means that the ECU is not receiving all of the signal. |
| Crank Position Status | N/A[a] | When status is 15, the ECU is receiving ALL of the signal. When the status is below 15, it means that the ECU is not receiving all of the signal. |
| Cruise Accelerate Switch | N/A[a] | The cruise accelerate function has been activated. This should increase the speed at which cruise is set. |
| Cruise Brake Switch | N/A[a] | The cruise brake function has been activated. This will cancel the cruise when the brake is applied until operator resumes operation. |
| Cruise Clutch Switch | N/A[a] | The cruise clutch function has been activated. This will cancel the cruise when the clutch is applied until operator resumes operation. |
| Cruise Coast Switch | N/A[a] | The cruise coast function has been activated. This should decrease the speed at which cruise is set. |
| Cruise Control Active | N/A[a] | Confirms that cruise is ON/OFF depending on the operators command. |
| Cruise Control State | N/A[a] | Confirms that the function chosen by the operator is activated: hold, accelerate, coast, resume, set, throttle override. |
| Cruise Control On/Off Switch | N/A[a] | The operator has turn the cruise ON/OFF. |
| [a]N/A = Not Applicable | | |

Continued on next page

| Parameter | Units | Description |
|---|---|---|
| Cruise Resume Switch | N/A[a] | The cruise resume function has been activated. This will reset the cruise to the speed at which cruise was at prior to using the brake or clutch. |
| Cruise Set Switch | N/A[a] | The cruise set function has been activated. This should lock the current engine speed in when switch is activated. |
| Desired Speed Governor Curve | N/A[a] | The mode selected is dependent on the application. See APPLICATION SPECIFICATIONS in Section 6, Group 210 of this manual. |
| ECU Boot Block Part Number | N/A[a] | Part number for the Engine Control Unit (ECU) boot block. |
| ECU Configuration File Part Number | N/A[a] | Part number for the configuration file in the ECU. |
| ECU EOL Data Part Number | N/A[a] | Part number for the data programmed into the ECU at the end of the assembly line. EOL = End of Line |
| ECU Fuel Shutoff | N/A[a] | ECU commands the pump to stop fueling if a problem is detected. |
| ECU Part Number | N/A[a] | Part number for the Engine Control Unit (ECU) hardware. |
| ECU Serial Number | N/A[a] | Serial number for the Engine Control Unit (ECU). |
| ECU Software Assembly Part Number | N/A[a] | Part number for the Engine Control Unit (ECU) software assembly. |
| ECU Software Part Number | N/A[a] | Part number for the Engine Control Unit (ECU) operating software. |
| Engine Coolant Temperature | °C (°F) | Engine Coolant Temperature value. *NOTE: If there is an active fault for the ECT circuit, the ECT value displayed will be the "limp-home" value.* |
| Engine Coolant Temperature Input Voltage | volts | Engine Coolant Temperature sensor input voltage to the ECU |
| Engine Hourmeter | hr -min- sec | Total hours the ECU has run on an engine. |
| Engine Load at Current Speed | % | Percentage of load on the engine at a given speed. |
| Engine Model Number | N/A[a] | The model number for the engine. |
| Engine Oil Pressure | kPa (psi) | Engine Oil pressure value |
| Engine Oil Pressure Input Voltage | volts | Oil Pressure sensor input voltage to the ECU |
| Engine Oil Temperature | °C (°F) | Engine Oil temperature value |
| Engine Serial Number | N/A[a] | Serial number for the engine. |
| Engine Speed | rpm | The speed that the crankshaft position sensor detects the crank timing wheel to be moving at. |
| [a]N/A = Not Applicable | | |



**Continued on next page**

| Parameter | Units | Description |
|---|---|---|
| Fuel Mode | N/A[a] | This code explains the operation mode of the engine. |
| Fuel Pressure - Actual | kPa (psi) | Fuel supply pressure at the final fuel filter housing in the actual state. |
| Fuel Pressure - Desired | kPa (psi) | Fuel supply pressure at the final fuel filter housing in the desired state. This is the pressure the ECU is commanding the pump to provide. |
| Fuel Pressure Input Voltage | volts | Fuel Pressure sensor input voltage to the ECU. |
| Fuel System Part Number | N/A[a] | The part number for the fuel system used on the engine. |
| Fuel System Serial Number | N/A[a] | The serial number for the fuel system used on the engine. |
| Fuel Temperature | °C (°F) | Fuel temperature value. |
| Fuel Usage Rate | L (gal) | Total amount of fuel the ECU has commanded the pump control unit to deliver during the total hours shown by the Engine Hour Meter parameter. |
| Manifold Absolute Pressure | kPa (psi) | Manifold Air Pressure value (boost pressure).<br>*NOTE: If there is an active fault for the MAP circuit, the MAP value displayed will be the "limp-home" value.* |
| Manifold Air Temperature | °C (°F) | Manifold Air Temperature value.<br><br>*NOTE: If there is an active fault for the MAP circuit, the MAP value displayed will be the "limp-home" value.* |
| Manifold Air Temperature Input Voltage | volts | Manifold Air Temperature sensor input voltage to the ECU. |
| Maximum Speed Governor Curve | N/A[a] | The mode selected is dependent on the application. See APPLICATION SPECIFICATIONS in Section 6, Group 210 of this manual. |
| Option Assembly Part Number | N/A[a] | Part number that describes all of the options on the entire vehicle. This includes the Performance Option Part Number and the Vehicle Option Part Number. |
| Performance Option Part Number | N/A[a] | These are the engine performance specific options relate to power and torque. |
| Pump Fuel Shutoff | N/A[a] | Pump Control Unit stops fueling if a problem is detected internal to the pump. |
| Pump Position Sensor Improper Pattern Indicator | % | "0" reading means that there is NO improper pattern. Between 0—100, the event sensor signal pattern becomes progressively more improper. When 100 is reached, a trouble code is thrown. |
| Pump Position Sensor Input Noise Indicator | % | "0" reading means that there is NO noise. Between 0—100, the noise on the event sensor signal becomes progressively worse. When 100 is reached, a trouble code is thrown. |
| Pump Position Sensor Speed | rpm | The speed of the event timing wheel. |
| [a]N/A = Not Applicable | | |

Continued on next page

| Parameter | Units | Description |
|---|---|---|
| Pump Position Sensor Status | N/A[a] | When status is 15, the ECU is receiving ALL of the signal. When the status is below 15, it means that the ECU is not receiving all of the signal. |
| Pump Self Test | N/A[a] | The injection pump performs a test on all internal components. |
| Pump Speed | rpm | The speed of the timing wheel internal to the injection pump. |
| Pump Status | N/A[a] | Current status of the pump - engine running or stopped. |
| Pump Timing - Actual | degrees | Timing of the injection pump. |
| Pump Timing - Commanded | degrees | Timing commanded to the injection pump from the ECU. |
| Pump Timing Duty Cycle | % | The ECU controls the duty cycle to maintain a constant fuel pressure at a given speed. |
| Pump Timing - Start of Pumping | degrees | The angle at which the pump starts to pump fuel. |
| Sensor Supply #1 Voltage | volts | Voltage that ECU supplies sensors on voltage supply #1 |
| Sensor Supply #2 Voltage | volts | Voltage that ECU supplies sensors on voltage supply #2 |
| Throttle Position | % | Percentage of throttle being used. |
| Throttle Type | N/A[a] | Level 4 Electronic Fuel Systems operate with several different types of throttles. Throttle Type displays the type being used on this application at the current time. |
| Torque Curve Number | N/A[a] | On some applications, the ECU limits the max fuel on multiple torque curves. This displays the torque curve the ECU is currently using to limit maximum fuel. See APPLICATION SPECIFICATIONS in Section 6, Group 210 of this manual. |
| Transfer Pump Control Status | N/A[a] | Transfer pump runs in open or closed loop mode |
| Transfer Pump Duty Cycle | % | Percentage of duty cycle that the pump is performing at. |
| Vehicle Option Part Number | N/A[a] | These are the vehicle specific options for the engine like fuel derates, shutdowns, sensor thresholds, ect. |
| Vehicle Serial Number | N/A[a] | The serial number of the vehicle that this engine is located in. |
| Vehicle Speed - Calculated | km/hr (mi/hr) | Vehicle speed calculated by ECU from the wheel speed PWM signal |
| Vehicle Speed - CAN | km/hr (mi/hr) | Vehicle speed ECU receives over the CAN bus via another electronic controller. |
| [a]N/A = Not Applicable | | |



RG41221,000012D –19–23APR03–4/4

## Engine Test Instructions—Cylinder Misfire Test

*NOTE: The availability of this test is dependent on the version of software in the ECU. If this test is unavailable, see TEST FOR CYLINDER MISFIRE (ENGINE RUNNING) in Section 4, Group 150 earlier in this manual.*

For instructions on connecting to the DST or SERVICE ADVISOR™, see CONNECTING TO DIAGNOSTIC SCAN TOOL (DST) OR SERVICE ADVISOR™ earlier in this Group.

The Cylinder Misfire Test is used to compare the output 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 the injection pump or nozzles. Other information such as the results of a Compression Test, Cylinder Cutout Test, and other engine diagnostic procedures should be used 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)

*NOTE: The ECU will not allow the test to run if there are any active DTCs.*

- 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 - 0% throttle

2. Select Cylinder Misfire Test on the DST or SERVICE ADVISOR™.

3. Follow instruction given by the diagnostic software. The software will instruct that the throttle lever be moved from low idle position to wide open throttle position, then back to low idle position 6 times.

*NOTE: On most Marine applications, either throttle may be used to run this test. However, on some early applications, only analog throttle (B) can run this test. In this situation the connectors for analog throttle (A) and analog throttle (B) need to be switched to allow operation from analog throttle (A). After this test is completed, the connectors need to be switched back.*

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%, that indicates the cylinder is contributing too much (above average) or not contributing enough (below average).

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*NOTE: It is recommended that the test be run at least 3 times to ensure repeatable, accurate results.*

The Compression Test should be performed to help determine the cause of the problem in the cylinder(s) that was above or below average.

RG,RG34710,1561 –19–21OCT02–2/2

## Engine Test Instructions—Compression Test

*NOTE: The availability of this test is dependent on the version of software in the ECU. If this test is unavailable, see TEST ENGINE COMPRESSION PRESSURE in Section 4, Group 150 of 4.5L & 6.8L Diesel Engines Base Engine Manual (CTM 104).*

For instructions on connecting to the DST or SERVICE ADVISOR™, see CONNECTING TO DIAGNOSTIC SCAN TOOL (DST) OR 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 (by not activating the high pressure solenoid valve in the injection pump), 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 lower 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)

*NOTE: The ECU will not allow the test to run if there are any active DTCs.*

- Ensure that the battery and starter are in good working condition

**Performing the Compression Test**

1. Key ON, engine OFF.
2. Select Compression Test on the DST or 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. The DST or SERVICE ADVISOR™. should be observed carefully for instructions during the test.

   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' compression as a percentage in relation to the average of all cylinders. If any cylinder is more than 10% below the rest, that indicates the cylinder's compression is lower than the rest.

*NOTE: It is recommended that the test be run 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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## Engine Test Instructions— Cylinder Cutout Test

*NOTE: The availability of this test is dependent on the version of software in the ECU.*

For instructions on connecting to the DST or SERVICE ADVISOR™, see CONNECTING TO DIAGNOSTIC SCAN TOOL (DST) OR 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(s) that the technician selects. This 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 the injection pump or nozzles. Other information such as the results of a Compression Test and other engine diagnostic procedures should be used 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)

*NOTE: The ECU will not allow the test to run if there are any active DTCs.*

- 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 on the DST or SERVICE ADVISOR™.
3. Follow instructions given by the DST or SERVICE ADVISOR™.
4. Select the cylinder to be cut out.
5. Observe engine operation and the parameters on the DST or SERVICE ADVISOR™. These parameters include: engine load at current speed, engine speed, and manifold air temperature.
6. Use this data and observations to help in the diagnosis of the problem.

*NOTE: It is recommended that the test be run at least 3 times to ensure repeatable, accurate results.*

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## Engine Test Instructions - Excavator Torque Curve Change Test

Torque curve adjustment may be necessary for excavators operating in high altitude areas. By selecting the altitude derate option, undesired observable symptoms such as excessive black smoke can be significantly reduced or eliminated. Torque curve adjustment can only be accomplished with the DST or SERVICE ADVISOR™. For instructions on connecting to the DST or SERVICE ADVISOR™, see CONNECTING TO DIAGNOSTIC SCAN TOOL (DST) OR SERVICE ADVISOR in Group 160 later in this manual.

**Performing the Torque Curve High-altitude Adjustment**

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1. Ignition ON, engine off.
2. Select Excavator Torque Curve Change Test on the DST or SERVICE ADVISOR™.
3. Select the option that corresponds to the desired operation.

    1. Normal operation
    2. Altitude derate

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## Engine Test Instructions - Tractor Torque Curve Change Test

Torque curve adjustment may be necessary for tractors while operating on a dynamometer. This test allows the user to select the highest torque curve available on the tractor in order to simulate the max power. Torque curve adjustment can only be accomplished with the DST or SERVICE ADVISOR™. For instructions on connecting to the DST or SERVICE ADVISOR™, see CONNECTING TO DIAGNOSTIC SCAN TOOL (DST) OR SERVICE ADVISOR in Group 160 later in this manual.

**Performing the Torque Curve Dynamometer Adjustment**

1. Ignition ON, engine off.
2. Select Tractor Torque Curve Change Test on the DST or SERVICE ADVISOR™.
3. Select the option that corresponds to the desired operation.
    1. Normal operation
    2. Dynamometer setup

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## Reprogramming Engine Control Unit (ECU)

John Deere Ag and Construction dealers are able to reprogram ECUs using SERVICE ADVISOR™. See REPROGRAMMING ENGINE CONTROL UNIT USING SERVICE ADVISOR later in this Group.

OEM Distributors are able to reprogram ECUs using Diagnostic Scan Tool (DST). See REPROGRAMMING ENGINE CONTROL UNIT USING DST later in this Group.



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## Downloading Payload File For DST

**IMPORTANT: The Engine Serial Number (ESN) for the engine that this instruction is to be performed on is required for downloading the proper payload file.**

*NOTE: An Internet connection will be needed for steps 1 - 12.*

1. Start Internet browser (Internet Explorer version 5.5 or later).



RG41221,0000097 –19–04NOV02–1/11


*Web Address*

2. In the address line (A) type in “http://sds.deere.com” and press the“Enter” key. Log in as required.

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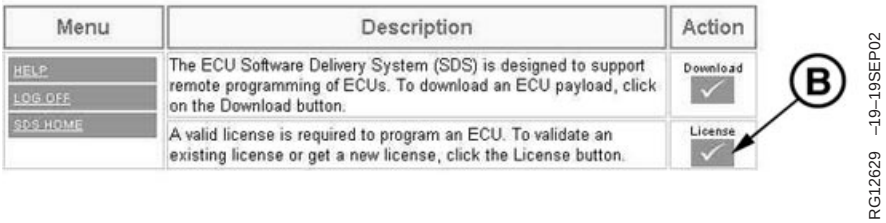
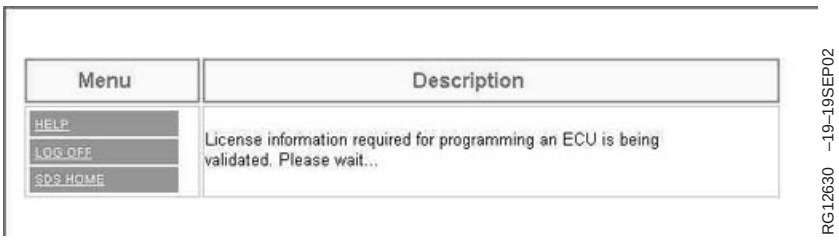



*Obtaining Valid License*




*Validating License*

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*NOTE: Steps 3 - 5 only need to be completed the first time this instruction is performed.*

3. A license file is required for each computer that will reprogram ECUs. Download the license file to gain permissions. Click on “License”(B). A screen will appear while validating license.

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*Grant Always Screen*

4. Click on “Grant Always” (G).

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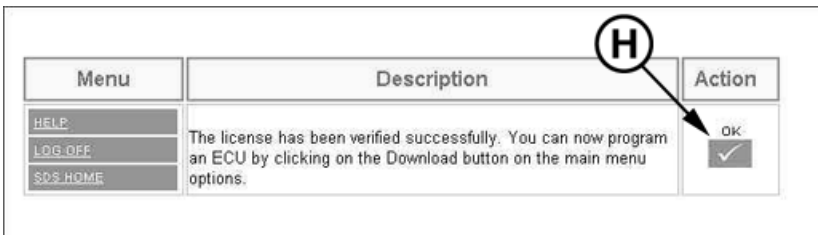
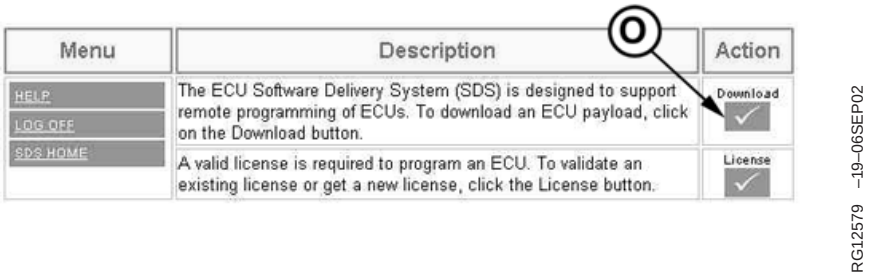



*Verification Successful*

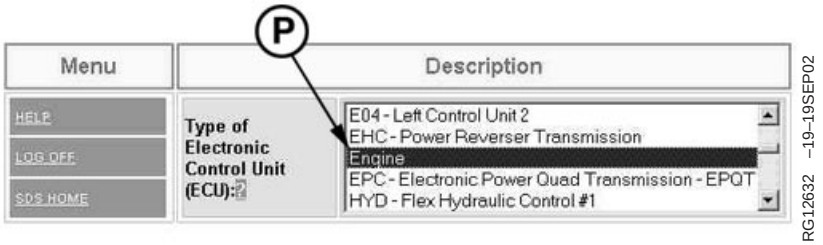
5. Click “OK” (H) when license verification has completed.

RG41221,0000097 –19–04NOV02–5/11




6. Click on “Download” button (O). A screen will appear as the system verifies that a valid license file is present.

RG41221,0000097 –19–04NOV02–6/11

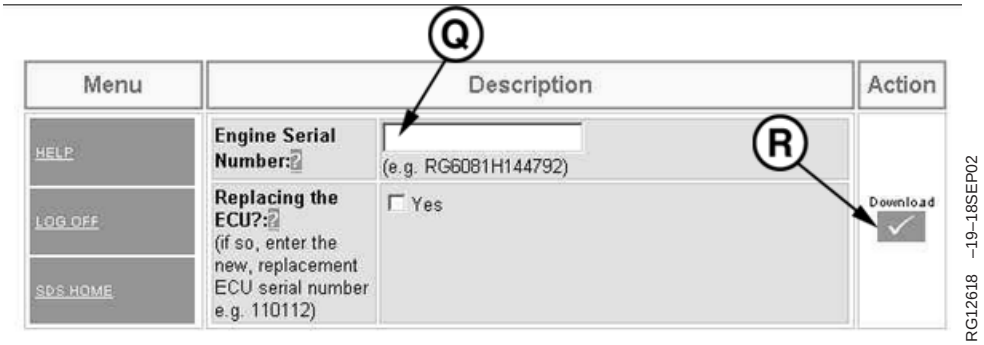



*Selecting Engine for ECU Type*

7. Scroll down and click on “Engine” (P).

**Continued on next page**

RG41221,0000097 –19–04NOV02–7/11




*Enter Engine Serial Number (ESN)*

8. Click once in the ESN text box (Q) so the cursor is in the box. Type in the ESN into the text field. If you are replacing the current ECU, GO TO 9. If you are reprogramming the existing ECU, click “Download” (R) and GO TO 11.

04
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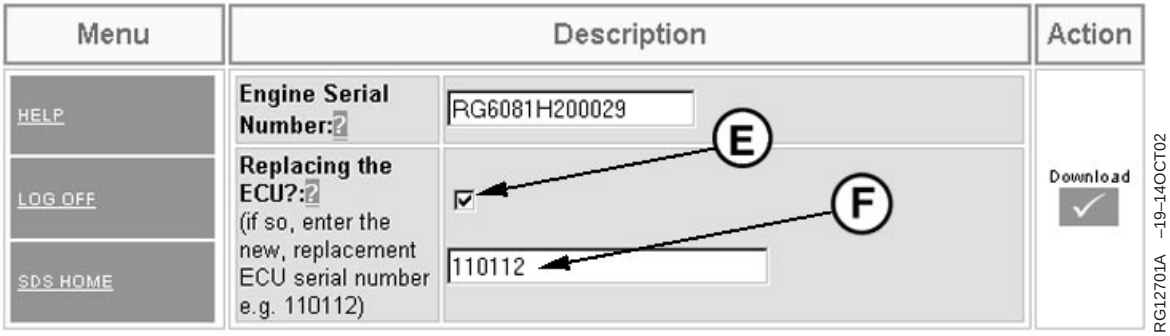
RG41221,0000097 –19–04NOV02–8/11




*Replacing ECU*

9. If the current machine is being replaced, check the “Replacing the ECU” box (E).

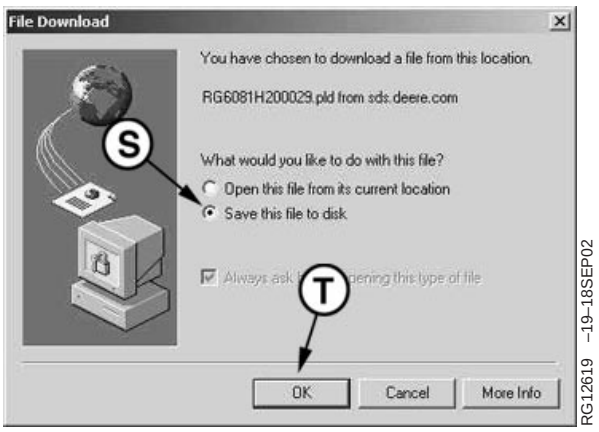
*NOTE: Sometimes the original ECU will not be available for reprogramming. When a new ECU is being programmed to replace the current ECU, the software will tie the engine serial number to the new ECU serial number.*

10. Enter in the new ECU’s serial number (F) located on the ECU label and click “Download”.

**Continued on next page**

RG41221,0000097 –19–04NOV02–9/11

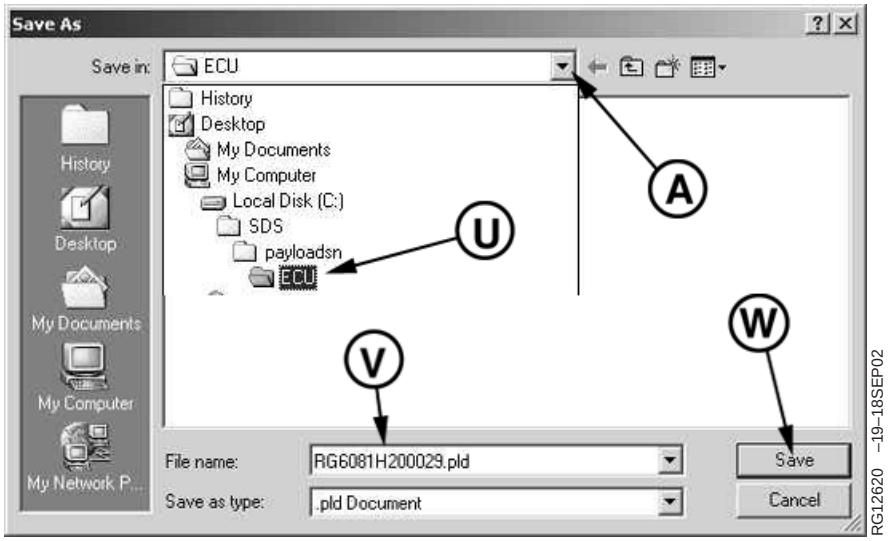
11. In the ”File Download” window ensure that the “Save this file to disk” button (S) is selected and click “OK” (T).




*File Download*

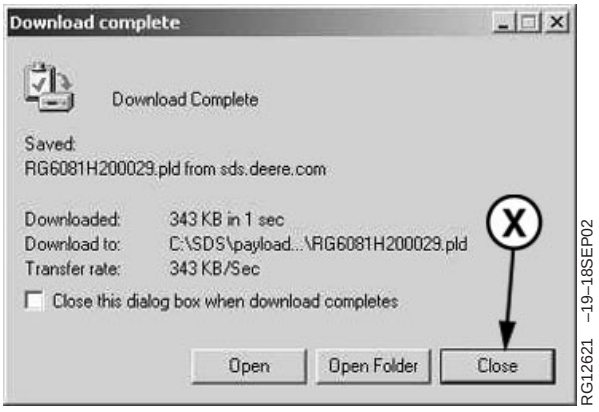


RG41221,0000097 –19–04NOV02–10/11




*Save As Window*

12. The “Save As” window will appear. The file must be saved in “C:\SDS\PAYLOADSN\ECU” folder. Click on the pull down menu arrow (A) and navigate to the ECU folder (U). Ensure that file name (V) is the correct number and click “Save” (W). When the file has been successfully downloaded the ”Download Complete” window will appear, click “OK” (X). Close the Internet browser.




*Download Complete*

RG41221,0000097 –19–04NOV02–11/11

## Reprogramming Engine Control Unit (ECU) With DST

**IMPORTANT: Diagnostic Scan Tool (DST) Version 4.1 or later must be installed prior to performing the following instructions.**

*NOTE: Internet connection is not required to program an engine control unit.*

1. If payload file has not been downloaded to computer, download now. See DOWNLOADING PAYLOAD FILE FOR DST earlier in this Group.
2. Ignition ON, engine OFF.
3. Connect computer with DST to the Diagnostic Connector on the engine.

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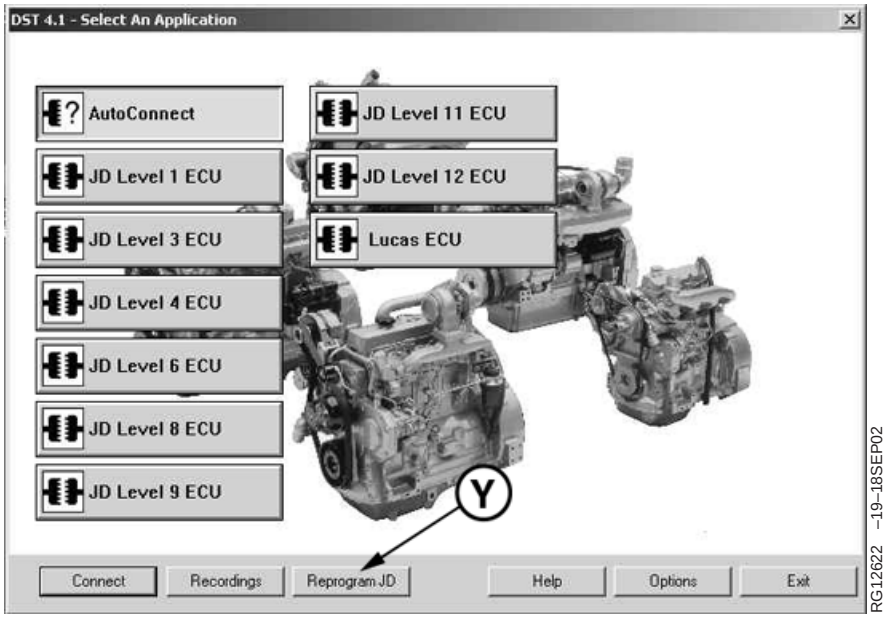
RG41221,0000098 –19–04NOV02–1/9



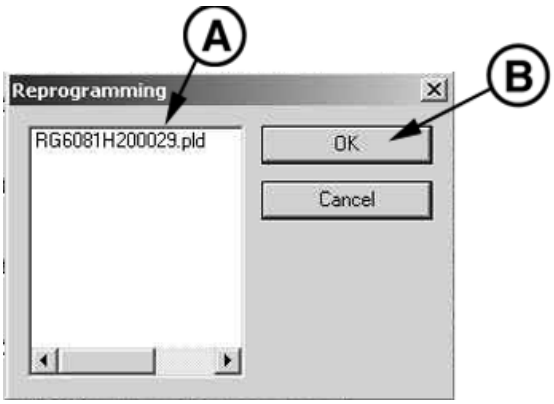

*DST Main Screen*

4. Start the DST software. Click on “Reprogram JD” (Y).

Continued on next page

RG41221,0000098 –19–04NOV02–2/9

5. Click on the proper payload (A) and click OK (B).

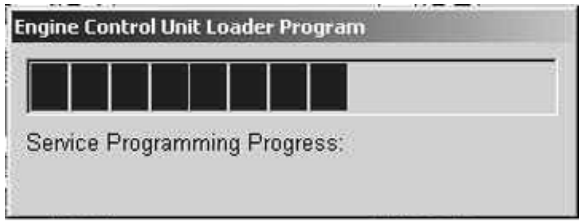



*Selecting Payload file for Reprogramming*



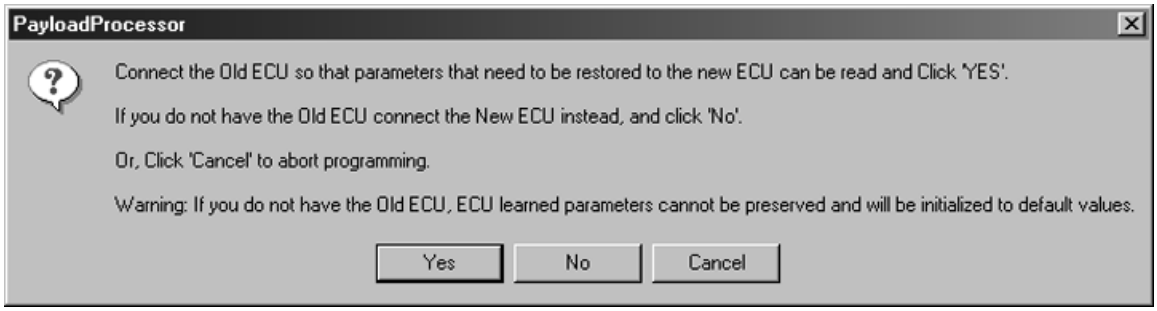
RG41221,0000098 –19–04NOV02–3/9

6. A progress bar will appear while reprogramming the ECU. If the engine is equipped with warning alarms, these may come on while in process of reprogramming and should be ignored.




*Status Bar*

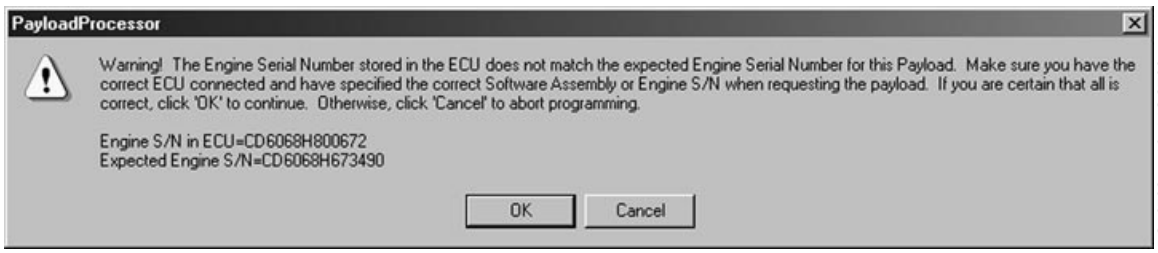
RG41221,0000098 –19–04NOV02–4/9




7. If the ECU is being replaced, the above message will appear. If you have the old ECU, connect to it and click YES. If the old ECU is not available, click NO.

Continued on next page

RG41221,0000098 –19–04NOV02–5/9




8. If the ECU is being replaced, the software will notice that the engine serial number does not match the ECU serial number. This message lets the user know that the ECU expects a different engine serial number to match its ECU serial number. Click “OK” to continue.

RG41221,0000098 –19–04NOV02–6/9

9. When reprogramming the ECU has been successfully completed, the Payload Processor window will appear. Click “OK”.

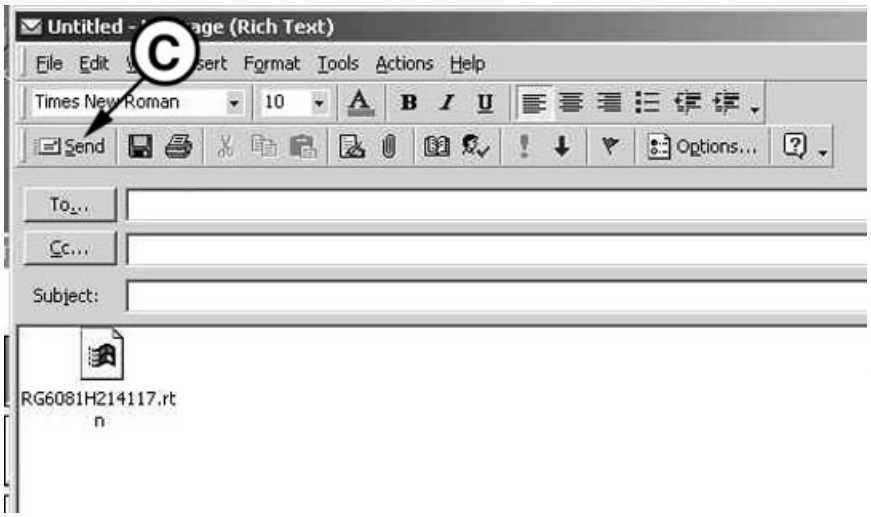

*Payload Processor Completed*

Continued on next page

RG41221,0000098 –19–04NOV02–7/9

RG12626 –19–18SEP02


*Return File Message*

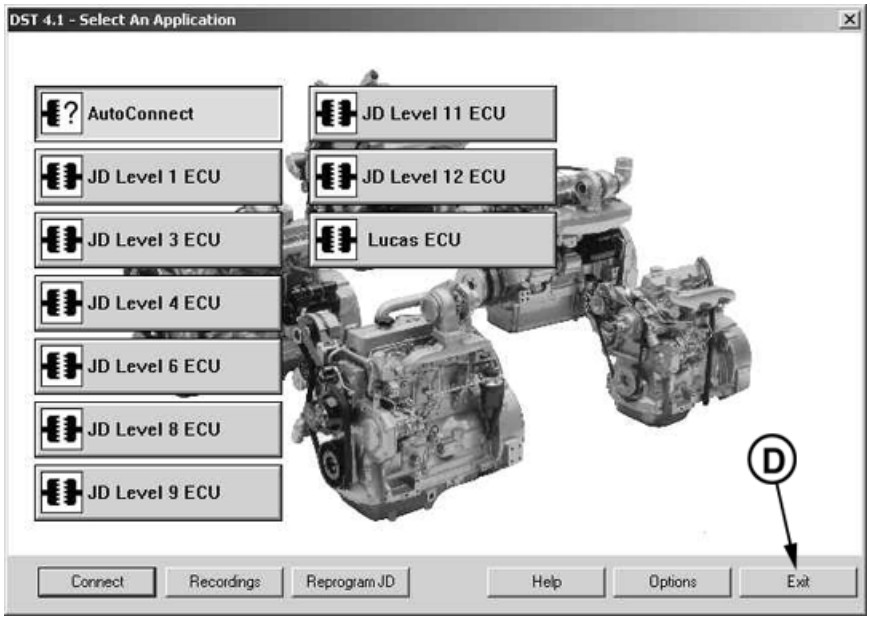



*Automatic E-mail Generated*

10. A return file is created when reprogramming an ECU is completed. The MFT window will appear showing the return file to send back. Click “OK”. This will automatically generate an E-mail message with the proper E-mail address. Click “Send” (C). The next time the mail application is connected to the mail server the message will be sent.

Continued on next page

RG41221,0000098 –19–04NOV02–8/9




*Exit DST Software*

11. Once the E-mail has been successfully sent, click “Exit” (D) to close DST.
12. Disconnect computer from diagnostic connector and start engine to ensure proper operation.

RG41221,0000098 –19–04NOV02–9/9

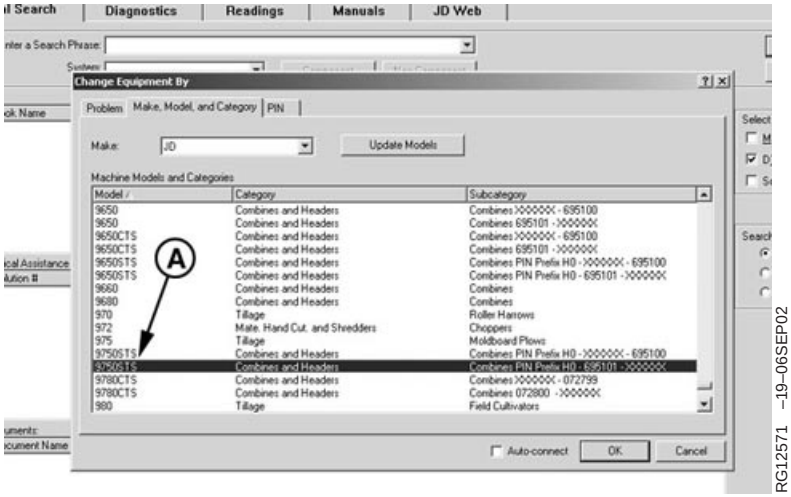
## Downloading Payload File For SERVICE ADVISOR™

*NOTE: An Internet connection will be needed for steps 1 - 15.*

1. Start SERVICE ADVISOR™

*SERVICE ADVISOR is a trademark of Deere & Company*

RG41221,0000094 –19–04NOV02–1/16

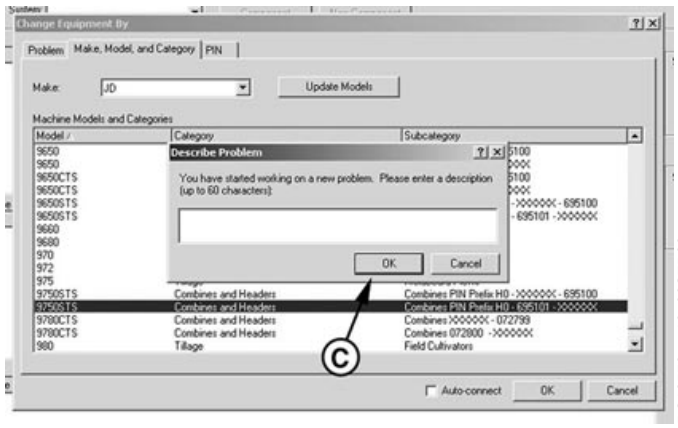



RG12571 –19–06SEP02

2. Select vehicle model (A) with the proper serial number range or if PIN is known select the PIN tab and enter PIN number. Click OK.

Continued on next page

RG41221,0000094 –19–04NOV02–2/16




3. Describe Problem window will appear, click OK (C).

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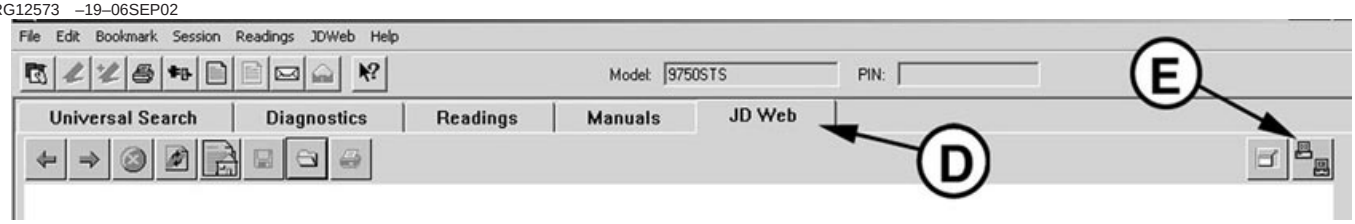
40

RG41221,0000094 –19–04NOV02–3/16

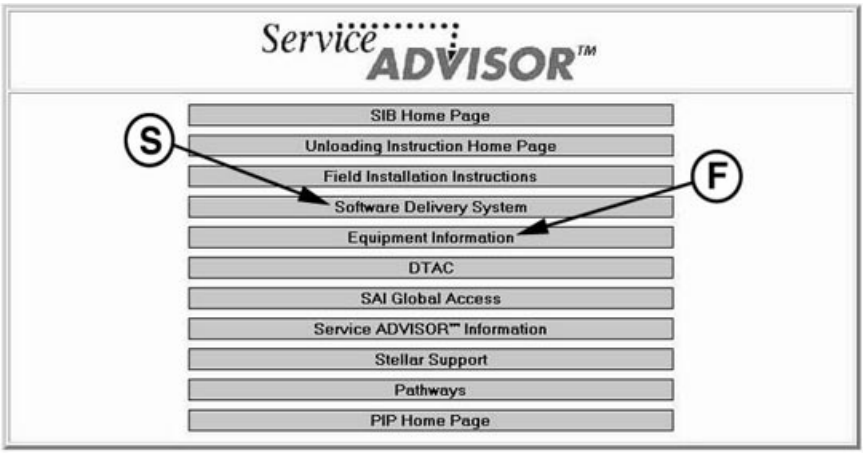
RG12573 –19–06SEP02




4. Click on “JD Web” tab (D). In the upper right hand corner click on “Connect to Network” button (E). Select network connection type and click OK.

**Continued on next page**

RG41221,0000094 –19–04NOV02–4/16



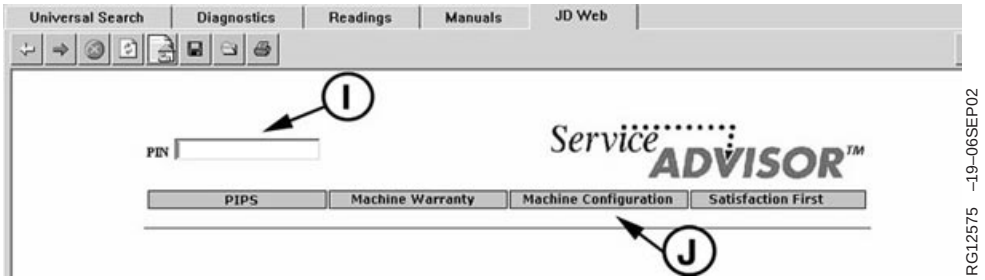

*NOTE: Menu options may vary on the SERVICE ADVISOR™ menu.*

5. If the Engine Serial number (ESN) is available click on "Software Delivery System" button (S) and skip to step 10. With the PIN number only available click on "Equipment Information" (F) button.

04
160
41

*SERVICE ADVISOR is a trademark of Deere & Company*

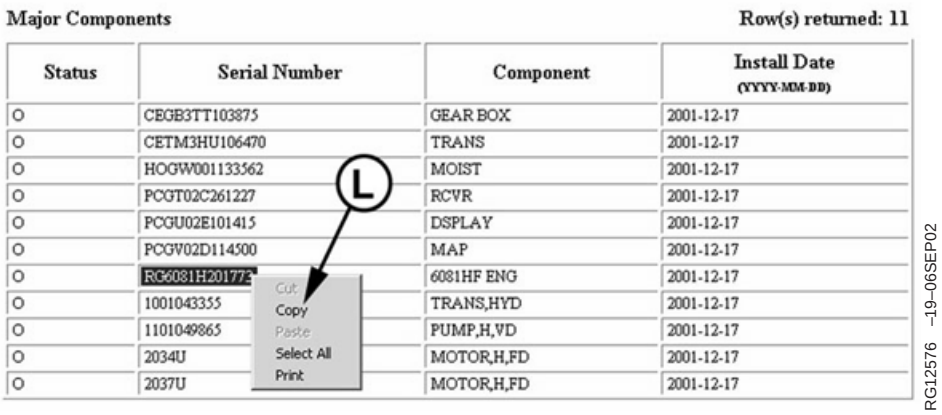
RG41221,0000094 –19–04NOV02–5/16




6. Enter PIN number (I) if not already filled in, and select “Machine Configuration” (J). Equipment detail information for this vehicle will appear on the screen.

**Continued on next page**

RG41221,0000094 –19–04NOV02–6/16

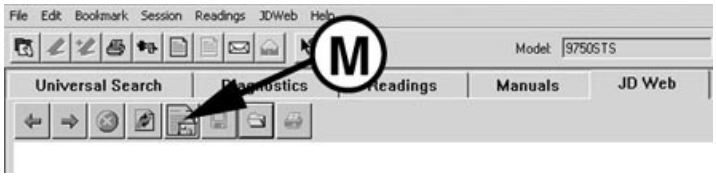



7. Hold left mouse button down and drag across the ESN so that it is highlighted. Click the right mouse button and select "Copy" (L) or record the ESN for later use.

04
160
42

RG41221,0000094 –19–04NOV02–7/16

RG12577 –19–06SEP02

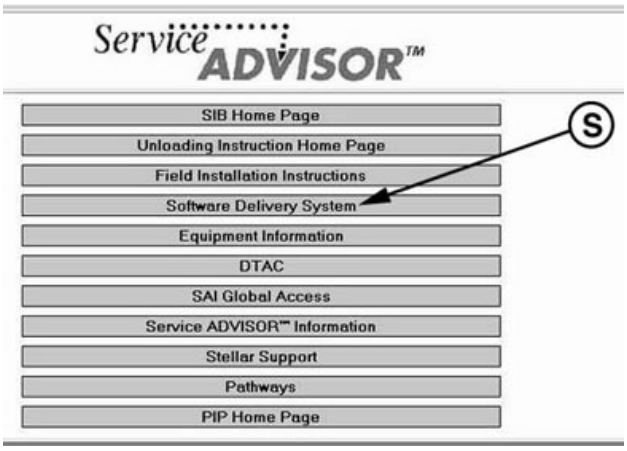



8. Click on the “Home” button (M) within SERVICE ADVISOR™ to go back to the menu.

*SERVICE ADVISOR is a trademark of Deere & Company*

RG41221,0000094 –19–04NOV02–8/16

9. Click on “Software Delivery System” button (S). Login if necessary.

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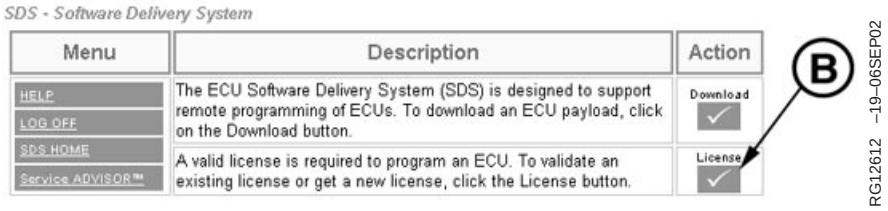
RG41221,0000094 –19–04NOV02–9/16




*Obtaining Valid License*


*Validating License*

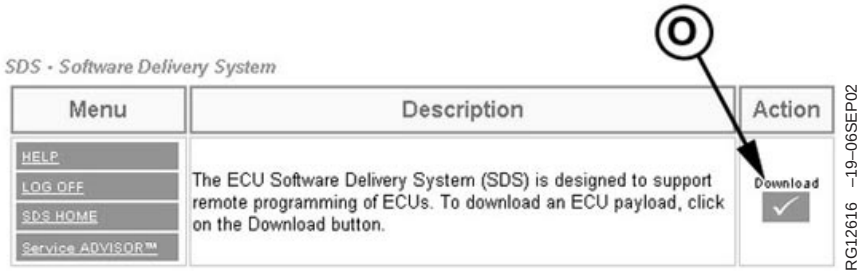



*Figure B*

*NOTE: Steps 10 - 12 only need to be completed the first time this instruction is performed.*

10. A license file is required for each computer that will reprogram ECUs. Download the license file to gain permissions. Click on “License” (B). A screen will appear while validating license. If the screen appears as “Figure B” allowing the option to download only, then skip to Step 13.

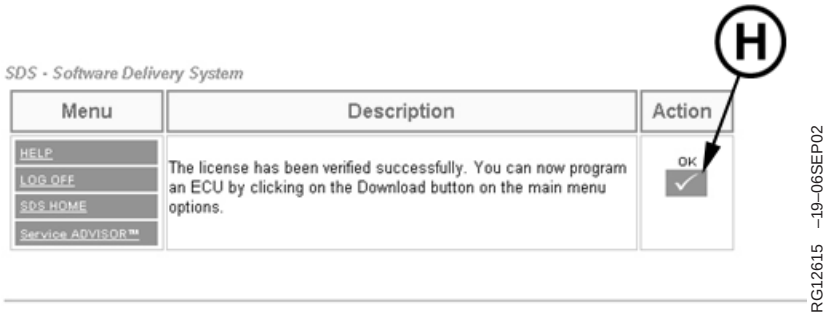
**Continued on next page**

RG41221,0000094 –19–04NOV02–10/16


11. Click on “Grant Always” (G).



RG41221,0000094 –19–04NOV02–11/16




12. Click “OK” (H) when license verification has been completed.

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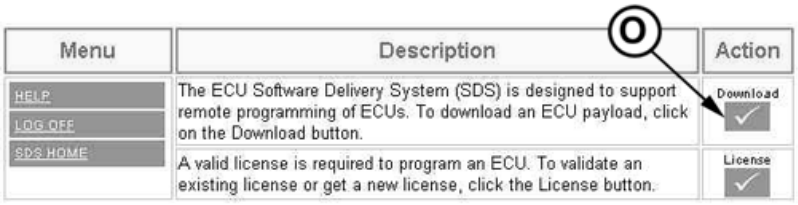
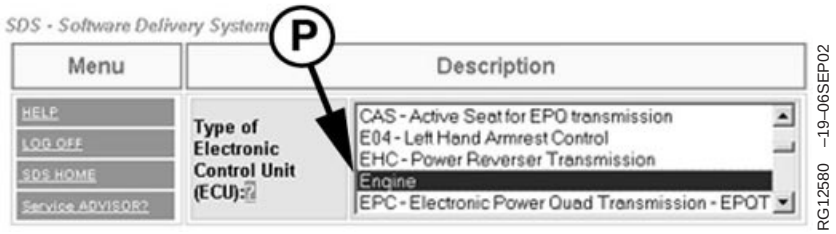
RG41221,0000094 –19–04NOV02–12/16




13. Click on “Download” button (O). A screen will appear as the system verifies that a valid license file is present.

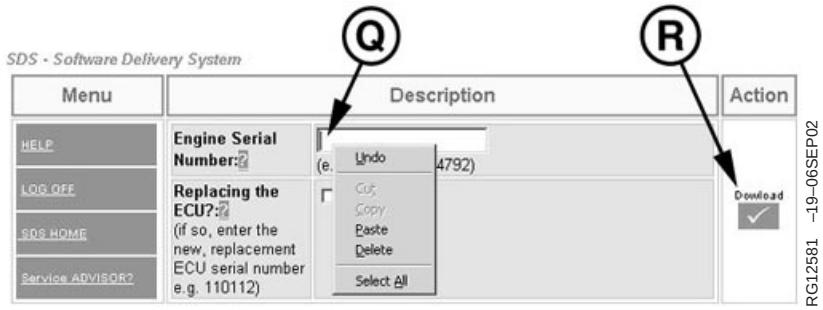


RG41221,0000094 –19–04NOV02–13/16




14. Scroll down and click on “Engine” (P).

RG41221,0000094 –19–04NOV02–14/16

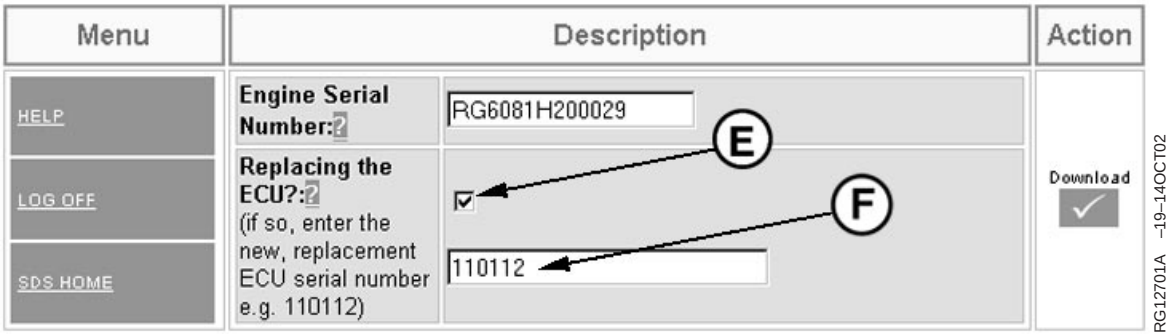



15. Click once in the ESN text box (Q) so the cursor is in the box. Type in the ESN or Right click and select "Paste" to copy the ESN into the text field.

If you are replacing the ECU, go to step 16. If you reprogramming the existing ECU, click "Download" (R) and go to step 18.

Continued on next page

RG41221,0000094 –19–04NOV02–15/16




*Replacing ECU*

16. If the current machine is being replaced, check the "Replacing the ECU" box (E).

*NOTE: Sometimes the original ECU will not be available for reprogramming. When a new ECU is being programmed to replace the current ECU, the software will tie the engine serial number to the new ECU serial number.*

17. Enter in the new ECU's serial number (F) located on the ECU label and click "Download".

**IMPORTANT: Service ADVISOR™ software must be closed and reopened prior to programming the ECU.**

18. After downloading the ECU payload to the computer, exit SERVICE ADVISOR™

*SERVICE ADVISOR is a trademark of Deere & Company*

RG41221,0000094 –19–04NOV02–16/16

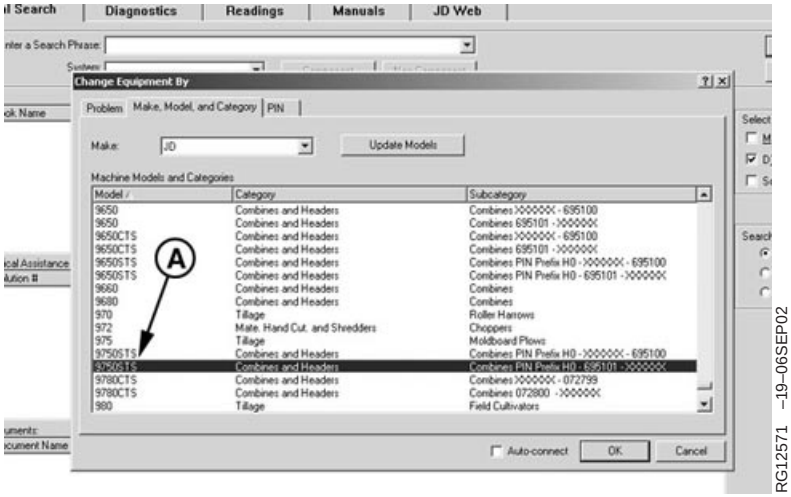
## Reprogramming Engine Control Unit (ECU) With SERVICE ADVISOR™

**IMPORTANT: Ignition ON, engine OFF.**

Connect computer with SERVICE ADVISOR™to the Diagnostic Connector in the cab or on the engine.

*SERVICE ADVISOR is a trademark of Deere & Company*

RG41221,0000099 –19–04NOV02–1/8




RG12571 –19–06SEP02

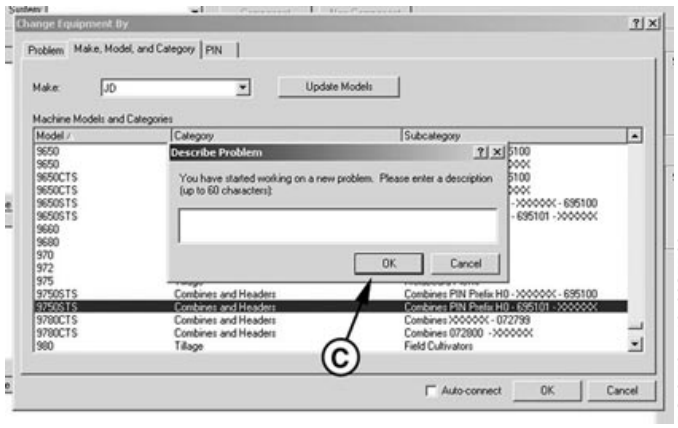
*NOTE: Internet connection is not required to program an engine control unit.*

1. Start SERVICE ADVISOR™. Select vehicle model (A) with the proper serial number range or if PIN is known select the PIN tab and enter PIN number. Click OK.

*SERVICE ADVISOR is a trademark of Deere & Company*

**Continued on next page**

RG41221,0000099 –19–04NOV02–2/8




2. Describe Problem window will appear, click OK (C).

04
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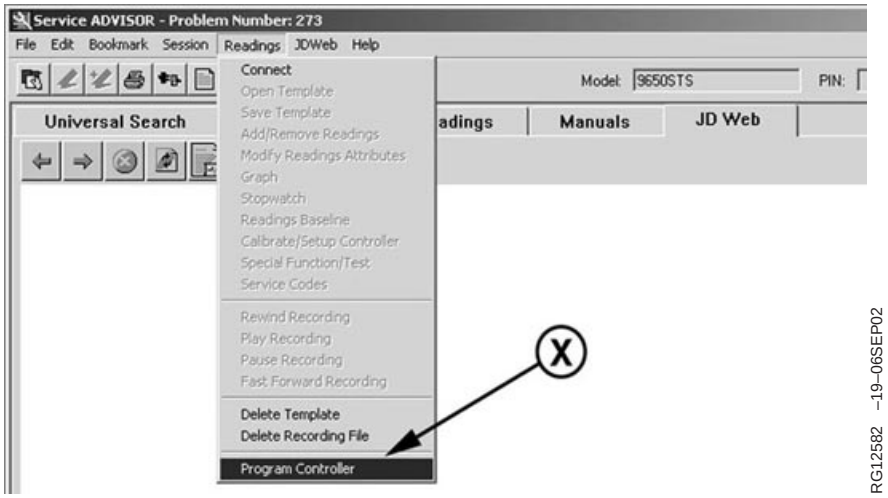
48

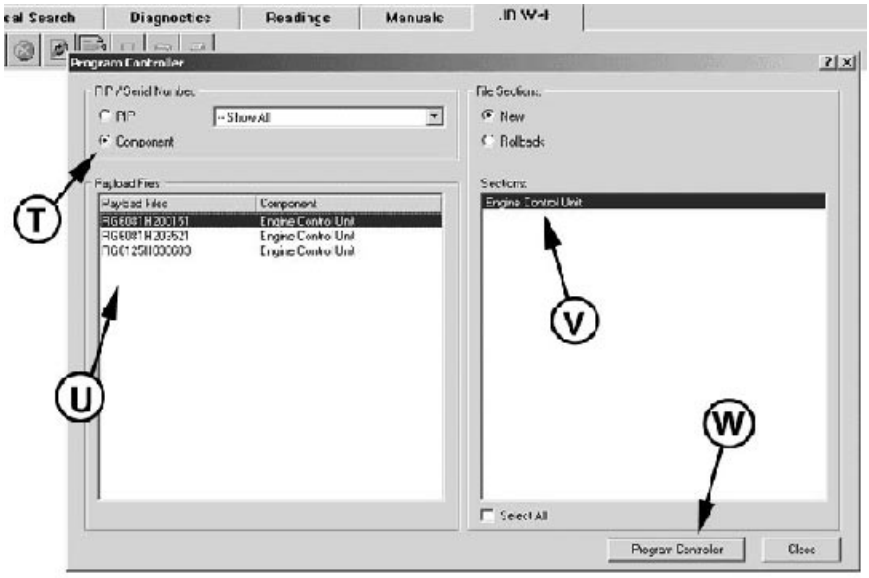
RG41221,0000099 –19–04NOV02–3/8




3. Click on “Readings” pull down menu and select “Program Controller” (X).

Continued on next page

RG41221,0000099 –19–04NOV02–4/8

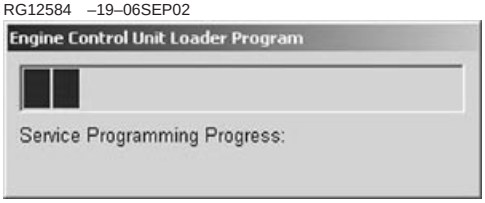



RG12583 –19–06SEP02

4. Select radio button for "Component" (T). Select the proper payload file for engine ECU (U).
5. Click once on "Engine Control Unit" (V) and click on "Program Controller" (W).

RG41221,0000099 –19–04NOV02–5/8

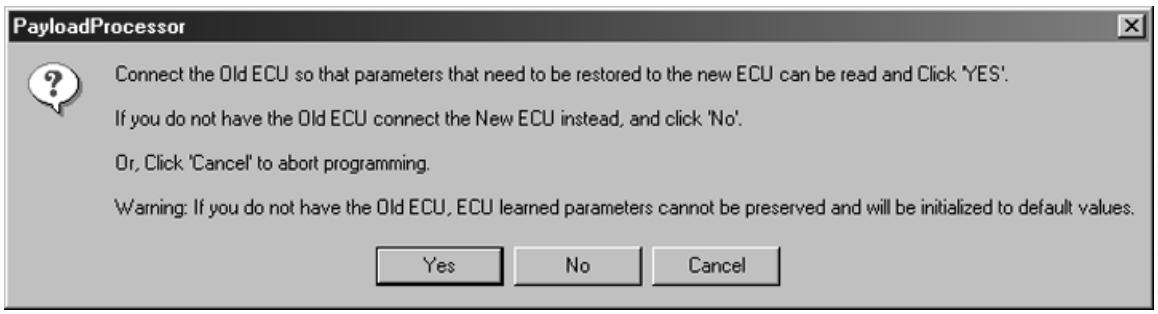
RG12584 –19–06SEP02




6. A progress bar will appear while reprogramming the ECU. The engine warning light may come on and a warning may sound while in process of reprogramming and should be ignored.

**Continued on next page**

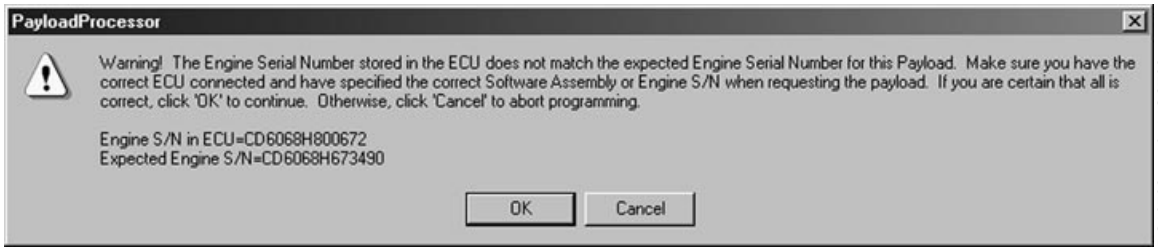
RG41221,0000099 –19–04NOV02–6/8




7. If the ECU is being replaced, the above message will appear. If you have the old ECU, connect to it and click YES. If the old ECU is not available, click NO.

04
160
50

RG41221,0000099 –19–04NOV02–7/8




8. If the ECU is being replaced, the software will notice that the engine serial number does not match the ECU serial number. This message lets the user know that the ECU expects a different engine serial number to match its ECU serial number. Click “OK” to continue.
9. Disconnect computer from diagnostic connector and start vehicle to ensure proper operation.

RG41221,0000099 –19–04NOV02–8/8

## Diagnostic Trouble Codes (DTCs)

There are several different methods of displaying both stored and active DTCs from the ECU.

### 2-DIGIT CODES

Most John Deere applications display DTCs as a 2-digit or a 3-digit code read from an on-board display. To translate 2-digit or 3-digit codes into SPN/FMI code for diagnosing, see LISTING OF DIAGNOSTIC TROUBLE CODES (DTCS) ON ECU - Ascending 2-Digit/3-Digit Codes later in this Group.

### SPN/FMI CODES

SPN/FMI codes are written from the SAE J1939 standard as a two part code. The first part is called the Suspect Parameter Number (SPN). Typically, it contains between 2 and 4 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. The FMI identifies the type of failure that has occurred; for example FMI 3 indicates value above normal. In order to determine the exact failure, both the SPN and FMI are required. Combining SPN 110 with FMI 3 yields engine coolant temperature input voltage high.

On all applications with the Level 4 Engine Control Unit (ECU), the ECU transmits SPN/FMI codes over the Controller Area Network (CAN). This allows for service tools such as the DST, SERVICE ADVISOR™, and the Diagnostic Gauge to display active and stored DTCs. When using DST or SERVICE ADVISOR™ the codes will be displayed in a 000000.00 format. For example, SPN 110 FMI 3 will be displayed as 000110.03.

### WARNING LAMP

On some applications, there is a warning lamp (also referred to as the “Air Heater Indicator” light) that is used when a code becomes active. When a code is active, this lamp will either blink or stay on solid. A solid light indicates that the ECU is taking extreme measures to protect the engine. A blinking light indicates that the ECU has detected a fault and engine performance may be affected.

### CLEARING STORED DTCS

Stored DTCs can be cleared through the OEM instrument panel, through the Diagnostic Scan Tool (DST) or SERVICE ADVISOR™. For more information on clearing DTCs using the diagnostic code reader on the instrument panel, see CLEARING STORED DTCS ON DIAGNOSTIC GAUGE earlier in this Group.

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*SERVICE ADVISOR*

DPSG,RG40854,467 –19–21OCT02–1/1

# Listing of Diagnostic Trouble Codes (DTCs) on ECU

## Ascending SPN/FMI Codes

**DTC's Listing in Ascending SPN/FMI Codes**

| SPN | FMI | 2-Digit Code | Definition |
|---|---|---|---|
| 000028 | 03 | 13 | Throttle Volts High |
| | 04 | 14 | Throttle Volts Low |
| 000029 | 03 | 15 | Throttle Volts High |
| | 04 | 16 | Throttle Volts Low |
| 000084 | 02 | 91 | Vehicle Speed Mismatch |
| 000091 | 03 | 11 | Throttle Volts High |
| | 04 | 12 | Throttle Volts Low |
| | 09 | | Throttle Invalid |
| 000094 | 01 | 58 | Fuel Supply Pressure Extremely Low |
| | 03 | 27 | Fuel Supply Pressure Input Voltage High |
| | 04 | 28 | Fuel Supply Pressure Input Voltage Low |
| | 18 | 57 | Fuel Supply Pressure Moderately Low |
| 000097 | 00 | | Water in Fuel Continuously Detected |
| | 16 | | Water in Fuel Detected |
| 000100 | 01 | 75 | Engine Oil Pressure Extremely Low |
| | 03 | 23 | Engine Oil Pressure Input Voltage High |
| | 04 | 24 | Engine Oil Pressure Input Voltage Low |
| | 18 | 74 | Engine Oil Pressure Moderately Low |
| 000105 | 00 | 56 | Manifold Air Temperature Extremely High |
| | 03 | 25 | Manifold Air Temperature Input Voltage High |
| | 04 | 26 | Manifold Air Temperature Input Voltage Low |
| | 16 | 55 | Manifold Air Temperature Moderately High |
| 000107 | 00 | | Air Filter Differential Pressure |
| 000110 | 00 | 63 | Engine Coolant Temperature Extremely High |
| | 03 | 18 | Engine Coolant Temperature Input Voltage High |
| | 04 | 19 | Engine Coolant Temperature Input Voltage Low |
| | 15 | 61 | Engine Coolant Temperature High Least Severe |
| | 16 | 62 | Engine Coolant Temperature Moderately High |
| 000111 | 01 | 64 | Engine Coolant Level Low |
| 000158 | 17 | 54 | ECU Power Down Error |
| 000174 | 00 | 67 | Fuel Temperature High Most Severe |
| | 15 | 33/53 | Fuel Temperature High Least Severe |
| | 16 | 71 | Fuel Temperature High Moderately Severe |
| | 31 | 98 | Fuel Temperature Sensor Faulty |
| 000189 | 00 | | Engine Speed Derate |
| | 31 | 48 | Engine Speed Derate |
| 000190 | 00 | 42 | Engine Overspeed Extreme |
| | 16 | 42 | Engine Overspeed Moderate |
| 000620 | 03 | 21 | Sensor Supply Voltage High |
| | 04 | 22 | Sensor Supply Voltage Low |
| 000627 | 04 | 76 | ECU Unswitched Power Missing |
| 000629 | 13 | 34 | ECU Error |
| | 19 | 34 | ECU to Pump Communication Error |
| 000632 | 02 | 37 | Fuel Shutoff Error |
| | 05 | 86 | Fuel Shutoff Non-Functional |
| 000636 | 02 | 44 | Pump Position Input Noise |
| | 08 | 43 | Pump Position Input Missing |
| | 10 | 44 | Pump Position Input Pattern Error |

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Continued on next page

| | | | |
|---|---|---|---|
| 000637 | 02 | 39 | Crank Position Input Noise |
| | 08 | 38 | Crank Position Input Missing |
| | 10 | 39 | Crank Position Input Pattern Error |
| 000729 | 03 | | Inlet Air Heater Signal High |
| | 05 | | Inlet Air Heater Signal Low |
| 000810 | 02 | 92 | Calculated Vehicle Speed Input Noise |
| 000898 | 09 | 77 | Vehicle Speed Invalid/Missing |
| 000970 | 02 | | Auxiliary Engine Shutdown Switch Signal Invalid |
| | 31 | 83 | Auxiliary Engine Shutdown Switch Active |
| 000971 | 31 | 84 | External Engine Derate Switch Active |
| 001069 | 02 | 93 | Tire Size Error |
| 001076 | 02 | 66 | Pump Detected Defect |
| 001077 | 07 | 35 | Attempting to Fuel Without Command |
| | 11 | 68 | Pump Supply Voltage Out of Range |
| | 12 | 97 | Pump Self Test Error |
| | 19 | 96 | Pump Detected Communication Error |
| | 31 | 36 | Pump Initiated Engine Protection |
| 001078 | 07 | 95 | ECU/Pump Timing Moderately Out of Sync |
| | 11 | 87 | ECU/Pump Speed Out of Sync |
| | 31 | 94 | ECU/Pump Timing Extremely Out of Sync |
| 001079 | 03 | 21 | Sensor Supply 1 Voltage High |
| | 04 | 22 | Sensor Supply 1 Voltage Low |
| 001080 | 03 | 51 | Sensor Supply 2 Voltage High |
| | 04 | 52 | Sensor Supply 2 Voltage Low |
| 001109 | 31 | | Engine Shutdown Warning |
| 001110 | 31 | 82 | Engine Shutdown |
| 001485 | 02 | 89 | Pump Power Relay Fault |
| 001569 | 31 | 47 | Fuel Derate |
| 002000 | 13 | | Security Violation |



**Continued on next page**

## Ascending 2-Digit Codes

**DTC's Listing in Ascending 2-Digit Codes**

| 2-Digit Code | SPN | FMI | Definition |
|---|---|---|---|
| 11 | 000091 | 03 | Throttle Volts High |
| 12 | 000091 | 04 | Throttle Volts Low |
| 13 | 000028 | 03 | Throttle Volts High |
| 14 | 000028 | 04 | Throttle Volts Low |
| 15 | 000029 | 03 | Throttle Volts High |
| 16 | 000029 | 04 | Throttle Volts Low |
| 18 | 000110 | 03 | Engine Coolant Temperature Input Voltage High |
| 19 | 000110 | 04 | Engine Coolant Temperature Input Voltage Low |
| 21 | 001079 | 03 | Sensor Supply 1 Voltage High |
| 22 | 001079 | 04 | Sensor Supply 1 Voltage Low |
| 23 | 000100 | 03 | Engine Oil Pressure Input Voltage High |
| 24 | 000100 | 04 | Engine Oil Pressure Input Voltage Low |
| 27 | 000094 | 03 | Fuel Supply Pressure Input Voltage High |
| 28 | 000094 | 04 | Fuel Supply Pressure Input Voltage Low |
| 31 | 001080 | 03 | Sensor Supply 2 Voltage High |
| 32 | 001080 | 04 | Sensor Supply 2 Voltage Low |
| 32 | NA[a] | NA[a] | When reading blink codes, signifies start of active fault codes. |
| 33 | 000174 | 15 | Fuel Temperature High Least Severe |
| 33 | NA[a] | NA[a] | When reading blink codes, signifies start of previously active fault codes. |
| 34 | 000629 | 19 | ECU to Pump Communication Error |
| 35 | 001077 | 07 | Attempting to Fuel Without Command |
| 36 | 001077 | 31 | Pump Initiated Engine Protection |
| 37 | 000632 | 02 | Fuel Shutoff Error |
| 38 | 000637 | 08 | Crank Position Input Missing |
| 39 | 000637 | 02/10 | Crank Position Input Noise/Crank Position Input Pattern Error |
| 42 | 000190 | 00/16 | Engine Overspeed Extreme/Engine Overspeed Moderate |
| 43 | 000636 | 08 | Pump Position Input Missing |
| 44 | 000636 | 02/10 | Pump Position Input Noise/Event Sensor Input Pattern Error |
| 47 | 001569 | 31 | Fuel Derate |
| 48 | 000189 | 31 | Engine Speed Derate |
| 53 | 000174 | 15 | Fuel Temperature High Least Severe |
| 54 | 000158 | 17 | ECU Power Down Error |
| 57 | 000094 | 18 | Fuel Supply Pressure Moderately Low |
| 58 | 000094 | 01 | Fuel Supply Pressure Extremely Low |
| 61 | 000111 | 01 | Engine Coolant Level Low |
| 62 | 000110 | 16 | Engine Coolant Temperature Moderately High |
| 63 | 000110 | 00 | Engine Coolant Temperature Extremely High |
| 66 | 001076 | 02 | Pump Detected Defect |
| 67 | 000174 | 00 | Fuel Temperature High Most Severe |
| 68 | 001077 | 11 | Pump Supply Voltage Out of Range |
| 71 | 000174 | 16 | Fuel Temperature High Moderately Severe |
| 74 | 000100 | 18 | Engine Oil Pressure Moderately Low |
| 75 | 000100 | 01 | Engine Oil Pressure Extremely Low |
| 76 | 000627 | 04 | ECU Unswitched Power Missing |
| 77 | 000898 | 09 | Vehicle Speed Invalid/Missing |
| 86 | 000632 | 05 | Fuel Shutoff Error |
| 87 | 001078 | 11 | ECU/Pump Engine Speed Out of Sync |
| 88 | NA[a] | NA[a] | When reading blink codes, signifies that no fault codes are in buffer. |
| 89 | 001485 | 02 | Pump Power Relay Fault |

[a]Not Applicable

Continued on next page

| | | | |
|---|---|---|---|
| 91 | 000084 | 02 | Vehicle Speed Mismatch |
| 92 | 000810 | 02 | Calculated Vehicle Speed Input Signal Noise |
| 93 | 001069 | 02 | Tire Size Error |
| 94 | 001078 | 31 | ECU/Pump Timing Extremely Out of Sync |
| 95 | 001078 | 07 | ECU/Pump Timing Moderately Out of Sync |
| 96 | 001077 | 19 | Pump Detected Communication Error |
| 97 | 001077 | 12 | Pump Self Test Error |
| 98 | 000174 | 31 | Fuel Temperature Sensor Faulty |

RG41221,0000130 –19–11MAY01–4/4

## Diagnostic Procedure

Diagnosis of the electronic control system should be performed according to the following procedure:

1. Make sure all engine mechanical and other systems not related to the electronic control system are operating properly.

2. Read and record DTC(s).

3. Go to the diagnostic chart that corresponds to the DTC(s) present.

*NOTE: If more than one DTC is present, go to the chart corresponding to the lowest number DTC and diagnose that problem to correction unless directed to do otherwise.*

4. If no DTC(s) are present, proceed to the appropriate symptom diagnostic chart in Group 150 of this Section.

5. After any repairs are made, recheck to make sure all DTCs have been eliminated.

*NOTE: After using the DST or SERVICE ADVISOR™, always replace the dust cap on the diagnostic connector.*

**IMPORTANT: Care should be used during diagnostic procedures to avoid damaging the terminals of connectors, sensors, and actuators. Probes should not be poked into or around the terminals or damage will result. Probes should only be touched against the terminals to make measurements. It is recommended that JT07328 Connector Adapter Test Kit be used to make measurements in connectors, sensors, and actuators. These adapters will ensure that terminal damage does not occur.**

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RG,RG34710,1564 –19–30SEP97–1/1

## Intermittent Fault Diagnostics

Intermittent faults are problems that periodically "go away". A problem such as a loose terminal that intermittently doesn't make contact is a likely cause of an intermittent fault. Other intermittent faults may be set only under certain operating conditions such as heavy load, extended idle, etc. When diagnosing intermittent faults, take special note of the condition of wiring and connectors since a high percentage of intermittent problems originate here. Check for loose, dirty, or disconnected connectors. Inspect the wiring routing looking for possible shorts caused by contact with external parts (for example, rubbing against sharp sheet metal edges). Inspect the connector vicinity looking for wires that have 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. Use good judgement if component replacement is thought to be required.

*NOTE: The ECU is the component LEAST likely to fail.*

**Suggestions for diagnosing intermittent faults:**

- If diagnostic chart indicates that the problem is intermittent, try to reproduce the operating conditions that were present when the DTC set. The Diagnostic Scan Tool (DST) or SERVICE ADVISOR™ can be used to help locate intermittent problems, as it includes a function called Recording. This 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 parameters' 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 the DST or SERVICE ADVISOR™ to see if the fault resets.
- To check the connection between the harness and a sensor or the harness and the ECU, use JT07328 Connector Adapter Test Kit. Insert the male end of the appropriate test adapter into the female end of the ECU or sensor connector terminal. There should be moderate resistance when the test adapter is inserted into the terminal. If the connection is loose, replace the female terminal.

**Possible Causes of Intermittent Faults:**

- 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 faulty signals to be sent to the ECU.
- Faulty ground feedback problems.

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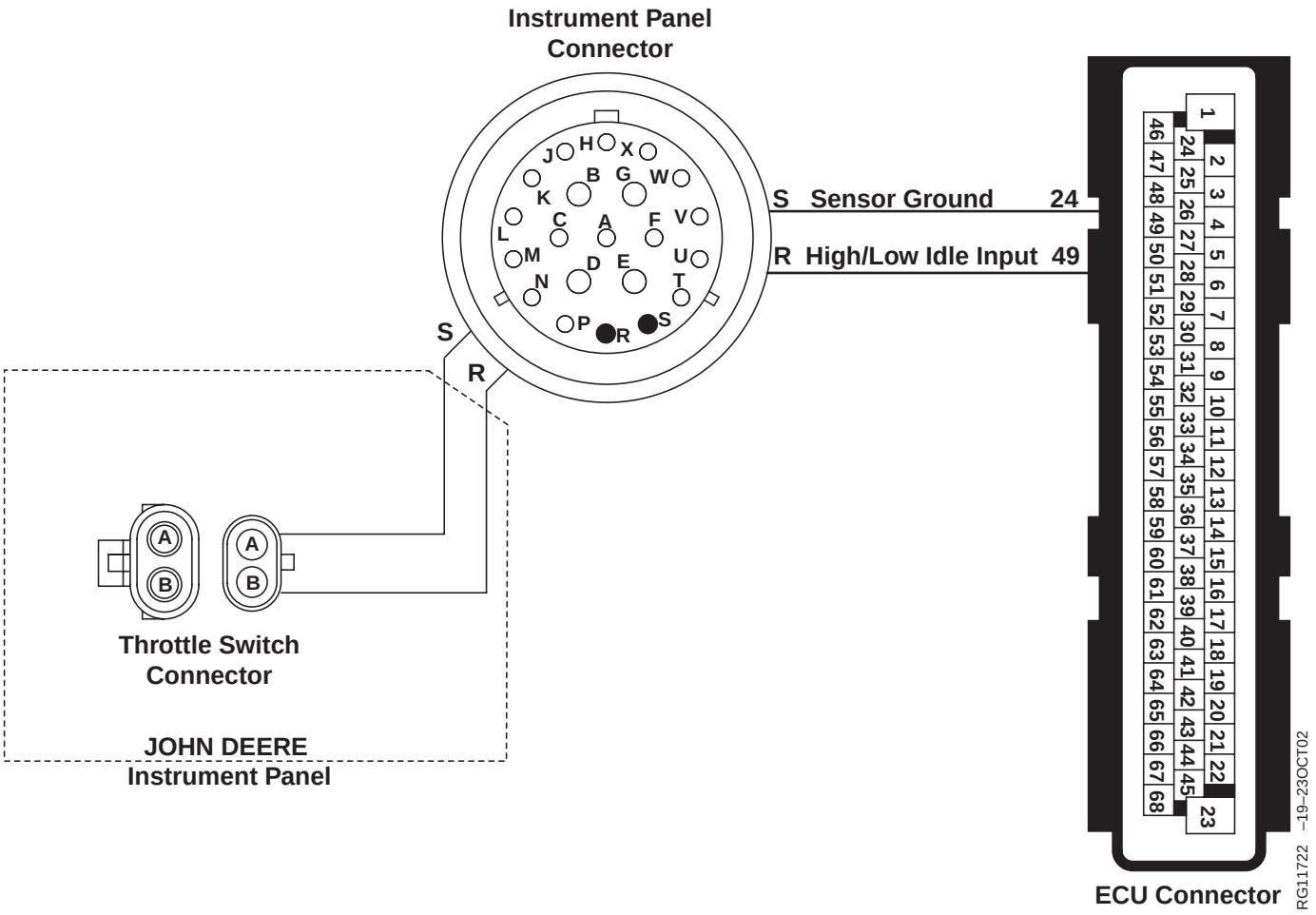
## T1 - Multi-state Throttle Input High






**Multi-state Throttle Switch**

- The multi-state throttle is used when a few fixed engine speeds are desired. Multi-state throttle is composed of an idle switch that allows engine speed to be at high or low idle. On some applications, there is a bump up and a bump down feature. This allows for high and low idle to be controlled. There are three types of multi-state throttles; Dual-state, Tri-state, and Ramp. All of these throttles are wired exactly the same. The only difference is the actual switch that is used to control the engine speed. For information on each of these throttles, see MEASURING THROTTLE POSITION in Section 03, Group 140 earlier in this manual.
- On certain applications, an additional throttle is used in addition to the multi-state throttle. If the desired engine speed of the additional throttle is greater than the multi-state throttle, the multi-state throttle will be overridden. When the desired engine speed of the multi-state throttle is greater than the additional throttle, the multi-state throttle will be in total control.

**This code will set if:**

- The multi-state throttle input voltage exceeds the maximum threshold. The voltage is higher than what is physically possible for the throttle lever to achieve.

**If this code sets, the following will occur:**

- If more than one throttle is available, the ECU will ignore the input from the multi-state throttle, and will use the input values from another throttle.

Continued on next page

- If the multi-state throttle is the only throttle or all additional throttles are also faulted, the ECU will use a default “limp-home” throttle value that will only allow idle engine speed.

RG41221,0000135 –19–21OCT02–2/2

## T1 - Multi-state Throttle Input High

RG41221,0000136 –19–27APR02–1/1

## T1 - Multi-State Throttle Input High Diagnostic Procedure

– – –1/1



| | | |
|---|---|---|
| ❶ **Connection Check** | **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.**<br><br>*NOTE: For wiring and theory of operation, see T1 - MULTI-STATE THROTTLE INPUT HIGH supporting information.*<br><br>Before using this diagnostic procedure, perform a preliminary inspection of the ECU connectors and the multi-state throttle connector looking for dirty, damaged, or poorly positioned terminals. | **No faulty connection(s):** GO TO ❷<br><br>**Faulty connection(s):** Repair faulty connection(s). |

– – –1/1

| | | |
|---|---|---|
| ❷ **Intermittent Fault Test** | *NOTE: For wiring and theory of operation, see T1 - MULTI-STATE THROTTLE INPUT HIGH supporting information.*<br><br>1. Connect the DST or SERVICE ADVISOR™. For instructions on connecting to the DST or SERVICE ADVISOR™, see CONNECTING TO DIAGNOSTIC SCAN TOOL (DST) OR SERVICE ADVISOR™ earlier in this Group.<br>2. Ignition ON, engine OFF<br>3. Start the ECU diagnostic software<br>4. Make note of any DTCs, then clear all DTCs.<br>5. Ignition ON, engine OFF<br>6. Move the multi-state switch through all the positions.<br>7. Read DTCs using DST or SERVICE ADVISOR™. | **000091.03 reoccurs:** GO TO ❸<br><br>**000091.03 does not reoccur:** Problem is intermittent. If no other codes are present, see INTERMITTENT FAULT DIAGNOSTICS earlier in this Group. |

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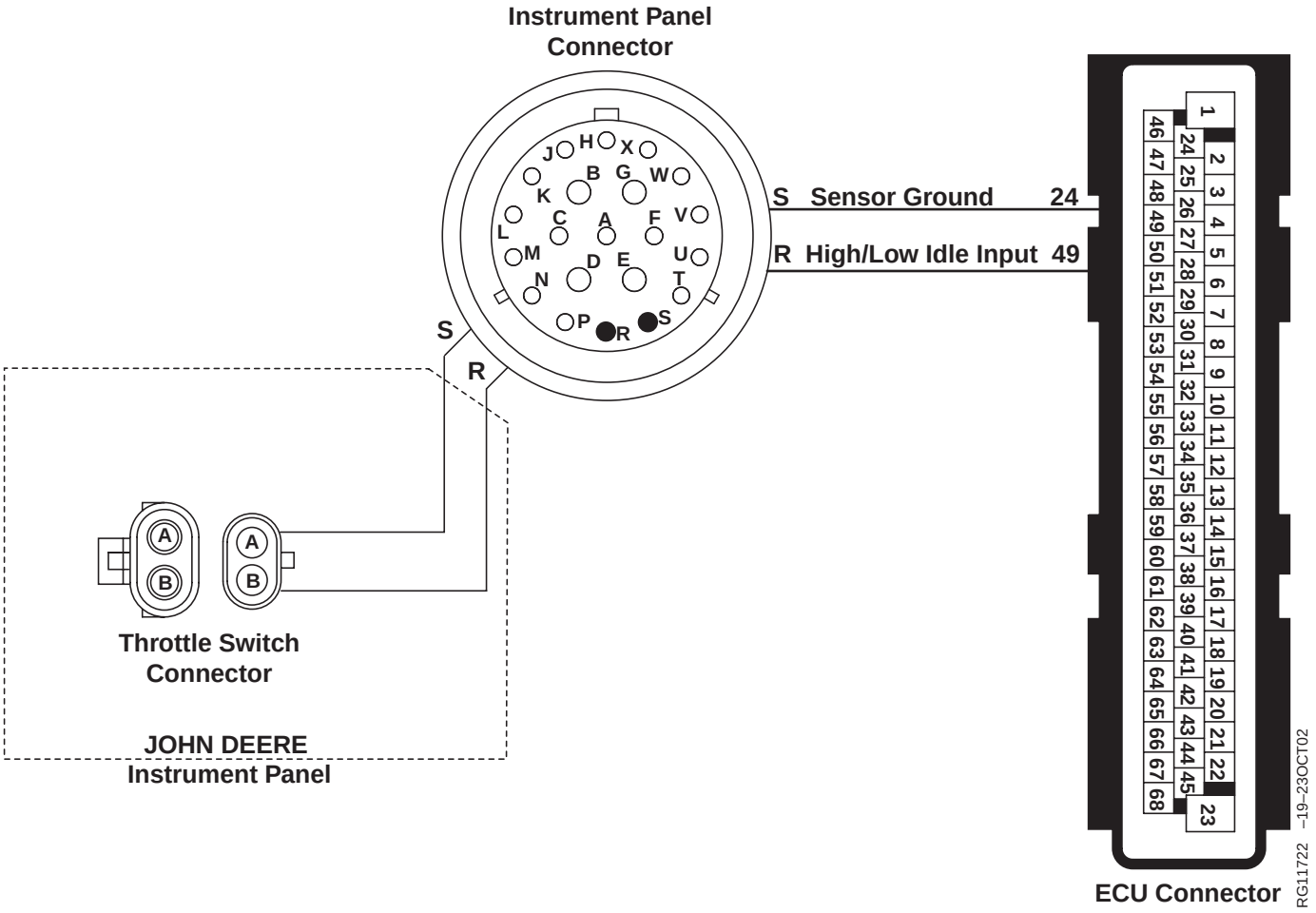
| | | |
|---|---|---|
| ❸ **Throttle Position Input Shorted Test** | *NOTE: For wiring and theory of operation, see T1 - MULTI-STATE THROTTLE INPUT HIGH supporting information.*<br><br>1. Ignition OFF<br><br>2. Disconnect multi-state throttle switch at two wire connector behind instrument panel.<br><br>3. Install a jumper wire between both terminals of the switch harness connector.<br><br>4. Make note of any DTCs, then clear all DTCs<br><br>5. Ignition ON, engine OFF<br><br>6. Using the ECU diagnostic software, read DTCs | **000091.03 reoccurs:** GO TO ❹<br><br>**000091.04 occurs:** Faulty multi-state throttle switch connector<br>OR<br>Faulty multi-state throttle switch<br><br>– – –1/1 |

| | | |
|---|---|---|
| ❹ **Throttle Position Ground Circuit Open Test** | *NOTE: For wiring and theory of operation, see T1 - MULTI-STATE THROTTLE INPUT HIGH supporting information.*<br><br>1. Ignition OFF<br><br>2. Remove jumper wire.<br><br>3. Ignition ON, engine OFF<br><br>4. Using a multimeter, measure voltage between multi-state switch 5 V input terminal (terminal B) and a good chassis ground. | **4.0 - 6.0 volts:**<br>Open in multi-state switch ground circuit<br>OR<br>Faulty ECU connection<br>OR<br>Faulty ECU<br><br>**Below 4.0 volts:**<br>Open in multi-state switch 5 V input circuit<br>OR<br>Faulty ECU connection<br>OR<br>Faulty ECU<br><br>– – –1/1 |

## T2 - Multi-state Throttle Input Low

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**Multi-state Throttle Switch**

- The multi-state throttle is used when a few fixed engine speeds are desired. Multi-state throttle is composed of an idle switch that allows engine speed to be at high or low idle. On some applications, there is a bump up and a bump down feature. This allows for high and low idle to be controlled. There are three types of multi-state throttles; Dual-state, Tri-state, and Ramp. All of these throttles are wired exactly the same. The only difference is the actual switch that is used to control the engine speed. For information on each of these throttles, see MEASURING THROTTLE POSITION in Section 03, Group 140 earlier in this manual.
- On certain applications, an additional throttle is used in addition to the multi-state throttle. If the desired engine speed of the additional throttle is greater than the multi-state throttle, the multi-state throttle will be overridden. When the desired engine speed of the multi-state throttle is greater than the additional throttle, the multi-state throttle will be in total control.

**This code will set if:**

- The multi-state throttle input voltage drops below the minimum threshold. The voltage is lower than what is physically possible for the throttle lever to achieve.

**If this code sets, the following will occur:**

- If more than one throttle is available, the ECU will ignore the input from the multi-state throttle, and will use the input values from another throttle.

Continued on next page
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- If the multi-state throttle is the only throttle or all additional throttles are also faulted, the ECU will use a default “limp-home” throttle value that will only allow idle engine speed.

RG41221,0000137 –19–21OCT02–2/2

## T2 - Multi-state Throttle Input Low

RG41221,0000138 –19–21OCT02–1/1

### T2 - Multi-State Throttle Input Low Diagnostic Procedure

– – –1/1



| | | |
|---|---|---|
| ❶ **Connection Check** | **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.**<br><br>*NOTE: For wiring and theory of operation, see T2 - MULTI-STATE THROTTLE INPUT LOW supporting information.*<br><br>Before using this diagnostic procedure, perform a preliminary inspection of the ECU connectors and the multi-state throttle connector looking for dirty, damaged, or poorly positioned terminals. | **No faulty connection(s):** GO TO ❷<br><br>**Faulty connection(s):** Repair faulty connection(s). |

– – –1/1

| | | |
|---|---|---|
| ❷ **Intermittent Fault Test** | *NOTE: For wiring and theory of operation, see T2 - MULTI-STATE THROTTLE INPUT LOW supporting information.*<br><br>1. Connect the DST or SERVICE ADVISOR™. For instructions on connecting to the DST or SERVICE ADVISOR™, see CONNECTING TO DIAGNOSTIC SCAN TOOL (DST) OR SERVICE ADVISOR™earlier in this Group.<br>2. Ignition ON, engine OFF<br>3. Start the ECU diagnostic software<br>4. Make note of any DTCs, then clear all DTCs.<br>5. Ignition ON, engine OFF<br>6. Move the multi-state switch through all the positions.<br>7. Read DTCs using DST or SERVICE ADVISOR™. | **000091.04 reoccurs:** GO TO ❸<br><br>**000091.04 does not reoccur:** Problem is intermittent. If no other codes are present, see INTERMITTENT FAULT DIAGNOSTICS earlier in this Group. |

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| | | |
|---|---|---|
| ❸ **Throttle Position Wiring Test** | *NOTE: For wiring and theory of operation, see T2 - MULTI-STATE THROTTLE INPUT LOW supporting information.*<br><br>1. Ignition OFF<br><br>2. Disconnect multi-state throttle switch at two wire connector behind instrument panel.<br><br>3. Make note of any DTCs, then clear all DTCs<br><br>4. Ignition ON, engine OFF<br><br>5. Using the ECU diagnostic software, read DTCs | **000091.04 reoccurs:**<br>Short to ground in multi-state input circuit<br>OR<br>Open in multi-state input circuit<br>OR<br>Faulty ECU<br><br>**000091.03 occurs:**<br>Faulty multi-state throttle switch connector<br>OR<br>Faulty multi-state throttle switch.<br><br>– – –1/1 |

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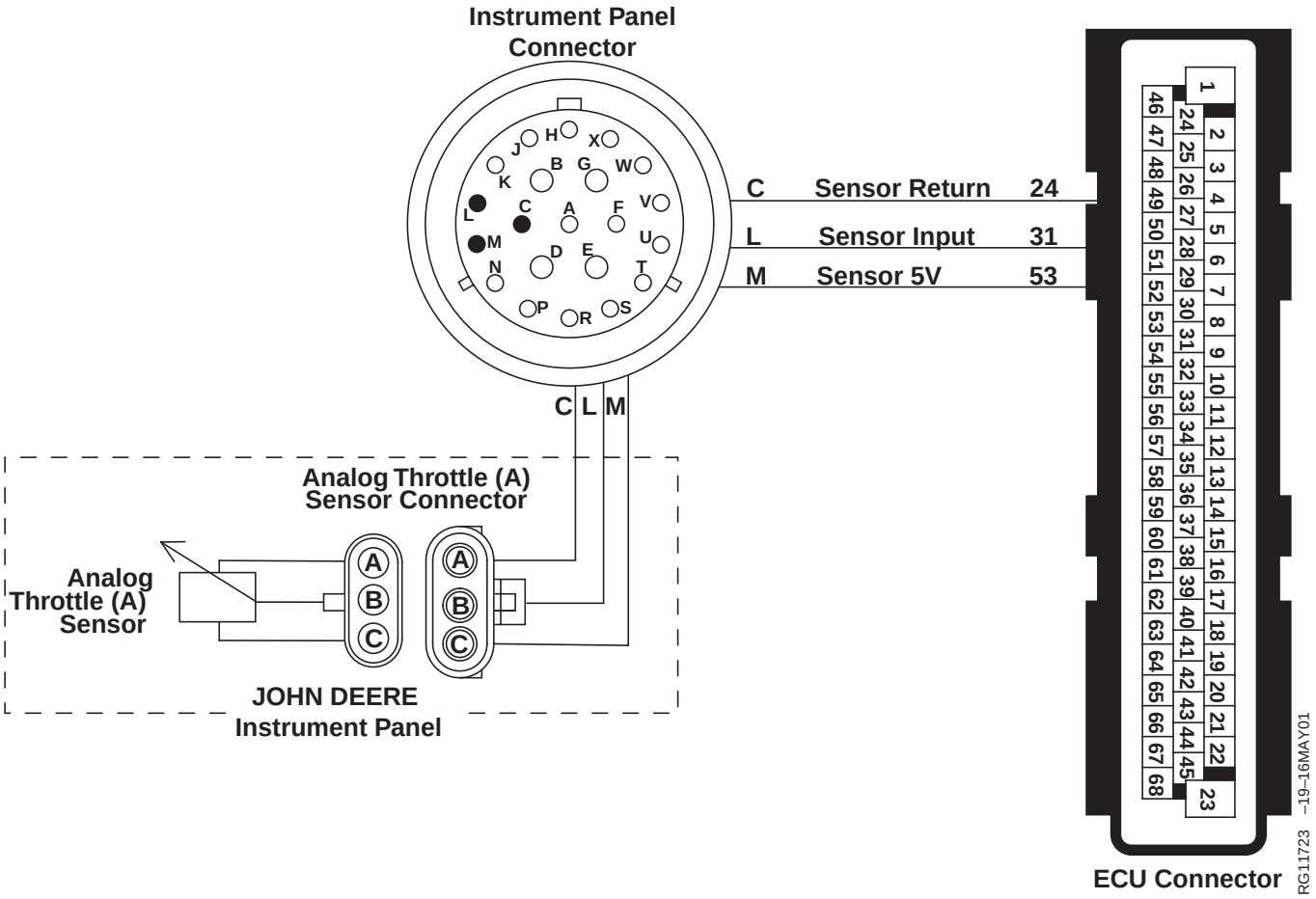
## T3 - Analog Throttle (A) Input High






*NOTE: Wiring schematic shows OEM engine applications only. For wiring information on other applications, see APPLICATION SPECIFICATIONS in Section 06, Group 210 of this manual.*

**Analog Throttle Position Sensor**

- The analog throttle position sensor is a variable resistor (potentiometer) used to measure the position of the throttle. The throttle input voltage normally varies between 1.0 and 4.0 volts depending on throttle position. Analog throttle voltage at low idle will be approximately 1.0 volt and 4.0 volts at high idle. The ECU has the ability to learn different voltages for low and high idle, so the voltages above may change depending on application.

**This code will set if:**

- The analog throttle (A) input voltage exceeds the sensor's high voltage specification. The voltage is higher than what is physically possible for the throttle lever to achieve.
  - For OEM applications, the analog throttle (A) input voltage specification is 4.7 volts.
  - For other applications, see APPLICATION SPECIFICATIONS in Section 06, Group 210 of this manual for the analog throttle (A) input voltage specification.

**If this code sets, the following will occur:**

- If more than one throttle is available, the ECU will ignore the input from the analog throttle, and will use the input values from another throttle.
- If the analog throttle is the only throttle or all additional throttles are also faulted, the ECU will use a default "limp-home" throttle value that will only allow idle engine speed.

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## T3 - Analog Throttle (A) Input High

RG41221,000013A –19–21OCT02–1/1

## T3 - Analog Throttle (A) Input High Diagnostic Procedure

– – –1/1

| | | |
|---|---|---|
| ❶ **Connection Check** | **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.**<br><br>*NOTE: For wiring and theory of operation, see T3 - ANALOG THROTTLE (A) INPUT HIGH supporting information.*<br><br>Before using this diagnostic procedure, perform a preliminary inspection of the ECU connectors and the analog throttle (A) connector looking for dirty, damaged, or poorly positioned terminals. | **No faulty connection(s):**<br>GO TO ❷<br><br>**Faulty connection(s):**<br>Repair faulty connection(s). |

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| | | |
|---|---|---|
| ❷ **Intermittent Fault Test** | *NOTE: For wiring and theory of operation, see T3 - ANALOG THROTTLE (A) INPUT HIGH supporting information.*<br><br>1. Connect the DST or SERVICE ADVISOR™. For instructions on connecting to the DST or SERVICE ADVISOR™, see CONNECTING TO DIAGNOSTIC SCAN TOOL (DST) OR SERVICE ADVISOR™earlier in this Group.<br><br>2. Ignition ON, engine OFF<br><br>3. Start the ECU diagnostic software<br><br>4. Analog Throttle (A) in the idle position.<br><br>5. Read the analog throttle (A) input voltage on DST or SERVICE ADVISOR™.<br><br>*NOTE: For OEM applications, the high analog throttle (A) input voltage is 4.7V. For the high voltage specification on non-OEM applications, see APPLICATION SPECIFICATIONS in Section 06, Group 210 later in this manual.* | **4.7 volts or greater:**<br>GO TO ❹<br><br>**Below 4.7 volts:**<br>GO TO ❸ |

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|---|---|---|
| ❸ **Throttle Travel Voltage Test** | *NOTE: For wiring and theory of operation, see T3 - ANALOG THROTTLE (A) INPUT HIGH supporting information.*<br><br>1. Slowly operate analog throttle (A) through its full travel.<br><br>2. Using the ECU diagnostic software, read the analog throttle (A) input voltage.<br><br>*NOTE: For OEM applications, the high analog throttle (A) input voltage is 4.7V. For the high voltage specification on non-OEM applications, see APPLICATION SPECIFICATIONS in Section 06, Group 210 later in this manual.* | **Goes above 4.7 volts:**<br>Faulty analog throttle (A) sensor connector<br>OR<br>Open in analog throttle (A) sensor ground circuit<br>OR<br>Faulty analog throttle (A) sensor<br><br>**Never goes above 4.7 volts:**<br>Problem is intermittent. If no other codes are present, see INTERMITTENT FAULT DIAGNOSTICS earlier in this Group<br><br>– – –1/1 |



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| ❹ **Throttle Position Input Shorted Test** | *NOTE: For wiring and theory of operation, see T3 - ANALOG THROTTLE (A) INPUT HIGH supporting information.*<br><br>1. Ignition OFF<br><br>2. Disconnect analog throttle (A) sensor connector.<br><br>3. Ignition ON, Engine OFF<br><br>4. Using the ECU diagnostic software, read the analog throttle (A) input voltage.<br><br>*NOTE: For OEM applications, the low analog throttle (A) input voltage is 0.3V. For the low voltage specification on non-OEM applications, see APPLICATION SPECIFICATIONS in Section 06, Group 210 later in this manual.* | **0.3 volts or less:**<br>GO TO ❺<br><br>**Above 0.3 volts:**<br>Short to voltage in analog throttle (A) input circuit<br>OR<br>Faulty ECU<br><br>– – –1/1 |

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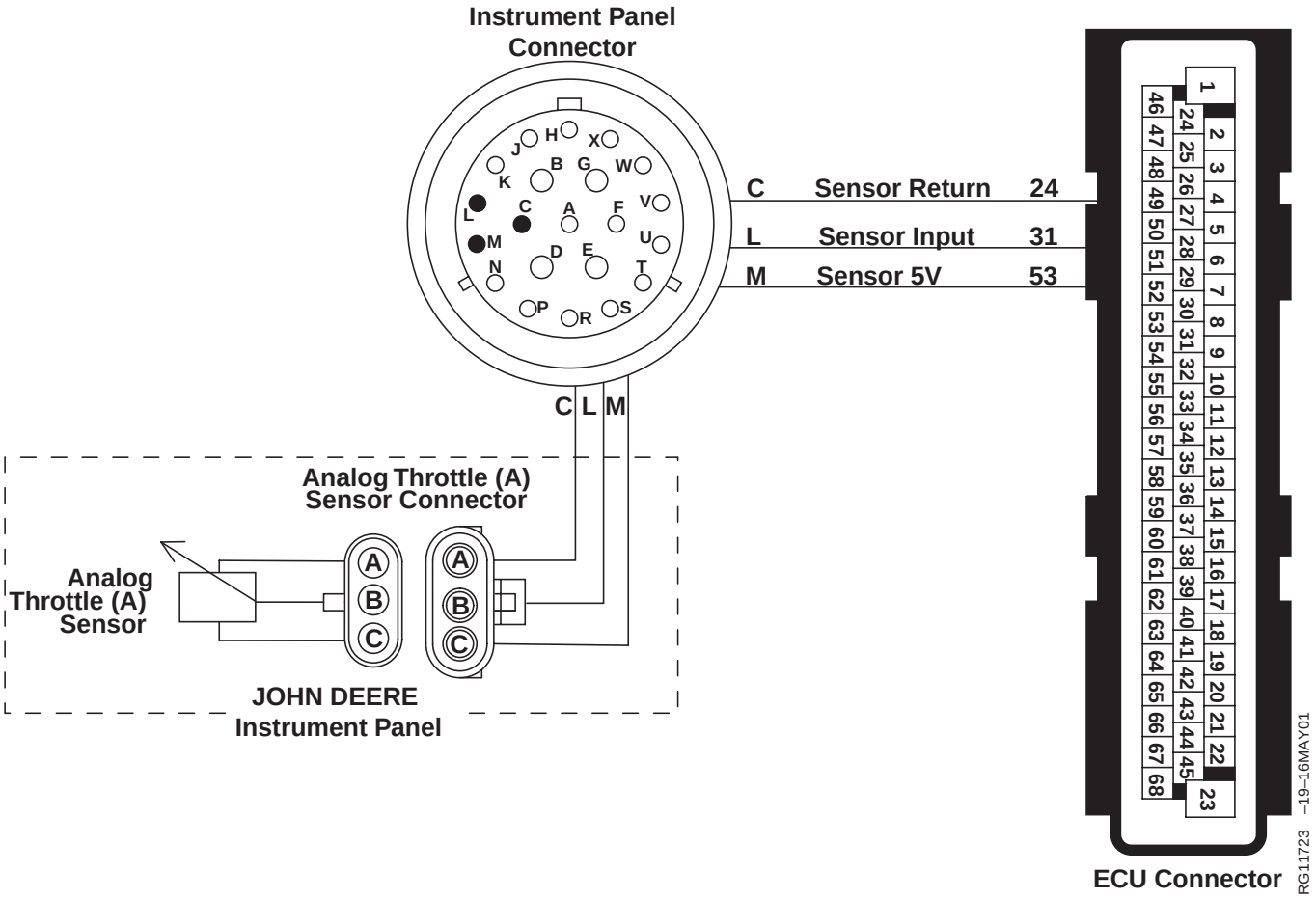
| ❺ **Throttle Position Ground Circuit Open Test** | *NOTE: For wiring and theory of operation, see T3 - ANALOG THROTTLE (A) INPUT HIGH supporting information.*<br><br>1. Ignition OFF<br><br>2. Analog throttle (A) sensor connector still disconnected.<br><br>3. Using a test light connected to battery (+), probe the ground terminal (terminal A) in the analog throttle (A) sensor connector. | **Light ON:**<br>Faulty analog throttle (A) sensor connector<br>OR<br>Faulty analog throttle (A) sensor<br><br>**Light OFF:**<br>Open in analog throttle (A) ground circuit<br><br>– – –1/1 |

## T4 - Analog Throttle (A) Input Low






*NOTE: Wiring schematic shows OEM engine applications only. For wiring information on other applications, see APPLICATION SPECIFICATIONS in Section 06, Group 210 of this manual.*

**Analog Throttle Position Sensor**

- The analog throttle position sensor is a variable resistor (potentiometer) used to measure the position of the throttle. The throttle input voltage normally varies between 1.0 and 4.0 volts depending on throttle position. Analog throttle voltage at low idle will be approximately 1.0 volt and 4.0 volts at high idle. The ECU has the ability to learn different voltages for low and high idle, so the voltages above may change depending on application.

**This code will set if:**

- The analog throttle (A) input voltage drops below the sensor's low voltage specification. The voltage is lower than what is physically possible for the throttle lever to achieve.
  - – For OEM applications, the low analog throttle (A) input voltage specification is 0.3 volts.
  - – For other applications, see APPLICATION SPECIFICATIONS in Section 06, Group 210 of this manual for the analog throttle (A) input voltage specification.

**If this code sets, the following will occur:**

- If more than one throttle is available, the ECU will ignore the input from the analog throttle, and will use the input values from another throttle.
- If the analog throttle is the only throttle or all additional throttles are also faulted, the ECU will use a default "limp-home" throttle value that will only allow idle engine speed.

RG41221,000013B –19–21OCT02–1/1

## T4 - Analog Throttle (A) Input Low

RG41221,000013C –19–21OCT02–1/1

## T4 - Analog Throttle (A) Input Low Diagnostic Procedure

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| ❶ **Connection Check** | **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.**<br><br>*NOTE: For wiring and theory of operation, see T4 - ANALOG THROTTLE (A) INPUT LOW supporting information.*<br><br>Before using this diagnostic procedure, perform a preliminary inspection of the ECU connectors and the analog throttle (A) connector looking for dirty, damaged, or poorly positioned terminals. | **No faulty connection(s):**<br>GO TO ❷<br><br>**Faulty connection(s):**<br>Repair faulty connection(s). |

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| ❷ **Intermittent Fault Test** | *NOTE: For wiring and theory of operation, see T4 - ANALOG THROTTLE (A) INPUT LOW supporting information.*<br><br>1. Connect the DST or SERVICE ADVISOR™. For instructions on connecting to the DST or SERVICE ADVISOR™, see CONNECTING TO DIAGNOSTIC SCAN TOOL (DST) OR SERVICE ADVISOR™earlier in this Group.<br><br>2. Ignition ON, engine OFF<br><br>3. Start the ECU diagnostic software<br><br>4. Throttle (A) in the idle position.<br><br>5. Read the analog throttle (A) input voltage on DST or SERVICE ADVISOR™.<br><br>*NOTE: For OEM applications, the low analog throttle (A) input voltage is 0.3V. For the low voltage specification on non-OEM applications, see APPLICATION SPECIFICATIONS in Section 06, Group 210 later in this manual.* | **0.3 volts or less:**<br>GO TO ❹<br><br>**Above 0.3 volts:**<br>GO TO ❸ |

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| ❸ **Throttle Travel Voltage Test** | *NOTE: For wiring and theory of operation, see T4 - ANALOG THROTTLE (A) INPUT LOW supporting information.*<br><br>1. Slowly operate analog throttle (A) through its full travel.<br><br>2. Using the ECU diagnostic software, read the analog throttle (A) input voltage.<br><br>*NOTE: For OEM applications, the low analog throttle (A) input voltage is 0.3V. For the low voltage specification on non-OEM applications, see APPLICATION SPECIFICATIONS in Section 06, Group 210 later in this manual.* | **Goes below 0.3 volts:**<br>Faulty analog throttle (A) sensor connector<br>OR<br>Open in analog throttle (A) sensor ground circuit<br>OR<br>Faulty analog throttle (A) sensor<br><br>**Never goes above 0.3 volts:**<br>Problem is intermittent. If no other codes are present, see INTERMITTENT FAULT DIAGNOSTICS earlier in this Group<br><br>– – –1/1 |



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| ❹ **Throttle Position Wiring Test** | *NOTE: For wiring and theory of operation, see T4 - ANALOG THROTTLE (A) INPUT LOW supporting information.*<br><br>1. Ignition OFF<br><br>2. Disconnect analog throttle (A) sensor connector.<br><br>3. Install a jumper wire between the 5 V Supply terminal and the input terminal (terminals B and C) in the analog throttle (A) sensor connector on the engine harness.<br><br>4. Ignition ON, engine OFF<br><br>5. Using the ECU diagnostic software, read the analog throttle (A) input voltage.<br><br>*NOTE: For OEM applications, the high analog throttle (A) input voltage is 4.7V. For the high voltage specification on non-OEM applications, see APPLICATION SPECIFICATIONS in Section 06, Group 210 later in this manual.* | **Below 4.7 volts:**<br>GO TO ❺<br><br>**4.7 volts or greater:**<br>Faulty analog throttle (A) sensor connector<br>OR<br>Faulty analog throttle (A) sensor<br><br>– – –1/1 |

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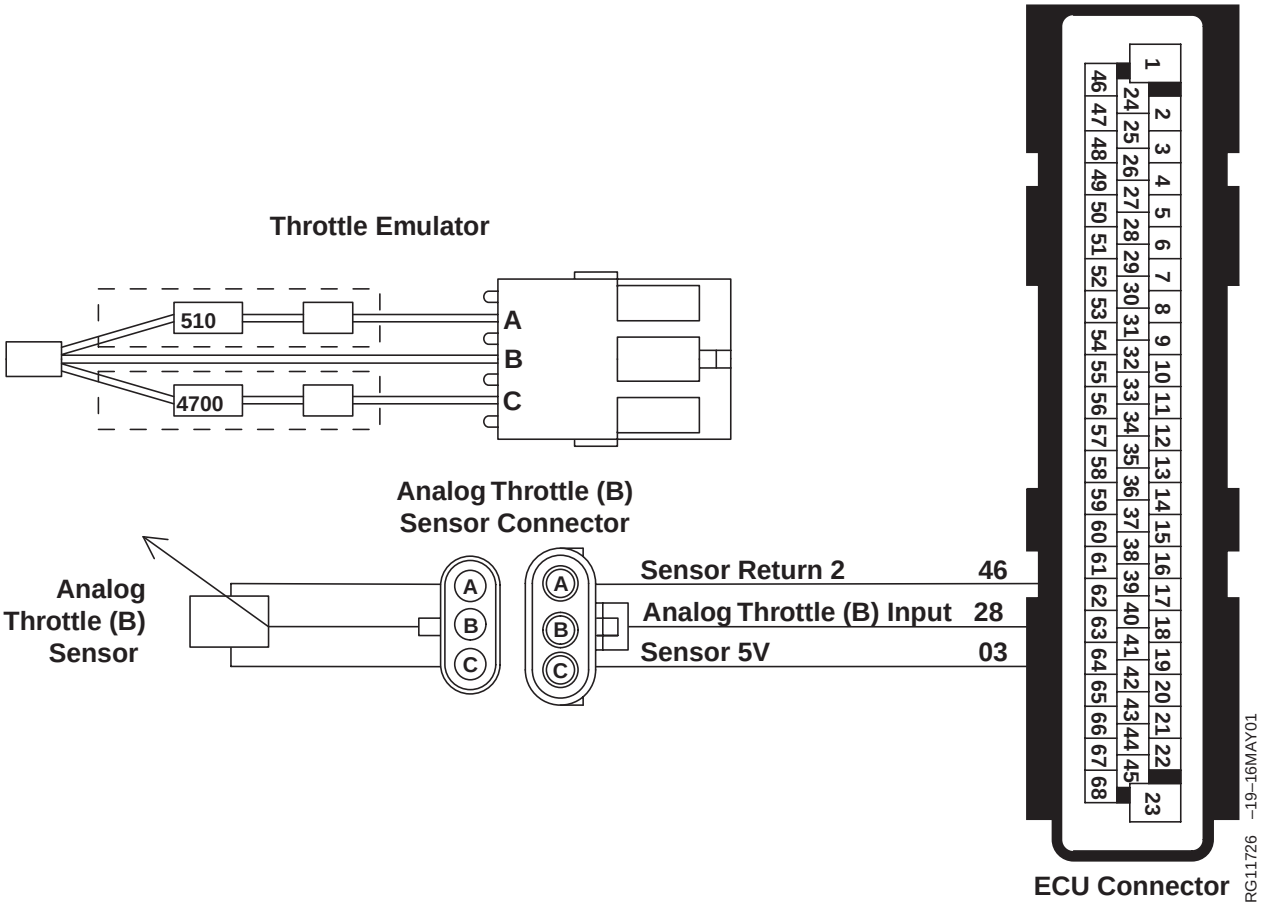
| ❺ **Throttle Position 5V Supply Test** | *NOTE: For wiring and theory of operation, see T4 - ANALOG THROTTLE (A) INPUT LOW supporting information.*<br><br>1. Ignition OFF<br><br>2. Remove jumper wire.<br><br>3. Ignition ON, engine OFF<br><br>4. Using a multimeter, measure the voltage between the analog throttle (A) ground terminal and the 5 V Supply terminal (terminals A and C) in the analog throttle (A) sensor connector on the engine harness. | **4.0-6.0 volts:**<br>Open in analog throttle (A) input circuit<br>OR<br>Short to ground in analog throttle (A) input circuit<br>OR<br>Faulty ECU connector<br>OR<br>Faulty ECU<br><br>**Below 4.0 volts:**<br>Open in analog throttle (A) 5 V Supply circuit<br>OR<br>Short to ground in analog throttle (A) 5 V Supply circuit<br>OR<br>Faulty ECU connector<br>OR<br>Faulty ECU<br><br>– – –1/1 |

## T5 - Analog Throttle (B) Input High






*NOTE: Wiring schematic shows OEM engine applications only. For wiring information on other applications, see APPLICATION SPECIFICATIONS in Section 06, Group 210 of this manual.*

**Analog Throttle Position Sensor**

- The analog throttle position sensor is a variable resistor (potentiometer) used to measure the position of the throttle. The throttle input voltage normally varies between 1.0 and 4.0 volts depending on throttle position. Analog throttle voltage at low idle will be approximately 1.0 volt and 4.0 volts at high idle. The ECU has the ability to learn different voltages for low and high idle, so the voltages above may change depending on application.

**This code will set if:**

- The analog throttle (B) input voltage exceeds the sensor's high voltage specification. The voltage is higher than what is physically possible for the throttle lever to achieve.
  - For OEM applications, the analog throttle (B) input voltage specification is 4.7 volts.
  - For other applications, see APPLICATION SPECIFICATIONS in Section 06, Group 210 of this manual for the analog throttle (B) input voltage specification.

**If this code sets, the following will occur:**

- If more than one throttle is available, the ECU will ignore the input from the analog throttle, and will use the input values from another throttle.
- If the analog throttle is the only throttle or all additional throttles are also faulted, the ECU will use a default "limp-home" throttle value that will only allow idle engine speed.

RG41221,000013D –19–21OCT02–1/1

## T5 - Analog Throttle (B) Input High

RG41221,000013E –19–21OCT02–1/1

## T5 - Analog Throttle (B) Input High Diagnostic Procedure

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| ❶ **Connection Check** | **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.**<br><br>*NOTE: For wiring and theory of operation, see T5 - ANALOG THROTTLE (B) INPUT HIGH supporting information.*<br><br>Before using this diagnostic procedure, perform a preliminary inspection ECU connectors and the analog throttle (B) sensor connector looking for dirty, damaged, or poorly positioned terminals. | **No faulty connection(s):** GO TO ❷<br><br>**Faulty connection(s):** Repair faulty connection(s). |

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| ❷ **Intermittent Fault Test** | *NOTE: For wiring and theory of operation, see T5 - ANALOG THROTTLE (B) INPUT HIGH supporting information.*<br><br>1. Connect the DST or SERVICE ADVISOR™. For instructions on connecting to the DST or SERVICE ADVISOR™, see CONNECTING TO DIAGNOSTIC SCAN TOOL (DST) OR SERVICE ADVISOR™earlier in this Group.<br><br>2. Ignition ON, engine OFF<br><br>3. Start the ECU diagnostic software<br><br>4. Analog Throttle (B) in the idle position.<br><br>5. Read the analog throttle (B) input voltage on DST or SERVICE ADVISOR™.<br><br>*NOTE: For OEM applications, the high analog throttle (B) input voltage is 4.7V. For the high voltage specification on non-OEM applications, see APPLICATION SPECIFICATIONS in Section 06, Group 210 later in this manual.* | **4.7 volts or greater:** GO TO ❹<br><br>**Below 4.7 volts:** GO TO ❸ |

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| ❸ **Throttle Travel Voltage Test** | *NOTE: For wiring and theory of operation, see T5 - ANALOG THROTTLE (B) INPUT HIGH supporting information.*<br><br>1. Slowly operate analog throttle (B) through its full travel.<br><br>2. Using the diagnostic software, read the analog throttle (B) input voltage.<br><br>*NOTE: For OEM applications, the high analog throttle (B) input voltage is 4.7V. For the high voltage specification on non-OEM applications, see APPLICATION SPECIFICATIONS in Section 06, Group 210 later in this manual.* | **Goes above 4.7 volts:**<br>Faulty analog throttle (B) sensor connector<br>OR<br>Open in analog throttle (B) sensor ground circuit<br>OR<br>Faulty analog throttle (B) sensor<br><br>**Never goes above 4.7 volts:**<br>Problem is intermittent. If no other codes are present, see INTERMITTENT FAULT DIAGNOSTICS earlier in this Group<br><br>– – –1/1 |



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| ❹ **Throttle Position Input Shorted Test** | *NOTE: For wiring and theory of operation, see T5 - ANALOG THROTTLE (B) INPUT HIGH supporting information.*<br><br>1. Ignition OFF<br><br>2. Disconnect analog throttle (B) sensor connector.<br><br>3. Ignition ON, Engine OFF<br><br>4. Using the ECU diagnostic software, read the analog throttle (B) input voltage.<br><br>*NOTE: For OEM applications, the low analog throttle (B) input voltage is 0.3V. For the low voltage specification on non-OEM applications, see APPLICATION SPECIFICATIONS in Section 06, Group 210 later in this manual.* | **0.3 volts or less:**<br>GO TO ❺<br><br>**Above 0.3 volts:**<br>Short to voltage in analog throttle (B) input circuit<br>OR<br>Faulty ECU<br><br>– – –1/1 |

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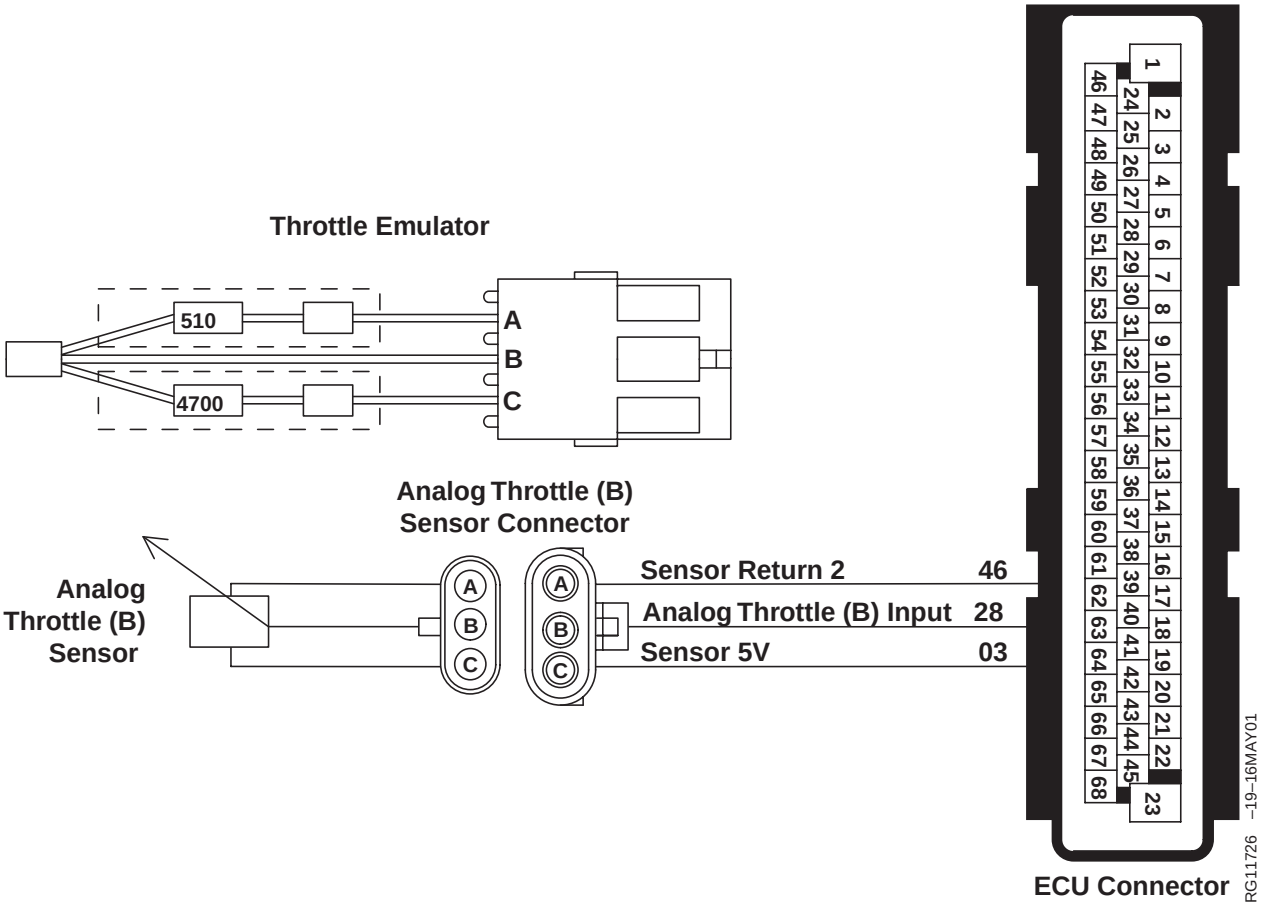
| ❺ **Throttle Position Ground Circuit Open Test** | *NOTE: For wiring and theory of operation, see T5 - ANALOG THROTTLE (B) INPUT HIGH supporting information.*<br><br>1. Ignition OFF<br><br>2. Analog throttle (B) sensor connector disconnected.<br><br>3. Using a test light connected to battery (+), probe the ground terminal (terminal A) in the analog throttle (B) sensor connector on the engine harness. | **Light ON:**<br>Faulty analog throttle (B) sensor connector<br>OR<br>Faulty analog throttle (B) sensor<br><br>**Light OFF:**<br>Open in analog throttle (B) ground circuit<br><br>– – –1/1 |

## T6 - Analog Throttle (B) Input Low






*NOTE: Wiring schematic shows OEM engine applications only. For wiring information on other applications, see APPLICATION SPECIFICATIONS in Section 06, Group 210 of this manual.*

**Analog Throttle Position Sensor**

- The analog throttle position sensor is a variable resistor (potentiometer) used to measure the position of the throttle. The throttle input voltage normally varies between 1.0 and 4.0 volts depending on throttle position. Analog throttle voltage at low idle will be approximately 1.0 volt and 4.0 volts at high idle. The ECU has the ability to learn different voltages for low and high idle, so the voltages above may change depending on application.

**This code will set if:**

- The analog throttle (B) input voltage drops below the sensor's low voltage specification. The voltage is lower than what is physically possible for throttle lever to achieve.
  - For OEM applications, the low analog throttle (B) input voltage specification is 0.3 volts.
  - For other applications, see APPLICATION SPECIFICATIONS in Section 06, Group 210 of this manual for the low analog throttle (B) input voltage specification.

**If this code sets, the following will occur:**

- If more than one throttle is available, the ECU will ignore the input from the analog throttle, and will use the input values from another throttle.
- If the analog throttle is the only throttle or all additional throttles are also faulted, the ECU will use a default "limp-home" throttle value that will only allow idle engine speed.

RG41221,000013F –19–21OCT02–1/1

## T6 - Analog Throttle (B) Input Low

RG41221,0000140 –19–21OCT02–1/1

## T6 - Analog Throttle (B) Input Low Diagnostic Procedure

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| ❶ **Connection Check** | **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.**<br><br>*NOTE: For wiring and theory of operation, see T6 - ANALOG THROTTLE (B) INPUT LOW supporting information.*<br><br>Before using this diagnostic procedure, perform a preliminary inspection of ECU connectors and the analog throttle (B) sensor connector looking for dirty, damaged, or poorly positioned terminals. | **No faulty connection(s):**<br>GO TO ❷<br><br>**Faulty connection(s):**<br>Repair faulty connection(s). |

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| ❷ **Intermittent Fault Test** | *NOTE: For wiring and theory of operation, see T6 - ANALOG THROTTLE (B) INPUT LOW supporting information.*<br><br>1. Connect the DST or SERVICE ADVISOR™. For instructions on connecting to the DST or SERVICE ADVISOR™, see CONNECTING TO DIAGNOSTIC SCAN TOOL (DST) OR SERVICE ADVISOR™earlier in this Group.<br><br>2. Ignition ON, engine OFF<br><br>3. Start the ECU diagnostic software<br><br>4. Analog Throttle (B) in the idle position.<br><br>5. Read the analog throttle (B) input voltage on DST or SERVICE ADVISOR™.<br><br>*NOTE: For OEM applications, the low analog throttle (B) input voltage is 0.3V. For the low voltage specification on non-OEM applications, see APPLICATION SPECIFICATIONS in Section 06, Group 210 later in this manual.* | **0.3 volts or less:**<br>GO TO ❹<br><br>**Above 0.3 volts:**<br>GO TO ❸ |

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| ❸ **Throttle Travel Voltage Test** | *NOTE: For wiring and theory of operation, see T6 - ANALOG THROTTLE (B) INPUT LOW supporting information.*<br><br>1. Slowly operate analog throttle (B) through its full travel.<br><br>2. Using the ECU diagnostic software, read the analog throttle (B) input voltage.<br><br>*NOTE: For OEM applications, the low analog throttle (B) input voltage is 0.3V. For the low voltage specification on non-OEM applications, see APPLICATION SPECIFICATIONS in Section 06, Group 210 later in this manual.* | **Goes below 0.3 volts:**<br>Faulty analog throttle (B) sensor connector<br>OR<br>Open in analog throttle (B) sensor ground circuit<br>OR<br>Faulty analog throttle (B) sensor<br><br>**Never goes above 0.3 volts:**<br>Problem is intermittent. If no other codes are present, see INTERMITTENT FAULT DIAGNOSTICS earlier in this Group<br><br>– – –1/1 |



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| ❹ **Throttle Position Wiring Test** | *NOTE: For wiring and theory of operation, see T6 - ANALOG THROTTLE (B) INPUT LOW supporting information.*<br><br>1. Ignition OFF<br><br>2. Disconnect analog throttle (B) sensor connector.<br><br>3. Install a jumper wire between the 5 V Supply terminal and the input terminal (terminals B and C) in the analog throttle (B) sensor connector on the engine harness.<br><br>4. Ignition ON, engine OFF<br><br>5. Using the ECU diagnostic software, read the analog throttle (B) input voltage.<br><br>*NOTE: For OEM applications, the high analog throttle (B) input voltage is 4.7V. For the high voltage specification on non-OEM applications, see APPLICATION SPECIFICATIONS in Section 06, Group 210 later in this manual.* | **Below 4.7 volts:**<br>GO TO ❺<br><br>**4.7 volts or greater:**<br>Faulty analog throttle (B) sensor connector<br>OR<br>Faulty analog throttle (B) sensor<br><br>– – –1/1 |

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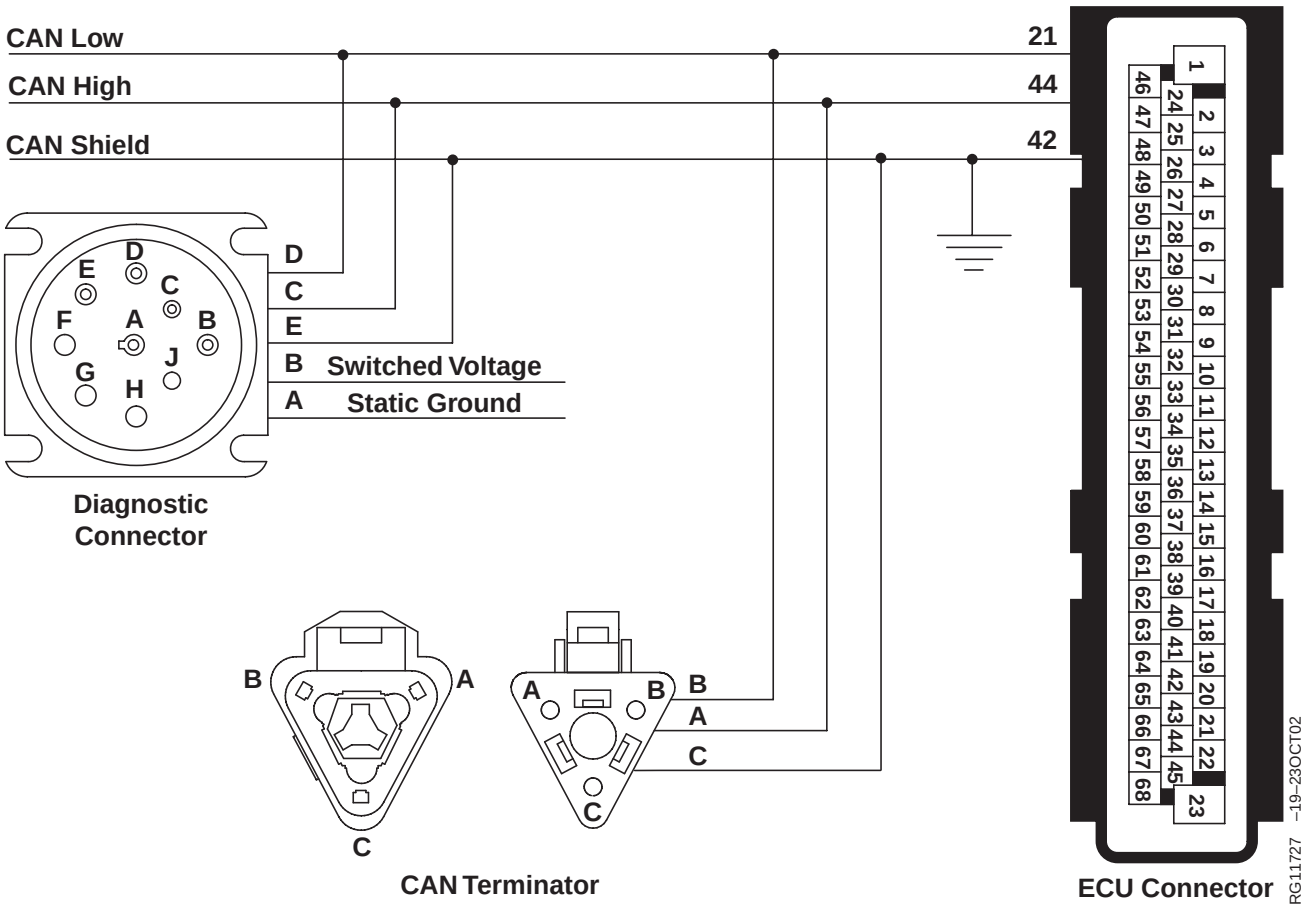
| ❺ **Throttle Position 5 V Supply Test** | *NOTE: For wiring and theory of operation, see T6 - ANALOG THROTTLE (B) INPUT LOW supporting information.*<br><br>1. Ignition OFF<br><br>2. Remove jumper wire.<br><br>3. Ignition ON, engine OFF<br><br>4. Using a multimeter, measure the voltage between the analog throttle (B) ground terminal and the 5 V Supply terminal (terminals A and C) in the analog throttle (B) sensor connector on the engine harness. | **4.0-6.0 volts:**<br>Open in analog throttle (B) input circuit<br>OR<br>Short to ground in analog throttle (B) input circuit<br>OR<br>Faulty ECU connector<br>OR<br>Faulty ECU<br><br>**Below 4.0 volts:**<br>Open in analog throttle (B) 5 V Supply circuit<br>OR<br>Short to ground in analog throttle (B) 5 V Supply circuit<br>OR<br>Faulty ECU connector<br>OR<br>Faulty ECU<br><br>– – –1/1 |

## T7 - CAN Throttle Invalid






**CAN (Controller Area Network) Throttle**

- CAN (Controller Area Network) throttle is information sent to the ECU by another controller over CAN of the desired throttle position.

**This code will set if:**

- The ECU either does not receive throttle information over CAN, or the information received is not valid.

**If this code sets, the following will occur:**

- If more than one throttle is available, the ECU will ignore the input from the CAN throttle, and will use the input values from another throttle.
- If the CAN throttle is the only throttle or all additional throttles are also faulted, the ECU will use a default “limp-home” throttle value that will only allow idle engine speed.

RG41221,0000145 –19–21OCT02–1/1

# T7 - CAN Throttle Invalid

RG41221,0000146 –19–27APR02–1/1

## T7 - CAN Throttle Invalid Diagnostic Procedure

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| ❶ **Connection Check** | **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.**<br><br>*NOTE: For wiring and theory of operation, see T7 - CAN THROTTLE INVALID supporting information.*<br><br>Before using this diagnostic procedure, perform a preliminary inspection of ECU connector looking for dirty, damaged, or poorly positioned terminals. | **No faulty connection(s):** GO TO ❷<br><br>**Faulty connection(s):** Repair faulty connection(s). |

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| ❷ **Intermittent Fault Test** | *NOTE: For wiring and theory of operation, see T7 - CAN THROTTLE INVALID supporting information.*<br><br>1. Connect the DST or SERVICE ADVISOR™. For instructions on connecting to the DST or SERVICE ADVISOR™, see CONNECTING TO DIAGNOSTIC SCAN TOOL (DST) OR SERVICE ADVISOR™earlier in this Group.<br>2. Ignition ON, engine OFF<br>3. Start the ECU diagnostic software<br>4. Make note of any DTCs, then clear all DTCs.<br>5. Ignition ON, engine running<br>6. Read DTCs using DST or SERVICE ADVISOR™. | **000091.09 reoccurs:** GO TO ❸<br><br>**000091.09 does not reoccur:** Problem is intermittent. If no other codes are present, see INTERMITTENT FAULT DIAGNOSTICS earlier in this Group. |

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| ❸ **Application Related DTCs Test** | *NOTE: For wiring and theory of operation, see T7 - CAN THROTTLE INVALID supporting information.*<br><br>If application has other machine controllers communicating on the CAN bus, check those controllers for CAN related DTCs. | **No CAN related DTCs found on other controllers:**<br>GO TO ❹<br><br>**Found CAN related DTCs found on other controllers:**<br>Refer to diagnostic procedure for that controller.<br><br>– – –1/1 |

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| ❹ **Resistance Between CAN High and Low Test** | *NOTE: For wiring and theory of operation, see T7 - CAN THROTTLE INVALID supporting information.*<br><br>1. Ignition OFF<br><br>2. Using a multimeter, measure resistance between terminals C and D in the harness end of the diagnostic connector. | **Between 45-75 ohms:**<br>GO TO ❺<br><br>**Less than 45 or greater than 75 ohms:**<br>Faulty or missing CAN terminator connector(s)<br>OR<br>Open or short in CAN wiring harness.<br><br>– – –1/1 |

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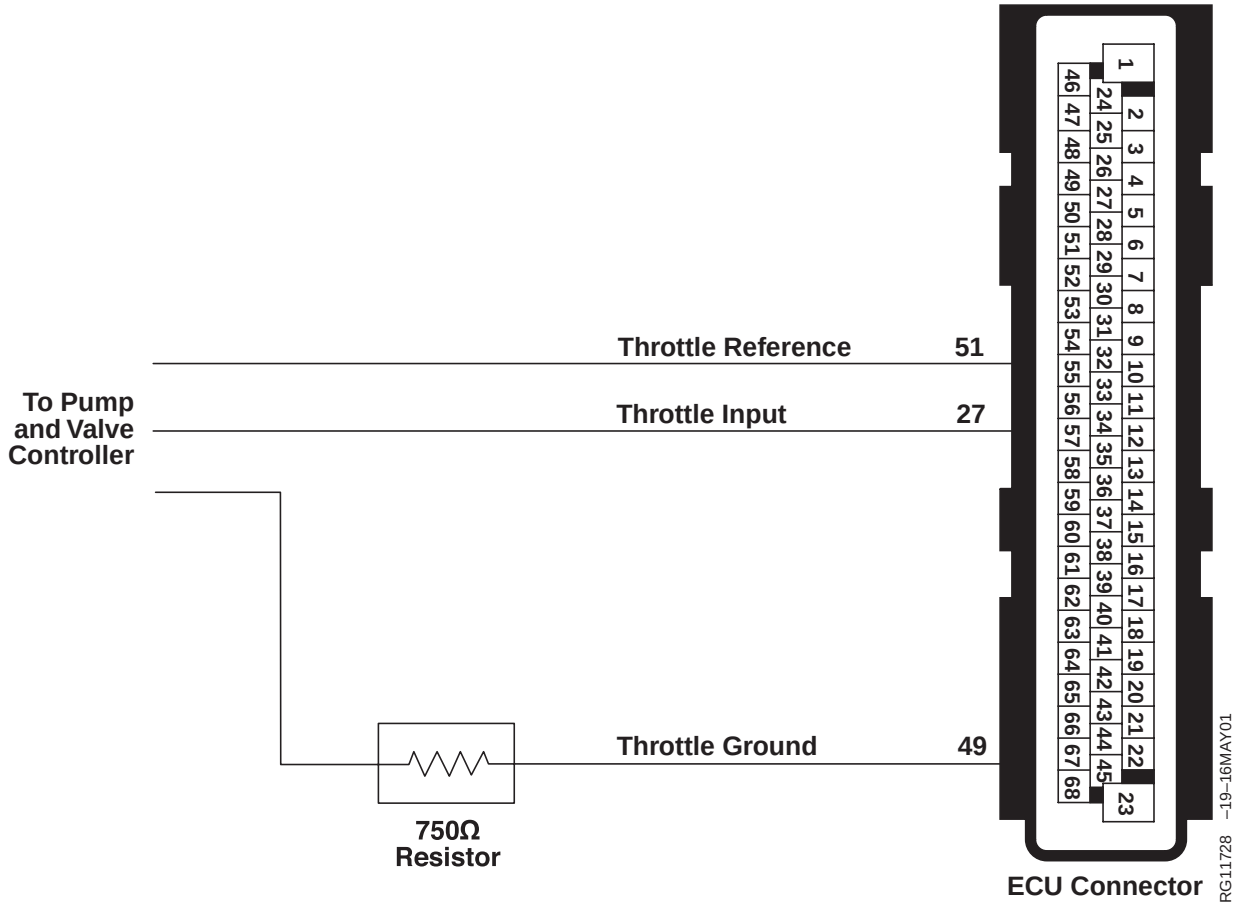
| ❺ **CAN Wiring Shorted to Ground or Voltage Test** | *NOTE: For wiring and theory of operation, see T7 - CAN THROTTLE INVALID supporting information.*<br><br>1. Ignition OFF<br><br>2. Using a multimeter, measure voltage between a good chassis ground and:<br><br>• Terminal C in the diagnostic connector.<br>• Terminal D in the diagnostic connector. | **Both measurements between 1.5-3.5 volts:**<br>Faulty ECU connector<br>OR<br>Other connector in the CAN system<br>OR<br>Faulty ECU.<br><br>**Either measurement less than 1.5 or greater than 3.5 volts:**<br>CAN wiring shorted to ground or voltage<br>OR<br>Another controller in the CAN system is faulty<br>OR<br>Faulty ECU<br><br>– – –1/1 |

## T11 - Excavator Throttle Reference Voltage High






*NOTE: For more Excavator throttle wiring information, refer to machine manual.*

**Excavator Throttle**

- The Excavator uses an analog throttle to measure throttle position. This throttle is connected to the Pump and Valve controller, which sends throttle input information to the ECU through a dedicated wire. Since the ECU uses and Pump and Valve controller do not share a common ground, a throttle voltage reference wire and a throttle ground wire accompany the throttle input wire. The ECU calculates the differences in controller grounds in order to determine the throttle request by the Pump and Valve controller.

**This code will set if:**

- The excavator throttle reference voltage to the ECU exceeds 4.2 volts.

**If this code sets, the following will occur:**

- The ECU will default excavator reference throttle voltage to 3.75 volts.

RG41221,0000147 –19–21OCT02–1/1

## T11 - Excavator Throttle Reference Voltage High

RG41221,0000148 –19–21OCT02–1/1

### T11 - Excavator Throttle Reference Voltage High Diagnostic Procedure

*NOTE: This procedure is only used to diagnose the Excavator Throttle.*

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| ❶ **Connection Check** | **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.**<br><br>*NOTE: For wiring and theory of operation, see T11 - EXCAVATOR THROTTLE REFERENCE VOLTAGE HIGH supporting information.*<br><br>Before using this diagnostic procedure, perform a preliminary inspection of the ECU connector and the throttle sensor connector looking for dirty, damaged, or poorly positioned terminals. | **No faulty connection(s):**<br>GO TO ❷<br><br>**Faulty connection(s):**<br>Repair faulty connection(s). |

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| ❷ **Intermittent Fault Test** | *NOTE: For wiring and theory of operation, see T11 - EXCAVATOR THROTTLE REFERENCE VOLTAGE HIGH supporting information.*<br><br>1. Connect the DST or SERVICE ADVISOR™. For instructions on connecting to the DST or SERVICE ADVISOR™, see CONNECTING TO DIAGNOSTIC SCAN TOOL (DST) OR SERVICE ADVISOR™earlier in this Group.<br><br>2. Ignition ON, engine OFF<br><br>3. Start the ECU diagnostic software<br><br>4. Make note of any DTCs, then clear all DTCs<br><br>*NOTE: If DTCs 000029.03 or 000029.04 are active, follow those DTCs first.*<br><br>5. Read DTCs using DST or SERVICE ADVISOR™.<br><br>• Ignition ON, engine OFF<br>• Ignition ON, engine running | **000028.03 reoccurs when engine is off and running:**<br>GO TO ❸<br><br>**000028.03 reoccurs only when engine is running:**<br>GO TO ❹<br><br>**000028.03 doesn't reoccur:**<br>Problem is intermittent. If no other codes are present, see INTERMITTENT FAULT DIAGNOSTICS earlier in this Group. |

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| ❸ **Throttle Reference Wire Test** | *NOTE: For wiring and theory of operation, see T11 - EXCAVATOR THROTTLE REFERENCE VOLTAGE HIGH supporting information.*<br><br>1. Ignition OFF<br><br>2. Disconnect ECU connector.<br><br>3. Using a multimeter, measure voltage between terminal 51 in the ECU connector on the engine harness and the ground stud of the Pump and Valve controller. | **3.9 volts or less:**<br>GO TO ❹<br><br>**Greater than 3.9 volts:**<br>Short to power in throttle reference wire<br>OR<br>Faulty Pump and Valve controller connector<br>OR<br>Faulty Pump and Valve controller<br><br>– – –1/1 |

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| ❹ **Ground Test** | *NOTE: For wiring and theory of operation, see T11 - EXCAVATOR THROTTLE REFERENCE VOLTAGE HIGH supporting information.*<br><br>There is a difference between grounds of the ECU and Pump and Valve controller. Check for loose ground connections at each controller. | – – –1/1 |

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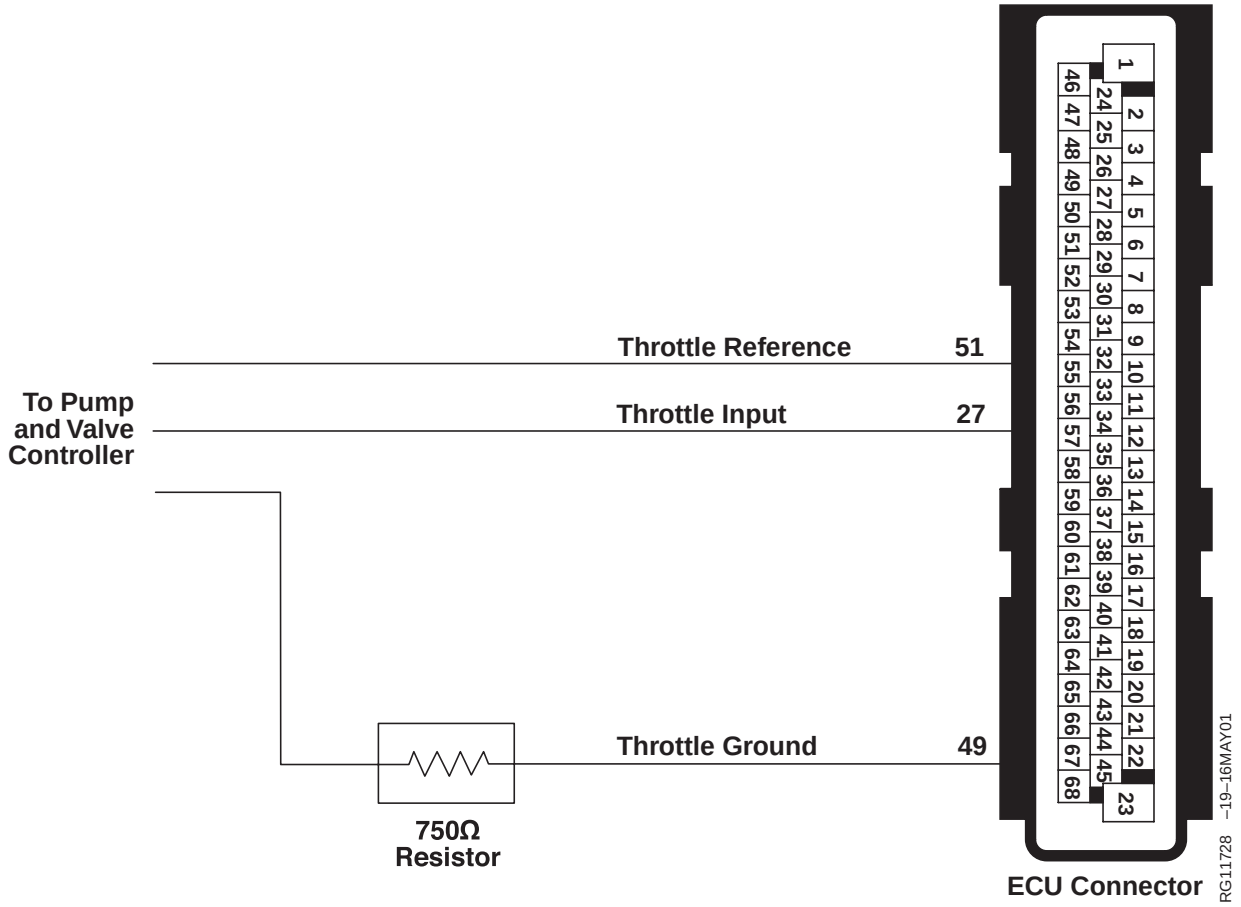
## T12 - Excavator Throttle Reference Voltage Low






*NOTE: For more Excavator throttle wiring information, refer to machine manual.*

**Excavator Throttle**

- The Excavator uses an analog throttle to measure throttle position. This throttle is connected to the Pump and Valve controller, which sends throttle input information to the ECU through a dedicated wire. Since the ECU uses and Pump and Valve controller do not share a common ground, a throttle voltage reference wire and a throttle ground wire accompany the throttle input wire. The ECU calculates the differences in controller grounds in order to determine the throttle request by the Pump and Valve controller.

**This code will set if:**

- The excavator throttle reference voltage to the ECU goes below 2.7 volts.

**If this code sets, the following will occur:**

- The ECU will default excavator reference throttle voltage to 3.75 volts.

RG41221,0000149 –19–21OCT02–1/1

## T12 - Excavator Throttle Reference Voltage Low

RG41221,000014A –19–21OCT02–1/1

### T12 - Excavator Throttle Reference Voltage Low Diagnostic Procedure

*NOTE: This procedure is only used to diagnose the Excavator Throttle.*

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| ❶ **Connection Check** | **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.**<br><br>*NOTE: For wiring and theory of operation, see T12 - EXCAVATOR THROTTLE REFERENCE VOLTAGE LOW supporting information.*<br><br>Before using this diagnostic procedure, perform a preliminary inspection of the ECU connector and the throttle sensor connector looking for dirty, damaged, or poorly positioned terminals. | **No faulty connection(s):**<br>GO TO ❷<br><br>**Faulty connection(s):**<br>Repair faulty connection(s). |

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| ❷ **Intermittent Fault Test** | *NOTE: For wiring and theory of operation, see T12 - EXCAVATOR THROTTLE REFERENCE VOLTAGE LOW supporting information.*<br><br>1. Connect the DST or SERVICE ADVISOR™. For instructions on connecting to the DST or SERVICE ADVISOR™, see CONNECTING TO DIAGNOSTIC SCAN TOOL (DST) OR SERVICE ADVISOR™earlier in this Group.<br><br>2. Ignition ON, engine OFF<br><br>3. Start the ECU diagnostic software<br><br>4. Make note of any DTCs, then clear all DTCs.<br><br>*NOTE: If DTCs 000029.03 or 000029.04 are active, follow those DTCs first.*<br><br>5. Read DTCs using DST or SERVICE ADVISOR™.<br><br>• Ignition ON, engine OFF<br>• Ignition ON, engine running | **000028.04 reoccurs when engine is off and running:**<br>GO TO ❸<br><br>**000028.04 reoccurs only when engine is running:**<br>GO TO ❹<br><br>**000028.04 doesn't reoccur:**<br>Problem is intermittent. If no other codes are present, see INTERMITTENT FAULT DIAGNOSTICS earlier in this Group. |

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| ❸ **Throttle Reference Wire Test** | *NOTE: For wiring and theory of operation, see T12 - EXCAVATOR THROTTLE REFERENCE VOLTAGE LOW supporting information.*<br><br>1. Ignition OFF<br><br>2. Disconnect the ECU connector.<br><br>3. Using a multimeter, measure voltage between terminal 51 in the harness end of the ECU connector and the ground stud of the Pump and Valve controller. | **3.5 volts or greater:**<br>GO TO ❹<br><br>**Less than 3.5 volts:**<br>Open in throttle reference wire<br>OR<br>Faulty Pump and Valve controller connector<br>OR<br>Faulty Pump and Valve controller<br><br>– – –1/1 |

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| ❹ **Ground Test** | *NOTE: For wiring and theory of operation, see T12 - EXCAVATOR THROTTLE REFERENCE VOLTAGE LOW supporting information.*<br><br>There is a difference between the grounds of the ECU and Pump and Valve controller. Check for loose ground connections at each controller. | – – –1/1 |

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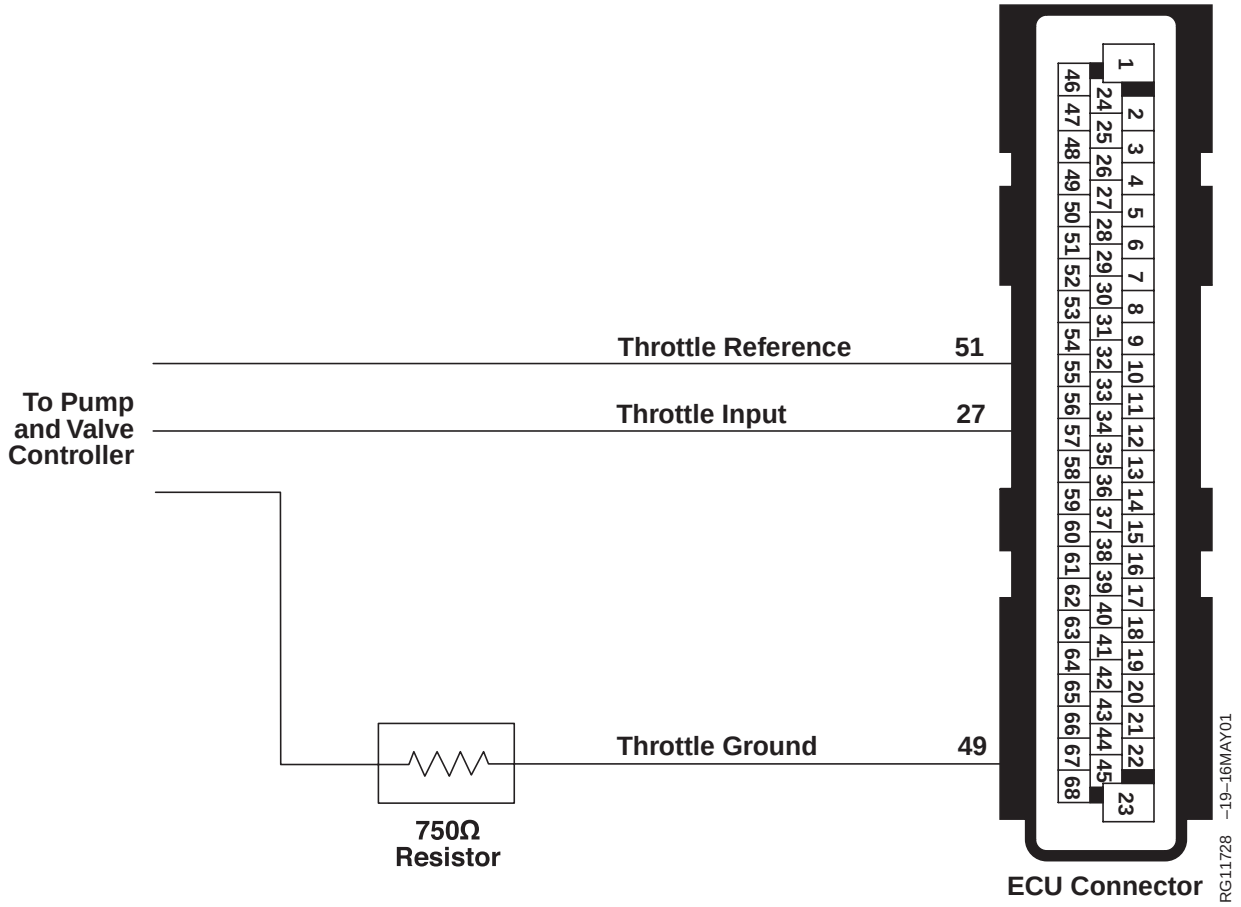
## T13 - Excavator Throttle Ground Voltage High






*NOTE: For more Excavator throttle wiring information, refer to machine manual.*

**Excavator Throttle**

- The Excavator uses an analog throttle to measure throttle position. This throttle is connected to the Pump and Valve controller, which sends throttle input information to the ECU through a dedicated wire. Since the ECU uses and Pump and Valve controller do not share a common ground, a throttle voltage reference wire and a throttle ground wire accompany the throttle input wire. The ECU calculates the differences in controller grounds in order to determine the throttle request by the Pump and Valve controller.

**This code will set if:**

- The excavator throttle ground voltage to the ECU exceeds 3.0 volts.

**If this code sets, the following will occur:**

- The ECU will default excavator throttle ground voltage to 0 volts.

RG41221,000014B –19–21OCT02–1/1

## T13 - Excavator Throttle Ground Voltage High

RG41221,000014C –19–21OCT02–1/1

### T13 - Excavator Throttle Ground Voltage High Diagnostic Procedure

*NOTE: This procedure is only used to diagnose the Excavator Throttle.*

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| ❶ **Connection Check** | **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.**<br><br>*NOTE: For wiring and theory of operation, see T13 - EXCAVATOR THROTTLE GROUND VOLTAGE HIGH supporting information.*<br><br>Before using this diagnostic procedure, perform a preliminary inspection of the ECU connector and the throttle sensor connector looking for dirty, damaged, or poorly positioned terminals. | **No faulty connection(s):**<br>GO TO ❷<br><br>**Faulty connection(s):**<br>Repair faulty connection(s). |

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| ❷ **Intermittent Fault Test** | *NOTE: For wiring and theory of operation, see T13 - EXCAVATOR THROTTLE GROUND VOLTAGE HIGH supporting information.*<br><br>1. Connect the DST or SERVICE ADVISOR™. For instructions on connecting to the DST or SERVICE ADVISOR™, see CONNECTING TO DIAGNOSTIC SCAN TOOL (DST) OR SERVICE ADVISOR™earlier in this Group.<br><br>2. Ignition ON, engine OFF<br><br>3. Start the ECU diagnostic software<br><br>4. Make note of any DTCs, then clear all DTCs.<br><br>5. Read DTCs using DST or SERVICE ADVISOR™.<br><br>• Ignition ON, engine OFF<br>• Ignition ON, engine running | **000029.03 reoccurs when engine is off and running:**<br>GO TO ❸<br><br>**000029.03 reoccurs only when engine is running:**<br>GO TO ❹<br><br>**000029.03 doesn't reoccur:**<br>Problem is intermittent. If no other codes are present, see INTERMITTENT FAULT DIAGNOSTICS earlier in this Group. |

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| ❸ **Throttle Ground Wire Test** | *NOTE: For wiring and theory of operation, see T13 - EXCAVATOR THROTTLE GROUND VOLTAGE HIGH supporting information.*<br><br>1. Ignition OFF<br><br>2. Disconnect the ECU connector.<br><br>3. Disconnect Pump and Valve controller connector.<br><br>4. Using a multimeter, measure resistance between terminal 49 in the harness end of the ECU connector and the corresponding ground terminal of the Pump and Valve controller connector. | **770 ohms or less:**<br>GO TO ❹<br><br>**Greater than 770 ohms:**<br>Short to power in throttle ground wire between ECU and 750 ohm resistor<br>OR<br>Open in throttle ground wire<br>OR<br>Faulty 750 ohm resistor<br>OR<br>Faulty ECU connector<br>OR<br>Faulty ECU<br><br>– – –1/1 |



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| ❹ **Pump and Valve Controller Test** | *NOTE: For wiring and theory of operation, see T13 - EXCAVATOR THROTTLE GROUND VOLTAGE HIGH supporting information.*<br><br>1. Ignition OFF<br><br>2. ECU connector still disconnected.<br><br>3. Using a multimeter, measure resistance between terminal 49 in the harness end of the ECU connector and the ground stud of the Pump and Valve controller. | **770 ohms or less:**<br>GO TO ❺<br><br>**Greater than 770 ohms:**<br>Faulty Pump and Valve controller connector<br>OR<br>Faulty Pump and Valve controller<br><br>– – –1/1 |

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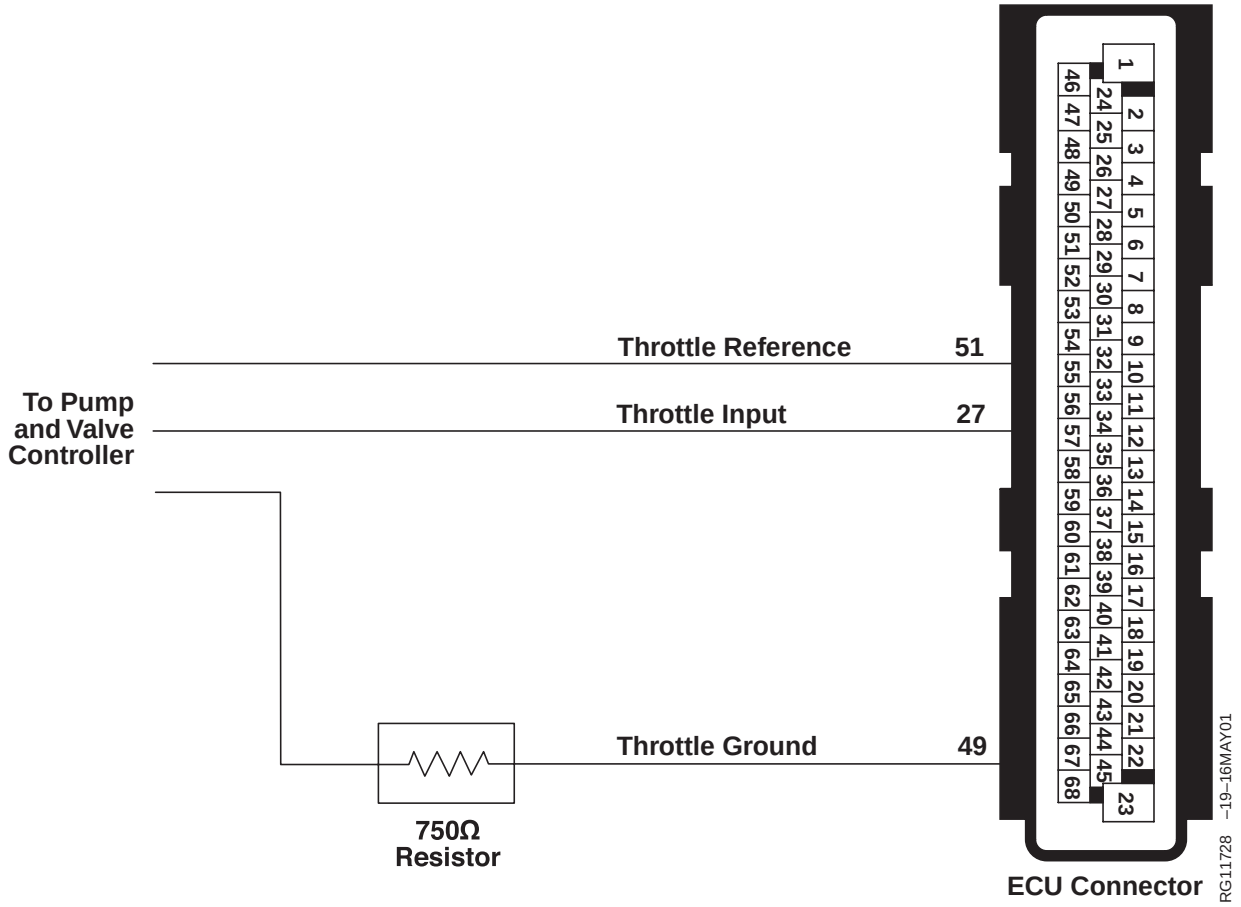
| ❺ **Ground Test** | *NOTE: For wiring and theory of operation, see T13 - EXCAVATOR THROTTLE GROUND VOLTAGE HIGH supporting information.*<br><br>There is a difference between grounds of the ECU and Pump and Valve controller. Check for loose ground connection at each controller. | – – –1/1 |

## T14 - Excavator Throttle Ground Voltage Low






*NOTE: For more Excavator throttle wiring information, refer to machine manual.*

**Excavator Throttle**

- The Excavator uses an analog throttle to measure throttle position. This throttle is connected to the Pump and Valve controller, which sends throttle input information to the ECU through a dedicated wire. Since the ECU uses and Pump and Valve controller do not share a common ground, a throttle voltage reference wire and a throttle ground wire accompany the throttle input wire. The ECU calculates the differences in controller grounds in order to determine the throttle request by the Pump and Valve controller.

**This code will set if:**

- The excavator throttle ground voltage to the ECU goes below 2.0 volts.

**If this code sets, the following will occur:**

- The ECU will default excavator throttle ground voltage to 0 volts.

RG41221,000014D –19–21OCT02–1/1

## T14 - Excavator Throttle Ground Voltage Low

RG41221,000014E –19–21OCT02–1/1

### T14 - Excavator Throttle Ground Voltage Low Diagnostic Procedure

*NOTE: This procedure is only used to diagnose the Excavator Throttle.*

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| ❶ **Connection Check** | **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.**<br><br>*NOTE: For wiring and theory of operation, see T14 - EXCAVATOR THROTTLE GROUND VOLTAGE LOW supporting information.*<br><br>Before using this diagnostic procedure, perform a preliminary inspection of ECU connector and the throttle sensor connector looking for dirty, damaged, or poorly positioned terminals. | **No faulty connection(s):**<br>GO TO ❷<br><br>**Faulty connection(s):**<br>Repair faulty connection(s). |

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| ❷ **Intermittent Fault Test** | *NOTE: For wiring and theory of operation, see T14 - EXCAVATOR THROTTLE GROUND VOLTAGE LOW supporting information.*<br><br>1. Connect the DST or SERVICE ADVISOR™. For instructions on connecting to the DST or SERVICE ADVISOR™, see CONNECTING TO DIAGNOSTIC SCAN TOOL (DST) OR SERVICE ADVISOR™earlier in this Group.<br><br>2. Ignition ON, engine OFF<br><br>3. Start the ECU diagnostic software<br><br>4. Make note of any DTCs, then clear all DTCs.<br><br>5. Read DTCs using DST or SERVICE ADVISOR™.<br><br>• Ignition ON, engine OFF<br>• Ignition ON, engine running | **000029.04 reoccurs when engine is off and running:**<br>GO TO ❸<br><br>**000029.04 reoccurs only when engine is running:**<br>GO TO ❹<br><br>**000029.04 doesn't reoccur:**<br>Problem is intermittent. If no other codes are present, see INTERMITTENT FAULT DIAGNOSTICS earlier in this Group. |

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| ❸ **Throttle Ground Test** | *NOTE: For wiring and theory of operation, see T14 - EXCAVATOR THROTTLE GROUND VOLTAGE LOW supporting information.*<br><br>1. Ignition OFF<br><br>2. Disconnect the ECU connector.<br><br>3. Using a multimeter, measure resistance between terminal 49 in the harness end of the ECU connector and the corresponding ground terminal of the Pump and Valve controller connector. | **730 ohms or greater:**<br>GO TO ❹<br><br>**Less than 730 ohms:**<br>Short to ground in throttle ground wire between ECU and resistor<br>OR<br>Faulty ECU connector<br>OR<br>Faulty ECU<br><br>– – –1/1 |

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| ❹ **Ground Test** | *NOTE: For wiring and theory of operation, see T14 - EXCAVATOR THROTTLE GROUND VOLTAGE LOW supporting information.*<br><br>There is a difference between grounds of the ECU and Pump and Valve controller. Check for loose ground connection at each controller. | – – –1/1 |

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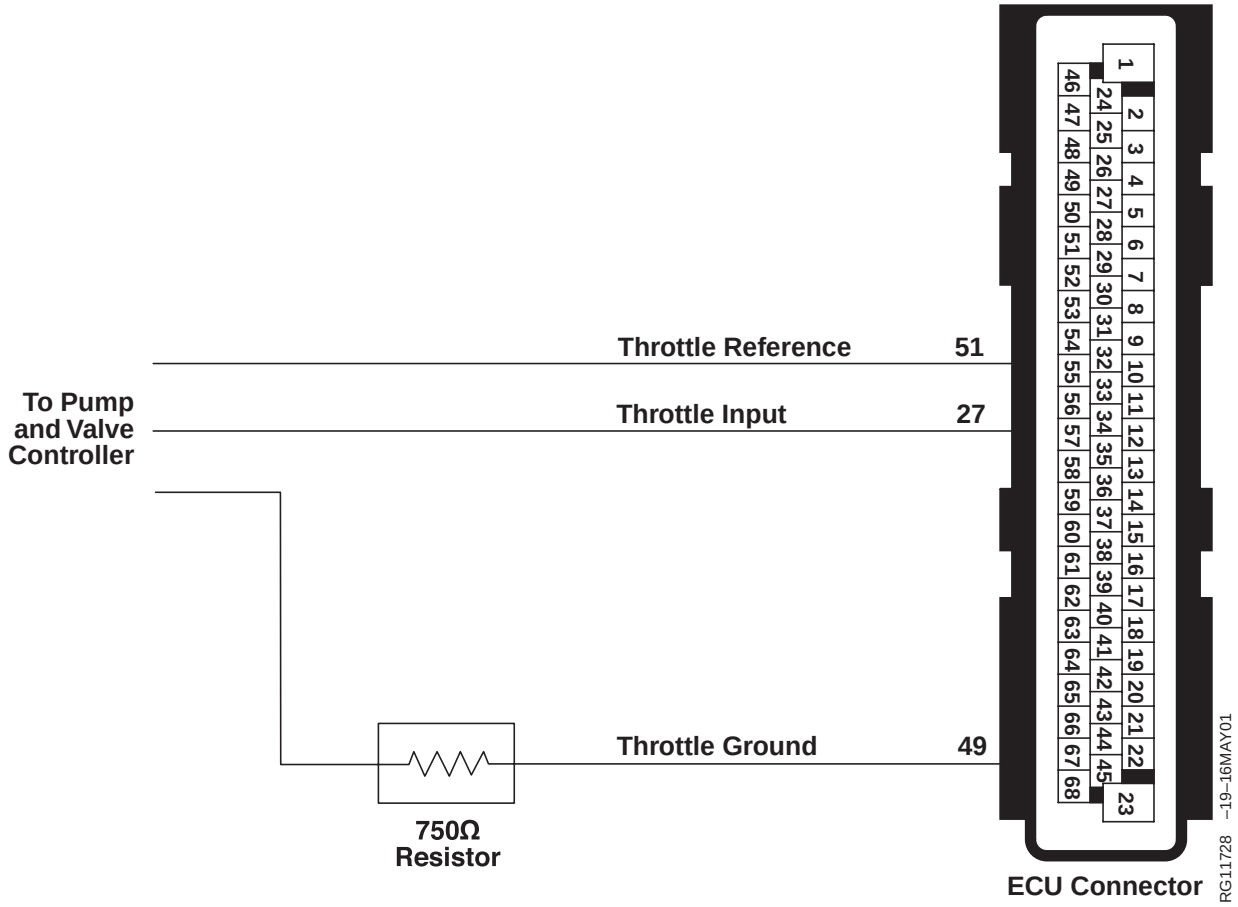
## T15 - Excavator Throttle Input Voltage High

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*NOTE: For more Excavator throttle wiring information, refer to machine manual.*

**Excavator Throttle**

- The Excavator uses an analog throttle to measure throttle position. This throttle is connected to the Pump and Valve controller, which sends throttle input information to the ECU through a dedicated wire. Since the ECU uses and Pump and Valve controller do not share a common ground, a throttle voltage reference wire and a throttle ground wire accompany the throttle input wire. The ECU calculates the differences in controller grounds in order to determine the throttle request by the Pump and Valve controller.

**This code will set if:**

- The excavator throttle input voltage to the ECU exceeds 4.9 volts.

**If this code sets, the following will occur:**

- The ECU will use a default “limp-home” throttle value that will only allow idle engine speed.

RG41221,000014F –19–21OCT02–1/1

## T15 - Excavator Throttle Input Voltage High

RG41221,0000150 –19–21OCT02–1/1

### T15 - Excavator Throttle Input Voltage High Diagnostic Procedure

*NOTE: This procedure is only used to diagnose the Excavator Throttle.*

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| ❶ **Connection Check** | **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.**<br><br>*NOTE: For wiring and theory of operation, see T15 - EXCAVATOR THROTTLE INPUT VOLTAGE HIGH supporting information.*<br><br>Before using this diagnostic procedure, perform a preliminary inspection of ECU connector and the throttle sensor connector looking for dirty, damaged, or poorly positioned terminals. | **No faulty connection(s):**<br>GO TO ❷<br><br>**Faulty connection(s):**<br>Repair faulty connection(s). |

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| ❷ **Intermittent Fault Test** | *NOTE: For wiring and theory of operation, see T15 - EXCAVATOR THROTTLE INPUT VOLTAGE HIGH supporting information.*<br><br>1. Connect the DST or SERVICE ADVISOR™. For instructions on connecting to the DST or SERVICE ADVISOR™, see CONNECTING TO DIAGNOSTIC SCAN TOOL (DST) OR SERVICE ADVISOR™earlier in this Group.<br><br>2. Ignition ON, engine OFF<br><br>3. Start the ECU diagnostic software<br><br>4. Make note of any DTCs, then clear all DTCs.<br><br>*NOTE: If DTCs 000029.03 or 000029.04 are active, follow those DTCs first.*<br><br>5. Read DTCs using DST or SERVICE ADVISOR™.<br><br>• Ignition ON, engine OFF<br>• Ignition ON, engine running | **000091.03 reoccurs when engine is off and running:**<br>GO TO ❸<br><br>**000091.03 reoccurs only when engine is running:**<br>GO TO ❹<br><br>**000091.03 doesn't reoccur:**<br>Problem is intermittent. If no other codes are present, see INTERMITTENT FAULT DIAGNOSTICS earlier in this Group. |

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| ❸ **Throttle Signal Wire Test** | *NOTE: For wiring and theory of operation, see T15 - EXCAVATOR THROTTLE INPUT VOLTAGE HIGH supporting information.*<br><br>1. Ignition OFF<br><br>2. Disconnect the ECU connector.<br><br>3. Using a multimeter, measure voltage between terminal 27 in the harness end of the ECU connector and the ground pin of the Pump and Valve controller. | **4.0 volts or less:**<br>GO TO ❹<br><br>**Greater than 4.0 volts:**<br>Short to power in throttle signal wire<br>OR<br>Faulty Pump and Valve controller connector<br>OR<br>Faulty Pump and Valve controller<br><br>– – –1/1 |

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| ❹ **Ground Test** | *NOTE: For wiring and theory of operation, see T15 - EXCAVATOR THROTTLE INPUT VOLTAGE HIGH supporting information.*<br><br>There is a difference between grounds of the ECU and Pump and Valve controller. Check for loose ground connection at each controller. | – – –1/1 |

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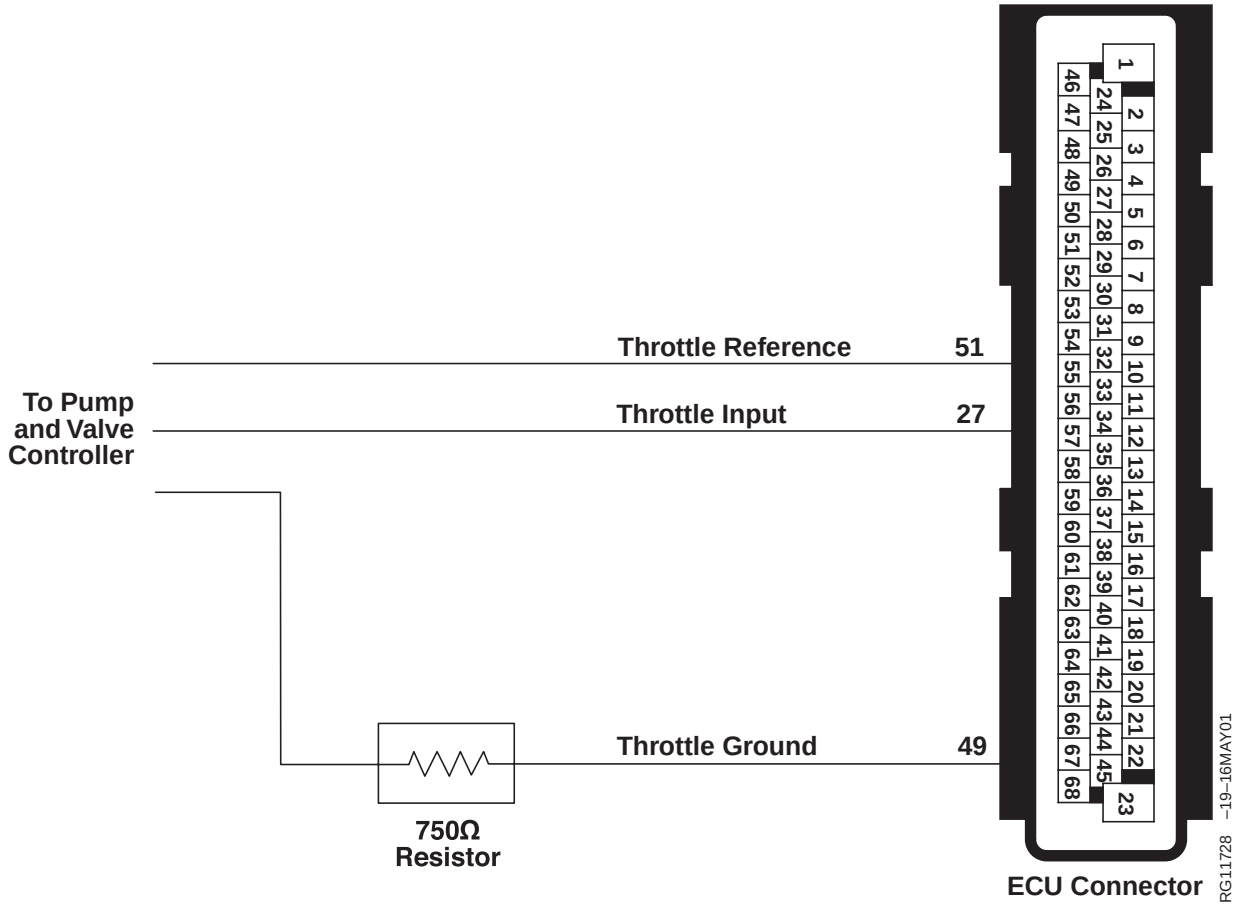
## T16 - Excavator Throttle Input Voltage Low

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*NOTE: For more Excavator throttle wiring information, refer to machine manual.*

**Excavator Throttle**

- The Excavator uses an analog throttle to measure throttle position. This throttle is connected to the Pump and Valve controller, which sends throttle input information to the ECU through a dedicated wire. Since the ECU uses and Pump and Valve controller do not share a common ground, a throttle voltage reference wire and a throttle ground wire accompany the throttle input wire. The ECU calculates the differences in controller grounds in order to determine the throttle request by the Pump and Valve controller.

**This code will set if:**

- The excavator throttle input voltage to the ECU goes below 0.1 volts.

**If this code sets, the following will occur:**

- The ECU will use a default “limp-home” throttle value that will only allow idle engine speed.

RG41221,0000151 –19–21OCT02–1/1

## T16 - Excavator Throttle Input Voltage Low

RG41221,0000152 –19–21OCT02–1/1

### T16 - Excavator Throttle Input Voltage Low Diagnostic Procedure

*NOTE: This procedure is only used to diagnose the Excavator Throttle.*

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| ❶ **Connection Check** | **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.**<br><br>*NOTE: For wiring and theory of operation, see T16 - EXCAVATOR THROTTLE INPUT VOLTAGE LOW supporting information.*<br><br>Before using this diagnostic procedure, perform a preliminary inspection of the ECU connector and the throttle sensor connector looking for dirty, damaged, or poorly positioned terminals. | **No faulty connection(s):**<br>GO TO ❷<br><br>**Faulty connection(s):**<br>Repair faulty connection(s). |

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| ❷ **Intermittent Fault Test** | *NOTE: For wiring and theory of operation, see T16 - EXCAVATOR THROTTLE INPUT VOLTAGE LOW supporting information.*<br><br>1. Connect the DST or SERVICE ADVISOR™. For instructions on connecting to the DST or SERVICE ADVISOR™, see CONNECTING TO DIAGNOSTIC SCAN TOOL (DST) OR SERVICE ADVISOR™earlier in this Group.<br><br>2. Ignition ON, engine OFF<br><br>3. Start the ECU diagnostic software<br><br>4. Make note of any DTCs, then clear all DTCs<br><br>*NOTE: If DTCs 000029.03 or 000029.04 are active, follow those DTCs first.*<br><br>5. Read DTCs using DST or SERVICE ADVISOR™.<br><br>• Ignition ON, engine OFF<br>• Ignition ON, engine running | **000091.04 reoccurs when engine is off and running:**<br>GO TO ❸<br><br>**000091.04 reoccurs only when engine is running:**<br>GO TO ❹<br><br>**000091.04 doesn't reoccur:**<br>Problem is intermittent. If no other codes are present, see INTERMITTENT FAULT DIAGNOSTICS earlier in this Group. |

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| ❸ **Throttle Signal Wire Test** | *NOTE: For wiring and theory of operation, see T16 - EXCAVATOR THROTTLE INPUT VOLTAGE LOW supporting information.*<br><br>1. Ignition OFF<br><br>2. Disconnect the ECU connector.<br><br>3. Using a multimeter, measure voltage between terminal 27 in the harness end of the ECU connector and the ground pin of the Pump and Valve controller. | **1.0 volts or greater:**<br>GO TO ❹<br><br>**Less than 1.0 volts:**<br>Open in throttle signal wire<br>OR<br>Faulty Pump and Valve controller connector<br>OR<br>Faulty Pump and Valve controller<br><br>– – –1/1 |

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| ❹ **Ground Test** | *NOTE: For wiring and theory of operation, see T16 - EXCAVATOR THROTTLE INPUT VOLTAGE LOW supporting information.*<br><br>There is a difference between grounds of the ECU and MCX controller. Check for loose ground connection at each controller. | – – –1/1 |

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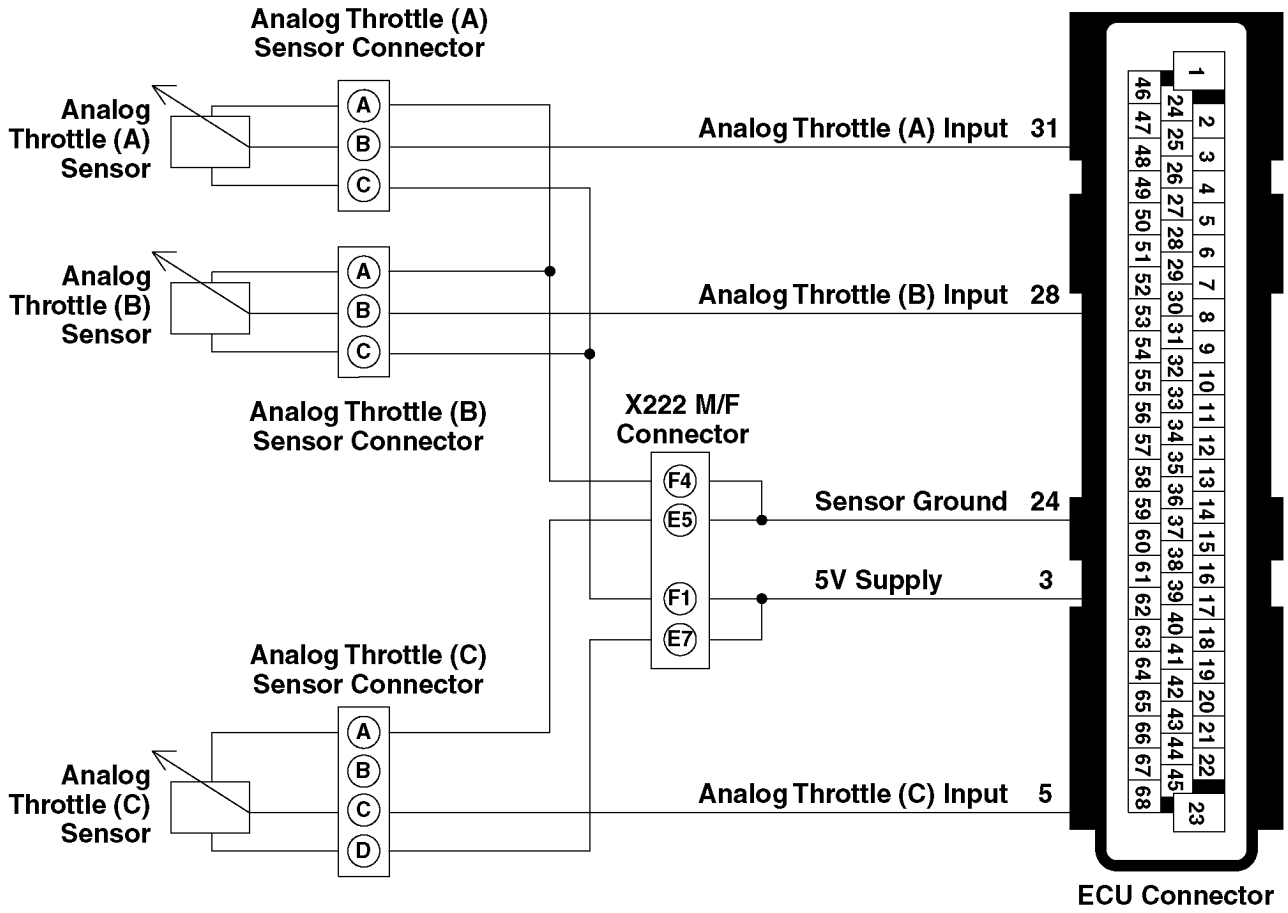
## T17 - Analog Throttle (C) Input High




**Analog Throttle (C) Position Sensor**

- The analog throttle (C) position sensor is a variable resistor (potentiometer) used to measure the position of the cruise throttle. The throttle input voltage normally varies between 0.75 and 4.25 volts depending on throttle position.

**This code will set if:**

- The analog throttle (C) input voltage exceeds the sensor's high voltage specification. The voltage is higher than what is physically possible for the throttle lever to achieve.
  - For OEM applications, the high analog throttle (C) input voltage specification is 4.8 volts.
  - For other applications, see APPLICATION SPECIFICATIONS in Section 06, Group 210 of this manual for the high analog throttle (C) input voltage specification.

**If this code sets, the following will occur:**

- The ECU will ignore the input from the cruise analog throttle, and it will use the input values from the hand and foot analog throttles.
- When this code is set, the ECU will limit the inputs of the hand and foot analog throttles from exceeding 1500 rpm.
- The ECU will set a BLINKING warning light.
- If the hand and foot analog throttles are also faulted, the ECU will use a default "limp-home" throttle value that will only allow idle engine speed.

RG41221,0000141 –19–21OCT02–1/1

## T17 - Analog Throttle (C) Input High

RG41221,0000142 –19–21OCT02–1/1

### T17 - Analog Throttle (C) Input High Diagnostic Procedure

*NOTE: If DTC 000028.03 is accompanied with DTC 001079.03, follow the DTC 001079.03 diagnostic chart first.*

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| ❶ **Connection Check** | **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.**<br><br>*NOTE: For wiring and theory of operation information, see T17 - ANALOG THROTTLE (C) INPUT HIGH supporting information.*<br><br>Before using this diagnostic procedure, perform a preliminary inspection of the ECU connector and the analog throttle (C) sensor connector looking for dirty, damaged, or poorly positioned terminals. | **No faulty connection(s):**<br>GO TO ❷<br><br>**Faulty connection(s):**<br>Repair faulty connection(s). |

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| ❷ **Intermittent Fault Test** | *NOTE: For wiring and theory of operation information, see T17 - ANALOG THROTTLE (C) INPUT HIGH supporting information.*<br><br>1. Connect the DST or SERVICE ADVISOR™. For instructions on connecting to the DST or SERVICE ADVISOR™, see CONNECTING TO DIAGNOSTIC SCAN TOOL (DST) OR SERVICE ADVISOR™earlier in this Group.<br><br>2. Ignition ON, engine OFF<br><br>3. Start the ECU diagnostic software<br><br>4. Throttle (C) in the idle position<br><br>5. Read the analog throttle (C) voltage parameter on DST or SERVICE ADVISOR™.<br><br>*NOTE: For OEM applications, the high analog throttle (C) input voltage is 4.8V. For the high voltage specification on non-OEM applications, see APPLICATION SPECIFICATIONS in Section 06, Group 210 later in this manual.* | **4.8 V or greater:**<br>GO TO ❹<br><br>**Below 4.8 V:**<br>GO TO ❸ |

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| ❸ **Throttle Travel Voltage Test** | *NOTE: For wiring and theory of operation information, see T17 - ANALOG THROTTLE (C) INPUT HIGH supporting information.*<br><br>1. Slowly operate the analog throttle (C) through its full travel.<br><br>2. Using the ECU diagnostic software, read the analog throttle (C) voltage parameter.<br><br>*NOTE: For OEM applications, the high analog throttle (C) input voltage is 4.8V. For the high voltage specification on non-OEM applications, see APPLICATION SPECIFICATIONS in Section 06, Group 210 later in this manual.* | **Goes above 4.8 V:**<br>Faulty analog throttle (C) sensor connector<br>OR<br>Open in analog throttle (C) sensor ground circuit<br>OR<br>Faulty analog throttle (C) sensor<br><br>**Never goes above 4.8 V:**<br>Problem is intermittent. If no other codes are present, see INTERMITTENT FAULT DIAGNOSTICS, earlier in this Group<br><br>– – –1/1 |

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| ❹ **Throttle Position Input Shorted Test** | *NOTE: For wiring and theory of operation information, see T17 - ANALOG THROTTLE (C) INPUT HIGH supporting information.*<br><br>1. Ignition OFF<br><br>2. Disconnect analog throttle (C) sensor connector<br><br>3. Ignition ON, engine OFF<br><br>4. Using the ECU diagnostic software, read the analog throttle (C) voltage parameter.<br><br>*NOTE: For OEM applications, the low analog throttle (C) input voltage is 0.2V. For the low voltage specification on non-OEM applications, see APPLICATION SPECIFICATIONS in Section 06, Group 210 later in this manual.* | **0.2 V or less:**<br>GO TO ❺<br><br>**Above 0.2 V:**<br>Short to voltage in analog throttle input circuit<br>OR<br>Faulty ECU<br><br>– – –1/1 |

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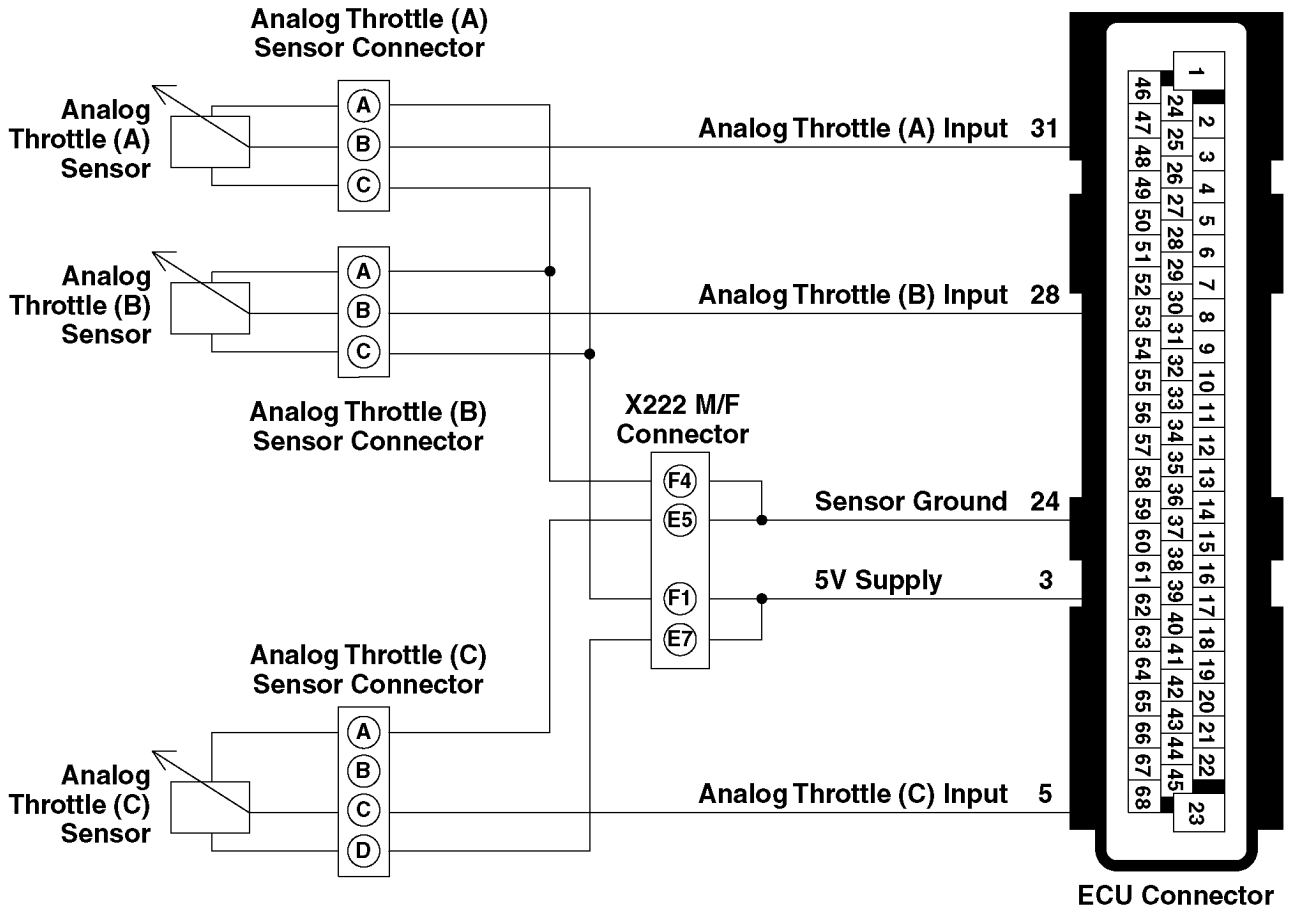
| ❺ **Throttle Position Ground Circuit Open Test** | *NOTE: For wiring and theory of operation information, see T17 - ANALOG THROTTLE (C) INPUT HIGH supporting information.*<br><br>1. Ignition OFF<br><br>2. Analog throttle (C) sensor connector disconnected<br><br>3. Using a test light connected to battery (+), probe the ground terminal in analog throttle (C) sensor connector. | **Light ON:**<br>Faulty analog throttle (C) sensor connector<br>OR<br>Faulty analog throttle (C) sensor<br><br>**Light OFF:**<br>Open in analog throttle (C) ground circuit<br><br>– – –1/1 |

## T18 - Analog Throttle (C) Input Low




**Analog Throttle (C) Position Sensor**

- The analog throttle (C) position sensor is a variable resistor (potentiometer) used to measure the position of the cruise throttle. The throttle input voltage normally varies between 0.75 and 4.25 volts depending on throttle position.

**This code will set if:**

- The analog throttle (C) input voltage drops below the sensor's low voltage specification. The voltage is lower than what is physically possible for the throttle lever to achieve.
  - For OEM applications, the low analog throttle (C) input voltage specification is 0.2 volts.
  - For other applications, see APPLICATION SPECIFICATIONS in Section 06, Group 210 of this manual for the low analog throttle (C) input voltage specification.

**If this code sets, the following will occur:**

- The ECU will ignore the input from the cruise analog throttle, and it will use the input values from the hand and foot analog throttles.
- When this code is set, the ECU will limit the inputs of the hand and foot analog throttles from exceeding 1500 rpm.
- The ECU will set a BLINKING warning light.
- If the hand and foot analog throttles are also faulted, the ECU will use a default "limp-home" throttle value that will only allow idle engine speed.

RG41221,0000143 –19–21OCT02–1/1

## T18 - Analog Throttle (C) Input Low

RG41221,0000144 –19–21OCT02–1/1

### T18 - Analog Throttle (C) Input Low Diagnostic Procedure

*NOTE: If DTC 000028.04 is accompanied with DTC 001079.04, follow the DTC 001079.04 diagnostic chart first.*

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| ❶ **Connection Check** | **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.**<br><br>*NOTE: For wiring and theory of operation information, see T18 - ANALOG THROTTLE (C) INPUT LOW supporting information*<br><br>Before using this diagnostic procedure, perform a preliminary inspection of the ECU connector and the analog throttle (C) sensor connector looking for dirty, damaged, or poorly positioned terminals. | **No faulty connection(s):**<br>GO TO ❷<br><br>**Faulty connection(s):**<br>Repair faulty connection(s). |

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| ❷ **Intermittent Fault Test** | *NOTE: For wiring and theory of operation information, see T18 - ANALOG THROTTLE (C) INPUT LOW supporting information*<br><br>1. Connect the DST or SERVICE ADVISOR™. For instructions on connecting to the DST or SERVICE ADVISOR™, see CONNECTING TO DIAGNOSTIC SCAN TOOL (DST) OR SERVICE ADVISOR™earlier in this Group.<br><br>2. Ignition ON, engine OFF<br><br>3. Start the ECU diagnostic software<br><br>4. Throttle (C) in the idle position<br><br>5. Read the analog throttle (C) voltage parameter<br><br>*NOTE: For OEM applications, the low analog throttle (C) input voltage is 0.2V. For the low voltage specification on non-OEM applications, see APPLICATION SPECIFICATIONS in Section 06, Group 210 later in this manual.* | **0.2 V or less:**<br>GO TO ❹<br><br>**Above 0.2 V:**<br>GO TO ❸ |

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| ❸ **Throttle Travel Voltage Test** | *NOTE: For wiring and theory of operation information, see T18 - ANALOG THROTTLE (C) INPUT LOW supporting information*<br><br>1. Slowly operate the analog throttle (C) through its full travel.<br><br>2. Using the ECU diagnostic software, read the analog throttle (C) voltage parameter.<br><br>*NOTE: For OEM applications, the low analog throttle (C) input voltage is 0.2V. For the low voltage specification on non-OEM applications, see APPLICATION SPECIFICATIONS in Section 06, Group 210 later in this manual.* | **Goes below 0.2 V:**<br>Faulty analog throttle (C) sensor connector<br>OR<br>Open in analog throttle (C) sensor ground circuit<br>OR<br>Faulty analog throttle (C) sensor<br><br>**Never goes below 0.2 V:**<br>Problem is intermittent. If no other codes are present, see INTERMITTENT FAULT DIAGNOSTICS, earlier in this Group<br><br>– – –1/1 |

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|---|---|---|
| ❹ **Throttle Position Wiring Test** | *NOTE: For wiring and theory of operation information, see T18 - ANALOG THROTTLE (C) INPUT LOW supporting information*<br><br>1. Ignition OFF<br><br>2. Disconnect analog throttle (C) sensor connector<br><br>3. Install a jumper wire between the 5 V supply terminal and the input terminal (terminals C and D) in the analog throttle (C) sensor connector.<br><br>4. Ignition ON, engine OFF<br><br>5. Using the ECU diagnostic software, read the analog throttle (C) voltage parameter.<br><br>*NOTE: For OEM applications, the high analog throttle (C) input voltage is 4.8V. For the high voltage specification on non-OEM applications, see APPLICATION SPECIFICATIONS in Section 06, Group 210 later in this manual.* | **Below 4.8 V:**<br>GO TO ❺<br><br>**4.8 V or greater:**<br>Faulty analog throttle (C) sensor connector<br>OR<br>Faulty analog throttle sensor<br><br>– – –1/1 |

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|---|---|---|
| ❺ **Throttle Position 5 V Supply Test** | *NOTE: For wiring and theory of operation information, see T18 - ANALOG THROTTLE (C) INPUT LOW supporting information*<br><br>1. Ignition OFF<br><br>2. Remove jumper wire between the two terminals<br><br>3. Ignition ON, engine OFF<br><br>4. Using a multimeter, measure the voltage between the throttle ground terminal and the 5 V supply terminal (terminals A and D) in the analog throttle (C) sensor connector. | **4.0 - 6.0 V:**<br>Open in analog throttle (C) input circuit<br>OR<br>Short to ground in analog throttle (C) input circuit<br>OR<br>Faulty ECU connection<br>OR<br>Faulty ECU<br><br>**Below 4.0 V:**<br>Open in analog throttle (C) 5 V supply circuit<br>OR<br>Short to ground in analog throttle (C) 5 V supply circuit<br>OR<br>Faulty ECU connection<br>OR<br>Faulty ECU<br><br>– – –1/1 |

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## 000028.03 — Throttle Voltage High

*Throttle voltage is above the specification.*

Diagnostic Trouble Codes (DTCs) assigned to throttles change per application. Choose the application from the list below and go to the corresponding diagnostic procedure earlier in this Group.

| Application | Diagnostic Procedure |
|---|---|
| Excavator | T11 - Excavator Throttle Reference Voltage High |
| OEM | T5 - Analog Throttle (B) Input High |
| Tractor | T17 - Analog Throttle (C) Input High |

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RG41221,00000B3 –19–21JAN03–1/1

## 000028.04 — Throttle Voltage Low

*Throttle voltage is below the specification.*

Diagnostic Trouble Codes (DTCs) assigned to throttles change per application. Choose the application from the list below and go to the corresponding diagnostic procedure earlier in this Group.

| Application | Diagnostic Procedure |
|---|---|
| Excavator | T12 - Excavator Throttle Reference Voltage Low |
| OEM | T6 - Analog Throttle (B) Input Low |
| Tractor | T18 - Analog Throttle (C) Input Low |

RG41221,00000B4 –19–21JAN03–1/1

## 000029.03 — Throttle Voltage High

*Throttle voltage is above the specification.*

Diagnostic Trouble Codes (DTCs) assigned to throttles change per application. Choose the application from the list below and go to the corresponding diagnostic procedure earlier in this Group.

| Application | Diagnostic Procedure |
|---|---|
| Excavator | T13 - Excavator Throttle Ground Voltage High |
| Marine | T5 - Analog Throttle (B) Input High |
| OEM | T3 - Analog Throttle (A) Input High |
| Tractor | T5 - Analog Throttle (B) Input High |



RG41221,00000B5 –19–21JAN03–1/1

## 000029.04 — Throttle Voltage Low

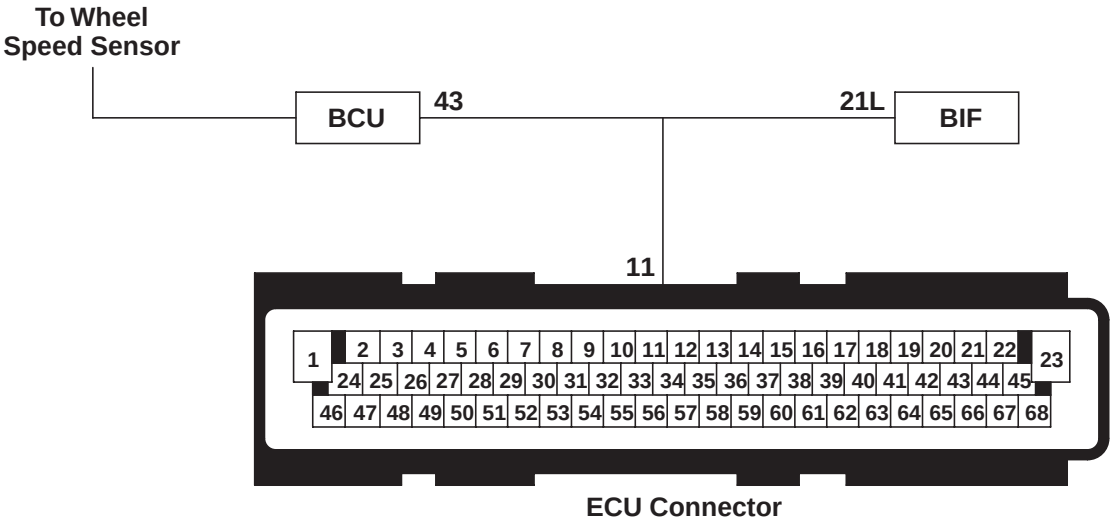
*Throttle voltage is below the specification.*

Diagnostic Trouble Codes (DTCs) assigned to throttles change per application. Choose the application from the list below and go to the corresponding diagnostic procedure earlier in this Group.

| Application | Diagnostic Procedure |
|---|---|
| Excavator | T14 - Excavator Throttle Ground Voltage Low |
| Marine | T6 - Analog Throttle (B) Input Low |
| OEM | T4 - Analog Throttle (A) Input Low |
| Tractor | T6 - Analog Throttle (B) Input Low |

RG41221,00000B6 –19–21JAN03–1/1

## 000084.02 — Vehicle Speed Mismatch




ECU Connector

RG10760 –19–08JUN00

**Vehicle Speed**

- The wheel speed sensor is an inductive type sensor that is mounted on the rear axle. As teeth on the axle rotate past the sensor, AC signals are generated. The frequency of these signals are proportional to the wheel speed. The signal from the sensor is sent to the Basic Control Unit (BCU). The BCU sends a Pulse Width Modulated (PWM) signal to the Basic Informator (BIF) and ECU. Wheel speed is also delivered to the ECU over CAN from the BIF. Both inputs to the ECU must be the same.

**DTC 000084.02 will set if:**

- The wheel speed from the BCU (PWM signal) and the BIF (CAN) do not match at the ECU.

**If DTC 000084.02 sets, the following will occur:**

- ECU will limit engine speed to 1950 rpm.
- DTC 000084.02 may also cause DTC 001069.02 to set. This code will clear once DTC 000084.02 is repaired.
- The ECU will set a BLINKING warning light.

RG41221,0000153 –19–21OCT02–1/1

## 000084.02 — Vehicle Speed Mismatch

*The wheel speed from the BCU (PWM signal) and the BIF (CAN) do not match at the ECU.*

RG41221,0000158 –19–07MAY02–1/1

### 000084.02 Vehicle Speed Mismatch Diagnostic Procedure

*NOTE: If 000084.02 is accompanied with 000810.02, follow that diagnostic procedure first.*



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|---|---|---|
| ❶ **Connection Check** | **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.**<br><br>*NOTE: For wiring and theory of operation information, see DTC 000084.02 VEHICLE SPEED MISMATCH supporting information*<br><br>Before using this diagnostic procedure, perform a preliminary inspection of the ECU, BIF, and BCU connectors looking for dirty, damaged, or poorly positioned terminals. | **No faulty connection(s):** GO TO ❷<br><br>**Faulty connection(s):** Repair faulty connection(s). |

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| ❷ **Intermittent Fault Test** | *NOTE: For wiring and theory of operation information, see DTC 000084.02 VEHICLE SPEED MISMATCH supporting information*<br><br>1. Connect the DST or SERVICE ADVISOR™. For instructions on connecting to the DST or SERVICE ADVISOR™, see CONNECTING TO DIAGNOSTIC SCAN TOOL (DST) OR SERVICE ADVISOR™earlier in this Group.<br>2. Ignition ON, engine OFF<br>3. Start the ECU diagnostic software<br>4. Make note of all DTCs, then clear all DTCs<br>5. Ignition ON, engine running<br>6. Read DTCs using DST or SERVICE ADVISOR™. | **000084.02 reoccurs:** GO TO ❸<br><br>**000084.02 doesn't reoccur:** Problem is intermittent. If no other codes are present, see INTERMITTENT FAULT DIAGNOSTICS, earlier in this Group. |

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| ❸ **CAN Vehicle Speed Check** | *NOTE: For wiring and theory of operation information, see DTC 000084.02 VEHICLE SPEED MISMATCH supporting information*<br>1. Drive vehicle under normal operating conditions<br>2. Read the CAN vehicle speed parameter | **Greater than 0 km/hr (0 mph):**<br>GO TO ❺<br>**0 km/hr (0 mph):**<br>GO TO ❹<br>– – –1/1 |

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| ❹ **BCU to BIF PWM Wire Check** | *NOTE: For wiring and theory of operation information, see DTC 000084.02 VEHICLE SPEED MISMATCH supporting information*<br>1. Ignition OFF<br>2. Disconnect BCU connector and BIF connector.<br>3. Using multimeter, measure resistance between terminal 43 of BCU connector and terminal 21L of BIF connector. | **5 ohms or less:**<br>Possible CAN error - follow vehicle CAN diagnostic procedure<br>**Greater than 5 ohms:**<br>Open in wheel speed sensor wire between BCU and BIF wire.<br>– – –1/1 |

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| ❺ **Calculated Vehicle Speed Check** | *NOTE: For wiring and theory of operation information, see DTC 000084.02 VEHICLE SPEED MISMATCH supporting information*<br>1. Drive vehicle under normal operating conditions<br>2. Read the calculated vehicle speed parameter | **Greater than 0 rpm:**<br>Tire size misprogrammed in BIF<br>**0 rpm:**<br>GO TO ❻<br>– – –1/1 |

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| ❻ **BCU to ECU PWM Wire Check** | *NOTE: For wiring and theory of operation information, see DTC 000084.02 VEHICLE SPEED MISMATCH supporting information*<br>1. Ignition OFF<br>2. Disconnect ECU connector and BCU connector.<br>3. Using multimeter, measure resistance between terminal 11 of ECU connector and terminal 43 of BCU connector. | **5 ohms or less:**<br>Faulty ECU connector<br>OR<br>Faulty ECU<br>**Greater than 5 ohms:**<br>Open in wheel speed sensor wire between ECU and BCU.<br>– – –1/1 |

## 000091.03 — Throttle Voltage High

*Throttle voltage is below the specification.*

Diagnostic Trouble Codes (DTCs) assigned to throttles change per application. Choose the application from the list below and go to the corresponding diagnostic procedure earlier in this Group.

| Application | Diagnostic Procedure |
|---|---|
| Excavator | T15 - Excavator Throttle Signal Voltage High |
| Marine | T3 - Analog Throttle (A) Input High |
| OEM | T1 - Multi-state Throttle Input High |
| Telehandler | T3 - Analog Throttle (A) Input High |
| Tractor | T3 - Analog Throttle (A) Input High |

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RG41221,00000B7 –19–21JAN03–1/1

## 000091.04 — Throttle Voltage Low

*Throttle voltage is below the specification.*

Diagnostic Trouble Codes (DTCs) assigned to throttles change per application. Choose the application from the list below and go to the corresponding diagnostic procedure earlier in this Group.

| Application | Diagnostic Procedure |
|---|---|
| Excavator | T16 - Excavator Throttle Signal Voltage Low |
| Marine | T4 - Analog Throttle (A) Input Low |
| OEM | T2 - Multi-state Throttle Input Low |
| Telehandler | T4 - Analog Throttle (A) Input Low |
| Tractor | T4 - Analog Throttle (A) Input Low |



RG41221,00000B8 –19–21JAN03–1/1

## 000091.09 — Throttle Invalid

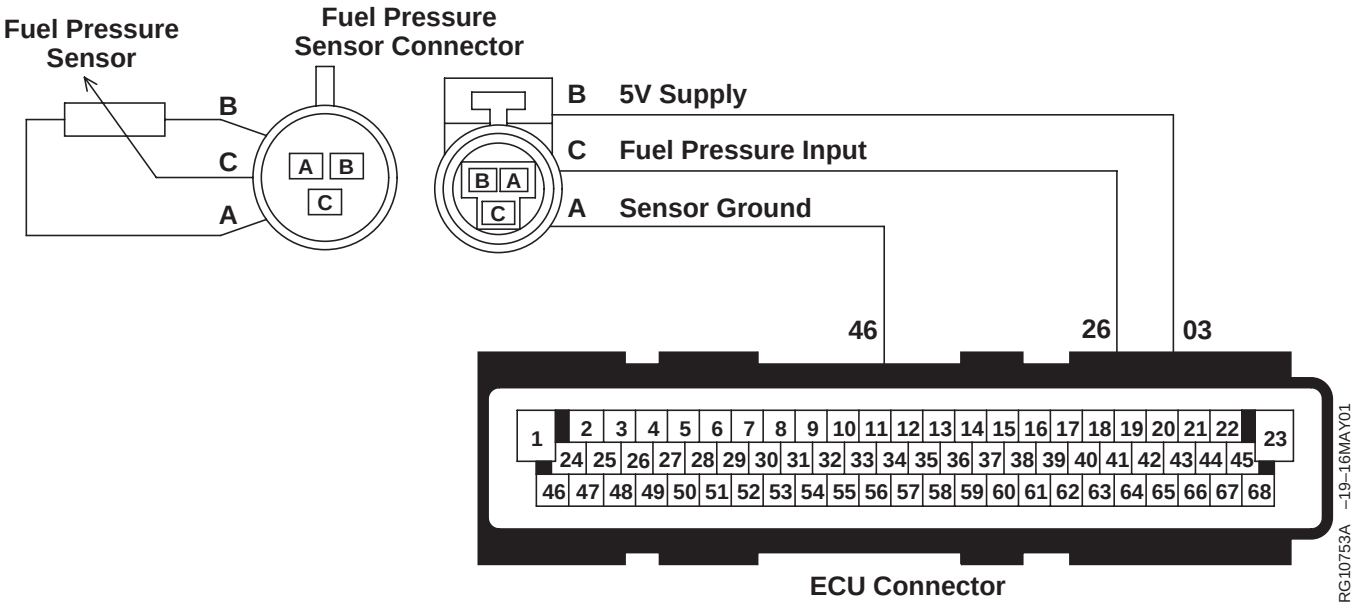
*ECU received invalid or missing throttle information.*

Diagnostic Trouble Codes (DTCs) assigned to throttles change per application. Choose the application from the list below and go to the corresponding diagnostic procedure earlier in this Group.

| Application | Diagnostic Procedure |
|---|---|
| Combine | T7 - CAN Throttle Invalid |

RG41221,00000B9 –19–21JAN03–1/1

## 000094.01 — Fuel Supply Pressure Extremely Low

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*NOTE: Wiring schematic shows OEM engine applications only. For wiring information on other applications, see APPLICATION SPECIFICATIONS in Section 06, Group 210 of this manual.*

**Fuel Pressure Sensor**

- The fuel pressure sensor, is located in the fuel filter housing and uses a pressure transducer to measure fuel pressure before the injection pump. As fuel pressure increases, the input voltage to the ECU increases. For further fuel pressure sensor information, see MEASURING PRESSURE in Section 03, Group 140 earlier in this manual.

**DTC 000094.01 will set if:**

- The ECU senses that fuel pressure is below -11 kPa (-0.11 bar) (-1.6 psi) with engine speed above low idle for more than 30 seconds.

**If DTC 000094.01 sets, the following will occur:**

- On OEM applications, the ECU will derate the engine 150 rpm per minute until the engine is running at 1200 rpm. For non-OEM applications, see APPLICATION SPECIFICATIONS in Section 06, Group 210 of this manual.
- The ECU will set a BLINKING stop lamp.
- The code will not clear unless a key-on/key-off cycle is performed.

RG41221,0000157 –19–21OCT02–1/1

## 000094.01 — Fuel Supply Pressure Extremely Low

*The ECU senses that fuel pressure is below specification with engine speed above low idle for more than 30 seconds.*

RG41221,0000159 –19–21OCT02–1/1

### 000094.01 Fuel Supply Pressure Extremely Low Diagnostic Procedure

*NOTE: If DTC 000094.01 is accompanied with DTC 000094.03 or 000094.04, follow that diagnostic procedure before DTC 000094.01.*

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|---|---|---|
| ❶ **Connection Check** | **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.**<br><br>*NOTE: For wiring and theory of operation information, see DTC 000094.01 FUEL SUPPLY PRESSURE EXTREMELY LOW supporting information*<br><br>Before using this diagnostic procedure, perform a preliminary inspection of the ECU connector, fuel pressure sensor connector, and the transfer pump connector looking for dirty, damaged, or poorly positioned terminals. | **No faulty connection(s):** GO TO ❷<br><br>**Faulty connection(s):** Repair faulty connection(s). |

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| ❷ **Fuel Supply Pressure Test** | *NOTE: For wiring and theory of operation information, see DTC 000094.01 FUEL SUPPLY PRESSURE EXTREMELY LOW supporting information*<br><br>Under the conditions where DTC 000094.01 occurs, measure fuel pressure. See CHECK FUEL SUPPLY PRESSURE in Group 150 of this manual. | **Fuel pressure within specification:** Verify that fuel pressure sensor 5 V supply, input, and ground circuits are OK. If fuel pressure sensor circuits are OK, replace fuel pressure sensor and retest<br><br>**Fuel pressure below specification:** Low fuel pressure problem. See F1 - FUEL SUPPLY SYSTEM CHECK - TIER 1 or F4 - FUEL SUPPLY SYSTEM CHECK - TIER 2 in Group 150 of this manual. |

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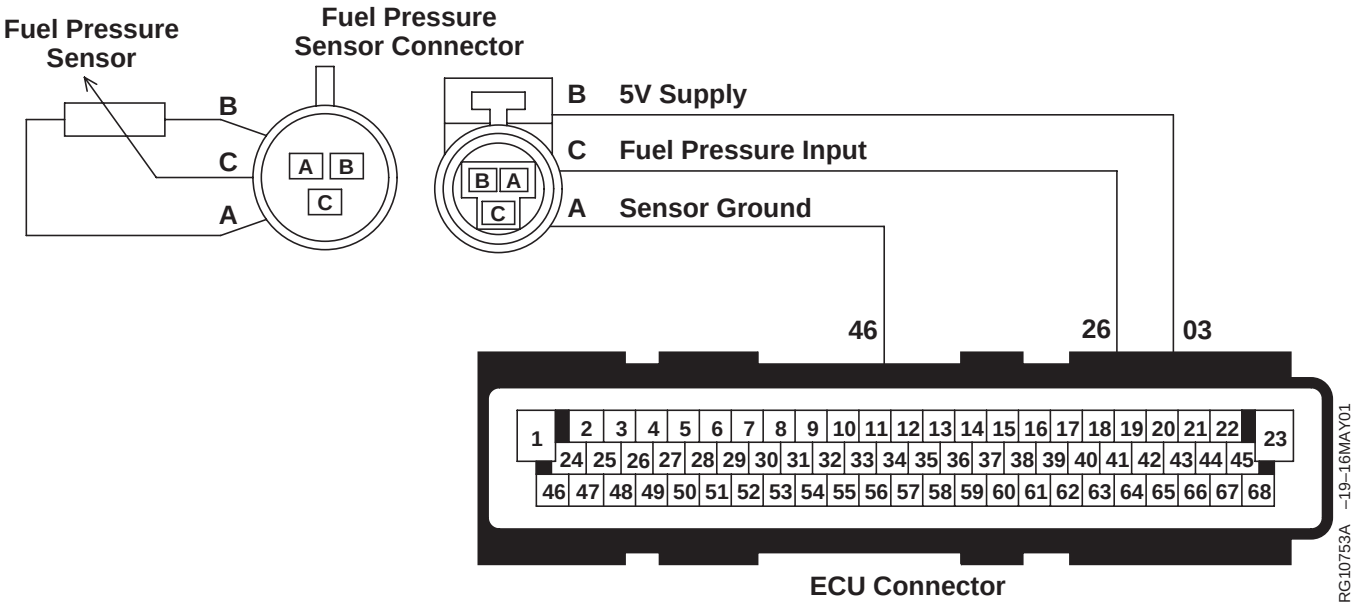
## 000094.03 — Fuel Supply Pressure Input Voltage High

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*NOTE: Wiring schematic shows OEM engine applications only. For wiring information on other applications, see APPLICATION SPECIFICATIONS in Section 06, Group 210 of this manual.*

**Fuel Pressure Sensor**

- The fuel pressure sensor, is located in the fuel filter housing and uses a pressure transducer to measure fuel pressure before the injection pump. As fuel pressure increases, the input voltage to the ECU increases. For further fuel pressure sensor information, see MEASURING PRESSURE in Section 03, Group 140 earlier in this manual.

**DTC 000094.03 will set if:**

- The fuel pressure input voltage exceeds the sensor's high voltage specification. The voltage corresponds to a pressure that is higher than what is physically possible for fuel pressure.
  - – For OEM applications, the high fuel pressure input voltage specification is 4.0 volts for more than 30 seconds.
  - – For other applications, see APPLICATION SPECIFICATIONS in Section 06, Group 210 of this manual for the high fuel pressure input voltage specification.

**If DTC 000094.03 sets, the following will occur:**

- The ECU will run the engine with a default fuel pressure of -12 kPa (-0.12 bar) (-1.74 psi).
- The ECU will set codes DTC 000094.01 and 000094.18.
- The ECU will derate the engine 150 rpm per minute until the engine is running at 1200 rpm.
- The ECU will set a BLINKING warning light and set a BLINKING stop lamp when DTC 000094.01 is set.
- The code will not clear unless a key-on/key-off cycle is performed.

RG41221,000015A –19–21OCT02–1/1

## 000094.03 — Fuel Supply Pressure Input Voltage High

*The fuel pressure input voltage exceeds the sensor's high voltage specification.*

RG41221,000015C –19–21OCT02–1/1

### 000094.03 Fuel Supply Pressure Input Voltage High Diagnostic Procedure

*NOTE: If DTC 000094.03 is accompanied with DTC 001080.03, follow that diagnostic procedure before DTC 000094.03.*

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| ❶ **Connection Check** | **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.**<br><br>*NOTE: For wiring and theory of operation information, see DTC 000094.03 FUEL SUPPLY PRESSURE INPUT VOLTAGE HIGH supporting information*<br><br>Before using this diagnostic procedure, perform a preliminary inspection of the ECU connector, fuel pressure sensor connector, and the transfer pump connector looking for dirty, damaged, or poorly positioned terminals. | **No faulty connection(s):** GO TO ❷<br><br>**Faulty connection(s):** Repair faulty connection(s). |

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| ❷ **Intermittent Fault Test** | *NOTE: For wiring and theory of operation information, see DTC 000094.03 FUEL SUPPLY PRESSURE INPUT VOLTAGE HIGH supporting information*<br><br>1. Connect the DST or SERVICE ADVISOR™. For instructions on connecting to the DST or SERVICE ADVISOR™, see CONNECTING TO DIAGNOSTIC SCAN TOOL (DST) OR SERVICE ADVISOR™earlier in this Group.<br>2. Ignition ON, engine OFF<br>3. Start the ECU diagnostic software<br>4. Make note of any DTCs, then clear all DTCs<br>5. Ignition ON, engine running.<br>6. Read DTCs using DST or SERVICE ADVISOR™. | **000094.03 reoccurs:** GO TO ❸<br><br>**000094.03 doesn't reoccur:** Problem is intermittent. If no other codes are present, see INTERMITTENT FAULT DIAGNOSTICS, earlier in this Group. |

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| ❸ **Fuel Pressure Signal Shorted Check** | *NOTE: For wiring and theory of operation information, see DTC 000094.03 FUEL SUPPLY PRESSURE INPUT VOLTAGE HIGH supporting information*<br><br>1. Ignition OFF<br><br>2. Disconnect fuel pressure sensor connector.<br><br>3. Ignition ON, engine OFF<br><br>4. Read fuel pressure input voltage. | **0.1 V or below:**<br>GO TO ❹<br><br>**Above 0.1 V:**<br>Short to voltage in fuel pressure sensor signal circuit<br>OR<br>Faulty ECU<br><br>– – –1/1 |

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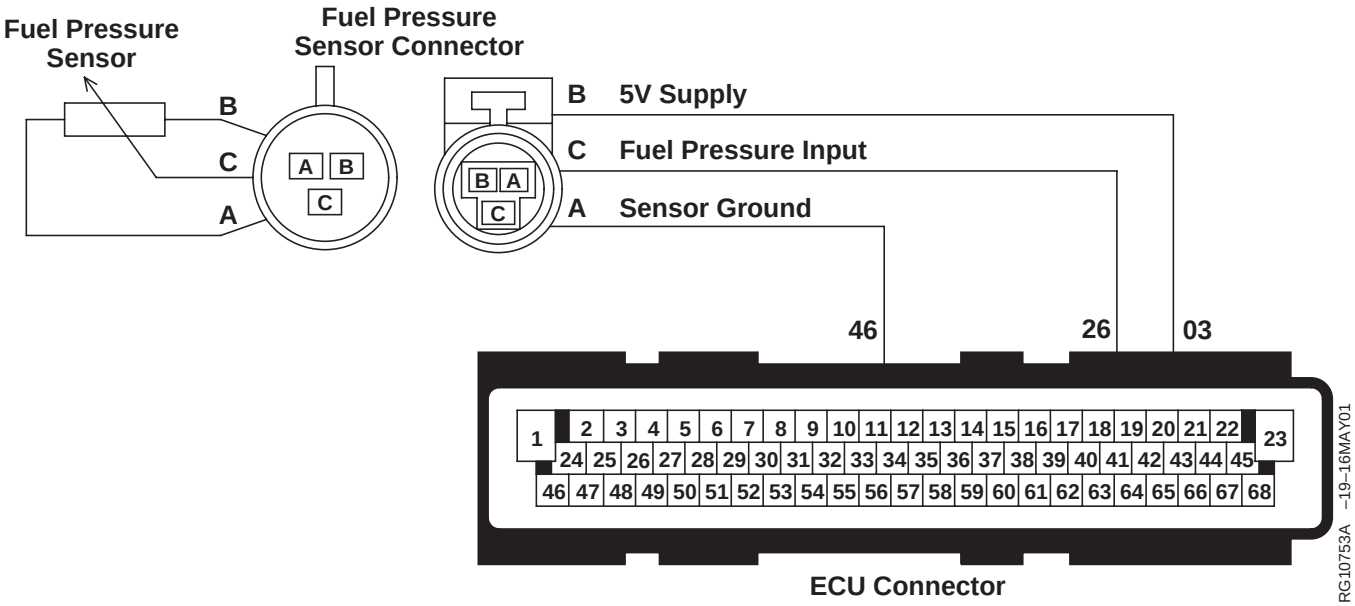
| ❹ **Fuel Pressure Ground Circuit Open Test** | *NOTE: For wiring and theory of operation information, see DTC 000094.03 FUEL SUPPLY PRESSURE INPUT VOLTAGE HIGH supporting information*<br><br>1. Ignition ON, engine OFF<br><br>2. Fuel pressure sensor still disconnected.<br><br>3. Probe fuel pressure sensor ground (terminal A) in sensor harness connector with a test light connected to battery voltage. | **Light ON:**<br>Faulty fuel pressure sensor<br>OR<br>Faulty ECU connection<br>OR<br>Faulty ECU<br><br>**Light OFF:**<br>Open in fuel pressure sensor ground circuit<br>OR<br>Faulty ECU connection<br>OR<br>Faulty ECU<br><br>– – –1/1 |

## 000094.04 — Fuel Supply Pressure Input Voltage Low

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*NOTE: Wiring schematic shows OEM engine applications only. For wiring information on other applications, see APPLICATION SPECIFICATIONS in Section 06, Group 210 of this manual.*

**Fuel Pressure Sensor**

- The fuel pressure sensor, is located in the fuel filter housing and uses a pressure transducer to measure fuel pressure before the injection pump. As fuel pressure increases, the input voltage to the ECU increases. For further fuel pressure sensor information, see MEASURING PRESSURE in Section 03, Group 140 earlier in this manual.

**DTC 000094.04 will set if:**

- The fuel 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 fuel pressure.
  - – For OEM applications, the low fuel pressure input voltage specification is 0.1 volts for more than 30 seconds.
  - – For other applications, see APPLICATION SPECIFICATIONS in Section 06, Group 210 of this manual for the low fuel pressure input voltage specification.

**If DTC 000094.04 sets, the following will occur:**

- The ECU will run the engine with a default fuel pressure of -12 kPa (-0.12 bar) (-1.74 psi).
- The ECU will set codes DTC 000094.01 and 000094.18.
- The ECU will derate the engine 150 rpm per minute until the engine is running at 1200 rpm.
- The ECU will set a BLINKING warning light and set a BLINKING stop lamp when DTC 000094.01 is set.
- The code will not clear unless a key-on/key-off cycle is performed.

DPSG,RG40854,497 –19–21OCT02–1/1

## 000094.04 — Fuel Supply Pressure Input Voltage Low

*The fuel pressure input voltage drops below the sensor's low voltage specification.*

RG41221,000015E –19–21OCT02–1/1

### 000094.04 Fuel Supply Pressure Input Voltage Low Diagnostic Procedure

*NOTE: If DTC 000094.04 is accompanied with DTC 001080.04, follow that diagnostic procedure before DTC 000094.04.*

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| ❶ **Connection Check** | **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.**<br><br>*NOTE: For wiring and theory of operation information, see DTC 000094.04 FUEL SUPPLY PRESSURE INPUT VOLTAGE LOW supporting information*<br><br>Before using this diagnostic procedure, perform a preliminary inspection of the ECU connector, fuel pressure sensor connector, and the transfer pump connector looking for dirty, damaged, or poorly positioned terminals. | **No faulty connection(s):** GO TO ❷<br><br>**Faulty connection(s):** Repair faulty connection(s). |

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| ❷ **Intermittent Fault Test** | *NOTE: For wiring and theory of operation information, see DTC 000094.04 FUEL SUPPLY PRESSURE INPUT VOLTAGE LOW supporting information*<br><br>1. Connect the DST or SERVICE ADVISOR™. For instructions on connecting to the DST or SERVICE ADVISOR™, see CONNECTING TO DIAGNOSTIC SCAN TOOL (DST) OR SERVICE ADVISOR™earlier in this Group.<br>2. Ignition ON, engine OFF<br>3. Start the ECU diagnostic software<br>4. Make note of any DTCs, then clear all DTCs<br>5. Ignition ON, engine OFF<br>6. Read DTCs using DST or SERVICE ADVISOR™. | **000094.04 reoccurs:** GO TO ❸<br><br>**000094.04 doesn't reoccur:** Problem is intermittent. If no other codes are present, see INTERMITTENT FAULT DIAGNOSTICS, earlier in this Group. |

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| ❸ **Transfer Pump Operation Check** | *NOTE: For wiring and theory of operation information, see DTC 000094.04 FUEL SUPPLY PRESSURE INPUT VOLTAGE LOW supporting information*<br>1. Ignition OFF<br>2. Wait 5-10 seconds<br>3. Ignition ON, engine OFF<br>4. Listen for transfer pump operation<br>*NOTE: Transfer pump runs for only 40 seconds after key ON* | **Pump ON:**<br>GO TO ❺<br>**Pump OFF:**<br>GO TO ❹<br>– – –1/1 |

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| ❹ **Voltage to Transfer Pump Check** | *NOTE: For wiring and theory of operation information, see DTC 000094.04 FUEL SUPPLY PRESSURE INPUT VOLTAGE LOW supporting information*<br>1. Ignition OFF<br>2. Disconnect transfer pump connector<br>3. Ignition ON, engine OFF<br>4. Using a multimeter, measure voltage between the terminals of the harness side of the transfer pump connector | **Positive voltage:**<br>Faulty transfer pump connector<br>OR<br>Faulty transfer pump<br>**NO voltage:**<br>Faulty transfer pump wiring<br>OR<br>Faulty ECU connector<br>OR<br>Faulty ECU<br>– – –1/1 |

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| ❺ **Fuel Pressure Wiring Test** | *NOTE: For wiring and theory of operation information, see DTC 000094.04 FUEL SUPPLY PRESSURE INPUT VOLTAGE LOW supporting information*<br>1. Ignition OFF<br>2. Disconnect fuel pressure sensor connector<br>3. Install a jumper wire between fuel pressure sensor 5 V supply and fuel pressure sensor input (terminals B and C) in sensor harness connector<br>4. Ignition ON, engine OFF<br>5. Using the ECU diagnostic software, read fuel pressure input voltage. | **Below 4.0 V:**<br>GO TO ❻<br>**4.0 V or greater:**<br>Faulty fuel pressure sensor connector<br>OR<br>Faulty fuel pressure sensor<br>– – –1/1 |

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| ❻ **Fuel Pressure 5 V Supply Test** | *NOTE: For wiring and theory of operation information, see DTC 000094.04 FUEL SUPPLY PRESSURE INPUT VOLTAGE LOW supporting information*<br><br>1. Ignition OFF<br><br>2. Remove jumper wire<br><br>3. Ignition ON, engine OFF<br><br>4. Using a multimeter, measure voltage between fuel pressure sensor 5 V supply terminal (terminal B) in sensor harness connector and a good chassis ground | **4.0 - 6.0 V:**<br>Open in fuel pressure sensor input circuit<br>OR<br>Short to ground in fuel pressure sensor input circuit<br>OR<br>Faulty ECU connector<br>OR<br>Faulty ECU<br><br>**Below 4.0 V:**<br>Open in fuel pressure sensor 5 V supply circuit<br>OR<br>Short to ground in fuel pressure sensor 5 V supply circuit<br>OR<br>Faulty ECU connector<br>OR<br>Faulty ECU<br><br>– – –1/1 |

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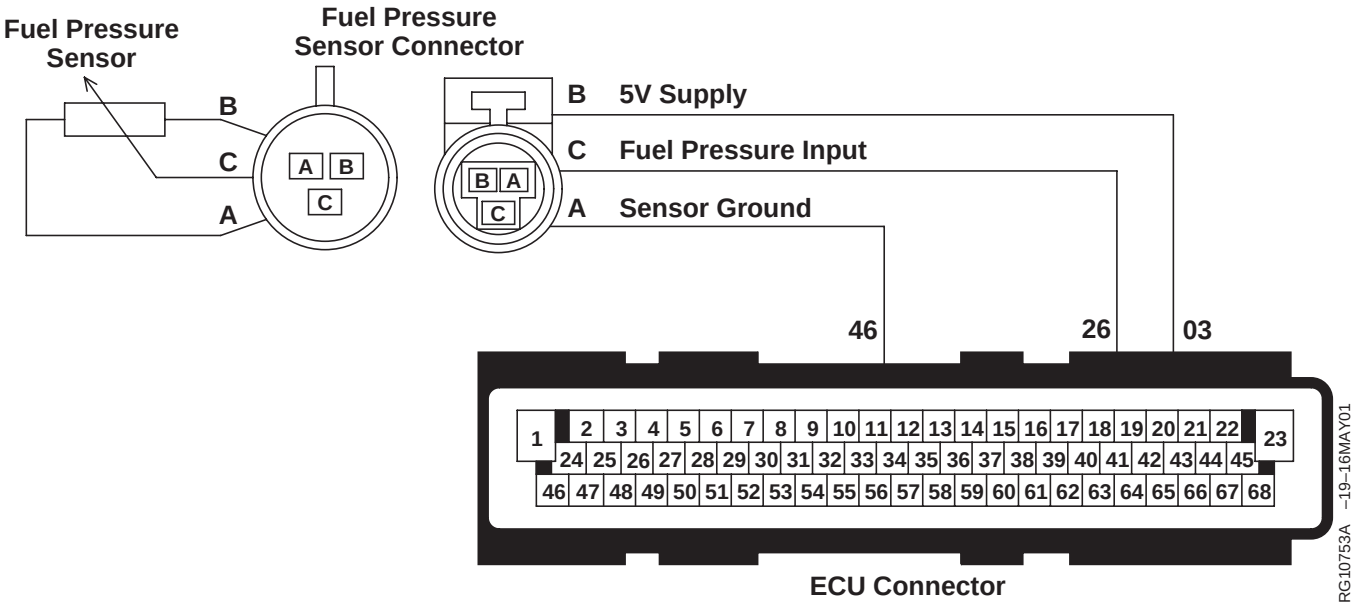
## 000094.18 — Fuel Supply Pressure Moderately Low

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*NOTE: Wiring schematic shows OEM engine applications only. For wiring information on other applications, see APPLICATION SPECIFICATIONS in Section 06, Group 210 of this manual.*

**Fuel Pressure Sensor**

- The fuel pressure sensor, is located in the fuel filter housing and uses a pressure transducer to measure fuel pressure before the injection pump. As fuel pressure increases, the input voltage to the ECU increases. For further fuel pressure sensor information, see MEASURING PRESSURE in Section 03, Group 140 earlier in this manual.

**DTC 000094.18 will set if:**

- The ECU senses that fuel pressure is below -1 kPa (-0.01 bar) (-.15 psi) at any engine speed for more than 30 seconds.

**If DTC 000094.18 sets, the following will occur:**

- The ECU will not derate the engine.
- The ECU will set a BLINKING warning light.

RG41221,0000161 –19–21OCT02–1/1

## 000094.18 — Fuel Supply Pressure Moderately Low

*The ECU senses that fuel pressure is below specification at any engine speed for more than 30 seconds.*

RG41221,0000160 –19–07MAY02–1/1

### 000094.18 Fuel Supply Pressure Moderately Low Diagnostic Procedure

*NOTE: If DTC 000094.18 is accompanied with DTC 000094.03 or 000094.04, follow that diagnostic procedure before DTC 000094.18.*

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| ❶ **Connection Check** | **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.**<br><br>*NOTE: For wiring and theory of operation information, see DTC 000094.18 FUEL SUPPLY PRESSURE MODERATELY LOW supporting information*<br><br>Before using this diagnostic procedure, perform a preliminary inspection of the ECU connector, fuel pressure sensor connector, and the transfer pump connector looking for dirty, damaged, or poorly positioned terminals. | **No faulty connection(s):** GO TO ❷<br><br>**Faulty connection(s):** Repair faulty connection(s). |

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| ❷ **Fuel Supply Pressure Test** | *NOTE: For wiring and theory of operation information, see DTC 000094.18 FUEL SUPPLY PRESSURE MODERATELY LOW supporting information*<br><br>Under the conditions where DTC 000094.18 occurs, measure fuel pressure. See CHECK FUEL SUPPLY PRESSURE in Group 150 of this manual. | **Fuel pressure within specification:** Verify that fuel pressure sensor 5 V supply, input, and ground circuits are OK. If fuel pressure sensor circuits are OK, replace fuel pressure sensor and retest<br><br>**Fuel pressure below specification:** Low fuel pressure problem. See F1 - FUEL SUPPLY SYSTEM CHECK - TIER 1 or F4 - FUEL SUPPLY SYSTEM CHECK - TIER 2 in Group 150 of this manual. |

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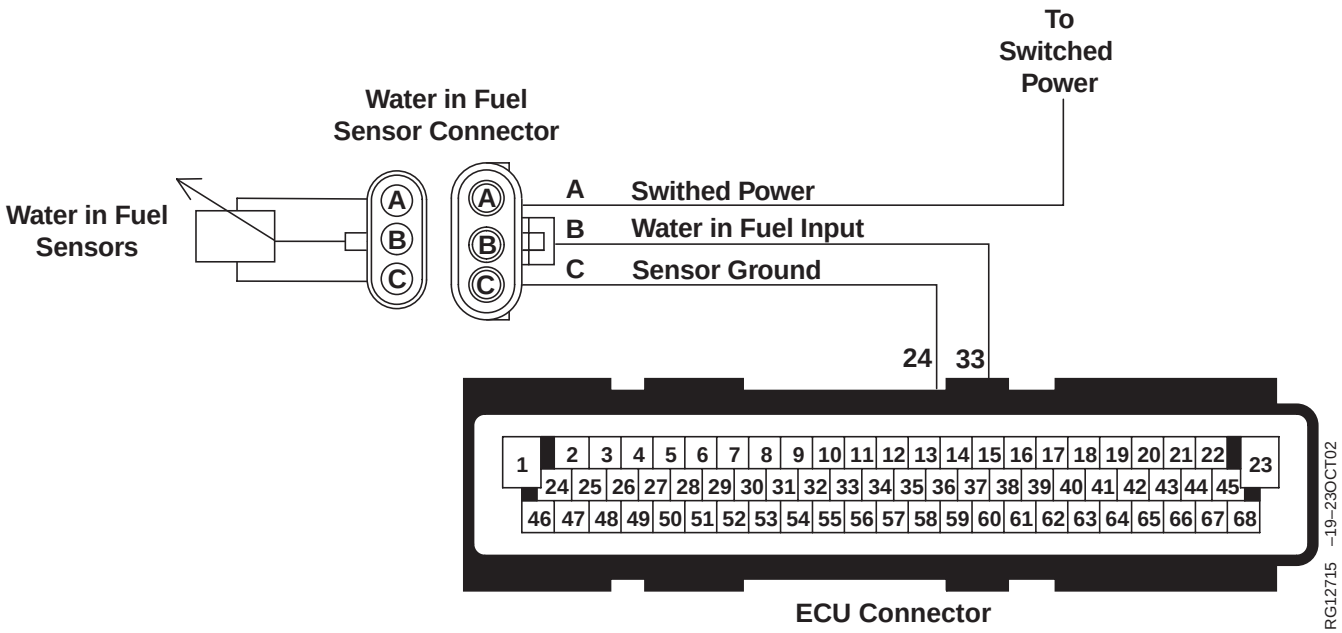
## 000097.00 — Water in Fuel Continuously Detected

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**Water in Fuel (WIF) Sensor**

- The WIF sensor uses the resistance of water and fuel to detect the presence of water in the fuel system. This uses the principle that water is a better conductor of electricity than fuel is. Because of this, the water in fuel sensor will read a lower voltage when water is present than when it is not present. For further WIF sensor information, see WATER IN FUEL (WIF) SENSOR in Section 03, Group 140.

**DTC 000097.00 will set if:**

- The WIF limit is above a predetermined quantity for longer than 3 minutes.

**If DTC 000097.00 sets, the following will occur:**

- Engine protection is enabled. See ENGINE PROTECTION in Section 03, Group 140 earlier in this manual.
  - – With Derate Feature: On OEM applications, the engine derates 2% per minute until the engine is running at 80% of full power. For non-OEM applications, see APPLICATION SPECIFICATIONS in Section 06, Group 210 later in this manual.

RG41221,0000060 –19–21OCT02–1/1

## 000097.00 — Water in Fuel Continuously Detected

*The WIF limit is above a predetermined quantity for longer than 3 minutes.*

RG41221,0000061 –19–21OCT02–1/1

## 000097.00 Water in Fuel Continuously Detected Diagnostic Procedure

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| ❶ **Connection Check** | **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.**<br><br>*NOTE: For wiring and theory of operation , see DTC 000097.00 WATER IN FUEL CONTINUOUSLY DETECTED supporting information.*<br><br>Perform a preliminary inspection of the ECU connectors and the WIF sensor connector looking for dirty, damaged, or poorly positioned terminals. | **No faulty connection(s):**<br>GO TO ❷<br><br>**Faulty Connections:**<br>Repair faulty connection(s). |

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| ❷ **Moisture Buildup Test** | *NOTE: For wiring and theory of operation , see DTC 000097.00 WATER IN FUEL CONTINUOUSLY DETECTED supporting information.*<br><br>1. Connect the DST or SERVICE ADVISOR™. For instructions on connecting to the DST or SERVICE ADVISOR™, see CONNECTING TO DIAGNOSTIC SCAN TOOL (DST) OR SERVICE ADVISOR™ earlier in this Group.<br>2. Ignition ON, engine OFF<br>3. Start the ECU diagnostic software<br>4. Drain sediment bowl on the bottom of the primary fuel filter until all the water is out.<br>5. Operate engine in normal use<br>6. Read DTCs using DST or SERVICE ADVISOR™. | **000097.00 reoccurs:**<br>GO TO ❸<br><br>**000097.00 doesn't reoccur:**<br>Problem was most likely caused by moisture build up over time.<br>Monitor the sediment bowl for moisture periodically, drain as needed. |

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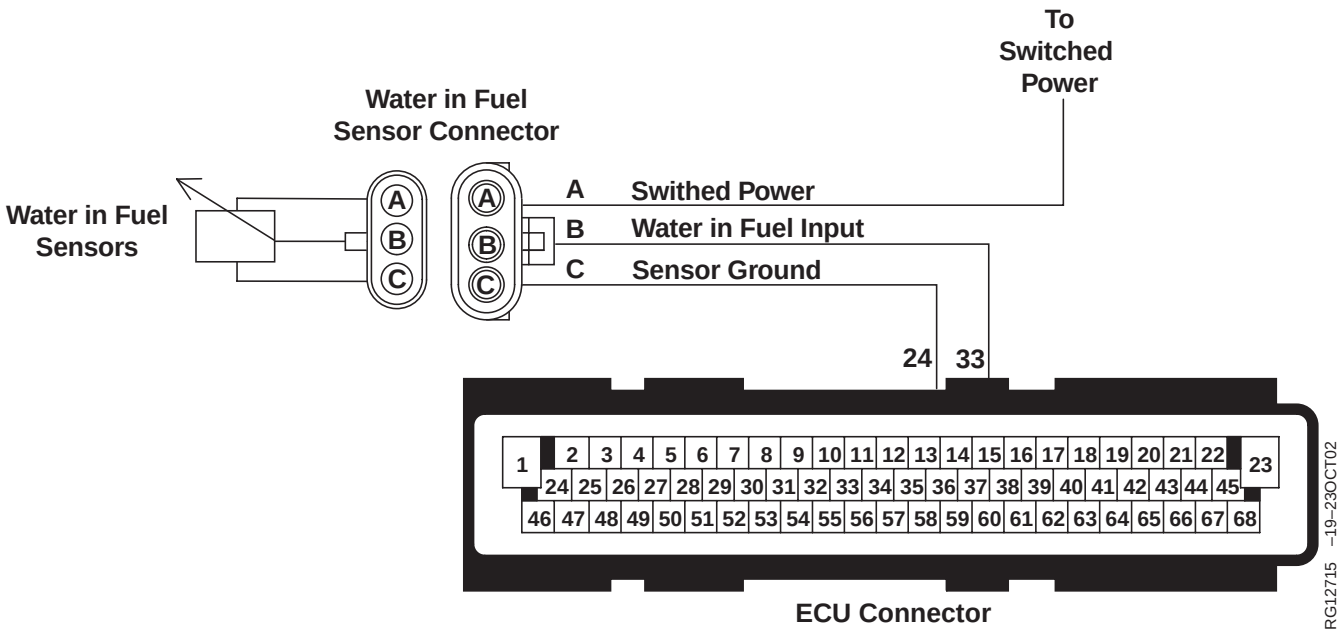
| ❸ **Water in Fuel (WIF) Circuit and Sensor Test** | *NOTE: For wiring and theory of operation , see DTC 000097.00 WATER IN FUEL CONTINUOUSLY DETECTED supporting information.*<br><br>**Check the following items that can cause water in the fuel:**<br><br>• Poor fuel quality or water in fuel storage tank<br>• Loose fuel tank cap<br>• Missing or damaged fuel tank cap seal<br>• Excessive condensation build up in fuel tank<br>• Loose or damaged fuel filter or sediment bowl | **Cause of water in fuel located:**<br>Repair problem, drain sediment bowl, and retest<br><br>**No cause of water in fuel located:**<br>Verify that WIF sensor input and ground circuits are OK.<br>If WIF sensor circuits are OK, replace WIF sensor and retest<br><br>– – –1/1 |

## 000097.16 — Water in Fuel Detected

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**Water in Fuel (WIF) Sensor**

- The WIF sensor uses the resistance of water and fuel to detect the presence of water in the fuel system. This uses the principle that water is a better conductor of electricity than fuel is. Because of this, the water in fuel sensor will read a lower voltage when water is present than when it is not present. For further WIF sensor information, see WATER IN FUEL (WIF) SENSOR in Section 03, Group 140.

**DTC 000097.16 will set if:**

- The WIF limit is above a predetermined quantity for longer than 20 seconds.

**If DTC 000097.16 sets, the following will occur:**

- Engine might not be able to develop full power
- Engine may be difficult to start

RG41221,0000062 –19–21OCT02–1/1

## 000097.16 — Water in Fuel Detected

*The WIF limit is above a predetermined quantity for longer than 20 seconds.*

RG41221,0000063 –19–21OCT02–1/1

## 000097.16 Water in Fuel Detected Diagnostic Procedure



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| ❶ **Connection Check** | **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.**<br><br>*NOTE: For wiring and theory of operation , see DTC 000097.16 WATER IN FUEL DETECTED supporting information.*<br><br>Perform a preliminary inspection of the ECU connectors and the WIF sensor connector looking for dirty, damaged, or poorly positioned terminals. | **No faulty connection(s):**<br>GO TO ❷<br><br>**Faulty Connections:**<br>Repair faulty connection(s). |

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| ❷ **Moisture Buildup Test** | *NOTE: For wiring and theory of operation , see DTC 000097.16 WATER IN FUEL DETECTED supporting information.*<br><br>1. Connect the DST or SERVICE ADVISOR™. For instructions on connecting to the DST or SERVICE ADVISOR™, see CONNECTING TO DIAGNOSTIC SCAN TOOL (DST) OR SERVICE ADVISOR™ earlier in this Group.<br>2. Ignition ON, engine OFF<br>3. Start the ECU diagnostic software<br>4. Drain sediment bowl on the bottom of the primary fuel filter until all the water is out.<br>5. Operate engine in normal use<br>6. Read DTCs using DST or SERVICE ADVISOR™. | **000097.16 reoccurs:**<br>GO TO ❸<br><br>**000097.16 doesn't reoccur:**<br>Problem was most likely caused by moisture build up over time.<br>Monitor the sediment bowl for moisture periodically, drain as needed. |

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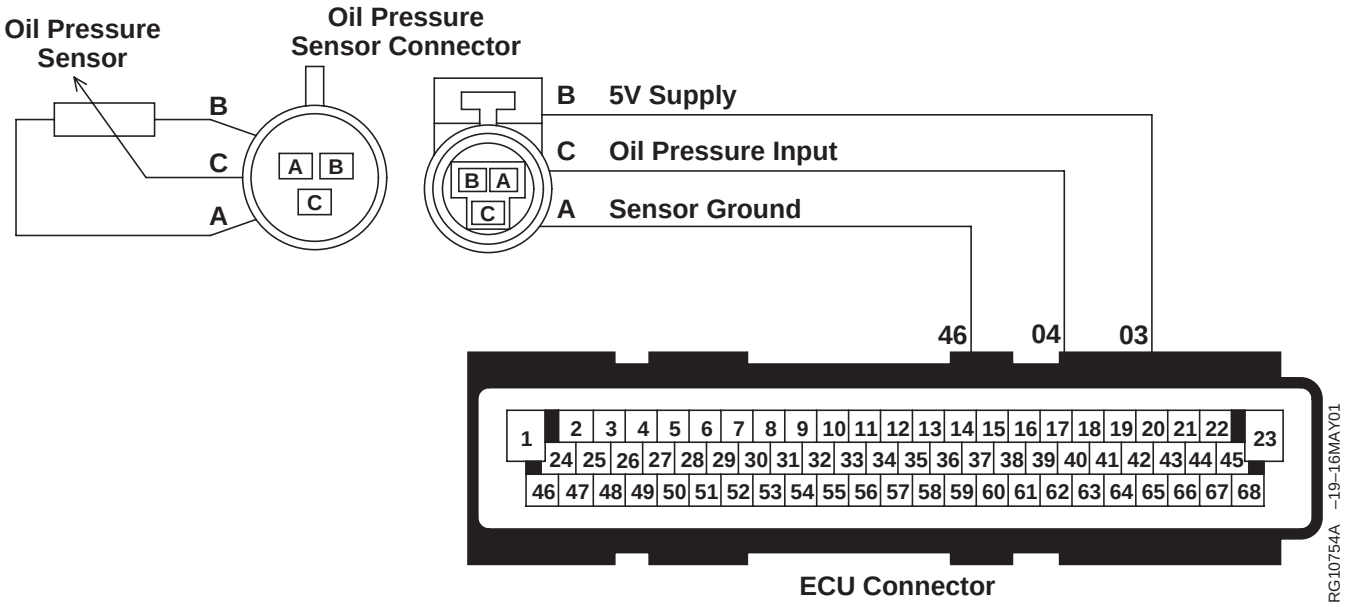
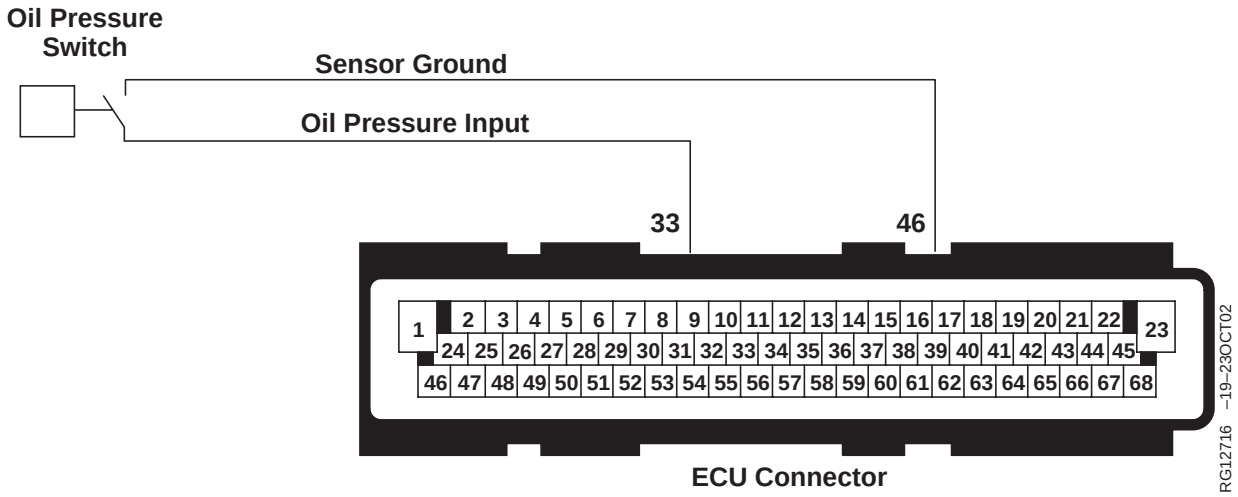
| ❸ **Water in Fuel (WIF) Circuit and Sensor Test** | *NOTE: For wiring and theory of operation , see DTC 000097.16 WATER IN FUEL DETECTED supporting information.*<br><br>**Check the following items that can cause water in the fuel:**<br><br>• Poor fuel quality or water in fuel storage tank<br>• Loose fuel tank cap<br>• Missing or damaged fuel tank cap seal<br>• Excessive condensation build up in fuel tank<br>• Loose or damaged fuel filter or sediment bowl | **Cause of water in fuel located:**<br>Repair problem, drain sediment bowl, and retest<br><br>**No cause of water in fuel located:**<br>Verify that WIF sensor input and ground circuits are OK.<br>If WIF sensor circuits are OK, replace WIF sensor and retest<br><br>– – –1/1 |

## 000100.01 — Engine Oil Pressure Extremely Low




*NOTE: Wiring schematic shows OEM engine and some Combine applications only. For wiring information on other applications, see APPLICATION SPECIFICATIONS in Section 06, Group 210 later in this manual.*

**Oil Pressure Sensor**

- The oil pressure sensor is a pressure transducer connected to the main oil galley. As engine oil pressure increases, the oil pressure sensor input voltage increases. The ECU monitors oil pressure in order to protect the engine in case of a low oil pressure condition. For further oil pressure sensor information, see MEASURING PRESSURE in Group 140 earlier in this manual.
- On some applications an oil pressure switch is used to detect a loss of oil pressure. Oil pressure causes the contacts in the switch to close. When oil pressure drops below the minimum pressure threshold the switch will open. When the engine is not running, the switch is open. For further oil pressure switch information, see MEASURING PRESSURE in Section 03, Group 140.

**DTC 000100.01 will set if:**

Continued on next page
RG41221,0000163 –19–21OCT02–1/2

- For engines with an oil pressure sensor, the ECU senses an oil pressure below 41 kPa (0.41 bar) (6.0 psi) at an engine speed above low idle.
- For engines with an oil pressure switch, the ECU senses that the oil pressure switch is open after the engine is above cranking RPM for several seconds.

**If DTC 000100.01 sets, the following will occur:**

- Engine protection is enabled. See ENGINE PROTECTION in Section 03, Group 140 earlier in this manual.
  - With Shutdown Feature: The derate feature will go into effect when the code is set and the engine will shut down after 30 seconds.
  - With Derate Feature: On OEM applications, the engine derates 60% per minute until the engine is running at 40% of full power. For non-OEM applications, see APPLICATION SPECIFICATIONS in Section 06, Group 210 later in this manual.

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RG41221,0000163 –19–21OCT02–2/2

## 000100.01 — Engine Oil Pressure Extremely Low

*Oil Pressure drops below specification.*

RG41221,0000164 –19–07MAY02–1/1

## 000100.01 Engine Oil Pressure Extremely Low Diagnostic Procedure

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| ❶ **Connection Check** | **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.**<br><br>*NOTE: For wiring and theory of operation information, see DTC 000100.01 ENGINE OIL PRESSURE EXTREMELY LOW supporting information*<br><br>Before using this diagnostic procedure, perform a preliminary inspection of the ECU connector and the oil pressure sensor connector looking for dirty, damaged, or poorly positioned terminals. | **No faulty connection(s):** GO TO ❷<br><br>**Faulty connection(s):** Repair faulty connection(s). |

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| ❷ **Oil Pressure Check** | *NOTE: For wiring and theory of operation information, see DTC 000100.01 ENGINE OIL PRESSURE EXTREMELY LOW supporting information*<br><br>Under the conditions where DTC 000100.01 occurs, measure engine oil pressure. See CHECK ENGINE OIL PRESSURE in Group 150 of 4.5 L & 6.8 L Diesel Engines Base Engine Manual (CTM 104). | **Oil pressure within specification:** Verify that oil pressure sensor 5 V supply, input, and ground circuits are OK. If oil pressure sensor circuits are OK, replace oil pressure sensor and retest.<br><br>**Oil pressure below specification:** Low oil pressure problem. See L2 - ENGINE OIL PRESSURE LOW in Group 150 of 4.5 and 6.8 L Diesel Engines Base Engine Manual (CTM 104). |

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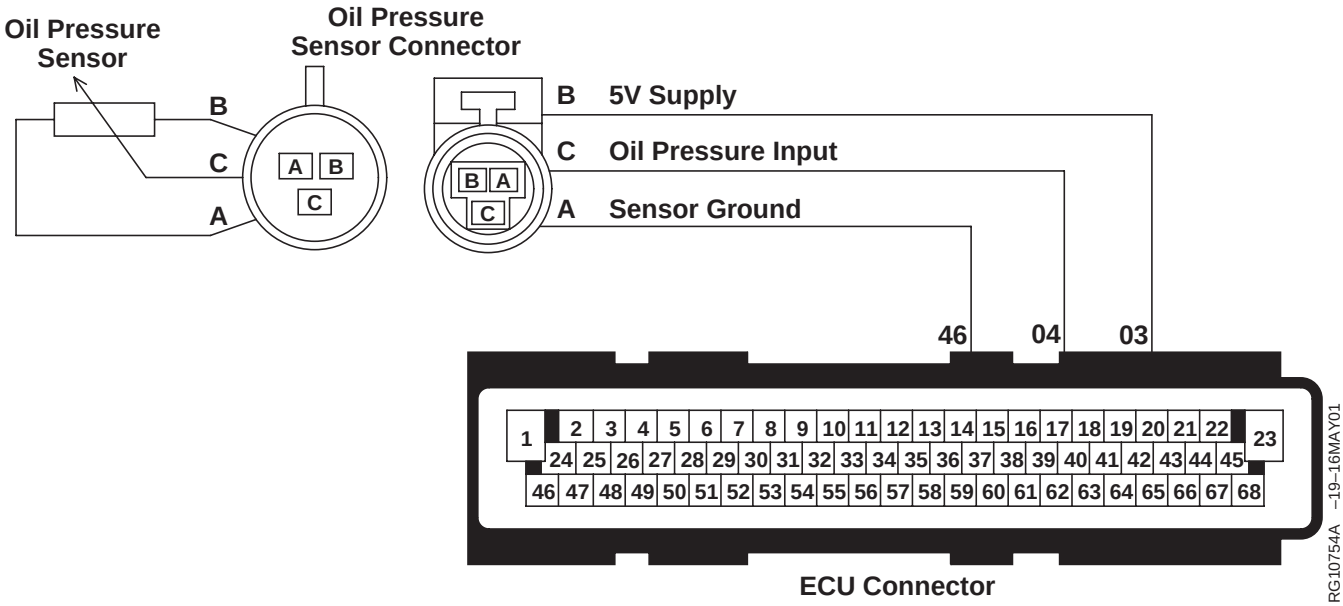
## 000100.03 — Engine Oil Pressure Input Voltage High

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*NOTE: Wiring schematic shows OEM engine applications only. For wiring information on other applications, see APPLICATION SPECIFICATIONS in Section 06, Group 210 of this manual.*

**Oil Pressure Sensor**

- The oil pressure sensor is a pressure transducer connected to the main oil galley. As engine oil pressure increases, the oil pressure sensor input voltage increases. The ECU monitors oil pressure in order to protect the engine in case of a low oil pressure condition. For further oil pressure sensor information, see MEASURING PRESSURE in Group 140 earlier in this manual.

**DTC 000100.03 will set if:**

- The oil pressure input voltage exceeds the sensor's high voltage specification. The voltage corresponds to a pressure that is higher than what is physically possible for oil pressure.
  - – For OEM applications, the high oil pressure input voltage specification is 4.9 volts.
  - – For other applications, see APPLICATION SPECIFICATIONS in Section 06, Group 210 of this manual for the high oil pressure input voltage specification.

**If DTC 000100.03 sets, the following will occur:**

- The ECU will run the engine with a default oil pressure of 260 kPa (2.6 bar) (37.5 psi).
- ECU's low oil pressure engine protection feature disabled.
- The ECU will set a BLINKING warning light.

RG41221,0000166 –19–21OCT02–1/1

## 000100.03 — Engine Oil Pressure Input Voltage High

*The oil pressure input voltage exceeds the sensor's high voltage specification.*

RG41221,0000167 –19–21OCT02–1/1

### 000100.03 Engine Oil Pressure Input Voltage High Diagnostic Procedure

*NOTE: If DTC 000100.03 is accompanied with DTC 001080.03, follow that diagnostic procedure before DTC 001080.03.*

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| ❶ **Connection Check** | **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.**<br><br>*NOTE: For wiring and theory of operation information, see DTC 000100.03 ENGINE OIL PRESSURE INPUT VOLTAGE HIGH supporting information*<br><br>Before using this diagnostic procedure, perform a preliminary inspection of the ECU connector and the oil pressure sensor connector looking for dirty, damaged, or poorly positioned terminals. | **No faulty connection(s):** GO TO ❷<br><br>**Faulty connection(s):** Repair faulty connection(s). |

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| ❷ **Intermittent Fault Test** | *NOTE: For wiring and theory of operation information, see DTC 000100.03 ENGINE OIL PRESSURE INPUT VOLTAGE HIGH supporting information*<br><br>1. Connect the DST or SERVICE ADVISOR™. For instructions on connecting to the DST or SERVICE ADVISOR™, see CONNECTING TO DIAGNOSTIC SCAN TOOL (DST) OR SERVICE ADVISOR™earlier in this Group.<br>2. Ignition ON, engine OFF<br>3. Start the ECU diagnostic software<br>4. Make note of any DTCs, then clear all DTCs<br>5. Ignition ON, engine running<br>6. Read DTCs using DST or SERVICE ADVISOR™. | **000100.03 reoccurs:** GO TO ❸<br><br>**000100.03 doesn't reoccur:** Problem is intermittent. If no other codes are present, see INTERMITTENT FAULT DIAGNOSTICS, earlier in this Group. |

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| ❸ **Oil Pressure Input Shorted Test** | *NOTE: For wiring and theory of operation information, see DTC 000100.03 ENGINE OIL PRESSURE INPUT VOLTAGE HIGH supporting information*<br><br>1. Ignition OFF<br><br>2. Disconnect oil pressure sensor connector<br><br>3. Ignition ON, engine OFF<br><br>4. Using the ECU diagnostic software, read oil pressure input voltage.<br><br>*NOTE: For OEM applications, the low oil pressure input voltage specification is 0.3V. For the low voltage specification on non-OEM applications, see APPLICATION SPECIFICATIONS in Section 06, Group 210 later in this manual.* | **0.3 V or below:**<br>GO TO ❹<br><br>**Above 0.3 V:**<br>Short to voltage in oil pressure sensor input circuit<br>OR<br>Faulty ECU<br><br>– – –1/1 |

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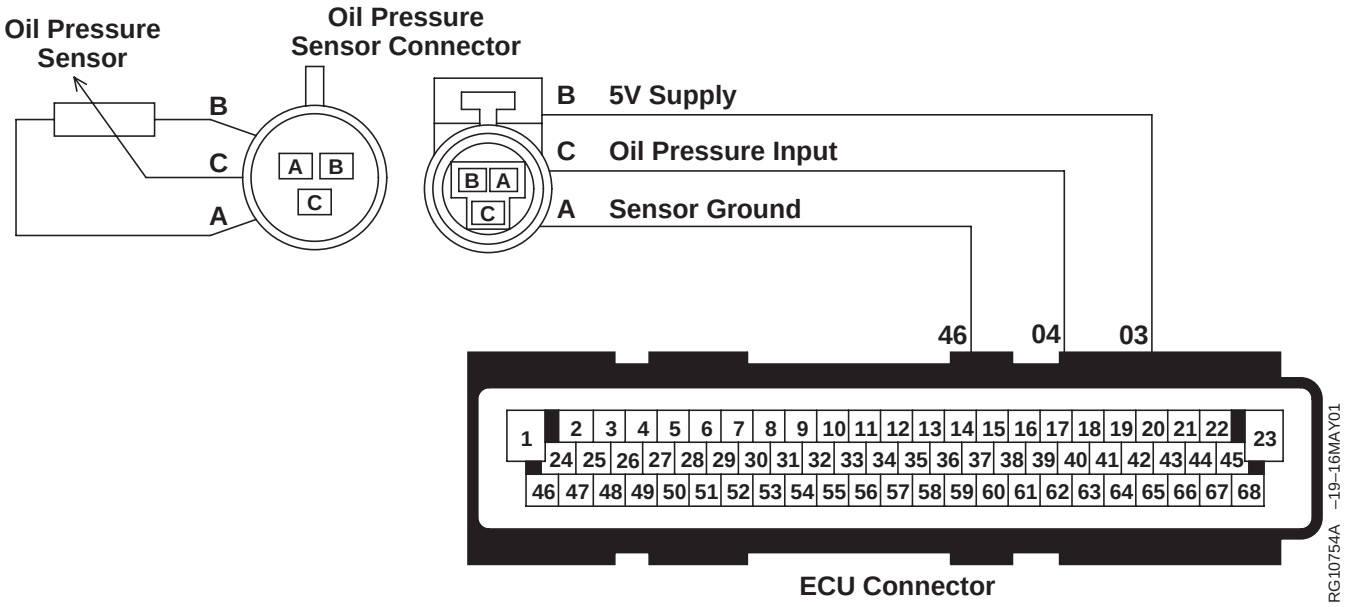
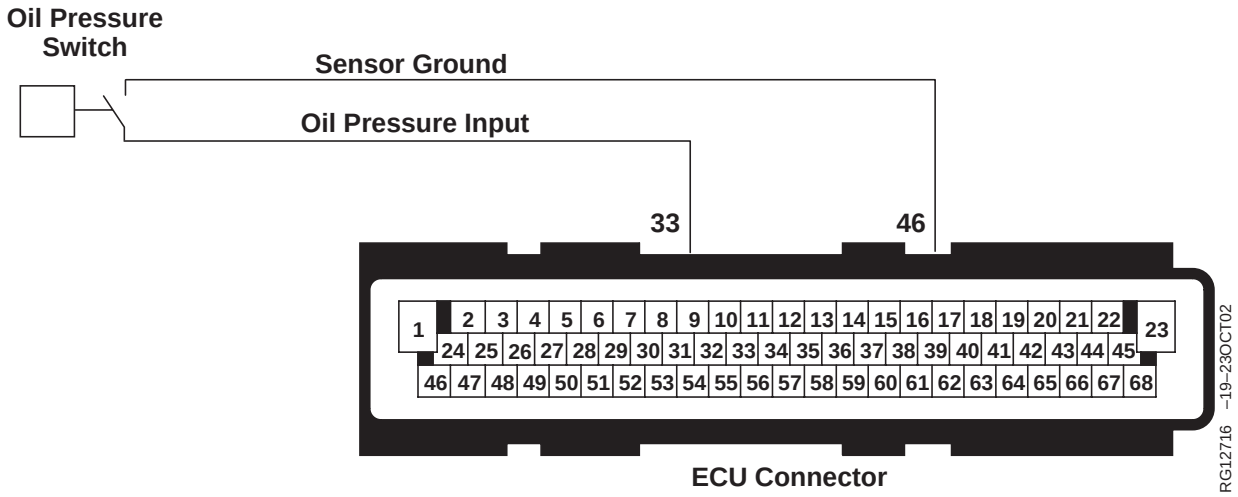
| ❹ **Oil Pressure Ground Circuit Open Test** | *NOTE: For wiring and theory of operation information, see DTC 000100.03 ENGINE OIL PRESSURE INPUT VOLTAGE HIGH supporting information*<br><br>Probe oil pressure sensor ground (terminal A) of the sensor connector on the engine harness with a test light connected to battery voltage. | **Light ON:**<br>Faulty oil pressure sensor<br>OR<br>Faulty ECU connection<br>OR<br>Faulty ECU<br><br>**Light OFF:**<br>Open in oil pressure sensor ground circuit<br>OR<br>Faulty ECU connection<br>OR<br>Faulty ECU<br><br>– – –1/1 |

## 000100.04 Engine Oil Pressure Input Voltage Low




*NOTE: Wiring schematic shows OEM engine applications only. For wiring information on other applications, see APPLICATION SPECIFICATIONS in Section 06, Group 210 of this manual.*

**Oil Pressure Sensor**

- The oil pressure sensor is a pressure transducer connected to the main oil galley. As engine oil pressure increases, the oil pressure sensor input voltage increases. The ECU monitors oil pressure in order to protect the engine in case of a low oil pressure condition. For further oil pressure sensor information, see MEASURING PRESSURE in Group 140 earlier in this manual.
- On some applications an oil pressure switch is used to detect a loss of oil pressure. Oil pressure causes the contacts in the switch to close. When oil pressure drops below the minimum pressure threshold the switch will open. When the engine is not running, the switch is open. For further oil pressure switch information, see MEASURING PRESSURE in Section 03, Group 140.

**DTC 000100.04 will set if:**

Continued on next page
RG41221,0000169 –19–21OCT02–1/2

- 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.
  - For OEM applications, the low oil pressure input voltage specification is 0.3 volts.
  - For other applications, see APPLICATION SPECIFICATIONS in Section 06, Group 210 later in this manual for the low oil pressure input voltage specification.

**If DTC 000100.04 sets, the following will occur:**

- For engines with an oil pressure sensor:
  - The ECU will run the engine with a default oil pressure of 260 kPa (2.6 bar) (37.5 psi).
  - ECU's low oil pressure engine protection feature disabled.
- For engines with an oil pressure switch, the ECU will set a BLINKING warning light.

RG41221,0000169 –19–21OCT02–2/2

## 000100.04 — Engine Oil Pressure Input Voltage Low

*The oil pressure input voltage drops below the sensor's low voltage specification.*

RG41221,000016A –19–21OCT02–1/1

### 000100.04 Engine Oil Pressure Input Voltage Low Diagnostic Procedure

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*NOTE: If DTC 000100.04 is accompanied with DTC 001080.04, follow that diagnostic procedure before DTC 000100.04.*

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| ❶ **Connection Check** | **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.**<br><br>*NOTE: For wiring and theory of operation information, see DTC 000100.04 ENGINE OIL PRESSURE INPUT VOLTAGE LOW supporting information*<br><br>Before using this diagnostic procedure, perform a preliminary inspection of the ECU connector and the oil pressure sensor connector, looking for dirty, damaged, or poorly positioned terminals. | **No faulty connection(s):** GO TO ❷<br><br>**Faulty connection(s):** Repair faulty connection(s). |

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| ❷ **Intermittent Fault Test** | *NOTE: For wiring and theory of operation information, see DTC 000100.04 ENGINE OIL PRESSURE INPUT VOLTAGE LOW supporting information*<br><br>1. Connect the DST or SERVICE ADVISOR™. For instructions on connecting to the DST or SERVICE ADVISOR™, see CONNECTING TO DIAGNOSTIC SCAN TOOL (DST) OR SERVICE ADVISOR™earlier in this Group.<br>2. Ignition ON, engine OFF<br>3. Start the ECU diagnostic software<br>4. Make note of any DTCs, then clear all DTCs<br>5. Ignition ON, engine running<br>6. Read DTCs using DST or SERVICE ADVISOR™. | **000100.04 reoccurs:** GO TO ❸<br><br>**000100.04 doesn't reoccur:** Problem is intermittent. If no other codes are present, see INTERMITTENT FAULT DIAGNOSTICS, earlier in this Group. |

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| ❸ **Oil Sensor Check** | *NOTE: For wiring and theory of operation information, see DTC 000100.04 ENGINE OIL PRESSURE INPUT VOLTAGE LOW supporting information*<br><br>Determine whether an oil pressure sensor or an oil pressure switch is being used. | **Oil pressure sensor being used:**<br>GO TO ❹<br><br>**Oil pressure switch being used:**<br>GO TO ❻<br><br>– – –1/1 |

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| ❹ **Oil Pressure Sensor and Connector Test** | *NOTE: For wiring and theory of operation information, see DTC 000100.04 ENGINE OIL PRESSURE INPUT VOLTAGE LOW supporting information*<br><br>1. Ignition OFF<br><br>2. Disconnect oil pressure sensor connector<br><br>3. Install a jumper wire between 5 V supply and input terminals (terminals B and C) in oil pressure sensor connector on the engine harness.<br><br>4. Ignition ON, engine OFF<br><br>5. Using the ECU diagnostic software, read oil pressure input voltage | **Below 4.9 V:**<br>GO TO ❺<br><br>**4.9 V or greater:**<br>Faulty oil pressure sensor connection<br>OR<br>Faulty oil pressure sensor<br><br>– – –1/1 |

04<br>160<br>,157

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| ❺ **Oil Pressure 5V Supply Test** | *NOTE: For wiring and theory of operation information, see DTC 000100.04 ENGINE OIL PRESSURE INPUT VOLTAGE LOW supporting information*<br><br>1. Ignition OFF<br><br>2. Remove jumper wire<br><br>3. Ignition ON, engine OFF<br><br>4. Using a multimeter, measure voltage between the 5 V supply (terminal B) of the oil pressure sensor connector on the engine harness and a good chassis ground | **4.0 - 6.0 V:**<br>Open in oil pressure sensor input circuit<br>OR<br>Short to ground in oil pressure sensor input circuit<br>OR<br>Faulty ECU connection<br>OR<br>Faulty ECU<br><br>**Below 4.0 V:**<br>Open in oil pressure sensor 5 V supply circuit<br>OR<br>Short to ground in oil pressure sensor 5 V supply circuit<br>OR<br>Faulty ECU connection<br>OR<br>Faulty ECU<br><br>– – –1/1 |

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| ❻ **Oil Pressure Switch Short in Wire Check** | *NOTE: For wiring and theory of operation information, see DTC 000100.04 ENGINE OIL PRESSURE INPUT VOLTAGE LOW supporting information*<br><br>1. Ignition OFF<br><br>2. Disconnect the oil pressure switch connector and the ECU connector.<br><br>3. Using a multimeter, measure resistance between terminal 33 in the ECU connector on the engine harness and:<br><br>• All other terminals in the ECU connector on the engine harness.<br>• A good chassis ground. | **All measurements greater than 2000 ohms:**<br>Faulty oil pressure switch<br>OR<br>Faulty ECU<br><br>**Any measurement less than 2000 ohms:**<br>Short in oil pressure input wire with low resistance.<br><br>– – –1/1 |

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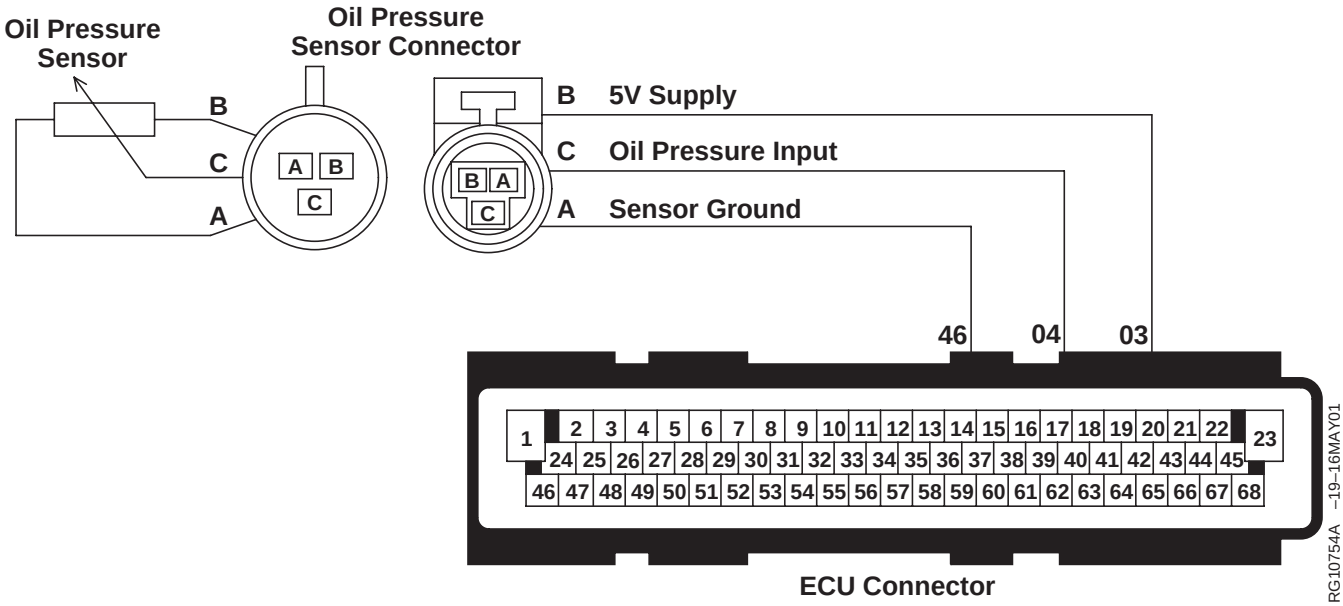
## 000100.18 — Engine Oil Pressure Moderately Low




*NOTE: Wiring schematic shows OEM engine applications only. For wiring information on other applications, see APPLICATION SPECIFICATIONS in Section 06, Group 210 of this manual.*

**Oil Pressure Sensor**

- The oil pressure sensor is a pressure transducer connected to the main oil galley. As engine oil pressure increases, the oil pressure sensor input voltage increases. The ECU monitors oil pressure in order to protect the engine in case of a low oil pressure condition. For further oil pressure sensor information, see MEASURING PRESSURE in Group 140 earlier in this manual.

**DTC 000100.18 will set if:**

- The ECU detects that oil pressure is below 71 kPa (7.1 bar) (10.3 psi) at any engine speed.

**If DTC 000100.18 sets, the following will occur:**

- Engine protection is enabled. See ENGINE PROTECTION in Section 03, Group 140 earlier in this manual.
  - With Derate Feature: On OEM applications, the engine derates 2% per minute until the engine is running at 80% of full power. For non-OEM applications, see APPLICATION SPECIFICATIONS in Section 06, Group 210 later in this manual.

RG41221,000016C –19–21OCT02–1/1

## 000100.18 — Engine Oil Pressure Moderately Low

*The ECU detects that oil pressure is below specification at any engine speed.*

RG41221,000016D –19–07MAY02–1/1

## 000100.18 Engine Oil Pressure Moderately Low Diagnostic Procedure



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| ❶ **Connection Check** | **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.**<br><br>*NOTE: For wiring and theory of operation information, see DTC 000100.18 ENGINE OIL PRESSURE MODERATELY LOW supporting information*<br><br>Before using this diagnostic procedure, perform a preliminary inspection of the ECU connector and the oil pressure sensor connector looking for dirty, damaged, or poorly positioned terminals. | **No faulty connection(s):**<br>GO TO ❷<br><br>**Faulty connection(s):**<br>Repair faulty connection(s). |

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| ❷ **Oil Pressure Check** | *NOTE: For wiring and theory of operation information, see DTC 000100.18 ENGINE OIL PRESSURE MODERATELY LOW supporting information*<br><br>Under the conditions where DTC 000100.18 occurs, measure engine oil pressure. See CHECK ENGINE OIL PRESSURE in Group 150 of 4.5 L & 6.8 L Diesel Engines Base Engine Manual (CTM 104). | **Oil pressure within specification:**<br>Low oil pressure problem. See L2 - ENGINE OIL PRESSURE LOW in Group 150 of 4.5 and 6.8 L Diesel Engines Base Engine Manual (CTM 104).<br><br>**Oil pressure below specification:**<br>Verify that oil pressure sensor 5 V supply, input, and ground circuits are OK.<br>If oil pressure sensor circuits are OK, replace oil pressure sensor and retest. |

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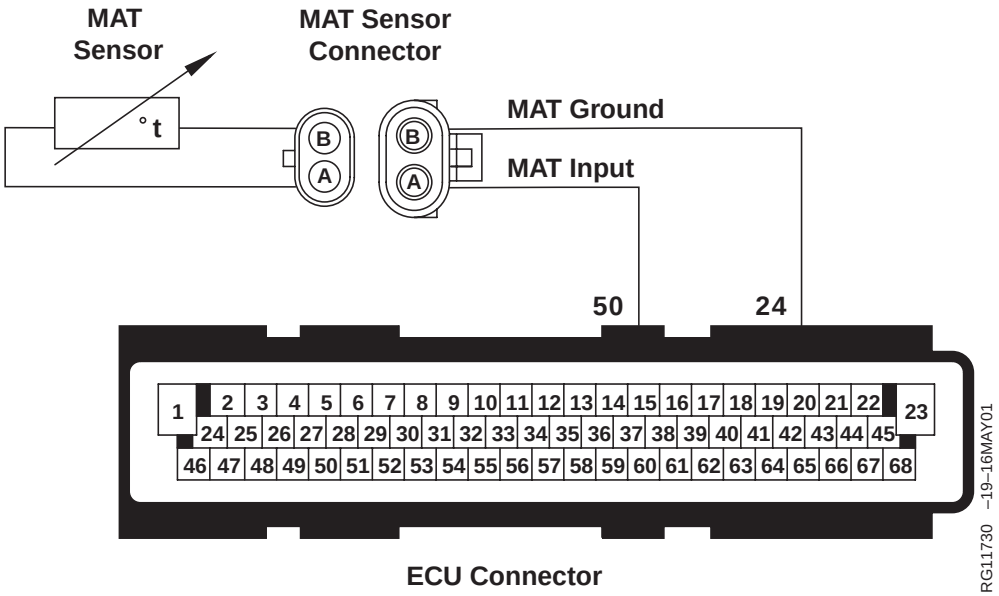
## 000105.00 — Manifold Air Temperature Extremely High




ECU Connector

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*NOTE: Wiring schematic shows OEM engine applications only. For wiring information on other applications, see APPLICATION SPECIFICATIONS in Section 06, Group 210 of this manual.*

**Manifold Air Temperature (MAT) Sensor**

- The MAT sensor is a thermistor (temperature sensitive resistor) mounted in the intake manifold. The MAT sensor is used to measure the temperature of the intake air. The MAT sensor's variable resistance causes the input voltage to the ECU to vary. Higher intake air temperatures result in lower MAT input voltages to the ECU; lower temperatures result in higher voltages. For further MAT sensor information, see MEASURING TEMPERATURE in Section 03, Group 140 earlier in this manual.

**DTC 000105.00 will set if:**

- The ECU senses a manifold air temperature on OEM applications above 100°C (212°F). For manifold air pressure specifications on other applications, see APPLICATION SPECIFICATIONS in Section 06, Group 210 later in this manual.

**If DTC 000105.00 sets, the following will occur:**

- Engine protection is enabled. See ENGINE PROTECTION in Section 03, Group 140 earlier in this manual.
  - With Shutdown Feature: The derate feature will go into effect when the code is set and the engine will shut down after 30 seconds.
  - With Derate Feature: On OEM applications, the engine derates 20% per minute until the engine is running at 60% of full power. For non-OEM applications, see APPLICATION SPECIFICATIONS in Section 06, Group 210 later in this manual.

RG41221,000017B –19–22OCT02–1/1

## 000105.00 — Manifold Air Temperature Extremely High

*The ECU senses a manifold air temperature above specification.*

RG41221,0000180 –19–07MAY02–1/1

## 000105.00 Manifold Air Temperature Extremely High Diagnostic Procedure



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| ❶ **Connection Check** | **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.**<br><br>*NOTE: For wiring and theory of operation information, see DTC 000105.00 MANIFOLD AIR TEMPERATURE EXTREMELY HIGH supporting information.*<br><br>Before using this diagnostic procedure, perform a preliminary inspection of the ECU connectors and the MAT sensor connector looking for dirty, damaged, or poorly positioned terminals. | **No faulty connection(s):** GO TO ❷<br><br>**Faulty connection(s):** Repair faulty connection(s). |

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| ❷ **Failures Causing High MAT Check** | *NOTE: For wiring and theory of operation information, see DTC 000105.00 MANIFOLD AIR TEMPERATURE EXTREMELY HIGH supporting information.*<br><br>Check the following items that can cause high intake air temperatures:<br><br>• Excessively high ambient air temperature.<br>• Restricted, dirty, or damaged charge air cooler.<br>• Loose cooling fan belt.<br>• Malfunctioning cooling fan.<br>• Restricted or damaged intake air piping.<br>• Damaged cooling fan shroud. | **Cause of high MAT located:** Repair problem and retest.<br><br>**No cause of high MAT located:** Verify that MAT sensor input and ground circuits are OK. If MAT sensor circuits are OK, replace MAT sensor and retest. |

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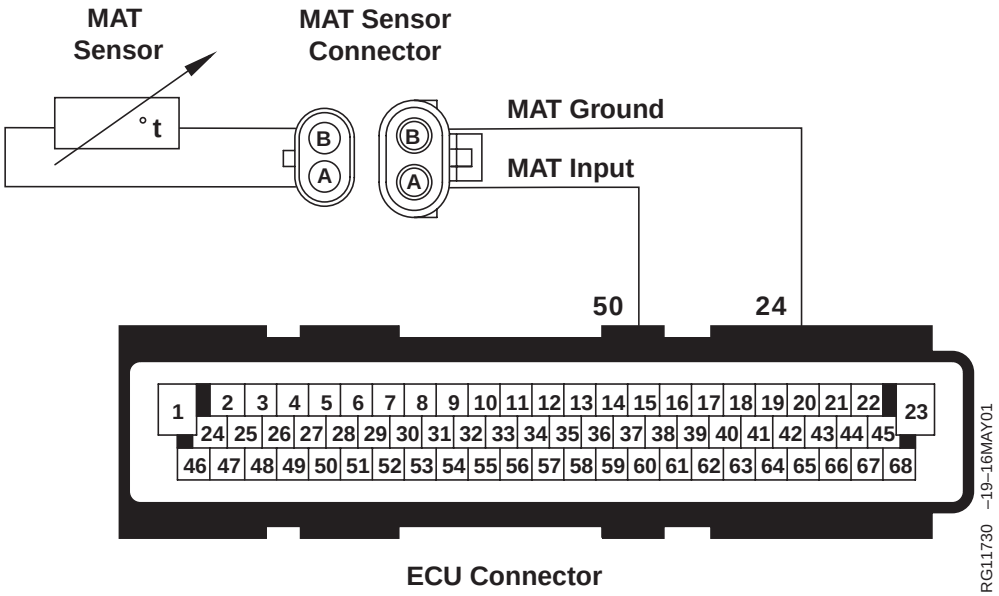
## 000105.03 — Manifold Air Temperature Input Voltage High




ECU Connector

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,164

*NOTE: Wiring schematic shows OEM engine applications only. For wiring information on other applications, see APPLICATION SPECIFICATIONS in Section 06, Group 210 of this manual.*

**Manifold Air Temperature (MAT) Sensor**

- The MAT sensor is a thermistor (temperature sensitive resistor) mounted in the intake manifold. The MAT sensor is used to measure the temperature of the intake air. The MAT sensor's variable resistance causes the input voltage to the ECU to vary. Higher intake air temperatures result in lower MAT input voltages to the ECU; lower temperatures result in higher voltages. For further MAT sensor information, see MEASURING TEMPERATURE in Section 03, Group 140.

**DTC 000105.03 will set if:**

- The manifold air temperature input voltage exceeds the sensor's high voltage specification. The voltage corresponds to a temperature that is lower than what is physically possible for manifold air temperature.
  - – For OEM applications, the high manifold air temperature input voltage specification is 4.9 volts.
  - – For other applications, see APPLICATION SPECIFICATIONS in Section 06, Group 210 of this manual for the high manifold air temperature input voltage specification.

**If DTC 000105.03 sets, the following will occur:**

- The ECU will use a default "limp-home" MAT value of 60°C (140°F).
- ECU's high manifold air temperature engine protection feature disabled.
- The ECU will set a BLINKING warning light.

RG41221,000017C –19–22OCT02–1/1

## 000105.03 — Manifold Air Temperature Input Voltage High

*The manifold air temperature input voltage exceeds the sensor's high voltage specification.*

RG41221,0000183 –19–22OCT02–1/1

## 000105.03 Manifold Air Temperature Input Voltage High Diagnostic Procedure

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| ❶ **Connection Check** | **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.**<br><br>*NOTE: For wiring and theory of operation information, see DTC 000105.03 MANIFOLD AIR TEMPERATURE INPUT VOLTAGE HIGH supporting information.*<br><br>Before using this diagnostic procedure, perform a preliminary inspection of the ECU connectors and the MAT sensor connector looking for dirty, damaged, or poorly positioned terminals. | **No faulty connection(s):** GO TO ❷<br><br>**Faulty connection(s):** Repair faulty connection(s). |

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| ❷ **Intermittent Fault Test** | *NOTE: For wiring and theory of operation information, see DTC 000105.03 MANIFOLD AIR TEMPERATURE INPUT VOLTAGE HIGH supporting information.*<br><br>1. Connect the DST or SERVICE ADVISOR™. For instructions on connecting to the DST or SERVICE ADVISOR™, see CONNECTING TO DIAGNOSTIC SCAN TOOL (DST) OR SERVICE ADVISOR™earlier in this Group.<br>2. Ignition ON, engine OFF<br>3. Start the ECU diagnostic software<br>4. Make note of any DTCs, then clear all DTCs<br>5. Ignition ON, engine OFF<br>6. Read DTCs using DST or SERVICE ADVISOR™. | **000105.03 reoccurs:** GO TO ❸<br><br>**000105.03 doesn't reoccur:** Problem is intermittent. If no other codes are present, see INTERMITTENT FAULT DIAGNOSTICS earlier in this Group. |

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| ❸ **MAT Sensor and Connector Test** | *NOTE: For wiring and theory of operation information, see DTC 000105.03 MANIFOLD AIR TEMPERATURE INPUT VOLTAGE HIGH supporting information.*<br><br>1. Ignition OFF<br><br>2. Disconnect MAT sensor connector<br><br>3. Install a jumper wire between both terminals in the MAT sensor connector on the engine harness.<br><br>4. Ignition ON, engine OFF<br><br>5. Using the ECU diagnostic software, read manifold air temperature input voltage | **Above 0.3 V:**<br>GO TO ❹<br><br>**0.3 V or below:**<br>Faulty MAT sensor connector<br>OR<br>Faulty MAT sensor<br><br>– – –1/1 |

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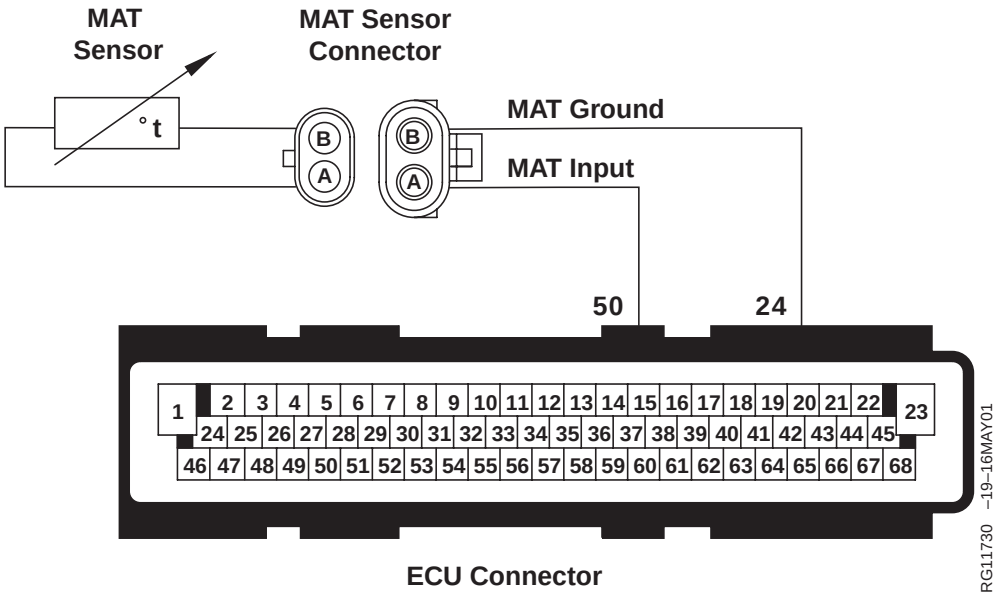
| ❹ **MAT Sensor Open Ground Circuit Test** | *NOTE: For wiring and theory of operation information, see DTC 000105.03 MANIFOLD AIR TEMPERATURE INPUT VOLTAGE HIGH supporting information.*<br><br>1. Ignition OFF<br><br>2. Remove jumper wire between both terminals.<br><br>3. Install jumper wire between MAT input terminal (terminal A) of the sensor connector on the engine harness and a good chassis ground.<br><br>4. Ignition ON, engine OFF<br><br>5. Using the ECU diagnostic software, read manifold air temperature input voltage | **Above 0.3 V:**<br>Open in MAT sensor input circuit<br>OR<br>Faulty ECU connection<br>OR<br>Faulty ECU<br><br>**0.3 V or below:**<br>Open in MAT sensor ground circuit<br>OR<br>Faulty ECU connection<br>OR<br>Faulty ECU<br><br>– – –1/1 |

## 000105.04 Manifold Air Temperature Input Voltage Low




ECU Connector

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*NOTE: Wiring schematic shows OEM engine applications only. For wiring information on other applications, see APPLICATION SPECIFICATIONS in Section 06, Group 210 of this manual.*

**Manifold Air Temperature (MAT) Sensor**

- The MAT sensor is a thermistor (temperature sensitive resistor) mounted in the intake manifold. The MAT sensor is used to measure the temperature of the intake air. The MAT sensor's variable resistance causes the input voltage to the ECU to vary. Higher intake air temperatures result in lower MAT input voltages to the ECU; lower temperatures result in higher voltages. For further MAT sensor information, see MEASURING TEMPERATURE in Section 03, Group 140.

**DTC 000105.04 will set if:**

- The manifold air temperature input voltage drops below the sensor's low voltage specification. The voltage corresponds to a temperature that is higher than what is physically possible for manifold air temperature.
  - – For OEM applications, the low manifold air temperature input voltage specification is 0.3 volts.
  - – For other applications, see APPLICATION SPECIFICATIONS in Section 06, Group 210 later in this manual for the low manifold air temperature input voltage specification.

**If DTC 000105.04 sets, the following will occur:**

- The ECU will use a MAT default "limp-home" MAT value of 60°C (140°F).
- ECU's high manifold air temperature engine protection feature disabled.
- The ECU will set a BLINKING warning light.

RG41221,000017D –19–22OCT02–1/1

## 000105.04 — Manifold Air Temperature Input Voltage Low

*The manifold air temperature input voltage drops below the sensor's low voltage specification.*

RG41221,0000185 –19–22OCT02–1/1

## 000105.04 Manifold Air Temperature Input Voltage Low Diagnostic Procedure

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| ❶ **Connection Check** | **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.**<br><br>*NOTE: For wiring and theory of operation information, see DTC 000105.04 MANIFOLD AIR TEMPERATURE INPUT VOLTAGE LOW supporting information.*<br><br>Before using this diagnostic procedure, perform a preliminary inspection of the ECU connectors and the MAT sensor connector looking for dirty, damaged, or poorly positioned terminals. | **No faulty connection(s):** GO TO ❷<br><br>**Faulty connection(s):** Repair faulty connection(s). |
| ❷ **Intermittent Fault Test** | *NOTE: For wiring and theory of operation information, see DTC 000105.04 MANIFOLD AIR TEMPERATURE INPUT VOLTAGE LOW supporting information.*<br><br>1. Connect the DST or SERVICE ADVISOR™. For instructions on connecting to the DST or SERVICE ADVISOR™, see CONNECTING TO DIAGNOSTIC SCAN TOOL (DST) OR SERVICE ADVISOR™earlier in this Group.<br>2. Ignition ON, engine OFF<br>3. Start the ECU diagnostic software<br>4. Make note of any DTCs, then clear all DTCs<br>5. Ignition ON, engine OFF<br>6. Read DTCs using DST or SERVICE ADVISOR™. | **000105.04 reoccurs:** GO TO ❸<br><br>**000105.04 doesn't reoccur:** Problem is intermittent. If no other codes are present, see INTERMITTENT FAULT DIAGNOSTICS earlier in this Group. |

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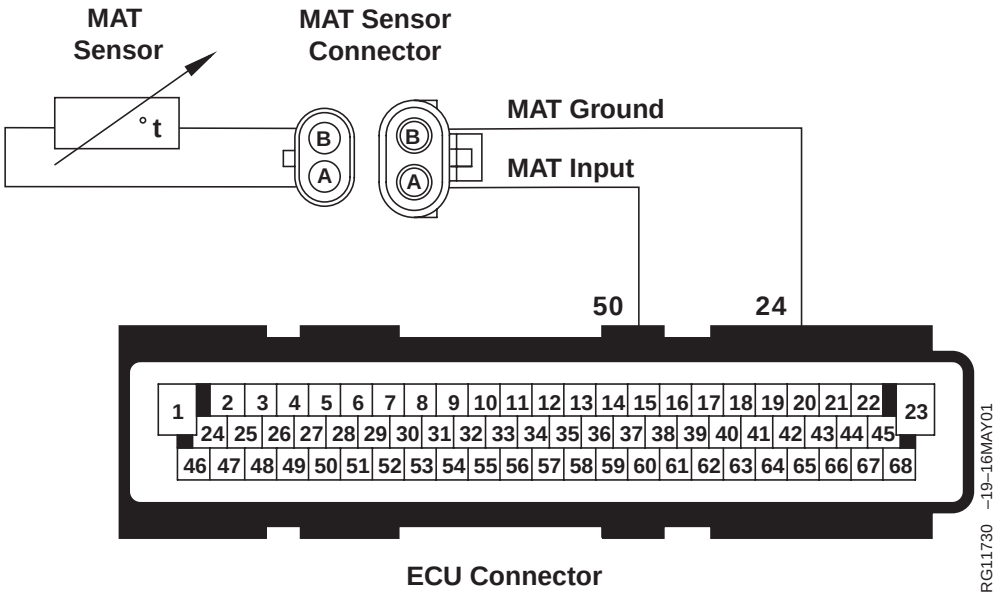
| ❸ **MAT Sensor Test** | *NOTE: For wiring and theory of operation information, see DTC 000105.04 MANIFOLD AIR TEMPERATURE INPUT VOLTAGE LOW supporting information.*<br><br>1. Ignition OFF<br><br>2. Disconnect MAT sensor connector.<br><br>3. Ignition ON, engine OFF<br><br>4. Using the ECU diagnostic software, read manifold air temperature input voltage | **Below 4.9 V:**<br>Short to ground in MAT sensor input circuit<br>OR<br>Faulty ECU connector<br>OR<br>Faulty ECU<br><br>**4.9 V or greater:**<br>Faulty MAT sensor connector<br>OR<br>Faulty MAT sensor<br><br>– – –1/1 |

## 000105.16 — Manifold Air Temperature Moderately High




ECU Connector

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**Manifold Air Temperature (MAT) Sensor**

- The MAT sensor is a thermistor (temperature sensitive resistor) mounted in the intake manifold. The MAT sensor is used to measure the temperature of the intake air. The MAT sensor's variable resistance causes the input voltage to the ECU to vary. Higher intake air temperatures result in lower MAT input voltages to the ECU; lower temperatures result in higher voltages. For further MAT sensor information, see MEASURING TEMPERATURE in Section 03, Group 140.

**DTC 000105.16 will set if:**

- The ECU senses a manifold air temperature on OEM applications above 100°C (212°F). For manifold air temperature specifications on other applications, see APPLICATION SPECIFICATIONS in Section 06, Group 210 later in this manual.

**If DTC 000105.16 sets, the following will occur:**

- Engine protection is enabled. See ENGINE PROTECTION in Section 03, Group 140 earlier in this manual.
  - – With Derate Feature: On OEM applications, the engine derates 2% per minute until the engine is running at 80% of full power. For non-OEM applications, see APPLICATION SPECIFICATIONS in Section 06, Group 210 later in this manual.

RG41221,000017E –19–22OCT02–1/1

## 000105.16 — Manifold Air Temperature Moderately High

*The ECU senses a manifold air temperature above specification.*

RG41221,0000181 –19–07MAY02–1/1

## 000105.16 Manifold Air Temperature Moderately High Diagnostic Procedure

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| ❶ **Connection Check** | **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.**<br><br>*NOTE: For wiring and theory of operation information, see DTC 000105.16 MANIFOLD AIR TEMPERATURE MODERATELY HIGH supporting information.*<br><br>Before using this diagnostic procedure, perform a preliminary inspection of the ECU connectors and the MAT sensor connector looking for dirty, damaged, or poorly positioned terminals. | **No faulty connection(s):** GO TO ❷<br><br>**Faulty connection(s):** Repair faulty connection(s). |

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| ❷ **Failures Causing High MAT Check** | *NOTE: For wiring and theory of operation information, see DTC 000105.16 MANIFOLD AIR TEMPERATURE MODERATELY HIGH supporting information.*<br><br>Check the following items that can cause high intake air temperatures:<br><br>• Excessively high ambient air temperature.<br>• Restricted, dirty, or damaged charge air cooler.<br>• Loose cooling fan belt.<br>• Malfunctioning cooling fan.<br>• Restricted or damaged intake air piping.<br>• Damaged cooling fan shroud. | **Cause of high MAT located:** Repair problem and retest.<br><br>**No cause of high MAT located:** Verify that MAT sensor input and ground circuits are OK. If MAT sensor circuits are OK, replace MAT sensor and retest. |

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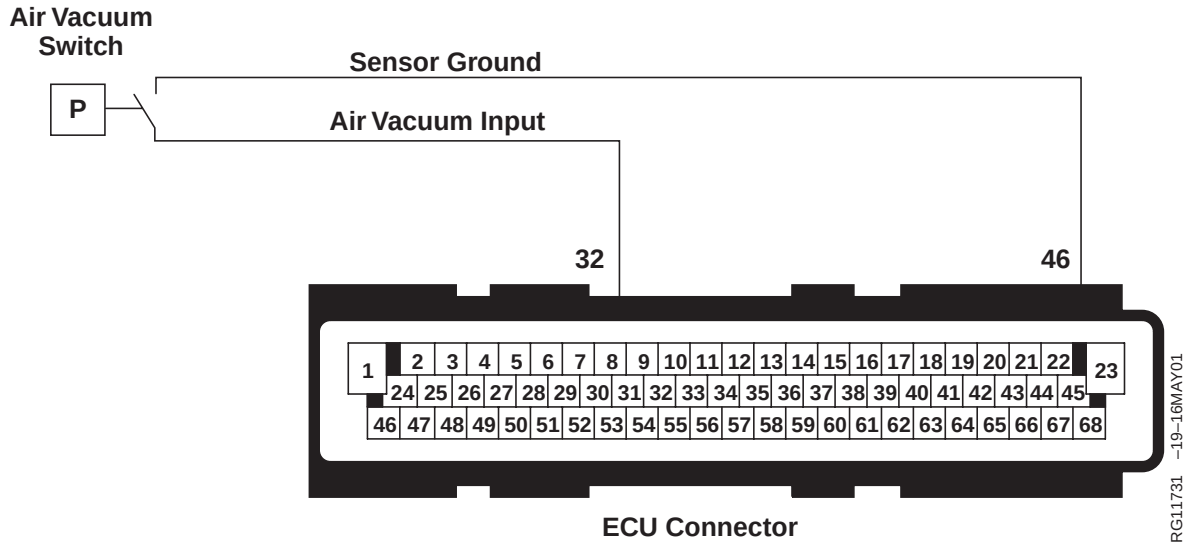
## 000107.00 — Air Filter Differential Pressure




ECU Connector

**Air Vacuum Switch**

- The air vacuum switch is located on the clean side of the air filter. Higher air pressure causes the contacts on the air vacuum switch to close.

**DTC 000107.00 will set if:**

- The ECU senses a high air pressure from the air vacuum switch.

**If DTC 000107.00 sets, the following will occur:**

- ECU will set a BLINKING warning light.
- Engine performance will not be effected.

RG41221,000017F –19–22OCT02–1/1

## 000107.00 — Air Filter Differential Pressure

*The ECU senses a high air pressure from the air vacuum switch.*

RG41221,0000187 –19–22OCT02–1/1

## 000107.00 Air Filter Differential Pressure Diagnostic Procedure



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| ❶ **Connection Check** | **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.**<br><br>*NOTE: For wiring and theory of operation information, see DTC 000107.00 AIR FILTER DIFFERENTIAL PRESSURE supporting information.*<br><br>Before using this diagnostic procedure, perform a preliminary inspection of the ECU connectors and the air filter switch connector looking for dirty, damaged, or poorly positioned terminals. | **No faulty connection(s):**<br>GO TO ❷<br><br>**Faulty connection(s):**<br>Repair faulty connection(s). |

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| ❷ **Air Filter Restriction Test** | *NOTE: For wiring and theory of operation information, see DTC 000107.00 AIR FILTER DIFFERENTIAL PRESSURE supporting information.*<br><br>Check air filter for restrictions. | **Restriction found in air filter:**<br>Replace, or clean as needed.<br><br>**No problem found with air filter:**<br>GO TO ❸ |

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| ❸ **Air Intake Restriction Test** | *NOTE: For wiring and theory of operation information, see DTC 000107.00 AIR FILTER DIFFERENTIAL PRESSURE supporting information.*<br><br>Under the conditions where DTC 000107.00 occurs, inspect air intake system on suction side of turbo. Looking specifically at the air filter element and for any source of blockage of the air intake system. See CHECK FOR INTAKE AND EXHAUST RESTRICTIONS in Group 150 of 4.5 L & 6.8 L Diesel Engines Base Engine Manual (CTM 104). | **Restriction found in intake system:**<br>Replace, repair, or clean components as needed.<br><br>**No problem found with intake system:**<br>GO TO ❹<br><br>– – –1/1 |

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| ❹ **Air Vacuum Switch Test** | *NOTE: For wiring and theory of operation information, see DTC 000107.00 AIR FILTER DIFFERENTIAL PRESSURE supporting information.*<br><br>Verify air vacuum switch is functioning correctly. | **Air vacuum switch is failed closed:**<br>Replace switch and retest.<br><br>**Air vacuum switch functions correctly:**<br>Verify that the air vacuum switch wiring is OK.<br><br>– – –1/1 |

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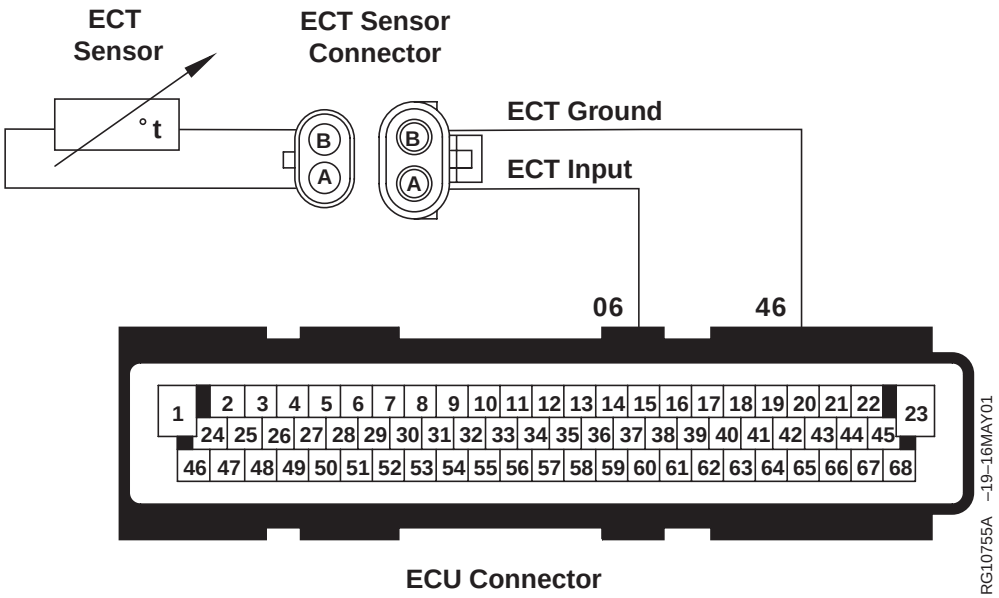
## 000110.00 — Engine Coolant Temperature Extremely High




ECU Connector

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*NOTE: Wiring schematic shows OEM engine applications only. For wiring information on other applications, see APPLICATION SPECIFICATIONS in Section 06, Group 210 of this manual.*

**Engine Coolant Temperature (ECT) Sensor**

- The ECT sensor is a thermistor (temperature sensitive resistor) mounted on the thermostat housing or in the rear of the cylinder head. It is used to measure the coolant temperature. The ECT's variable resistance causes the input voltage to the ECU to vary. Higher coolant temperatures result in lower ECT input voltages to the ECU; lower temperatures result in higher voltages. For further ECT sensor information, see MEASURING TEMPERATURE in Section 03, Group 140 earlier in this manual.

**DTC 000110.00 will set if:**

- The ECU senses a coolant temperature on OEM applications above 118°C (244°F). For most severe engine coolant temperature specifications on other applications, see APPLICATION SPECIFICATIONS in Section 06, Group 210 later in this manual.

**If DTC 000110.00 sets, the following will occur:**

- Engine protection is enabled. See ENGINE PROTECTION in Section 03, Group 140 earlier in this manual.
  - – With Shutdown Feature: The derate feature will go into effect when the code is set and the engine will shut down after 30 seconds.
  - – With Derate Feature: On OEM applications, the engine derates 60% per minute until the engine is running at 40% of full power. For non-OEM applications, see APPLICATION SPECIFICATIONS in Section 06, Group 210 later in this manual.

RG41221,0000171 –19–22OCT02–1/1

## 000110.00 — Engine Coolant Temperature Extremely High

*The ECU senses a coolant temperature above specification.*

RG41221,0000170 –19–22OCT02–1/1

## 000110.00 Engine Coolant Temperature Extremely High Diagnostic Procedure

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| ❶ **Connection Check** | **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.**<br><br>*NOTE: For wiring and theory of operation information, see DTC 000110.00 ENGINE COOLANT TEMPERATURE EXTREMELY HIGH supporting information*<br><br>Before using this diagnostic procedure, perform a preliminary inspection of the ECU connector and the ECT sensor connector looking for dirty, damaged, or poorly positioned terminals. | **No faulty connection(s):** GO TO ❷<br><br>**Faulty connection(s):** Repair faulty connection(s). |

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| ❷ **ECT Sensor and Circuit Test** | *NOTE: For wiring and theory of operation information, see DTC 000110.00 ENGINE COOLANT TEMPERATURE EXTREMELY HIGH supporting information*<br><br>Under the conditions where DTC 000110.00 occurs, using a temperature gauge, verify that engine coolant temperature is above the extremely high specification.<br><br>*NOTE: On OEM applications, the most severe ECT specification is 118°C (244°F). For the most severe ECT spec on other applications, see APPLICATION SPECIFICATIONS in Section 06, Group 210 later in this manual.* | **Temperature at or above specification:** Engine overheating problem. See C1 - ENGINE COOLANT TEMPERATURE ABOVE NORMAL in Group 150 of 4.5 L & 6.8 L Diesel Engines Base Engine Manual (CTM 104).<br><br>**Temperature significantly less than specification:** Verify that ECT sensor input and ground circuits are OK.<br>If ECT sensor circuits are OK, replace ECT sensor and retest |

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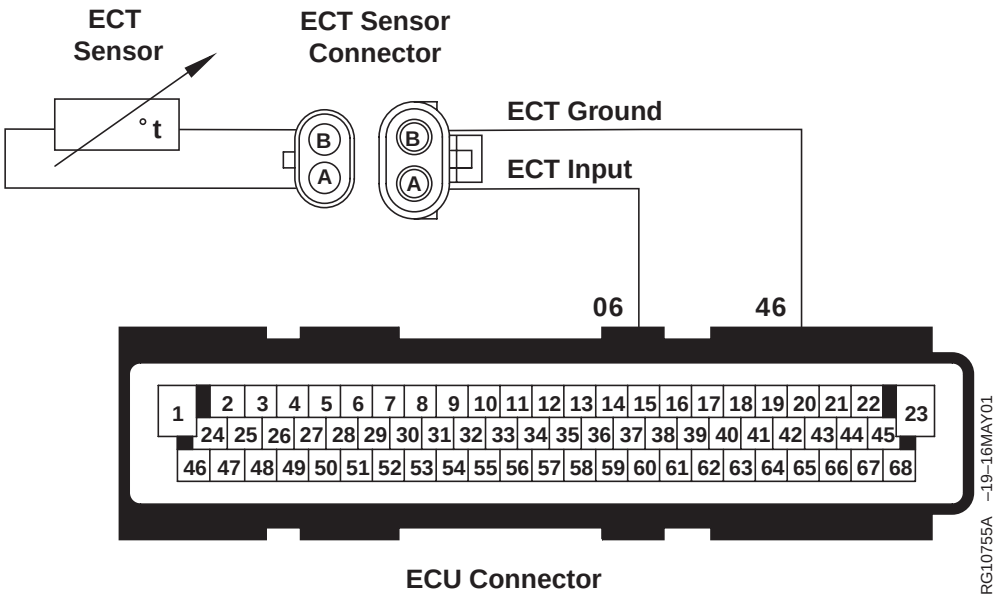
## 000110.03 — Engine Coolant Temperature Input Voltage High




ECU Connector

*NOTE: Wiring schematic shows OEM engine applications only. For wiring information on other applications, see APPLICATION SPECIFICATIONS in Section 06, Group 210 of this manual.*

**Engine Coolant Temperature (ECT) Sensor**

- The ECT sensor is a thermistor (temperature sensitive resistor) mounted on the thermostat housing or rear of cylinder head. It is used to measure the coolant temperature. The ECT's variable resistance causes the input voltage to the ECU to vary. Higher coolant temperatures result in lower ECT input voltages to the ECU; lower temperatures result in higher voltages. For further ECT sensor information, see MEASURING TEMPERATURE in Section 03, Group 140 earlier in this manual.

**DTC 000110.03 will set if:**

- The engine coolant temperature input voltage exceeds the sensor's high voltage specification. The voltage corresponds to a temperature that is lower than what is physically possible for engine coolant temperature.
  - – For OEM applications, the high engine coolant temperature input voltage specification is 4.9 volts.
  - – For other applications, see APPLICATION SPECIFICATIONS in Section 06, Group 210 later in this manual for the high engine coolant temperature input voltage specification.

**If DTC 000110.03 sets, the following will occur:**

- When in start mode, the ECU will default the ECT to -30°C (-22°F).
- When in running mode, the ECU will default the ECT to 90°C (194°F).
- ECU's high ECT engine protection feature disabled.
- The ECU will set a BLINKING warning light.

RG41221,0000173 –19–22OCT02–1/1

## 000110.03 — Engine Coolant Temperature Input Voltage High

*The engine coolant temperature input voltage exceeds the sensor's high voltage specification.*

RG41221,0000174 –19–22OCT02–1/1

### 000110.03 Engine Coolant Temperature Input Voltage High Diagnostic Procedure

*NOTE: If DTC 000110.03 is accompanied with DTC 001080.03, follow that diagnostic procedure before DTC 000110.03.*

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| ❶ **Connection Check** | **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.**<br><br>*NOTE: For wiring and theory of operation information, see DTC 000110.03 ENGINE COOLANT TEMPERATURE INPUT VOLTAGE HIGH supporting information*<br><br>Before using this diagnostic procedure, perform a preliminary inspection of the ECU connector and the ECT sensor connector looking for dirty, damaged, or poorly positioned terminals. | **No faulty connection(s):** GO TO ❷<br><br>**Faulty connection(s):** Repair faulty connection(s). |
| ❷ **Intermittent Fault Test** | *NOTE: For wiring and theory of operation information, see DTC 000110.03 ENGINE COOLANT TEMPERATURE INPUT VOLTAGE HIGH supporting information*<br><br>1. Connect the DST or SERVICE ADVISOR™. For instructions on connecting to the DST or SERVICE ADVISOR™, see CONNECTING TO DIAGNOSTIC SCAN TOOL (DST) OR SERVICE ADVISOR™earlier in this Group.<br>2. Ignition ON, engine OFF<br>3. Start the ECU diagnostic software<br>4. Make note of any DTCs, then clear all DTCs<br>5. Ignition ON, engine running<br>6. Read DTCs using DST or SERVICE ADVISOR™. | **000110.03 reoccurs:** GO TO ❸<br><br>**000110.03 doesn't reoccur:** Problem is intermittent. If no other codes are present, see INTERMITTENT FAULT DIAGNOSTICS, earlier in this Group. |

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| ❸ **Engine Coolant Temperature (ECT) Sensor and Connector Test** | *NOTE: For wiring and theory of operation information, see DTC 000110.03 ENGINE COOLANT TEMPERATURE INPUT VOLTAGE HIGH supporting information*<br><br>1. Ignition OFF<br><br>2. Disconnect ECT sensor connector<br><br>3. Install a jumper wire between both terminals in the ECT sensor connector on the engine harness.<br><br>4. Ignition ON, engine OFF<br><br>5. Using the ECU diagnostic software, read engine coolant temperature input voltage<br><br>*NOTE: For OEM applications, the low engine coolant temperature input voltage specification is 0.3V. For the low voltage specification on non-OEM applications, see APPLICATION SPECIFICATIONS in Section 06, Group 210 later in this manual.* | **Above 0.3 V:**<br>GO TO ❹<br><br>**0.3 V or below:**<br>Faulty ECT sensor connector<br>OR<br>Faulty ECT sensor<br><br>– – –1/1 |

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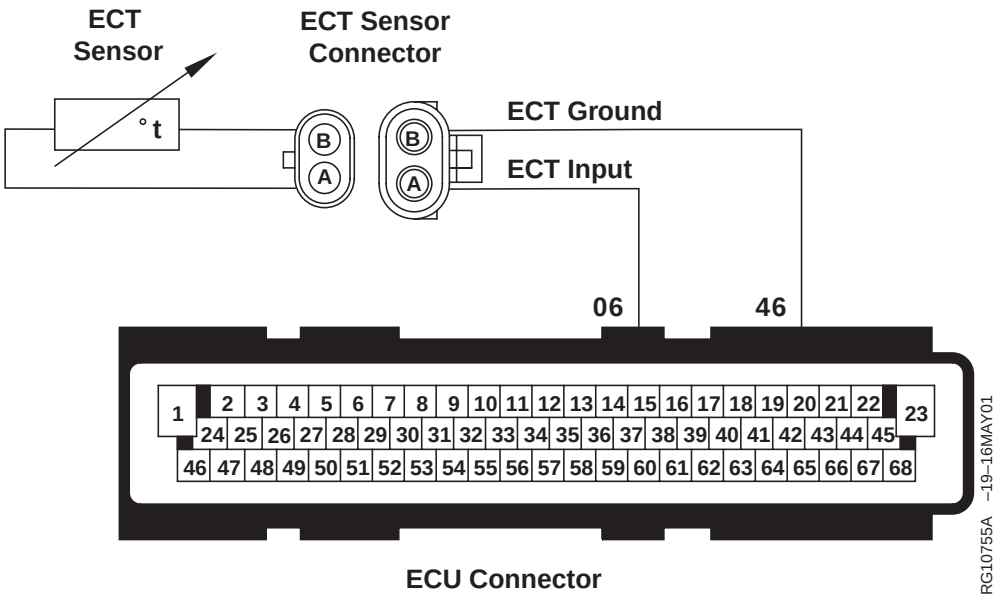
| ❹ **Engine Coolant Temperature (ECT) Open Ground Test** | *NOTE: For wiring and theory of operation information, see DTC 000110.03 ENGINE COOLANT TEMPERATURE INPUT VOLTAGE HIGH supporting information*<br><br>1. Ignition OFF<br><br>2. Remove jumper wire between both terminals<br><br>3. Install jumper wire between ECT input terminal (terminal A) of the sensor connector on the engine harness and a good chassis ground<br><br>4. Ignition ON, engine OFF<br><br>5. Using the ECU diagnostic software, read engine coolant temperature input voltage<br><br>*NOTE: For OEM applications, the low engine coolant temperature input voltage specification is 0.3V. For the low voltage specification on non-OEM applications, see APPLICATION SPECIFICATIONS in Section 06, Group 210 later in this manual.* | **Above 0.3 V:**<br>Open in ECT input sensor circuit<br>OR<br>Faulty ECU connection<br>OR<br>Faulty ECU<br><br>**0.3 V or below:**<br>Open in ECT sensor ground circuit<br>OR<br>Faulty ECU connection<br>OR<br>Faulty ECU<br><br>– – –1/1 |

## 000110.04 — Engine Coolant Temperature Input Voltage Low




ECU Connector



*NOTE: Wiring schematic shows OEM engine applications only. For wiring information on other applications, see APPLICATION SPECIFICATIONS in Section 06, Group 210 of this manual.*

**Engine Coolant Temperature (ECT) Sensor**

- The ECT sensor is a thermistor (temperature sensitive resistor) mounted on the thermostat housing. It is used to measure the coolant temperature. The ECT's variable resistance causes the input voltage to the ECU to vary. Higher coolant temperatures result in lower ECT input voltages to the ECU; lower temperatures result in higher voltages. For further ECT sensor information, see MEASURING TEMPERATURE in Section 03, Group 140 earlier in this manual.

**DTC 000110.04 will set if:**

- The engine coolant temperature input voltage drops below the sensor's low voltage specification. The voltage corresponds to a temperature that is higher than what is physically possible for engine coolant temperature .
  - – For OEM applications, the low engine coolant temperature input voltage specification is 0.3 volts.
  - – For other applications, see APPLICATION SPECIFICATIONS in Section 06, Group 210 later in this manual for the low engine coolant temperature input voltage specification.

**If DTC 000110.04 sets, the following will occur:**

- When in start mode, the ECU will default the ECT to -30°C (-22°F).
- When in running mode, the ECU will default the ECT to 90°C (194°F).
- ECU's high ECT engine protection feature disabled.
- The ECU will set a BLINKING warning light.

RG41221,0000176 –19–22OCT02–1/1

## 000110.04 — Engine Coolant Temperature Input Voltage Low

*The engine coolant temperature input voltage drops below the sensor's low voltage specification.*

RG41221,0000177 –19–22OCT02–1/1

### 000110.04 Engine Coolant Temperature Input Voltage Low Diagnostic Procedure

*NOTE: If DTC 000110.04 is accompanied with DTC 001080.04, follow that diagnostic procedure before DTC 000110.04.*

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| ❶ **Connection Check** | **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.**<br><br>*NOTE: For wiring and theory of operation information, see DTC 000110.04 ENGINE COOLANT TEMPERATURE INPUT VOLTAGE LOW supporting information*<br><br>Before using this diagnostic procedure, perform a preliminary inspection of the ECU connector and the ECT sensor connector looking for dirty, damaged, or poorly positioned terminals. | **No faulty connection(s):** GO TO ❷<br><br>**Faulty connection(s):** Repair faulty connection(s). |
| ❷ **Intermittent Fault Test** | *NOTE: For wiring and theory of operation information, see DTC 000110.04 ENGINE COOLANT TEMPERATURE INPUT VOLTAGE LOW supporting information*<br><br>1. Connect the DST or SERVICE ADVISOR™. For instructions on connecting to the DST or SERVICE ADVISOR™, see CONNECTING TO DIAGNOSTIC SCAN TOOL (DST) OR SERVICE ADVISOR™earlier in this Group.<br>2. Ignition ON, engine OFF<br>3. Start the ECU diagnostic software<br>4. Make note of any DTCs, then clear all DTCs<br>5. Ignition ON, engine OFF<br>6. Read DTCs using DST or SERVICE ADVISOR™. | **000110.04 reoccurs:** GO TO ❸<br><br>**000110.04 doesn't reoccur:** Problem is intermittent. If no other codes are present, see INTERMITTENT FAULT DIAGNOSTICS, earlier in this Group. |

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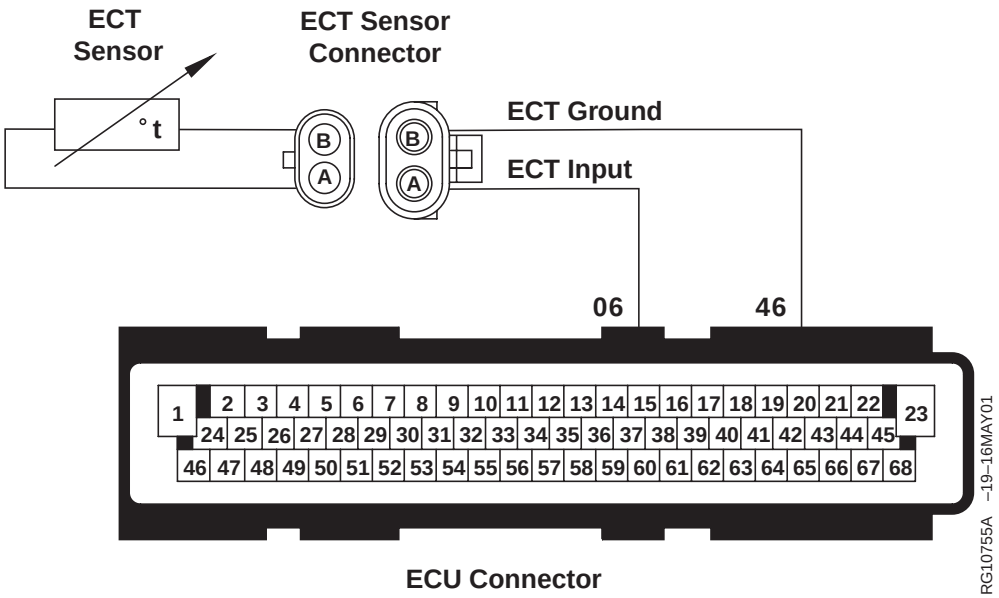
| ❸ **Engine Coolant Temperature (ECT) Sensor Test** | *NOTE: For wiring and theory of operation information, see DTC 000110.04 ENGINE COOLANT TEMPERATURE INPUT VOLTAGE LOW supporting information*<br><br>1. Ignition OFF<br><br>2. Disconnect ECT sensor connector<br><br>3. Ignition ON, engine OFF<br><br>4. Using the ECU diagnostic software read engine coolant temperature input voltage<br><br>*NOTE: For OEM applications, the high engine coolant temperature input voltage specification is 4.9V. For the high voltage specification on non-OEM applications, see APPLICATION SPECIFICATIONS in Section 06, Group 210 later in this manual.* | **Below 4.9 V:**<br>Short to ground in ECT sensor input circuit<br>OR<br>Faulty ECU<br><br>**4.9 V or greater:**<br>Faulty ECT sensor<br><br>– – –1/1 |

## 000110.15 — Engine Coolant Temperature High Least Severe




ECU Connector

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*NOTE: Wiring schematic shows OEM engine applications only. For wiring information on other applications, see APPLICATION SPECIFICATIONS in Section 06, Group 210 of this manual.*

**ECT (Engine Coolant Temperature) Sensor**

- The ECT sensor is a thermistor (temperature sensitive resistor) mounted on the thermostat housing or at the rear of the cylinder head. It is used to measure the coolant temperature. The ECT's variable resistance causes the input voltage to the ECU to vary. Higher coolant temperatures result in lower ECT input voltages to the ECU; lower temperatures result in higher voltages. For further ECT sensor information, see MEASURING TEMPERATURE in Section 03, Group 140 earlier in this manual.

**DTC 000110.15 will set if:**

- The ECU senses engine coolant temperature on OEM applications above 108°C (226°F). For moderately high engine coolant temperature specification, see APPLICATION SPECIFICATIONS in Section 06, Group 210 later in this manual.

**If DTC 000110.15 sets, the following will occur:**

- Engine protection is enabled. See ENGINE PROTECTION in Section 03, Group 140 earlier in this manual.
  - – With Derate Feature: On OEM applications, the engine derates 2% per minute until the engine is running at 95% of full power. For non-OEM applications, see APPLICATION SPECIFICATIONS in Section 06, Group 210 later in this manual.

RG41221,0000207 –19–22OCT02–1/1

## 000110.15 — Engine Coolant Temperature High Least Severe

*The ECU senses engine coolant temperature above specification.*

RG41221,0000209 –19–22OCT02–1/1

## 000110.15 Engine Coolant Temperature High Least Severe Diagnostic Procedure

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| ❶ **Connection Check** | **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.**<br><br>*NOTE: For wiring and theory of operation information, see DTC 000110.15 ENGINE COOLANT TEMPERATURE HIGH LEAST SEVERE supporting information*<br><br>Before using this diagnostic procedure, perform a preliminary inspection of the ECU connector and the ECT sensor connector looking for dirty, damaged, or poorly positioned terminals. | **No faulty connection(s):** GO TO ❷<br><br>**Faulty connection(s):** Repair faulty connection(s). |

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| ❷ **Engine Coolant Temperature (ECT) Sensor and Circuit Test** | *NOTE: For wiring and theory of operation information, see DTC 000110.15 ENGINE COOLANT TEMPERATURE HIGH LEAST SEVERE supporting information*<br><br>Under the conditions where DTC 000110.15 occurs, using a temperature gauge, verify that engine coolant temperature is above the moderately high specification.<br><br>*NOTE: On OEM applications, the high least severe ECT specification is 108°C (226°F). For the high least severe ECT spec on other applications, see APPLICATION SPECIFICATIONS in Section 06, Group 210 later in this manual.* | **Temperature at or above specification:** Engine overheating problem. See C1 - ENGINE COOLANT TEMPERATURE ABOVE NORMAL in Group 150 of 4.5 L & 6.8 L Diesel Engines Base Engine Manual (CTM 104).<br><br>**Temperature significantly less than specification:** Verify that ECT sensor input and ground circuits are OK.<br>If ECT sensor circuits are OK, replace ECT sensor and retest |

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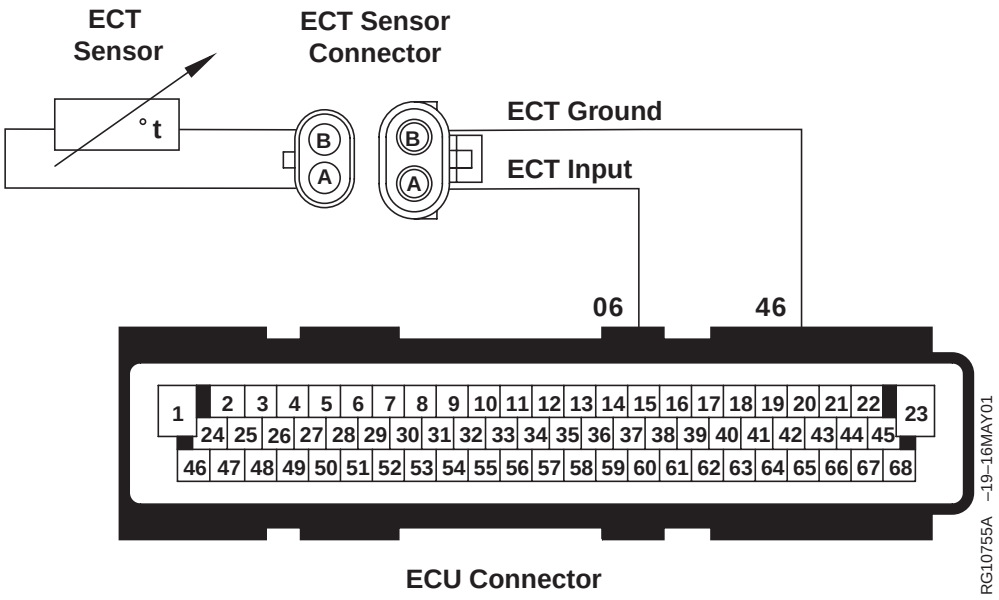
## 000110.16 — Engine Coolant Temperature Moderately High




ECU Connector



*NOTE: Wiring schematic shows OEM engine applications only. For wiring information on other applications, see APPLICATION SPECIFICATIONS in Section 06, Group 210 of this manual.*

**Engine Coolant Temperature (ECT) Sensor**

- The ECT sensor is a thermistor (temperature sensitive resistor) mounted on the thermostat housing or at the rear of the cylinder head. It is used to measure the coolant temperature. The ECT's variable resistance causes the input voltage to the ECU to vary. Higher coolant temperatures result in lower ECT input voltages to the ECU; lower temperatures result in higher voltages. For further ECT sensor information, see MEASURING TEMPERATURE in Section 03, Group 140 earlier in this manual.

**DTC 000110.16 will set if:**

- The ECU senses engine coolant temperature on OEM applications above 113°C (235°F). For moderately high engine coolant temperature specification, see APPLICATION SPECIFICATIONS in Section 06, Group 210 later in this manual.

**If DTC 000110.16 sets, the following will occur:**

- Engine protection is enabled. See ENGINE PROTECTION in Section 03, Group 140 earlier in this manual.
  - – With Derate Feature: On OEM applications, the engine derates 40% per minute until the engine is running at 60% of full power. For non-OEM applications, see APPLICATION SPECIFICATIONS in Section 06, Group 210 later in this manual.

RG41221,000017A –19–22OCT02–1/1

## 000110.16 — Engine Coolant Temperature Moderately High

*The ECU senses engine coolant temperature above specification.*

RG41221,0000179 –19–22OCT02–1/1

## 000110.16 Engine Coolant Temperature Moderately High Diagnostic Procedure

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| ❶ **Connection Check** | **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.**<br><br>*NOTE: For wiring and theory of operation information, see DTC 000110.16 ENGINE COOLANT TEMPERATURE MODERATELY HIGH supporting information*<br><br>Before using this diagnostic procedure, perform a preliminary inspection of the ECU connector and the ECT sensor connector looking for dirty, damaged, or poorly positioned terminals. | **No faulty connection(s):** GO TO ❷<br><br>**Faulty connection(s):** Repair faulty connection(s). |

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| ❷ **Engine Coolant Temperature (ECT) Sensor and Circuit Test** | *NOTE: For wiring and theory of operation information, see DTC 000110.16 ENGINE COOLANT TEMPERATURE MODERATELY HIGH supporting information*<br><br>Under the conditions where DTC 000110.16 occurs, using a temperature gauge, verify that engine coolant temperature is above the moderately high specification.<br><br>*NOTE: On OEM applications, the moderately high ECT specification is 113°C (235°F). For the moderately high ECT spec on other applications, see APPLICATION SPECIFICATIONS in Section 06, Group 210 later in this manual.* | **Temperature at or above specification:** Engine overheating problem. See C1 - ENGINE COOLANT TEMPERATURE ABOVE NORMAL in Group 150 of 4.5 L & 6.8 L Diesel Engines Base Engine Manual (CTM 104).<br><br>**Temperature significantly less than specification:** Verify that ECT sensor input and ground circuits are OK.<br>If ECT sensor circuits are OK, replace ECT sensor and retest |

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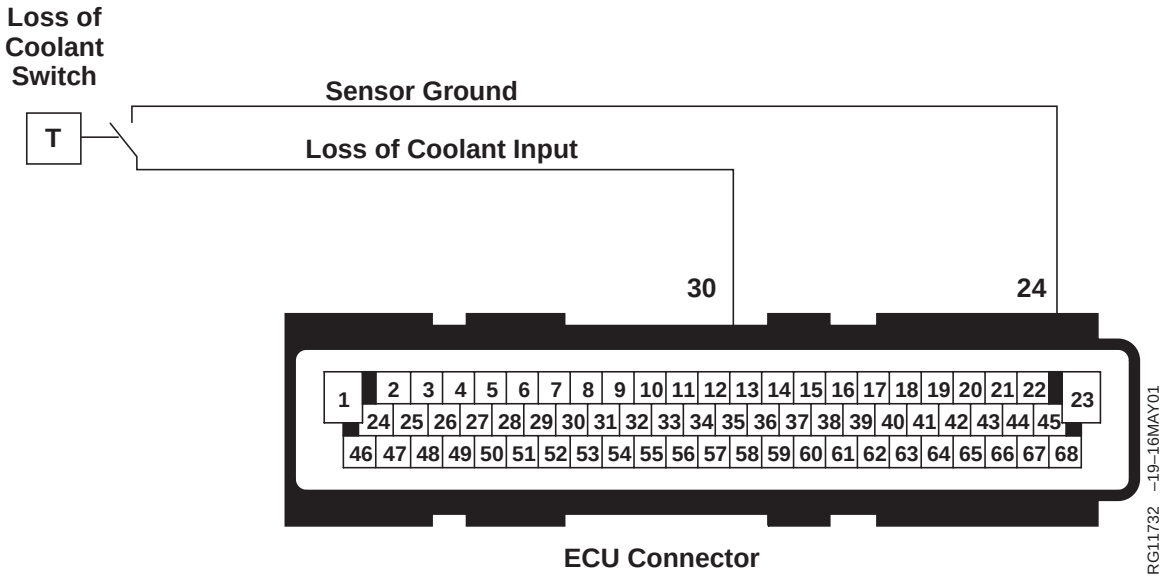
## 000111.01 — Engine Coolant Level Low




ECU Connector

04 160 ,192

**Loss of Coolant Temperature Switch**

- The loss of coolant temperature switch is a normally open temperature sensitive switch. When engine coolant is at the proper level, the temperature sensitive end of the switch is submerged in coolant, and the switch contacts will be open. If coolant level drops, the switch will no longer be submerged causing the temperature of the switch to rise beyond the point that causes the switch contacts to close. This causes the ECU to sense continuity to ground through the external shutdown/derate input terminal.

**DTC 000111.01 will set if:**

- The loss of coolant temperature switch contacts close causing the ECU to sense continuity to ground through the external shutdown/derate input terminal.

**If DTC 000111.01 sets, the following occur:**

- Engine protection is enabled. See ENGINE PROTECTION in Section 03, Group 140 earlier in this manual.
  - – With Shutdown Feature: The derate feature will go into effect when the code is set and the engine will shut down after 30 seconds.
  - – With Derate Feature: On OEM applications, the engine derates 40% per minute until the engine is running at 60% of full power. For non-OEM applications, see APPLICATION SPECIFICATIONS in Section 06, Group 210 later in this manual.

RG41221,0000188 –19–22OCT02–1/1

## 000111.01 — Engine Coolant Level Low

*Engine coolant level drops below specification.*

RG41221,000018A –19–22OCT02–1/1

## 000111.01 Engine Coolant Level Low Diagnostic Procedure



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| ❶ **Connection Check** | **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.**<br><br>*NOTE: For wiring and theory of operation information, see DTC 000111.01 ENGINE COOLANT LEVEL LOW supporting information.*<br><br>Before using this diagnostic procedure, perform a preliminary inspection of the ECU connectors and the loss of coolant temperature switch connector, looking for dirty, damaged, or poorly positioned terminals. | **No faulty connection(s):** GO TO ❷<br><br>**Faulty connection(s):** Repair faulty connection(s). |

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| ❷ **Coolant Level Test** | *NOTE: For wiring and theory of operation information, see DTC 000111.01 ENGINE COOLANT LEVEL LOW supporting information.*<br><br>**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 strop to relieve pressure before removing completely.**<br><br>• Check coolant level. | **Coolant level OK:** GO TO ❸<br><br>**Coolant level low:** Determine cause of low coolant level, repair problem and retest. |

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| ❸ **Intermittent Fault Test** | *NOTE: For wiring and theory of operation information, see DTC 000111.01 ENGINE COOLANT LEVEL LOW supporting information.*<br><br>1. Connect the DST or SERVICE ADVISOR™. For instructions on connecting to the DST or SERVICE ADVISOR™, see CONNECTING TO DIAGNOSTIC SCAN TOOL (DST) OR SERVICE ADVISOR™ earlier in this Group.<br><br>2. Ignition ON, engine OFF<br><br>3. Start the ECU diagnostic software<br><br>4. Make note of all active DTCs, then clear all DTCs<br><br>5. Ignition ON, engine running<br><br>6. Read DTCs using DST or SERVICE ADVISOR™. | **000111.01 reoccurs:**<br>GO TO ❹<br><br>**000111.01 doesn't reoccur:**<br>Problem is intermittent. If no other codes are present, see INTERMITTENT FAULT DIAGNOSTICS earlier in this Group. |

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| ❹ **Loss of Coolant Temperature Switch Test** | *NOTE: For wiring and theory of operation information, see DTC 000111.01 ENGINE COOLANT LEVEL LOW supporting information.*<br><br>1. Ignition OFF<br><br>2. Disconnect loss of coolant temperature switch connector.<br><br>3. Ignition ON, engine OFF<br><br>4. Using the ECU diagnostic software, read DTCs. | **000111.01 reoccurs:**<br>Short to ground in loss of coolant temperature switch input circuit.<br><br>**000111.01 doesn't reoccur:**<br>Faulty loss of coolant temperature switch. |

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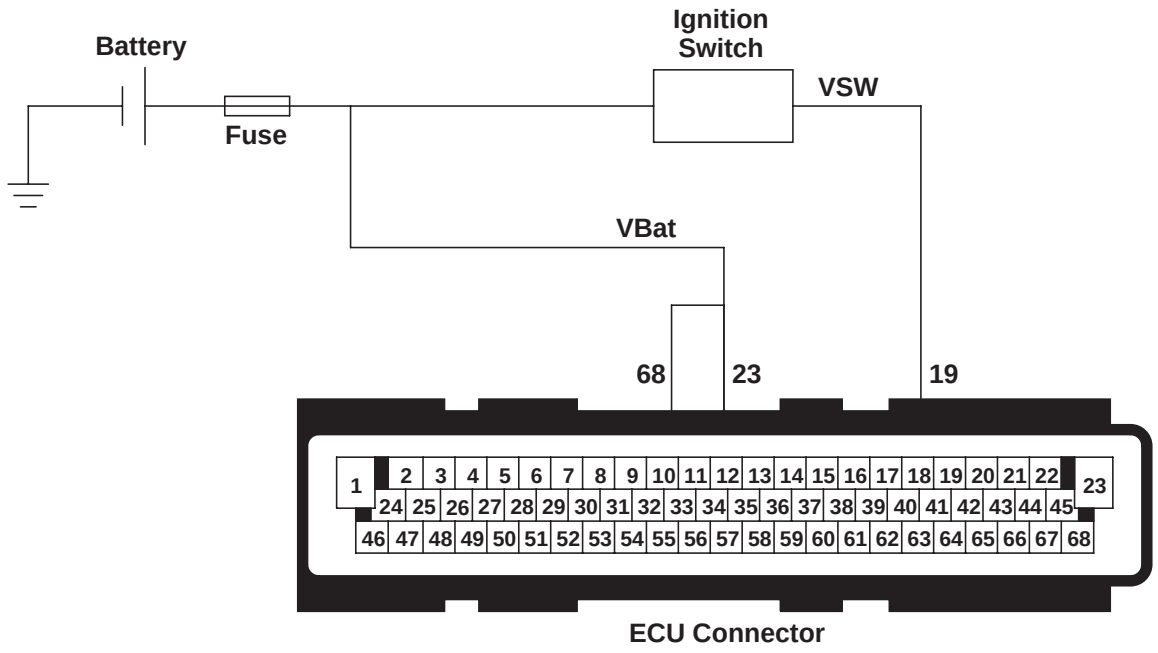
## 000158.17 — ECU Power Down Error




RG10761 –19–23OCT02

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*NOTE: Wiring schematic shows OEM engine applications only. For wiring information on other applications, see APPLICATION SPECIFICATIONS in Section 06, Group 210 of this manual.*

**DTC 000158.17 will set if:**

- ECU is unable to complete proper power down procedures after detecting key off conditions. The ECU detects voltage on the switched voltage input wire to the ECU.

**If DTC 000158.17 sets, the following will occur:**

- Vehicle battery may be drained, because ECU will not power down.

RG41221,0000213 –19–22OCT02–1/1

## 000158.17 — ECU Power Down Error

*ECU is unable to complete proper power down procedures after detecting key off conditions.*

RG41221,0000212 –19–22OCT02–1/1

## 000158.17 ECU Power Down Error Diagnostic Procedure



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| ❶ **Connection Check** | **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.**<br><br>*NOTE: For wiring and theory of operation information, see DTC 000158.17 ECU POWER DOWN ERROR supporting information.*<br><br>Before using this diagnostic procedure, perform a preliminary inspection of the ECU connectors and the ignition power circuit, looking for dirty, damaged, or poorly positioned terminals. | **No faulty connection(s):** GO TO ❷<br><br>**Faulty connection(s):** Repair faulty connection(s). |
| ❷ **Intermittent Fault Test** | *NOTE: For wiring and theory of operation information, see DTC 000158.17 ECU POWER DOWN ERROR supporting information.*<br><br>1. Connect the DST or SERVICE ADVISOR™. For instructions on connecting to the DST or SERVICE ADVISOR™, see CONNECTING TO DIAGNOSTIC SCAN TOOL (DST) OR SERVICE ADVISOR™earlier in this Group.<br>2. Ignition ON, engine OFF<br>3. Start the ECU diagnostic software<br>4. Make note of any DTCs, then clear all DTCs<br>5. Cycle ignition OFF for 10 seconds, then back ON<br>6. Read DTCs using DST or SERVICE ADVISOR™. | **000158.17 reoccurs:** GO TO ❸<br><br>**000158.17 does not reoccur:** Problem is intermittent. If no other codes are present, see INTERMITTENT FAULT DIAGNOSTICS earlier in this Group. |

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| ❸ **Wiring Test** | *NOTE: For wiring and theory of operation information, see DTC 000158.17 ECU POWER DOWN ERROR supporting information.*<br><br>1. Ignition OFF<br><br>2. Disconnect the ECU connector<br><br>3. Using a multimeter, measure voltage between terminal 19 of the ECU wiring harness connector and a good chassis ground. | **Measurement above 3.0 volts:**<br>Faulty ignition switch circuit<br>OR<br>ECU key-on power supply shorted to voltage<br>OR<br>Faulty Ignition switch<br><br>**Measurement below 3.0 volts:**<br>Faulty ECU connection<br>OR<br>Faulty ECU<br><br>– – –1/1 |

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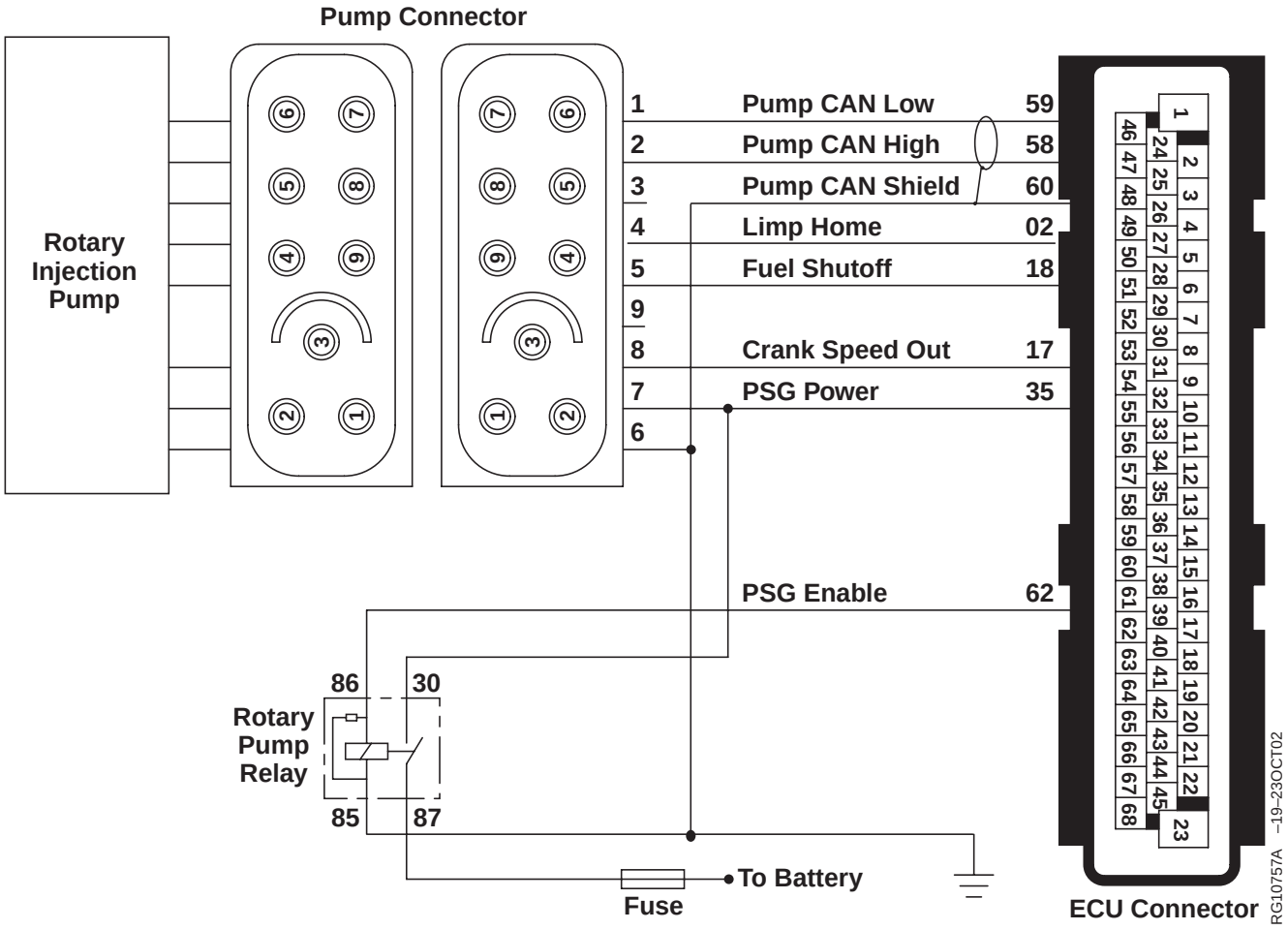
## 000174.00 — Fuel Temperature High Most Severe




*NOTE: Wiring schematic shows OEM engine applications only. For wiring information on other applications, see APPLICATION SPECIFICATIONS in Section 06, Group 210 of this manual.*

**Bosch VP44 Rotary Injection Pump**

- The Bosch VP44 rotary injection pump is controlled by a pump control unit that monitors information received from sensors inside the pump. It also acquires information from the ECU over a CAN bus and other dedicated wires between the ECU and pump. This helps the pump control unit to provide for the accurate quantity and timing of fuel delivery to the engine.

**DTC 000174.00 will set if:**

- The ECU senses fuel temperature on OEM applications above 75°C (167°F). For the most severe fuel temperature specifications on other applications, see APPLICATION SPECIFICATIONS in Section 06, Group 210 later in this manual.

**If DTC 000174.00 sets, the following will occur:**

- DTC 001077.31 will also be present.
- DTC 001569.31 will also be present.
- Engine protection is enabled. See ENGINE PROTECTION in Section 03, Group 140 earlier in this manual.

Continued on next page

– With Derate Feature: On OEM applications, the engine derates 20% per minute until the engine is running at 50% of full power. For non-OEM applications, see APPLICATION SPECIFICATIONS in Section 06, Group 210 later in this manual.

RG41221,000018C –19–15MAY01–2/2

## 000174.00 — Fuel Temperature High Most Severe

*The ECU senses fuel temperature above specification.*

RG41221,000018D –19–15MAY01–1/1

## 000174.00 Fuel Temperature High Most Severe Diagnostic Procedure

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| ❶ **Preliminary Check** | *NOTE: For wiring and theory of operation information, see DTC 000174.00 FUEL TEMPERATURE HIGH MOST SEVERE supporting information*<br><br>Before using this diagnostic procedure, make the following checks that could cause high fuel temperatures:<br><br>1. Ensure that the fuel level in the fuel tank is not extremely low.<br>2. Ensure that the fuel cooler is clean. | **No problems found:**<br>GO TO ❷<br><br>**Problem found:**<br>Repair and retest. |

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| ❷ **Connection Check** | **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.**<br><br>*NOTE: For wiring and theory of operation information, see DTC 000174.00 FUEL TEMPERATURE HIGH MOST SEVERE supporting information*<br><br>Before using this diagnostic procedure, perform a preliminary inspection of the ECU connector and the injection pump connector looking for dirty, damaged, or poorly positioned terminals. | **No faulty connection(s):**<br>GO TO ❸<br><br>**Faulty connection(s):**<br>Repair faulty connection(s). |

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|---|---|---|
| ❸ **Fuel Supply Pressure Check** | *NOTE: For wiring and theory of operation information, see DTC 000174.00 FUEL TEMPERATURE HIGH MOST SEVERE supporting information*<br><br>Determine fuel supply pressure. See CHECK FUEL SUPPLY PRESSURE in Group 150 of this manual. | **Fuel pressure within specification:**<br>GO TO ❹<br><br>**Fuel pressure below specification:**<br>Determine cause of low supply pressure. See F1 - FUEL SUPPLY SYSTEM CHECK - TIER 1 or F4 - FUEL SUPPLY SYSTEM CHECK - TIER 2 in Group 150 of this manual.<br>Repair and retest.<br><br>– – –1/1 |

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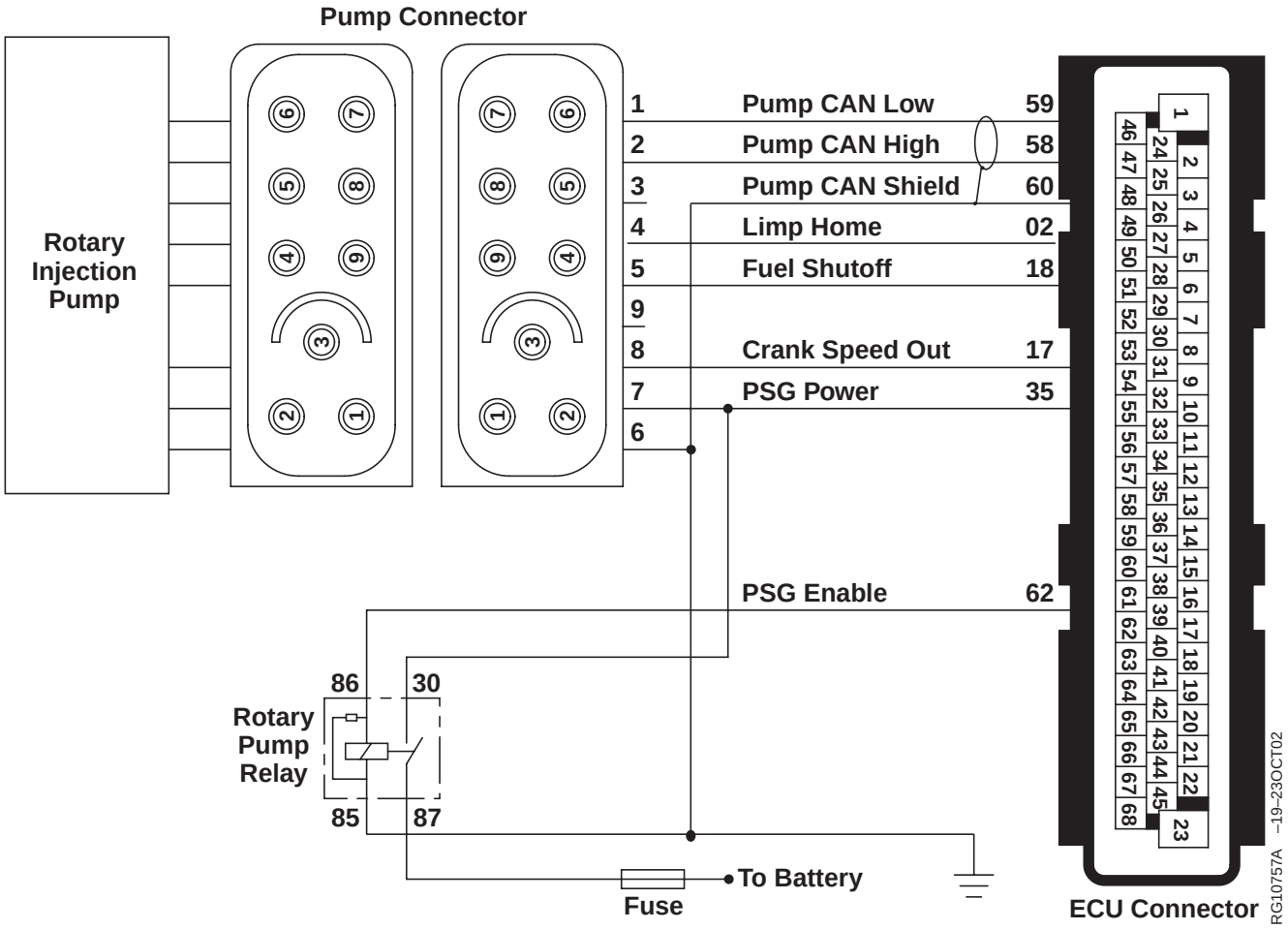
| ❹ **Fuel Return Lines Restriction Check** | *NOTE: For wiring and theory of operation information, see DTC 000174.00 FUEL TEMPERATURE HIGH MOST SEVERE supporting information*<br><br>Check return fuel lines for restriction between fuel tank and:<br><br>• Overflow valve on injection pump<br>• Fuel leak off line at injection nozzles | **Fuel return lines NOT restricted:**<br>Faulty injection pump overflow valve<br>OR<br>Faulty fuel cooler<br>OR<br>Faulty injection pump<br><br>**Restriction found in either fuel return line:**<br>Determine the cause of restriction<br>Repair and retest<br><br>– – –1/1 |

## 000174.15 — Fuel Temperature High Least Severe




*NOTE: Wiring schematic shows OEM engine applications only. For wiring information on other applications, see APPLICATION SPECIFICATIONS in Section 06, Group 210 of this manual.*

**Bosch VP44 Rotary Injection Pump**

- The Bosch VP44 rotary injection pump is controlled by a pump control unit that monitors information received from sensors inside the pump. It also acquires information from the ECU over a CAN bus and other dedicated wires between the ECU and pump. This helps the pump control unit to provide for the accurate quantity and timing of fuel delivery to the engine.

**DTC 000174.15 will set if:**

- The ECU senses fuel temperature on OEM applications above 65°C (149°F). For the high least severe fuel temperature specifications on other applications, see APPLICATION SPECIFICATIONS in Section 06, Group 210 later in this manual.

**If DTC 000174.15 sets, the following will occur:**

- The ECU will not derate the engine.
- The ECU will set a BLINKING warning light.

RG41221,000018F –19–22OCT02–1/1

## 000174.15 — Fuel Temperature High Least Severe

*The ECU senses fuel temperature above specification.*

RG41221,0000190 –19–22OCT02–1/1

## 000174.15 Fuel Temperature High Least Severe Diagnostic Procedure



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| ❶ **Preliminary Check** | *NOTE: For wiring and theory of operation information, see DTC 000174.15 FUEL TEMPERATURE HIGH LEAST SEVERE supporting information*<br><br>Before using this diagnostic procedure, make the following checks that could cause high fuel temperatures:<br><br>1. Ensure that the fuel level in the fuel tank is not extremely low.<br>2. Ensure that the fuel cooler is clean. | **No problems found:**<br>GO TO ❷<br><br>**Problem found:**<br>Repair and retest. |

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|---|---|---|
| ❷ **Connection Check** | **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.**<br><br>*NOTE: For wiring and theory of operation information, see DTC 000174.15 FUEL TEMPERATURE HIGH LEAST SEVERE supporting information*<br><br>*Before using this diagnostic procedure, perform a preliminary inspection of the ECU connector and the injection pump connector looking for dirty, damaged, or poorly positioned terminals.* | **No faulty connection(s):**<br>GO TO ❸<br><br>**Faulty connection(s):**<br>Repair faulty connection(s). |

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| ❸ **Fuel Supply Pressure Check** | *NOTE: For wiring and theory of operation information, see DTC 000174.15 FUEL TEMPERATURE HIGH LEAST SEVERE supporting information*<br><br>Determine fuel supply pressure. See CHECK FUEL SUPPLY PRESSURE in Group 150 of this manual. | **Fuel pressure within specification:**<br>GO TO ❹<br><br>**Fuel pressure below specification:**<br>Determine cause of low supply pressure. See F1 - FUEL SUPPLY SYSTEM CHECK - TIER 1 or F4 - FUEL SUPPLY SYSTEM CHECK - TIER 2 in Group 150 of this manual.<br>Repair and retest.<br><br>– – –1/1 |

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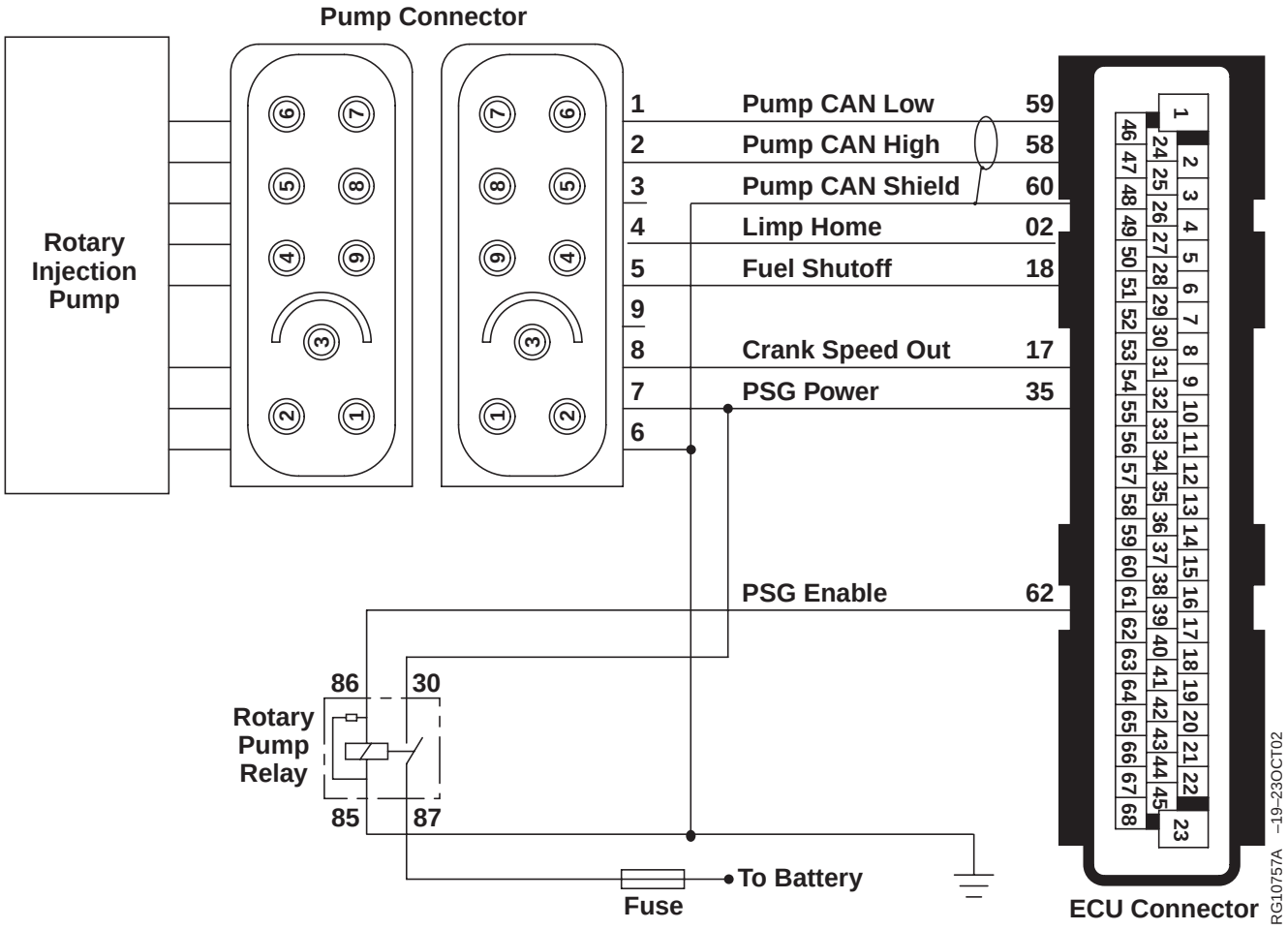
| ❹ **Fuel Return Lines Restriction Check** | *NOTE: For wiring and theory of operation information, see DTC 000174.15 FUEL TEMPERATURE HIGH LEAST SEVERE supporting information*<br><br>Check return fuel lines for restriction between fuel tank and:<br><br>• Overflow valve on injection pump<br>• Fuel leak off line at injection nozzles | **Fuel return lines NOT restricted:**<br>Faulty injection pump overflow valve<br>OR<br>Faulty fuel cooler<br>OR<br>Faulty injection pump<br><br>**Restriction found in either fuel return line:**<br>Determine the cause of restriction<br>Repair and retest<br><br>– – –1/1 |

## 000174.16 — Fuel Temperature High Moderately Severe




*NOTE: Wiring schematic shows OEM engine applications only. For wiring information on other applications, see APPLICATION SPECIFICATIONS in Section 06, Group 210 of this manual.*

**Bosch VP44 Rotary Injection Pump**

- The Bosch VP44 rotary injection pump is controlled by a pump control unit that monitors information received from sensors inside the pump. It also acquires information from the ECU over a CAN bus and other dedicated wires between the ECU and pump. This helps the pump control unit to provide for the accurate quantity and timing of fuel delivery to the engine.

**DTC 000174.16 will set if:**

- The ECU senses fuel temperature inside the injection pump on OEM applications above 73°C (163°F). For moderately high fuel temperature specifications, see APPLICATION SPECIFICATIONS in Section 06, Group 210 later in this manual.

**If DTC 000174.16 sets, the following will occur:**

- Engine protection is enabled. See ENGINE PROTECTION in Section 03, Group 140 earlier in this manual.
  - With Derate Feature: On OEM applications, the engine derates 75% per minute until the engine is running at 25% of full power. For non-OEM applications, see APPLICATION SPECIFICATIONS in Section 06, Group 210 later in this manual.

RG41221,0000192 –19–22OCT02–1/1

## 000174.16 — Fuel Temperature High Moderately Severe

*The ECU senses fuel temperature inside the injection pump above specification.*

RG41221,0000193 –19–15MAY01–1/1

## 000174.16 Fuel Temperature High Moderately Severe Diagnostic Procedure



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| ❶ **Preliminary Check** | *NOTE: For wiring and theory of operation information, see DTC 000174.16 FUEL TEMPERATURE HIGH MODERATELY SEVERE supporting information*<br><br>Before using this diagnostic procedure, make the following checks that could cause high fuel temperatures:<br><br>1. Ensure that the fuel level in the fuel tank is not extremely low.<br>2. Ensure that the fuel cooler is clean. | **No problems found:**<br>GO TO ❷<br><br>**Problem found:**<br>Repair and retest.<br><br>– – –1/1 |

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| ❷ **Connection Check** | **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.**<br><br>*NOTE: For wiring and theory of operation information, see DTC 000174.16 FUEL TEMPERATURE HIGH MODERATELY SEVERE supporting information*<br><br>Before using this diagnostic procedure, perform a preliminary inspection of the ECU connector and the injection pump connector looking for dirty, damaged, or poorly positioned terminals. | **No faulty connection(s):**<br>GO TO ❸<br><br>**Faulty connection(s):**<br>Repair faulty connection(s).<br><br>– – –1/1 |

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|---|---|---|
| ❸ **Fuel Supply Pressure Check** | *NOTE: For wiring and theory of operation information, see DTC 000174.16 FUEL TEMPERATURE HIGH MODERATELY SEVERE supporting information*<br><br>Determine fuel supply pressure. See CHECK FUEL SUPPLY PRESSURE in Group 150 of this manual. | **Fuel pressure within specification:**<br>GO TO ❹<br><br>**Fuel pressure below specification:**<br>Determine cause of low supply pressure. See F1 - FUEL SUPPLY SYSTEM CHECK - TIER 1 or F4 - FUEL SUPPLY SYSTEM CHECK - TIER 2 in Group 150 of this manual.<br>Repair and retest.<br><br>– – –1/1 |

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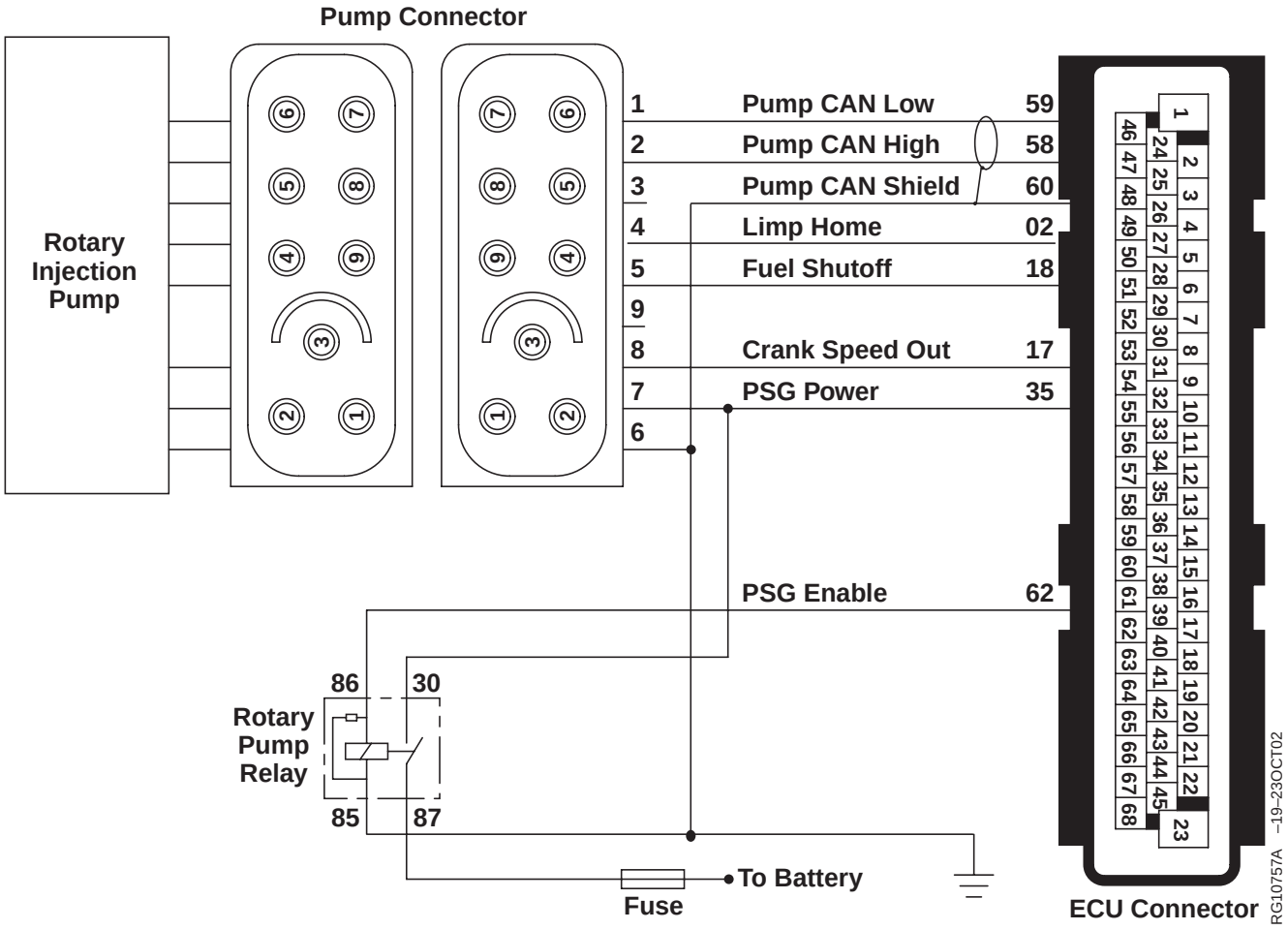
| ❹ **Fuel Return Lines Restriction Check** | *NOTE: For wiring and theory of operation information, see DTC 000174.16 FUEL TEMPERATURE HIGH MODERATELY SEVERE supporting information*<br><br>Check return fuel lines for restriction between fuel tank and:<br><br>• Overflow valve on injection pump<br>• Fuel leak off line at injection nozzles | **Fuel return lines NOT restricted:**<br>Faulty injection pump overflow valve<br>OR<br>Faulty fuel cooler<br>OR<br>Faulty injection pump<br><br>**Restriction found in either fuel return line:**<br>Determine the cause of restriction<br>Repair and retest<br><br>– – –1/1 |

## 000174.31 — Fuel Temperature Sensor Faulty




*NOTE: Wiring schematic shows OEM engine applications only. For wiring information on other applications, see APPLICATION SPECIFICATIONS in Section 06, Group 210 of this manual.*

**Bosch VP44 Rotary Injection Pump**

- The Bosch VP44 rotary injection pump is controlled by a pump control unit that monitors information received from sensors inside the pump. It also acquires information from the ECU over a CAN bus and other dedicated wires between the ECU and pump. This helps the pump control unit to provide for the accurate quantity and timing of fuel delivery to the engine.

**DTC 000174.31 will set if:**

- The fuel temperature input voltage is outside the range of what is physically possible for fuel temperature.

**If DTC 000174.31 sets, the following will occur:**

- DTC 001077.31 will also be present.
- DTC 001569.31 will also be present.
- Engine protection is enabled. See ENGINE PROTECTION in Section 03, Group 140 earlier in this manual.
  - – With Derate Feature: On OEM applications, the engine derates 20% per minute until the engine is running at 50% of full power. For non-OEM applications, see APPLICATION SPECIFICATIONS in Section 06, Group 210 later in this manual.

RG41221,0000195 –19–15MAY01–1/1

## 000174.31 — Fuel Temperature Sensor Faulty

*The fuel temperature input voltage is outside the range of what is physically possible for fuel temperature.*

RG41221,0000196 –19–15MAY01–1/1

### 000174.31 Fuel Temperature Sensor Faulty Diagnostic Procedure

*NOTE: Other DTCs may be active with DTC 000174.31. If either DTC 000629.19 or 001077.19 is active, follow that diagnostic chart first.*

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| ❶ **Connection Check** | **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.**<br><br>*NOTE: For wiring and theory of operation information, see DTC 000174.31 FUEL TEMPERATURE SENSOR FAULTY supporting information*<br><br>Before using this diagnostic procedure, perform a preliminary inspection of the ECU connector and the fuel injection pump connector looking for dirty, damaged, or poorly positioned terminals. | **No faulty connection(s):** GO TO ❷<br><br>**Faulty connection(s):** Repair faulty connection(s). |
| ❷ **Intermittent Fault Test** | *NOTE: For wiring and theory of operation information, see DTC 000174.31 FUEL TEMPERATURE SENSOR FAULTY supporting information*<br><br>1. Connect the DST or SERVICE ADVISOR™. For instructions on connecting to the DST or SERVICE ADVISOR™, see CONNECTING TO DIAGNOSTIC SCAN TOOL (DST) OR SERVICE ADVISOR™earlier in this Group.<br>2. Ignition ON, engine OFF<br>3. Start the ECU diagnostic software<br>4. Make note of any DTCs, then clear all DTCs<br>5. Ignition ON, engine running or cranking for 15 seconds<br>6. Read DTCs using DST or SERVICE ADVISOR™. | **000174.31 reoccurs:** Faulty injection pump<br><br>**000174.31 doesn't reoccur:** Problem is intermittent. If no other codes are present, see INTERMITTENT FAULT DIAGNOSTICS, earlier in this Group. |

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## 000189.00 — Engine Speed Derate

*The ECU detects a condition that requires an engine speed derate.*

**Engine Speed Derate**

- The engine speed derate trouble code is set to indicate that the ECU has detected a condition such as low fuel pressure and is limiting the engine speed.

**DTC 000189.00 will set if:**

- The ECU detects a condition that requires an engine speed derate.
- The ECU senses fuel pressure below -11 kPa (-0.11 bar) (-1.6 psi) with engine speed above low idle for more than 30 seconds.

**If DTC 000189.00 sets, the following will occur:**

- The ECU will limit engine speed in an attempt to protect the engine.

**If DTC 000189.00 sets:**

- If DTC 000094.01 is active, see DTC 000094.01 FUEL SUPPLY PRESSURE EXTREMELY LOW DIAGNOSTIC PROCEDURE
- Check for other stored or active DTCs that indicate the reason for the speed derate.

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DPSG,RG40854,213 –19–22OCT02–1/1

## 000189.31 — Engine Speed Derate

*The ECU detects a condition that requires an engine speed derate.*

**Engine Speed Derate**

- The engine speed derate trouble code is set to indicate that the ECU has detected a condition such as low fuel pressure and is limiting the engine speed.

**DTC 000189.31 will set if:**

- The ECU detects a condition that requires an engine speed derate.
- The ECU senses fuel pressure below -11 kPa (-0.11 bar) (-1.6 psi) with engine speed above low idle for more than 30 seconds.

**If DTC 000189.31 sets, the following will occur:**

- The ECU will limit engine speed in an attempt to protect the engine.

**If DTC 000189.31 sets:**

- If DTC 000094.01 is active, see DTC 000094.01 FUEL SUPPLY PRESSURE EXTREMELY LOW DIAGNOSTIC PROCEDURE
- Check for other stored or active DTCs that indicate the reason for the speed derate.

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RG41221,00000A9 –19–18DEC02–1/1

## 000190.00 — Engine Overspeed Extreme

*The ECU detects that engine speed exceeds 3400 rpm.*

**Crankshaft Position Sensor**

- The crankshaft position sensor is located on the front of the crankshaft, behind the pressed-on crank gear. It is an inductive type pickup sensor that detects teeth on the crank timing wheel. The ECU uses the crankshaft position input to determine engine speed and precise piston position in relation to the firing order. The crank timing wheel is composed of 46 evenly spaced teeth and 2 missing teeth. The missing teeth help the ECU to determine Top-Dead-Center (TDC).

**DTC 000190.00 will set if:**

- The ECU detects that engine speed exceeds 3400 rpm.

**If DTC 000190.00 sets, the following will occur:**

- The ECU commands the PSG to shut fuel off until engine speed is below 2600 rpm.
- The ECU will set a BLINKING warning light.

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DPSG,RG40854,213 –19–22OCT02–1/1

## 000190.16 — Engine Overspeed Moderate

*The ECU detects that engine speed exceeds 3000 rpm.*

**Crankshaft Position Sensor**

- The crankshaft position sensor is located on the front of the crankshaft, behind the pressed-on crank gear. It is an inductive type pickup sensor that detects teeth on the crank timing wheel. The ECU uses the crankshaft position input to determine engine speed and precise piston position in relation to the firing order. The crank timing wheel is composed of 46 evenly spaced teeth and 2 missing teeth. The missing teeth help the ECU to determine Top-Dead-Center (TDC).

**DTC 000190.16 will set if:**

- The ECU detects that engine speed exceeds 3000 rpm.

**If DTC 000190.16 sets, the following will occur:**

- The ECU commands the PSG to shut fuel off until engine speed is below 2600 rpm.
- The ECU will set a BLINKING warning light.

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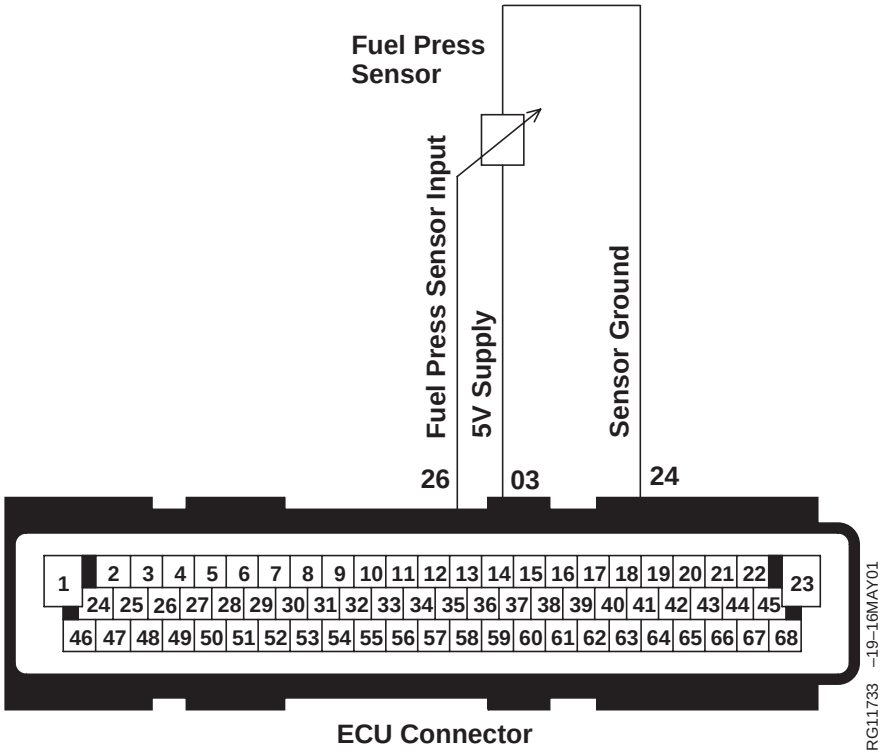
DPSG,RG40854,213 –19–22OCT02–1/1

## 000620.03 — Sensor Supply Voltage High




ECU Connector

**Sensor Supply Voltage**

- The ECU supplies voltage to a few different sensors depending on the application. The ECU monitors the drop in voltage that the sensor causes and compares that drop to preprogrammed values in the ECU's memory to determine the value of the parameter the sensor was measuring. In addition, the ECU monitors the exact voltage on the 5 volt supply circuit in order to ensure accurate readings.

**DTC 000620.03 will set if:**

- The ECU detects a voltage that is higher than 5.5 volts on the ECU 5 volt sensor supply circuit.

**If DTC 000620.03 sets, the following will occur:**

- The ECU will use default values for the sensors that use sensor supply input voltage.
- The ECU will set a BLINKING warning light.

RG41221,0000197 –19–22OCT02–1/1

## 000620.03 — Sensor Supply Voltage High

*The ECU detects a voltage above specification on the ECU 5 volt sensor supply circuit.*

RG41221,0000198 –19–22OCT02–1/1

## 000620.03 Sensor Supply Voltage High Diagnostic Procedure

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,219

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| ❶ **Connection Check** | **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.**<br><br>*NOTE: For wiring and theory of operation information, see DTC 000620.03 SENSOR SUPPLY VOLTAGE HIGH supporting information.*<br><br>Before using this diagnostic procedure, perform a preliminary inspection of the ECU connector and all of the sensor connectors using this 5V supply, looking for dirty, damaged, or poorly positioned terminals. | **No faulty connection(s):** GO TO ❷<br><br>**Faulty connection(s):** Repair faulty connection(s). |

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| ❷ **Intermittent Fault Test** | *NOTE: For wiring and theory of operation information, see DTC 000620.03 SENSOR SUPPLY VOLTAGE HIGH supporting information.*<br><br>1. Connect the DST or SERVICE ADVISOR™. For instructions on connecting to the DST or SERVICE ADVISOR™, see CONNECTING TO DIAGNOSTIC SCAN TOOL (DST) OR SERVICE ADVISOR™earlier in this Group.<br>2. Ignition ON, engine OFF<br>3. Start the ECU diagnostic software<br>4. Make note of any DTCs, then clear all DTCs<br>5. Ignition ON, engine OFF<br>6. Read DTCs using DST or SERVICE ADVISOR™. | **000620.03 reoccurs:** GO TO ❸<br><br>**000620.03 doesn't reoccur:** Problem is intermittent. If no other codes are present, see INTERMITTENT FAULT DIAGNOSTICS, earlier in this Group. |

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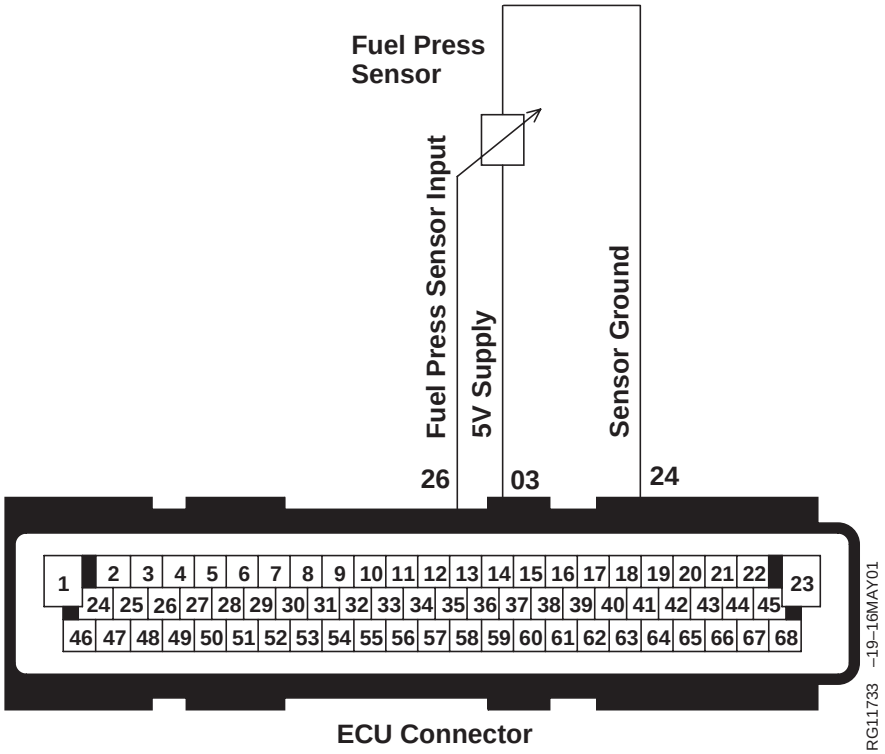
| ❸ **Sensor Supply Wire Check for Short** | *NOTE: For wiring and theory of operation information, see DTC 000620.03 SENSOR SUPPLY VOLTAGE HIGH supporting information.*<br><br>1. Ignition OFF<br><br>2. Disconnect ECU connector<br><br>3. Using multimeter, measure resistance between terminal 3 in the ECU connector on the engine harness and all other terminals in the harness end of the ECU connector. | **Greater than 20k ohms:**<br>Faulty ECU connector<br>OR<br>Faulty ECU<br><br>**Less than 20k ohms:**<br>Short to voltage in sensor supply wire<br><br>– – –1/1 |

## 000620.04 — Sensor Supply Voltage Low




ECU Connector

**Sensor Supply Voltage**

- The ECU supplies voltage to a few different sensors depending on the application. The ECU monitors the drop in voltage that the sensor causes and compares that drop to preprogrammed values in the ECU's memory to determine the value of the parameter the sensor was measuring. In addition, the ECU monitors the exact voltage on the 5 volt supply circuit in order to ensure accurate readings.

**DTC 000620.04 will set if:**

- The ECU detects a voltage that is lower than 4.44 volts on the ECU 5 volt sensor supply circuit.

**If DTC 000620.04 sets, the following will occur:**

- The ECU will use default values for the sensors that use sensor supply input voltage.
- The ECU will set a BLINKING warning light.

RG41221,0000199 –19–22OCT02–1/1

## 000620.04 — Sensor Supply Voltage Low

*The ECU detects a voltage below specification on the ECU 5 volt sensor supply circuit.*

RG41221,000019A –19–22OCT02–1/1

## 000620.04 Sensor Supply Voltage Low Diagnostic Procedure

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160
,223

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| ❶ **Connection Check** | **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.**<br><br>*NOTE: For wiring and theory of operation information, see DTC 000620.04 SENSOR SUPPLY VOLTAGE LOW supporting information.*<br><br>Before using this diagnostic procedure, perform a preliminary inspection of the ECU connector and all of the sensor connectors using this 5V supply, looking for dirty, damaged, or poorly positioned terminals. | **No faulty connection(s):** GO TO ❷<br><br>**Faulty connection(s):** Repair faulty connection(s). |

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| ❷ **Sensor Check** | *NOTE: For wiring and theory of operation information, see DTC 000620.04 SENSOR SUPPLY VOLTAGE LOW supporting information.*<br><br>1. Connect the DST or SERVICE ADVISOR™. For instructions on connecting to the DST or SERVICE ADVISOR™, see CONNECTING TO DIAGNOSTIC SCAN TOOL (DST) OR SERVICE ADVISOR™earlier in this Group.<br>2. Ignition ON, engine OFF<br>3. Start the ECU diagnostic software<br>4. Make note of any DTCs, then clear all DTCs<br>5. Ignition OFF<br>6. Disconnect the Fuel Pressure Sensor<br>7. Ignition ON, engine running<br>8. Read DTCs using DST or SERVICE ADVISOR™. | **000620.04 reoccurs:** GO TO ❹<br><br>**000620.04 doesn't reoccur:** GO TO ❸ |

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| ❸ **Intermittent Fault Test** | *NOTE: For wiring and theory of operation information, see DTC 000620.04 SENSOR SUPPLY VOLTAGE LOW supporting information.*<br><br>1. Ignition ON, engine OFF<br><br>2. Reconnect the Fuel Pressure Sensor while monitoring DTCs. | **000620.04 reoccurs:**<br>Faulty Fuel Pressure Sensor<br>Replace and retest<br><br>**000620.04 doesn't reoccur:**<br>Problem is intermittent. If no other codes are present, see INTERMITTENT FAULT DIAGNOSTICS, earlier in this Group.<br><br>– – –1/1 |

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| ❹ **Sensor Supply Short to Ground Check** | *NOTE: For wiring and theory of operation information, see DTC 000620.04 SENSOR SUPPLY VOLTAGE LOW supporting information.*<br><br>1. Ignition OFF<br><br>2. Disconnect the ECU connector<br><br>3. Using a multimeter, measure resistance between terminal 3 in the ECU connector and:<br><br>• A good chassis ground<br>• Terminal 1 in the ECU connector on the engine harness<br>• Terminal 24 in the ECU connector on the engine harness<br>• Terminal 46 in the ECU connector on the engine harness | **Greater than 20k ohms:**<br>Faulty ECU connector<br>OR<br>Faulty ECU<br><br>**Less than 20k ohms:**<br>Sensor 5 volt supply circuit shorted to ground<br><br>– – –1/1 |

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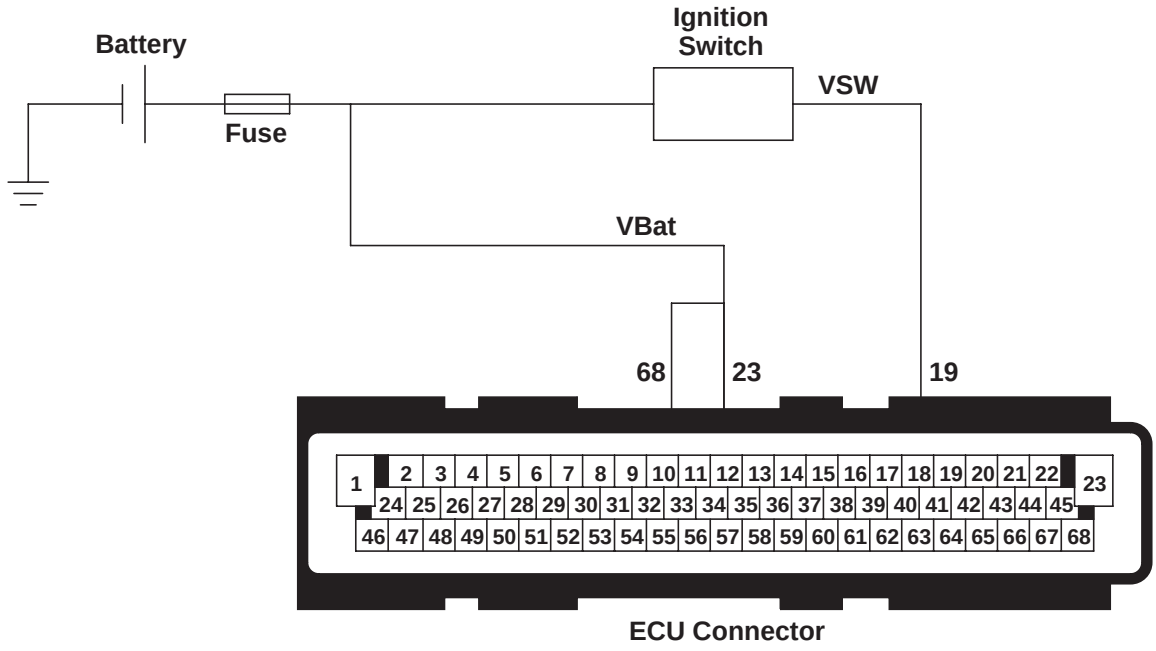
160
,224

## 000627.04 — ECU Unswitched Power Missing




RG10761 –19–23OCT02

04 160 ,226

*NOTE: Wiring schematic shows OEM engine applications only. For wiring information on other applications, see APPLICATION SPECIFICATIONS in Section 06, Group 210 of this manual.*

**DTC 000627.04 will set if:**

- The ECU does not detect battery voltage.

**If DTC 000627.04 sets, the following will occur:**

- The engine will not start or run.
- The ECU will set a BLINKING warning light.

RG41221,000019C –19–22OCT02–1/1

## 000627.04 — ECU Unswitched Power Missing

*The ECU does not detect battery voltage.*

RG41221,000019D –19–15MAY01–1/1

## 000627.04 ECU Unswitched Power Missing Diagnostic Procedure

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160
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| ❶ **Connection Check** | **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.**<br><br>*NOTE: For wiring and theory of operation information, see DTC 000627.04 ECU UNSWITCHED POWER MISSING supporting information.*<br><br>Before using this diagnostic procedure, perform a preliminary inspection of the ECU connector and all ECU grounds looking for dirty, damaged, or poorly positioned terminals. | **No faulty connection(s):**<br>GO TO ❷<br><br>**Faulty connection(s):**<br>Repair faulty connection(s).<br><br>– – –1/1 |
| ❷ **ECU and ECU Connector Test** | *NOTE: For wiring and theory of operation information, see DTC 000627.04 ECU UNSWITCHED POWER MISSING supporting information.*<br><br>1. Ignition OFF<br><br>2. Disconnect ECU connector<br><br>3. Using a multimeter, measure voltage between a good chassis ground and:<br><br>• Terminal 23 in the ECU connector on the engine harness<br>• Terminal 68 in the ECU connector on the engine harness | **Voltage is substantially less than battery voltage:**<br>GO TO ❸<br><br>**Voltages are at or near battery voltage on both terminals:**<br>Faulty ECU connection<br>OR<br>Faulty ECU<br><br>– – –1/1 |

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| ❸ **Battery Voltage Check** | *NOTE: For wiring and theory of operation information, see DTC 000627.04 ECU UNSWITCHED POWER MISSING supporting information.*<br><br>Using a multimeter, measure battery voltage at the battery terminals. | **Voltage within specification for battery:**<br>Faulty ECU power supply fuse<br>OR<br>Faulty ECU connection<br>OR<br>Open or short in ECU power circuit<br><br>**Voltage substantially less than battery voltage:**<br>Faulty battery or charging system<br><br>– – –1/1 |

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,228

## 000629.13 — ECU Error

**Engine Control Unit (ECU)**

- The ECU error fault code can only occur because of an incorrectly programmed ECU or a faulty ECU.

**DTC 000629.13 will set if:**

- The ECU detects an internal problem.

**If DTC 000629.13 sets, the following will occur:**

- The engine will not start or run.

DPSG,RG40854,619 –19–22OCT02–1/1

## 000629.13 — ECU Error

*The ECU detects an internal problem.*

RG41221,000019E –19–15MAY01–1/1

## 000629.13 ECU Error Diagnostic Procedure



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| ❶ **Connection Check** | **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.**<br><br>*NOTE: For theory of operation information, see DTC 000629.13 ECU ERROR supporting information.*<br><br>Before using this diagnostic procedure, perform a preliminary inspection of the ECU connector looking for dirty, damaged, or poorly positioned terminals. | **No faulty connection(s):** GO TO ❷<br><br>**Faulty connection(s):** Repair faulty connection(s). |
| ❷ **Intermittent Fault Test** | *NOTE: For wiring and theory of operation information, see DTC 000629.13 ECU ERROR supporting information.*<br><br>1. Verify that controllers on vehicle are in correct location and connected to the correct wiring harness<br><br>2. Connect the DST or SERVICE ADVISOR™. For instructions on connecting to the DST or SERVICE ADVISOR™, see CONNECTING TO DIAGNOSTIC SCAN TOOL (DST) OR SERVICE ADVISOR™earlier in this Group.<br><br>3. Ignition ON, engine OFF<br><br>4. Start the ECU diagnostic software<br><br>5. Make note of any DTCs, then clear all DTCs<br><br>6. Ignition ON, engine running or cranking for 15 seconds<br><br>7. Read DTCs using DST or SERVICE ADVISOR™. | **000629.13 reoccurs:** Faulty ECU connector OR Faulty ECU<br><br>**000629.13 doesn't reoccur:** Problem is intermittent. If no other codes are present, see INTERMITTENT FAULT DIAGNOSTICS, earlier in this Group. |

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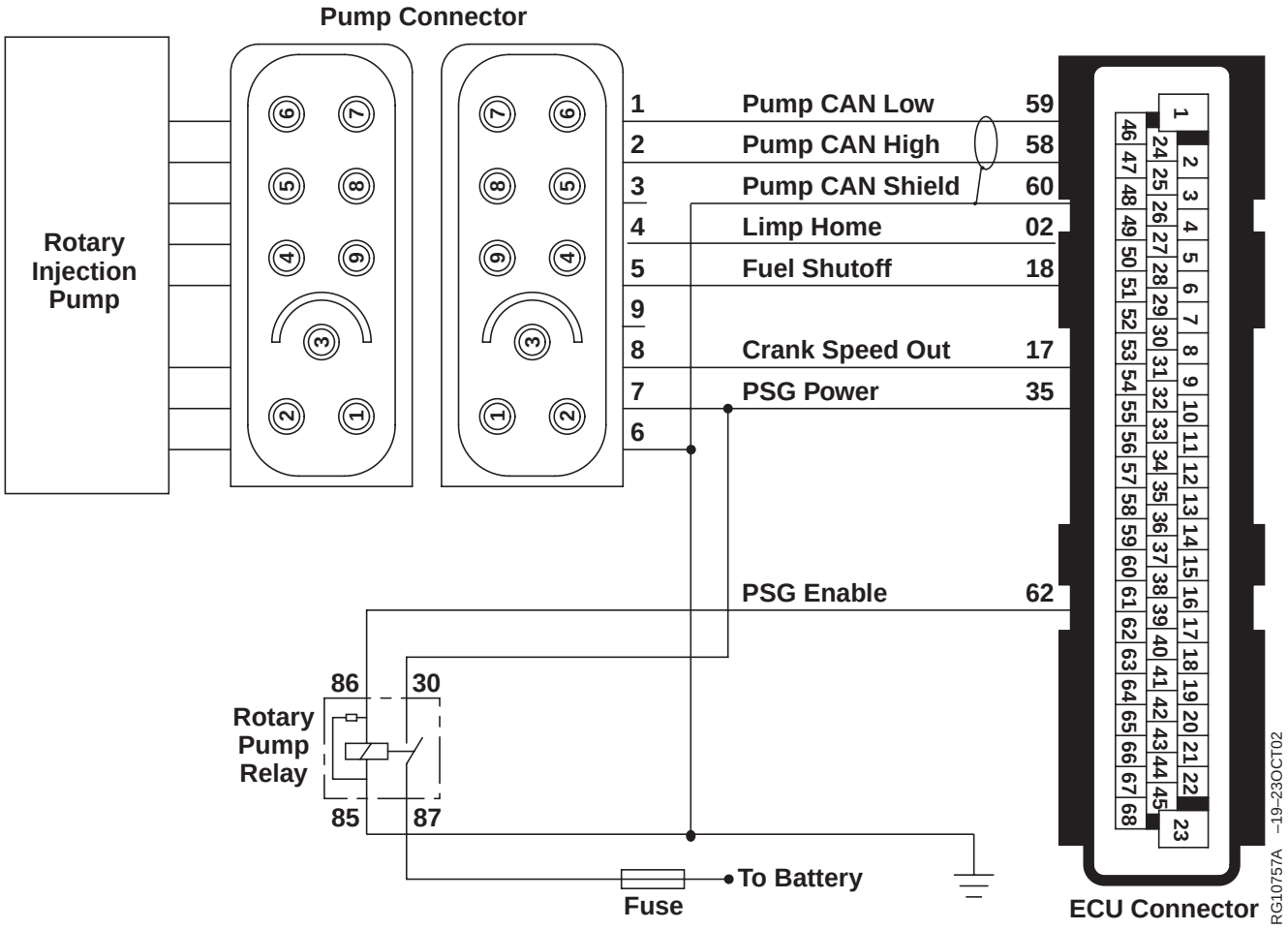
## 000629.19 — ECU to Pump Communication Error




*NOTE: Wiring schematic shows OEM engine applications only. For wiring information on other applications, see APPLICATION SPECIFICATIONS in Section 06, Group 210 of this manual.*

**Bosch VP44 Rotary Injection Pump**

- The Bosch VP44 rotary injection pump is controlled by a pump control unit that monitors information received from sensors inside the pump. It also acquires information from the ECU over a CAN bus and other dedicated wires between the ECU and pump. This helps the pump control unit to provide for the accurate quantity and timing of fuel delivery to the engine.

**DTC 000629.19 will set if:**

- The ECU does not receive CAN messages from the injection pump.

**If DTC 000629.19 sets, the following will occur:**

- If no other codes are present, the ECU will allow the pump to run at low throttle.
- If other codes are present, the ECU might shut down the engine.
- The ECU will set a BLINKING stop lamp.

RG41221,00001A0 –19–22OCT02–1/1

## 000629.19 — ECU to Pump Communication Error

*The ECU does not receive CAN messages from the injection pump.*

RG41221,00001A1 –19–22OCT02–1/1

### 000629.19 ECU to Pump Communication Error Diagnostic Procedure

*NOTE: Other DTCs may be active with 000629.19. If 001485.02 is active also, follow that diagnostic chart first.*

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| ❶ **Connection Check** | **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.**<br><br>*NOTE: For wiring and theory of operation information, see DTC 000629.19 ECU TO PUMP COMMUNICATION ERROR supporting information.*<br><br>Before using this diagnostic procedure, perform a preliminary inspection of the ECU connector and the injection pump harness connector looking for dirty, damaged, or poorly positioned terminals. | **No faulty connection(s):** GO TO ❷<br><br>**Faulty connection(s):** Repair faulty connection(s). |
| ❷ **Intermittent Fault Test** | *NOTE: For wiring and theory of operation information, see DTC 000629.19 ECU TO PUMP COMMUNICATION ERRORsupporting information.*<br><br>1. Connect the DST or SERVICE ADVISOR™. For instructions on connecting to the DST or SERVICE ADVISOR™, see CONNECTING TO DIAGNOSTIC SCAN TOOL (DST) OR SERVICE ADVISOR™earlier in this Group.<br>2. Ignition ON, engine OFF<br>3. Start the ECU diagnostic software<br>4. Make note of any DTCs, then clear all DTCs<br>5. Ignition ON, engine running or cranking for 15 seconds<br>6. Read DTCs using DST or SERVICE ADVISOR™. | **000629.19 reoccurs:** GO TO ❸<br><br>**000629.19 doesn't reoccur:** Problem is intermittent. If no other codes are present, see INTERMITTENT FAULT DIAGNOSTICS, earlier in this Group. |

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| ❸ **Open in PSG Power Circuit Wire Test** | *NOTE: For wiring and theory of operation information, see DTC 000629.19 ECU TO PUMP COMMUNICATION ERROR supporting information.*<br>1. Ignition OFF<br>2. Disconnect injection pump connector<br>3. Ignition ON, engine OFF<br>4. Using a multimeter, measure voltage between terminal 7 in the injection pump connector on the engine harness and a good chassis ground | **Approximately battery voltage:**<br>GO TO ❹<br>**Substantially less than battery voltage:**<br>Open in PSG power circuit<br>– – –1/1 |

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| ❹ **Pump Communication Wiring Check** | *NOTE: For wiring and theory of operation information, see DTC 000629.19 ECU TO PUMP COMMUNICATION ERROR supporting information.*<br>1. Ignition OFF<br>2. Disconnect ECU connector<br>3. Using a multimeter, measure resistance between:<br>• Terminal 1 in the injection pump connector and terminal 59 in the ECU connector on the engine harness<br>• Terminal 2 in the injection pump connector and terminal 58 in the ECU connector on the engine harness | **Both measurements 5 ohms or less:**<br>GO TO ❺<br>**Either measurement greater than 5 ohms:**<br>Faulty CAN wiring between injection pump and the ECU<br>– – –1/1 |

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160
,234

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| ❺ **Pump CAN Low Wire Check for Short** | *NOTE: For wiring and theory of operation information, see DTC 000629.19 ECU TO PUMP COMMUNICATION ERROR supporting information.*<br>1. Ignition OFF<br>2. Keep ECU and pump connectors disconnected<br>3. Using a multimeter, measure resistance between terminal 59 in the ECU connector and:<br>• A good ground<br>• All other terminals in the ECU connector | **All measurements greater than 20k ohms:**<br>GO TO ❻<br>**Either measurement less than 20k ohms:**<br>Pump CAN Low wire shorted to ground or another wire in harness<br>– – –1/1 |

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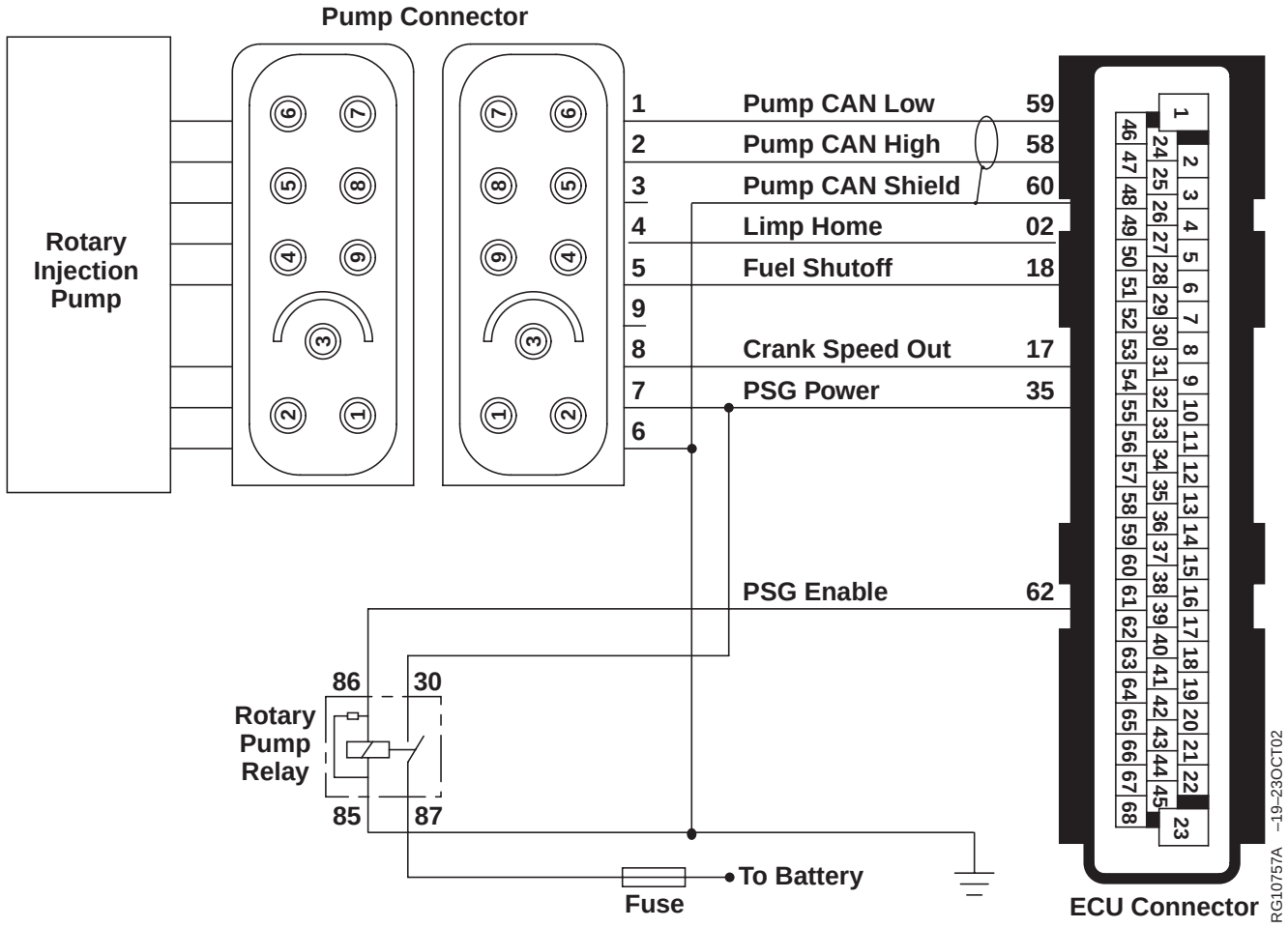
| ❻ **Pump CAN High Wire Check for Short** | *NOTE: For wiring and theory of operation information, see DTC 000629.19 ECU TO PUMP COMMUNICATION ERROR supporting information.*<br>1. Ignition OFF<br>2. Keep ECU and pump connectors disconnected<br>3. Using a multimeter, measure resistance between terminal 58 in the ECU connector and:<br>• A good ground<br>• All other terminals in the ECU connector | **All measurements greater than 20k ohms:**<br>Faulty injection pump connector<br>OR<br>Faulty injection pump<br>**Either measurement less than 20k ohms:**<br>Pump CAN High wire shorted to ground or another wire in harness<br>– – –1/1 |

## 000632.02 Fuel Shutoff Error




*NOTE: Wiring schematic shows OEM engine applications only. For wiring information on other applications, see APPLICATION SPECIFICATIONS in Section 06, Group 210 of this manual.*

**Bosch VP44 Rotary Injection Pump**

- The Bosch VP44 rotary injection pump is controlled by a pump control unit that monitors information received from sensors inside the pump. It also acquires information from the ECU over a CAN bus and other dedicated wires between the ECU and pump. This helps the pump control unit to provide for the accurate quantity and timing of fuel delivery to the engine.

**DTC 000632.02 will set if:**

- The pump control unit (PSG) detects a fuel shutoff voltage that does not match the information being communicated over CAN.

**If DTC 000632.02 sets, the following will occur:**

- The engine will shut down or may not restart.
- The ECU will set a BLINKING warning light.

RG41221,00001A3 –19–15MAY01–1/1

## 000632.02 — Fuel Shutoff Error

*The pump control unit (PSG) detects a fuel shutoff voltage that does not match the information being communicated over CAN.*

RG41221,00001A4 –19–22OCT02–1/1

## 000632.02 Fuel Shutoff Error Diagnostic Procedure

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160
,237

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| ❶ **Connection Check** | **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.**<br><br>*NOTE: For wiring and theory of operation information, see DTC 000632.02 FUEL SHUTOFF ERROR supporting information.*<br><br>Before using this diagnostic procedure, perform a preliminary inspection of the ECU connector and the fuel injection pump harness connector looking for dirty, damaged, or poorly positioned terminals. | **No faulty connection(s):** GO TO ❷<br><br>**Faulty connection(s):** Repair faulty connection(s). |

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| ❷ **Intermittent Fault Test** | *NOTE: For wiring and theory of operation information, see DTC 000632.02 FUEL SHUTOFF ERROR supporting information.*<br><br>1. Connect the DST or SERVICE ADVISOR™. For instructions on connecting to the DST or SERVICE ADVISOR™, see CONNECTING TO DIAGNOSTIC SCAN TOOL (DST) OR SERVICE ADVISOR™earlier in this Group.<br><br>2. Ignition ON, engine OFF<br><br>3. Start the ECU diagnostic software<br><br>4. Make note of any DTCs, then clear all DTCs<br><br>5. Ignition ON, engine running or cranking<br><br>6. Read DTCs using DST or SERVICE ADVISOR™. | **000632.02 reoccurs:** GO TO ❸<br><br>**000632.02 doesn't reoccur:** Problem is intermittent. If no other codes are present, see INTERMITTENT FAULT DIAGNOSTICS, earlier in this Group. |

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| ❸ **Voltage at Injection Pump Check** | *NOTE: For wiring and theory of operation information, see DTC 000632.02 FUEL SHUTOFF ERROR supporting information.*<br><br>1. Ignition OFF<br><br>2. Disconnect injection pump connector<br><br>3. Ignition ON, engine OFF<br><br>4. Using a multimeter, measure voltage between a good chassis ground and terminal 5 in the injection pump connector on the engine harness | **Battery voltage present:**<br>GO TO ❹<br><br>**No battery voltage present:**<br>Faulty injection pump connector<br>OR<br>Faulty injection pump<br><br>– – –1/1 |

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| ❹ **Fuel Shutoff Wire Check for Short to Voltage** | *NOTE: For wiring and theory of operation information, see DTC 000632.02 FUEL SHUTOFF ERROR supporting information.*<br><br>1. Ignition OFF<br><br>2. Using a multimeter, measure resistance between terminal 18 in the ECU connector and all other terminals in the ECU connector on the engine harness | **Greater than 20k ohms:**<br>Faulty ECU connector<br>OR<br>Faulty ECU<br><br>**Less than 20k ohms:**<br>Short to voltage in fuel shutoff wire<br><br>– – –1/1 |

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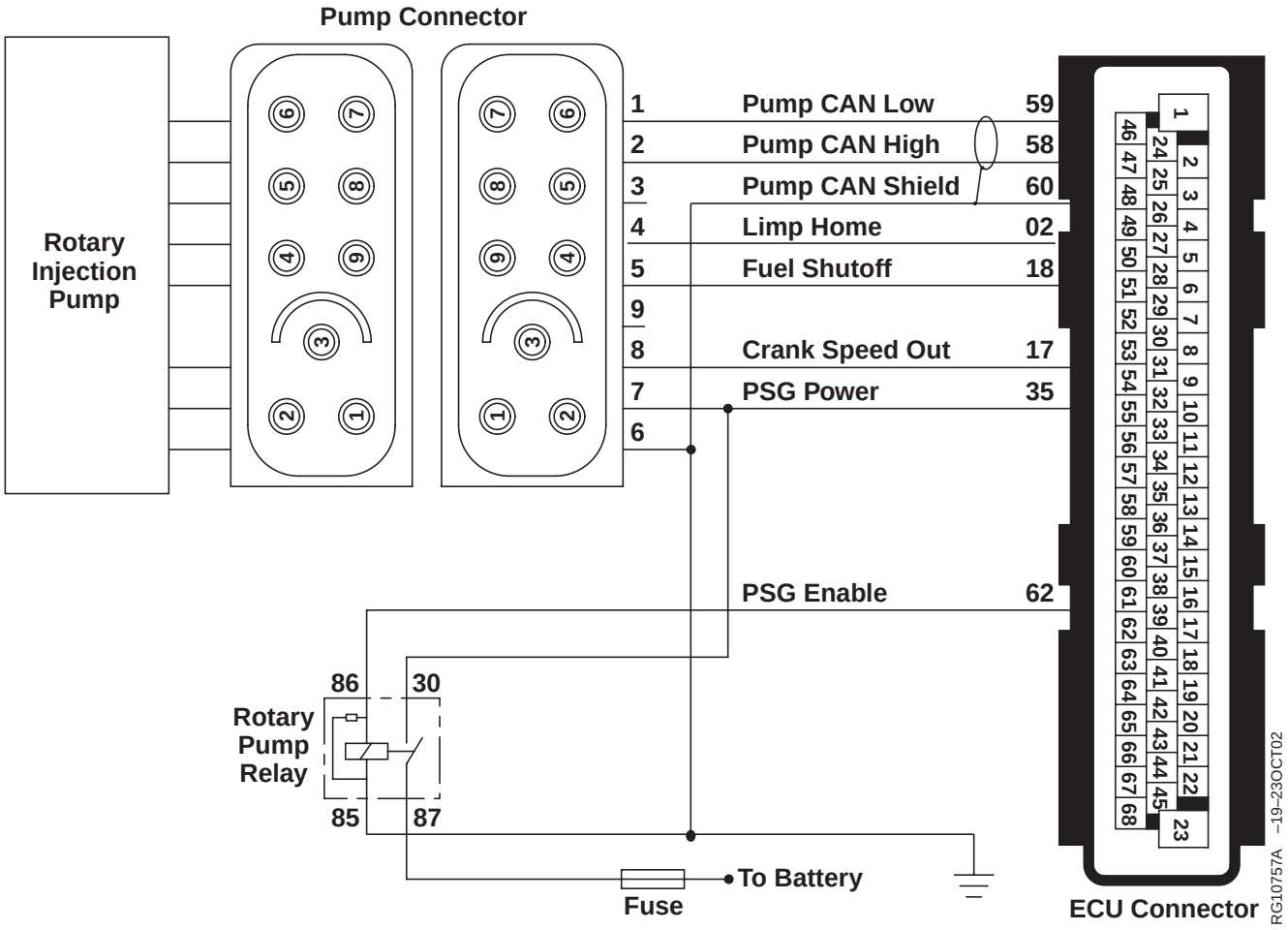
160
,238

## 000632.05 — Fuel Shutoff Non-Functional




*NOTE: Wiring schematic shows OEM engine applications only. For wiring information on other applications, see APPLICATION SPECIFICATIONS in Section 06, Group 210 of this manual.*

**Bosch VP44 Rotary Injection Pump**

- The Bosch VP44 rotary injection pump is controlled by a pump control unit that monitors information received from sensors inside the pump. It also acquires information from the ECU over a CAN bus and other dedicated wires between the ECU and pump. This helps the pump control unit to provide for the accurate quantity and timing of fuel delivery to the engine.

**DTC 000632.05 will set if:**

- The ECU does not detect a change in engine speed during a period of time after the key is turned off.

**If DTC 000632.05 sets, the following will occur:**

- No change in engine performance will be detected.
- The ECU will set a BLINKING warning light.

RG41221,00001A6 –19–22OCT02–1/1

## 000632.05 — Fuel Shutoff Non-Functional

*The ECU does not detect a change in engine speed during a period of time after the key is turned off.*

RG41221,00001A7 –19–15MAY01–1/1

### 000632.05 Fuel Shutoff Non-Functional Diagnostic Procedure

*NOTE: This DTC will appear only as a stored trouble code.*

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160
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| ❶ **Connection Check** | **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.**<br><br>*NOTE: For wiring and theory of operation information, see DTC 000632.05 FUEL SHUTOFF NON-FUNCTIONAL supporting information.*<br><br>Before using this diagnostic procedure, perform a preliminary inspection of the ECU connector and the injection pump connector looking for dirty, damaged, or poorly positioned terminals. | **No faulty connection(s):** GO TO ❷<br><br>**Faulty connection(s):** Repair faulty connection(s). |

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| ❷ **Intermittent Fault Test** | *NOTE: For wiring and theory of operation information, see DTC 000632.05 FUEL SHUTOFF NON-FUNCTIONAL supporting information.*<br><br>1. Connect the DST or SERVICE ADVISOR™. For instructions on connecting to the DST or SERVICE ADVISOR™, see CONNECTING TO DIAGNOSTIC SCAN TOOL (DST) OR SERVICE ADVISOR™earlier in this Group.<br>2. Ignition ON, engine OFF<br>3. Start the ECU diagnostic software<br>4. Make note of any DTCs, then clear all DTCs<br>5. Ignition ON, engine running<br>6. Ignition OFF<br>7. Ignition ON, engine OFF<br>8. Read DTCs using DST or SERVICE ADVISOR™. | **000632.05 reoccurs:** GO TO ❸<br><br>**000632.05 doesn't reoccur:** Problem is intermittent. If no other codes are present, see INTERMITTENT FAULT DIAGNOSTICS, earlier in this Group. |

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| ❸ **Open in Fuel Shutoff Wire Check** | *NOTE: For wiring and theory of operation information, see DTC 000632.05 FUEL SHUTOFF NON-FUNCTIONAL supporting information.*<br><br>1. Ignition OFF<br><br>2. Disconnect ECU and injection pump connectors<br><br>3. Using a multimeter, measure resistance between terminal 18 in the harness end of the ECU connector and terminal 5 in the harness end of the injection pump connector. | **Less than 5 ohms:**<br>GO TO ❹<br><br>**Greater than 5 ohms:**<br>Open in fuel shutoff wire<br><br>– – –1/1 |

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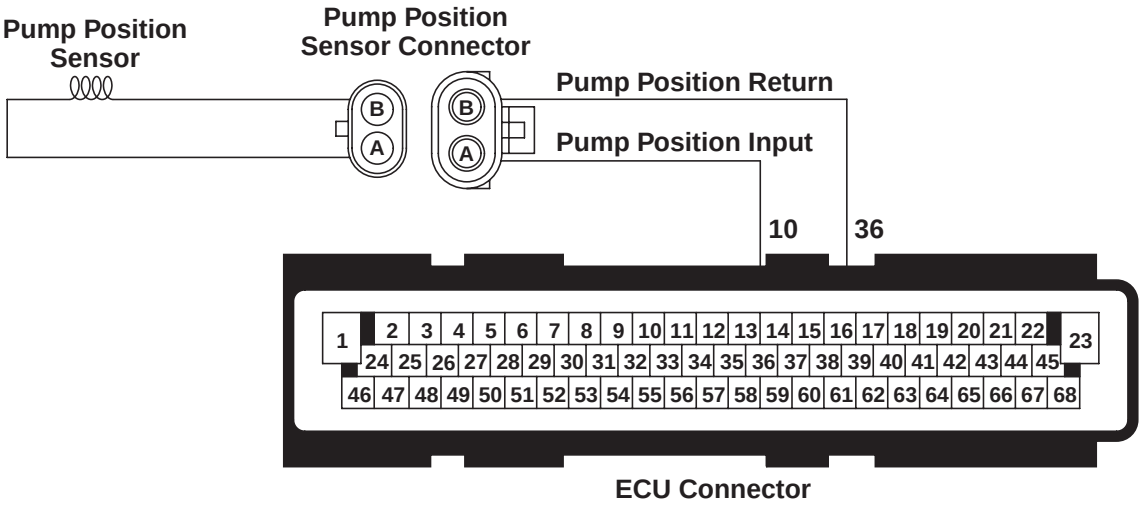
| ❹ **Fuel Shutoff Wire Check for Short** | *NOTE: For wiring and theory of operation information, see DTC 000632.05 FUEL SHUTOFF NON-FUNCTIONAL supporting information.*<br><br>1. Ignition OFF<br><br>2. Using multimeter, measure resistance between terminal 18 in the harness end of the ECU connector and a good chassis ground | **Greater than 20k ohms:**<br>Faulty ECU connector<br>OR<br>Faulty ECU<br><br>**Less than 20k ohms:**<br>Short to ground in fuel shutoff wire<br><br>– – –1/1 |

04
160
,242

## 000636.02 — Pump Position Input Noise




RG10758 –19–21JUN01

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,244

*NOTE: Wiring schematic shows OEM engine applications only. For wiring information on other applications, see APPLICATION SPECIFICATIONS in Section 06, Group 210 of this manual.*

**Pump Position Sensor**

- The pump position sensor is located behind the injection pump. It is an inductive type pickup sensor that detects slots in the injection pump gear. The ECU uses the pump position input to determine cylinder identification to keep the pump in time with the engine. The injection pump gear is composed of 12 evenly spaced slots with one additional notch offset to tell the ECU that cylinder #1 is approaching Top-Dead-Center. For further pump position sensor information, see MEASURING ENGINE SPEED in Section 03, Group 140 earlier in this manual.

**DTC 000636.02 will set if:**

- The ECU detects excessive noise (extra pulses) on the Pump Position input.

**If DTC 000636.02 sets, the following will occur:**

- If a crankshaft position sensor trouble code accompanies DTC 000636.02, the engine will die and won't restart until at least one of the two codes is repaired.
- ECU will use only the crankshaft position sensor input to determine piston position.
- The moment that the trouble codes sets, the engine may hesitate or die, but it will re-start.
- Prolonged cranking time may be required to start the engine.
- The ECU will set a BLINKING warning light.

RG41221,00001A9 –19–22OCT02–1/1

## 000636.02 — Pump Position Input Noise

*The ECU detects excessive noise (extra pulses) on the Pump Position input.*

RG41221,00001AA –19–22OCT02–1/1

## 000636.02 Pump Position Input Noise Diagnostic Procedure



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| ❶ **Connection Check** | **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.**<br><br>*NOTE: For wiring and theory of operation information, see DTC 000636.02 PUMP POSITION INPUT NOISE supporting information.*<br><br>Before using this diagnostic procedure, perform a preliminary inspection of the ECU connector and the pump position sensor connector looking for dirty, damaged, or poorly positioned terminals. | **No faulty connection(s):** GO TO ❷<br><br>**Faulty connection(s):** Repair faulty connection(s). |

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| ❷ **Intermittent Fault Test** | *NOTE: For wiring and theory of operation information, see DTC 000636.02 PUMP POSITION INPUT NOISE supporting information.*<br><br>1. Connect the DST or SERVICE ADVISOR™. For instructions on connecting to the DST or SERVICE ADVISOR™, see CONNECTING TO DIAGNOSTIC SCAN TOOL (DST) OR SERVICE ADVISOR™earlier in this Group.<br>2. Ignition ON, engine OFF<br>3. Start the ECU diagnostic software<br>4. Make note of all DTCs, then clear all DTCs<br>5. Ignition ON, engine running<br>6. Warm engine<br>7. Read DTCs using DST or SERVICE ADVISOR™. | **000636.02 reoccurs:** GO TO ❸<br><br>**000636.02 doesn't reoccur:** Problem is intermittent. If no other codes are present, see INTERMITTENT FAULT DIAGNOSTICS, earlier in this Group. |

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| ❸ **Noise Detection Test** | *NOTE: For wiring and theory of operation information, see DTC 000636.02 PUMP POSITION INPUT NOISE supporting information.*<br><br>1. 000636.02 is most likely caused by radiated or conducted electrical "noise" from some part of the machine. This problem may be caused by loose electrical ground or power connections anywhere on the machine. Things to check:<br><br>• All harness connectors<br>• Alternator connections<br>• Chassis ground connections, battery ground connection<br>• Corrosion, dirt, or paint can cause intermittent and "noisy" connections<br>• Check the wiring for intermittent open and short circuits; particularly the pump position sensor wiring<br>• Check wiring for proper pin location in the pump position sensor and ECU connectors<br><br>2. Other possible causes of 000636.02:<br><br>• Electromagnetic interference (EMI) from an incorrectly installed 2-way radio<br>• Interference from some radar source<br>• Possible burrs on the pump position timing wheel.<br>• Notches should have clean, square edges. | – – –1/1 |

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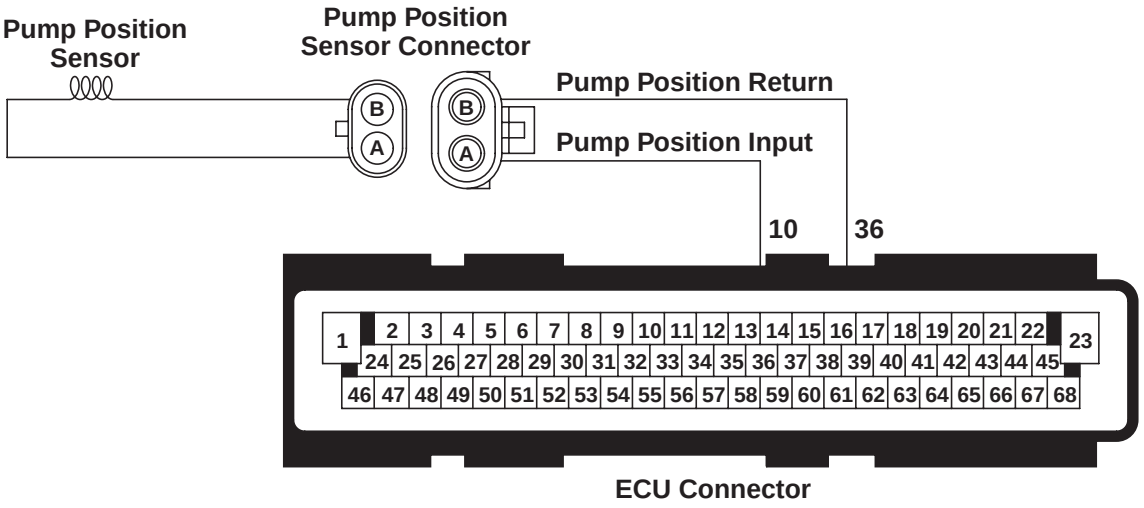
160
,246

## 000636.08 — Pump Position Input Missing




RG10758 –19–21JUN01

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*NOTE: Wiring schematic shows OEM engine applications only. For wiring information on other applications, see APPLICATION SPECIFICATIONS in Section 06, Group 210 of this manual.*

**Pump Position Sensor**

- The pump position sensor is located behind the injection pump. It is an inductive type pickup sensor that detects slots in the injection pump gear. The ECU uses the pump position input to determine cylinder identification to keep the pump in time with the engine. The injection pump gear is composed of 12 evenly spaced slots with one additional notch offset to tell the ECU that cylinder #1 is approaching Top-Dead-Center. For further pump position sensor information, see MEASURING ENGINE SPEED in Section 03, Group 140 earlier in this manual.

**DTC 000636.08 will set if:**

- The ECU does not detect the Pump Position input.

**If DTC 000636.08 sets, the following will occur:**

- If a crankshaft position sensor trouble code accompanies DTC 000636.08, the engine will die and won't restart until at least one of the two codes is repaired.
- ECU will use only the crankshaft position sensor input to determine piston position.
- The moment that the trouble codes sets, the engine may hesitate or die, but it will re-start.
- Prolonged cranking time may be required to start the engine.
- The ECU will set a BLINKING warning light.

RG41221,00001AC –19–22OCT02–1/1

## 000636.08 — Pump Position Input Missing

*The ECU does not detect the Pump Position input.*

RG41221,00001AD –19–22OCT02–1/1

## 000636.08 Pump Position Input Missing Diagnostic Procedure



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| ❶ **Connection Check** | **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.**<br><br>*NOTE: For wiring and theory of operation information, see DTC 000636.08 PUMP POSITION INPUT MISSING supporting information.*<br><br>Before using this diagnostic procedure, perform a preliminary inspection of the ECU connector and the pump position sensor connector looking for dirty, damaged, or poorly positioned terminals. | **No faulty connection(s):** GO TO ❷<br><br>**Faulty connection(s):** Repair faulty connection(s). |

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| ❷ **Intermittent Fault Test** | *NOTE: For wiring and theory of operation information, see DTC 000636.08 PUMP POSITION INPUT MISSING supporting information.*<br><br>1. Connect the DST or SERVICE ADVISOR™. For instructions on connecting to the DST or SERVICE ADVISOR™, see CONNECTING TO DIAGNOSTIC SCAN TOOL (DST) OR SERVICE ADVISOR™earlier in this Group.<br>2. Ignition ON, engine OFF<br>3. Start the ECU diagnostic software<br>4. Make notes of any DTCs, then clear all DTCs<br>5. Ignition ON, engine running<br>6. Read DTCs using DST or SERVICE ADVISOR™. | **000636.08 reoccurs:** GO TO ❸<br><br>**000636.08 doesn't reoccur:** Problem is intermittent. If no other codes are present, see INTERMITTENT FAULT DIAGNOSTICS, earlier in this Group. |

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| ❸ **Pump Position Sensor Test** | *NOTE: For wiring and theory of operation information, see DTC 000636.08 PUMP POSITION INPUT MISSING supporting information.*<br><br>1. Ignition OFF<br><br>2. Disconnect pump position sensor connector<br><br>3. Using a multimeter, measure resistance between both terminals of the pump position sensor connector on the engine harness. | **Between 2500 and 3500 ohms:**<br>GO TO ❹<br><br>**Below 2500 ohms or above 3500 ohms:**<br>Faulty pump position sensor<br><br>– – –1/1 |

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| ❹ **Open in Pump Position Sensor Input and Return Wires Check** | *NOTE: For wiring and theory of operation information, see DTC 000636.08 PUMP POSITION INPUT MISSING supporting information.*<br><br>1. Ignition OFF<br><br>2. Disconnect pump position sensor connector<br><br>3. Disconnect ECU connector<br><br>4. Using a multimeter, measure resistance between:<br><br>• Terminal A of the pump position sensor connector AND terminal 10 in the ECU connector on the engine harness<br>• Terminal B of the pump position sensor connector AND terminal 36 in the ECU connector on the engine harness | **Both measurements 5 ohms or less:**<br>GO TO ❺<br><br>**Either measurement greater than 5 ohms:**<br>Open in pump position sensor input wire<br>OR<br>Open in pump position sensor return wire<br>OR<br>Terminals A and B in the pump position sensor harness connector possibly inverted<br><br>– – –1/1 |

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| ❺ **Pump Position Sensor Wiring Check** | *NOTE: For wiring and theory of operation information, see DTC 000636.08 PUMP POSITION INPUT MISSING supporting information.*<br><br>1. Ignition OFF<br><br>2. Pump position sensor connector and ECU connector still disconnected<br><br>3. Using a multimeter, measure resistance between terminal 10 in the ECU connector on the engine harness and the following:<br><br>• A good chassis ground<br>• All other terminals the ECU connector | **All measurements greater than 2k ohms:**<br>GO TO ❻<br><br>**Any measurement less than 2k ohms:**<br>Short in pump position input wire to wire with low resistance<br><br>– – –1/1 |

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| ❻ **Pump Position Sensor Return Wiring Check** | *NOTE: For wiring and theory of operation information, see DTC 000636.08 PUMP POSITION INPUT MISSING supporting information.*<br><br>1. Ignition OFF<br><br>2. Pump position sensor connector and ECU connector still disconnected<br><br>3. Using a multimeter, measure resistance between terminal 36 in the ECU connector on the engine harness and the following:<br><br>• A good chassis ground<br>• All other terminals the ECU connector | **All measurements greater than 2k ohms:**<br>Faulty pump position sensor connector<br>OR<br>Damaged pump position sensor<br>OR<br>Faulty ECU connector<br>OR<br>Faulty ECU<br><br>**Any measurement less than 2k ohms:**<br>Faulty pump position sensor return wiring harness<br><br>– – –1/1 |

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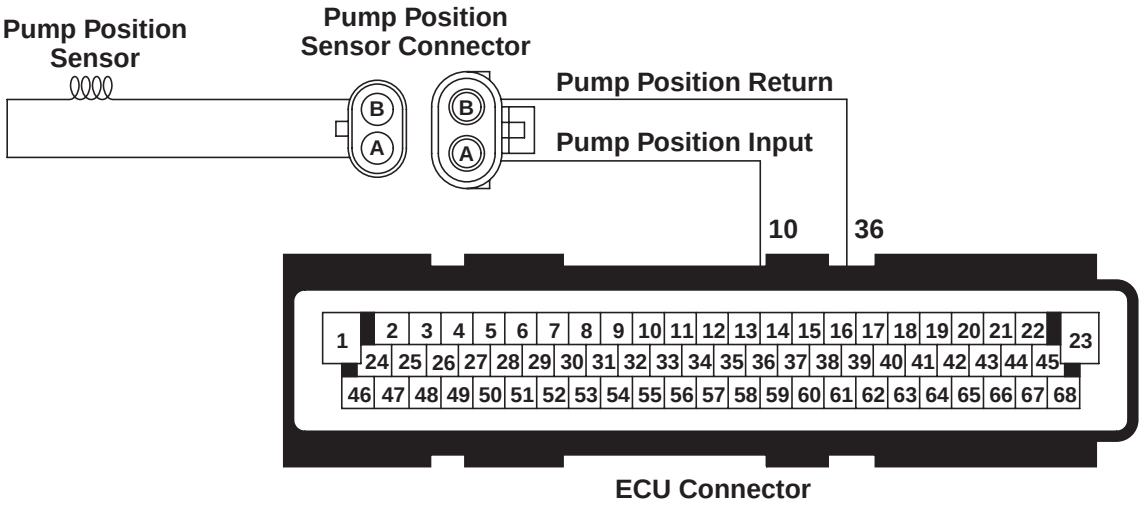
,251

## 000636.10 — Pump Position Input Pattern Error




RG10758 –19–21JUN01

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*NOTE: Wiring schematic shows OEM engine applications only. For wiring information on other applications, see APPLICATION SPECIFICATIONS in Section 06, Group 210 of this manual.*

**Pump Position Sensor**

- The pump position sensor is located behind the injection pump. It is an inductive type pickup sensor that detects slots in the injection pump gear. The ECU uses the pump position input to determine cylinder identification to keep the pump in time with the engine. The injection pump gear is composed of 12 evenly spaced slots with one additional notch offset to tell the ECU that cylinder #1 is approaching Top-Dead-Center. For further pump position sensor information, see MEASURING ENGINE SPEED in Section 03, Group 140 earlier in this manual.

**DTC 000636.10 will set if:**

- The ECU detects an improper pattern on the Pump Position input.

**If DTC 000636.10 sets, the following will occur:**

- If a crankshaft position sensor trouble code accompanies DTC 000636.10, the engine will die and won't restart until at least one of the two codes is repaired.
- ECU will use only the crankshaft position sensor input to determine piston position.
- The moment that the trouble codes sets, the engine may hesitate or die, but it will re-start.
- Prolonged cranking time may be required to start the engine.
- The ECU will set a BLINKING warning light.

RG41221,00001AF –19–22OCT02–1/1

## 000636.10 — Pump Position Input Pattern Error

*The ECU detects an improper pattern on the Pump Position input.*

RG41221,00001B0 –19–22OCT02–1/1

## 000636.10 Pump Position Input Pattern Error Diagnostic Procedure

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,253

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| ❶ **Connection Check** | **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.**<br><br>*NOTE: For wiring and theory of operation information, see DTC 000636.10 PUMP POSITION INPUT PATTERN ERROR supporting information.*<br><br>Before using this diagnostic procedure, perform a preliminary inspection of the ECU connector and the pump position sensor connector looking for dirty, damaged, or poorly positioned terminals. | **No faulty connection(s):** GO TO ❷<br><br>**Faulty connection(s):** Repair faulty connection(s). |
| ❷ **Intermittent Fault Test** | *NOTE: For wiring and theory of operation information, see DTC 000636.10 PUMP POSITION INPUT PATTERN ERROR supporting information.*<br><br>1. Connect the DST or SERVICE ADVISOR™. For instructions on connecting to the DST or SERVICE ADVISOR™, see CONNECTING TO DIAGNOSTIC SCAN TOOL (DST) OR SERVICE ADVISOR™earlier in this Group.<br>2. Ignition ON, engine OFF<br>3. Start the ECU diagnostic software<br>4. Make notes of any DTCs, then clear all DTCs<br>5. Ignition ON, engine running<br>6. Read DTCs using DST or SERVICE ADVISOR™. | **000636.10 reoccurs:** GO TO ❸<br><br>**000636.10 doesn't reoccur:** Problem is intermittent. If no other codes are present, see INTERMITTENT FAULT DIAGNOSTICS, earlier in this Group. |

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| ❸ **Pump Position Sensor Test** | *NOTE: For wiring and theory of operation information, see DTC 000636.10 PUMP POSITION INPUT PATTERN ERROR supporting information.*<br><br>1. Ignition OFF<br><br>2. Disconnect pump position sensor connector<br><br>3. Using a multimeter, measure resistance between both terminals of the pump position sensor connector on the engine harness | **Between 2500 and 3500 ohms:**<br>GO TO ❹<br><br>**Below 2500 ohms or above 3500 ohms:**<br>Faulty pump position sensor<br><br>– – –1/1 |

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| ❹ **Open in Pump Position Input or Return Wire Test** | *NOTE: For wiring and theory of operation information, see DTC 000636.10 PUMP POSITION INPUT PATTERN ERROR supporting information.*<br><br>1. Ignition OFF<br><br>2. Disconnect pump position sensor connector<br><br>3. Disconnect ECU connector<br><br>4. Using a multimeter, measure resistance between:<br><br>• Terminal A of the pump position sensor connector AND terminal 10 in the ECU connector on the engine harness<br>• Terminal B of the pump position sensor connector AND terminal 36 in the ECU connector on the engine harness | **Both measurements 5 ohms or less:**<br>GO TO ❺<br><br>**Either measurement greater than 5 ohms:**<br>Open in pump position sensor input wire<br>OR<br>Open in pump position sensor return wire<br>OR<br>Terminals A and B in the pump position sensor harness connector possibly inverted<br><br>– – –1/1 |

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| ❺ **Pump Position Sensor Input Wiring Check** | *NOTE: For wiring and theory of operation information, see DTC 000636.10 PUMP POSITION INPUT PATTERN ERROR supporting information.*<br><br>1. Ignition OFF<br><br>2. Pump position sensor connector and ECU connector still disconnected<br><br>3. Using a multimeter, measure resistance between terminal 10 in the ECU connector on the engine harness and the following:<br><br>• A good chassis ground<br>• All other terminals in the ECU connector | **All measurements greater than 2k ohms:**<br>GO TO ❻<br><br>**Any measurement less than 2k ohms:**<br>Faulty pump position sensor input wiring harness<br><br>– – –1/1 |

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| ❻ **Pump Position Sensor Return Wiring Check** | *NOTE: For wiring and theory of operation information, see DTC 000636.10 PUMP POSITION INPUT PATTERN ERROR supporting information.*<br><br>1. Ignition OFF<br><br>2. Pump position sensor connector and ECU connector still disconnected<br><br>3. Using a multimeter, measure resistance between terminal 36 in the ECU connector on the engine harness and the following:<br><br>• A good chassis ground<br>• All other terminals in the ECU connector | **All measurements greater than 2k ohms:** GO TO ❼<br><br>**Any measurement less than 2k ohms:** Faulty pump position sensor return wiring harness<br><br>– – –1/1 |

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| ❼ **Pump Position Sensor and Timing Wheel Check** | *NOTE: For wiring and theory of operation information, see DTC 000636.10 PUMP POSITION INPUT PATTERN ERROR supporting information.*<br><br>1. Remove pump position sensor from injection pump Inspect sensor for cracks, corrosion, or any foreign material on the end of the sensor.<br><br>2. Inspect the pump timing wheel notches for burrs or chips. | **All components OK:** GO TO ❽<br><br>**Fault found in a component:** Repair or replace component as needed<br><br>– – –1/1 |



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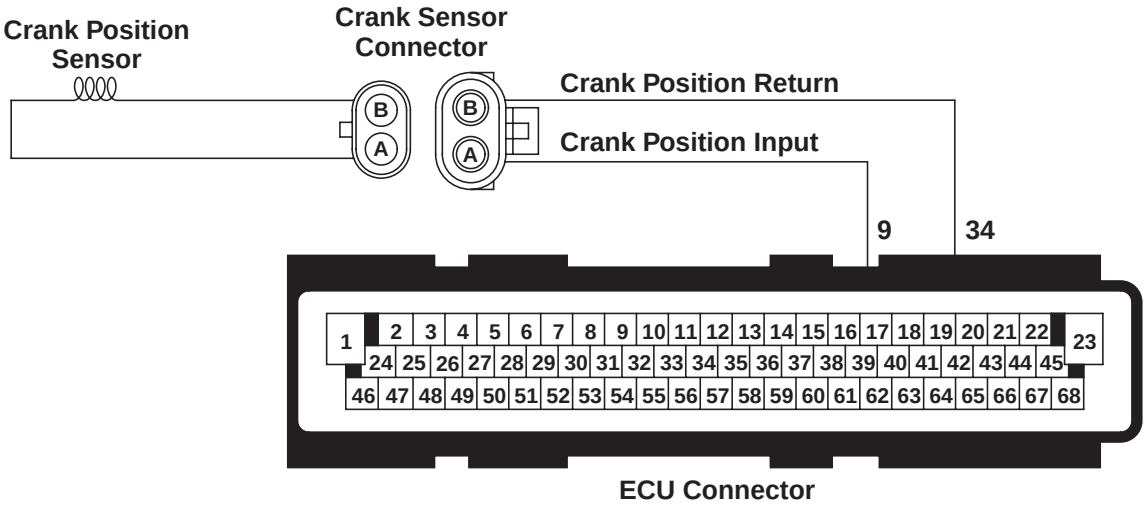
| ❽ **Cam and Crank Timing Test** | *NOTE: For wiring and theory of operation information, see DTC 000636.10 PUMP POSITION INPUT PATTERN ERROR supporting information.*<br><br>1. Ignition OFF<br><br>2. Remove timing cover<br><br>3. Check timing between camshaft, crankshaft, and injection pump gears. See INSTALL CAMSHAFT in Group 050 of 4.5 & 6.8 L Diesel Engines Base Engine Manual (CTM 104). | **All gears in time:** Faulty pump position sensor connector OR Faulty ECU connector OR Faulty ECU<br><br>**One or more gears out of time:** Make necessary adjustments to ensure correct timing. See INSTALL CAMSHAFT in Group 050 of 4.5 & 6.8 L Diesel Engines Base Engine Manual (CTM 104).<br><br>– – –1/1 |

## 000637.02 — Crankshaft Position Input Noise




RG10759 –19–18MAY00

04 160 ,256

*NOTE: Wiring schematic shows OEM engine applications only. For wiring information on other applications, see APPLICATION SPECIFICATIONS in Section 06, Group 210 of this manual.*

**Crankshaft Position Sensor**

- The crankshaft position sensor is located on the front of the crankshaft, behind the pressed-on crank gear. It is an inductive type pickup sensor that detects teeth on the crank timing wheel. The ECU uses the crankshaft position input to determine engine speed and precise piston position in relation to the firing order. The crank timing wheel is composed of 48 evenly spaced teeth and 2 gaps between the teeth missing. The missing gaps help the ECU to determine Top-Dead-Center (TDC). For further crankshaft position sensor information, see MEASURING ENGINE SPEED in Section 03, Group 140.

**DTC 000637.02 will set if:**

- The ECU detects excessive noise (extra pulses) on the crankshaft position input.

**If DTC 000637.02 sets, the following will occur:**

- Engine protection is enabled. See ENGINE PROTECTION in Section 03, Group 140 earlier in this manual.
  - With Derate Feature: On OEM applications, the engine derates 20% per minute until the engine is running at 50% of full power. For non-OEM applications, see APPLICATION SPECIFICATIONS in Section 06, Group 210 later in this manual.
- If a pump position sensor trouble code accompanies DTC 000637.02, the engine will die and won't restart until at least one of the two codes is repaired.
- ECU will use only the pump position sensor input to determine piston position.
- The moment that the trouble codes sets, the engine may hesitate or die, but it will re-start.
- Prolonged cranking may be required to start engine.

Continued on next page

RG41221,00001B2 –19–22OCT02–1/2

- The ECU will set a BLINKING stop lamp.

RG41221,00001B2 –19–22OCT02–2/2

## 000637.02 — Crankshaft Position Input Noise

*The ECU detects excessive noise (extra pulses) on the crankshaft position input.*

RG41221,00001B3 –19–22OCT02–1/1

### 000637.02 Crankshaft Position Input Noise Diagnostic Procedure

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| ❶ **Connection Check** | **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.**<br><br>*NOTE: For wiring and theory of operation information, see DTC 000637.02 CRANKSHAFT POSITION INPUT NOISE supporting information.*<br><br>Before using this diagnostic procedure, perform a preliminary inspection of the ECU connector and the crankshaft position sensor connector looking for dirty, damaged, or poorly positioned terminals. | **No faulty connection(s):** GO TO ❷<br><br>**Faulty connection(s):** Repair faulty connection(s). |

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| ❷ **Intermittent Fault Test** | *NOTE: For wiring and theory of operation information, see DTC 000637.02 CRANKSHAFT POSITION INPUT NOISE supporting information.*<br><br>1. Connect the DST or SERVICE ADVISOR™. For instructions on connecting to the DST or SERVICE ADVISOR™, see CONNECTING TO DIAGNOSTIC SCAN TOOL (DST) OR SERVICE ADVISOR™earlier in this Group.<br>2. Ignition ON, engine OFF<br>3. Start the ECU diagnostic software<br>4. Make note of all DTCs, then clear all DTCs<br>5. Ignition ON, engine running<br>6. Warm engine<br>7. Read DTCs using DST or SERVICE ADVISOR™. | **000637.02 reoccurs:** GO TO ❸<br><br>**000637.02 doesn't reoccur:** Problem is intermittent. If no other codes are present, see INTERMITTENT FAULT DIAGNOSTICS, earlier in this Group. |

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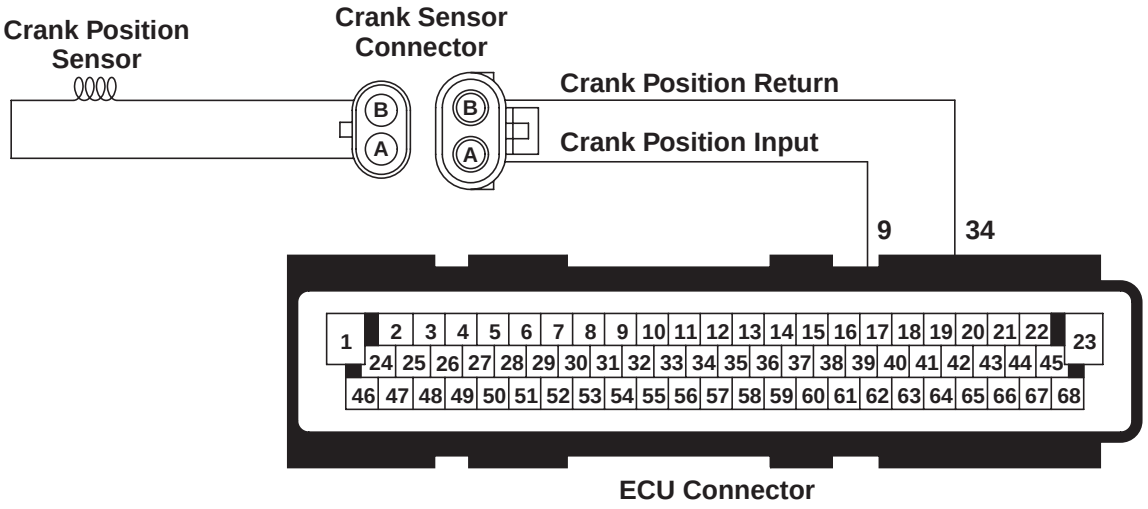
| ❸ **Crank Signal Noise Test** | *NOTE: For wiring and theory of operation information, see DTC 000637.02 CRANKSHAFT POSITION INPUT NOISE supporting information.*<br><br>1. 000637.02 is most likely caused by radiated or conducted electrical "noise" from some part of the machine. This problem may be caused by loose electrical ground or power connections anywhere on the machine. Things to check:<br><br>• All harness connectors<br>• Alternator connections<br>• Chassis ground connections, battery ground connection<br>• Corrosion, dirt, or paint can cause intermittent and "noisy" connections<br>• Check the wiring for intermittent open and short circuits; particularly the crankshaft position sensor wiring<br>• Check wiring for proper pin location in the crankshaft position sensor and ECU connectors<br><br>2. Other possible causes of 000637.02:<br><br>• Electromagnetic interference (EMI) from an incorrectly installed 2-way radio<br>• Interference from some radar source<br>• Possible broken teeth on the crankshaft timing ring | – – –1/1 |

## 000637.08 — Crankshaft Position Input Missing




RG10759 –19–18MAY00

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,260

*NOTE: Wiring schematic shows OEM engine applications only. For wiring information on other applications, see APPLICATION SPECIFICATIONS in Section 06, Group 210 of this manual.*

**Crankshaft Position Sensor**

- The crankshaft position sensor is located on the front of the crankshaft, behind the pressed-on crank gear. It is an inductive type pickup sensor that detects teeth on the crank timing wheel. The ECU uses the crankshaft position input to determine engine speed and precise piston position in relation to the firing order. The crank timing wheel is composed of 48 evenly spaced teeth and 2 gaps between the teeth missing. The missing gaps help the ECU to determine Top-Dead-Center (TDC). For further crankshaft position sensor information, see MEASURING ENGINE SPEED in Section 03, Group 140.

**DTC 000637.08 will set if:**

- The ECU does not detect the crankshaft position input.

**If DTC 000637.08 sets, the following will occur:**

- Engine protection is enabled. See ENGINE PROTECTION in Section 03, Group 140 earlier in this manual.
  - With Derate Feature: On OEM applications, the engine derates 20% per minute until the engine is running at 50% of full power. For non-OEM applications, see APPLICATION SPECIFICATIONS in Section 06, Group 210 later in this manual.
- If a pump position sensor trouble code accompanies DTC 000637.08, the engine will die and won't restart until at least one of the two codes is repaired.
- ECU will use only the pump position sensor input to determine piston position.
- The moment that the trouble codes sets, the engine may hesitate or die, but it will re-start.
- Prolonged cranking may be required to start engine.

Continued on next page

RG41221,00001B5 –19–22OCT02–1/2

- The ECU will set a BLINKING stop lamp.

RG41221,00001B5 –19–22OCT02–2/2

## 000637.08 — Crankshaft Position Input Missing

*The ECU does not detect the crankshaft position input.*

RG41221,00001B6 –19–22OCT02–1/1

### 000637.08 Crankshaft Position Input Missing Diagnostic Procedure

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160
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| ❶ **Connection Check** | **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.**<br><br>*NOTE: For wiring and theory of operation information, see DTC 000637.08 CRANKSHAFT POSITION INPUT MISSING supporting information.*<br><br>Before using this diagnostic procedure, perform a preliminary inspection of the ECU connector and the crankshaft position sensor connector looking for dirty, damaged, or poorly positioned terminals. | **No faulty connection(s):** GO TO ❷<br><br>**Faulty connection(s):** Repair faulty connection(s). |

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| ❷ **Intermittent Fault Test** | *NOTE: For wiring and theory of operation information, see DTC 000637.08 CRANKSHAFT POSITION INPUT MISSING supporting information.*<br><br>1. Connect the DST or SERVICE ADVISOR™. For instructions on connecting to the DST or SERVICE ADVISOR™, see CONNECTING TO DIAGNOSTIC SCAN TOOL (DST) OR SERVICE ADVISOR™earlier in this Group.<br>2. Ignition ON, engine OFF<br>3. Start the ECU diagnostic software<br>4. Make notes of any DTCs, then clear all DTCs<br>5. Ignition ON, engine running<br>6. Read DTCs using DST or SERVICE ADVISOR™. | **000637.08 reoccurs:** GO TO ❸<br><br>**000637.08 doesn't reoccur:** Problem is intermittent. If no other codes are present, see INTERMITTENT FAULT DIAGNOSTICS, earlier in this Group. |

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| ❸ **Crankshaft Position Sensor Check** | *NOTE: For wiring and theory of operation information, see DTC 000637.08 CRANKSHAFT POSITION INPUT MISSING supporting information.*<br>1. Ignition OFF<br>2. Remove crankshaft position sensor from timing gear cover. See REPLACE CRANKSHAFT POSITION SENSOR in Section 02, Group 110 earlier in this manual.<br>3. Inspect sensor tip for damage, such as cracks or debris | **No signs of damage:** GO TO ❹<br>**Damage to sensor:** Determine and repair the cause of damage to sensor<br>Replace sensor and retest<br>– – –1/1 |

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| ❹ **Crankshaft Position Sensor Resistance Check** | *NOTE: For wiring and theory of operation information, see DTC 000637.08 CRANKSHAFT POSITION INPUT MISSING supporting information.*<br>1. Ignition OFF<br>2. Disconnect crankshaft position sensor connector<br>3. Using a multimeter, measure resistance between both terminals of the crankshaft position sensor | **Measurement between 2500 and 3500 ohms:** GO TO ❺<br>**Measurement below 2500 ohms or above 3500 ohms:** Faulty crankshaft position sensor<br>– – –1/1 |



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| ❺ **Open in Crankshaft Position Sensor Input and Return Wire Check** | *NOTE: For wiring and theory of operation information, see DTC 000637.08 CRANKSHAFT POSITION INPUT MISSING supporting information.*<br>1. Ignition OFF<br>2. Disconnect crankshaft position sensor connector<br>3. Disconnect ECU connector<br>4. Using a multimeter, measure resistance between:<br>• Terminal A of the crankshaft position sensor connector AND terminal 9 in the ECU connector on the engine harness<br>• Terminal B of the crankshaft position sensor connector AND terminal 34 in the ECU connector on the engine harness | **Both measurements 5 ohms or less:** GO TO ❻<br>**Either measurement greater than 5 ohms:** Open in crankshaft position sensor input wire<br>OR<br>Open in crankshaft position sensor return wire<br>OR<br>Terminals A and B in the crankshaft position sensor harness connector possibly inverted<br>– – –1/1 |

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| ❻ **Crankshaft Position Input Wiring Check** | *NOTE: For wiring and theory of operation information, see DTC 000637.08 CRANKSHAFT POSITION INPUT MISSING supporting information.*<br><br>1. Ignition OFF<br><br>2. Crankshaft position sensor connector and ECU connector still disconnected<br><br>3. Using a multimeter, measure resistance between terminal 9 in the , ECU connector on the engine harness and the following:<br><br>• A good chassis ground<br>• All other terminals in the ECU connector | **All measurements greater than 2k ohms:**<br>GO TO ❼<br><br>**Any measurement less than 2k ohms:**<br>Short in crankshaft position input wire to wire with low resistance<br><br>– – –1/1 |

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| ❼ **Crankshaft Position Return Wiring Check** | *NOTE: For wiring and theory of operation information, see DTC 000637.08 CRANKSHAFT POSITION INPUT MISSING supporting information.*<br><br>1. Ignition OFF<br><br>2. Crankshaft position sensor connector and ECU connector still disconnected<br><br>3. Using a multimeter, measure resistance between terminal 34 in the ECU connector on the engine harness and the following:<br><br>• A good chassis ground<br>• All other terminals in the ECU connector | **All measurements greater than 2k ohms:**<br>Faulty crankshaft position sensor connector<br>OR<br>Damaged crankshaft position sensor<br>OR<br>Faulty ECU connector<br>OR<br>Faulty ECU<br><br>**Any measurement less than 2k ohms:**<br>Faulty crankshaft position sensor return wiring harness<br><br>– – –1/1 |

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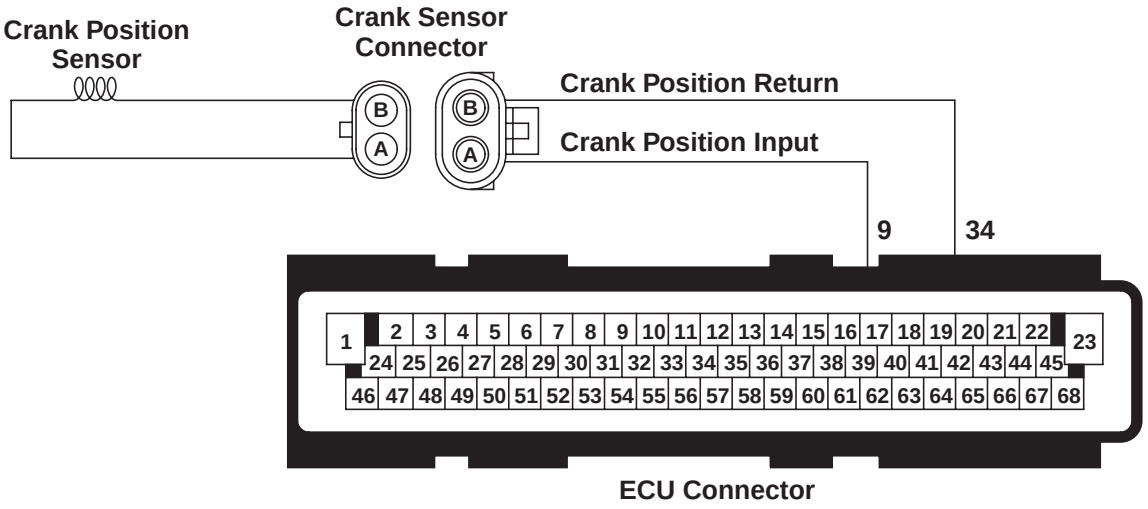
## 000637.10 — Crankshaft Position Input Pattern Error




RG10759 –19–18MAY00

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*NOTE: Wiring schematic shows OEM engine applications only. For wiring information on other applications, see APPLICATION SPECIFICATIONS in Section 06, Group 210 of this manual.*

**Crankshaft Position Sensor**

- The crankshaft position sensor is located on the front of the crankshaft, behind the pressed-on crank gear. It is an inductive type pickup sensor that detects teeth on the crank timing wheel. The ECU uses the crankshaft position input to determine engine speed and precise piston position in relation to the firing order. The crank timing wheel is composed of 48 evenly spaced teeth and 2 gaps between the teeth missing. The missing gaps help the ECU to determine Top-Dead-Center (TDC). For further crankshaft position sensor information, see MEASURING ENGINE SPEED in Section 03, Group 140.

**DTC 000637.10 will set if:**

- The ECU detects an improper pattern on the crankshaft position input.

**If DTC 000637.10 sets, the following will occur:**

- Engine protection is enabled. See ENGINE PROTECTION in Section 03, Group 140 earlier in this manual.
  - With Derate Feature: On OEM applications, the engine derates 20% per minute until the engine is running at 50% of full power. For non-OEM applications, see APPLICATION SPECIFICATIONS in Section 06, Group 210 later in this manual.
- If a pump position sensor trouble code accompanies DTC 000637.10, the engine will die and won't restart until at least one of the two codes is repaired.
- ECU will use only the pump position sensor input to determine piston position.
- The moment that the trouble codes sets, the engine may hesitate or die, but it will re-start.
- Prolonged cranking may be required to start engine.

Continued on next page
RG41221,00001B8 –19–22OCT02–1/2

- The ECU will set a BLINKING stop lamp.

RG41221,00001B8 –19–22OCT02–2/2

## 000637.10 — Crankshaft Position Input Pattern Error

*The ECU detects an improper pattern on the crankshaft position input.*

RG41221,00001B9 –19–22OCT02–1/1

## 000637.10 Crankshaft Position Input Pattern Error Diagnostic Procedure

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| ❶ **Connection Check** | **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.**<br><br>*NOTE: For wiring and theory of operation information, see DTC 000637.10 CRANKSHAFT POSITION INPUT PATTERN ERROR supporting information.*<br><br>Before using this diagnostic procedure, perform a preliminary inspection of the ECU connector and the crankshaft position sensor connector looking for dirty, damaged, or poorly positioned terminals. | **No faulty connection(s):** GO TO ❷<br><br>**Faulty connection(s):** Repair faulty connection(s). |

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| ❷ **Intermittent Fault Test** | *NOTE: For wiring and theory of operation information, see DTC 000637.10 CRANKSHAFT POSITION INPUT PATTERN ERROR supporting information.*<br><br>1. Connect the DST or SERVICE ADVISOR™. For instructions on connecting to the DST or SERVICE ADVISOR™, see CONNECTING TO DIAGNOSTIC SCAN TOOL (DST) OR SERVICE ADVISOR™earlier in this Group.<br>2. Ignition ON, engine OFF<br>3. Start the ECU diagnostic software<br>4. Make note of any DTCs, then clear all DTCs<br>5. Ignition ON, engine running<br>6. Read DTCs using DST or SERVICE ADVISOR™. | **000637.10 reoccurs:** GO TO ❸<br><br>**000637.10 doesn't reoccur:** Problem is intermittent. If no other codes are present, see INTERMITTENT FAULT DIAGNOSTICS, earlier in this Group. |

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| ❸ **Crankshaft Position Sensor Test** | *NOTE: For wiring and theory of operation information, see DTC 000637.10 CRANKSHAFT POSITION INPUT PATTERN ERROR supporting information.*<br><br>1. Ignition OFF<br><br>2. Disconnect crankshaft position sensor connector<br><br>3. Using a multimeter, measure resistance between both terminals of the crankshaft position sensor | **Between 2500 and 3500 ohms:**<br>GO TO ❹<br><br>**Below 2500 ohms or above 3500 ohms:**<br>Faulty crankshaft position sensor<br><br>– – –1/1 |

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| ❹ **Open in Crankshaft Position Sensor Input and Return Check** | *NOTE: For wiring and theory of operation information, see DTC 000637.10 CRANKSHAFT POSITION INPUT PATTERN ERROR supporting information.*<br><br>1. Ignition OFF<br><br>2. Disconnect crankshaft position sensor connector<br><br>3. Disconnect ECU connector<br><br>4. Using a multimeter, measure resistance between:<br><br>• Terminal A of the crankshaft position sensor connector and terminal 9 in the ECU connector on the engine harness<br>• Terminal B of the crankshaft position sensor connector and terminal 34 in the ECU connector on the engine harness | **Both measurements 5 ohms or less:**<br>GO TO ❺<br><br>**Either measurement greater than 5 ohms:**<br>Open in crankshaft position sensor input wire<br>OR<br>Open in crankshaft position sensor return wire<br>OR<br>Terminals A and B in the crankshaft position sensor harness connector possibly inverted<br><br>– – –1/1 |

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| ❺ **Crankshaft Sensor Input Wiring Check** | *NOTE: For wiring and theory of operation information, see DTC 000637.10 CRANKSHAFT POSITION INPUT PATTERN ERROR supporting information.*<br><br>1. Ignition OFF<br><br>2. Crankshaft position sensor connector and ECU connector still disconnected<br><br>3. Using a multimeter measure resistance between terminal 9 in the ECU connector on the engine harness and the following:<br><br>• A good chassis ground<br>• All other terminals in the ECU connector | **All measurements greater than 2k ohms:**<br>GO TO ❻<br><br>**Any measurement less than 2k ohms:**<br>Faulty crankshaft position sensor input wiring harness<br><br>– – –1/1 |

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| ❻ **Crankshaft Sensor Return Wiring Check** | *NOTE: For wiring and theory of operation information, see DTC 000637.10 CRANKSHAFT POSITION INPUT PATTERN ERROR supporting information.*<br><br>1. Ignition OFF<br><br>2. Crankshaft position sensor connector and ECU connector still disconnected<br><br>3. Using a multimeter measure resistance between terminal 34 in the ECU connector on the engine harness and the following:<br><br>• A good chassis ground<br>• All other terminals in the ECU connector | **All measurements greater than 2k ohms:**<br>GO TO ❼<br><br>**Any measurement less than 2k ohms:**<br>Faulty crankshaft position sensor return wiring harness<br><br>– – –1/1 |

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| ❼ **Crankshaft Sensor and Timing Wheel Check** | *NOTE: For wiring and theory of operation information, see DTC 000637.10 CRANKSHAFT POSITION INPUT PATTERN ERROR supporting information.*<br><br>1. Remove crankshaft position sensor<br><br>2. Inspect sensor for cracks, corrosion, or any foreign material on the end of the sensor<br><br>3. Inspect the crank timing wheel notches for burrs or chips | **All components OK:**<br>GO TO ❽<br><br>**Fault found in a component:**<br>Repair or replace component as needed<br><br>– – –1/1 |

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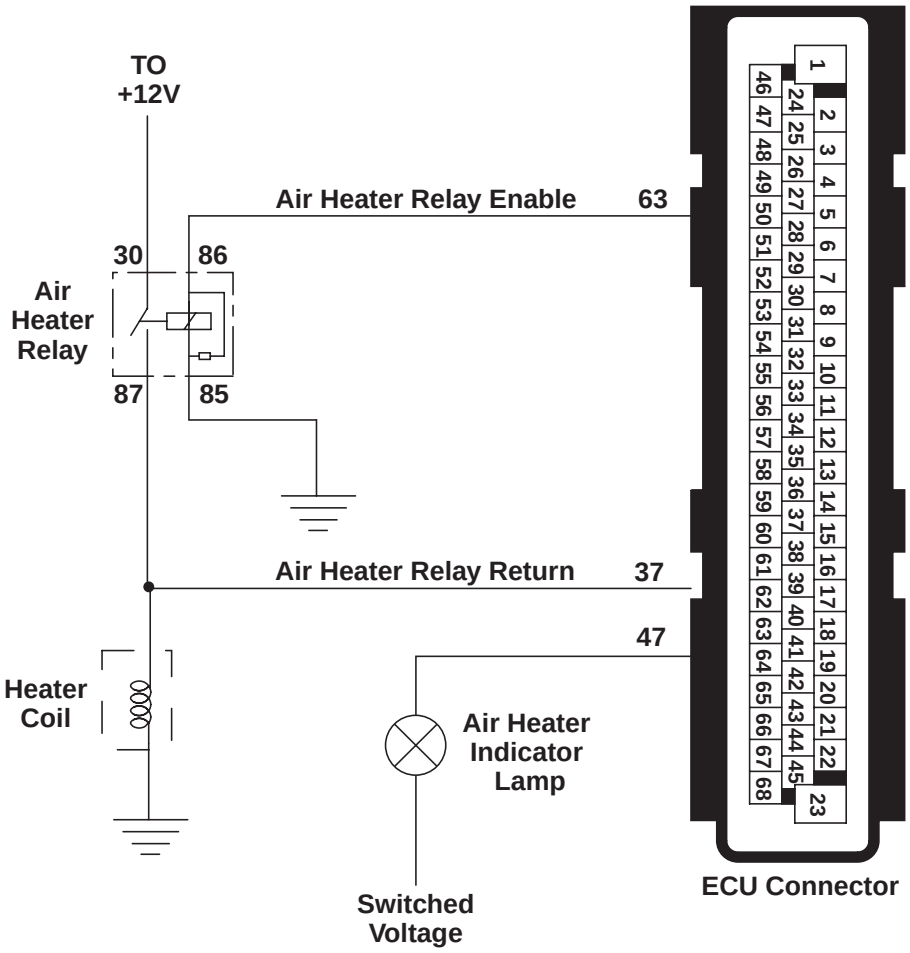
| ❽ **Gear Timing Check** | *NOTE: For wiring and theory of operation information, see DTC 000637.10 CRANKSHAFT POSITION INPUT PATTERN ERROR supporting information.*<br><br>1. Ignition OFF<br><br>2. Remove timing cover<br><br>3. Check timing between camshaft, crankshaft, and injection pump gears. See INSTALL CAMSHAFT in Group 050 of 4.5 & 6.8 L Diesel Engines Base Engine Manual (CTM 104). | **All gears in time:**<br>Faulty crankshaft position sensor connector<br>OR<br>Faulty ECU connector<br>OR<br>Faulty ECU<br><br>**One or more gears out of time:**<br>Make necessary adjustments to ensure correct timing. See INSTALL CAMSHAFT in Group 050 of 4.5 & 6.8 L Diesel Engines Base Engine Manual (CTM 104).<br><br>– – –1/1 |

## 000729.03 — Inlet Air Heater Signal High




RG11735 –19–26JUN01

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**Air Heater**

- The air heater is used to warm the engine's air temperature prior to starting. The ECU reads engine coolant temperature at the key ON position. If the temperature is below 0°C (32°F) the ECU sends out battery voltage to energize the air heater relay coil. This activates the relay passing 12 volts to the heater coil.

**DTC 000729.03 will set if:**

- The ECU is not sending current to the air heater relay, but detects 12 volts going to the heater coil.

**DTC 000729.03 sets, the following will occur:**

- Engine performance will not be effected while running.
- Hard starting may occur
- The ECU will set a BLINKING warning light.

RG41221,00001BD –19–22OCT02–1/1

## 000729.03 — Inlet Air Heater Signal High

*The ECU is not sending current to the air heater relay, but detects 12 volts at the heater coil.*

RG41221,00001BF –19–22OCT02–1/1

## 000729.03 Inlet Air Heater Signal Low Diagnostic Procedure

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| ❶ **Connection Check** | **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.**<br><br>*NOTE: For wiring and theory of operation information, see DTC 000729.03 INLET AIR HEATER SIGNAL HIGH supporting information.*<br><br>Before using this diagnostic procedure, perform a preliminary inspection of ECU connectors, air heater relay, and the air heater looking for dirty, damaged, or poorly positioned terminals. | **No faulty connection(s):** GO TO ❷<br><br>**Faulty connection(s):** Repair faulty connection(s).<br><br>– – –1/1 |
| ❷ **Intermittent Fault Test** | *NOTE: For wiring and theory of operation information, see DTC 000729.03 INLET AIR HEATER SIGNAL HIGH supporting information.*<br><br>1. Ignition ON, engine OFF<br><br>2. Using a multimeter, measure voltage between the heater coil power stud and a good chassis ground. | **Approximately battery voltage:** GO TO ❸<br><br>**Substantially less than battery voltage:** Problem is intermittent. If no other codes are present, see INTERMITTENT FAULT DIAGNOSTICS earlier in this Group.<br><br>– – –1/1 |

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| ❸ **Air Heater Relay Return Wire Test** | *NOTE: For wiring and theory of operation information, see DTC 000729.03 INLET AIR HEATER SIGNAL HIGH supporting information.*<br><br>1. Ignition OFF<br><br>2. Disconnect the ECU connector<br><br>3. Using a multimeter, measure resistance between terminal 37 in the ECU connector on the engine harness and the following:<br><br>• Terminal 87 on the air heater relay<br>• Heater coil power stud | **All measurements 5 ohms or less:**<br>GO TO ❹<br><br>**Either measurement greater than 5 ohms:**<br>Air heater relay return wire shorted to power.<br><br>– – –1/1 |

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| ❹ **Air Heater Relay Test** | *NOTE: For wiring and theory of operation information, see DTC 000729.03 INLET AIR HEATER SIGNAL HIGH supporting information.*<br><br>1. Ignition OFF<br><br>2. ECU connector still disconnected<br><br>3. Using a multimeter, measure resistance between terminal 63 in the ECU connector and terminal 86 on the air heater relay on the engine harness | **Measurements 5 ohms or less:**<br>Faulty air heater relay<br><br>**Measurements greater than 5 ohms:**<br>Air heater relay enable wire shorted to power<br><br>– – –1/1 |

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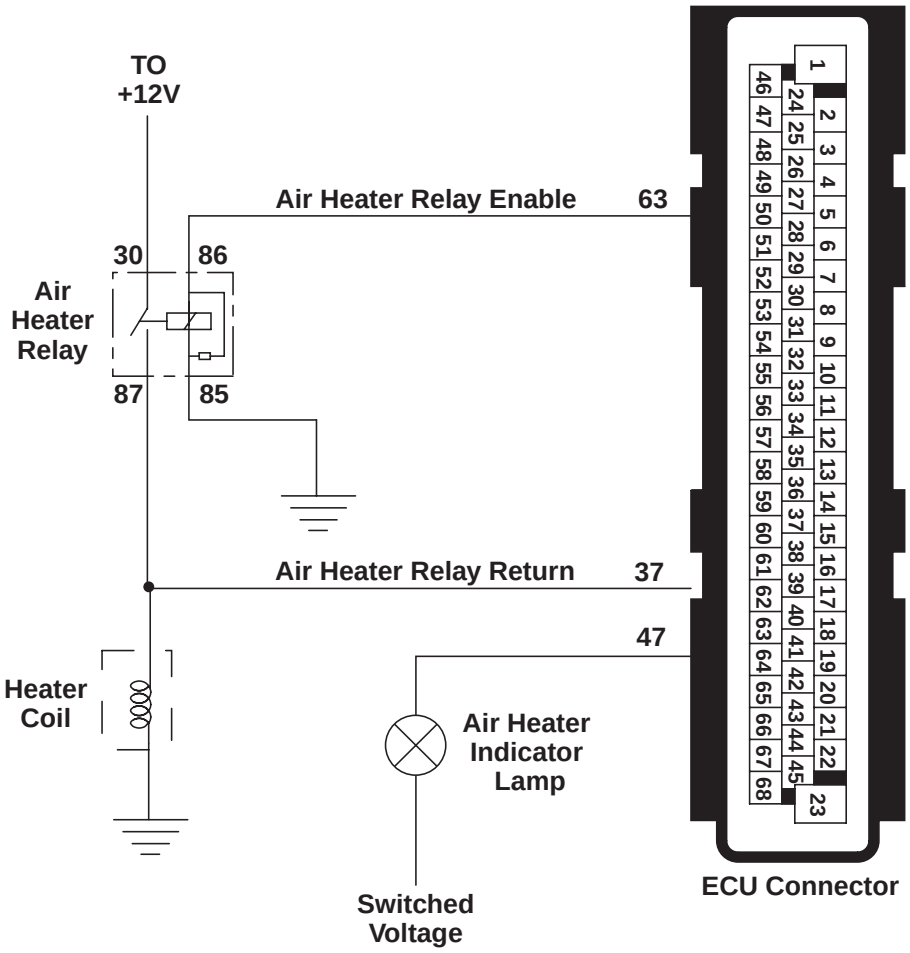
## 000729.05 — Inlet Air Heater Signal Low




RG11735 –19–26JUN01

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**Air Heater**

- The air heater is used to warm the engine's air temperature prior to starting. The ECU reads engine coolant temperature at the key ON position. If the temperature is below 0°C (32°F) the ECU sends out battery voltage to energize the air heater relay coil. This activates the relay passing 12 volts to the heater coil.

**DTC 000729.05 will set if:**

- The ECU is sending current to the air heater relay, but does not detect 12 volts going to the heater coil.

**DTC 000729.05 sets, the following will occur:**

- Engine performance will not be effected while running.
- Hard starting may occur
- The ECU will set a BLINKING warning light.

RG41221,00001BE –19–15MAY01–1/1

## 000729.05 — Inlet Air Heater Signal Low

*The ECU is sending current to the air heater relay, but does not detect 12 volts at the heater coil.*

RG41221,00001C0 –19–22OCT02–1/1

## 000729.05 Inlet Air Heater Signal Low Diagnostic Procedure

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| ❶ **Connection Check** | **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.**<br><br>*NOTE: For wiring and theory of operation information, see DTC 000729.05 INLET AIR HEATER SIGNAL LOW supporting information.*<br><br>Before using this diagnostic procedure, perform a preliminary inspection of ECU connectors, air heater relay, and the air heater looking for dirty, damaged, or poorly positioned terminals. | **No faulty connection(s):** GO TO ❷<br><br>**Faulty connection(s):** Repair faulty connection(s). |

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| ❷ **Intermittent Fault Test** | *NOTE: For wiring and theory of operation information, see DTC 000729.05 INLET AIR HEATER SIGNAL LOW supporting information.*<br><br>1. Connect the DST or SERVICE ADVISOR™. For instructions on connecting to the DST or SERVICE ADVISOR™, see CONNECTING TO DIAGNOSTIC SCAN TOOL (DST) OR SERVICE ADVISOR™earlier in this Group.<br>2. Ignition ON, engine OFF<br>3. Start the ECU diagnostic software<br>4. Make note of any DTCs, then clear all DTCs<br>5. Ignition ON, engine OFF<br>6. Read DTCs using DST or SERVICE ADVISOR™. | **000729.05 reoccurs:** GO TO ❸<br><br>**000729.05 doesn't reoccur:** Problem is intermittent. If no other codes are present, see INTERMITTENT FAULT DIAGNOSTICS earlier in this Group. |

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| ❸ **Air Heater Relay Test** | *NOTE: For wiring and theory of operation information, see DTC 000729.05 INLET AIR HEATER SIGNAL LOW supporting information.*<br><br>1. Cycle ignition from OFF to ON<br><br>2. Listen to air heater relay | **Relay clicks:**<br>GO TO ❹<br><br>**Relay doesn't click:**<br>Open in air heater relay enable wire<br>OR<br>Open in air heater relay ground<br>OR<br>Faulty Relay<br><br>– – –1/1 |

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| ❹ **Air Heater Relay Voltage Test** | *NOTE: For wiring and theory of operation information, see DTC 000729.05 INLET AIR HEATER SIGNAL LOW supporting information.*<br><br>1. Ignition ON, engine OFF<br><br>2. Using a multimeter, measure voltage between terminal 30 on the air heater relay and a good chassis ground | **Approximately battery voltage:**<br>GO TO ❺<br><br>**Substantially less than battery voltage:**<br>Open in battery voltage supply wire<br>OR<br>Short to ground in battery voltage supply wire<br><br>– – –1/1 |

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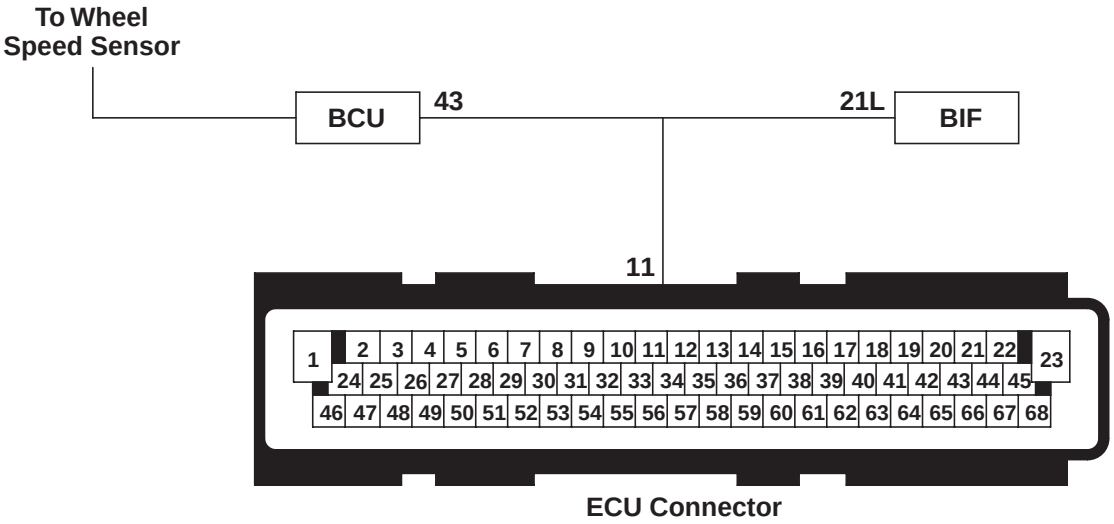
| ❺ **Heater Coil Power Test** | *NOTE: For wiring and theory of operation information, see DTC 000729.05 INLET AIR HEATER SIGNAL LOW supporting information.*<br><br>1. Ignition ON, engine OFF<br><br>2. Using a multimeter, measure voltage between the heater coil power stud and a good chassis ground | **Approximately battery voltage:**<br>Open in air heater relay return wire<br><br>**Substantially less than battery voltage:**<br>Open in wire between air heater relay terminal 87 and the heater coil<br>OR<br>Short to ground in wire between air heater relay terminal 87 and the heater coil<br><br>– – –1/1 |

## 000810.02 — Calculated Vehicle Speed Input Signal Noise




ECU Connector

RG10760 –19–08JUN00

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**Vehicle Speed**

- The wheel speed sensor is an inductive type sensor that is mounted on the rear axle. As teeth on the axle rotate past the sensor, AC signals are generated. The frequency of these signals are proportional to the wheel speed. The signal from the sensor is sent to the Basic Control Unit (BCU). The BCU sends a Pulse Width Modulated (PWM) signal to the Basic Informator (BIF) and ECU. Wheel speed is delivered to the ECU over CAN from the BIF and by PWM from the BCU.

**DTC 000810.02 will set if:**

- ECU detects noise on the wheel speed sensor from the BCU.

**If DTC 000810.02 sets, the following will occur:**

- ECU will limit engine speed to 1950 rpm.
- DTC 000810.02 may also cause DTC 000084.02 and DTC 001069.02 to set. These codes will clear once DTC 000084.02 is repaired.
- The ECU will set a BLINKING warning light.

RG41221,00001C2 –19–22OCT02–1/1

## 000810.02 — Calculated Vehicle Speed Input Signal Noise

*ECU detects noise on the wheel speed sensor from the BCU.*

RG41221,00001C3 –19–22OCT02–1/1

## 000810.02 Calculated Vehicle Speed Input Signal Noise Diagnostic Procedure

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| ❶ **Connection Check** | **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.**<br><br>*NOTE: For wiring and theory of operation information, see DTC 000810.02 CALCULATED VEHICLE SPEED INPUT SIGNAL NOISE supporting information.*<br><br>Before using this diagnostic procedure, perform a preliminary inspection of the ECU, BIF, and BCM connectors looking for dirty, damaged, or poorly positioned terminals. | **No faulty connection(s):** GO TO ❷<br><br>**Faulty connection(s):** Repair faulty connection(s). |

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| ❷ **Intermittent Fault Test** | *NOTE: For wiring and theory of operation information, see DTC 000810.02 CALCULATED VEHICLE SPEED INPUT SIGNAL NOISE supporting information.*<br><br>1. Connect the DST or SERVICE ADVISOR™. For instructions on connecting to the DST or SERVICE ADVISOR™, see CONNECTING TO DIAGNOSTIC SCAN TOOL (DST) OR SERVICE ADVISOR™earlier in this Group.<br>2. Ignition ON, engine OFF<br>3. Start the ECU diagnostic software<br>4. Make note of all DTCs, then clear all DTCs<br>5. Engine running, vehicle moving under normal operating conditions.<br>6. Read DTCs using DST or SERVICE ADVISOR™. | **000810.02 reoccurs:** GO TO ❸<br><br>**000810.02 doesn't reoccur:** Problem is intermittent. If no other codes are present, see INTERMITTENT FAULT DIAGNOSTICS, earlier in this Group. |

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| ❸ **Noise Test** | *NOTE: For wiring and theory of operation information, see DTC 000810.02 CALCULATED VEHICLE SPEED INPUT SIGNAL NOISE supporting information.*<br><br>1. 000810.02 is most likely caused by radiated or conducted electrical "noise" from some part of the machine. This problem may be caused by loose electrical ground or power connections anywhere on the machine. Things to check:<br><br>• All harness connectors<br>• Alternator connections<br>• Chassis ground connections, battery ground connections<br>• Corrosion, dirt, or paint can cause intermittent and "noisy" connections<br>• Check wiring harness for intermittent open and short circuits; particularly the wheel speed sensor wiring.<br><br>2. Other possible causes of 000810.02:<br><br>• Electromagnetic interference (EMI) from an incorrectly installed 2-way radio<br>• Interference from some radar source | – – –1/1 |

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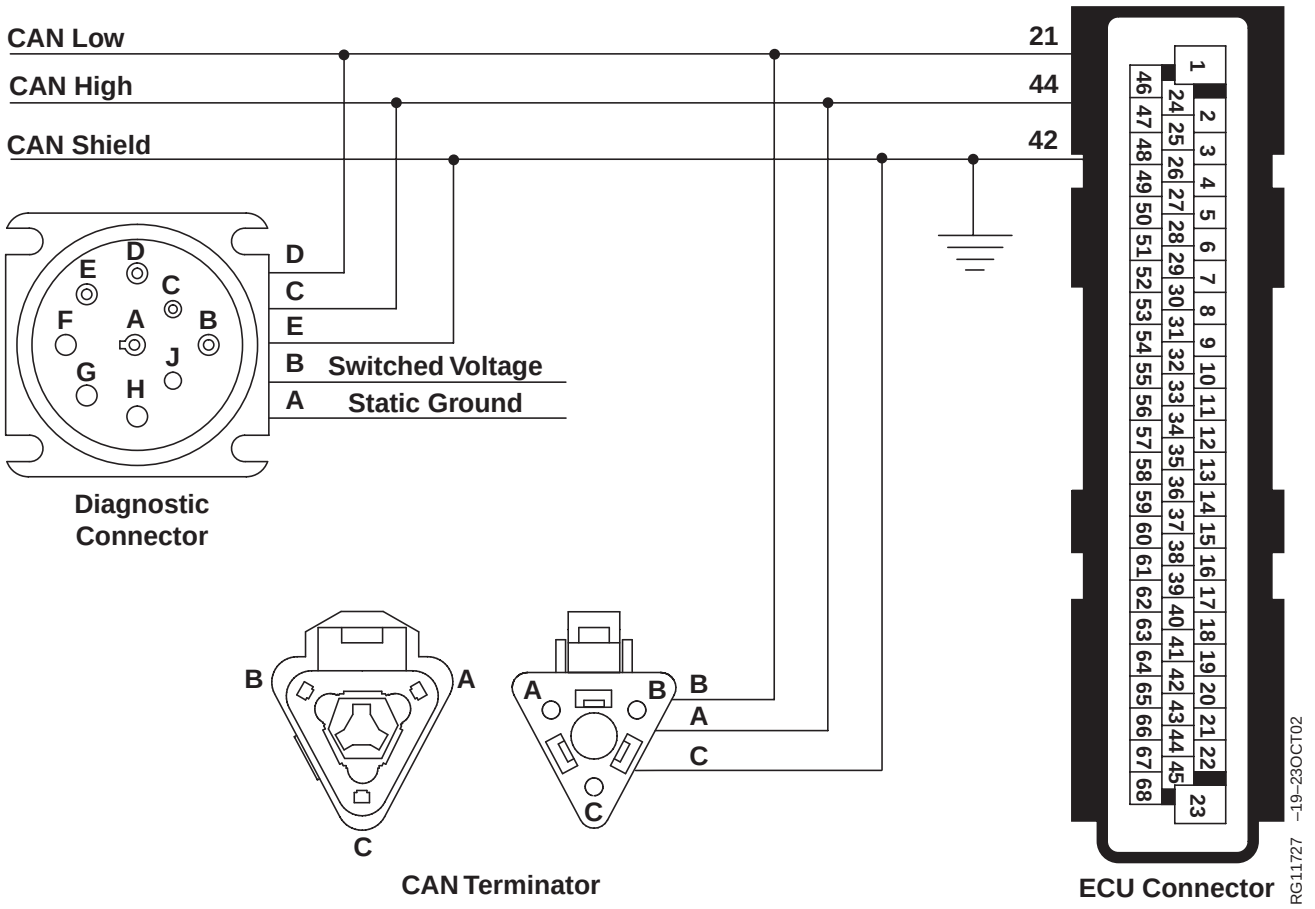
## 000898.09 — Vehicle Speed Invalid/Missing






**CAN (Controller Area Network) Throttle**

- CAN (Controller Area Network) throttle is information sent to the ECU by another controller over CAN about the desired throttle position.

**DTC 000898.09 will set if:**

- ECU does not receive throttle information over CAN, or the information that is received is not valid.

**If DTC 000898.09 sets, the following will occur:**

- The ECU limits engine to low idle (0% throttle)
- ECU will set a BLINKING warning light.

RG41221,00001C5 –19–15MAY01–1/1

## 000898.09 — Vehicle Speed Invalid/Missing

*ECU does not receive throttle information over CAN, or the information that is received is not valid.*

RG41221,00001C6 –19–22OCT02–1/1

## 000898.09 Vehicle Speed Invalid/Missing Diagnostic Procedure

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| ❶ **Connection Check** | **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.**<br><br>*NOTE: For wiring and theory of operation information, see DTC 000898.09 VEHICLE SPEED INVALID/MISSING supporting information.*<br><br>Before using this diagnostic procedure, perform a preliminary inspection of ECU connectors, diagnostic connector, and the CAN terminator looking for dirty, damaged, or poorly positioned terminals. | **No faulty connection(s):** GO TO ❷<br><br>**Faulty connection(s):** Repair faulty connection(s). |
| ❷ **Intermittent Fault Test** | *NOTE: For wiring and theory of operation information, see DTC 000898.09 VEHICLE SPEED INVALID/MISSING supporting information.*<br><br>1. Connect the DST or SERVICE ADVISOR™. For instructions on connecting to the DST or SERVICE ADVISOR™, see CONNECTING TO DIAGNOSTIC SCAN TOOL (DST) OR SERVICE ADVISOR™earlier in this Group.<br>2. Ignition ON, engine OFF<br>3. Start the ECU diagnostic software<br>4. Make note of any DTCs, then clear all DTCs<br>5. Ignition ON, engine running<br>6. Read DTCs using DST or SERVICE ADVISOR™. | **000898.09 reoccurs:** GO TO ❸<br><br>**000898.09 doesn't reoccur:** Problem is intermittent. If no other codes are present, see INTERMITTENT FAULT DIAGNOSTICS, earlier in this Group. |

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| ❸ **CAN Codes Check** | *NOTE: For wiring and theory of operation information, see DTC 000898.09 VEHICLE SPEED INVALID/MISSING supporting information.*<br><br>If application has other machine controllers communicating on the CAN bus, check those controllers for CAN related DTCs | **No CAN related DTCs found on other controllers:**<br>GO TO ❹<br><br>**Found CAN related DTCs on other controllers:**<br>Refer to diagnostic procedures for controller<br>Repair cause of throttle related DTC and retest<br><br>– – –1/1 |

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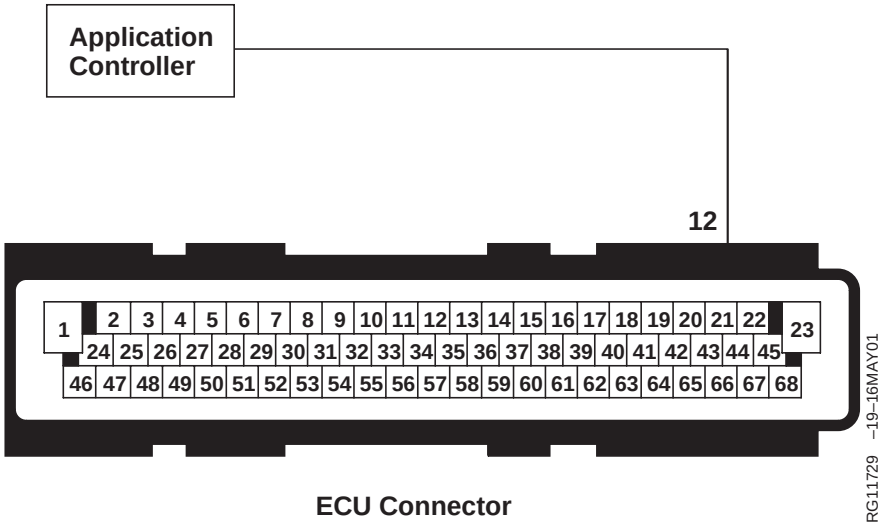
| ❹ **Machine Manual CAN Diagnostic Check** | *NOTE: For wiring and theory of operation information, see DTC 000898.09 VEHICLE SPEED INVALID/MISSING supporting information.*<br><br>Refer to vehicle manual specific to your application and follow the CAN diagnostic section | **Problem detected:**<br>Repair fault as needed and repair as needed<br><br>**No problems detected:**<br>Faulty ECU connector<br>OR<br>Faulty ECU<br><br>– – –1/1 |

## 000970.02 — Auxiliary Engine Shutdown Switch Signal Invalid




**ECU Connector**

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*NOTE: Wiring schematic shows OEM engine applications only. For wiring information on other applications, see APPLICATION SPECIFICATIONS in Section 06, Group 210 of this manual.*

**Auxiliary Shutdown:**

- The ECU has the ability to receive shutdown signals from other application controllers. When the ECU receives the signal from this controller, the ECU shuts the engine down for vehicle protection.

**DTC 000970.02 will set if:**

- The ECU reads an input voltage from the application's controller to be less than 0.5 volts or greater than 2.5 volts.

**If DTC 000970.02 will sets, the following will occur:**

- The ECU will shut the engine down.
- The ECU will set a BLINKING stop lamp.

RG41221,00001C7 –19–22OCT02–1/1

## 000970.02 — Auxiliary Engine Shutdown Switch Signal Invalid

*The ECU receives an invalid signal request from another controller to shut the engine down.*

RG41221,00001CA –19–22OCT02–1/1

## 000970.02 Auxiliary Engine Shutdown Switch Signal Invalid Diagnostic Procedure

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| ❶ **Connection Check** | **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.**<br><br>*NOTE: For wiring and theory of operation information, see DTC 000970.02 AUXILIARY ENGINE SHUTDOWN SWITCH SIGNAL INVALID supporting information.*<br><br>Before using this diagnostic procedure, perform a preliminary inspection of ECU connectors and the corresponding application controller connector(s) looking for dirty, damaged, or poorly positioned terminals. | **No faulty connection(s):** GO TO ❷<br><br>**Faulty connection(s):** Repair faulty connection(s). |
| ❷ **Intermittent Fault Test** | *NOTE: For wiring and theory of operation information, see DTC 000970.02 AUXILIARY ENGINE SHUTDOWN SWITCH SIGNAL INVALID supporting information.*<br><br>1. Connect the DST or SERVICE ADVISOR™. For instructions on connecting to the DST or SERVICE ADVISOR™, see CONNECTING TO DIAGNOSTIC SCAN TOOL (DST) OR SERVICE ADVISOR™earlier in this Group.<br>2. Ignition ON, engine OFF<br>3. Start the ECU diagnostic software<br>4. Make note of any DTCs, then clear all DTCs<br>5. Ignition ON, engine running<br>6. Read DTCs using DST or SERVICE ADVISOR™. | **000970.02 reoccurs:** GO TO ❸<br><br>**000970.02 doesn't reoccur:** Problem is intermittent. If no other codes are present, see INTERMITTENT FAULT DIAGNOSTICS, earlier in this Group. |

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| ❸ **Other Controller DTC Test** | *NOTE: For wiring and theory of operation information, see DTC 000970.02 AUXILIARY ENGINE SHUTDOWN SWITCH SIGNAL INVALID supporting information.*<br><br>Check another controller for related DTCs.<br><br>*NOTE: Auxiliary shutdown signal originates from another controller.* | **Controller reports no related DTCs:**<br>GO TO ❹<br><br>**Controller has related DTCs:**<br>Refer to diagnostic procedures for controller. Repair cause of DTC and retest.<br><br>– – –1/1 |

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| ❹ **Controller Test** | *NOTE: For wiring and theory of operation information, see DTC 000970.02 AUXILIARY ENGINE SHUTDOWN SWITCH SIGNAL INVALID supporting information.*<br><br>1. Ignition OFF<br><br>2. Disconnect ECU connector<br><br>3. Ignition ON<br><br>4. Using a multimeter, measure voltage between terminal 12 in the ECU connector on the engine harness and a good chassis ground | **Less than 0.5 V or greater than 2.5V:**<br>GO TO ❺<br><br>**Between 0.5 V and 2.5V:**<br>Wrong ECU for the vehicle<br>OR<br>Faulty ECU connector<br>OR<br>Faulty ECU<br>OR<br>Faulty auxiliary shutdown signal source controller<br><br>– – –1/1 |

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| ❺ **Open in Auxiliary Shutdown Signal Circuit Test** | *NOTE: For wiring and theory of operation information, see DTC 000970.02 AUXILIARY ENGINE SHUTDOWN SWITCH SIGNAL INVALID supporting information.*<br><br>1. Ignition OFF<br><br>2. ECU connector still disconnected<br><br>3. Obtain wiring information for this application and determine the source of the auxiliary shutdown signal<br><br>4. Disconnect the connector that outputs the shutdown signal<br><br>5. Using a multimeter, measure the resistance between terminal 12 of the ECU connector on the engine harness and the originating shutdown signal terminal | **5 ohms or less:**<br>GO TO ❻<br><br>**Greater than 5 ohms:**<br>Open in auxiliary shutdown signal circuit<br><br>– – –1/1 |

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| ❻ **Short in Auxiliary Shutdown Signal Circuit Test** | *NOTE: For wiring and theory of operation information, see DTC 000970.02 AUXILIARY ENGINE SHUTDOWN SWITCH SIGNAL INVALID supporting information.*<br><br>1. Ignition OFF<br><br>2. Using a multimeter measure resistance between terminal 12 in the ECU connector on the engine harness and<br><br>• All other terminals in that connector<br>• A good chassis ground | **All measurements greater than 2k ohms:**<br>Faulty signal source controller wiring<br>OR<br>Faulty auxiliary shutdown controller connector<br>OR<br>Faulty auxiliary shutdown signal source controller<br><br>**Any measurement less than 2k ohms:**<br>Short in auxiliary shutdown signal circuit<br><br>– – –1/1 |

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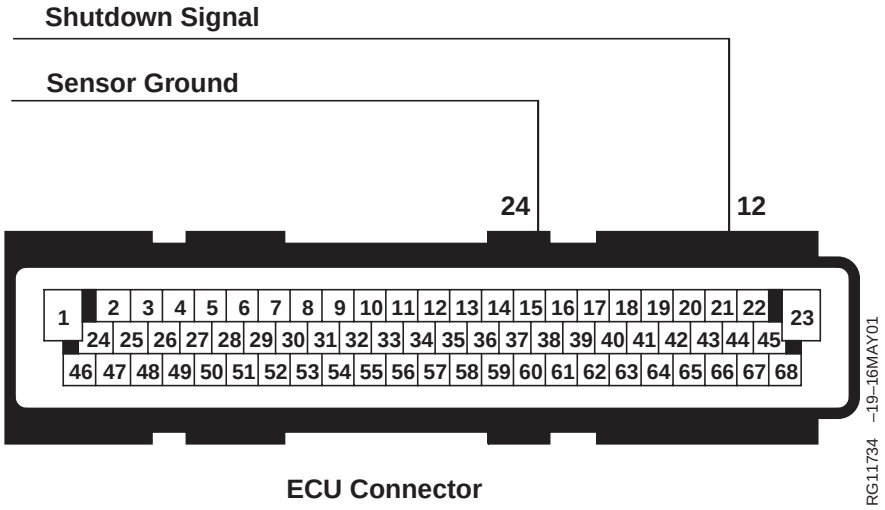
## 000970.31 — Auxiliary Engine Shutdown Switch Active

*Engine shutdown switch is active.*

RG41221,00001CB –19–15MAY01–1/2






**ECU Connector**

*NOTE: Wiring schematic shows OEM engine applications only. For wiring information on other applications, see APPLICATION SPECIFICATIONS in Section 06, Group 210 of this manual.*

**Auxiliary Engine Shutdown Switch**

- On OEM applications, the engine shutdown switch is a normally open switch. When the property being measured exceeds a certain value, the switch will close. When the switch is closed, the voltage is grounded, which will cause the ECU to shutdown the engine.

**DTC 000970.31 will set if:**

- The ECU does not read an input voltage.

**If DTC 000970.31 sets, the following will occur:**

- The ECU will shut the engine down.
- The ECU will set a BLINKING stop lamp.

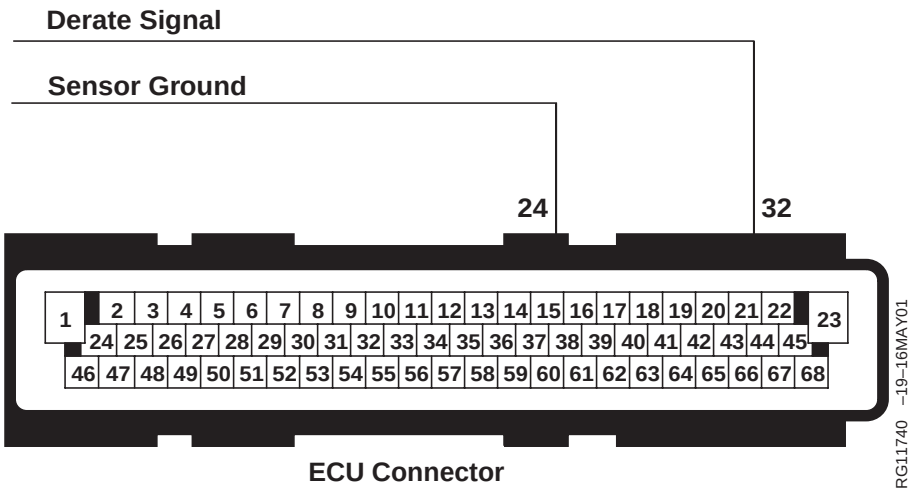
RG41221,00001CB –19–15MAY01–2/2

## 000971.31 — External Engine Derate Switch Active

*Engine derate switch is active.*

RG41221,00001CC –19–15MAY01–1/2






**ECU Connector**

*NOTE: Wiring schematic shows OEM engine applications only. For wiring information on other applications, see APPLICATION SPECIFICATIONS in Section 06, Group 210 of this manual.*

**External Fuel Derate Switch**

- On OEM applications, the external derate switch is a normally open switch. When property being measured exceeds a certain value, the switch will close. When the switch is closed, the voltage is grounded, which will cause the ECU to derate the engine.

**DTC 000971.31 will set if:**

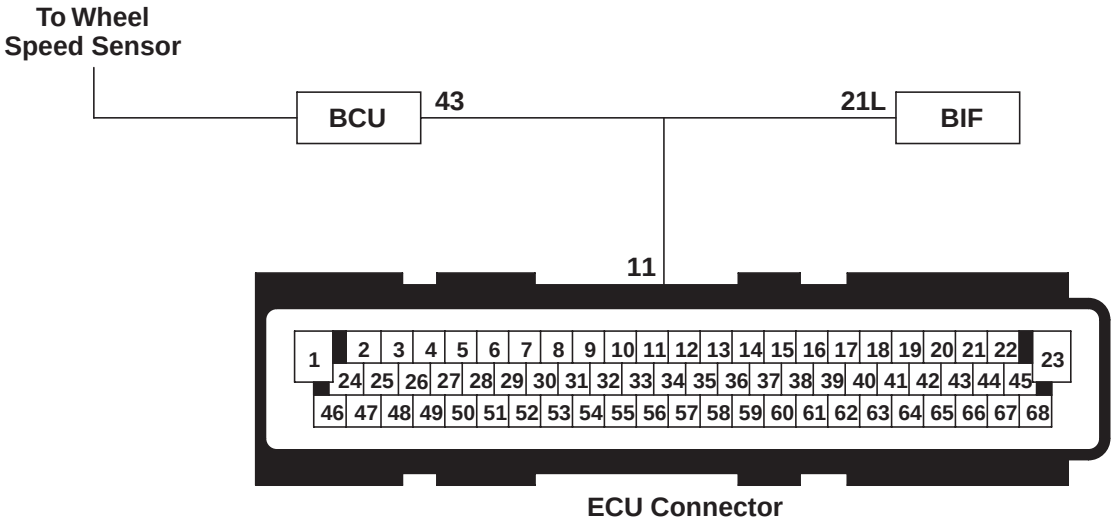
- The ECU does not read an input voltage.

**If DTC 000971.31 sets, the following will occur:**

- Engine protection is enabled. See ENGINE PROTECTION in Section 03, Group 140 earlier in this manual.
  - With Derate Feature: On OEM applications, the engine derates 2% per minute until the engine is running at 80% of full power. For non-OEM applications, see APPLICATION SPECIFICATIONS in Section 06, Group 210 later in this manual.
- The ECU will set a BLINKING warning light.

RG41221,00001CC –19–15MAY01–2/2

## 001069.02 — Tire Size Error




RG10760 –19–08JUN00

**Tire Size**

- Tire size is in direct proportion to wheel speed in revolutions per kilometer. Wheel speed is supplied to the ECU in rpm and through several conversions the ECU outputs revolutions per kilometer.

**DTC 001069.02 will set if:**

- ECU calculates a wheel speed of rev/km that does not match the available tire size option for the application.

**If DTC 001069.02 sets, the following will occur:**

- ECU will assume the largest tire size.
- ECU will limit engine speed to 1950 rpm when the vehicle is in top gear.
- ECU will set a BLINKING warning light.

RG41221,00001CF –19–22OCT02–1/1

## 001069.02 — Tire Size Error

*ECU calculates a wheel speed of rev/km that does not match the available tire size option for the application.*

RG41221,00001D0 –19–22OCT02–1/1

### 001069.02 Tire Size Error Diagnostic Procedure

*NOTE: If 001069.02 is accompanied with 000084.02 and/or 000810.02, follow those diagnostic procedures first.*



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| ❶ **Connection Check** | **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.**<br><br>*NOTE: For wiring and theory of operation information, see DTC 001069.02 TIRE SIZE ERROR supporting information.*<br><br>Before using this diagnostic procedure, perform a preliminary inspection of ECU connectors, the BIF connector, BCU connector, and the wheel speed sensor connector looking for dirty, damaged, or poorly positioned terminals. | **No faulty connection(s):** GO TO ❷<br><br>**Faulty connection(s):** Repair faulty connection(s). |
| ❷ **Intermittent Fault Test** | *NOTE: For wiring and theory of operation information, see DTC 001069.02 TIRE SIZE ERROR supporting information.*<br><br>1. Connect the DST or SERVICE ADVISOR™. For instructions on connecting to the DST or SERVICE ADVISOR™, see CONNECTING TO DIAGNOSTIC SCAN TOOL (DST) OR SERVICE ADVISOR™earlier in this Group.<br><br>2. Ignition ON, engine OFF<br><br>3. Start the ECU diagnostic software<br><br>4. Make note of all DTCs, then clear all DTCs<br><br>5. Engine running, vehicle under normal operating conditions.<br><br>6. Read DTCs using DST or SERVICE ADVISOR™. | **001069.02 reoccurs:** Reprogram tire size in BCU and BIF.<br><br>**001069.02 doesn't reoccur:** Problem is intermittent. If no other codes are present, see INTERMITTENT FAULT DIAGNOSTICS, earlier in this Group. |

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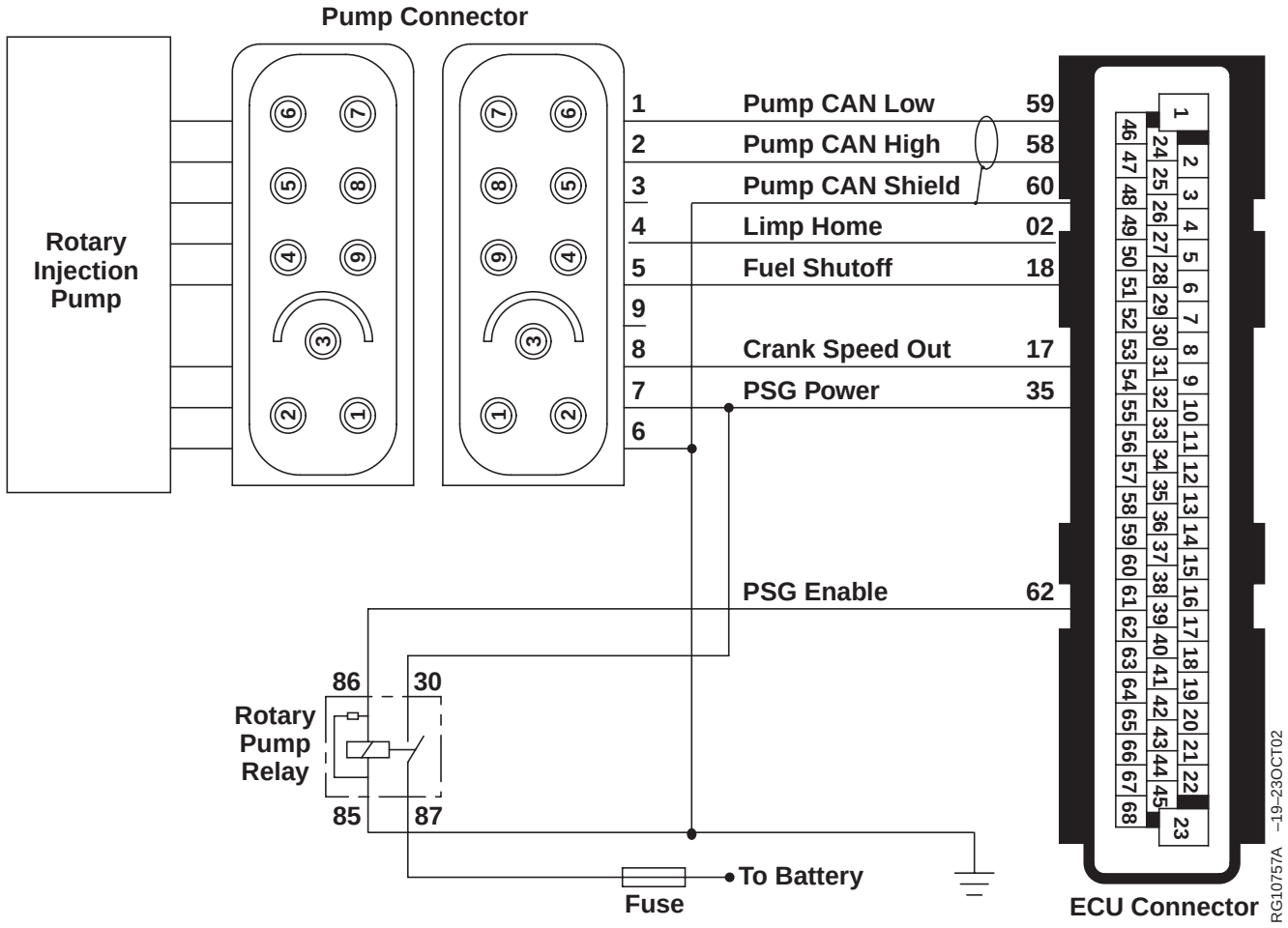
## 001076.02 — Pump Detected Defect




*NOTE: Wiring schematic shows OEM engine applications only. For wiring information on other applications, see APPLICATION SPECIFICATIONS in Section 06, Group 210 of this manual.*

**Bosch VP44 Rotary Injection Pump**

- The Bosch VP44 rotary injection pump is controlled by a pump control unit that monitors information received from sensors inside the pump. It also acquires information from the ECU over a CAN bus and other dedicated wires between the ECU and pump. This helps the pump control unit to provide for the accurate quantity and timing of fuel delivery to the engine.

**DTC 001076.02 will set if:**

- The high pressure solenoid within the pump is continuously energized.
- PSG unable to detect closure of the high pressure solenoid valve.
- Internal pump speed sensor is broken.

**If DTC 001076.02 sets, the following will occur:**

- The ECU will set a BLINKING stop lamp.
- If the engine is not running when this code is set, it may not start.
- DTC 001077.31 will also be present.
- DTC 001569.31 will also be present.

- Engine protection is enabled. See ENGINE PROTECTION in Section 03, Group 140 earlier in this manual.

Continued on next page

RG41221,00001D2 –19–22OCT02–1/2

– With Derate Feature: On OEM applications, the engine derates 20% per minute until the engine is running at 50% of full power. For non-OEM applications, see APPLICATION SPECIFICATIONS in Section 06, Group 210 later in this manual.

RG41221,00001D2 –19–22OCT02–2/2

## 001076.02 — Pump Detected Defect

*The pump control unit (PSG) detects an internal problem.*

RG41221,00001D3 –19–22OCT02–1/1

### 001076.02 Pump Detected Defect Diagnostic Procedure

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| ❶ **Connection Check** | **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.**<br><br>*NOTE: For wiring and theory of operation information, see DTC 001076.02 PUMP DETECTED DEFECT supporting information.*<br><br>Before using this diagnostic procedure, perform a preliminary inspection of ECU connectors and the injection pump connector looking for dirty, damaged, or poorly positioned terminals. | **No faulty connection(s):** GO TO ❷<br><br>**Faulty connection(s):** Repair faulty connection(s). |

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| ❷ **Intermittent Fault Test** | *NOTE: For wiring and theory of operation information, see DTC 001076.02 PUMP DETECTED DEFECT supporting information.*<br><br>1. Connect the DST or SERVICE ADVISOR™. For instructions on connecting to the DST or SERVICE ADVISOR™, see CONNECTING TO DIAGNOSTIC SCAN TOOL (DST) OR SERVICE ADVISOR™earlier in this Group.<br>2. Ignition ON, engine OFF<br>3. Start the ECU diagnostic software<br>4. Make note of any DTCs, then clear all DTCs<br>5. Ignition ON, engine cranking or running<br>6. Read DTCs using DST or SERVICE ADVISOR™. | **001076.02 reoccurs:** Faulty injection pump connector OR Faulty injection pump<br><br>**001076.02 doesn't reoccur:** Problem is intermittent. If no other codes are present, see INTERMITTENT FAULT DIAGNOSTICS, earlier in this Group. |

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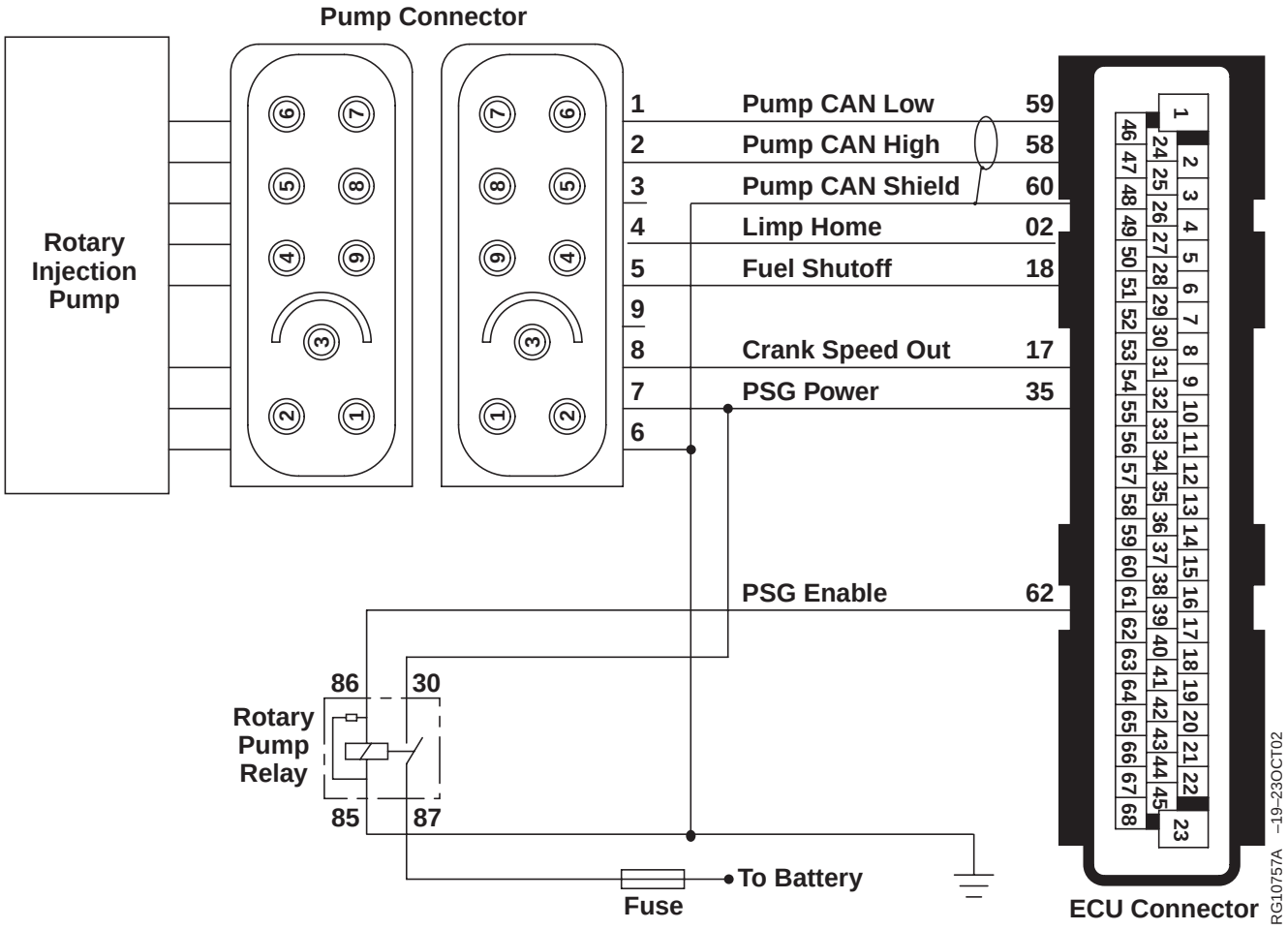
## 001077.07 — Attempting to Fuel Without Command




*NOTE: Wiring schematic shows OEM engine applications only. For wiring information on other applications, see APPLICATION SPECIFICATIONS in Section 06, Group 210 of this manual.*

**Bosch VP44 Rotary Injection Pump**

- The Bosch VP44 rotary injection pump is controlled by a pump control unit that monitors information received from sensors inside the pump. It also acquires information from the ECU over a CAN bus and other dedicated wires between the ECU and pump. This helps the pump control unit to provide for the accurate quantity and timing of fuel delivery to the engine.

**DTC 001077.07 will set if:**

- The pump control unit informs the ECU that the high pressure solenoid valve is closed when the ECU is commanding the pump control unit to stop delivering fuel.

**If DTC 001077.07 sets, the following will occur:**

- The ECU will not derate the engine.
- The ECU will set a BLINKING warning light.

RG41221,00001D5 –19–15MAY01–1/1

## 001077.07 — Attempting to Fuel Without Command

*The high pressure solenoid valve is closed when the ECU is commanding the pump to stop fueling.*

RG41221,00001D6 –19–22OCT02–1/1

## 001077.07 Attempting to Fuel Without Command Diagnostic Procedure

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| ❶ **Connection Check** | **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.**<br><br>*NOTE: For wiring and theory of operation information, see DTC 001077.07 ATTEMPTING TO FUEL WITHOUT COMMAND supporting information.*<br><br>Before using this diagnostic procedure, perform a preliminary inspection of ECU connector and the injection pump connector looking for dirty, damaged, or poorly positioned terminals. | **No faulty connection(s):** GO TO ❷<br><br>**Faulty connection(s):** Repair faulty connection(s). |

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| ❷ **Intermittent Fault Test** | *NOTE: For wiring and theory of operation information, see DTC 001077.07 ATTEMPTING TO FUEL WITHOUT COMMAND supporting information.*<br><br>1. Connect the DST or SERVICE ADVISOR™. For instructions on connecting to the DST or SERVICE ADVISOR™, see CONNECTING TO DIAGNOSTIC SCAN TOOL (DST) OR SERVICE ADVISOR™earlier in this Group.<br><br>2. Ignition ON, engine OFF<br><br>3. Start the ECU diagnostic software<br><br>4. Make note of any DTCs, then clear all DTCs<br><br>5. Ignition ON, engine cranking or running<br><br>6. Read DTCs using DST or SERVICE ADVISOR™. | **001077.07 reoccurs:** Faulty injection pump connector OR Faulty injection pump<br><br>**001077.07 doesn't reoccur:** Problem is intermittent. If no other codes are present, see INTERMITTENT FAULT DIAGNOSTICS, earlier in this Group. |

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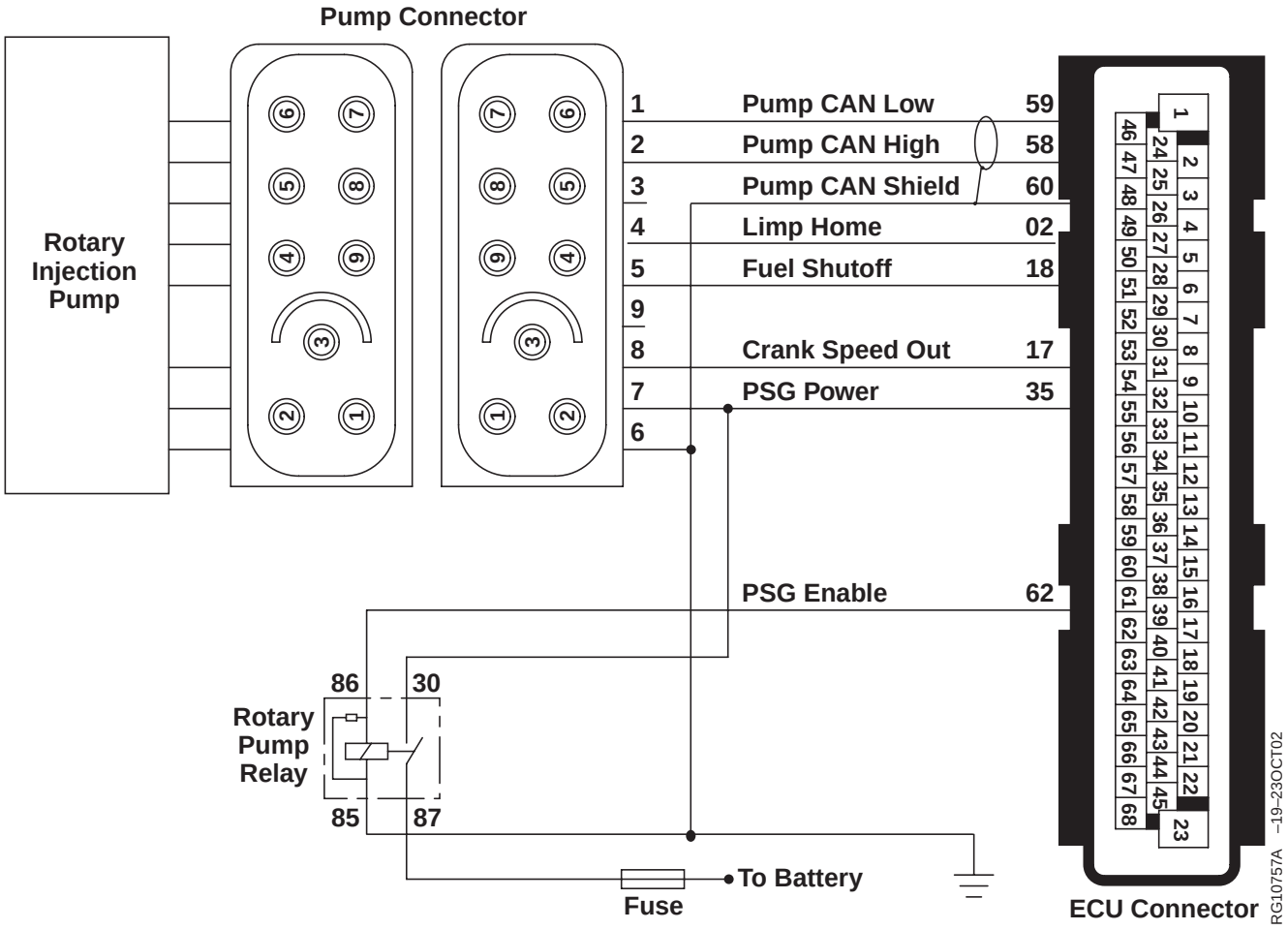
## 001077.11 — Pump Supply Voltage Out Of Range




*NOTE: Wiring schematic shows OEM engine applications only. For wiring information on other applications, see APPLICATION SPECIFICATIONS in Section 06, Group 210 of this manual.*

**Bosch VP44 Rotary Injection Pump**

- The Bosch VP44 rotary injection pump is controlled by a pump control unit that monitors information received from sensors inside the pump. It also acquires information from the ECU over a CAN bus and other dedicated wires between the ECU and pump. This helps the pump control unit to provide for the accurate quantity and timing of fuel delivery to the engine.

**DTC 001077.11 will set if:**

- The pump control unit (PSG) senses an abnormal battery voltage.

**If DTC 001077.11 sets, the following will occur:**

- Engine may not run.
- The ECU will set a BLINKING warning light.

RG41221,00001D8 –19–15MAY01–1/1

## 001077.11 — Pump Supply Voltage Out Of Range

*The pump control unit (PSG) senses an abnormal battery voltage.*

RG41221,00001D9 –19–22OCT02–1/1

## 001077.11 Pump Supply Voltage Out Of Range Diagnostic Procedure



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| ❶ **Connection Check** | **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.**<br><br>*NOTE: For wiring and theory of operation information, see DTC 001077.11 PUMP SUPPLY VOLTAGE OUT OF RANGE supporting information.*<br><br>Before using this diagnostic procedure, perform a preliminary inspection of ECU connectors and the injection pump connector looking for dirty, damaged, or poorly positioned terminals. | **No faulty connection(s):** GO TO ❷<br><br>**Faulty connection(s):** Repair faulty connection(s). |
| ❷ **Intermittent Fault Test** | *NOTE: For wiring and theory of operation information, see DTC 001077.11 PUMP SUPPLY VOLTAGE OUT OF RANGE supporting information.*<br><br>1. Connect the DST or SERVICE ADVISOR™. For instructions on connecting to the DST or SERVICE ADVISOR™, see CONNECTING TO DIAGNOSTIC SCAN TOOL (DST) OR SERVICE ADVISOR™earlier in this Group.<br>2. Ignition ON, engine OFF<br>3. Start the ECU diagnostic software<br>4. Make note of any DTCs, then clear all DTCs<br>5. Ignition ON, engine running<br>6. Read DTCs using DST or SERVICE ADVISOR™. | **001077.11 reoccurs:** GO TO ❸<br><br>**001077.11 doesn't reoccur:** Problem is intermittent. If no other codes are present, see INTERMITTENT FAULT DIAGNOSTICS, earlier in this Group. |

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| ❸ **Injection Pump Check** | *NOTE: For wiring and theory of operation information, see DTC 001077.11 PUMP SUPPLY VOLTAGE OUT OF RANGE supporting information.*<br><br>1. Ignition OFF<br><br>2. Disconnect injection pump connector<br><br>3. Ignition ON, engine OFF<br><br>4. Using a multimeter, measure voltage between terminal 7 in the injection pump connector on the engine harness and a good chassis ground | **Substantially greater or less than battery voltage:**<br>GO TO ❹<br><br>**Approximately battery voltage:**<br>Faulty injection pump connector<br>OR<br>Faulty injection pump<br><br>– – –1/1 |

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| ❹ **PSG Wire Between Relay and Battery Check** | *NOTE: For wiring and theory of operation information, see DTC 001077.11 PUMP SUPPLY VOLTAGE OUT OF RANGE supporting information.*<br><br>1. Ignition OFF<br><br>2. Disconnect PSG relay connector<br><br>3. Using a multimeter, measure voltage between terminal 30 in the PSG relay on the engine harness and a good chassis ground | **Approximately battery voltage:**<br>GO TO ❺<br><br>**Substantially greater or less than battery voltage:**<br>Faulty PSG power circuit between PSG relay and the battery<br><br>– – –1/1 |

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| ❺ **Short in PSG Wire Check** | *NOTE: For wiring and theory of operation information, see DTC 001077.11 PUMP SUPPLY VOLTAGE OUT OF RANGE supporting information.*<br><br>1. Ignition OFF<br><br>2. Disconnect ECU connector while keeping injection pump connector and connector at PSG relay disconnected<br><br>3. Using a multimeter, measure resistance between terminal 35 in the ECU connector on the engine harness and the following:<br><br>• A good ground<br>• All other terminals in the ECU connector | **Greater than 2k ohms:**<br>GO TO ❻<br><br>**Less than 2k ohms:**<br>PSG power circuit shorted to ground<br>OR<br>PSG power circuit shorted to another wire in the harness<br><br>– – –1/1 |

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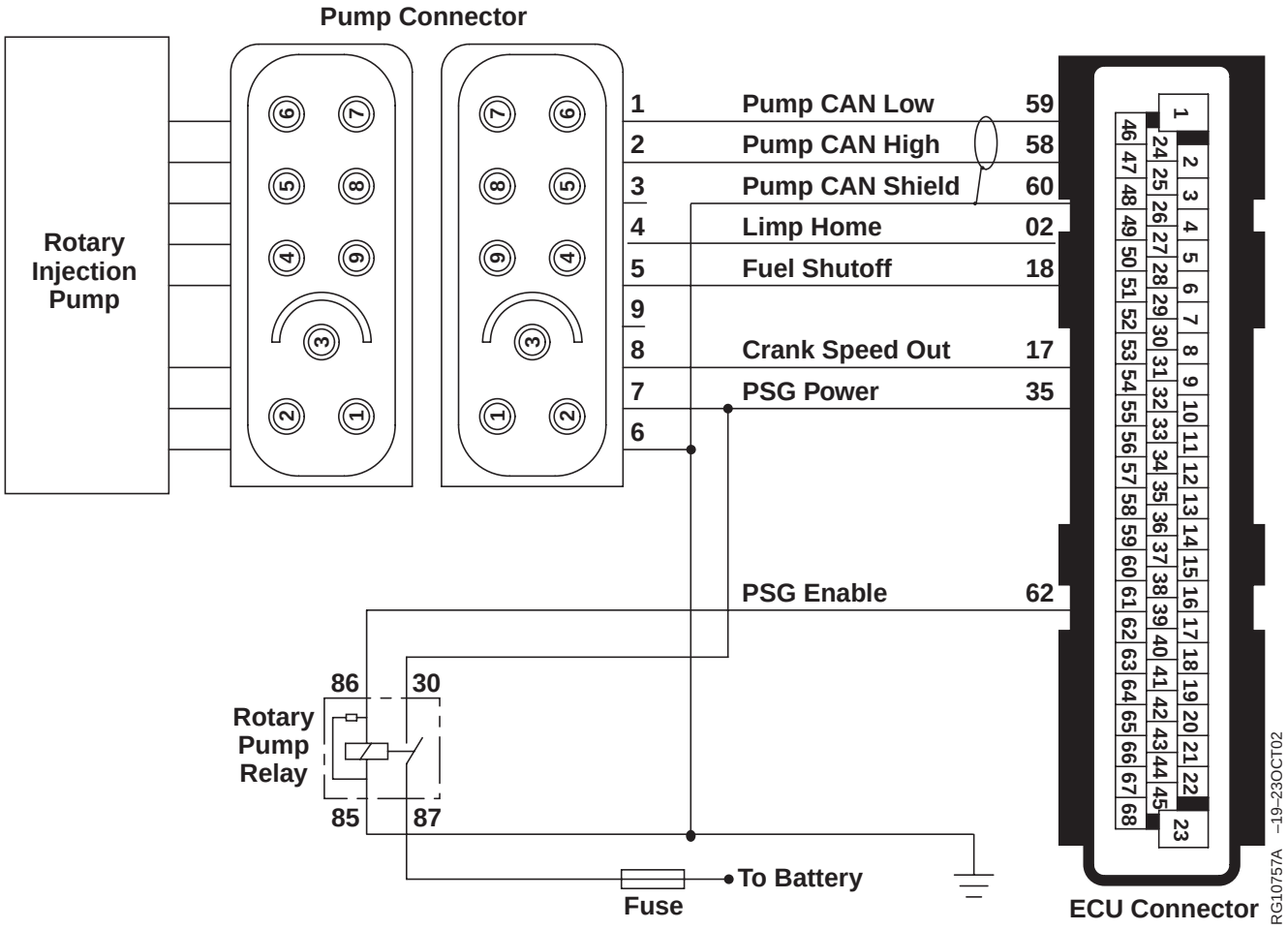
| ❻ **Open in PSG Wire Check** | *NOTE: For wiring and theory of operation information, see DTC 001077.11 PUMP SUPPLY VOLTAGE OUT OF RANGE supporting information.*<br><br>1. Ignition OFF<br><br>2. Using a multimeter, measure resistance between terminal 35 in the ECU connector on the engine harness and the following:<br><br>• Terminal 7 of the injection pump connector<br>• Terminal 30 of the PSG relay | **Less than 5 ohms:**<br>Faulty rotary pump relay connector<br>OR<br>Faulty rotary pump relay<br><br>**Greater than 5 ohms:**<br>Short in injection pump PSG power supply circuit<br><br>– – –1/1 |

## 001077.12 — Pump Self-Test Error




*NOTE: Wiring schematic shows OEM engine applications only. For wiring information on other applications, see APPLICATION SPECIFICATIONS in Section 06, Group 210 of this manual.*

**Bosch VP44 Rotary Injection Pump**

- The Bosch VP44 rotary injection pump is controlled by a pump control unit that monitors information received from sensors inside the pump. It also acquires information from the ECU over a CAN bus and other dedicated wires between the ECU and pump. This helps the pump control unit to provide for the accurate quantity and timing of fuel delivery to the engine.

**DTC 001077.12 will set if:**

- The pump control unit (PSG) determines that the internal components within the pump are not working properly.

**If DTC 001077.12 sets, the following will occur:**

- The ECU will set a BLINKING warning light.
- DTC 001077.31 will also be present.
- DTC 001569.31 will also be present.
- Engine protection is enabled. See ENGINE PROTECTION in Section 03, Group 140 earlier in this manual.
  - With Derate Feature: On OEM applications, the engine derates 20% per minute until the engine is running at 50% of full power. For non-OEM applications, see APPLICATION SPECIFICATIONS in Section 06, Group 210 later in this manual.

RG41221,00001DB –19–22OCT02–1/1

## 001077.12 — Pump Self-Test Error

*The pump control unit (PSG) determines that the internal components within the pump are not working properly.*

RG41221,00001DC –19–15MAY01–1/1

## 001077.12 Pump Self-Test Error Diagnostic Procedure

04
160
,307

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| ❶ **Connection Check** | **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.**<br><br>*NOTE: For wiring and theory of operation information, see DTC 001077.12 PUMP SELF-TEST ERROR supporting information.*<br><br>Before using this diagnostic procedure, perform a preliminary inspection of the ECU connector and the injection pump connector looking for dirty, damaged, or poorly positioned terminals. | **No faulty connection(s):**<br>GO TO ❷<br><br>**Faulty connection(s):**<br>Repair faulty connection(s). |

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| ❷ **Intermittent Fault Test** | *NOTE: For wiring and theory of operation information, see DTC 001077.12 PUMP SELF-TEST ERROR supporting information.*<br><br>1. Connect the DST or SERVICE ADVISOR™. For instructions on connecting to the DST or SERVICE ADVISOR™, see CONNECTING TO DIAGNOSTIC SCAN TOOL (DST) OR SERVICE ADVISOR™earlier in this Group.<br><br>2. Ignition ON, engine OFF<br><br>3. Start the ECU diagnostic software<br><br>4. Make note of any DTCs, then clear all DTCs<br><br>5. Ignition ON, engine cranking or running<br><br>6. Read DTCs using DST or SERVICE ADVISOR™. | **001077.12 reoccurs:**<br>Faulty injection pump connector<br>OR<br>Faulty injection pump<br><br>**001077.12 doesn't reoccur:**<br>Problem is intermittent. If no other codes are present, see INTERMITTENT FAULT DIAGNOSTICS, earlier in this Group. |

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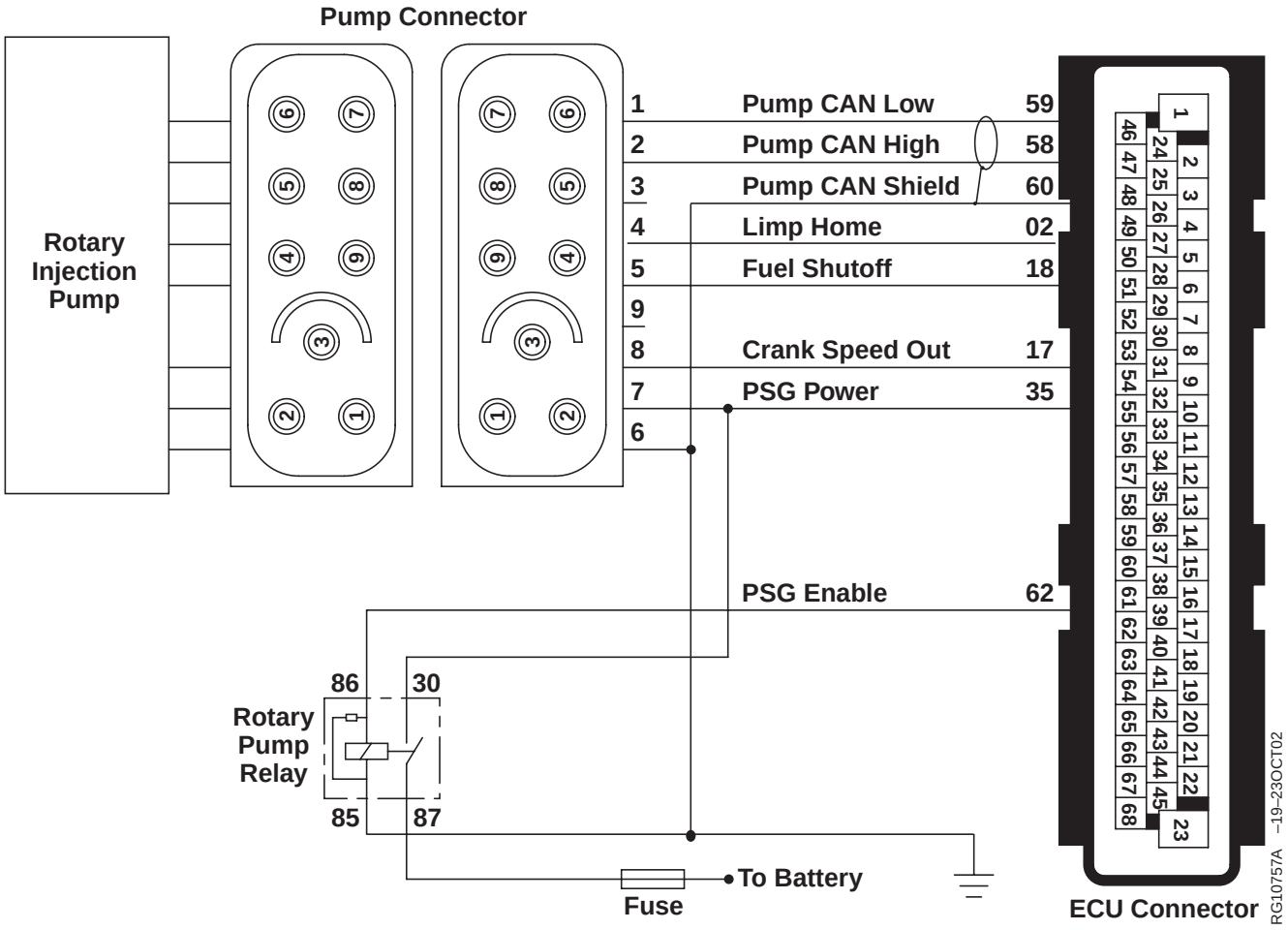
## 001077.19 — Pump Detected Communication Error




*NOTE: Wiring schematic shows OEM engine applications only. For wiring information on other applications, see APPLICATION SPECIFICATIONS in Section 06, Group 210 of this manual.*

**Bosch VP44 Rotary Injection Pump**

- The Bosch VP44 rotary injection pump is controlled by a pump control unit that monitors information received from sensors inside the pump. It also acquires information from the ECU over a CAN bus and other dedicated wires between the ECU and pump. This helps the pump control unit to provide for the accurate quantity and timing of fuel delivery to the engine.

**DTC 001077.19 will set if:**

- The pump is not receiving any inputs from the ECU over CAN when there is a speed being detected on the crank speed out wire.

**If DTC 001077.19 sets, the following will occur:**

- If the engine is not running when this code is set, it may not start.
- The ECU will set a BLINKING warning light.

RG41221,00001DE –19–22OCT02–1/1

## 001077.19 — Pump Detected Communication Error

*The pump is not receiving input from the ECU over CAN when speed is being detected on the crank speed out wire.*

RG41221,00001DF –19–22OCT02–1/1

## 001077.19 Pump Detected Communication Error Diagnostic Procedure

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160
,309

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| ❶ **Connection Check** | **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.**<br><br>*NOTE: For wiring and theory of operation information, see DTC 001077.19 PUMP DETECTED COMMUNICATION ERROR supporting information.*<br><br>Before using this diagnostic procedure, perform a preliminary inspection of the ECU connector and the injection pump harness connector looking for dirty, damaged, or poorly positioned terminals. | **No faulty connection(s):** GO TO ❷<br><br>**Faulty connection(s):** Repair faulty connection(s). |
| | | – – –1/1 |
| ❷ **Intermittent Fault Test** | *NOTE: For wiring and theory of operation information, see DTC 001077.19 PUMP DETECTED COMMUNICATION ERROR supporting information.*<br><br>1. Connect the DST or SERVICE ADVISOR™. For instructions on connecting to the DST or SERVICE ADVISOR™, see CONNECTING TO DIAGNOSTIC SCAN TOOL (DST) OR SERVICE ADVISOR™earlier in this Group.<br><br>2. Ignition ON, engine OFF<br><br>3. Start the ECU diagnostic software<br><br>4. Make notes of any DTCs, then clear all DTCs<br><br>5. Ignition ON, engine cranking or running<br><br>6. Read DTCs using DST or SERVICE ADVISOR™. | **001077.19 reoccurs:** GO TO ❸<br><br>**001077.19 doesn't reoccur:** Problem is intermittent. If no other codes are present, see INTERMITTENT FAULT DIAGNOSTICS, earlier in this Group. |

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| ❸ **Pump CAN Wiring Check** | *NOTE: For wiring and theory of operation information, see DTC 001077.19 PUMP DETECTED COMMUNICATION ERROR supporting information.*<br><br>1. Ignition OFF<br><br>2. Disconnect the ECU and injection pump connectors<br><br>3. Using a multimeter, measure resistance between:<br><br>• Terminal 1 in the injection pump connector and terminal 59 in the ECU connector on the engine harness<br>• Terminal 2 in the injection pump connector and terminal 58 in the ECU connector on the engine harness | **Both measurements less 5 ohms or less:**<br>GO TO ❹<br><br>**Either measurement greater than 5 ohms:**<br>Faulty CAN BUS wiring between injection pump and the ECU<br><br>– – –1/1 |

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| ❹ **Pump CAN Wiring Check for Short** | *NOTE: For wiring and theory of operation information, see DTC 001077.19 PUMP DETECTED COMMUNICATION ERROR supporting information.*<br><br>1. Ignition OFF<br><br>2. ECU connector still disconnected.<br><br>3. Using a multimeter, measure resistance between a good chassis ground and:<br><br>• Terminal 1 in the injection pump connector on the engine harness<br>• Terminal 2 in the injection pump connector on the engine harness | **Both measurements greater than 20k ohms:**<br>Faulty ECU connector<br>OR<br>Faulty ECU<br><br>**Either measurement less than 20k ohms:**<br>CAN BUS wiring between pump and ECU is shorted to ground<br><br>– – –1/1 |

## 001077.31 — Pump Initiated Engine Protection

*Pump initiated fuel derate for engine protection.*

**Injection Pump Derate**

- The pump control unit (PSG) has the ability to initiate protection to the injection pump and engine when it detects a problem within the pump. As a result, the pump derates the amount of fuel that it will send to the engine.

**DTC 001077.31 will set if:**

04
160
,312

- The PSG senses an extremely high fuel temperature.
- The PSG senses fuel temperature input voltage to be outside the range of what is physically possible for fuel temperature.
- The PSG senses the high pressure solenoid to be continuously energized, it is unable to detect closure of the high pressure solenoid valve, or the internal pump speed sensor is broken.
- The PSG detects that components within the pump are not working properly.
- The PSG senses a crank signal from the ECU that is out of range with respect to the internal timing within the pump.

**If DTC 001077.31 sets, the following will occur:**

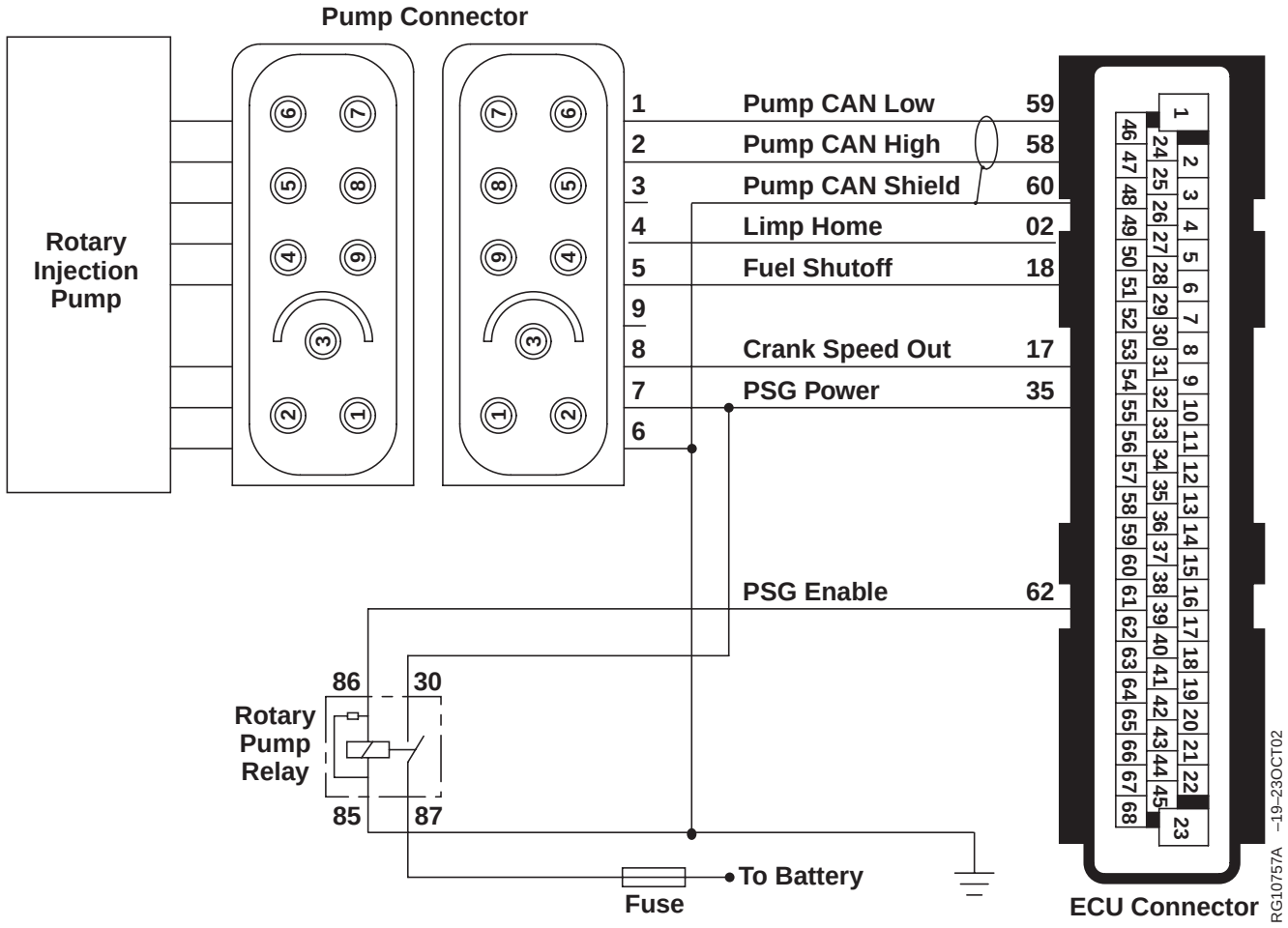
- The ECU will set a BLINKING warning light.
- If the engine is not running when this code is set, it may not start.
- Engine protection is enabled. See ENGINE PROTECTION in Section 03, Group 140 earlier in this manual.
  - – With Derate Feature: On OEM applications, the engine derates 20% per minute until the engine is running at 50% of full power. For non-OEM applications, see APPLICATION SPECIFICATIONS in Section 06, Group 210 later in this manual.

**If DTC 001077.31 sets:**

- If DTC 000174.00 is active, see DTC 000174.00 FUEL TEMPERATURE HIGH MOST SEVERE DIAGNOSTIC PROCEDURE earlier in this Group.
- If DTC 000174.31 is active, see DTC 000174.31 FUEL TEMPERATURE SENSOR FAULTY DIAGNOSTIC PROCEDURE earlier in this Group.
- If DTC 001076.02 is active, see DTC 001076.02 PUMP DETECTED DEFECT DIAGNOSTIC PROCEDURE earlier in this Group.
- If DTC 001077.12 is active, see DTC 001077.12 PUMP SELF-TEST ERROR DIAGNOSTIC PROCEDURE earlier in this Group.
- If DTC 001078.07 is active, see DTC 001078.07 ECU/PUMP MODERATELY OUT OF SYNC DIAGNOSTIC PROCEDURE earlier in this Group.
- If DTC 001078.31 is active, see DTC 001078.31 ECU/PUMP EXTREMELY OUT OF SYNC DIAGNOSTIC PROCEDURE earlier in this Group.

DPSG,RG40854,232 –19–30JUN99–1/1

## 001078.07 — ECU/Pump Timing Moderately Out of Sync




*NOTE: Wiring schematic shows OEM engine applications only. For wiring information on other applications, see APPLICATION SPECIFICATIONS in Section 06, Group 210 of this manual.*

**Bosch VP44 Rotary Injection Pump**

- The Bosch VP44 rotary injection pump is controlled by a pump control unit that monitors information received from sensors inside the pump. It also acquires information from the ECU over a CAN bus and other dedicated wires between the ECU and pump. This helps the pump control unit to provide for the accurate quantity and timing of fuel delivery to the engine.

**DTC 001078.07 will set if:**

- The pump control unit (PSG) senses a crank signal from the ECU that is moderately out of range with respect to the internal timing within the pump.

**If DTC 001078.07 sets, the following will occur:**

- If the engine is not running when this code is set, it may not start.
- The ECU will set a BLINKING warning light.
- DTC 001077.31 will also be present.
- DTC 001569.31 will also be present.
- Engine protection is enabled. See ENGINE PROTECTION in Section 03, Group 140 earlier in this manual.

Continued on next page

RG41221,00001E1 –19–22OCT02–1/2

– With Derate Feature: On OEM applications, the engine derates 20% per minute until the engine is running at 50% of full power. For non-OEM applications, see APPLICATION SPECIFICATIONS in Section 06, Group 210 later in this manual.

RG41221,00001E1 –19–22OCT02–2/2

## 001078.07 — ECU/Pump Timing Moderately Out of Sync

*The pump control unit (PSG) senses a crank signal from the ECU that is moderately out of range with respect to the internal timing within the pump.*

RG41221,00001E2 –19–22OCT02–1/1

### 001078.07 ECU/Pump Timing Moderately Out of Sync Diagnostic Procedure

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160
,316

*NOTE: If DTC 001078.07 is accompanied with a DTC SPN 636 or 637, diagnose those codes first*

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| ❶ **Connection Check** | **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.**<br><br>*NOTE: For wiring and theory of operation information, see DTC 001078.07 ECU/PUMP TIMING MODERATELY OUT OF SYNC supporting information.*<br><br>Before using this diagnostic procedure, perform a preliminary inspection of the ECU connector and the injection pump connector looking for dirty, damaged, or poorly positioned terminals. | **No faulty connection(s):** GO TO ❷<br><br>**Faulty connection(s):** Repair faulty connection(s). |

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| ❷ **Intermittent Fault Test** | *NOTE: For wiring and theory of operation information, see DTC 001078.07 ECU/PUMP TIMING MODERATELY OUT OF SYNC supporting information.*<br><br>1. Connect the DST or SERVICE ADVISOR™. For instructions on connecting to the DST or SERVICE ADVISOR™, see CONNECTING TO DIAGNOSTIC SCAN TOOL (DST) OR SERVICE ADVISOR™earlier in this Group.<br>2. Ignition ON, engine OFF<br>3. Start the ECU diagnostic software<br>4. Make notes of any DTCs, then clear all DTCs<br>5. Ignition ON, engine cranking or running<br>6. Read DTCs using DST or SERVICE ADVISOR™. | **001078.07 reoccurs:** GO TO ❸<br><br>**001078.07 doesn't reoccur:** Problem is intermittent. If no other codes are present, see INTERMITTENT FAULT DIAGNOSTICS, earlier in this Group. |

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| ❸ **Crank and Pump Position Noise and Crank Status Check** | *NOTE: For wiring and theory of operation information, see DTC 001078.07 ECU/PUMP TIMING MODERATELY OUT OF SYNC supporting information.*<br><br>1. Engine running<br><br>2. While cranking observe pump position noise, crankshaft position noise, and crank status. See Pump Position/Crank parameters. For an explanation of these parameters, go to DATA PARAMETER DESCRIPTION in Group 160. | **No crank or pump position noise detected OR crank status reaches 15:**<br>GO TO ❺<br><br>**Crank or pump position noise detected OR crank status doesn't reach 15:**<br>GO TO ❹<br><br>– – –1/1 |

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| ❹ **Crank/Pump Position Failures** | *NOTE: For wiring and theory of operation information, see DTC 001078.07 ECU/PUMP TIMING MODERATELY OUT OF SYNC supporting information.*<br><br>Inspect vehicle for possible failures that can cause these conditions:<br><br>• Bad electrical connections<br>• Damaged pump position or crankshaft position sensor<br>• Damaged injection pump gear or crank timing wheels<br>• Electro-magnetic interference from other electronic devices around vehicle | – – –1/1 |

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160
,317

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| ❺ **Check Crank Speed Out Wire for Short** | *NOTE: For wiring and theory of operation information, see DTC 001078.07 ECU/PUMP TIMING MODERATELY OUT OF SYNC supporting information.*<br><br>1. Disconnect injection pump connector and ECU connector<br><br>2. Using multimeter, measure resistance between terminal 17 of the ECU connector and all terminals in the ECU connector on the engine harness | **All measurements greater than 2k ohms:**<br>GO TO ❻<br><br>**Any measurement less than 2k ohms:**<br>Short in crank speed out wire<br><br>– – –1/1 |

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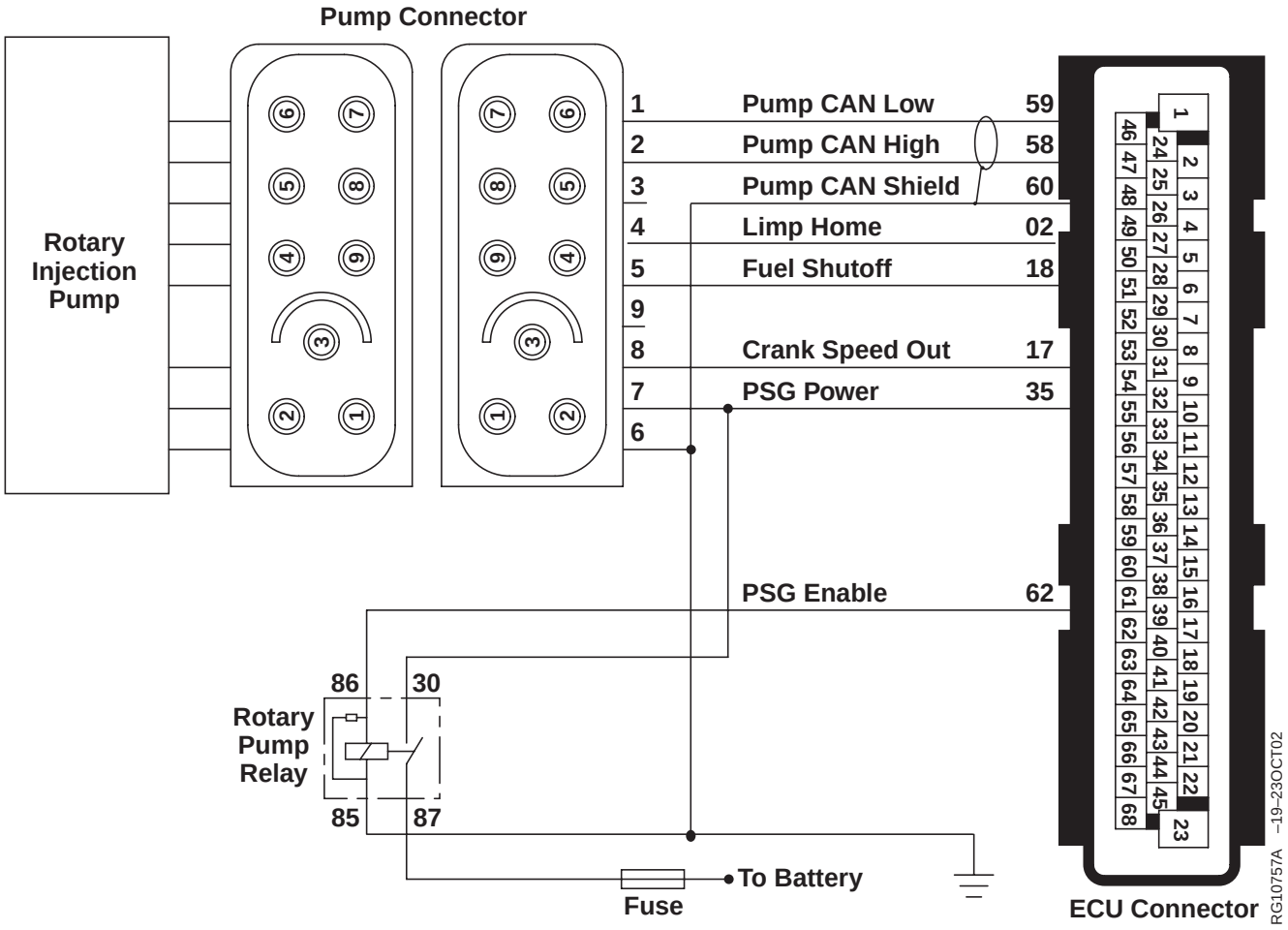
| ❻ **Open in Crank Speed Wire Check** | *NOTE: For wiring and theory of operation information, see DTC 001078.07 ECU/PUMP TIMING MODERATELY OUT OF SYNC supporting information.*<br><br>1. Keep injection pump and ECU connectors disconnected<br><br>2. Using multimeter, measure resistance between terminal 17 of the ECU connector and terminal 8 of the injection pump connector on the engine harness | **5 ohms or less:**<br>Injection pump mounted incorrectly. See INSTALL BOSCH VP44 FUEL INJECTION PUMP<br>OR<br>Faulty injection pump<br><br>**Greater than 5 ohms:**<br>Open in crank speed out wire<br><br>– – –1/1 |

## 001078.11 — ECU/Pump Engine Speed Out of Sync




*NOTE: Wiring schematic shows OEM engine applications only. For wiring information on other applications, see APPLICATION SPECIFICATIONS in Section 06, Group 210 of this manual.*

**Bosch VP44 Rotary Injection Pump**

- The Bosch VP44 rotary injection pump is controlled by a pump control unit that monitors information received from sensors inside the pump. It also acquires information from the ECU over a CAN bus and other dedicated wires between the ECU and pump. This helps the pump control unit to provide for the accurate quantity and timing of fuel delivery to the engine.

**DTC 001078.11 will set if:**

- The ECU detects timing internal to the pump does not match engine speed.

**If DTC 001078.11 sets, the following will occur:**

- Engine may run rough.
- Engine may be hard to start.
- The ECU will set a BLINKING warning light.

DPSG,RG40854,233 –19–30JUN99–1/1

## 001078.11 — ECU/Pump Engine Speed Out of Sync

*The ECU detects timing internal to the pump does not match engine speed.*

RG41221,00001E3 –19–22OCT02–1/1

### 001078.11 ECU/Pump Engine Speed Out of Sync Diagnostic Procedure

*NOTE: If DTC 001078.11 is accompanied with a DTC SPN 636 or 637, diagnose those codes first*

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160
,319

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| ❶ **Connection Check** | **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.**<br><br>*NOTE: For wiring and theory of operation information, see DTC 001078.11 ECU/PUMP SPEED OUT OF SYNC supporting information.*<br><br>Before using this diagnostic procedure, perform a preliminary inspection of the ECU connector and the injection pump connector looking for dirty, damaged, or poorly positioned terminals. | **No faulty connection(s):** GO TO ❷<br><br>**Faulty connection(s):** Repair faulty connection(s). |
| ❷ **Intermittent Fault Test** | *NOTE: For wiring and theory of operation information, see DTC 001078.11 ECU/PUMP SPEED OUT OF SYNC supporting information.*<br><br>1. Connect the DST or SERVICE ADVISOR™. For instructions on connecting to the DST or SERVICE ADVISOR™, see CONNECTING TO DIAGNOSTIC SCAN TOOL (DST) OR SERVICE ADVISOR™earlier in this Group.<br>2. Ignition ON, engine OFF<br>3. Start the ECU diagnostic software<br>4. Make note of any DTCs, then clear all DTCs<br>5. Ignition ON, engine cranking or running<br>6. Read DTCs using DST or SERVICE ADVISOR™. | **001078.11 reoccurs:** GO TO ❸<br><br>**001078.11 doesn't reoccur:** Problem is intermittent. If no other codes are present, see INTERMITTENT FAULT DIAGNOSTICS, earlier in this Group. |

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| ❸ **Crank and Pump Position Noise and Crank Status Check** | *NOTE: For wiring and theory of operation information, see DTC 001078.11 ECU/PUMP SPEED OUT OF SYNC supporting information.*<br><br>1. Engine running<br><br>2. While cranking observe pump position noise, crankshaft position noise, and crank status. See Pump Position/Crank parameters. For an explanation of these parameters, go to DATA PARAMETER DESCRIPTION in Group 160. | **No crank or pump position noise detected OR crank status reaches 15:**<br>GO TO ❺<br><br>**Crank or pump position noise detected OR crank status doesn't reach 15:**<br>GO TO ❹<br><br>– – –1/1 |



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|---|---|---|
| ❹ **Crank/Pump Position Failures** | *NOTE: For wiring and theory of operation information, see DTC 001078.11 ECU/PUMP SPEED OUT OF SYNC supporting information.*<br><br>Inspect vehicle for possible failures that can cause these conditions:<br><br>• Bad electrical connection<br>• Damaged pump position sensor or crankshaft position sensor<br>• Damaged injection pump gear or crank timing wheels<br>• Electro-magnetic interference from other electronic devices around vehicle | – – –1/1 |

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| ❺ **Check Crank Speed Out Wire for Short** | *NOTE: For wiring and theory of operation information, see DTC 001078.11 ECU/PUMP SPEED OUT OF SYNC supporting information.*<br><br>1. Disconnect injection pump connector and ECU connector<br><br>2. Using multimeter, measure resistance between terminal 17 of the ECU connector and all other terminals in the ECU connector on the engine harness. | **All measurements greater than 2k ohms:**<br>GO TO ❻<br><br>**Any measurement less than 2k ohms:**<br>Short in crank speed out wire<br><br>– – –1/1 |

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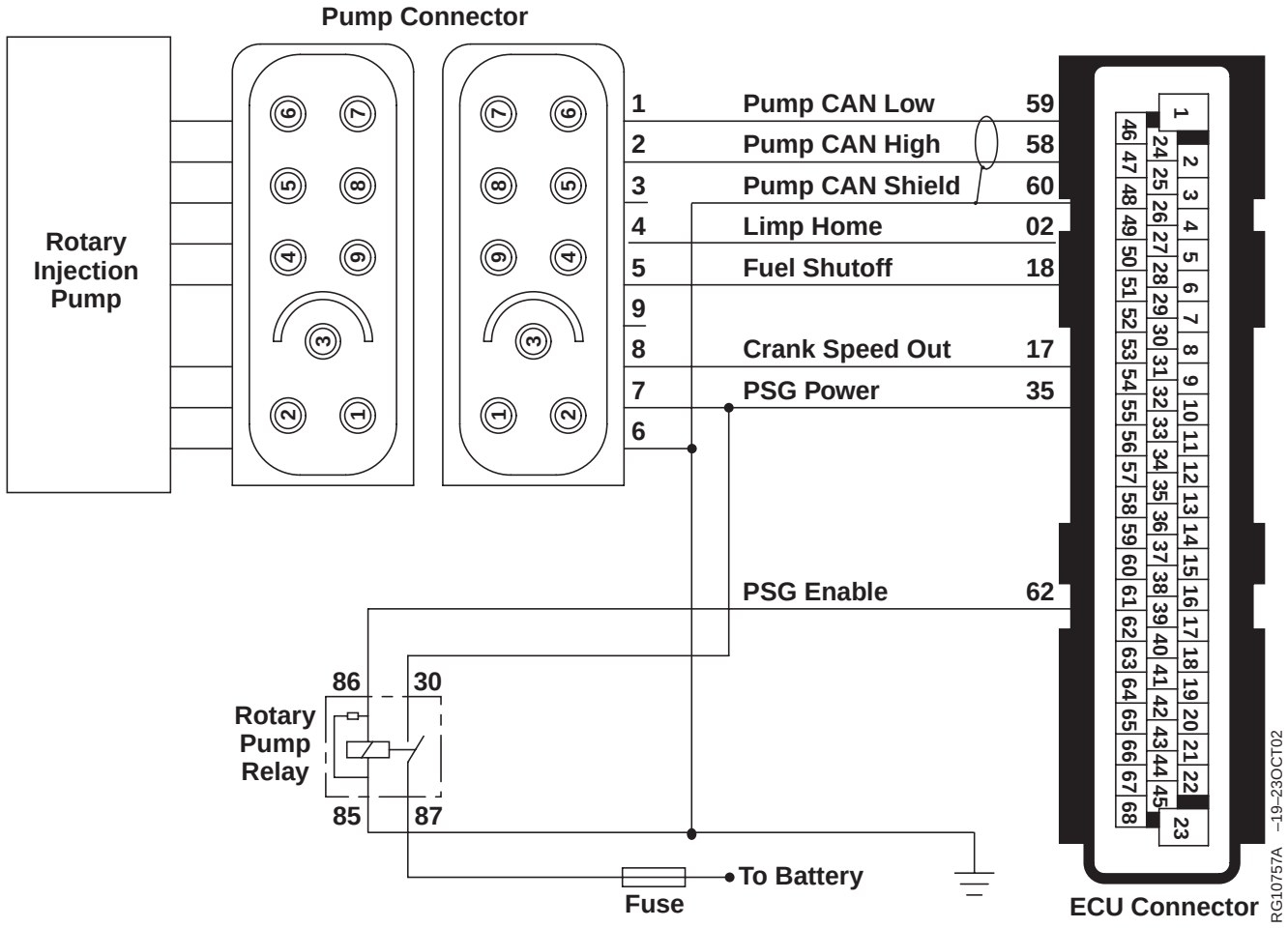
|---|---|---|
| ❻ **Open in Crank Speed Wire Check** | *NOTE: For wiring and theory of operation information, see DTC 001078.11 ECU/PUMP SPEED OUT OF SYNC supporting information.*<br><br>1. Keep injection pump and ECU connector s disconnected.<br><br>2. Using a multimeter, measure resistance between terminal 17 of the ECU connector and terminal 8 of the injection pump connector on the engine harness. | **5 ohms or less:**<br>Injection pump mounted incorrectly<br>OR<br>Faulty injection pump<br><br>**Greater than 5 ohms:**<br>Open in crank speed out wire<br><br>– – –1/1 |

## 001078.31 — ECU/Pump Timing Extremely Out of Sync




*NOTE: Wiring schematic shows OEM engine applications only. For wiring information on other applications, see APPLICATION SPECIFICATIONS in Section 06, Group 210 of this manual.*

**Bosch VP44 Rotary Injection Pump**

- The Bosch VP44 rotary injection pump is controlled by a pump control unit that monitors information received from sensors inside the pump. It also acquires information from the ECU over a CAN bus and other dedicated wires between the ECU and pump. This helps the pump control unit to provide for the accurate quantity and timing of fuel delivery to the engine.

**DTC 001078.31 will set if:**

- The pump control unit (PSG) senses a crank signal from the ECU that is extremely out of range with respect to the internal timing within the pump.

**If DTC 001078.31 sets, the following will occur:**

- The ECU will set a BLINKING stop lamp.
- If the engine is not running when this code is set, it may not start.
- DTC 001077.31 will also be present.
- DTC 001569.31 will also be present.
- Engine protection is enabled. See ENGINE PROTECTION in Section 03, Group 140 earlier in this manual.

Continued on next page

RG41221,00001E5 –19–22OCT02–1/2

– With Derate Feature: On OEM applications, the engine derates 20% per minute until the engine is running at 50% of full power. For non-OEM applications, see APPLICATION SPECIFICATIONS in Section 06, Group 210 later in this manual.

RG41221,00001E5 –19–22OCT02–2/2

## 001078.31 — ECU/Pump Timing Extremely Out of Sync

*The pump control unit (PSG) senses a crank signal from the ECU that is extremely out of range with respect to the internal timing within the pump.*

RG41221,00001E6 –19–22OCT02–1/1

### 001078.31 ECU/Pump Timing Extremely Out of Sync Diagnostic Procedure

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160
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*NOTE: If DTC 001078.31 is accompanied with a DTC SPN 636 or 637, diagnose those codes first*

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| ❶ **Connection Check** | **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.**<br><br>*NOTE: For wiring and theory of operation information, see DTC 001078.31 ECU/PUMP TIMING EXTREMELY OUT OF SYNC supporting information.*<br><br>Before using this diagnostic procedure, perform a preliminary inspection of the ECU connector and the injection pump connector looking for dirty, damaged, or poorly positioned terminals. | **No faulty connection(s):** GO TO ❷<br><br>**Faulty connection(s):** Repair faulty connection(s). |

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| ❷ **Intermittent Fault Test** | *NOTE: For wiring and theory of operation information, see DTC 001078.31 ECU/PUMP TIMING EXTREMELY OUT OF SYNC supporting information.*<br><br>1. Connect the DST or SERVICE ADVISOR™. For instructions on connecting to the DST or SERVICE ADVISOR™, see CONNECTING TO DIAGNOSTIC SCAN TOOL (DST) OR SERVICE ADVISOR™earlier in this Group.<br>2. Ignition ON, engine OFF<br>3. Start the ECU diagnostic software<br>4. Make notes of any DTCs, then clear all DTCs<br>5. Ignition ON, engine cranking or running<br>6. Read DTCs using DST or SERVICE ADVISOR™. | **001078.31 reoccurs:** GO TO ❸<br><br>**001078.31 doesn't reoccur:** Problem is intermittent. If no other codes are present, see INTERMITTENT FAULT DIAGNOSTICS, earlier in this Group. |

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| ❸ **Fuel Pressure Check (Running) on Open Loop Systems** | *NOTE: For wiring and theory of operation information, see DTC 001078.31 ECU/PUMP TIMING EXTREMELY OUT OF SYNC supporting information.*<br><br>*NOTE: If the engine being diagnosed is on a closed loop system skip this procedure and GO TO* ❹. For more information on closed loop versus open loop systems, see ELECTRONIC FUEL TRANSFER PUMP in Section 03, Group 140 earlier in this manual.<br><br>1. Ignition OFF<br><br>2. Connect proper pressure gauge from Universal Pressure Kit JT05412 to spare outlet port on the final fuel filter.<br><br>3. Ignition ON, engine running at fast idle<br><br>4. Using gauge, read pressure | **Between 1-83 kPa (0.01-0.8 bar) (0.15-12.0 psi):**<br>GO TO ❹<br><br>**Consistently below 1 kPa (0.01 bar) (0.15 psi):**<br>See F4 - FUEL SUPPLY SYSTEM CHECK - TIER 2 for cause of low fuel pressure.<br><br>– – –1/1 |



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| ❹ **Crank and Pump Position Noise and Crank Status Check** | *NOTE: For wiring and theory of operation information, see DTC 001078.31 ECU/PUMP TIMING EXTREMELY OUT OF SYNC supporting information.*<br><br>1. Engine running<br><br>2. While cranking observe pump position noise, crankshaft position noise, and crank status. See Pump Position/Crank parameters. For an explanation of these parameters, go to DATA PARAMETER DESCRIPTION in Group 160. | **No crank or pump position noise detected OR crank status reaches 15:**<br>GO TO ❻<br><br>**Crank or pump position noise detected OR crank status does not reach 15:**<br>GO TO ❺<br><br>– – –1/1 |

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| ❺ **Crank/Pump Position Failures** | *NOTE: For wiring and theory of operation information, see DTC 001078.31 ECU/PUMP TIMING EXTREMELY OUT OF SYNC supporting information.*<br><br>Inspect vehicle for possible failures that can cause these conditions:<br><br>• Bad electrical connections<br>• Damaged pump position or crankshaft position sensor<br>• Damaged injection pump gear or crank timing wheels<br>• Electro-magnetic interference from other electronic devices around vehicle | – – –1/1 |

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| ❻ **Check Crank Speed Out Wire for Short** | *NOTE: For wiring and theory of operation information, see DTC 001078.31 ECU/PUMP TIMING EXTREMELY OUT OF SYNC supporting information.*<br><br>1. Disconnect injection pump connector and ECU connector<br><br>2. Using a multimeter, measure resistance between terminal 17 of the ECU connector and all other terminals in the ECU connector on the engine harness. | **All measurements greater than 2k ohms:**<br>GO TO ❼<br><br>**Any measurement less than 2k ohms:**<br>Short in crank speed out wire<br><br>– – –1/1 |

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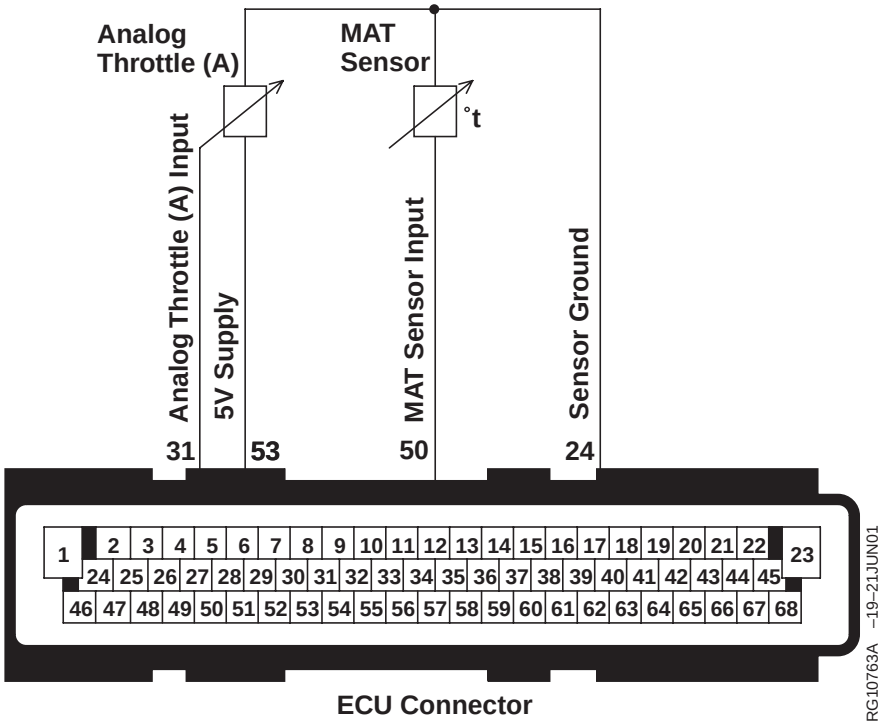
| ❼ **Open in Crank Speed Wire Check** | *NOTE: For wiring and theory of operation information, see DTC 001078.31 ECU/PUMP TIMING EXTREMELY OUT OF SYNC supporting information.*<br><br>1. Keep injection pump and ECU connectors disconnected<br><br>2. Using a multimeter, measure resistance between terminal 17 of the ECU connector and terminal 8 of the injection pump connector on the engine harness. | **5 ohms or less:**<br>Injection pump mounted incorrectly<br>OR<br>Faulty injection pump<br><br>**Greater than 5 ohms:**<br>Open in crank speed out wire<br><br>– – –1/1 |

04
160
,326

## 001079.03 — Sensor Supply 1 Voltage High




ECU Connector



*NOTE: Wiring schematic shows OEM engine applications only. For wiring information on other applications, see APPLICATION SPECIFICATIONS in Section 06, Group 210 of this manual.*

**Sensor Supply Voltage**

- The ECU supplies voltage to a few different sensors depending on the application. The ECU monitors the drop in voltage that the sensor causes and compares that drop to preprogrammed values in the ECU's memory to determine the value of the parameter the sensor was measuring. In addition, the ECU monitors the exact voltage on the 5 volt supply circuit in order to ensure accurate readings.

**DTC 001079.03 will set if:**

- The ECU detects a voltage that is higher than 5.5 volts on the ECU 5 volt sensor supply 1 circuit.

**If DTC 001079.03 sets, the following will occur:**

- The ECU will use default values for the sensors that use sensor supply 1 input voltage.
- The ECU will set a BLINKING warning light.

RG41221,00001E8 –19–16MAY01–1/1

## 001079.03 — Sensor Supply 1 Voltage High

*The ECU detects a voltage above specification on the ECU 5 volt sensor supply circuit.*

RG41221,00001E9 –19–22OCT02–1/1

## 001079.03 Sensor Supply 1 Voltage High Diagnostic Procedure

04
160
,329

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| ❶ **Connection Check** | **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.**<br><br>*NOTE: For wiring and theory of operation information, see DTC 001079.03 SENSOR SUPPLY 1 VOLTAGE HIGH supporting information.*<br><br>Before using this diagnostic procedure, perform a preliminary inspection of the ECU connector and all of the sensor connectors using this 5V supply looking for dirty, damaged, or poorly positioned terminals. | **No faulty connection(s):** GO TO ❷<br><br>**Faulty connection(s):** Repair faulty connection(s). |
| ❷ **Intermittent Fault Test** | *NOTE: For wiring and theory of operation information, see DTC 001079.03 SENSOR SUPPLY 1 VOLTAGE HIGH supporting information.*<br><br>1. Connect the DST or SERVICE ADVISOR™. For instructions on connecting to the DST or SERVICE ADVISOR™, see CONNECTING TO DIAGNOSTIC SCAN TOOL (DST) OR SERVICE ADVISOR™earlier in this Group.<br>2. Ignition ON, engine OFF<br>3. Start the ECU diagnostic software<br>4. Make notes of any DTCs, then clear all DTCs<br>5. Ignition ON, engine OFF<br>6. Read DTCs using DST or SERVICE ADVISOR™. | **001079.03 reoccurs:** GO TO ❸<br><br>**001079.03 doesn't reoccur:** Problem is intermittent. If no other codes are present, see INTERMITTENT FAULT DIAGNOSTICS, earlier in this Group. |

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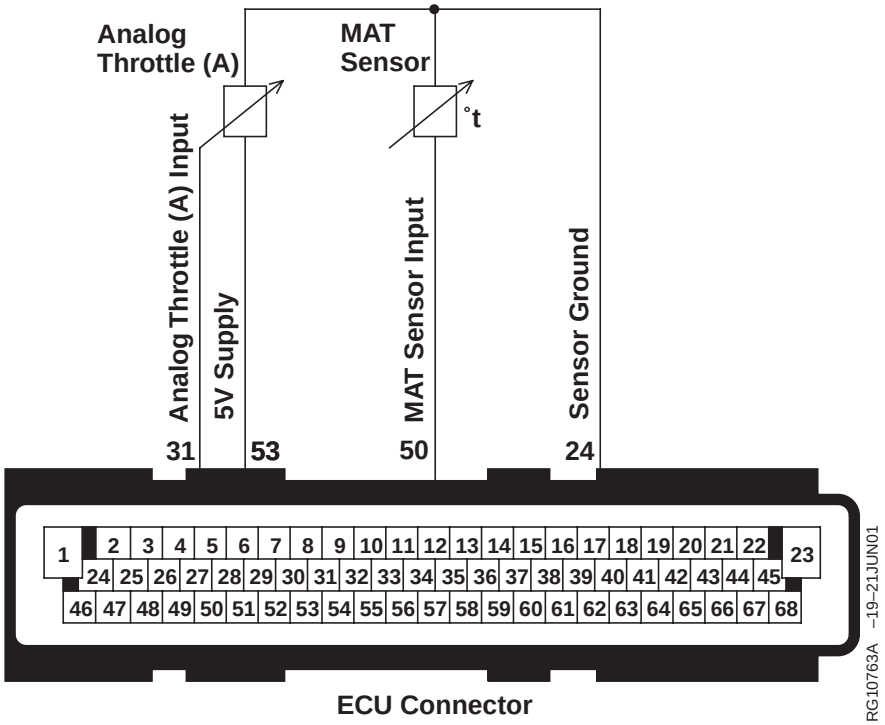
| ❸ **Sensor Supply 1 Wire Check for Short** | *NOTE: For wiring and theory of operation information, see DTC 001079.03 SENSOR SUPPLY 1 VOLTAGE HIGH supporting information.*<br><br>1. Ignition OFF<br><br>2. Disconnect ECU connector<br><br>3. Using a multimeter, measure resistance between terminal 53 in the ECU connector and all other terminals in the ECU connector on the engine harness | **Greater than 20k ohms:**<br>Faulty ECU connector<br>OR<br>Faulty ECU<br><br>**Less than 20k ohms:**<br>Short to voltage in sensor supply 1 wire<br><br>– – –1/1 |

## 001079.04 — Sensor Supply 1 Voltage Low




ECU Connector

*NOTE: Wiring schematic shows OEM engine applications only. For wiring information on other applications, see APPLICATION SPECIFICATIONS in Section 06, Group 210 of this manual.*

**Sensor Supply Voltage**

- The ECU supplies voltage to a few different sensors depending on the application. The ECU monitors the drop in voltage that the sensor causes and compares that drop to preprogrammed values in the ECU's memory to determine the value of the parameter the sensor was measuring. In addition, the ECU monitors the exact voltage on the 5 volt supply circuit in order to ensure accurate readings.

**DTC 001079.04 will set if:**

- The ECU detects a voltage that is lower than 4.44 volts on the ECU 5 volt sensor supply 1 circuit.

**If DTC 001079.04 sets, the following will occur:**

- The ECU will use default values for the sensors that use sensor supply 1 input voltage.
- The ECU will set a BLINKING warning light.

RG41221,00001EB –19–16MAY01–1/1

## 001079.04 — Sensor Supply 1 Voltage Low

*The ECU detects a voltage below specification on the ECU 5 volt sensor supply circuit.*

RG41221,00001EC –19–22OCT02–1/1

## 001079.04 Sensor Supply 1 Voltage Low Diagnostic Procedure

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160
,333

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| ❶ **Connection Check** | **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.**<br><br>*NOTE: For wiring and theory of operation information, see DTC 001079.04 SENSOR SUPPLY 1 VOLTAGE LOW supporting information.*<br><br>Before using this diagnostic procedure, perform a preliminary inspection of the ECU connector and all of the sensor connectors using this 5V supply looking for dirty, damaged, or poorly positioned terminals. | **No faulty connection(s):**<br>GO TO ❷<br><br>**Faulty connection(s):**<br>Repair faulty connection(s). |

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| ❷ **Sensor Check** | *NOTE: For wiring and theory of operation information, see DTC 001079.04 SENSOR SUPPLY 1 VOLTAGE LOW supporting information.*<br><br>1. Connect the DST or SERVICE ADVISOR™. For instructions on connecting to the DST or SERVICE ADVISOR™, see CONNECTING TO DIAGNOSTIC SCAN TOOL (DST) OR SERVICE ADVISOR™earlier in this Group.<br><br>2. Ignition ON, engine OFF<br><br>3. Start the ECU diagnostic software<br><br>4. Make note of any DTCs, then clear all DTCs<br><br>5. Ignition OFF<br><br>6. Disconnect all of the sensors that receive their 5 V supply from terminal 53 in the ECU connector.<br><br>7. Ignition ON, engine running<br><br>8. Read DTCs using DST or SERVICE ADVISOR™. | **001079.04 reoccurs:**<br>GO TO ❹<br><br>**001079.04 doesn't reoccur:**<br>GO TO ❸ |

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| ❸ **Intermittent Fault Test** | *NOTE: For wiring and theory of operation information, see DTC 001079.04 SENSOR SUPPLY 1 VOLTAGE LOW supporting information.*<br><br>1. Ignition ON<br><br>2. Reconnect each of the sensors one at a time while monitoring DTCs. After each connection, monitor DTCs on the ECU diagnostic software. | **001079.04 reoccurs:**<br>Sensor that reset the DTC is faulty<br>Replace and retest<br><br>**001079.04 doesn't reoccur:**<br>Problem is intermittent. If no other codes are present, see INTERMITTENT FAULT DIAGNOSTICS, earlier in this Group.<br><br>– – –1/1 |

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160
,334

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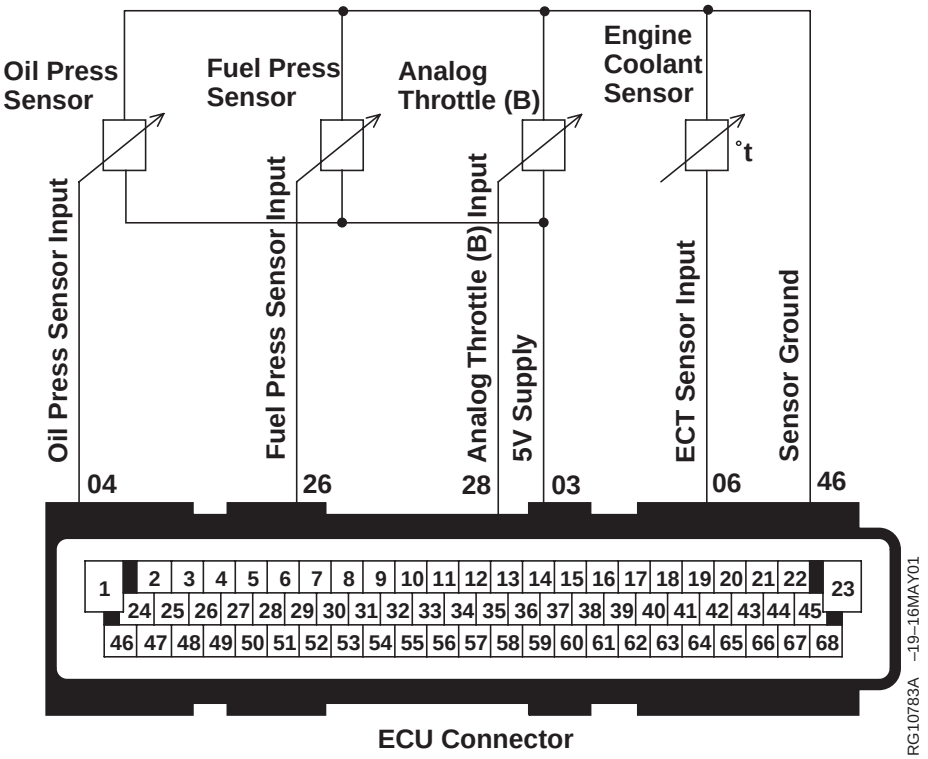
| ❹ **Sensor Supply 1 Short to Ground Check** | *NOTE: For wiring and theory of operation information, see DTC 001079.04 SENSOR SUPPLY 1 VOLTAGE LOW supporting information.*<br><br>1. Ignition OFF<br><br>2. Disconnect ECU connector<br><br>3. Using a multimeter, measure resistance individually between terminal 53 in the ECU connector on the engine harness and:<br><br>• A good chassis ground<br>• Terminal 1 in the harness end of the ECU connector<br>• Terminal 24 in the harness end of the ECU connector<br>• Terminal 46 in the harness end of the ECU connector | **Greater than 20k ohms:**<br>Faulty ECU connector<br>OR<br>Faulty ECU<br><br>**Less than 20k ohms:**<br>Sensor 5 volt supply circuit shorted to a ground<br><br>– – –1/1 |

## 001080.03 — Sensor Supply 2 Voltage High




**ECU Connector**

*NOTE: Wiring schematic shows OEM engine applications only. For wiring information on other applications, see APPLICATION SPECIFICATIONS in Section 06, Group 210 of this manual.*

**Sensor Supply Voltage**

- The ECU supplies voltage to a few different sensors depending on the application. The ECU monitors the drop in voltage that the sensor causes and compares that drop to preprogrammed values in the ECU's memory to determine the value of the parameter the sensor was measuring. In addition, the ECU monitors the exact voltage on the 5 volt supply circuit in order to ensure accurate readings.

**DTC 001080.03 will set if:**

- The ECU detects a voltage that is higher than 5.5 volts on the ECU 5 volt sensor supply 2 circuit.

**If DTC 001080.03 sets, the following will occur:**

- The ECU will use default values for the sensors that use sensor supply 2 input voltage.
- The ECU will set a BLINKING warning light.

RG41221,00001EE –19–16MAY01–1/1

## 001080.03 — Sensor Supply 2 Voltage High

*The ECU detects a voltage above specification on the ECU 5 volt sensor supply circuit.*

RG41221,00001EF –19–22OCT02–1/1

## 001080.03 Sensor Supply 2 Voltage High Diagnostic Procedure

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160
,337

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| ❶ **Connection Check** | **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.**<br><br>*NOTE: For wiring and theory of operation information, see DTC 001080.03 SENSOR SUPPLY 2 VOLTAGE HIGH supporting information.*<br><br>Before using this diagnostic procedure, perform a preliminary inspection of the ECU connector and all of the sensor connectors using this 5V supply looking for dirty, damaged, or poorly positioned terminals. | **No faulty connection(s):** GO TO ❷<br><br>**Faulty connection(s):** Repair faulty connection(s). |
| ❷ **Intermittent Fault Test** | *NOTE: For wiring and theory of operation information, see DTC 001080.03 SENSOR SUPPLY 2 VOLTAGE HIGH supporting information.*<br><br>1. Connect the DST or SERVICE ADVISOR™. For instructions on connecting to the DST or SERVICE ADVISOR™, see CONNECTING TO DIAGNOSTIC SCAN TOOL (DST) OR SERVICE ADVISOR™earlier in this Group.<br>2. Ignition ON, engine OFF<br>3. Start the ECU diagnostic software<br>4. Make notes of any DTCs, then clear all DTCs<br>5. Ignition ON, engine OFF<br>6. Read DTCs using DST or SERVICE ADVISOR™. | **001080.03 reoccur:** GO TO ❸<br><br>**001080.03 doesn't reoccur:** Problem is intermittent. If no other codes are present, see INTERMITTENT FAULT DIAGNOSTICS, earlier in this Group. |

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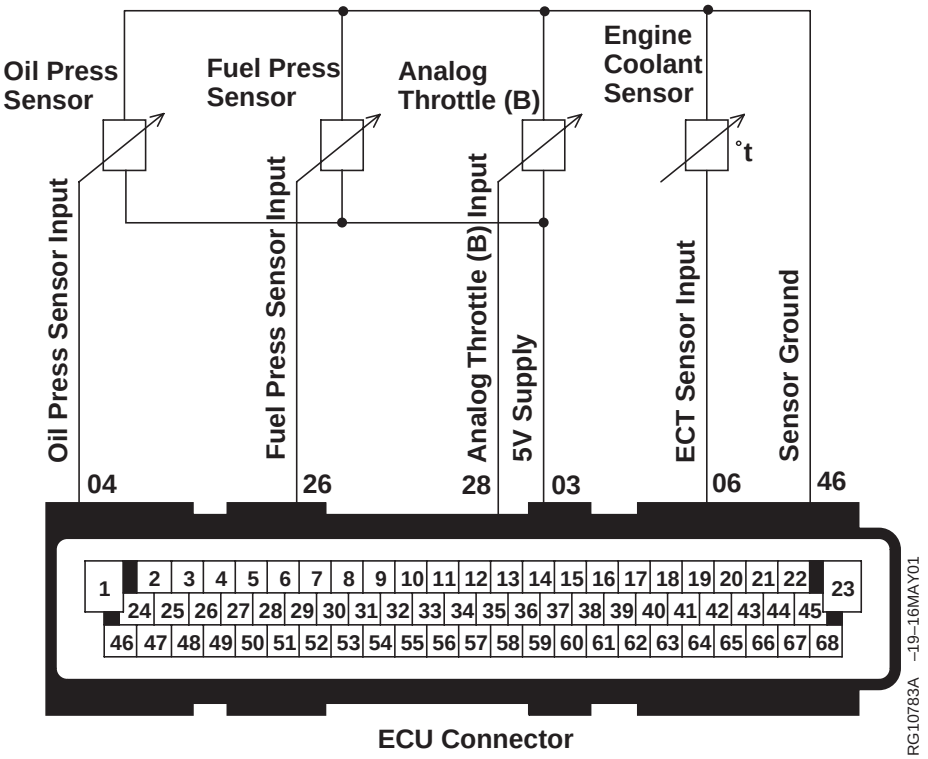
| ❸ **Sensor Supply 2 Check for Short** | *NOTE: For wiring and theory of operation information, see DTC 001080.03 SENSOR SUPPLY 2 VOLTAGE HIGH supporting information.*<br><br>1. Ignition OFF<br><br>2. Disconnect ECU connector<br><br>3. Using a multimeter, measure resistance between terminal 3 and all other terminals in the ECU connector on the engine harness | **Greater than 20k ohms:**<br>Faulty ECU connector<br>OR<br>Faulty ECU<br><br>**Less than 20k ohms:**<br>Short to voltage in sensor supply 2 wire<br><br>– – –1/1 |

## 001080.04 — Sensor Supply 2 Voltage Low




**ECU Connector**

*NOTE: Wiring schematic shows OEM engine applications only. For wiring information on other applications, see APPLICATION SPECIFICATIONS in Section 06, Group 210 of this manual.*

**Sensor Supply Voltage**

- The ECU supplies voltage to a few different sensors depending on the application. The ECU monitors the drop in voltage that the sensor causes and compares that drop to preprogrammed values in the ECU's memory to determine the value of the parameter the sensor was measuring. In addition, the ECU monitors the exact voltage on the 5 volt supply circuit in order to ensure accurate readings.

**DTC 001080.04 will set if:**

- The ECU detects a voltage that is lower than 4.4 volts on the ECU 5 volt sensor supply 2 circuit.

**If DTC 001080.04 sets, the following will occur:**

- The ECU will use default values for the sensors that use sensor supply 2 input voltage.
- The ECU will set a BLINKING warning light.

RG41221,00001F1 –19–16MAY01–1/1

## 001080.04 — Sensor Supply 2 Voltage Low

*The ECU detects a voltage below specification on the ECU 5 volt sensor supply circuit.*

RG41221,00001F2 –19–22OCT02–1/1

## 001080.04 Sensor Supply 2 Voltage Low Diagnostic Procedure

04
160
,341

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| ❶ **Connection Check** | **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.**<br><br>*NOTE: For wiring and theory of operation information, see DTC 001080.04 SENSOR SUPPLY 2 VOLTAGE LOW supporting information.*<br><br>Before using this diagnostic procedure, perform a preliminary inspection of the ECU connector and all of the sensor connectors using this 5V supply looking for dirty, damaged, or poorly positioned terminals. | **No faulty connection(s):** GO TO ❷<br><br>**Faulty connection(s):** Repair faulty connection(s). |

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| ❷ **Sensor Test** | *NOTE: For wiring and theory of operation information, see DTC 001080.04 SENSOR SUPPLY 2 VOLTAGE LOW supporting information.*<br><br>1. Connect the DST or SERVICE ADVISOR™. For instructions on connecting to the DST or SERVICE ADVISOR™, see CONNECTING TO DIAGNOSTIC SCAN TOOL (DST) OR SERVICE ADVISOR™earlier in this Group.<br><br>2. Ignition ON, engine OFF<br><br>3. Start the ECU diagnostic software<br><br>4. Make note of any DTCs, then clear all DTCs<br><br>5. Ignition OFF<br><br>6. Disconnect all of the sensors that receive their 5 V supply from terminal 3 in the ECU connector. See ECU TERMINAL IDENTIFICATION in Group 210 of this manual.<br><br>7. Ignition ON, engine running<br><br>8. Read DTCs using DST or SERVICE ADVISOR™. | **001080.04 reoccurs:**<br>GO TO ❹<br><br>**001080.04 doesn't reoccur:**<br>GO TO ❸ |

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| ❸ **Intermittent Fault Test** | *NOTE: For wiring and theory of operation information, see DTC 001080.04 SENSOR SUPPLY 2 VOLTAGE LOW supporting information.*<br><br>1. Ignition ON, engine OFF<br><br>2. Reconnect each of the sensors one at a time while reading DTCs. After each connection, monitor DTCs on the ECU diagnostic software. | **001080.04 reoccurs:**<br>Sensor that reset the DTC is faulty<br>Replace and retest<br><br>**001080.04 doesn't reoccur:**<br>Problem is intermittent. If no other codes are present, see INTERMITTENT FAULT DIAGNOSTICS, earlier in this Group. |

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| ❹ **Sensor Supply 2 Short to Ground Check** | *NOTE: For wiring and theory of operation information, see DTC 001080.04 SENSOR SUPPLY 2 VOLTAGE LOW supporting information.*<br><br>1. Ignition OFF<br><br>2. Disconnect ECU connector<br><br>3. Using a multimeter, measure resistance between terminal 3 in the ECU connector on the engine harness and:<br><br>• A good chassis ground<br>• Terminal 1 in the harness end of the ECU connector<br>• Terminal 24 in the harness end of the ECU connector<br>• Terminal 46 in the harness end of the ECU connector | **Greater than 20k ohms:**<br>Faulty ECU connector<br>OR<br>Faulty ECU<br><br>**Less than 20k ohms:**<br>Sensor 5 volt supply circuit shorted to a ground |

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## 001109.31 — Engine Protection Shutdown Warning

*The ECU will shut the engine down to protect the engine from damage.*

**Engine Shutdown Warning:**

- This code informs the operator that the ECU will shut the engine down because it has detected a condition such as water in fuel, low oil pressure, high engine coolant temperature, ECU error or low coolant level. If the ECU is programmed with engine protection with shutdown, the ECU has shut the engine down within 30 seconds. Prior to shutdown, the engine will be derated.



**DTC 001109.31 will set if:**

- ECU detects extremely low oil pressure.
- ECU detects extremely high engine coolant temperature.
- The ECU detects a loss of engine coolant.

**If DTC 001109.31 sets, the following will occur:**

- If the ECU has engine protection with shutdown, it will derate (according to relating DTC) the engine for 30 seconds and will shut the engine down.

**If DTC 001109.31 sets:**

- If DTC 000100.01 is active, see DTC 000100.01 ENGINE OIL PRESSURE EXTREMELY LOW DIAGNOSTIC PROCEDURE earlier in this Group.
- If DTC 000110.00 is active, see DTC 000110.00 ENGINE COOLANT TEMPERATURE EXTREMELY HIGH DIAGNOSTIC PROCEDURE earlier in this Group:
- If DTC 000111.01 is active, see DTC 000111.01 ENGINE COOLANT LEVEL LOW DIAGNOSTIC PROCEDURE earlier in this Group.

RG41221,0000210 –19–22OCT02–1/1

## 001110.31 — Engine Protection Shutdown

*The ECU shut the engine down to protect the engine from damage.*

**Engine Protection Shutdown:**

- This code informs the operator that the ECU shut the engine down because it has detected a condition such as low fuel pressure, low oil pressure, high engine coolant temperature, ECU error or low coolant level. If the ECU is programmed with engine protection with shutdown, the ECU has shut the engine down.

**DTC 001110.31 will set if:**

- ECU detects extremely low oil pressure.
- ECU detects extremely high engine coolant temperature.
- The ECU detects a loss of engine coolant.

**If DTC 001110.31 sets, the following will occur:**

- The ECU will have shut the engine down.

**If DTC 001110.31 sets:**

- If DTC 000100.01 is active, see DTC 000100.01 ENGINE OIL PRESSURE EXTREMELY LOW DIAGNOSTIC PROCEDURE earlier in this Group.
- If DTC 000110.00 is active, see DTC 000110.00 ENGINE COOLANT TEMPERATURE EXTREMELY HIGH DIAGNOSTIC PROCEDURE earlier in this Group:
- If DTC 000111.01 is active, see DTC 000111.01 ENGINE COOLANT LEVEL LOW DIAGNOSTIC PROCEDURE earlier in this Group.

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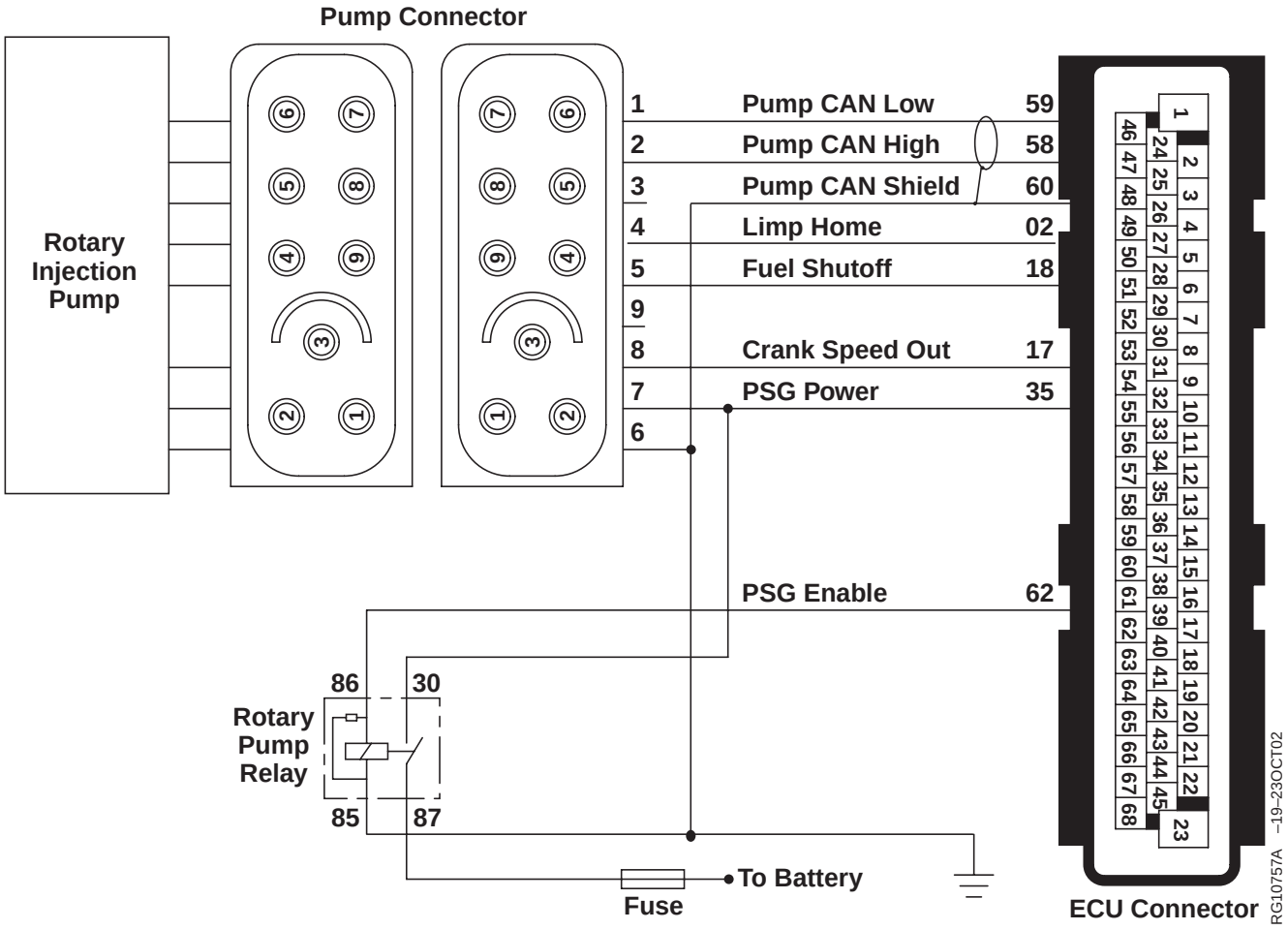
160
,345

RG41221,0000211 –19–22OCT02–1/1

## 001485.02 — Pump Power Relay Fault




*NOTE: Wiring schematic shows OEM engine applications only. For wiring information on other applications, see APPLICATION SPECIFICATIONS in Section 06, Group 210 of this manual.*

**Bosch VP44 Rotary Injection Pump**

- The Bosch VP44 rotary injection pump is controlled by a pump control unit that monitors information received from sensors inside the pump. It also acquires information from the ECU over a CAN bus and other dedicated wires between the ECU and pump. This helps the pump control unit to provide for the accurate quantity and timing of fuel delivery to the engine.

**DTC 001485.02 will set if:**

- The ECU detects that the voltage at terminal 62 does not match the voltage at terminal 35.

**If DTC 001485.02 sets, the following will occur:**

- Engine may not start.
- The ECU will set a BLINKING warning light.

RG41221,00001F4 –19–16MAY01–1/1

## 001485.02 — Pump Power Relay Fault

*The ECU detects different voltages at two separate terminals.*

RG41221,00001F3 –19–22OCT02–1/1

## 001485.02 Pump Power Relay Fault Diagnostic Procedure

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160
,347

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| ❶ **Connection Check** | **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.**<br><br>*NOTE: For wiring and theory of operation information, see DTC 001485.02 PUMP POWER RELAY FAULT supporting information.*<br><br>Before using this diagnostic procedure, perform a preliminary inspection of the ECU connector and the injection pump harness connector looking for dirty, damaged, or poorly positioned terminals. | **No faulty connection(s):**<br>GO TO ❷<br><br>**Faulty connection(s):**<br>Repair faulty connection(s). |

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| ❷ **Intermittent Fault Test** | *NOTE: For wiring and theory of operation information, see DTC 001485.02 PUMP POWER RELAY FAULT supporting information.*<br><br>1. Connect the DST or SERVICE ADVISOR™. For instructions on connecting to the DST or SERVICE ADVISOR™, see CONNECTING TO DIAGNOSTIC SCAN TOOL (DST) OR SERVICE ADVISOR™earlier in this Group.<br><br>2. Ignition ON, engine OFF<br><br>3. Start the ECU diagnostic software<br><br>4. Make note of any DTCs, then clear all DTCs<br><br>5. Ignition ON, engine running or cranking for 15 seconds<br><br>6. Read DTCs using DST or SERVICE ADVISOR™. | **Only 001485.02 reoccurs:**<br>GO TO ❽<br><br>**001485.02 and 000629.19 reoccur:**<br>GO TO ❸<br><br>**001485.02 doesn't reoccur:**<br>Problem is intermittent. If no other codes are present, see INTERMITTENT FAULT DIAGNOSTICS, earlier in this Group |

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| ❸ **Check for Battery Voltage Prior to Rotary Pump Relay** | *NOTE: For wiring and theory of operation information, see DTC 001485.02 PUMP POWER RELAY FAULT supporting information.*<br>1. Disconnect rotary pump relay connector<br>2. Using a multimeter, measure voltage between terminal 30 in the rotary pump relay connector on the engine harness and a good chassis ground | **Approximately battery voltage:**<br>GO TO ❹<br>**Significantly less than battery voltage:**<br>Blown fuse(s)<br>OR<br>Short to ground in power wire<br>OR<br>Open in PSG relay power wire<br>– – –1/1 |
| ❹ **Open in Rotary Pump Ground Wire Check** | *NOTE: For wiring and theory of operation information, see DTC 001485.02 PUMP POWER RELAY FAULT supporting information.*<br>1. Ignition ON, engine OFF<br>2. Using a multimeter, measure voltage between terminal 30 and terminal 85 in the rotary pump relay connector on the engine harness. | **Approximately battery voltage:**<br>GO TO ❺<br>**Substantially less than battery voltage:**<br>Open in rotary pump relay ground wire<br>– – –1/1 |
| ❺ **PSG Enable Wire Voltage Check** | *NOTE: For wiring and theory of operation information, see DTC 001485.02 PUMP POWER RELAY FAULT supporting information.*<br>1. Ignition ON, engine OFF<br>2. Using a multimeter, measure voltage between terminal 86 in the rotary pump relay connector on the engine harness and a good chassis ground | **Approximately battery voltage:**<br>GO TO ❻<br>**Substantially less than battery voltage:**<br>GO TO ❼<br>– – –1/1 |
| ❻ **PSG Power Wire Resistance Check** | *NOTE: For wiring and theory of operation information, see DTC 001485.02 PUMP POWER RELAY FAULT supporting information.*<br>1. Ignition OFF<br>2. Disconnect injection pump connector<br>3. Using a multimeter, measure resistance between terminal 7 in the injection pump connector and terminal 30 in the rotary pump relay connector on the engine harness. | **Less than 5 ohms:**<br>Faulty pump relay connector<br>OR<br>Faulty pump relay<br>**Greater than 5 ohms:**<br>Faulty PSG power wire<br>– – –1/1 |

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|---|---|---|
| ❼ **PSG Enable Wire Resistance Check** | *NOTE: For wiring and theory of operation information, see DTC 001485.02 PUMP POWER RELAY FAULT supporting information.*<br>1. Ignition OFF<br>2. Disconnect ECU connector<br>3. Using a multimeter, measure resistance between terminal 62 in the ECU connector and terminal 86 in the pump relay connector on the engine harness. | **Less than 5 ohms:**<br>Faulty ECU connector<br>OR<br>Faulty ECU<br>**Greater than 5 ohms:**<br>Faulty PSG enable wire<br>– – –1/1 |
| ❽ **PSG Wire Voltage Check at Injection Pump** | *NOTE: For wiring and theory of operation information, see DTC 001485.02 PUMP POWER RELAY FAULT supporting information.*<br>1. Ignition OFF<br>2. Disconnect injection pump connector<br>3. Using a multimeter, measure voltage between terminal 7 in the injection pump connector on the engine harness and a good chassis ground<br>4. Ignition ON, engine OFF<br>5. Measure voltage at same location | **Approximately battery voltage with ignition ON and OFF:**<br>GO TO ❿<br>**No voltage with ignition OFF and approximately battery voltage with ignition ON:**<br>GO TO ❾<br>– – –1/1 |
| ❾ **Open in PSG Power Wire Check** | *NOTE: For wiring and theory of operation information, see DTC 001485.02 PUMP POWER RELAY FAULT supporting information.*<br>1. Ignition OFF<br>2. Disconnect ECU connector and rotary pump relay connector<br>3. Using a multimeter, measure resistance between terminal 35 in the ECU connector and terminal 30 in the rotary pump relay connector on the engine harness. | **Less than 5 ohms:**<br>Faulty ECU connector<br>OR<br>Faulty ECU<br>**Greater than 5 ohms:**<br>Open in PSG power wire<br>– – –1/1 |
| ❿ **PSG Enable Wire Voltage Check** | *NOTE: For wiring and theory of operation information, see DTC 001485.02 PUMP POWER RELAY FAULT supporting information.*<br>1. Ignition OFF<br>2. Disconnect pump relay connector<br>3. Using a multimeter, measure voltage between terminal 86 in the rotary pump relay connector on the engine harness and a good chassis ground.<br>4. Ignition ON, engine OFF<br>5. Measure voltage at same location | **No voltage with ignition OFF and approximately battery voltage with ignition ON:**<br>GO TO ⓬<br>**Approximately battery voltage with ignition ON and OFF:**<br>GO TO ⓫<br>– – –1/1 |

| | | |
|---|---|---|
| **11 PSG Enable Wire Check for Short to Power** | *NOTE: For wiring and theory of operation information, see DTC 001485.02 PUMP POWER RELAY FAULT supporting information.*<br>1. Ignition OFF<br>2. Disconnect ECU connector<br>3. Ignition ON, engine OFF<br>4. Using a multimeter, measure voltage between terminal 86 in the pump relay connector on the engine harness and a good chassis ground | **Substantially less than battery voltage:**<br>Faulty ECU connector<br>OR<br>Faulty ECU<br>**Approximately battery voltage:**<br>Short to power on PSG enable wire<br>– – –1/1 |

| | | |
|---|---|---|
| **12 PSG Power Wire Check for Short to Power** | *NOTE: For wiring and theory of operation information, see DTC 001485.02 PUMP POWER RELAY FAULT supporting information.*<br>1. Ignition OFF<br>2. Disconnect rotary pump relay connector<br>3. Ignition ON, engine OFF<br>4. Using a multimeter, measure voltage between terminal 30 in the pump relay connector on the engine harness and a good chassis ground | **Substantially less than battery voltage:**<br>Faulty pump relay<br>**Approximately battery voltage:**<br>Short to power on PSG power wire<br>– – –1/1 |

## 001569.31 — Fuel Derate

*The ECU has commanded a fuel derate for engine protection.*

**Fuel Derate**

The fuel derate trouble code is information to the operator that the ECU has detected a condition such as low fuel pressure, high fuel pressure, water in fuel, low oil pressure, high manifold air temperature, high air filter restriction, high engine coolant temperature, or low coolant level, and is derating the engine by limiting the maximum amount of fuel available to the engine.

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**DTC 001569.31 will set if:**

- ECU detects a low oil pressure.
- ECU detects a high manifold air temperature.
- ECU detects a high engine coolant temperature.
- The ECU detects water in fuel above the threshold quantity for an extended period of time.
- The ECU detects a loss of engine coolant.
- ECU detects a high fuel temperature.
- ECU detects a problem with the crankshaft timing.
- ECU receives a request from another electronic control unit on the vehicle/application.
- ECU receives a signal from the PSG for a pump problem.

**If DTC 001569.31 sets, the following will occur:**

- The ECU will limit the amount of fuel available to the engine in an attempt to protect the engine.
- If more than one derate is active, the most severe derate will have priority.
- The ECU may set a BLINKING warning light or stop lamp.

**If DTC 001569.31 sets:**

- If DTC 000097.00 is active, see DTC 000097.00 WATER IN FUEL CONTINUOUSLY DETECTED DIAGNOSTIC PROCEDURE earlier in this Group.
- If DTC 000100.01 or 000100.18 is active, see one of the following procedures earlier in this Group:
  - DTC 000100.01 ENGINE OIL PRESSURE EXTREMELY LOW DIAGNOSTIC PROCEDURE
  - DTC 000100.18 ENGINE OIL PRESSURE MODERATELY LOW DIAGNOSTIC PROCEDURE
- If DTC 000105.00 or 000105.16 is active, see earlier in this Group.
  - DTC 000105.00 MANIFOLD AIR TEMPERATURE EXTREMELY HIGH DIAGNOSTIC PROCEDURE
  - DTC 000105.16 MANIFOLD AIR TEMPERATURE MODERATELY HIGH DIAGNOSTIC PROCEDURE
- If DTC 000110.00, 000110.15 or 000110.16 is active, see one of the following procedures earlier in this Group:
  - DTC 000110.00 ENGINE COOLANT TEMPERATURE EXTREMELY HIGH DIAGNOSTIC PROCEDURE
  - DTC 000110.15 ENGINE COOLANT TEMPERATURE HIGH LEAST SEVERE DIAGNOSTIC PROCEDURE
  - DTC 000110.16 ENGINE COOLANT TEMPERATURE MODERATELY HIGH DIAGNOSTIC PROCEDURE
- If DTC SPN 000111.01 is active, see DTC 000111.01 ENGINE COOLANT LEVEL LOW DIAGNOSTIC PROCEDURE earlier in this Group.
- If DTC 000174.00, 000174.16, or 000174.31 is active, see one of the following procedures earlier in this Group:
  - DTC 000174.00 FUEL TEMPERATURE HIGH MOST SEVERE DIAGNOSTIC PROCEDURE
  - DTC 000174.16 FUEL TEMPERATURE HIGH MODERATELY SEVERE DIAGNOSTIC PROCEDURE
  - DTC 000174.31 FUEL TEMPERATURE SENSOR FAULTY DIAGNOSTIC PROCEDURE
- If DTC 000637.02, 000637.08, or 000637.10 is active, see one of the following procedures earlier in this Group:

**Continued on next page**

  - DTC 000637.02 CRANKSHAFT POSITION INPUT NOISE DIAGNOSTIC PROCEDURE
  - DTC 000637.08 CRANKSHAFT POSITION INPUT MISSING DIAGNOSTIC PROCEDURE
  - DTC 000637.10 CRANKSHAFT POSITION INPUT PATTERN ERROR DIAGNOSTIC PROCEDURE
- If DTC 001076.02 is active, see DTC 001076.02 PUMP DETECTED DEFECT DIAGNOSTIC PROCEDURE earlier in this Group.
- If DTC 001077.12 is active, see DTC 001077.12 PUMP SELF-TEST ERROR DIAGNOSTIC PROCEDURE earlier in this Group.
- If DTC 001077.31 is active, see DTC 001077.31 PUMP INITIATED ENGINE PROTECTION earlier in this Group.
- If DTC 001078.07 is active, see DTC 001078.07 ECU/PUMP MODERATELY OUT OF SYNC DIAGNOSTIC PROCEDURE earlier in this Group.
- If DTC 001078.31 is active, see DTC 001078.31 ECU/PUMP EXTREMELY OUT OF SYNC DIAGNOSTIC PROCEDURE earlier in this Group.

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DPSG,RG40854,320 –19–22OCT02–2/2

## 002000.13 — Security Violation

*The ECU determines that it, OR another controller on the machine is not the right controller for this particular machine.*

**Security Violation**

- When the ignition is first turned on, all of the controllers on the machine communicate with each other to make sure that all controllers are correct for the particular machine.

**DTC 002000.13 will set if:**

- The ECU determines that it, OR another controller on the machine is not the right controller for this particular machine.

**If DTC 002000.13 sets, the following will occur:**

- The ECU will allow the engine to start, but will only allow low idle engine speed.
- The ECU will set a BLINKING warning light.

**If DTC 002000.13 sets:**

- If one of the controllers on the machine has just been replaced, make sure the correct controller was installed.
- If all controllers on the machine are the correct part numbers, check to see if any of the controllers have active or stored CAN related DTCs. If they do, go to the appropriate diagnostic procedure.

RG41221,00001F5 –19–16AUG01–1/1

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# Section 05
# Tools and Other Materials

## Contents

## Group 090 - Electronic Fuel System Repair and Adjustment Essential Tools

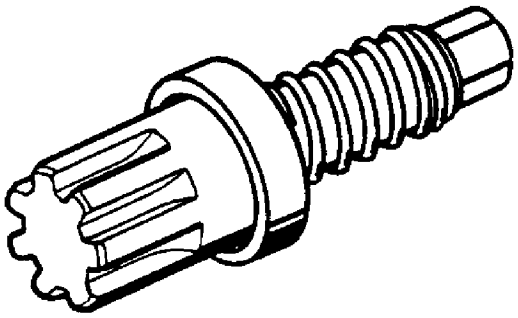
*NOTE: Order tools according to information given in the U.S. SERVICEGARD™ Catalog or from the European Microfiche Tool Catalog (MTC).*

*SERVICEGARD is a trademark of Deere & Company*

DPSG,OUO1004,2751 –19–04MAY00–1/9

Flywheel Turning Tool . . . . . JDG820

Used to rotate engine flywheel to lock engine at “TDC” to check high pressure fuel pump timing. Use with JDE81-4 Timing Pin.



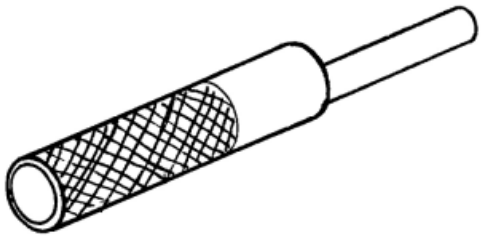
RG7056 –UN–05DEC97

RG7056

DPSG,OUO1004,2751 –19–04MAY00–2/9

VP44 Timing Pin . . . . . .KJD10233

Used to lock Bosch VP44 in-line fuel injection pump timing during removal and installation of pump.



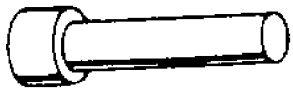
RG11755 –UN–16JUL01

DPSG,OUO1004,2751 –19–04MAY00–3/9

RG5068 –UN–05DEC97

Timing Pin . . . . . .JDE81-4

Used to lock flywheel at No. 1 TDC for injection pump timing.



RG5068

*Timing Pin*

Continued on next page

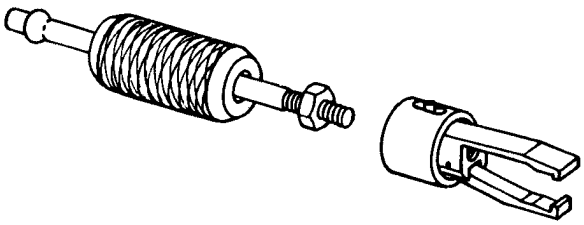
DPSG,OUO1004,2751 –19–04MAY00–4/9

Injection Nozzle Puller . . . . . JDE38B

Remove injection nozzles.

If JDE38B is not available, JDE38A Nozzle Puller with JDG716 Adapter can be used. JDG716 can be used with slide handle adapter from JDE38 or JDE38A to remove 9.5 mm nozzles without removing the rocker arm cover.

JDG716-1 Repair Kit is available if leg of JDG716 Adapter is damaged.



RG9478 –UN–12NOV98

*JDE38B*

DPSG,OUO1004,2751 –19–04MAY00–5/9

RG5084 –UN–23AUG88

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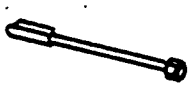
170
2

Nozzle Bore Cleaning Tool . . . . . JDE39

Clean injection nozzle bore in cylinder head.



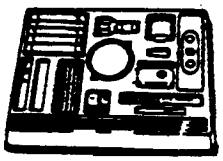
*JDE39*

DPSG,OUO1004,2751 –19–04MAY00–6/9

RG5224 –UN–23AUG88

Nozzle Cleaning Kit . . . . . JDF13B

Clean injection nozzles.



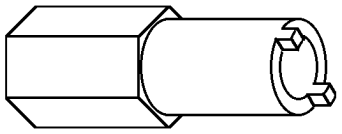
*JDF13B*

**Continued on next page**

DPSG,OUO1004,2751 –19–04MAY00–7/9

Injection Nozzle Wrench . . . . . JDG949

Used to loosen or tighten lift adjusting screws on injection nozzles.



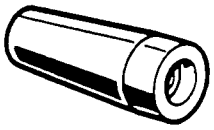
RG7644 –UN–23NOV97

*JDG949*

DPSG,OUO1004,2751 –19–04MAY00–8/9

Nozzle Carbon Stop Seal Installer . . . . .JD258 (JD-258)

Used to install carbon stop seal in injection nozzle groove.



RG6254 –UN–22JUL92

*JD258 (JD-258)*

DPSG,OUO1004,2751 –19–04MAY00–9/9

05
170
3

## Fuel System Repair and Adjustment Service Equipment and Tools

*NOTE: Order tools according to information given in the U.S. SERVICEGARD™ Catalog or from the European Microfiche Tool Catalog (MTC). Some tools may be available from a local supplier.*

*SERVICEGARD is a trademark of Deere & Company*

DPSG,OUO1004,2752 –19–04MAY00–1/5

Bosch Bench Mounted Nozzle Tester . . . . . JT25510

Check nozzle opening pressure.

**Continued on next page**

DPSG,OUO1004,2752 –19–04MAY00–2/5

Fuel Line . . . . . .KJD10109

Use with JT25510 Nozzle Tester to check nozzle opening pressure.

DPSG,OUO1004,2752 –19–04MAY00–3/5

Fuel Injection Nozzle Tester Adapter Set . . . . D01110AA

Check nozzle opening pressure.

DPSG,OUO1004,2752 –19–04MAY00–4/5

OTC Portable Nozzle Tester . . . . . D01109AA

Check nozzle opening pressure.

DPSG,OUO1004,2752 –19–04MAY00–5/5



## Fuel System Repair and Adjustment Other Materials

| Number | Name | Use |
|---|---|---|
| AR54749 (U.S.) | Soap Lubricant | Apply to Bosch VP44 injection pump O-ring. |

DPSG,OUO1004,2655 –19–18APR00–1/1

## Group 110 - Electronic Engine Control System Repair Tools

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

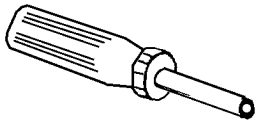
*SERVICEGARD is a trademark of Deere & Company*

**Continued on next page**

DPSG,OUO1004,2634 –19–10APR00–1/19

RW25539 –UN–28AUG96

Terminal Extraction Tool[1] . . . . . .JDG364



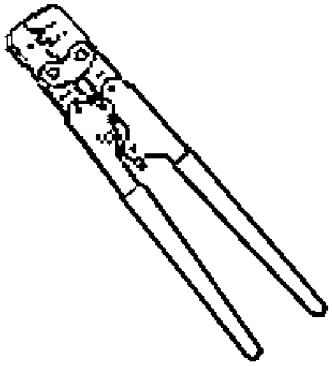
Used to extract WEATHER PACK™ terminals from electrical connectors.

*WEATHER PACK is a trademark of Packard Electric*

*[1]Included in Technician's Electrical Repair Kit - JT07195B*

DPSG,OUO1004,2634 –19–10APR00–2/19

WEATHER PACK™ Crimping Tool . . . . . JDG783



RW25542A –UN–07MAR02

Used to crimp WEATHER PACK™ male and female terminals on 14-20 gauge wires. This tool crimps both the wire and the seal retainer at the same time.

*WEATHER PACK is a trademark of Packard Electric*

DPSG,OUO1004,2634 –19–10APR00–3/19

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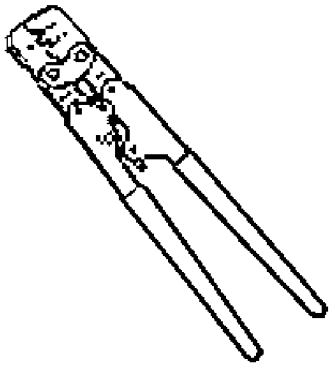
5

METRI-PACK™ Crimping Tool . . . . . JDG865



RW25542A –UN–07MAR02

Used to crimp METRI-PACK™ male and female terminals on 14-20 gauge wires.

*METRI-PACK is a trademark of Packard Electric Inc.*

DPSG,OUO1004,2634 –19–10APR00–4/19

Packard Crimper . . . . . JDG707

RG11679 –UN–05FEB01

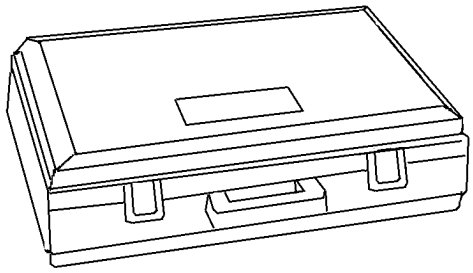
Used to crimp WEATHER PACK, METRIPACK, SUMITOMO, and YAZAKI male and female terminals on 12-20 gauge wires. This tool crimps the wire and the seal retainer separately.

**Continued on next page**

DPSG,OUO1004,2634 –19–10APR00–5/19

Technician's Electrical Repair Kit . . . . . .JT07195B

This kit is assembled with the most commonly used terminal extraction tools used to repair wiring harnesses on John Deere applications. This kit includes the following: **JDG140** - CPC and Metrimate terminal extraction tool, **JDG141** - CPC Blade Type terminal extraction tool, **JDG361** - Deutsch 12-14 gauge terminal extraction/insertion tool, **JDG362** - Deutsch 16-18 gauge terminal extraction/insertion tool, **JDG364** - WEATHERPACK terminal extraction tool, **JDG776** - Metripack terminal extraction tool - Wide, **JDG777** - METRI-PACK terminal extraction tool - Narrow, and **JDG785** - Deutsch 6-8 gauge terminal extraction/insertion tool.



RW25558 –UN–29AUG96

DPSG,OUO1004,2634 –19–10APR00–6/19

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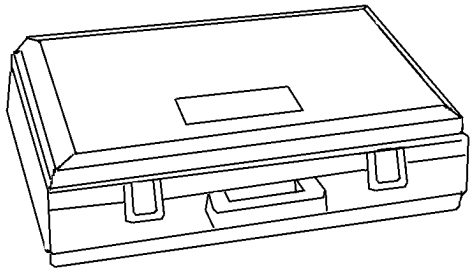
6

Technician's Electrical Repair Kit . . . . . JDG155

This kit is assembled with the most commonly used terminal extraction tools used to repair wiring harnesses on John Deere applications. This kit includes the following: **JDG107** - Holding Plate, **JDG139** - Sure-Seal terminal insertion tool, **JDG140** - CPC and Metrimate terminal extraction tool, **JDG141** - CPC Blade Type terminal extraction tool, **JDG142** - Mate-N-Lock terminal extraction tool, **JDG143** - Mate-N-Lock terminal extraction tool, **JDG144** - Universal Crimping Pliers, **JDG145** - Electrician's Pliers, **JDG146** - Carrying Case, and **JDG785** - Deutsch 6-8 gauge terminal extraction/insertion tool.



RW25558 –UN–29AUG96

DPSG,OUO1004,2634 –19–10APR00–7/19

Electrician's Pliers[1] . . . . . JDG145

Used to cut, strip, and splice wires.

RG11686 –UN–13FEB01

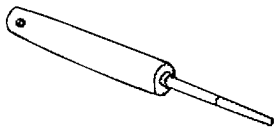
*[1]Included in Technician's Electrical Repair Kit - JDG155*

**Continued on next page**

DPSG,OUO1004,2634 –19–10APR00–8/19

RW25541 –UN–20AUG96

METRI-PACK™ Extractor (Wide)[1] . . . . . JDG776



Used to remove terminals from 56-Series, 280-Series, and 630-Series METRI-PACK™ connectors.

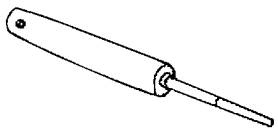
*METRI-PACK is a trademark of Packard Electric Inc.*

*[1]Included in Technician's Electrical Repair Kit - JT07195B*

DPSG,OUO1004,2634 –19–10APR00–9/19

RW25541 –UN–20AUG96

METRI-PACK™ Extractor (Narrow)[1]. . . . . JDG777



Used to remove terminals from 150-Series METRI-PACK™, SUMITOMO, and YAZAKI connectors.

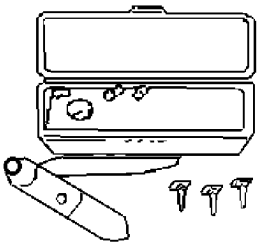


*METRI-PACK is a trademark of Packard Electric Inc.*

*[1]Included in Technician's Electrical Repair Kit - JT07195B*

DPSG,OUO1004,2634 –19–10APR00–10/19

DEUTSCH™ Electrical Repair Tool Kit. . . . . .JDG359



RW25540 –UN–06SEP96

Used to extract terminals from DEUTSCH™ electrical connectors. A special crimping tool is also included to crimp DEUTSCH terminals on wires. The following tools are included: **JDG360** - Deutsch Terminal Crimping Tool, **JDG361** - Deutsch 12-14 gauge terminal extraction/insertion tool (set of 2), **JDG362** - Deutsch 16-18 gauge terminal extraction/insertion tool (set of 2), and **JDG363** - Deutsch 20-24 gauge terminal extraction/insertion tool (set of 2)

*DEUTSCH is a trademark of Deutsch Co.*

**Continued on next page**

DPSG,OUO1004,2634 –19–10APR00–11/19

12—14 Gauge Extractor (Set of Two)[1]. . . . . JDG361

Used to remove terminals on 12-14 gauge wires in DEUTSCH connectors.

RG12278 –UN–22APR02

*Deutsch Extraction Tool*

[1]*Included in DEUTSCH Electrical Repair Kit - JDG359*

DPSG,OUO1004,2634 –19–10APR00–12/19

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16—18 Gauge Extractor (Set of Two)[1]. . . . . JDG362

Used to remove terminals on 16-18 gauge wires in DEUTSCH connectors.

RG12278 –UN–22APR02

*Deutsch Extraction Tool*

[1]*Included in DEUTSCH Electrical Repair Kit - JDG359*

**Continued on next page**

DPSG,OUO1004,2634 –19–10APR00–13/19

20—24 Gauge Extractor (Set of Two)[1] . . . . . JDG363

Used to remove terminals on 20-24 gauge wires in DEUTSCH connectors.

RG12278 –UN–22APR02

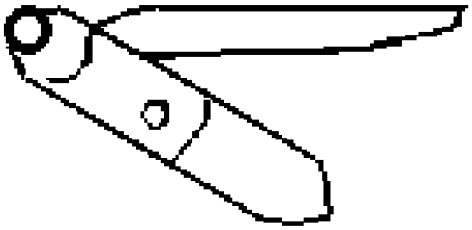
*Deutsch Extraction Tool*

*[1]Included in DEUTSCH Electrical Repair Kit - JDG359*

DPSG,OUO1004,2634 –19–10APR00–14/19

Crimping Tool[1] . . . . . JDG360

Used to crimp DEUTSCH closed barrel terminals on 12-24 gauge wires.



RG12235 –UN–15MAR02

*[1]Included in DEUTSCH Electrical Repair Kit - JDG359*

DPSG,OUO1004,2634 –19–10APR00–15/19



RG10740 –UN–31MAY00

Terminal Extraction Tool. . . . . FKM10457

Used to extract female terminals from Level 1 and Level 4 Engine Control Unit (ECU) using Amp connectors.

*FKM10457*

DPSG,OUO1004,2634 –19–10APR00–16/19

RG10739 –UN–26MAY00

Crimping Pliers[1] . . . . . .JDG144

Universal crimp tool is used to crimp terminals on wires. It is recommended to use crimp tools specific for the terminal being crimped. If there is not a specified crimp tool, use this tool.

*JDG144*

*[1]Included in Technician's Electrical Repair Kit - JDG155*

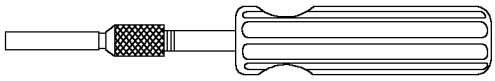
**Continued on next page**

DPSG,OUO1004,2634 –19–10APR00–17/19

RG10741 –UN–31MAY00

Terminal Extractor Tool . . . . . .JDG1369

Used to extract terminals from the Level 4 Electronic Engine Controller (ECU) connector on applications that use the Bosch VP44 fuel injection pump.

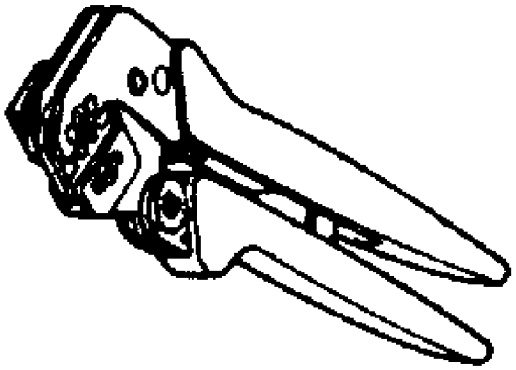


*JDG1369*

DPSG,OUO1004,2634 –19–10APR00–18/19

AMP Crimping Tool . . . . . .JDG708

Used to crimp AMP terminals on wires.



RG10737 –UN–25MAY00

*JDG708*

DPSG,OUO1004,2634 –19–10APR00–19/19

05
170
10

## Control Repair and Adjustment Other Materials

| Number | Name | Use |
|---|---|---|
| JDT405 (U.S.) | High Temperature Grease | Sensor O-rings. |
| TY9375 (U.S.)<br>TY9480 (Canadian)<br>592 (LOCTITE®) | Pipe Sealant | Apply to threads of oil pressure sensor. |
| AT66865 (U.S.) | Lubricant | Insulate electrical connectors. |

*LOCTITE is a registered trademark of Loctite Corp.*

DPSG,OUO1004,2636 –19–10APR00–1/1

## Group 150/160 - Electronic Fuel System Diagnostic Tools

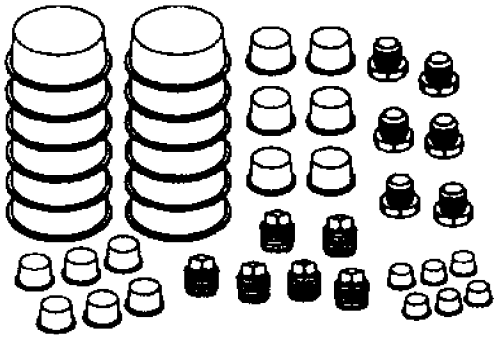
*NOTE: Order tools according to information given in the U.S. SERVICEGARD™ Catalog or in the European Microfiche Tool Catalog (MTC) unless otherwise noted.*

*SERVICEGARD is a trademark of Deere & Company.*

RG,RG34710,1605 –19–30SEP97–1/9

Fuel System Cap Plug Kit . . . . . JDG998

Used to protect the fuel system from dirt and debris when disconnecting fuel system components during fuel transfer pump pressure check.



RG8518 –UN–09OCT02

*JDG998*

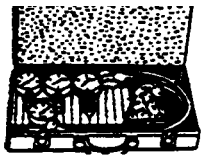
RG,RG34710,1605 –19–30SEP97–2/9



RG5162 –UN–23AUG88

Universal Pressure Test Kit . . . . . JT05412

Used for testing engine oil pressure, intake manifold pressure (turbo boost), and fuel transfer pump pressure.



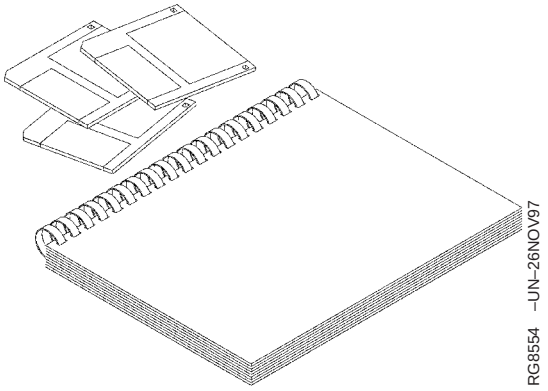
*JT05412*

**Continued on next page**

RG,RG34710,1605 –19–30SEP97–3/9

ECU Communication Software Kit. . . . . .

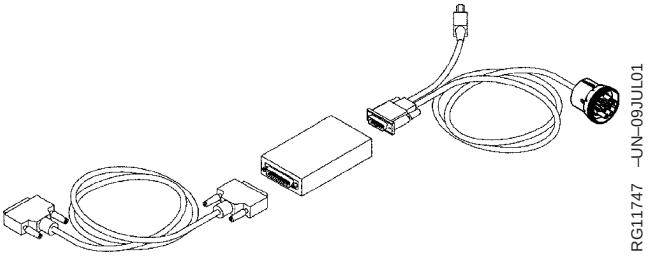
Please refer to your John Deere Dealer website for information on obtaining the latest version of software.




RG,RG34710,1605 –19–30SEP97–4/9

ECU Communication Hardware Kit . . . . . JDIS121

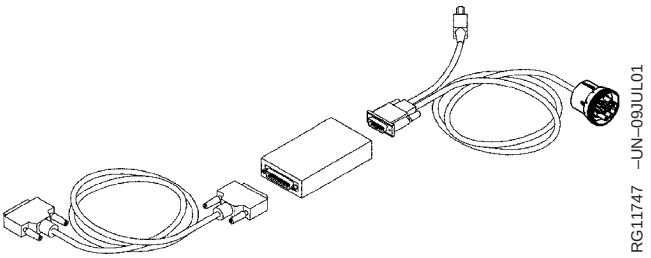
Used with ECU Communication Software Kit. Together, the kits enable a Windows (’95, ’98, 2000, ME, and XP) or NT compatible computer to read information from the Engine Control Unit (ECU). The computer must be at least a 486/66 with 8 MB of RAM and an IEEE 1284 compliant parallel port. This kit allows communication with all John Deere applications that use one of the following diagnostic connectors: black 9-pin Deutsch diagnostic connector, gray 9-pin Deutsch diagnostic connector (early 8000 series tractors), or the flat 6-pin Weatherpack diagnostic connector (Lucas controllers). Not all of the components in this kit are shown to the right.




RG,RG34710,1605 –19–30SEP97–5/9

ECU Communication Hardware Kit . . . . . DS10023

Used with ECU Communication Software Kit. Together, the kits enable a Windows (’95, ’98, 2000, ME, and XP) or NT compatible computer to read information from the Engine Control Unit (ECU). The computer must be at least a 486/66 with 8 MB of RAM and an IEEE 1284 compliant parallel port. This kit allows communication with all John Deere applications that use the black 9-pin Deutsch diagnostic connector. All of the components in this kit are shown to the right.




**Continued on next page**

RG,RG34710,1605 –19–30SEP97–6/9

*NOTE: Available from John Deere Distribution Service Center (DSC).* **United States and Canadian Agricultural dealers DO NOT ORDER without first contacting your Branch or TAM.**

RG,RG34710,1605 –19–30SEP97–7/9

Digital Multimeter . . . . . JT07306

Test electrical components for voltage, resistance, current flow, or temperature. It is especially good for measuring low voltage or high resistance circuits.

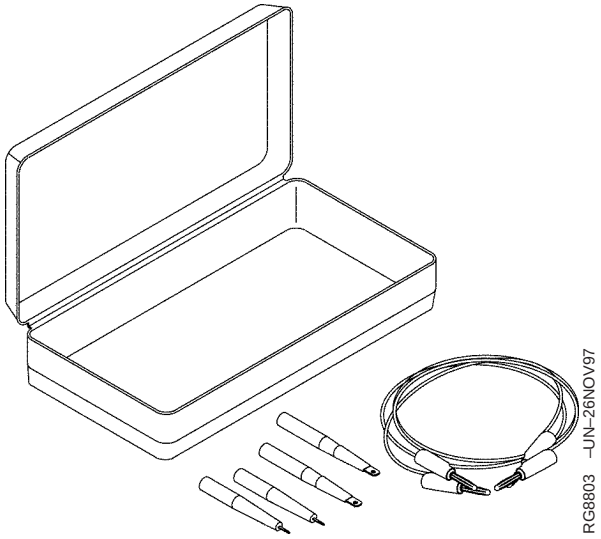
RG11126 –UN–19JUN00

RG,RG34710,1605 –19–30SEP97–8/9

05
180
3

Connector Adapter Test Kit . . . . . .JT07328

Used with JT05791 Digital Multimeter to make voltage and resistance measurements in control system wiring harness connectors. Can also be used to test terminals for proper fit.



RG8803 –UN–26NOV97

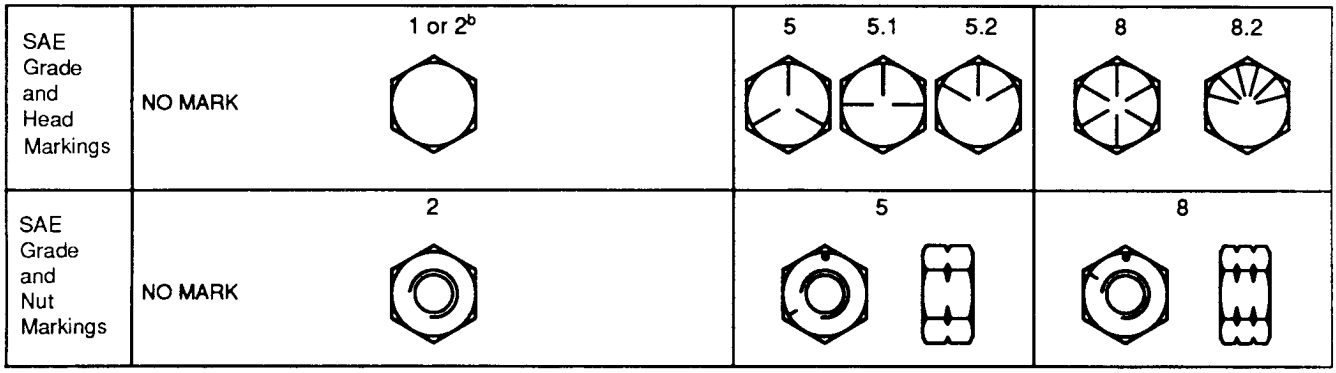
*JT07328*

RG,RG34710,1605 –19–30SEP97–9/9

# Section 06
# Specifications

## Contents

## Unified Inch Bolt and Cap Screw Torque Values




| Size | Grade 1 | | | | Grade 2[b] | | | | Grade 5, 5.1, or 5.2 | | | | Grade 8 or 8.2 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Lubricated[a] | | Dry[a] | | Lubricated[a] | | Dry[a] | | Lubricated[a] | | Dry[a] | | Lubricated[a] | | Dry[a] | |
| | N·m | lb-ft | N·m | lb-ft | N·m | lb-ft | N·m | lb-ft | N·m | lb-ft | N·m | lb-ft | N·m | lb-ft | N·m | lb-ft |
| 1/4 | 3.7 | 2.8 | 4.7 | 3.5 | 6 | 4.5 | 7.5 | 5.5 | 9.5 | 7 | 12 | 9 | 13.5 | 10 | 17 | 12.5 |
| 5/16 | 7.7 | 5.5 | 10 | 7 | 12 | 9 | 15 | 11 | 20 | 15 | 25 | 18 | 28 | 21 | 35 | 26 |
| 3/8 | 14 | 10 | 17 | 13 | 22 | 16 | 27 | 20 | 35 | 26 | 44 | 33 | 50 | 36 | 63 | 46 |
| 7/16 | 22 | 16 | 28 | 20 | 35 | 26 | 44 | 32 | 55 | 41 | 70 | 52 | 80 | 58 | 100 | 75 |
| 1/2 | 33 | 25 | 42 | 31 | 53 | 39 | 67 | 50 | 85 | 63 | 110 | 80 | 120 | 90 | 150 | 115 |
| 9/16 | 48 | 36 | 60 | 45 | 75 | 56 | 95 | 70 | 125 | 90 | 155 | 115 | 175 | 130 | 225 | 160 |
| 5/8 | 67 | 50 | 85 | 62 | 105 | 78 | 135 | 100 | 170 | 125 | 215 | 160 | 240 | 175 | 300 | 225 |
| 3/4 | 120 | 87 | 150 | 110 | 190 | 140 | 240 | 175 | 300 | 225 | 375 | 280 | 425 | 310 | 550 | 400 |
| 7/8 | 190 | 140 | 240 | 175 | 190 | 140 | 240 | 175 | 490 | 360 | 625 | 450 | 700 | 500 | 875 | 650 |
| 1 | 290 | 210 | 360 | 270 | 290 | 210 | 360 | 270 | 725 | 540 | 925 | 675 | 1050 | 750 | 1300 | 975 |
| 1-1/8 | 400 | 300 | 510 | 375 | 400 | 300 | 510 | 375 | 900 | 675 | 1150 | 850 | 1450 | 1075 | 1850 | 1350 |
| 1-1/4 | 570 | 425 | 725 | 530 | 570 | 425 | 725 | 530 | 1300 | 950 | 1650 | 1200 | 2050 | 1500 | 2600 | 1950 |
| 1-3/8 | 750 | 550 | 950 | 700 | 750 | 550 | 950 | 700 | 1700 | 1250 | 2150 | 1550 | 2700 | 2000 | 3400 | 2550 |
| 1-1/2 | 1000 | 725 | 1250 | 925 | 990 | 725 | 1250 | 930 | 2250 | 1650 | 2850 | 2100 | 3600 | 2650 | 4550 | 3350 |

DO NOT use these values if a different torque value or tightening procedure is given for a specific application. Torque values listed are for general use only. Check tightness of fasteners periodically.

Shear bolts are designed to fail under predetermined loads. Always replace shear bolts with identical grade.

Fasteners should be replaced with the same or higher grade. If higher grade fasteners are used, these should only be tightened to the strength of the original.

Make sure fasteners threads are clean and that you properly start thread engagement. This will prevent them from failing when tightening.

Tighten plastic insert or crimped steel-type lock nuts to approximately 50 percent of the dry torque shown in the chart, applied to the nut, not to the bolt head. Tighten toothed or serrated-type lock nuts to the full torque value.

*[a] "Lubricated" means coated with a lubricant such as engine oil, or fasteners with phosphate and oil coatings. "Dry" means plain or zinc plated without any lubrication.*

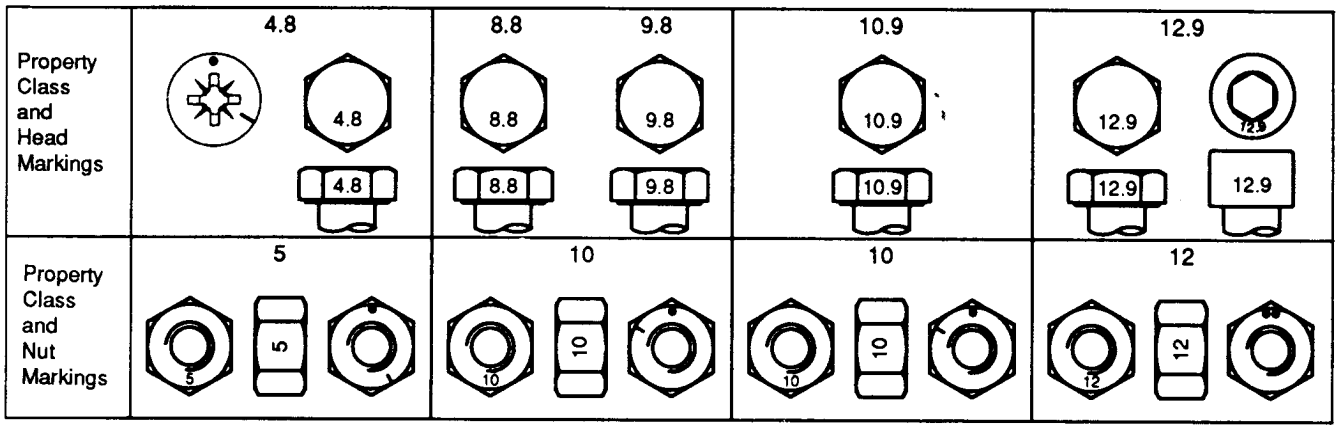
*[b] Grade 2 applies for hex cap screws (not hex bolts) up to 152 mm (6-in.) long. Grade 1 applies for hex cap screws over 152 mm (6-in.) long, and for all other types of bolts and screws of any length.*



TS1656 –19–02APR97

DX,TORQ1 –19–20JUL94–1/1

## Metric Bolt and Cap Screw Torque Values




| Size | Class 4.8 | | | | Class 8.8 or 9.8 | | | | Class 10.9 | | | | Class 12.9 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Lubricated[a] | | Dry[a] | | Lubricated[a] | | Dry[a] | | Lubricated[a] | | Dry[a] | | Lubricated[a] | | Dry[a] | |
| | N·m | lb-ft | N·m | lb-ft | N·m | lb-ft | N·m | lb-ft | N·m | lb-ft | N·m | lb-ft | N·m | lb-ft | N·m | lb-ft |
| M6 | 4.8 | 3.5 | 6 | 4.5 | 9 | 6.5 | 11 | 8.5 | 13 | 9.5 | 17 | 12 | 15 | 11.5 | 19 | 14.5 |
| M8 | 12 | 8.5 | 15 | 11 | 22 | 16 | 28 | 20 | 32 | 24 | 40 | 30 | 37 | 28 | 47 | 35 |
| M10 | 23 | 17 | 29 | 21 | 43 | 32 | 55 | 40 | 63 | 47 | 80 | 60 | 75 | 55 | 95 | 70 |
| M12 | 40 | 29 | 50 | 37 | 75 | 55 | 95 | 70 | 110 | 80 | 140 | 105 | 130 | 95 | 165 | 120 |
| M14 | 63 | 47 | 80 | 60 | 120 | 88 | 150 | 110 | 175 | 130 | 225 | 165 | 205 | 150 | 260 | 190 |
| M16 | 100 | 73 | 125 | 92 | 190 | 140 | 240 | 175 | 275 | 200 | 350 | 255 | 320 | 240 | 400 | 300 |
| M18 | 135 | 100 | 175 | 125 | 260 | 195 | 330 | 250 | 375 | 275 | 475 | 350 | 440 | 325 | 560 | 410 |
| M20 | 190 | 140 | 240 | 180 | 375 | 275 | 475 | 350 | 530 | 400 | 675 | 500 | 625 | 460 | 800 | 580 |
| M22 | 260 | 190 | 330 | 250 | 510 | 375 | 650 | 475 | 725 | 540 | 925 | 675 | 850 | 625 | 1075 | 800 |
| M24 | 330 | 250 | 425 | 310 | 650 | 475 | 825 | 600 | 925 | 675 | 1150 | 850 | 1075 | 800 | 1350 | 1000 |
| M27 | 490 | 360 | 625 | 450 | 950 | 700 | 1200 | 875 | 1350 | 1000 | 1700 | 1250 | 1600 | 1150 | 2000 | 1500 |
| M30 | 675 | 490 | 850 | 625 | 1300 | 950 | 1650 | 1200 | 1850 | 1350 | 2300 | 1700 | 2150 | 1600 | 2700 | 2000 |
| M33 | 900 | 675 | 1150 | 850 | 1750 | 1300 | 2200 | 1650 | 2500 | 1850 | 3150 | 2350 | 2900 | 2150 | 3700 | 2750 |
| M36 | 1150 | 850 | 1450 | 1075 | 2250 | 1650 | 2850 | 2100 | 3200 | 2350 | 4050 | 3000 | 3750 | 2750 | 4750 | 3500 |

DO NOT use these values if a different torque value or tightening procedure is given for a specific application. Torque values listed are for general use only. Check tightness of fasteners periodically.

Shear bolts are designed to fail under predetermined loads. Always replace shear bolts with identical property class.

Fasteners should be replaced with the same or higher property class. If higher property class fasteners are used, these should only be tightened to the strength of the original.

Make sure fasteners threads are clean and that you properly start thread engagement. This will prevent them from failing when tightening.

Tighten plastic insert or crimped steel-type lock nuts to approximately 50 percent of the dry torque shown in the chart, applied to the nut, not to the bolt head. Tighten toothed or serrated-type lock nuts to the full torque value.

[a] *"Lubricated" means coated with a lubricant such as engine oil, or fasteners with phosphate and oil coatings. "Dry" means plain or zinc plated without any lubrication.*

TS1657 –19–02APR97

DX,TORQ2 –19–20JUL94–1/1

## General OEM Engine Specifications - Tier 1

| General OEM Engine Specifications ITEM | ENGINE | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 4045DF150 | 4045TF150 | 4045TF250 | 4045HF150 | 6068DF150 | 6068TF150 | 6068TF250 | 6068HF150 | 6068HF250 |
| Number of Cylinders | 4 | 4 | 4 | 4 | 6 | 6 | 6 | 6 | 6 |
| Bore | 106 mm (4.19 in.) | 106 mm (4.19 in.) | 106 mm (4.19 in.) | 106 mm (4.19 in.) | 106 mm (4.19 in.) | 106 mm (4.19 in.) | 106 mm (4.19 in.) | 106 mm (4.19 in.) | 106 mm (4.19 in.) |
| Stroke | 127 mm (5.0 in.) | 127 mm (5.0 in.) | 127 mm (5.0 in.) | 127 mm (5.0 in.) | 127 mm (5.0 in.) | 127 mm (5.0 in.) | 127 mm (5.0 in.) | 127 mm (5.0 in.) | 127 mm (5.0 in.) |
| Displacement | 4.5 L (276 cu in.) | 4.5 L (276 cu in.) | 4.5 L (276 cu in.) | 4.5 L (276 cu in.) | 6.8 L (414 cu in.) | 6.8 L (414 cu in.) | 6.8 L (414 cu in.) | 6.8 L (414 cu in.) | 6.8 L (414 cu in.) |
| Compression | 17.6:1 | 17.0:1 | 17.0:1 | 17.0:1 | 17.6:1 | 17.0:1 | 17.0:1 | 17.0:1 | 17.0:1 |
| Max. Crank Pressure | 0.5 kPa (2 $H_2O$) | 0.5 kPa (2 $H_2O$) | 0.5 kPa (2 $H_2O$) | 0.5 kPa (2 $H_2O$) | 0.5 kPa (2 $H_2O$) | 0.5 kPa (2 $H_2O$) | 0.5 kPa 2 $H_2O$) | 0.5 kPa (2 $H_2O$) | 0.5 kPa (2 $H_2O$) |
| Governor Regulation (Industrial) | 7—10 % | 7—10 % | 7—10 % | 7—10 % | 7—10 % | 7—10 % | 7—10 % | 7—10 % | 7—10 % |
| Governor Regulation (Generator) | 5 % | 5 % | 5 % | 5 % | 5 % | 5 % | 5 % | 5 % | 5 % |
| Oil Pressure Rated Speed | 345 kPa (50 psi) | 345 kPa (50 psi) | 345 kPa (50 psi) | 345 kPa (50 psi) | 345 kPa (50 psi) | 345 kPa (50 psi) | 345 kPa (50 psi) | 345 kPa (50 psi) | 345 kPa (50 psi) |
| Oil Pressure Low Idle | 105 kPa (15 psi) | 105 kPa (15 psi) | 105 kPa (15 psi) | 105 kPa (15 psi) | 105 kPa (15 psi) | 105 kPa (15 psi) | 105 kPa (15 psi) | 105 kPa (15 psi) | 105 kPa (15 psi) |
| Length | 861.0 mm (33.9 in.) | 861.0 mm (33.9 in.) | 861.0 mm (33.9 in.) | 861.0 mm (33.9 in.) | 1117 mm (44.0 in.) | 1117 mm (44.0 in.) | 1117 mm (44.0 in.) | 1116 mm (43.9 in.) | 1141 mm (44.9 in.) |
| Width | 598 mm (23.5 in.) | 598 mm (23.5 in.) | 598 mm (23.5 in.) | 598 mm (23.5 in.) | 598 mm (23.5 in.) | 598 mm (23.5 in.) | 598 mm (23.5 in.) | 623 mm (24.5 in.) | 623 mm (24.5 in.) |
| Height | 854 mm (33.6 in.) | 980 mm (38.6 in.) | 980 mm (38.6 in.) | 980 mm (38.6 in.) | 956 mm (37.6 in.) | 984 mm (38.7 in.) | 984 mm (38.7 in.) | 1009 mm (39.7 in.) | 1009 mm (39.7 in.) |
| Weight | 387 kg (851 lb) | 396 kg (872 lb) | 396 kg (872 lb) | 396 kg (872 lb) | 522 kg (1149 lb) | 533 kg (1172 lb) | 533 kg (1172 lb) | 550 kg (1210 lb) | 568 kg (1250 lb) |



DPSG,OUO1004,102 –19–28APR98–1/1

## General OEM Engine Specifications - Tier 2

| ITEM | 4045TF275 | 4045HF275 | 4045HF475 | 6068TF275 | 6068HF275 | 6068HF475 |
|---|---|---|---|---|---|---|
| Number of Cylinders | 4 | 4 | 4 | 6 | 6 | 6 |
| Bore | 106 mm (4.19 in.) | 106 mm (4.19 in.) | 106 mm (4.19 in.) | 106 mm (4.19 in.) | 106 mm (4.19 in.) | 106 mm (4.19 in.) |
| Stroke | 127 mm (5.0 in.) | 127 mm (5.0 in.) | 127 mm (5.0 in.) | 127 mm (5.0 in.) | 127 mm (5.0 in.) | 127 mm (5.0 in.) |
| Displacement | 4.5 L (276 cu in.) | 4.5 L (276 cu in.) | 4.5 L (276 cu in.) | 6.8 L (414 cu in.) | 6.8 L (414 cu in.) | 6.8 L (414 cu in.) |
| Compression Ratio | 17.0:1 | 17.0:1 | 17.0:1 | 17.0:1 | 17.0:1 | 17.0:1 |
| Aspiration | Turbocharged | Turbocharged | Turbocharged | Turbocharged | Turbocharged | Turbocharged |
| Engine Firing Order | 1-3-4-2 | 1-3-4-2 | 1-3-4-2 | 1-5-3-6-2-4 | 1-5-3-6-2-4 | 1-5-3-6-2-4 |
| Valves Per Cylinder | 1 Intake 1 Exhaust | 1 Intake 1 Exhaust | 2 Intake 2 Exhaust | 1 Intake 1 Exhaust | 1 Intake 1 Exhaust | 2 Intake 2 Exhaust |
| Valve Clearance (Cold) | | | | | | |
| Intake (Checking) | 0.31-0.38 mm (0.012-0.015 in) | 0.31-0.38 mm (0.012-0.015 in) | 0.31-0.38 mm (0.012-0.015 in) | 0.31-0.38 mm (0.012-0.015 in) | 0.31-0.38 mm (0.012-0.015 in) | 0.31-0.38 mm (0.012-0.015 in) |
| Exhaust (Checking) | 0.41-0.48 mm (0.016-0.019 in) | 0.41-0.48 mm (0.016-0.019 in) | 0.41-0.48 mm (0.016-0.019 in) | 0.41-0.48 mm (0.016-0.019 in) | 0.41-0.48 mm (0.016-0.019 in) | 0.41-0.48 mm (0.016-0.019 in) |
| Intake (Adjusting) | 0.36 mm (0.014 in.) | 0.36 mm (0.014 in.) | 0.36 mm (0.014 in.) | 0.36 mm (0.014 in.) | 0.36 mm (0.014 in.) | 0.36 mm (0.014 in.) |
| Exhaust (Adjusting) | 0.46 mm (0.018 in.) | 0.46 mm (0.018 in.) | 0.46 mm (0.018 in.) | 0.46 mm (0.018 in.) | 0.46 mm (0.018 in.) | 0.46 mm (0.018 in.) |
| Max. Crank Pressure | 0.5 kPa (2 $H_2O$) | 0.5 kPa (2 $H_2O$) | 0.5 kPa (2 $H_2O$) | 0.5 kPa (2 $H_2O$) | 0.5 kPa (2 $H_2O$) | 0.5 kPa (2 $H_2O$) |
| Vibration Damper Maximum Radial Runout | 1.50 mm (0.060 in.) | 1.50 mm (0.060 in.) | 1.50 mm (0.060 in.) | 1.50 mm (0.060 in.) | 1.50 mm (0.060 in.) | 1.50 mm (0.060 in.) |
| Battery Capacities (CCA) | | | | | | |
| 12-Volt System | 640 | 640 | 640 | 800 | 800 | 800 |
| 24-Volt System | 570 | 570 | 570 | 570 | 570 | 570 |
| Governor Regulation (Industrial) | 7—10 % | 7—10 % | 7—10 % | 7—10 % | 7—10 % | 7—10 % |
| Governor Regulation (Generator) | 5 % | 5% | 5% | 5% | 5 % | 5% |
| Thermostat Start To Open Temperature | 82°C (180°F) | 82°C (180°F) | 82°C (180°F) | 82°C (180°F) | 82°C (180°F) | 82°C (180°F) |
| Thermostat Fully Open Temperature | 94°C (202°F) | 94°C (202°F) | 94°C (202°F) | 94°C (202°F) | 94°C (202°F) | 94°C (202°F) |
| Coolant Capacity | 8.5 L (9 qt) | 8.5 L (9 qt) | 8.5 L (9 qt) | 11.3 L (12 qt) | 11.3 L (12 qt) | 11.3 L (12 qt) |
| Recommended Radiator Pressure Cap | 70 kPa (10 psi) | 70 kPa (10 psi) | 70 kPa (10 psi) | 70 kPa (10 psi) | 70 kPa (10 psi)[a] | 100 kPa (15 psi)[b] |

[a]Pressure cap for 6068HF275 with VP44 fuel system for non gen-set applications is 100 kPa (15 psi)

[b]Pressure cap for 6068HF475 for gen-set applications is 70 kPa (10 psi)

06 200 4

Continued on next page

| ITEM | 4045TF275 | 4045HF275 | 4045HF475 | 6068TF275 | 6068HF275 | 6068HF475 |
|---|---|---|---|---|---|---|
| Oil Pressure At Rated Speed, Full Load (± 15 psi) | 345 kPa (50 psi) | 345 kPa (50 psi) | 345 kPa (50 psi) | 345 kPa (50 psi) | 345 kPa (50 psi) | 345 kPa (50 psi) |
| Oil Pressure At Low Idle (Minimum) | 105 kPa (15 psi) | 105 kPa (15 psi) | 105 kPa (15 psi) | 105 kPa (15 psi) | 105 kPa (15 psi) | 105 kPa (15 psi) |
| Length | 860 mm (33.9 in.) | 860 mm (33.9 in.) | 860 mm (33.9 in.) | 1116 mm (43.9 in.) | 1123 mm (44.2 in.) | 1123 mm (44.2 in.) |
| Width | 612 mm (24.1 in.) | 612 mm (24.1 in.) | 612 mm (24.1 in.) | 623 mm (24.5 in.) | 623 mm (24.5 in.) | 608 mm (23.9 in.) |
| Height | 994 mm (39.1 in.) | 994 mm (39.1 in.) | 994 mm (39.1 in.) | 1012 mm (39.9 in.) | 1015 mm (40.0 in.) | 1044 mm (41.1 in.) |
| Weight | 451 kg (993 lb) | 451 kg (993 lb) | 451 kg (993 lb) | 587 kg (1290 lb) | 587 kg (1290 lb) | 587 kg (1290 lb) |

RG,RG34710,5614 –19–26APR02–2/2

## Electronic Fuel System Repair and Adjustment Specifications

| Item | Measurement | Specification |
|---|---|---|
| Primary Fuel Filter Mounting Bracket-to-Cylinder Head Cap Screws | Torque | 74 N•m (54.5 lb-ft) |
| Primary Fuel Filter Base-to Bracket Cap Screws | Torque | 60 N•m (44 lb-ft) |
| Primary and Final Fuel Filter Fittings and Plugs | Torque | 9 N•m (6.5 lb-ft) |
| Primary Fuel Filter Inlet Line | Torque | 30 N•m (22 lb-ft) |
| Primary Fuel Filter Outlet Line | Torque | 30 N•m (22 lb-ft) |
| Final Fuel Filter Mounting Bracket-to-Exhaust Manifold | Torque | 70 N•m (53 lb-ft) |
| Final Fuel Filter Base-to-Bracket Cap Screws | Torque | 70 N•m (53 lb-ft) |
| Final Fuel Filter Inlet Line | Torque | 30 N•m (22 lb-ft) |
| Final Fuel Filter Outlet Line | Torque | 30 N•m (22 lb-ft) |
| Fuel Injection Pump Overflow Valve (VP44) | Torque | 25 N•m (18 lb-ft) |
| Bosch VP44 Injection Pump Drive Gear Cap Screws | Torque | 50 N•m (37 lb-ft) |
| Bosch VP44 Injection Pump Mounting Nuts | Torque | 50 N•m (35 lb-ft) |
| Bosch VP44 Injection Pump Delivery Lines | Torque | 27 N•m (20 lb-ft) |
| Bosch VP44 Injection Pump Supply Line | Torque | 27 N•m (20 lb-ft) |
| Bosch VP44 Injection Pump Return Line | Torque | 27 N•m (20 lb-ft) |
| Bosch VP44 Injection Pump Drive Gear-to-Pump Hub Screws | Torque | 48 N•m (35 lb-ft) |



Continued on next page

| Item | Measurement | Specification |
|---|---|---|
| Bosch VP44 Injection Pump Drive Gear Cover | Torque | 6 N•m (4.4 lb-ft) |
| Fuel Injection Nozzles (RE48786) | | |
| New or Reconditioned Nozzle with New Internal Parts | Opening Pressure for Setting | 25,511—26,062 kPa (255—260 bar) (3700—3780 psi) |
| | Opening Pressure for Checking (Minimum) | 24,683 kPa (246 bar) (3580 psi) |
| Used Nozzle | Opening Pressure for Checking (Minimum) | 23,511 kPa (235 bar) (3410 psi) |
| Opening Pressure Difference between Cylinders | Pressure Difference (Maximum) | 700 kPa (7 bar) (100 psi) |
| Fuel Injection Nozzle Tip | Spray Angle | 144° |
| Nozzle Valve/Seat Tightness Condition at Pressure Test of 2800—3500 kPa (28—35 bar) (400—500 psi) | Leakage | Nozzle tip dry after 5 seconds. (Slight dampness permissible on used nozzles.) |
| Fuel Injection Nozzle Return Leakage at Pressure Test of 10,300 kPa (103 bar) (1500 psi) | Leakage | 3—10 Drops/30 Seconds |
| Fuel Injection Nozzle Tip Orifice | Number of Orifices per Nozzle | 4 |
| Fuel Injection Nozzle Tip Orifice | ID | 0.29 mm (0.0116 in.) |
| Injection Nozzle Pressure Adjusting Screw Lock Nut | Torque | 10 N•m (7 lb-ft) |
| Fuel Injection Nozzle Valve Needle Lift | Needle Lift (Based on Zero Lift) | 3/4 Turn Counterclockwise |
| Fuel Injection Nozzle Lift Adjusting Screw Lock Nut | Torque | 5 N•m (3.5 lb-ft) (42 lb-in.) |



Continued on next page

| Item | Measurement | Specification |
|---|---|---|
| Fuel Injection Nozzle Hold-Down Clamp Cap Screws | Torque | 40 N•m (30 lb-ft) |
| Fuel Leak-Off Hex Nut | Torque | 5 N•m (3.7 lb-ft) (44 lb-in.) |

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## Electrical Engine Control Repair and Adjustment Specifications

| Item | Measurement | Specification |
|---|---|---|
| Coolant Temperature Sensor (In Thermostat Cover) | Torque | 15 N•m (11 lb-ft) |
| Coolant Temperature Sensor (In Cylinder Head) | Torque | 35 N•m (26 lb-ft) |
| Fuel Pressure Sensor (VP44 Pump) | Torque | 8 N•m (6 lb-ft) |
| Pump Position Sensor (VP44 Pump) | Torque | 14 N•m (10 lb-ft) |
| Oil Pressure Sensor | Torque | 15 N•m (11 lb-ft) |
| Crankshaft Position Sensor | Torque | 14 N•m (10 lb-ft) |

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## Fuel System Diagnostic Specifications

| Item | Measurement | Specification |
|---|---|---|
| Fuel Transfer Pump Pressure — Closed Loop Systems (Fuel Pressure Sensor on Final Fuel Filter) | Priming | -51—350 kPa (-0.5—3.5 bar) (-7.4—51.0 psi) |
| Fuel Transfer Pump Pressure — Closed Loop Systems (Fuel Pressure Sensor on Final Fuel Filter) | Cranking | -171—230 kPa (-1.7—2.3 bar) (-25—33.0 psi) |
| Fuel Transfer Pump Pressure — Closed Loop Systems (Fuel Pressure Sensor on Final Fuel Filter) | Running | 70—110 kPa (0.7—1.1 bar) (10.0—15.5 psi) |
| Fuel Transfer Pump Pressure — Open Loop Systems (No Fuel Pressure Sensor) | Priming | Above 0 kPa (Above 0 bar) (Above 0 psi) |
| Fuel Transfer Pump Pressure — Open Loop Systems (No Fuel Pressure Sensor) | Cranking | Above 0 kPa (Above 0 bar) (Above 0 psi) |
| Fuel Transfer Pump Pressure — Open Loop Systems (No Fuel Pressure Sensor) | Running | Above 0 kPa (Above 0 bar) (Above 0 psi) |



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## Application Specifications

Below is an overview of the specifications listed for applications in the next few pages.

- **Combines**
  - SENSOR SPECIFICATIONS
  - TORQUE CURVE SELECTION
  - GOVERNOR MODE SELECTION
  - ECU TERMINAL IDENTIFICATION
  - VEHICLE WIRING - See Vehicle manual.
- **Excavators**
  - SENSOR SPECIFICATIONS
  - TORQUE CURVE SELECTION
  - GOVERNOR MODE SELECTION
  - ECU TERMINAL IDENTIFICATION
  - VEHICLE WIRING - See Vehicle manual.
- **Marine**
  - SENSOR SPECIFICATIONS
  - TORQUE CURVE SELECTION
  - GOVERNOR MODE SELECTION
  - ECU TERMINAL IDENTIFICATION
  - ELECTRONIC CONTROL SYSTEM WIRING DIAGRAM
  - WHEEL HOUSE PANEL ELECTRICAL WIRING DIAGRAM
  - FLY BRIDGE PANEL ELECTRICAL WIRING DIAGRAM
  - VEHICLE WIRING - See Vehicle manual.
- **OEM Engines**
  - SENSOR SPECIFICATIONS
  - TORQUE CURVE SELECTION
  - GOVERNOR MODE SELECTION WITH OC03041 SOFTWARE OR LATER
  - GOVERNOR MODE SELECTION WITH OC03034 SOFTWARE OR EARLIER
  - ECU TERMINAL IDENTIFICATION
  - ELECTRONIC CONTROL SYSTEM WIRING DIAGRAM
  - INSTRUMENT PANEL/ENGINE START COMPONENTS ELECTRICAL WIRING DIAGRAM
- **Telehandler**
  - SENSOR SPECIFICATIONS
  - TORQUE CURVE SELECTION
  - GOVERNOR MODE SELECTION
  - ECU TERMINAL IDENTIFICATION
  - VEHICLE WIRING - See Vehicle manual.
- **Tractors - 6010 Series**
  - SENSOR SPECIFICATIONS
  - TORQUE CURVE SELECTION
  - GOVERNOR MODE SELECTION
  - ECU TERMINAL IDENTIFICATION
  - VEHICLE WIRING - See Vehicle manual.
- **Tractors - 6020 Series**
  - SENSOR SPECIFICATIONS
  - TORQUE CURVE SELECTION
  - GOVERNOR MODE SELECTION
  - ECU TERMINAL IDENTIFICATION
  - VEHICLE WIRING - See Vehicle manual.
- **Tractors - 7020 Series**
  - SENSOR SPECIFICATIONS
  - TORQUE CURVE SELECTION
  - ECU TERMINAL IDENTIFICATION
  - VEHICLE WIRING - See Vehicle manual.



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## Combines - Sensor Specifications

The specifications shown below are voltage, pressure, and temperature parameters that the Engine Control Unit (ECU) uses to determine whether a Diagnostic Trouble Code (DTC) is set for a given sensor.

**Continued on next page**

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| Sensor Specifications for Combines | | | | |
|---|---|---|---|---|
| **Sensor** | **SPN-FMI** | **Measured Sensor Parameter** | **Out of Range Value** | **Derate** |
| Engine Coolant Temperature (ECT) | 000110.00 | Most Severe Temperature | Exceeds 115°C (239°F) | ECU derates engine 40% per minute until engine runs at 60% of full power. |
| | 000110.03 | High Input Voltage | Above 4.9 Volts | High ECT engine protection is disabled. |
| | 000110.04 | Low Input Voltage | Below 0.3 Volts | High ECT engine protection is disabled. |
| | 000110.16 | Moderately High Temperature | Exceeds 100°C (212°F) | ECU derates engine 2% per minute until engine runs at 95% of full power. |
| Engine Coolant Level | 000111.01 | Coolant Level Low | Coolant level is low or switch is faulty. | ECU derates engine 40% per minute until engine runs at 60% of full power. |
| Fuel Pressure | 000094.01 | Extremely Low Pressure | 90 kPa (13 psi) (0.9 bar) Absolute | ECU derates engine 200 rpm per minute until engine runs at 1300 rpm. |
| | 000094.03 | High Input Voltage | Above 4.0 Volts | NA[a] |
| | 000094.04 | Low Input Voltage | Below 0.1Volts | NA[a] |
| | 000094.18 | Moderately Low Pressure | 100 kPa (14.5 psi) (1.0 bar) Absolute | NA[a] |
| Fuel Temperature | 000174.00 | Extremely High Temperature | Exceeds 75°C (167°F) | ECU derates engine 10% per minute until engine runs at 50% of full power. |
| | 000174.15 | High Least Severe Temperature | Exceeds 65°C (149°F) | NA[a] |
| | 000174.16 | Moderately High Temperature | Exceeds 73°C (163°F) | ECU derates engine 75% per minute until engine runs at 25% of full power. |
| | 000174.31 | Fuel Temperature Sensor Faulty | Voltage out of Range | ECU derates engine 10% per minute until engine runs at 50% of full power. |
| Manifold Air Temperature (MAT) | 000105.00 | Extremely High Temperature | Exceeds 100°C (212°F) | ECU derates engine 20% per minute until engine runs at 60% of full power. |
| | 000105.03 | High Input Voltage | Above 4.9 Volts | High MAT engine protection is disabled. |
| | 000105.04 | Low Input Voltage | Below 0.3 Volts | High MAT engine protection is disabled. |
| | 000105.16 | Moderately High Temperature | Exceeds 88°C (190°F) | ECU derates engine 2% per minute until engine runs at 80% of full power. |
| Oil Pressure Switch (9450 Series ONLY) | 000100.01 | Loss of Oil Pressure | Oil pressure drops below the threshold for running condition. | NA[a] |
| [a]Not Applicable | | | | |



Continued on next page

| Sensor Specifications for Combines | | | | |
|---|---|---|---|---|
| | 000100.04 | Low Input Voltage | Switch is closed when key ON, engine OFF. | NA[a] |
| VP44 Fuel Injection Pump | 001076.02 | Pump Detected Defect | Internal pump defect | ECU derates engine 10% per minute until engine runs at 50% of full power. |
| | 001077.12 | Pump Self-Test Error | Internal pump defect | ECU derates engine 10% per minute until engine runs at 50% of full power. |
| | 001077.31 | Pump Requested Derate | Derate for any pump problem. | ECU derates engine 10% per minute until engine runs at 50% of full power. |
| | 001078.07 | ECU/Pump Out of Time - Moderately | Internal pump timing out of sync with engine. | ECU derates engine 10% per minute until engine runs at 50% of full power. |
| | 001078.31 | ECU/Pump Out of Time - Extremely | Internal pump timing out of sync with engine. | ECU derates engine 10% per minute until engine runs at 50% of full power. |

[a]Not Applicable

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## Combines - Torque Curve Selection

| Torque Curve Selection for Level 4 Combines | |
|---|---|
| **Torque Curve # on DST or SERVICE ADVISOR™** | **Conditions** |
| 1 | Normal Operation |
| 2 | Chopper OFF Derate (1550 Series ONLY) |
| 16 | Transition Curve |
| 17 | Cold Temperature Starting |

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## Combines -

| Desired Speed for Level 4 Combines | |
|---|---|
| **Governor Mode** | **Conditions** |
| 0 | Normal condition with Isochronous governor |

| Max. Speed for Level 4 Combines | |
|---|---|
| **Governor Mode** | **Conditions** |
| 9 | High speed governor - drooped |
| 10 | Isochronous high speed governor in 3rd gear |

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## Combines - ECU Terminal Identification

| ECU Terminal Function | ECU Terminal # | Sensor Connector Terminal # |
|---|---|---|
| Air Filter Restriction Input | 32 | B |
| Air Heater Relay Enable | 63 | 86 |
| Air Heater Relay Return | 37 | 87 |
| Battery Power | 23 | Battery (+) |
| Battery Power | 68 | Battery (+) |
| CAN High | 44 | NA[a] |
| CAN Low | 21 | NA[a] |
| Crank Sensor Input | 9 | A |
| Crank Sensor Return | 34 | B |
| Engine Coolant Temperature Input | 6 | A |
| Fuel Pressure Sensor 5V Supply | 3 | C |
| Fuel Pressure Sensor Input | 26 | B |
| Fuel Pressure Sensor Return | 24 | A |
| Fuel Transfer Pump Power | 22 | A |
| Fuel Transfer Pump Power | 67 | A |
| Manifold Air Temperature Input | 50 | A |
| Oil Pressure Input | 33 | B |
| Pump CAN High | 58 | 1 |
| Pump CAN Low | 59 | 2 |
| Pump CAN Shield | 60 | NA[a] |
| Pump Crank Speed Out | 17 | 5 |
| Pump Fuel Shutoff | 18 | 8 |
| Pump Limp Home | 2 | 4 |
| Pump Position Input | 10 | A |
| Pump Position Sensor Return | 36 | B |
| Pump Power | 35 | 7 |
| Pump Relay Enable | 62 | 86 |
| Sensor Return 1 | 24 | Changes with each sensor |
| Sensor Return 2 | 46 | Changes with each sensor |
| Sensor 5V Supply 1 | 3 | Changes with each sensor |
| Switched Power | 19 | NA[a] |
| System Ground | 1 | Battery (-) |
| 3rd Gear Input | 30 | B |
| [a]Not Applicable | | |



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## Excavators - Sensor Specifications

The specifications shown below are voltage, pressure, and temperature parameters that the Engine Control Unit (ECU) uses to determine whether a Diagnostic Trouble Code (DTC) is set for a given sensor.

**Continued on next page**

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| Sensor Specifications for Excavators | | | | |
|---|---|---|---|---|
| **Sensor** | **SPN-FMI** | **Measured Sensor Parameter** | **Out of Range Value** | **Derate** |
| Engine Coolant Temperature (ECT) | 000110.00 | Most Severe Temperature | Exceeds 115°C (239°F) | ECU derates engine 20% per minute until engine runs at 75% of full power. |
| | 000110.03 | High Input Voltage | Above 4.9 Volts | High ECT engine protection is disabled. |
| | 000110.04 | Low Input Voltage | Below 0.1 Volts | High ECT engine protection is disabled. |
| | 000110.15 | High Least Severe Temperature | Exceeds 110°C (230°F) | ECU derates engine 2% per minute until engine runs at 95% of full power. |
| | 000110.16 | Moderately High Temperature | Exceeds 113°C (235°F) | ECU derates engine 4% per minute until engine runs at 90% of full power. |
| Fuel Pressure | 000094.01 | Extremely Low Pressure | 90 kPa (13 psi) (0.9 bar) Absolute | ECU derates engine 200 rpm per minute until engine runs at 1200 rpm. |
| | 000094.03 | High Input Voltage | Above 4.0 Volts | NA[a] |
| | 000094.04 | Low Input Voltage | Below 0.1Volts | NA[a] |
| | 000094.18 | Moderately Low Pressure | 100 kPa (14.5 psi) (1.0 bar) Absolute | NA[a] |
| Fuel Temperature | 000174.00 | Extremely High Temperature | Exceeds 75°C (167°F) | ECU derates engine 20% per minute until engine runs at 50% of full power. |
| | 000174.16 | Moderately High Temperature | Exceeds 73°C (163°F) | ECU derates engine 75% per minute until engine runs at 25% of full power. |
| Manifold Air Temperature (MAT) | 000105.03 | High Input Voltage | Above 4.9 Volts | High MAT engine protection is disabled. |
| | 000105.04 | Low Input Voltage | Below 0.1Volts | High MAT engine protection is disabled. |
| | 000105.16 | Moderately High Temperature | Exceeds 88°C (190°F) | ECU derates engine 2% per minute until engine runs at 80% of full power. |
| VP44 Fuel Injection Pump | 001076.02 | Pump Detected Defect | Internal pump defect | ECU derates engine 20% per minute until engine runs at 50% of full power. |
| | 001077.12 | Pump Self-Test Error | Internal pump defect | ECU derates engine 20% per minute until engine runs at 50% of full power. |
| | 001077.31 | Pump Requested Derate | Derate for any pump problem. | ECU derates engine 20% per minute until engine runs at 50% of full power. |
| [a]Not Applicable | | | | |



Continued on next page

| Sensor Specifications for Excavators | | | | |
|---|---|---|---|---|
| | 001078.07 | ECU/Pump Out of Time - Moderately | Internal pump timing out of sync with engine. | ECU derates engine 20% per minute until engine runs at 50% of full power. |
| | 001078.31 | ECU/Pump Out of Time - Extremely | Internal pump timing out of sync with engine. | ECU derates engine 20% per minute until engine runs at 50% of full power. |

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## Excavators - Torque Curve Selection

| Torque Curve Selection for Excavators | |
|---|---|
| **Torque Curve # on DST or SERVICE ADVISOR™** | **Conditions** |
| 1 | Normal (Nominal) |
| 2 | Altitude Derate |
| 16 | Transition Curve |
| 17 | Cold Temperature Starting |

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## Excavators -

| Desired Speed for Excavators | |
|---|---|
| **Governor Mode** | **Conditions** |
| 0 | Normal condition with Isochronous governor |

| Max. Speed for Excavators | |
|---|---|
| **Governor Mode** | **Conditions** |
| 9 | High speed governor - Drooped |

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## Excavators - ECU Terminal Identification

| ECU Terminal Function | ECU Terminal # | Sensor Connector Terminal # |
|---|---|---|
| Battery Power | 23 | Battery (+) |
| Battery Power | 68 | Battery (+) |
| CAN High | 44 | NA[a] |
| CAN Low | 21 | NA[a] |
| Check Engine Light | 47 | NA[a] |
| Crank Sensor Input | 9 | A |
| Crank Sensor Return | 34 | B |
| Engine Coolant Temperature Input | 6 | A |
| Fuel Pressure Sensor 5V Supply | 3 | C |
| Fuel Pressure Sensor Input | 26 | B |
| Fuel Pressure Sensor Return | 24 | A |
| Fuel Transfer Pump Power | 22 | A |
| Fuel Transfer Pump Power | 67 | A |
| Manifold Air Temperature Input | 50 | A |
| Pump CAN High | 58 | 2 |
| Pump CAN Low | 59 | 1 |
| Pump CAN Shield | 60 | NA[a] |
| Pump Crank Speed Out | 17 | 8 |
| Pump Fuel Shutoff | 18 | 5 |
| Pump Limp Home | 2 | 4 |
| Pump Position Input | 10 | A |
| Pump Position Sensor Return | 36 | B |
| Pump Power | 35 | 7 |
| Pump Relay Enable | 62 | 86 |
| Sensor Return 1 | 24 | Changes with each sensor |
| Sensor Return 2 | 46 | Changes with each sensor |
| Sensor 5V Supply 1 | 3 | Changes with each sensor |
| Switched Power | 19 | NA[a] |
| System Ground | 1 | Battery (-) |
| Throttle Command | 27 | NA[a] |
| Throttle Ground | 49 | NA[a] |
| Throttle Reference | 51 | NA[a] |

[a]Not Applicable

## Marine - Sensor Specifications

The specifications shown below are voltage, pressure, and temperature parameters that the Engine Control Unit (ECU) uses to determine whether a Diagnostic Trouble Code (DTC) is set for a given sensor.

**Continued on next page**

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| Sensor Specifications for Marine | | | | |
|---|---|---|---|---|
| **Sensor** | **SPN-FMI** | **Measured Sensor Parameter** | **Out of Range Value** | **Derate** |
| Analog Throttle (A) | 000091.03 | High Input Voltage | Above 4.7 volts | If no other throttle is available, engine will run at idle speed. |
| | 000091.04 | Low Input Voltage | Below 0.3 volts | If no other throttle is available, engine will run at idle speed. |
| Analog Throttle (B) | 000029.03 | High Input Voltage | Above 4.7 volts | If no other throttle is available, engine will run at idle speed. |
| | 000029.04 | Low Input Voltage | Below 0.3 volts | If no other throttle is available, engine will run at idle speed. |
| Engine Coolant Temperature (ECT) | 000110.00 | Most Severe Temperature | Exceeds 113°C (235°F) | ECU derates engine 60% per minute until engine runs at 40% of full power. |
| | 000110.03 | High Input Voltage | Above 4.9 Volts | High ECT engine protection is disabled. |
| | 000110.04 | Low Input Voltage | Below 0.3 Volts | High ECT engine protection is disabled. |
| | 000110.15 | High Least Severe Temperature | Exceeds 100°C (212°F) | ECU derates engine 2% per minute until engine runs at 95% of full power. |
| | 000110.16 | Moderately High Temperature | Exceeds 105°C (221°F) | ECU derates engine 40% per minute until engine runs at 60% of full power. |
| Engine Coolant Level | 000111.01 | Coolant Level Low | Coolant level is low or switch is faulty. | ECU derates engine 40% per minute until engine runs at 60% of full power. |
| Fuel Pressure | 000094.01 | Extremely Low Pressure | 90 kPa (13 psi) (0.9 bar) Absolute | ECU derates engine 150 rpm per minute until engine runs at 1200 rpm. |
| | 000094.03 | High Input Voltage | Above 4.0 Volts | NA[a] |
| | 000094.04 | Low Input Voltage | Below 0.1Volts | NA[a] |
| | 000094.18 | Moderately Low Pressure | 100 kPa (14.5 psi) (1.09 bar) Absolute | NA[a] |
| Fuel Temperature | 000174.00 | Extremely High Temperature | Exceeds 75°C (167°F) | ECU derates engine 20% per minute until engine runs at 50% of full power. |
| | 000174.15 | High Least Severe Temperature | Exceeds 65°C (149°F) | NA[a] |
| | 000174.16 | Moderately High Temperature | Exceeds 73°C (163°F) | ECU derates engine 75% per minute until engine runs at 25% of full power. |

[a]Not Applicable

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| Sensor Specifications for Marine | | | | |
|---|---|---|---|---|
| Manifold Air Temperature (MAT) | 000105.00 | Extremely High Temperature | Exceeds 62°C (144°F) | ECU derates engine 20% per minute until engine runs at 60% of full power. |
| | 000105.03 | High Input Voltage | Above 4.9 Volts | High MAT engine protection is disabled. |
| | 000105.04 | Low Input Voltage | Below 0.3 Volts | High MAT engine protection is disabled. |
| | 000105.16 | Moderately High Temperature | Exceeds 57°C (135°F) | NA[a] |
| Oil Pressure | 000100.01 | Extremely Low Pressure | Oil pressure drops below the threshold for running condition | ECU derates engine 60% per minute until engine runs at 40% of full power. |
| | 000100.03 | High Input Voltage | Above 4.9 Volts | High MAT engine protection is disabled. |
| | 000100.04 | Low Input Voltage | Below 0.3 Volts | High MAT engine protection is disabled. |
| | 000100.18 | Moderately Low Pressure | Oil pressure drops below the threshold for running condition | ECU derates engine 2% per minute until engine runs at 80% of full power. |
| Water in Fuel | 000097.00 | Water in Fuel Continuously Detected | Water detected for longer than 3 minutes. | ECU derates engine 2% per minute until engine runs at 80% of full power. |
| | 000097.16 | Water in Fuel Detected | Water detected for longer than 20 seconds. | NA[a] |
| VP44 Fuel Injection Pump | 001076.02 | Pump Detected Defect | Internal pump defect | ECU derates engine 20% per minute until engine runs at 50% of full power. |
| | 001077.12 | Pump Self-Test Error | Internal pump defect | ECU derates engine 20% per minute until engine runs at 50% of full power. |
| | 001077.31 | Pump Requested Derate | Derate for any pump problem. | ECU derates engine 20% per minute until engine runs at 50% of full power. |
| | 001078.07 | ECU/Pump Out of Time - Moderately | Internal pump timing out of sync with engine. | ECU derates engine 20% per minute until engine runs at 50% of full power. |
| | 001078.31 | ECU/Pump Out of Time - Extremely | Internal pump timing out of sync with engine. | ECU derates engine 20% per minute until engine runs at 50% of full power. |

[a]Not Applicable



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## Marine - Torque Curve Selection

| Torque Curve Selection for Marine | |
|---|---|
| **Torque Curve # on DST or SERVICE ADVISOR™** | **Conditions** |
| 1 | Default |

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## Marine -

| Desired Speed for Marine | |
|---|---|
| **Governor Mode** | **Conditions** |
| 0 | Desired/All speed governor - Droop |
| 7 | Low speed Governor - Droop |
| 8 | Low speed Governor - Isochronous |

| Max. Speed for Marine | |
|---|---|
| **Governor Mode** | **Conditions** |
| 10 | High speed governor - Isochronous |

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## Marine - ECU Terminal Identification

| ECU Terminal Function | ECU Terminal # | Sensor Connector Terminal # |
|---|---|---|
| Air Heater Diagnostic Input | 29 | 30 |
| Air Heater Relay Enable | 63 | 86 |
| Analog Throttle (A) Input | 31 | B |
| Analog Throttle (B) Input | 28 | B |
| Analog Throttle (A) 5V Supply | 53 | C |
| Analog Throttle (B) 5V Supply | 3 | C |
| Analog Throttle (A) Sensor Ground | 24 | A |
| Analog Throttle (B) Sensor Ground | 46 | A |
| Battery Power | 23 | Battery (+) |
| Battery Power | 68 | Battery (+) |
| Bump Down | 39 | D |
| Bump Enable | 37 | B |
| Bump Up | 38 | C |
| CAN High | 44 | NA[a] |
| CAN Low | 21 | NA[a] |
| CAN Shield | 42 | NA[a] |
| Crank Sensor Input | 9 | A |
| Crank Sensor Return | 34 | B |
| Engine Coolant Temperature Input | 6 | A |
| External Shutdown Signal | 12 | A |
| Fuel Pressure Sensor 5V Supply | 3 | B |
| Fuel Pressure Sensor Input | 26 | C |
| Fuel Pressure Sensor Return | 46 | A |
| Fuel Transfer Pump Power | 22 | A |
| Fuel Transfer Pump Power | 67 | A |
| Isochronous Governor | 5 | B |
| Loss of Coolant Switch Input | 30 | A |
| Loss of Coolant Switch Return | 46 | B |
| Low Idle Droop | 27 | C |
| Manifold Air Temperature Input | 50 | A |
| Oil Pressure Input | 4 | C |
| Oil Pressure 5V Supply | 3 | B |
| Oil Pressure Sensor Ground | 46 | A |
| Pump CAN High | 58 | 2 |
| Pump CAN Low | 59 | 1 |
| Pump CAN Shield | 60 | NA[a] |
| Pump Crank Speed Out | 17 | 8 |

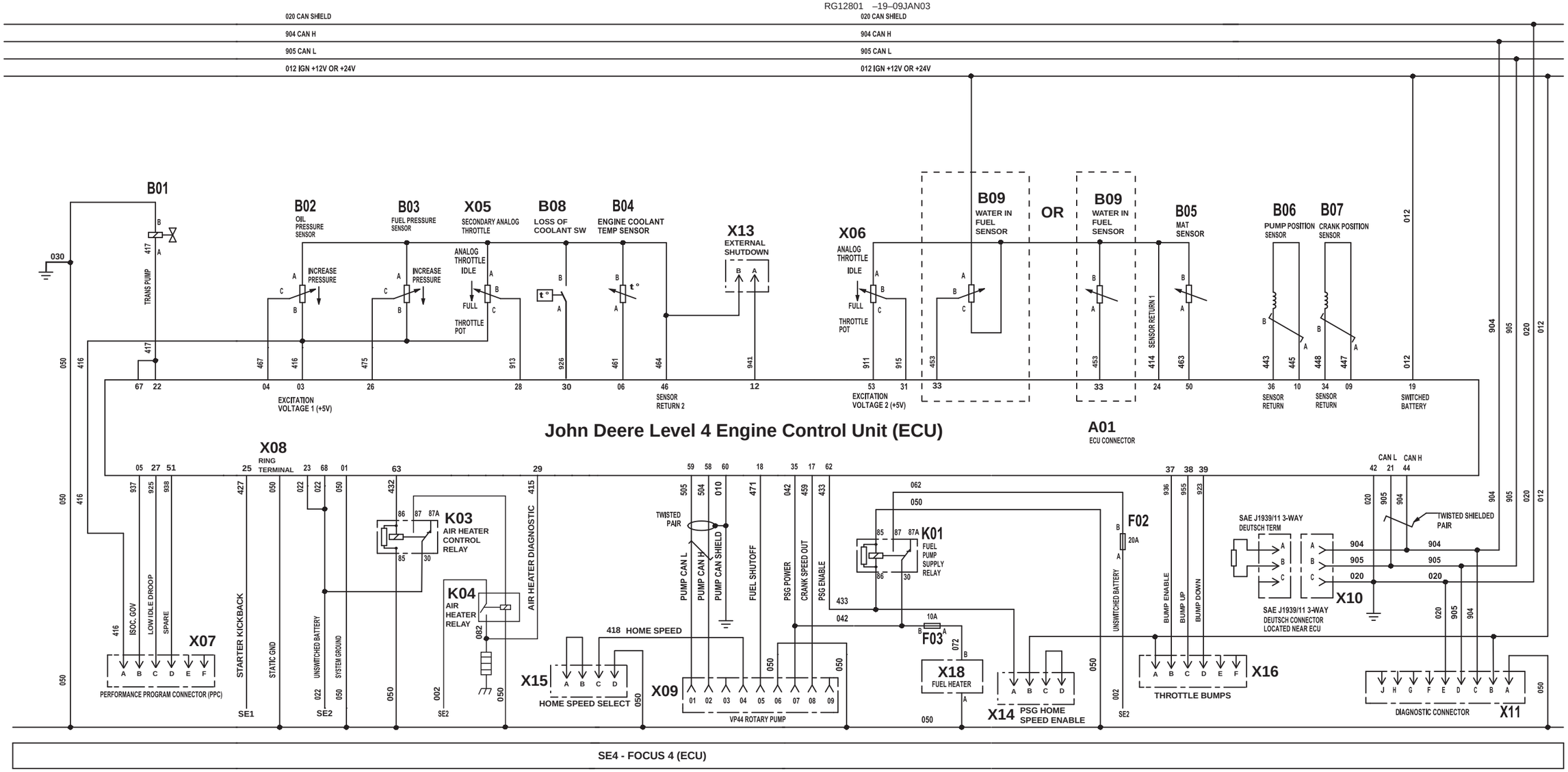
[a]Not Applicable

Continued on next page

| | | |
|---|---|---|
| Pump Fuel Shutoff | 18 | 5 |
| Pump Position Input | 10 | A |
| Pump Position Sensor Return | 36 | B |
| Pump Power | 35 | 7 |
| Pump Relay Enable | 62 | 86 |
| Sensor Return 1 | 24 | Changes with each sensor |
| Sensor Return 2 | 46 | Changes with each sensor |
| Sensor 5V Supply 1 | 3 | Changes with each sensor |
| Starter Kickback | 25 | NA[a] |
| Switched Power | 19 | NA[a] |
| System Ground | 1 | Battery (-) |
| Water in Fuel +12V Supply | 19 | A |
| Water in Fuel Input | 33 | B |
| Water in Fuel Return | 24 | C |
| [a]Not Applicable | | |

## 6.8 L Marine Application Electronic Control System Wiring Diagram

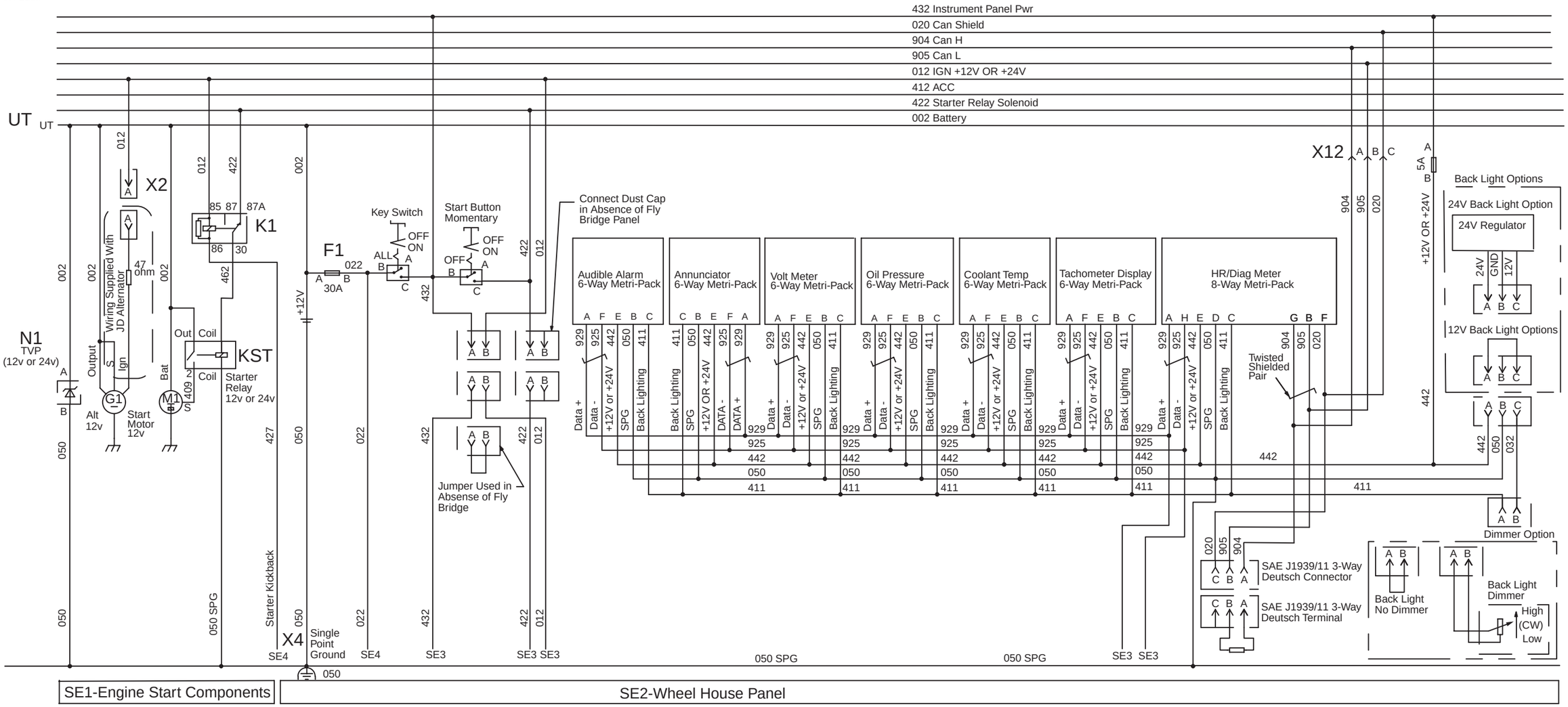
RG12801 –19–09JAN03




**A01—ECU Connector**
**B01—Transfer Pump**
**B02—Oil Pressure Sensor**
**B03—Fuel Pressure Sensor**
**B04—ECT Sensor**
**B05—MAT Sensor**
**B06—Pump Position Sensor**
**B07—Crankshaft Position Sensor**
**B08—Loss of Coolant Switch**
**B09—Water in Fuel Sensor**
**F02—Fuse (20A)**
**F03—Fuse (10A)**
**K01—Fuel Pump Supply Relay**
**K03—Air Heater Control Relay**
**K04—Air Heater Relay**
**X05—Secondary Analog Throttle**
**X06—Analog Throttle**
**X07—Performance Program Connector**
**X08—ECU Ground Ring Terminal**
**X09—Rotary Pump**
**X10—CAN Terminator**
**X11—Diagnostic Connector**
**X12—Rotary Pump**
**X13—External Shutdown**
**X14—PSG Home Speed Enable**
**X15—Home Speed Select**
**X16—Throttle Bumps**
**X18—Fuel Heater**

## 6.8 L Marine Application Wheel House Panel Electrical Wiring Diagram

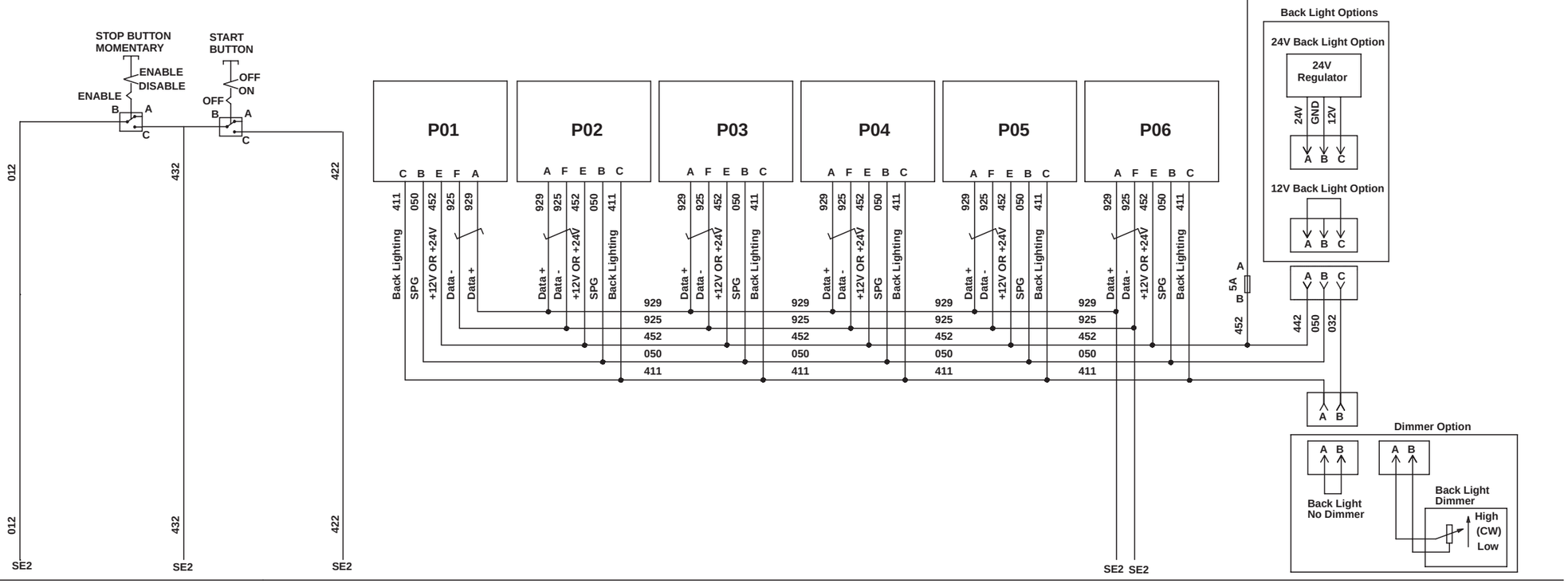
RG12802 –19–07FEB03



# 6.8 L Marine Application Fly Bridge Panel Electrical Wiring Diagram

RG12803 –19–07JAN03

| 432 MURPHY PANEL POWER | 432 MURPHY PANEL POWER | 432 MURPHY PANEL POWER |
|---|---|---|
| 020 CAN Shield | 020 CAN Shield | 020 CAN Shield |
| 904 CAN H | 904 CAN H | 904 CAN H |
| 905 CAN L | 905 CAN L | 905 CAN L |
| 012 IGN +12V OR +24V | 012 IGN +12V OR +24V | 012 IGN +12V OR +24V |
| 412 ACC | 412 ACC | 412 ACC |
| 422 Starter Relay Solenoid | 422 Starter Relay Solenoid | 422 Starter Relay Solenoid |
| 002 BAT | 002 BAT | 002 BAT |



## OEM Engines - Sensor Specifications

The specifications shown below are voltage, pressure, and temperature parameters that the Engine Control Unit (ECU) uses to determine whether a Diagnostic Trouble Code (DTC) is set for a given sensor.

**Continued on next page**

RG41221,0000072 –19–22OCT02–1/3

| Sensor Specifications for OEM Engines | | | | |
|---|---|---|---|---|
| **Sensor** | **SPN-FMI** | **Measured Sensor Parameter** | **Out of Range Value** | **Derate** |
| Analog Throttle (A) | 000029.03 | High Input Voltage | Above 4.7 Volts | If no other throttle is available, engine will run at idle speed. |
| | 000029.04 | Low Input Voltage | Below 0.3 Volts | If no other throttle is available, engine will run at idle speed. |
| Analog Throttle (B) | 000028.03 | High Input Voltage | Above 4.7 Volts | If no other throttle is available, engine will run at idle speed. |
| | 000028.04 | Low Input Voltage | Below 0.3 Volts | If no other throttle is available, engine will run at idle speed. |
| Engine Coolant Temperature (ECT) | 000110.00 | Most Severe Temperature | Exceeds 118°C (244°F) | ECU derates engine 60% per minute until engine runs at 40% of full power. |
| | 000110.03 | High Input Voltage | Above 4.9 Volts | High ECT engine protection is disabled. |
| | 000110.04 | Low Input Voltage | Below 0.3 Volts | High ECT engine protection is disabled. |
| | 000110.15 | Moderately High Temperature | Exceeds 108°C (226°F) | ECU derates engine 2% per minute until engine runs at 95% of full power. |
| | 000110.16 | Moderately High Temperature | Exceeds 113°C (235°F) | ECU derates engine 40% per minute until engine runs at 60% of full power. |
| Coolant Level | 000111.01 | Coolant Level Low | Coolant level is low or switch is faulty. | ECU derates engine 40% per minute until engine runs at 60% of full power. |
| Fuel Pressure | 000094.01 | Extremely Low Pressure | 90 kPa (13 psi) (0.9 bar) Absolute | ECU derates engine 150 rpm per minute until engine runs at 1200 rpm. |
| | 000094.03 | High Input Voltage | Above 4.0 Volts | Default fuel pressure 160 MPa (1600 bar) (23,206 psi) |
| | 000094.04 | Low Input Voltage | Below 0.1 Volts | Default fuel pressure 160 MPa (1600 bar) (23,206 psi) |
| | 000094.18 | Moderately Low Pressure | 100 kPa (14.5 psi) (1.0 bar) Absolute | NA[a] |
| Fuel Temperature | 000174.00 | Most Severe Temperature | Exceeds 75°C (167°F) | ECU derates engine 20% per minute until engine runs at 50% of full power. |
| | 000174.15 | Moderately High Temperature | Exceeds 65°C (149°F) | NA[a] |
| [a]Not Applicable | | | | |



Continued on next page

| Sensor Specifications for OEM Engines | | | | |
|---|---|---|---|---|
| | 000174.16 | Moderately High Temperature | Exceeds 73°C (163°F) | ECU derates engine 75% per minute until engine runs at 25% of full power. |
| Manifold Air Temperature (MAT) | 000105.03 | High Input Voltage | Above 4.8 Volts | High MAT engine protection is disabled. |
| | 000105.04 | Low Input Voltage | Below 0.1 Volts | High MAT engine protection is disabled. |
| | 000105.16 | Moderately High Temperature | Exceeds 100°C (212°F) | ECU derates engine 2% per minute until engine runs at 80% of full power. |
| Oil Pressure | 000100.01 | Extremely Low Pressure | Oil pressure drops below threshold for running condition. | ECU derates engine 60% per minute until engine runs at 40% of full power. |
| | 000100.03 | High Input Voltage | Above 4.9 Volts | Low oil pressure engine protection is disabled. |
| | 000100.04 | Low Input Voltage | Below 0.3 Volts | Low oil pressure engine protection is disabled. |
| | 000100.18 | Moderately Low Pressure | Oil pressure drops below threshold for running condition. | ECU derates engine 2% per minute until engine runs at 80% of full power. |
| VP44 Fuel Injection Pump | 001076.02 | Pump Detected Defect | Internal pump defect | ECU derates engine 20% per minute until engine runs at 50% of full power. |
| | 001077.12 | Pump Self-Test Error | Internal pump defect | ECU derates engine 20% per minute until engine runs at 50% of full power. |
| | 001077.31 | Pump Requested Derate | Derate for any pump problem. | ECU derates engine 20% per minute until engine runs at 50% of full power. |
| | 001078.07 | ECU/Pump Out of Time - Moderately | Internal pump timing out of sync with engine. | ECU derates engine 20% per minute until engine runs at 50% of full power. |
| | 001078.31 | ECU/Pump Out of Time - Extremely | Internal pump timing out of sync with engine. | ECU derates engine 20% per minute until engine runs at 50% of full power. |



RG41221,0000072 –19–22OCT02–3/3

## OEM Engines - Torque Curve Selection

| Torque Curve Selection for OEM Engines | |
|---|---|
| **Torque Curve # on DST or SERVICE ADVISOR™** | **Condition for Torque Curve** |
| 1 | Normal (Nominal) |
| 16 | Transition Curve |
| 17 | Cold Temperature Starting |

*SERVICE ADVISOR is a trademark of Deere & Company*

RG41221,0000073 –19–22OCT02–1/1

## OEM Engines - With OC03041 Software or Later

*NOTE: To determine the ECU software for this engine, read ECU Software Part Number using the diagnostic software. The later the software, the higher the number will be.*

| Desired Speed for OEM Engines | |
|---|---|
| **Governor Mode** | **Conditions** |
| 0 | Normal Droop - (Default Gainset) |
| 1 | Isochronous Droop- (Default Gainset) |
| 2 | Normal Droop - (Selectable Gainset) |
| 3 | Isochronous Droop- (Selectable Gainset) |
| 6 | Engine Cruise |

| Desired Speed for OEM Engines | |
|---|---|
| **Governor Mode** | **Conditions** |
| 9 | Normal Droop - (Default Gainset) |
| 10 | Isochronous Droop- (Default Gainset) |
| 11 | Normal Droop - (Selectable Gainset) |
| 12 | Isochronous Droop- (Selectable Gainset) |
| 15 | Absolute Maxspeed (used for speed derates) |

RG41221,00000B0 –19–21JAN03–1/1

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210
25

## OEM Engines - With OC03034 Software or Earlier

*NOTE: To determine the ECU software for this engine, read ECU Software Part Number using the diagnostic software. The earlier the software, the lower the number will be.*

| Desired Speed for OEM Engines | |
|---|---|
| **Governor Mode** | **Conditions** |
| 0 | Normal Droop |

| Max. Speed for OEM Engines | |
|---|---|
| **Governor Mode** | **Conditions** |
| 10 | Isochronous high speed governor |

RG41221,0000074 –19–22OCT02–1/1

## OEM Engines - ECU Terminal Identification

| ECU Terminal Function | ECU Terminal # OEM | Sensor Connector Terminal # | Circuit # OEM | Wire Color OEM |
|---|---|---|---|---|
| Air Heater Indicator | 47 | B | 474 | Yellow |
| Air Heater Relay Enable | 63 | NA[a] | 429 | White |
| Air Heater Relay Return | 37 | NA[a] | 923A | Orange |
| Analog Throttle (A) Input | 31 | B | 915 | Green |
| Analog Throttle (B) Input | 28 | B | 913 | Orange |
| Analog Throttle (A) 5V Supply | 53 | C | 911 | Brown |
| Analog Throttle (B) 5V Supply | 3 | C | 416A | Blue |
| Analog Throttle (A) Sensor Ground | 24 | A | 414A | Yellow |
| Analog Throttle (B) Sensor Ground | 46 | A | 464A | Blue |
| Battery Power | 23, 68 | Battery (+) | 022A,B | Red |
| Blink Code Enable | 48 | NA[a] | 945 | Green |
| Bump Down | 39 | C | 936A | Blue |
| Bump Enable | 37 | A | 923A | Orange |
| Bump Up | 38 | A | 955A | Green |
| CAN High | 44 | NA[a] | 904B | Yellow |
| CAN Low | 21 | NA[a] | 905B | Green |
| CAN Shield | 42 | NA[a] | 020C | Black |
| Crankshaft Position Input | 9 | A | 447 | Purple |
| Crankshaft Position Return | 34 | B | 448 | Gray |
| Crank Speed Out | 17 | 8 | 459 | White |
| Cruise On | 52 | NA[a] | 954 | Yellow |
| Cruise Turn Around | 54 | NA[a] | 981 | Brown |
| ECT Input | 6 | A | 461 | Brown |
| ECT Sensor Ground | 46 | B | 464A | Yellow |
| Pump Position Input | 10 | A | 445 | Green |
| Pump Position Return | 36 | B | 443 | Orange |
| External Derate | 32 | NA[a] | 939 | White |
| External Shutdown | 12 | NA[a] | 941 | Brown |
| Fuel Pressure Input | 26 | C | 475 | Green |
| Fuel Pressure 5V Supply | 3 | B | 416A | Blue |
| Fuel Pressure Sensor Ground | 46 | A | 464A | Yellow |

[a]Not Applicable



DPSG,RG40854,674 –19–16AUG01–1/1

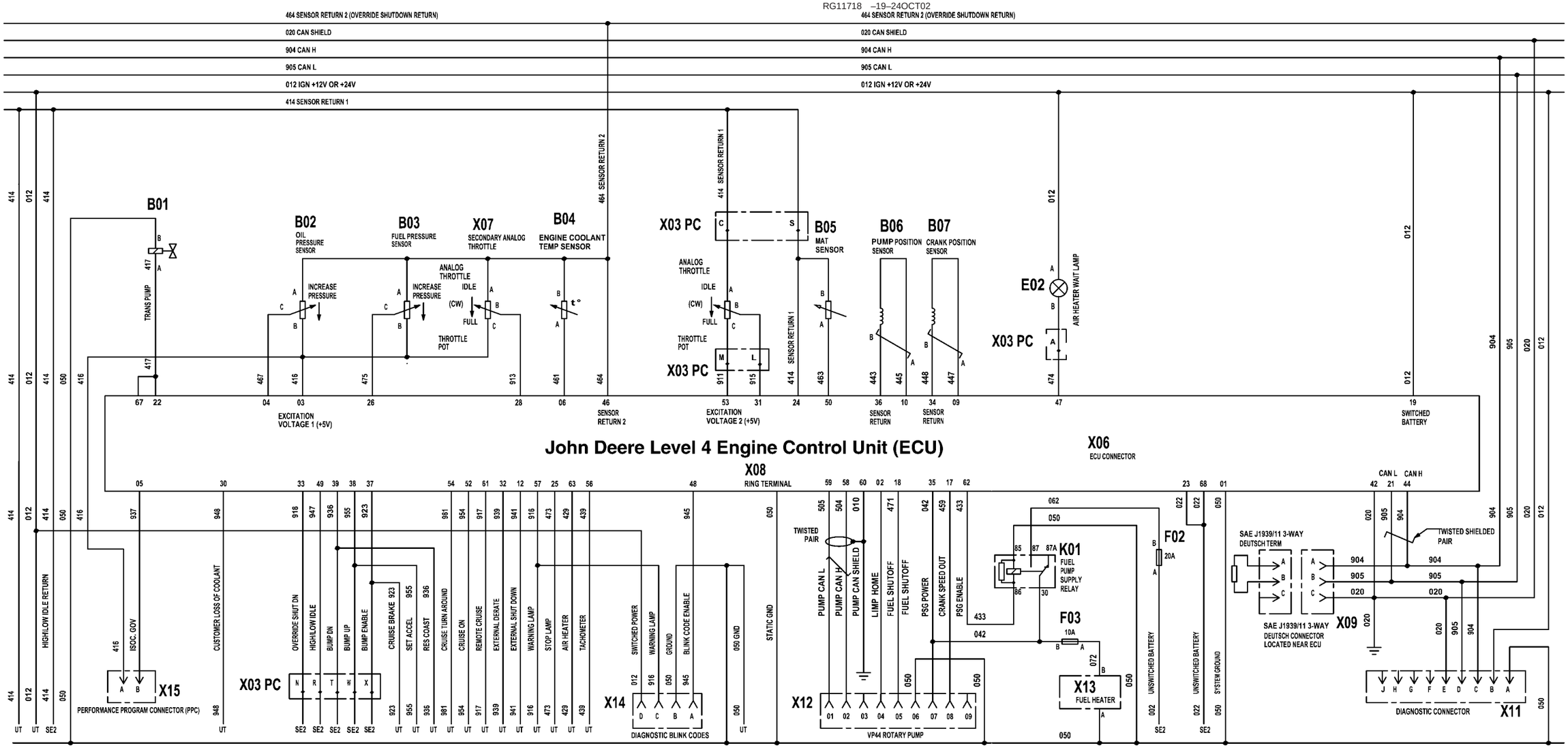
## ECU Terminal Identification - Continued

| ECU Terminal Function | ECU Terminal # OEM | Sensor Connector Terminal # | Circuit # OEM | Wire Color OEM |
|---|---|---|---|---|
| Fuel Shutoff | 18 | 5 | 471 | Brown |
| Ground | 1 | Battery (-) | 050A | Black |
| High/Low Idle | 49 | A | 947 | Purple |
| Loss of Coolant Switch | 30 | NA[a] | 948 | Gray |
| High/Low Idle Return | 24 | | 414A | Yellow |
| MAT Input | 50 | A | 463 | Orange |
| MAT Sensor Ground | 24 | B | 414A | Yellow |
| Oil Pressure Input | 4 | C | 467 | Purple |
| Oil Pressure 5V Supply | 3 | B | 416A | Blue |
| Oil Pressure Sensor Ground | 46 | A | 464A | Yellow |
| Override Shutdown | 33 | NA[a] | 918 | Gray |
| PPC 5V Supply | 3 | A | 416A | Blue |
| PPC Isochronous Governor | 5 | B | 937 | Purple |
| Pump CAN High | 58 | 2 | 504 | Yellow |
| Pump CAN Low | 59 | 1 | 505 | Green |
| Pump CAN Shield | 60 | NA[a] | 010A | Black |
| PSG Enable | 62 | 86 | 433 | Orange |
| PSG Power | 35 | 7 | 042A | Red |
| Remote Cruise | 61 | NA[a] | 917 | Purple |
| Stop Lamp | 25 | NA[a] | 473 | Orange |
| Switched Power | 19 | BAT | 012A | Red |
| Tachometer | 56 | NA[a] | 439 | White |
| Transfer Pump | 22, 67 | A | 417A,B | Purple |
| Warning Lamp | 57 | NA[a] | 916A | Blue |
| [a]Not Applicable | | | | |

DPSG,RG40854,674 –19–16AUG01–1/1

## 6.8 L OEM Application Electronic Control System Wiring Diagram

RG11718 –19–24OCT02



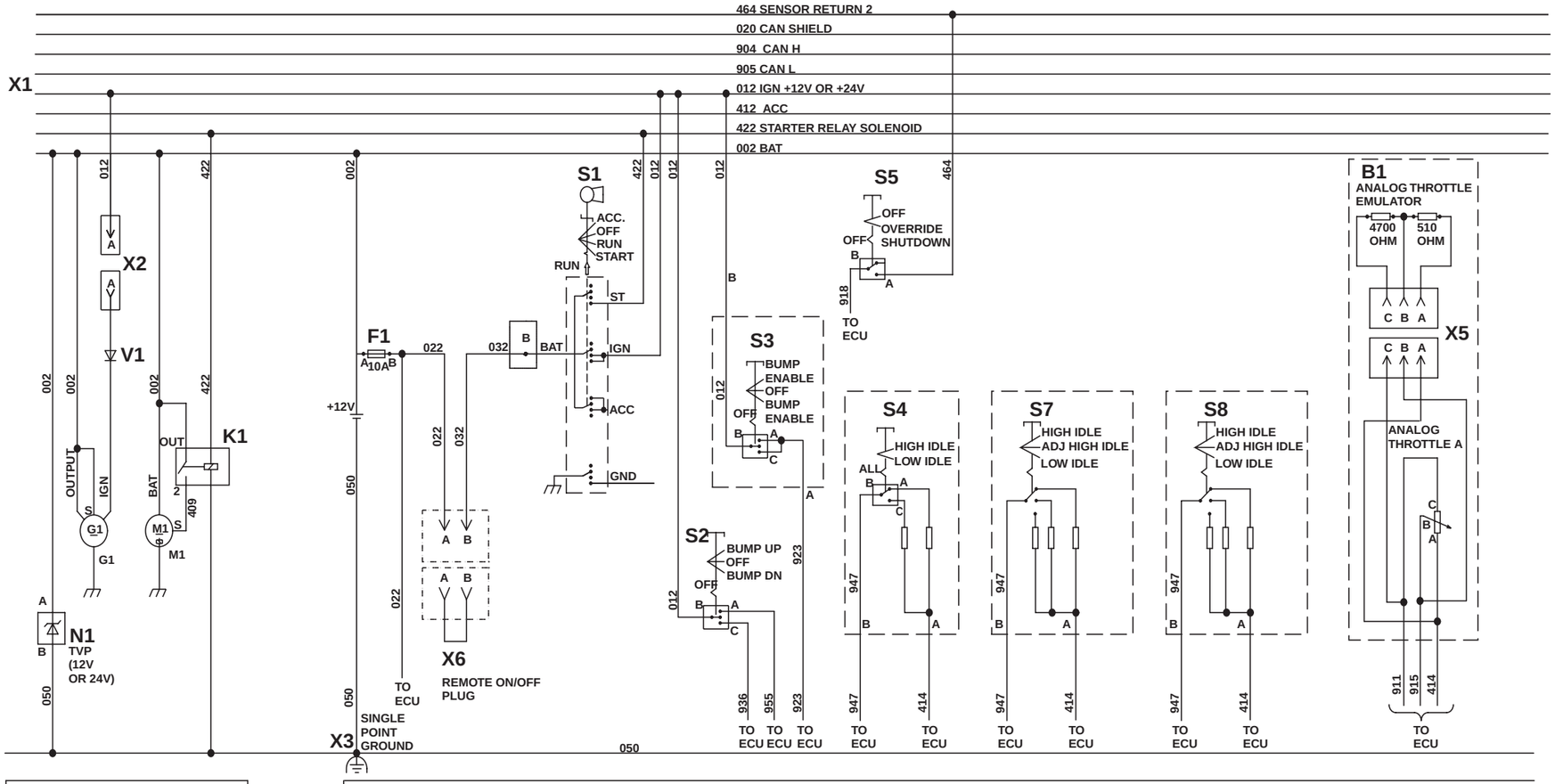

*Electronic Control System Wiring Diagram*

**B01—Transfer Pump**
**B02—Oil Pressure Sensor**
**B03—Fuel Pressure Sensor**
**B04—ECT Sensor**
**B05—MAT Sensor**
**B06—Pump Position Sensor**
**B07—Crankshaft Position Sensor**
**E02—Air Heater Wait Lamp**
**F02—Fuse (20A)**
**F03—Fuse (10A)**
**K01—Fuel Pump Supply Relay**
**X03—Panel Connector**
**X06—ECU Connector**
**X07—Analog Throttle (B) Connector**
**X08—ECU Ground Ring Terminal**
**X09—CAN Terminator**
**X11—Diagnostic Connector**
**X12—Rotary Pump**
**X13—Fuel Heater**
**X14—Diagnostic Blink Codes**
**X15—Performance Program Connector**

RG41221,0000076 –19–22OCT02–1/1

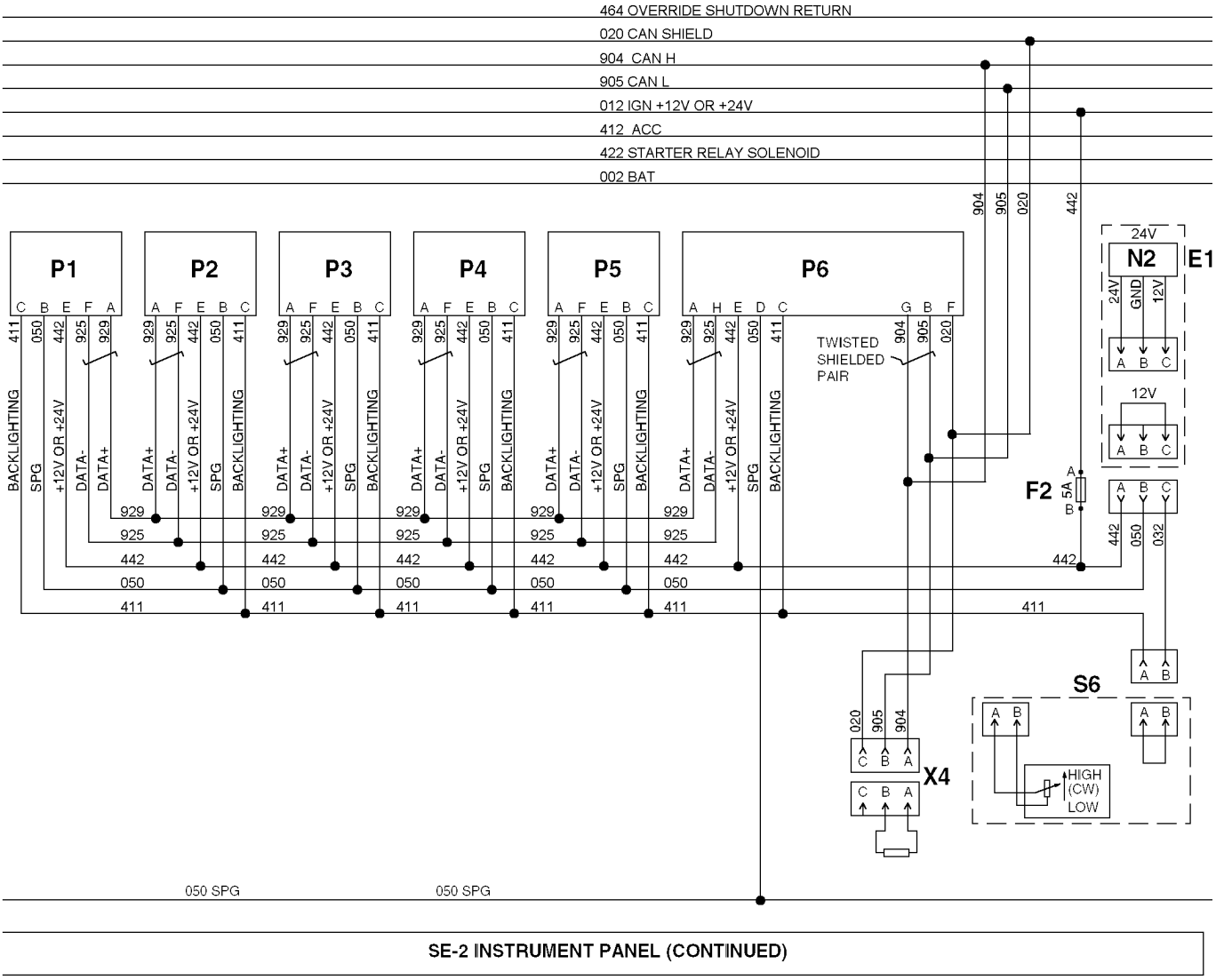
## 6.8 L OEM Application Instrument Panel/Engine Start Components Electrical Wiring Diagram

RG12288 –19–23AUG02




B1—Analog Throttle Emulator
E1—Back Light Regulator (24V) or Plug (12V)
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)
P1—Optional Gauge
P2—Optional Gauge
P3—Oil Pressure Gauge
P4—Coolant Temperature Gauge
P5—Tachometer Display
P6—Hourmeter/Diagnostic Meter
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

## 6.8 L OEM Application Instrument Panel/Engine Start Components Electrical Wiring Diagram - Continued




RG10040 –19–18MAY99

**B1—Analog Throttle Emulator**
**E1—Back Light Regulator (24V) or Plug (12V)**
**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)**
**P1—Optional Gauge**
**P2—Optional Gauge**
**P3—Oil Pressure Gauge**
**P4—Coolant Temperature Gauge**
**P5—Tachometer Display**
**P6—Hourmeter/Diagnostic Meter**
**S1—Ignition Key Switch**
**S2—Speed Select Switch (Momentary)**
**S3—Bump Enable Switch (Momentary**
**S4—High-Low Speed Switch**
**S5—Override Shutdown Switch (Momentary)**
**S6—Dimmer Control or Jumper Plug**
**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**

RG41221,0000078 –19–22OCT02–1/1

## Telehandlers - Sensor Specifications

The specifications shown below are voltage, pressure, and temperature parameters that the Engine Control Unit (ECU) uses to determine whether a Diagnostic Trouble Code (DTC) is set for a given sensor.

**Continued on next page**

RG41221,0000012 –19–02AUG02–1/3

| Sensor Specifications for Telehandlers | | | | |
|---|---|---|---|---|
| **Sensor** | **SPN-FMI** | **Measured Sensor Parameter** | **Out of Range Value** | **Derate** |
| Analog Throttle (A) | 000091.03 | High Input Voltage | Above 4.7 volts | If no other throttle is available, engine will run at idle speed. |
| | 000091.04 | Low Input Voltage | Below 0.3 volts | If no other throttle is available, engine will run at idle speed. |
| Engine Coolant Temperature (ECT) | 000110.00 | Most Severe Temperature | Exceeds 124°C (255°F) | ECU derates engine 60% per minute until engine runs at 40% of full power. |
| | 000110.03 | High Input Voltage | Above 4.9 Volts | High ECT engine protection is disabled. |
| | 000110.04 | Low Input Voltage | Below 0.3 Volts | High ECT engine protection is disabled. |
| | 000110.15 | High Least Severe Temperature | Exceeds 108°C (226°F) | ECU derates engine 2% per minute until engine runs at 80% of full power. |
| | 000110.16 | Moderately High Temperature | Exceeds 115°C (239°F) | ECU derates engine 40% per minute until engine runs at 60% of full power. |
| Fuel Pressure | 000094.01 | Extremely Low Pressure | 90 kPa (13 psi) (0.9 bar) Absolute | ECU derates engine 200 rpm per minute until engine runs at 1200 rpm. |
| | 000094.03 | High Input Voltage | Above 4.0 Volts | Limit engine speed to 1200 rpm |
| | 000094.04 | Low Input Voltage | Below 0.1Volts | Limit engine speed to 1200 rpm |
| | 000094.18 | Moderately Low Pressure | 100 kPa (14.5 psi) (1.0 bar) Absolute | NA[a] |
| Fuel Temperature | 000174.00 | Extremely High Temperature | Exceeds 75°C (167°F) | ECU derates engine 10% per minute until engine runs at 50% of full power. |
| | 000174.15 | High Least Severe Temperature | Exceeds 65°C (149°F) | NA[a] |
| | 000174.16 | Moderately High Temperature | Exceeds 73°C (163°F) | ECU derates engine 75% per minute until engine runs at 25% of full power. |
| Oil Pressure Switch | 000100.01 | Loss of Oil Pressure | Oil pressure drops below the threshold for running condition | NA[a] |
| | 000100.04 | Low Input Voltage | Below 0.3 Volts | NA[a] |
| VP44 Fuel Injection Pump | 001076.02 | Pump Detected Defect | Internal pump defect | ECU derates engine 10% per minute until engine runs at 50% of full power. |
| [a]Not Applicable | | | | |

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210
33

Continued on next page

| Sensor Specifications for Telehandlers | | | | |
|---|---|---|---|---|
| | 001077.12 | Pump Self-Test Error | Internal pump defect | ECU derates engine 10% per minute until engine runs at 50% of full power. |
| | 001077.31 | Pump Requested Derate | Derate for any pump problem. | ECU derates engine 10% per minute until engine runs at 50% of full power. |
| | 001078.07 | ECU/Pump Out of Time - Moderately | Internal pump timing out of sync with engine. | ECU derates engine 10% per minute until engine runs at 50% of full power. |
| | 001078.31 | ECU/Pump Out of Time - Extremely | Internal pump timing out of sync with engine. | ECU derates engine 10% per minute until engine runs at 50% of full power. |

RG41221,0000012 –19–02AUG02–3/3

## Telehandlers - Torque Curve Selection

| Torque Curve Selection for Telehandlers | |
|---|---|
| **Torque Curve # on DST or SERVICE ADVISOR™** | **Conditions** |
| 0 | Normal (Nominal) |
| 1 | Cold Temperature Starting |



*SERVICE ADVISOR is a trademark of Deere & Company*

RG41221,0000079 –19–23OCT02–1/1

## Telehandlers -

| Desired Speed for Telehandlers | |
|---|---|
| **Governor Mode** | **Conditions** |
| 0 | Normal Droop |
| 8 | Low speed governor |

| Max. Speed for Telehandlers | |
|---|---|
| **Governor Mode** | **Conditions** |
| 9 | Drooped high speed governor |

RG41221,000007A –19–23OCT02–1/1

## Telehandlers - ECU Terminal Identification

| ECU Terminal Function | ECU Terminal # | Sensor Connector Terminal # |
|---|---|---|
| Air Heater Relay Enable | 63 | 86 |
| Air Heater Relay Return | 37 | 87 |
| Battery Power | 23 | Battery (+) |
| Battery Power | 68 | Battery (+) |
| Blink Codes | 39 | NA[a] |
| CAN High | 44 | NA[a] |
| CAN Low | 21 | NA[a] |
| Check Engine Light | 47 | NA[a] |
| Crank Sensor Input | 9 | A |
| Crank Sensor Return | 34 | B |
| Engine Coolant Temperature Input | 6 | A |
| Fuel Pressure Sensor 5V Supply | 3 | C |
| Fuel Pressure Sensor Input | 26 | B |
| Fuel Pressure Sensor Return | 24 | A |
| Fuel Transfer Pump Power | 22 | A |
| Fuel Transfer Pump Power | 67 | A |
| Manifold Air Temperature Input | 50 | A |
| Oil Pressure Input | 33 | B |
| Pump CAN High | 58 | 2 |
| Pump CAN Low | 59 | 1 |
| Pump CAN Shield | 60 | NA[a] |
| Pump Crank Speed Out | 17 | 8 |
| Pump Fuel Shutoff | 18 | 5 |
| Pump Limp Home | 2 | 4 |
| Pump Position Input | 10 | A |
| Pump Position Sensor Return | 36 | B |
| Pump Power | 35 | 7 |
| Pump Relay Enable | 62 | 86 |
| Sensor Return 1 | 24 | Changes with each sensor |
| Sensor Return 2 | 46 | Changes with each sensor |
| Sensor 5V Supply 1 | 3 | Changes with each sensor |
| Stop Lamp | 25 | NA[a] |
| Switched Power | 19 | NA[a] |
| System Ground | 1 | Battery (-) |
| Throttle Input | 31 | NA[a] |
| [a]Not Applicable | | |



RG41221,000007B –19–23OCT02–1/1

## Tractors - 6010 Series - Sensor Specifications

The specifications shown below are voltage, pressure, and temperature parameters that the Engine Control Unit (ECU) uses to determine whether a Diagnostic Trouble Code (DTC) is set for a given sensor.

**Continued on next page**

RG41221,000007C –19–23OCT02–1/3

| Sensor Specifications for Tractors - 6010 Series | | | | |
|---|---|---|---|---|
| **Sensor** | **SPN-FMI** | **Measured Sensor Parameter** | **Out of Range Value** | **Derate** |
| Analog Throttle (A) | 000091.03 | High Input Voltage | Above 4.5 volts | If no other throttle is available, engine will run at idle speed. |
| | 000091.04 | Low Input Voltage | Below 0.5 volts | If no other throttle is available, engine will run at idle speed. |
| Analog Throttle (B) | 000029.03 | High Input Voltage | Above 4.5 volts | If no other throttle is available, engine will run at idle speed. |
| | 000029.04 | Low Input Voltage | Below 0.5 volts | If no other throttle is available, engine will run at idle speed. |
| Analog Throttle (C) | 000028.03 | High Input Voltage | Above 4.7 volts | If no other throttle is available, engine will run at idle speed. |
| | 000028.04 | Low Input Voltage | Below 0.3 volts | If no other throttle is available, engine will run at idle speed. |
| Engine Coolant Temperature (ECT) | 000110.00 | Most Severe Temperature | Exceeds 114°C (237°F) | ECU derates engine 40% per minute until engine runs at 60% of full power. |
| | 000110.03 | High Input Voltage | Above 4.9 Volts | High ECT engine protection is disabled. |
| | 000110.04 | Low Input Voltage | Below 0.1 Volts | High ECT engine protection is disabled. |
| | 000110.16 | Moderately High Temperature | Exceeds 111°C (232°F) | ECU derates engine 2% per minute until engine runs at 80% of full power. |
| Fuel Pressure | 000094.01 | Extremely Low Pressure | 80 kPa (11.5 psi) (0.8 bar) Absolute | ECU derates engine 200 rpm per minute until engine runs at 1200 rpm. |
| | 000094.03 | High Input Voltage | Above 4.7 Volts | NA[a] |
| | 000094.04 | Low Input Voltage | Below 0.9 Volts | NA[a] |
| | 000094.18 | Moderately Low Pressure | 100 kPa (14.5 psi) (1.0 bar) Absolute | NA[a] |
| Fuel Temperature | 000174.00 | Extremely High Temperature | Exceeds 75°C (167°F) | ECU derates engine 10% per minute until engine runs at 50% of full power. |
| | 000174.15 | High Least Severe Temperature | Exceeds 65°C (149°F) | NA[a] |
| | 000174.16 | Moderately High Temperature | Exceeds 73°C (163°F) | ECU derates engine 75% per minute until engine runs at 25% of full power. |

[a]Not Applicable



Continued on next page

| Sensor Specifications for Tractors - 6010 Series | | | | |
|---|---|---|---|---|
| Manifold Air Temperature (MAT) | 000105.03 | High Input Voltage | Above 4.8 Volts | High MAT engine protection is disabled. |
| | 000105.04 | Low Input Voltage | Below 0.1 Volts | High MAT engine protection is disabled. |
| | 000105.16 | Moderately High Temperature | Exceeds 95°C (203°F) | ECU derates engine 2% per minute until engine runs at 80% of full power. |
| Oil Pressure | 000100.01 | Extremely Low Pressure | Oil pressure drops below the threshold for running condition. | ECU derates engine 40% per minute until engine runs at 60% of full power. |
| | 000100.03 | High Input Voltage | Above 4.9 Volts | NA[a] |
| | 000100.04 | Low Input Voltage | Below 0.3 Volts | NA[a] |
| | 000100.18 | Moderately Low Pressure | Oil pressure drops below the threshold for running condition. | NA[a] |
| VP44 Fuel Injection Pump | 001076.02 | Pump Detected Defect | Internal pump defect | ECU derates engine 10% per minute until engine runs at 50% of full power. |
| | 001077.12 | Pump Self-Test Error | Internal pump defect | ECU derates engine 10% per minute until engine runs at 50% of full power. |
| | 001077.31 | Pump Requested Derate | Derate for any pump problem. | ECU derates engine 10% per minute until engine runs at 50% of full power. |
| | 001078.07 | ECU/Pump Out of Time - Moderately | Internal pump timing out of sync with engine. | ECU derates engine 10% per minute until engine runs at 50% of full power. |
| | 001078.31 | ECU/Pump Out of Time - Extremely | Internal pump timing out of sync with engine. | ECU derates engine 10% per minute until engine runs at 50% of full power. |
| [a]Not Applicable | | | | |



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## Tractors - 6010 Series - Torque Curve Selection

| Torque Curve Selection for 6010 Series Tractors | |
|---|---|
| **Torque Curve # on DST or SERVICE ADVISOR™** | **Conditions** |
| 0, 10 | Normal (Nominal) |
| 11 | 15-16 km/hr |
| 12 | 16-17 km/hr |
| 13 | 17-18 km/hr |
| 14 | 18-19 km/hr |
| 15 | Greater than 19 km/hr |
| 16 | Greater than 2 km/hr and PTO boost active |

*SERVICE ADVISOR is a trademark of Deere & Company*

RG41221,000007D –19–23OCT02–1/1

## Tractors - 6010 Series -

| Desire Speed on 6010 Series Tractors | |
|---|---|
| **Governor Mode** | **Condition** |
| 0 | Normal droop |
| 1 | Field cruise with isochronous governor |

| Max. Speed on 6010 Series Tractors | |
|---|---|
| **Governor Mode** | **Condition** |
| 9 | Normal Droop with isochronous governor |
| 10 | Field cruise with isochronous governor |
| 11 | Road Speed Limiting |



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## Tractors - 6010 Series - ECU Terminal Identification

| ECU Terminal Function | ECU Terminal # | Sensor Connector Terminal # |
|---|---|---|
| Air Heater Indicator Light | 47 | NA[a] |
| Air Heater Relay Enable | 63 | 86 |
| Air Heater Relay Return | 37 | 87 |
| Battery Power | 23 | Battery (+) |
| Analog Throttle (A) Input | 31 | B |
| Analog Throttle (B) Input | 28 | B |
| Analog Throttle (C) Input | 5 | B |
| Battery Power | 68 | Battery (+) |
| CAN High | 44 | NA[a] |
| CAN Low | 21 | NA[a] |
| CAN Shield | 42 | 3 |
| Crank Sensor Input | 9 | A |
| Crank Sensor Return | 34 | B |
| Engine Coolant Temperature Input | 6 | A |
| Fuel Pressure Sensor 5V Supply | 3 | C |
| Fuel Pressure Sensor Input | 26 | B |
| Fuel Pressure Sensor Return | 24 | A |
| Fuel Transfer Pump Power | 22 | A |
| Fuel Transfer Pump Power | 67 | A |
| Oil Pressure Input | 4 | C |
| Oil Pressure 5V Supply | 3 | B |
| Oil Pressure Sensor Ground | 24 | A |
| PTO Speed - Front | 7 | NA[a] |
| PTO Speed - Rear | 8 | NA[a] |
| Pump CAN High | 58 | 2 |
| Pump CAN Low | 59 | 1 |
| Pump CAN Shield | 60 | NA[a] |
| Pump Crank Speed Out | 17 | 8 |
| Pump Fuel Shutoff | 18 | 5 |
| Pump Limp Home | 2 | 4 |
| Pump Position Input | 10 | A |
| Pump Position Sensor Return | 36 | B |
| Pump Power | 35 | 7 |
| Pump Relay Enable | 62 | 86 |
| Sensor Return 1 | 24 | Changes with each sensor |
| Sensor Return 2 | 46 | Changes with each sensor |
| Sensor 5V Supply 1 | 3 | Changes with each sensor |
| [a]Not Applicable | | |



Continued on next page

| | | |
|---|---|---|
| Sensor 5V Supply 2 | 53 | Changes with each sensor |
| Switched Power | 19 | NA[a] |
| System Ground | 1 | Battery (-) |
| Tach Output | 56 | NA[a] |
| Wheel Speed Input | 11 | NA[a] |
| [a]Not Applicable | | |

RG41221,000001C –19–02AUG02–2/2

## Tractors - 6020 Series - Sensor Specifications

The specifications shown below are voltage, pressure, and temperature parameters that the Engine Control Unit (ECU) uses to determine whether a Diagnostic Trouble Code (DTC) is set for a given sensor.

**Continued on next page**

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| Sensor Specifications for Tractors - 6020 Series | | | | |
|---|---|---|---|---|
| **Sensor** | **SPN-FMI** | **Measured Sensor Parameter** | **Out of Range Value** | **Derate** |
| Analog Throttle (A) | 000091.03 | High Input Voltage | Above 4.5 volts | If no other throttle is available, engine will run at idle speed. |
| | 000091.04 | Low Input Voltage | Below 0.5 volts | If no other throttle is available, engine will run at idle speed. |
| Analog Throttle (B) | 000029.03 | High Input Voltage | Above 4.5 volts | If no other throttle is available, engine will run at idle speed. |
| | 000029.04 | Low Input Voltage | Below 0.5 volts | If no other throttle is available, engine will run at idle speed. |
| Analog Throttle (C) | 000028.03 | High Input Voltage | Above 4.7 volts | If no other throttle is available, engine will run at idle speed. |
| | 000028.04 | Low Input Voltage | Below 0.3 volts | If no other throttle is available, engine will run at idle speed. |
| Engine Coolant Temperature (ECT) | 000110.00 | Most Severe Temperature | Exceeds 118°C (244°F) | ECU derates engine 20% per minute until engine runs at 60% of full power. |
| | 000110.03 | High Input Voltage | Above 4.9 Volts | High ECT engine protection is disabled. |
| | 000110.04 | Low Input Voltage | Below 0.1 Volts | High ECT engine protection is disabled. |
| | 000110.16 | Moderately High Temperature | Exceeds 112°C (234°F) | ECU derates engine 2% per minute until engine runs at 80% of full power. |
| Fuel Pressure | 000094.01 | Extremely Low Pressure | 80 kPa (11.5 psi) (0.8 bar) Absolute | ECU derates engine 200 rpm per minute until engine runs at 1200 rpm. |
| | 000094.03 | High Input Voltage | Above 4.0 Volts | NA[a] |
| | 000094.04 | Low Input Voltage | Below 0.3 Volts | NA[a] |
| | 000094.18 | Moderately Low Pressure | 100 kPa (14.5 psi) (1.09 bar) Absolute | NA[a] |
| Fuel Temperature | 000174.00 | Extremely High Temperature | Exceeds 75°C (167°F) | ECU derates engine 10% per minute until engine runs at 50% of full power. |
| | 000174.15 | High Least Severe Temperature | Exceeds 65°C (149°F) | NA[a] |
| | 000174.16 | Moderately High Temperature | Exceeds 73°C (163°F) | ECU derates engine 75% per minute until engine runs at 25% of full power. |

[a]Not Applicable



Continued on next page

| Sensor Specifications for Tractors - 6020 Series | | | | |
|---|---|---|---|---|
| Oil Pressure | 000100.01 | Extremely Low Pressure | Oil pressure drops below the threshold for running condition | ECU derates engine 40% per minute until engine runs at 60% of full power. |
| | 000100.03 | High Input Voltage | Above 4.9 Volts | High MAT engine protection is disabled. |
| | 000100.04 | Low Input Voltage | Below 0.3 Volts | High MAT engine protection is disabled. |
| | 000100.18 | Moderately Low Pressure | Oil pressure drops below the threshold for running condition | ECU derates engine 2% per minute until engine runs at 80% of full power. |
| VP44 Fuel Injection Pump | 001076.02 | Pump Detected Defect | Internal pump defect | ECU derates engine 10% per minute until engine runs at 50% of full power. |
| | 001077.12 | Pump Self-Test Error | Internal pump defect | ECU derates engine 10% per minute until engine runs at 50% of full power. |
| | 001077.31 | Pump Requested Derate | Derate for any pump problem. | ECU derates engine 10% per minute until engine runs at 50% of full power. |
| | 001078.07 | ECU/Pump Out of Time - Moderately | Internal pump timing out of sync with engine. | ECU derates engine 10% per minute until engine runs at 50% of full power. |
| | 001078.31 | ECU/Pump Out of Time - Extremely | Internal pump timing out of sync with engine. | ECU derates engine 10% per minute until engine runs at 50% of full power. |



RG41221,0000348 –19–01APR02–3/3

## Tractors - 6020 Series - Torque Curve Selection

| Torque Curve Selection for Tractors - 6020 Series | |
|---|---|
| **Torque Curve # on DST or SERVICE ADVISOR™** | **Conditions** |
| 0, 10 | Normal (Nominal) |
| 1 | Cold Temperature Starting |
| 11 | 15-16 km/hr |
| 12 | 16-17 km/hr |
| 13 | 17-18 km/hr |
| 14 | 18-19 km/hr |
| 15 | Greater than 19 km/hr |
| 16 | Greater than 2 km/hr and PTO boost active |

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RG41221,000007F –19–23OCT02–1/1

## Tractors - 6020 Series -

| Desire Speed on Tractors - 6020 Series | |
|---|---|
| **Governor Mode** | **Condition** |
| 0 | Normal droop |
| 1 | Field cruise with isochronous governor |

| Max. Speed on Tractors - 6020 Series | |
|---|---|
| **Governor Mode** | **Condition** |
| 9 | Normal Droop with isochronous governor |
| 10 | Field cruise with isochronous governor |
| 11 | Road Speed Limiting |

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## Tractors - 6020 Series - ECU Terminal Identification

| ECU Terminal Function | ECU Terminal # | Sensor Connector Terminal # |
|---|---|---|
| Air Heater Indicator Light | 47 | NA[a] |
| Air Heater Relay Enable | 63 | 86 |
| Air Heater Relay Return | 37 | 87 |
| Battery Power | 23 | Battery (+) |
| Analog Throttle (A) Input | 31 | B |
| Analog Throttle (B) Input | 28 | B |
| Analog Throttle (C) Input | 5 | B |
| Battery Power | 68 | Battery (+) |
| CAN High | 44 | NA[a] |
| CAN Low | 21 | NA[a] |
| CAN Shield | 42 | 3 |
| Crank Sensor Input | 9 | A |
| Crank Sensor Return | 34 | B |
| Engine Coolant Temperature Input | 6 | A |
| Fuel Pressure Sensor 5V Supply | 3 | C |
| Fuel Pressure Sensor Input | 26 | B |
| Fuel Pressure Sensor Return | 24 | A |
| Fuel Transfer Pump Power | 22 | A |
| Fuel Transfer Pump Power | 67 | A |
| Oil Pressure Input | 4 | C |
| Oil Pressure 5V Supply | 3 | B |
| Oil Pressure Sensor Ground | 24 | A |
| PTO Speed - Front | 7 | NA[a] |
| PTO Speed - Rear | 8 | NA[a] |
| Pump CAN High | 58 | 2 |
| Pump CAN Low | 59 | 1 |
| Pump CAN Shield | 60 | NA[a] |
| Pump Crank Speed Out | 17 | 8 |
| Pump Fuel Shutoff | 18 | 5 |
| Pump Limp Home | 2 | 4 |
| Pump Position Input | 10 | A |
| Pump Position Sensor Return | 36 | B |
| Pump Power | 35 | 7 |
| Pump Relay Enable | 62 | 86 |
| Sensor Return 1 | 24 | Changes with each sensor |
| Sensor Return 2 | 46 | Changes with each sensor |
| Sensor 5V Supply 1 | 3 | Changes with each sensor |
| [a]Not Applicable | | |



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| | | |
|---|---|---|
| Sensor 5V Supply 2 | 53 | Changes with each sensor |
| Switched Power | 19 | NA[a] |
| System Ground | 1 | Battery (-) |
| Tach Output | 56 | NA[a] |
| Wheel Speed Input | 11 | NA[a] |
| [a]Not Applicable | | |

RG41221,0000081 –19–23OCT02–2/2

## Tractors - 7020 Series - Sensor Specifications

The specifications shown below are voltage, pressure, and temperature parameters that the Engine Control Unit (ECU) uses to determine whether a Diagnostic Trouble Code (DTC) is set for a given sensor.

**Continued on next page**

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| Sensor Specifications for Tractors - 7020 Series | | | | |
|---|---|---|---|---|
| **Sensor** | **SPN-FMI** | **Measured Sensor Parameter** | **Out of Range Value** | **Derate** |
| Analog Throttle (A) | 000091.03 | High Input Voltage | Above 4.5 volts | If no other throttle is available, engine will run at idle speed. |
| | 000091.04 | Low Input Voltage | Below 0.5 volts | If no other throttle is available, engine will run at idle speed. |
| Analog Throttle (B) | 000029.03 | High Input Voltage | Above 4.5 volts | If no other throttle is available, engine will run at idle speed. |
| | 000029.04 | Low Input Voltage | Below 0.5 volts | If no other throttle is available, engine will run at idle speed. |
| Analog Throttle (C) | 000028.03 | High Input Voltage | Above 4.7 volts | If no other throttle is available, engine will run at idle speed. |
| | 000028.04 | Low Input Voltage | Below 0.3 volts | If no other throttle is available, engine will run at idle speed. |
| Engine Coolant Temperature (ECT) | 000110.00 | Most Severe Temperature | Exceeds 118°C (244°F) | ECU derates engine 20% per minute until engine runs at 60% of full power. |
| | 000110.03 | High Input Voltage | Above 4.9 Volts | High ECT engine protection is disabled. |
| | 000110.04 | Low Input Voltage | Below 0.1 Volts | High ECT engine protection is disabled. |
| | 000110.16 | Moderately High Temperature | Exceeds 112°C (234°F) | ECU derates engine 2% per minute until engine runs at 80% of full power. |
| Fuel Pressure | 000094.01 | Extremely Low Pressure | 80 kPa (11.5 psi) (0.8 bar) Absolute | ECU derates engine 200 rpm per minute until engine runs at 1200 rpm. |
| | 000094.03 | High Input Voltage | Above 4.0 Volts | NA[a] |
| | 000094.04 | Low Input Voltage | Below 0.3Volts | NA[a] |
| | 000094.18 | Moderately Low Pressure | 100 kPa (14.5 psi) (1.09 bar) Absolute | NA[a] |
| Fuel Temperature | 000174.00 | Extremely High Temperature | Exceeds 75°C (167°F) | ECU derates engine 10% per minute until engine runs at 50% of full power. |
| | 000174.15 | High Least Severe Temperature | Exceeds 65°C (149°F) | NA[a] |
| | 000174.16 | Moderately High Temperature | Exceeds 73°C (163°F) | ECU derates engine 75% per minute until engine runs at 25% of full power. |
| [a]Not Applicable | | | | |

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| Sensor Specifications for Tractors - 7020 Series | | | | |
|---|---|---|---|---|
| Oil Pressure | 000100.01 | Extremely Low Pressure | Oil pressure drops below the threshold for running condition | ECU derates engine 40% per minute until engine runs at 60% of full power. |
| | 000100.03 | High Input Voltage | Above 4.9 Volts | High MAT engine protection is disabled. |
| | 000100.04 | Low Input Voltage | Below 0.3 Volts | High MAT engine protection is disabled. |
| | 000100.18 | Moderately Low Pressure | Oil pressure drops below the threshold for running condition | ECU derates engine 2% per minute until engine runs at 80% of full power. |
| VP44 Fuel Injection Pump | 001076.02 | Pump Detected Defect | Internal pump defect | ECU derates engine 10% per minute until engine runs at 50% of full power. |
| | 001077.12 | Pump Self-Test Error | Internal pump defect | ECU derates engine 10% per minute until engine runs at 50% of full power. |
| | 001077.31 | Pump Requested Derate | Derate for any pump problem. | ECU derates engine 10% per minute until engine runs at 50% of full power. |
| | 001078.07 | ECU/Pump Out of Time - Moderately | Internal pump timing out of sync with engine. | ECU derates engine 10% per minute until engine runs at 50% of full power. |
| | 001078.31 | ECU/Pump Out of Time - Extremely | Internal pump timing out of sync with engine. | ECU derates engine 10% per minute until engine runs at 50% of full power. |



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## Tractors - 7020 Series - Torque Curve Selection

| Torque Curve Selection for Tractors - 7020 Series | |
|---|---|
| **Torque Curve # on DST or SERVICE ADVISOR™** | **Conditions** |
| 0, 10 | Normal (Nominal) |
| 11 | 15-16 km/hr |
| 12 | 16-17 km/hr |
| 13 | 17-18 km/hr |
| 14 | 18-19 km/hr |
| 15 | Greater than 19 km/hr |
| 16 | Greater than 2 km/hr and PTO boost active |

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RG41221,000034D –19–01APR02–1/1

## Tractors - 7020 Series -

| Desire Speed on Tractors - 7020 Series | |
|---|---|
| **Governor Mode** | **Condition** |
| 0 | Normal droop |
| 1 | Field cruise with isochronous governor |

| Max. Speed on Tractors - 7020 Series | |
|---|---|
| **Governor Mode** | **Condition** |
| 9 | Normal Droop with isochronous governor |
| 10 | Field cruise with isochronous governor |
| 11 | Road Speed Limiting |

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## Tractors - 7020 Series - ECU Terminal Identification

| ECU Terminal Function | ECU Terminal # | Sensor Connector Terminal # |
|---|---|---|
| Air Heater Indicator Light | 47 | NA[a] |
| Air Heater Relay Enable | 63 | 86 |
| Air Heater Relay Return | 37 | 87 |
| Battery Power | 23 | Battery (+) |
| Analog Throttle (A) Input | 31 | B |
| Analog Throttle (B) Input | 28 | B |
| Analog Throttle (C) Input | 5 | B |
| Battery Power | 68 | Battery (+) |
| CAN High | 44 | NA[a] |
| CAN Low | 21 | NA[a] |
| CAN Shield | 42 | 3 |
| Crank Sensor Input | 9 | A |
| Crank Sensor Return | 34 | B |
| Engine Coolant Temperature Input | 6 | A |
| Fuel Pressure Sensor 5V Supply | 3 | C |
| Fuel Pressure Sensor Input | 26 | B |
| Fuel Pressure Sensor Return | 24 | A |
| Fuel Transfer Pump Power | 22 | A |
| Fuel Transfer Pump Power | 67 | A |
| Oil Pressure Input | 4 | C |
| Oil Pressure 5V Supply | 3 | B |
| Oil Pressure Sensor Ground | 24 | A |
| PTO Speed - Front | 7 | NA[a] |
| PTO Speed - Rear | 8 | NA[a] |
| Pump CAN High | 58 | 2 |
| Pump CAN Low | 59 | 1 |
| Pump CAN Shield | 60 | NA[a] |
| Pump Crank Speed Out | 17 | 8 |
| Pump Fuel Shutoff | 18 | 5 |
| Pump Limp Home | 2 | 4 |
| Pump Position Input | 10 | A |
| Pump Position Sensor Return | 36 | B |
| Pump Power | 35 | 7 |
| Pump Relay Enable | 62 | 86 |
| Sensor Return 1 | 24 | Changes with each sensor |
| Sensor Return 2 | 46 | Changes with each sensor |
| Sensor 5V Supply 1 | 3 | Changes with each sensor |
| [a]Not Applicable | | |



Continued on next page

| | | |
|---|---|---|
| Sensor 5V Supply 2 | 53 | Changes with each sensor |
| Switched Power | 19 | NA[a] |
| System Ground | 1 | Battery (-) |
| Tach Output | 56 | NA[a] |
| Wheel Speed Input | 11 | NA[a] |
| [a]Not Applicable | | |

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