POWERTECH 10.5 L & 12.5 L Diesel Engines

Lucas Electronic Fuel Systems With Lucas EUIs

TECHNICAL MANUAL

POWERTECH 10.5 L & 12.5 L Lucas Electronic Fuel System

CTM115 28JUL04 (ENGLISH)

For complete service information also see:

John Deere Power Systems

LITHO IN U.S.A.

Foreword

This manual is written for an experienced technician. Special tools required in performing certain service work are identified in this manual and are recommended for use.

This manual (CTM115) covers only the dual rail fuel system on 10.5 L and 12.5 L engines with Lucas electronic fuel control. It is one of three volumes. The following two companion manuals cover the base engine and John Deere Level 6 electronic fuel systems:

- CTM100—10.5 L and 12.5 L Diesel Engines—Base Engine
- CTM188—10.5 L and 12.5 L Diesel Engines—Level 6 Electronic Fuel Systems With Lucas EUIs

This new CTM includes dual rail fuel system and electrical engine control repair procedures formerly in CTM100, Groups 35 and 45 (9NOV99).

A complete set of all three manuals covering 10.5 L and 12.5 L engines can be procured by ordering CTM650 Binder Set.

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 in this manual, be alert to the potential for personal injury.

Use this component technical manual in conjunction with the base engine repair manual (CTM100) and the respective machine technical manual. See the repair manual for information on component removal and installation, and gaining access to the components.

This manual is divided in three parts: repair, theory of operation and diagnostics. Repair procedures are provided for the fuel system and electrical engine control system. The theory of operation section contains information that explains how these engine subsystems operate. The diagnostics section helps identify the cause of engine problems.

Applicable special tools and other materials needed to do the job, specifications, and helpful reference materials are covered in separate groups toward end of manual.

Engine Training Guide (DSEGET550A) is available to give the service technician a detailed overview of general engine construction and design features. This manual is recommended prior to performing major service procedures on *POWERTECH*® 6105 and 6125 engines.

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

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.

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.

PowerTech is a registered trademark of Deere & Company.

CTM115,IFC –19–14DEC00–1/1

John Deere Dealers

CTM 115 is now part of a three manual binder set (CTM650) covering repair, operation and test procedures on 10.5 L and 12.5 L engines. **Discard CTM115 dated 30SEPT97 and replace with the following new manuals:**

- CTM100—10.5 L and 12.5 L Diesel Engines—Base Engine
- CTM115—10.5 L and 12.5 L Diesel Engines—Lucas Electronic Fuel Systems With Lucas EUIs
- CTM188—10.5 L and 12.5 L Diesel Engines—Level 6 Electronic Fuel Systems With Lucas EUIs

IMPORTANT: The changes listed below make your CTM obsolete. Please copy this page, listing changes, and route through your service department.

This new CTM115—Lucas Electronic Fuel Systems With Lucas EUIs, contains dual rail fuel system and electronic engine control repair procedures formerly in CTM100, Groups 35 and 45 (09NOV99).

SECTION 01—GROUP 001 (Engine Identification)

- Updated engine model designation chart.
- Updated engine application charts.

SECTION 01—GROUP 002 (Fuels)

- Updated general information on diesel fuels.

SECTION 02—GROUP 090 (Electronic Fuel System Repair and Adjustments)

- Added fuel system repair procedures formerly in CTM100, Group 35.
- Revised procedure for replacement of fuel filters and water separator.
- Revised procedure for adjusting electronic unit injector preload.

SECTION 02—GROUP 110 (Electrical Engine Control Repair and Adjustment)

- Added electrical engine control repair procedures formerly in CTM100, Group 45.
- Revised procedures for repair of electrical connectors.

SECTION 03—GROUP 130 (Electronic Fuel System Operation)

- Electronic fuel system operation is covered in this new group.

SECTION 03—GROUP 140 (Electronic Fuel System Operation)

- Electrical control system operation is covered in this new group.

SECTION 04—GROUP 150 (Observable Diagnostics and Tests)

- Revised diagnostic procedures for low pressure fuel system.

SECTION 04—GROUP 160 (Trouble Code Diagnostics and Tests)

- Revised trouble code diagnostic and test procedures for Lucas electronic controlled fuel system.

SECTION 05 (Tools and Other Materials)

- All essential tools, service tools, dealer fabricated tools and other materials listed throughout this manual are consolidated in this section for ease of reference.

SECTION 06 (Specifications)

- All repair, test and diagnostic specifications listed throughout this manual are consolidated in this section for ease of reference.
- Wiring diagrams have been revised.

OUO1004,0000C33 –19–15DEC00–1/1

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INDX

Section 01
General Information

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

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

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

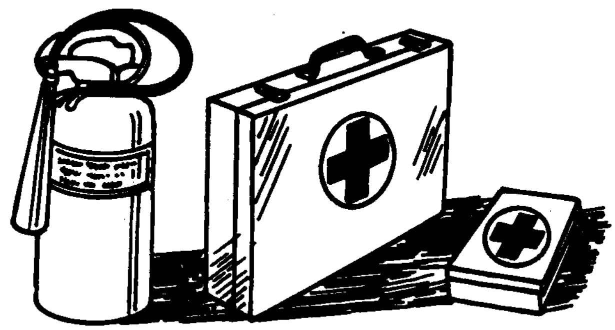
DX,SPARKS –19–03MAR93–1/1

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.**

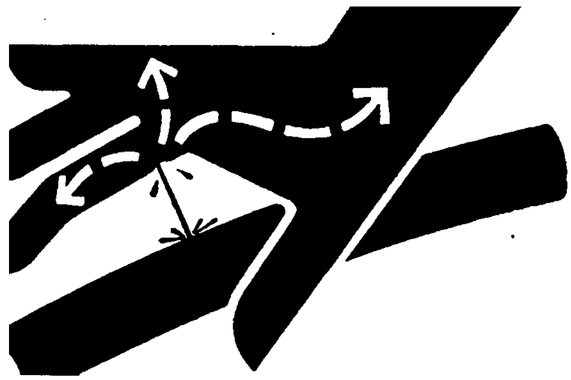
If acid is swallowed:

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

Avoid High-Pressure Fluids



X9811 –UN–23AUG88

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

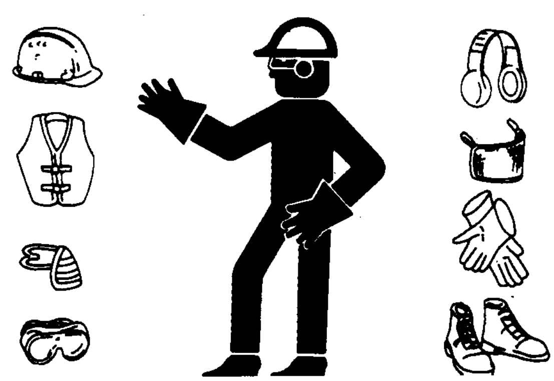
Avoid the hazard by relieving pressure before disconnecting hydraulic or other lines. Tighten all connections before applying pressure.

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.

DX,FLUID –19–03MAR93–1/1

Wear Protective Clothing



TS206 –UN–23AUG88

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.

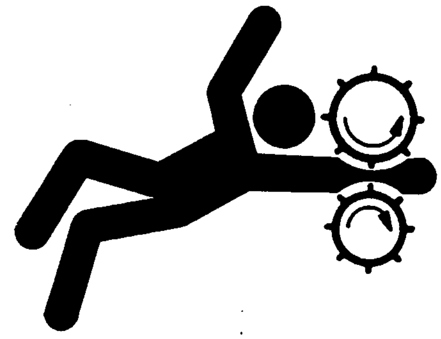
Operating equipment safely requires the full attention of the operator. Do not wear radio or music headphones while operating machine.

DX,WEAR –19–10SEP90–1/1

Service Machines Safely

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

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



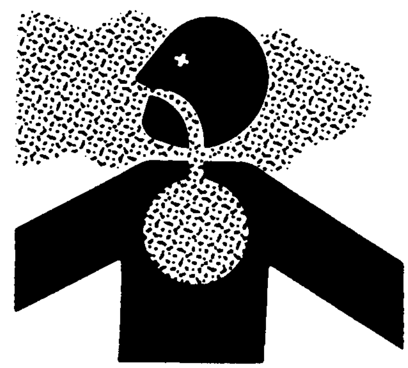
TS228 –UN–23AUG88

DX,LOOSE –19–04JUN90–1/1

Work In Ventilated Area

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

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



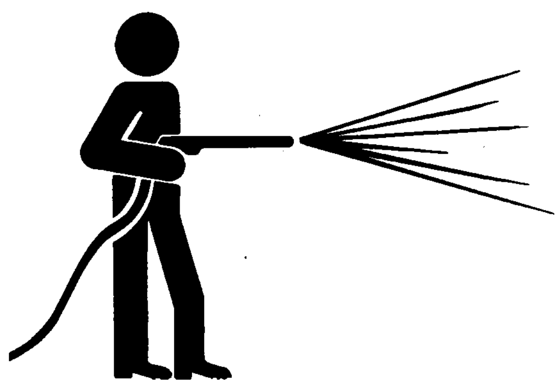
TS220 –UN–23AUG88

DX,AIR –19–17FEB99–1/1

Work in Clean Area

Before starting a job:

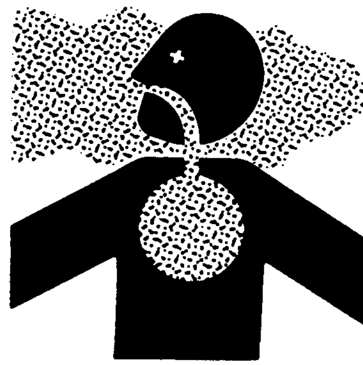
- Clean work area and machine.
- Make sure you have all necessary tools to do your job.
- Have the right parts on hand.
- Read all instructions thoroughly; do not attempt shortcuts.



T6642EJ –UN–18OCT88

DX,CLEAN –19–04JUN90–1/1

Remove Paint Before Welding or Heating



TS220 –UN–23AUG88

Avoid potentially toxic fumes and dust.

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

Remove paint before heating:

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

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

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

Dispose of paint and solvent properly.

DX,PAINT –19–24JUL02–1/1

Avoid Heating Near Pressurized Fluid Lines

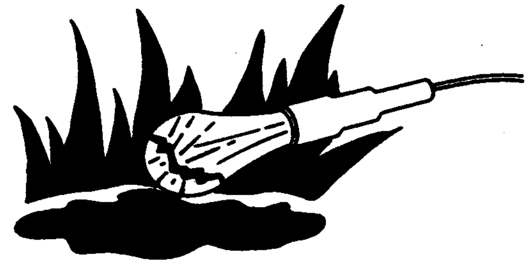
Flammable spray can be generated by heating near pressurized fluid lines, resulting in severe burns to yourself and bystanders. Do not heat by welding, soldering, or using a torch near pressurized fluid lines or other flammable materials. Pressurized lines can be accidentally cut when heat goes beyond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

TS953 –UN–15MAY90

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

DX,LIGHT –19–04JUN90–1/1

Practice Safe Maintenance

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

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

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

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

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

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

TS218 –UN–23AUG88

DX,SERV –19–17FEB99–1/1

Use Proper Tools

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

Use power tools only to loosen threaded parts and fasteners.

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

Use only service parts meeting John Deere specifications.

TS779 –UN–08NOV89

DX,REPAIR –19–17FEB99–1/1

Dispose of Waste Properly

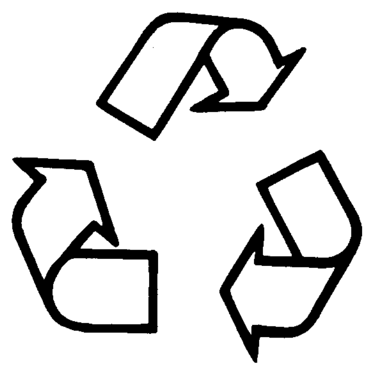
Improperly disposing of waste can threaten the environment and ecology. Potentially harmful waste used with John Deere equipment include such items as oil, fuel, coolant, brake fluid, filters, and batteries.

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

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

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

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



TS1133 –UN–26NOV90

DX,DRAIN –19–03MAR93–1/1

Live With Safety

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

TS231 –19–07OCT88

DX,LIVE –19–25SEP92–1/1

Engine Model Designation

Example: John Deere Engine Model—6105HRW01

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

6105HRW01 Engine

6	Number of cylinders
10.5	Liter designation
H	Aspiration
RW	User code
01	Application Code

Aspiration Code

A	Turbocharged and air-to-coolant aftercooled
H	Turbocharged and air-to-air aftercooled

User Code

DW	Davenport (Heavy-Duty Industrial) Works
F	OEM
RW	Waterloo (Tractor) Works
T8	Cameco
Z	Zweibrucken (Forage Harvester) Works

Application Code

01, 02, etc.,	Code for specific application

RG8427 –UN–21MAY98

Engine Serial Number Plate

RG,RG34710,23 –19–11OCT00–1/1

Engine Serial Number Plate Information

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

1. Example Engine Serial Number (A)

   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:

RG6105H000000

RG .... Factory code producing engine
6105H .... Engine model designation
000000 .... Sequential number

Factory Code Producing Engine

RG .... Waterloo Engine Works

Engine Model Designation

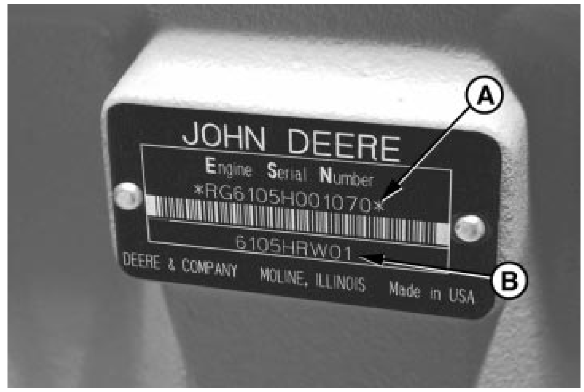
6105H .... See Engine Model Designation on previous page

Sequential Number

000000 .... 6-digit sequential number

2. Engine Application Data (B)

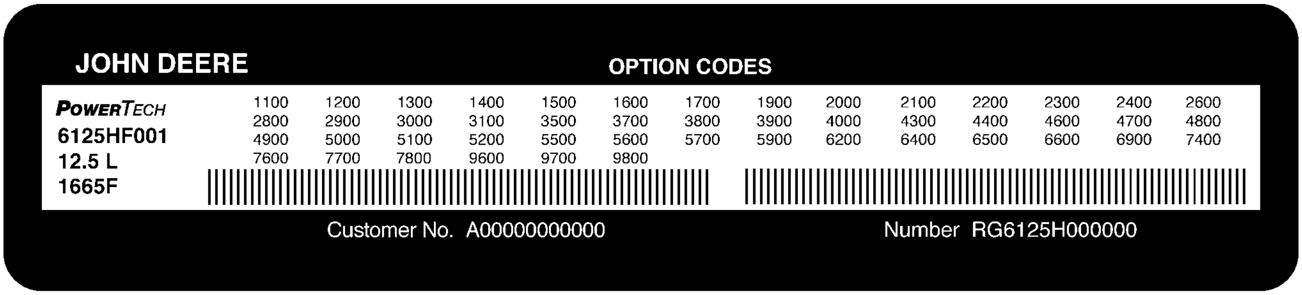
   The second line of information on the engine serial number plate identifies the engine/Deere machine or OEM relationship. See ENGINE APPLICATION CHART later in this group.



Example Engine Serial Number Plate

RG,RG34710,24 –19–07NOV00–1/1

Engine Option Code Label



RG8740 –UN–12JUL99

Option Code Label

In addition to the serial number plate, OEM engines have an engine option code label affixed to the rocker arm cover. These codes indicate which of the engine options were installed on your engine at the factory.

When in need of parts or service, furnish your authorized servicing dealer or engine distributor with these numbers.

DPSG,OUO1004,917 –19–30JUN99–1/1

Engine Application Chart

John Deere Agricultural Equipment Applications

Machine Model No.	Engine Model
TRACTORS—4-WHEEL DRIVE	
9200	6105HRW01, 6125HRW02
9300	6125HRW01, 6125HRW11
9400	6125HRW02, 6125HRW12
TRACTORS—LTV TRACKS	
9300T	6125HRW03
9400T	6125HRW04
FORAGE HARVESTERS — SELF-PROPELLED	
6750	6125HZ002, 6125HZ006
6850	6125HZ001, 6125HZ005
CANE HARVESTER (CAMECO)	
CH2500	6125AT801

John Deere Construction Equipment Application

Machine Model No.	Engine Model
744H Loader—4-Wheel Drive	6125ADW01
744H/MH Log Loader	6125ADW01
230LC Excavator	6125ADW70

Original Equipment Manufacturers (OEM) Applications

Machine Model No.	Engine Model
OEM	6105AF001 6105HF001 6125AF001 6125AFM01 6125HF001

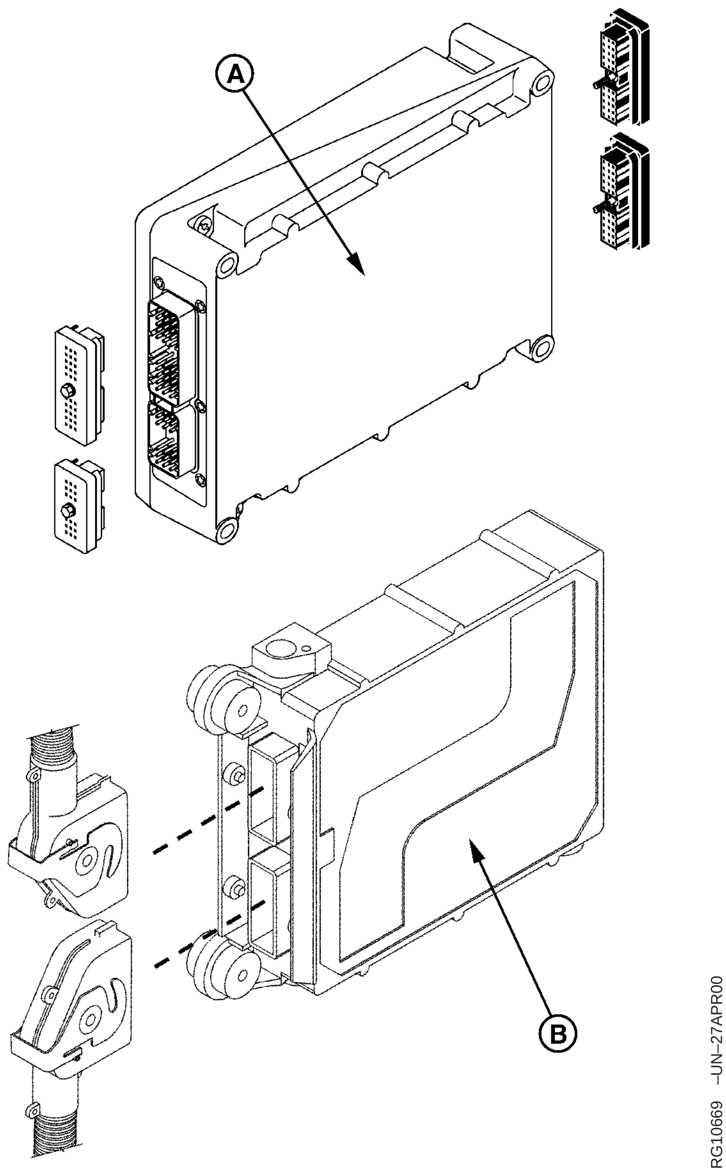
RG,RG34710,25 –19–11OCT00–1/1

Distinguishing ECUs

The Lucas ECU is used on earlier 10.5 L/12.5 L Diesel Engines. This manual (CTM 115) supports all fuel and control system repair, theory of operation, diagnostics and tests for engines that use this controller. This controller (B) has 2 connectors going into it.

The John Deere Level 6 ECU is used on later 10.5 L/12.5 L Diesel Engines. CTM 188 supports all fuel and control system repair, theory of operation, diagnostics and tests for engines that use this controller. The John Deere Level 6 (A) has 4 connectors going into it. Please refer to the drawing below to determine the controller that is being used.

RG40854,000006B –19–31JAN01–1/2



Distinguishing between the Lucas and the John Deere Level 6 ECU

A—John Deere Level 6 ECU **B—Lucas ECU**

RG40854,000006B –19–31JAN01–2/2

Lubricants and Coolant

NOTE: Refer to Section 01, Group 002 of CTM100 Base Engine Manual for information on lubricants and coolants.

OUO1004,0000C15 –19–17NOV00–1/1

Diesel Fuel

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

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

Diesel fuels specified to EN 590 or ASTM D975 are recommended.

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% sulfur content 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%.

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

RG40854,0000027 –19–19MAR01–1/1

Bio-Diesel Fuel

Bio-diesel fuels may be used ONLY if the fuel properties meet DIN 51606 or equivalent specification. It has been shown that bio-diesel fuels have been found to improve lubricity in concentrations up to 5% blend in petroleum diesel fuel.

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

Users of bio-diesel fuel should always remember that a major selling merit is its ability to biodegrade, so the storage and handling of this fuel is very important. This importance can be seen in the following areas of concern:

- The quality of the fresh 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/blocked injector nozzles, leading to poor atomization of fuel,
- Filter plugging,
- Lacquering/seizure of internal components,
- Sludge and sediments,
- Reduced service life.

Continued on next page

RG40854,0000028 –19–19MAR01–1/2

Bio-Diesel Property List for DIN 51606		
Property	**Unit**	**DIN 51606 Sept 1997**
Density at 15° C (59° F)	g/cm³ (lb/ft³)	0.875—0.900 (55—56)
Viscosity at 40° C (104° F)	mm²/s (cST)	3.5—5.0
Flash Point	°C (°F)	Min. 110 (230)
Cold Filter Plugging Point—Summer	°C (°F)	Max. 0 (32)
Cold Filter Plugging Point—Winter	°C (°F)	Max. -20 (-4)
Total Sulfur	% Mass	0.01
Conradson (CCR) at 100%	% Mass	Max. 0.05
Cetane Number	—	Min. 49
Ash Content	% Mass	Max. 0.03
Water Content	% Mass	Max. 0.03
Total Contamination	% Mass	Max. 0.002
Copper Corrosion (3 hours, 50° C) (3 hours, 122° F)	Degree of Corrosion	1
Neutralization Value	mg KOH/g	Max. 0.5
Methanol Content	% Mass	Max. 0.3
Monoglycerides	% Mass	Max. 0.8
Diglycerides	% Mass	Max. 0.4
Trigycerides	% Mass	Max. 0.4
Free Glycerine	% Mass	Max. 0.02
Total Glycerine	% Mass	Max. 0.25
Iodine Number	—	Max. 115
Phosphorus	% Mass	Max. 0.001
Alkali Content (Na + K)	% Mass	Max. 0.0005

RG40854,0000028 –19–19MAR01–2/2

Lubricity of Diesel Fuel

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

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

Sulfur content of diesel fuel for highway use is less than 0.05% (500 ppm) in the United States and Canada, and less than 0.035% (350 ppm) in the European Union.

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 load level of 3100 grams as measured by ASTM D6078 or maximum scar diameter of 0.45 mm as measured by ASTM D6079 or ISO 12156-1.

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

DX,FUEL5 –19–19DEC03–1/1

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.

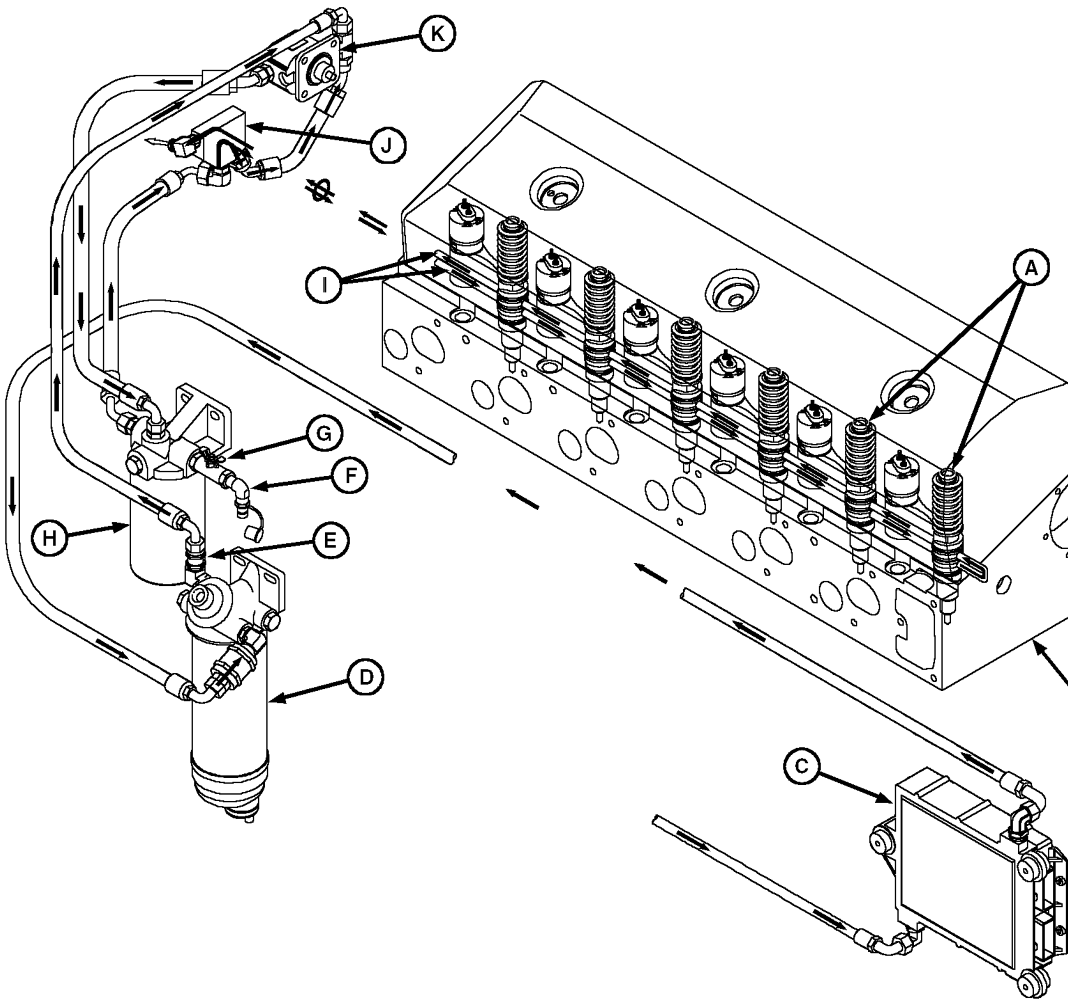
DIESELSCAN is a trademark of Deere & Company

DX,FUEL6 –19–06DEC00–1/1

Section 02
Repair and Adjustments

Contents

Fuel System Components



Fuel System Components (Dual Rail)

A—Electronic Unit Injector (EUI) (6 used)
B—Cylinder Head
C—ECU (Engine Control Unit)
D—Primary Fuel Filter/Water Separator/Primer Pump
E—Check Valve
F—Diagnostic Fitting
G—Air Purge Valve[1]
H—Final Fuel Filter
I—Fuel Supply Rails
J—Fuel Manifold
K—Fuel Supply Pump

6125ADW engines and 6125HF(AF) are shown above. 6105HRW and 6125HRW engines have fuel system components located on left side of engine as viewed from flywheel end as shown in FLUSH FUEL RAILS later in this group. Service procedures are same for both engines.

[1]*On some applications, purge valve (G) is installed in-line on opposite side of filter header.*

Continued on next page

RG,RG34710,257 –19–13JUN01–1/2

IMPORTANT: During engine repair, cleanliness of the fuel supply rails (I) in cylinder head (B) is extremely important due to fuel flow through passages. Think of the fuel rails as internal passages of an injection pump; therefore, the same cleanliness must be maintained.

RG,RG34710,257 –19–13JUN01–2/2

Replace Final (Secondary) Fuel Filter Element

Remove Old Final Fuel Filter

1. Close fuel shut-off valve at bottom of fuel tank (not illustrated).

2. Clean entire area surrounding fuel filter assembly to keep debris from entering fuel system.

3. Remove final fuel filter using a suitable filter wrench (A). Dispose of fuel and filter in an environmentally safe manner.

Install New Final Fuel Filter

1. If removed, install fuel filter mounting bracket and tighten cap screws to the following specifications.

Specification	
Fuel Filter Header-to-Bracket—Torque	50 N•m (37 lb-ft)
Fuel Filter Bracket-to-Head—Torque	35 N•m (26 lb-ft)
Fuel Filter Bracket-to-Block—Torque	65 N•m (48 lb-ft)
Fuel Filter-to-Air Intake—Torque	25 N•m (18 lb-ft)

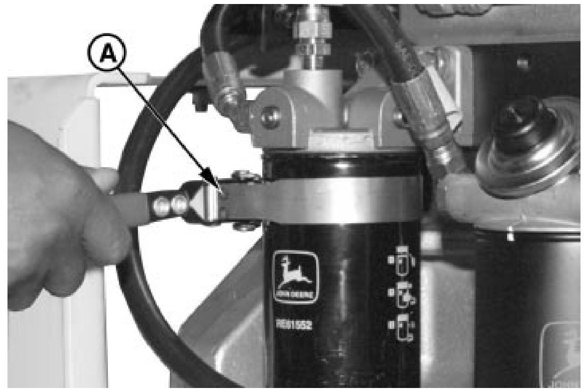
2. Clean filter gasket sealing surface with a clean, lint-free towel.

3. Apply a light coating of clean engine oil to filter gasket/O-ring (B).

4. Fill filter element with clean diesel fuel.

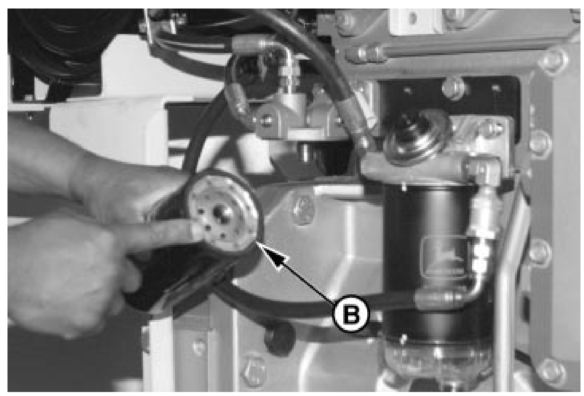
5. Install filter element onto threaded adapter and tighten until gasket contacts sealing surface on mounting base. Then, tighten an additional 3/4 turn.

6. Open fuel shut-off valve and bleed the fuel system. See BLEED FUEL SYSTEM later in this group.



RG8720 –UN–05DEC97

Removing Final Fuel Filter



RG8721 –UN–05DEC97

Installing Final Fuel Filter

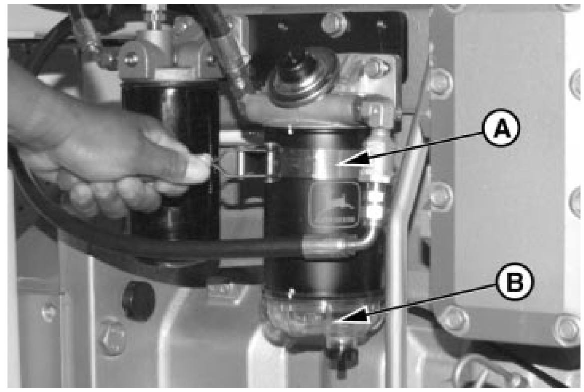
A—Fuel Filter Wrench
B—Filter Gasket/O-Ring

RG,RG34710,258 –19–26OCT00–1/1

Replacing Primary Fuel Filter/Water Separator

Remove Old Primary Fuel Filter/Water Separator

1. Close fuel shut-off valve at bottom of fuel tank (not illustrated).
2. Clean entire area surrounding fuel filter assembly to keep debris from entering fuel system.
3. Remove primary fuel filter using a suitable filter wrench (A). Drain filter element and sediment bowl into appropriate container.
4. Clamp filter element in a vise and remove clear water separator bowl (B).
5. Thoroughly clean sediment bowl and dry with compressed air.



RG8722 –UN–05DEC97

Removing Primary Fuel Filter

A—Filter Wrench
B—Clear Water Separator Bowl

Continued on next page RG,RG34710,259 –19–03AUG99–1/2

Install New Primary Fuel Filter/Water Separator

1. If removed, install fuel filter mounting bracket and tighten cap screws to the following specifications.

Specification

Fuel Filter Bracket-to-Head—Torque	35 N•m (26 lb-ft)
Fuel Filter Bracket-to-Block—Torque	65 N•m (48 lb-ft)
Primary Fuel Filter Header-to-Bracket—Torque	50 N•m (37 lb-ft)

2. Lubricate sediment bowl O-ring with clean engine oil and install onto new filter element. Tighten bowl an additional 1/2 turn after O-ring contacts filter element.

3. Apply a light coating of engine oil to filter gasket/O-ring (A).

4. Close sediment bowl drain adapter and fill filter element with clean diesel fuel.

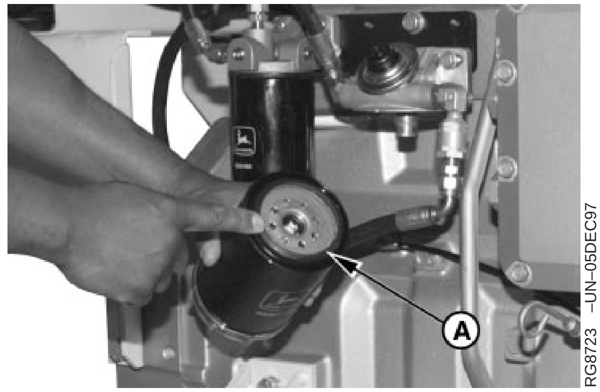
5. Install filter element onto threaded adapter and tighten until gasket contacts sealing surface on mounting base. Then, tighten an additional 1-1/2 turn.

6. Install any plugs removed from filter header and tighten to specifications.

Specification

Primary Fuel Filter Header Plugs—Torque	47 N•m (35 lb-ft)

7. Open fuel shut-off valve and bleed the fuel system. See BLEED FUEL SYSTEM in this group.



Installing Primary Fuel Filter

A—Filter Gasket/O-Ring

RG,RG34710,259 –19–03AUG99–2/2

Remove and Install Air Purge Valve

NOTE: Purge valves are located on outlet side of fuel filter.

1. Disconnect fuel line (B) or remove elbow (D) as required.

2. Remove air purge valve.

3. Install air purge valve. Tighten line (B) to specifications.

Specification

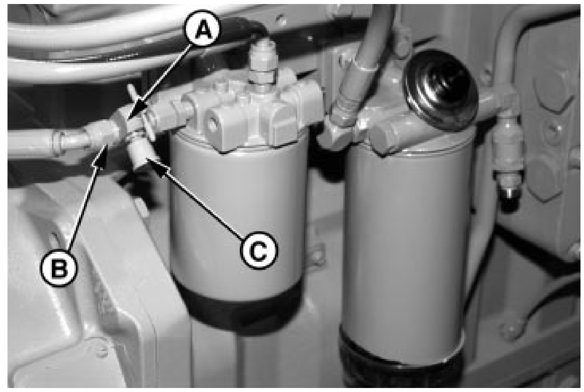
Fuel Line-to-Fuel Filter/Air Purge Valve—Torque .... 24 N•m (18 lb-ft)

4. Install elbow (D) and diagnostic port fitting (E) if removed. Tighten diagnostic fitting to specifications.

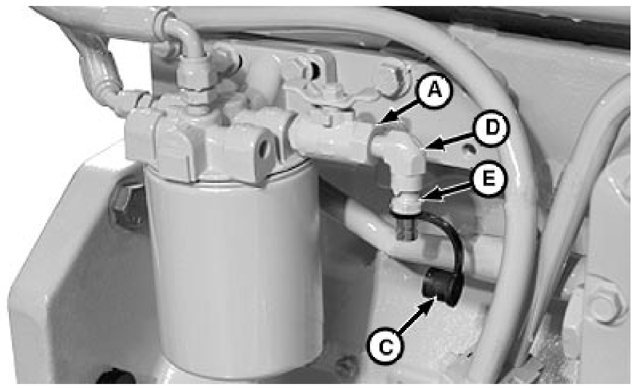
Specification

Air Purge Valve Diagnostic Port Fitting—Torque .... 24 N•m (18 lb-ft)

5. Install cap (C).



In-Line Purge Valve



Header Mounted Purge Valve

A—Purge Valve
B—Filter Outlet Line
C—Cap
D—Elbow
E—Diagnostic Port Fitting

DPSG,OUO1004,975 –19–03AUG99–1/1

Remove and Install Primary Fuel Filter Check Valve

NOTE: Fuel filter check valve is located in an outlet port on the fuel filter header. Depending on engine application, it may be located on left or right-hand side of header. Additionally, check valve may connect directly to header port or to elbow (C).

1. Disconnect fuel line (A) and remove check valve (B). Remove O-rings from both ends of check valve.

2. Apply LOCTITE® 242 Thread Lock and Sealer to threads on check valve and install valve on elbow (C) or header. Tighten valve to specifications.

Specification

Fuel Filter Check Valve to Fuel Filter Header or Elbow on Header—Torque .... 46 N•m (34 lb-ft)

3. If elbow (C) was removed, apply LOCTITE® 242 Thread Lock and Sealer to threads of elbow and install in fuel filter header. Tighten elbow lock nut to specifications.

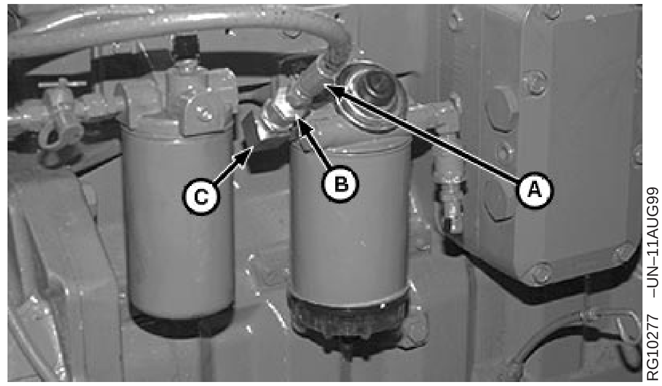
Specification

Elbow, Fuel Filter Check Valve-to-Filter Header—Torque .... 46 N•m (34 lb-ft)

4. Connect fuel line (A) and tighten to specifications.

Specification

Fuel Line-to-Fuel Filter Check Valve—Torque... 24 N•m (18 lb-ft)



Fuel Filter Check Valve

A—Fuel Filter Outlet Line
B—Check Valve
C—Elbow

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DPSG,OUO1004,976 –19–03AUG99–1/1

Remove and Install Fuel System Surge Tank (6125ADW01/70 Engines)

1. Disconnect fuel line from adapter (C) (shown disconnected).

2. Disconnect fuel line (E).

   Cap and plug all lines and fittings to prevent fuel system contamination.

3. Remove surge tank (A) from mounting bracket (B).

4. If fuel line adapters (C) and (F) are removed, install new O-rings in adapters and install adapters in surge tank. Tighten adapters to the following specifications.

Specification
Surge Tank Fuel Line Adapter (Top)—Torque .... 46 N•m (34 lb-ft)
Surge Tank Fuel Line Adapter (Bottom)—Torque .... 39 N•m (29 lb-ft)

5. If removed, install mounting bracket (B) and tighten cap screws to specifications.

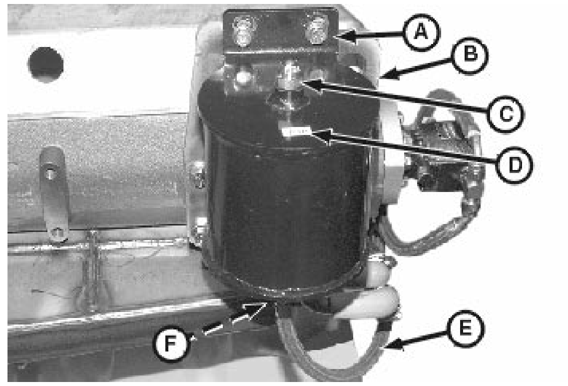
Specification
Surge Tank Mounting Bracket-to-Cylinder Head Cap Screws—Torque .... 130 N•m (95 lb-ft)

6. Install surge tank on mounting bracket with end labeled "TOP" (D) in the up position as shown. Center cap screws in surge tank slots and tighten to specifications.

Specification
Surge Tank-to-Mounting Bracket Cap Screws—Torque .... 50 N•m (37 lb-ft)

7. Connect fuel lines and tighten to specifications.

Specification
Surge Tank Fuel Lines—Torque .... 24 N•m (18 lb-ft)



RG10292 –UN–09SEP99

Surge Tank

A—Surge Tank
B—Mounting Bracket
C—Line Adapter (Fuel Tank Return Line)
D—Label (Marked "TOP")
E—Fuel Line (Surge Tank-to-Fuel Manifold)
F—Line Adapter (Fuel Manifold Line)

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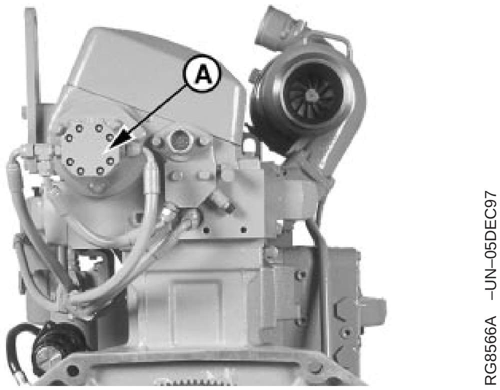
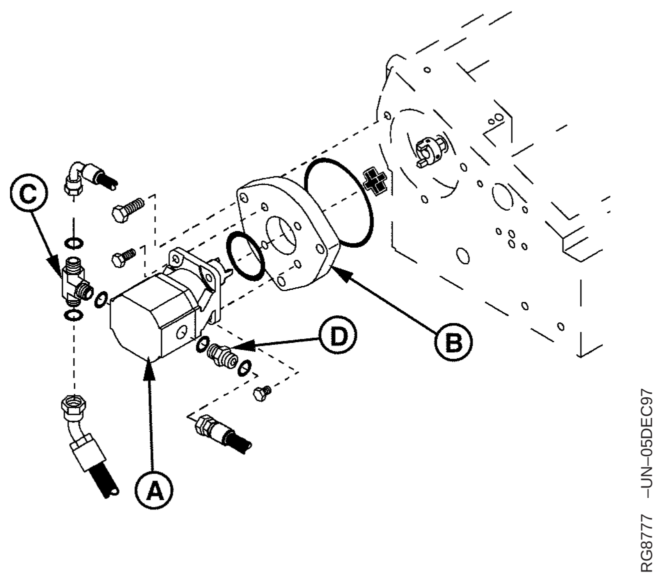
DPSG,OUO1004,1007 –19–26OCT00–1/1

Remove and Install Fuel Supply Pump



Fuel Supply Pump



Fuel Supply Pump Exploded View

A—Fuel Supply Pump **B—Mounting Bracket** **C—Tee Fitting** **D—Straight Fitting**

IMPORTANT: Plug or cap all fuel system connections and passages as lines or components are removed to keep debris out using JDG998 Fuel System Cap Plug Kit.

Remove Fuel Manifold

NOTE: Label fuel lines as they are disconnected to ensure correct reassembly.

1. Remove three fuel lines connected to fuel supply pump (A). Cap all lines and fittings to keep debris out of fuel system.

2. Remove four cap screws securing supply pump to mounting bracket (B) and remove pump. Remove and discard O-ring.

NOTE: Fuel supply pump is not serviceable; replace pump if determined to be defective.

3. Remove tee fitting (C) and straight fitting (D) from pump and clean thoroughly if pump is to be replaced.

Install Fuel Supply Pump

1. Install tee fitting and straight fitting onto new pump (using new O-rings) in same orientation as on original pump. Tighten fittings securely.

2. Ensure that drive coupler set screw is tightened to specifications on supply pump drive shaft with end of shaft flush with coupler ID. Check drive coupler on camshaft drive pin also; adjust as needed.

Specification

Fuel Supply Pump and
Camshaft Drive Coupler Set
Screws—Torque .... 4 N•m (3 lb-ft)

3. Position new rubber spider (vibration absorber) on drive coupler. Position new O-ring on face of supply pump.

4. If removed, apply AR54749 Soap Lubricant to new O-ring on supply pump mounting bracket (B) and install. Tighten mounting bracket cap screws to specifications.

Continued on next page

Specification

Fuel Supply Pump Mounting Bracket Cap Screws—Torque .... 50 N•m (37 lb-ft)

5. Install fuel supply pump with rubber spider properly meshed with coupler on rear of camshaft.

6. Install four cap screws and tighten to specifications.

Specification

Fuel Supply Pump-to-Bracket—Torque... 25 N•m (18 lb-ft)

IMPORTANT: Before connecting ORFS fuel line fittings, be sure O-ring is correctly positioned in the groove of fitting. Tighten fitting ONLY to specified torque. DO NOT OVERTIGHTEN.

7. Install three fuel lines and tighten to specifications.

Specification

Fuel Line ORFS Fittings—Torque.. 24 N•m (18 lb-ft)

RG,RG34710,260 –19–13JUN01–2/2

02
090
10

Remove and Install Fuel Manifold

IMPORTANT: Plug or cap all fuel system connections and fuel rail passages as lines or components are removed to keep debris out using JDG998 Fuel System Cap Plug Kit.

Remove Fuel Manifold

1. Disconnect wiring lead from fuel temperature sensor (E).

2. Remove three fuel lines from fuel manifold (A). Cap all lines and fittings to keep debris out of fuel system.

IMPORTANT: Plug fuel rails with clean plugs from JDG998 Fuel System Cap Plug Kit to keep dirt and debris out even if rail is to be open for a short period of time.

3. Remove two cap screws securing fuel manifold to cylinder head and remove manifold. Remove O-ring (B) and discard.

Install Fuel Manifold

1. Install fuel manifold using new O-ring. Tighten cap screws to specifications.

Specification

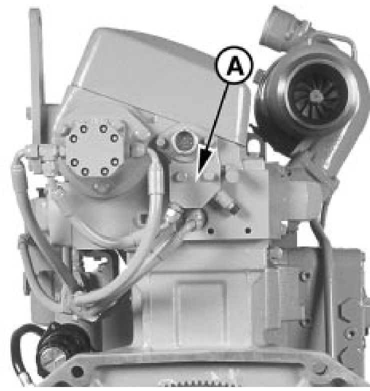
Fuel Manifold-to-Head—Torque .... 35 N•m (26 lb-ft)

IMPORTANT: Before connecting ORFS fuel line fittings, be sure O-ring is correctly positioned in the groove of fitting. Tighten fitting ONLY to specified torque. DO NOT OVERTIGHTEN.

2. Install fuel lines with O-rings and tighten to specifications.

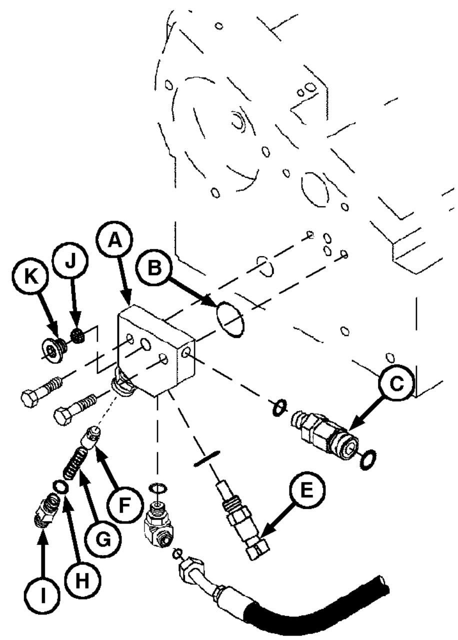
Specification

Fuel Lines-to-Fuel Manifold—
Torque .... 24 N•m (18 lb-ft)



RG8566B –UN–05DEC97

Fuel Manifold



RG10240 –UN–05NOV99

Fuel Manifold Exploded View

A—Fuel Manifold
B—O-Ring
C—Check Valve
D—Not Used
E—Temperature Sensor
F—Pressure Regulating Valve
G—Spring
H—O-Ring
I—Fitting
J—Screen[1]
K—Plug

[1]*On earlier engines, screen was located in end of check valve (C).*

Continued on next page RG,RG34710,261 –19–13JUN01–1/2

3. Install fuel temperature sensor wiring lead.

RG,RG34710,261 –19–13JUN01–2/2

Inspect Fuel Pressure Regulating Valve and Return Check Valve

1. Carefully remove parts (A—C). Do not drop pressure regulating valve (C).

IMPORTANT: The pressure regulating valve (C) should come out with the spring. If the valve is stuck in the fuel manifold, replace the fuel manifold and flush the fuel rail. See REMOVE AND INSTALL FUEL MANIFOLD earlier in this group. See FLUSH FUEL RAILS later in this group.

2. Inspect the pressure regulating valve for debris. If debris is found, clean valve assembly and flush the fuel rail. See FLUSH FUEL RAILS later in this group.

3. Remove fuel return check valve from manifold block.

4. Inspect screen (D) in end of check valve or remove plug and screen (E) from manifold block and check for debris. Clean screen as required.

5. Reinstall parts in reverse order of removal. Hand tighten return check valve.

6. Whenever the fuel manifold is serviced, air must be removed from the fuel galley.

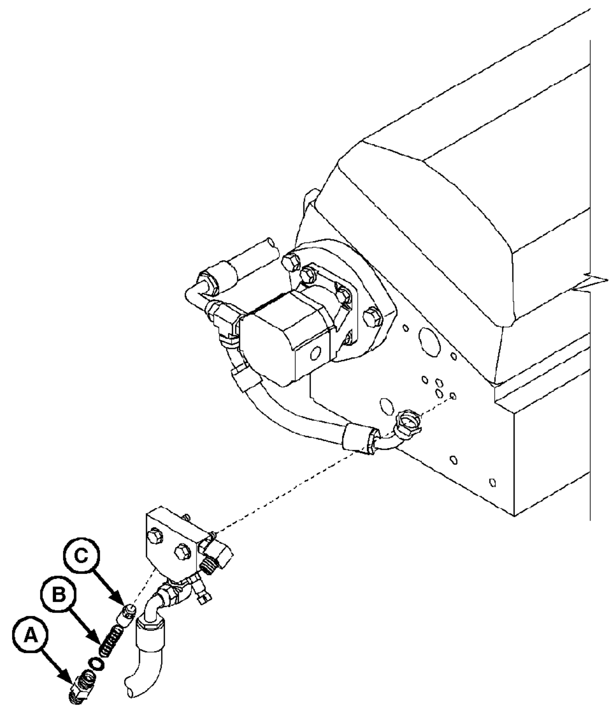
   Loosen return check valve (F) and operate hand primer on fuel filter until air is removed and fuel is leaking past the O-ring.

   Tighten check valve to specifications.

Specification

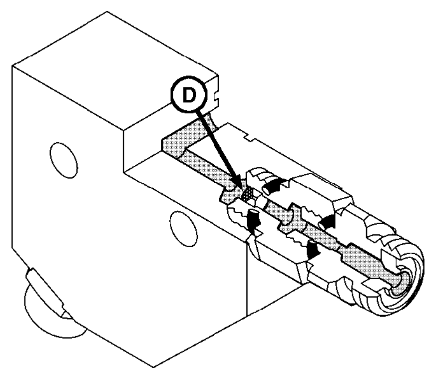
Fuel Return Check Valve (On Manifold)—Torque .... 33 N•m (24 lb-ft)

A—Fitting
B—Spring
C—Pressure Regulating Valve
D—Screen (Early Engines)
E—Screen (Later Engines)
F—Check Valve



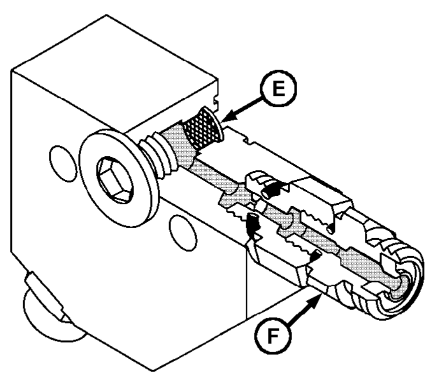
RG10348 –UN–14SEP99

Pressure Regulating Valve



RG10347 –UN–14SEP99

Check Valve with Screen



RG10346 –UN–14SEP99

Fuel Screen and Check Valve

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7. Bleed fuel system. See BLEED FUEL SYSTEM later in this group.

DPSG,OUO1004,1023 –19–13JUN01–2/2

Remove and Install Electronic Unit Injectors

IMPORTANT: Electronic unit injectors on dual rail fuel systems are different from injectors on single rail systems. Use the appropriate injector for engine/fuel system applications. Replace injector with the same type removed. DO NOT intermix injectors.

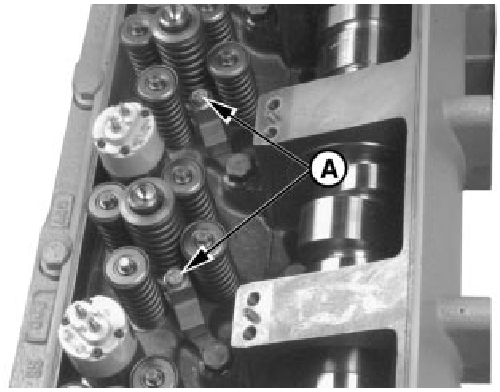
1. Remove rocker arm cover. See REMOVE AND INSTALL ROCKER ARM COVER in CTM100, Section 02, Group 020.

2. Remove rocker arm shaft assembly. See REMOVE ROCKER ARM ASSEMBLY in CTM100, Section 02, Group 020.

3. Disconnect fuel lines and drain fuel from lines and fuel rail in cylinder head.

4. Reconnect lines (or install cap plugs from JDG998 Fuel System Cap Plug Kit) to keep debris out of fuel system.

5. Remove injector hold-down clamp cap screws (A).



RG8279 –UN–05DEC97

Unit Injector Clamp Screws

A—Clamp Cap Screws

Continued on next page RG,RG34710,262 –19–04AUG99–1/5

6. Pry upward on the injector hold-down clamp (A) against cylinder head using a prybar (B) as shown.

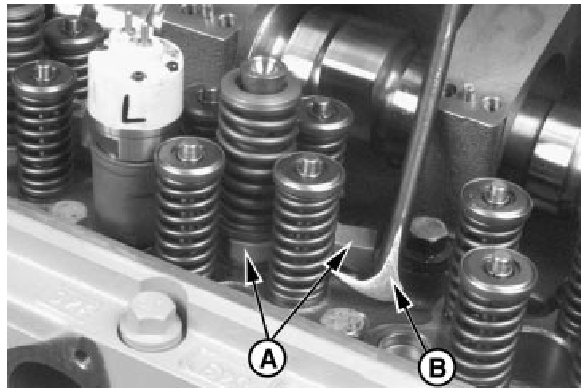
7. Remove injector and clamp from cylinder head. Label injector for installation in same cylinder location as removed.

8. Immediately plug injector bore with clean cap plug to keep debris out of fuel system.

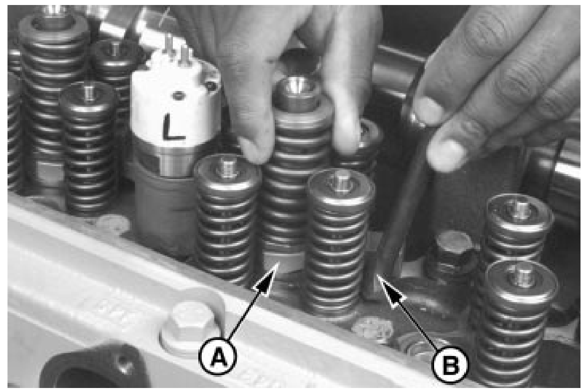
9. Remove injector O-rings (C) and discard.

10. Store injector in a clean, lint-free container.

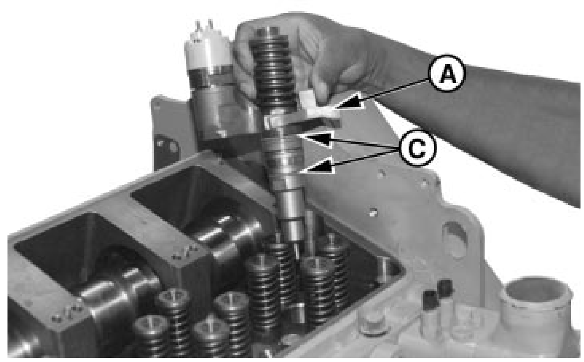
A—Hold-Down Clamp
B—Prybar
C—Injector O-Rings



Position Prybar



Removing Unit Injector



Unit Injector Removed

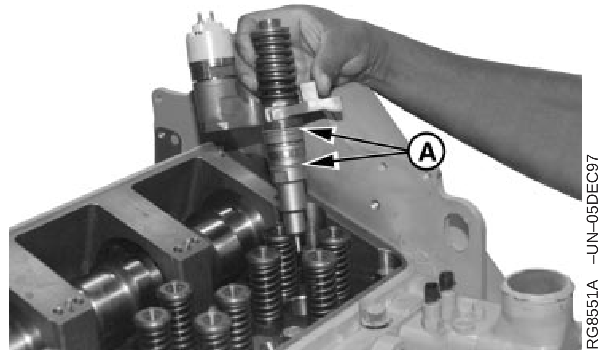
Continued on next page RG,RG34710,262 –19–04AUG99–2/5

Install Electronic Unit Injectors

1. Remove cap plug from injector bore in cylinder head. Clean entire sleeve using a clean, lint-free cloth wrapped around a wooden stick.

2. Install two new O-rings (A) on unit injector body. Lubricate O-rings with clean engine oil or AMOJELL lubricant.

A—O-Rings



Installing Unit Injector

Continued on next page RG,RG34710,262 –19–04AUG99–3/5

IMPORTANT: Press on top of injector plunger with palm of hand to properly seat O-rings and center injector between valve springs.

NOTE: New EUI hold-down clamp cap screws have pre-applied sealant.

3. Install unit injector with hold-down clamp into same cylinder as removed (solenoid outward toward exhaust manifold side of engine at equal distance between exhaust valve springs). Apply LOCTITE® 242 Thread Lock and Sealer to **used** hold-down cap screw. Initially tighten cap screw to specifications.

Specification

Electronic Unit Injector
Hold-Down Clamp Cap Screws—
Initial Torque.. 20 N•m (15 lb-ft)

4. Mark head of cap screw at twelve o'clock position (A) (viewed from rear) using a paint stick.

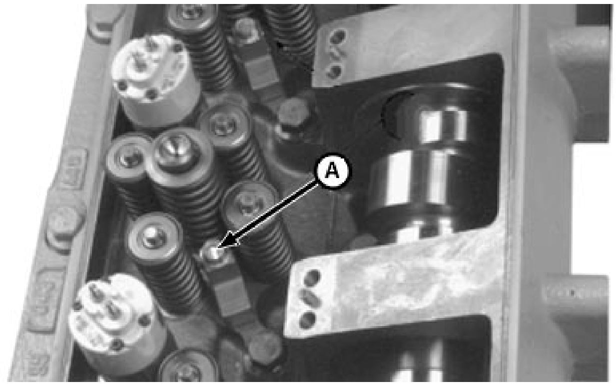
5. Install 13 mm swivel socket on head of cap screw. Position ratchet handle (B) parallel with centerline of engine camshaft/crankshaft.

   Torque-turn cap screw to the following specification.

Specification

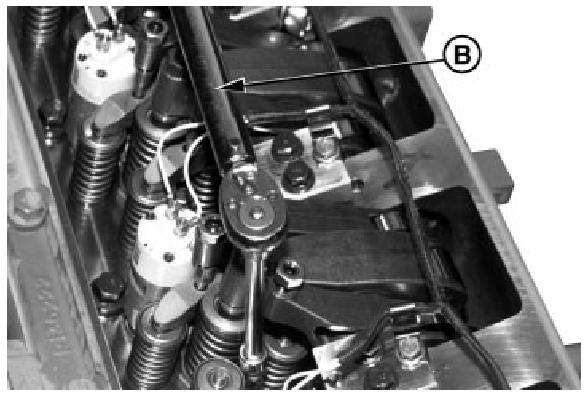
Electronic Unit Injector
Hold-Down Clamp Cap Screws—
Final Torque-Turn.. 90—100°

6. Remove socket from head of cap screw and verify that mark has been tightened/turned at least 90° but not more than 100° from its original position.



RG10249 –UN–30JUL99

Injector Hold-Down Clamp Screws



RG9574 –UN–04DEC98

Torque-Turn EUI

A—Clamp Cap Screw
B—Ratchet Handle

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RG,RG34710,262 –19–04AUG99–4/5

IMPORTANT: DO NOT use red or blue LOCTITE® on solenoid studs. Bonding strength is too high for small studs, making future removal impossible without twisting off stud.

7. Reconnect injector solenoid wiring leads onto solenoid studs. Apply LOCTITE® 222 Small Screw Thread Locker (TY24311) to studs and tighten retaining nuts (B) to specifications.

Specification

Electronic Unit Injector Harness Connector Nuts—Torque .... 2 N•m (1.75 lb-ft) (18 lb-in.)

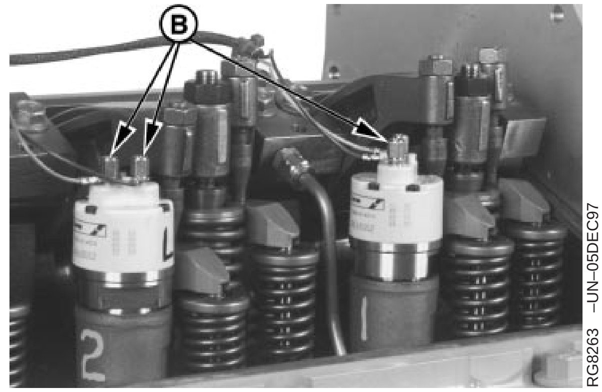
8. Install valve bridges, push tubes, and rocker arm assembly. Adjust valve stem-to-bridge clearances. See INSTALL ROCKER ARM ASSEMBLY in CTM100, Section 02, Group 020.

9. If removed or loosened, tighten all harness and line clamps to specifications.

Specification

Fuel Line Clamps—Torque .... 5 N•m (4 lb-ft)
Electronic Unit Injector Harness-to-Shaft Clamps—Torque .... 35 N•m (26 lb-ft)
Electronic Unit Injector Wiring Connector Bracket-to-Head—Torque .... 25 N•m (18 lb-ft)

10. Adjust electronic unit injector preload as detailed later in this group.



Wiring Terminal Nuts

B—Retaining Nuts

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RG,RG34710,262 –19–04AUG99–5/5

Adjust Electronic Unit Injector Preload

1. Remove plug from cylinder block and install JDG820 Flywheel Turning Tool (B).

IMPORTANT: Timing pin MUST BE installed in slot of camshaft first. Then install second timing pin in crankshaft slot by carefully rocking flywheel back and forth.

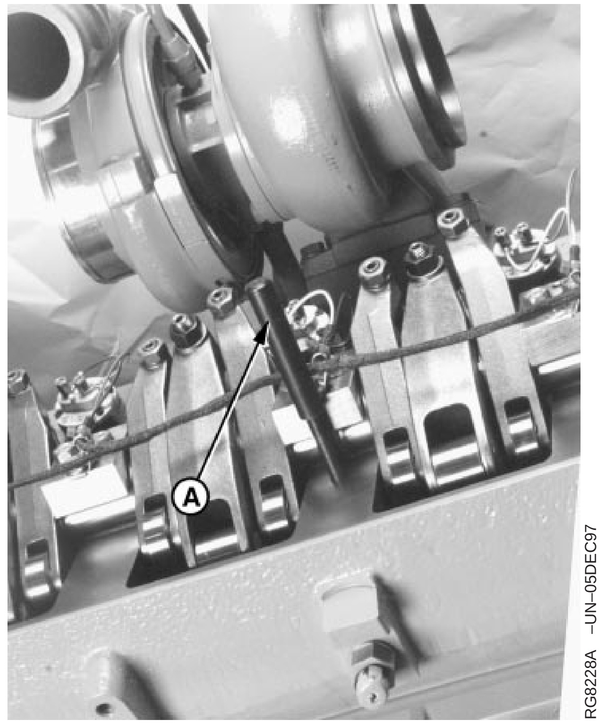
2. Rotate engine flywheel in running direction (counterclockwise as viewed from rear) until JDG971 Timing Pin (A) engages single timing slot (D) in camshaft. The proper timing slot can be found by viewing camshaft timing lobe through camshaft timing pin bore while rotating engine. The double timing slot (E) will be at approximately 11 o'clock (viewed from rear of engine) when pin is installed in slot (D).This ensures that engine is locked at TDC of No. 1 cylinder's compression stroke. Intake and exhaust rocker arms on No. 1 cylinder should be loose.

3. Remove threaded plug from crankshaft timing hole below oil cooler and filter housing assembly.

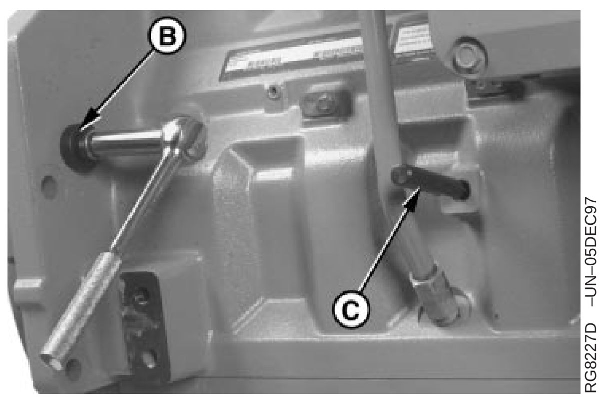
IMPORTANT: DO NOT insert timing pin full depth into cylinder block crankshaft timing hole when rotating engine flywheel until double slot on camshaft timing lobe is at approximately 11 o'clock (viewed from rear of engine) to avoid crankshaft counterweight bending timing pin.

4. Slightly move engine flywheel back and forth with turning tool until a second JDG971 Timing Pin (C) can be installed in slot in crankshaft. This ensures that camshaft and crankshaft are in sync (properly timed).

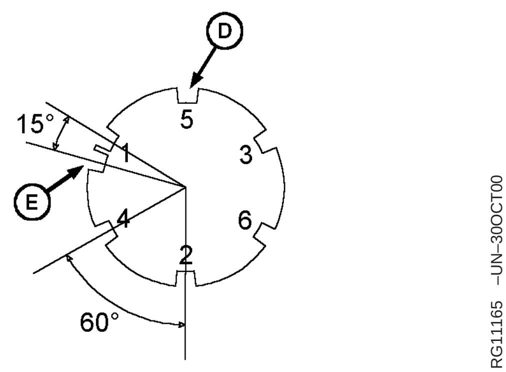
A—JDG971 Timing Pin
B—JDG820 Flywheel Turning Tool
C—JDG971 Timing Pin
D—Single Timing Slot
E—Double Timing Slot



JDG971 Timing Pin in Camshaft



JDG971 Timing Pin in Crankshaft



Camshaft Timing Slot

Continued on next page

If timing pin does not enter crankshaft timing slot, crankshaft is not properly timed with camshaft. Crankshaft MUST BE timed to camshaft. See CHECK AND ADJUST CAMSHAFT- TO- CRANKSHAFT TIMING in CTM100, Section 02, Group 050.

RG,RG34710,263 –19–03NOV00–2/3

5. Loosen lock nut (A) and loosen cylinders Nos. 3, 5, and 6 injector rocker arm adjusting screws (B) to relieve tension.

6. Slowly tighten adjusting screw until rocker arm roller contacts camshaft lobe at 0.0 clearance.

7. Tighten adjusting screw an additional 1/2 turn (180°) to preload injector. Tighten adjusting screw lock nut to specifications while holding adjusting screw stationary.

Specification

Electronic Unit Injector Adjusting Screw Lock Nut—Torque	65 N•m (48 lb-ft)

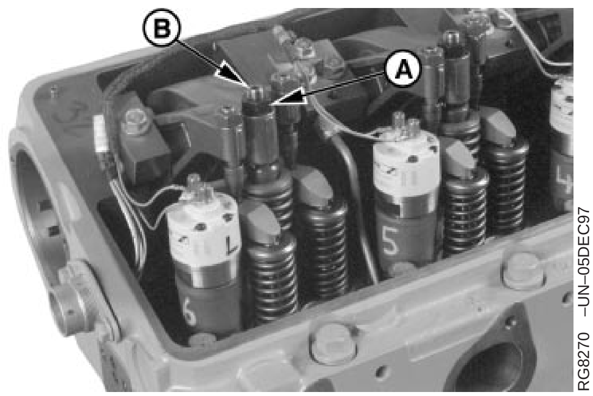
8. Remove both timing lock pins, rotate crankshaft one full revolution (360°) and pin crankshaft only. Engine will now be locked at No. 6 TDC.

9. Set injector preload on cylinders Nos. 1, 2, and 4.

10. Install plug in timing pin hole in block and tighten to specifications.

Specification

Timing Pin Plug in Cylinder Block—Torque	33 N•m (24 lb-ft)



Unit Injector Adjusting Screw

A—Lock Nut
B—Adjusting Screws

RG,RG34710,263 –19–03NOV00–3/3

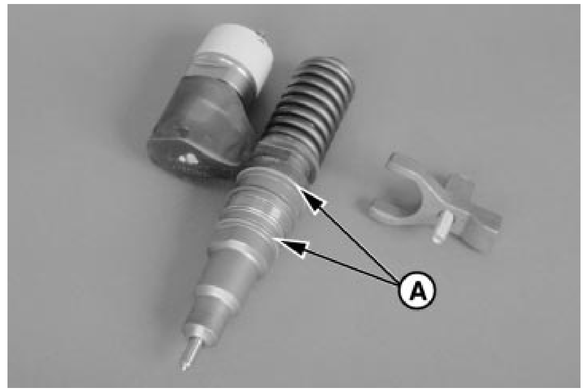
Replace Electronic Unit Injector O-Rings

1. The electronic unit injector's two external O-rings (A) must be replaced whenever injector is removed.

2. Fuel system diagnosis will determine if unit injector is not functioning properly. Refer to Section 04, Groups 150 and 160, as required.

3. Replaced unit injectors will be returned by your authorized servicing dealer to the manufacturer for testing and rebuilding.

A—O-Rings



RG8567 –UN–05DEC97

Unit Injector and Clamp

RG,RG34710,264 –19–20NOV00–1/1

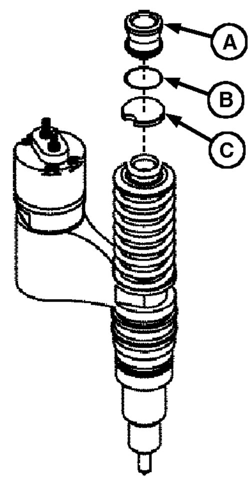
Replace Electronic Unit Injector Thrust Sleeve, Pad and O-Ring

1. Using an O-ring pick, remove O-ring (B).

2. Remove thrust socket (A) and pad (C).

3. Coat parts with clean engine oil and install in reverse order.

A—Thrust Socket
B—O-Ring
C—Thrust Pad

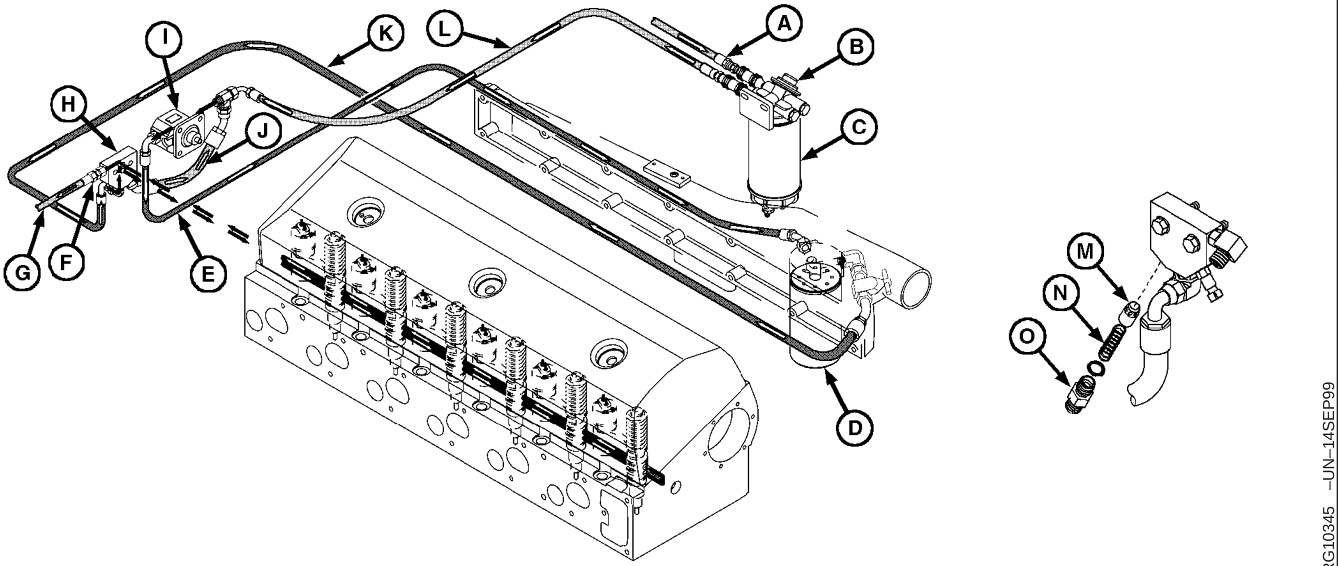


RG10352 –UN–16SEP99

Electronic Unit Injector

DPSG,OUO1004,1027 –19–15SEP99–1/1

Flush Fuel Rails



Flush Fuel Rail (Dual Rail Fuel System)

A—Primary Filter Inlet Check Valve
B—Hand Primer Pump
C—Primary Filter
D—Final Filter
E—Transfer Pump-to-Final Filter (High Pressure)
F—Return-to-Tank Check Valve
G—Return-to-Tank Fuel Line (Low Pressure)
H—Fuel Manifold
I—Fuel Supply Pump
J—Recirculation Fuel Line (Low Pressure)
K—Fuel Inlet Line-to-Fuel Manifold (High Pressure)
L—Primary Filter Outlet-to-Supply Pump Inlet (Low Pressure)
M—Pressure Regulating Valve
N—Spring
O—Fitting

Whenever the fuel system is opened for major service, flush the fuel rails in cylinder head.

1. Disconnect recirculation fuel line (J) from pressure regulating valve and remove parts (M—O). Reinstall fitting (O) and connect fuel line, leaving spring (N) and valve (M) out.

2. Disconnect recirculation line (J) from fuel supply pump inlet fitting and install cap on inlet fitting. Attach the clear line from JT03513 Fuel Supply System Test Kit to the end of the recirculation line and place end in a bucket or route to fuel tank.

3. Operate hand primer pump (B) until clear fuel flows out of the recirculating line into the bucket/fuel tank.

4. Pinch off the recirculation line **(not the plastic line from test kit)** from the fuel manifold to the bucket just long enough to start the engine. When engine starts, release line and allow fuel to flow into bucket/fuel tank. Run engine for five minutes.

5. Stop engine.

6. Disconnect fuel line and remove fitting (O). Install valve (M), spring (N) and fitting (O). Connect fuel line.

7. Remove cap from fuel supply pump inlet fitting and remove clear test line from recirculation line. Connect recirculation line to pump inlet fitting.

8. Tighten fuel lines to specifications.

Specification

Fuel Line ORFS Fittings—
Torque... 24 N•m (18 lb-ft)

Continued on next page

9. Whenever the fuel manifold is opened, air must be removed from the fuel galley.

   Loosen return check valve (F) and operate hand primer on fuel filter until air is removed and fuel is leaking past the O-ring.

   Tighten check valve to specifications.

Specification

Fuel Return Check Valve (On Manifold)—Torque .... 33 N•m (24 lb-ft)

DPSG,OUO1004,1024 –19–08SEP99–2/2

Bleed Fuel System

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

1. Drain water and contaminants from clear water separator sediment bowl (C) by opening drain valve and operating primer until bowl is clear of water and debris.

2. Loosen secondary (final) fuel filter outlet line (A) or remove cap (E) and open air purge valve (D), (if equipped).

3. Pump hand primer (B) on primary filter until a steady flow of fuel (without bubbles) comes out of connection.

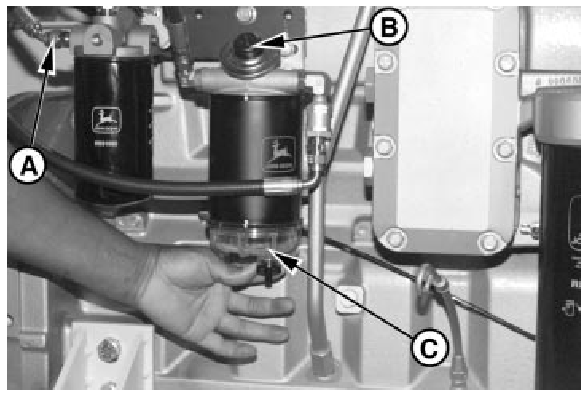
4. Continue pumping hand primer and simultaneously close purge valve or tighten outlet line connection to specifications. DO NOT overtighten.

Specification

Fuel Filter Outlet Line—Torque....................................... 24 N•m (18 lb-ft)

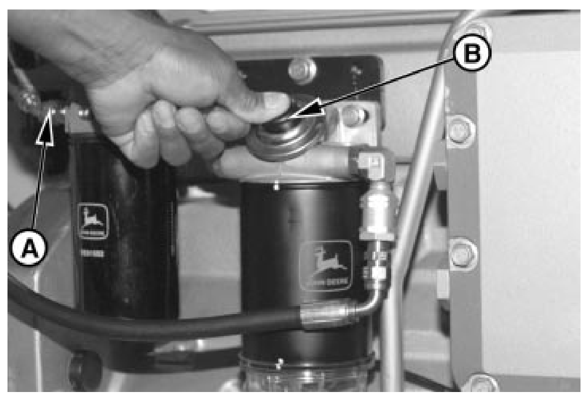
5. Start engine and run at high idle for 5—10 minutes.

A—Fuel Filter Outlet Line
B—Hand Primer
C—Clear Water Separator Sediment Bowl
D—Air Purge Valve
E—Cap



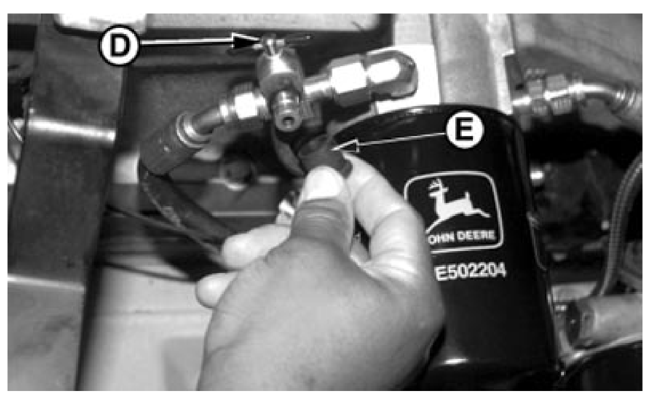
RG8714A –UN–05DEC97

Draining Water Separator



RG8725 –UN–05DEC97

Bleeding Fuel System

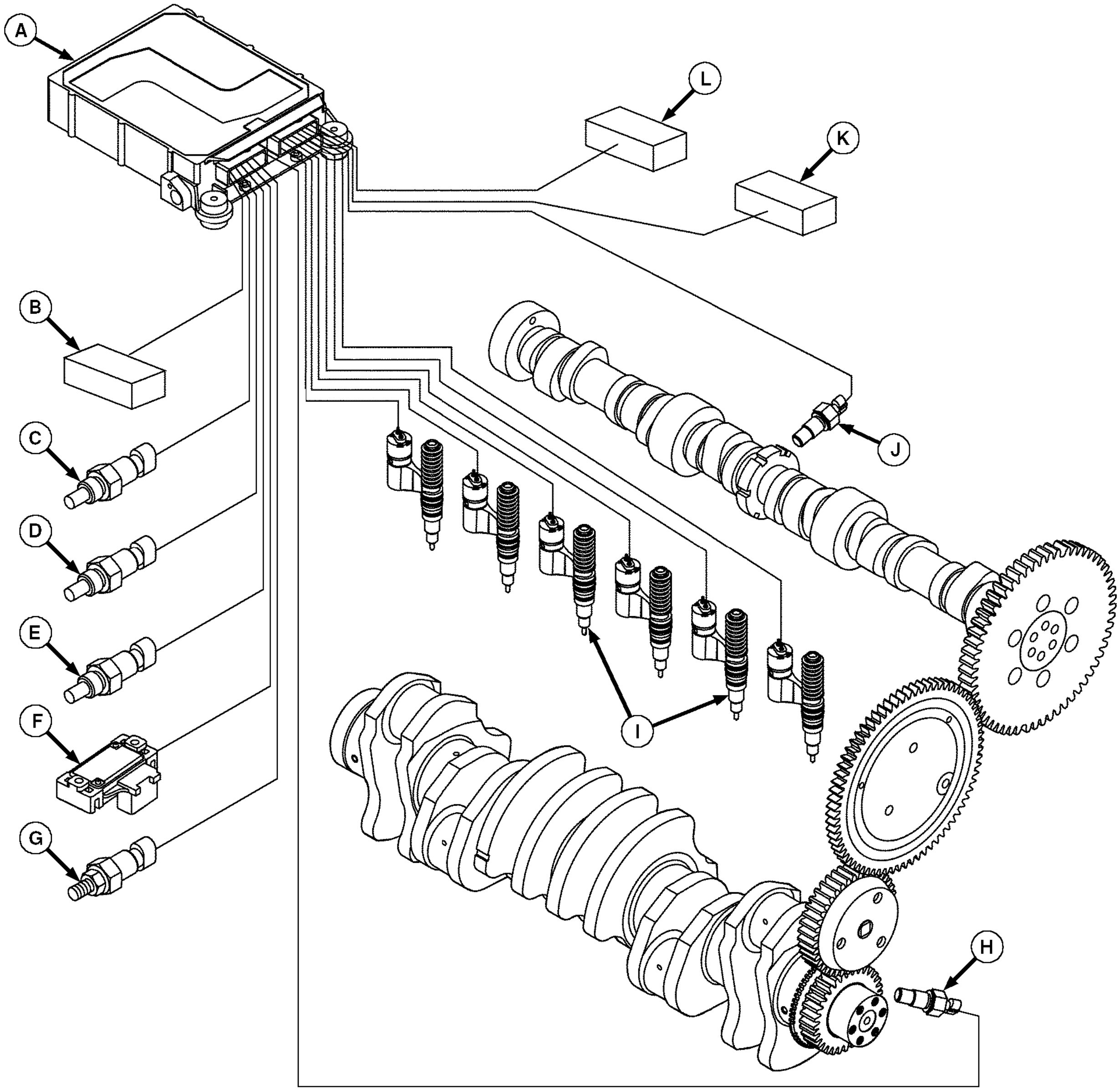


RG10250 –UN–30JUL99

Air Purge Valve

RG,RG34710,265 –19–04AUG99–1/1

Lucas Electronic Control System



RG11178 –UN–22DEC00

Electronic Control System

A—Engine Control Unit (ECU)
B—Throttle Position Sensor
C—Coolant Temperature Sensor (1 or 2 used)
D—Fuel Temperature Sensor
E—Manifold Air Temperature (MAT) Sensor
F—Manifold Absolute Pressure (MAP) Sensor
G—Oil Pressure Sensor
H—Crankshaft Position Sensor
I—Electronic Unit Injector (6 used)
J—Camshaft Position Sensor
K—Diagnostic Reader
L—Vehicle Output Monitor

Continued on next page RG,RG34710,268 –19–20NOV00–1/2

NOTE: Electronic control system diagnosis will determine if a sensor is not functioning properly. Refer Section 04, Groups 150 and 160 as required.

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.**
3. **Connect welder ground close to welding point and make sure ECU and other electrical components are not in the ground path.**

The ECU mounting bracket is attached to the cylinder block. If removed, reinstall and tighten mounting bracket cap screws to the following specifications.

Specification

ECU Mounting
Bracket-to-Cylinder Block
Lower Cap Screws—Torque .... 68 N•m (55 lb-ft)
ECU Mounting
Bracket-to-Cylinder Block
Upper Front Cap Screw—
Torque... 110 N•m (81 lb-ft)

RG,RG34710,268 –19–20NOV00–2/2

Remove and Install Coolant Temperature Sensor

NOTE: Your engine may be equipped with either one or two coolant temperature sensor(s) (A).

The ECU monitors coolant temperature for engine protection purposes and starting. Using the coolant temperature signal, the ECU will derate engine power as coolant temperature becomes excessive. The ECU will also adjust fuel delivery during start-up during low coolant temperature conditions.

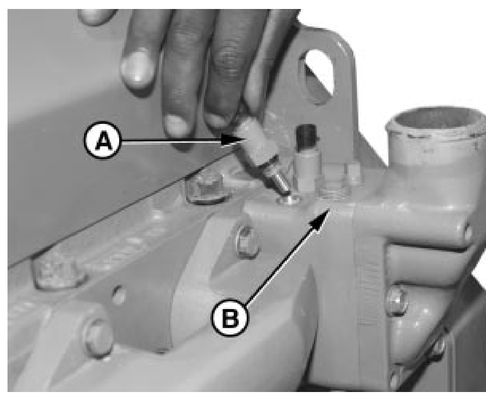
1. Disconnect coolant temperature sensor wiring connector and remove sensor from thermostat housing (B).

2. Coat sensor O-ring with JDT405 High Temperature Grease and install sensor in thermostat housing. Tighten to specifications.

Specification

Coolant Temperature Sensor—
Torque .... 10 N•m (7.5 lb-ft)

3. Install sensor wiring connector.



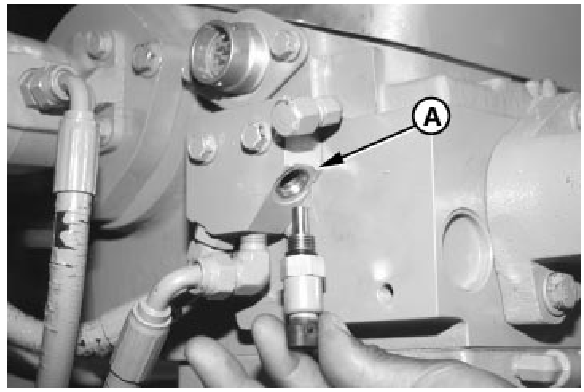
RG8550 –UN–10DEC97

Coolant Temperature Sensor

A—Coolant Temperature Sensor
B—Thermostat Housing

RG,RG34710,269 –19–13AUG99–1/1

Remove and Install Fuel Temperature Sensor



Fuel Temperature Sensor

A—Fuel Manifold

The ECU monitors fuel temperature to determine fuel density and adjust delivery as necessary.

1. Disconnect fuel temperature sensor wiring connector and remove sensor from fuel manifold (A).

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

2. Coat sensor O-ring with JDT405 High Temperature Grease and install sensor in fuel manifold. Tighten to specifications.

Specification	
Fuel Temperature Sensor-to-Fuel Manifold—Torque	10 N•m (7.5 lb-ft)

3. Install sensor wiring connector.

RG,RG34710,270 –19–13JUN01–1/1

Remove and Install Oil Pressure Sensor

The ECU monitors engine oil pressure for engine protection purposes. Under low oil pressure conditions, the ECU will derate engine power and in some applications, may shut the engine down. A diagnostic trouble code or warning light is generated.

1. Disconnect oil pressure sensor wiring connector and remove sensor from oil cooler housing.

2. Coat sensor O-ring with JDT405 High Temperature Grease. Coat threads of sensor with LOCTITE® 592 Pipe Sealant with TEFLON®. Install sensor in oil cooler housing and tighten to specifications.

Specification

Engine Oil Pressure Sensor—
Torque .... 9 N•m (80 lb-in.)
Engine Oil Pressure Sensor
Adapter-to-Filter Housing—
Torque .... 11 N•m (97 lb-in.)

3. Install sensor wiring connector.

RG10296 –UN–27AUG99

Oil Pressure Sensor

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

DPSG,OUO1004,1012 –19–26OCT00–1/1

Remove and Install Manifold Air Temperature (MAT) Sensor

Manifold Air Temperature (MAT) Sensor

The ECU uses the manifold air temperature and manifold absolute pressure sensor signals for engine airflow calculations.

1. Disconnect manifold air temperature sensor wiring connector.

2. Remove sensor from bottom side of intake manifold (6105H and 6125H engines) or aftercooler (6105A engines).

3. Coat O-ring with JDT405 High Temperature Grease.

4. Install MAT sensor in bottom side of intake manifold or aftercooler. Tighten to specifications.

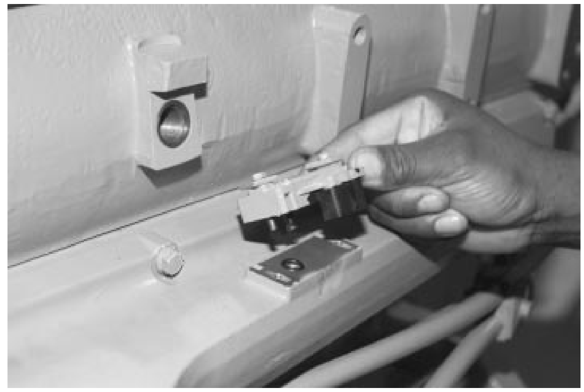
Specification

Manifold Air Temperature (MAT)
Sensor—Torque .... 10 N•m (7.5 lb-ft)

5. Install sensor wiring connector.

RG,RG34710,271 –19–13AUG99–1/1

Remove and Install Manifold Absolute Pressure (MAP) Sensor



Manifold Absolute Pressure (MAP) Sensor

The ECU uses the manifold absolute pressure and manifold air temperature sensor signals for engine airflow calculations.

1. Disconnect manifold absolute pressure sensor hose (6105A and 6125A engines) and/or wiring connector.
2. Remove sensor from intake manifold or aftercooler.
3. Remove two cap screws and remove sensor.
4. Coat O-ring with JDT405 High Temperature Grease.
5. Install sensor on intake manifold or aftercooler. Tighten two cap screws to specifications.

Specification	
Manifold Absolute Pressure (MAP) Sensor—Torque	7 N•m (5 lb-ft)

6. Connect hose (6105A and 6125A engines) and /or wiring connector.

RG,RG34710,272 –19–13AUG99–1/1

Remove and Install Camshaft Position Sensor

IMPORTANT: Camshaft position sensor MUST BE removed for camshaft removal and installation.

The ECU monitors the position of the camshaft and crankshaft to determine piston position and the optimum time to start and stop injecting fuel. The camshaft position sensor monitors camshaft position and sends it to the ECU.

RG8546 –UN–20MAY98

Camshaft Position Sensor

1. Disconnect camshaft position sensor wiring connector.

2. Remove sensor from cylinder head.

3. Coat O-ring with JDT405 High Temperature Grease.

4. Install sensor in cylinder head. Tighten to specifications.

Specification

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

RG,RG34710,273 –19–13AUG99–1/1

Remove and Install Crankshaft Position Sensor

NOTE: Crankshaft vibration damper and front seal shown removed.

The ECU monitors the position of the crankshaft and camshaft to determine piston position and the optimum time to start and stop injecting fuel. The crankshaft position sensor monitors crankshaft position and sends it to the ECU.

1. Disconnect crankshaft position sensor wiring connector.

2. Remove sensor (B) from timing gear cover.

3. Before installing sensor, check sensor-to-crankshaft timing wheel dimension, using one of the following methods.

   Measure sensor depth using JDG1334 Depth Checking Tool:

   Install JDG1334 Depth Checking Tool (G) in sensor bore in timing gear cover and tighten by hand.

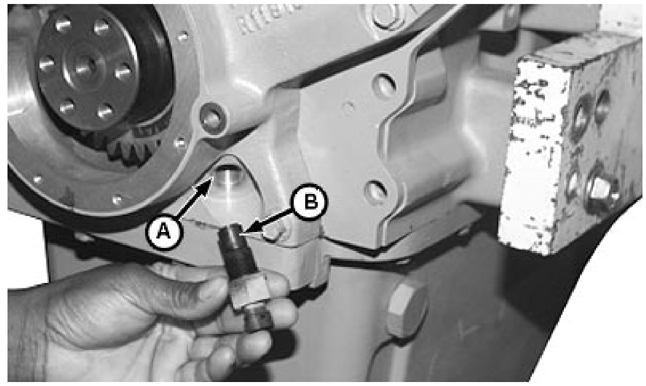
   Push in on pin (C) until it firmly contacts timing wheel (H).

   Check position of pin end (C) in relation to top surface of tool as shown in (D, E and F).

   If the lower shoulder of the pin extends above the top surface of the depth tool (D), sensor depth is too low. Add one R60756 shim to sensor when installing.

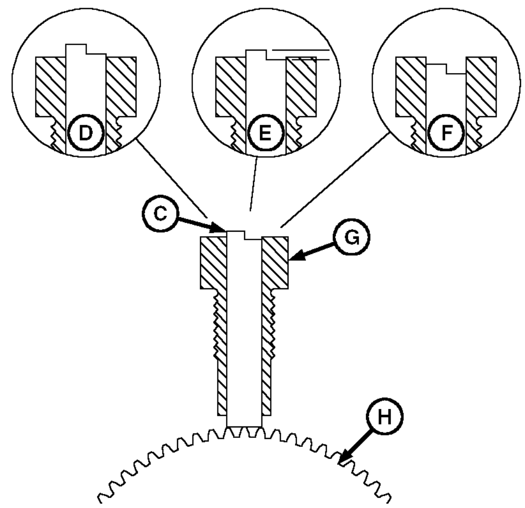
   If the lower shoulder of the pin is within ranges of marks (E), sensor depth is correct and no shim is required. (The correct sensor depth is between the top of the pin and the lower shoulder of the pin flush with the top surface of the depth tool.)

   If pin end is below top surface of depth tool (F), sensor is too high. Further investigation is required. Contact your Dealer DTAC representative.



RG10290 –UN–24AUG99

Crankshaft Position Sensor



RG10380 –UN–19OCT99

Using JDG1334 Depth Checking Tool

A—Machined Mounting Surface (Spotface)
B—Crankshaft Position Sensor
C—Pin (In JDG1334 Depth Checking Tool)
D—Sensor Depth Low (Shim Required)
E—Sensor Depth Correct (No Shim Required)
F—Sensor Depth too High (Requires Investigation)
G—JDG1334 Depth Checking Tool
H—Crankshaft Timing Wheel

Continued on next page

RG,RG34710,274 –19–13AUG99–1/2

If JDG1334 Depth Checking Tool is not available, use a depth gauge to measure distance from sensor spotface (machined mounting surface) (A) on timing gear cover to face of crankshaft timing wheel tooth and compare to following specifications.

Specification

Crankshaft Position Sensor Spotface (Mounting Surface)-to-Crankshaft Timing Wheel Tooth—Distance.......................... 36.7—38.2 mm (1.44—1.50 in.)

If distance is less than 36.7 mm (1.44 in.), install R60756 shim when installing sensor. If distance is greater than 38.2 mm (1.50 in.), further investigation is required. Contact your Dealer DTAC representative.

4. Coat O-ring on sensor with JDT405 High Temperature Grease.

5. Install sensor (and shim if required) in timing gear cover. Tighten to specifications.

Specification

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

RG,RG34710,274 –19–13AUG99–2/2

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.

NOTE: See 6105H/6125H ENGINES ELECTRONIC CONTROL SYSTEM COMPONENT LOCATION, in Section 06, Group 210, for a diagram showing location of sensor connectors. See ELECTRONIC CONTROL SYSTEM OVERVIEW in Section 03, Group 140 for additional diagrams showing location of sensors and connectors. For vehicle engines, refer to machine Operation and Tests manual for complete wiring diagrams, including connectors.

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 –19–18DEC00–1/1

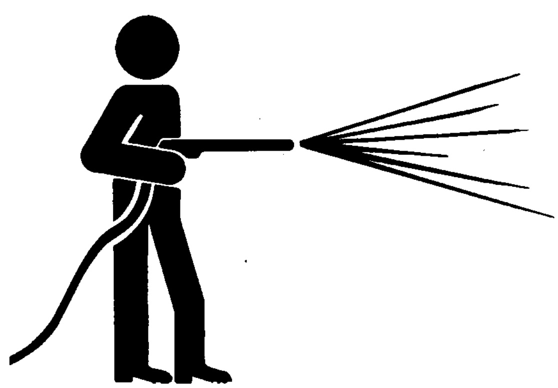
Use Electrical Insulating Compound

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

Using High-Pressure Washer

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 –19–03NOV99–1/4

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*

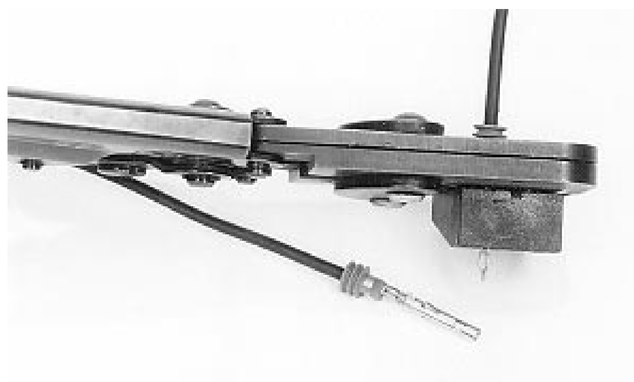
TS0136 –UN–23AUG88

AG,OUOD008,296 –19–03NOV99–2/4

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

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AG,OUOD008,296 –19–03NOV99–3/4

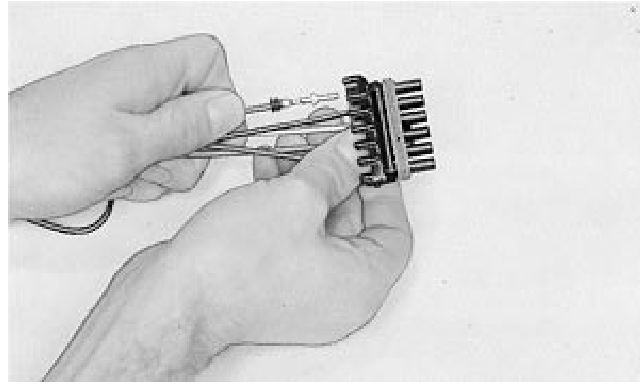
9. Insert terminal into connector. Terminal should click when it is fully seated. Make sure the wire is inserted into the correct connector cavity.

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.

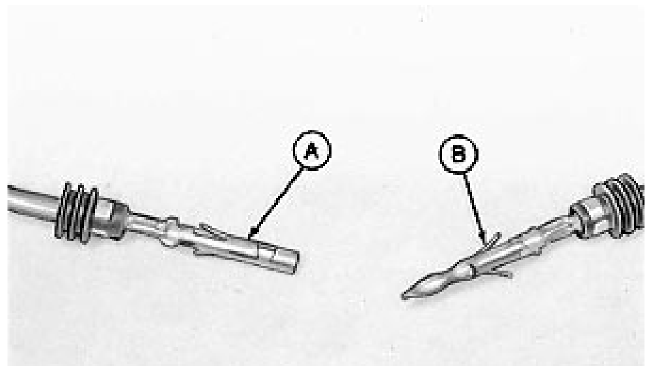
NOTE: Connector bodies are “keyed” for correct terminals. Be sure terminals are correctly aligned.

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 –19–03NOV99–4/4

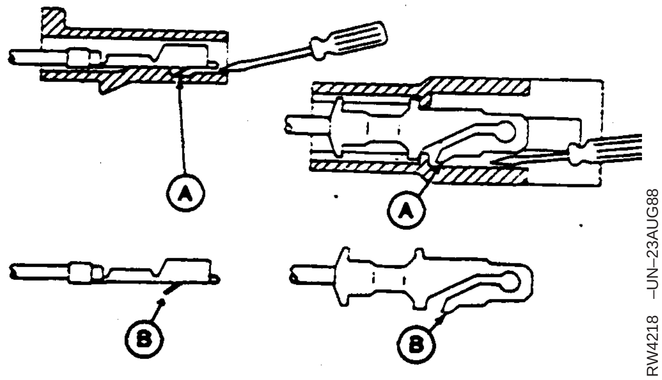
Remove Blade Terminals from Connector Body

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.



A—Locking Tang
B—Original Position

[1]Included in JT07195B Electrical Repair Kit

AG,OUOD008,297 –19–27OCT99–1/1

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.

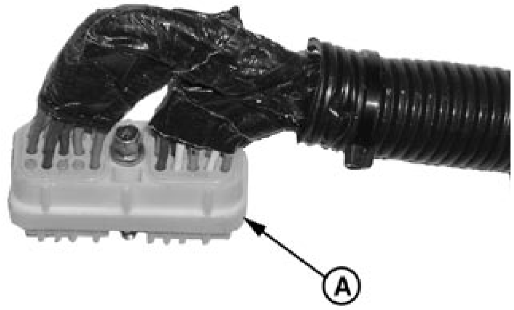
NOTE: Extraction tool must be used from the back of the connector.

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.

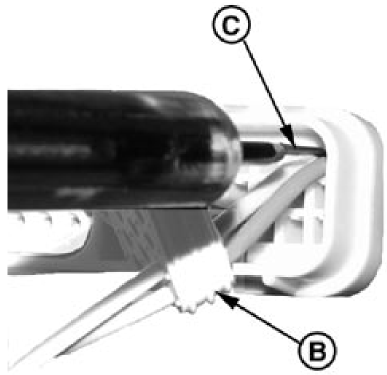
6. With extraction tool inserted into the connector, gently rotate tool clockwise and counter-clockwise (no more than 1/8 turn each direction) to depress the terminal locking tang (D).

7. Remove extraction tool from back of connector.

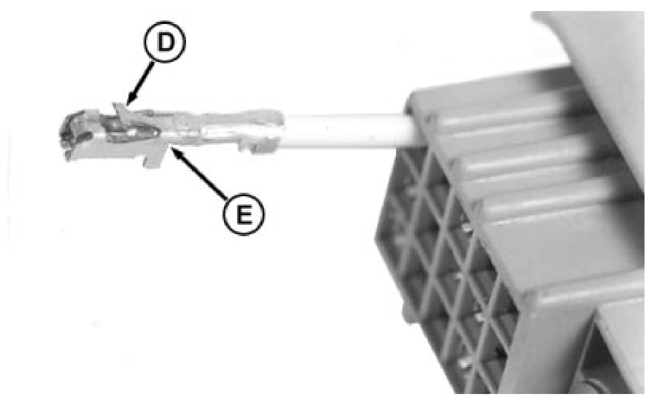
8. Push wire until terminal has extracted from the front of the connector. If terminal does not extract, repeat steps 4-6.



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

AG,OUOD008,298 –19–03NOV99–1/2

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.

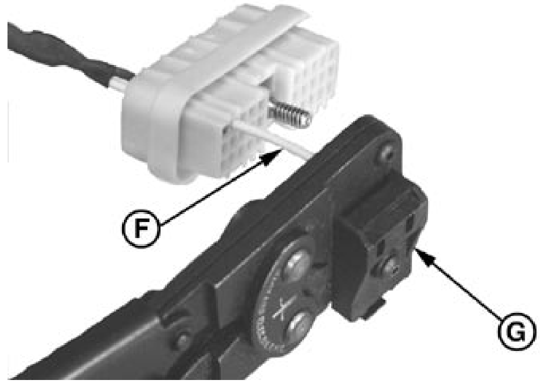
13. Make sure terminal locking tang (D) on new terminal is in outward position. Pull wire back into connector cavity until terminal locks.

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

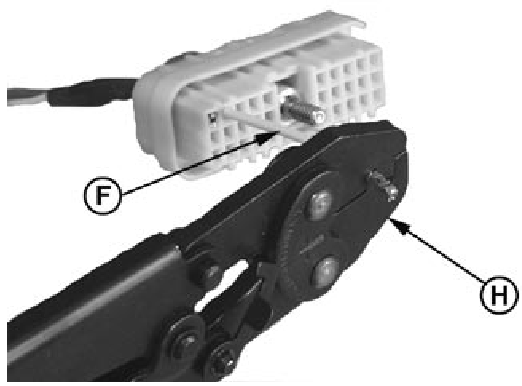
14. Push on the wire to make sure terminal is locked into the connector.

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

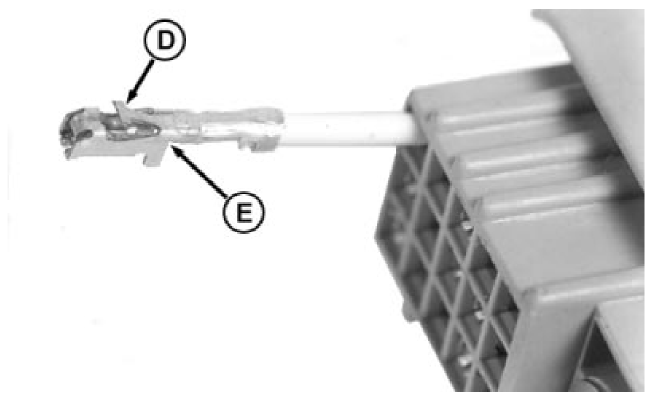
16. Retape the wires and add the required tie bands to the harness.



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 –19–03NOV99–2/2

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.

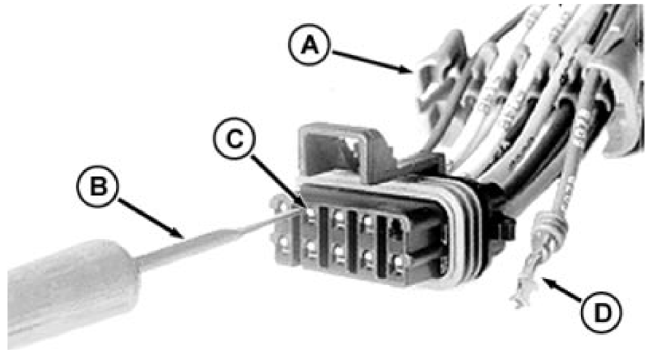
NOTE: Use JDG776 Extraction Tool with 56, 280, and 630 Series METRI-PACK terminals. Use JDG777 Extraction Tool with 150 Series METRI-PACK terminals.

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

02
110
17

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 –19–03NOV99–1/3

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 AG,OUOD008,299 –19–03NOV99–2/3

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.

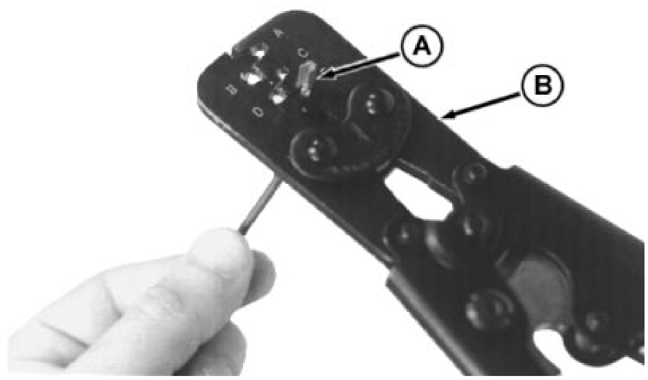
13. Push terminal into the correct connector cavity until terminal locks.

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

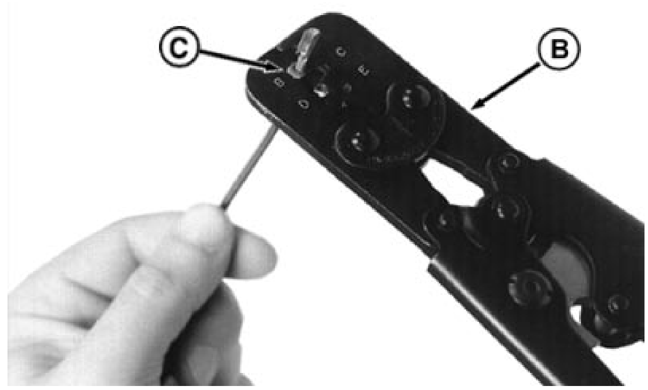
15. Place the secondary lock back on the connector.

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

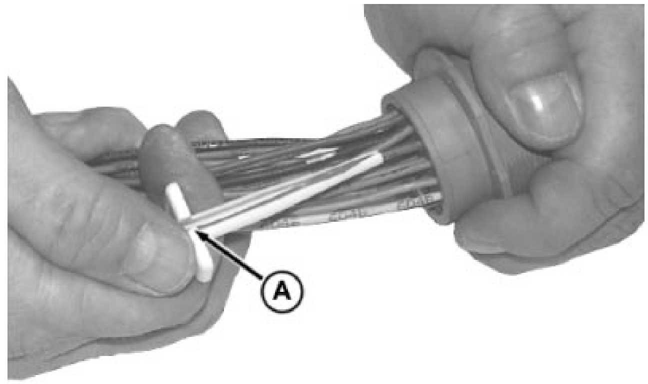


RW77138A –UN–15MAR02

RW77140A –UN–15MAR02

AG,OUOD008,299 –19–03NOV99–3/3

Repair DEUTSCH™ Connectors



RW77142 –UN–07DEC98

A—Handle

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.

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

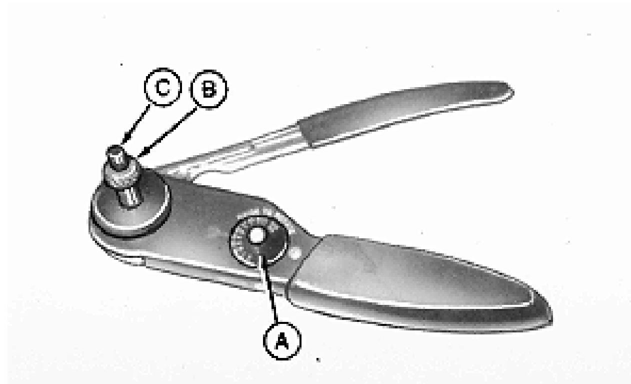
[4]Included in JDG155 Electrical Repair Tool Kit

Continued on next page

AG,OUOD008,304 –19–03NOV99–1/4

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.



TS117 –UN–23AUG88

A—Selector
B—Lock Nut
C—Adjusting Screw

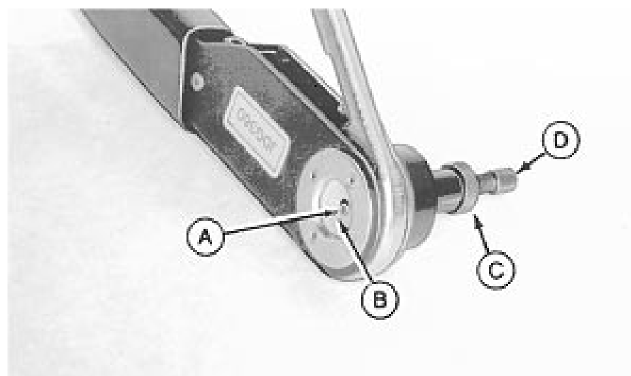
[1]*Included in JDG359 Electrical Repair Kit*

AG,OUOD008,304 –19–03NOV99–2/4

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).



TS0134 –UN–23AUG88

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

Continued on next page

AG,OUOD008,304 –19–03NOV99–3/4

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.

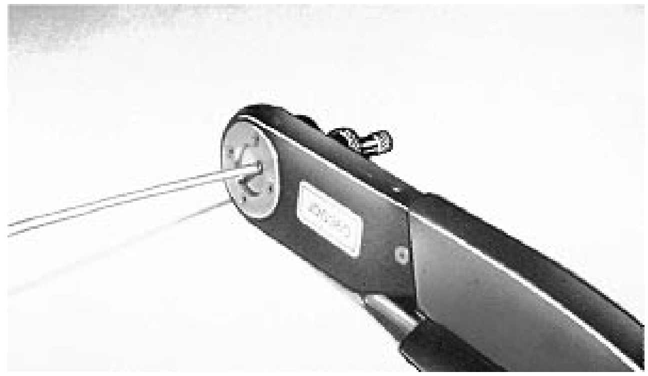
17. Push terminal straight into correct connector cavity until positive stop is felt.

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

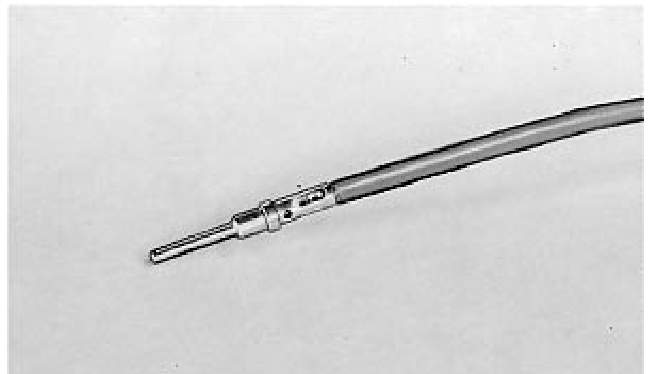
18. Gently pull on wire to verify terminal is locked into the connector.

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 –19–03NOV99–4/4

Section 03
Theory of Operation

Contents

03

Electronic Fuel System Operation

About This Group

This group of the manual contains information on the operation of the dual rail low pressure fuel system. The group is divided into the following headings:

- Low Pressure Fuel System Flow Diagram
- Low Pressure Fuel Supply System Operation
- Electronic Unit Injector (EUI) Operation

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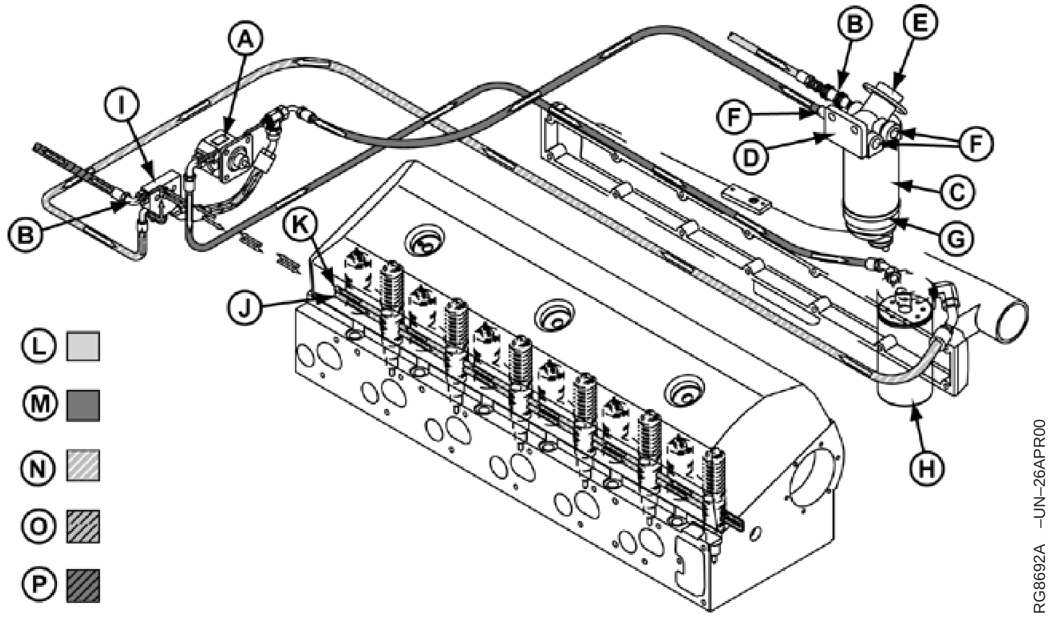
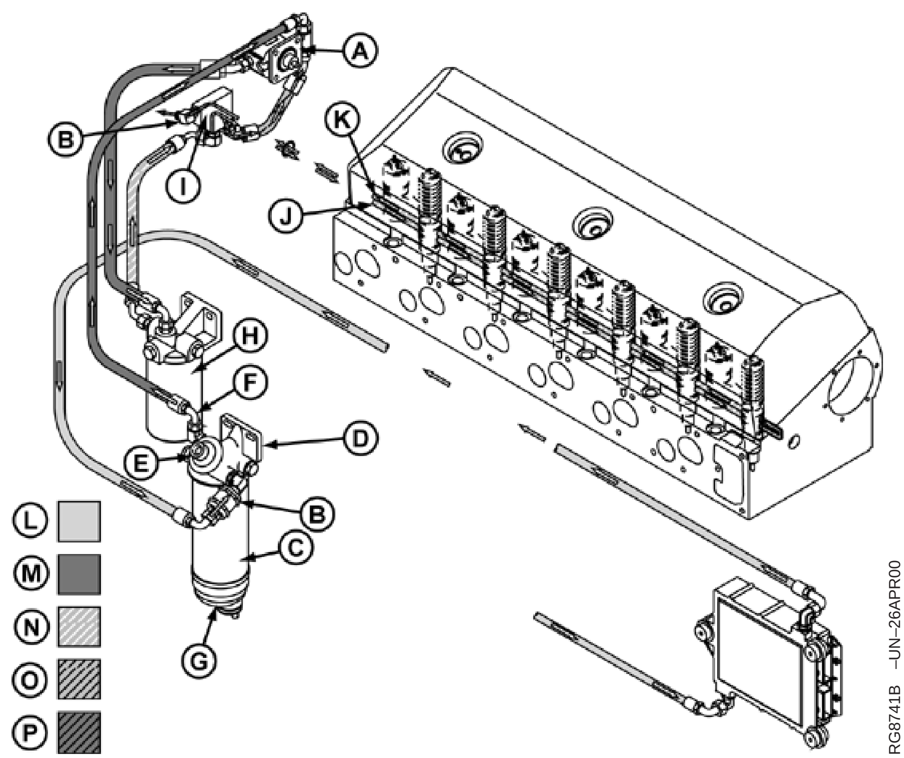
Low Pressure Fuel System Flow Diagram



John Deere Applications Fuel System



OEM Applications Fuel System

A—Fuel Transfer Pump
B—In-line Check Valves
C—Primary Filter
D—Primary Filter Base
E—Hand Primer Pump
F—Primary Filter Base Outlets
G—Water Separator Bowl
H—Final Filter
I—Fuel Manifold
J—Fuel Supply Rail
K—Fuel Return Rail
L—Suction Fuel from Tank
M—Primary-Filtered Fuel
N—Final-Filtered Fuel
O—Recirculated Fuel
P—Return-to-Tank Fuel

RG,RG34710,1526 –19–30SEP97–1/1

Low Pressure Fuel Supply System Operation

The fuel transfer pump (A) draws fuel from the fuel tank through an in-line check valve (B) into the primary filter base inlet and the primary filter (C). The primary filter base (D) contains a hand primer pump (E) and three outlet passages (F). The water separator bowl (G) screws on to the bottom of the primary filter. A self venting drain valve is mounted on the bottom of the clear bowl.

Fuel flows from one of the primary filter base outlets to the inlet of the fuel transfer pump mounted on the rear of the head. The fuel transfer pump is a gear type pump. The pump shaft is coupled to the end of the camshaft. The fuel transfer pump contains a pressure regulating valve for system over-pressure protection. A bypass valve in the pump base allows fuel to bypass the gears during hand priming.

Fuel flows from the outlet of the fuel transfer pump to the inlet of the final fuel filter (H). The spin-on final filter is the last clean-up of the fuel before entering the engine.

Fuel flows from the outlet of the final filter to the fuel manifold (I) mounted on the rear of the cylinder head. The fuel manifold contains a fuel temperature sensor, pressure regulating valve, return to tank orifice, and passages to route fuel into and out of the cylinder head. On some applications, the fuel manifold also contains a fuel pressure sensing switch. The fuel pressure regulator will maintain fuel pressure at 410–480 kPa (4.1–4.8 Bar) (60–70 psi).

Fuel flows from the fuel manifold into the fuel supply rail in the cylinder head. Fuel rails are drilled passages in the cylinder head that route fuel to each unit injector. The fuel supply rail (J) is the bottom drilled passage; the return fuel rail (K) is the top drilled passage. The two passages are connected at the front of the head.

Excess fuel not needed by the electronic unit injectors flows from the cylinder head into the fuel manifold. The fuel flows past the fuel temperature sensor. At this point the fuel is routed in one of two directions. The return to tank orifice will cause approximately 10% of the fuel to flow back to the fuel tank. The return-to-tank fuel enters the tank at the bottom to prevent fuel drain-back. The remaining 90% of the fuel will flow past the pressure regulating valve and return to the inlet of the fuel transfer pump to be recirculated through the cylinder head.

RG,RG34710,1525 –19–30SEP97–1/1

Electronic Unit Injector (EUI) Operation

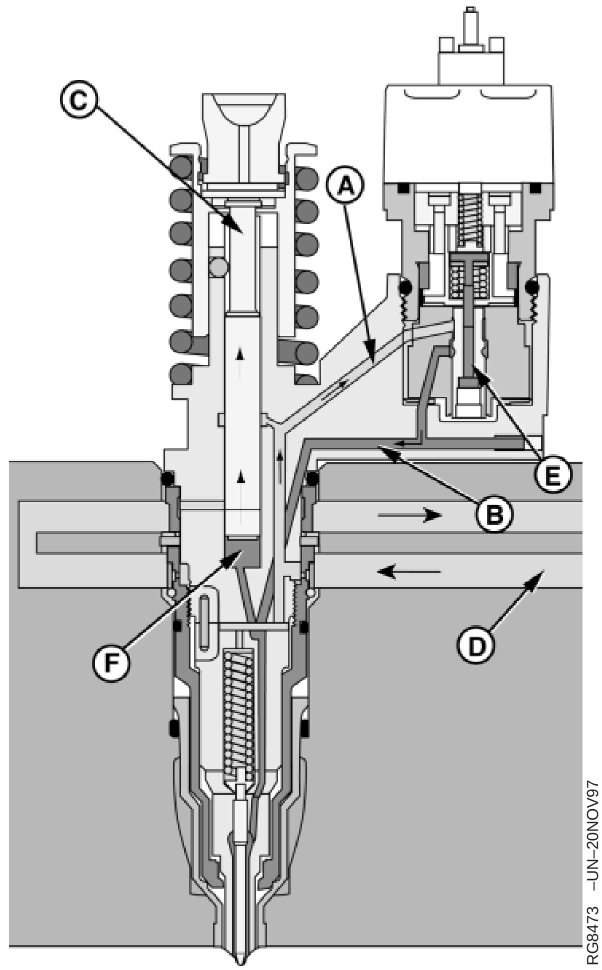
The electronic unit injector pumping action is created by the up and down movement of the plunger. The plunger movement is caused by the rotation of the camshaft and the rocking action of the rocker arms. The larger return spring will move the plunger up as the camshaft rotates and relaxes the force on the rocker arm.

Continued on next page

RG,RG34710,1527 –19–30SEP97–1/5

Fill Cycle

The electronic unit injector will fill with fuel when the plunger (C) is moving up. Fuel from the fuel supply rail (D) enters fuel passage (A) of the unit injector. Fuel flows past the open spill valve (E) into fuel passage (B). Passage B routes fuel into the plunger cylinder (F), which fills as the plunger moves up.

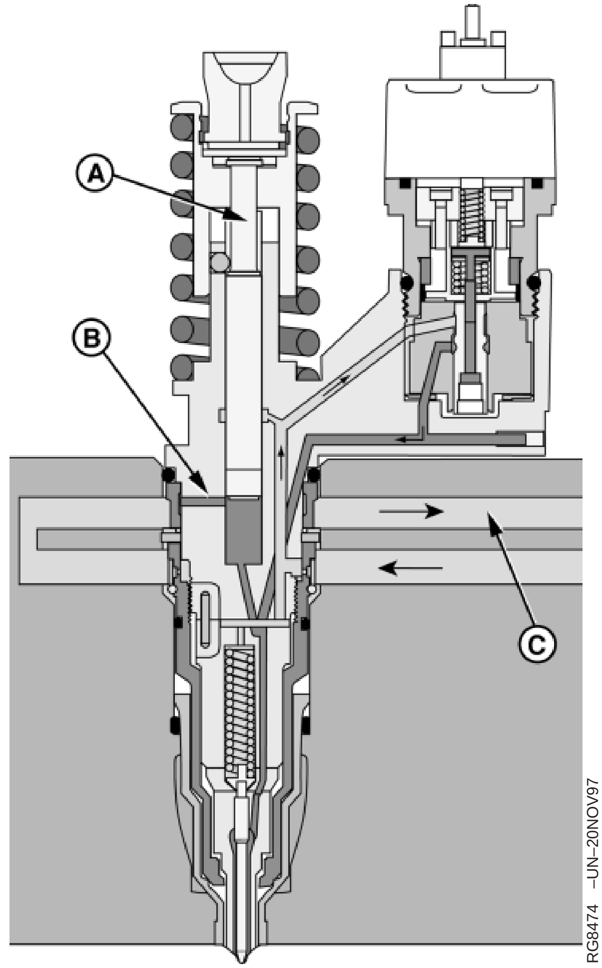


EUI Fill Cycle

Continued on next page RG,RG34710,1527 –19–30SEP97–2/5

Vent Cycle

The vent cycle begins when the plunger (A) nears the top of the fill cycle stroke. At this point a vent port (B) will be uncovered and fuel and any trapped air can flow to the return fuel rail (C).



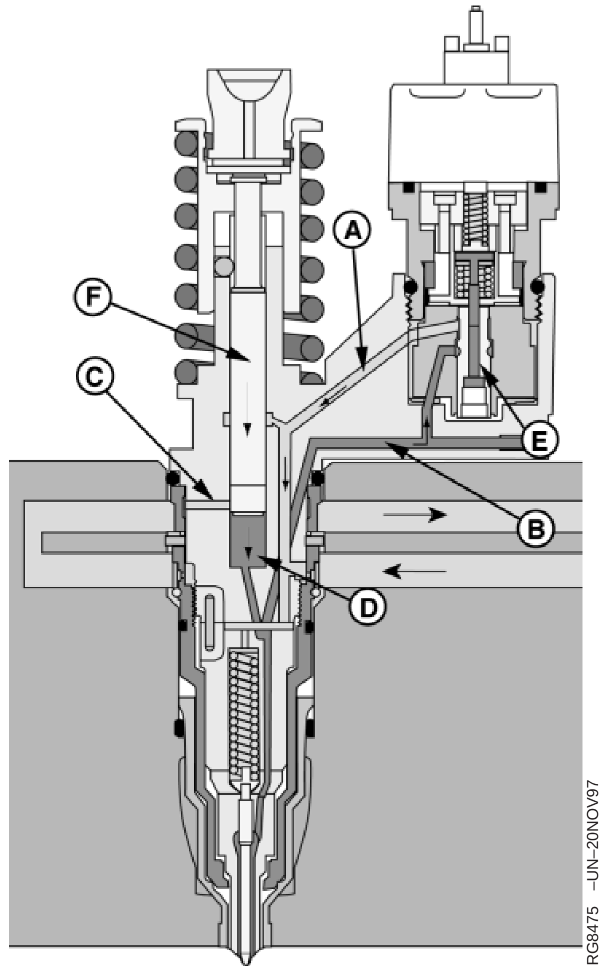
EUI Vent Cycle

Continued on next page RG,RG34710,1527 –19–30SEP97–3/5

Pumping Cycle

The pumping cycle begins when the camshaft lobe pushes on the rocker arm to cause the plunger (F) to start moving down. During the first downward movement of the plunger, the vent port (C) will close.

Further downward movement of the plunger will force fuel from the plunger cylinder (D). Fuel will flow out fuel passage (B), through the open spill valve (E), into fuel passage (A) and back to the fuel supply rail (G). This flow will continue until the injection cycle begins.



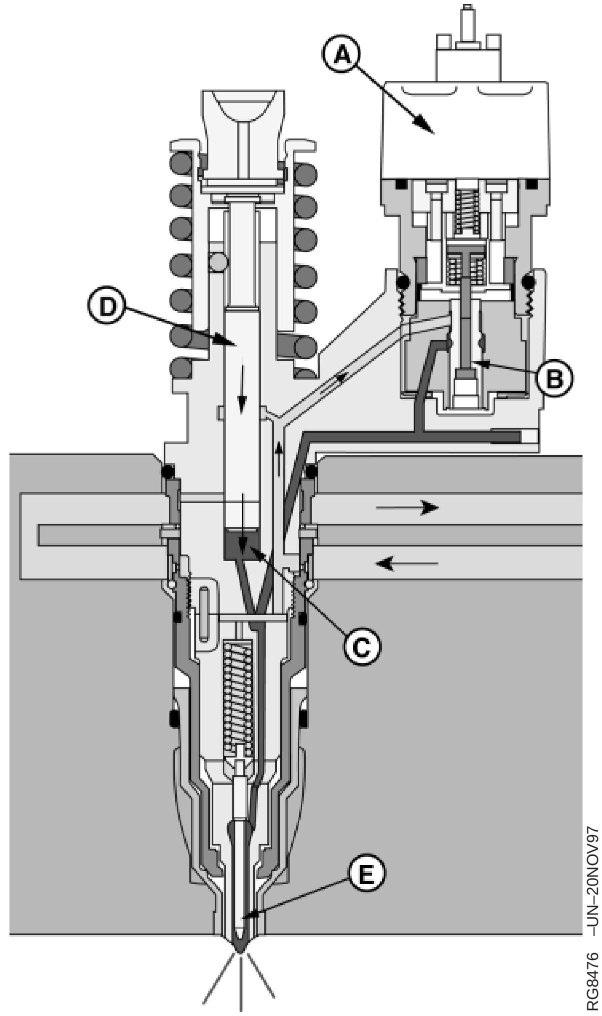
EUI Pumping Cycle

Continued on next page RG,RG34710,1527 –19–30SEP97–4/5

Injection Cycle

The injection cycle will start when the Engine Control Unit (ECU) energizes the EUI solenoid (A). This will occur during the downward stoke of the plunger.

The energized solenoid will close the spill valve (B). With the spill valve closed, fuel can not escape from the plunger cylinder (C). The downward movement of the plunger (D) will cause the fuel pressure to rise. When the pressure reaches 30,000 kPa (300 bar) (4350 psi), the injector needle (E) will start to move up and injection will begin. As the plunger continues to move down, pressure will rapidly rise to approximately 160,000 kPa (1600 bar) (23,200 psi). Injection will continue until the ECU de-energizes the solenoid. The spill valve will then open allowing fuel pressure to drop rapidly. The injector needle will close and injection will stop.



EUI Injection Cycle

RG,RG34710,1527 –19–30SEP97–5/5

Electronic Control System Glossary of Terms

Actuator	A device controlled by the (ECU) to perform a certain function.
Analog	Signal which has a continuous range of possible voltages. Usually 0 to 5 volt or 0 to 12 volt signals.
BOB	Break-Out-Box. A BOB tees into the engine wiring harness, and allows easy voltage checks on control system circuits even while the system is in operation. Voltage, resistance, and ground feed measurements can be made without having to backprobe into connectors. See USING THE BREAK-OUT-BOX in Section 04, Group 160, for more information.
Boost	Air pressure in the intake manifold.
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. The tool used to read and clear DTCs, read sensor and actuator data, and perform engine tests. The DST consists of an Windows ('95, '98 or '2000) or NT compatible computer and 2 kits available from John Deere Distribution Service Center (DSC): JDIS121 ECU Communication Hardware Kit, and JDIS122 ECU Communication Software Kit.
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.
ECU	Engine Control Unit. The computer which controls the fuel, air, and ignition systems on the engine. See ENGINE CONTROL UNIT (ECU) in this group.
EUI	Electronic Unit Injector. An EUI is an electronically controlled injection pump and injector combined. The ECU controls the start of injection and the amount of fuel injected by energizing and de-energizing the solenoid in the EUI valve housing. See ELECTRONIC UNIT INJECTOR (EUI) OPERATION in Group 130.
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.
MAP	Manifold Air Pressure (sensor). Measures the pressure of the air in the intake manifold. See MEASURING MANIFOLD AIR PRESSURE later in this group.
MAT	Manifold Air Temperature (sensor). Measures the temperature of the air in the intake manifold. See MEASURING TEMPERATURE.
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.
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.
Sensor	Device used by the ECU to monitor various engine parameters.
TPS	Throttle Position Sensor. The TPS measures the position of the throttle, which is controlled by the machine operator. See MEASURING THROTTLE POSITION later in this group.

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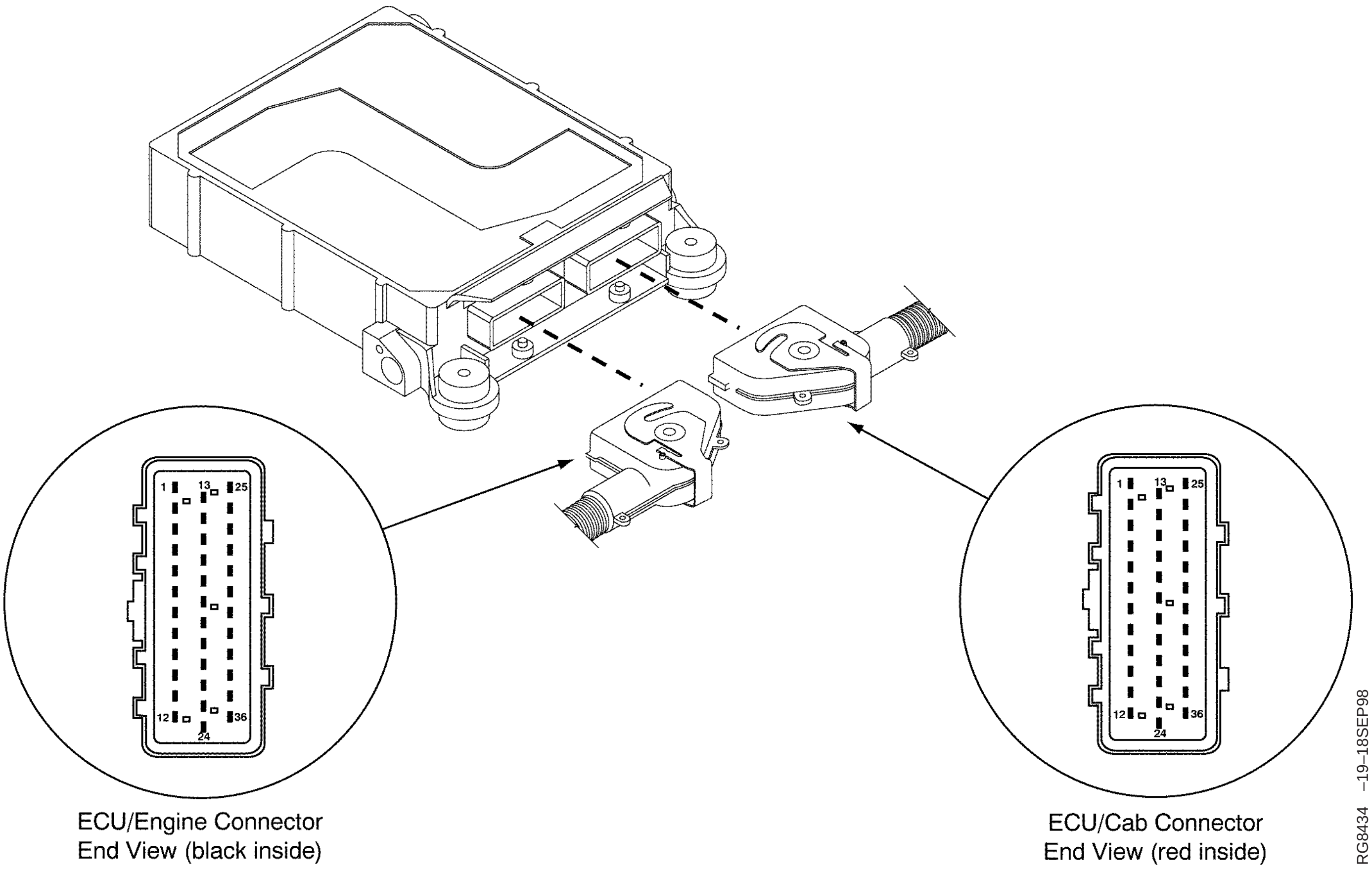
Electronic Control System Overview



Electronic Control System

The electronic control system serves as an engine governor by controlling the Electronic Unit Injectors (EUIs) so that fuel is delivered according to a given set of engine conditions, in precise amounts, and at a precise time in relation to piston position. In order to achieve this, the control system performs the following functions:

- Constantly monitor engine operating conditions
- Precisely determines piston position
- Deliver optimum amount of fuel for a given set of operating conditions
- Deliver fuel at optimum piston position
- Provide multiple control modes
- Perform self-diagnosis

RG,RG34710,1529 –19–30SEP97–1/1

Electronic Control System Operation

Engine Starting Mode

When the key is turned to the “ON” position, a switched power voltage signal is sent to the ECU. This key ON signal causes the ECU to energize the ECU power relay, allowing battery voltage to be available at ECU/cab connector terminals 11 and 12; this causes the ECU to “boot-up” and ready itself for engine start.

NOTE: If a wiring problem prevents the key ON signal from getting to the ECU, the engine will not start.

As soon as the ECU determines using the crankshaft position sensor input that the engine is cranking, it will determine using the camshaft position sensor input when cylinder number 1 is coming to top-dead-center at the end of the compression stroke. It will then start injecting fuel when the next cylinder in the firing order (cylinder number 5) is at the correct position before top-dead-center at the end of compression. 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, the ECU monitors information from the various sensors, then determines the optimum amount of fuel to inject and the optimum injection timing in order to allow the engine to develop high power while maintaining low exhaust emission output. The camshaft and crankshaft position sensors allow the ECU to precisely determine piston position in relation to top-dead-center so that the ECU can command the correct Electronic Unit Injector (EUI) solenoid at the correct time. The ECU controls fuel delivery by energizing and de-energizing the individual solenoids that open and close the EUI spill valves. When the ECU energizes the EUI solenoid, the spill valve closes and injection begins. When the correct amount of fuel has been injected, the ECU de-energizes the solenoid, causing the spill valve to open, and fuel injection to stop.

RG,RG34710,1530 –19–30SEP97–1/1

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 Temperature
- Manifold Air Pressure (MAP)
- Throttle Position
- Engine Speed

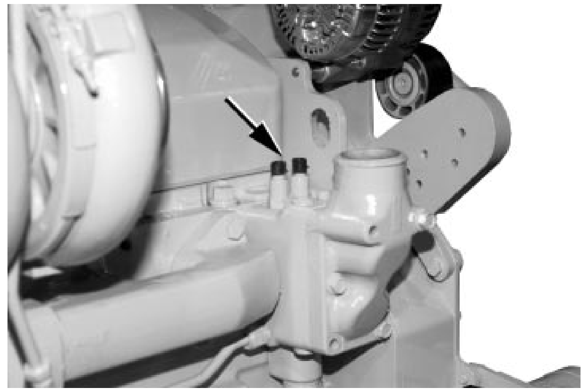
RG,RG34710,1531 –19–30SEP97–1/1

Measuring Temperature

The Engine Coolant Temperature (ECT) sensor, the Manifold Air Temperature (MAT) sensor, and the fuel temperature sensor are all temperature sensitive variable resistors. The sensors' resistance goes down as the temperature it is exposed to goes up (negative temperature coefficient). The Engine Control Unit (ECU) sends 5 volts to the sensor, monitors the voltage drop across the sensor, then compares the voltage drop to preprogrammed values in the ECU's memory to determine temperature.

Continued on next page RG,RG34710,1532 –19–30SEP97–1/4

ECT (Engine Coolant Temperature) Sensor



ECT Sensor Location

The ECT sensor *(arrow)* is located on top of the thermostat housing. The ECU monitors coolant temperature for:

Engine protection purposes – If coolant temperatures become excessive, the ECU will derate power to protect the engine.

- At a coolant temperature of 100°C (212°F) power will be derated 1.5%
- At a coolant temperature of 105°C (220°F) power will be derated 4%
- At a coolant temperature of 113°C (235°F) power will be derated 14%

The above derates will stay in effect until the coolant temperature drops below the derate threshold. If the coolant temperature again goes above a derate threshold, engine power will again be derated.

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 temp is measured.

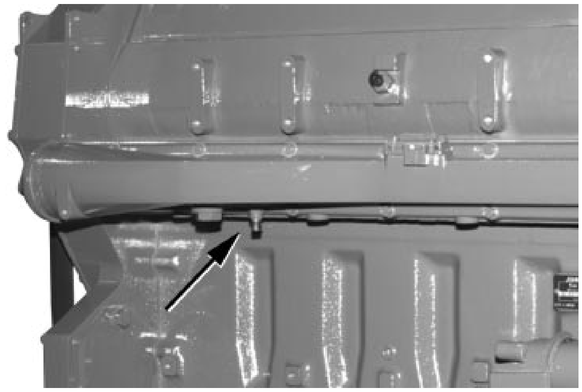
ECT Sensor Temperature to Resistance Values (Approximate)

Temperature °C (°F)	Resistance (Ω)
-20 (-4)	18,700
-10 (14)	10,940
0 (32)	6,400
10 (50)	3,740
20 (68)	2,190
30 (86)	1,280
40 (104)	750
50 (122)	440
60 (140)	260
70 (158)	150
80 (176)	90

Continued on next page
RG,RG34710,1532 –19–30SEP97–2/4

MAT (Manifold Air Temperature) Sensor

The MAT sensor *(arrow)* is located on the underside of the intake manifold. The ECU uses the manifold air temperature measurement in engine airflow calculations.



RG8792A –UN–21NOV97

MAT Sensor Location

MAT Sensor Temperature to Resistance Values (Approximate)

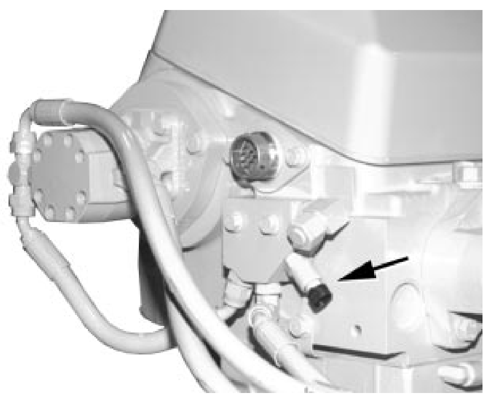
Temperature °C (°F)	Resistance (Ω)
-20 (-4)	12,540
-10 (14)	8,290
0 (32)	5,490
10 (50)	3,630
20 (68)	2,400
30 (86)	1,590
40 (104)	1,050
50 (122)	700
60 (140)	460
70 (158)	300
80 (176)	200

03
140
6

RG,RG34710,1532 –19–30SEP97–3/4

Fuel Temperature Sensor

The fuel temperature sensor *(arrow)* is located on the fuel manifold. Using the fuel temperature measurement, the ECU will determine fuel density, and adjust fuel delivery accordingly.



RG8795A –UN–21NOV97

Fuel Temperature Sensor Location

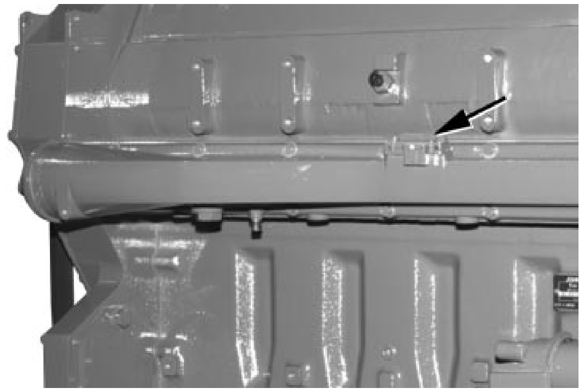
Fuel Temperature Sensor Temperature to Resistance Values (Approximate)

Temperature °C (°F)	Resistance (Ω)
-20 (-4)	18,700
-10 (14)	10,940
0 (32)	6,400
10 (50)	3,740
20 (68)	2,190
30 (86)	1,280
40 (104)	750
50 (122)	440
60 (140)	260
70 (158)	150
80 (176)	90

RG,RG34710,1532 –19–30SEP97–4/4

Measuring Manifold Air Pressure

The Manifold Air Pressure (MAP) sensor is a pressure sensitive variable resistor; as the air pressure that the sensor is exposed to changes, sensor resistance changes. The ECU sends a 5 volt reference to the sensor, then monitors the voltage on the sensor signal wire. The voltage is then compared to preprogrammed values in the ECU's memory to determine manifold air pressure. The MAP sensor measures gauge pressure; therefore to determine absolute pressure, atmospheric pressure must be added to the MAP sensor pressure reading. The MAP sensor *(arrow)* is located on top of the intake manifold.



RG8792B –UN–21NOV97

MAP Sensor Location

RG,RG34710,1533 –19–30SEP97–1/1

Measuring Throttle Position

The 10.5 and 12.5 L engines have the option of operating with a pulse-width-modulated (PWM) throttle signal, an analog throttle position sensor output signal, or both. If the system is equipped with both throttle options, the PWM signal will be the primary throttle signal and the analog throttle signal will be secondary.

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 and indicates the desired throttle opening.

Analog Throttle

An analog throttle signal comes from a poteniometer-type sensor. The ECU converts the voltage returning from the poteniometer into a percent of full throttle signal.

RG,RG34710,1534 –19–30SEP97–1/1

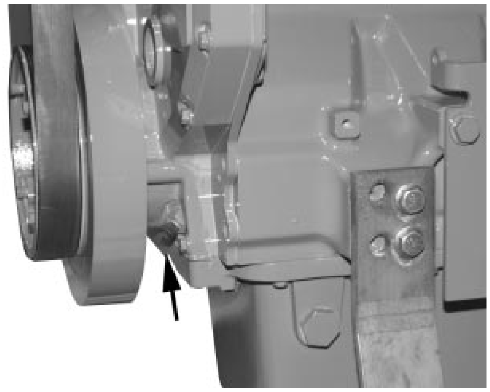
Determining Engine Airflow

Engine airflow is calculated by the ECU using the MAP sensor and the MAT sensor. Information from these sensors is effectively used to calculate intake manifold air density, which at a given engine speed gives an approximation of mass air flow.

RG,RG34710,1535 –19–30SEP97–1/1

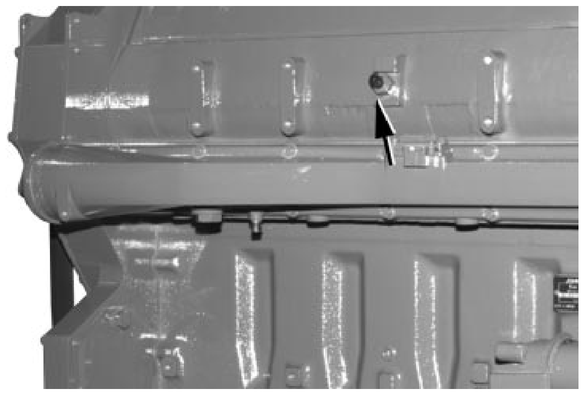
Determining Engine Speed and Piston Position

Engine speed and precise piston position in relation to Top-Dead-Center (TDC) is determined by the ECU using the crankshaft position sensor and the crankshaft timing wheel. Cylinder identification in relation to the engine firing order is determined by the ECU using the camshaft position sensor, and the camshaft timing wheel. Both sensors operate by detecting notches on a timing wheel. When a notch on the timing wheel is directly under the sensor, a voltage is induced. The ECU monitors this voltage to determine timing wheel position.



RG8794 –UN–21NOV97

Crank Position Sensor Location



RG8792C –UN–21NOV97

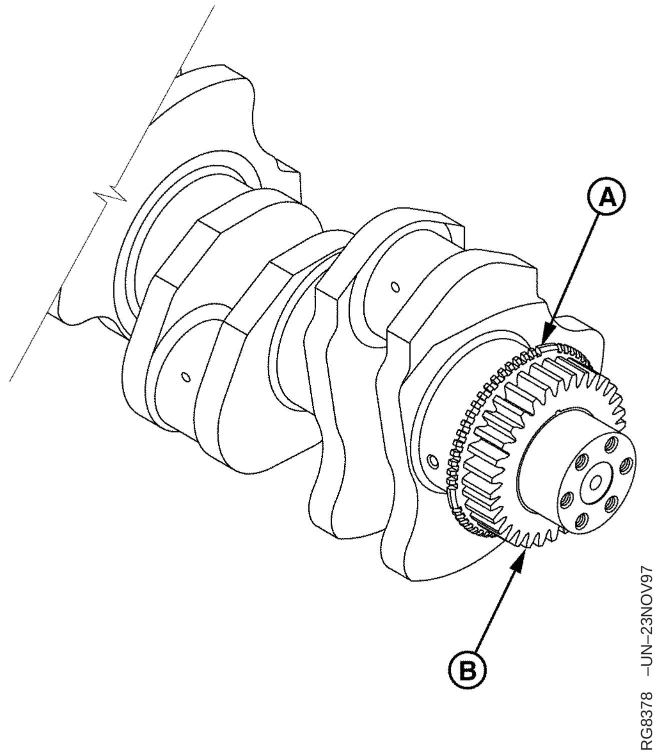
Cam Position Sensor Location

Continued on next page

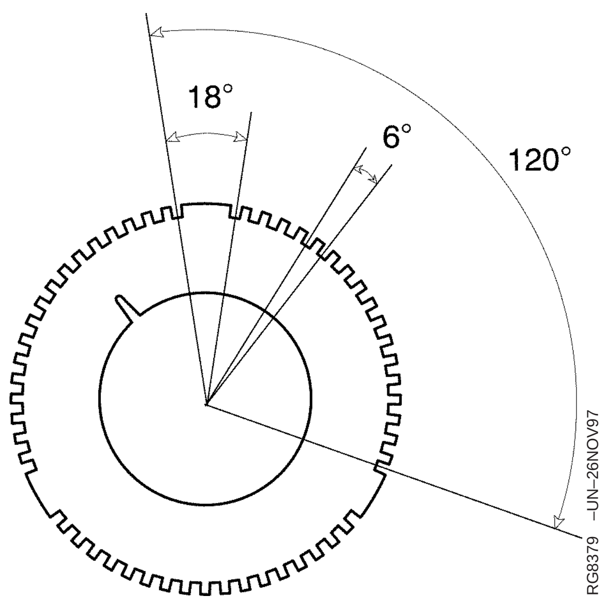
RG,RG34710,1536 –19–30SEP97–1/4

Crankshaft Position

The crank timing wheel (A) is located on the front of the crankshaft, behind the pressed-on crank gear (B). The timing wheel is composed of 54 notches, divided into 3 groups of 18 notches. Before the first notch in each group is a flat area equal to 18° of crankshaft rotation, the following 17 notches are separated by 6° of crankshaft rotation. Each group of 18 notches and a flat area is equal to 120°, or a third of a full turn.



Crankshaft Timing Wheel

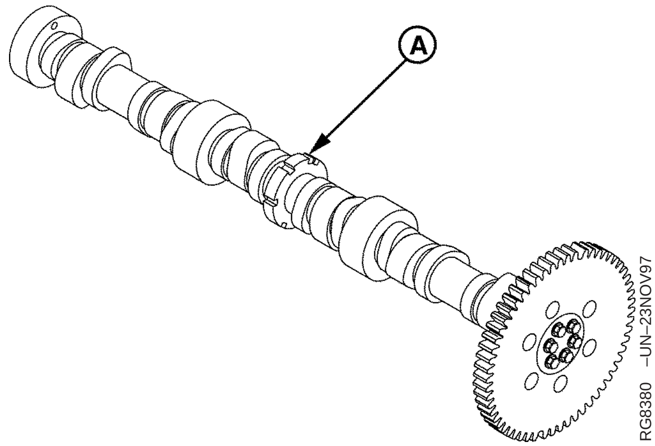


Crankshaft Timing Wheel Notches

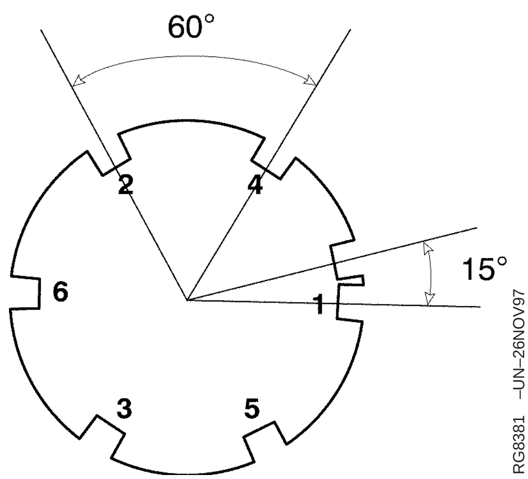
Continued on next page RG,RG34710,1536 –19–30SEP97–2/4

Camshaft Position

The camshaft timing wheel (A) consists of 7 notches cut into the center journal of the camshaft. Six of the 7 notches are evenly spaced at 60° center-to-center. Each of the 6 notches correspond to a cylinder; the 7th notch is located 15° center-to-center before the notch that identifies cylinder number 1. The ECU has the engine firing order stored in memory, therefore it knows that following the notch identifying cylinder 1 will be the notch identifying cylinder 5 etc. The camshaft timing wheel turns at one half the speed of the crankshaft timing wheel.



Camshaft Timing Wheel



Camshaft Timing Wheel Notches

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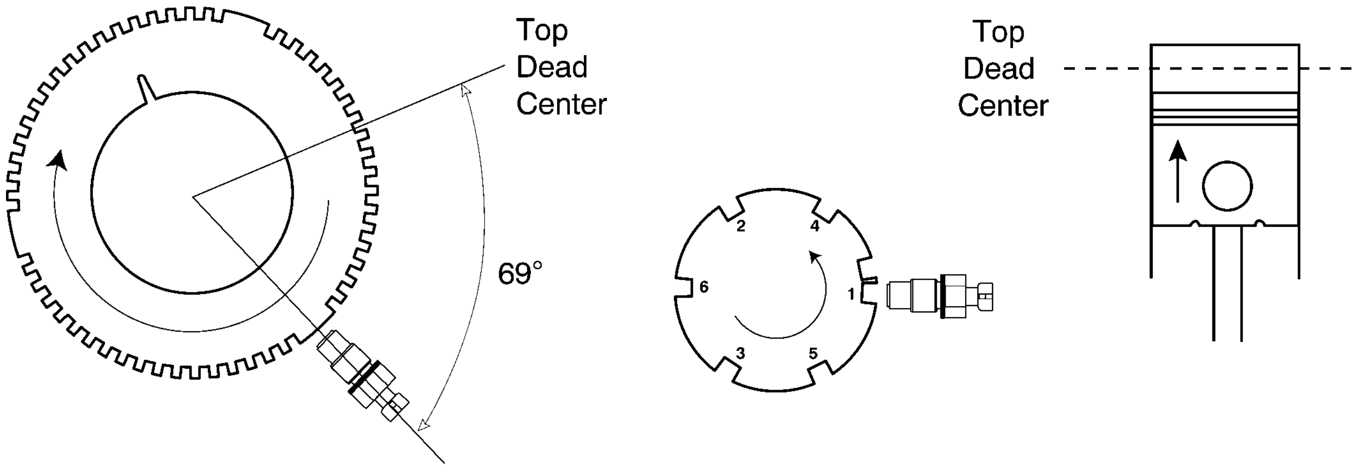


RG8383 –19–18SEP98

Crankshaft/Camshaft Timing Wheels Relationship

Crankshaft/Camshaft Position Relationship

When the cam position sensor detects the extra notch on the cam timing wheel, the ECU is informed that the notch identifying cylinder 1 is 15° of crank rotation away from the cam position sensor, and the center of the flat area on the crank timing wheel is 30° of crank rotation away from the crank position sensor. One timing cycle will then begin when the cam position sensor is directly in the center of a notch on the cam timing wheel. At this time, the crank position sensor is directly in the center of a flat area on the crank timing wheel, and piston number 1 is 69° of crankshaft rotation away from TDC on the compression stroke. During the previous 120°, the ECU calculated engine speed and determined the optimum time to start injecting fuel and the optimum time to stop injecting (determines fuel amount).

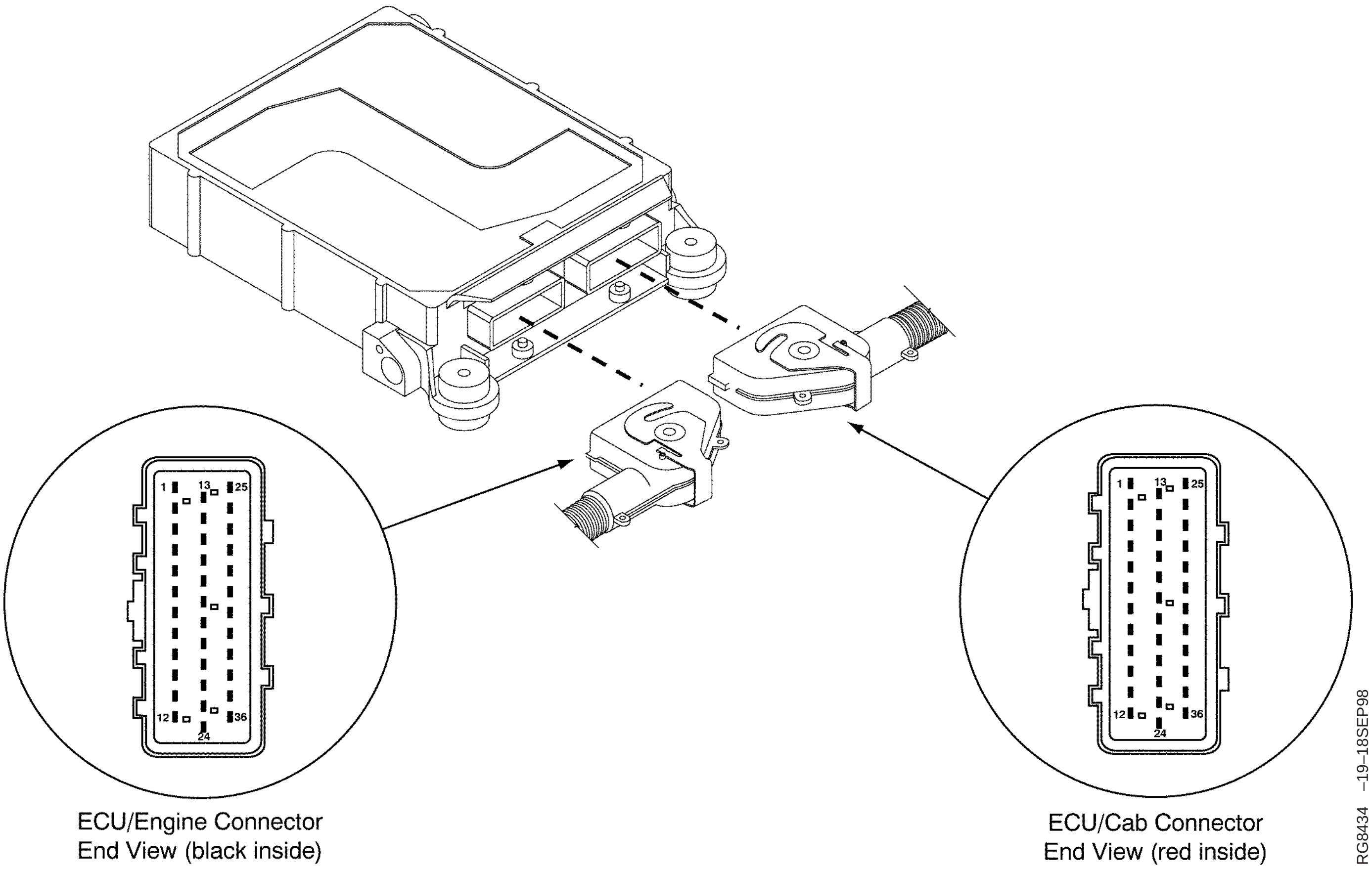
It then monitors each crank timing notch until the time to start injection occurs, at which time it energizes the Electronic Unit Injector (EUI) solenoid to start fuel delivery.

It continues to monitor each crank timing notch until the time to end injection occurs, at which time it will denergize the EUI solenoid to stop fuel delivery.

In the event of a crank or cam position sensor failure, a “limp-home” mode will allow the ECU to operate with only one position sensor input. If the crank position sensor fails, engine power will be low. If the cam position sensor fails, long cranking times will be required to start the engine. If both sensors fail, the engine will die and won’t restart.

RG,RG34710,1536 –19–30SEP97–4/4

Engine Control Unit (ECU)



ECU and Connectors

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:

Convert the electrical signals from the various sensors into digital signals

Make decisions of optimum fuel quantity and injection timing based on information from various sensors

Limit maximum fuel for operation on multiple power curves

Control fuel delivery

Provide min-max or all-speed governing

Perform self diagnosis on the control system

Store trouble codes in memory

The ECU connects to the wiring harness through an ECU/engine connector and an ECU/cab connector. Each connector can be identified by its color and key configuration. The ECU/engine connector is black; the ECU/cab connector is red. Both connectors contain 36 terminals, individually identified by numbers 1 through 36.

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

RG,RG34710,1537 –19–30SEP97–1/2

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 commands the Electronic Unit Injectors (EUIs) and 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

Governor Modes

The electronic control system has the ability to provide two types of governing; all-speed governing and min-max speed governing. When operating in the all-speed governor mode, the Engine Control Unit (ECU) controls the engine speed based on the analog throttle input or the PWM throttle input. When operating in the min-max speed governor mode, the ECU provides the same minimum (low idle) and maximum (fast idle) speed governing as with the all-speed governor. However, in between the minimum and maximum speeds, the analog throttle input or PWM throttle input is used by the ECU to select a fuel quantity. Thus, the throttle commands fuel quantity rather than engine speed in the min-max governor mode.

The electronic control system also has the ability to provide two types of droop; normal droop and isochronous (0% droop). The normal droop characteristic is a linear increase of engine speed with decreasing load. The 0% droop will only be selected by a switch input, without a switch signal present, the normal droop will be used.

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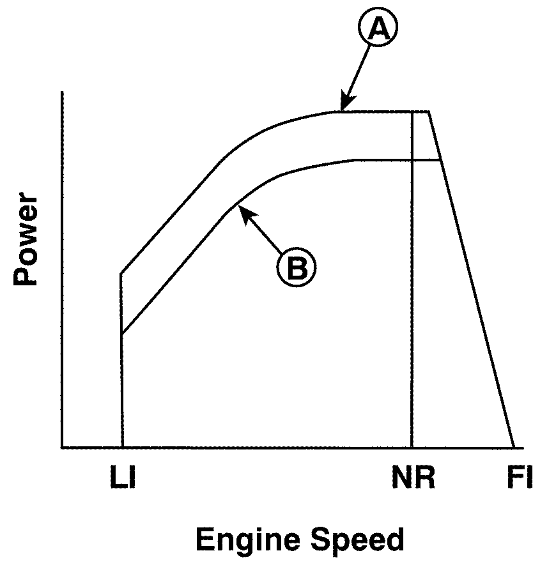
Maximum Fuel Quantity Control

The Engine Control Unit (ECU) has the ability to limit the maximum fuel quantity such that multiple torque curves can individually be selected while the engine is running. The selection of a torque curve is determined by switch inputs. 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 under certain operating conditions.



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

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Torque Curves

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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 of the sensor input voltages are too high or too low, if the camshaft and crankshaft position sensor inputs are valid, and if the unit injector solenoids are responding properly. If the ECU detects a problem with the electronic control system a Diagnostic Trouble Code (DTC) specific to the failed system will be stored in the ECU’s memory.

There are two types of DTCs:

- Active
- 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.

If a sensor or wiring fails and a DTC is active for that sensor, the ECU will use a substitute “limp home” value in it’s calculations to continue engine operation.

NOTE: If the Diagnostic Scan Tool (DST) is used to read a sensor voltage and calculated value, and there is a current 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.

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Section 04
Diagnostics

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04

04

About this Group of the Manual

This group of the manual contains necessary information for observable diagnostics and fuel-related test procedures. Use this information in conjunction with the 10.5 L & 12.5 L Diesel Engines Base Engine Manual (CTM 100). 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:

- B1 - ECU Does Not Communicate with DST
- B2 - Engine Cranks/No Start or Starts Hard (DST Available)
- B3 - Engine Cranks/No Start or Starts Hard (DST Not Available)
- B4 - Engine Misfires/Runs Irregularly
- B5 - Low Power/Excessive Black Smoke (DST Available)
- B6 - Low Power/Excessive Black Smoke (DST Not Available)
- B7 - Fuel Supply System 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 Pressure
  – Bleed the Fuel System

OUO1004,0000C34 –19–15DEC00–1/1

Lucas ECU - Diagnosing Engine Malfunctions

Symptom	Problem	Solution
Lucas ECU - 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 for faulty wiring, fuses, or relays in the start circuit.
Lucas ECU - Engine Hard to Start or Will Not Start	Poor fuel quality	Drain fuel and replace with quality fuel of the proper grade.
	Slow cranking speed	Check for problem in the charging/starting system.
	Too high viscosity crankcase oil	Drain crankcase oil and replace with correct viscosity oil.
	Electronic Control System problem or basic engine problem	See B2 - ENGINE CRANKS/NO START OR STARTS HARD (DST AVAILABLE) in this group.
Lucas ECU - Engine Misfiring or Runs Irregularly	Electronic Control System problem or basic engine problem	See B4 - ENGINE MISFIRES/RUNS IRREGULARLY in this group.
Lucas ECU - Lack of Engine Power	Poor fuel quality	Drain fuel and replace with quality fuel of the proper grade.
	Engine overloaded	Reduce engine load.
	Improper crankcase oil	Drain crankcase oil and replace with correct viscosity oil.
	Electronic Control System problem or basic engine problem	See B5 - LOW POWER/EXCESSIVE BLACK SMOKE in this group.

Continued on next page
RG,RG34710,1541 –19–13JUN01–1/4

Symptom	Problem	Solution
Lucas ECU - Black or Gray Exhaust Smoke	Engine overloaded	Reduce engine load.
	Engine burning oil	See L1 - EXCESSIVE OIL CONSUMPTION, in CTM100, Section 04, Group 150.
	Air cleaner restricted or dirty	Replace air cleaner element as required.
	Defective muffler/exhaust piping (causing back pressure)	Replace muffler or defective piping.
	Electronic Control System problem or basic engine problem	See B5 - LOW POWER/EXCESSIVE BLACK SMOKE (DST AVAILABLE) in this group.
Lucas ECU - White Exhaust Smoke	Engine compression too low	Determine cause of low compression and repair as required.
	Defective thermostat(s) (does not close)	Test thermostats; replace thermostats as required. See REMOVE THERMOSTATS in Section 02, Group 070 of CTM100.
	Coolant entering combustion chamber (failed cylinder head gasket or cracked cylinder head)	See Section 02, Group 020 of CTM100.
	Failed water-to-air aftercooler— if equipped	Remove and inspect water-to-air aftercooler. See REMOVE AND INSTALL AFTERCOOLER ASSEMBLY in Section 02, Group 080 of CTM100.
Lucas ECU - 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 Section 02, Group 080 of CTM100.)
	Electronic control system problem or basic engine problem	See B4 - ENGINE MISFIRES/RUNS IRREGULARLY in this group.

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RG,RG34710,1541 –19–13JUN01–2/4

Symptom	Problem	Solution
Lucas ECU - 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.
Lucas ECU - Abnormal Engine Noise	Worn main or connecting rod bearings	Determine bearing clearance. See CYLINDER BLOCK, LINERS, PISTONS AND RODS (GROUP 030) SPECIFICATIONS in Section 06, Group 200 of CTM100. See CRANKSHAFT, MAIN BEARINGS AND FLYWHEEL (GROUP 040) SPECIFICATIONS in Section 06, Group 200 of CTM100.
	Excessive crankshaft end play	Check crankshaft end play. See CHECK CRANKSHAFT END PLAY in Section 02, Group 040 of CTM100.
	Loose main bearing caps	Check bearing clearance; replace bearings and bearing cap screws as required. See CRANKSHAFT, MAIN BEARINGS AND FLYWHEEL (GROUP 040) SPECIFICATIONS in Section 06, Group 200 of CTM100.
	Worn connecting rod bushings and piston pins	Inspect piston pins and bushings. See INSPECT PISTON PINS AND ROD BUSHINGS in Section 02, Group 030 of CTM100.
	Scored pistons	Inspect pistons. See PRELIMINARY LINER, PISTON, AND ROD CHECKS in Section 02, Group 030 of CTM100.

Continued on next page

RG,RG34710,1541 –19–13JUN01–3/4

Symptom	Problem	Solution
	Worn timing gears or excess back lash	Check timing gear back lash. See ADJUST FRONT TIMING GEAR BACKLASH in Section 02, Group 050 of CTM100.
	Excessive valve clearance	Check and adjust valve clearance. See CHECK AND ADJUST VALVE ASSEMBLY CLEARANCES AND INJECTOR PRELOAD in Section 02, Group 020 of CTM100.
Lucas ECU - Abnormal Engine Noise	Worn camshaft	Inspect camshaft. See VISUALLY INSPECT CAMSHAFT AND ROLLER FOLLOWERS in Section 02, Group 050 of CTM100.
	Worn rocker arm shaft(s)	Inspect rocker arm shafts. See REMOVE ROCKER ARM ASSEMBLY in Section 02, Group 020 of CTM100.
	Insufficient engine lubrication	See L3 - ENGINE OIL PRESSURE LOW in CTM100, Section 04, Group 150.
	Turbocharger noise	See TURBOCHARGER SEVEN-STEP INSPECTION in Section 02, Group 080 of CTM100.

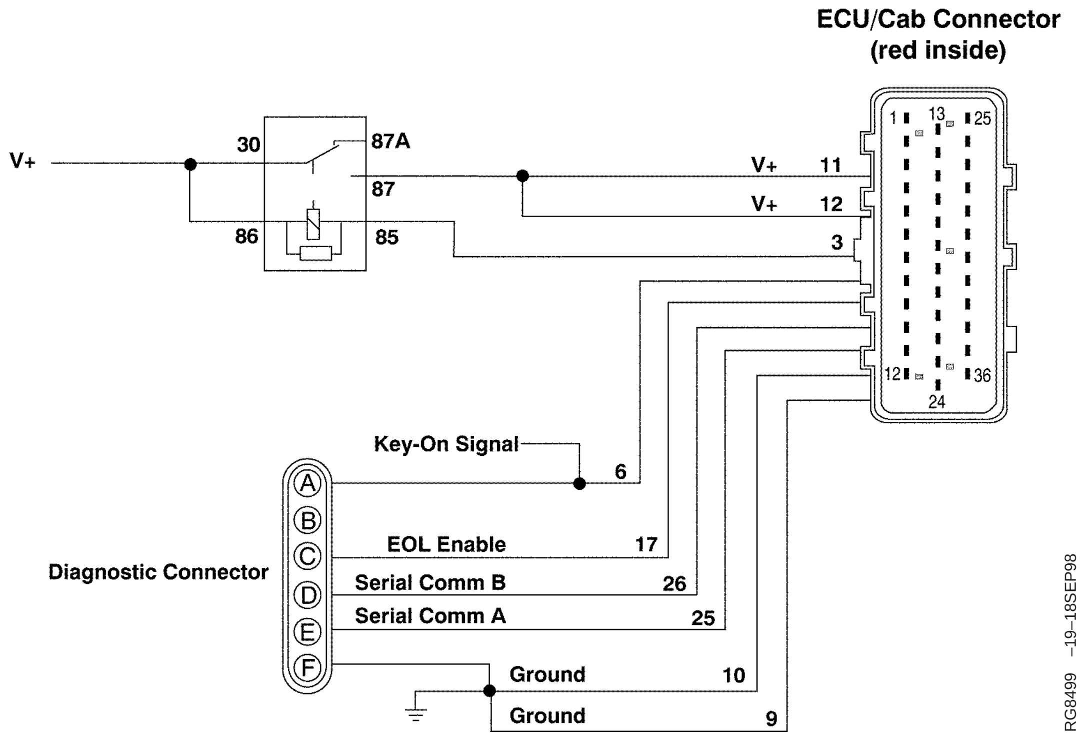
RG,RG34710,1541 –19–13JUN01–4/4

Lucas ECU - Diagnosing Low Pressure Fuel System Malfunctions

Symptom	Problem	Solution
Lucas ECU - Fuel in Oil	Cracked or worn Electronic Unit Injector (EUI) O-ring	Remove suspected EUI, replace EUI O-ring as required. See REMOVE AND INSTALL ELECTRONIC UNIT INJECTORS in Section 02, Group 090.
	Cracked cylinder head	Locate crack, repair / replace components as required.
Lucas ECU - Fuel Aeration	EUI hold-down clamp loose	Tighten hold-down clamp cap screw to proper torque. See REMOVE AND INSTALL ELECTRONIC UNIT INJECTORS in Section 02, Group 090
	Cracked or worn Electronic Unit Injector (EUI) O-ring	Remove suspected EUI, replace EUI O-ring as required. See REMOVE AND INSTALL ELECTRONIC UNIT INJECTORS in Section 02, Group 090

DPSG,OUOE003,2770 –19–20NOV00–1/1

B1 - ECU Does Not Communicate With DST



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.

The B1 diagnostic procedure should be used if communication between the Diagnostic Scan Tool (DST) and the Engine Control Unit (ECU) cannot be established.

RG,RG34710,1566 –19–20NOV00–1/1

B1 - ECU Does Not Communicate With DST

OUO1004,0000C4F –19–05JAN01–1/1

B1 - ECU Does Not Communicate With DST Diagnostic Procedure

NOTE: Before using this diagnostic procedure, perform a preliminary inspection of the ECU/ connector (red inside) and the diagnostic connector looking for dirty, damaged, or poorly positioned terminals.

– – –1/1

❶ **Intermittent Problem Test**	*NOTE: For wiring information, see B1 - ECU DOES NOT COMMUNICATE WITH DST supporting information.* 1. Connect the DST 2. Ignition ON 3. Start the ECU communication software	**DST doesn't communicate with ECU:** GO TO ❷ **DST communicates with ECU:** Problem is intermittent. If no DTCs are present, see INTERMITTENT FAULT DIAGNOSTICS, in Group 160.

– – –1/1

❷ **ECU Power Check**	*NOTE: For wiring information, see B1 - ECU DOES NOT COMMUNICATE WITH DST supporting information.* 1. Ignition OFF 2. Disconnect the fuel temperature sensor, the MAT sensor or the ECT sensor 3. Ignition ON 4. Using a multimeter, measure the voltage between both terminals of the sensor harness connector	**3.0 volts or above:** GO TO ❹ **Below 3.0 volts:** GO TO ❸

– – –1/1

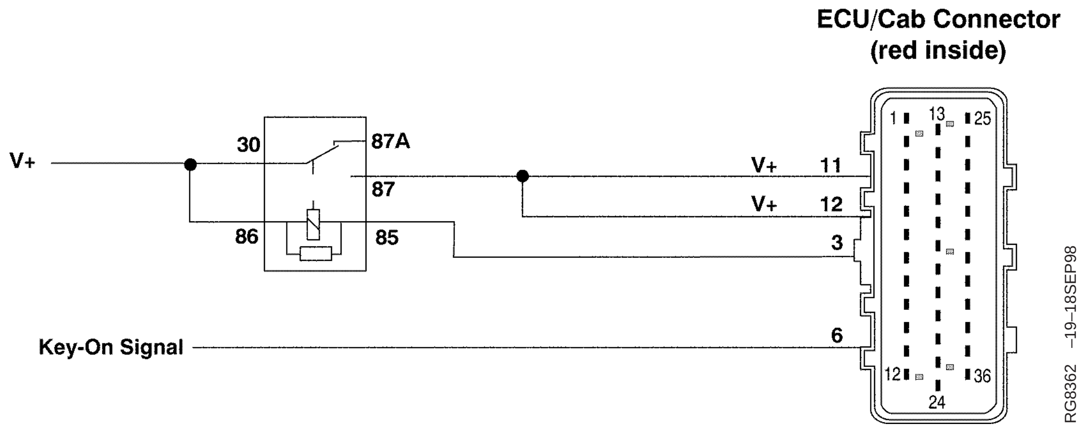
❸ **Key-on Voltage Check**	*NOTE: For wiring information, see B1 - ECU DOES NOT COMMUNICATE WITH DST supporting information.* 1. Ignition OFF 2. Disconnect ECU/Cab connector 3. Using a multimeter, measure the voltage between a good ground and ECU/Cab connector terminal 6 with the ignition in the ON position	**3.0 volts or above:** Faulty ECU power fuse OR Faulty ECU power relay or other power supply component (refer to specific machine manual) OR Faulty ECU power wiring OR Faulty ECU **Below 3.0 volts:** Key-on signal wire open or shorted to ground OR Faulty ignition switch – – –1/1

❹ **PDM Power Check**	*NOTE: For wiring information, see B1 - ECU DOES NOT COMMUNICATE WITH DST supporting information.* 1. Ignition ON 2. Note the power light on the Parallel Data Module (PDM)	**Power light ON:** GO TO ❻ **Power light OFF:** GO TO ❺ – – –1/1

❺ **Diagnostic Connector Ground Circuit Check**	*NOTE: For wiring information, see B1 - ECU DOES NOT COMMUNICATE WITH DST supporting information.* 1. Ignition OFF 2. Disconnect the diagnostic cable from the diagnostic connector 3. Probe terminal F in diagnostic connector with a test light connected to battery voltage	**Light ON:** Open or short in diagnostic connector switched power wire **Light OFF:** Open in diagnostic connector ground wire – – –1/1

❻ **Serial Communication Circuits Check**	*NOTE: For wiring information, see B1 - ECU DOES NOT COMMUNICATE WITH DST supporting information.* 1. Ignition OFF 2. Disconnect ECU/Cab connector and diagnostic cable from the diagnostic connector 3. Check continuity between the following terminals in the diagnostic connector and the ECU/Cab connector: • D to 26 • E to 25	**Continuity at both terminals:** Faulty ECU/Cab connector OR Faulty diagnostic cable OR Faulty diagnostic connector OR Faulty Parallel Data Module (PDM) OR Faulty diagnostic software/computer configuration OR Faulty ECU **No continuity at one or both terminals:** Open in harness in circuit with no continuity – – –1/1

B2 - Engine Cranks/No Start or Starts Hard (DST Available)



Simplified ECU Power Wiring

The B2 - Engine Cranks/No Start or Starts Hard (DST Available) diagnostic procedure should be used if the engine cranks OK, but will not start or starts only after prolonged cranking. If the engine will not crank, determine problem in the starting/charging system. See DIAGNOSING ENGINE MALFUNCTIONS in this group.

RG,RG34710,1567 –19–20NOV00–1/1

B2 - Engine Cranks/No Start or Starts Hard (DST Available)

OUO1004,0000C50 –19–05JAN01–1/1

B2 - Engine Cranks/No Start or Starts Hard (DST Available) Diagnostic Procedure

NOTE: This diagnostic procedure should be used witht the Diagnostic Scan Tool (DST). If the DST is unavailable, but JT02171 is available, see B3 - ENGINE CRANKS/NO START OR STARTS HARD (DST NOT AVAILABLE) Diagnostic Procedure.

– – –1/1

❶ **B2 - Preliminary Check**	**Before using this diagnostic procedure:** • Ensure fuel quantity and quality are OK • Ensure engine mechanical condition is OK • Ensure engine cranking speed is OK	**Preliminary checks OK:** GO TO ❷

– – –1/1

❷ **Active DTC Test**	1. Connect the DST 2. Crank engine for 10 seconds 3. Using the DST, monitor DTCs on the active code display parameter	**No DTCs present:** GO TO ❸ **DTC(s) present:** Diagnose active DTCs If more than 1 DTC is present, go to the chart corresponding to the lowest number DTC **ECU will not communicate with DST:** See diagnostic procedure B1 - ECU DOES NOT COMMUNICATE WITH DST, earlier in this Group

– – –1/1

❸ **Fuel Hand Primer Test**	1. Ignition OFF 2. Operate hand primer pump located on the primary filter base until moderate resistance is felt 3. Retry engine start	**Engine does not start:** GO TO ❺ **Engine starts:** GO TO ❹

– – –1/1

❹ **Air in Fuel Check**	1. If fuel system has been recently opened (filter changed, line removed etc.) perform fuel system bleed procedure. See BLEED THE FUEL SYSTEM in Section 02, Group 090 and retest. 2. Inspect check valves and primary filter base flapper valve for proper operation 3. Check to see that all fuel fittings are tightened to the correct torque 4. Check the weep hole on the under side of the fuel transfer pump, if weep hole is wet with fuel, replace pump and retest 5. Check that the hold down clamp cap screw on all EUIs is tightened to spec. See step 3 of REMOVE AND INSTALL ELECTRONIC UNIT INJECTORS in Section 02, Group 090. 6. If torques are correct, remove EUIs and inspect seats for combustion gas leaks. See REMOVE AND INSTALL ELECTRONIC UNIT INJECTORS of Section 02, Group 090.	– – –1/1

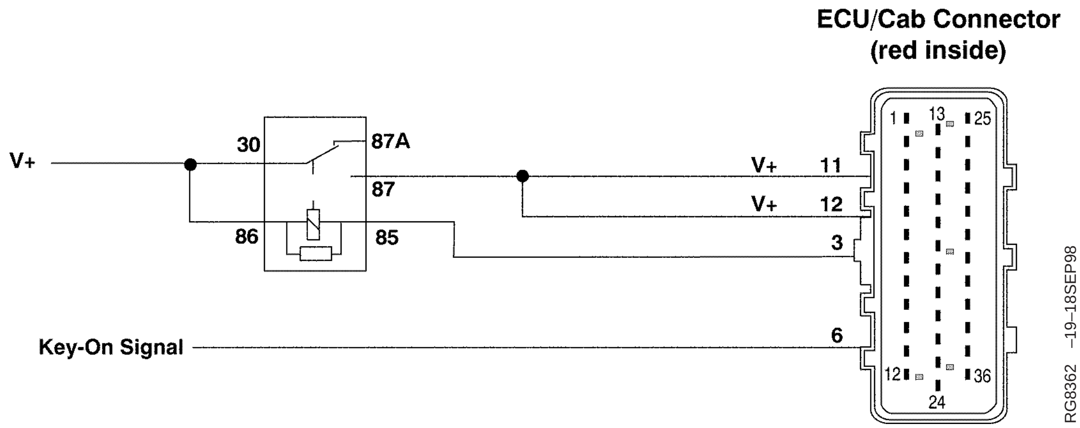
❺ **Pilot Injection Test**	While cranking the engine, read the pilot injection parameter	**Pilot Injection reads ON or N/A:** GO TO ❻ **Pilot Injection reads OFF:** Pilot Injection should be ON if the ECT is below 35°C (95°F). If Pilot Injection is OFF under this condition, determine problem in the ECT sensor circuit. – – –1/1

❻ **Check Fuel Supply System**	Check the fuel supply system. See B7 - FUEL SUPPLY SYSTEM CHECK later in this Group	**Fuel supply system OK:** GO TO ❼ **Fuel supply system problem found:** Repair fuel supply system problem and retest – – –1/1

❼ **EUI Cap Screw and EUI Harness and Connector Test**	1. Ignition OFF 2. Remove rocker arm cover *NOTE: Rocker arm cover gasket is reusable if no visible damage is detected. Do not store cover resting on gasket surface.* 3. Check EUI rocker arms, valve rocker arms, and camshaft operation. 4. Check that the hold down clamp cap screws on all EUIs are tightened to specification. See REMOVE AND INSTALL ELECTRONIC UNIT INJECTORS in Section 02, Group 090. 5. Inspect EUI harness and EUI harness connector for damage.	**All components operating correctly:** GO TO ❽ **Faulty component found:** Repair faulty component and retest. – – –1/1

❽ **Cam to Crank Timing Test**	Verify cam/crank timing is correct. See CHECK AND ADJUST CAMSHAFT- TO- CRANKSHAFT TIMING in CTM100, Section 02, Group 050.	**Cam/crank timing OK:** Replace ECU and retest. **Cam/crank timing NOT OK:** See CHECK AND ADJUST CAMSHAFT- TO- CRANKSHAFT TIMING in CTM100, Section 02, Group 050. – – –1/1

B3 - Engine Cranks/No Start or Starts Hard (DST Not Available)



Simplified ECU Power Wiring

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.

The B3 - Engine Cranks/No Start or Starts Hard (DST Not Available) diagnostic procedure should be used if the engine cranks OK, but will not start or starts only after prolonged cranking. If the engine will not crank, determine problem in the starting/charging system. See DIAGNOSING ENGINE MALFUNCTIONS in this group.

RG40854,0000002 –19–11DEC00–1/1

B3 - Engine Cranks/No Start or Starts Hard (DST Not Available)

OUO1004,0000C51 –19–05JAN01–1/1

B3 - Engine Cranks/No Start or Starts Hard (DST Not Available) Diagnostic Procedure

NOTE: This diagnostic chart should be used along with JT02171 Break-Out-Box (BOB). If the Diagnostic Scan Tool (DST) is available, see B2 - ENGINE CRANKS/NO START OR STARTS HARD (DST AVAILABLE) Diagnostic Procedure.

– – –1/1

❶ **B3 - Preliminary Check**	**Before using this diagnostic procedure:** • Ensure fuel quantity and quality are OK • Ensure engine mechanical condition is OK • Ensure engine cranking speed is OK	**Preliminary checks OK:** GO TO ❷

– – –1/1

❷ **Active DTC Test**	1. Crank engine for 10 seconds 2. Check for Diagnostic Trouble Codes (DTCs)	**No DTCs present:** GO TO ❸ **DTC(s) present:** Go to the appropriate diagnostic procedure If more than 1 DTC is present, go to the chart corresponding to the lowest number DTC

– – –1/1

❸ **Fuel Hand Primer Test**	1. Ignition OFF 2. Operate hand primer pump located on the primary filter base until moderate resistance is felt 3. Retry engine start	**Engine does not start:** GO TO ❺ **Engine starts:** GO TO ❹

– – –1/1

❹ **Air In Fuel Test**	1. If fuel system has been recently opened (filter changed, line removed etc.) perform fuel system bleed procedure. See BLEED THE FUEL SYSTEM in Section 02, Group 090 and retest. 2. Inspect check valves and primary filter base flapper valve for proper operation 3. Check to see that all fuel fittings are tightened to the correct torque 4. Check the weep hole on the under side of the fuel transfer pump, if weep hole is wet with fuel, replace pump and retest 5. Check that the hold down clamp cap screw on all EUIs is tightened to spec. See step 3 of REMOVE AND INSTALL ELECTRONIC UNIT INJECTORS in Section 02, Group 090. 6. If torques are correct, remove EUIs and inspect seats for combustion gas leaks. See REMOVE AND INSTALL ELECTRONIC UNIT INJECTORS of Section 02, Group 090.	– – –1/1

❺ **5V Supply Check**	1. Ignition OFF 2. Disconnect the fuel temperature sensor, the MAT sensor or the ECT sensor. 3. Ignition ON 4. Using a multimeter, measure the voltage between both terminals of the sensor harness connector.	**3.0 volts or above:** GO TO ❼ **Below 3.0 volts:** GO TO ❻ – – –1/1

❻ **Power Wire Test**	1. Ignition OFF 2. Connect the BOB to the ECU/Cab connector 3. Ignition ON 4. Using a multimeter, measure the voltage between BOB pin 6 (+) and pin 9 (-)	**3.0 volts or above:** Faulty ECU power fuse OR Faulty ECU power relay or other power supply component (refer to specific machine manual) OR Faulty ECU power wiring OR Faulty ECU **Below 3.0 volts:** Key-on signal open or shorted to ground OR Faulty ignition switch – – –1/1

❼ **Fuel Supply System Check**	Check the fuel supply system. See B7 - FUEL SUPPLY SYSTEM CHECK	**Fuel supply system OK:** GO TO ❽ **Fuel supply system problem found:** Repair fuel supply system problem and retest. – – –1/1

❽ **EUI Cap Screw and EUI Harness and Connector Test**	1. Ignition OFF 2. Remove rocker arm cover *NOTE: Rocker arm cover gasket is reusable if no visible damage is detected. Do not store cover resting on gasket surface.* 3. Check EUI rocker arms, valve rocker arms, and camshaft operation. 4. Check that the hold down clamp cap screws on all EUIs are tightened to specification. See REMOVE AND INSTALL ELECTRONIC UNIT INJECTORS in Section 02, Group 090. 5. Inspect EUI harness and EUI harness connector for damage.	**All components operating correctly:** GO TO ❾ **Faulty component found:** Repair faulty component and retest. – – –1/1

❾ **Cam to Crank Timing Test**	Verify cam/crank timing is correct. See CHECK AND ADJUST CAMSHAFT- TO-CRANKSHAFT TIMING in CTM100, Section 02, Group 050.	**Cam/crank timing OK:** Replace ECU and retest. **Cam/crank timing NOT OK:** See CHECK AND ADJUST CAMSHAFT- TO- CRANKSHAFT TIMING in CTM100, Section 02, Group 050. – – –1/1

B4 - Engine Misfires/Runs Irregularly

The B4 - Engine Misfires/Runs Irregularly diagnostic procedure should be used if the engine does not seem to be running on all cylinders either intermittently or all of the time. If the engine is delivering lower than expected power, see B5 - LOW POWER/EXCESSIVE BLACK SMOKE (DST AVAILABLE).

RG,RG34710,1569 –19–20NOV00–1/1

B4 - Engine Misfires/Runs Irregularly Diagnostic Procedure

– – –1/1

❶ **B4 - Preliminary Check**	Before using this diagnostic procedure, check for the following that could cause or be mistaken as misfire/rough running: • Intake manifold air leaks • Engine mechanical problems • Transmission problems • Engine accessories, such as A/C cycling on and off • Electromagnetic interference (EMI) from improperly installed radios etc.	**Preliminary checks OK:** GO TO ❷

– – –1/1

❷ **Active DTC Check**	1. Ignition ON, engine idling 2. Using the DST, monitor DTCs on the active code display parameter	**No DTCs:** GO TO ❸ **DTCs present:** Go to the appropriate diagnostic procedure If more than one DTC is present, go to the procedure corresponding to the lowest number DTC

– – –1/1

❸ **Engine Performance Check**	1. Ignition ON, engine idling 2. Note engine performance	**Running rough:** GO TO ❻ **Not running rough:** GO TO ❹

– – –1/1

❹ **Recreate Conditions**	1. Operate engine under the conditions where the misfire/rough running complaint occurs 2. Note engine operation	**Running rough:** GO TO ❺ **Not running rough:** No problem found, verify complaint and try to reproduce conditions where the complaint occurs – – –1/1

❺ **Active DTC Check**	Using the DST, monitor DTCs on the active code display parameter	**No DTCs:** GO TO ❻ **DTCs present:** Go to the appropriate diagnostic procedure If more than one DTC is present, go to the procedure corresponding to the lowest number DTC – – –1/1

❻ **Compression and Misfire Test**	1. Perform the Relative Compression Test. For instructions, see DIAGNOSTIC SCAN TOOL (DST) ENGINE TEST INSTRUCTIONS—RELATIVE COMPRESSION TEST in Group 160. Make note of the results 2. Perform the Cylinder Misfire Test. For instructions, see DIAGNOSTIC SCAN TOOL (DST) ENGINE TEST INSTRUCTIONS—CYLINDER MISFIRE TEST in Group 160. Make note of the results	**All cylinder scored within 10% of each other on both tests:** GO TO ❼ **One or more cylinders scored 10% or more lower than the rest on the compression test and DIFFERENT cylinder(s) scored 10% or more lower on the misfire test:** GO TO ❽ **One or more cylinders scored 10% or more lower than the rest on the compression test and the SAME cylinder(s) scored 10% or more lower on the misfire test:** GO TO ❾ **All cylinders scored within 10% of each other on the compression test and one or more cylinders scored 10% or more lower than the rest on the misfire test:** GO TO ❿ **One cylinder low on compression but normal on misfire:** A low compression problem that may cause hard start but once running does not cause misfire. – – –1/1

❼ **Fuel Supply System Check**	Check the fuel supply system. See B7 - FUEL SUPPLY SYSTEM CHECK	**Fuel supply system OK:** GO TO ⓫ **Fuel supply system problem found:** Repair fuel supply system problem and retest – – –1/1

❽ **Inconclusive Compression and Misfire Tests**	These type of results indicate that either the misfire test or the compression test could not operate correctly. Further engine diagnostics should be performed to determine if the engine misfire is caused by a faulty EUI or by a compression problem	– – –1/1

❾ **Low Compression Pressure Check**	Determine cause of low compression pressure on the low scoring cylinders, repair and retest	– – –1/1

❿ **Suspected EUI(s) Pre-load Adjustment Check**	1. Check EUI pre-load adjustment on the EUI(s) of the cylinder(s) that tested low on the misfire test. See CHECK AND ADJUST VALVE ASSEMBLY CLEARANCES AND INJECTOR PRELOAD in Section 02, Group 020 of CTM100 2. If EUI pre-load is adjusted properly, replace the EUI(s) of the cylinder(s) that tested low on the misfire test, and retest	– – –1/1

⓫ **EUI Preload and Valve Clearance Adjustment Check**	Check EUI pre-load adjustment and check valve adjustment. See CHECK AND ADJUST VALVE ASSEMBLY CLEARANCES AND INJECTOR PRELOAD in Section 02, Group 020 of CTM100	**EUIs and valves properly adjusted:** Ensure there are no engine mechanical problems Ensure there isn't something drawing excessive engine power If none of the above problems are found, see B5 - LOW POWER/EXCESSIVE BLACK SMOKE (DST AVAILABLE) **EUI(s) and/or valve(s) NOT properly adjusted:** Adjust EUI(s) and valve(s) to specification and retest – – –1/1

B5 - Low Power/Excessive Black Smoke (DST Available)

The B5 - Low Power/Excessive Black Smoke (DST Available) diagnostic procedure should be used if the engine delivers less power than expected or emits excessive black exhaust smoke. If the engine seems to be misfiring on one or more cylinders or running irregularly, see B4 - ENGINE MISFIRES/RUNS IRREGULARLY.

RG,RG34710,1570 –19–20NOV00–1/1

B5 - Low Power/Excessive Black Smoke (DST Available) Diagnostic Procedure

NOTE: This diagnostic procedure should be used along with the Diagnostic Scan Tool (DST). If the DST is not available, but JT02171 Break-Out-Box is, see B6 - LOW POWER/EXCESSIVE BLACK SMOKE (DST NOT AVAILABLE) DIAGNOSTIC PROCEDURE.

– – –1/1

❶ **B5 - Preliminary Check**	Before using this diagnostic procedure, ensure that: • There are no problems with the transmission • There are no engine mechanical problems • There is not an excessive load on the engine • Fuel quality is OK	**Preliminary checks OK:** GO TO ❷ – – –1/1

❷ **Active DTC Check**	1. Operate engine and attempt to recreate the conditions of the low power/excessive black smoke complaint 2. Check Diagnostic Trouble Codes (DTCs)	**No DTCs:** GO TO ❸ **DTCs present:** Go to the appropriate diagnostic procedure If more than one DTC is present, go to the procedure corresponding to the lowest number DTC – – –1/1

❸ **Torque Curve Selection Check**	*NOTE: 6750/6850 Self-Propelled Forage Harvesters only use one torque curve; therefore this check is not required* The ECU on 10.5/12.5 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/excessive black smoke complaint: 1. Recreate the conditions of the low power/excessive black smoke complaint 2. Using the DST, read the torque curve number 3. Compare the torque number to the appropriate TORQUE CURVE SELECTION chart in Section 06, Group 210.	**The torque curve number displayed IS correct for the operating conditions of the low power complaint:** GO TO ❹ **The torque curve number displayed IS NOT correct for the operating conditions of the low power complaint:** Refer to machine manual to determine components that if faulty could prevent the correct torque curve from being selected OR Faulty torque curve select wiring – – –1/1

❹ **Engine Coolant Temperature Check**	1. Warm engine 2. Recreate the conditions of the low power/excessive black smoke complaint 3. Using the DST, read the ECT sensor temperature	**Below 100°C (212°F):** GO TO ❺ **Above 100° C (212° F):** Engine coolant temperature is too high. The ECU derates engine power when coolant temperature exceeds 100° C (212° F) to protect the engine from overheating See C1 - ENGINE COOLANT TEMPERATURE ABOVE NORMAL in CTM100, Section 04, Group 150. – – –1/1

❺ **Throttle Test**	1. Operate engine at full load/rated speed 2. Using the DST, read the Percent Throttle parameter	**97% or greater:** GO TO ❻ **Below 97%:** Refer to machine manual and perform throttle calibration procedure, then retest – – –1/1

❻ **Turbocharger Boost Pressure Test**	1. Operate engine at full load/rated speed 2. Using the DST, read the boost pressure - MAP parameter 3. Compare value to boost specification. See INTAKE MANIFOLD PRESSURE (TURBOCHARGER BOOST) SPECIFICATIONS in CTM100, Section 06, Group 210.	**MAP in range or above compared to boost specification:** GO TO ❿ **MAP below range compared to boost specification:** GO TO ❼

– – –1/1

❼ **Causes of Low Turbocharger Boost Checks**	Check for the following that can cause low boost pressure: • Restricted air cleaner • Intake air leak • Exhaust air leak • Exhaust system restriction • Faulty turbocharger • Low cylinder compression pressure	**No cause of low boost pressure found:** GO TO ❽ **Cause of low boost pressure found:** Repair problem and retest

– – –1/1

❽ **Fuel Supply System Check with Low Turbocharger Boost Pressure**	Check the fuel supply system. See B7 - FUEL SUPPLY SYSTEM CHECK later in this group.	**Fuel supply system OK:** GO TO ❾ **Fuel supply system problem found:** Repair fuel supply system problem and retest

– – –1/1

❾ **EUI and Excessive Load Check**	1. Ensure EUI pre-load is correctly adjusted. See CHECK AND ADJUST VALVE ASSEMBLY CLEARANCES AND INJECTOR PRELOAD in Section 02, Group 020 of CTM100 2. Ensure there are no engine mechanical problems 3. Ensure there isn’t something drawing excessive engine power 4. If none of the above problems are found, the most likely cause of low power is damaged spill valves in the EUIs. Replace EUIs and retest	

– – –1/1

10 **Fuel Supply System Check with Good Turbocharger Boost Pressure**	Check the fuel supply system. See B7 - FUEL SUPPLY SYSTEM CHECK later in this group.	**Fuel supply system OK:** GO TO 11 **Fuel supply system problem found:** Repair fuel supply system problem and retest – – –1/1

11 **Vehicle Check for Low Power**	Engine appears to be developing full power. Check for vehicle problems that could cause an excessive load on the engine.	– – –1/1

B6 - Low Power/Excessive Black Smoke (DST Not Available)

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.

The B6 - Low Power/Excessive Black Smoke (DST Not Available) diagnostic procedure should be used if the engine delivers less power than expected or emits excessive black exhaust smoke. If the engine seems to be misfiring on one or more cylinders or running irregularly, see B4 - ENGINE MISFIRES/RUNS IRREGULARLY

Determining Torque Curve Using BOB

NOTE: Not all applications use all eight torque curves.

	Voltage between BOB pin 21 and pin 9	Voltage between BOB pin 31 and pin 9	Voltage between BOB pin 15 and pin 9
Torque Curve 1	0 volts	0 volts	0 volts
Torque Curve 2	0 volts	0 volts	5 volts
Torque Curve 3	0 volts	5 volts	0 volts
Torque Curve 4	0 volts	5 volts	5 volts
Torque Curve 5	5 volts	0 volts	0 volts
Torque Curve 6	5 volts	0 volts	5 volts
Torque Curve 7	5 volts	5 volts	0 volts
Torque Curve 8	5 volts	5 volts	5 volts

RG40854,0000001 –19–22JUN01–1/1

B6 - Low Power/Excessive Black Smoke (DST Not Available)

OUO1004,0000C53 –19–05JAN01–1/1

B6 - Low Power/Excessive Black Smoke (DST Not Available) Diagnostic Procedure

NOTE: The B6 - Low Power/Excessive Black Smoke (DST Not Available) diagnostic procedure should be used along with JT02171 Break-Out -Box (BOB). If the Diagnostic Scan Tool (DST) is available, see B5 - LOW POWER/EXCESSIVE BLACK SMOKE (DST AVAILABLE).

– – –1/1

➊ **B6 - Preliminary Check**	Before using this diagnostic procedure, ensure that: • There are no problems with the transmission • There are no engine mechanical problems • There is not an excessive load on the engine • Fuel quality is OK	**Preliminary checks OK:** GO TO ➋

– – –1/1

➋ **Active DTC Check**	1. Operate engine and attempt to recreate the conditions of the low power/excessive black smoke complaint 2. Check Diagnostic Trouble Codes (DTCs)	**No DTCs:** GO TO ➌ **DTCs present:** Go to the appropriate diagnostic procedure If more than one DTC is present, go to the procedure corresponding to the lowest number DTC

– – –1/1

❸ **Engine Coolant Temperature Check**	1. Warm engine 2. Recreate the conditions of the low power/excessive black smoke complaint 3. Observe the engine coolant temperature	**Below 100°C (212°F):** GO TO ❹ **Above 100°C (212°F):** Engine Coolant Temperature is too high. ECU derates engine power when coolant temperature exceeds 100°C (212°F) to protect the engine from overheating. See C1 - ENGINE COOLANT TEMPERATURE ABOVE NORMAL in CTM100, Section 04, Group 150. – – –1/1

❹ **Torque Curve Parameter Check**	*NOTE: 6750/6850 Self-Propelled Forage Harvester applications only use one torque curve; therefore this check is not required.* The ECU on 10.5/12.5 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/excessive black smoke complaint: • Connect the BOB to the ECU/Cab connector (connector inside is red) • Recreate the conditions of the low power/excessive black smoke complaint • Under these conditions, measure voltage between the following BOB pins and pin 9 (-): – pin 15 (+) – pin 31 (+) – pin 21 (+) • Compare the voltage readings observed to the chart on the preceding page to determine the torque curve number • Compare the torque curve number to specification. See TORQUE CURVE SELECTION in Section 06, Group 210 of this manual.	**Torque curve number is correct for conditions:** GO TO ❺ **Torque curve number is NOT correct for conditions:** Refer to machine manual to determine components that if faulty could prevent the correct torque curve from being selected OR Faulty torque curve select wiring – – –1/1

❺ **Throttle Duty Cycle Check**	1. Ignition ON, engine OFF 2. BOB still connected to the ECU/Cab connector 3. Move the throttle to the high idle position • On 9000 series 4WD tractor and 744H loader applications, use a multimeter to measure the duty cycle of the signal on the BOB pin 16. • On OEM and 6750/6850 Self-Propelled Forage Harvester applications, use a multimeter to measure the voltage between pin 35 (+) and pin 22 (-)	**Tractor/Loader applications duty cycle 90-95% OR OEM/Forage Harvester applications voltage 4.0V or greater:** GO TO ❻ **Tractor/Loader applications duty cycle below 90% OR OEM/Forage Harvester applications voltage below 4.0V:** Determine why throttle is not going to full throttle position. Refer to application specific manual if necessary. – – –1/1

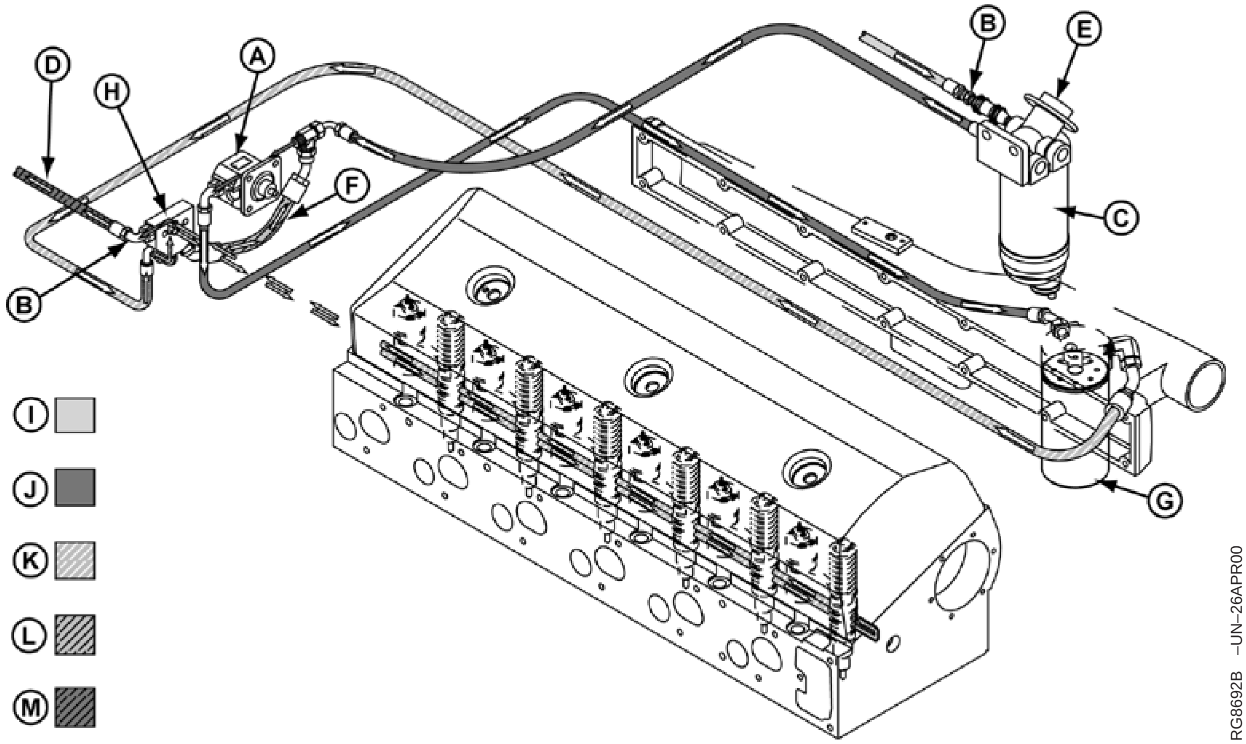
❻ **Turbocharger Boost Pressure Test**	Measure turbo boost. See CHECK INTAKE MANIFOLD PRESSURE (TURBOBOOST) in CTM100 Section 04, Group 150.	**Boost in range OR above compared to spec in Group 210:** GO TO ❽ **Boost below range compared to spec in Group 210:** GO TO ❼ – – –1/1

❼ **Causes of Low Turbocharger Boost Checks**	Check for the following faulty components: • Restriction in air cleaner OR • Intake air leak OR • Exhaust air leak OR • Faulty turbocharger OR • Low cylinder compression pressure	**No faulty component found:** GO TO ❽ **Faulty component found:** Repair component – – –1/1

❽ **Fuel Supply System Check**	Check the fuel supply system. See B7 - FUEL SUPPLY SYSTEM CHECK	**Fuel supply system OK:** GO TO ❾ **Fuel supply system problem found:** Repair fuel supply system problem and retest – – –1/1

❾ **EUI and Excessive Load Check**	1. Ensure EUI pre-load is correctly adjusted. See CHECK AND ADJUST VALVE ASSEMBLY CLEARANCES AND INJECTOR PRELOAD in Section 02, Group 020 of CTM100 2. Ensure there are no engine mechanical problems 3. Ensure there isn’t something drawing excessive engine power 4. If none of the above problems are found, the most likely cause of low power is damaged spill valves in the EUIs. Replace EUIs and retest	– – –1/1

B7 - Fuel Supply System Check



Fuel Supply System Components

NOTE: Diagram shows John Deere application, other applications similar.

The B7 - Fuel Supply System Check diagnostic procedure should be used if referred by another diagnostic procedure or if a fuel supply system problem is suspected.

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B7 - Fuel Supply System Check

OUO1004,0000C54 –19–05JAN01–1/1

B7 - Fuel Supply System Check Diagnostic Procedure

– – –1/1

❶ **Air in Return Fuel Check**	*NOTE: For a fuel system diagram, see B7 - FUEL SUPPLY SYSTEM CHECK supporting information.* 1. Fit Clear Line from JT03513 Fuel Supply System Test Kit after the check valve on the return-to-tank fuel line (D) such that the line forms a loop 2. Start/crank engine and after loop fills with fuel watch clear line for bubbles	**Small amount of small bubbles are observed:** GO TO ❸ **Large quantity of bubbles are observed:** GO TO ❷

– – –1/1

❷ **Causes of Air in Return Fuel Check**	*NOTE: For a fuel system diagram, see B7 - FUEL SUPPLY SYSTEM CHECK supporting information.* 1. If fuel system has been recently opened (filter changed, line removed etc.) perform fuel system bleed procedure. See BLEED THE FUEL SYSTEM in Section 02, Group 090 and retest 2. Check to see that all fuel fittings are tightened to the correct torque 3. Check the weep hole on the under side of the fuel transfer pump, if weep hole is wet with fuel, replace pump and retest 4. Check that the hold down clamp cap screw on all EUIs is tightened to spec. See REMOVE AND INSTALL ELECTRONIC UNIT INJECTORS in Section 02, Group 090 5. If torques are correct, remove EUIs and inspect seats for combustion gas leaks. See REMOVE AND INSTALL ELECTRONIC UNIT INJECTORS in Section 02, Group 090	

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❸ **Fuel Pressure Check**	**IMPORTANT: Before disconnecting any fuel line, completely clean any debris from around the fitting. Do not allow debris to enter the fuel line.** *NOTE: For a fuel system diagram, see B7 - FUEL SUPPLY SYSTEM CHECK supporting information.* 1. Connect Pressure Test Fitting from JT03513 Fuel Supply System Test Kit and a 0–1000 kPa (0–150 psi) gauge to the outlet of the final fuel filter (G) 2. Start engine and check pressure at idle and at rated speed 3. If engine won't start, check pressure while cranking	**410–480 kPa (60–70 psi) @ idle, 620–690 kPa (90–100 psi) @ rated speed:** GO TO ❹ **410–480 kPa (60–70 psi) @ idle, Below 620 kPa (90 psi) @ rated speed:** GO TO ❺ **Low pressure all conditions; below 100 kPa (15 psi) cranking:** GO TO ❻ **Engine won't start; 100–170 kPa (15–25 psi) cranking:** Return to B2 - ENGINE CRANKS/NO START OR STARTS HARD (DST AVAILABLE) diagnostic procedure. See B2 - ENGINE CRANKS/NO START OR STARTS HARD (DST AVAILABLE) – – –1/1

❹ **Pump Weep Hole and Check Valve Check**	*NOTE: For a fuel system diagram, see B7 - FUEL SUPPLY SYSTEM CHECK supporting information.* 1. Check the weep hole on the under side of the fuel transfer pump (A). If weep hole is wet with fuel, replace pump and retest 2. Test the check valve on the return-to-tank fuel line (D) for leakage 3. If both of the items above check OK, the fuel supply system appears to be operating correctly	– – –1/1

❺ **Fuel Strainer and Filters Replace**	*NOTE: For a fuel system diagram, see B7 - FUEL SUPPLY SYSTEM CHECK supporting information.* 1. Check fuel strainer (in fuel line before primary filter). Replace if necessary 2. Change primary (C) and final fuel (G) filters and retest. See REPLACE FINAL (SECONDARY) FUEL FILTER ELEMENT in Section 02, Group 090. See REPLACING PRIMARY FUEL FILTER/WATER SEPARATOR in Section 02, Group 090.	– – –1/1

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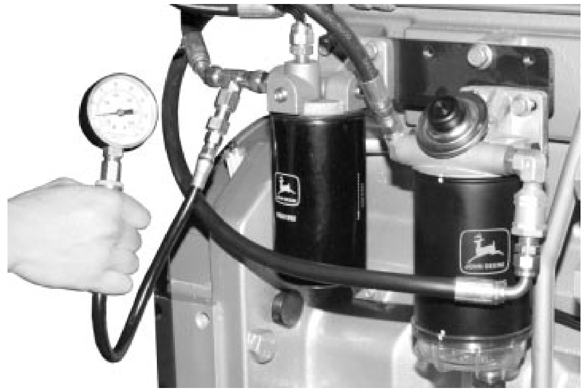
36

❻ **Recirculation Line Pinched Pressure Check**	*NOTE: For a fuel system diagram, see B7 - FUEL SUPPLY SYSTEM CHECK supporting information.* 1. Pinch-off the recirculation fuel line (F) 2. Start/crank engine and check pressure	**With line pinched, pressure increased to at least 410 kPa (60 psi) @ idle; 100–170 kPa (15–25) psi cranking:** GO TO ❼ **Pressure does not increase:** GO TO ❽ – – –1/1
❼ **Fuel Pressure Regulator Check**	*NOTE: For a fuel system diagram, see B7 - FUEL SUPPLY SYSTEM CHECK supporting information.* 1. Check pressure regulator on fuel manifold (B) for debris 2. If no debris is found, replace fuel manifold and retest. See REMOVE AND INSTALL FUEL MANIFOLD in Section 02, Group 090.	– – –1/1
❽ **Transfer Pump Check**	*NOTE: For a fuel system diagram, see B7 - FUEL SUPPLY SYSTEM CHECK supporting information.* 1. Remove fuel transfer pump (A), check relief valve for debris 2. Check transfer pump drive coupling 3. Check transfer pump 4. If the above items check OK, change primary (C) and final (G) fuel filters and retest. See REPLACE FINAL (SECONDARY) FUEL FILTER ELEMENT in Section 02, Group 090. See REPLACING PRIMARY FUEL FILTER/WATER SEPARATOR in Section 02, Group 090.	– – –1/1

Check Fuel Supply Pressure


RG8798 –UN–26NOV97

Measuring Fuel Pressure

1. Disconnect final filter-to-fuel manifold fuel line at the final filter.

IMPORTANT: Before disconnecting any fuel line, completely clean any debris from around the fitting. Do not allow debris to enter the fuel line.

If a fuel line is going to be left disconnected any longer than it takes to install the test fitting, cap line with JDG998 Fuel System Cap Plug Kit to ensure that debris does not enter the fuel system.

2. Install Pressure Test Fitting from JT03513 Fuel Supply System Test Kit and pressure gauge as shown. Torque fitting connections to 24 N•m (18 lb-ft).

3. Start/crank engine. Fuel transfer pump should maintain minimum pressure shown in specification at right. If pressure is low, check strainer (in fuel line before primary filter) replace if necessary; replace primary and final filter elements and recheck pressure.

4. If pressure is still low, look for a possible restriction in one of the fuel lines; check pressure regulator. Make sure the gauge/hose assembly is not at fault. If none of the above problems are found, repair/replace fuel transfer pump.

IMPORTANT: Before connecting ORFS fuel line fittings, be sure O-ring is correctly positioned in the groove of fitting. Tighten fitting ONLY to specified torque. DO NOT OVERTIGHTEN.

5. After completing test, remove test equipment and reinstall fuel line. Torque fuel line connections to 25 N•m (18 lb-ft).

Continued on next page

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Specification

Fuel Transfer Pump Pressure—
Normal (Idle)... 410–480 kPa (4.1–4.8 bar) (60–70 psi)
Cranking (Minimum 200 RPM)............. 70–170 kPa (0.7–1.7 bar) (15–25 psi)

RG,RG34710,1550 –19–30SEP97–2/2

Bleed the Fuel System

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

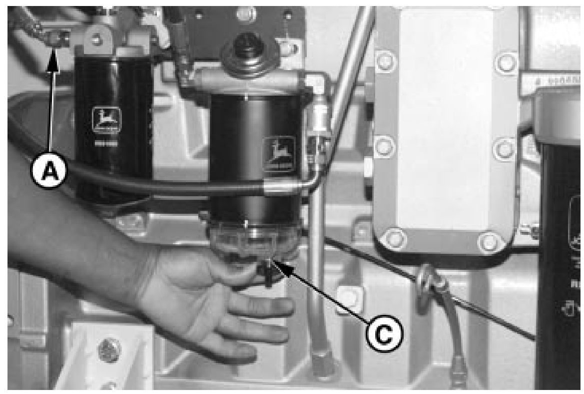
1. Drain water and contaminants from clear water separator sediment bowl (C).

2. Loosen secondary (final) fuel outlet line (A).

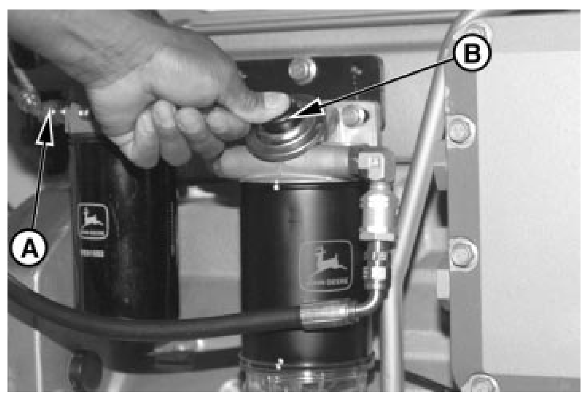
3. Pump hand primer (B) on primary filter until a steady flow of fuel (without bubbles) comes out of connection.

4. Continue pumping hand primer and simultaneously tighten outlet line connection to 24 N•m (18 lb-ft). DO NOT overtighten.

5. Start engine and run at high idle for 3–5 minutes.



Draining Sediment Bowl



Primary Filter Hand Primer

RG,RG34710,1551 –19–30SEP97–1/1

About This Group of the Manual

This group of the manual contains necessary information to diagnose the electronic control system. Use this information in conjunction with the base engine repair manual (CTM100).

Parts such as sensors, actuators, connectors, and wiring harnesses are serviceable and available.

To help diagnose electronic control system problems, Section 06, Group 210 contains useful information, such as ECU terminal identification, system wiring schematic, component location and diagnostic specifications.

IMPORTANT: Not under any 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/Cab connector and the ECU/Engine 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.*

RG,RG34710,1552 –19–20NOV00–1/1

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

Electrical Circuit Malfunctions

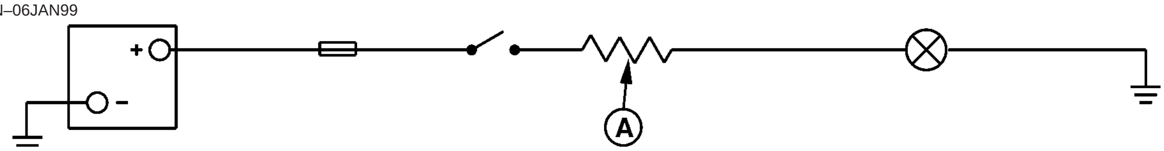
Circuit Malfunctions

There are four major circuit malfunctions. They are:

1. High-resistance circuit
2. Open circuit
3. Grounded circuit
4. Shorted circuit

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

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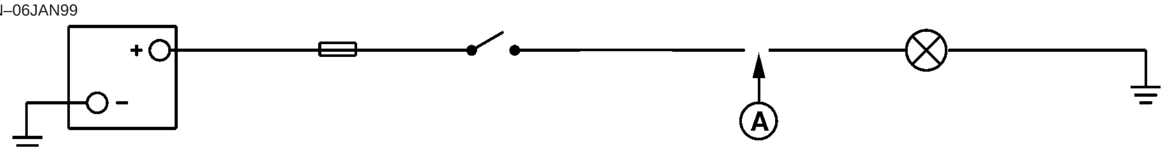

Open Circuit

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.

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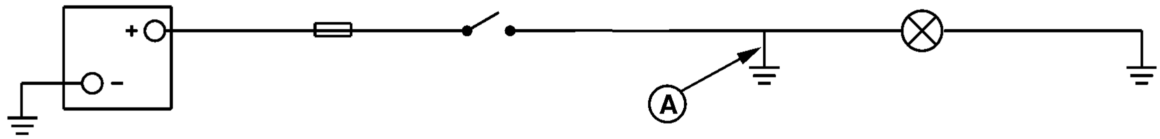

Grounded Circuit

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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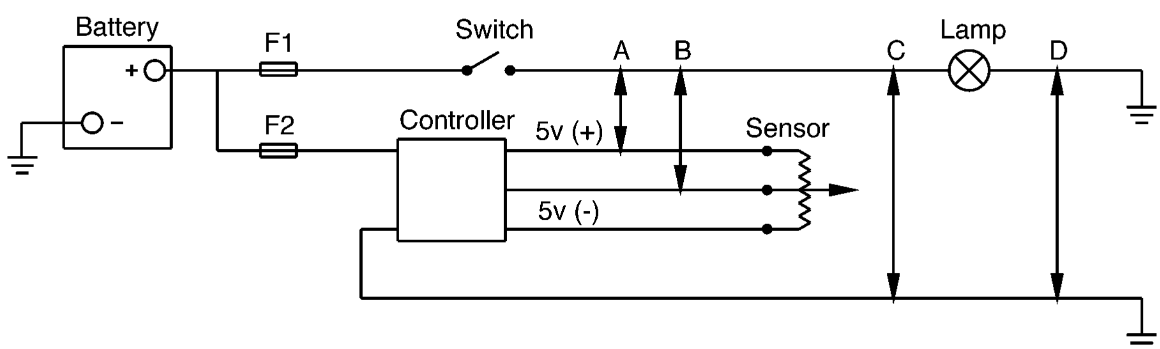

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Shorted Circuit

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).

NOTE: This type of short does not create an observable malfunction. Therefore, no further explanation for trouble shooting is necessary.

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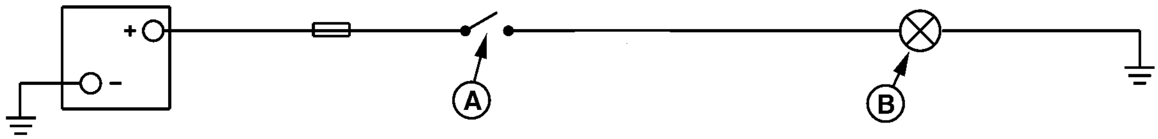
DPSG,RG40854,37 –19–15DEC98–5/6

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.

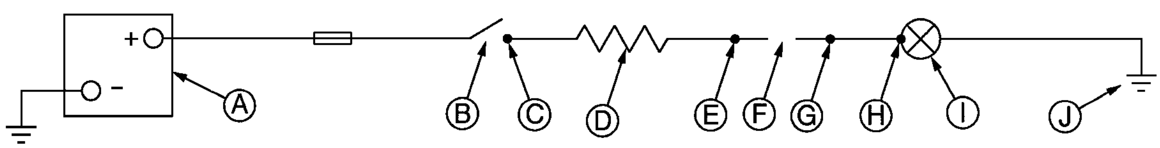
Example: A component may not operate before disconnecting an electrical connection, but it operates after reconnecting the connector.

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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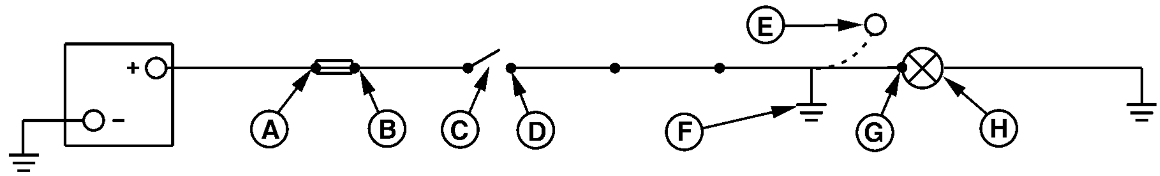
RG9897 –UN–06JAN99



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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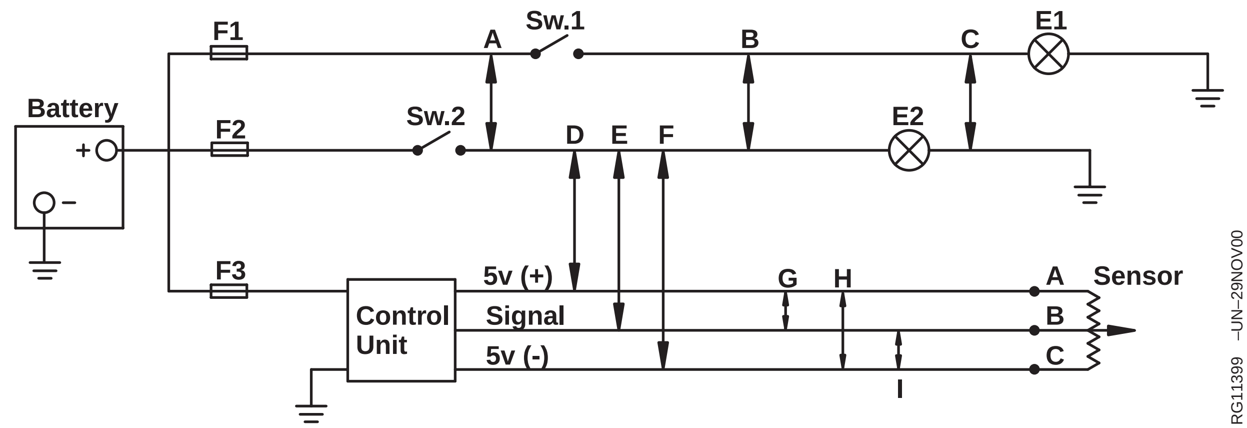


Shorted Circuit

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 trouble 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

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

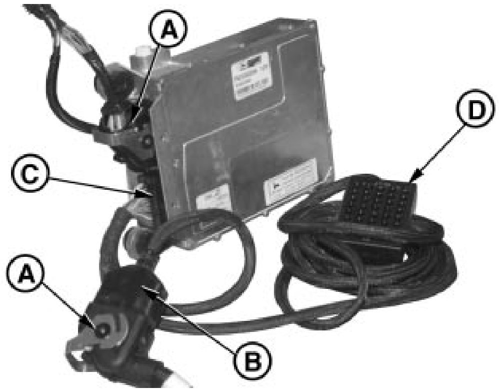
RG,RG34710,1554 –19–30SEP97–1/1

Using the Break-Out-Box (BOB)

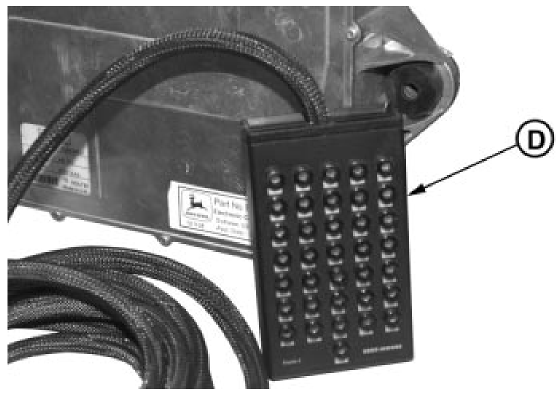
IMPORTANT: Make sure that probes are inserted into the BOB sockets that the diagnostic procedures instruct or engine control system circuitry may be damaged. Never install jumper wires between BOB sockets.

The diagnostic procedures on the following pages are written such that diagnosis can be made using the Diagnostic Scan Tool (DST) or JT02171 10.5/12.5 L Engine Control Unit Break-Out-Box. To use the Break-Out-Box (BOB), first determine using the wiring schematic on the left-hand page of the diagnostic procedure if the BOB will be connected to the ECU/Engine connector (inside of connector is black) or the ECU/Cab connector (inside of the connector is red). With the ignition OFF, disconnect the appropriate ECU connector (A), connect the male end of the BOB connector to the wiring harness (B); connect the female end of the BOB connector to the ECU (C). The BOB is now teed into the ECU wiring. The numbers on the face of the BOB (D) correspond to the individual ECU connector terminals. The diagnostic procedures will instruct voltage measurements be made from certain positive (+) BOB sockets to certain negative (-) BOB sockets.

NOTE: If resistance measurements are made at the BOB, disconnect the BOB from the ECU or faulty readings may result.



ECU Connected to BOB



Break-Out-Box Display

RG,RG34710,1555 –19–30SEP97–1/1

Cylinder Cutout Test Using JDG1250

The injector disable box JDG1250 is another aid to identify a cylinder that is having a problem or to help in diagnosing mechanical or intermittent problems. During the test the technician can disable a cylinder by selectively turning off an injector and detecting a change in the performance of the engine.

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 an Electronic Unit Injector (EUI). 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.

JDG1250 has three switch positions for each cylinder and are labeled as: Run, Code, and Test.

RUN — Normal engine operation. All cylinders are activated. Flashing light means the ECU is sending a signal to the EUI for injection cycles.
CODE — Disconnects the circuit to the specific EUI, disabling that cylinder, while causing a diagnostic code to set.
TEST — Disconnects the circuit to the specific EUI, disabling that cylinder, but does not cause a diagnostic code to set.

This tool especially beneficial to use on a tractor that will not start.

With the JDG1250 installed crank the engine over to verify ECU is sending a signal to the EUIs, which is indicated by the LED lights flashing.

If lights flash it will give you the indication to look for a fuel system problem, if they do not flash perform the proper electrical diagnostic procedures.

RG13644 –UN–28APR04

JDG1250 Injector Disable Box

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RG41183,00000AA –19–22JUL04–1/3

While using diagnostic tool JDG1250 the injector fires (light blinks) when the toggle switch is in the "run" position. When the toggle switch is moved to the "code" or "test" position the injector quits firing (light is off). When the switch is toggled back in the "run" position the injector does not fire (light is off). The ECU monitors the performance of the EUI. In the event of a repeat electrical short or if an open circuit is detected, the ECU will no longer send a signal for the EUI to fire. If the toggle switch is placed in the "code" or "test" position for more than 10 firing pulses the ECU assumes the EUI is not performing correctly and will not send a signal to fire.

Before executing the Cylinder Cutout Test

- Warm engine to normal operating temperature
- Repair the cause of any Diagnostic Trouble Codes (DTCs)
- Ensure that the battery and starter are in good working condition

Performing the Cylinder Cutout Test

1. Disconnect EUI harness connector from cylinder head. Install JDG1250 Injector Disable Box by connecting one end to the wire harness and the other end to the cylinder head.

2. Have all switches in the **RUN** cylinder setting.

3. Engine idling or under the conditions that the problem occurred.

4. Select the cylinder to be cut out.

5. Observe engine operation for any change. If no change occurred in the way the engine is operating, cylinder is not contributing.

NOTE: It is recommended that the test be run at least 3 times to ensure repeatable, accurate results.

EUI Harness Connector

EUI (Electronic Unit Injector)

Continued on next page

- The fuel in 10.5 L and 12.5 L engines is delivered by 6 (one for each cylinder) electronic unit injectors (EUIs). The EUIs are mounted in the cylinder head, under the valve cover, so that they spray directly into the center of the cylinder bore. Each EUI is an injection pump and injector combined, operating at much higher pressures than standard in-line or rotary injection pumps. The ECU controls the start of injection and the amount of fuel injected by turning the solenoid in the EUI valve housing on and off which in turn opens and closes the EUI spill valve.
- Power is supplied to the EUIs for cylinders 1, 2, and 3 by a common wire, and to the EUIs for cylinders 4, 5, and 6 by a different common wire. The ECU energizes and de-energizes the solenoids of individual EUIs by closing and opening the individual EUI ground circuits.

RG41183,00000AA –19–22JUL04–3/3

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, '98 or '2000) or NT compatible computer, 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
PWM% Throttle	%	Optional component, not included on all applications. The position of the PWM throttle expressed as a percentage. Low idle should read 0%, wide open throttle should read 100%.
Analog % Throttle	%	Optional component, not included on all applications. The position of the analog throttle expressed as a percentage. Low idle should read 0%, wide open throttle should read 100%.
Analog Throttle Volts	volts	Optional component, not included on all applications. The voltage from the analog throttle position sensor (potentiometer).
Throttle Type	N/A[a]	Type of throttle detected by the ECU.
Engine Speed	rpm	The engine speed measured by the crankshaft position sensor.
% of Max Allowed Fuel	%	The amount of fuel the ECU is requesting, expressed as a percent of maximum fuel allowed at a given engine speed; representative of engine load.
Boost Pressure (MAP)	kPa (psi)	Manifold Air Pressure value (boost pressure). *NOTE: If there is an active fault for the MAP circuit, the MAP value displayed will be the "limp-home" value.*
MAP Volts	volts	Manifold Air Pressure sensor input voltage to the ECU
Intake Air Temperature (MAT)	°C (°F)	Manifold Air Temperature value. *NOTE: If there is an active fault for the MAT circuit, the MAT value displayed will be the "limp-home" value.*
MAT Sensor Volts	volts	Manifold Air Temperature sensor input voltage to the ECU.
Engine Coolant Temperature (ECT)	°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.*
ECT Sensor Volts	volts	Engine Coolant Temperature sensor input voltage to the ECU

[a]N/A = Not Applicable

Continued on next page

Parameter	Units	Description
Fuel Pressure	N/A[a]	On some applications, the ECU monitors fuel pressure using a pressure switch. This parameter displays normal when fuel pressure is greater than 296 kPa (43 psi); low when fuel pressure is less than 296 kPa (43 psi).
Fuel Temperature	°C (°F)	Fuel temperature value. *NOTE: If there is an active fault for the fuel temperature circuit, the fuel temperature value displayed will be the "limp-home" value.*
Fuel Temperature Sensor Volts	volts	Fuel Temperature sensor input voltage to the ECU.
Governor Type	N/A[a]	On some applications, the ECU will govern the engine in either normal droop (standard operation) or isochronous (0% droop; field cruise) mode. This displays the ECU governor mode.
Pilot Injection	N/A[a]	On some applications, a pilot injection feature aids engine starting. On applications with the pilot injection feature, this parameter displays ON when pilot injection is on; OFF when pilot injection is off. On applications that don't have pilot injection, this parameter will read N/A.
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. Definition of the possible torque curves is found in Section 06, Group 210.
Fuel Used	L (gal)	Total amount of fuel the ECU has commanded the EUIs to deliver during the total hours shown by the Engine Hour Meter parameter.
Engine Hour Meter	hr -min- sec	Total hours the ECU has run on an engine.

[a]N/A = Not Applicable

RG,RG34710,1560 –19–21DEC00–2/2

Diagnostic Scan Tool (DST) Engine Test Instructions—Cylinder Misfire Test

The Diagnostic Scan Tool (DST) consists of a Windows (’95, ’98 or ’2000) or NT compatible computer, JDIS121 ECU Communication Hardware Kit, and JDIS122 ECU Communication Software Kit, available from John Deere.

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 5 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 an Electronic Unit Injector (EUI). Other information such as the results of a Relative Compression 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.

2. Select Cylinder Misfire Test on the DST.

3. Follow instruction given by the DST. The DST 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.

The DST 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).

NOTE: It is recommended that the test be run at least 3 times to ensure repeatable, accurate results.

The Relative 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 –19–30SEP97–1/1

Diagnostic Scan Tool (DST) Engine Test Instructions—Relative Compression Test

The Diagnostic Scan Tool (DST) consists of a Windows ('95, '98 or '2000) or NT compatible computer, JDIS121 ECU Communication Hardware Kit, and JDIS122 ECU Communication Software Kit, available from John Deere.

The Relative 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 pulsing the unit injectors), 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 Relative 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 and other engine diagnostic procedures should be used to accurately determine the source of an engine problem.

Before executing the Relative 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 Relative Compression Test

1. Engine OFF.

2. Select Relative Compression Test on the DST.

3. Follow instruction given by the DST. The DST will instruct that the engine be cranked for up to 15 seconds. Typically, it should take less than 5 seconds. The DST should be observed carefully for instructions during the test.

   The DST 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.

   After performing the test, it will be necessary to completely power-down the ECU before the engine will start. On 9000 series 4-WD tractor applications, this will involve turning the key to the "OFF" position and getting off the operator's seat. On other applications it will involve turning the key to the "OFF" position.

RG,RG34710,1562 –19–30SEP97–1/1

Listing of Diagnostic Trouble Codes (DTCs)

Following is a list of Diagnostic Trouble Codes (DTCs) that can occur in the electronic control system.

NOTE: Not all of these codes are used in all engine applications.

Code	Description
011	Analog Throttle input voltage too high
012	Analog Throttle input voltage too low
013	Pulse-Width-Modulated (PWM) Throttle input voltage too high
014	Pulse-Width-Modulated (PWM) Throttle input voltage too low
021	Manifold Air Pressure (MAP) input voltage too high
022	Manifold Air Pressure (MAP) input voltage too low
023	Manifold Air Temperature (MAT) input voltage too high
024	Manifold Air Temperature (MAT) input voltage too low
025	Engine Coolant Temperature (ECT) input voltage too high
026	Engine Coolant Temperature (ECT) input voltage too low
027	Fuel rail pressure periodically low
028	Fuel rail pressure continuously low
031	Cylinder 1 Electronic Unit Injector (EUI) fault
032	Cylinder 2 Electronic Unit Injector (EUI) fault
033	Cylinder 3 Electronic Unit Injector (EUI) fault
034	Cylinder 4 Electronic Unit Injector (EUI) fault
035	Cylinder 5 Electronic Unit Injector (EUI) fault
036	Cylinder 6 Electronic Unit Injector (EUI) fault
037	Fuel Temperature input voltage too high
038	Fuel Temperature input voltage too low
041	Crankshaft Position input missing
042	Crankshaft Position input out of sync
043	Camshaft Position input missing
044	Camshaft Position input out of sync
045	Camshaft/Crankshaft Position inputs out of sync
050	Fuel rail pressure switch fault
052	Manifold Air Pressure (MAP) input voltage erratic
053	Manifold Air Temperature (MAT) input voltage erratic
054	Engine Coolant Temperature (ECT) input voltage erratic
055	Fuel Temperature input voltage erratic
081	Engine Control Unit (ECU) error
084	Power Down error

RG,RG34710,1563 –19–30SEP97–1/1

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 B1–B7 symptom diagnostic chart, later in this group, that is appropriate.

5. After any repairs are made, recheck to make sure all DTCs have been eliminated.

NOTE: After using the DST, always replace the dust cover 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.

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) can be used to help locate intermittent problems, as it includes a function called Snap Shot. The Snap Shot 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 to see if the fault resets.

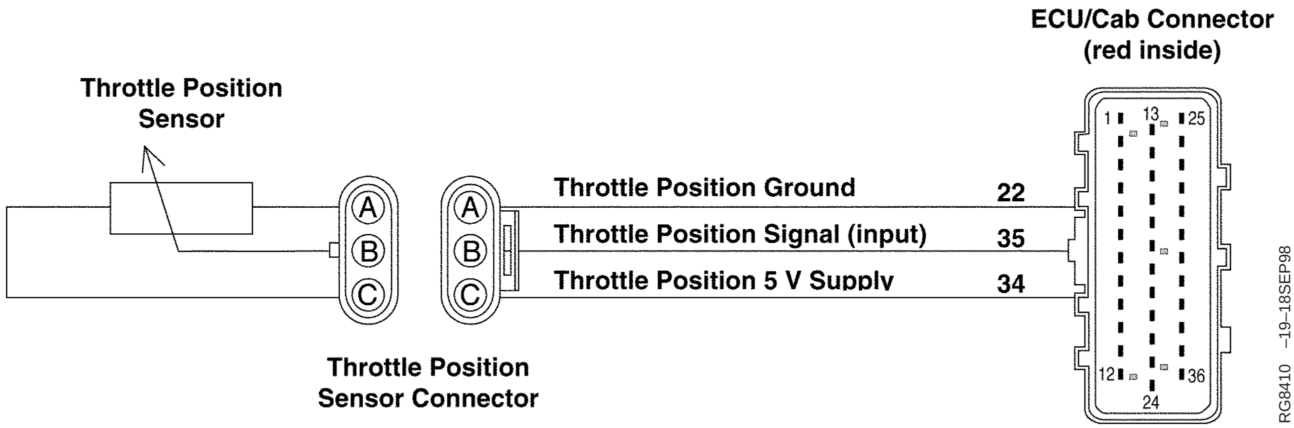
To check the connection between the harness and a sensor or the harness and the ECU, use JT07328 Connector Adapter Test Kit. Insert the male end of the appropriate test adapter into the female end of the ECU or sensor connector terminal. There should be moderate resistance when the test adapter is inserted 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.

RG,RG34710,1565 –19–30SEP97–1/1

Engine 011 — Analog Throttle Input Voltage Too High



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.

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 0.5 and 4.0 volts depending on throttle position. Analog throttle voltage at low idle will be approximately 0.5 volts and 4.0 volts at high idle.

Engine 011 will set if:

- The analog throttle input voltage exceeds 4.25 volts.

If Engine 011 sets, the following will occur:

- The ECU will ignore the analog throttle input, and only use the PWM throttle input (if used) if it is a valid signal.
- If codes 13 or 14 (indicating a faulty PWM throttle input) are also set with code 011, the ECU will use a default “limp-home” throttle value that will only allow low idle engine speed.
- If application uses only an analog throttle, the ECU will use a default “limp-home” throttle value that will only allow low idle engine speed.

RG,RG34710,1573 –19–15DEC00–1/1

Engine 011 — Analog Throttle Input Voltage Too High

The analog throttle input voltage exceeds the specification.

OUO1004,0000C55 –19–05JAN01–1/1

Engine 011 Analog Throttle Input Voltage Too High Diagnostic Procedure

NOTE: Before using this diagnostic procedure, perform a preliminary inspection of the ECU/Cab connector (red inside) and the analog throttle sensor connector looking for dirty, damaged, or poorly positioned terminals.

– – –1/1

❶ **Engine 011 Intermittent Fault Test**	*NOTE: For wiring, theory of operation, and sensor location information, see ENGINE 011 ANALOG THROTTLE INPUT VOLTAGE TOO HIGH supporting information.* 1. Ignition ON, engine OFF 2. Throttle in the idle position 3. Using the DST, read the analog throttle voltage parameter. *NOTE: If the DST is not available, connect the BOB to the ECU/Cab connector (red inside). Using a multimeter, measure voltage between pins 35 (+) and 22 (—).*	**4.25 V or greater:** GO TO ❸ **Below 4.25 V:** GO TO ❷

– – –1/1

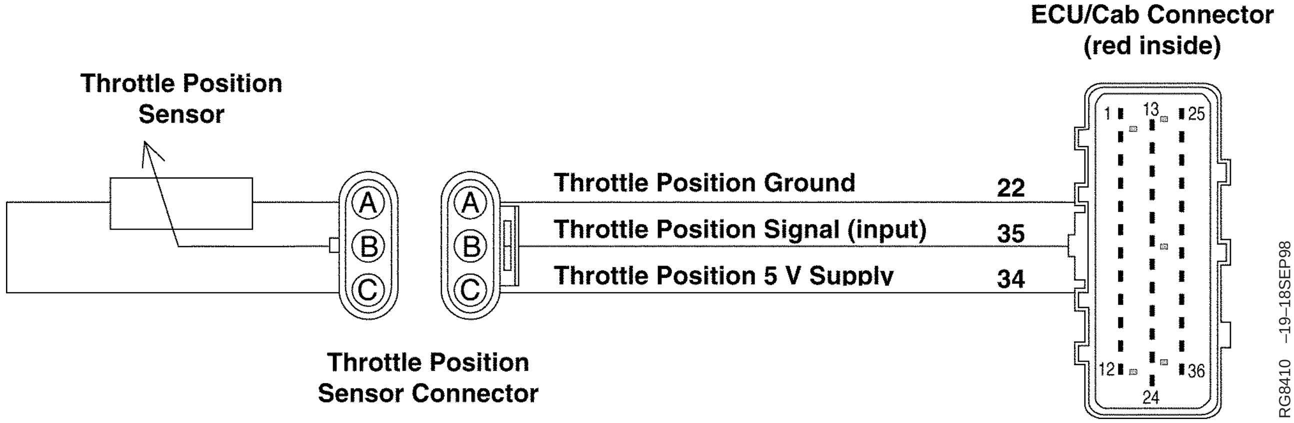
❷ **Throttle Travel Voltage Test**	*NOTE: For wiring, theory of operation, and sensor location information, see ENGINE 011 ANALOG THROTTLE INPUT VOLTAGE TOO HIGH supporting information.* Slowly operate the analog throttle through full travel while watching the analog throttle voltage parameter on the DST. *NOTE: If the DST is not available, connect the BOB to the ECU/Cab connector (red inside). Using a multimeter, measure voltage between pins 35 (+) and 22 (—) while operating the analog throttle through full travel.*	**Goes above 4.25 V:** Faulty analog throttle sensor connector OR Open in analog throttle sensor ground circuit OR Faulty analog throttle sensor **Never goes above 4.25V:** Problem is intermittent. If no other codes are present, see INTERMITTENT FAULT DIAGNOSTICS, earlier in this group.

– – –1/1

❸ **Throttle Position Input Shorted Test**	*NOTE: For wiring, theory of operation, and sensor location information, see ENGINE 011 ANALOG THROTTLE INPUT VOLTAGE TOO HIGH supporting information.* 1. Ignition OFF 2. Disconnect analog throttle position sensor connector 3. Ignition ON, engine OFF 4. Using the DST, read the analog throttle voltage parameter. *NOTE: If the DST is not available, connect the BOB to the ECU/Cab connector (red inside). Using a multimeter, measure voltage between pins 35 (+) and 22 (—).*	**0.2 V or less:** GO TO ❹ **Above 0.2 V:** Short to voltage in analog throttle input circuit OR Faulty ECU – – –1/1

❹ **Throttle Position Ground Circuit Open Test**	*NOTE: For wiring, theory of operation, and sensor location information, see ENGINE 011 ANALOG THROTTLE INPUT VOLTAGE TOO HIGH supporting information.* 1. Ignition OFF 2. Probe ground terminal in throttle sensor harness connector with a test light connected to battery voltage	**Light ON:** Faulty analog throttle sensor connector OR Faulty analog throttle sensor **Light OFF:** Open in analog throttle ground circuit – – –1/1

Engine 012 — Analog Throttle Input Voltage Too Low



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.

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 0.5 and 4.0 volts depending on throttle position. Analog throttle voltage at low idle will be approximately 0.5 volts and 4.0 volts at high idle.

Engine 012 will set if:

- The analog throttle input voltage drops below 0.42 volts.

If Engine 012 sets, the following will occur:

- The ECU will ignore the analog throttle input, and only use the PWM throttle input (if used) if it is a valid signal.
- If codes 13 or 14 (indicating a faulty PWM throttle input) are also set with code 012, the ECU will use a default “limp-home” throttle value that will only allow low idle engine speed.
- If application uses only an analog throttle, the ECU will use a default “limp-home” throttle value that will only allow low idle engine speed.

RG,RG34710,1574 –19–15DEC00–1/1

Engine 012 — Analog Throttle Input Voltage Too Low

The analog throttle input voltage drops below specification.

OUO1004,0000C56 –19–05JAN01–1/1

Engine 012 Analog Throttle Input Voltage Too Low Diagnostic Procedure

NOTE: Before using this diagnostic procedure, perform a preliminary inspection of the ECU/Cab connector (red inside) and the analog throttle sensor connector looking for dirty, damaged, or poorly positioned terminals.

– – –1/1

❶ **Engine 012 Intermittent Fault Test**	*NOTE: For wiring, theory of operation, and sensor location information, see ENGINE 012 ANALOG THROTTLE INPUT VOLTAGE TOO LOW supporting information.* 1. Ignition ON, engine OFF 2. Throttle in the idle position 3. Using the DST, read the analog throttle voltage parameter. *NOTE: If the DST is not available, connect the BOB to the ECU/Cab connector (red inside). Using a multimeter, measure voltage between pins 35 (+) and 22 (—).*	**0.42 V or less:** GO TO ❸ **Above 0.42 V:** GO TO ❷

– – –1/1

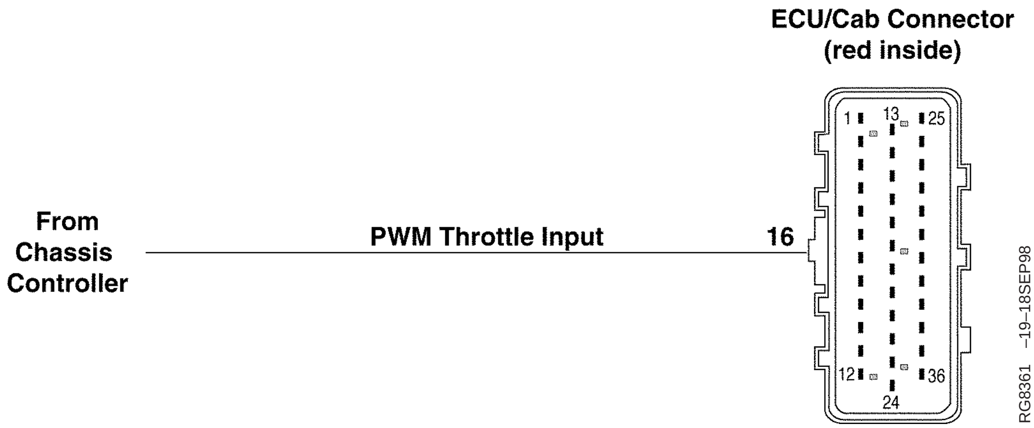
❷ **Throttle Travel Voltage Test**	*NOTE: For wiring, theory of operation, and sensor location information, see ENGINE 012 ANALOG THROTTLE INPUT VOLTAGE TOO LOW supporting information.* Slowly operate the analog throttle through full travel while watching the analog throttle voltage parameter on the DST. *NOTE: If the DST is not available, connect the BOB to the ECU/Cab connector (red inside). Using a multimeter, measure voltage between pins 35 (+) and 22 (—) while operating the analog throttle through full travel.*	**Goes below 0.42 V:** Faulty analog throttle sensor connector OR Faulty analog throttle sensor OR Faulty ECU **Never goes below 0.42V:** Problem is intermittent. If no other codes are present, see INTERMITTENT FAULT DIAGNOSTICS, earlier in this group.

– – –1/1

❸ **Throttle Position Wiring Test**	*NOTE: For wiring, theory of operation, and sensor location information, see ENGINE 012 ANALOG THROTTLE INPUT VOLTAGE TOO LOW supporting information.* 1. Ignition OFF 2. Disconnect analog throttle sensor 3. Install a jumper wire between throttle 5 V supply and throttle input in the analog throttle harness connector 4. Ignition ON, engine OFF 5. Using the DST, read the analog throttle voltage parameter. *NOTE: If the DST is not available, connect the BOB to the ECU/Cab connector (red inside). Using a multimeter, measure voltage between pins 35 (+) and 22 (—).*	**Below 4.0 V:** GO TO ❹ **4.0 V or greater:** Faulty analog throttle sensor connector OR Faulty analog throttle sensor – – –1/1

❹ **Throttle Position 5 V Supply Test**	*NOTE: For wiring, theory of operation, and sensor location information, see ENGINE 012 ANALOG THROTTLE INPUT VOLTAGE TOO LOW supporting information.* 1. Ignition OFF 2. Remove jumper wire 3. Ignition ON 4. Using a multimeter, measure voltage between throttle 5 V supply terminal and throttle ground terminal in analog throttle harness connector	**4.0 - 6.0 V:** Open in analog throttle input circuit OR Short to ground in analog throttle input circuit OR Faulty ECU connection OR Faulty ECU **Below 4.0 V:** Open in analog throttle 5 V supply circuit OR Short to ground in analog throttle 5 V supply circuit OR Faulty ECU connection OR Faulty ECU – – –1/1

Engine 013 — PWM Throttle Input Too High



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.

PWM (Pulse Width Modulated) Throttle Position Input

- The PWM throttle signal is sent to the ECU by the Chassis Computer. The PWM signal is a square wave signal with a constant frequency. The pulse-width of the signal (amount of time the signal is high) varies as throttle input from the Chassis Computer varies.

Engine 013 will set if:

- The pulse-width of the PWM signal is higher than the normal operating range of the signal.

If Engine 013 sets, the following will occur:

- If the only throttle input to the ECU is the PWM throttle, the ECU will only allow low idle engine speed.
- If the ECU has an analog throttle in addition to the PWM throttle, the ECU will ignore the PWM input, and use the analog throttle input to control the engine.

RG,RG34710,1575 –19–30SEP97–1/1

Engine 013 — PWM Throttle Input Too High

The pulse-width of the PWM signal is higher than the normal operating range of the signal.

OUO1004,0000C57 –19–13JUN01–1/1

Engine 013 PWM Throttle Input Too High Diagnostic Procedure

NOTE: Before using this diagnostic procedure, perform a preliminary inspection of the ECU/Cab connector (red inside) and the Chassis Controller connector for the PWM wire looking for dirty, damaged, or poorly positioned terminals.

– – –1/1

❶ **Engine 013 Intermittent Fault Test**	*NOTE: For wiring and theory of operation information, see ENGINE 013 PWM THROTTLE INPUT TOO HIGH supporting information.* 1. Ignition ON, engine OFF 2. Using the DST, monitor DTCs on the active code display parameter. 3. Make note of all DTCs, then clear all DTCs 4. Ignition ON, engine running 5. Using the DST, monitor DTCs on the active code display parameter	**Engine 013 reoccurs:** GO TO ❷ **Engine 013 cleared:** Problem is intermittent. If no other codes are present, see INTERMITTENT FAULT DIAGNOSTICS, earlier in this group.

– – –1/1

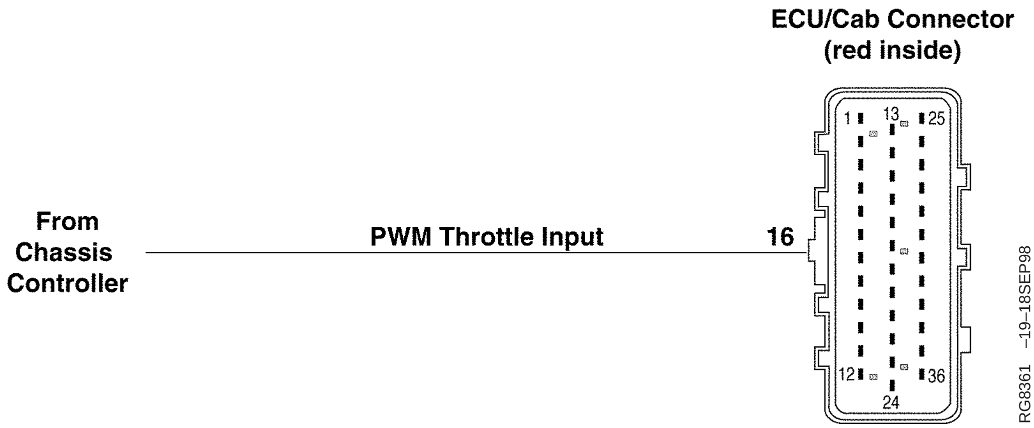
❷ **Check Other Controllers For Throttle Related DTCs**	*NOTE: For wiring and theory of operation information, see ENGINE 013 PWM THROTTLE INPUT TOO HIGH supporting information.* If PWM throttle signal originates from another controller, check that controller for throttle related DTCs	**Controller reports no throttle related DTCs:** GO TO ❸ **Controller does report a throttle related DTC:** Refer to diagnostic procedures for controller Repair cause of throttle related DTC and restart

– – –1/1

❸ **PWM Throttle Open Circuit Test**	*NOTE: For wiring and theory of operation information, see ENGINE 013 PWM THROTTLE INPUT TOO HIGH supporting information.* 1. Ignition OFF 2. Disconnect ECU/Cab connector 3. Obtain wiring information for this application and determine the source of the PWM throttle signal 4. Disconnect the connector that outputs the PWM throttle signal 5. Measure resistance between ECU/Cab connector terminal 16 and originating PWM throttle signal terminal	**5.0 ohms or less:** GO TO ❹ **Greater than 5.0 ohms:** Open in PWM throttle signal circuit – – –1/1

❹ **PWM Throttle Short Circuit Test**	*NOTE: For wiring and theory of operation information, see ENGINE 013 PWM THROTTLE INPUT TOO HIGH supporting information.* 1. Ignition OFF 2. Measure resistance between ECU/Cab connector terminal 16 and all other ECU/Cab connector terminals 3. Measure resistance between originating PWM throttle signal terminal and all other terminals of that connector	**5.0 ohms or less:** PWM throttle signal circuit shorted to another circuit in the wiring harness **Greater than 5.0 ohms:** Faulty ECU OR Faulty PWM throttle signal source – – –1/1

Engine 014 — PWM Throttle Input Too Low



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.

PWM (Pulse Width Modulated) Throttle Position Input

- The PWM throttle signal is sent to the ECU by the Chassis Computer. The PWM signal is a square wave signal with a constant frequency. The pulse-width of the signal (amount of time the signal is high) varies as throttle input from the Chassis Computer varies.

Engine 014 will set if:

- The pulse-width of the PWM signal is lower than the normal operating range of the signal.

If Engine 014 sets, the following will occur:

- If the only throttle input to the ECU is the PWM throttle, the ECU will only allow low idle engine speed.
- If the ECU has an analog throttle in addition to the PWM throttle, the ECU will ignore the PWM input, and use the analog throttle input to control the engine.

RG,RG34710,1576 –19–30SEP97–1/1

Engine 014 — PWM Throttle Input Too Low

The pulse-width of the PWM signal is lower than the normal operating range of the signal.

OUO1004,0000C58 –19–13JUN01–1/1

Engine 014 PWM Throttle Input Too Low Diagnostic Procedure

NOTE: Before using this diagnostic procedure, perform a preliminary inspection of the ECU/Cab connector (red inside) and the Chassis Controller connector for the PWM wire looking for dirty, damaged, or poorly positioned terminals.

– – –1/1

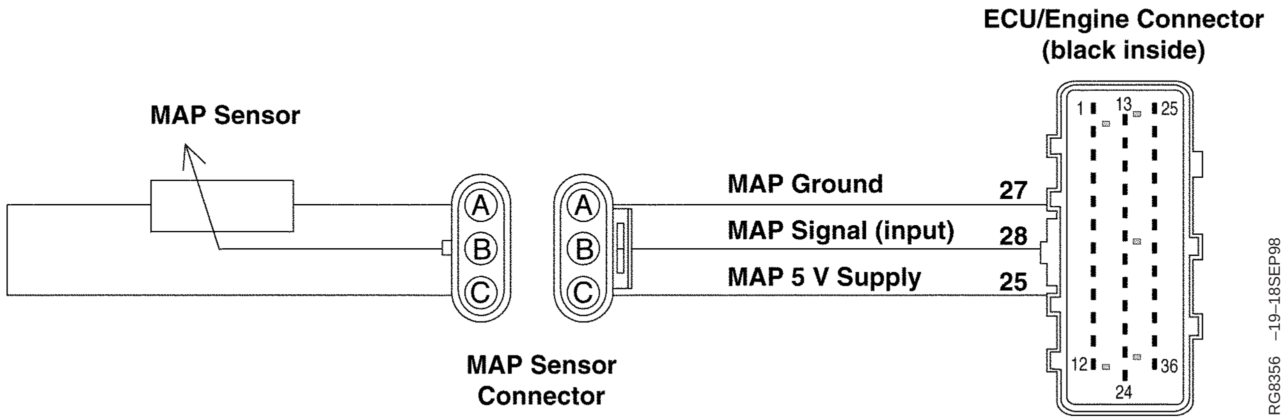
❶ **Engine 014 Intermittent Fault Test**	*NOTE: For wiring and theory of operation information, see ENGINE 014 PWM THROTTLE INPUT TOO LOW supporting information.* 1. Ignition ON, engine OFF 2. Using the DST, monitor DTCs on the active code display parameter 3. Make note of all DTCs, then clear all DTCs 4. Ignition ON, engine running 5. Using the DST, monitor DTCs on the active code display parameter	**Engine 014 reoccurs:** GO TO ❷ **Engine 014 cleared:** Problem is intermittent. If no other codes are present, see INTERMITTENT FAULT DIAGNOSTICS, earlier in this group. – – –1/1

❷ **Check Other Controllers For Throttle Related DTCs**	*NOTE: For wiring and theory of operation information, see ENGINE 014 PWM THROTTLE INPUT TOO LOW supporting information.* If PWM throttle signal originates from another controller, check that controller for throttle related DTCs	**Controller reports no throttle related DTCs:** GO TO ❸ **Controller does report a throttle related DTC:** Refer to diagnostic procedures for controller Repair cause of throttle related DTC and restart – – –1/1

❸ **PWM Throttle Open Circuit Test**	*NOTE: For wiring and theory of operation information, see ENGINE 014 PWM THROTTLE INPUT TOO LOW supporting information.* 1. Ignition OFF 2. Disconnect ECU/Cab connector 3. Obtain wiring information for this application and determine the source of the PWM throttle signal 4. Disconnect the connector that outputs the PWM throttle signal 5. Measure resistance between ECU/Cab connector terminal 16 and originating PWM throttle signal terminal	**5.0 ohms or less:** GO TO ❹ **Greater than 5.0 ohms:** Open in PWM throttle signal circuit – – –1/1

❹ **PWM Throttle Short Circuit Test**	*NOTE: For wiring and theory of operation information, see ENGINE 014 PWM THROTTLE INPUT TOO LOW supporting information.* 1. Ignition OFF 2. Measure resistance between ECU/Cab connector terminal 16 and all other ECU/Cab connector terminals 3. Measure resistance between originating PWM throttle signal terminal and all other terminals of that connector	**5.0 ohms or less:** PWM throttle signal circuit shorted to another circuit in the wiring harness **Greater than 5.0 ohms:** Faulty ECU OR Faulty PWM throttle signal source – – –1/1

Engine 021 — MAP Input Voltage Too High



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.

MAP (Manifold Air Pressure) Sensor

- The MAP sensor is a pressure transducer connected to intake manifold air pressure. It is used to measure the air pressure in the intake manifold. The MAP input voltage varies as intake manifold pressure varies. As pressure increases, input voltage to the ECU increases. The ECU uses the MAP sensor input in conjunction with the MAT sensor input to determine engine air flow. For further MAP sensor information, see MEASURING MANIFOLD AIR PRESSURE in Section 03, Group 140 of this manual.

Engine 021 will set if:

- The MAP input voltage exceeds 4.76 volts

If Engine 021 sets, the following will occur:

- The ECU will use “limp-home” MAP values
- Engine power will be slightly derated

RG,RG34710,1577 –19–15DEC00–1/1

Engine 021 — MAP Input Voltage Too High

The MAP input voltage exceeds the specification.

OUO1004,0000C59 –19–05JAN01–1/1

Engine 021 MAP Input Voltage Too High Diagnostic Procedure

NOTE: Before using this diagnostic procedure, perform a preliminary inspection of the ECU/Cab connector (red inside) and the MAP sensor connector looking for dirty, damaged, or poorly positioned terminals.

– – –1/1

❶ **Check For Engine Mechanical Problem**	If engine idle is rough or unstable due to a suspected engine mechanical problem, correct the condition before continuing to use this diagnostic chart	**Engine mechanical condition OK:** GO TO ❷

– – –1/1

❷ **Engine 021 Intermittent Fault Test**	*NOTE: For wiring, theory of operation, and sensor location information, see ENGINE 021 MAP INPUT VOLTAGE TOO HIGH supporting information.* 1. Ignition ON, engine idling 2. Using the DST, read the MAP voltage parameter *NOTE: If the DST is not available, connect the BOB to the ECU/Cab connector (red inside). Using a multimeter, measure voltage between pins 28 (+) and 27 (—).*	**4.76 V or greater:** GO TO ❸ **Below 4.76 V:** Problem is intermittent. If no other codes are present, see INTERMITTENT FAULT DIAGNOSTICS, earlier in this group.

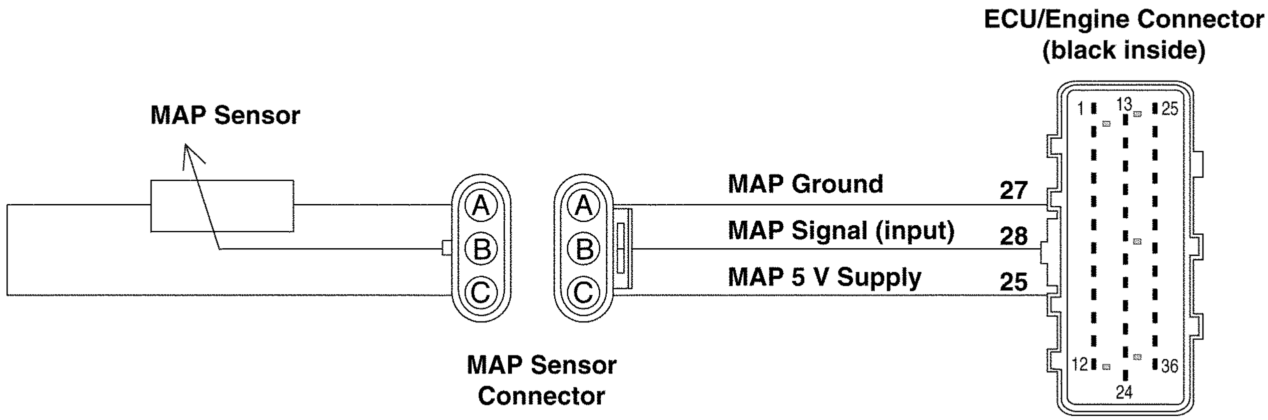
– – –1/1

❸ **MAP Input Shorted Test**	*NOTE: For wiring, theory of operation, and sensor location information, see ENGINE 021 MAP INPUT VOLTAGE TOO HIGH supporting information.* 1. Ignition OFF 2. Disconnect MAP sensor connector 3. Ignition ON, engine OFF 4. Using the DST, read the MAP voltage parameter *NOTE: If the DST is not available, connect the BOB to the ECU/Cab connector (red inside). Using a multimeter, measure voltage between pins 28 (+) and 27 (—).*	**Below 0.2 V:** GO TO ❹ **0.2 V or greater:** Short to voltage in MAP input circuit OR Faulty ECU

– – –1/1

❹ **MAP Ground Circuit Open Test**	*NOTE: For wiring, theory of operation, and sensor location information, see ENGINE 021 MAP INPUT VOLTAGE TOO HIGH supporting information.* 1. Ignition OFF 2. Probe MAP ground (terminal A) in harness sensor connector with a test light connected to battery voltage	**Light ON:** Plugged or leaking MAP sensor air supply OR Faulty ECU connection OR Faulty MAP sensor **Light OFF:** Open in MAP ground circuit – – –1/1

Engine 022 — MAP Input Voltage Too Low



RG8356 –19–18SEP98

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.

MAP (Manifold Air Pressure) Sensor

The MAP sensor is a pressure transducer connected to intake manifold air pressure. It is used to measure the air pressure in the intake manifold. The MAP input voltage varies as intake manifold pressure varies. As pressure increases, input voltage to the ECU increases. The ECU uses the MAP sensor input in conjunction with the MAT sensor input to determine engine air flow. For further MAP sensor information, see MEASURING MANIFOLD AIR PRESSURE in Section 03, Group 140 of this manual.

Engine 022 will set if:

- The MAP input voltage drops below 0.08 volts

If Engine 022 sets the following will occur:

- The ECU will use “limp-home” MAP values
- Engine power will be slightly derated

RG,RG34710,1578 –19–15DEC00–1/1

Engine 022 — MAP Input Voltage Too Low

The MAP input voltage drops below the specification.

OUO1004,0000C5B –19–05JAN01–1/1

Engine 022 MAP Input Voltage Too Low Diagnostic Procedure

NOTE: Before using this diagnostic procedure, perform a preliminary inspection of the ECU/Cab connector (red inside) and the MAP sensor connector looking for dirty, damaged, or poorly positioned terminals.

– – –1/1

❶ **Engine 022 Intermittent Fault Test**	*NOTE: For wiring, theory of operation, and sensor location information, see ENGINE 022 MAP INPUT VOLTAGE TOO LOW supporting information.* 1. Ignition ON, engine idling 2. Using the DST, read MAP voltage parameter *NOTE: If the DST is not available, connect the BOB to the ECU/Cab connector (red inside). Using a multimeter, measure voltage between pins 28 (+) and 27 (—).*	**0.08 V or less:** GO TO ❷ **Above 0.08 V:** Problem is intermittent. If no other codes are present, see INTERMITTENT FAULT DIAGNOSTICS, earlier in this group.

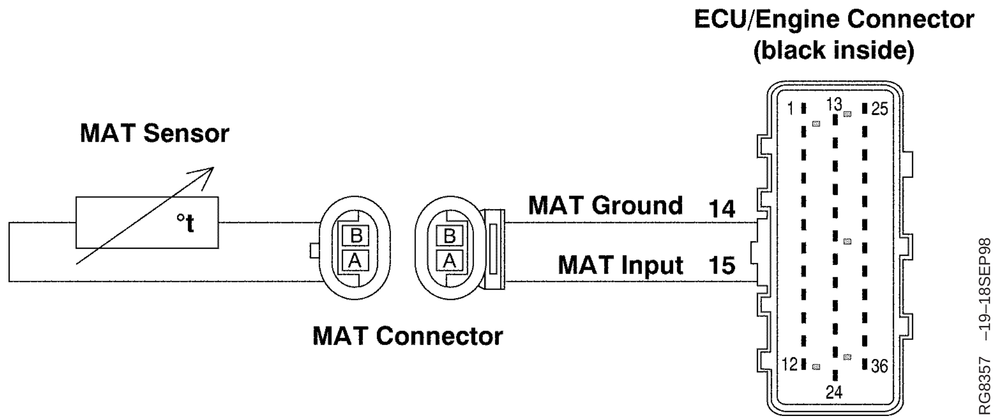
– – –1/1

❷ **MAP Wiring Test**	*NOTE: For wiring, theory of operation, and sensor location information, see ENGINE 022 MAP INPUT VOLTAGE TOO LOW supporting information.* 1. Ignition OFF 2. Disconnect MAP sensor connector 3. Install a jumper wire between MAP 5 V supply (terminal C) and MAP input (terminal B) in harness sensor connector 4. Ignition ON, engine OFF 5. Using the DST, read the MAP voltage parameter *NOTE: If the DST is not available, connect the BOB to the ECU/Cab connector (red inside). Using a multimeter, measure voltage between pins 28 (+) and 27 (—).*	**Below 4.5 V:** GO TO ❸ **4.5 V or greater:** Faulty MAP sensor connection OR Faulty MAP sensor

– – –1/1

❸ **MAP 5 V Supply Test**	*NOTE: For wiring, theory of operation, and sensor location information, see ENGINE 022 MAP INPUT VOLTAGE TOO LOW supporting information.* 1. Ignition OFF 2. Remove jumper wire 3. Ignition ON, engine OFF 4. Using a multimeter, measure voltage between MAP ground (terminal A) and MAP 5 V supply (terminal C) in harness sensor connector	**4.0 - 6.0 V:** Open in MAP input circuit OR Short to ground in MAP input circuit OR Faulty ECU connection OR Faulty ECU **Below 4.0 V:** Open in MAP 5 V supply circuit OR Short to ground in MAP 5 V supply circuit OR Faulty ECU connection OR Faulty ECU – – –1/1

Engine 023 — MAT Input Voltage Too High



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.

MAT (Manifold Air Temperature) 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. The ECU uses the MAT sensor input in conjunction with the MAP sensor input to determine engine air flow. For further MAT sensor information, see MEASURING TEMPERATURE in Section 03, Group 140.

Engine 023 will set if:

- The MAT input voltage exceeds 4.93 volts

If Engine 023 sets the following will occur:

- The ECU will use a default "limp-home" MAT value of 20°C (68°F)
- Cold temperature starting may be slightly harder than normal

RG,RG34710,1579 –19–15DEC00–1/1

Engine 023 — MAT Input Voltage Too High

he MAT input voltage exceeds the specification.

OUO1004,0000C5C –19–05JAN01–1/1

Engine 023 MAT Input Voltage Too High Diagnostic Procedure

NOTE: Before using this diagnostic procedure, perform a preliminary inspection of the ECU/Engine connector (black inside) and the MAT sensor connector looking for dirty, damaged, or poorly positioned terminals.

– – –1/1

❶ **Engine 023 Intermittent Fault Test**	*NOTE: For wiring, theory of operation, and sensor location information, see ENGINE 023 MAT INPUT VOLTAGE TOO HIGH supporting information.* 1. Warm engine 2. Ignition ON, engine OFF or running 3. Using the DST, read the MAT voltage parameter *NOTE: If the DST is not available, connect the BOB to the ECU/Cab connector (red inside). Using a multimeter, measure voltage between pins 15 (+) and 14 (—).*	**4.93 V or greater:** GO TO ❷ **Below 4.93 V:** Problem is intermittent. If no other codes are present, see INTERMITTENT FAULT DIAGNOSTICS, earlier in this group.

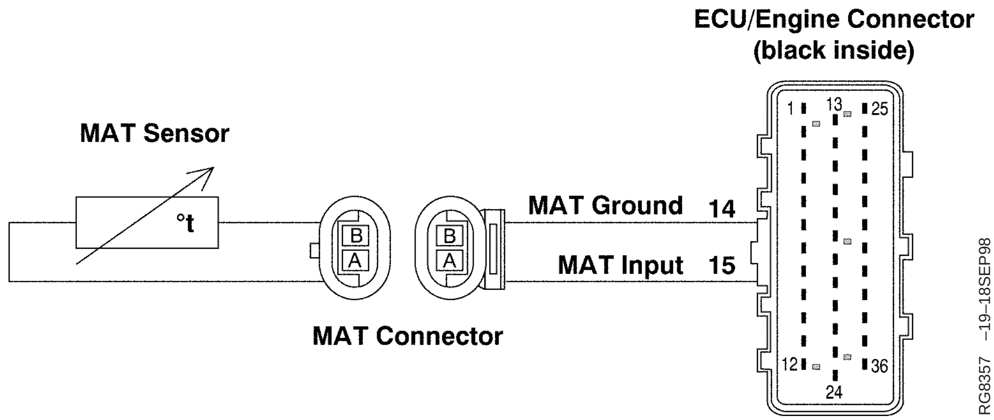
– – –1/1

❷ **MAT Wiring Open Test**	*NOTE: For wiring, theory of operation, and sensor location information, see ENGINE 023 MAT INPUT VOLTAGE TOO HIGH supporting information.* 1. Ignition OFF 2. Disconnect MAT sensor connector 3. Install a jumper wire between both terminals A and B in the MAT sensor harness connector 4. Ignition ON, engine OFF 5. Using the DST, read the MAT voltage parameter *NOTE: If the DST is not available, connect the BOB to the ECU/Cab connector (red inside). Using a multimeter, measure voltage between pins 15 (+) and 14 (—).*	**Above 0.1 V:** GO TO ❸ **0.1 V or less:** Faulty MAT sensor connector OR Faulty MAT sensor

– – –1/1

❸ **MAT Ground Circuit Open Test**	*NOTE: For wiring, theory of operation, and sensor location information, see ENGINE 023 MAT INPUT VOLTAGE TOO HIGH supporting information.* 1. Remove jumper wire between terminals A and B 2. Install a jumper wire between MAT input (terminal A) in harness connector and a good chassis ground 3. Using the DST, read the MAT voltage parameter *NOTE: If the DST is not available, connect the BOB to the ECU/Cab connector (red inside). Using a multimeter, measure voltage between pins 15 (+) and 14 (—).*	**Above 0.1 V:** Open in MAT input circuit OR Faulty ECU connection OR Faulty ECU **0.1 V or less:** Open in MAT ground circuit OR Faulty ECU connection OR Faulty ECU – – –1/1

Engine 024 — MAT Input Voltage Too Low



04
160
52

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.

MAT (Manifold Air Temperature) 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. The ECU uses the MAT sensor input in conjunction with the MAP sensor input to determine engine air flow. For further MAT sensor information, see MEASURING TEMPERATURE in Section 03, Group 140.

Engine 024 will set if:

- The MAT input voltage drops below 0.08 volts

If Engine 024 sets, the following will occur:

- The ECU will use a default "limp-home" MAT value of 20°C (68°F)
- Cold temperature starting may be slightly harder than normal

RG,RG34710,1580 –19–15DEC00–1/1

Engine 024 — MAT Input Voltage Too Low

The MAT input voltage drops below the specification.

OUO1004,0000C5D –19–05JAN01–1/1

Engine 024 MAT Input Voltage Too Low Diagnostic Procedure

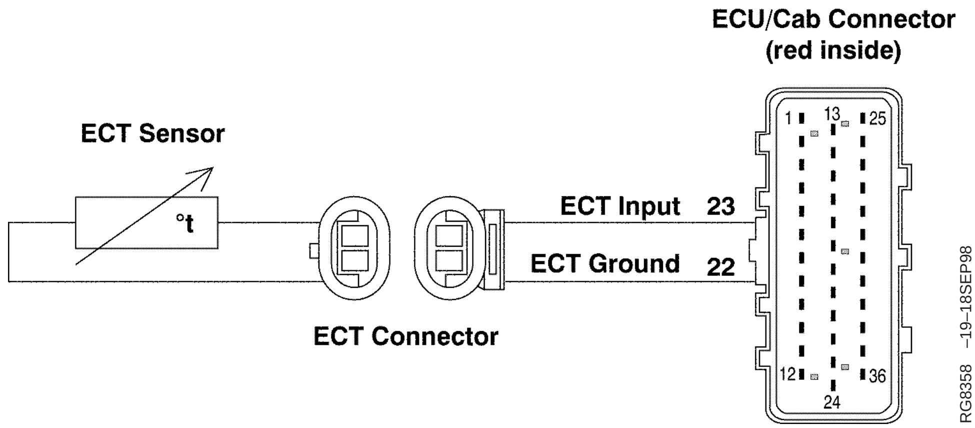
NOTE: Before using this diagnostic procedure, perform a preliminary inspection of the ECU/Engine connector (black inside) and the MAT sensor connector looking for dirty, damaged, or poorly positioned terminals.

– – –1/1

❶ **Engine 024 Intermittent Fault Test**	*NOTE: For wiring, theory of operation, and sensor location information, see ENGINE 024 MAT INPUT VOLTAGE TOO LOW supporting information.* 1. Warm engine 2. Ignition ON, engine OFF or running 3. Using the DST, read the MAT voltage parameter *NOTE: If the DST is not available, connect the BOB to the ECU/Cab connector (red inside). Using a multimeter, measure voltage between pins 15 (+) and 14 (—).*	**0.08 V or less:** GO TO ❷ **Above 0.08 V:** Problem is intermittent. If no other codes are present, see INTERMITTENT FAULT DIAGNOSTICS, earlier in this group. – – –1/1

❷ **MAT Input Circuit Grounded Test**	*NOTE: For wiring, theory of operation, and sensor location information, see ENGINE 024 MAT INPUT VOLTAGE TOO LOW supporting information.* 1. Ignition OFF 2. Disconnect MAT sensor connector 3. Ignition ON 4. Using the DST, read the MAT voltage parameter *NOTE: If the DST is not available, connect the BOB to the ECU/Cab connector (red inside). Using a multimeter, measure voltage between pins 15 (+) and 14 (—).*	**Below 4.9 V:** Short to ground in MAT input circuit OR Faulty ECU **4.9 V or greater:** Faulty MAT sensor – – –1/1

Engine 025 — ECT Input Voltage Too High



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.

ECT (Engine Coolant Temperature) 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.

Engine 025 will set if:

- The ECT input voltage exceeds 4.93 volts

If Engine 025 sets, the following will occur

- The ECU will use a default "limp-home" ECT value of approximately -20°C (-4°F) during cranking, and approximately 100°C (212°F) during running.
- Engine power will be slightly derated

RG,RG34710,1581 –19–15DEC00–1/1

Engine 025 — ECT Input Voltage Too High

The ECT input voltage exceeds the specification.

OUO1004,0000C5E –19–05JAN01–1/1

Engine 025 ECT Input Voltage Too High Diagnostic Procedure

NOTE: Before using this diagnostic procedure, perform a preliminary inspection of the ECU/Cab connector (red inside) and the ECT sensor connector looking for dirty, damaged, or poorly positioned terminals.

– – –1/1

❶ Engine 025 Intermittent Fault Test	*NOTE: For wiring, theory of operation, and sensor location information, see ENGINE 025 ECT INPUT VOLTAGE TOO HIGH supporting information.* 1. Warm engine 2. Ignition ON, engine OFF or running 3. Using the DST, read the ECT voltage parameter *NOTE: If the DST is not available, connect the BOB to the ECU/Cab connector (red inside). Using a multimeter, measure voltage between pins 23 (+) and 22 (—).*	**4.9 V or greater:** GO TO ❷ **Below 4.9 V:** Problem is intermittent. If no other codes are present, see INTERMITTENT FAULT DIAGNOSTICS, earlier in this group.

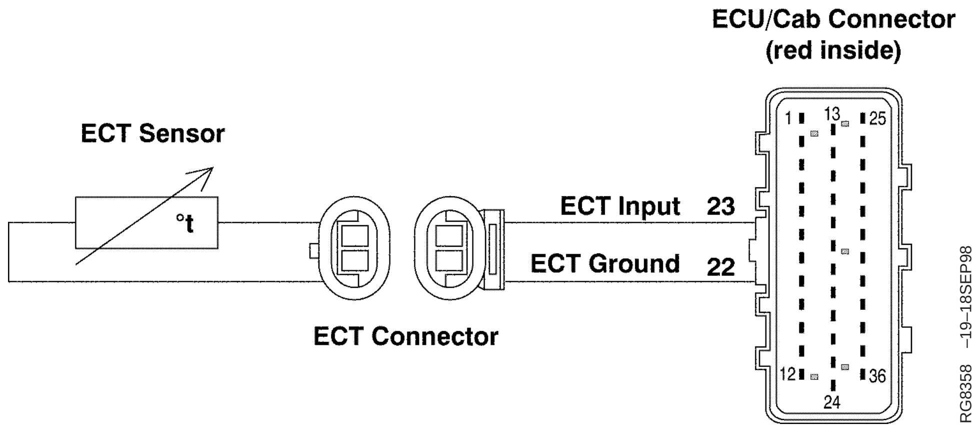
– – –1/1

❷ ECT Wiring Open Test	*NOTE: For wiring, theory of operation, and sensor location information, see ENGINE 025 ECT INPUT VOLTAGE TOO HIGH supporting information.* 1. Ignition OFF 2. Disconnect ECT sensor connector 3. Install a jumper wire between both terminals A and B in the ECT sensor harness connector 4. Ignition ON, engine OFF 5. Using the DST, read the ECT voltage parameter *NOTE: If the DST is not available, connect the BOB to the ECU/Cab connector (red inside). Using a multimeter, measure voltage between pins 23 (+) and 22 (—).*	**Above 0.1 V:** GO TO ❸ **0.1 V or less:** Faulty ECT sensor connector OR Faulty ECT sensor

– – –1/1

❸ **ECT Ground Circuit Open Test**	*NOTE: For wiring, theory of operation, and sensor location information, see ENGINE 025 ECT INPUT VOLTAGE TOO HIGH supporting information.* 1. Remove jumper wire between terminals A and B 2. Install a jumper wire between ECT input (refer to machine manual to determine which terminal is input) in harness sensor connector and a good chassis ground 3. Using the DST, read the ECT voltage parameter *NOTE: If the DST is not available, connect the BOB to the ECU/Cab connector (red inside). Using a multimeter, measure voltage between pins 23 (+) and 22 (—).*	**Above 0.1 V:** Open in ECT input circuit OR Faulty ECU connection OR Faulty ECU **0.1 V or less:** Open in ECT ground circuit OR Faulty ECU connection OR Faulty ECU – – –1/1

Engine 026 — ECT Input Voltage Too Low



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.

ECT (Engine Coolant Temperature) 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.

Engine 026 will set if:

- The ECT input voltage drops below 0.08 volts.

If Engine 026 sets, the following will occur

- The ECU will use a default "limp-home" ECT value of approximately -20°C (-4°F) during cranking, and approximately 100°C (212°F) during running.
- Engine power will be slightly derated.

RG,RG34710,1582 –19–15DEC00–1/1

Engine 026 — ECT Input Voltage Too Low

The ECT input voltage drops below the specification.

OUO1004,0000C5F –19–13JUN01–1/1

Engine 026 ECT Input Voltage Too Low Diagnostic Procedure

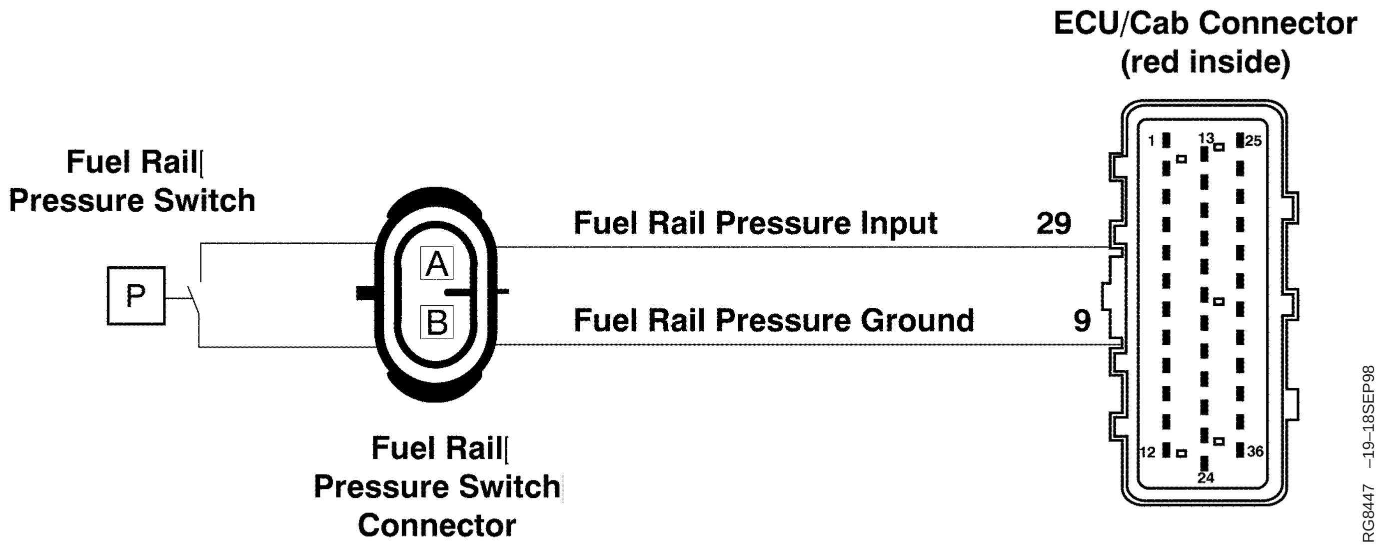
NOTE: Before using this diagnostic procedure, perform a preliminary inspection of the ECU/Cab connector (red inside) and the ECT sensor connector looking for dirty, damaged, or poorly positioned terminals.

– – –1/1

❶ **Engine 026 Intermittent Fault Test**	*NOTE: For wiring, theory of operation, and sensor location information, see ENGINE 026 ECT INPUT VOLTAGE TOO LOW supporting information.* 1. Warm engine 2. Ignition ON, engine OFF or running 3. Using the DST, read the ECT voltage parameter *NOTE: If the DST is not available, connect the BOB to the ECU/Cab connector (red inside). Using a multimeter, measure voltage between pins 23 (+) and 22 (—).*	**0.1 V or less:** GO TO ❷ **Above 0.1 V:** Problem is intermittent. If no other codes are present, see INTERMITTENT FAULT DIAGNOSTICS, earlier in this group. – – –1/1

❷ **ECT Input Circuit Grounded Test**	*NOTE: For wiring, theory of operation, and sensor location information, see ENGINE 026 ECT INPUT VOLTAGE TOO LOW supporting information.* 1. Ignition OFF 2. Disconnect ECT sensor connector 3. Using the DST, read the ECT voltage parameter *NOTE: If the DST is not available, connect the BOB to the ECU/Cab connector (red inside). Using a multimeter, measure voltage between pins 23 (+) and 22 (—).*	**Below 4.9 V:** Short to ground in ECT input circuit OR Faulty ECU **4.9 V or greater:** Faulty ECT sensor – – –1/1

Engine 027 — Fuel Rail Pressure Periodically Low



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.

Fuel Pressure Switch

- The fuel pressure switch is located on the fuel manifold and is used to alert the ECU in the event of low fuel rail pressure. If fuel rail pressure drops too low, the Electronic Unit Injectors (EUIs) could be damaged. Fuel pressure causes the contacts of the fuel pressure switch to close. If fuel pressure drops below 296 kPa (43 psi) the switch will open.

Engine 027 will set if:

- Fuel rail pressure is below 296 kPa (43 psi) for 40 seconds.

If Engine 027 sets, the following will occur:

- Engine operation will not be affected.

RG,RG34710,1583 –19–30SEP97–1/1

Engine 027 — Fuel Rail Pressure Periodically Low

Fuel rail pressure is below specification.

RG40854,0000070 –19–12FEB01–1/1

Engine 027 Fuel Rail Pressure Periodically Low Diagnostic Procedure

NOTE: Before using this diagnostic procedure, perform a preliminary inspection of the ECU/Cab connector (red inside) and the fuel pressure switch connector looking for dirty, damaged, or poorly positioned terminals.

– – –1/1

❶ **Fuel Supply Pressure Check**	1. Warm engine to normal operating temperature 2. Using a pressure gauge, measure fuel pressure. See CHECK FUEL SUPPLY PRESSURE in Group 150.	**Fuel pressure OK:** GO TO ❷ **Fuel pressure low:** Determine cause of low fuel pressure, repair problem and retest.

– – –1/1

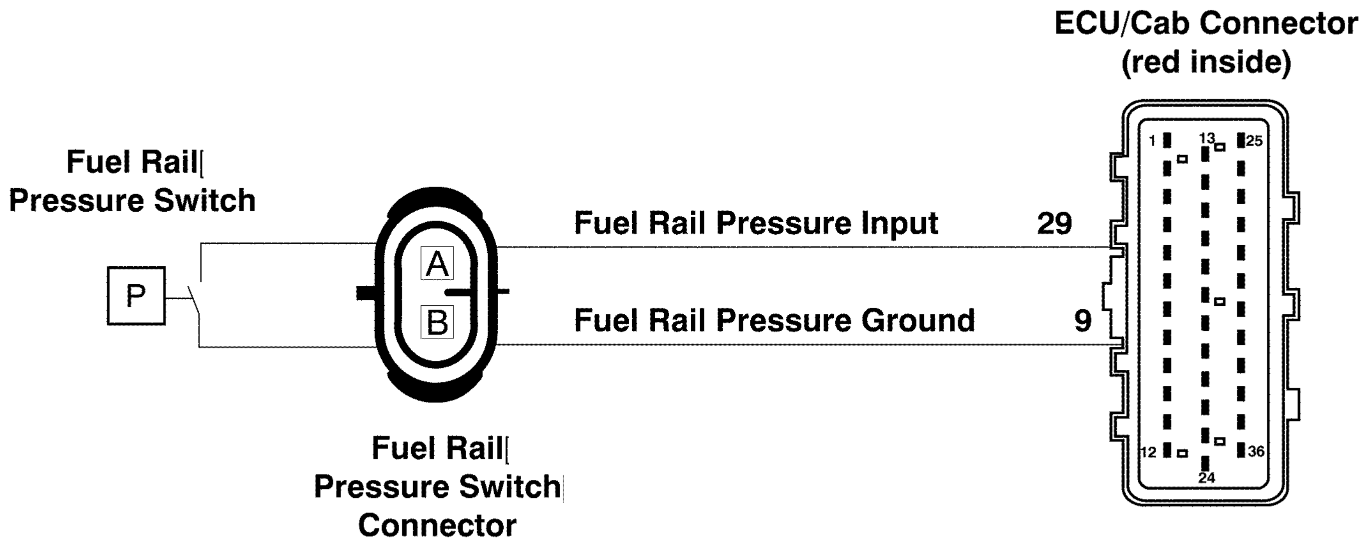
❷ **Intermittent Fault Test**	1. Ignition ON, engine OFF 2. Using the DST, clear Engine 027 3. Ignition ON, engine idling for at least one minute 4. Using the DST, monitor DTCs on the active code display parameter	**Engine 027 reoccurs:** GO TO ❸ **Engine 027 doesn't occur:** Problem is intermittent. If no other codes are present, see INTERMITTENT FAULT DIAGNOSTICS, earlier in this group.

– – –1/1

❸ **Fuel Pressure Switch Check**	*NOTE: For wiring, theory of operation, and connector location information, see ENGINE 027 FUEL RAIL PRESSURE PERIODICALLY LOW supporting information.* 1. Ignition ON, engine OFF 2. Using the DST, clear Engine 027 3. Ignition OFF 4. Disconnect fuel pressure switch harness connector 5. Install jumper wire between both terminals in fuel pressure switch connector 6. Ignition ON, engine idling for at least one minute 7. Using the DST, monitor DTCs on the active code display parameter	**Engine 027 reoccurs:** GO TO ❹ **Engine 027 doesn't occur:** Faulty fuel pressure switch – – –1/1

❹ **Fuel Pressure Switch Wiring Check**	*NOTE: For wiring, theory of operation, and connector location information, see ENGINE 027 FUEL RAIL PRESSURE PERIODICALLY LOW supporting information.* 1. Ignition OFF 2. Remove jumper wire 3. Probe ground terminal in fuel pressure swtich harness connector with a test light connected to battery voltage	**Light ON:** Open in fuel pressure switch signal (input) circuit OR Faulty fuel pressure switch connection OR Faulty ECU **Light OFF:** Open in fuel pressure switch ground circuit – – –1/1

Engine 028 — Fuel Rail Pressure Continuously Low



RG8447 –19–18SEP98

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.

Fuel Pressure Switch

- The fuel pressure switch is located on the fuel manifold and is used to alert the ECU in the event of low fuel rail pressure. If fuel rail pressure drops too low, the Electronic Unit Injectors (EUIs) could be damaged. Fuel pressure causes the contacts of the fuel pressure switch to close. If fuel pressure drops below 296 kPa (43 psi) the switch will open.

Engine 028 will set if:

- Fuel rail pressure is below 296 kPa (43 psi) continuously for 14 minutes.

If Engine 028 sets, the following will occur:

- Immediately after fault code 028 sets, engine power will be derated 10%.
- If Engine 028 stays active for 20 minutes, engine power will be derated 30%.

RG,RG34710,1584 –19–30SEP97–1/1

Engine 028 — Fuel Rail Pressure Continuously Low

Fuel rail pressure is below specification.

RG40854,0000071 –19–12FEB01–1/1

Engine 028 Fuel Rail Pressure Continuously Low Diagnostic Procedure

NOTE: Before using this diagnostic procedure, perform a preliminary inspection of the ECU/Cab connector (red inside) and the fuel pressure switch connector looking for dirty, damaged, or poorly positioned terminals.

– – –1/1

❶ **Fuel Supply Pressure Check**	1. Warm engine to normal operating temperature 2. Using a pressure gauge, measure fuel pressure. See CHECK FUEL SUPPLY PRESSURE in Group 150.	**Fuel pressure OK:** GO TO ❷ **Fuel pressure low:** Determine cause of low fuel pressure, repair problem and retest.

– – –1/1

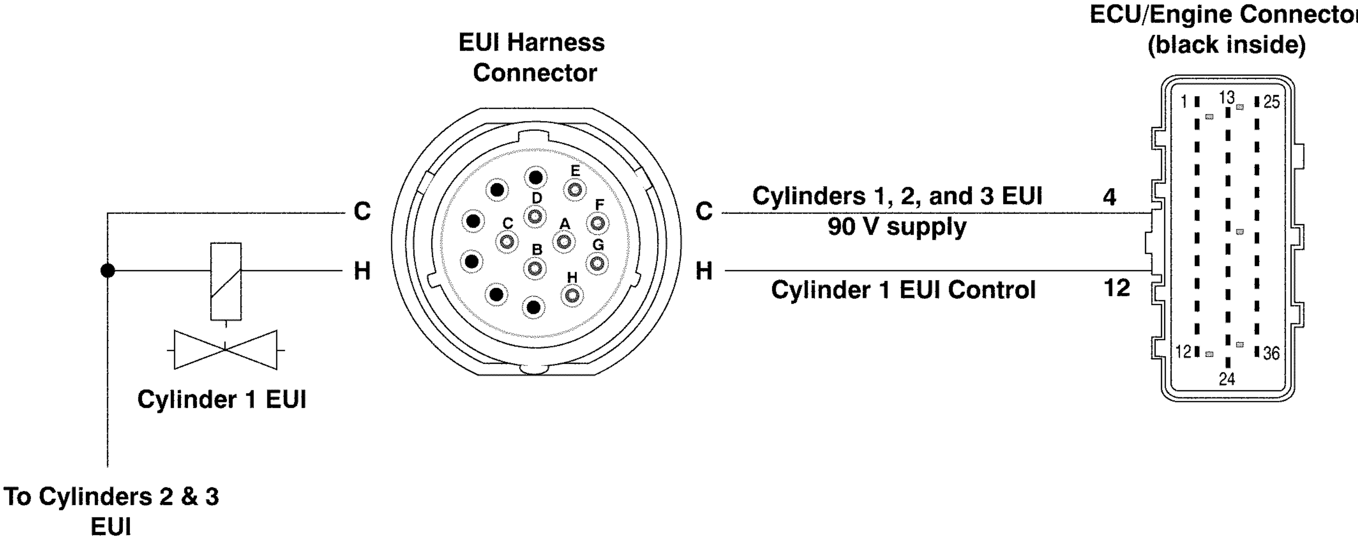
❷ **Intermittent Fault Test**	1. Ignition ON, engine OFF 2. Using the DST, clear Engine 028 3. Ignition ON, engine idling for at least one minute 4. Using the DST, monitor DTCs on the active code display parameter	**Engine 028 reoccurs:** GO TO ❸ **Engine 028 doesn’t occur:** Problem is intermittent. If no other codes are present, see INTERMITTENT FAULT DIAGNOSTICS, earlier in this group.

– – –1/1

❸ **Fuel Pressure Switch Check**	*NOTE: For wiring, theory of operation, and connector location information, see ENGINE 028 FUEL RAIL PRESSURE CONTINUOUSLY LOW supporting information.* 1. Ignition ON, engine OFF 2. Using the DST, clear Engine 028 3. Ignition OFF 4. Disconnect fuel pressure switch harness connector 5. Install jumper wire between both terminals in fuel pressure switch harness connector 6. Ignition ON, engine idling for at least one minute 7. Using the DST, monitor DTCs on the active code display parameter	**Engine 028 resets:** GO TO ❹ **Engine 028 doesn't reset:** Faulty fuel pressure switch – – –1/1

❹ **Fuel Pressure Switch Wiring Check**	*NOTE: For wiring, theory of operation, and connector location information, see ENGINE 028 FUEL RAIL PRESSURE CONTINUOUSLY LOW supporting information.* 1. Ignition OFF 2. Remove jumper wire 3. Probe ground terminal in fuel pressure switch harness connector witha test light	**Light ON:** Open in fuel pressure switch signal (input) circuit OR Faulty fuel pressure switch connection OR Faulty ECU **Light OFF:** Open in fuel pressure switch ground circuit – – –1/1

Engine 031 — Cylinder 1 EUI Fault



RG8348 –19–18SEP98

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.

EUI (Electronic Unit Injector)

- The fuel in 10.5 L and 12.5 L engines is delivered by 6 (one for each cylinder) electronic unit injectors (EUIs). The EUIs are mounted in the cylinder head, under the valve cover, so that they spray directly into the center of the cylinder bore. Each EUI is an injection pump and injector combined, operating at much higher pressures than standard in-line or rotary injection pumps. The ECU controls the start of injection and the amount of fuel injected by turning the solenoid in the EUI valve housing on and off which in turn opens and closes the EUI spill valve.
- Power is supplied to the EUIs for cylinders 1, 2, and 3 by a common wire, and to the EUIs for cylinders 4, 5, and 6 by a different common wire. The ECU energizes and de-energizes the solenoids of individual EUIs by closing and opening the individual EUI ground circuits.
- If Engine 032 and 033 are set along with 031, there is a problem in the wiring supplying power to cylinders 1, 2, and 3 EUIs.

Engine 031 will set if:

- The ECU detects an open or a short in the cylinder number 1 EUI circuitry.

If Engine 031 sets, the following will occur:

- With Engine 031 active, the ECU doesn’t control the system any differently. Depending on the cause of code 031, cylinder number 1 may not be firing; engine may have a miss, or a dead short.
- If Engine 032 and 033 are set along with code 031, the ECU will NOT turn cylinders 1, 2, and 3 EUIs ON; the engine will be running on cylinders 4, 5, and 6 only.

RG,RG34710,1585 –19–30SEP97–1/1

Engine 031 — Cylinder 1 EUI Fault

The ECU detects an open or a short in the cylinder number 1 EUI circuitry.

OUO1004,0000C60 –19–05JAN01–1/1

Engine 031 Cylinder 1 EUI Fault Diagnostic Procedure

NOTE: Before using this diagnostic procedure, perform a preliminary inspection of the ECU/Engine connector (black inside) and the EUI harness connector (located at the back of the cylinder head) looking for dirty, damaged, or poorly positioned terminals.

– – –1/1

❶ **Engine 031 Intermittent Fault Test**	*NOTE: For wiring, theory of operation, and connector location information, see ENGINE 031 CYLINDER 1 EUI FAULT supporting information.* 1. Ignition ON, engine OFF 2. Using the DST, monitor DTCs on the active code display parameter. 3. Make note of any DTCs, then clear all DTCs 4. Ignition ON, engine running 5. Using the DST, monitor DTCs on the active code display parameter	**Engine 031 reoccurs:** GO TO ❷ **Engine 031 cleared:** Problem is intermittent. If no other codes are present, see INTERMITTENT FAULT DIAGNOSTICS, earlier in this group.

– – –1/1

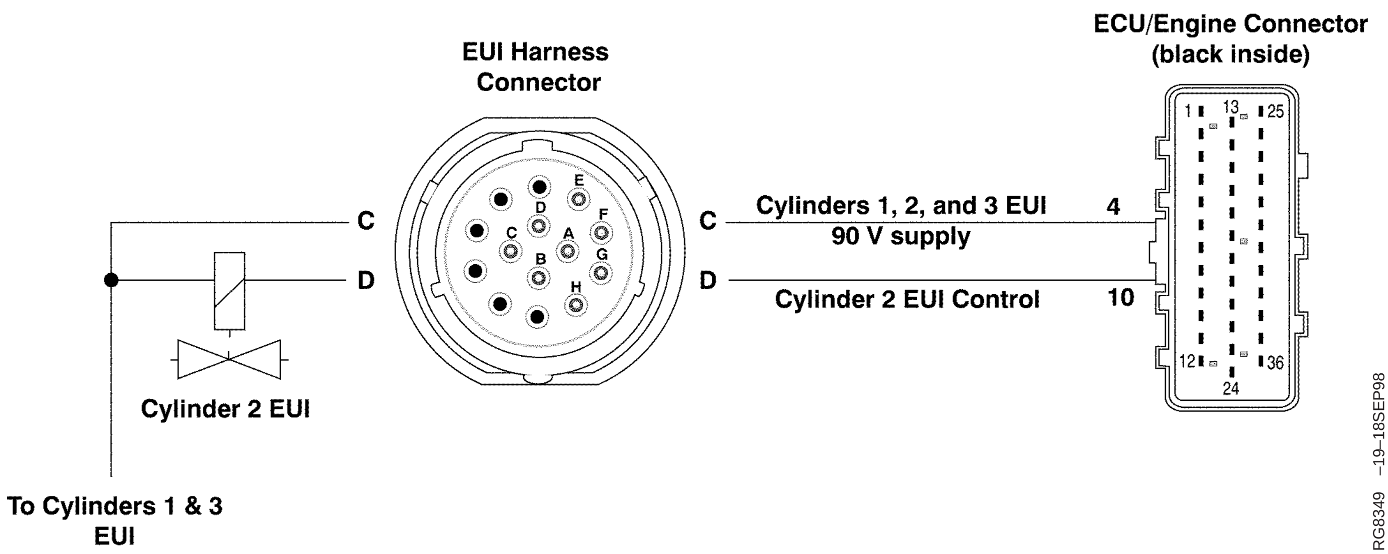
❷ Cyl 1 EUI Wiring Open in Vehicle Harness Test	*NOTE: For wiring, theory of operation, and connector location information, see ENGINE 031 CYLINDER 1 EUI FAULT supporting information.* 1. Ignition OFF **CAUTION: Possible strong electrical shock hazard if engine is cranking or running** 2. Disconnect the EUI wiring harness connector and the ECU/Engine connector (inside the harness end of connector is black) 3. Measure resistance between terminal H in the harness end of the EUI wiring harness connector and terminal 12 in the harness end of the ECU connector 4. Measure resistance between terminal C in the harness end of the EUI wiring harness connector and terminal 4 in the harness end of the ECU connector	**Both measurements 5.0 ohms or less:** GO TO ❸ **H to 12 greater than 5.0 ohms:** Open in cylinder 1 EUI control circuit in vehicle harness **C to 4 greater than 5.0 ohms:** Open in cylinders 1, 2, and 3 EUI 90 V supply in vehicle harness – – –1/1

❸ Cyl 1 EUI Wiring Short-to-Ground in Vehicle Harness Test	*NOTE: For wiring, theory of operation, and connector location information, see ENGINE 031 CYLINDER 1 EUI FAULT supporting information.* 1. Ignition OFF **CAUTION: Possible strong electrical shock hazard if engine is cranking or running** 2. ECU/Engine and EUI wiring harness connectors still disconnected 3. Measure resistance between terminal H in the harness end of the EUI wiring harness connector and a good ground 4. Measure resistance between terminal C in the harness end of the EUI wiring harness connector and a good ground	**Both measurements greater than 20,000 ohms:** GO TO ❹ **H to good ground less than 20,000 ohms:** Short to ground in cylinder 1 EUI control circuit in vehicle harness **C to good ground less than 20,000 ohms:** Short to ground in cylinder 1, 2, and 3 EUI 90 V supply circuit in vehicle harness – – –1/1

❹ **Cyl 1 EUI Resistance Test**	*NOTE: For wiring, theory of operation, and connector location information, see ENGINE 031 CYLINDER 1 EUI FAULT supporting information.* 1. Ignition OFF ⚠ **CAUTION: Possible strong electrical shock hazard if engine is cranking or running.** 2. Remove rocker arm cover from engine 3. Disconnect electrical connections to cylinder 1 EUI and to a known good EUI 4. Measure resistance of cylinder 1 EUI, record the resistance 5. Measure resistance of the know good EUI, record the resistance Compare the readings. **Because EUI resistance varies with temperature, a comparison should be used in order to compensate for the effects of temperature on the measured resistance.** The difference between the resistance of cylinder 1 EUI and the known good EUI should be no more than 0.2 ohms. EUI resistance should be 1.0 - 1.8 ohms.	**Resistance within specification:** GO TO ❺ **Resistance NOT within specification:** Faulty cylinder 1 EUI – – –1/1
❺ **Cyl 1 EUI Short-to-Ground Test**	*NOTE: For wiring, theory of operation, and connector location information, see ENGINE 031 CYLINDER 1 EUI FAULT supporting information.* 1. Ignition OFF ⚠ **CAUTION: Possible strong electrical shock hazard if engine is cranking or running.** 2. Electrical connections to cylinder 1 EUI still disconnected 3. Measure resistance between one terminal on the EUI and the EUI body; then between the other terminal and EUI body	**Both measurements greater than 20,000 ohms:** GO TO ❻ **Either measurement less than 20,000 ohms:** Faulty cylinder 1 EUI – – –1/1
❻ **Cyl 1 EUI Wiring Harness Open Test**	*NOTE: For wiring, theory of operation, and connector location information, see ENGINE 031 CYLINDER 1 EUI FAULT supporting information.* 1. Ignition OFF ⚠ **CAUTION: Possible strong electrical shock hazard if engine is cranking or running.** 2. With the electrical connections to cylinder 1 EUI still disconnected and the wiring harness still disconnected from EUI wiring harness connector on the cylinder head 3. Measure resistance between one of the cylinder 1 EUI harness eyelets and the corresponding terminal at the EUI harness connector (either C or H, the EUIs are not polarity sensitive) 4. Measure resistance between the other cylinder 1 EUI harness eyelets and the corresponding terminal at the EUI harness connector	**Both measurements 2.0 ohms or less:** GO TO ❼ **Either measurement greater than 2.0 ohms:** Faulty EUI wiring harness – – –1/1

7 Cyl 1 EUI Wiring Harness Short-to-Ground Test	*NOTE: For wiring, theory of operation, and connector location information, see ENGINE 031 CYLINDER 1 EUI FAULT supporting information.* 1. Ignition OFF **CAUTION: Possible strong electrical shock hazard if engine is cranking or running.** 2. With the electrical connections to cylinder 1 EUI still disconnected and the wiring harness still disconnected from EUI wiring harness connector on the cylinder head 3. Measure resistance in the engine end of the EUI harness connector between terminal C and a good ground; between terminal H and a good ground	**Both measurements greater than 20,000 ohms:** Faulty EUI harness connector OR Faulty ECU/Engine connector OR Faulty ECU **Either measurement less than 20,000 ohms:** Faulty EUI wiring harness – – –1/1

Engine 032 — Cylinder 2 EUI Fault



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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.

EUI (Electronic Unit Injector)

- The fuel in 10.5 L and 12.5 L engines is delivered by 6 (one for each cylinder) electronic unit injectors (EUIs). The EUIs are mounted in the cylinder head, under the valve cover, so that they spray directly into the center of the cylinder bore. Each EUI is an injection pump and injector combined, operating at much higher pressures than standard in-line or rotary injection pumps. The ECU controls the start of injection and the amount of fuel injected by turning the solenoid in the EUI valve housing on and off which in turn opens and closes the EUI spill valve.
- Power is supplied to the EUIs for cylinders 1, 2, and 3 by a common wire, and to the EUIs for cylinders 4, 5, and 6 by a different common wire. The ECU energizes and de-energizes the solenoids of individual EUIs by closing and opening the individual EUI ground circuits.
- If Engine 031 and 033 are set along with 032, there is a problem in the wiring supplying power to cylinders 1, 2, and 3 EUIs.

Engine 032 will set if:

- The ECU detects an open or a short in the cylinder number 2 EUI circuitry.

If Engine 032 sets, the following will occur:

- With Engine 032 active, the ECU doesn't control the system any differently. Depending on the cause of code 32, cylinder number 2 may not be firing; engine may have a miss, or a dead short.
- If Engine 031 and 033 are set along with code 032, the ECU will NOT turn cylinders 1, 2, and 3 EUIs ON; the engine will be running on cylinders 4, 5, and 6 only.

RG,RG34710,1586 –19–30SEP97–1/1

Engine 032 — Cylinder 2 EUI Fault

The ECU detects an open or a short in the cylinder number 2 EUI circuitry.

OUO1004,0000C61 –19–05JAN01–1/1

Engine 032 Cylinder 2 EUI Fault Diagnostic Procedure

NOTE: Before using this diagnostic procedure, perform a preliminary inspection of the ECU/Engine connector (black inside) and the EUI harness connector (located at the back of the cylinder head) looking for dirty, damaged, or poorly positioned terminals.

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❶ **Engine 032 Intermittent Fault Test**	*NOTE: For wiring, theory of operation, and connector location information, see ENGINE 032 CYLINDER 2 EUI FAULT supporting information.* 1. Ignition ON, engine OFF 2. Using the DST, monitor DTCs on the active code display parameter. 3. Make note of all DTCs, then clear all DTCs 4. Ignition ON, engine running 5. Using the DST, monitor DTCs on the active code display parameter	**Engine 032 reoccurs:** GO TO ❷ **Engine 032 cleared:** Problem is intermittent. If no other codes are present, see INTERMITTENT FAULT DIAGNOSTICS, earlier in this group.

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❷ Cyl 2 EUI Wiring Open in Vehicle Harness Test	*NOTE: For wiring, theory of operation, and connector location information, see ENGINE 032 CYLINDER 2 EUI FAULT supporting information.* 1. Ignition OFF **CAUTION: Possible strong electrical shock hazard if engine is cranking or running** 2. Disconnect the EUI wiring harness connector and the ECU/Engine connector (inside the harness end of connector is black) 3. Measure resistance between terminal D in the harness end of the EUI wiring harness connector and terminal 10 in the harness end of the ECU connector 4. Measure resistance between terminal C in the harness end of the EUI wiring harness connector and terminal 4 in the harness end of the ECU connector	**Both measurements 5.0 ohms or less:** GO TO ❸ **D to 10 greater than 5.0 ohms:** Open in cylinder 2 EUI control circuit in vehicle harness **C to 4 greater than 5.0 ohms:** Open in cylinders 1, 2, and 3 EUI 90 V supply in vehicle harness – – –1/1

❸ Cyl 2 EUI Wiring Short-to-Ground in Vehicle Harness Test	*NOTE: For wiring, theory of operation, and connector location information, see ENGINE 032 CYLINDER 2 EUI FAULT supporting information.* 1. Ignition OFF **CAUTION: Possible strong electrical shock hazard if engine is cranking or running** 2. ECU/Engine and EUI wiring harness connectors still disconnected 3. Measure resistance between terminal D in the harness end of the EUI wiring harness connector and a good ground 4. Measure resistance between terminal C in the harness end of the EUI wiring harness connector and a good ground	**Both measurements greater than 20,000 ohms:** GO TO ❹ **D to good ground less than 20,000 ohms:** Short to ground in cylinder 2 EUI control circuit in vehicle harness **C to good ground less than 20,000 ohms:** Short to ground in cylinder 1, 2, and 3 EUI 90 V supply circuit in vehicle harness – – –1/1

❹ Cyl 2 EUI Resistance Test

NOTE: For wiring, theory of operation, and connector location information, see ENGINE 032 CYLINDER 2 EUI FAULT supporting information.

1. Ignition OFF

CAUTION: Possible strong electrical shock hazard if engine is cranking or running.

2. Remove rocker arm cover from engine
3. Disconnect electrical connections to cylinder 2 EUI and to a known good EUI
4. Measure resistance of cylinder 2 EUI, record the resistance
5. Measure resistance of the know good EUI, record the resistance
6. Compare the readings. **Because EUI resistance varies with temperature, a comparison should be used in order to compensate for the affects of temperature on the measured resistance.** The difference between the resistance of cylinder 2 EUI and the known good EUI should be no more than 0.2 ohms. EUI resistance should be 1.0 - 1.8 ohms.

Resistance within specification:
GO TO ❺

Resistance NOT within specification:
Faulty cylinder 2 EUI

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❺ Cyl 2 EUI Short-to-Ground Test

NOTE: For wiring, theory of operation, and connector location information, see ENGINE 032 CYLINDER 2 EUI FAULT supporting information.

1. Ignition OFF

CAUTION: Possible strong electrical shock hazard if engine is cranking or running.

2. Electrical connections to cylinder 2 EUI still disconnected
3. Measure resistance between one terminal on the EUI and the EUI body; then between the other terminal and EUI body

Both measurements greater than 20,000 ohms:
GO TO ❻

Either measurement less than 20,000 ohms:
Faulty cylinder 2 EUI

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❻ Cyl 2 EUI Wiring Harness Open Test

NOTE: For wiring, theory of operation, and connector location information, see ENGINE 032 CYLINDER 2 EUI FAULT supporting information.

1. Ignition OFF

CAUTION: Possible strong electrical shock hazard if engine is cranking or running.

2. With the electrical connections to cylinder 2 EUI still disconnected and the wiring harness still disconnected from EUI wiring harness connector on the cylinder head
3. Measure resistance between one of the cylinder 2 EUI harness eyelets and the corresponding terminal at the EUI harness connector (either C or D, the EUIs are not polarity sensitive)
4. Measure resistance between the other cylinder 2 EUI harness eyelets and the corresponding terminal at the EUI harness connector

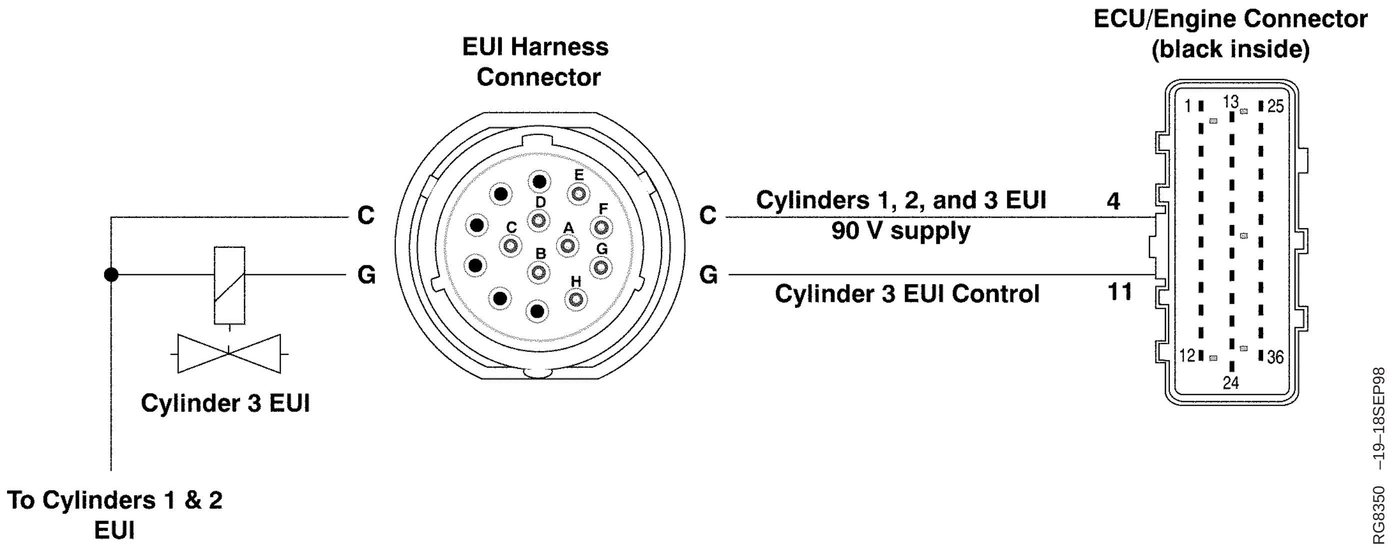
Both measurements 2.0 ohms or less:
GO TO ❼

Either measurement greater than 2.0 ohms:
Faulty EUI wiring harness

– – –1/1

❼ **Cyl 2 EUI Wiring Harness Short-to-Ground Test**	*NOTE: For wiring, theory of operation, and connector location information, see ENGINE 032 CYLINDER 2 EUI FAULT supporting information.* 1. Ignition OFF ⚠ **CAUTION: Possible strong electrical shock hazard if engine is cranking or running.** 2. With the electrical connections to cylinder 2 EUI still disconnected and the wiring harness still disconnected from EUI wiring harness connector on the cylinder head 3. Measure resistance in the engine end of the EUI harness connector between terminal C and a good ground; between terminal D and a good ground	**Both measurements greater than 20,000 ohms:** Faulty EUI harness connector OR Faulty ECU/Engine connector OR Faulty ECU **Either measurement less than 20,000 ohms:** Faulty EUI wiring harness – – –1/1

Engine 033 — Cylinder 3 EUI Fault



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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.

EUI (Electronic Unit Injector)

- The fuel in 10.5 L and 12.5 L engines is delivered by 6 (one for each cylinder) electronic unit injectors (EUIs). The EUIs are mounted in the cylinder head, under the valve cover, so that they spray directly into the center of the cylinder bore. Each EUI is an injection pump and injector combined, operating at much higher pressures than standard in-line or rotary injection pumps. The ECU controls the start of injection and the amount of fuel injected by turning the solenoid in the EUI valve housing on and off which in turn opens and closes the EUI spill valve.
- Power is supplied to the EUIs for cylinders 1, 2, and 3 by a common wire, and to the EUIs for cylinders 4, 5, and 6 by a different common wire. The ECU energizes and de-energizes the solenoids of individual EUIs by closing and opening the individual EUI ground circuits.
- If Engine 031 and 032 are set along with 33, there is a problem in the wiring supplying power to cylinders 1, 2, and 3 EUIs.

Engine 033 will set if:

- The ECU detects an open or a short in the cylinder number 3 EUI circuitry.

If Engine 033 sets, the following will occur:

- With Engine 033 active, the ECU doesn’t control the system any differently. Depending on the cause of code 033, cylinder number 3 may not be firing; engine may have a miss, or a dead short.
- If Engine 031 and 032 are set along with code 033, the ECU will NOT turn cylinders 1, 2, and 3 EUIs ON; the engine will be running on cylinders 4, 5, and 6 only.

RG,RG34710,1587 –19–30SEP97–1/1

Engine 033 — Cylinder 3 EUI Fault

The ECU detects an open or a short in the cylinder number 3 EUI circuitry.

OUO1004,0000C62 –19–05JAN01–1/1

Engine 033 Cylinder 3 EUI Fault Diagnostic Procedure

NOTE: Before using this diagnostic procedure, perform a preliminary inspection of the ECU/Engine connector (black inside) and the EUI harness connector (located at the back of the cylinder head) looking for dirty, damaged, or poorly positioned terminals.

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❶ **Engine 033 Intermittent Fault Test**	*NOTE: For wiring, theory of operation, and connector location information, see ENGINE 033 CYLINDER 3 EUI FAULT supporting information.* 1. Ignition ON, engine OFF 2. Using the DST, monitor DTCs on the active code display parameter. 3. Make note of all DTCs, then clear all DTCs 4. Ignition ON, engine running 5. Using the DST, monitor DTCs on the active code display parameter	**Engine 033 reoccurs:** GO TO ❷ **Engine 033 cleared:** Problem is intermittent. If no other codes are present, see INTERMITTENT FAULT DIAGNOSTICS, earlier in this group.

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❷ **Cyl 3 EUI Wiring Open in Vehicle Harness Test**	*NOTE: For wiring, theory of operation, and connector location information, see ENGINE 033 CYLINDER 3 EUI FAULT supporting information.* 1. Ignition OFF **CAUTION: Possible strong electrical shock hazard if engine is cranking or running** 2. Disconnect the EUI wiring harness connector and the ECU/Engine connector (inside the harness end of connector is black) 3. Measure resistance between terminal G in the harness end of the EUI wiring harness connector and terminal 11 in the harness end of the ECU connector 4. Measure resistance between terminal C in the harness end of the EUI wiring harness connector and terminal 4 in the harness end of the ECU connector	**Both measurements 5.0 ohms or less:** GO TO ❸ **G to 11 greater than 5.0 ohms:** Open in cylinder 3 EUI control circuit in vehicle harness **C to 4 greater than 5.0 ohms:** Open in cylinders 1, 2, and 3 EUI 90 V supply in vehicle harness – – –1/1

❸ **Cyl 3 EUI Wiring Short-to-Ground in Vehicle Harness Test**	*NOTE: For wiring, theory of operation, and connector location information, see ENGINE 033 CYLINDER 3 EUI FAULT supporting information.* 1. Ignition OFF **CAUTION: Possible strong electrical shock hazard if engine is cranking or running** 2. ECU/Engine and EUI wiring harness connectors still disconnected 3. Measure resistance between terminal G in the harness end of the EUI wiring harness connector and a good ground 4. Measure resistance between terminal C in the harness end of the EUI wiring harness connector and a good ground	**Both measurements greater than 20,000 ohms:** GO TO ❹ **G to good ground less than 20,000 ohms:** Short to ground in cylinder 3 EUI control circuit in vehicle harness **C to good ground less than 20,000 ohms:** Short to ground in cylinder 1, 2, and 3 EUI 90 V supply circuit in vehicle harness – – –1/1

❹ **Cyl 3 EUI Resistance Test**	*NOTE: For wiring, theory of operation, and connector location information, see ENGINE 033 CYLINDER 3 EUI FAULT supporting information.* 1. Ignition OFF **CAUTION: Possible strong electrical shock hazard if engine is cranking or running.** 2. Remove rocker arm cover from engine 3. Disconnect electrical connections to cylinder 3 EUI and to a known good EUI 4. Measure resistance of cylinder 3 EUI, record the resistance 5. Measure resistance of the know good EUI, record the resistance 6. Compare the readings. **Because EUI resistance varies with temperature, a comparison should be used in order to compensate for the affects of temperature on the measured resistance.** The difference between the resistance of cylinder 3 EUI and the known good EUI should be no more than 0.2 ohms. EUI resistance should be 1.0 - 1.8 ohms.	**Resistance within specification:** GO TO ❺ **Resistance NOT within specification:** Faulty cylinder 3 EUI – – –1/1

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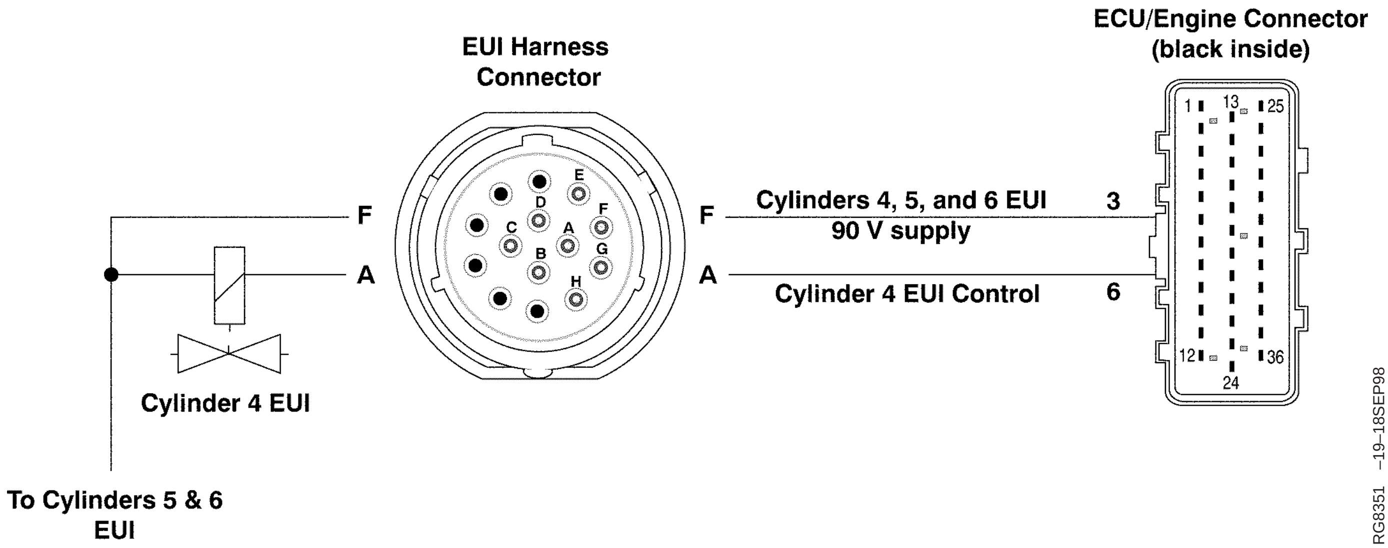
❺ **Cyl 3 EUI Short-to-Ground Test**	*NOTE: For wiring, theory of operation, and connector location information, see ENGINE 033 CYLINDER 3 EUI FAULT supporting information.* 1. Ignition OFF **CAUTION: Possible strong electrical shock hazard if engine is cranking or running.** 2. Electrical connections to cylinder 3 EUI still disconnected 3. Measure resistance between one terminal on the EUI and the EUI body; then between the other terminal and EUI body	**Both measurements greater than 20,000 ohms:** GO TO ❻ **Either measurement less than 20,000 ohms:** Faulty cylinder 3 EUI – – –1/1

❻ **Cyl 3 EUI Wiring Harness Open Test**	*NOTE: For wiring, theory of operation, and connector location information, see ENGINE 033 CYLINDER 3 EUI FAULT supporting information.* 1. Ignition OFF **CAUTION: Possible strong electrical shock hazard if engine is cranking or running.** 2. With the electrical connections to cylinder 3 EUI still disconnected and the wiring harness still disconnected from EUI wiring harness connector on the cylinder head 3. Measure resistance between one of the cylinder 3 EUI harness eyelets and the corresponding terminal at the EUI harness connector (either C or G, the EUIs are not polarity sensitive) 4. Measure resistance between the other cylinder 3 EUI harness eyelets and the corresponding terminal at the EUI harness connector	**Both measurements 2.0 ohms or less:** GO TO ❼ **Either measurement greater than 2.0 ohms:** Faulty EUI wiring harness – – –1/1

❼ **Cyl 3 EUI Wiring Harness Short-to-Ground Test**	*NOTE: For wiring, theory of operation, and connector location information, see ENGINE 033 CYLINDER 3 EUI FAULT supporting information.* 1. Ignition OFF **CAUTION: Possible strong electrical shock hazard if engine is cranking or running.** 2. With the electrical connections to cylinder 3 EUI still disconnected and the wiring harness still disconnected from EUI wiring harness connector on the cylinder head 3. Measure resistance in the engine end of the EUI harness connector between terminal C and a good ground; between terminal G and a good ground	**Both measurements greater than 20,000 ohms:** Faulty EUI harness connector OR Faulty ECU/Engine connector OR Faulty ECU **Either measurement less than 20,000 ohms:** Faulty EUI wiring harness – – –1/1

Engine 034 — Cylinder 4 EUI Fault



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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.

EUI (Electronic Unit Injector)

- The fuel in 10.5 L and 12.5 L engines is delivered by 6 (one for each cylinder) electronic unit injectors (EUIs). The EUIs are mounted in the cylinder head, under the valve cover, so that they spray directly into the center of the cylinder bore. Each EUI is an injection pump and injector combined, operating at much higher pressures than standard in-line or rotary injection pumps. The ECU controls the start of injection and the amount of fuel injected by turning the solenoid in the EUI valve housing on and off which in turn opens and closes the EUI spill valve.
- Power is supplied to the EUIs for cylinders 1, 2, and 3 by a common wire, and to the EUIs for cylinders 4, 5, and 6 by a different common wire. The ECU energizes and de-energizes the solenoids of individual EUIs by closing and opening the individual EUI ground circuits.
- If Engine 035 and 036 are set along with 034, there is a problem in the wiring supplying power to cylinders 4, 5, and 6 EUIs.

Engine 034 will set if:

- The ECU detects an open or a short in the cylinder number 4 EUI circuitry.

If Engine 034 sets, the following will occur:

- With Engine 034 active, the ECU doesn't control the system any differently. Depending on the cause of code 034, cylinder number 4 may not be firing; engine may have a miss, or a dead short.
- If Engine 035 and 036 are set along with code 034, the ECU will NOT turn cylinders 4, 5, and 6 EUIs ON; the engine will be running on cylinders 1, 2, and 3 only.

RG,RG34710,1588 –19–30SEP97–1/1

Engine 034 — Cylinder 4 EUI Fault

The ECU detects an open or a short in the cylinder number 4 EUI circuitry.

OUO1004,0000C63 –19–05JAN01–1/1

Engine 034 Cylinder 4 EUI Fault Diagnostic Procedure

NOTE: Before using this diagnostic procedure, perform a preliminary inspection of the ECU/Engine connector (black inside) and the EUI harness connector (located at the back of the cylinder head) looking for dirty, damaged, or poorly positioned terminals.

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❶ **Engine 034 Intermittent Fault Test**	*NOTE: For wiring, theory of operation, and connector location information, see ENGINE 034 CYLINDER 4 EUI FAULT supporting information.* 1. Ignition ON, engine OFF 2. Using the DST, monitor DTCs on the active code display parameter. 3. Make note of all DTCs, then clear all DTCs 4. Ignition ON, engine running 5. Using the DST, monitor DTCs on the active code display parameter	**Engine 034 reoccurs:** GO TO ❷ **Engine 034 cleared:** Problem is intermittent. If no other codes are present, see INTERMITTENT FAULT DIAGNOSTICS, earlier in this group. – – –1/1

❷ **Cyl 4 EUI Wiring Open in Vehicle Harness Test**	*NOTE: For wiring, theory of operation, and connector location information, see ENGINE 034 CYLINDER 4 EUI FAULT supporting information.* 1. Ignition OFF **CAUTION: Possible strong electrical shock hazard if engine is cranking or running** 2. Disconnect the EUI wiring harness connector and the ECU/Engine connector (inside the harness end of connector is black) 3. Measure resistance between terminal A in the harness end of the EUI wiring harness connector and terminal 6 in the harness end of the ECU connector 4. Measure resistance between terminal F in the harness end of the EUI wiring harness connector and terminal 3 in the harness end of the ECU connector	**Both measurements 5.0 ohms or less:** GO TO ❸ **A to 6 greater than 5.0 ohms:** Open in cylinder 4 EUI control circuit in vehicle harness **F to 3 greater than 5.0 ohms:** Open in cylinders 4, 5, and 6 EUI 90 V supply in vehicle harness – – –1/1

❸ **Cyl 4 EUI Wiring Short-to-Ground in Vehicle Harness Test**	*NOTE: For wiring, theory of operation, and connector location information, see ENGINE 034 CYLINDER 4 EUI FAULT supporting information.* 1. Ignition OFF **CAUTION: Possible strong electrical shock hazard if engine is cranking or running** 2. ECU/Engine and EUI wiring harness connectors still disconnected 3. Measure resistance between terminal A in the harness end of the EUI wiring harness connector and a good ground 4. Measure resistance between terminal F in the harness end of the EUI wiring harness connector and a good ground	**Both measurements greater than 20,000 ohms:** GO TO ❹ **A to good ground less than 20,000 ohms:** Short to ground in cylinder 4 EUI control circuit in vehicle harness **F to good ground less than 20,000 ohms:** Short to ground in cylinder 4, 5, and 6 EUI 90 V supply circuit in vehicle harness – – –1/1

❹ **Cyl 4 EUI Resistance Test**	*NOTE: For wiring, theory of operation, and connector location information, see ENGINE 034 CYLINDER 4 EUI FAULT supporting information.* 1. Ignition OFF **CAUTION: Possible strong electrical shock hazard if engine is cranking or running.** 2. Remove rocker arm cover from engine 3. Disconnect electrical connections to cylinder 4 EUI and to a known good EUI 4. Measure resistance of cylinder 4 EUI, record the resistance 5. Measure resistance of the know good EUI, record the resistance 6. Compare the readings. **Because EUI resistance varies with temperature, a comparison should be used in order to compensate for the affects of temperature on the measured resistance.** The difference between the resistance of cylinder 4 EUI and the known good EUI should be no more than 0.2 ohms. EUI resistance should be 1.0 - 1.8 ohms.	**Resistance within specification:** GO TO ❺ **Resistance NOT within specification:** Faulty cylinder 4 EUI – – –1/1

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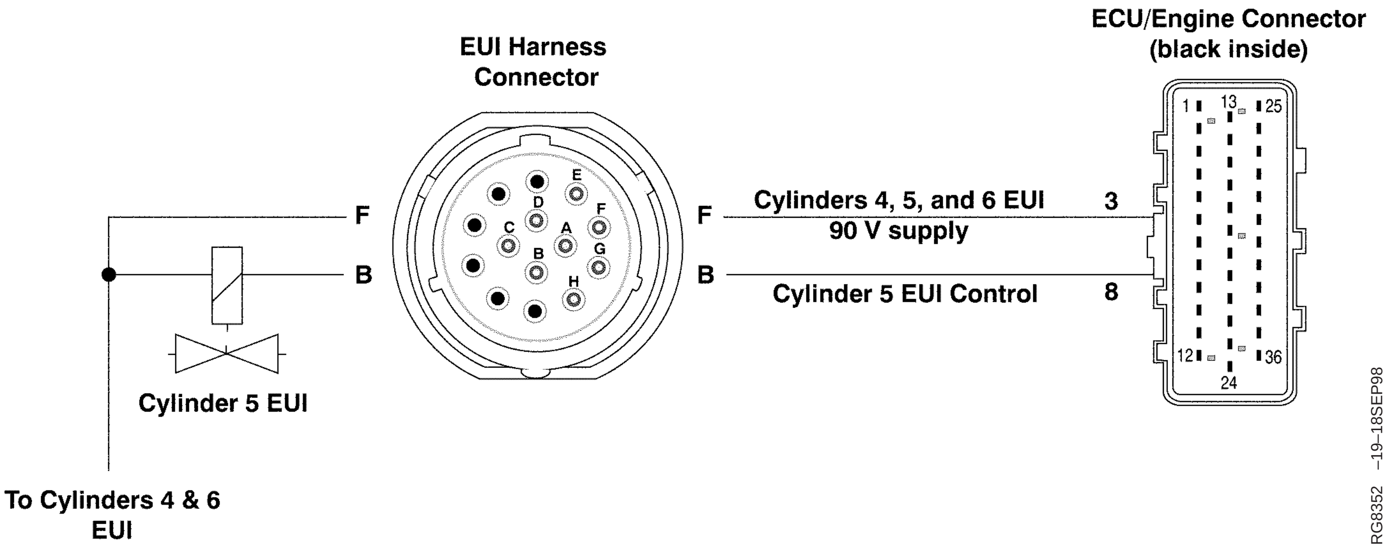
❺ **Cyl 4 EUI Short-to-Ground Test**	*NOTE: For wiring, theory of operation, and connector location information, see ENGINE 034 CYLINDER 4 EUI FAULT supporting information.* 1. Ignition OFF **CAUTION: Possible strong electrical shock hazard if engine is cranking or running.** 2. Electrical connections to cylinder 4 EUI still disconnected 3. Measure resistance between one terminal on the EUI and the EUI body; then between the other terminal and EUI body	**Both measurements greater than 20,000 ohms:** GO TO ❻ **Either measurement less than 20,000 ohms:** Faulty cylinder 4 EUI – – –1/1

❻ **Cyl 4 EUI Wiring Harness Open Test**	*NOTE: For wiring, theory of operation, and connector location information, see ENGINE 034 CYLINDER 4 EUI FAULT supporting information.* 1. Ignition OFF **CAUTION: Possible strong electrical shock hazard if engine is cranking or running.** 2. With the electrical connections to cylinder 4 EUI still disconnected and the wiring harness still disconnected from EUI wiring harness connector on the cylinder head 3. Measure resistance between one of the cylinder 4 EUI harness eyelets and the corresponding terminal at the EUI harness connector (either F or A, the EUIs are not polarity sensitive) 4. Measure resistance between the other cylinder 4 EUI harness eyelets and the corresponding terminal at the EUI harness connector	**Both measurements 2.0 ohms or less:** GO TO ❼ **Either measurement greater than 2.0 ohms:** Faulty EUI wiring harness – – –1/1

❼ **Cyl 4 EUI Wiring Harness Short-to-Ground Test**	*NOTE: For wiring, theory of operation, and connector location information, see ENGINE 034 CYLINDER 4 EUI FAULT supporting information.* 1. Ignition OFF ⚠ **CAUTION: Possible strong electrical shock hazard if engine is cranking or running.** 2. With the electrical connections to cylinder 4 EUI still disconnected and the wiring harness still disconnected from EUI wiring harness connector on the cylinder head 3. Measure resistance in the engine end of the EUI harness connector between terminal F and a good ground; between terminal A and a good ground	**Both measurements greater than 20,000 ohms:** Faulty EUI harness connector OR Faulty ECU/Engine connector OR Faulty ECU **Either measurement less than 20,000 ohms:** Faulty EUI wiring harness – – –1/1

Engine 035 — Cylinder 5 EUI Fault



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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.

EUI (Electronic Unit Injector)

- The fuel in 10.5 L and 12.5 L engines is delivered by 6 (one for each cylinder) electronic unit injectors (EUIs). The EUIs are mounted in the cylinder head, under the valve cover, so that they spray directly into the center of the cylinder bore. Each EUI is an injection pump and injector combined, operating at much higher pressures than standard in-line or rotary injection pumps. The ECU controls the start of injection and the amount of fuel injected by turning the solenoid in the EUI valve housing on and off which in turn opens and closes the EUI spill valve.
- Power is supplied to the EUIs for cylinders 1, 2, and 3 by a common wire, and to the EUIs for cylinders 4, 5, and 6 by a different common wire. The ECU energizes and de-energizes the solenoids of individual EUIs by closing and opening the individual EUI ground circuits.
- If Engine 034 and 036 are set along with 035, there is a problem in the wiring supplying power to cylinders 4, 5, and 6 EUIs.

Engine 035 will set if:

- The ECU detects an open or a short in the cylinder number 5 EUI circuitry.

If Engine 035 sets, the following will occur:

- With Engine 035 active, the ECU doesn't control the system any differently. Depending on the cause of code 035, cylinder number 5 may not be firing; engine may have a miss, or a dead short.
- If Engine 034 and 036 are set along with code 035, the ECU will NOT turn cylinders 4, 5, and 6 EUIs ON; the engine will be running on cylinders 1, 2, and 3 only.

RG,RG34710,1589 –19–30SEP97–1/1

Engine 035 — Cylinder 5 EUI Fault

The ECU detects an open or a short in the cylinder number 5 EUI circuitry.

OUO1004,0000C64 –19–05JAN01–1/1

Engine 035 Cylinder 5 EUI Fault Diagnostic Procedure

NOTE: Before using this diagnostic procedure, perform a preliminary inspection of the ECU/Engine connector (black inside) and the EUI harness connector (located at the back of the cylinder head) looking for dirty, damaged, or poorly positioned terminals.

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❶ **Engine 035 Intermittent Fault Test**	*NOTE: For wiring, theory of operation, and connector location information, see ENGINE 035 CYLINDER 5 EUI FAULT supporting information.* 1. Ignition ON, engine OFF 2. Using the DST, monitor DTCs on the active code display parameter. 3. Make note of all DTCs, then clear all DTCs 4. Ignition ON, engine running 5. Using the DST, monitor DTCs on the active code display parameter	**Engine 035 reoccurs:** GO TO ❷ **Engine 035 cleared:** Problem is intermittent. If no other codes are present, see INTERMITTENT FAULT DIAGNOSTICS, earlier in this group. – – –1/1

❷ **Cyl 5 EUI Wiring Open in Vehicle Harness Test**	*NOTE: For wiring, theory of operation, and connector location information, see ENGINE 035 CYLINDER 5 EUI FAULT supporting information.* 1. Ignition OFF **CAUTION: Possible strong electrical shock hazard if engine is cranking or running** 2. Disconnect the EUI wiring harness connector and the ECU/Engine connector (inside the harness end of connector is black) 3. Measure resistance between terminal B in the harness end of the EUI wiring harness connector and terminal 8 in the harness end of the ECU connector 4. Measure resistance between terminal F in the harness end of the EUI wiring harness connector and terminal 3 in the harness end of the ECU connector	**Both measurements 5.0 ohms or less:** GO TO ❸ **B to 8 greater than 5.0 ohms:** Open in cylinder 5 EUI control circuit in vehicle harness **F to 3 greater than 5.0 ohms:** Open in cylinders 4, 5, and 6 EUI 90 V supply in vehicle harness – – –1/1

❸ **Cyl 5 EUI Wiring Short-to-Ground in Vehicle Harness Test**	*NOTE: For wiring, theory of operation, and connector location information, see ENGINE 035 CYLINDER 5 EUI FAULT supporting information.* 1. Ignition OFF **CAUTION: Possible strong electrical shock hazard if engine is cranking or running** 2. ECU/Engine and EUI wiring harness connectors still disconnected 3. Measure resistance between terminal B in the harness end of the EUI wiring harness connector and a good ground 4. Measure resistance between terminal F in the harness end of the EUI wiring harness connector and a good ground	**Both measurements greater than 20,000 ohms:** GO TO ❹ **B to good ground less than 20,000 ohms:** Short to ground in cylinder 5 EUI control circuit in vehicle harness **F to good ground less than 20,000 ohms:** Short to ground in cylinder 4, 5, and 6 EUI 90 V supply circuit in vehicle harness – – –1/1

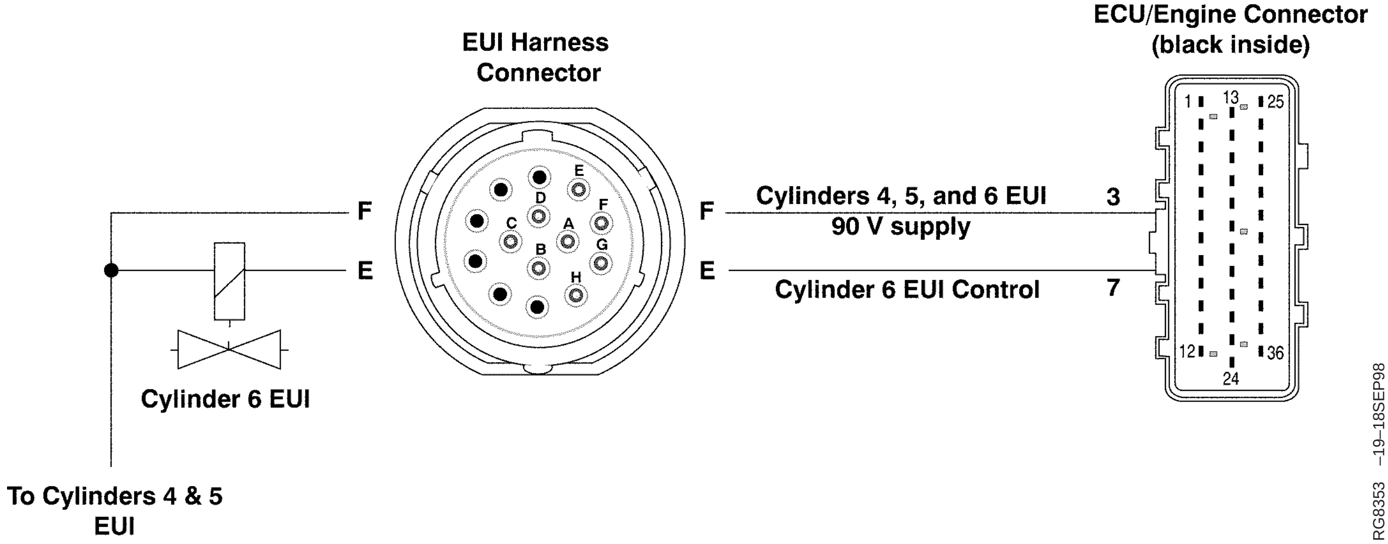
❹ **Cyl 5 EUI Resistance Test**	*NOTE: For wiring, theory of operation, and connector location information, see ENGINE 035 CYLINDER 5 EUI FAULT supporting information.* 1. Ignition OFF **CAUTION: Possible strong electrical shock hazard if engine is cranking or running.** 2. Remove rocker arm cover from engine 3. Disconnect electrical connections to cylinder 5 EUI and to a known good EUI 4. Measure resistance of cylinder 5 EUI, record the resistance 5. Measure resistance of the know good EUI, record the resistance 6. Compare the readings. **Because EUI resistance varies with temperature, a comparison should be used in order to compensate for the affects of temperature on the measured resistance.** The difference between the resistance of cylinder 5 EUI and the known good EUI should be no more than 0.2 ohms. EUI resistance should be 1.0 - 1.8 ohms.	**Resistance within specification:** GO TO ❺ **Resistance NOT within specification:** Faulty cylinder 5 EUI – – –1/1

❺ **Cyl 5 EUI Short-to-Ground Test**	*NOTE: For wiring, theory of operation, and connector location information, see ENGINE 035 CYLINDER 5 EUI FAULT supporting information.* 1. Ignition OFF **CAUTION: Possible strong electrical shock hazard if engine is cranking or running.** 2. Electrical connections to cylinder 5 EUI still disconnected 3. Measure resistance between one terminal on the EUI and the EUI body; then between the other terminal and EUI body	**Both measurements greater than 20,000 ohms:** GO TO ❻ **Either measurement less than 20,000 ohms:** Faulty cylinder 5 EUI – – –1/1

❻ **Cyl 5 EUI Wiring Harness Open Test**	*NOTE: For wiring, theory of operation, and connector location information, see ENGINE 035 CYLINDER 5 EUI FAULT supporting information.* 1. Ignition OFF **CAUTION: Possible strong electrical shock hazard if engine is cranking or running.** 2. With the electrical connections to cylinder 5 EUI still disconnected and the wiring harness still disconnected from EUI wiring harness connector on the cylinder head 3. Measure resistance between one of the cylinder 5 EUI harness eyelets and the corresponding terminal at the EUI harness connector (either F or B, the EUIs are not polarity sensitive) 4. Measure resistance between the other cylinder 5 EUI harness eyelets and the corresponding terminal at the EUI harness connector	**Both measurements 2.0 ohms or less:** GO TO ❼ **Either measurement greater than 2.0 ohms:** Faulty EUI wiring harness – – –1/1

❼ **Cyl 5 EUI Wiring Harness Short-to-Ground Test**	*NOTE: For wiring, theory of operation, and connector location information, see ENGINE 035 CYLINDER 5 EUI FAULT supporting information.* 1. Ignition OFF ⚠ **CAUTION: Possible strong electrical shock hazard if engine is cranking or running.** 2. With the electrical connections to cylinder 5 EUI still disconnected and the wiring harness still disconnected from EUI wiring harness connector on the cylinder head 3. Measure resistance in the engine end of the EUI harness connector between terminal F and a good ground; between terminal B and a good ground	**Both measurements greater than 20,000 ohms:** Faulty EUI harness connector OR Faulty ECU/Engine connector OR Faulty ECU **Either measurement less than 20,000 ohms:** Faulty EUI wiring harness – – –1/1

Engine 036 — Cylinder 6 EUI Fault



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98

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.

EUI (Electronic Unit Injector)

- The fuel in 10.5 L and 12.5 L engines is delivered by 6 (one for each cylinder) electronic unit injectors (EUIs). The EUIs are mounted in the cylinder head, under the valve cover, so that they spray directly into the center of the cylinder bore. Each EUI is an injection pump and injector combined, operating at much higher pressures than standard in-line or rotary injection pumps. The ECU controls the start of injection and the amount of fuel injected by turning the solenoid in the EUI valve housing on and off which in turn opens and closes the EUI spill valve.
- Power is supplied to the EUIs for cylinders 1, 2, and 3 by a common wire, and to the EUIs for cylinders 4, 5, and 6 by a different common wire. The ECU energizes and de-energizes the solenoids of individual EUIs by closing and opening the individual EUI ground circuits.
- If Engine 034 and 035 are set along with 036, there is a problem in the wiring supplying power to cylinders 4, 5, and 6 EUIs.

Engine 036 will set if:

- The ECU detects an open or a short in the cylinder number 6 EUI circuitry.

If Engine 036 sets, the following will occur:

- With Engine 036 active, the ECU doesn’t control the system any differently. Depending on the cause of code 036, cylinder number 6 may not be firing; engine may have a miss, or a dead short.
- If Engine 034 and 035 are set along with code 036, the ECU will NOT turn cylinders 4, 5, and 6 EUIs ON; the engine will be running on cylinders 1, 2, and 3 only.

RG,RG34710,1590 –19–30SEP97–1/1

Engine 036 — Cylinder 6 EUI Fault

The ECU detects an open or a short in the cylinder number 6 EUI circuitry.

OUO1004,0000C65 –19–05JAN01–1/1

Engine 036 Cylinder 6 EUI Fault Diagnostic Procedure

NOTE: Before using this diagnostic procedure, perform a preliminary inspection of the ECU/Engine connector (black inside) and the EUI harness connector (located at the back of the cylinder head) looking for dirty, damaged, or poorly positioned terminals.

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❶ **Engine 036 Intermittent Fault Test**	*NOTE: For wiring, theory of operation, and connector location information, see ENGINE 036 CYLINDER 6 EUI FAULT supporting information.* 1. Ignition ON, engine OFF 2. Using the DST, monitor DTCs on the active code display parameter. 3. Make note of all DTCs, then clear all DTCs 4. Ignition ON, engine running 5. Using the DST, monitor DTCs on the active code display parameter	**Engine 036 reoccurs:** GO TO ❷ **Engine 036 cleared:** Problem is intermittent. If no other codes are present, see INTERMITTENT FAULT DIAGNOSTICS, earlier in this group. – – –1/1

❷ **Cyl 6 EUI Wiring Open in Vehicle Harness Test**	*NOTE: For wiring, theory of operation, and connector location information, see ENGINE 036 CYLINDER 6 EUI FAULT supporting information.* 1. Ignition OFF **CAUTION: Possible strong electrical shock hazard if engine is cranking or running** 2. Disconnect the EUI wiring harness connector and the ECU/Engine connector (inside the harness end of connector is black) 3. Measure resistance between terminal E in the harness end of the EUI wiring harness connector and terminal 7 in the harness end of the ECU connector 4. Measure resistance between terminal F in the harness end of the EUI wiring harness connector and terminal 3 in the harness end of the ECU connector	**Both measurements 5.0 ohms or less:** GO TO ❸ **E to 7 greater than 5.0 ohms:** Open in cylinder 6 EUI control circuit in vehicle harness **F to 3 greater than 5.0 ohms:** Open in cylinders 4, 5, and 6 EUI 90 V supply in vehicle harness – – –1/1

❸ **Cyl 6 EUI Wiring Short-to-Ground in Vehicle Harness Test**	*NOTE: For wiring, theory of operation, and connector location information, see ENGINE 036 CYLINDER 6 EUI FAULT supporting information.* 1. Ignition OFF **CAUTION: Possible strong electrical shock hazard if engine is cranking or running** 2. ECU/Engine and EUI wiring harness connectors still disconnected 3. Measure resistance between terminal E in the harness end of the EUI wiring harness connector and a good ground 4. Measure resistance between terminal F in the harness end of the EUI wiring harness connector and a good ground	**Both measurements greater than 20,000 ohms:** GO TO ❹ **E to good ground less than 20,000 ohms:** Short to ground in cylinder 6 EUI control circuit in vehicle harness **F to good ground less than 20,000 ohms:** Short to ground in cylinder 4, 5, and 6 EUI 90 V supply circuit in vehicle harness – – –1/1

❹ **Cyl 6 EUI Resistance Test**	*NOTE: For wiring, theory of operation, and connector location information, see ENGINE 036 CYLINDER 6 EUI FAULT supporting information.* 1. Ignition OFF **CAUTION: Possible strong electrical shock hazard if engine is cranking or running.** 2. Remove rocker arm cover from engine 3. Disconnect electrical connections to cylinder 6 EUI and to a known good EUI 4. Measure resistance of cylinder 6 EUI, record the resistance 5. Measure resistance of the know good EUI, record the resistance 6. Compare the readings. **Because EUI resistance varies with temperature, a comparison should be used in order to compensate for the affects of temperature on the measured resistance.** The difference between the resistance of cylinder 6 EUI and the known good EUI should be no more than 0.2 ohms. EUI resistance should be 1.0 - 1.8 ohms.	**Resistance within specification:** GO TO ❺ **Resistance NOT within specification:** Faulty cylinder 6 EUI – – –1/1

❺ **Cyl 6 EUI Short-to-Ground Test**	*NOTE: For wiring, theory of operation, and connector location information, see ENGINE 036 CYLINDER 6 EUI FAULT supporting information.* 1. Ignition OFF **CAUTION: Possible strong electrical shock hazard if engine is cranking or running.** 2. Electrical connections to cylinder 6 EUI still disconnected 3. Measure resistance between one terminal on the EUI and the EUI body; then between the other terminal and EUI body	**Both measurements greater than 20,000 ohms:** GO TO ❻ **Either measurement less than 20,000 ohms:** Faulty cylinder 6 EUI – – –1/1

❻ **Cyl 6 EUI Wiring Harness Open Test**	*NOTE: For wiring, theory of operation, and connector location information, see ENGINE 036 CYLINDER 6 EUI FAULT supporting information.* 1. Ignition OFF **CAUTION: Possible strong electrical shock hazard if engine is cranking or running.** 2. With the electrical connections to cylinder 6 EUI still disconnected and the wiring harness still disconnected from EUI wiring harness connector on the cylinder head 3. Measure resistance between one of the cylinder 6 EUI harness eyelets and the corresponding terminal at the EUI harness connector (either F or E, the EUIs are not polarity sensitive) 4. Measure resistance between the other cylinder 6 EUI harness eyelets and the corresponding terminal at the EUI harness connector	**Both measurements 2.0 ohms or less:** GO TO ❼ **Either measurement greater than 2.0 ohms:** Faulty EUI wiring harness – – –1/1

❼ **Cyl 6 EUI Wiring Harness Short-to-Ground Test**	*NOTE: For wiring, theory of operation, and connector location information, see ENGINE 036 CYLINDER 6 EUI FAULT supporting information.* 1. Ignition OFF ⚠ **CAUTION: Possible strong electrical shock hazard if engine is cranking or running.** 2. With the electrical connections to cylinder 6 EUI still disconnected and the wiring harness still disconnected from EUI wiring harness connector on the cylinder head 3. Measure resistance in the engine end of the EUI harness connector between terminal F and a good ground; between terminal E and a good ground	**Both measurements greater than 20,000 ohms:** Faulty EUI harness connector OR Faulty ECU/Engine connector OR Faulty ECU **Either measurement less than 20,000 ohms:** Faulty EUI wiring harness – – –1/1

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160
,102

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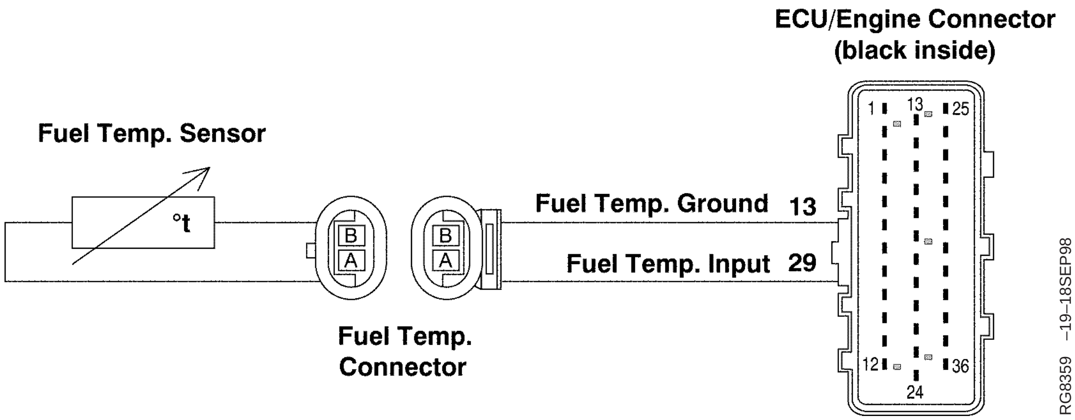
Engine 037 — Fuel Temperature Input Voltage Too High



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.

Fuel Temperature Sensor

- The fuel temperature sensor is a thermistor (temperature sensitive resistor) located on the fuel manifold. It is used to measure the fuel temperature. The fuel temperature sensor's variable resistance causes the input voltage to the ECU to vary. Higher fuel temperatures result in lower fuel temperature input voltages to the ECU; lower temperatures result in higher voltages. The ECU uses the fuel temperature sensor input to adjust the fuel delivery for variations in fuel density caused by varying fuel temperatures. For further fuel temperature sensor information, see MEASURING TEMPERATURE in Section 03, Group 140 of this manual.

Engine 037 will set if:

- The fuel temperature input voltage exceeds 4.93 volts.

If Engine 037 sets, the following will occur:

- Engine power will be slightly derated.
- The ECU will use a default “limp-home” fuel temperature value of approximately -20°C (-4°F) during cranking, and approximately 100°C (212°F) during running.

RG,RG34710,1591 –19–15DEC00–1/1

Engine 037 — Fuel Temperature Input Voltage Too High

The fuel temperature input voltage exceeds specification.

OUO1004,0000C66 –19–05JAN01–1/1

Engine 037 Fuel Temperature Input Voltage Too High Diagnostic Procedure

NOTE: Before using this diagnostic procedure, perform a preliminary inspection of the ECU/Engine connector (black inside) and the fuel temperature sensor connector looking for dirty, damaged, or poorly positioned terminals.

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❶ **Engine 037 Intermittent Fault Test**	*NOTE: For wiring, theory of operation, and sensor location information, see ENGINE 037 FUEL TEMPERATURE INPUT VOLTAGE TOO HIGH supporting information.* 1. Warm engine 2. Ignition ON, engine OFF or running 3. Using the DST, read the fuel temperature voltage parameter *NOTE: If the DST is not available, connect the BOB to the ECU/Cab connector (red inside). Using a multimeter, measure voltage between pins 29 (+) and 13 (—).*	**4.93 V or greater:** GO TO ❷ **Below 4.93 V:** Problem is intermittent. If no other codes are present, see INTERMITTENT FAULT DIAGNOSTICS, earlier in this group.

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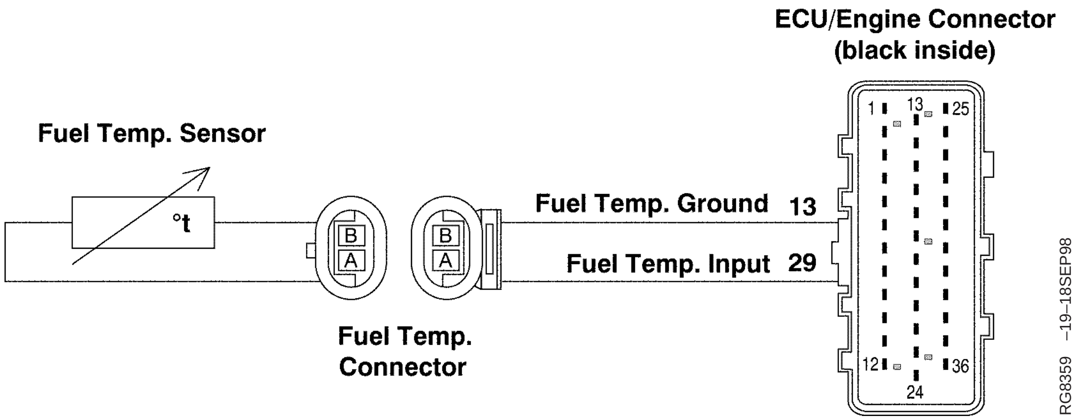
❷ **Fuel Temperature Wiring Open Test**	*NOTE: For wiring, theory of operation, and sensor location information, see ENGINE 037 FUEL TEMPERATURE INPUT VOLTAGE TOO HIGH supporting information.* 1. Ignition OFF 2. Disconnect fuel temp sensor connector 3. Install a jumper wire between terminals A and B in the fuel temp sensor harness connector 4. Ignition ON, engine OFF 5. Using the DST, read the fuel temperature voltage parameter *NOTE: If the DST is not available, connect the BOB to the ECU/Cab connector (red inside). Using a multimeter, measure voltage between pins 29 (+) and 13 (—).*	**Above 0.1 V:** GO TO ❸ **0.1 V or less:** Faulty fuel temp sensor connector OR Faulty fuel temp sensor

– – –1/1

❸ **Fuel Temperature Ground Circuit Open Test**	*NOTE: For wiring, theory of operation, and sensor location information, see ENGINE 037 FUEL TEMPERATURE INPUT VOLTAGE TOO HIGH supporting information.* 1. Remove jumper wire between terminals A and B 2. Install a jumper wire between fuel temp input (terminal A) in harness connector and a good chassis ground 3. Using the DST, read the fuel temperature voltage parameter *NOTE: If the DST is not available, connect the BOB to the ECU/Cab connector (red inside). Using a multimeter, measure voltage between pins 29 (+) and 13 (—).*	**Above 0.1 V:** Open in fuel temp input circuit OR Faulty ECU connection OR Faulty ECU **0.1 V or less:** Open in fuel temp ground circuit OR Faulty ECU connection OR Faulty ECU – – –1/1

Engine 038 — Fuel Temperature Input Voltage Too Low



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.

Fuel Temperature Sensor

- The fuel temperature sensor is a thermistor (temperature sensitive resistor) located on the fuel manifold. It is used to measure the fuel temperature. The fuel temperature sensor's variable resistance causes the input voltage to the ECU to vary. Higher fuel temperatures result in lower fuel temperature input voltages to the ECU; lower temperatures result in higher voltages. The ECU uses the fuel temperature sensor input to adjust the fuel delivery for variations in fuel density caused by varying fuel temperatures. For further fuel temperature sensor information, see MEASURING TEMPERATURE in Section 03, Group 140 of this manual.

Engine 038 will set if:

- The fuel temperature input voltage drops below 0.08 volts.

If Engine 038 sets, the following will occur:

- The ECU will use a default "limp-home" fuel temp value of approximately -20°C (-4°F) during cranking, and approximately 100°C (212°F) during running.
- Engine power will be slightly derated.

RG,RG34710,1592 –19–15DEC00–1/1

Engine 038 — Fuel Temperature Input Voltage Too Low

The fuel temperature input voltage drops below specification.

OUO1004,0000C67 –19–05JAN01–1/1

Engine 038 Fuel Temperature Input Voltage Too Low Diagnostic Procedure

NOTE: Before using this diagnostic procedure, perform a preliminary inspection of the ECU/Engine connector (black inside) and the fuel temperature sensor connector looking for dirty, damaged, or poorly positioned terminals.

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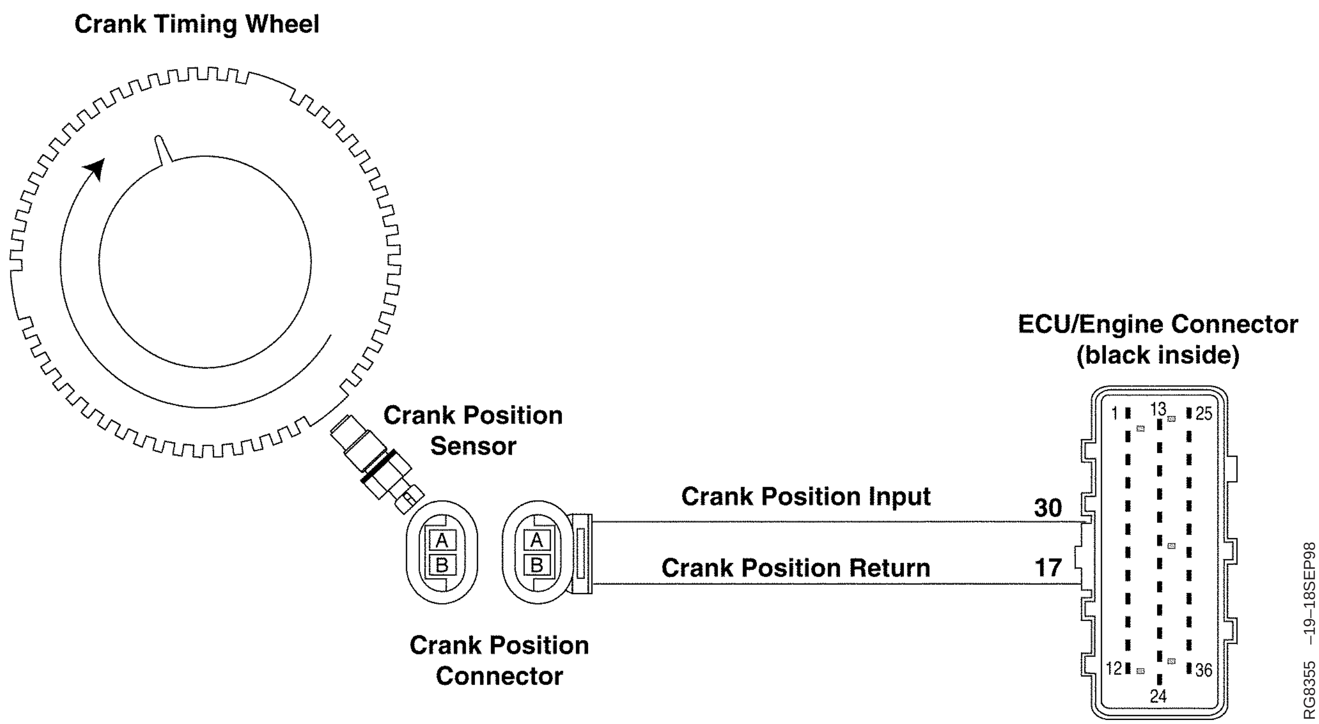
❶ **Engine 038 Intermittent Fault Test**	*NOTE: For wiring, theory of operation, and sensor location information, see ENGINE 038 FUEL TEMPERATURE INPUT VOLTAGE TOO LOW supporting information.* 1. Warm engine 2. Ignition ON, engine OFF or running 3. Using the DST, read the fuel temperature voltage parameter *NOTE: If the DST is not available, connect the BOB to the ECU/Cab connector (red inside). Using a multimeter, measure voltage between pins 29 (+) and 13 (—).*	**0.1 V or less:** GO TO ❷ **Above 0.1 V:** Problem is intermittent. If no other codes are present, see INTERMITTENT FAULT DIAGNOSTICS, earlier in this group. – – –1/1

❷ **Fuel Temperature Input Circuit Grounded Test**	*NOTE: For wiring, theory of operation, and sensor location information, see ENGINE 038 FUEL TEMPERATURE INPUT VOLTAGE TOO LOW supporting information.* 1. Ignition OFF 2. Disconnect fuel temperature sensor connector 3. Ignition ON 4. Using the DST, read the fuel temperature voltage parameter *NOTE: If the DST is not available, connect the BOB to the ECU/Cab connector (red inside). Using a multimeter, measure voltage between pins 29 (+) and 13 (—).*	**Below 4.9 V:** Short to ground in fuel temperature input circuit OR Faulty ECU **4.9 V or greater:** Faulty fuel temperature sensor – – –1/1

Engine 041 — Crank Position Input Missing



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.

Crank Position Sensor

- The crank position sensor is an inductive type pickup sensor that detects notches on the crank timing wheel. The ECU uses the crank position input to determine engine speed and precise piston position in relation to TDC. The ECU monitors the cam position sensor input to determine piston position in relation to the firing order. Based on information from the crank and cam position sensors, the ECU calculates the correct start of injection and amount of fuel to inject, then commands the EUIs accordingly. For further crank position sensor information, see DETERMINING ENGINE SPEED AND PISTON POSITION in Section 03, Group 140.

Engine 041 will set if:

- The ECU does not receive a crank position input on terminal 30 of the engine harness connector.

If Engine 041 sets, the following will occur:

- If Engine 043 occurs with code 041, the engine will die and won’t restart until at least one of the two codes is repaired.
- ECU will use only the cam position sensor input to determine piston position.
- The moment the trouble code sets, the engine may hesitate, or it may die but will re-start.
- Engine power output will be significantly reduced.
- Longer cold temperature cranking times will occur.

RG,RG34710,1593 –19–30SEP97–1/1

Engine 041 — Crank Position Input Missing

The ECU does not receive a crank position input.

OUO1004,0000C68 –19–05JAN01–1/1

Engine 041 Crank Position Input Missing Diagnostic Procedure

NOTE: Before using this diagnostic procedure, perform a preliminary inspection of the ECU/Engine connector (black inside) and the crank position sensor connector looking for dirty, damaged, or poorly positioned terminals.

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❶ **Engine 041 Intermittent Fault Test**	*NOTE: For wiring, theory of operation, and sensor location information, see ENGINE 041 CRANK POSITION INPUT MISSING supporting information.* 1. Ignition ON, engine OFF 2. Using the DST, monitor DTCs on the active code display parameter. 3. Make note of all DTCs, then clear all DTCs 4. Ignition ON, engine running 5. Using the DST, monitor DTCs on the active code display parameter	**Engine 041 reoccurs:** GO TO ❷ **Engine 041 cleared:** Problem is intermittent. If no other codes are present, see INTERMITTENT FAULT DIAGNOSTICS, earlier in this group.

– – –1/1

❷ **Crank Position Sensor Resistance Test**	*NOTE: For wiring, theory of operation, and sensor location information, see ENGINE 041 CRANK POSITION INPUT MISSING supporting information.* 1. Ignition OFF 2. Disconnect crank position sensor connector 3. Measure resistance of the crank position sensor	**Between 2500 and 3500 ohms:** GO TO ❸ **Below 2500 or greater than 3500 ohms:** Faulty crank position sensor

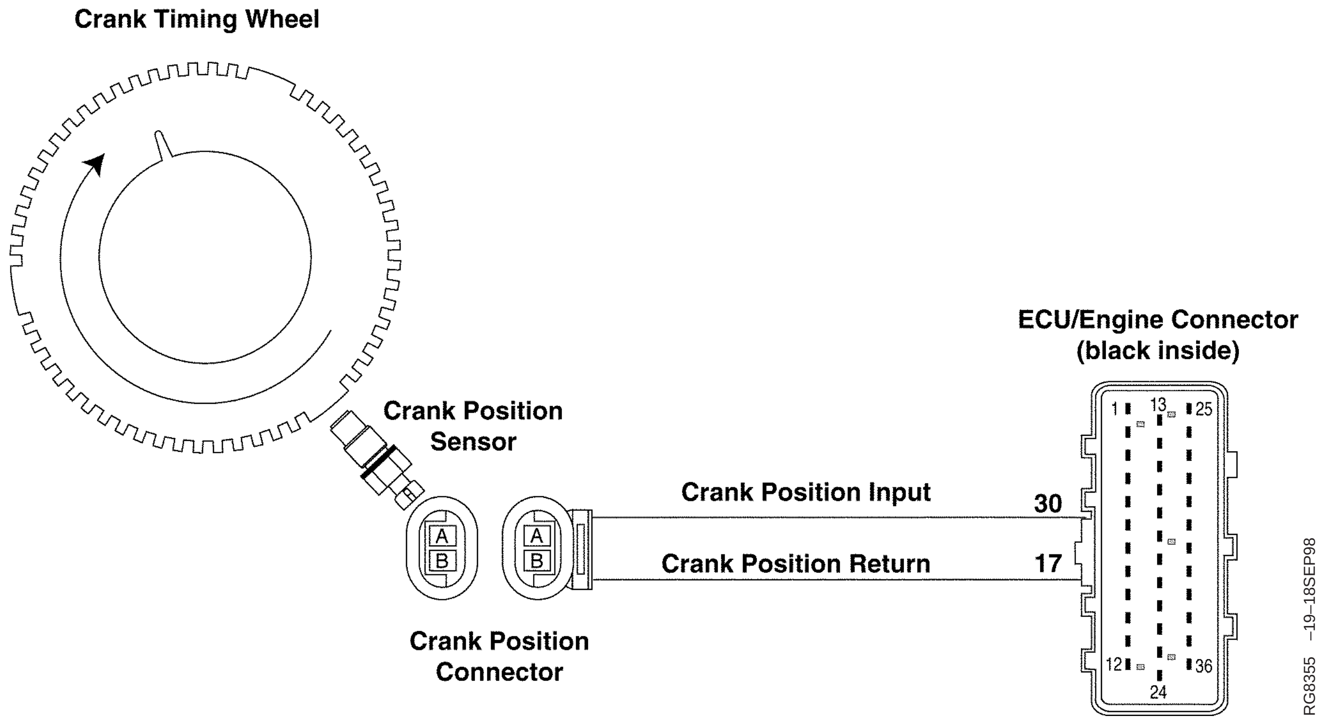
– – –1/1

❸ **Crank Position Wiring Open Test**	*NOTE: For wiring, theory of operation, and sensor location information, see ENGINE 041 CRANK POSITION INPUT MISSING supporting information.* 1. Ignition OFF 2. With the crank position sensor still disconnected, also disconnect the ECU/Engine connector (connector black on the inside) 3. Measure resistance between crank position sensor harness connector terminal A and ECU/Engine connector terminal 30 4. Measure resistance between crank position sensor harness connector terminal B and ECU/Engine connector terminal 17	**Both measurements 5.0 ohms or less:** GO TO ❹ **A to 30 greater than 5.0 ohms:** Open in crank position input circuit **B to 17 greater than 5.0 ohms:** Open in crank position ground circuit – – –1/1

❹ **Crank Position Wiring Short To Ground Test**	*NOTE: For wiring, theory of operation, and sensor location information, see ENGINE 041 CRANK POSITION INPUT MISSING supporting information.* 1. Ignition OFF 2. Measure resistance between ECU/Engine connector terminal 30 and a good ground; between terminal 17 and a good ground	**Both measurements greater than 2000 ohms:** GO TO ❺ **Either measurement less than 2000 ohms:** Short to ground in crank position input circuit OR Short to ground in crank position ground circuit – – –1/1

❺ **Crank Position Wiring Shorted Test**	*NOTE: For wiring, theory of operation, and sensor location information, see ENGINE 041 CRANK POSITION INPUT MISSING supporting information.* 1. Ignition OFF 2. Measure resistance between ECU/Engine connector terminal 30 and all other terminals 3. Measure resistance between ECU/Engine connector terminal 17 and all other terminals	**All measurements greater than 2000 ohms:** Damaged or incorrectly installed crank position sensor OR Faulty ECU **Any measurement less than 2000 ohms:** Faulty crank position wiring in ECU/engine wiring harness – – –1/1

Engine 042 — Crank Position Input Out of Sync



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.

Crank Position Sensor

- The crank position sensor is an inductive type pickup sensor that detects notches on the crank timing wheel. The ECU uses the crank position input to determine engine speed and precise piston position in relation to TDC. The ECU monitors the cam position sensor input to determine piston position in relation to the firing order. Based on information from the crank and cam position sensors, the ECU calculates the correct start of injection and amount of fuel to inject, then commands the EUIs accordingly. A known relationship between the cam position sensor signal and the crank position sensor signal allows the ECU to recognize when one signal is not in sync with the other. For further crank position sensor information, see DETERMINING ENGINE SPEED AND PISTON POSITION in Section 03, Group 140.

Engine 042 will set if:

- The ECU determines that the crank position input is out of sync with the cam position input.

If Engine 042 sets, the following will occur:

- ECU will use only the cam position sensor input to determine piston position.
- The moment the trouble code sets, the engine may hesitate, or it may die but will re-start.
- Engine power output will be significantly reduced.
- Longer cold temperature cranking times will occur.

RG,RG34710,1594 –19–30SEP97–1/1

Engine 042 — Crank Position Input Out of Sync

The ECU determines that the crank position input is out of sync with the cam position input.

OUO1004,0000C69 –19–05JAN01–1/1

Engine 042 Crank Position Input Out of Sync Diagnostic Procedure

NOTE: Before using this diagnostic procedure, perform a preliminary inspection of the ECU/Engine connector (black inside) and the crank position sensor connector looking for dirty, damaged, or poorly positioned terminals.

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❶ **Engine 042 Intermittent Fault Test**	*NOTE: For wiring, theory of operation, and sensor location information, see ENGINE 042 CRANK POSITION INPUT OUT OF SYNC supporting information.* 1. Ignition ON, engine OFF 2. Using the DST, monitor DTCs on the active code display parameter. 3. Make note of all DTCs, then clear all DTCs 4. Ignition ON, engine running 5. Using the DST, monitor DTCs on the active code display parameter	**Engine 042 reoccurs:** GO TO ❷ **Engine 042 cleared:** Problem is intermittent. If no other codes are present, see INTERMITTENT FAULT DIAGNOSTICS, earlier in this group.

– – –1/1

❷ **Cam/Crank Timing Check**	*NOTE: For wiring, theory of operation, and sensor location information, see ENGINE 042 CRANK POSITION INPUT OUT OF SYNC supporting information.* 1. Ignition OFF 2. Remove rocker arm cover by loosening three hold-down cap screws 3. Remove two outside cap screws with isolators, and screw into hole on isolator seat. This will allow the screws and isolators to be used as handles to lift rocker arm cover off. 4. Lift rocker arm cover off engine *NOTE: Rocker arm cover gasket is reusable if no visible damage is detected. Do not store cover resting on gasket surface* 5. Remove plug from cylinder block and install JDG820 Flywheel Turning Tool 6. Remove threaded plug from timing hole below oil cooler and filter housing assembly 7. Rotate engine flywheel in running direction until JDG971 Timing Pin engages slot in camshaft 8. Slightly move engine flywheel back and forth with turning tool while attempting to engage a second JDG971 Timing Pin in crankshaft slot	**Crank timing pin engages in slot:** GO TO ❸ **Crank timing pin won't engage slot:** Cam and crank out of time Perform cam and crank timing procedure. See CHECK AND ADJUST CAMSHAFT- TO-CRANKSHAFT TIMING in Section 02, Group 050 of CTM100 – – –1/1

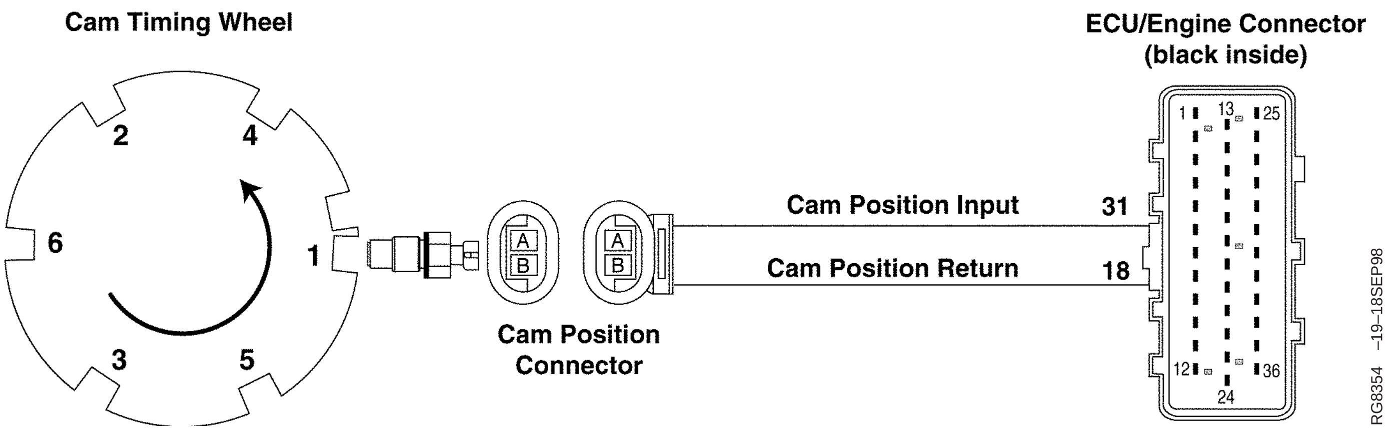
❸ **Crank Position Sensor Resistance Test**	*NOTE: For wiring, theory of operation, and sensor location information, see ENGINE 042 CRANK POSITION INPUT OUT OF SYNC supporting information.* 1. Ignition OFF 2. Remove cam and crank timing pins 3. Disconnect crank position sensor connector 4. Measure resistance of the crank position sensor	**Between 2500 and 3500 ohms:** GO TO ❹ **Below 2500 or greater than 3500 ohms:** Faulty crank position sensor – – –1/1

❹ **Crank Position Wiring Open Test**	*NOTE: For wiring, theory of operation, and sensor location information, see ENGINE 042 CRANK POSITION INPUT OUT OF SYNC supporting information.* 1. Ignition OFF 2. With the crank position sensor still disconnected, also disconnect the ECU/Engine connector (connector black on the inside) 3. Measure resistance between crank position sensor harness connector terminal A and ECU/Engine connector terminal 30 4. Measure resistance between crank position sensor harness connector terminal B and ECU/Engine connector terminal 17	**Both measurements 5.0 ohms or less:** GO TO ❺ **A to 30 greater than 5.0 ohms:** Open in crank position input circuit **B to 17 greater than 5.0 ohms:** Open in crank position ground circuit – – –1/1

❺ **Crank Position Wiring Short To Ground Test**	*NOTE: For wiring, theory of operation, and sensor location information, see ENGINE 042 CRANK POSITION INPUT OUT OF SYNC supporting information.* 1. Ignition OFF 2. Measure resistance between ECU/Engine connector terminal 30 and a good ground; between terminal 17 and a good ground	**Both measurements greater than 2000 ohms:** GO TO ❻ **Either measurement less than 2000 ohms:** Short to ground in crank position input circuit OR Short to ground in crank position ground circuit – – –1/1

❻ **Crank Position Wiring Shorted Test**	*NOTE: For wiring, theory of operation, and sensor location information, see ENGINE 042 CRANK POSITION INPUT OUT OF SYNC supporting information.* 1. Ignition OFF 2. Measure resistance between ECU/Engine connector terminal 30 and all other terminals 3. Measure resistance between ECU/Engine connector terminal 17 and all other terminals	**All measurements greater than 2000 ohms:** Damaged or incorrectly installed crank position sensor OR Damaged crank timing wheel OR Faulty ECU **Any measurement less than 2000 ohms:** Faulty crank position wiring in ECU/Engine wiring harness – – –1/1

Engine 043 — Cam Position Input Missing



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.

Camshaft Position Sensor

- The cam position sensor is an inductive type pickup sensor that detects 7 notches on the camshaft timing wheel. 6 of the 7 notches correspond to a cylinder; the 7th notch allows the ECU to identify cylinder number 1. Using the cam position input, the ECU is able to determine when a cylinder is at the end of the compression stroke. The ECU uses the crank position input to determine engine speed and precise piston position in relation to TDC. Based on this information, the ECU calculates the correct start of injection and amount of fuel to inject, then commands the EUIs accordingly. For further cam position sensor information, see DETERMINING ENGINE SPEED AND PISTON POSITION in Section 03, Group 140.

Engine 043 will set if:

- The ECU does not receive a cam position input on terminal 31 of the engine harness connector.

If Engine 043 sets, the following will occur:

- If Engine 041 occurs with code 043, the engine will die and won’t restart until at least one of the two codes is repaired.
- ECU will use only the crank position sensor input to determine piston position.
- The moment the trouble code sets, the engine may hesitate, or it may die but will re-start.
- Prolonged cranking time will be required.

RG,RG34710,1595 –19–30SEP97–1/1

Engine 043 — Cam Position Input Missing

The ECU does not receive a cam position input.

OUO1004,0000C6A –19–05JAN01–1/1

Engine 043 Cam Position Input Missing Diagnostic Procedure

NOTE: Before using this diagnostic procedure, perform a preliminary inspection of the ECU/Engine connector (black inside) and the cam position sensor connector looking for dirty, damaged, or poorly positioned terminals.

– – –1/1

❶ **Engine 043 Intermittent Fault Test**	*NOTE: For wiring, theory of operation, and sensor location information, see ENGINE 043 CAM POSITION INPUT MISSING supporting information.* 1. Ignition ON, engine OFF 2. Using the DST, monitor DTCs on the active code display parameter. 3. Make note of any DTCs, then clear all DTCs 4. Ignition ON, engine running 5. Using the DST, monitor DTCs on the active code display parameter	**Engine 043 reoccurs:** GO TO ❷ **Engine 043 cleared:** Problem is intermittent. If no other codes are present, see INTERMITTENT FAULT DIAGNOSTICS, earlier in this group.

– – –1/1

❷ **Cam Position Sensor Resistance Test**	*NOTE: For wiring, theory of operation, and sensor location information, see ENGINE 043 CAM POSITION INPUT MISSING supporting information.* 1. Ignition OFF 2. Disconnect cam position sensor connector 3. Measure resistance of the cam position sensor	**Between 2500 and 3500 ohms:** GO TO ❸ **Below 2500 or greater than 3500 ohms:** Faulty cam position sensor

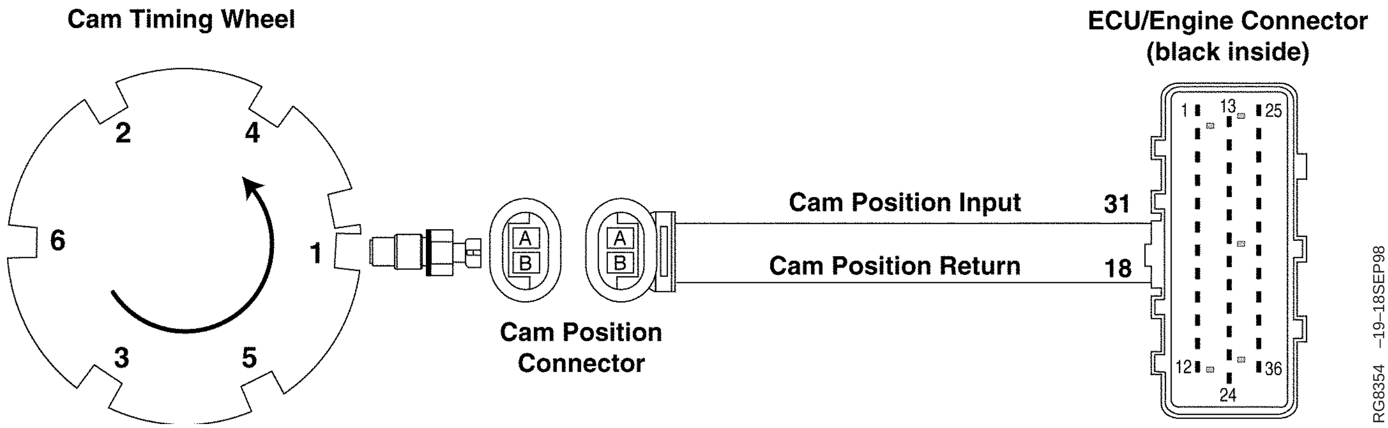
– – –1/1

❸ **Cam Position Wiring Open Test**	*NOTE: For wiring, theory of operation, and sensor location information, see ENGINE 043 CAM POSITION INPUT MISSING supporting information.* 1. Ignition OFF 2. With the cam position sensor still disconnected, also disconnect the ECU/Engine connector (connector black on the inside) 3. Measure resistance between cam position sensor harness connector terminal A and ECU/Engine connector terminal 31 4. Measure resistance between cam position sensor harness connector terminal B and ECU/Engine connector terminal 18	**Both measurements 5.0 ohms or less:** GO TO ❹ **A to 31 greater than 5.0 ohms:** Open in cam position input circuit **B to 18 greater than 5.0 ohms:** Open in cam position ground circuit – – –1/1

❹ **Cam Position Wiring Short To Ground Test**	*NOTE: For wiring, theory of operation, and sensor location information, see ENGINE 043 CAM POSITION INPUT MISSING supporting information.* 1. Ignition OFF 2. Measure resistance between ECU/Engine connector terminal 31 and a good ground; between terminal 18 and a good ground	**Both measurements greater than 2000 ohms:** GO TO ❺ **Either measurement less than 2000 ohms:** Short to ground in cam position input circuit OR Short to ground in cam position ground circuit – – –1/1

❺ **Cam Position Wiring Shorted Test**	*NOTE: For wiring, theory of operation, and sensor location information, see ENGINE 043 CAM POSITION INPUT MISSING supporting information.* 1. Ignition OFF 2. Measure resistance between ECU/Engine connector terminal 31 and all other terminals 3. Measure resistance between ECU/Engine connector terminal 18 and all other terminals	**All measurements greater than 2000 ohms:** Damaged or incorrectly installed cam position sensor OR Faulty ECU **Any measurement less than 2000 ohms:** Faulty cam position wiring in ECU/engine wiring harness – – –1/1

Engine 044 — Cam Position Input Out of Sync



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.

Camshaft Position Sensor

- The cam position sensor is an inductive type pickup sensor that detects 7 notches on the camshaft timing wheel. 6 of the 7 notches correspond to a cylinder; the 7th notch allows the ECU to identify cylinder number 1. Using the cam position input, the ECU is able to determine when a cylinder is at the end of the compression stroke. The ECU uses the crank position input to determine engine speed and precise piston position in relation to TDC. Based on this information, the ECU calculates the correct start of injection and amount of fuel to inject, then commands the EUIs accordingly. A known relationship between the cam position sensor signal and the crank position sensor signal allows the ECU to recognize when one signal is not in sync with the other. For further cam position sensor information, see DETERMINING ENGINE SPEED AND PISTON POSITION in Section 03, Group 140.

Engine 044 will set if:

- The ECU determines that the cam position input is out of sync with the crank position input.

If Engine 044 sets, the following will occur:

- ECU will use only the crank position sensor input to determine piston position.
- The moment the trouble code sets, the engine may hesitate, or it may die but will re-start.
- Longer cold temperature cranking times will occur.

RG,RG34710,1596 –19–30SEP97–1/1

Engine 044 — Cam Position Input Out of Sync

The ECU determines that the cam position input is out of sync with the crank position input.

OUO1004,0000C6B –19–05JAN01–1/1

Engine 044 Cam Position Input Out of Sync Diagnostic Procedure

NOTE: Before using this diagnostic procedure, perform a preliminary inspection of the ECU/Engine connector (black inside) and the cam position sensor connector looking for dirty, damaged, or poorly positioned terminals.

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❶ **Engine 044 Intermittent Fault Test**	*NOTE: For wiring, theory of operation, and sensor location information, see ENGINE 044 CAM POSITION INPUT OUT OF SYNC supporting information.* 1. Ignition ON, engine OFF 2. Using the DST, monitor DTCs on the active code display parameter. 3. Make note of all DTCs, then clear all DTCs 4. Ignition ON, engine running 5. Using the DST, monitor DTCs on the active code display parameter	**Engine 044 reoccurs:** GO TO ❷ **Engine 044 cleared:** Problem is intermittent. If no other codes are present, see INTERMITTENT FAULT DIAGNOSTICS, earlier in this group.

– – –1/1

❷ **Cam/Crank Timing Check**	*NOTE: For wiring, theory of operation, and sensor location information, see ENGINE 044 CAM POSITION INPUT OUT OF SYNC supporting information.* 1. Ignition OFF 2. Remove rocker arm cover by loosening three hold-down cap screws 3. Remove two outside cap screws with isolators, and screw into hole on isolator seat. This will allow the screws and isolators to be used as handles to lift rocker arm cover off. 4. Lift rocker arm cover off engine *NOTE: Rocker arm cover gasket is reusable if no visible damage is detected. Do not store cover resting on gasket surface* 5. Remove plug from cylinder block and install JDG820 Flywheel Turning Tool 6. Remove threaded plug from timing hole below oil cooler and filter housing assembly 7. Rotate engine flywheel in running direction until JDG971 Timing Pin engages slot in camshaft 8. Slightly move engine flywheel back and forth with turning tool while attempting to engage a second JDG971 Timing Pin in crankshaft slot	**Crank timing pin engages in slot:** GO TO ❸ **Crank timing pin won't engage slot:** Cam and crank out of time Perform cam and crank timing procedure. See CHECK AND ADJUST CAMSHAFT- TO- CRANKSHAFT TIMING in Section 02, Group 050 of CTM100 – – –1/1

❸ **Cam Position Sensor/Timing Wheel Inspection**	*NOTE: For wiring, theory of operation, and sensor location information, see ENGINE 044 CAM POSITION INPUT OUT OF SYNC supporting information.* 1. Ignition OFF 2. Remove cam and crank timing pins 3. Inspect cam timing wheel for nicks, burrs, or other damage 4. Remove cam position sensor and inspect for damage or debris on end	**Cam position sensor and timing wheel OK:** GO TO ❹ **Faulty component found:** Repair/replace faulty component and retest – – –1/1

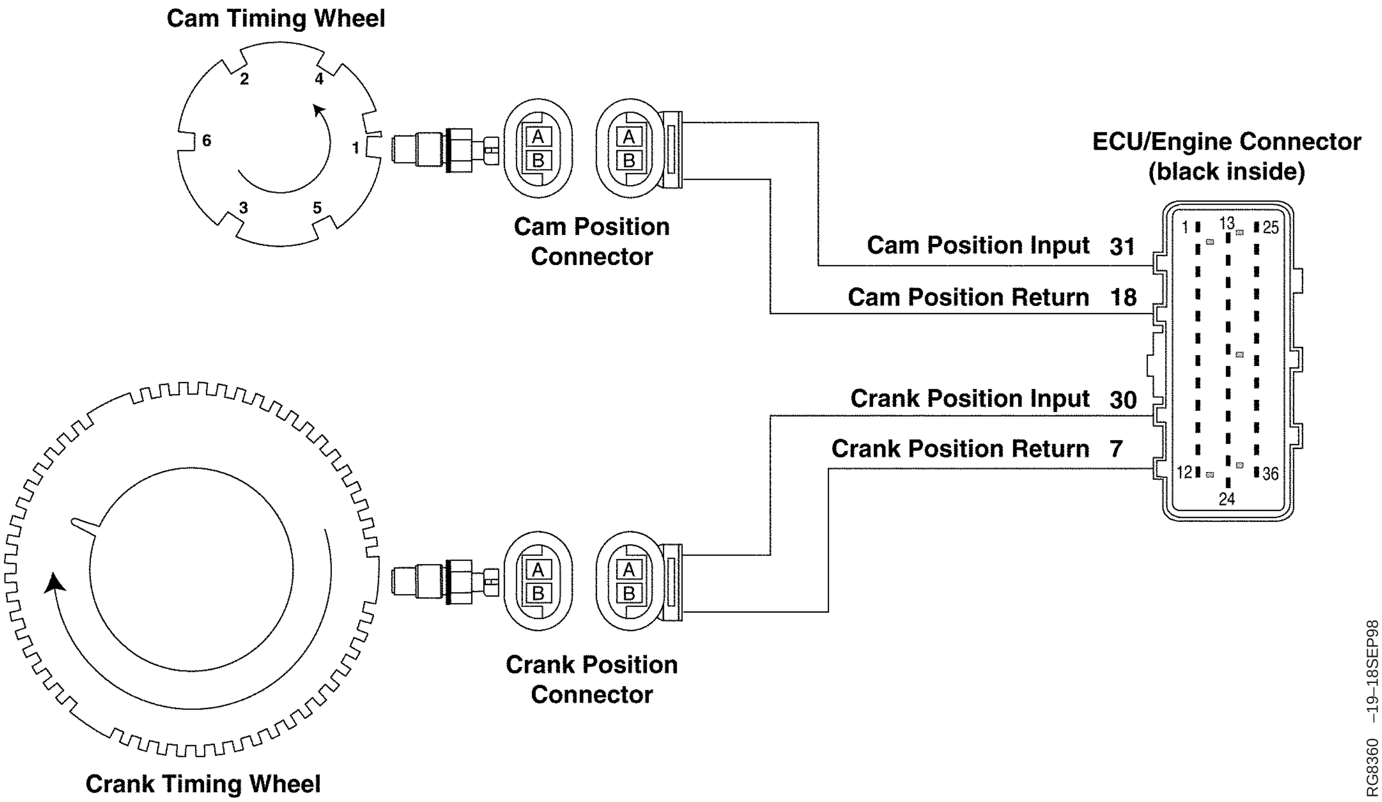
❹ **Cam Position Sensor Resistance Test**	*NOTE: For wiring, theory of operation, and sensor location information, see ENGINE 044 CAM POSITION INPUT OUT OF SYNC supporting information.* 1. Ignition OFF 2. Measure resistance of the cam position sensor	**Between 2500 and 3500 ohms:** GO TO ❺ **Below 2500 or greater than 3500 ohms:** Faulty cam position sensor – – –1/1

❺ **Cam Position Input Wiring Open Test**	*NOTE: For wiring, theory of operation, and sensor location information, see ENGINE 044 CAM POSITION INPUT OUT OF SYNC supporting information.* 1. Ignition OFF 2. With the cam position sensor still disconnected, also disconnect the ECU/Engine connector (connector black on the inside) 3. Measure resistance between cam position sensor harness connector terminal A and ECU/Engine connector terminal 31 4. Measure resistance between cam position sensor harness connector terminal B and ECU/Engine connector terminal 18	**Both measurements 5.0 ohms or less:** GO TO ❻ **A to 31 greater than 5.0 ohms:** Open in cam position input circuit **B to 18 greater than 5.0 ohms:** Open in cam position ground circuit – – –1/1

❻ **Cam Position Wiring Short To Ground Test**	*NOTE: For wiring, theory of operation, and sensor location information, see ENGINE 044 CAM POSITION INPUT OUT OF SYNC supporting information.* 1. Ignition OFF 2. Measure resistance between ECU/Engine connector terminal 31 and a good ground; between terminal 18 and a good ground	**Both measurements greater than 2000 ohms:** GO TO ❼ **Either measurement less than 2000 ohms:** Short to ground in cam position input circuit OR Short to ground in cam position ground circuit – – –1/1

❼ **Cam Position Wiring Shorted Test**	*NOTE: For wiring, theory of operation, and sensor location information, see ENGINE 044 CAM POSITION INPUT OUT OF SYNC supporting information.* 1. Ignition OFF 2. Measure resistance between ECU/Engine connector terminal 31 and all other terminals 3. Measure resistance between ECU/Engine connector terminal 18 and all other terminals	**All measurements greater than 2000 ohms:** Incorrectly installed cam position sensor OR Faulty ECU **Any measurement less than 2000 ohms:** Faulty cam position wiring in ECU/Engine wiring harness – – –1/1

Engine 045 — Cam/Crank Inputs Out of Sync



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.

Camshaft and Crankshaft Position Sensors

- The cam and crank position sensors are both inductive type pickup sensors that detect notches on the cam and crank timing wheels. The ECU uses the crank position input to determine engine speed and precise piston position in relation to TDC. Using the cam position input, the ECU is able to determine when a cylinder is at the end of the compression stroke. Based on this information, the ECU calculates the correct start of injection and amount of fuel to inject, then commands the EUIs accordingly. A known relationship between the cam position sensor signal and the crank position sensor signal allows the ECU to recognize when one signal is not in sync with the other. For further cam and crank position sensor information, see DETERMINING ENGINE SPEED AND PISTON POSITION in Section 03, Group 140.

Engine 045 will set if:

- The ECU detects that the cam and crank inputs are not in sync with each other.

If Engine 045 sets, the following will occur:

- Depending on the cause of the fault, the engine may die, then it may or may not restart.
- If the engine dies and won’t restart it is possible that disconnecting the crank position sensor will allow the engine to start.
- If the engine continues to run, it will develop low power.

RG40854,000006C –19–01FEB01–1/1

Engine 045 — Cam/Crank Inputs Out of Sync

The ECU detects that the cam and crank inputs are not in sync with each other.

RG40854,000006D –19–01FEB01–1/1

Engine 045 Cam/Crank Inputs Out of Sync Diagnostic Procedure

NOTE: Before using this diagnostic procedure, perform a preliminary inspection of the ECU/Engine connector (black inside), the crank position sensor, and the cam position sensor connector looking for dirty, damaged, or poorly positioned terminals.

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❶ **Engine 045 Intermittent Fault Test**	*NOTE: For wiring, theory of operation, and sensor location information, see ENGINE 045 CAM/CRANK INPUTS OUT OF SYNC supporting information.* 1. Ignition ON, engine OFF 2. Using the DST, monitor DTCs on the active code display parameter. 3. Make note of all DTCs, then clear all DTCs 4. Ignition ON, engine running 5. Using the DST, monitor DTCs on the active code display parameter	**Engine 045 reoccurs:** GO TO ❷ **Engine 045 does not reoccur:** Problem is intermittent. If no other codes are present, see INTERMITTENT FAULT DIAGNOSTICS, earlier in this Group.

– – –1/1

❷ **Cam to Crank Timing Test**	*NOTE: For wiring, theory of operation, and sensor location information, see ENGINE 045 CAM/CRANK INPUTS OUT OF SYNC supporting information.* 1. Ignition OFF 2. Remove rocker arm cover *NOTE: Rocker arm cover gasket is reusable if no visible damage is detected. Do not store cover resting on gasket surface.* 3. Perform CHECK AND ADJUST CAMSHAFT- TO- CRANKSHAFT TIMING in CTM100, Section 02, Group 050.	**Crank timing pin engages in slot:** GO TO ❸ **Crank timing pin won't engage in slot:** Cam and crank out of time. Perform CHECK AND ADJUST CAMSHAFT- TO- CRANKSHAFT TIMING in CTM100, Section 02, Group 050.

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❸ **Crank and Cam Timing Wheel and Sensor Test**	*NOTE: For wiring, theory of operation, and sensor location information, see ENGINE 045 CAM/CRANK INPUTS OUT OF SYNC supporting information.* 1. Ignition OFF 2. Remove cam and crank timing pins 3. Inspect crank timing wheel and cam timing wheel for broken teeth, nicks burrs, or other damage 4. Remove cam and crank sensors from cylinder head and timing gear cover 5. Inspect cam and crank position sensors for cracks, debris, or other damage.	**All components OK:** GO TO ❹ **Faulty component found:** Replace faulty component and retest. – – –1/1

❹ **Crankshaft Position Sensor Test**	*NOTE: For wiring, theory of operation, and sensor location information, see ENGINE 045 CAM/CRANK INPUTS OUT OF SYNC supporting information.* 1. Ignition OFF 2. Disconnect crank position sensor connector 3. Using a multimeter, measure resistance between both terminal of the crank position sensor	**Measurement between 2500 and 3500 ohms:** GO TO ❺ **Measurement below 2500 ohms or above 3500 ohms:** Faulty crankshaft position sensor – – –1/1

❺ **Camshaft Position Sensor Test**	*NOTE: For wiring, theory of operation, and sensor location information, see ENGINE 045 CAM/CRANK INPUTS OUT OF SYNC supporting information.* 1. Ignition OFF 2. Disconnect cam position sensor connector 3. Using a multimeter, measure resistance between both terminals of the cam position sensor	**Measurement between 2500 and 3500 ohms:** GO TO ❻ **Measurement below 2500 ohms or above 3500 ohms:** Faulty camshaft position sensor – – –1/1

❻ Open in Crank Position Sensor Input and Return Wire Test	*NOTE: For wiring, theory of operation, and sensor location information, see ENGINE 045 CAM/CRANK INPUTS OUT OF SYNC supporting information.* 1. Ignition OFF 2. Disconnect crank position sensor connector 3. Disconnect ECU/Engine connector (black inside) 4. Using a multimeter, measure resistance between: • Terminal A of the crank position sensor harness connector AND terminal 30 in the harness end of the ECU/Engine connector (black inside). • Terminal B of the crank position sensor harness connector AND terminal 7 in the harness end of the ECU/Engine connector (black inside).	**Both measurements 5 ohms or less:** GO TO ❼ **Either measurement greater than 5 ohms:** Open in crank position sensor input wire OR Open in crank position sensor return wire OR Terminals A and B in the crank position sensor harness connector possibly inverted – – –1/1

❼ Crank Position Sensor Input Wiring Harness Test	*NOTE: For wiring, theory of operation, and sensor location information, see ENGINE 045 CAM/CRANK INPUTS OUT OF SYNC supporting information.* 1. Ignition OFF 2. Crank position sensor connector and ECU/Engine connector (black inside) connector still disconnected 3. Using a multimeter measure resistance between terminal 30 in the harness end of the ECU/Engine connector (black inside) and the following: • A good ground • All other terminals in both ECU connectors	**All measurements greater than 2000 ohms:** GO TO ❽ **Any measurement less than 2000 ohms:** Faulty crank position sensor input wiring harness – – –1/1

❽ Crank Position Sensor Return Wiring Harness Test	*NOTE: For wiring, theory of operation, and sensor location information, see ENGINE 045 CAM/CRANK INPUTS OUT OF SYNC supporting information.* 1. Ignition OFF 2. Crank position sensor connector and ECU/Engine connector (black inside) still disconnected 3. Using a multimeter measure resistance between terminal 7 in the harness end of the ECU/Engine connector (black inside) and the following: • A good ground • All other terminals in both ECU connectors	**All measurements greater than 2000 ohms:** GO TO ❾ **Any measurement less than 2000 ohms:** Faulty crank position sensor return wiring harness – – –1/1

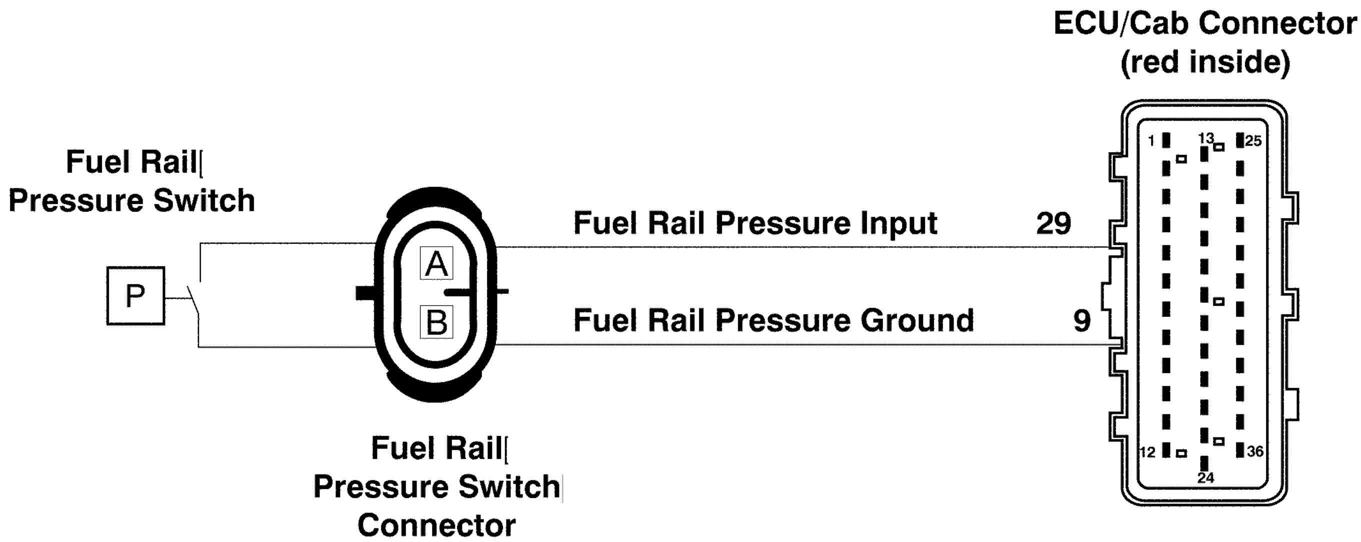
9 Open in Cam Position Input and Return Wire Test	*NOTE: For wiring, theory of operation, and sensor location information, see ENGINE 045 CAM/CRANK INPUTS OUT OF SYNC supporting information.* 1. Ignition OFF 2. Disconnect cam position sensor connector 3. Disconnect ECU/Engine connector (black inside) 4. Using a multimeter, measure resistance between: • Terminal A of the cam position sensor harness connector AND terminal 31 in the harness end of the ECU/Engine connector (black inside) • Terminal B of the cam position sensor harness connector AND terminal 18 in the harness end of the ECU/Engine connector (black inside)	**Both measurements 5 ohms or less:** GO TO 10 **Either measurement greater than 5 ohms:** Open in cam position sensor input wire OR Open in cam position sensor return wire OR Terminals A and B in the cam position sensor harness connector possibly inverted – – –1/1

04
160
,130

10 Cam Position Sensor Input Wiring Harness Test	*NOTE: For wiring, theory of operation, and sensor location information, see ENGINE 045 CAM/CRANK INPUTS OUT OF SYNC supporting information.* 1. Ignition OFF 2. Cam position sensor connector and ECU/Engine connector (black inside) still disconnected 3. Using a multimeter measure resistance between terminal 31 in the harness end of the ECU/Engine connector (black inside)and the following: • A good ground • All other terminals in both ECU connectors	**All measurements greater than 2000 ohms:** GO TO 11 **Any measurement less than 2000 ohms:** Faulty cam position sensor input wiring harness – – –1/1

11 Cam Position Sensor Return Wiring Harness Test	*NOTE: For wiring, theory of operation, and sensor location information, see ENGINE 045 CAM/CRANK INPUTS OUT OF SYNC supporting information.* 1. Ignition OFF 2. Cam position sensor connector and ECU/Engine connector (black inside) still disconnected 3. Using a multimeter measure resistance between terminal 18 in the harness end of the ECU/Engine connector (black inside) and the following: • A good ground • All other terminals in both ECU connectors	**All measurements greater than 2000 ohms:** Faulty crank sensor connector OR Faulty cam sensor connector OR Faulty ECU connector OR Faulty ECU **Any measurement less than 2000 ohms:** Faulty cam position sensor return wiring harness – – –1/1

Engine 050 — Fuel Rail Pressure Switch Fault



RG8447 –19–18SEP98

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.

Fuel Pressure Switch

- The fuel pressure switch is located on the fuel manifold and is used to alert the ECU in the event of low fuel rail pressure. If fuel rail pressure drops too low, the Electronic Unit Injectors (EUIs) could be damaged. Fuel pressure causes the contacts of the fuel pressure switch to close. If fuel pressure drops below 296 kPa (43 psi), the switch will open.

Engine 050 will set if:

- The ECU reads normal pressure with the key ON, engine OFF.

If Engine 050 sets, the following will occur:

- After 14 minutes, engine power will be derated 10%.
- After 20 minutes, engine power will be derated 30%.

RG,RG34710,1598 –19–30SEP97–1/1

Engine 050 — Fuel Rail Pressure Switch Fault

The ECU reads normal pressure with the key ON, engine OFF.

RG40854,0000072 –19–12FEB01–1/1

Engine 050 Fuel Rail Pressure Switch Fault Diagnostic Procedure

NOTE: Before using this diagnostic procedure, perform a preliminary inspection of the ECU/Cab connector (red inside) and the fuel pressure switch connector looking for dirty, damaged, or poorly positioned terminals.

– – –1/1

❶ **Fuel Pressure Check**	*NOTE: For wiring, theory of operation, and sensor location information, see ENGINE 050 FUEL RAIL PRESSURE SWITCH FAULT supporting information.* 1. Ignition ON, engine OFF 2. Using a pressure gauge, measure fuel pressure. See CHECK FUEL SUPPLY PRESSURE in Group 150. 3. If the BOB is available, connect it to the ECU/Cab connector (red inside). Using a multimeter, measure voltage between pins 29 (+) and 9 (—).	**Fuel pressure normal OR there is continuity with BOB:** GO TO ❷ **Fuel pressure low OR there is not continuity with BOB:** Problem is intermittent. If no other codes are present, see INTERMITTENT FAULT DIAGNOSTICS, earlier in this group.

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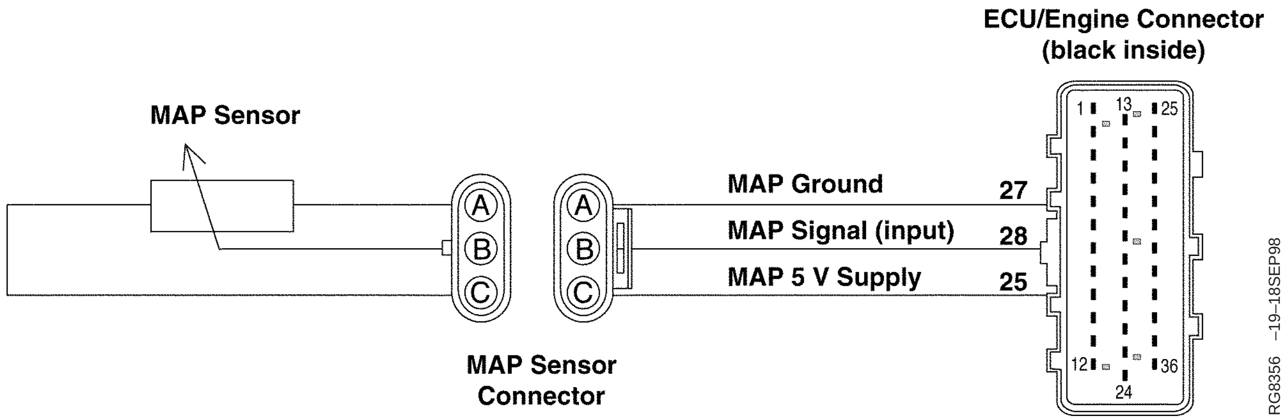
❷ **Fuel Pressure Switch Check**	*NOTE: For wiring, theory of operation, and sensor location information, see ENGINE 050 FUEL RAIL PRESSURE SWITCH FAULT supporting information.* 1. Disconnect fuel pressure switch connector 2. Using a pressure gauge, measure fuel pressure. See CHECK FUEL SUPPLY PRESSURE in Group 150. 3. If the BOB is available, connect it to the ECU/Cab connector (red inside). Using a multimeter, measure voltage between pins 29 (+) and 9 (—).	**Fuel pressure is normal OR there is continuity with BOB:** Faulty ECU connection OR Short to ground in fuel pressure input circuit **Fuel pressure is low OR there is not continuity with BOB:** Faulty fuel pressure switch connector OR Faulty fuel pressure switch

– – –1/1

Engine 052 — MAP Input Voltage Erratic



MAP (Manifold Air Pressure) Sensor

- The MAP sensor is a pressure transducer connected to intake manifold air pressure. It is used to measure the air pressure in the intake manifold. The MAP input voltage varies as intake manifold pressure varies. As pressure increases, input voltage to the ECU increases. The ECU uses the MAP sensor input in conjunction with the MAT sensor input to determine engine air flow. For further MAP sensor information, see MEASURING MANIFOLD AIR PRESSURE in Section 03, Group 140 of this manual.

Engine 052 will set if:

- The MAP input changes more erratically than what can occur under normal operating conditions.

If Engine 052 sets, the following will occur:

- The ECU will use default “limp home” MAP values.
- Engine power will be low.

RG,RG34710,1599 –19–30SEP97–1/1

Engine 052 — MAP Input Voltage Erratic

The MAP input changes more erratically than what can occur under normal operating conditions.

OUO1004,0000C6C –19–05JAN01–1/1

Engine 052 MAP Input Voltage Erratic Diagnostic Procedure

NOTE: Before using this diagnostic procedure, perform a preliminary inspection of the ECU/Engine connector (black inside) and the MAP sensor connector looking for dirty, damaged, or poorly positioned terminals.

– – –1/1

❶ **Check For Engine 021 And 022**	If DTCs 21 or 22 are active, repair the cause of those codes first	**Engine 021 and 022 not active:** GO TO ❷

– – –1/1

❷ **Engine 052 Intermittent Fault Test**	*NOTE: For wiring, theory of operation, and sensor location information, see ENGINE 052 MAP INPUT VOLTAGE ERRATIC supporting information.* 1. Ignition ON, engine OFF 2. Using the DST, monitor DTCs on the active code display parameter. 3. Make note of all DTCs, then clear all DTCs 4. Ignition ON, engine running 5. Using the DST, monitor DTCs on the active code display parameter while operating engine under varying engine speed and load conditions	**Engine 052 reoccurs:** GO TO ❸ **Engine 052 cleared:** Problem is intermittent. If no other codes are present, see INTERMITTENT FAULT DIAGNOSTICS, earlier in this group.

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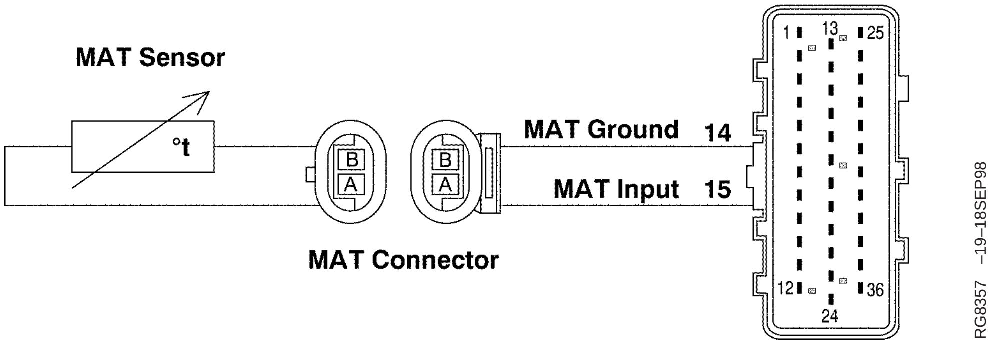
❸ **MAP Input Erratic Check**	*NOTE: For wiring, theory of operation, and sensor location information, see ENGINE 052 MAP INPUT VOLTAGE ERRATIC supporting information.* Engine 052 is mostly likely cased by radiated or conducted electrical "noise" from some part of the machine. This problem may be caused by loose electrical ground or power connections any where on the machine. Things to check: • All harness connectors • Alternator connections • Chassis ground connections, battery ground connection • Corrosion, dirt, or paint can cause intermittent and "noisy" connections • Check the wiring harness for intermittent open and short circuits, particularly the MAP sensor wiring Other possible causes of Engine 052: • Electromagnetic interference (EMI) from an incorrectly installed 2-way radio • Interference from some radar source	– – –1/1

Engine 053 — MAT Input Voltage Erratic



MAT (Manifold Air Temperature) 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. The ECU uses the MAT sensor input in conjunction with the MAP sensor input to determine engine air flow. For further MAT sensor information, see MEASURING TEMPERATURE in Section 03, Group 140 of this manual.

Engine 053 will set if:

- The MAT input changes more erratically than what can occur under normal operating conditions.

If Engine 053 sets, the following will occur:

- The ECU will use a default "limp-home" MAT value of 20°C (68°F).
- Cold temperature starting may be slightly harder than normal.

RG,RG34710,1600 –19–30SEP97–1/1

Engine 053 — MAT Input Voltage Erratic

The MAT input changes more erratically than what can occur under normal operating conditions.

OUO1004,0000C6D –19–05JAN01–1/1

Engine 053 MAT Input Voltage Erratic Diagnostic Procedure

NOTE: Before using this diagnostic procedure, perform a preliminary inspection of the ECU/Engine connector (black inside) and the MAT sensor connector looking for dirty, damaged, or poorly positioned terminals.

– – –1/1

❶ **Check For Engine 023 And 024**	If DTCs 23 or 24 are active, repair the cause of those codes first	**Engine 023 and 024 not active:** GO TO ❷

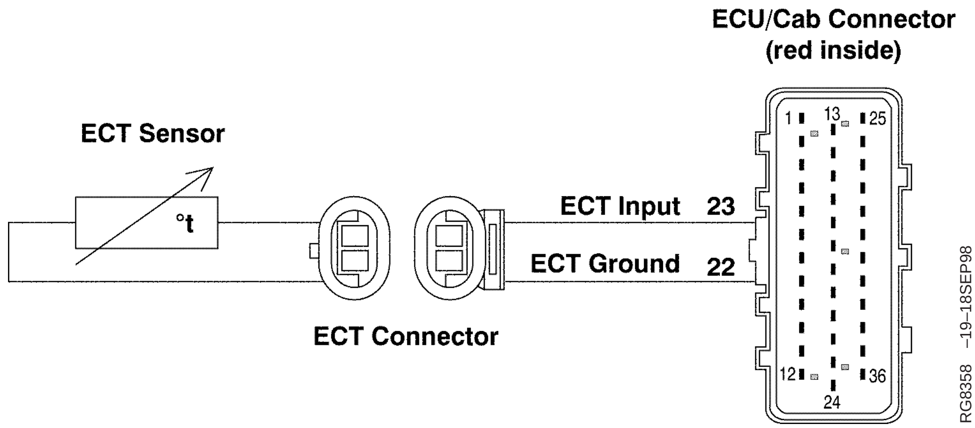
– – –1/1

❷ **Engine 053 Intermittent Fault Test**	*NOTE: For wiring, theory of operation, and sensor location information, see ENGINE 053 MAT INPUT VOLTAGE ERRATIC supporting information.* 1. Ignition ON, engine OFF 2. Using the DST, monitor DTCs on the active code display parameter. 3. Make note of all DTCs, then clear all DTCs 4. Ignition ON, engine running 5. Using the DST, monitor DTCs on the active code display parameter while operating engine under varying engine speed and load conditions	**Engine 053 reoccurs:** GO TO ❸ **Engine 053 cleared:** Problem is intermittent. If no other codes are present, see INTERMITTENT FAULT DIAGNOSTICS, earlier in this group.

– – –1/1

❸ **MAT Input Erratic Check**	*NOTE: For wiring, theory of operation, and sensor location information, see ENGINE 053 MAT INPUT VOLTAGE ERRATIC supporting information.* Engine 053 is mostly likely cased by radiated or conducted electrical "noise" from some part of the machine. This problem may be caused by loose electrical ground or power connections any where on the machine. Things to check: • All harness connectors • Alternator connections • Chassis ground connections, battery ground connection • Corrosion, dirt, or paint can cause intermittent and "noisy" connections • Check the wiring harness for intermittent open and short circuits, particularly the MAT sensor wiring Other possible causes of Engine 053: • Electromagnetic interference (EMI) from an incorrectly installed 2-way radio • Interference from some radar source	– – –1/1

Engine 054 — ECT Input Voltage Erratic



ECT (Engine Coolant Temperature) 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 of this manual.

Engine 054 will set if:

- The ECT input changes more erratically than what can occur under normal operating conditions.

If Engine 054 sets, the following will occur:

- The ECU will use a default "limp-home" ECT value of approximately -20°C (-4°F) during cranking, and approximately 100°C (212°F) during running.
- Engine power will be slightly derated.

RG,RG34710,1601 –19–30SEP97–1/1

Engine 054 — ECT Input Voltage Erratic

The ECT input changes more erratically than what can occur under normal operating conditions.

OUO1004,0000C6E –19–05JAN01–1/1

Engine 054 ECT Input Voltage Erratic Diagnostic Procedure

NOTE: Before using this diagnostic procedure, perform a preliminary inspection of the ECU/Cab connector (red inside) and the ECT sensor connector looking for dirty, damaged, or poorly positioned terminals.

– – –1/1

❶ **Check For Engine 025 And 026**	If Engine 025 or 026 are active, repair the cause of those codes first	**Engine 025 and 026 not active:** GO TO ❷

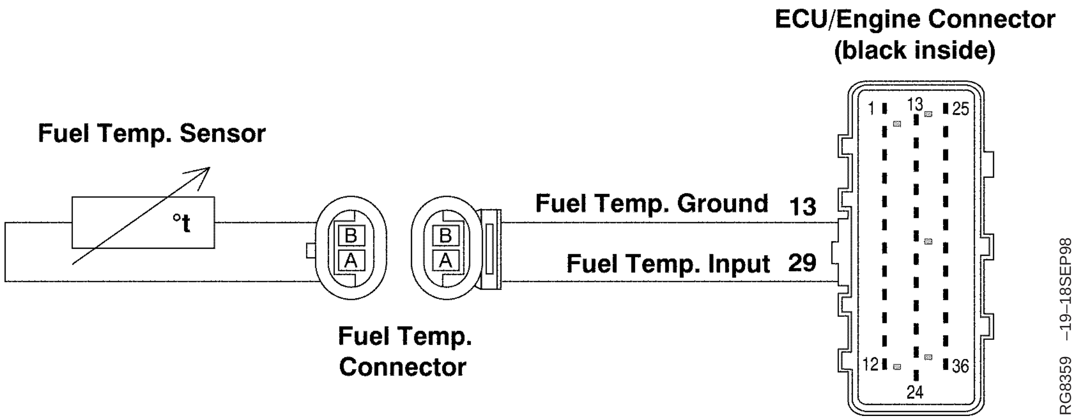
– – –1/1

❷ **Engine 054 Intermittent Fault Test**	*NOTE: For wiring, theory of operation, and sensor location information, see ENGINE 054 ECT INPUT VOLTAGE ERRATIC supporting information* 1. Ignition ON, engine OFF 2. Using the DST, monitor DTCs on the active code display parameter. 3. Make note of all DTCs, then clear all DTCs 4. Ignition ON, engine running 5. Using the DST, monitor DTCs on the active code display parameter while operating engine under varying engine speed and load conditions	**Engine 054 reoccurs:** GO TO ❸ **Engine 054 cleared:** Problem is intermittent. If no other codes are present, see INTERMITTENT FAULT DIAGNOSTICS, earlier in this group.

– – –1/1

❸ **ECT Input Erratic Check**	*NOTE: For wiring, theory of operation, and sensor location information, see ENGINE 054 ECT INPUT VOLTAGE ERRATIC supporting information* Engine 054 is mostly likely cased by radiated or conducted electrical "noise" from some part of the machine. This problem may be caused by loose electrical ground or power connections any where on the machine. Things to check: • All harness connectors • Alternator connections • Chassis ground connections, battery ground connection • Corrosion, dirt, or paint can cause intermittent and "noisy" connections • Check the wiring harness for intermittent open and short circuits, particularly the ECT sensor wiring Other possible causes of Engine 054: • Electromagnetic interference (EMI) from an incorrectly installed 2-way radio • Interference from some radar source	– – –1/1

Engine 055 — Fuel Temp Input Voltage Erratic



04
160
,146

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.

Fuel Temperature Sensor

- The fuel temperature sensor is a thermistor (temperature sensitive resistor) located on the fuel manifold. It is used to measure the fuel temperature. The fuel temperature sensor's variable resistance causes the input voltage to the ECU to vary. Higher fuel temperatures result in lower fuel temperature input voltages to the ECU; lower temperatures result in higher voltages. The ECU uses the fuel temperature sensor input to adjust the fuel delivery for variations in fuel density caused by varying fuel temperatures. For further fuel temperature sensor information, see MEASURING TEMPERATURE in Section 03, Group 140 of this manual.

Engine 055 will set if:

- The fuel temperature input changes more erratically than what can occur under normal operating conditions.

If Engine 055 sets, the following will occur:

- The ECU will use a default “limp-home” fuel temperature value of approximately -20°C (-4°F) during cranking, and approximately 100°C (212°F) during running.
- Engine power will be slightly derated.

RG,RG34710,1602 –19–30SEP97–1/1

Engine 055 — Fuel Temp Input Voltage Erratic

The fuel temperature input changes more erratically than what can occur under normal operating conditions.

OUO1004,0000C6F –19–05JAN01–1/1

Engine 055 Fuel Temp Voltage Erratic Diagnostic Procedure

NOTE: Before using this diagnostic procedure, perform a preliminary inspection of the ECU/Engine connector (black inside) and the fuel temperature sensor connector looking for dirty, damaged, or poorly positioned terminals.

– – –1/1

❶ **Check For Engine 037 And 038**	If Engine 037 or 038 are active, repair the cause of those codes first	**Engine 037 and 038 not active:** GO TO ❷

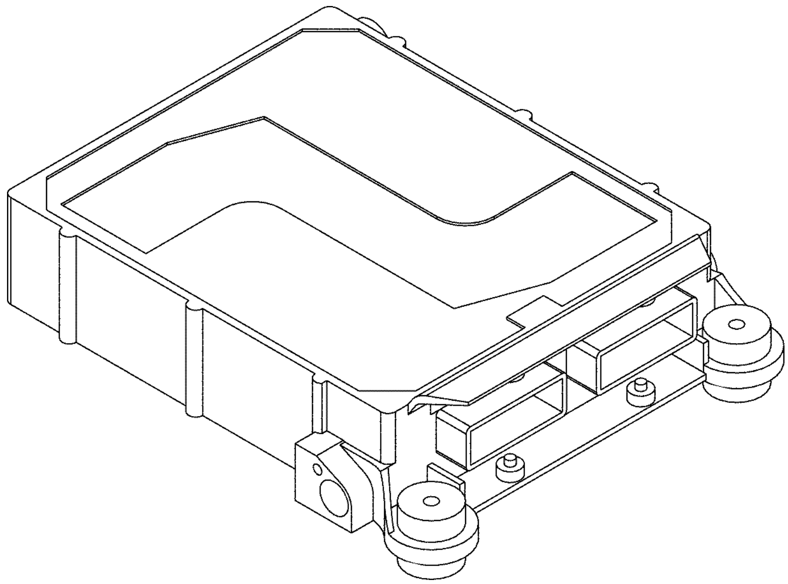
– – –1/1

❷ **Engine 055 Intermittent Fault Test**	*NOTE: For wiring, theory of operation, and sensor location information, see ENGINE 055 FUEL TEMP INPUT VOLTAGE ERRATIC supporting information.* 1. Ignition ON, engine OFF 2. Using the DST, monitor DTCs on the active code display parameter. 3. Make note of all DTCs, then clear all DTCs 4. Ignition ON, engine running 5. Using the DST, monitor DTCs on the active code display parameter while operating engine under varying engine speed and load conditions	**Engine 055 reoccurs:** GO TO ❸ **Engine 055 cleared:** Problem is intermittent. If no other codes are present, see INTERMITTENT FAULT DIAGNOSTICS, earlier in this group.

– – –1/1

❸ **Fuel Temperature Input Erratic Check**	*NOTE: For wiring, theory of operation, and sensor location information, see ENGINE 055 FUEL TEMP INPUT VOLTAGE ERRATIC supporting information.* Engine 055 is mostly likely cased by radiated or conducted electrical "noise" from some part of the machine. This problem may be caused by loose electrical ground or power connections any where on the machine. Things to check: • All harness connectors • Alternator connections • Chassis ground connections, battery ground connection • Corrosion, dirt, or paint can cause intermittent and "noisy" connections • Check the wiring harness for intermittent open and short circuits, particularly the fuel temperature sensor wiring Other possible causes of Engine 055: • Electromagnetic interference (EMI) from an incorrectly installed 2-way radio • Interference from some radar source	– – –1/1

Engine 081 — Engine Control Unit (ECU) Error



RG8436 –UN–26NOV97

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.

Engine 081 can be caused by:

- Faulty ECU ground connections.
- Cranking the engine until battery voltage drops below 6 volts.
- An internal ECU problem.

If Engine 081 sets, the following will occur:

- Depending on the severity of the problem, the engine may not run or engine operation may not be adversely affected.

RG,RG34710,1603 –19–30SEP97–1/1

Engine 081 — Engine Control Unit (ECU) Error

OUO1004,0000C70 –19–05JAN01–1/1

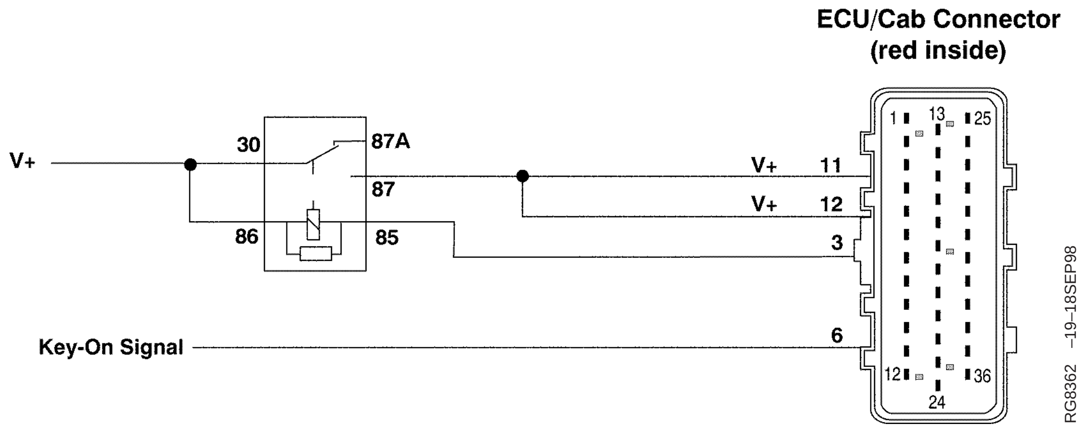
Engine 081 Engine Control Unit (ECU) Error Diagnostic Procedure

– – –1/1

❶ **Engine 081 Intermittent Fault Test**	*NOTE: For wiring, theory of operation, and sensor location information, see ENGINE 081 ENGINE CONTROL UNIT (ECU) ERROR supporting information.* 1. Ignition ON, engine OFF 2. Using the DST, monitor DTCs on the active code display parameter. 3. Make note of all DTCs, then clear all DTCs 4. Ignition ON, engine running 5. Using the DST, monitor DTCs on the active code display parameter	**Engine 081 reoccurs:** GO TO ❷ **Engine 081 cleared:** Problem is intermittent. If no other codes are present, see INTERMITTENT FAULT DIAGNOSTICS, earlier in this group. – – –1/1

❷ **Causes of Engine 081 Check**	*NOTE: For wiring, theory of operation, and sensor location information, see ENGINE 081 ENGINE CONTROL UNIT (ECU) ERROR supporting information.* 1. Using the appropriate adapter from JT07328 Connector Adapter Test Kit, test all female terminals in the ECU/Engine and the ECU/Cab connectors. There should be moderate resistance when the test adapter is inserted into each terminal. If a loose terminal is found, replace it 2. Check all ECU ground circuits 3. If Engine 081 occurred after an engine start where battery voltage was low, recharge battery and retest 4. If none of the above problems are found, replace the ECU and retest	– – –1/1

Engine 084 — Power Down Error



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.

ECU Power

- Power is supplied to the ECU through a relay controlled by the ECU. Battery voltage is always available at the relay; the ECU energizes the relay when it “sees” voltage at the switched power input (indicating that the ignition has been turned on). When the ECU energizes the relay, battery voltage is available at ECU/cab connector terminals 11 and 12; this causes the ECU to “boot-up” and ready itself for engine start. When the ECU no longer sees voltage at the switched power input (as when the ignition has been turned off) the ECU goes through a power-down sequence before denergizing the relay.

Engine 084 will set if:

- The ECU power down error occurs when the ECU has attempted to denergize the relay that provides power to it, but voltage still exists at terminals 11 and 12 of the ECU/cab connector.

If Engine 084 sets, the following will occur:

- Engine 084 won’t affect engine operation.

RG,RG34710,1604 –19–30SEP97–1/1

Engine 084 — Power Down Error

The ECU power down error occurs when the ECU has attempted to denergize the relay that provides power to it, but voltage still exists at terminals 11 and 12 of the ECU/cab connector.

OUO1004,0000C71 –19–05JAN01–1/1

Engine 084 Power Down Error Diagnostic Procedure

NOTE: Before using this diagnostic procedure, perform a preliminary inspection of the ECU/Cab connector (red inside) looking for dirty, damaged, or poorly positioned terminals.

– – –1/1

❶ **Engine 084 Intermittent Fault Test**	*NOTE: For wiring, theory of operation, and sensor location information, see ENGINE 084 POWER DOWN ERROR supporting information.* 1. Ignition ON, engine OFF 2. Using the DST, read DTCs on the active code display parameter 3. Make note of all DTCs, then clear all DTCs 4. Cycle ignition OFF for 10 seconds, then back ON 5. Using the DST, read DTCs on the active code display parameter	**Engine 084 reoccurs:** GO TO ❷ **Engine 084 cleared:** Problem is intermittent. If no other codes are present, see INTERMITTENT FAULT DIAGNOSTICS, earlier in this group.

– – –1/1

❷ **ECU Voltage Supply Check**	*NOTE: For wiring, theory of operation, and sensor location information, see ENGINE 084 POWER DOWN ERROR supporting information.* 1. Ignition OFF 2. Disconnect ECU/Cab connector 3. Measure voltage between a good ground and ECU/Cab connector terminal; between a good ground and ECU/Cab connector terminal 12	**One or both measurements above 3.0 volts:** Faulty ECU power relay OR ECU power supply wires shorted to voltage **Both measurements below 3.0 volts:** Faulty ECU connection OR Faulty ECU

– – –1/1

Section 05
Tools

Contents

Fuel System Essential Tools

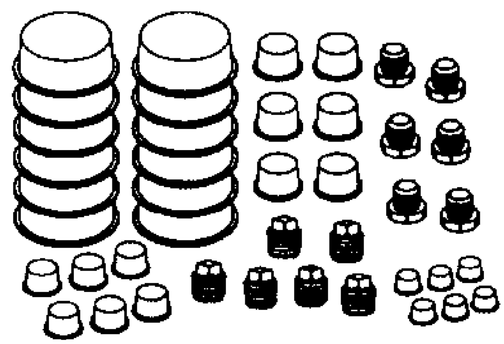
NOTE: Order tools according to information given in the U.S. SERVICEGARD™ Catalog or from the European Microfiche Tool Catalog (MTC).

SERVICEGARD is a trademark of Deere & Company

OUO1004,0000BDF –19–03NOV00–1/4

Fuel System Cap Plug Kit JDG998

Use to protect the fuel system from dirt and debris when disconnecting fuel system components during routine maintenance and service.

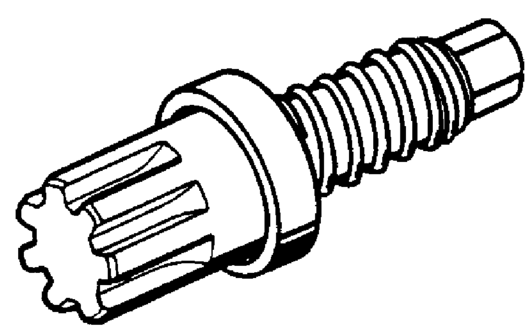


JDG998

OUO1004,0000BDF –19–03NOV00–2/4

Flywheel Turning Tool JDG820

Use to rotate engine flywheel to find cylinder No. 1 and No. 6 “Top Dead Center” when adjusting electronic unit injector (EUI) preload. Use with JDG971 Timing Pins.



JDG820

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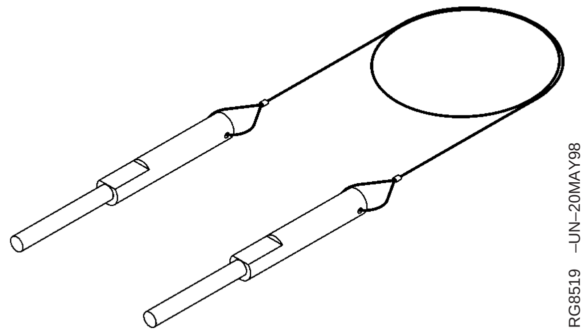
OUO1004,0000BDF –19–03NOV00–3/4

Cam/Crankshaft Timing Lock Pins JDG971

Set of two. Used to lock camshaft and crankshaft at "Top Dead Center" during timing gear backlash adjustment. Use on crankshaft only for valve clearance adjustments. Set consists of two 313796 Lock Pins.



JDG971

OUO1004,0000BDF –19–03NOV00–4/4

Fuel System 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.

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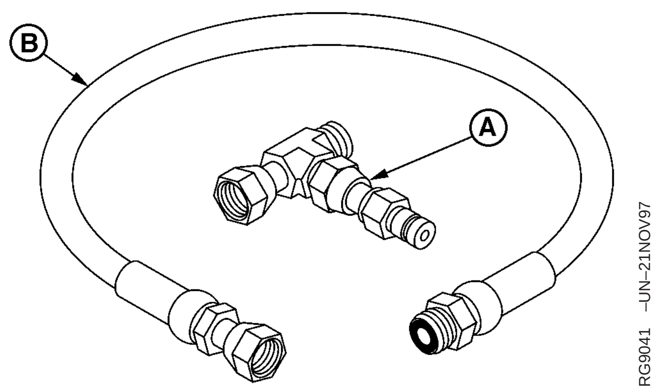
170
2

SERVICEGARD is a trademark of Deere & Company

OUO1004,0000BE0 –19–03NOV00–1/2

Fuel Supply System Test Kit JT03513

Fuel Pressure Test Fitting is used with JT05472 Universal Pressure Test Kit to measure fuel transfer pump pressure. Fuel Air Detection Line is used to determine if air is present in fuel system. Kit consists of: JT03509 Fuel Pressure Test Fitting (A) and JT03513-1 Fuel Air Detection Line (B).



JT03513

OUO1004,0000BE0 –19–03NOV00–2/2

Fuel System Other Material

Number	Name	Use
T43512 (U.S.) TY9473 (Canadian) 242 (LOCTITE®)	Thread Lock and Sealer (Medium Strength)	Apply to fuel filter check valve and elbow (filter header end). Apply to EUI hold-down clamp cap screws.
AR54749 (U.S.)	Soap Lubricant	Apply to fuel supply pump mounting bracket O-ring.
TY24311 (U.S.) CXTY24311 (Canadian) 222 (LOCTITE®)	Thread Lock and Sealer (Low Strength)	Electronic unit injector wiring connector stud nuts.

LOCTITE is a registered trademark of Loctite Corp.

OUO1004,0000BE1 –19–03NOV00–1/1

Electronic Control System Essential Tools

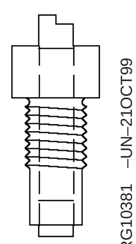
NOTE: Order tools according to information given in the U.S. SERVICEGARD™ Catalog or from the European Microfiche Tool Catalog (MTC).

SERVICEGARD is a trademark of Deere & Company

OUO1004,0000BDB –19–03NOV00–1/17

Depth Checking Tool JDG1334

Used to check depth of crankshaft position sensor in timing gear cover.



JDG1334

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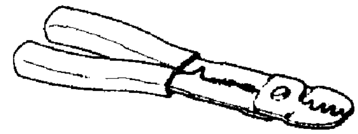
OUO1004,0000BDB –19–03NOV00–2/17

RG10739 –UN–26MAY00

Crimping Pliers JDG144

Used to crimp wire terminal ends for METRI-PACK™ connectors.



JDG144

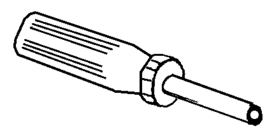
METRI-PACK is a trademark of Delphi Packard Electric Systems

OUO1004,0000BDB –19–03NOV00–3/17

RW25539 –UN–28AUG96

Terminal Extraction Tool[1] JDG364

Used to extract WEATHER PACK™ terminals from electrical connectors.



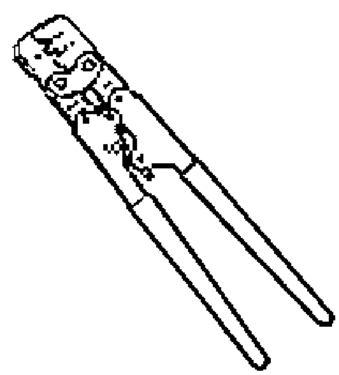
WEATHER PACK is a trademark of Packard Electric

[1]*Included in Technician's Electrical Repair Kit - JT07195B*

OUO1004,0000BDB –19–03NOV00–4/17

WEATHER PACK™ Crimping Tool JDG783

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.



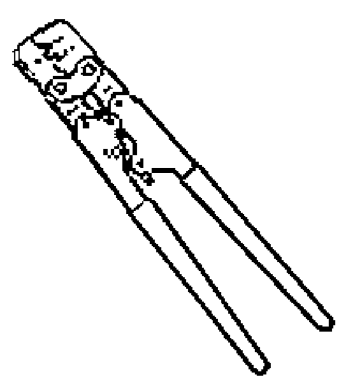
RW25542A –UN–07MAR02

WEATHER PACK is a trademark of Packard Electric

OUO1004,0000BDB –19–03NOV00–5/17

METRI-PACK™ Crimping Tool JDG865

Used to crimp METRI-PACK™ male and female terminals on 14-20 gauge wires.



RW25542A –UN–07MAR02

METRI-PACK is a trademark of Packard Electric Inc.

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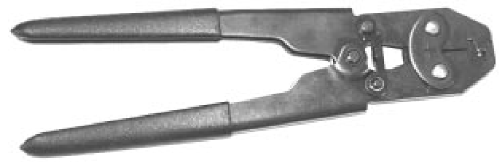
OUO1004,0000BDB –19–03NOV00–6/17

Packard Crimper JDG707

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.

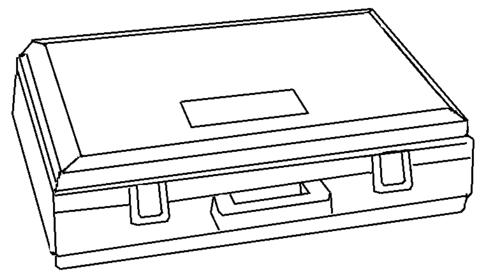


RG11679 –UN–05FEB01

OUO1004,0000BDB –19–03NOV00–7/17

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.

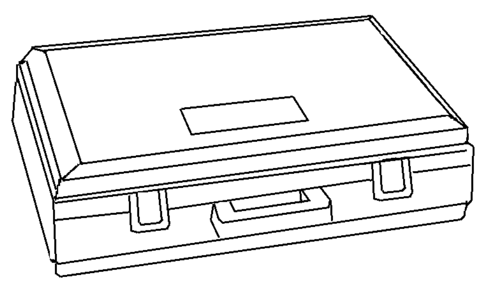


RW25558 –UN–29AUG96

OUO1004,0000BDB –19–03NOV00–8/17

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

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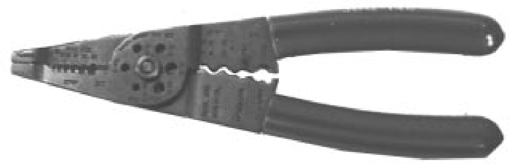
OUO1004,0000BDB –19–03NOV00–9/17

Electrician's Pliers[1] JDG145

Used to cut, strip, and splice wires.



RG11686 –UN–13FEB01

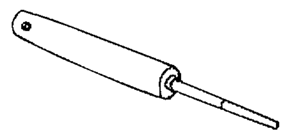
[1]*Included in Technician's Electrical Repair Kit - JDG155*

OUO1004,0000BDB –19–03NOV00–10/17

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.

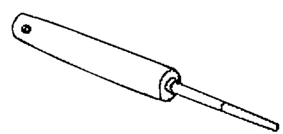
[1]*Included in Technician's Electrical Repair Kit - JT07195B*

OUO1004,0000BDB –19–03NOV00–11/17

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*

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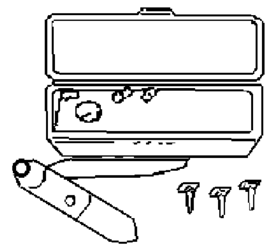
OUO1004,0000BDB –19–03NOV00–12/17

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.

OUO1004,0000BDB –19–03NOV00–13/17

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*

Continued on next page

OUO1004,0000BDB –19–03NOV00–14/17

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*

OUO1004,0000BDB –19–03NOV00–15/17

20—24 Gauge Extractor (Set of Two)[1] JDG363

Used to remove terminals on 20-24 gauge wires in DEUTSCH connectors.

RG12278 –UN–22APR02

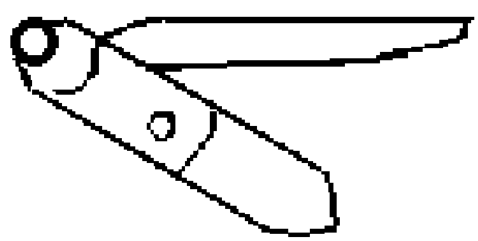
Deutsch Extraction Tool

[1]*Included in DEUTSCH Electrical Repair Kit - JDG359*

OUO1004,0000BDB –19–03NOV00–16/17

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*

OUO1004,0000BDB –19–03NOV00–17/17

Electronic Control System 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

OUO1004,0000C32 –19–13DEC00–1/2

Electrician's Pliers JDG145

Remove terminals and strip wires on METRI-PACK™ connectors.

METRI-PACK is a trademark of Delphi Packard Electric Systems

OUO1004,0000C32 –19–13DEC00–2/2

Electronic Control System Other Material

Number	Name	Use
JDT405 (U.S.)	High Temperature Grease	Sensor O-rings.
TY9375 (U.S.) TY9480 (Canadian) 592 (LOCTITE®)	Pipe Sealant with TEFLON®	Apply to threads of oil pressure sensor.
AT66865 (U.S.)	Lubricant	Insulate electrical connectors

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

OUO1004,0000BDD –19–03NOV00–1/1

Engine Diagnostics and Testing Procedure Tools

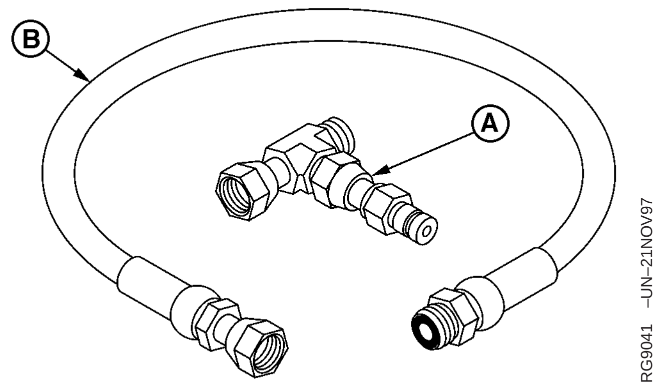
NOTE: Order tools according to information given in the U.S. SERVICEGARD™ Catalog or in the European Microfiche Tool Catalog (MTC) unless otherwise noted.

SERVICEGARD is a trademark of Deere & Company.

RG,RG34710,1605 –19–30SEP97–1/6

Fuel Supply System Test Kit JT03513

Fuel Pressure Test Fitting is used with JT05472 Universal Pressure Test Kit to measure fuel transfer pump pressure. Fuel Air Detection Line is used to determine if air is present in fuel system. Kit consists of: JT03509 Fuel Pressure Test Fitting (A) and JT03513-1 Fuel Air Detection Line (B).

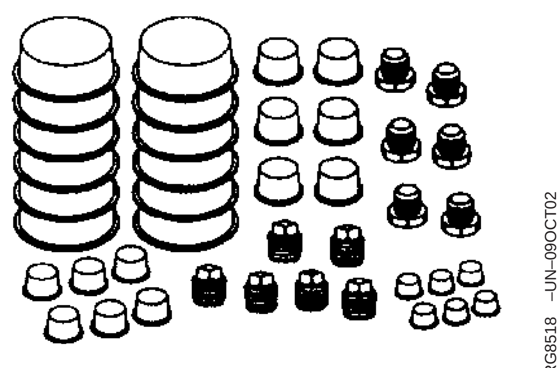


JT03513

RG,RG34710,1605 –19–30SEP97–2/6

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.



JDG998

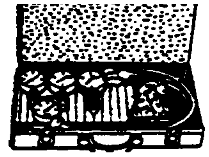
Continued on next page

RG,RG34710,1605 –19–30SEP97–3/6

RG5162 –UN–23AUG88

Universal Pressure Test Kit JT05412

Used for testing engine oil pressure, intake manifold pressure (turbo boost), and fuel transfer pump pressure.

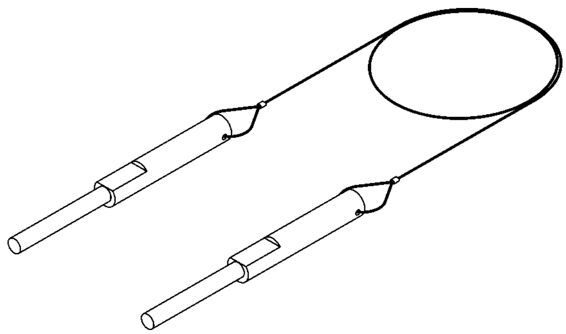


JT05412

RG,RG34710,1605 –19–30SEP97–4/6

Cam/Crankshaft Timing Lock Pins (2) JDG971

Used to verify cam/crank gear train is correctly timed. Use with JDG820.



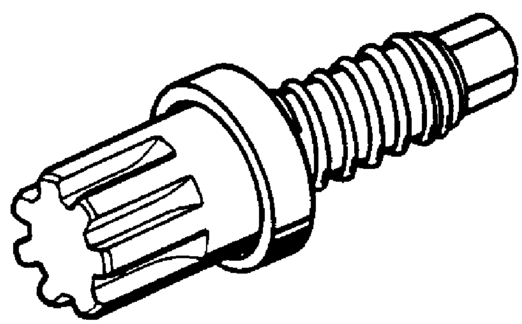
RG8519 –UN–20MAY98

JDG971

RG,RG34710,1605 –19–30SEP97–5/6

Flywheel Turning Tool JDG820

Used to rotate flywheel on engine, with 129-tooth flywheel ring gear and a 29.9 mm (1.18 in.) I.D. flywheel housing guide bore diameter, to verify cam/crank gear train is correctly timed. JDE81-1 may be used also if JDG820 is not available. Use with JDG971 Timing Pins.



RG7056

RG7056 –UN–05DEC97

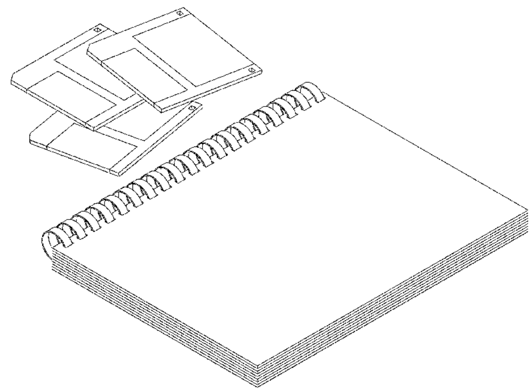
JDG820

RG,RG34710,1605 –19–30SEP97–6/6

Electronic Control System Diagnostic Tools

ECU Communication Software Kit. JDIS122

Please refer to your John Deere Dealer website for information on obtaining the latest version of software.

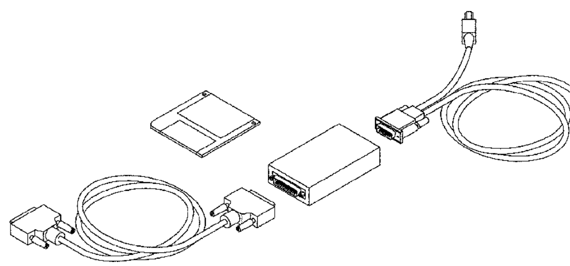

RG8554 –UN–26NOV97

JDIS122

RG,RG34710,111 –19–30SEP97–1/5

ECU Communication Hardware Kit JDIS121

Used with ECU Communication Software. Refer to the John Deere Dealer Website on information on obtaining the latest version of software. JDIS121 with the software enables a Windows ('95, '98 or 2000) 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. Available from John Deere Distribution Service Center (DSC). **United States and Canadian Agricultural dealers DO NOT ORDER without first contacting your Branch or TAM.**


RG8553 –UN–26NOV97

JDIS121

RG,RG34710,111 –19–30SEP97–2/5

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.

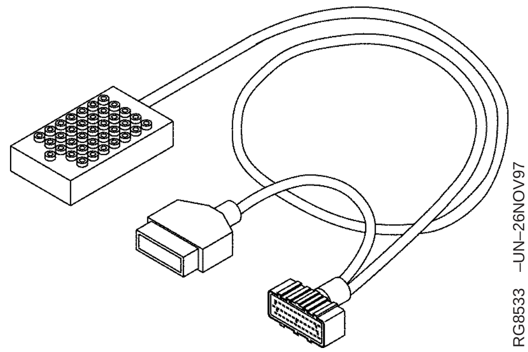

RG11126 –UN–19JUN00

Continued on next page

RG,RG34710,111 –19–30SEP97–3/5

10.5/12.5 Engine Control Unit Break-Out-Box . . . JT02171

Used during diagnostics to allow easy measurement of Lucas electronic control system voltage and resistance values.

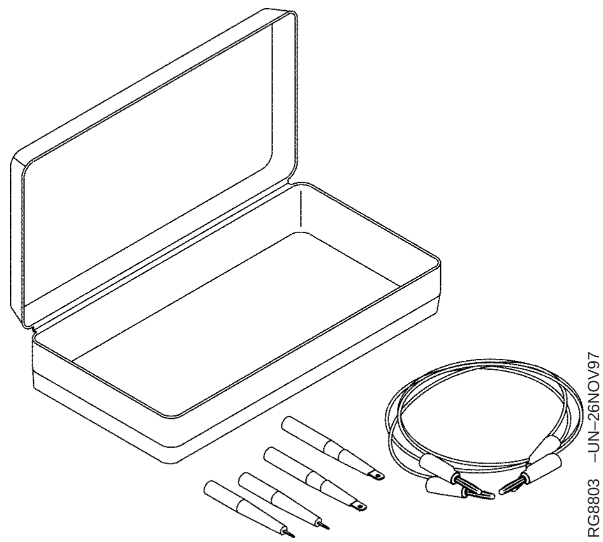


JT02171

RG,RG34710,111 –19–30SEP97–4/5

Connector Adapter Test Kit JT07328

Used with JT07328 Digital Multimeter to make voltage and resistance measurements in control system wiring harness connectors. Can also be used to test terminals for proper fit.



JT07328

RG,RG34710,111 –19–30SEP97–5/5

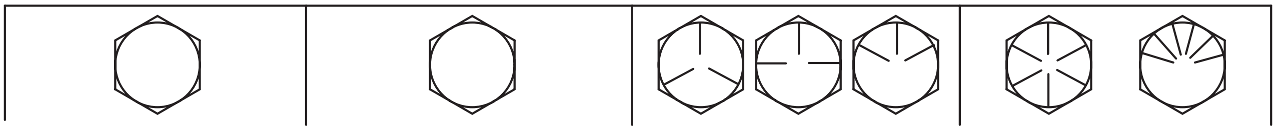
Section 06
Specifications

Contents

06

Unified Inch Bolt and Cap Screw Torque Values

TS1671 –UN–01MAY03



Bolt or	SAE Grade 1				SAE Grade 2[a]				SAE Grade 5, 5.1 or 5.2				SAE Grade 8 or 8.2			
Screw	Lubricated[b]		Dry[c]		Lubricated[b]		Dry[c]		Lubricated[b]		Dry[c]		Lubricated[b]		Dry[c]	
Size	N•m	lb-in	N•m	lb-in	N•m	lb-in	N•m	lb-in	N•m	lb-in	N•m	lb-in	N•m	lb-in	N•m	lb-in
1/4	3.7	33	4.7	42	6	53	7.5	66	9.5	84	12	106	13.5	120	17	150
													N•m	**lb-ft**	**N•m**	**lb-ft**
5/16	7.7	68	9.8	86	12	106	15.5	137	19.5	172	25	221	28	20.5	35	26
									N•m	**lb-ft**	**N•m**	**lb-ft**				
3/8	13.5	120	17.5	155	22	194	27	240	35	26	44	32.5	49	36	63	46
			N•m	**lb-ft**	**N•m**	**lb-ft**	**N•m**	**lb-ft**								
7/16	22	194	28	20.5	35	26	44	32.5	56	41	70	52	80	59	100	74
	N•m	**lb-ft**														
1/2	34	25	42	31	53	39	67	49	85	63	110	80	120	88	155	115
9/16	48	35.5	60	45	76	56	95	70	125	92	155	115	175	130	220	165
5/8	67	49	85	63	105	77	135	100	170	125	215	160	240	175	305	225
3/4	120	88	150	110	190	140	240	175	300	220	380	280	425	315	540	400
7/8	190	140	240	175	190	140	240	175	490	360	615	455	690	510	870	640
1	285	210	360	265	285	210	360	265	730	540	920	680	1030	760	1300	960
1-1/8	400	300	510	375	400	300	510	375	910	670	1150	850	1450	1075	1850	1350
1-1/4	570	420	725	535	570	420	725	535	1280	945	1630	1200	2050	1500	2600	1920
1-3/8	750	550	950	700	750	550	950	700	1700	1250	2140	1580	2700	2000	3400	2500
1-1/2	990	730	1250	930	990	730	1250	930	2250	1650	2850	2100	3600	2650	4550	3350

Torque values listed are for general use only, based on the strength of the bolt or screw. DO NOT use these values if a different torque value or tightening procedure is given for a specific application. For plastic insert or crimped steel type lock nuts, for stainless steel fasteners, or for nuts on U-bolts, see the tightening instructions for the specific application. Shear bolts are designed to fail under predetermined loads. Always replace shear bolts with identical grade.

Replace fasteners with the same or higher grade. If higher grade fasteners are used, tighten these to the strength of the original. Make sure fastener threads are clean and that you properly start thread engagement. When possible, lubricate plain or zinc plated fasteners other than lock nuts, wheel bolts or wheel nuts, unless different instructions are given for the specific application.

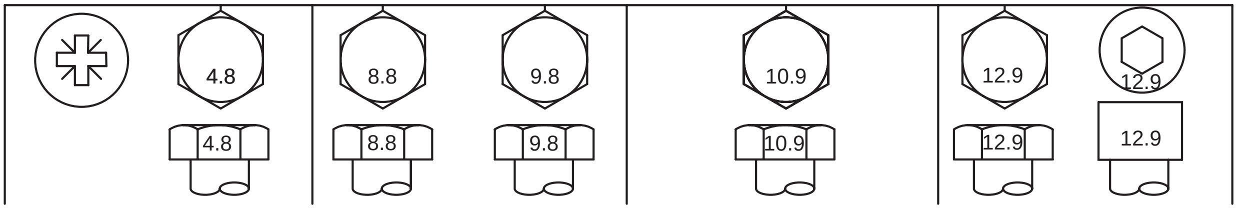
[a] Grade 2 applies for hex cap screws (not hex bolts) up to 6. in (152 mm) long. Grade 1 applies for hex cap screws over 6 in. (152 mm) long, and for all other types of bolts and screws of any length.

[b] "Lubricated" means coated with a lubricant such as engine oil, fasteners with phosphate and oil coatings, or 7/8 in. and larger fasteners with JDM F13C zinc flake coating.

[c] "Dry" means plain or zinc plated without any lubrication, or 1/4 to 3/4 in. fasteners with JDM F13B zinc flake coating.

DX,TORQ1 –19–11DEC03–1/1

Metric Bolt and Cap Screw Torque Values



TS1670 –UN–01MAY03

Bolt or	Class 4.8				Class 8.8 or 9.8				Class 10.9				Class 12.9			
Screw	**Lubricated**[a]		**Dry**[b]		**Lubricated**[a]		**Dry**[b]		**Lubricated**[a]		**Dry**[b]		**Lubricated**[a]		**Dry**[b]	
Size	**N•m**	**lb-in**	**N•m**	**lb-in**	**N•m**	**lb-in**	**N•m**	**lb-in**	**N•m**	**lb-in**	**N•m**	**lb-in**	**N•m**	**lb-in**	**N•m**	**lb-in**
M6	4.7	42	6	53	8.9	79	11.3	100	13	115	16.5	146	15.5	137	19.5	172
									N•m	**lb-ft**	**N•m**	**lb-ft**	**N•m**	**lb-ft**	**N•m**	**lb-ft**
M8	11.5	102	14.5	128	22	194	27.5	243	32	23.5	40	29.5	37	27.5	47	35
			N•m	**lb-ft**	**N•m**	**lb-ft**	**N•m**	**lb-ft**								
M10	23	204	29	21	43	32	55	40	63	46	80	59	75	55	95	70
	N•m	**lb-ft**														
M12	40	29.5	50	37	75	55	95	70	110	80	140	105	130	95	165	120
M14	63	46	80	59	120	88	150	110	175	130	220	165	205	150	260	190
M16	100	74	125	92	190	140	240	175	275	200	350	255	320	235	400	300
M18	135	100	170	125	265	195	330	245	375	275	475	350	440	325	560	410
M20	190	140	245	180	375	275	475	350	530	390	675	500	625	460	790	580
M22	265	195	330	245	510	375	650	480	725	535	920	680	850	625	1080	800
M24	330	245	425	315	650	480	820	600	920	680	1150	850	1080	800	1350	1000
M27	490	360	625	460	950	700	1200	885	1350	1000	1700	1250	1580	1160	2000	1475
M30	660	490	850	625	1290	950	1630	1200	1850	1350	2300	1700	2140	1580	2700	2000
M33	900	665	1150	850	1750	1300	2200	1625	2500	1850	3150	2325	2900	2150	3700	2730
M36	1150	850	1450	1075	2250	1650	2850	2100	3200	2350	4050	3000	3750	2770	4750	3500

Torque values listed are for general use only, based on the strength of the bolt or screw. DO NOT use these values if a different torque value or tightening procedure is given for a specific application. For stainless steel fasteners or for nuts on U-bolts, see the tightening instructions for the specific application. Tighten plastic insert or crimped steel type lock nuts by turning the nut to the dry torque shown in the chart, unless different instructions are given for the specific application.

Shear bolts are designed to fail under predetermined loads. Always replace shear bolts with identical property class. Replace fasteners with the same or higher property class. If higher property class fasteners are used, tighten these to the strength of the original. Make sure fastener threads are clean and that you properly start thread engagement. When possible, lubricate plain or zinc plated fasteners other than lock nuts, wheel bolts or wheel nuts, unless different instructions are given for the specific application.

[a]“Lubricated” means coated with a lubricant such as engine oil, fasteners with phosphate and oil coatings, or M20 and larger fasteners with JDM F13C zinc flake coating.

[b]“Dry” means plain or zinc plated without any lubrication, or M6 to M18 fasteners with JDM F13B zinc flake coating.

DX,TORQ2 –19–11DEC03–1/1

General OEM Engine Specifications

ITEM	UNIT OF MEASURE	6105AF	6105HF	6125AF	6125HF S.N. (—29999)
Number of Cylinders	——	6	6	6	6
Fuel	——	Diesel	Diesel	Diesel	Diesel
Stroke	mm (in.)	138 (5.43)	138 (5.43)	165 (6.50)	165 (6.50)
Bore	mm (in.)	127 (5.00)	127 (5.00)	127 (5.00)	127 (5.00)
Displacement	L (cu in.)	10.5 (640)	10.5 (640)	12.5 (766)	12.5 (766)
Compression Ratio	——	16:1	16:1	16:1	16:1
Physical Dimensions: Width	mm (in.)	741 (29.2)	808 (31.8)	741 (29.2)	808 (31.8)
Height	mm (in.)	1224 (48.2)	1239 (48.8)	1224 (48.2)	1239 (48.8)
Length	mm (in.)	1326 (52.2)	1326 (52.2)	1326 (52.2)	1326 (52.2)
Basic Dry Weight	kg (lb)	1211 (2665)	1200 (2640)	1216 (2675)	1205 (2650)

OUO1004,0000C35 –19–15DEC00–1/1

Fuel System Repair Specifications

Item	Measurement	Specification
Fuel Filter Header-to-Bracket	Torque	50 N•m (37 lb-ft)
Fuel Filter Bracket-to-Head	Torque	35 N•m (26 lb-ft)
Fuel Filter Bracket-to-Block	Torque	65 N•m (48 lb-ft)
Fuel Filter-to-Air Intake	Torque	25 N•m (18 lb-ft)
Primary Fuel Filter Header Plugs	Torque	47 N•m (35 lb-ft)
Fuel Line-to-Fuel Filter/Air Purge Valve	Torque	24 N•m (18 lb-ft)
Air Purge Valve Diagnostic Port Fitting	Torque	24 N•m (18 lb-ft)
Fuel Filter Check Valve to Fuel Filter Header or Elbow on Header	Torque	46 N•m (34 lb-ft)
Elbow, Fuel Filter Check Valve-to-Filter Header	Torque	46 N•m (34 lb-ft)
Fuel Line-to-Fuel Filter Check Valve	Torque	24 N•m (18 lb-ft)
Surge Tank Fuel Line Adapter (Top)	Torque	46 N•m (34 lb-ft)
Surge Tank Fuel Line Adapter (Bottom)	Torque	39 N•m (29 lb-ft)
Surge Tank Mounting Bracket-to-Cylinder Head Cap Screws	Torque	130 N•m (95 lb-ft)
Surge Tank-to-Mounting Bracket Cap Screws	Torque	50 N•m (37 lb-ft)
Surge Tank Fuel Lines	Torque	24 N•m (18 lb-ft)
Fuel Supply Pump and Camshaft Drive Coupler Set Screws	Torque	4 N•m (3 lb-ft)
Fuel Supply Pump Mounting Bracket Cap Screws	Torque	50 N•m (37 lb-ft)
Fuel Supply Pump-to-Bracket	Torque	25 N•m (18 lb-ft)

Continued on next page

OUO1004,0000C4E –19–21DEC00–1/2

Item	Measurement	Specification
Fuel Line ORFS Fittings	Torque	24 N•m (18 lb-ft)
Dual Rail Fuel Manifold-to-Head	Torque	35 N•m (26 lb-ft)
Fuel Lines-to-Fuel Manifold	Torque	24 N•m (18 lb-ft)
Fuel Return Check Valve (On Manifold)	Torque	33 N•m (24 lb-ft)
Electronic Unit Injector Hold-Down Clamp Cap Screws	Initial Torque	20 N•m (15 lb-ft)
Electronic Unit Injector Hold-Down Clamp Cap Screws	Final Torque-Turn	90—100°
Electronic Unit Injector Wiring Harness Connector Nuts	Torque	2 N•m (1.75 lb-ft) (18 lb-in.)
Fuel Line Clamps	Torque	5 N•m (4 lb-ft)
Electronic Unit Injector Harness-to-Shaft Clamps	Torque	35 N•m (26 lb-ft)
Electronic Unit Injector Wiring Connector Bracket-to-Head	Torque	25 N•m (18 lb-ft)
Electronic Unit Injector Adjusting Screw Lock Nut	Torque	65 N•m (48 lb-ft)
Timing Pin Plug in Cylinder Block	Torque	33 N•m (24 lb-ft)
Fuel Filter Outlet Line	Torque	24 N•m (18 lb-ft)

OUO1004,0000C4E –19–21DEC00–2/2

Electronic Engine Control System Specifications

Item	Measurement	Specification
ECU Mounting Bracket-to-Cylinder Block Lower Cap Screws	Torque	68 N•m (55 lb-ft)
ECU Mounting Bracket-to-Cylinder Block Upper Front Cap Screw	Torque	110 N•m (81 lb-ft)
Coolant Temperature Sensor	Torque	10 N•m (7.5 lb-ft)
Fuel Temperature Sensor-to-Fuel Manifold (Dual Rail Fuel System)	Torque	10 N•m (7.5 lb-ft)
Engine Oil Pressure Sensor	Torque	9 N•m (80 lb-in.)
Engine Oil Pressure Sensor Adapter-to-Filter Housing	Torque	11 N•m (97 lb-in.)
Manifold Air Temperature (MAT) Sensor	Torque	10 N•m (7.5 lb-ft)
Manifold Absolute Pressure (MAP) Sensor	Torque	7 N•m (5 lb-ft)
Camshaft Position Sensor	Torque	14 N•m (10 lb-ft)
Crankshaft Position Sensor Spotface (Mounting Surface)-to-Crankshaft Timing Wheel Tooth	Distance	36.7—38.2 mm (1.44—1.50 in.)
Crankshaft Position Sensor	Torque	14 N•m (10 lb-ft)

OUO1004,0000BDE –19–03NOV00–1/1

Fuel System Diagnostic Specifications

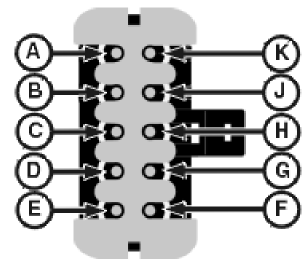
ITEM	SPECIFICATION
Fuel Transfer Pump Pressure:	
Normal (Idle)	410–480 kPa (4.1 –4.8 bar) (60–70 psi)
Cranking (Minimum 200 rpm)	70–170 kPa (0.7–1.7 bar) (10–25 psi)
Fuel System O-ring-Face-Seal Fittings:	
Final Filter-to-Fuel Manifold	24 N•m (18 lb-ft)
Transfer Pump-to-Final Filter	24 N•m (18 lb-ft)

RG,RG34710,1609 –19–20NOV00–1/1

Torque Curve Selection

OEM Applications

Torque Curve Selection for OEM Engines		
Torque Curve Displayed on DST:	**Application Guideline Curve**	**Jumper Wire on Program Performance Connector:**
1	Intermittent Default Power Curve 4	No jumper wires installed
2	Continuous Default Power Curve 3	Jumper wire installed between terminals A and K only
3	Intermittent Power Curve 1	Jumper wire installed between terminals B and J only
4	Continuous Power Curve 2	Jumper wire installed between terminals A and K and jumper wire installed between terminals B and J



Performance Program Connector

John Deere Applications

NOTE: 6750/6850 Self-Propelled Forage Harvester applications only use one torque curve.

Torque Curve Selection for 9000 Series 4WD Tractor			
Torque Curve Displayed on DST:	**PST Transmission**	**12 Speed MST Transmission**	**24 Speed MST Transmission**
1	When none of the below conditions are met	When none of the below conditions are met	When none of the below conditions are met
3	• 3-pt. hitch lowered OR • Vehicle speed less than 0.5 mph and PTO engaged	• 3-pt. hitch lowered OR • Vehicle speed less than 0.5 mph and PTO engaged OR • When in gears A1, A2, A3, or AR	• 3-pt. hitch lowered OR • Vehicle speed less than 0.5 mph and PTO engaged OR • When in gears A1L, A1H, A2L, A2H, A3L, ARL, or ARH
5	When in gear 3F	When in gear B1	When in gears A3H or B1L
7	When in gears 1F, 2F, or 1R	Not Used	Not Used

Torque Curve Selection for 744H Loader	
Torque Curve Displayed on DST:	**Conditions**
1	When in any gear other than 1st
5	When in 1st gear

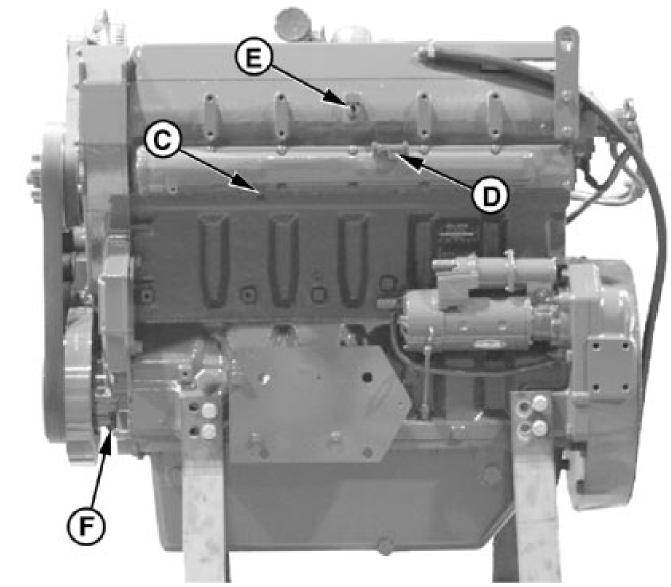
RG,RG34710,1611 –19–22JUN01–1/1

ECU Terminal Identification

ECU/Cab Connector (red)	Terminal Number	ECU/Engine Connector (black)
unused	1	unused
unused	2	case ground
ECU power relay	3	EUI 4, 5, 6 90 volt supply
fault code output	4	EUI 1, 2, 3, 90 volt supply
unused	5	unused
switched power input	6	cylinder 4 EUI control
unused	7	cylinder 6 EUI control
engine speed output	8	cylinder 5 EUI control
ground	9	unused
ground	10	cylinder 2 EUI control
battery power input	11	cylinder 3 EUI control
battery power input	12	cylinder 1 EUI control
unused	13	fuel temperature ground
unused	14	MAT ground
torque curve select 1	15	MAT ground
PWM throttle input	16	unused
EOL enable	17	crank position return
unused	18	cam position return
unused	19	unused
unused	20	unused
torque curve select 3	21	unused
ECT and analog throttle gnd	22	unused
ECT input	23	unused
unused	24	unused
SAE J1708 communication	25	MAP 5 volt supply
SAE J1708 communication	26	unused
fuel value output	27	MAP ground
unused	28	MAP signal
fuel rail pressure switch input	29	fuel temperature input
unused	30	crank position input
torque curve select 2	31	cam position input
transport max speed governor select	32	unused
isochronous governor select	33	unused
analog throttle 5 volt supply	34	unused
analog throttle input	35	unused
unused	36	unused

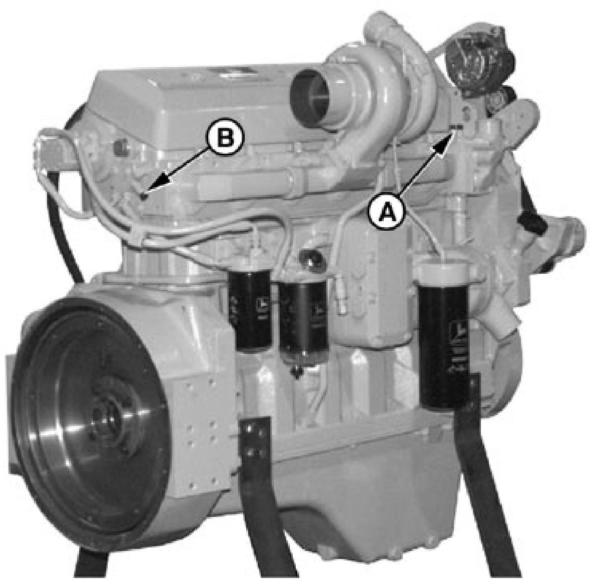
RG,RG34710,1612 –19–30SEP97–1/1

6105H/6125H Engines Electronic Control System Component Location



RG8793 –UN–27SEP99

Left-Side Sensor Locations



RG8796 –UN–27SEP99

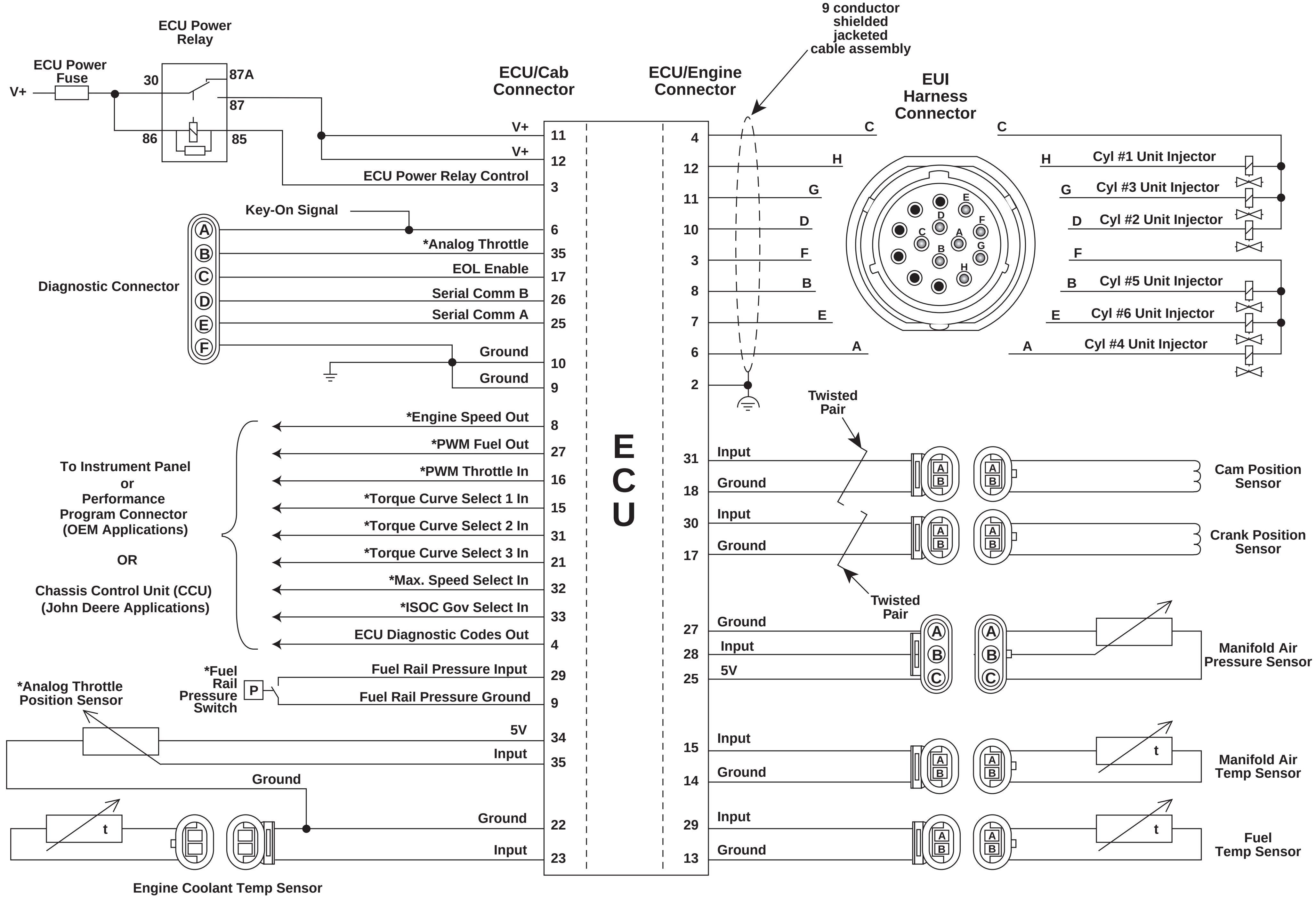
Right-Side Sensor Locations

A—Engine Coolant Temperature
B—Fuel Temperature Sensor
C—Manifold Air Temperature (MAT) Sensor
D—Manifold Air Pressure (MAP) Sensor
E—Camshaft Position Sensor
F—Crankshaft Position Sensor

RG,RG34710,1613 –19–30SEP97–1/1

10.5 L & 12.5 L Electronic Control System Wiring Diagram

RG8776 –19–14DEC00

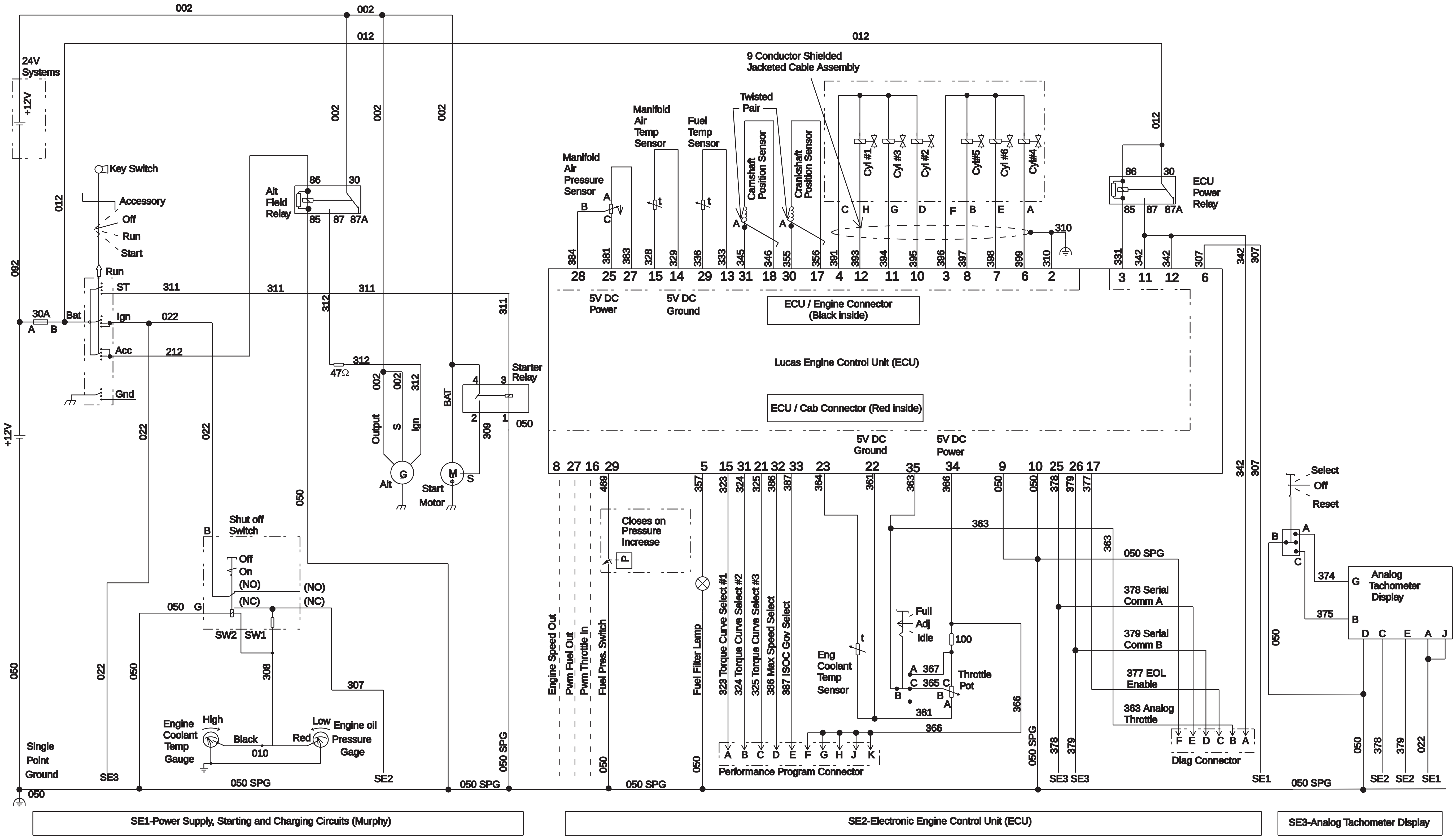


*Optional function not included on all applications

RG,RG34710,1614 –19–30SEP97–1/1

10.5 L & 12.5 L OEM Application (With John Deere Instrument Panel) Electronic Control System Wiring Diagram

RG8689 –19–18SEP98



RG,RG34710,1615 –19–30SEP97–1/1

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