

JOHN DEERE

COMPONENT TECHNICAL MANUAL

PowerTech® 8.1 L Diesel Engines
Mechanical Fuel System

CTM243 14MAY03 (English)



POWERTECH[®] 8.1 L Diesel Engines

Mechanical Fuel Systems

TECHNICAL MANUAL *POWERTECH*[®] 8.1L Diesel Engine Mechanical Fuel Systems

CTM243 14MAY03 (ENGLISH)

For complete service information also see:

POWERTECH[®]8.1 L Diesel Engines—Base	
Engine	CTM86
Alternators and Starter Motors.....	CTM77
OEM Engine Accessories	CTM67

Introduction

Forward

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

This manual (CTM243) covers only the mechanical fuel system. It is one of five volumes on the 8.1L engine. The following four companion manuals cover the base engine and electronic fuel system repair, operation and diagnostics:

- CTM68—Electronic Fuel Injection Systems
- CTM86—Base Engine
- CTM134—John Deere Level 3 Electronic Fuel Systems with Bosch In-Line Pump.
- CTM255—John Deere Level 9 Electronic Fuel Systems with Denso In-Line Pump.

This new CTM covers information formerly in Group 35 of CTM86 dated 06JUL99 and Group 115 of CTM134 dated 22FEB99.

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

A complete set of all manuals covering the 8.1L engines, excluding CTM68, can be procured by ordering CTM450 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 on the machine or in this manual, be alert to the potential for personal injury.

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

Information is organized in sections and groups for the various components requiring service instruction.

Before beginning repair on an engine, clean the engine.

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

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

Read each block of material completely before performing service to check for differences in procedures or specifications. Follow only the procedures that apply to the engine model number you are working on. If only one procedure is given, that procedure applies to all the engines in the manual.

CALIFORNIA PROPOSITION 65 WARNING

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

RG41183,000002E -19-21FEB01-1/1

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A John Deere ILLUSTRATION® Manual

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Section 01 General

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Contents

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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.



Avoid Fires

TS227 -JUN-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 -JUN-18MAR92

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

Handling Batteries Safely

! **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.

! **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.

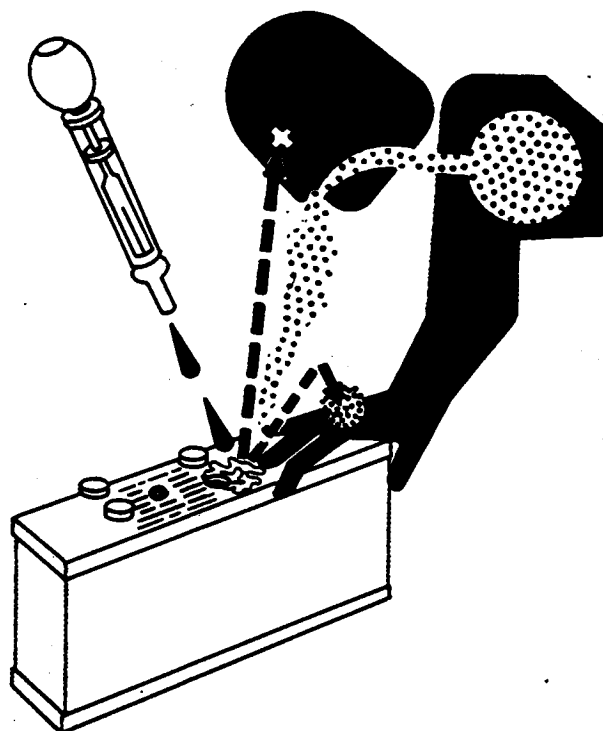
If acid is swallowed:

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.**



TS204 -UN-23AUG88



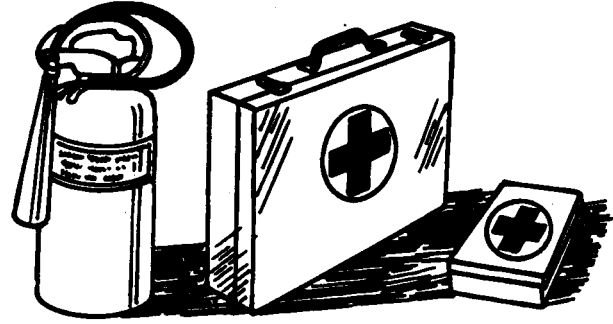
TS203 -UN-23AUG88

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.



First Aid Kit

T5291 -UN-23AUG88

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

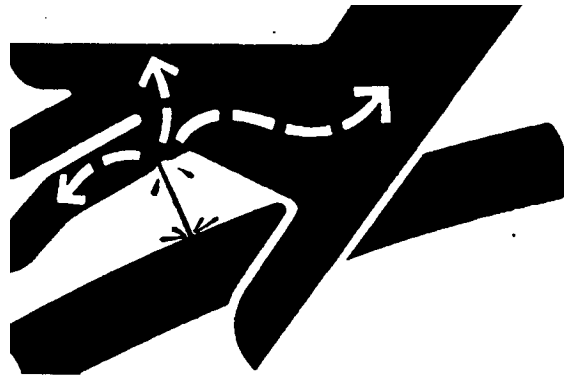
Avoid High-Pressure Fluids

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

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

Search for leaks with a piece of cardboard. Protect hands and body from high pressure fluids.

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



High-Pressure Fluids

X9811 -UN-23AUG88

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

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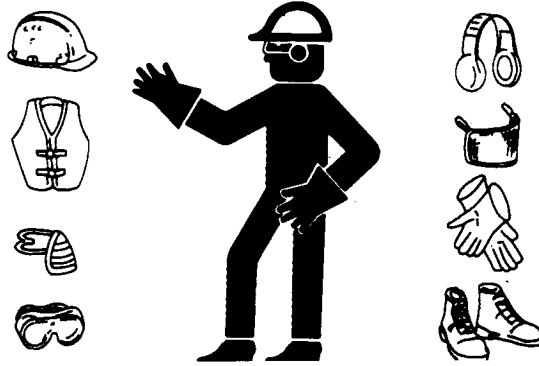
Wear Protective Clothing

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

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

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

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



Protective Clothing

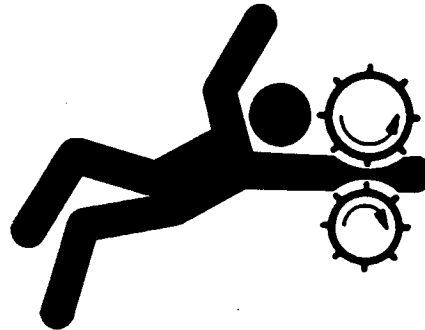
TS206 -UN-23AUG88

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.



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



Engine exhaust fumes

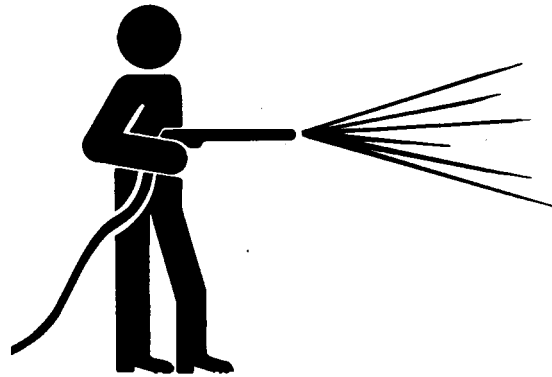
T5220 -JUN-23AUG88

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.



Clean Work Area

T6642EJ -JUN-18OCT88

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

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Remove Paint Before Welding or Heating

Avoid potentially toxic fumes and dust.

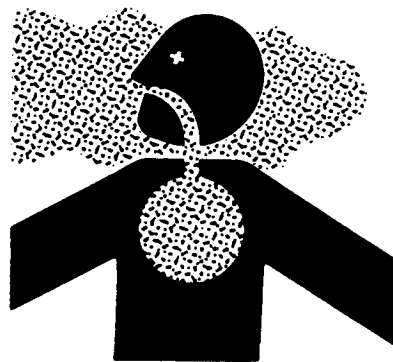
Hazardous fumes can be generated when paint is heated by welding, soldering, or using a torch.

Remove paint before heating:

- Remove paint a minimum of 76 mm (3 in.) from area to be affected by heating.
- If you sand or grind paint, avoid breathing the dust. Wear an approved respirator.
- If you use solvent or paint stripper, remove stripper with soap and water before welding. Remove solvent or paint stripper containers and other flammable material from area. Allow fumes to disperse at least 15 minutes before welding or heating.

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

Dispose of paint and solvent properly.



TS220 -UN-23AUG88

DX,PAINT -19-22OCT99-1/1

Avoid Heating Near Pressurized Fluid Lines

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



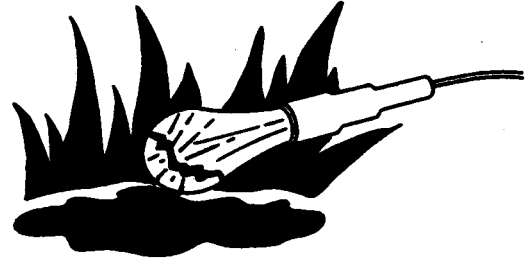
Flammable Spray

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.



Work Area Safely

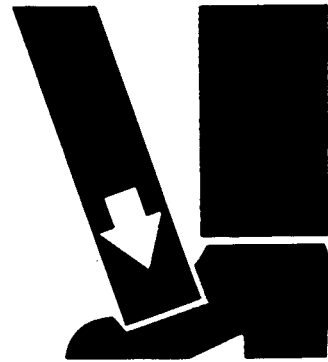
TS223 -JUN-23AUG88

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

Use Proper Lifting Equipment

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

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



Proper Lifting Equipment

TS226 -JUN-23AUG88

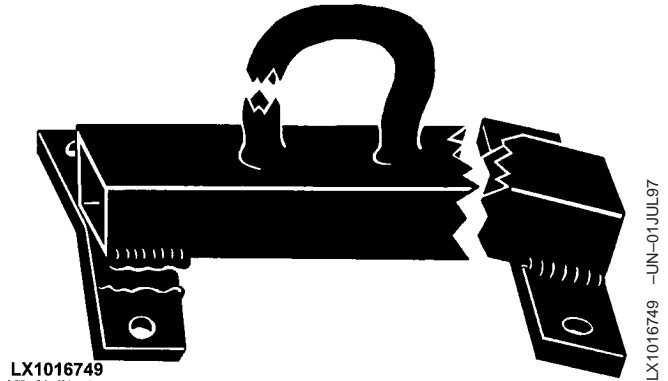
DX,LIFT -19-04JUN90-1/1

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Construct Dealer-Made Tools Safely

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

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



Construct Dealer-Made Tools Safely

LX1016749 -UN-01JUL97

DPSG,OUO1004,899 -19-19MAY99-1/1

Practice Safe Maintenance

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

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

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

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

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

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



Keep Area Clean

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.



Proper Tools

TS779 -JN-08NOV89

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

Dispose of Waste Properly

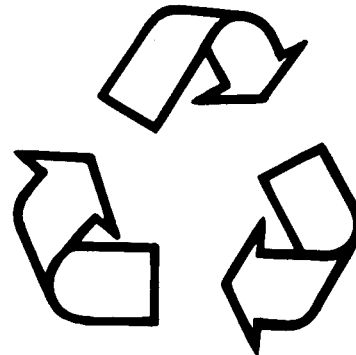
Improperly disposing of waste can threaten the environment and ecology. Potentially harmful waste used with John Deere equipment include such items as oil, fuel, coolant, brake fluid, filters, and batteries.

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.



Recycle Waste

TS1133 -JN-26NOV90

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

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Live With Safety

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



Safety Systems

TS231 -19-07OCT88

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

Engine Model Designation

JOHN DEERE ENGINE MODEL—6081

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

6081 HRW01 Engine

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

Aspiration Code

T Turbocharged, not aftercooled
A Turbocharged and water-to-air aftercooled
H Turbocharged and air-to-air aftercooled

User Code

CQ S.L.C. Horizontina (Brazil)
DW Davenport
F OEM
FF Kernersville Deere-Hitachi (North Carolina)
H Harvester
N Des Moines
RW Waterloo (Tractors)
T Dubuque
TJ Ontario (Canada)
Bessemer (Alabama)
Z Zweibrucken

Application Code

001, etc. See Application Charts, later in this Group

RG, RG34710, 1021 -19-23OCT97-1/1

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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.

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:

RG6081H000000

RG Factory code producing engine
6081H Engine model designation
000000 Sequential serial number

Factory Code

RG Waterloo Engine Works

Engine Model Designation

6801H (See ENGINE MODEL DESIGNATION.)

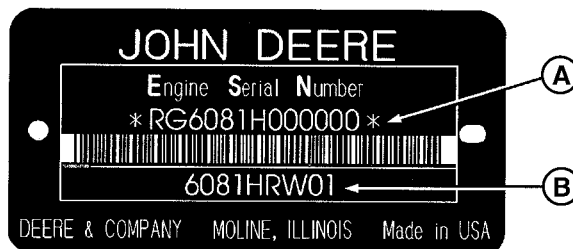
Sequential Number

000000 6-digit sequential number

The engine serial number plate is located either on the right-hand side of engine between the oil filter base and fuel injection pump (viewed from flywheel end) or on the left-hand side of the engine directly above the starter motor.

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.

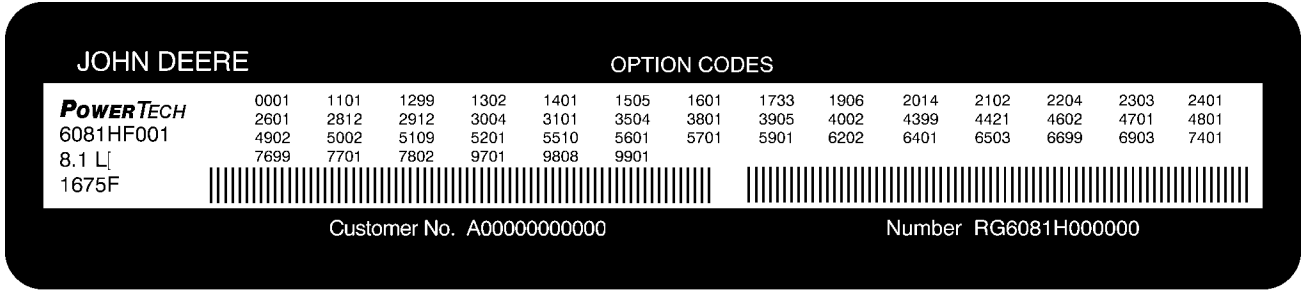


RG7010 -UN-26NOV97

Engine Serial Number Plate

A—Engine Serial Number
B—Engine Application Data

Engine Option Code Label



Option Code Label

In addition to the serial number plate, later 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,OUO1004,900 -19-19MAY99-1/1

Engine Application Chart (John Deere Agricultural Equipment)

Machine Model	Engine Model
DES MOINES—COTTON PICKERS	
9970 Cotton Picker	6081AN001
WATERLOO—TRACTORS	
7710 Tractor	6081TRW01, 09
7810 Tractor	6081TRW02, 10, 11
ZWEIBRUCKEN—COMBINES/FORAGE HARVESTERS	
2256 Combine	6081HZ003, 007
2258 Combine	6081HZ005
2264 Combine	6081HZ002
2266 Combine	6081HZ001
S.L.C. HORIZONTINA (BRAZIL)—COMBINES	
1185A Combine	6081ACQ01

RG,RG34710,1023 -19-23OCT97-1/1

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Engine Application Chart (John Deere Construction Equipment)

Machine Model	Engine Model
DAVENPORT	
644G Loader	6081HDW04
740G/748G/748G II/748G III Skidder	6081TDW01
770C Motor Grader (Early)	6081HDW03
DUBUQUE	
762B Series II Scraper	6081AT001
850C Series II Crawler Dozer (822868—)	6081AT002
KERNERSVILLE (DEERE-HITACHI)	
330LC/370 Excavator	6081HT001
WOODSTOCK, ON	
660D Skidder	6081ATJ02

RG41183,0000024 -19-25JAN01-1/1

Engine Application Chart (OEM) (Outside Equipment Manufacturers)

Application	Engine Model
OEM Engine (Tier I Emissions Certified)	6081TF001
OEM Engine (Tier I Emissions Certified)	6081AF001
OEM Engine (Tier I Emissions Certified)	6081HF001
Marine Engine	6081AFM01
OEM Engine (Tier II Emissions Certified)	6081HF070

RG, RG34710, 1025 -19-20MAY99-1/1

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.

RG41165,0000071 -19-13MAR01-1/1

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.

Fuels, Lubricants and Coolant

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Bio-Diesel Property List for DIN 51606

Property	Unit	DIN 51606 Sept 1997
Density at 15° C (59° F)	g/cm ³ (lb/ft ³)	0.875—0.900 (55—56)
Viscosity at 40° C (104° F)	mm ² /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
Triglycerides	% 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

RG41165,0000034 -19-13MAR01-2/2

Lubricity of Diesel Fuel

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

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

Diesel fuel in the European Union requires sulfur content less than 0.05%.

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

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

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

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

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

DX,FUEL5 -19-24JAN00-1/1

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

Diesel Engine Break-In Oil

New engines are filled at the factory with John Deere ENGINE BREAK-IN OIL. During the break-in period, add John Deere ENGINE BREAK-IN OIL as needed to maintain the specified oil level.

Change the oil and filter after the first 100 hours of operation of a new or rebuilt engine.

After engine overhaul, fill the engine with John Deere ENGINE BREAK-IN OIL.

If John Deere ENGINE BREAK-IN OIL is not available, use a diesel engine oil meeting one of the following during the first 100 hours of operation:

- API Service Classification CE

- ACEA Specification E1

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

IMPORTANT: Do not use PLUS-50 oil or engine oils meeting API CH-4, API CG4, API CF4, ACEA E3, or ACEA E2 performance levels during the first 100 hours of operation of a new or rebuilt engine. These oils will not allow the engine to break-in properly.

PLUS-50 is a registered trademark of Deere & Company.

DX,ENOIL4 -19-24JAN00-1/1

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Diesel Engine Oil

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

The following oil is preferred:

- John Deere PLUS-50®

The following oil is also recommended:

- John Deere TORQ-GARD SUPREME®

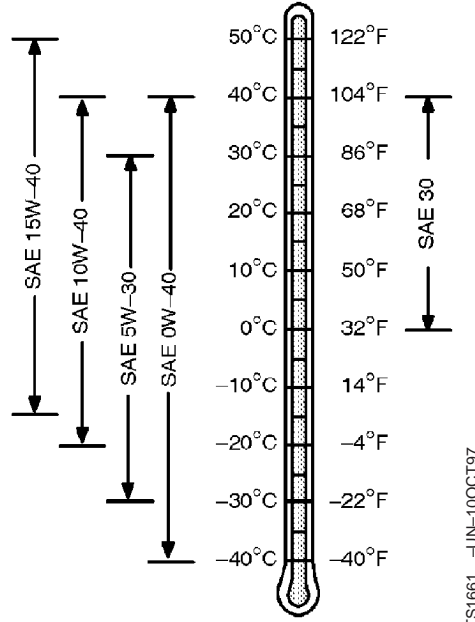
Other oils may be used if they meet one or more of the following:

- API Service Classification CH-4
- API Service Classification CG-4
- API Service Classification CF-4
- ACEA Specification E3
- ACEA Specification E2

Multi-viscosity diesel engine oils are preferred.

If diesel fuel with sulfur content greater than 0.5% is used, reduce the service interval by 50%.

Extended service intervals may apply when John Deere preferred engine oils are used. Consult your John Deere dealer for more information.



TS1661 -JUN-10OCT97

*PLUS-50 is a registered trademark of Deere & Company.
TORQ-GARD SUPREME is a registered trademark of Deere & Company*

DX,ENOIL -19-24JAN00-1/1

Extended Diesel Engine Oil Service Intervals

When John Deere PLUS-50® oil and the specified John Deere filter are used, the service interval for engine oil and filter changes may be increased by 50%.

If other than PLUS-50® oil and the specified John Deere filter are used, change the engine oil and filter at the normal service interval.

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DX,ENOIL6 -19-10OCT97-1/1

Alternative and Synthetic Lubricants

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

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

Consult your John Deere dealer to obtain information and recommendations.

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

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

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

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

Mixing of Lubricants

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

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

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

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

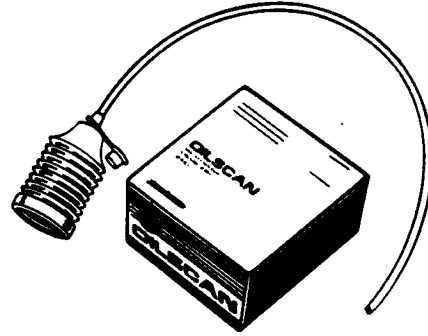
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OILSCAN® and CoolScan®

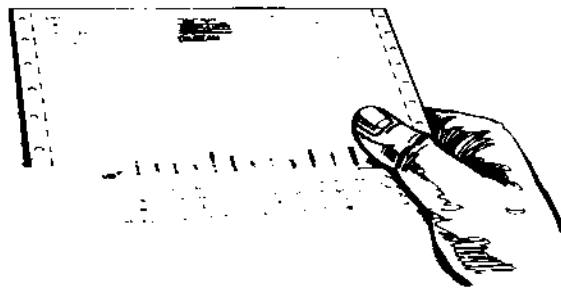
OILSCAN® and CoolScan® are John Deere sampling programs to help you monitor machine performance and identify potential problems before they cause serious damage.

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

Check with your John Deere dealer for the availability of OILSCAN® and CoolScan® kits.



T6828AB -UN-15JUN89



T6829AB -UN-18OCT88

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CoolScan is a registered trademark of Deere & Company.*

DPSG,OUOD002,1824 -19-02AUG00-1/1

Grease

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

The following greases are preferred:

- John Deere SD POLYUREA GREASE

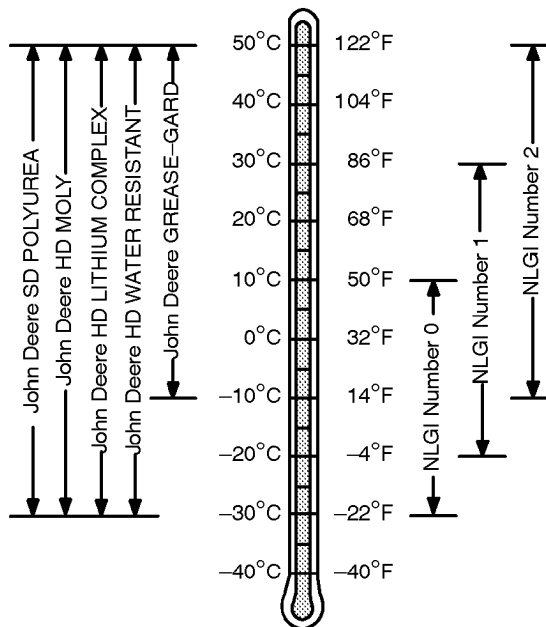
The following greases are also recommended:

- John Deere HD MOLY GREASE
- John Deere HD LITHIUM COMPLEX GREASE
- John Deere HD WATER RESISTANT GREASE
- John Deere GREASE-GARD

Other greases may be used if they meet the following:

- NLGI Performance Classification GC-LB

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



TS1667 -UN-30JUN99

DX.GRE1 -19-24JAN00-1/1

Diesel Engine Coolant

The engine cooling system is filled to provide year-round protection against corrosion and cylinder liner pitting, and winter freeze protection to -37°C (-34°F).

The following engine coolant is preferred for service:

- John Deere COOL-GARD Prediluted Coolant

The following engine coolant is also recommended:

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

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

- ASTM D5345 (prediluted coolant)
- ASTM D4985 (coolant concentrate) in a 40 to 60% mixture of concentrate with quality water

Coolants meeting these specifications require use of supplemental coolant additives, formulated for heavy-duty diesel engines, for protection against corrosion and cylinder liner erosion and pitting.

A 50% mixture of ethylene glycol engine coolant in water provides freeze protection to -37°C (-34°F). If

protection at lower temperatures is required, consult your John Deere dealer for recommendations.

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

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

Coolant Drain Intervals

Drain the factory fill engine coolant, flush the cooling system, and refill with new coolant after the first 3 years or 3000 hours of operation. Subsequent drain intervals are determined by the coolant used for service. At each interval, drain the coolant, flush the cooling system, and refill with new coolant.

When John Deere COOL-GARD is used, the drain interval may be extended to 5 years or 5000 hours of operation, provided that the coolant is tested annually AND additives are replenished, as needed, by adding a supplemental coolant additive.

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

Diesel Engine Coolants, Supplemental Additive Information

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

Coolant Specifications

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

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

Coolants meeting ASTM D5345 (prediluted coolant) or ASTM D4985 (coolant concentrate) require an initial charge of supplemental coolant additives.

Replenish Coolant Additives

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

Why Use Supplemental Coolant Additives?

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

Use of supplemental coolant additives reduces corrosion, erosion, and pitting. These chemicals reduce the number of vapor bubbles in the coolant and help form a protective film on cylinder liner surfaces.

This film acts as a barrier against the harmful effects of collapsing vapor bubbles.

Avoid Automotive-Type Coolants

Never use automotive-type coolants (such as those meeting ASTM D3306 or ASTM D4656). These coolants do not contain the correct additives to protect heavy-duty diesel engines. They often contain a high concentration of silicates and may damage the engine or cooling system.

Non-Aqueous Propylene Glycol

Non-aqueous propylene glycol should not be used with John Deere diesel engines. This coolant works best with coolant temperatures above the acceptable engine operating range. This could decrease engine life due to lower engine oil viscosity. In addition, electronically controlled engines could experience premature power de-rate due to high coolant temperature.

Water Quality

Water quality is important to the performance of the cooling system. Distilled, deionized, or demineralized water is recommended for mixing with ethylene glycol base engine coolant concentrate. All water used in the cooling system should meet the following minimum specifications for quality:

Chlorides	40 mg/L or less
Sulfates	100 mg/L or less
Total Dissolved Solids	340 mg/L or less
Total Hardness	170 mg/L or less
pH Level	5.5 to 9.0

Freeze Protection

The relative concentrations of ethylene glycol and water in the engine coolant determine its freeze protection limit. Refer to the chart on the following page.

Ethylene Glycol	Freeze Protection Limit
40%	-24°C (-12°F)
50%	-37°C (-34°F)
60%	-52°C (-62°F)

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

DPSG,OUOD002,1835 -19-03AUG00-2/2

Testing Diesel Engine Coolant

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

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

Coolant Test Strips

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

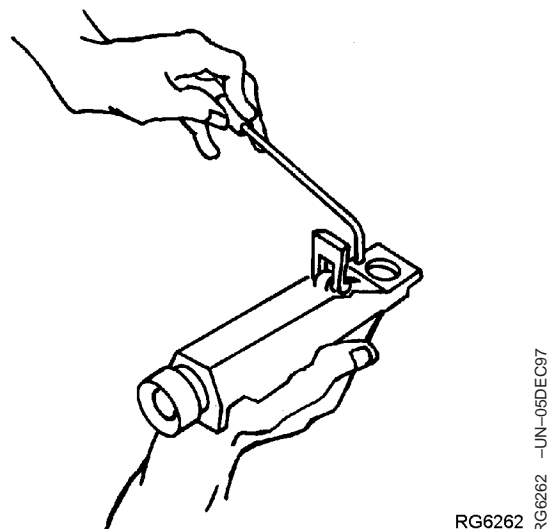
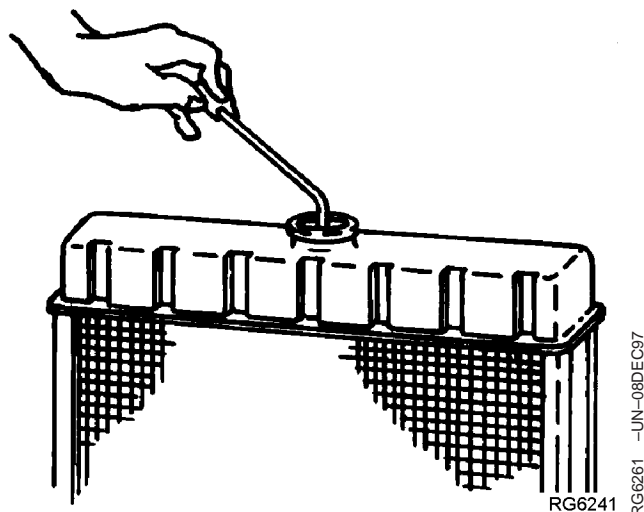
Compare the results to the supplemental coolant additive (SCA) chart to determine the amount of inhibiting additives in your coolant and whether more John Deere COOLANT CONDITIONER should be added.

CoolScan

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

DPSG,OUOD002,1825 -19-02AUG00-1/1

Replenishing Supplemental Coolant Additives (SCAs) Between Coolant Changes



IMPORTANT: Do not add supplemental coolant additives when the cooling system is drained and refilled with John Deere ANTIFREEZE/SUMMER COOLANT or John Deere COOL-GARD®.

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

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

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

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

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

Test the coolant solution at 600 hours or 12 months of operation using either John Deere coolant test strips or a COOLSCAN® analysis. If a COOLSCAN® analysis is not available, recharge system per instructions printed on label of John Deere Liquid Coolant Conditioner.

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

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RG,01,DT7035 -19-14NOV00-1/2

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

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

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

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

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

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

RG,01,DT7035 -19-14NOV00-2/2

Operating in Warm Temperature Climates

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

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

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

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

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

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

Flush and Service Cooling System

CAUTION: Explosive release of fluids from pressurized cooling system can cause serious burns. Shut off engine. Only remove filler cap when cool enough to touch with bare hands. Slowly loosen cap to first stop to relieve pressure before removing cap completely.



IMPORTANT: Air must be expelled from cooling system when system is refilled. (See **CHECKING COOLING SYSTEM** in operator's manual.)

The ethylene glycol base (antifreeze) can become depleted of SCAs allowing various acids to form that will damage engine components. In addition, heavy metals, such as lead, copper and zinc, accumulate in the ethylene glycol base. The heavy metals come from corrosion that occurs to some degree with in a cooling system. When a coolant is saturated to the point where it can no longer hold heavy metals and other dissolved solids, they settle out and act as abrasives on engine parts.

NOTE: Refer to your operator's manual for a specific service interval. (See LUBRICATION AND MAINTENANCE SERVICE INTERVAL CHART in operator's manual.)

Flush cooling system as described in your operator's manual. (See FLUSHING COOLING SYSTEM in operator's manual.) Clean cooling system with clean water and TY15979 John Deere Heavy-Duty Cooling System Cleaner or an equivalent cleaner such as FLEETGUARD® RESTORE™ or RESTORE PLUS™. Follow the instructions provided with the cleaner. Refill cooling system with the appropriate coolant solution. See ENGINE COOLANT SPECIFICATIONS, earlier in this group.

FLEETGUARD is a registered trademark of the Cummins Engine Company.

RESTORE is a trademark of FLEETGUARD.

RESTORE PLUS is a trademark of FLEETGUARD.

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IMPORTANT: NEVER overfill the system. A pressurized system needs space for heat expansion without overflowing at the top of the radiator. Coolant level should be at bottom of radiator filler neck.

Air must be expelled from cooling system when system is refilled. Loosen plug in side of thermostat housing to allow air to escape when filling system. Retighten plug when all the air has been expelled.

After adding new coolant solution, run engine until it reaches operating temperature. This mixes the coolant solution uniformly and circulates it through the entire system. After running engine, check coolant level and entire cooling system for leaks.

Contact your engine servicing dealer, if there are further questions.

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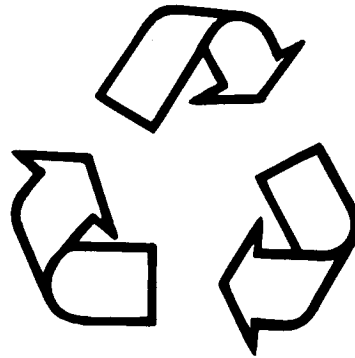
Disposing of Coolant

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

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

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

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



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Section 02

Repair and Adjustment

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02

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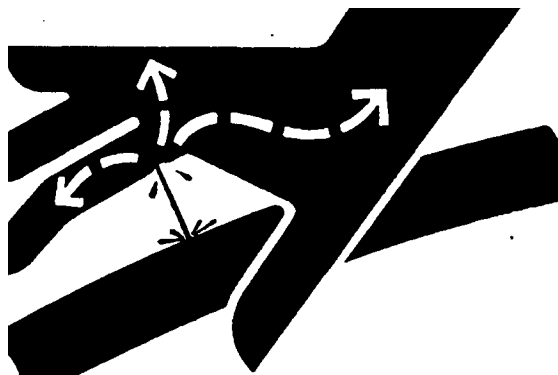
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Relieve Fuel System Pressure

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

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

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



Avoid High-Pressure Fluids

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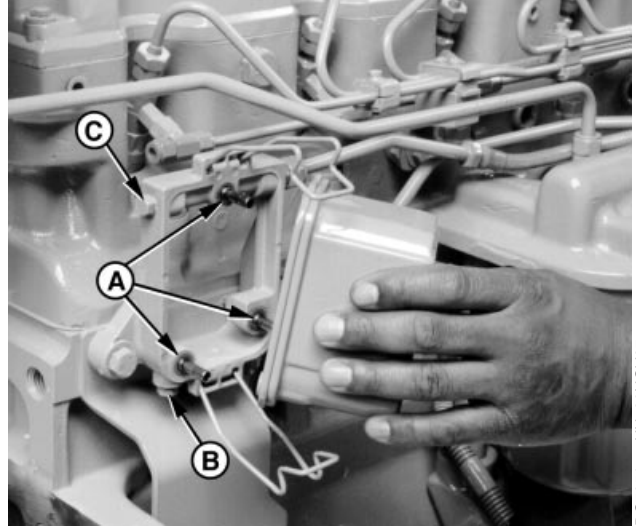
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Replace Rectangular Fuel Filter Element

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

1. Close fuel shut-off valve at bottom of fuel tank (not illustrated).
2. Loosen bleed plug (C) and remove drain plug (B). Drain fuel from filter.
3. With fuel filter held firmly against base, lift up on top retaining spring and pull down on bottom retaining spring. Pull fuel filter off guide pins (A) of fuel filter base and discard filter.

A—Guide Pins
B—Drain Plug
C—Bleed Plug

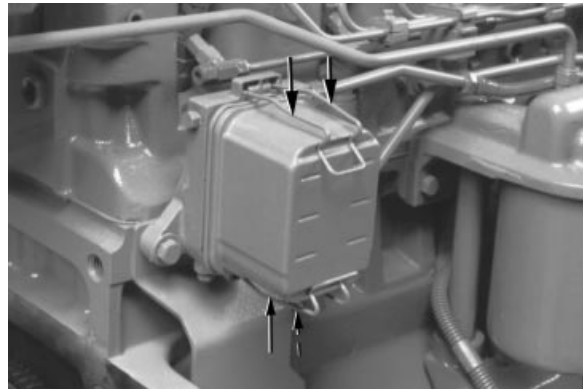


Replacing Rectangular Fuel Filter Element

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4. Install fuel filter onto guide pins on fuel filter base. Hold filter against base.
5. Secure bottom retaining spring first, then secure top retaining spring. (See arrows.)
6. Apply LOCTITE® 592 Pipe Sealant with TEFLON® to drain plug and bleed plug. Install drain plug, shown installed. Tighten bleed plug and drain plug securely. Do not overtighten.
7. Open fuel shut-off valve and bleed fuel system.
8. If fuel filter base was removed from engine, reinstall and tighten cap screws to specifications.



Installing Fuel Filter Element

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Specification

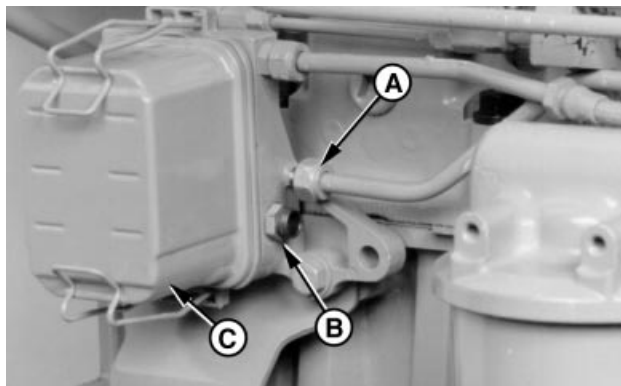
Fuel Filter Base-to-Block
 Mounting Cap Screws—Torque 35 N•m (25 lb-ft)

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

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Replace Fuel Filter Check Valve

1. Drain and remove fuel filter (C) as described earlier in this group.
2. Remove fuel filter inlet line (A), (shown removed).
3. Inspect and clean fuel filter base (if needed).
4. Remove check valve assembly (B) from fuel filter base and discard.
5. Install new check valve assembly and tighten securely.
6. Install fuel inlet line and tighten connection to specifications.



Replacing Fuel Filter Check Valve

- A—Fuel Filter Inlet Line
- B—Chick Valve Assembly
- C—Fuel Filter

Specification

Fuel Pipe Connections at Filter

Base—Maximum Torque..... 17 N•m (12 lb-ft) (150 lb-in.)
maximum

DO NOT overtighten.

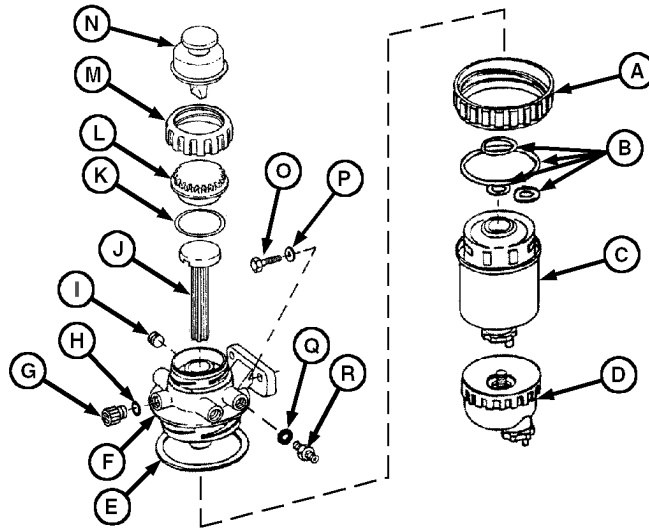
7. Install fuel filter and bleed fuel system.

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Replace Primary (Round) Fuel Filter/Water Separator



Fuel Filter/Water Separator

RG9545 -UN-06MAY99

A—Retaining Ring	F—Filter Head	K—O-Ring	O—Cap Screw (2 used)
B—Seal Kit	G—Bleed Screw	L—Cap	P—Washer (2 used)
C—Filter Element	H—O-Ring	M—Retaining Ring	Q—O-Ring
D—Water Separator Bowl	I—Plug	N—Primer Assembly	R—Fitting
E—Seal	J—Stem		

NOTE: Refer to operator's manual for proper servicing and (hourly) replacement intervals. See LUBRICATION AND MAINTENANCE SERVICE INTERVAL CHART in operator's manual.)

1. Thoroughly clean fuel filter/water separator assembly and surrounding area, if not previously done.

2. Connect a drain line to filter drain adapters and drain all fuel from filters.

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

3. Firmly grasp the retaining ring and rotate it counterclockwise 1/4 turn. Remove ring with filter element (C).

4. Inspect filter mounting base for cleanliness. Clean as required.

5. Remove water separator bowl (D). Drain and clean separator bowl. Dry with compressed air.

6. Install water separator bowl onto new filter element. Tighten securely.

7. Thoroughly inspect filter and base seals (B). Replace as needed.

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

8. Install new filter element onto mounting base and position element using a slight rocking motion. Be sure element is properly indexed on mounting base.

9. Install retaining ring onto mounting base and tighten about 1/3 turn until ring "snaps" into the detent. DO NOT overtighten the retaining ring.

Continued on next page

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10. If removed, install fuel filter base and tighten cap screws to specifications.

11. Bleed fuel system.

Specification

Fuel Filter Base-to-Oil Filter

Base Cap Screws—Torque..... 61 N•m (45 lb-ft)

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Identification of Fuel Supply Pumps

6081 Engines are equipped with a mechanical fuel supply pump mounted on the outside of the injection pump (Bosch, Nippondenso or Motorpal).

A tappet on the final supply pump is actuated by the injection pump rotating cam during engine revolution. The tappet on the supply pump may be either a flat plunger type (Bosch or Motorpal) or a roller tappet type (Nippondenso). (The Nippondenso pump is an option on 6081T engines only.)

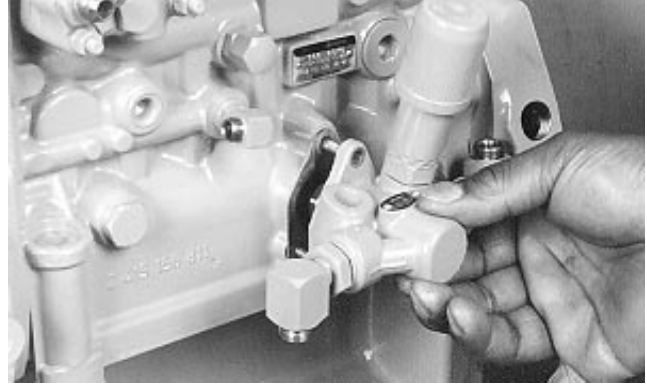
Fuel supply pumps are furnished as complete assemblies for repair. Only the primer, washers, and fittings are available as separate parts.

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Remove Fuel Supply Pump (Bosch and Nippondenso)

Thoroughly clean exterior of supply pump. Also clean around supply pump mounting area on injection pump housing.

1. Disconnect fuel inlet line and outlet line, shown disconnected. Cap all line openings so contaminants do not enter fuel system.
2. Remove three supply pump mounting nuts and pull fuel supply pump straight out from mounting studs as shown.
3. Cover supply pump mounting bore so debris cannot enter injection pump housing.



Removing Fuel Supply Pump

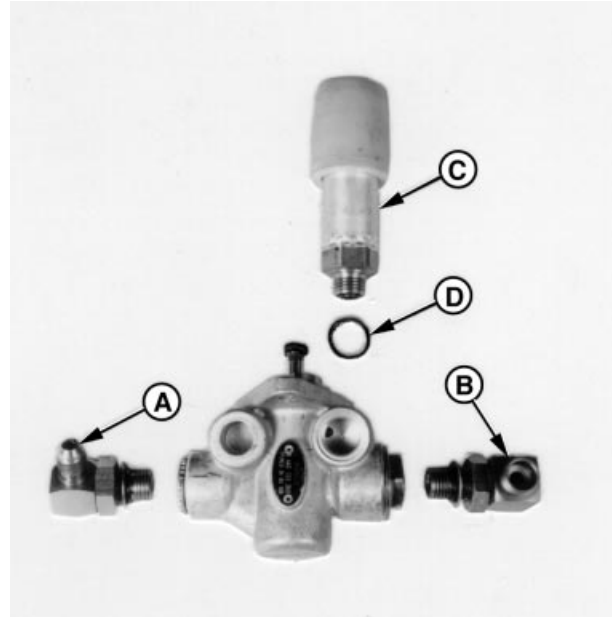
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Inspect Fuel Supply Pump

NOTE: Bosch fuel supply pump shown. Inspection procedures similar for all supply pumps.

1. Inspect supply pump housing (E) for cracks and wear. Be sure plunger or roller tappet bore is not worn or scored. Check condition of threads for inlet and outlet fittings (A and B), hand primer pump (C) and spindle guide plug.
2. Inspect plunger (F) or roller tappet for wear, scoring on O.D. and burrs. Check lands that contact plunger and fuel pump cam lobe to be sure they are flat and undamaged, or that roller tappet is not worn. Remove any deposits with a suitable solvent.
3. If pump housing or plunger/roller tappet mechanism is worn or damaged, replace pump assembly (E). Use new O-rings on fittings and new copper washer (D) on primer.



Fuel Supply Pump (Bosch Shown)

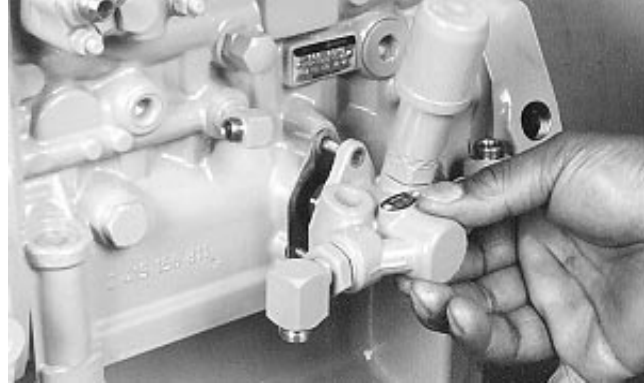
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- A—Inlet Elbow Fitting
- B—Outlet Elbow Fitting
- C—Hand Primer Pump
- D—Copper Washer
- E—Pump Housing
- F—Plunger (Roller Tappet on Nippondenso)

RG41183,0000067 -19-30NOV00-1/1

Install Fuel Supply Pump (Bosch and Nippondenso)

IMPORTANT: Before installing supply pump, test pump to make sure fuel will not leak around plunger (or roller tappet) and seal. See CHECK FUEL SUPPLY PUMP OPERATION in Group 150.



Installing Fuel Supply Pump

1. On Bosch pumps, install a new gasket on supply pump mounting face and position pump over mounting studs.

On Nippondenso pumps, place a new O-ring in counterbore of injection pump housing at supply pump mounting face.

2. Position supply pump on mounting studs as shown.
3. Tighten mounting stud nuts to specifications.

Specification

Bosch and Nippondenso Fuel
Supply Pump Mounting Stud
Nuts—Torque 5—7 N•m (4—5 lb-ft) (45—60
lb-in.)

4. Install fuel inlet and outlet lines and tighten to specifications.

Specification

Fuel Supply Pump Inlet and
Outlet Lines—Torque 10 N•m (7 lb-ft)

Specification

Bosch and Nippondenso Fuel
Supply Pump Elbow Lock Nuts—
Torque 35 N•m (26 lb-ft)

5. Bleed fuel system. See BLEED THE FUEL SYSTEM in Group 150.

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RG7053 -UN-10AUG94

Install Fuel Supply Pump (Motorpal)

IMPORTANT: Before installing supply pump, test pump to make sure fuel will not leak around plunger (or roller tappet) and seal. See CHECK FUEL SUPPLY PUMP OPERATION in Group 150.

1. Install new O-rings (A and E) and copper washer (G) as required.
2. Install fuel supply pump in injection pump bore. Pump should be oriented as shown, with inlet and outlet ports pointing down. Install clamps (B) over flange of supply pump and install cap screws (C). Tighten cap screws to specifications.

Specification

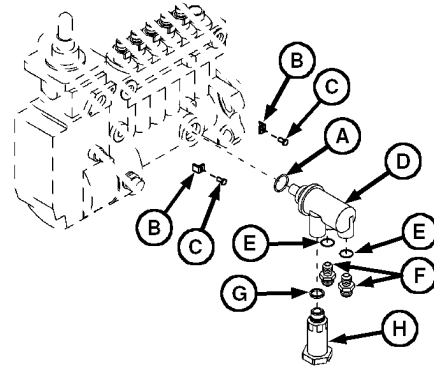
Motorpal Fuel Supply Pump
 Mounting Cap Screws—Torque 8 N•m (6 lb-ft) (72 lb-in.)

3. Install fuel inlet and outlet lines and tighten to specifications.

Specification

Fuel Supply Pump Inlet and
 Outlet Lines—Torque 10 N•m (7 lb-ft)

4. Bleed fuel system. See BLEED THE FUEL SYSTEM in Group 150.



Install Fuel Supply Pump

- A—O-Ring
- B—Bracket (2 used)
- C—Cap Screw (2 used)
- D—Fuel Supply Pump
- E—O-Rings (2 used)
- F—Fittings (2 used)
- G—Copper Washer
- H—Hand Primer Pump

RG10048 -UN-01JUN99

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RG41183,0000069 -19-30NOV00-1/1

Repair Injection Pump Aneroid (Bosch and Nippondenso)—If Equipped

For aneroid repair and adjustment, have an authorized diesel repair station perform the work.

The aneroid controls fuel delivery to pump when intake manifold pressure is about 100 kPa (1.00 bar) (15 psi) or less. Therefore, all final adjustments are to be made on the test stand with aneroid mounted on injection pump.

IMPORTANT: Correct aneroid adjustments are essential for satisfactory engine performance. Whenever aneroid has been disassembled or adjustments have been altered, injection pump (including aneroid) must be calibrated on test stand before releasing pump for service.

RG41183.000006A -19-30NOV00-1/1

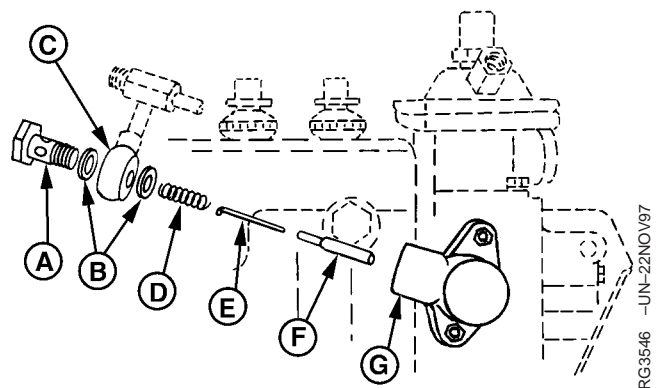
Remove Hydraulic Aneroid Activator (Bosch and Nippondenso)—If Equipped

NOTE: The hydraulic aneroid activator is located on back side of pump governor housing next to cylinder block.

1. Remove injection pump as described later in this group.
2. Remove special screw (A), copper washers (B) and banjo connector (C). Discard copper washers.

NOTE: Do not bend restrictor wire or other activator parts.

3. Remove spring (D), restrictor wire (E) and capillary valve (F) from activator housing (G). Remove activator housing.



Removing Hydraulic Aneroid Activator

- A—Special Screw
- B—Copper Washer
- C—Banjo Connector
- D—Spring
- E—Restrictor Wire
- F—Capillary Valve
- G—Activator Housing (2 Used)

RG41183.000006B -19-30NOV00-1/1

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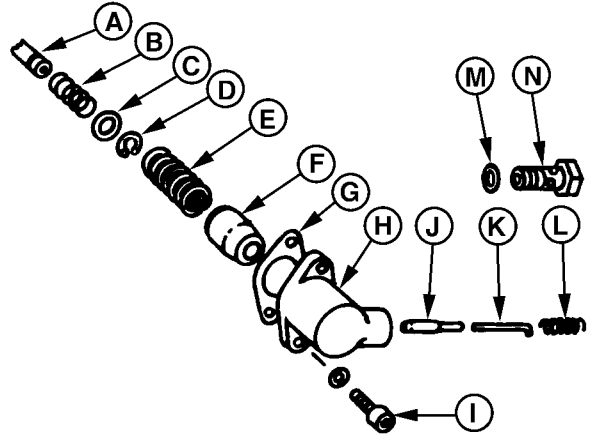
Disassemble, Clean, Assemble and Install Hydraulic Aneroid Activator Parts (Bosch and Nippondenso)—If Equipped

1. Remove gasket (G), piston (F) and piston spring (E).
2. Wash all parts in clean solvent and dry with compressed air. Blow out all openings to make sure they are open.
3. Check piston (F) and activator housing (H) for general condition. Piston must move freely in its bore.
4. Inspect piston spring (E) and capillary valve spring (L). Replace if weak or broken.
5. Inspect condition of restrictor wire (K). Wire must not be bent or broken and must fit loosely in capillary valve (J).
6. Check condition of return spring (B), washer (C) and retaining ring (D) on starting fuel control shaft (A). Replace spring if weak or broken. Be sure retaining ring is secure on shaft.
7. To assemble and install activator, reverse disassembly procedure using new gaskets.

Tighten special screw (N) to specifications.

Specification

Aneroid Activator Special
Screw—Torque..... 14 N•m (10 lb-ft)



Inspecting Hydraulic Aneroid Activator

- A—Starting Fuel Control Shaft
- B—Return Spring
- C—Washer
- D—Retainer Ring
- E—Piston Spring
- F—Piston
- G—Gasket
- H—Activator Housing
- I—Mounting Screw (2 Used)
- J—Capillary Valve Spring
- K—Restrictor Wire
- L—Capillary Valve
- M—Washers
- N—Special Screw

RG3547 -JUN-22NOV97

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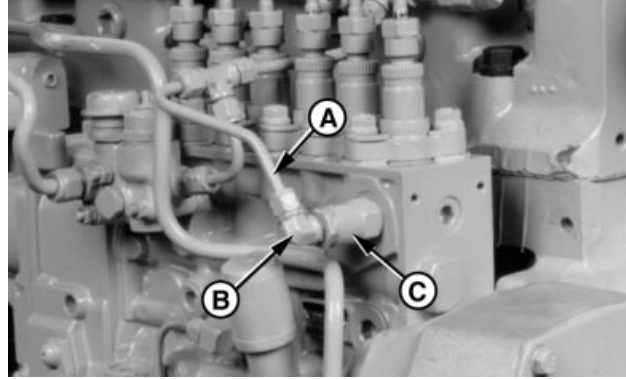
RG41183,000006C -19-30NOV00-1/1

Service Injection Pump Overflow Valve (Bosch and Nippondenso)

NOTE: Overflow valve can be serviced with injection pump installed.

1. Remove leak-off line (A) from elbow (B). Remove elbow from overflow valve assembly (C).
2. Remove valve assembly from pump.

A—Leak-Off Line
B—Elbow
C—Overflow Valve Assembly



Removing Injection Pump Overflow Valve

RG7075 -UN-26NOV97

RG41183,000006D -19-30NOV00-1/2

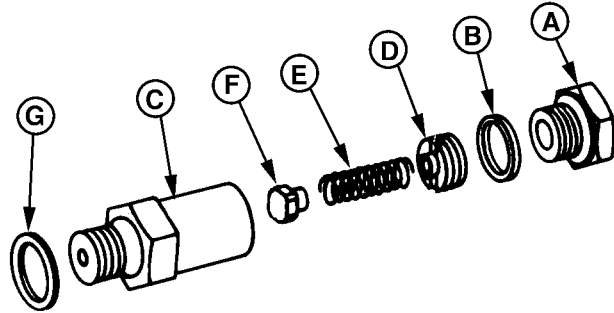
3. Remove reducer (A) and copper washer (B) from valve body (C). Discard copper washer.
4. Unscrew for spring seat (D); then remove spring (E) and valve (F).
5. Inspect for foreign material imbedded in seat of nylon valve.
6. Check spring to see that it is not weak or broken.
7. Wash all parts in solvent and air dry.

NOTE: There is no adjustment on valve to regulate housing pressure. If suspected that valve is malfunctioning, replace valve to restore proper operation.

Specification

Fuel Injection Pump Overflow Valve—Opening Pressure..... 130—180 kPa (1.3—1.8 bar)
(19—26 psi)

8. Reverse order of removal for reassembly of overflow valve. Install new copper washers.



Inspecting Injection Pump Overflow Valve

A—Reducer
B—Washer
C—Valve Body
D—Spring Seat
E—Spring
F—Valve
G—Washer

RG3549 -UN-22NOV97

RG41183,000006D -19-30NOV00-2/2

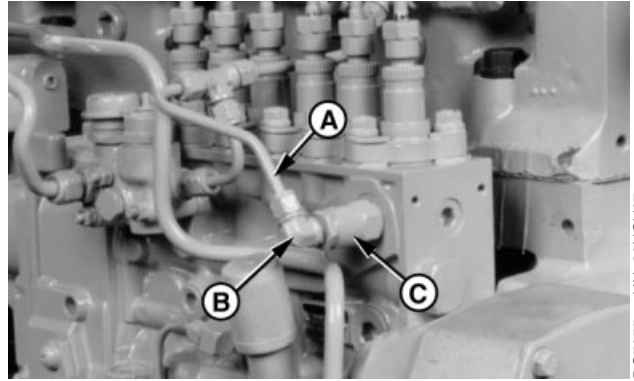
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Service Injection Pump Overflow Valve (Bosch and Nippondenso)

NOTE: Overflow valve can be serviced with injection pump installed.

1. Remove leak-off line (A) from elbow (B). Remove elbow from overflow valve assembly (C).
2. Remove valve assembly from pump.

A—Leak-Off Line
B—Elbow
C—Overflow Valve Assembly

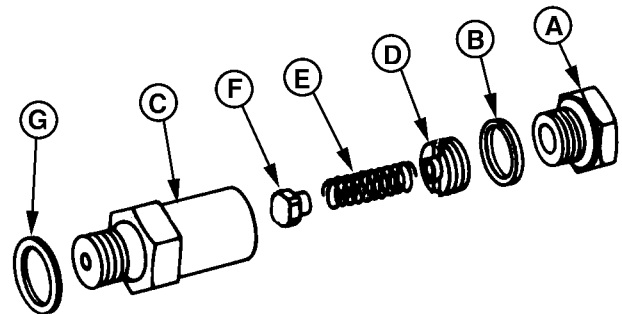


Removing Injection Pump Overflow Valve

RG7075 -UN-26NOV97

RG41183.000006E -19-30NOV00-1/2

3. Remove reducer (A) and copper washer (B) from valve body (C). Discard copper washer.
4. Unscrew for spring seat (D); then remove spring (E) and valve (F).
5. Inspect for foreign material imbedded in seat of nylon valve.
6. Check spring to see that it is not weak or broken.
7. Wash all parts in solvent and air dry.



Inspecting Injection Pump Overflow Valve

A—Reducer
B—Washer
C—Valve Body
D—Spring Seat
E—Spring
F—Valve
G—Washer

RG3549 -UN-22NOV97

NOTE: There is no adjustment on valve to regulate housing pressure. If suspected that valve is malfunctioning, replace valve to restore proper operation.

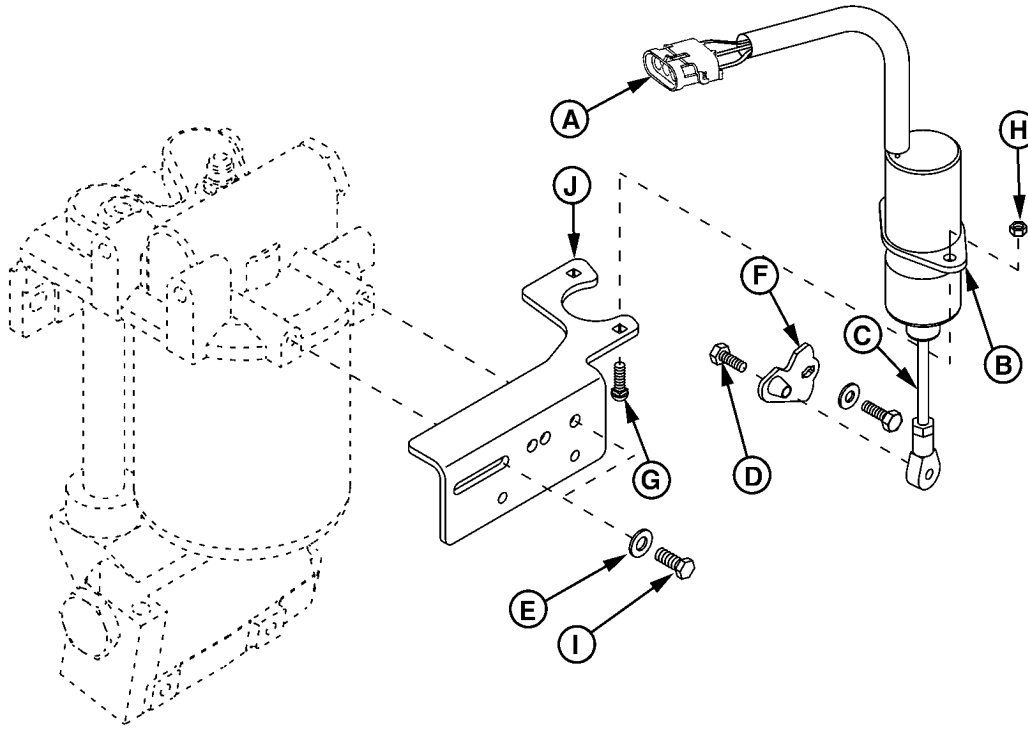
Specification

Fuel Injection Pump Overflow
Valve—Opening Pressure 130—180 kPa (1.3—1.8 bar)
(19—26 psi)

8. Reverse order of removal for reassembly of overflow valve. Install new copper washers.

RG41183.000006E -19-30NOV00-2/2

Remove and Install Fuel Shut-off Solenoid (Bosch and Nippondenso)—If Equipped



Fuel Shut-off Solenoid

RG8759 -UN-02DEC97

- | | | | |
|--------------------------|-----------------------|--------------------------|-----------------------------|
| A—Wiring Connector | D—Lever Cap Screw | G—Lock Washer and Screws | I—Cap Screws |
| B—Fuel Shut-off Solenoid | E—Washer | H—Hex Nuts | J—Solenoid Mounting Bracket |
| C—Solenoid Shaft | F—Fuel Shut-off Lever | | |

1. Disconnect electrical wiring connector (A) in solenoid lead.
2. Remove cap screw (D), and detach solenoid shaft (C) from fuel shut-off lever (F).
3. Remove fuel shut-off solenoid (B) from solenoid mounting bracket (J) by removing hex nuts (H) and machine screws (G).
4. If solenoid mounting bracket is to be removed, remove cap screws (I) and washers (E) that fasten the bracket to oil filter base.
5. Inspect condition of solenoid and replace parts as necessary. (A repair kit is available from parts for this solenoid assembly.)

IMPORTANT: Fuel shut-off solenoid linkage should move freely back and forth. On "A" pumps if linkage is binding, check

pump for proper alignment. See INSTALL FUEL INJECTION PUMP (BOSCH AND NIPPONDENSO), later in this group.

NOTE: Electric fuel shut-off solenoids are factory adjusted to a specified length and should not require additional adjustment. See CHECK FUEL SHUT-OFF SOLENOID OPERATION in Group 150.

6. To install fuel shut-off solenoid, reverse removal procedure. Tighten cap screws and hex nuts to specifications.

Specification

Fuel Shut-off Solenoid	
Mounting Cap Screw—Torque	23 N•m (17 lb-ft)
Fuel Shut-off Solenoid	
Mounting Hex Nut—Torque	7 N•m (5 lb-ft)

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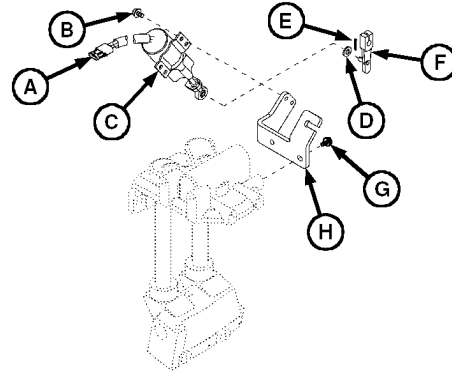
Remove and Install Fuel Shut-off Solenoid (Motorpal)—If Equipped

1. Disconnect wiring connector (A) in solenoid lead.
2. Remove cotter pin (E) and washer (D) and detach solenoid shaft from fuel shut-off lever (F).
3. Remove cap screws (B) and remove shut-off solenoid (C) from bracket.
4. Inspect condition of solenoid and replace parts as necessary.

IMPORTANT: Fuel shut-off solenoid linkage should move freely back and forth.

NOTE: Electric fuel shut-off solenoids are factory adjusted to a specified length and should not require additional adjustment. See CHECK FUEL SHUT-OFF SOLENOID OPERATION in Group 150.

5. To install fuel shut-off solenoid, reverse removal procedure.



Remove and Install Fuel Shut-off Solenoid

- A—Connector
- B—Cap Screw (4 used)
- C—Fuel Shut-Off Solenoid
- D—Washer
- E—Cotter Pin
- F—Fuel Shut-Off Lever
- G—Cap Screw
- H—Mounting Bracket

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Identification of In-Line Fuel Injection Pumps

The in-line fuel injection pumps used on 6081 engines are either P-Series Bosch pumps, A-Series Nippondenso pumps or Mf Series Motorpal pumps. (The A-Series pump is optional on 6081T engines only.) The type of pump is easily determined by the pump identification plate.

BOSCH INJECTION PUMP IDENTIFICATION NUMBER

A-76417 00136 B	Pump Serial Number
B-0 402 796 813	Bosch Part Number
C-PES6P120A720RS7356	
PES	Injection Pump With Housing Flange
6	Number of plungers
P	Type or Size of Pump
120	Plunger Diameter in mm (120 is 12 mm)
A	Letter Designating Design Change
000	Three Numbers Denoting an Assembly
R	Right-Hand Rotation (Viewed From Drive End)
S	Production Pump
0000	Pump Identification Number
D-RE 61 658	John Deere Part Number

MOTORPAL INJECTION PUMP IDENTIFICATION NUMBER

E-PP6M10P1f3468	
PP	Injection Pump With Flange Attachment
6	Number of plungers
M	Type or Size of Pump
10	Plunger Diameter in mm
P	Plunger Design Type
1	Drive Direction and Injection Order
f	Basic Design Designation
3468	Pump Identification Number
F-XX0000	Pump Serial Number
G-RE501784	John Deere Part Number

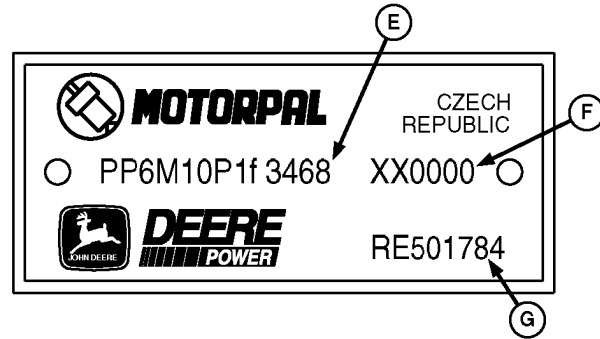
Pumps may have mechanical or electrical shut-off. Electronically controlled governors and hydraulic aneroids are an option on Bosch pumps only.

To summarize pump applications:

P-Series Bosch Pumps	P3000 optional 6081T and A; P7100 optional on 6081A; standard on 6081H.
A-Series Nippondenso Pumps	A2500 optional on 6081T only.
Mf-Series Motorpal Pumps	PPMf optional on 6081T



Bosch Fuel Injection Pump Identification Plate



Motorpal Fuel Injection Pump Identification Plate

- A—Bosch Pump Serial Number
- B—Bosch Part Number
- C—Bosch Identification Number
- D—John Deere Part Number (Bosch)
- E—Motorpal Identification Number
- F—Motorpal Pump Serial Number
- G—John Deere Part Number (Motorpal)

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Service of Fuel Injection Pumps

Have an authorized diesel repair station perform any internal service or test stand calibration required on injection pumps.

For diagnostics and tests of electronic control systems, refer to the following:

- Older Bosch ECU controls, see CTM68.
- John Deere ECU controls with electronic fuel systems, see CTM134.
- John Deere ECU controls with high pressure common rail (HPCR) fuel systems, see CTM255

NOTE: If no injection pump repair and testing stations are available locally complete remanufactured pumps are available for Motorpal pumps. If a Motorpal injection pump fails, return it for a replacement pump. In the U.S. and Canada, return the failed pump to:

ReGen Manufacturing Co.

4500 Mustard Way

Springfield, MO. 65803

Outside the U.S. and Canada, return pump to nearest Service Parts Depot.

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Replace Motorpal Fuel Injection Pump Delivery Valve O-Rings

IMPORTANT: ALWAYS clean area around injection pump and fuel delivery lines with a steam cleaner and/or compressed air as needed so that no dirt or debris is allowed to enter injection pump. Never steam clean or pour cold water on an injection pump while pump is running or while pump is warm. This could cause seizure of internal pump parts.

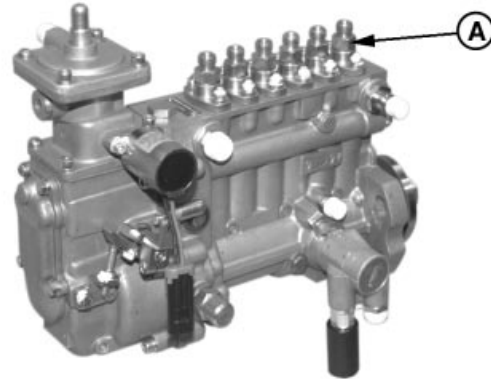
NOTE: Delivery valve O-rings (B) may be replaced with pump removed or installed on engine.

1. Clean area around injection pump and delivery lines as needed.
2. Remove delivery valve (A) using a 17 mm deep well socket.
3. Remove O-ring (B) from delivery valve and discard.
4. Clean delivery valve in diesel fuel and dry with compressed air.
5. Lightly lubricate new O-ring with clean engine oil or dip in clean diesel fuel. Install O-ring against shoulder of delivery valve as shown.
6. Carefully install delivery valve and tighten to the following specification.

Specification

Fuel Injection Pump Delivery Valve (Motorpal)—Torque 47 N•m (35 lb-ft)

7. After installation, cover delivery valve with a clean cap to keep dirt out of fuel system.
8. Repeat procedure on remaining delivery valves as needed.



Delivery Valve

RG10261 -UN-01JUL99



Delivery Valve O-Rings

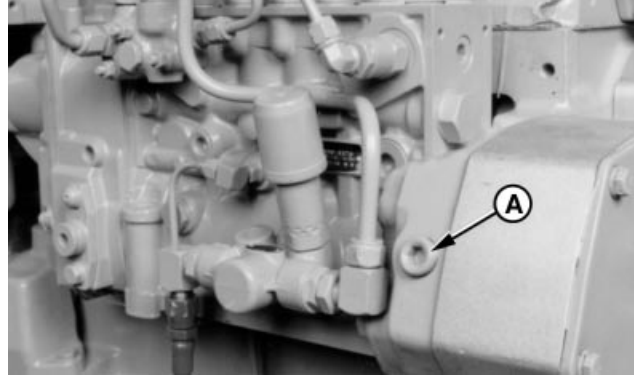
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A—Delivery Valve
B—O-Ring

Remove Fuel Injection Pump (Bosch and Nippondenso)

IMPORTANT: Never steam clean or pour cold water on an injection pump while pump is running, or while it is still warm. To do so may cause seizure of pump parts.

1. Clean injection lines and area around the injection pump with cleaning solvent or a steam cleaner.
2. Remove timing hole plug (A).
3. Rotate engine flywheel (in normal running direction) with JDG820 Flywheel Turning Tool until No. 1 piston is at "TDC" of its compression stroke. At this point, JDE81-4 Timing Pin should enter hole in flywheel.
4. Timing marks on injection pump drive hub and fixed timing pointer should be aligned.



Injection Pump Timing Access Hole

A—Timing Hole Plug

RG7739 -UN-28NOV97

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- Remove injection pump drive gear cover (shown removed), remove and discard all gasket material or O-ring.

NOTE: If removal of pump drive gear cap screw is difficult due to interference from the radiator, fan or fan belt, perform the following step:

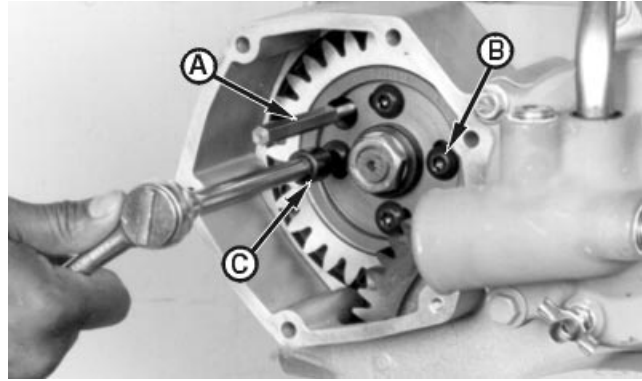
- Remove JDG81-4 Timing Pin from flywheel and rotate engine until cap screw (B) at 5 o'clock position is clearly accessible. Remove cap screw using a T45 TORX® adapter.

Rotate engine with JDG820 Flywheel Turning Tool until JDE81-4 Timing Pin enters flywheel at No. 1 cylinder's compression stroke.

IMPORTANT: To assure that accurate injection pump timing is maintained when pump is removed and reinstalled, it is recommended that JDG886 Injection Pump Timing Pin (A) is used prior to removal and installation of injection pump. If injection pump will be serviced at an authorized repair station, remove timing pin prior to shipping for service.

NOTE: It may be necessary to rotate injection pump drive hub slightly to install timing pin.

- Install JDG886 Timing Pin (A) through hole in injection pump drive gear. Thread timing pin into injection pump hub until it bottoms.
- Remove remaining injection pump drive gear cap screws using a T45 TORX® adapter (C) and remove drive gear from pump drive hub.



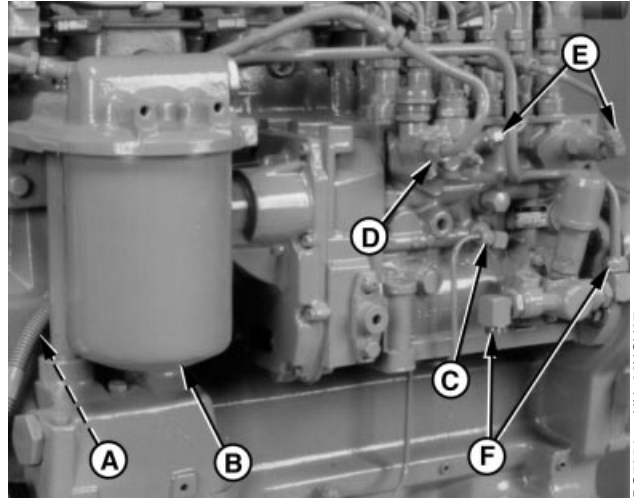
Installing Timing Pin and Removing Pump Gear

A—Timing Pin
B—Cap Screw
C—Adapter

RG9546 -JUN-04MAY99

9. Remove engine oil filter (B) from filter base.
10. Disconnect governor pigtail connectors (A) from main wiring harness. Disconnect fuel shut-off solenoid wiring lead (shown disconnected and capped).
11. Remove injection pump lube line (C) from elbow fitting.
12. Remove fuel inlet (D) from shut-off solenoid. Remove fuel leak-off line assembly (E).
13. Disconnect fuel supply pump lines (F). (Photo shows outlet line only.)

Cap all openings on pump and line connections so contaminants do not enter fuel system.



Removing Injection Pump

- A—Governor Pigtail Connectors
- B—Oil Filter
- C—Injection Pump Lube Line
- D—Fuel Inlet Line
- E—Leak-off Line Assembly
- F—Fuel Supply Pump Lines

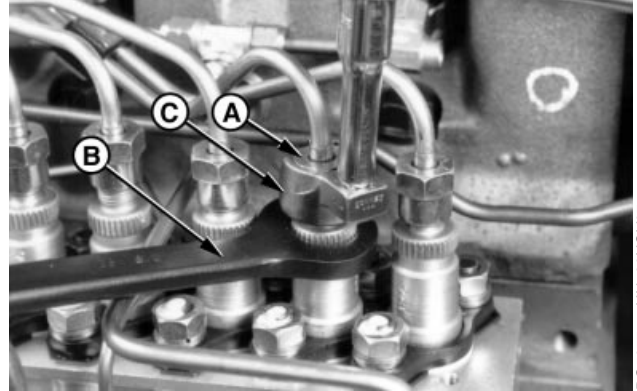
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RC7054 -UN-28NOV97

IMPORTANT: DO NOT move delivery valve fittings while loosening line nuts. If a delivery valve and barrel housing rotates while loosening or tightening a fuel line nut, injection pump must be recalibrated on a test stand. Use a backup wrench. On Bosch "P" pumps, JDE90 Serrated Wrench (B) **MUST BE** used.



Removing Lines (Bosch "P" Pump Shown)

A—Injection Line Nuts
B—Serrated Wrench
C—Crow's Foot Wrench

14. Remove injection line nuts (A) from injection pump delivery valves. On Bosch "P" pumps, use JDE90 Serrated Wrench (B) along with either JDF22 Crowsfoot Wrench (C) or a standard 3/4-in. line wrench. (On Nippondenso "A" pumps, use JDF22 Crowsfoot Wrench and a 22 mm open end wrench to hold valve fittings.)
15. Disconnect throttle linkage from pump.
16. Remove four injection pump mounting stud nuts.
17. Carefully remove injection pump and place it on a clean flat surface.
18. Cap all delivery valve fittings.

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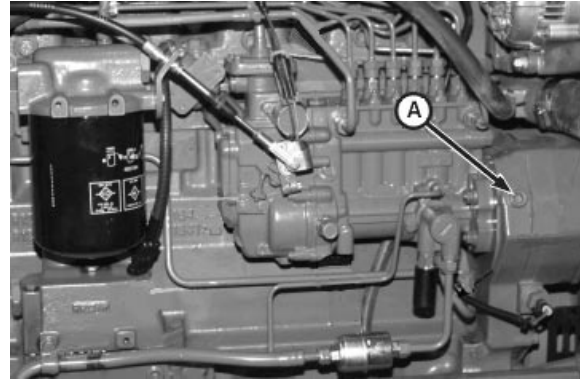
Remove Fuel Injection Pump (Motorpal)

IMPORTANT: Never steam clean or pour cold water on an injection pump while pump is running, or while it is still warm. To do so may cause seizure of pump parts.

1. Clean injection lines and area around the injection pump with cleaning solvent or a steam cleaner.
2. Drain enough coolant from radiator to remove heater hose and upper radiator hose from water pump inlet elbow (shown removed) for access to injection pump drive gear cover.
3. Remove timing hole plug (A) to view drive hub timing mark.
4. Rotate engine flywheel (in normal running direction) with JDG820 Flywheel Turning Tool until No. 1 piston is at "TDC" of its compression stroke. At this point, JDE81-4 Timing Pin should enter hole in flywheel.

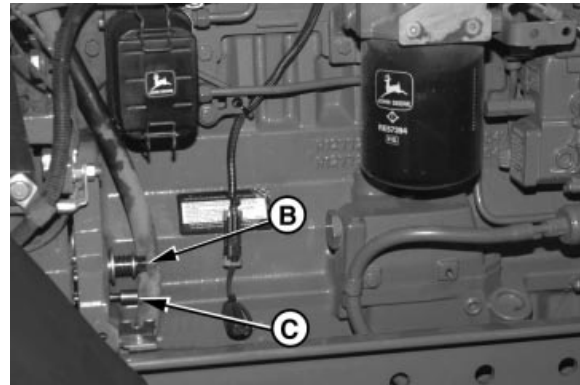
Timing mark on injection pump drive hub should be visible.

5. If timing mark is not visible, remove timing pin from flywheel and rotate flywheel one full revolution until timing pin enters hole in flywheel and timing mark on injection pump drive hub is visible.
6. Reinstall timing hole plug using LOCTITE® 242 (TY9370) Thread Lock and Sealer. Tighten plug securely.



RG10042 -UN-25MAY99

Timing Hole Plug



RG9579 -UN-04DEC98

Flywheel Turning/Locking Tools

- A—Timing Hole Plug
- B—JDG820 Flywheel Turning Tool
- C—JDE81-4 Timing Pin

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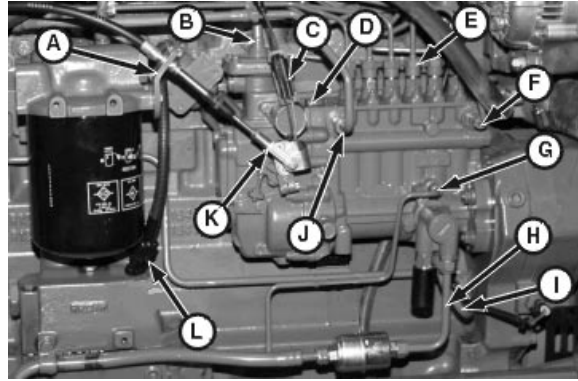
NOTE: Use a thin-wall 17 mm open-end crowsfoot wrench to keep delivery valve fittings from turning when loosening line nuts at injection pump.

If delivery valves are disturbed when loosening lines, valves are retorqued to 47N•m (35 lb-ft).

O-rings on delivery valves are available for service.

7. Remove all fuel delivery lines (E) from injection pump using JDF22 Crowsfoot Wrench and an open end wrench. Cap all delivery valves and lines to keep debris out.
8. Disconnect leak-off line (F), supply pump inlet line (H), supply pump outlet line (I) and fuel inlet line (J). Cap lines and fittings.
9. Disconnect throttle cable (K) from injection pump throttle lever and bracket (A).
10. Disconnect injection pump lube line (G).
11. Disconnect line (B) and harness connector (C) from aneroid.
12. Disconnect fuel shut-off solenoid harness connector (L) (shown disconnected).
13. Disconnect fuel shut-off solenoid with bracket from oil filter base.

NOTE: Injection pump will be removed with shut-off solenoid and bracket attached.



Remove Injection Pump

- A—Throttle Bracket
- B—Aneroid Line
- C—Aneroid Connector
- D—Oil Fill Plug
- E—Injection Line
- F—Leak-Off Line
- G—Lube Line
- H—Supply Pump Inlet Line
- I—Supply Pump Outlet Line
- J—Fuel Inlet Line
- K—Throttle Cable
- L—Fuel Shut-Off Solenoid Connector

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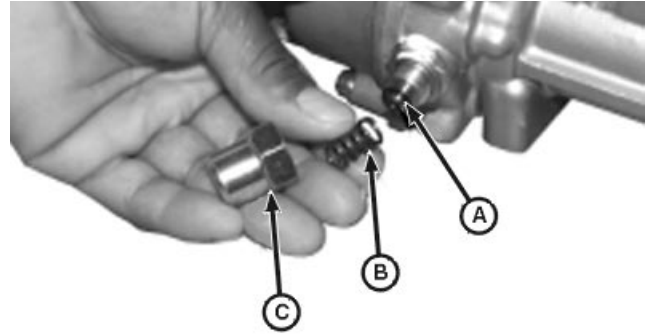
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14. Remove V-belt and remove injection pump drive gear cover (shown removed). Remove and discard all gasket material.

IMPORTANT: To ensure that accurate injection pump timing is maintained when pump is removed and reinstalled, perform the following step:

15. Remove cap (C), pin (A) and spring (B) from pump. Reinstall parts as show, with pin first, then spring and cap. Tighten cap by hand. This will lock injection pump timing.
16. Remove four injection pump drive gear-to-pump hub cap screws using a T45 TORX® adapter.
17. Remove four injection pump mounting stud nuts.
18. Carefully remove injection pump and shut-off solenoid with bracket from mounting studs.
19. Remove injection pump drive gear from timing gear cover.



A—Timing Pin
B—Spring
C—Cap

RG10044 -UN-25MAY99

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Install Fuel Injection Pump (Bosch and Nippondenso)

1. If engine was rotated after injection pump was removed, rotate flywheel until timing pin enters flywheel at No. 1 cylinder's "TDC" compression stroke.

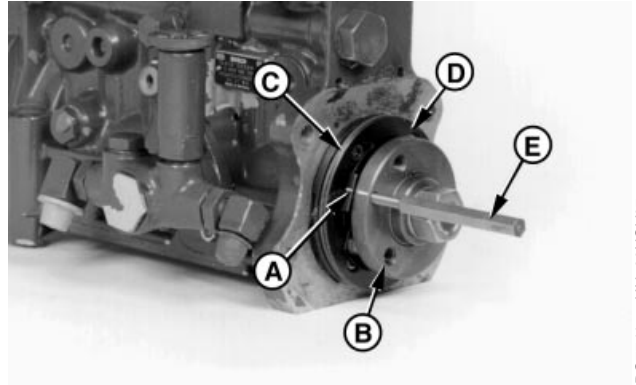
NOTE: When No.1 cylinder is at "TDC" compression stroke, intake and exhaust valves for No. 1 cylinder will be closed and both rocker arms will be loose.

2. Rotate injection pump drive hub until marks on drive hub (B) and pointer (A) are aligned.

NOTE: It may be necessary to rotate pump hub slightly to get timing pin (E) to enter bearing plate.

3. Thread JDG886 Timing Pin (E) into drive hub, as shown, and tighten until it bottoms against bearing plate (D).
4. Install a new O-ring (C) on pump mounting hub. Lightly lubricate O-ring with AR54749 Soap Lubricant to aid in pump installation and prevent O-ring damage.

NOTE: Place injection pump drive gear in timing gear housing (if previously removed) with chamfered side of gear toward injection pump. Chamfer is at outer edge of bore for easier installation of gear to pump drive hub.



Preparing Injection Pump for Installation

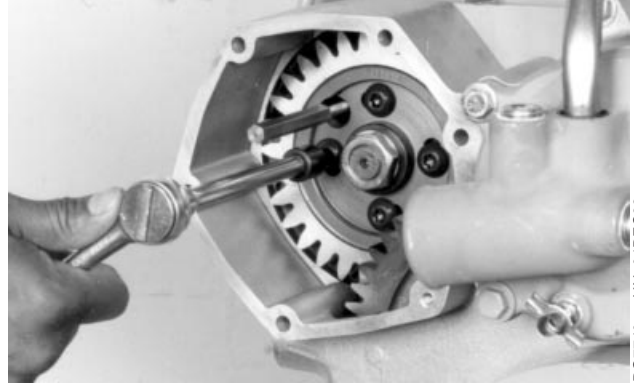
- A—Pointer
- B—Drive Hub
- C—O-Ring
- D—Bearing Plate
- E—JDG886 Timing Pin

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IMPORTANT: Nippondenso “A” injection pumps must be installed straight (upright) on the engine to assure correct alignment of fuel shut-off solenoid linkage. Misaligned linkage will bind and not allow shut-off solenoid to operate properly, if pump is incorrectly installed. Pump is correctly aligned if linkage can be moved freely back and forth.



Installing Pump Drive Gear

A—Timing Pin
B—Adapter

5. Install injection pump using moderate forward pressure and slight rocking motion to work O-ring into mounting bore.

Injection pump flange should seat solidly against cylinder block and injection pump drive hub nut should be positioned in I.D. of pump drive gear.

6. Install mounting stud nuts and tighten to specifications.

Specification

Bosch and Nippondenso Injection
Pump-to-Cylinder Block Stud
Nuts—Torque 47 N•m (35 lb-ft)

7. Carefully install drive gear on pump drive hub, position gear so mounting cap screws are approximately centered in mounting slots. This will allow for minor adjustment of pump timing, should the need arise.

8. Install four drive gear-to-pump hub cap screws and tighten to specifications using a T45 TORX® adapter (B).

Specification

Bosch and Nippondenso Injection
Pump Drive Gear-to-Pump Hub
Cap Screw—Torque 61 N•m (45 lb-ft)

9. Remove JDG886 Timing Pin (A) from injection pump hub. Install timing hole plug using LOCTITE® 242 (TY9370) Thread Lock and Sealer, tighten plug securely.

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RG7740 -UN-04DEC98

TORX is a registered trademark of Camcar/Textron
LOCTITE is a registered trademark of Loctite Corp.

NOTE: Also remove timing pin from engine flywheel (if installed).

10. Install injection pump drive gear cover using a new gasket or O-ring. Tighten cap screws to specifications.

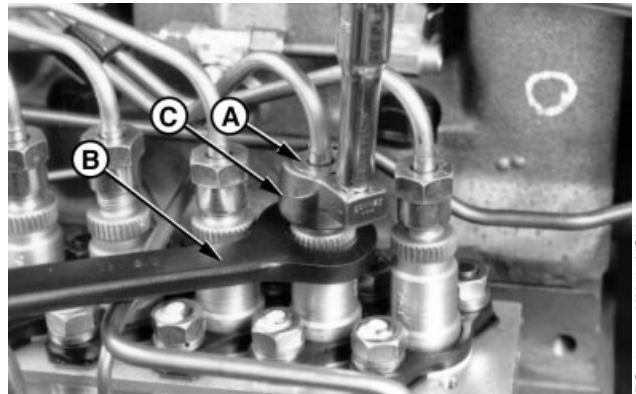
Specification

Injection Pump Drive Gear Cover
 Cap Screws—Torque 27 N•m (20 lb-ft)

RG41183,0000076 -19-30NOV00-3/6

NOTE: Remove protective caps and plugs that were installed on fuel system components during injection pump removal.

11. Connect fuel delivery line nuts (A) to injection pump delivery valve fittings using two wrenches as shown. On Bosch "P" pumps, use JDE90 Serrated Wrench (B) and JDF22 Crowsfoot Wrench (C). (On Nippondenso "A" pumps, use JDF22 Crowsfoot Wrench and a 22 mm open end wrench to hold valve fittings.) Tighten line nuts to specifications.



Installing Lines (Bosch "P" Pump Shown)

- A—Fuel Delivery Line Nuts
- B—Serrated Wrench
- C—Crowsfoot Wrench

Specification

Fuel Delivery Line Connectors @
 Delivery Valves and Nozzles—
 Torque 27 N•m (20 lb-ft)

IMPORTANT: DO NOT move delivery valve fittings while tightening line nuts. If delivery valve and barrel housing rotates while tightening a fuel line nut, injection pump fuel delivery will be altered. The injection pump will have to be recalibrated on a test stand by an authorized diesel repair station.

Continued on next page

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RG5877 -UN-26NOV97

IMPORTANT: Tighten all fuel system connections securely to avoid leakage and air entering system.

12. Install fuel leak-off line assembly (E) onto pump connectors and tighten all connections

to specifications.

Specification

Bosch and Nippondenso Fuel Leak-Off Lines-to-Injection Pump Connectors—Torque 13 N•m (10 lb-ft)

13. Connect fuel supply pump lines (F) and fuel inlet line (D) at fuel shut-off solenoid.

Specification

Fuel Supply Pump Lines-to-Injection Pump—Torque..... 10 N•m (7 lb-ft)

Specification

Fuel Inlet Line-to-Injection Pump—Torque 10 N•m (7 lb-ft)

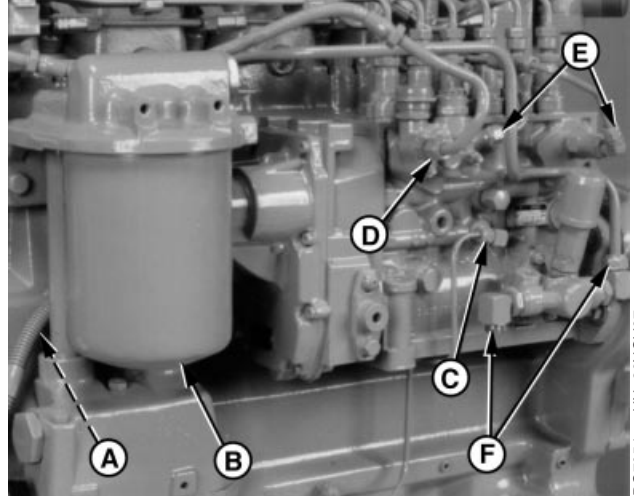
14. Connect injection pump lube line (C) to cylinder block fitting.

Specification

Injection Pump Lube Line—Torque 4.5 N•m (3 lb-ft) (36 lb-in.)

15. Connect governor pigtail connectors (A) to wiring harness.

16. Install engine oil filter (B).



RG7054 -UN-26NOV97

Installing Injection Pump

- A—Governor Pigtail Connectors
- B—Oil Filter
- C—Injection Pump Lube Line
- D—Fuel Inlet Line
- E—Leak-off Line Assembly
- F—Supply Pump Lines

Continued on next page

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IMPORTANT: NEVER operate injection pump without engine lubricating oil in pump housing. Doing so may cause damage to internal pump rotating parts.

- 17. Remove oil fill plug (A) and add enough clean engine oil until oil comes out fill hole. Engine should be level when checking oil level. Tighten plug to specifications.

Specification

Nippondenso and Bosch Injection
 Pump Housing Oil Fill Plug—
 Torque 25 N•m (18 lb-ft)

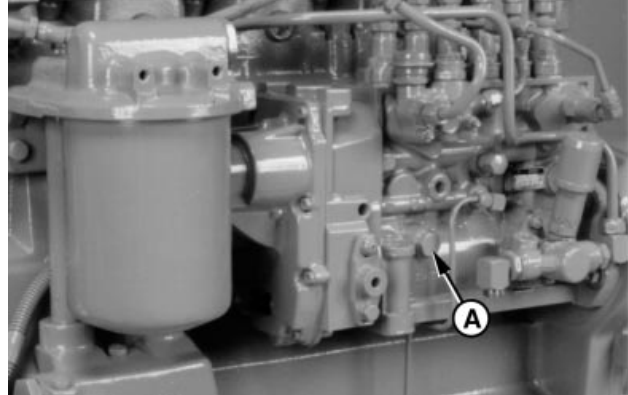
NOTE: On Nippondenso "A" pumps, oil fill plug is on top of pump housing. Add 1/2 pint of clean engine oil.

- 18. Also add clean engine oil to pump rear governor housing by removing plug (B) at top. Add 0.1 Liter (1/5 quart). Tighten plug to specifications.

Specification

Nippondenso and Bosch Injection
 Pump Governor Housing Oil Fill
 Plug—Torque..... 40 N•m (30 lb-ft)

- 19. Service fuel filter and water separator as needed.
- 20. Bleed fuel system. See BLEED THE FUEL SYSTEM in Group 150.
- 21. Connect throttle linkage to pump. To check fast and slow idle speeds, refer to Group 105 of CTM134. See CHECK AND ADJUST SLOW IDLE SPEED in Group 150. See CHECK FAST IDLE SPEED in Group 150.



RG7055 -UN-26NOV97

Adding Oil to Pump Housings

A—Oil Fill Plug
 B—Governor Oil Fill Plug

Install Fuel Injection Pump (Motorpal)

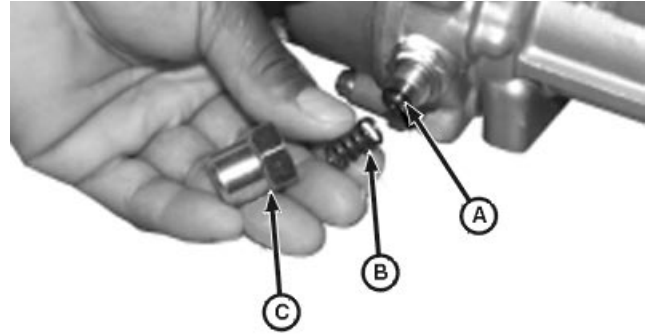
NOTE: If missing, timing pin assembly is available through John Deere Service Parts.

1. If engine was rotated after injection pump was removed, rotate flywheel until timing pin enters flywheel at No. 1 cylinder's "TDC" compression stroke.

NOTE: When No.1 cylinder is at "TDC" compression stroke, intake and exhaust valves for No. 1 cylinder will be closed and both rocker arms will be loose.

2. Check to make sure that injection pump timing pin (A) is fully engaged in pump timing slot with spring (B) on the outboard side of pin.
3. Reinstall spring and tighten cap (C) finger tight.

Applying a light turning force, attempt to rotate pump by hand to verify pump is locked.



Install Pump Timing Pin

A—Timing Pin
B—Spring
C—Cap

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NOTE: Fuel shut-off solenoid and bracket assembly **MUST BE** installed onto injection pump before installing pump on engine.

4. Install fuel shut-off solenoid (A) and bracket assembly onto shut-off lever using washer (B) and cotter pin (C). Offset (E) in rod should face away from pump as shown.

5. Install new O-ring (D) in groove of pump mounting hub. Lubricate O-ring with AR54749 Soap Lubricant to aid in pump installation and prevent damage to O-ring.

6. Install injection pump drive gear in timing gear cover with part number facing front of engine. Four slots in gear should be at 3, 6, 9 and 12 o'clock positions.

NOTE: It may be necessary to reposition drive gear in timing gear cover so that mounting slots align with threaded holes in pump drive hub.

7. Install injection pump with shut-off solenoid and bracket onto mounting studs as O-ring seats in mounting bore using moderate forward pressure and a slight rocking motion. Injection pump flange should seat solidly against cylinder block and injection pump drive hub nut should be positioned in I.D. of pump drive gear.

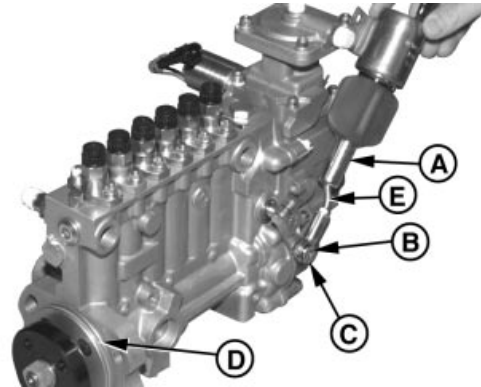
8. If necessary, rotate and reposition pump drive gear so that four threaded holes in drive hub line up in the middle of gear slots.

9. Install four mounting stud nuts and tighten to specifications.

Specification

Motorpal Injection	
Pump-to-Cylinder Block Stud	
Nuts—Torque	47 N•m (35 lb-ft)

10. Using a T45 TORX® adapter, install four drive gear-to-pump hub cap screws and tighten to the following specifications.



Install Fuel Shut-Off Solenoid

- A—Shut-Off Solenoid
- B—Washer
- C—Cotter Pin
- D—O-ring
- E—Solenoid Rod Offset

RG9561 -UN-04DEC98

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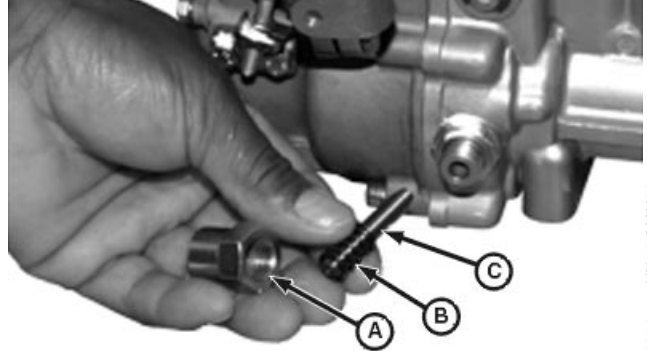
Specification

Motorpal Injection Pump Drive
Gear-to-Pump Hub Cap Screws—
Torque 61 N•m (45 lb-ft)

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11. Remove timing cap (A), spring (B) and pin (C). Place spring (B) over pin as shown. Reinstall pin with spring into hole. *This installs timing pin in disengaged position.* Make sure sealing washer is installed in cap. Install cap and tighten to specifications.



RG10045 -JUN-25MAY99

Specification

Motorpal Injection Pump Timing
Pin Cap—Torque..... 70 N.m (52 lb-ft)

12. Install injection pump drive gear cover and new gasket. Tighten cover cap screws to specifications.

Specification

Injection Pump Drive Gear Cover
Cap Screws—Torque 27 N•m (20 lb-ft)

Pump Timing Pin

- A—Cap
- B—Spring
- C—Timing Pin

13. Install fan belt.
14. Remove timing pin and flywheel turning tool from engine and install plugs in respective locations.

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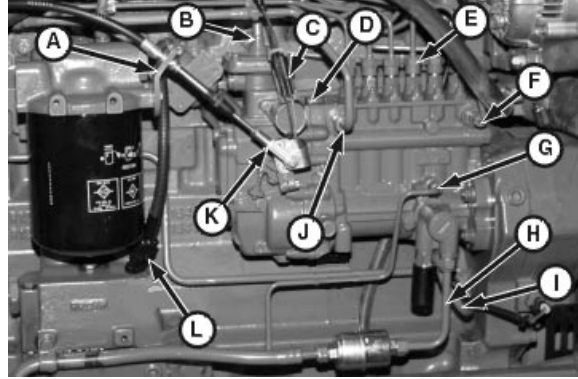
15. Connect fuel shut-off solenoid with bracket to oil filter base and tight hardware to specifications.

Specification

Fuel Shut-Off Solenoid Bracket to
Oil Filter Base Cap Screws—
Torque 27 N•m (20 lb-ft)

Specification

Throttle Bracket to Oil Filter Base
Cap Screws—Torque 27 N•m (20 lb-ft)



RG10043 -UN-25MAY99

Remove Injection Pump

IMPORTANT: Use a thin-wall crowsfoot open-end wrench to keep delivery valve fittings from turning when tightening line nuts at injection pump.

IMPORTANT: Tighten all fuel system connections securely to avoid leakage and air entering system.

- A—Throttle Bracket
- B—Aneroid Line
- C—Aneroid Connector
- D—Oil Fill Plug
- E—Injection Line
- F—Leak-Off Line
- G—Lube Line
- H—Supply Pump Inlet Line
- I—Supply Pump Outlet Line
- J—Fuel Inlet Line
- K—Throttle Cable
- L—Fuel Shut-Off Solenoid Connector

16. Connect all fuel injection pump delivery lines (E) to pump delivery valves using JDF22 Crowsfoot Wrench and an open end wrench. Tighten line nuts to specifications.

Specification

Fuel Delivery Line Connectors @
Delivery Valves and Nozzles—
Torque 27 N•m (20 lb-ft)

17. Connect aneroid air line (B).

18. Connect injection pump inlet line (J) and tighten to specifications.

Specification

Fuel Inlet Line-to-Injection
Pump—Torque 10 N•m (7 lb-ft)

19. Connect leak-off line (F) and tighten to specifications.

Specification

Motorpal Fuel Leak-Off
Line-to-Injection Pump—Torque..... 13 N•m (10 lb-ft)

20. Connect injection pump lube line (G) and tighten to specifications.

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Specification

Injection Pump Lube Line—
Torque 4.5 N•m (3 lb-ft) (36 lb-in.)

21. Connect fuel supply pump lines (H and I) and tighten to specifications.

Specification

Fuel Supply Pump
Lines-to-Injection Pump—Torque..... 10 N•m (7 lb-ft)

IMPORTANT: NEVER operate injection pump without engine lubricating oil in pump housing. Doing so may cause damage to internal pump rotating parts.

22. Remove oil fill plug (D) and add 360 cc (12 oz.) of clean engine oil. Install plug and tighten to specifications.

Specification

Motorpal Injection Pump Housing
Oil Fill Plug—Torque 25 N•m (18 lb-ft)

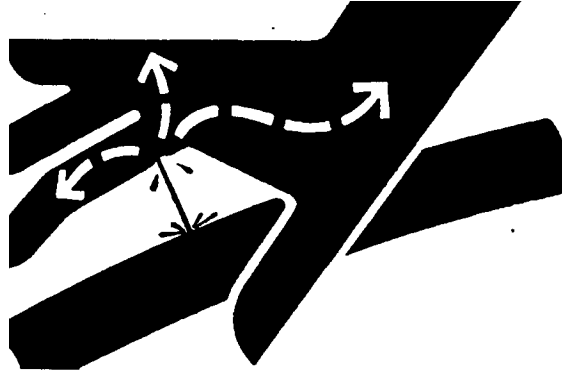
IMPORTANT: Aneroid deactivator solenoid wiring harness and connector (C) MUST BE routed straight up as shown to avoid contact with throttle lever.

23. Connect vehicle wiring harness connector to aneroid deactivator solenoid connector (C).
24. Connect fuel shut-off solenoid harness connector (L) to vehicle harness connector.
25. Connect throttle cable (K) to throttle bracket and to injection pump throttle lever.
26. Bleed fuel system. See BLEED THE FUEL SYSTEM in Group 150.
27. To check fast and slow idle speeds, refer to Group 105 of CTM134. See CHECK AND ADJUST SLOW IDLE SPEED in Group 150. See CHECK FAST IDLE SPEED in Group 150.

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Remove Fuel Injection Nozzles

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



Avoid High-Pressure Fluids

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

IMPORTANT: Cap or plug all fuel lines as they are disconnected to prevent dirt and debris from entering fuel system. Debris in fuel system can plug injectors which affects engine performance.

Injection nozzles on 6081 engines may be either Bosch or Nippondenso. Both nozzles are of same basic design and procedures are combined on the following pages. Nozzle types and size tips are as follows:

Specification

Fuel Injection Nozzle—Type 21 mm with 7 mm tip

Specification

Fuel Injection Nozzle¹—Tip Hole
Sizes 7 hole x 0.208—0.255 mm ID x
148° Spray Angle

¹ Nozzle tips available in various ID hole sizes: 0.208, 0.220, 0.236, 0.240, 0.244 and 0.255 mm.

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To test injection nozzles before removal, see Group 150.
See CYLINDER MISFIRE TEST in Group 150.

1. Thoroughly clean area around injection pump and nozzles, including all line connections, using compressed air.

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IMPORTANT: On Bosch “P” pumps, JDE90 Serrated Wrench (B) **MUST BE** used to keep delivery valve fittings stationary while loosening line nuts. If a delivery valve and barrel housing rotates while loosening or tightening a fuel line nut, injection pump must be recalibrated on a test stand. On Nippondenso “A” pumps, use an open end wrench to avoid turning valve fittings.

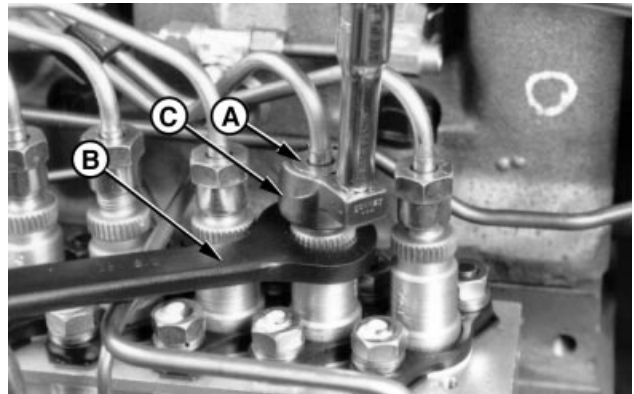
2. Disconnect injection line nuts (A) from injection pump delivery valves as follows:

Use JD90 Serrated Wrench (B) and JDF22 Crowsfoot Wrench (C) or a standard 3/4-in. line wrench on Bosch “P” pumps.

Use JDF22 Crowsfoot Wrench and 22 mm open end wrench on Nippondenso “A” pumps

Use JDF22 Crowsfoot Wrench and an open end wrench on Motorpal pumps.

3. Disconnect fuel delivery lines from injection nozzles. Lift injection line assembly from engine.
4. Disconnect fuel leak-off line from injection nozzle leak-off assembly.



Disconnecting Injection Nozzle Line (Bosch “P” Pump Shown)

A—Injection Line Nuts
B—Serrated Wrench
C—Crowsfoot Wrench

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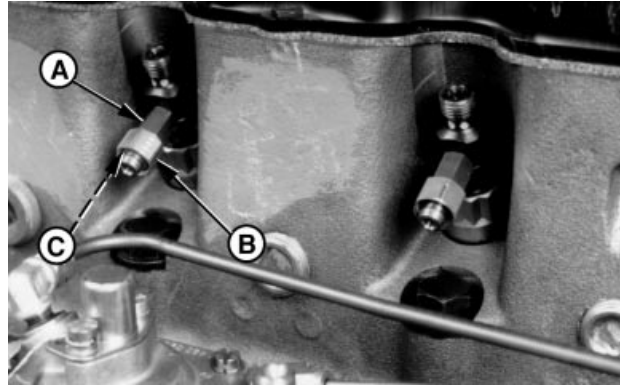
RG41183.0000078 -19-30NOV00-3/5

- Remove packing (C) (if equipped) and line nuts (B) from each leak-off connector. Discard packing.

NOTE: Engines with metal leak-off lines have O-rings (C) between leak-off connector and nozzle. Engines with nylon leak-off lines have O-rings in groove of connector body on line nut end.

- Remove leak-off connector (A) and O-rings from each injection nozzle.

A—Leak-Off Connector
B—Line Nuts
C—Packing

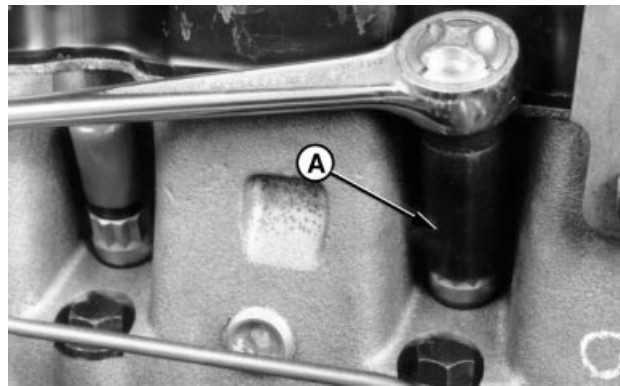


Engine with Metal Leak-Off Lines Shown

RG41183,0000078 -19-30NOV00-4/5

NOTE: The socket portion of JDE92 Nozzle Wrench (A) may be used to remove nozzles from cylinder head.

- If JDE92 Nozzle Wrench is not used, use a 24 mm (15/16-in.) deep socket on nozzles gland nut to remove nozzles. Gland nut will act as a jack screw to raise nozzle out of cylinder head bore. Remove hardened steel washer from injection nozzle bore if it does not come out with nozzle.
- To prevent debris from entering combustion chamber after nozzles are removed, insert a 12.7 mm (1/2 in.) hardwood dowel in nozzle bore.



Removing Injection Nozzles

A—JDE92 Nozzle Wrench

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Diagnose Injection Nozzle Malfunction

Problem	Possible Cause	Suggested Remedy
Failed Carbon Stop Seal Washer	Nozzle replaced without using new seal or washer.	Install new washer.
Incorrect Opening Pressure	Improper adjustment. Broken spring.	Adjust opening pressure. Replace spring.
Nozzle Will Not Open	Plugged orifices. Chipped orifices. Bottomed lift screw.	Clean. Replace nozzle. Adjust lift screw.
Poor Spray Pattern	Plugged orifices. Chipped orifices. Cracked nozzle tip.	Clean. Replace nozzle. Replace nozzle.
Poor Atomization	Plugged orifice. Chipped orifice. Cracked nozzle tip. Valve not free.	Clean. Replace nozzle. Replace nozzle. See "Inconsistent Chatter".
Inconsistent Chatter	Spring components misaligned. Varnish on valve. Deposits in seat area. Bent valve. Distorted body.	Adjust opening pressure. Clean guide area. Clean seat. Replace nozzle. Replace nozzle.
No Chatter	Spring components misaligned. Varnish on valve. Deposits in seat area. Bent valve. Valve seat eroded or pitted. Tip seat pitted. Seat interference angle worn. Distorted body.	Adjust opening pressure. Clean guide area. Clean seat. Replace nozzle. Lap valve to seat. Replace nozzle as necessary. Lap tip to seat. Replace nozzle as necessary. Replace nozzle. Replace nozzle.
Seat Leakage	Deposits in seat area. Valve seat eroded or pitted. Tip seat pitted. Valve not free. Distorted body. Cracked tip.	Clean seat. Lap valve to seat. Replace nozzle as necessary. Lap tip to seat. Replace nozzle as necessary. See "Inconsistent Chatter". See "No Chatter". Replace nozzle. Replace nozzle.
High Leak-Off	Wear or Scratched at Guide	Lap valve to guide. Replace nozzle.
Low Leak-Off	Varnish on valve. Insufficient clearance.	Clean guide area. Clean nozzle. Lap valve to guide. Replace nozzle as necessary.

Test Fuel Injection Nozzles

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

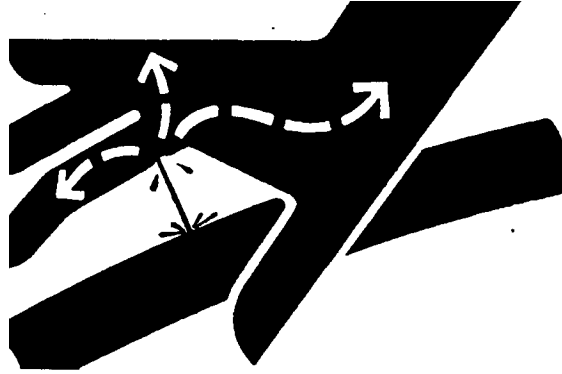
Before applying pressure to nozzle tester, be sure all connections are tight and fittings are not damaged. Fuel escaping from a very small hole can be almost invisible. Use a piece of cardboard or wood rather than your hands, to search for suspected leaks.

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

Before disassembling, test injection nozzles with clean filtered fuel to determine its condition.

Test for:

- Opening Pressure
- Leakage
- Chatter
- Spray Pattern



Avoid High-Pressure Fluids

X9811 -UN-23AUG88

RG41183,000007A -19-30NOV00-1/1

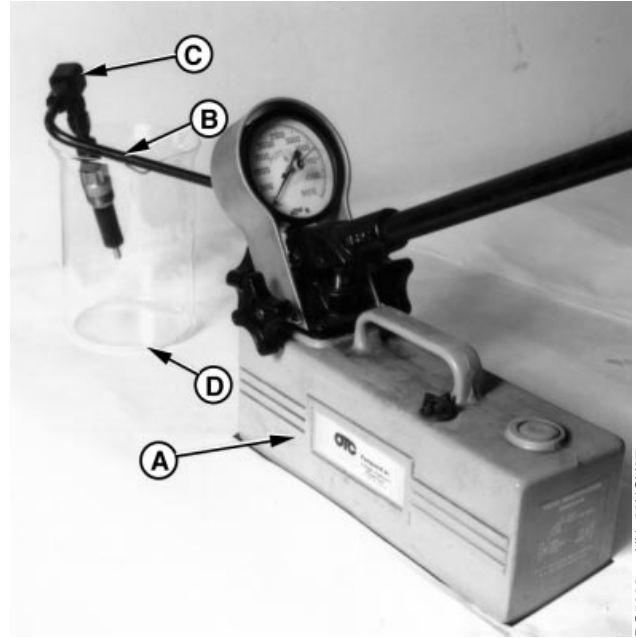
Perform Opening Pressure Test

1. Connect injection nozzle to D01109AA Nozzle Tester (Y900) (A), using No. Y900-2A Fuel Line (B) and Y900-7 and Y90-15 Straight Adapters (C).

Y900-21 90° Adapter may also be used. Place a glass beaker (D) around nozzle.

2. Pump handle several times to flush out nozzle fittings. Tighten fittings.
3. Expel air from nozzle by operating pump handle several strokes. Then raise pressure until valve opens.
4. Recheck by completely releasing pressure, then gradually building pressure until valve opens.

IMPORTANT: Nozzle tester should be checked periodically for accuracy.



RG5883 -JUN-26NOV97

Testing Nozzle Opening Pressure

- A—Nozzle Tester
- B—Fuel Line
- C—Adapter
- D—Glass Beaker

RG41183,000007B -19-30NOV00-1/1

Injection Nozzle Opening Pressure Specifications

A new nozzle or a used nozzle with a new spring (A), should open at approximately the following pressures. A used nozzle that has been rebuilt with a new spring and/or valve should be reset to same pressures as a new nozzle. New nozzle opening pressures are:

Specification

New Injection Nozzle (All Tip Sizes)—Opening Pressure 29 000 kPa (290 bar) (4200 psi) minimum

On nozzles which have been in service, spring and spring seat (B) will have taken a normal set. In this case, opening pressure is satisfactory if it meets or exceeds used nozzle minimum opening pressure given below, but does not exceed new opening pressure given above. Used nozzle minimum opening pressures are:

Specification

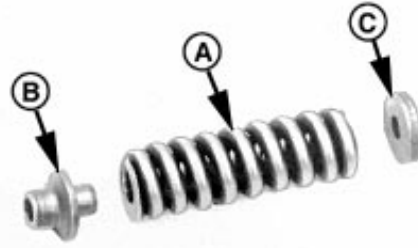
Used Injection Nozzle (All Tip Sizes)—Opening Pressure 26 200 kPa (262 bar) (3800 psi) minimum

IMPORTANT: ALWAYS use John Deere nozzle adjusting shims which are specially hardened. Other shims will not be satisfactory.

Shims (C) of different thicknesses are available for changing opening pressure adjustment. Each 0.05 mm (0.002 in.) of shim thickness changes opening pressure approximately 700 kPa (7 bar) (100 psi).

If nozzle opening pressures are not correct, disassemble injection nozzles (as described in this group) and change shims until nozzles open at proper **new** nozzle pressure given above.

The difference in nozzle opening pressures between cylinders in an engine should not exceed 350 kPa (3.5 bar) (50 psi).

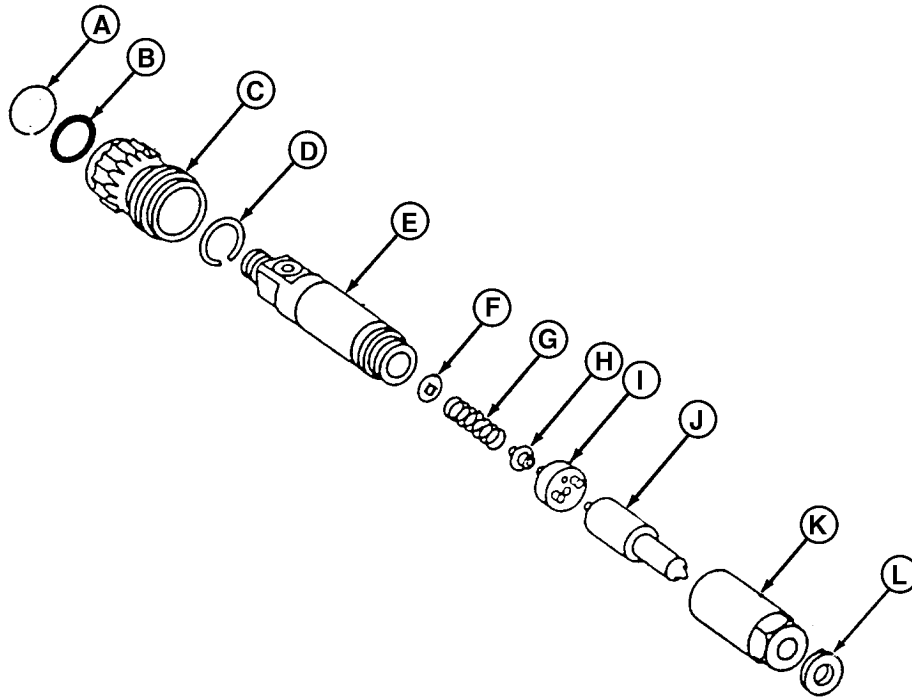


Injection Nozzle Spring and Pressure Adjusting Shims

- A—Spring
- B—Spring Seat
- C—Shim

RG3410 -UN-22NOV97

Perform Nozzle Leakage Test



RG6184 -UN-26NOV97

Bosch Injection Nozzle (Nippondenso Similar)

A—Upper Snap Ring (Bosch only)	D—Lower Snap Ring	G—Nozzle Valve Spring	J—Nozzle and Valve
B—Gland Nut O-Ring	E—Nozzle Holder	H—Spring Seat	K—Nozzle Retaining Nut
C—Gland Nut	F—Shim	I—Intermediate Plate	L—Washer

1. Wipe nozzle dry.
2. Bring pressure up slowly to 1970 kPa (20 bar) (285 psi) below the opening pressure. Watch for an accumulation of fuel from spray orifice, indicating a bad seat.

If nozzle drips within 10 seconds, replace nozzle and valve (J).

3. Check for leakage around nozzle retaining nut (K) thread connection with nozzle holder (E).

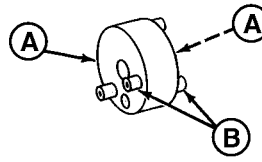
Leakage indicates a bad seat either between nozzle and intermediate plate (I) or between nozzle holder and intermediate plate.

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RG41183,000007D -19-30NOV00-1/2

RG2248 -UN-22NOV97

IMPORTANT: Do not lap the machined surfaces (A) of the intermediate plate in an attempt to stop fuel leakage at these locations. Dowels (spring pins) (B) in plate have to be removed before surfaces can be lapped. Removing dowels is not recommended as removal is likely to damage them, and replacement dowels are not available as service parts.



Nozzle Intermediate Plate

A—Machined Surfaces
B—Dowels

If leakage is observed, tighten nozzle retaining nut to a maximum of 79 N•m (58 lb-ft). Replace injection nozzle if leakage continues.

RG41183,000007D -19-30NOV00-2/2

Perform Chatter and Spray Pattern Test

1. Injection nozzle should chatter very softly, and only when hand lever movement is very rapid (four to six downward movements per second). Failure to chatter may be caused by a binding or bent nozzle valve.
2. Until chattering range is reached, the test oil emerges as non-atomized streams. When lever movement is accelerated, sprays should be very broad and finely atomized.

A partially clogged or eroded orifice will usually cause spray to deviate from the correct angle. Spray will also be steady rather than finely atomized.

3. Disassemble nozzle for cleaning or reconditioning if it fails to chatter or spray properly.

RG41183,000007E -19-30NOV00-1/1

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Disassemble Fuel Injection Nozzle

General Nozzle Repair Notes:

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

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

Cover workbench with clean paper before disassembly of injection nozzles.

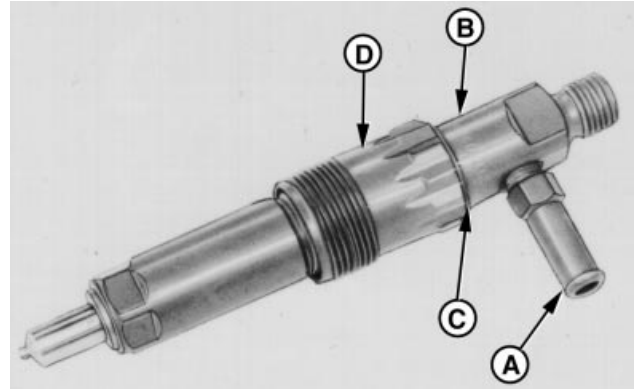
As parts are disassembled, place them in a pan of clean diesel fuel and leave there until needed. Do not permit parts to strike each other.

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

NOTE: *Bosch KDEL and Nippondenso KDAL injection nozzles are metric design. Use only metric tools to service nozzles.*

1. Use an 11 mm box or open-ended wrench and unscrew leak-off connector (A) (if not removed previously) out of nozzle holder (B).
2. Clamp flats of nozzle holder in a soft-jawed vise. Remove upper snap ring (C) from nozzle holder.
3. Slip gland nut (D) off nozzle holder.

NOTE: *Bosch nozzles have a snap ring and O-ring at top of gland nut that must be removed before gland nut can be removed.*



Disassembly of Injection Nozzle

- A—Leak-off Connector
- B—Nozzle Holder
- C—O-Ring and Upper Snap Ring
- D—Gland Nut

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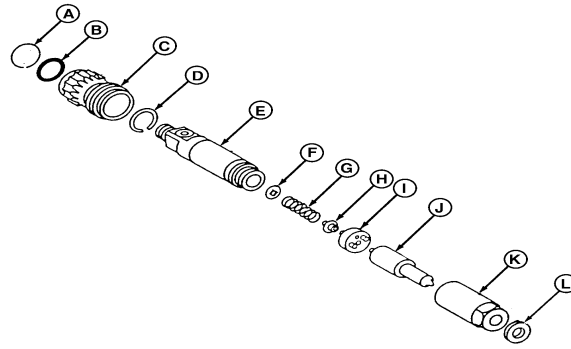
RG41183,000007F -19-30NOV00-1/2

4. Remove lower snap ring (D).
5. Clamp the two flats of the nozzle holder (fuel inlet end) in a soft-jawed vise and remove nozzle retaining nut (K), using a 12-point 19 mm wrench.
6. Remove nozzle and valve assembly (J).
7. Pull off intermediate plate (I).
8. Remove spring seat (H), spring (G), and shims (F).
9. Remove gland nut O-ring (B).

CAUTION: Use nozzle cleaning fluids in accordance with manufacturer's instructions.

10. Withdraw nozzle valve from nozzle. If valve is stuck, it may be necessary to soak nozzle assembly in Bendix cleaner, acetone, or other commercial cleaners sold especially for freeing stuck valves.

Do not permit lapped surfaces of valve and nozzle to come in contact with any hard substance. DO NOT touch valve unless your hands are wet with fuel.



Bosch Injection Nozzle (Nippondenso Similar)

- A—Upper Snap Ring (Bosch only)
- B—Gland Nut O-Ring
- C—Gland Nut
- D—Lower Snap Ring
- E—Nozzle Holder
- F—Shim
- G—Nozzle Valve Spring
- H—Spring Seat
- I—Intermediate Plate
- J—Nozzle and Valve
- K—Nozzle Retaining Nut
- L—Washer

RG6184 -19-

RG41183,000007F -19-30NOV00-2/2

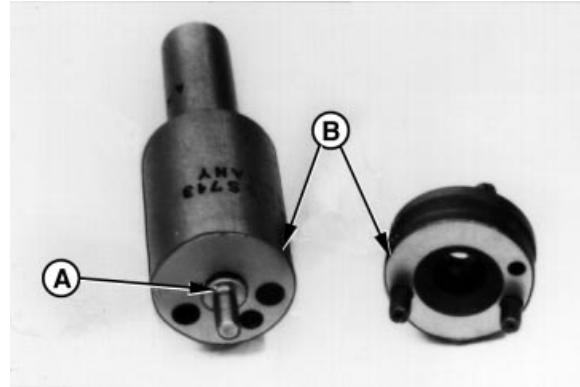
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Clean and Inspect Fuel Injection Nozzle Assembly

IMPORTANT: Never use a steel brush to clean nozzles. Steel brush may damage injection nozzles.

1. Remove anti-corrosive coating from new or reconditioned nozzles by washing them thoroughly with diesel fuel.
2. Remove carbon from used nozzles and clean by washing them in diesel fuel. If parts are coated with hardened carbon or lacquer, it may be necessary to use a brass wire brush.
3. After removing carbon or lacquer from nozzle exterior, inspect lapped surface for nicks or scratches. Replace if not in good condition.
4. Inspect piston part of nozzle valve (A) to see that it is not scratched or scored. If any of these conditions are present, replace nozzle assembly.
5. Inspect nozzle valve seat, nozzle, and intermediate plate. Contact area of parts (B) must not be scored or pitted. Use inspection magnifier in JDF13 (JDE105) Nozzle Cleaning Kit to aid inspection.

NOTE: A bad nozzle valve seat will cause fuel to drip from nozzle. This condition will usually be noted when making the "Leakage Test".



RG3411 -UN-22NOV97

Inspecting Nozzle Parts

A—Nozzle Valve
B—Fuel Injection Nozzle Assembly

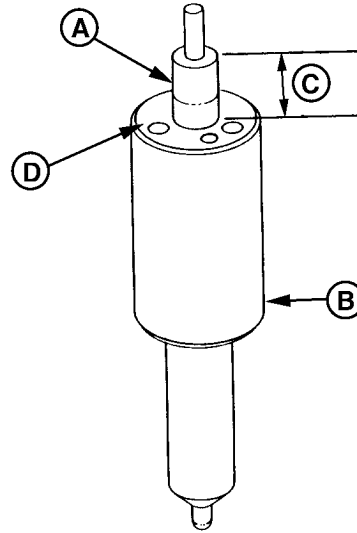
RG41183,0000080 -19-30NOV00-1/1

Perform Nozzle Slide Test

NOTE: DO NOT touch lapped surface (D) unless hands are wet with diesel fuel.

1. Dip nozzle valve (A) in clean diesel fuel.
2. Insert valve in nozzle (B).
3. Hold nozzle vertical and pull valve out about one-third of its engaged length.
4. Release valve. Valve should slide down (C) to its seat by its own weight. Always replace a nozzle assembly if the valve does not fall freely to its seat.

A—Nozzle Valve
 B—Nozzle
 C—Free-Fall Distance
 D—Lapped Surface



Performing Nozzle Slide Test

RG2233 -UN-21NOV97

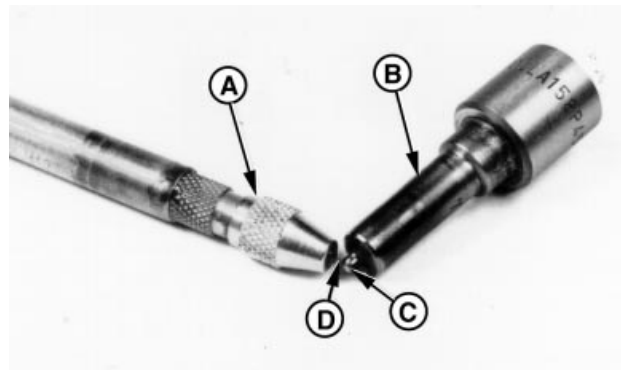
RG41183,0000081 -19-30NOV00-1/1

Clean Spray Orifices

1. Begin with cleaning wire (D) 0.07—0.10 mm (0.003—0.004 in.) from JDE105 Nozzle Cleaning Kit.

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

2. Clamp cleaning wire in pin vise (A). Wire should not protrude from vise more than 0.8 mm (1/32 in.).
3. Insert wire into orifice (C) and rotate.
4. For final cleaning, use cleaning wire 0.03 mm (0.01 in.) smaller than orifice size. Follow previous steps until orifices are clean of any carbon deposits.



Cleaning Nozzle Spray Orifices

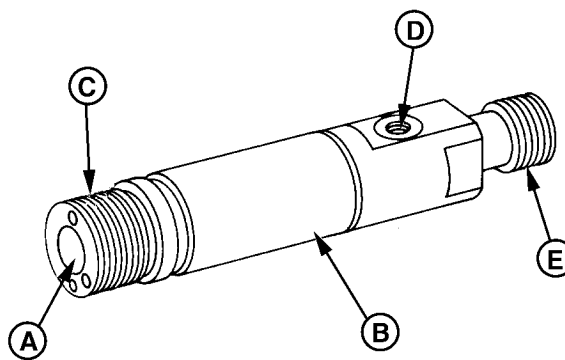
A—Pin Vise
 B—Nozzle
 C—Orifice
 D—Cleaning Wire

RG5954 -UN-26NOV97

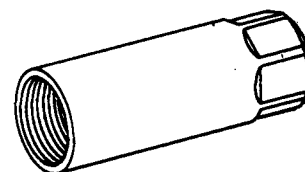
RG41183,0000082 -19-30NOV00-1/1

Inspect Nozzle Holder

1. Inspect lapped surface (A) on bottom end of nozzle holder (B) for nicks or scratches. Replace holder if not in good condition.
2. Inspect threads M19 x 0.75 (C), M6 x 1.0 (D), and M14 x 1.5 (E) on nozzle holder for general condition. Threads that are nicked slightly may be "dressed-up". Replace holder if threads cannot be restored to a serviceable condition.
3. Check fuel passages in nozzle holder to make sure they are open. Clean with compressed air.
4. Remove carbon deposits on both inner and outer surfaces of nozzle retaining nut.
5. Inspect retaining nut for cracks caused by overtightening or a damaged lower seating surface. A seat may be restored by rubbing surface with emery cloth. Any nozzle nut which cannot be reconditioned, must be replaced.



RG3413 -JUN-22NOV97



RG2247

Inspecting Nozzle Holder

- A—Lapped Surface
- B—Nozzle Holder
- C—M19 x 0.75
- D—M6 x 1.0
- E—M14 x 1.5

RG2247 -JUN-20DEC88

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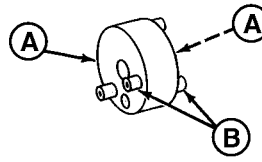
RG41183,0000083 -19-30NOV00-1/3

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RG2248 -UN-22NOV97

6. Examine lapped surfaces on intermediate plate (A) for nicks, scratches, or worn areas which would permit fuel to leak past.

IMPORTANT: Do not lap the machined surfaces of the intermediate plate. Dowel pins (B) in plate have to be removed before surfaces can be lapped. Removing dowels is not recommended as removal is likely to damage them, and replacement dowels are not available as service parts.



Inspecting Nozzle Intermediate Plate
RG2249 -UN-20APR89



RG2249!

Inspecting Nozzle Spring Seat

7. Replace intermediate plate if lapped surfaces are worn or damaged.
8. Inspect spring seat for splitting, cracking, or excessive wear.

Replace seat if any of these conditions are evident.

A—Intermediate Plate
B—Dowel Pins

Continued on next page

RG41183,0000083 -19-30NOV00-2/3

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9. Examine spring and shims for pitting or excessive wear.

Replace as necessary.

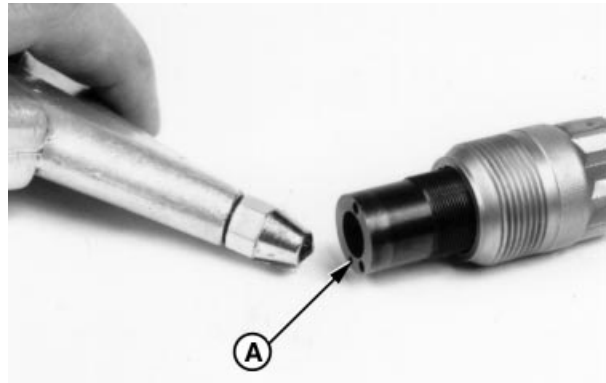
NOTE: The edge-type filter is pressed into nozzle holder and is not removable for service.

10. Clean filter by applying compressed air to nozzle holder fuel passage (A) at nozzle end.

A—Nozzle Holder Fuel Passage



Inspecting Nozzle Spring and Shims



Cleaning Nozzle Filter

RG41183.0000083 -19-30NOV00-3/3

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RG5955 -UN-30AUG91

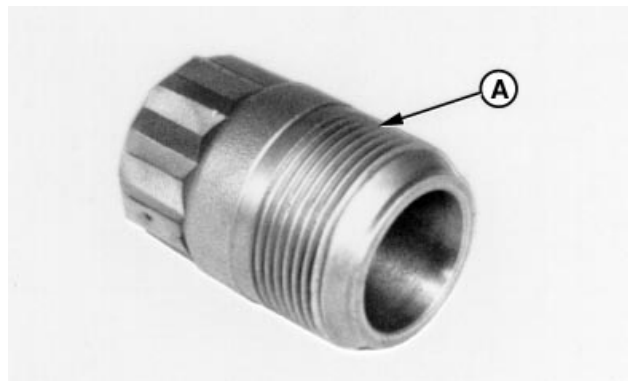
RG5962 -UN-26NOV97

Inspect Gland Nut

1. Inspect nozzle holder gland nut for general condition; be sure that it is not cracked or split.
2. Inspect M28 x 1.5 threads (A) for general condition. Threads which are slightly nicked or damaged may be "dressed up".

Replace gland nut if unable to restore to a serviceable condition.

A—Gland Nut Threads



Inspecting Nozzle Gland Nut

RG5956 -UN-26NOV97

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RG41183.0000084 -19-30NOV00-1/2

3.

Check passage in leak-off connector to see that is open.

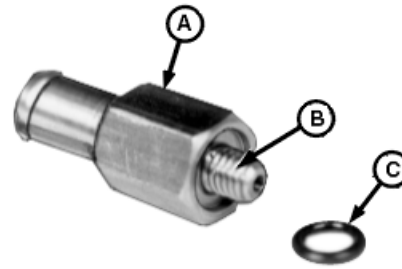
4. Blow through connector passage with compressed air.

5. Inspect the M6 x 1 threads (B) for general condition. Replace connector if threads are damaged and cannot be restored to a serviceable condition.

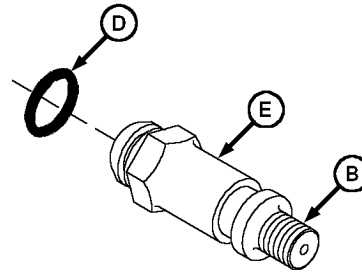
NOTE: Engines with metal leak-off lines have O-rings (C) between leak-off connector and nozzle. Engines with nylon leak-off lines have O-rings in groove of connector body on line nut end.

6. Replace O-rings (C) or (D).

- A—Connector Body (Metal Lines)
- B—Leak-Off Threads
- C—O-Ring (Metal Lines)
- D—O-Ring (Nylon Lines)
- E—Connector Body (Nylon Lines)



Leak-Off Connector (Metal Lines)



Leak-Off Connector (Nylon Lines)

RG41183,0000084 -19-30NOV00-2/2

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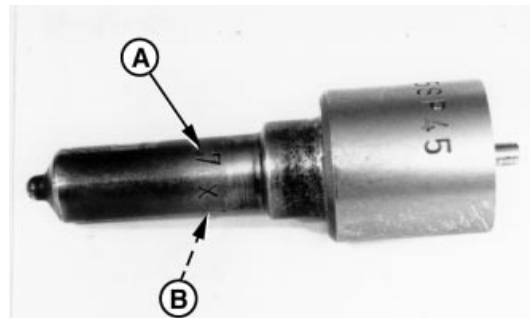
RG10228 -UN-15JUN99

Assemble Fuel Injection Nozzle

IMPORTANT: Be sure to install correct nozzle assembly on nozzle holder. Do not intermix different size nozzle assemblies.

To help determine correct nozzle assembly for each application, note markings on lower part of nozzle.

The illustration shows a nozzle marked 7 x 0.23. The number "7" (A) indicates the number of orifices and "0.23" (B) indicates the size of each orifice in millimeters.



Markings on Nozzle Tip

- A—Number "7"
- B—"0.23"

RG5958 -UN-26NOV97

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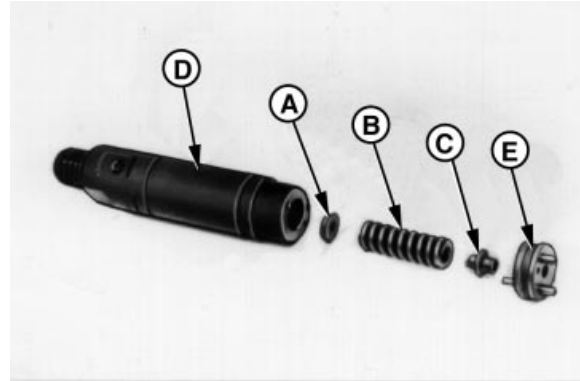
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IMPORTANT: Immerse parts in clean fuel before assembly. **DO NOT** dry parts with towels or compressed air. Dust particles might collect and stay on pressure faces of nozzle valve and nozzle holder.

1. Place shims (A), spring (B), and spring seat (C) in nozzle holder (D) while still wet with diesel fuel.

NOTE: Make sure intermediate plate (E) is free of any foreign material before reassembling.

- A—Shims
- B—Spring
- C—Spring Seat
- D—Nozzle Holder
- E—Intermediate Plate



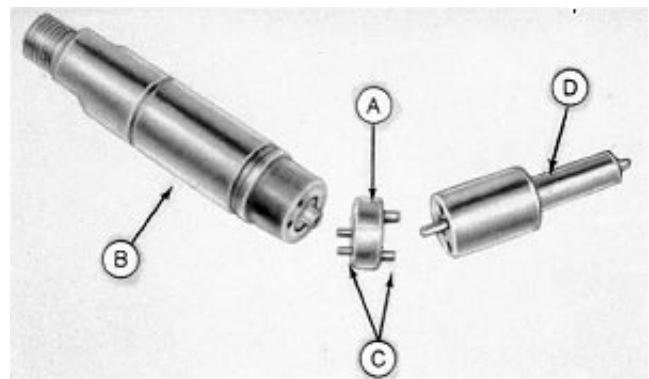
RG3415 -UN-22NOV97

Assembling Nozzle Holder Parts

RG41183,0000085 -19-30NOV00-2/4

2. Position intermediate plate (A) on nozzle holder (B). Dowel pins (C) in plate will permit installation only one way.
3. Insert nozzle valve into nozzle (D) while holding parts below diesel fuel level in pan.

- A—Intermediate Plate
- B—Nozzle Holder
- C—Dowel Pins
- D—Nozzle and Valve

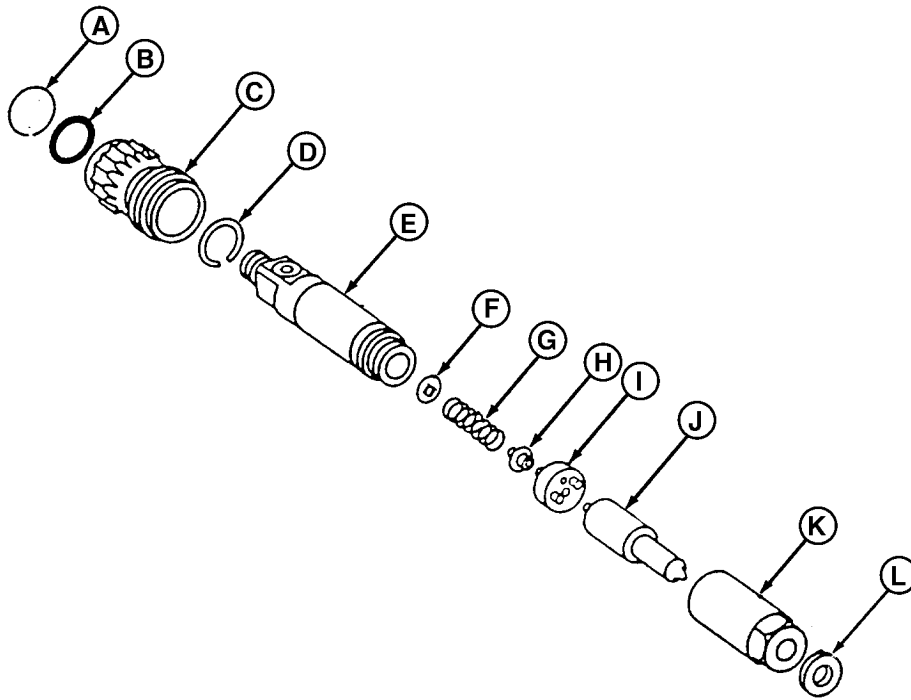


RG2254 -UN-29NOV88

Assembling Nozzle Valve Parts

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RG41183,0000085 -19-30NOV00-3/4



RG6184 -UN-26NOV97

Bosch Injection Nozzle (Nippondenso Similar)

- | | | | |
|--------------------------------|-------------------|-----------------------|------------------------|
| A—Upper Snap Ring (Bosch only) | D—Lower Snap Ring | G—Nozzle Valve Spring | J—Nozzle and Valve |
| B—Gland Nut O-Ring | E—Nozzle Holder | H—Spring Seat | K—Nozzle Retaining Nut |
| C—Gland Nut | F—Shim | I—Intermediate Plate | L—Washer |

- Install nozzle assembly on nozzle holder (E) and secure with nozzle retaining nut (K).
- Clamp nozzle holder in a soft-jawed vise. Tighten nozzle retaining nut to specifications.

Specification

Fuel Injection Nozzle Retaining
Nut—Torque 60—80 N•m (44—59 lb-ft)

- Install lower snap ring (D) on nozzle holder.
- Coat bore of gland nut (C) liberally with PT569 NEVER-SEEZ® compound to prevent gland nut from seizing on holder body.
- Install upper snap ring (A) on nozzle holder (Bosch only) and position O-ring (B) against gland nut.

- Install leak-off connector on nozzle holder (E) using a new O-ring.

NOTE: Leak-off connector and O-ring should be installed on nozzle holder even though they will have to be removed to install injection nozzle in cylinder head. This will prevent misplacement of connector and washer before installation on engine.

Engines with metal leak-off lines have O-rings between the connector and nozzle. Engines with nylon leak-off lines have O-rings in groove of connector body on line nut end.

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Test and Adjust Injection Nozzle Opening Pressure

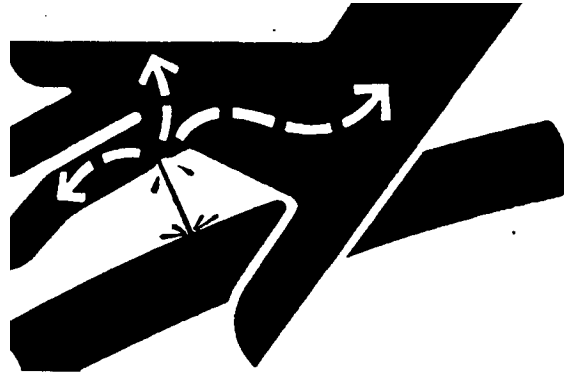


CAUTION: 'Nozzle tip should always be directed away from operator. Fuel from spray orifices can penetrate clothing and skin causing serious personal injury. Enclosing nozzle in a glass beaker is recommended.

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

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

1. Refer to PERFORM OPENING PRESSURE TEST, earlier in this group to test nozzle opening pressure. Adjust opening pressure as needed.
2. Refer to PERFORM NOZZLE LEAKAGE TEST, earlier in this group to test for leakage. Repair as needed.
3. Refer to PERFORM CHATTER AND SPRAY PATTERN TEST, earlier in this group to test nozzle overall operation. Repair as needed.



Avoid High-Pressure Fluids

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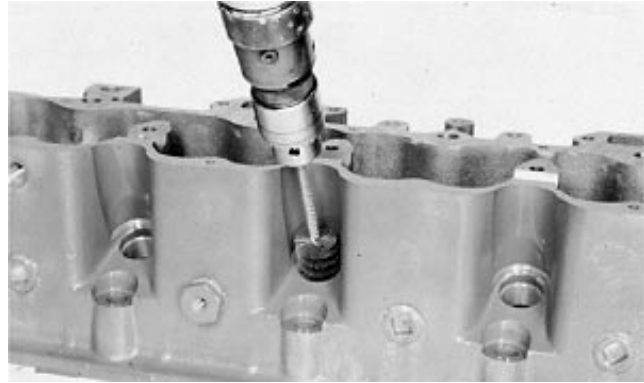
Inspect and Clean Cylinder Head Nozzle Bore

1. Inspect condition of threads for gland nut. Threads are metric (M28 x 1.5).
2. Inspect condition of nozzle seating in cylinder head.

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

IMPORTANT: If injection nozzle gland nut threads are not clean, a false torque wrench reading may be obtained when injection nozzle is installed. This may prevent injection nozzle from seating properly in cylinder head.

3. Clean threads which have light foreign deposits using an electric drill and D17030BR Thread Cleaning Brush. Work brush up and down several times to clean threads.



Cleaning Nozzle Bores in Cylinder Head

RG5251 -UN-14DEC88

RG41183,0000087 -19-30NOV00-1/2

4. Clean threads with heavy foreign deposits or clean up damaged threads by using JDF5 Tap (M28 X 1.5 mm). Be sure to start tap straight to avoid possible cross-threading. A light coat of grease on tap will help collect foreign deposits on tap and prevent them from falling into nozzle bore.
5. After cleaning threads, insert a 13 mm (1/2 in.) tapered hardwood dowel to plug nozzle tip bore.
6. Blow out debris from nozzle cavity with compressed air; then remove wood dowel.



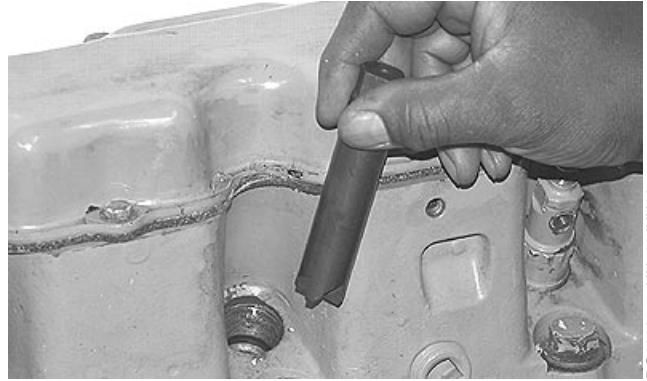
Using Tap to Clean Threads in Nozzle Bores

R28263N -UN-20DEC88

RG41183,0000087 -19-30NOV00-2/2

Inspect and Clean Nozzle Seating Surface

1. Inspect nozzle seating surface for carbon deposits.
2. If seat is not clean, use the JDG609 Nozzle Seat Reamer to remove carbon. Stop using tool when seat comes clean.
3. Insert a 13 mm (1/2 in.) tapered hardwood dowel to plug the nozzle tip bore.
4. Blow out debris from nozzle cavity with compressed air; then remove wood dowel.



Cleaning Nozzle Seats in Head

RG10227 -UN-18JUN99

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RG41183,0000088 -19-30NOV00-1/1

Install Fuel Injection Nozzles

1. Apply PT569 NEVER-SEEZ® Compound to gland nut threads and nozzle barrel (arrows). Be sure that NEVER-SEEZ® compound was also applied to inside bore of gland nut during assembly.

NOTE: Applying NEVER-SEEZ® Compound at these locations will help prevent possible seizure of gland nut to holder body.

IMPORTANT: Do not intermix injection nozzles of different suppliers or different tip sizes within a single engine.

2. Install a new special steel washer (A) on tip end of assembled injection nozzle.



Preparing Nozzle for Installation

A—Special Steel Washer

RG5688 -UN-26NOV97

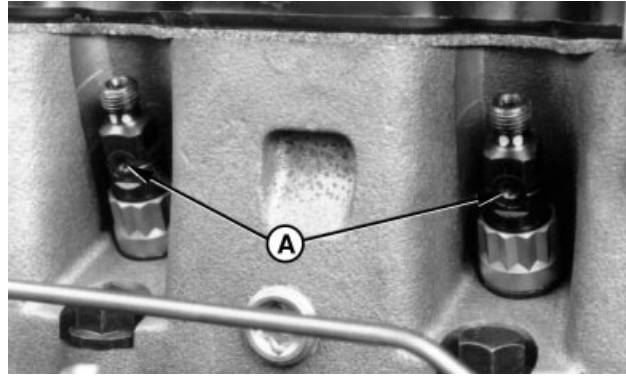
NEVER-SEEZ is a registered trademark of Emhart Chemical Group.

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RG41183,0000089 -19-30NOV00-1/8

3. Insert injection nozzle into cylinder head. Turn gland nut by hand to make sure it is threaded straight in cylinder head.
4. Use outer socket of JDE92 Nozzle Socket and turn gland nut down to remove most of the looseness.
5. Rotate nozzle holder so holes for leak-off connector threads (A) are facing straight out from cylinder head.

A—Leak-Off Connector Threads



Installing Injection Nozzles in Cylinder Head

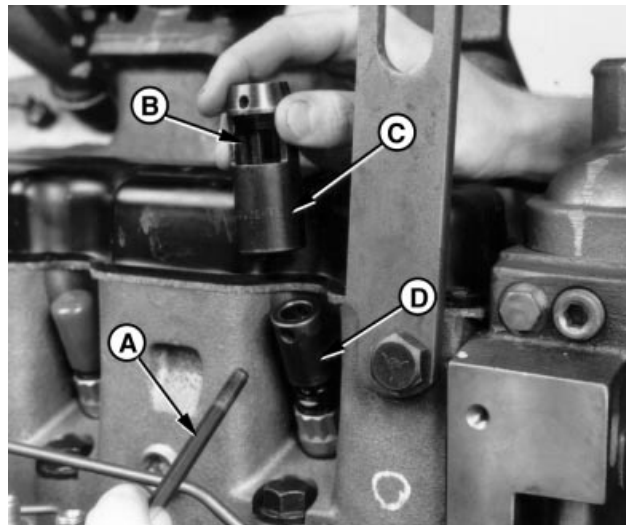
RG5889 -UN-26NOV97

RG41183,0000089 -19-30NOV00-2/8

6. Position inner socket (D) of JDE92 Nozzle Socket over nozzle holder and engage with flats at top of nozzle holder.
7. Place outer socket (C) on gland nut with socket "window" (B) facing outward.
8. Insert handle (A) through window into inner socket. Ball detent in handle will keep it secured to inner socket.

NOTE: Handle simulates position of leak-off connector, which must be square with engine to permit proper installation of leak-off lines.

A—Handle
B—Window
C—Outer Socket
D—Inner Socket



Indexing of Injection Nozzle

RG5758 -UN-26NOV97

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RG41183,0000089 -19-30NOV00-3/8

9. Tighten injection nozzle gland nut to specifications.
Keep handle (A) pointing straight out while tightening.

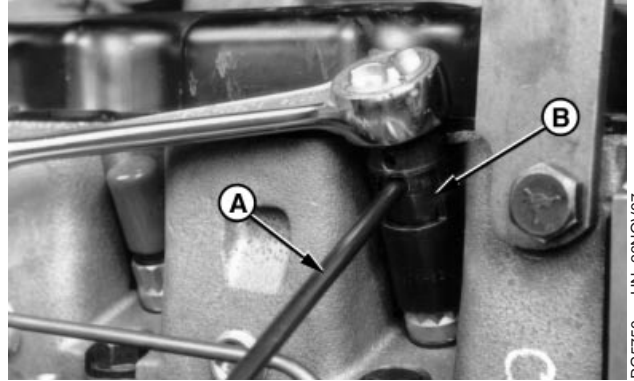
Specification

Fuel Injection Nozzle Gland
Nut-to-Cylinder Head—Torque..... 88 N•m (65 lb-ft)

Socket window (B) is cut deep enough to obtain a new “bite” without removing inner socket.

10. Be sure O-ring is positioned against injection nozzle gland nut.

A—Handle
B—Socket Window



Torquing Nozzle Gland Nut

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NOTE: Engines with metal leak-off lines have O-rings between the connector and nozzle. Engines with nylon leak-off lines have O-rings in groove of connector body on line nut end.

- 11.

On engines with nylon leak off lines only, clean threads on end of connector and apply LOCTITE® 242 Thread Lock and Sealer to threads.

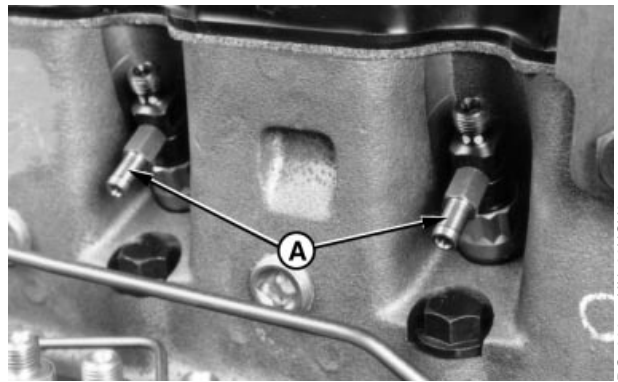
12. Install leak-off connectors (A) with O-rings on injection nozzles. Tighten leak-off connectors to the following specifications.

Specification

Fuel Injection Nozzle Leak-Off
Connectors (Metal Lines)—
Torque 7.5 N•m (5.5 lb-ft) (66 lb-in.)

Specification

Fuel Injection Nozzle Leak-Off
Connectors (Nylon Lines)—
Torque 15 N•M (11 lb-ft) (133 lb in.)



Engine with Metal Leak-Off Lines Shown

A—Nozzle Leak-off Connectors

RG41183,0000089 -19-30NOV00-5/8

LOCTITE is a registered trademark of Loctite Corp.

Continued on next page

13. Perform the following on engines with metal leak-off lines:

Loosen all leak-off line fittings (A), remove pipes (B), and inspect packings (C). Discard packings that are worn or cut.

NOTE: Mark each leak-off before disassembly to assure assembly in correct location.

Check all pipes and fittings for wear or damage and replace as necessary.

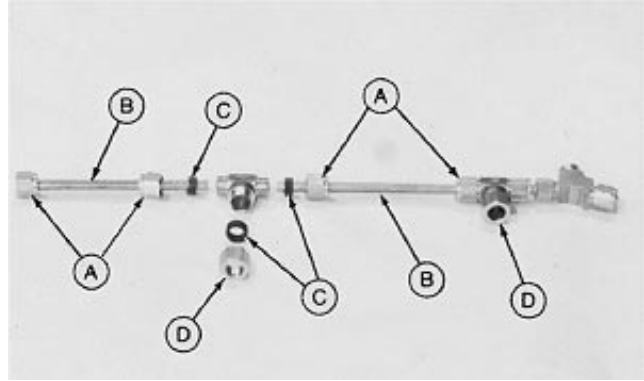
Reinstall new packings (if needed), and pipes into T-Fittings. Tighten all connections securely.

Install nuts (D) and packings onto leak-off connectors. Install complete assembly over appropriate leak-off line connectors.

14. Tighten all leak-off line nuts-to-connectors to specifications.

Specification

Fuel Leak-Off Line
Nuts-to-Connectors—Torque..... 11 N•m (8 lb-ft) (97 lb-in.)



Installing Nozzle Leak-off Lines (Metal)

- A—Fittings
- B—Pipes
- C—Packings
- D—Nuts

RG5091 -UN-14DEC88

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15. Perform the following on engines with nylon leak-off lines:

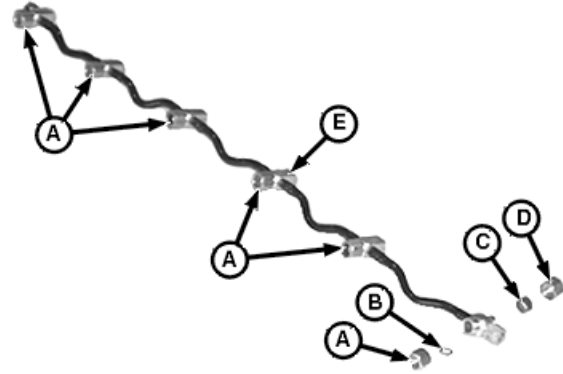
IMPORTANT: The nylon leak-off line assembly is not repairable. DO NOT attempt to separate lines from connections. Replace entire assembly if unserviceable.

Check all nylon lines for cracks or damage and replace assembly as necessary.

Reinstall new packings (C), if needed.

Install nuts (A) and O-rings (B) onto leak-off connectors. Lubricate O-rings with petroleum jelly.

Lubricate bores of connectors (E) with petroleum jelly and install complete assembly over appropriate leak-off line connectors.



Installing Nozzle Leak-off Lines (Nylon)

- A—Nuts
- B—O-Rings (Installed in Groove on Connector Body)
- C—Packings
- D—Nuts

16. Tighten all leak-off line nuts-to-connectors to specifications.

Specification

Fuel Leak-Off Line
Nuts-to-Connectors—Torque..... 11 N•m (8 lb-ft) (97 lb-in.)

17. Connect leak-off line at injection pump and tighten to specifications.

Specification

Fuel Leak-Off Line-to-Injection
Pump—Torque 13 N•m (10 lb-ft) (115 lb-in.)

If removed, install plug at end of leak-off line assembly and tighten to specifications.

Specification

Fuel Leak-Off Line End Plug—
Torque 16 N•m (12 lb-ft) (142 lb-in.)

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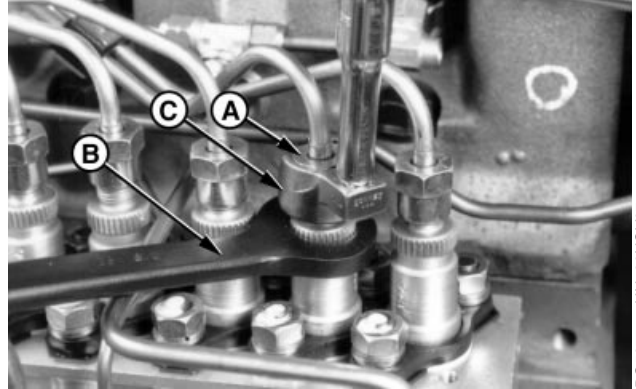
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18. Remove protective caps and plugs, that were installed during disassembly, from injection lines, nozzles, and delivery valves.

IMPORTANT: On Bosch "P" pumps, use JDE90 Serrated Wrench (B) to keep delivery valve fittings stationary while tightening fuel line nuts. If a delivery valve and barrel housing rotates while tightening a fuel line nut, injection pump fuel delivery will be altered, and pump will have to be recalibrated on a test stand. On Nippondenso "A" pumps, use an open end wrench to avoid turning valve fittings.



Connecting Injection Lines (Bosch "P" Pump Shown)

- A—Fuel Injection Line Nuts
- B—JDE90 Serrated Wrench
- C—JDF22 Crowsfoot Wrench

19. Install and connect injection line assembly at each respective injection nozzle and delivery valve.

20. Tighten line nuts (A) at delivery valves to specification below as follows:

Use JD90 Serrated Wrench (B) and JDF22 Crowsfoot Wrench (C) or a standard 3/4-in. line wrench on Bosch "P" pumps.

Use JDF22 and an open-end wrench on Motorpal pumps.

Use JDF22 Crowsfoot Wrench and 22 mm open end wrench on Nippondenso "A" pumps.

Specification

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

21. Bleed the fuel system. See BLEED THE FUEL SYSTEM in Group 150.

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Section 03 Theory of Operation

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Fuel Injection Pump - General Information

Certain 6081 engines are equipped with Bosch, Nippondenso, and Motorpal mechanical in-line fuel injection pumps.

The multi-plunger type injection pump has an engine driven camshaft which rotates at one-half engine speed. Roller cam followers, riding on camshaft lobes, operate the plungers to supply high pressure fuel through delivery valves to the injection nozzle.

A governor operated fuel rack is connected to six control sleeve and control assemblies and plunger assemblies, to regulate the quantity of fuel delivered to the engine.

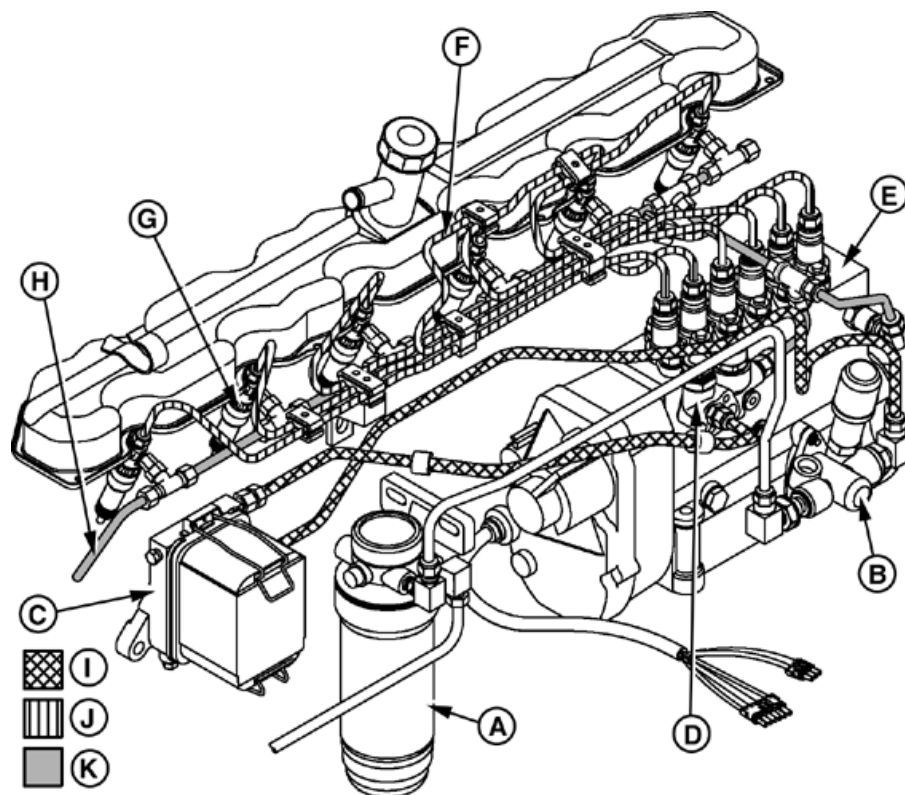
The governor is mounted at the rear of the injection pump housing and is completely enclosed to permit splash lubrication of working parts.

On certain 6081 engine models, a boost pressure sensitive hydraulically actuated aneroid fuel control system is installed on turbocharged engines. Its purpose is to prevent excessive exhaust smoke during acceleration. It causes a slight delay in the fuel delivery to allow the turbocharger to obtain optimum speed, providing sufficient air to burn the requested fuel.

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Fuel System Overview



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A—Primary Fuel Filter/Water Separator
B—Supply Pump

C—Final Fuel Filter
D—Fuel Inlet Housing
E—Injection Pump

F—Injection Pressure Lines
G—Injection Nozzles
H—Leak-off Line Assembly

I—Supply Pump Pressure Fuel
J—Injection Pressure Fuel
K—Return Fuel

The supply pump (B) draws fuel from the vented fuel tank through the optional pre-filter and primary filter/water separator (A). The supply pump pressurizes the fuel so that it flows through the final filter (C), enters the fuel injection pump (E) through a connection on the pump fuel inlet housing (D), and on to the fuel gallery in the pump housing. Supply pump output pressure (I) will vary depending on load and application.

The in-line injection pump has six plungers that pressurize the fuel further. The timing that the plungers deliver fuel is based off the injection pump camshaft. The timing of the injection pump camshaft is connected to the engine camshaft and crankshaft of the engine through timing gears. The engine camshaft

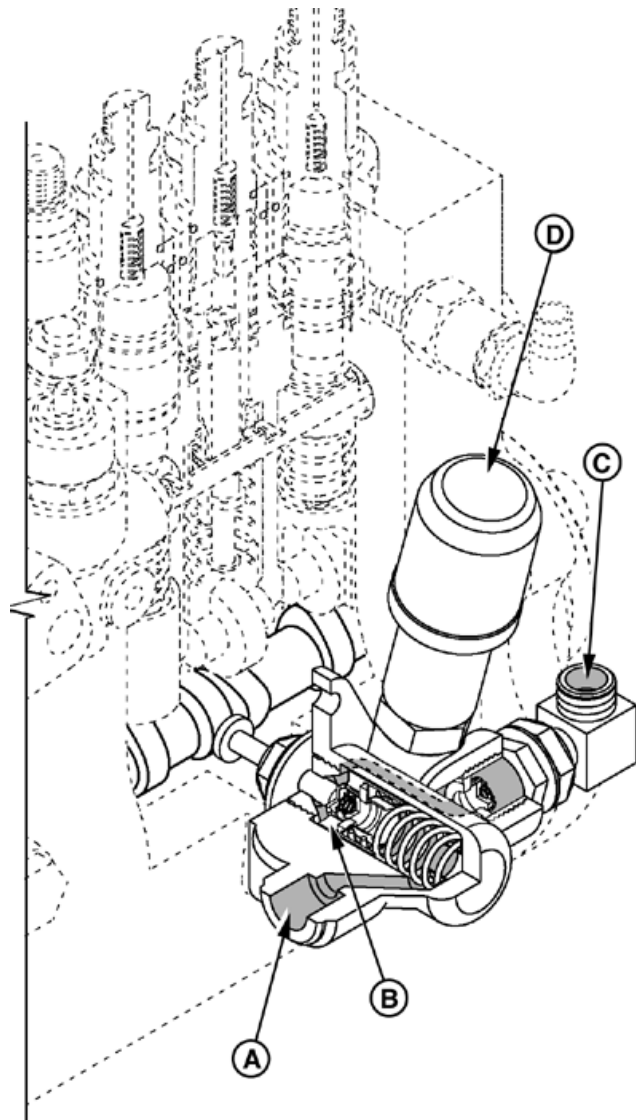
(which drives the injection pump) rotates at one-half the crankshaft speed. The amount of fuel delivered depends on the rack, which is controlled by the mechanical governor. Injection pressure lines (F) route the fuel to the nozzles (G). The high-pressure fuel (J) opens the nozzle valve and forces fuel out the small orifices in the nozzle tip. This atomizes the fuel as it enters the combustion chamber.

There are two sources of excess fuel incorporated into the system. The supply pump supplies more fuel to the pump than is required by the engine, and the nozzle requires excess fuel to lubricate the nozzle valve. A leak-off line assembly (H) returns this excess fuel (K) to the tank from both the pump and nozzles.

Fuel Supply Pump Operation

Robert Bosch and Denso plunger-type fuel supply pumps are used for 6081 engine applications. The supply pump is mounted on the side of the injection pump housing and is driven by the injection pump camshaft. Fuel enters the supply pump at (A), is pressurized by the plunger (B), and discharged through outlet (C). The hand primer (D) provides manual pump operation for bleeding air from the fuel system.

- A—Fuel Inlet
- B—Plunger
- C—Fuel Outlet
- D—Hand Primer

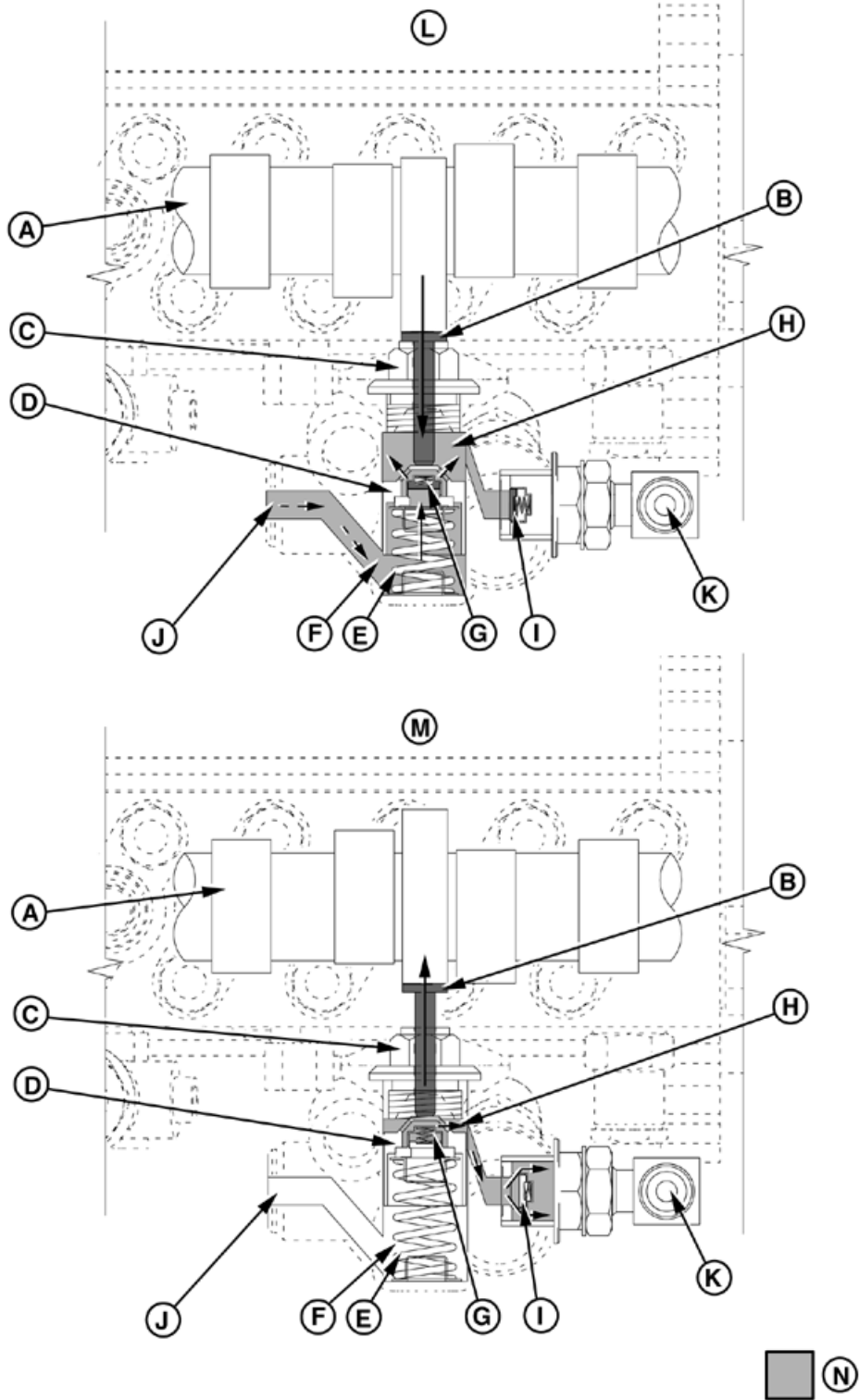


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A—Injection Pump Camshaft
 B—Roller Tappet
 C—Pressure Spindle
 D—Plunger

E—Plunger Spring
 F—Suction Chamber
 G—Pressure Valve
 H—Pressure Chamber

I—Suction Valve
 J—Fuel Inlet
 K—Fuel Outlet
 L—Intermediate Stroke Position

M—Suction and Discharge Stroke Position
 N—Fuel Flow

As the pump camshaft (A) rotates toward the “high cam” intermediate stroke position (L), the roller tappet (B) and pressure spindle (C) cause the plunger (D) to move against and compress the plunger spring (E).

Plunger movement forces the fuel out of the suction chamber (F), through the pressure valve (G), and into the pressure chamber (H). The amount of fuel discharged from the suction chamber is equal to the amount of fuel delivered for each stroke of the plunger. Towards the end of the intermediate stroke, the spring-loaded pressure valve closes again.

As the camshaft rotates toward the “low cam” or suction and discharge position (M), plunger spring pressure causes the plunger, pressure spindle, and roller tappet to follow the camshaft.

Movement of the plunger pushes the fuel from the pressure chamber, and delivers it to the fuel filters and

injection pump. At the same time, plunger suction pressure is permitting fuel to enter the suction chamber through the suction valve (I). With the suction chamber charged with fuel, the pumping cycle begins again.

Fuel is allowed to flow in around the pressure spindle to lubricate the spindle as it moves back and forth in housing. To prevent the fuel from entering the pump crankcase, a rubber O-ring is positioned in the spindle bore of housing at the roller tappet end.

Pulling upward on the hand primer pump causes the suction valve to open and fuel to flow into the suction chamber. When the hand plunger is pushed downward, the suction valve closes, and fuel is forced out of the pressure valve.

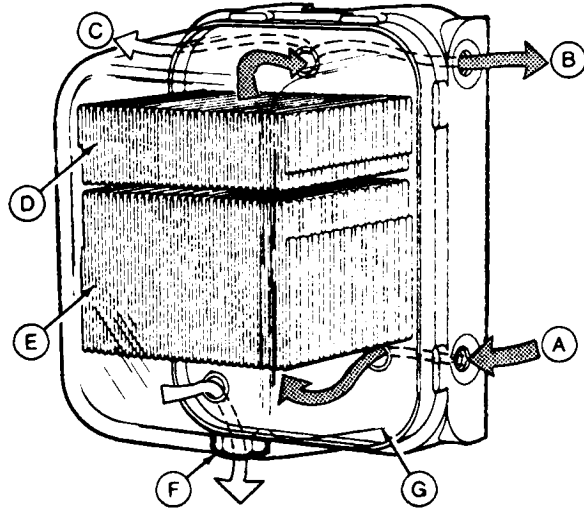
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Rectangular Final Fuel Filter Operation

Fuel enters the filter at (A) and flows through a first stage filtering media (E) and a second stage filtering media (D) before flowing through outlet (B) to the injection pump. The filtering media is housed in the metal sediment bowl (G) and epoxied to the bowl as one assembly.

Since water and other contaminants may settle to the bottom of the sediment bowl, a drain plug (F) is provided to permit their removal.

An air vent (C) enables air in the fuel system to be expelled to the outside through the filters when bleed plug is loosened while pumping hand primer on fuel supply pump or primary fuel filter.



- A—Inlet
- B—Outlet
- C—Air Vent
- D—Second Stage Filtering Media
- E—First Stage Filtering Media
- F—Drain Plug
- G—Sediment Bowl

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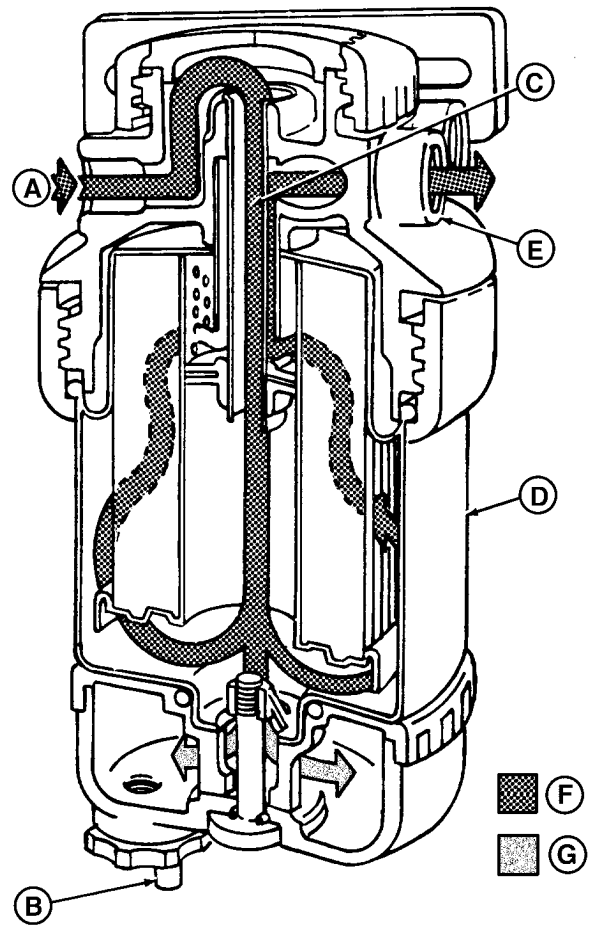
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Round Primary Fuel Filter/Water Separator Operation

The primary fuel filter/water separator is a single-stage filter. Fuel enters the filter at the inlet (A), then flows to the center port (C), travels to the bottom of the filter element (D), onward to the outboard side of the filter, up the sides and back inward through the media before exiting filter through outlet (E) to the fuel supply pump. The filter element is attached to the base with a threaded (detent) ring.

Water and contaminants settle at the bottom of the water separator (clear sediment bowl). A drain plug (B) is provided to drain these contaminants from system.

- A—Fuel Inlet
- B—Drain Plug
- C—Center Port
- D—Filter Element
- E—Fuel Outlet
- F—Fuel
- G—Water and Contaminants



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Fuel Injection Pump Operation

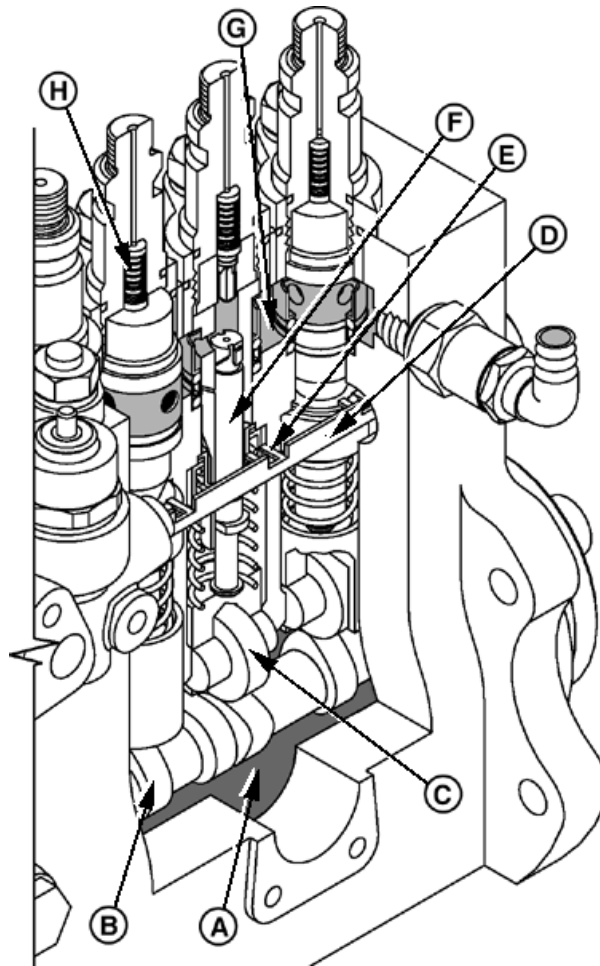
The 6081 engine uses the Bosch P3000 and P7100, as well as the Denso AS2500 injection pumps. The Bosch and Denso pumps are similar in design, application is specified according to power output requirements.

Filtered fuel under pressure by the supply pump fills the injection pump fuel gallery (G). As the camshaft rotates, roller tappets (C) riding on the camshaft lobes (B) operate the plungers (F) to supply high pressure fuel through the delivery valves (H) to the injection nozzles.

An electronically-controlled governor operates control rack (D). The rack is connected to the control sleeves (E) and plungers to regulate the quantity of fuel delivered to the engine.

Engine lubricating oil is piped to the injection pump crankcase (A) to provide splash lubrication of the working parts. Two drain holes at the front end of the pump determine the level of oil maintained in the crankcase. Excess oil drains out these holes and returns back to the engine through the timing gear housing.

- A—Crankcase
- B—Camshaft
- C—Roller Tappet
- D—Control Rack
- E—Control Sleeve
- F—Plunger
- G—Fuel Gallery
- H—Delivery Valve

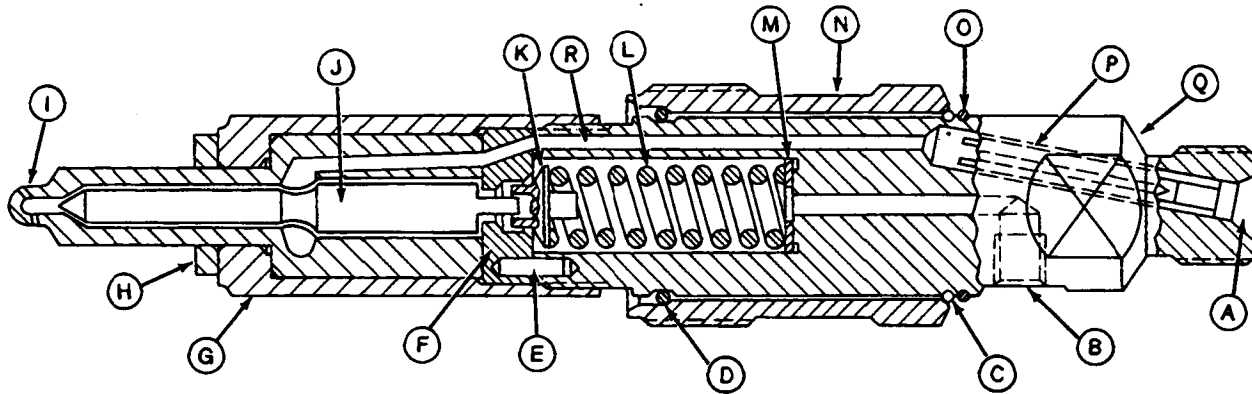


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Fuel Injection Nozzle Operation



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|-----------------------|------------------------|---------------|--------------------|
| A—Fuel Inlet | F—Intermediate Plate | K—Spring Seat | O—Snap Ring |
| B—Leak-Off Connection | G—Nozzle Retaining Nut | L—Spring | P—Edge-Type Filter |
| C—O-Ring | H—Washer | M—Shims | Q—Nozzle Holder |
| D—Snap Ring | I—Nozzle | N—Gland Nut | R—Fuel Passage |
| E—Dowel Pin | J—Valve | | |

The nozzle valve (J) is held on its seat by a spring (L). Shims (M) are used to regulate the nozzle opening pressure.

The nozzle (I) and valve fit together by precision lapping. These parts are referred to as a nozzle assembly, and are not serviced separately.

Correct alignment of the nozzle assembly with its holder is essential so that the atomized fuel will be sprayed into the combustion chamber at the angle and location intended by design. KDEL holders use an intermediate plate (F) with dowel pins (E) on both sides to insure alignment.

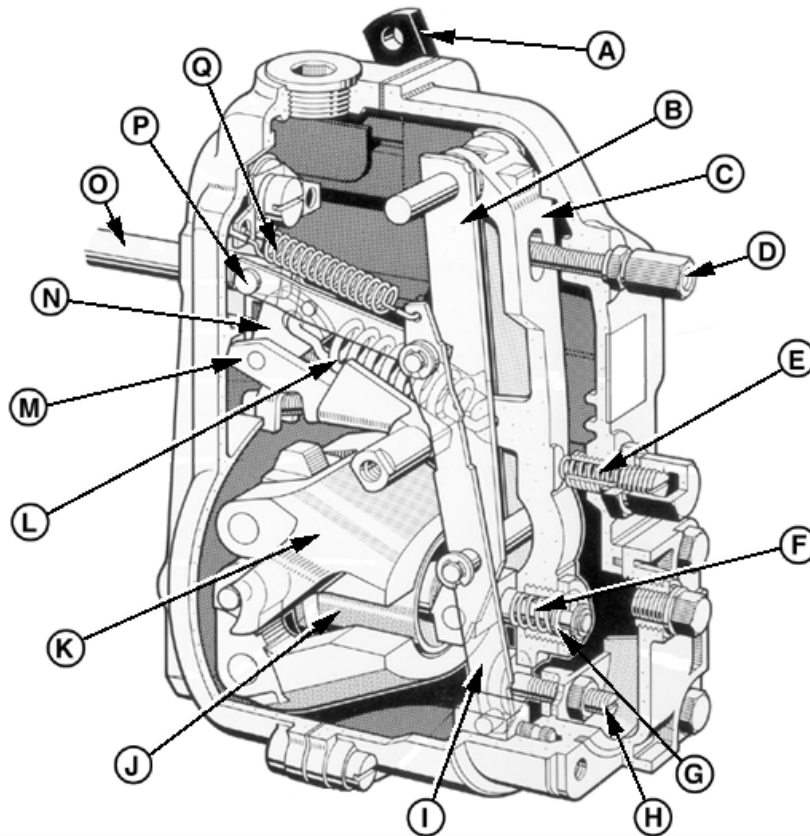
A retaining nut (G) is used to fasten the nozzle assembly to the holder body. The diameter of the holder body is 21 mm, and from this dimension the fuel injection nozzles are known as 21 mm nozzles.

An edge-type filter (P) is placed in the fuel inlet of the nozzle holder. Its purpose is to prevent coarse, foreign particles from damaging the nozzle assembly or plugging the orifices. Finer particles pass through the filter without harm. The filter is not removable.

To provide a seal between the injection nozzle and the engine cylinder head, a steel washer (H) is used at the base of the nozzle retaining nut.

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Mechanical Governor Operation



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- | | | | |
|-------------------------|-------------------------|------------------------|-------------------|
| A—Throttle Lever | F—Torque Control Spring | J—Guide Bushing | N—Rocker |
| B—Guide Lever | G—Shim (s) | K—Flyweights | O—Control Rack |
| C—Tensioning Lever | H—Full Load Stop Screw | L—Main Governor Spring | P—Link |
| D—Low Idle (Stop) Screw | I—Fulcrum Lever | M—Swivel Lever | Q—Starting Spring |
| E—Bumper Spring | | | |

The 6081 engine uses a centrifugal, variable-speed type governor on both Bosch and Denso injection pumps with mechanical governor options. This governor is capable of holding a steady speed (within rated regulation) in the range between idling and maximum speed positions.

The governor is mounted on the rear of the injection pump housing. The governor flyweight assembly (K) is mounted on the injection pump camshaft. The

flyweight assembly acts upon the governor linkage, which is connected to the control rack (O), to provide the desired speed regulation.

The governor is completely enclosed to permit splash lubrication of the working parts and a common oil level with the injection pump. A cable-operated throttle lever (A) mounted on the side of the governor housing is used to shut off fuel delivery to the engine.

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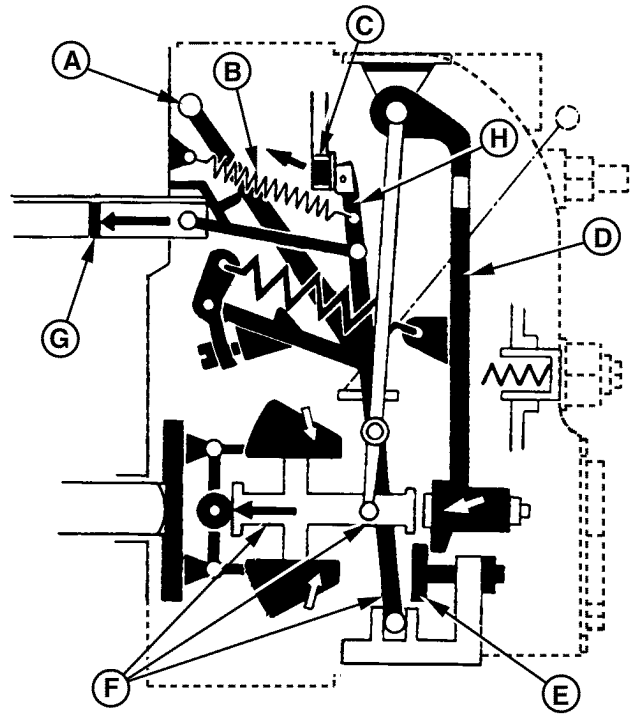
Starting Engine — Mechanical Governor

With the engine stopped and speed control lever (A) advanced slightly from the slow idle position permits starting spring (B) to move the tensioning lever (D), pulling the control rack (G) all the way forward to the "STARTING FUEL" position. An internal magnet (C) attracts a plate on the control rack lever (H) and helps keep the control rack in the starting fuel position until after the engine starts.

At the same time the tensioning lever is pulled up against the full load stop screw (E), moving the guide lever, knuckle, and thrust sleeve (F) forward. As a result of these movements, the flyweights come to rest against the thrust sleeve (innermost position).

While the engine is cranking, the injection pump begins to supply the largest quantity of fuel that it can deliver to the engine. Remember that when the control rack is fully forward, the pump plungers are positioned for their maximum effective pumping stroke.

Once the engine starts, the centrifugal force acting on the flyweights will overcome the starting spring force and magnetic force (after engine speed exceeds approximately 1300 rpm). The control rack then moves to a position where the force on the flyweights and governor springs are balanced.



- A—Speed Control Lever
- B—Starting Spring
- C—Internal Magnet
- D—Tensioning Lever
- E—Full Load Stop Screw
- F—Thrust Sleeve, Knuckle, and Guide Lever
- G—Control Rack
- H—Control Rack Lever

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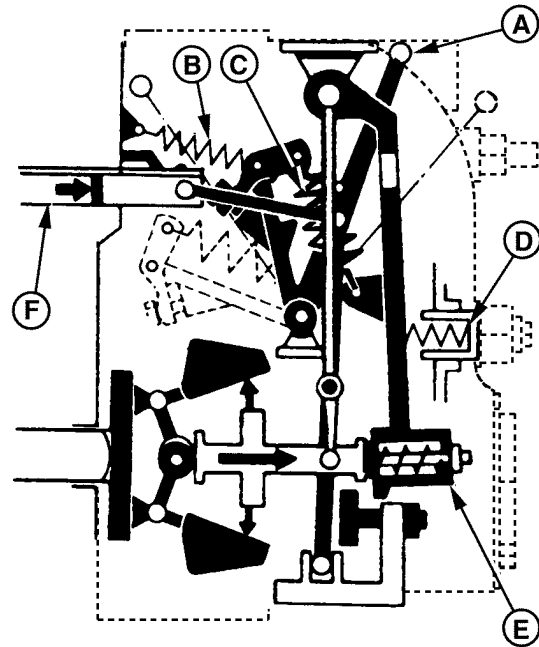
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Engine Running at Slow Idle — Mechanical Governor

As the control lever (A) is moved to the slow idle position, the governor spring (C) becomes nearly vertical and almost free of tension. Tension on the starting spring (B) increases as the control rack (F) and control rack lever move to the rear to obtain slow idle fuel delivery. Since the starting spring is a very light spring, its tension is not great enough to offset even the low tension on the governor spring.

The governor spring has only a slight effect on the governor linkage at idle speed because of low tension. This means that the flyweights can swing outward with very little resistance, even at low speed. At slow idle, the centrifugal and spring forces are low. Therefore, the torque capsule (E, mounted on the tensioning lever) is only slightly compressed.

Speed regulation at slow idle is obtained by the tensioning lever bearing against the supplementary idling spring (D) located in the center of the governor cover. Basically, the supplementary idling spring assists the governor spring in maintaining a constant idle speed, it has no other function.



- A—Speed Control Lever
- B—Starting Spring
- C—Governor Spring
- D—Idling Spring
- E—Torque Capsule
- F—Control Rack

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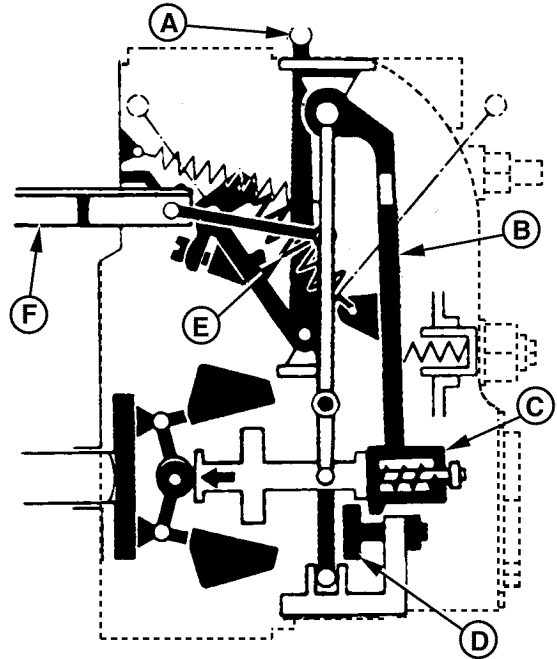
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Engine Running at Medium Speed — Mechanical Governor

Any movement of the speed control lever (A) above slow idle speed will cause the control rack to move to the full load fuel delivery position. The tensioning lever (B) is pulled up against the full load stop screw (D) by the governor spring (E). Also note that the torque capsule spring (C) is fully compressed.

As a result, engine speed increases from the additional fuel being supplied by the injection pump. Once the flyweight centrifugal force exceeds the force of the governor spring (E), the governor linkage moves the control rack (F) rearward to decrease delivery until forces are balanced.

- A—Speed Control Lever
- B—Tensioning Lever
- C—Torque Capsule
- D—Full Load Stop Screw
- E—Governor Spring
- F—Control Rack



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Engine Running at Full Load Rated Speed — Mechanical Governor

The governor operation at full load rated speed is basically the same as at medium speed. However, in this speed condition the swivel lever tensions the governor spring (E) to the full extent.

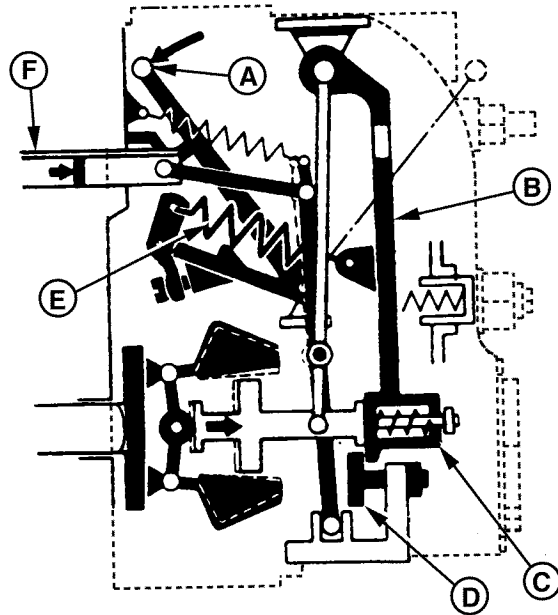
With the governor spring fully tensioned, the tensioning lever (B) is pulled against the full load stop (D) with greater force than when running at medium speed. This means that the control rack (F) is moved into the maximum (full load) fuel delivery position.

Note that the torque capsule (C) is fully compressed, the same as at medium speed.

Here are two conditions which will cause the rated speed to change:

1. If engine load decreases, the flyweights swing outward and press against the thrust sleeve and knuckle. This will move the tensioning lever away from the full load stop. Fuel delivery is then reduced as forces acting on the governor become balanced.
2. If engine load increases, the flyweights swing inward as the engine slows down. The torque capsule spring (which until now has been compressed to the face of the capsule) extends out of capsule and presses against the knuckle.

The torque capsule spring continues to extend out of capsule and press against knuckle if engine speed decreases further. It will extend to the limit of its travel or until the overload condition is removed.



A—Speed Control Lever
 B—Tensioning Lever
 C—Torque Capsule
 D—Full Load Stop Screw
 E—Governor Spring
 F—Control Rack

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NOTE: The purpose of the torque capsule spring is to exert constant pressure on the knuckle and thrust sleeve. This positions the control rack through the connecting linkage for maximum fuel delivery (but not starting fuel delivery).

NOTE: Starting fuel delivery can not be obtained because the flyweights are open sufficiently (even under overload conditions) to prevent the control rack from going all the way forward. Only when the flyweights are nearly collapsed, (as when cranking) can the injection pump provide starting fuel delivery.

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Stopping the Engine — Mechanical Governor

Moving the fuel shut-off lever (G) to the stop position actuates the stop device (C) to force the control rack (D) to move rearward, shutting off fuel delivery to the engine.

The stop device can be operated at any time, independent of the flyweight or speed control lever (A) positions. Note that the stop device mechanism is coupled to the shaft (H) and shut-off lever, housed three pressure springs (E).

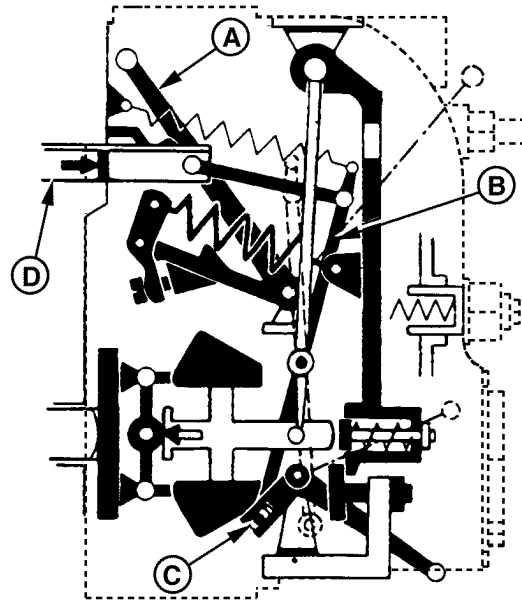
These springs each have a different diameter so that they fit inside each other.

Further movement of the fuel shut-off lever to its stop position (I) on the governor cover, places tension on the three stop device springs. Therefore, the springs serve a twofold purpose:

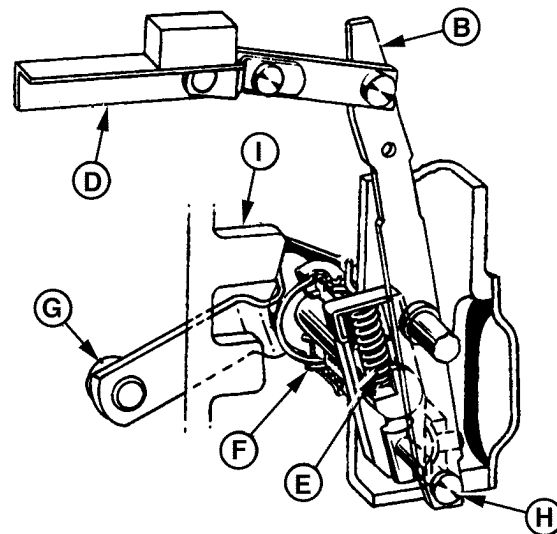
1. To prevent stressing the stop device mechanism between the time the rack is fully rearward and the time the fuel shut-off lever contacts its stop.
2. To permit the control rack to move fully rearward under all operating speeds and conditions.

NOTE: To ensure that the fuel delivery can be shut off under all speed and load conditions, the fuel shut-off lever must move the control rack to the "stop" position **BEFORE** the lever contacts its stop on the governor cover.

When the engine speed decreases, the tension on the three springs lessen. The stop device and lower end of the control rack lever are pushed forward as flyweights close, but the upper end of the control rack lever remains nearly stationary to hold the rack in the "stop" position.



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- A—Speed Control Lever
- B—Control Rack Lever
- C—Stop Device
- D—Control Rack
- E—Pressure Springs (3 used)
- F—Return Spring
- G—Fuel Shut-Off Lever
- H—Shaft
- I—Stop

Speed Droop

Speed droop is the variation in engine speeds between full load and no load speed range, and usually is expressed as a percent of rated speed.

For example, if any engine has been operating at full load, and this load is suddenly removed, the engine speed will increase to the fast idle speed. The amount of permissible speed increase is determined by governor design, but is usually no more than 10 percent.

Most engines used in field machine applications have a speed droop of 8—10 percent. On the other hand, stationary engines used on generator set applications usually have a 3—5 percent speed droop.

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Fuel Shut-off Solenoid

The fuel shut-off solenoid (A) will shut off fuel to the injection pump when the ignition switch is turned off.

A—Fuel Shut-off Solenoid



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Aneroid Operation

The aneroid is a diaphragm-type control unit that mounts on top of the governor housing. The purpose of the diaphragm is to eliminate unnecessary black smoke during acceleration, until sufficient manifold pressure is reached to overcome aneroid operation. Under certain speed and load conditions, adequate air is not immediately available (via turbocharger) to correspond with the amount of fuel injected into each cylinder.

Intake Manifold pressure (created by the turbocharger) enters aneroid at inlet (A). This pressurized air is directed to the upper side of diaphragm chamber (C) and exerts pressure on diaphragm (D).

When the pressure rises to about 100 kPa (1 bar) (15 psi), or about 1000 engine rpm under moderate to heavy loads, spring pressure (E) is overcome. Diaphragm then moves adjusting shaft (F) downward.

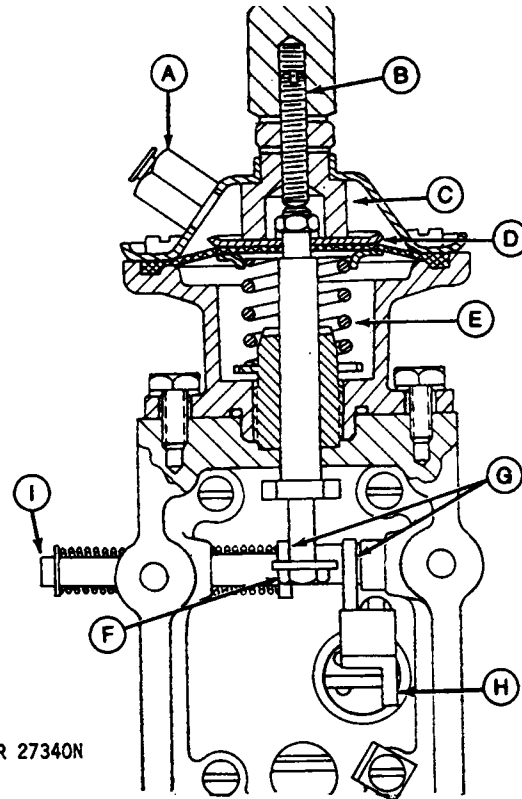
NOTE: *Diaphragm adjusting screw (B) regulates the minimum fuel delivery quantity at a specified rpm and zero pressure acting on the diaphragm. The diaphragm spring determines acceleration time (the greater the spring tension, the greater the manifold pressure required to overcome spring tension; hence, a slower acceleration).*

Downward movement of the adjusting shaft causes arm (G) to rotate on starting fuel control shaft (I), permitting control rack (H) to move it's normal amount.

If the intake manifold pressure is below 100 kPa (1 bar) (15 psi) because of low engine speed, or is under light load at higher engine speeds, the aneroid spring pressure is greater than intake manifold pressure. As a result, the control rack travel is limiter, (therefore, fuel delivery is limited) by the arm and adjusting shaft.

Aneroid control will be in effect until manifold pressure is high enough to overcome diaphragm spring pressure.

A hydraulic aneroid activator (described later in this group) is used to control the lever arm engagement with the control rack by moving the starting fuel control shaft in and out.



- A—Aneroid Air Inlet
- B—Adjusting Screw
- C—Diaphragm chamber
- D—Diaphragm
- E—Spring
- F—Adjusting Shaft Screw
- G—Control Rack-to-Adjusting Shaft Arm
- H—Control Rack
- I—Starting Fuel Shaft

R27340 -UN-17APR89

Mechanical Fuel Systems Operation

During starting, the hydraulic aneroid activator disengages the lever arm from the control rack block to permit the rack to move all the way forward to the starting fuel delivery position.

DPSG, RG33894,3 -19-02OCT98-2/2

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Hydraulic Aneroid Activator Operation

The hydraulic aneroid activator mounts on the inboard side of the governor housing. It has an internal piston (F) that is operated by engine oil pressure to hydraulically move the starting fuel control shaft inward for aneroid control.

Engine lubricating oil is piped from the oil filter body to operate the activator. This oil is then piped to the injection pump housing to lubricate the internal working parts.

Engine oil (upon starting the engine) is routed to the aneroid activator housing (I) through a connector (A), connector screw (B), and an orifice in the capillary valve (E) to head of piston (F).

Whenever the engine oil pressure is 60 kPa (0.6 bar) (9 psi) or higher, the piston will overcome resistance of piston spring (G) and move the starting fuel control shaft (H) inward to provide aneroid control.

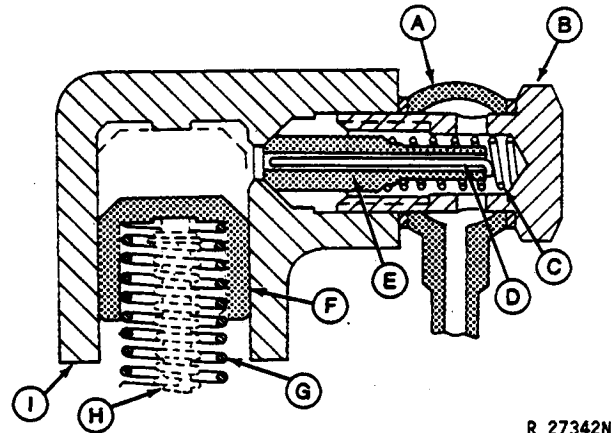
Loss of oil pressure permits a return spring on the starting fuel control shaft to hold the lever arm out of engagement with the control rack. This prevents the aneroid from limiting rack travel.

A restrictor wire (D) is inserted in the capillary valve for two reasons:

1. To retard engagement of the aneroid when engine is cold.
2. To help maintain an open passage in the capillary valve (oil pressure action moves the wire enough to prevent orifice from plugging).

The length of time required to achieve aneroid control depends on the ambient air temperature and the viscosity of the engine oil. warm ambient air temperatures will permit the aneroid to activate in a few seconds. Cold temperatures may delay activation for several minutes.

The following table gives the approximate ambient temperature-engagement time based on different engine lubricating oil viscosities:



R 27342N
R27342 -UN-17APR89

- A—Activator Connector
- B—Connector Screw
- C—Capillary Valve Spring
- D—Restrictor Wire
- E—Capillary Valve
- F—Piston
- G—Piston Spring
- H—Starting Fuel control Shaft
- I—Activator Housing

Mechanical Fuel Systems Operation

Ambient Temp. °C (°F)	Engine Crankcase Oil	Engagement in Second (Approx.)
-1° (30°)	SAE 30	86
-18° (1°)	10W-20	255
-29° (-20°)	5W-20	360

DPSG, RG33894.6 -19-09OCT98-2/2

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Section 04 Diagnostics

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About This Section of the Manual

This section of the manual contains necessary information to diagnose general engine and fuel system observable symptoms for 8.1 L Diesel Engines using a mechanical fuel system. Use this information in conjunction with the 8.1 L Diesel Engines Base Engine Manual (CTM86). This section is divided into two areas: diagnosing observable malfunctions and testing procedures. The observable diagnostic section is divided into the following symptoms:

- **(E)** Diagnosing Engine Malfunctions:
 - E1 - Engine Cranks/Won't Start
 - E2 - Engine Misfires/Runs Irregularly
 - E3 - Engine Does Not Develop Full Power
 - E4 - Engine Emits Excessive White Exhaust Smoke
 - E5 - Engine Emits Excessive Black or Gray Exhaust Smoke
 - E6 - Engine Will Not Crank
 - E7 - Engine Idles Poorly
 - E8 - Abnormal Engine Noise
- **(F)** Diagnosing Fuel System Malfunctions
 - F1 - Fuel Supply System Check
 - F2 - Excessive Fuel Consumption
 - F3 - Fuel in Oil

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 problems first. Symptoms arranged in both formats refer to testing procedures in the second part of this section. The second part of this section of the manual contains the following testing procedures:

- Fuel System Testing Procedures:
 - Check Fuel Supply Quality
 - Measure Fuel Supply Pump Pressure
 - Check Fuel Supply Pump Operation
 - Bleed The Fuel System
 - Cylinder Misfire Test (Engine Running)
 - Test For Fuel Drain Back
 - Test For Air In Fuel
 - Check For Restricted Fuel Return Line
 - Check And Adjust Injection Pump Static Timing
 - Check Fuel Shut-Off Solenoid Operation
 - Fuel Shut-off Solenoid Resistance Test
 - Fuel Shut-off Linkage Adjustment
 - Check Fast Idle Speed

E1 - Engine Cranks/Won't Start

NOTE: This procedure applies to engines using mechanical fuel systems. For engines using

electronic fuel systems, refer to the manual that corresponds to the ECU being used.

RG40854.0000004 -19-21DEC01-1/1

E1 - Engine Cranks/Won't Start Diagnostic Procedure

NOTE: This procedure should be used if engine cranking speed is OK, but it will not start or starts only after prolonged cranking. If the engine will not crank, determine problem in the starting/charging system.

--1/1

① E1 - Preliminary Check

1. Ensure fuel quantity and quality are OK. See CHECK FUEL SUPPLY QUALITY later in this Group.
2. Ensure engine cranking speed is OK. See CHECK ENGINE CRANKING SPEED in Section 04, Group 150 of 8.1L Diesel Engines Base Engine Manual (CTM 86).

Problem solved: No further investigation is required.

Problem still exists:
GO TO ②

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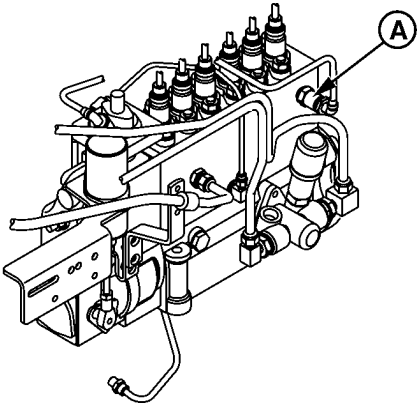
② Fuel Shut-off Operation Check

Check operation of the fuel shut-off mechanism. See CHECK FUEL SHUT-OFF SOLENOID OPERATION later in this Group.

Shut-off mechanism works correctly:
GO TO ③

Problem found with the shut-off mechanism:
Repair problem and retest.

--1/1

<p>3 Fuel Present At Injection Nozzle Check</p>	<p>Perform following procedure to check for fuel at injection nozzle:</p> <p>⚠ CAUTION: Escaping fluid under pressure can penetrate the skin causing serious injury. Keep hands and body away from pinholes and nozzles which could inject fluids under high pressure.</p> <p>If ANY fluid is injected into the skin, it must be surgically removed within a few hours by a doctor familiar with this type of injury or gangrene may result. Doctors unfamiliar with this type of injury may call the Deere & Company Medical Department in Moline, Illinois, or other knowledgeable medical source.</p> <ol style="list-style-type: none"> Using two open-end wrenches, loosen fuel line connection at one of the injection nozzles. Crank engine while monitoring loosened connection for consistent squirts of fuel. Retighten connection at nozzle to specification. <p style="text-align: center;">Specification</p> <p>Fuel Injection Nozzle Delivery Lines— Torque 27 N•m (20 lb-ft)</p>	<p>Consistent squirts of fuel observed: GO TO 6</p> <p>Don't see consistent squirts of fuel: GO TO 4</p>
<p>4 Return Fuel Check</p>	 <p>RG9989 -UN-20JAN99</p> <ol style="list-style-type: none"> Disconnect fuel line from injection pump overflow valve (A). Loosen overflow valve from injection pump. Turn ignition switch to "ON" position. Operate hand primer on fuel supply pump until fuel flows out the overflow valve fitting location. If fuel flow out the hole cannot be obtained, retighten all fittings. 	<p>Good fuel flow out of loose overflow valve, but engine still doesn't start: GO TO 6</p> <p>NOT good fuel flow or no flow out of loose overflow valve: See F1 - FUEL SUPPLY SYSTEM CHECK later in this Group.</p>

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Observable Diagnostics and Tests

<p>5 Fuel Delivery Line Check</p>	<p>Perform the following steps to determine if fuel delivery lines are restricted:</p> <ol style="list-style-type: none"> 1. Disconnect the suspected fuel delivery line on the injection nozzle end and injection pump end. 2. Force air through one end of the delivery line. 3. If the delivery line is not restricted, the compressed air should flow freely out the other side. 4. If air does not flow freely, there are restrictions in the fuel line. 	<p>Lines are not restricted: Have injection pump repaired by authorized diesel repair station or replace pump. See REMOVE FUEL INJECTION PUMP (BOSCH AND DENSO) or REMOVE FUEL INJECTION PUMP (MOTORPAL) in Section 02, Group 090 of this manual.</p> <p>Lines are restricted: Repair or replace lines and retest.</p> <p style="text-align: right;">-- -1/1</p>
<p>6 Intake and Exhaust Restriction Check</p>	<p>Check for intake and exhaust restrictions. See CHECK FOR INTAKE AND EXHAUST RESTRICTIONS in Section 04, Group 150 in 8.1 L Diesel Engines Base Engine Manual (CTM86).</p>	<p>No restrictions are found: GO TO 7</p> <p>Restrictions found: Repair or replace components as needed.</p> <p style="text-align: right;">-- -1/1</p>
<p>7 Injection Pump Timing Check</p>	<p>Check injection pump timing. See CHECK AND ADJUST INJECTION PUMP STATIC TIMING later in this Group.</p>	<p>Timing is correct: GO TO 8</p> <p>Timing is incorrect. Follow adjustment procedure in timing check procedure.</p> <p style="text-align: right;">-- -1/1</p>

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Observable Diagnostics and Tests

<p>8 Compression Pressure Check</p>	<p>Check compression pressure. See TEST ENGINE COMPRESSION PRESSURE in Section 04, Group 150 in 8.1 L Diesel Engines Base Engine Manual (CTM86).</p>	<p>Compression pressure within specification. GO TO 9</p> <p>Compression pressure is below specification. Investigate problems related to low compression.</p> <p style="text-align: right;">-- -1/1</p>
<p>9 Fuel Injection Nozzle Check</p>	<p>Test fuel injection nozzles. See TEST FUEL INJECTION NOZZLES in Section 02, Group 090 of this manual.</p>	<p>Injection nozzles test good. Have injection pump repaired by authorized diesel repair station or replace pump. See REMOVE FUEL INJECTION PUMP (BOSCH AND DENSO) or REMOVE FUEL INJECTION PUMP (MOTORPAL) in Section 02, Group 090 of this manual.</p> <p>Faulty injection nozzle(s) found. Repair or replace injection nozzles. See REMOVE FUEL INJECTION NOZZLES in Section 02, Group 090 of this manual.</p> <p style="text-align: right;">-- -1/1</p>

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E2 - Engine Misfires/Runs Irregularly

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E2 - Engine Misfires/Runs Irregularly Diagnostic Procedure

NOTE: This procedure applies to engines using mechanical fuel systems. For engines using electronic fuel systems, refer to the manual that corresponds to the ECU being used.

---1/1

1 E2 - Preliminary Check

Ensure fuel quantity and quality are OK. See CHECK FUEL SUPPLY QUALITY later in this Group.

Problem solved: No further investigation is required.

Problem still exists:
GO TO **2**

---1/1

2 Cylinder Misfire Check

Check cylinders for misfire. See CYLINDER MISFIRE TEST (ENGINE RUNNING) later in this Group.

Single cylinder misfire:
GO TO **3**

Random or all cylinder misfire: See F1 - FUEL SUPPLY SYSTEM CHECK later in this Group.

---1/1

3 Head Gasket Check

Check for head gasket joint failures. See CHECK FOR HEAD GASKET FAILURES in Section 04, Group 150 of 8.1 L Diesel Engines Base Engine Manual (CTM86).

No sign of head gasket failure:
GO TO **4**

Signs of head gasket failure found: Replace head gasket and retest.

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Observable Diagnostics and Tests

<p>4 Fuel Delivery Line Check</p>	<p>Perform the following steps to determine if fuel delivery lines are restricted:</p> <ol style="list-style-type: none"> 1. Disconnect the suspected fuel delivery line on the injection nozzle end and injection pump end. 2. Force air through one end of the delivery line. 3. If the delivery line is not restricted, the compressed air should flow freely out the other side. 4. If air does not flow freely, there are restrictions in the fuel line. 	<p>Lines are not restricted: GO TO 5</p> <p>Lines are restricted: Repair or replace lines and retest.</p> <p style="text-align: right;">-- -1/1</p>
<p>5 Compression Pressure Check</p>	<p>Check compression pressure. See TEST ENGINE COMPRESSION PRESSURE in Section 04, Group 150 of 8.1 L Diesel Engines Base Engine Manual (CTM86).</p>	<p>Compression pressure is within specification: GO TO 6</p> <p>Compression pressure is not within specification: GO TO 7</p> <p style="text-align: right;">-- -1/1</p>
<p>6 Fuel Injection Nozzle Check</p>	<p>Test fuel injection nozzles. See TEST FUEL INJECTION NOZZLES later in this Group.</p>	<p>Injection nozzles test good: Have injection pump repaired by authorized diesel repair station or replace pump. See REMOVE FUEL INJECTION PUMP (BOSCH AND DENSO) or REMOVE FUEL INJECTION PUMP (MOTORPAL) in Section 02, Group 090 of this manual.</p> <p>Faulty injection nozzle(s) found: Repair or replace injection nozzles.</p> <p style="text-align: right;">-- -1/1</p>

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Observable Diagnostics and Tests

<p>7 Piston Ring Check</p>	<p>Apply oil to ring area of piston through injection nozzle bore. DO NOT use too much oil. DO NOT get oil on the valves. Retest the compression pressure.</p>	<p>Compression pressure is within specification: GO TO 10</p> <p>Compression pressure is not within specification: GO TO 8</p> <p style="text-align: right;">---1/1</p>
<p>8 Valve Lash Check</p>	<p>Check valve lash. See CHECK AND ADJUST VALVE CLEARANCE in Section 02, Group 020 of 8.1 L Diesel Engines Base Engine Manual (CTM86).</p>	<p>Valve lash is within specification: GO TO 9</p> <p>Valve lash on one or more valves out of specification: Adjust valve lash and retest.</p> <p style="text-align: right;">---1/1</p>
<p>9 Valve Lift Check</p>	<p>Check valve lift. See CHECK VALVE LIFT in Section 02, Group 020 of 8.1 L Diesel Engines Base Engine Manual (CTM86).</p>	<p>Lift on all valves within specification: GO TO 10</p> <p>Valve lift on one or more valves is out of specification: Reset clearance to specification after measuring lift. See CHECK AND ADJUST VALVE CLEARANCE in Section 02, Group 020 of 8.1 L Diesel Engines Base Engine Manual (CTM86).</p> <p style="text-align: right;">---1/1</p>

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Observable Diagnostics and Tests

<p>10 Pistons, Rings, Cylinder Liners Check</p>	<p>At this point, the most likely cause of the low engine compression pressure is one of the following failures in the pistons, rings, and/or cylinder liners or in the valve guides. Check the most likely items as needed.</p> <ul style="list-style-type: none">• Oil control rings worn or broken• Scored cylinder liners or pistons• Piston ring grooves excessively worn• Piston rings sticking in ring grooves• Insufficient piston ring tension• Piston ring gaps not staggered• Cylinder liners glazed (insufficient load during engine break-in)• Worn valve guides or stems• Cylinder head may need reconditioning	<p>Problem found with pistons, rings, and/or liners or valve guides: Repair problem as necessary.</p> <p>-- -1/1</p>
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E3 - Engine Does Not Develop Full Power

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E3 - Engine Does Not Develop Full Power Diagnostic Procedure

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① E3 - Preliminary Check

1. Ensure fuel quantity and quality are OK. See CHECK FUEL SUPPLY QUALITY later in this Group.
2. Check for restricted or plugged air filter.

Problem solved: No further investigation is required.

Problem still exists:
GO TO ②

---1/1

② Exhaust Emission Check

Operate engine at full load rated speed. Under these conditions, determine type of exhaust emitted.

Small amount or no exhaust smoke:
GO TO ③

Heavy white exhaust smoke:
See E4 - ENGINE EMITS EXCESSIVE WHITE EXHAUST SMOKE diagnostic procedure later in this Group.

Heavy gray or black exhaust smoke:
See E5 - ENGINE EMITS EXCESSIVE BLACK OR GRAY EXHAUST SMOKE diagnostic procedure later in this Group.

---1/1

③ Turbocharger Boost Pressure Check

Check turbo boost pressure. See MEASURE INTAKE MANIFOLD PRESSURE (TURBO BOOST) in Section 04, Group 150 of 8.1 L Diesel Engines Base Engine Manual (CTM86).

Pressure within specification:
GO TO ④

Pressure below specification: GO TO ⑤

---1/1

④ Excessive Parasitic Load Check

At this point it appears that the engine is producing the correct power. The low power complaint is most likely a result of excessive parasitic load on the engine. The excessive load could be caused by incorrect vehicle ballasting, faulty hydraulic pump, faulty transmission, etc. Investigate problems associated with excessive parasitic load.

Excessive parasitic load found:

Repair cause of excessive load and retest.

---1/1

Observable Diagnostics and Tests

<p>5 Fast Idle Speed Check</p>	<p>Check fast idle speed. See CHECK FAST IDLE SPEED later in this Group.</p>	<p>Fast idle is within specification: GO TO 6</p> <p>Fast idle is below specification: Contact your authorized diesel repair station.</p> <p style="text-align: right;">-- -1/1</p>
<p>6 Fuel Supply Pressure Check</p>	<p>Check fuel supply system. See</p> <p>Check fuel supply pressure. See F1 - FUEL SUPPLY SYSTEM CHECK later in this Group.</p>	<p>Fuel supply system is OK: GO TO 7</p> <p>Fuel supply system problem found: Repair fuel supply system problem and retest.</p> <p style="text-align: right;">-- -1/1</p>
<p>7 Intake and Exhaust Restriction or Air Leak Check</p>	<p>Check for intake and exhaust restrictions and air leaks. See CHECK FOR INTAKE AND EXHAUST RESTRICTIONS and CHECK FOR EXHAUST AIR LEAKS (TURBOCHARGED ENGINES) in Section 04, Group 150 of 8.1 L Diesel Engines Base Engine Manual (CTM86).</p>	<p>No restrictions or leaks found: GO TO 8</p> <p>Restrictions or found: Repair and replace components as needed.</p> <p style="text-align: right;">-- -1/1</p>
<p>8 Injection Pump Timing Check</p>	<p>Check injection pump timing. See CHECK AND ADJUST INJECTION PUMP STATIC TIMING later in this Group.</p>	<p>Timing is correct: GO TO 9</p> <p>Timing is incorrect: Follow adjustment procedure found in above check.</p> <p style="text-align: right;">-- -1/1</p>

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Observable Diagnostics and Tests

<p>9 Turbocharger Failure Check</p>	<p>Check for turbocharger failures. See TURBOCHARGER INSPECTION in Section 02, Group 080 of 8.1 L Diesel Engines Base Engine Manual (CTM86).</p>	<p>No turbocharger failure found: GO TO 10</p> <p>Failure found: Follow appropriate repair procedure in Section 02, Group 080 of 8.1 L Diesel Engines Base Engine Manual (CTM86).</p> <p style="text-align: right;">---1/1</p>
<p>10 Valve Lash Check</p>	<p>Check valve lash. See CHECK AND ADJUST VALVE CLEARANCE in Section 02, Group 020 of 8.1 L Diesel Engines Base Engine Manual (CTM86).</p>	<p>Valve lash on all valves within specification. GO TO 11</p> <p>Valve lash on one or more valves out of specification. Adjust valve lash and retest.</p> <p style="text-align: right;">---1/1</p>
<p>11 Fuel Injection Nozzle Check</p>	<p>Test fuel injection nozzles. See TEST FUEL INJECTION NOZZLES in Section 02, Group 090 of 8.1 L Diesel Engines Base Engine Manual (CTM86).</p>	<p>Injection nozzles test good. GO TO 12</p> <p>Faulty injection nozzle(s) found. Repair or replace injection nozzles. See REMOVE FUEL INJECTION NOZZLES in Section, Group 090 of 8.1 L Diesel Engines Base Engine Manual (CTM86).</p> <p style="text-align: right;">---1/1</p>
<p>12 Injection Pump Check</p>	<p>Have injection pump repaired by authorized diesel repair station or replace pump. See REMOVE FUEL INJECTION PUMP (BOSCH AND DENSO) or REMOVE FUEL INJECTION PUMP (MOTORPAL) in Section 02, Group 090 of this manual.</p>	<p>Low power problem found: No further investigation is required</p> <p style="text-align: right;">---1/1</p>

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E4 - Engine Emits Excessive White Exhaust Smoke

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E4 - Engine Emits Excessive White Exhaust Smoke Diagnostic Procedure

NOTE: This procedure should be used if the engine emits excessive white exhaust smoke. This type of exhaust smoke causes a burning sensation to the eyes. If engine emits a less heavy, bluish exhaust smoke see L1 - EXCESSIVE OIL CONSUMPTION diagnostic procedure in Section 04, Group 150 of 8.1 L Diesel Engines Base Engine Manual (CTM86).

-- 1/1

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<p>❶ E4 - Preliminary Check</p>	<p>1. Ensure fuel quantity and quality are OK. See CHECK FUEL SUPPLY QUALITY later in this Group.</p> <p>2. Ensure engine coolant temperature isn't extremely low.</p>	<p>Problem solved: No further investigation is required.</p> <p>Problem still exists: GO TO ❷</p> <p>-- 1/1</p>
<p>❷ Failed Head Gasket Check</p>	<p>Check for a failed head gasket. See CHECK FOR HEAD GASKET FAILURES in Section 04, Group 150 of 8.1 L Diesel Engines Base Engine Manual (CTM86).</p>	<p>No signs of head gasket failure: GO TO ❸</p> <p>Signs of head gasket failure are found: See HEAD GASKET INSPECTION AND REPAIR SEQUENCE in Section 02, Group 080 of 8.1 L Diesel Engines Base Engine Manual (CTM86).</p> <p>-- 1/1</p>
<p>❸ Injection Pump Timing Check</p>	<p>Check injection pump timing. See CHECK AND ADJUST INJECTION PUMP STATIC TIMING later in this Group.</p>	<p>Timing is correct: GO TO ❹</p> <p>Timing is incorrect: Adjust timing.</p> <p>-- 1/1</p>

Observable Diagnostics and Tests

<p>④ Compression Pressure Check</p>	<p>Check compression pressure. See TEST ENGINE COMPRESSION PRESSURE in Section 04, Group 150 of 8.1L Diesel Engines Base Engine Manual (CTM86).</p>	<p>Compression pressure within specification: GO TO ⑤</p> <p>Compression pressure below specification: Investigate problems related to low compression.</p>
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<p>⑤ Fuel Injection Nozzle Check</p>	<p>Test fuel injection nozzles. See TEST FUEL INJECTION NOZZLES in Section 02, Group 090 of this manual.</p>	<p>Injection nozzles test good: Have injection pump repaired by authorized diesel repair station or replace pump. See REMOVE FUEL INJECTION PUMP (BOSCH AND DENSO) or REMOVE FUEL INJECTION PUMP (MOTORPAL) in Section 02, Group 090 of this manual.</p> <p>Faulty injection nozzle(s) found: Repair or replace injection nozzles. See REMOVE FUEL INJECTION NOZZLES in Section 02, Group 090 of this manual.</p>
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E5 - Engine Emits Excessive Black or Gray Exhaust Smoke

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E5 - Engine Emits Excessive Black or Gray Exhaust Smoke Diagnostic Procedure

NOTE: This procedure should be used if the engine emits excessive black or gray exhaust smoke. If engine emits a less heavy, bluish exhaust smoke go to L1 - EXCESSIVE OIL CONSUMPTION diagnostic procedure in Section 04, Group 150 of 8.1 L Diesel Engines Base Engine Manual (CTM86).

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<p>① E5 - Preliminary Check</p>	<ol style="list-style-type: none"> 1. Ensure fuel quantity and quality are OK. See CHECK FUEL SUPPLY QUALITY later in this Group. 2. Ensure engine is not excessively loaded. 3. Ensure air filter is not restricted or plugged. 	<p>Problem solved: No further investigation is required.</p> <p>Problem still exists: GO TO ②</p> <p>--1/1</p>
<p>② Intake and Exhaust Restriction or Air Leak Check</p>	<p>Check for intake and exhaust restrictions and air leaks. See CHECK FOR INTAKE AND EXHAUST RESTRICTIONS, TEST FOR INTAKE AIR LEAKS, and CHECK FOR EXHAUST AIR LEAKS (TURBOCHARGED ENGINES) in Section 04, Group 150 of 8.1 L Diesel Engines Base Engine Manual (CTM86).</p>	<p>No restrictions or leaks found: GO TO ③</p> <p>Restrictions or leaks found: Repair and replace components as needed.</p> <p>--1/1</p>
<p>③ Injection Pump Timing Check</p>	<p>Check injection pump timing. See CHECK AND ADJUST INJECTION PUMP STATIC TIMING later in this Group.</p>	<p>Timing is correct: GO TO ④</p> <p>Timing is incorrect: Adjust timing.</p> <p>--1/1</p>

Observable Diagnostics and Tests

<p>4 Turbocharger Check</p>	<p>Check for turbocharger failure. See TURBOCHARGER INSPECTION in Section 02, Group 080 of 8.1 L Diesel Engines Base Engine Manual (CTM86).</p>	<p>No turbocharger failure found: GO TO 5</p> <p>Failure found. Follow appropriate repair procedure in Section 02, Group 080 of 8.1 L Diesel Engines Base Engine Manual (CTM86).</p> <p style="text-align: right;">-- -1/1</p>
<p>5 Valve Lash Check</p>	<p>Check valve lash. See CHECK AND ADJUST VALVE CLEARANCE in Section 02, Group 020 of 8.1 L Diesel Engines Base Engine Manual (CTM86).</p>	<p>Valve lash on all valves within specification: GO TO 6</p> <p>Valve lash on one or more valves out of specification: Adjust valve lash and retest.</p> <p style="text-align: right;">-- -1/1</p>
<p>6 Fuel Injection Nozzle Check</p>	<p>Test fuel injection nozzles. See TEST FUEL INJECTION NOZZLES in Section 02, Group 090 of this manual.</p>	<p>Injection nozzles test good: Have injection pump repaired by authorized diesel repair station or replace pump. See REMOVE FUEL INJECTION PUMP (BOSCH AND DENSO) or REMOVE FUEL INJECTION PUMP (MOTORPAL) in Section 02, Group 090 of this manual.</p> <p>Faulty injection nozzle(s) found: Repair or replace injection nozzles. See REMOVE FUEL INJECTION NOZZLES in Section 02, Group 090 of this manual.</p> <p style="text-align: right;">-- -1/1</p>

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E6 - Engine Will Not Crank

Symptom	Problem	Solution
E6 - 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.

DPSG, RG41221,26 -19-21DEC01-1/1

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E7 - Engine Idles Poorly

Symptom	Problem	Solution
E7 - Engine Idles Poorly	Poor fuel quality	Drain fuel and replace with quality fuel of the proper grade.
	Air leak on suction side of air intake system	Check hose and pipe connections for tightness; repair as required. See AIR INTAKE AND EXHAUST SYSTEM SPECIFICATIONS in Section 06, Group 200 of 8.1L Diesel Engines Base Engine Manual (CTM86).
	Electronic control system problem or basic engine problem	See E2 - ENGINE MISFIRES/RUNS IRREGULARLY earlier in this Group.

DPSG, RG41221,37 -19-21DEC01-1/1

E8 - Abnormal Engine Noise

Symptom	Problem	Solution
E8 - Abnormal Engine Noise	Worn main or connecting rod bearings	Determine bearing clearance. See INSPECT AND MEASURE CONNECTING ROD BEARINGS in Section 02, Group 030 of 8.1L Diesel Engines Base Engine Manual or CHECK MAIN BEARING OIL CLEARANCE in Section 02, Group 040 of 8.1L Diesel Engines Base Engine Manual (CTM86).
	Excessive crankshaft end play	Check crankshaft end play. See CHECK CRANKSHAFT END PLAY in Section 02, Group 040 of 8.1L Diesel Engines Base Engine Manual (CTM86).
	Loose main bearing caps	Check bearing clearance; replace bearings and bearing cap screws as required. See CHECK MAIN BEARING OIL CLEARANCE in Section 02, Group 040 of 8.1L Diesel Engines Base Engine Manual (CTM86)
	Worn connecting rod bushings and piston pins	Inspect piston pins and bushings. See INSPECT PISTON PINS AND BUSHINGS in Section 02, Group 030 of 8.1L Diesel Engines Base Engine Manual (CTM86).
	Scored pistons	Inspect pistons. See PRELIMINARY LINER, PISTON, AND ROD CHECKS in Section 02, Group 030 of 8.1L Diesel Engines Base Engine Manual (CTM86).
	Worn timing gears or excess back lash	Check timing gear back lash. See CAMSHAFT AND TIMING GEAR TRAIN SPECIFICATIONS in Section 06, Group 50 of 8.1L Diesel Engines Base Engine Manual (CTM86).

Continued on next page

DPSG.RG41221.36 -19-21DEC01-1/2

Symptom	Problem	Solution
Abnormal Engine Noise - Continued	Excessive valve clearance	Check and adjust valve clearance. See CHECK AND ADJUST VALVE CLEARANCE in Section 02, Group 020 of 8.1L Diesel Engines Base Engine Manual (CTM86).
	Worn camshaft	Inspect camshaft. See VISUALLY INSPECT CAMSHAFT in Section 02, Group 040 of 8.1L Diesel Engines Base Engine Manual (CTM86).
	Worn rocker arm shaft(s)	Inspect rocker arm shafts. See DISASSEMBLE AND INSPECT ROCKER ARM SHAFT ASSEMBLY in Section 02, Group 020 of 8.1L Diesel Engines Base Engine Manual (CTM86).
	Insufficient engine lubrication	See L2 - ENGINE OIL PRESSURE LOW in Section 04, Group 150 of 8.1L Diesel Engines Base Engine Manual (CTM86).
	Turbocharger noise	See TURBOCHARGER INSPECTION in Section 02, Group 080 of 8.1L Diesel Engines Base Engine Manual (CTM86).

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DPSG, RG41221, 36 -19-21DEC01-2/2

F1 - Fuel Supply System Check

DPSG,OUOE003,2770 -19-21DEC01-1/1

F1 - Fuel Supply System Check Diagnostic Procedure

NOTE: This procedure applies to engines using mechanical fuel systems. For engines using electronic fuel systems, refer to the manual that corresponds to the ECU being used. This procedure should be used if problem has been diagnosed to be a fuel problem.

--1/1

① F1 - Preliminary Check

1. Ensure fuel quantity and quality are OK. See CHECK FUEL SUPPLY QUALITY later in this Group.
2. Inspect all fuel lines and fittings for ruptures or leaks.
3. If fuel system has recently been opened, bleed fuel system. See BLEED THE FUEL SYSTEM later in this Group.

Problem solved: No further investigation is required.

Problem still exists: GO TO ②

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② Air In Fuel Check

Check for air in the fuel. See TEST FOR AIR IN FUEL later in this Group.

No air found in fuel system: GO TO ③

Air found in fuel system: Bleed fuel system. See BLEED THE FUEL SYSTEM later in this Group.

--1/1

③ Fuel Supply Pressure Check

Check fuel supply pressure. See MEASURE FUEL SUPPLY PUMP PRESSURE later in this Group.

Pressure within specification: GO TO ⑦

Pressure is below specification: GO TO ④

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Observable Diagnostics and Tests

<p>4 Fuel Filter Test</p>	<ol style="list-style-type: none"> 1. Replace final fuel filter and retest. 2. Replace primary fuel filter (if equipped) and retest. 	<p>Problem solved: No further investigating is needed.</p> <p>Problem still exist: GO TO 5</p> <p style="text-align: right;">-- -1/1</p>
<p>5 Fuel Supply Lines Check</p>	<p>Remove fuel supply lines and determine if there are any internal restrictions.</p>	<p>No restrictions found: GO TO 6</p> <p>Restrictions found: Repair or replace components as needed.</p> <p style="text-align: right;">-- -1/1</p>
<p>6 Fuel Supply Pump Check</p>	<p>At this point, the most likely cause for low fuel pressure is one of the following failures in the fuel supply pump. Check the most likely items as needed.</p> <p>IMPORTANT: Visually inspect the fuel inlet fitting and pump filter for possible plugging before disassembling pump to determine cause of malfunction.</p> <ol style="list-style-type: none"> 1. Test Fuel Supply Pump for leaks. See CHECK FUEL SUPPLY QUALITY later in this Group. 2. Hand primer not screwed down tight, allowing dirt to enter hand primer plunger chamber. 3. Worn or pitted valves. 4. Missing or broken spring(s). 5. Hand primer lever left in upward position. 	<p>No supply pump problems found: GO TO 7</p> <p>Supply pump problems found: Refer to Section 02, Group 090 of this manual for repair.</p> <p style="text-align: right;">-- -1/1</p>
<p>7 Restricted Pre - Injection Fuel Line Check</p>	<p>This check will help determine if the pre-injection fuel line is restricted.</p> <ul style="list-style-type: none"> • Disconnect fuel line from the final filter. • Disconnect fuel line from injection pump. • Force air through the fuel line. • If the fuel line is not restricted, the compressed air should freely flow out the other side. • If air does not flow freely, there are restrictions in the fuel line. 	<p>No restrictions found: GO TO 8</p> <p>Restrictions found: Repair or replace components as needed.</p> <p style="text-align: right;">-- -1/1</p>

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Observable Diagnostics and Tests

8 Fuel Injection Pump Check

NOTE: If you are here because engine does not develop full power, see E3 - ENGINE DOES NOT DEVELOP FULL POWER earlier in this Group and proceed with diagnostics.

Have injection pump repaired by authorized diesel repair station or replace pump. See REMOVE FUEL INJECTION PUMP (BOSCH AND DENSO) or REMOVE FUEL INJECTION PUMP (MOTORPAL) in Section 02, Group 090 of this manual.

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F2 - Excessive Fuel Consumption

Symptom	Problem	Solution
F2 - Excessive Fuel Consumption	Poor fuel quality	Drain fuel and replace with quality fuel of the proper grade.
	Engine overloaded	Reduce engine load.
	Air cleaner restricted or dirty	Replace air cleaner element as required.
	Compression too low	Determine cause of low compression and repair as required.
	Leaks in fuel supply system	Locate source of leak and repair as required.

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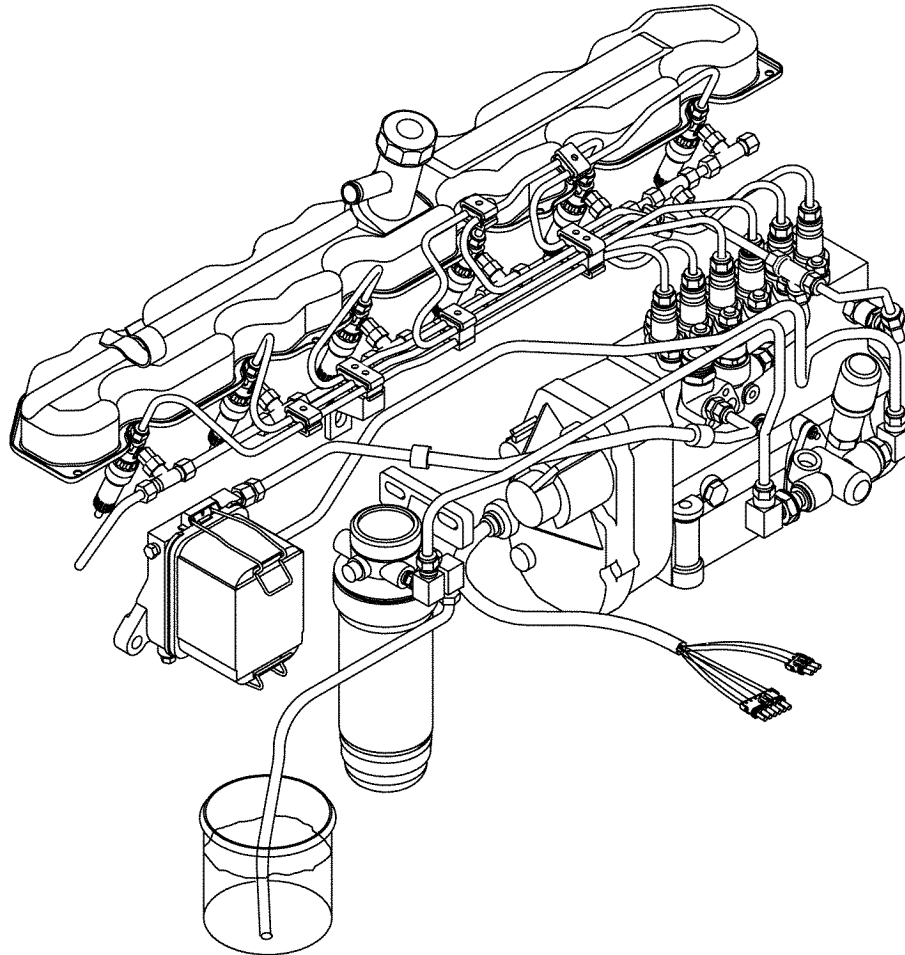
DPSG, RG41221,25 -19-21DEC01-1/1

F3 - Fuel in Oil

Symptom	Problem	Solution
F3 - Fuel in Oil	Cracked cylinder head	Locate crack, repair/replace components as required.

DPSG, RG41221,38 -19-21DEC01-1/1

Check Fuel Supply Quality



RG9722 -UN-04DEC98

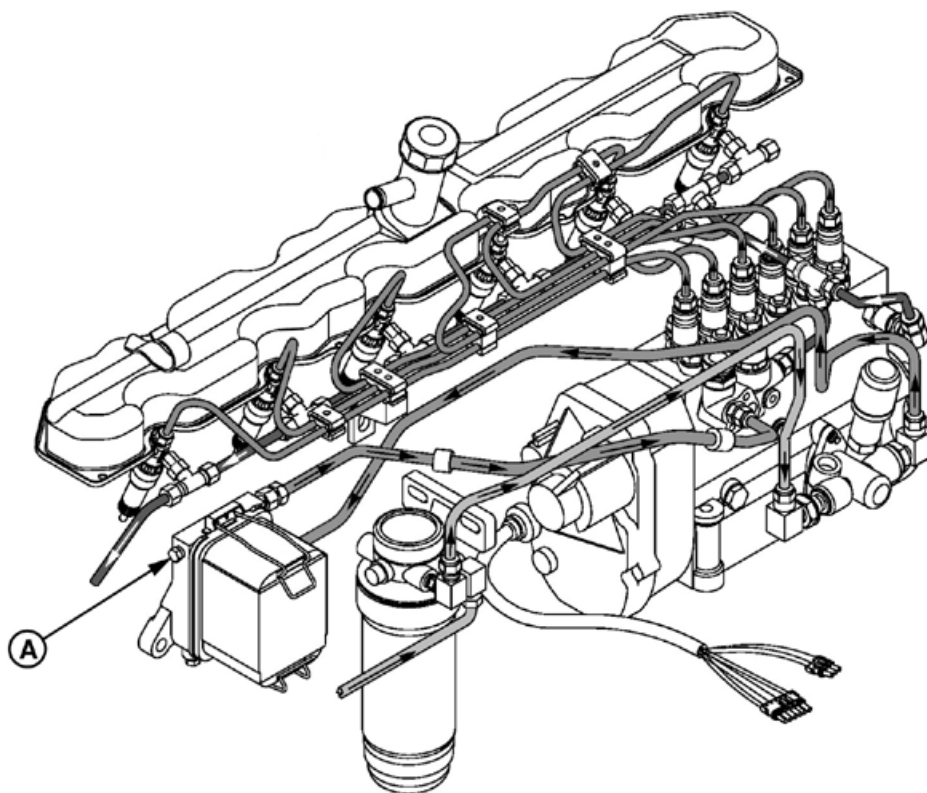
The quality of diesel fuel effects engine performance. Check your operator's manual for correct fuel specifications.

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

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

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

Measure Fuel Supply Pump Pressure



A—Bleed Plug

RG9727 -UN-04DEC98

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

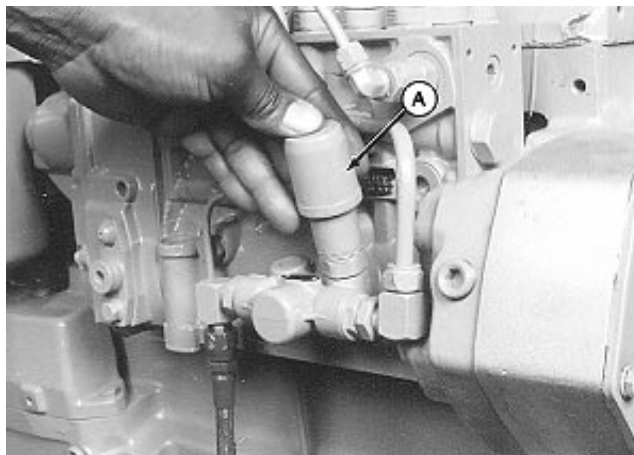
1. Remove bleed plug (A) at final fuel filter and connect a 0—400 kPa (0—4 bar) (0—60 psi) pressure gauge. All air must be out of system.
2. Start engine and run at low idle. Supply pump minimum outlet pressure should be 200 kPa (2.0 bar) (29.0 psi).
3. If pressure is below the minimum specified and no restriction is visible in any of the fuel lines, replace primary and final fuel filters and recheck pressure.
4. If pressure is still low, connect the primary filter inlet line to temporary fuel tank and recheck pressure. If pressure increases to specification, check the fuel supply line, the pre-filter strainer (if equipped), the fuel tank, and the fuel tank vent for any possible restrictions.
5. If pressure does not increase, repair/replace the fuel supply pump and retest.

Check Fuel Supply Pump Operation

NOTE: The following procedure can best be performed under moderate air temperature conditions to reduce electrical loads when cranking the engine is required.

1. Make a preliminary inspection of the supply pump. Thoroughly clean area around pump. All connections must be tight and not leaking.
2. Start engine and bring to operating temperature. Turn ignition to "OFF" position.

NOTE: Hand primer (A) is spring loaded to remain in the fully extended position. If fuel leaks around a hand primer while seated in the extended position, replace the hand primer.



RG7071 -UN-07SEP94

A—Hand Primer

Check operation of hand primer:

With ignition at "OFF" position, operate hand primer through several strokes.

Moderate to heavy leakage of fuel between plunger and barrel indicates seal is defective. Replace hand primer.

NOTE: Appearance of a slight quantity of fuel around the plunger is normal.

Test operation of suction side of pump:

1. Disconnect suction and discharge lines at pump.
2. Drain all fuel from pump by operating hand primer. Then, reconnect suction line to pump.

NOTE: When operating hand primer, a moderate resistance should be felt. When only a slight resistance (or no resistance) occurs, replace hand primer or repair pump (valves may be defective).

3. Operate hand primer until fuel flows from pump outlet (discharge).

Fuel should flow within 15-25 strokes. If not, the suction line may be obstructed or be leaking air, (replace in-line filter when used).

If fuel does not flow and if no leak or obstruction is found, pump is defective. It must be repaired or replaced.

Test operation of discharge side of pump:

1. Suction line must be connected and discharge (pressure) line disconnected.
2. Place injection pump fuel shut-off control in "STOP" position to prevent engine from starting.
3. Crank engine with starting motor.

Fuel should flow from pump outlet within 10 seconds. If not, the suction line may be obstructed (replace in-line filter when used), or leaking air.

Test pump output pressure while cranking:

1. Connect a 0-400 kPa (0-4 bar) (0-60 psi) pressure gauge to one end of a pressure hose about 250-300 mm (10-12 in.) long. Connect other end of hose to pump outlet. All air must be out of system.
2. Crank engine for 10 seconds with starting motor (approximately 300 engine rpm). Supply pump minimum outlet pressure should be 200 kPa (2.0 bar) (29.0 psi).

IMPORTANT: The starting motor must crank the engine at normal cranking speed. Use booster batteries if necessary.

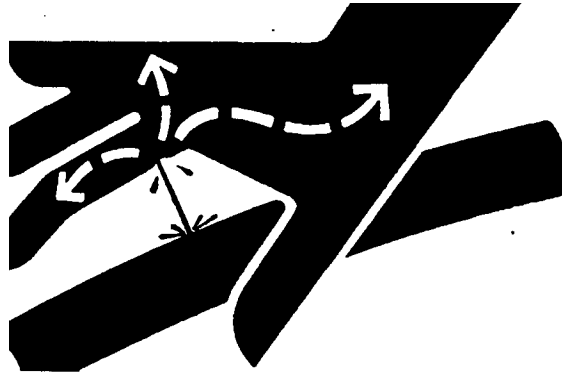
3. Compare measured output with the minimum pressure specifications.

If pressure is below the minimum specified and if no obstruction or leak is found, repair or replace the pump.

Bleed the Fuel System



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



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

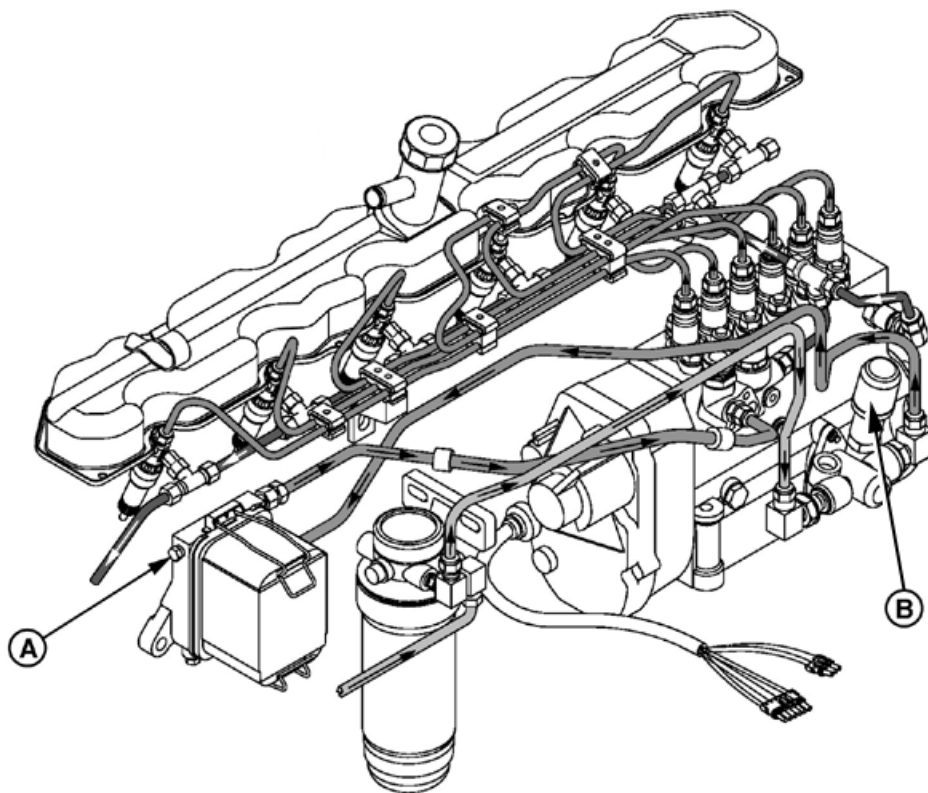
Whenever the fuel system has been opened up for service (lines disconnected or filters removed), it will be necessary to bleed air from the system.

The fuel system may be bled at one of several locations. On some engine applications it may be necessary to consult your operator's manual and choose the location best for your engine/machine application.

Continued on next page

DPSG,RG40854,21 -19-25NOV98-1/4

X9811 -UN-23AUG88



RG9727A -JUN-15,JAN99

A—Bleed Plug

B—Hand Primer

At Final Fuel Filter:

1. Turn ignition switch to "ON" position.
2. Use a shop towel or pan to catch escaping fuel.
3. Loosen bleed plug (A) on side of fuel filter base.
4. Operate the hand primer (B) on fuel supply pump until a smooth flow of fuel, free of bubbles, comes out of the filter plug hole.
5. Tighten bleed plug and start engine.

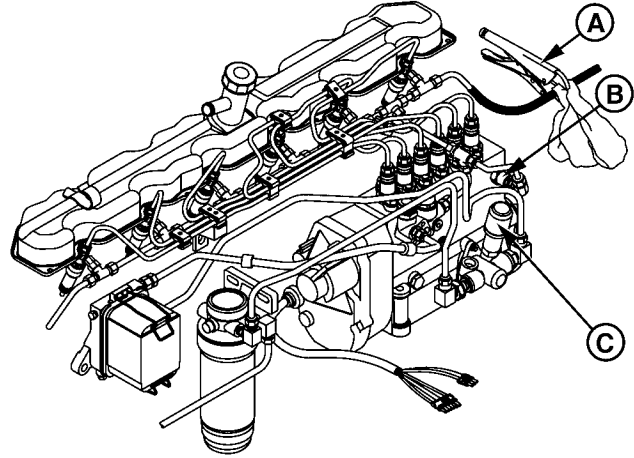
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DPSG, RG40854, 21 -19-25NOV98-2/4

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At Fuel Injection Pump:

1. Pinch-off return fuel line (A).
2. Use a shop towel to catch escaping fuel.
3. Disconnect fuel line from injection pump overflow valve (B).
4. Loosen overflow valve body (B) from where valve threads into injection pump.
5. Turn ignition switch to "ON" position.
6. Operate the hand primer (C) on fuel supply pump until fuel free from air bubbles flows out of injection pump at the overflow valve fitting location.
7. Simultaneously, continue to operate hand primer (C) while tightening overflow valve on injection pump to specification.



A—Return Line Hose Pinched-off
 B—Overflow Valve
 C—Hand Primer

RG9748 -JUN-26JAN99

Specification

Overflow Valve—Torque 30 N•m (22 lb-ft)

8. Operate the hand primer on fuel supply pump until moderate resistance is felt.
9. Release pinch-off from return line hose.

Continued on next page

DPSG, RG40854, 21 -19-25NOV98-3/4

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At Fuel Injection Nozzles:

1. Place throttle lever in half-throttle position. On engines equipped with electronic fuel shut-off solenoid, energize solenoid.

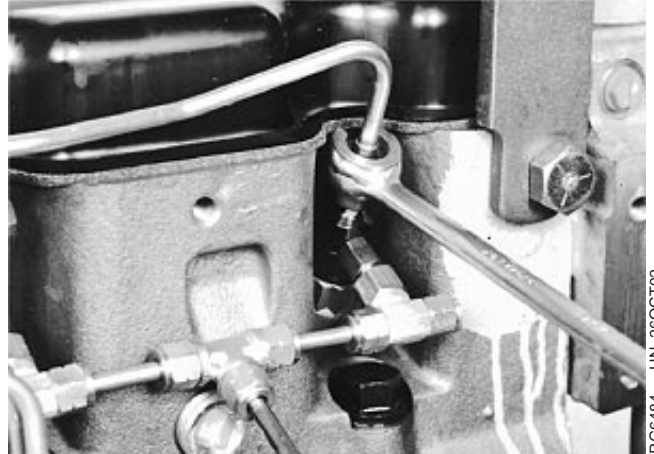
IMPORTANT: Always use a backup wrench when loosening or tightening fuel lines at nozzles and/or injection pump to avoid damage.

2. Place a shop towel around fuel line-to-nozzle connection to catch escaping fuel.
3. Using two open-end wrenches, loosen fuel line connection at injection nozzles.
4. Crank engine over with starting motor, (but do not start engine), until fuel free from bubbles flows out of loosened connection. Retighten connection to specifications.

Specification

FUEL INJECTION NOZZLE
DELIVERY LINES—Torque 27 N•m (20 lb-ft)

5. Repeat procedure for remaining injection nozzles (if necessary) until all air has been removed from fuel system.



RG6484 -UN-26OCT92

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DPSG, RG40854, 21 -19-25NOV98-4/4

Cylinder Misfire Test (Engine Running)



CAUTION: Escaping fluid under pressure can penetrate the skin causing serious injury. Keep hands and body away from pinholes and nozzles which could inject fluids under high pressure.

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

1. Operate engine at intermediate speed with no load.
2. Place a shop towel around nozzle-to-line connection to absorb escaping fuel.

3. Slowly loosen the fuel pressure line at one of the nozzles until fuel escapes at the connection (fuel not opening nozzle valve).
 - If engine speed changes, the cylinder is probably working satisfactory.
 - If engine speed does not change, a cylinder is faulty.
4. Repeat test for each remaining cylinder.
5. Tighten fuel lines to specifications.

Specification

FUEL INJECTION NOZZLE
DELIVERY LINES—Torque..... 27 N•m (20 lb-ft)

DPSG.RG40854,23 -19-25NOV98-1/1

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Test for Fuel Drain Back

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

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

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

2. Drain all fuel from the system, including the fuel transfer pump, fuel injection pump, fuel filters, and water separator (if equipped).
3. Securely plug off the end of the fuel return pipe.
4. Using a low-pressure air source, pressurize the fuel system at the fuel supply line.

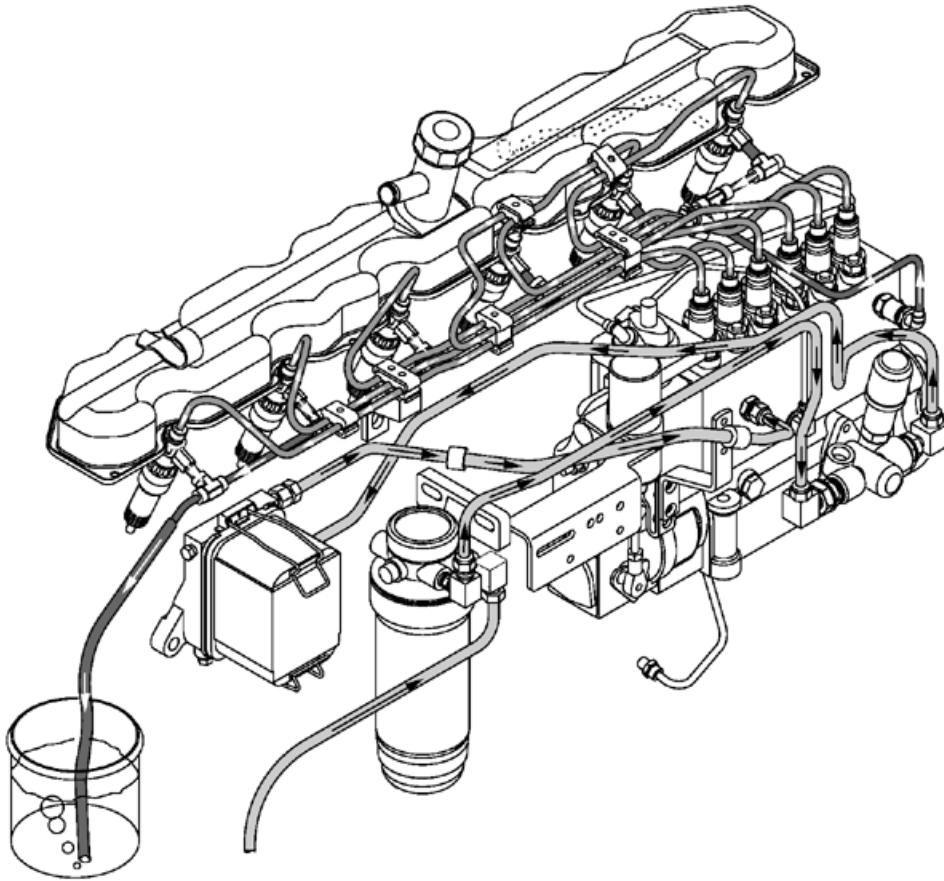


CAUTION: Maximum air pressure should be 100 kPa (1 bar) (15 psi) when performing this test.

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

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

6. If any leaks are found, take necessary steps to repair.
7. Reconnect supply and return lines and prime system.
8. Start engine and run for approximately 10 minutes.
9. Allow engine to sit overnight and try starting the following morning.

Test for Air in Fuel

RG9705 -UN-04DEC98

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

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

1. Disconnect hose from end of fuel leak-off line assembly. Connect a hose to end of leak-off line assembly and place opposite end of hose in a suitable container filled with fuel as shown.
2. Operate engine and check for air bubbles in container. If bubbles are present, bleed the fuel

system and repeat test. See BLEED THE FUEL SYSTEM in this Group.

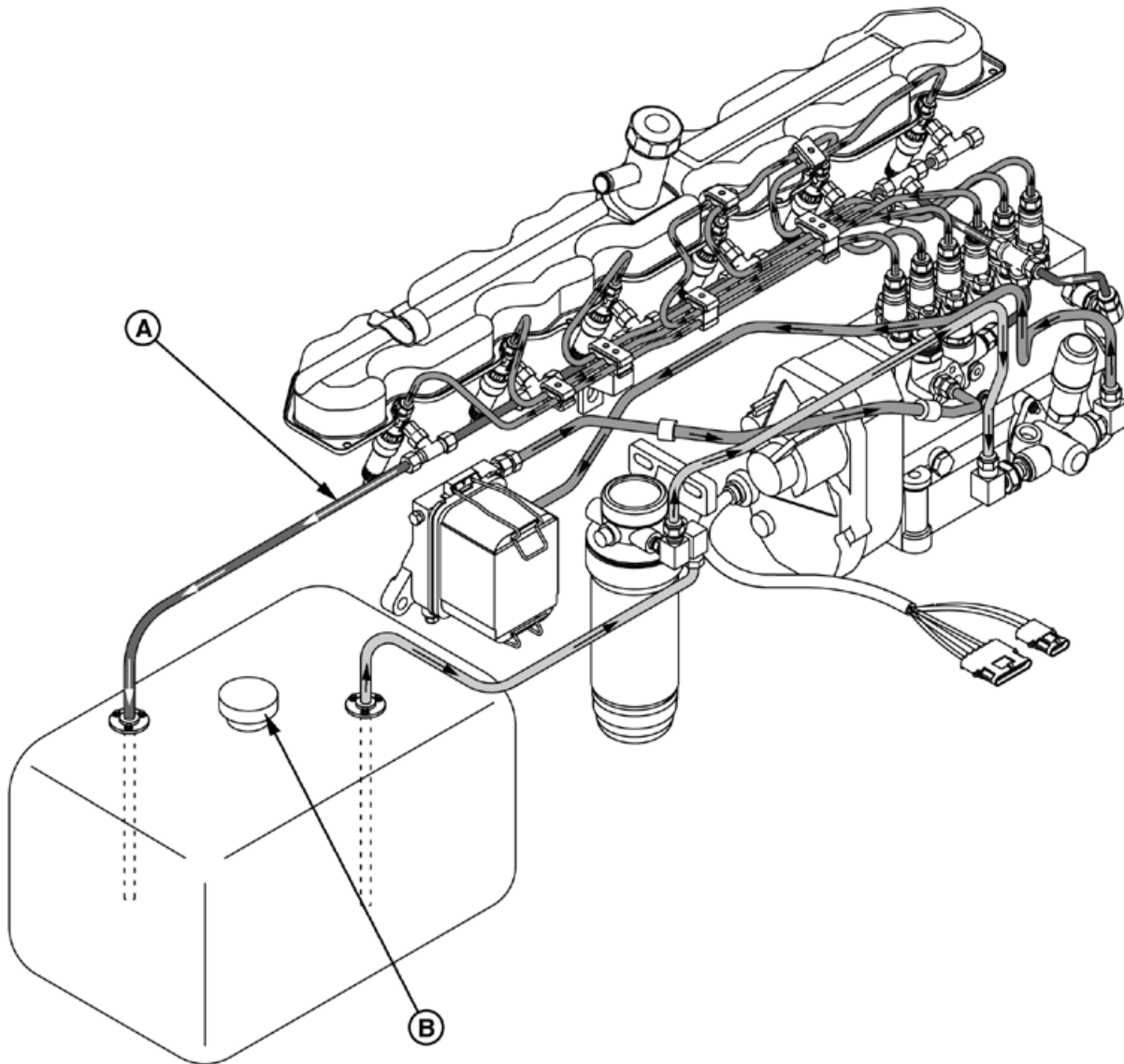
3. If bubbles are still present, check the following:

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

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

DPSG.RG40854,32 -19-30NOV98-1/1

Check for Restricted Fuel Return Line



A—Fuel Return Line

B—Fuel Tank Cap

This check will help determine if the fuel return line is restricted.

1. Disconnect the fuel return line (A) from the fuel leak-off line at the engine.
2. Remove fuel tank cap (B).
3. Force compressed air through the fuel return line while listening at the fuel tank filler neck.

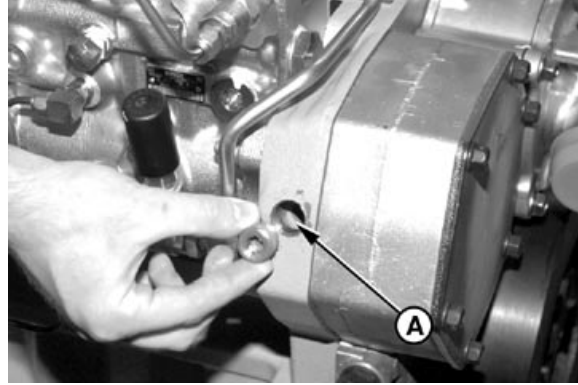
4. If the return line isn't restricted, the compressed air bubbling into the fuel tank should be audible through the tank filler neck.
5. If no air bubbling through the tank is audible, completely check the fuel return line for any possible restrictions.

RC9706A -JUN-02FEB99

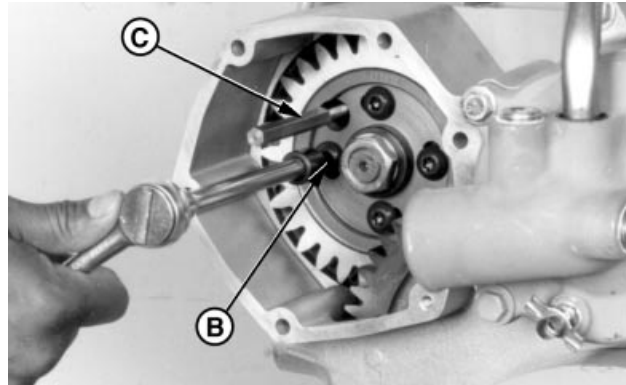
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Check and Adjust Injection Pump Static Timing

1. Rotate engine flywheel (in normal running direction) until No. 1 piston is at "TDC" of it's compression stroke. At this point, JDE81-4 Timing Pin should enter hole in flywheel.
2. Remove timing hole plug (A).
3. Timing marks on injection pump drive hub and fixed pointer should be aligned. If timing mark on injection pump drive hub is not visible, remove JDE81-4 Timing Pin from flywheel and rotate engine (in normal running direction) one more revolution, and reinstall JDE81-4 Timing Pin in flywheel. Look again to see if timing mark aligns with fixed pointer.
4. If timing mark and fixed pointer are aligned, injection pump is correctly timed. If they don't align, remove injection pump drive gear cover and O-ring.
5. Loosen drive gear-to-pump hub cap screws (B) and rotate hub slightly until JDG866 Injection Pump Timing Pin (C) threads into drive hub and bottoms out.
6. Tighten drive gear-to-pump hub cap screws to specification.



RG9732 -UN-04DEC98



RG7740E -UN-02FEB99

Specification

Injection Pump Drive
 Gear-to-Pump Hub Cap Screws—
 Torque 61 N•m (45 lb-ft)

7. Remove JDG866 Injection Pump Timing Pin from injection pump hub.
8. Install injection pump drive gear cover using a new O-ring, if needed. Tighten cap screws to specification.

Specification

Injection Pump Drive Gear
 Cover—Torque 27 N•m (20 lb-ft)

9. Remove JDE81-4 Timing Pin from flywheel.

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Check Fuel Shut-Off Solenoid Operation

1. Observe fuel shut-off lever (A) when ignition switch is turned "OFF" to "START" (engine running at slow idle) and then released to "ON" position.
2. Fuel shut-off lever should move from "NO FUEL" position (B) to "RUN" position (C) when starting motor begins to crank. The lever should remain at the "RUN" position after ignition switch is released to "ON" position.

If fuel shut-off lever does not move to the "RUN" position with ignition switch at "ON" position, check for:

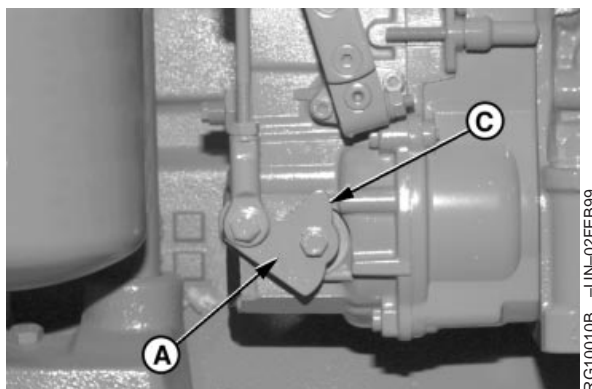
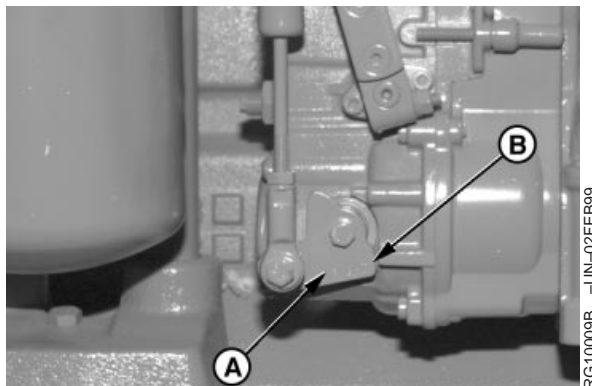
- Loss of battery voltage to fuel shut-off winding. Check voltage and wiring connection to solenoid.
- Binding of fuel shut-off lever, solenoid rod or linkage does not allow solenoid to lock in position. Repair or replace linkage.
- Torn or leaking rubber boot allowing dirt or moisture to enter at spring end of solenoid rod.
- Improperly adjusted fuel shut-off solenoid linkage. See FUEL SHUT-OFF SOLENOID LINKAGE ADJUSTMENT later in this Group.
- Faulty fuel shut-off solenoid. See TEST FUEL SHUT-OFF SOLENOID RESISTANCE later in this Group.

3. Start engine and run at slow idle. Turn ignition switch to "OFF" position.
4. Fuel shut-off lever should move to "NO FUEL" position and engine should stop.

If the solenoid stops just short of the "NO FUEL" position, slight adjustment of the linkage is required. See FUEL SHUT-OFF SOLENOID LINKAGE ADJUSTMENT, later in this Group.

If engine continues to run with ignition switch at "OFF" POSITION, unplug shut-off solenoid 3-way connector.

- If solenoid moves lever to "NO FUEL" position, problem is in the electrical circuit.



A—Shut-Off Lever
B—NO FUEL Position
C—RUN Position

- If solenoid does not shut off fuel to engine, check linkage for binding or excessive tightness. Replacement service kit is available with a swivel rod which is less sensitive to misalignment and binding.

DPSG, RG40854, 28 -19-30NOV98-2/2

Test Fuel Shut-Off Solenoid Resistance

Disconnect shut-off solenoid 3-way WEATHER PACK™ connector.

1. Measure "PULL" coil resistance between black lead wire "C" and white lead wire "B".
2. Measure "HOLD" coil resistance between black lead wire "C" and red wire "A".

Replace solenoid if resistance is not within specification given below.

PULL AND HOLD COIL RESISTANCE SPECIFICATIONS		
Solenoid Voltage	Pull Coil Resistance (Ohms)	Hold Coil Resistance (Ohms)
12-Volt System	0.195-0.239 ^a	10.035-12.265
24-Volt System	0.735-0.899 ^a	37.215-45.485

^aSubtract multimeter test lead resistance.

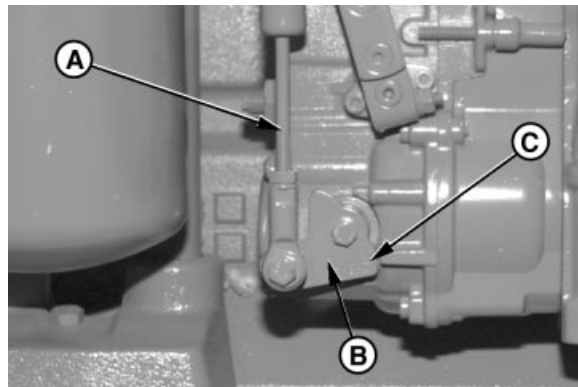
DPSG, RG40854, 29 -19-30NOV98-1/1

Fuel Shut-Off Solenoid Linkage Adjustment

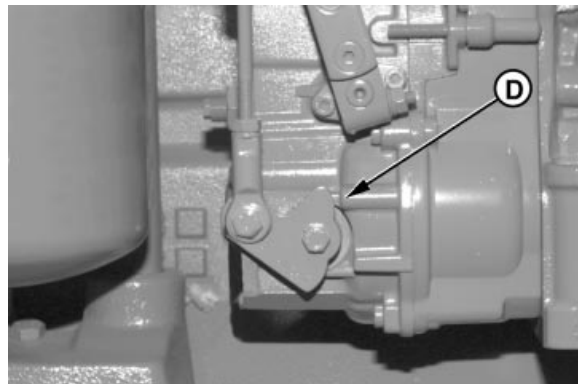
Shut-off solenoid linkage is factory adjusted and usually will not require additional field adjustment. ALWAYS check linkage and lever for alignment and binding before making adjustments.

1. Thoroughly lubricate all linkage and lever pivot points.
2. If necessary, adjust linkage (A) so that lever (B) contacts no fuel position stop (C) with ignition switch "OFF" and engine not running.
3. Start engine and run at slow idle. Lever should contact run position stop (D) or nearly contact when the lever is being pushed up.

- A—Link
- B—Lever
- C—No Fuel Position Stop
- D—Run Position Stop



RG10009A -UN-02FEB99



RG10010A -UN-02FEB99

DPSG, RG40854, 30 -19-30NOV98-1/1

Check and Adjust Slow Idle Speed

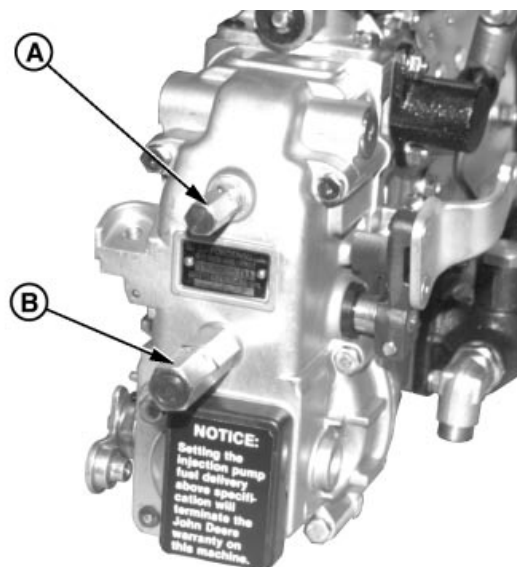
IMPORTANT: Verify that throttle linkage is properly adjusted and it moves freely without binding before drawing the conclusion that slow idle speed requires adjustment.

1. Start engine and move throttle lever to slow idle and check idle speed using a hand-held tachometer or vehicle instrument panel tachometer.

NOTE: Hold governor throttle lever against slow idle stop or disconnect speed control rod from throttle lever if you suspect it is not resting against stop.

2. If slow idle speed needs to be adjusted, the slow idle adjusting screw cover (A) and bumper spring adjusting screw cover (B) must be removed on Denso injection pumps only.

NOTE: Refer to the appropriate machine technical manual for slow idle speed adjustment specifications.



A—Adjusting Screw Cover
B—Bumper Spring Adjusting Screw Cover

Continued on next page

DPSG, RG34710, 84 -19-15FEB99-1/3

04
150
39

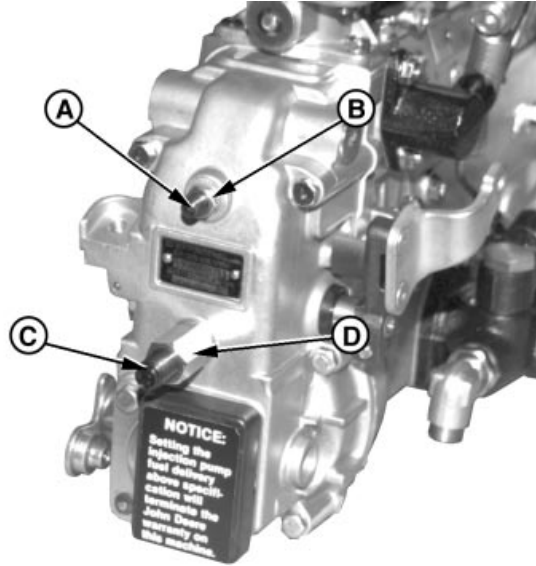
IMPORTANT: Minor adjustment of the slow idle speed may be made with the bumper spring screw (C). However, it should not be used by itself to change engine speed more than 50 rpm (100 rpm for 6081TRW01, 02, 09, 10 engines), as overspeeding of the engine may result.

If slow idle screw (A) and bumper spring screw are not adjusted according to instructions, engine damage could result because of overspeeding.

3. Loosen bumper spring lock nut (D) and either remove bumper spring screw or back it out until there is no preload on spring.
4. Loosen slow idle screw lock nut (B) and adjust slow idle screw to obtain an idle speed 50 rpm (100 rpm for 6081TRW01, 02, 09, 10 engines) less than desired slow idle speed setting.
5. Turn the bumper spring adjusting screw in to increase engine speed a maximum of 50 rpm (100 rpm for 6081TRW01, 02, 09, 10 engines) to desired slow idle speed.

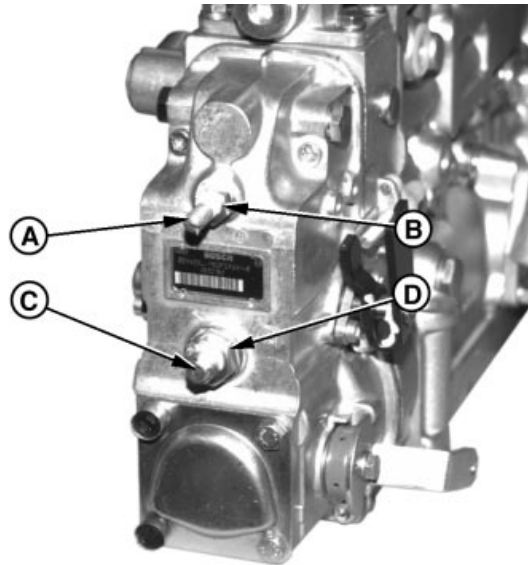
For example, to obtain an 850 rpm slow idle speed, use the slow idle screw to set speed at approximately 800 rpm. Then increase speed to 850 rpm using the bumper spring adjusting screw.

NOTE: Increasing the slow idle speed a slight amount above the specified speed range may help to reduce engine surge (or hunting). If this occurs, use the procedure given above; but do not exceed 850 rpm.



Denso Injection Pump

RG10011 -UN-16FEB99



Bosch Injection Pump

RG10012 -UN-16FEB99

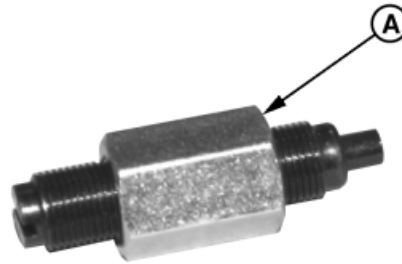
- A—Slow Idle Adjusting Screw
- B—Slow Idle Lock Nut
- C—Bumper Spring Adjusting Screw
- D—Bumper Spring Lock Nut

Continued on next page

DPSG, RG34710,84 -19-15FEB99-2/3

04
150
40

6. If engine surging or hunting persists at slow idle after adjustments are made, the bumper spring adjustment screw (A) may need to be replaced. Remove the pump from the engine and have it repaired by an authorized diesel repair station (ADS shop). For Bosch and Denso fuel injection pump removal and installation, see REMOVE FUEL INJECTION PUMP (BOSCH AND DENSO) in Section 02, Group 090 of 8.1L Diesel Engines Base Engine Manual (CTM86). For Motorpal fuel injection pump removal and installation, see REMOVE FUEL INJECTION PUMP (MOTORPAL) in Section 02, Group 090 of 8.1L Diesel Engines Base Engine Manual (CTM86).



RG10013 -JUN-16FEB99

NOTE: Motorpal injection pumps need to be exchanged if a faulty pump is found.

7. Check the fast and slow idle speeds again. Readjust, slow idle speed if not correct.
8. Check all adjusting screw lock nuts for tightness. Install covers (and copper washers) on slow idle adjusting screw and bumper spring adjusting screw.
9. Connect speed control rod.

04
150
41

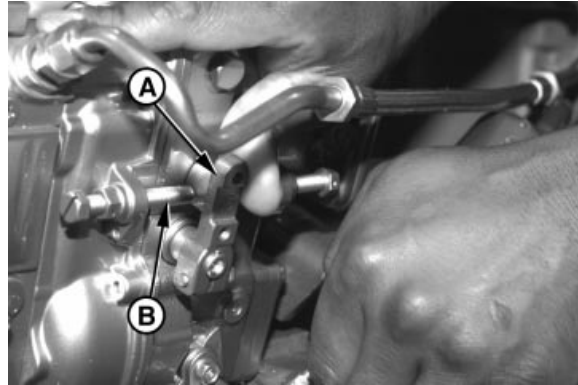
DPSG, RG34710,84 -19-15FEB99-3/3

Check Fast Idle Speed

1. Remove speed control rod. With engine running, move governor control lever (A) against fast idle stop screw (B).

NOTE: The governor control lever on an injection pump may be inboard (next to engine block) or outboard (away from engine block), depending upon engine application.

2. Using a tachometer, check fast idle speed to see if it is within specification for the specific application you are checking.



A—Governor Control Lever
B—Fast Idle Stop Screw

IMPORTANT: If fast idle speed must be adjusted, see your authorized diesel repair station for Bosch and Denso injection pumps. Motorpal injection pumps need to be exchanged if a faulty pump is found.

NOTE: For some applications such as generator sets, special equipment may be required for fast idle adjustment in conjunction with droop adjustment. See your OEM dealer or John Deere Engine Distributor.

DPSG, RG40854, 33 -19-30NOV98-1/1

Section 05 Tools

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Group 180—Diagnostic Service Tools

Base Engine Diagnostic Tools.	05-180-1
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Mechanical Fuel System Repair Tools

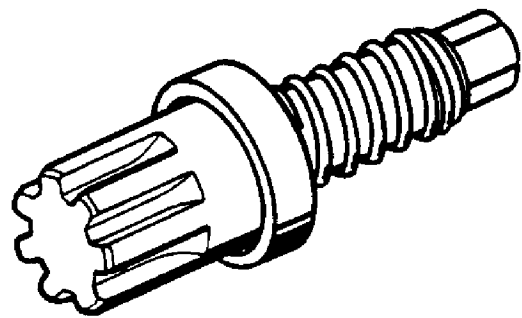
NOTE: Order tools according to information given in the U.S. SERVICEGARD™ Catalog or from the European Microfiche Tool Catalog (MTC).

SERVICEGARD is a trademark of Deere & Company

RG41183,000008D -19-01DEC00-1/12

Flywheel Turning Tool JDG820

Used to rotate flywheel on engine to check damper radial runout and time engine. JDE81-1 may be used also if JDG820 is not available.



JDG820

RG7056

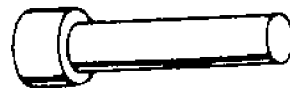
RG7056 -UN-05DEC97

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170
1

RG41183,000008D -19-01DEC00-2/12

Timing Pin JDE81-4

Lock engine at TDC when timing valve train, adjusting valve clearance, and installing fuel injection pump. Use with JDG820 and JDE81-1 Flywheel Turning Tools.



JDE81-4

RG5068

RG5068 -UN-05DEC97

Continued on next page

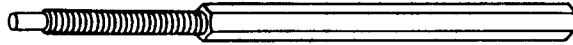
RG41183,000008D -19-01DEC00-3/12

Repair Tools

RG7212 -UN-23NOV97

Injection Pump Timing Pin. JDG886

Used to set Bosch and Nippondenso fuel injection pump timing prior to removal of pump.



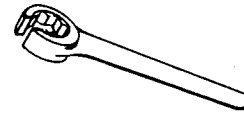
JDG886

RG41183.000008D -19-01DEC00-4/12

RG5290 -UN-15OCT92

Serrated Wrench. JDE90

Use to hold injection pump fuel outlet fittings on Bosch "P" pump from turning when loosening and tightening fuel pipe connections.



JDE90

RG41183.000008D -19-01DEC00-5/12

RG5288 -UN-23AUG88

Crowsfoot Wrench. JDF22

Used to loosen and tighten fuel pipes at injection nozzles and at injection pump.



JDF22

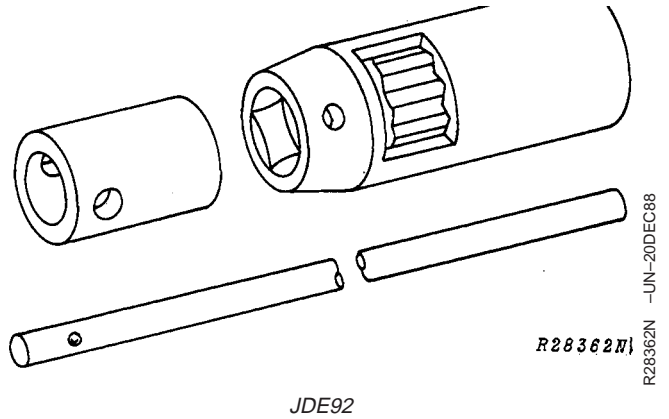
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RG41183.000008D -19-01DEC00-6/12

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2

Nozzle Socket JDE92

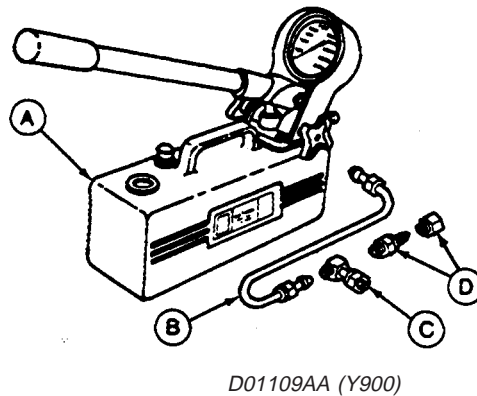
Used to remove and install 21 mm injection nozzles.



RG41183,000008D -19-01DEC00-7/12

Fuel Injection Nozzle Tester and Attaching Hardware D01109AA (Y900)

Used to test operational performance and opening pressure of nozzles. Shown are D01109AA (Y900) Fuel Injection Nozzle Tester (A), Y900-2A Fuel Injection Line Assembly (B)¹, Y900-21 Adapter Nut (C)², and Y900-7 and Y900-15 Straight Adapters (D).¹



¹Included in D01110AA (Y910A) Adapter Set.

²May be used instead of Y900-7 and Y900-15.

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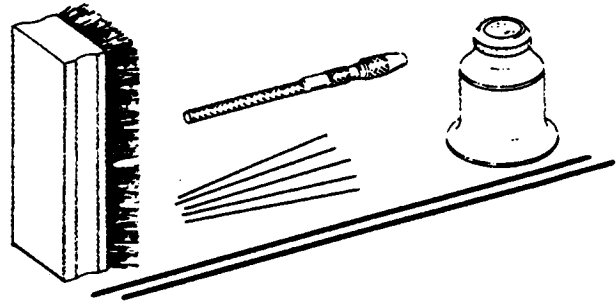
RG41183,000008D -19-01DEC00-8/12

RG4954 -UN-14DEC88

Repair Tools

Nozzle Cleaning Kit JDF13 (JDE105)

Used to clean injection nozzles.



JDF13 (JDE105)

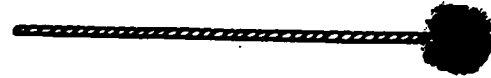
RG4953 -UN-14DEC88

RG41183,000008D -19-01DEC00-9/12

05
170
4

Nozzle Thread Cleaning Brush. D17030BR

Used to clean nozzle threads in cylinder head.



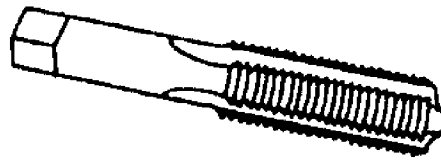
D17030BR

RG5099 -UN-23AUG88

RG41183,000008D -19-01DEC00-10/12

Tap JDF5

Used to restore nozzle threads in cylinder head.



JDF5

RG5100

RG5100 -UN-05DEC97

Continued on next page

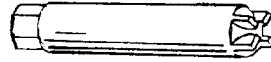
RG41183,000008D -19-01DEC00-11/12

Repair Tools

RG5289 -UN-07NOV97

Nozzle Seat Reamer JDG609

Used to clean carbon from nozzle seats in cylinder head.



JDG609

RG5289

RG41183,000008D -19-01DEC00-12/12

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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DPSG,OUO1004,881 -19-13MAY99-1/2

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170
5

Adapter TORX® T45

Injection pump drive gear-to-hub cap screws.

TORX is a registered trademark of Camcar/Textron.

DPSG,OUO1004,881 -19-13MAY99-2/2

Other Material

Number	Name	Use
TY9375 (U.S.) TY9480 (Canadian) 592 (LOCTITE®)	Pipe Sealant	Apply to rectangular fuel filter bleed plug and drain plug.
T43512 (U.S.) TY9473 (Canadian) 242 (LOCTITE®)	Thread Lock and Sealer (Medium Strength)	Apply to injection pump timing hole plug. Apply to threads of leak-off connectors on engines with nylon leak-off lines.
AR54749 (U.S.)	Soap Lubricant	Injection pump mounting flange O-ring.
PT569 (U.S.)	NEVER-SEEZ® Compound	Injection nozzle gland nut threads and barrel.

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170
6

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

DPSG,OUO1004,882 -19-13MAY99-1/1

Base Engine Diagnostic Tools

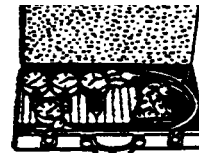
NOTE: Order tools according to information given in the U.S. SERVICEGARD™ Catalog or from the European Microfiche Tool Catalog (MTC).

SERVICEGARD is a trademark of Deere & Company

DPSG,OUO1004,201 -19-07JUL98-1/5

Universal Pressure Test Kit JT05470 (formerly D15027NU or FKM10002)

RG5162 -UN-23AUG88



Used for testing engine oil pressure, intake manifold pressure (turbo boost), and fuel supply pump pressure.

DPSG,OUO1004,201 -19-07JUL98-2/5

05
180
1

Cooling System Pressure Pump D05104ST

Used to pressure test radiator cap and cooling system.



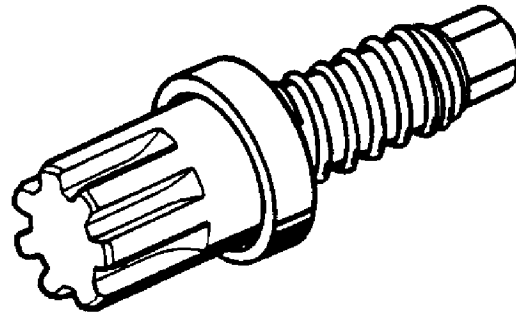
R26406N -UN-29NOV88

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DPSG,OUO1004,201 -19-07JUL98-3/5

Flywheel Turning Tool JDG820

Used to rotate engine flywheel to lock engine at "TDC" to check fuel injection pump timing. Use with JDE81-4 Timing Pin.



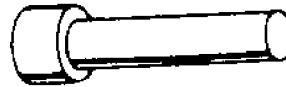
RG7056 -UN-05DEC97
RG7056

DPSG,OUO1004,201 -19-07JUL98-4/5

RG5068 -UN-05DEC97

Timing Pin JDE81-4

Used to lock engine at "TDC". Use with JDG820 Flywheel Turning Tool.



RG5068

DPSG,OUO1004,201 -19-07JUL98-5/5

05
180
2

Section 6 Specifications

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Contents

General Engine Specifications (OEM Applications)

NOTE: For vehicle engines, see Machine Technical Manual.

ITEM	UNIT OF MEASURE	6081TF	6081AF	6081HF
General Data				
Engine Type	—	In-line, 4 cycle diesel	In-line, 4 cycle diesel	In-line, 4 cycle diesel
Aspiration	—	Turbocharged	Turbocharged, water-to-air aftercooled	Turbocharged and air-to-air aftercooled
Number of Cylinders	—	6	6	6
Bore	mm (in.)	116 (4.56)	116 (4.56)	116 (4.56)
Stroke	mm (in.)	129 (5.06)	129 (5.06)	129 (5.06)
Displacement	L (cu in.)	8.1 (496)	8.1 (496)	8.1 (496)
Combustion System	—	Direct injection	Direct injection	Direct injection
Compression Ratio	—	16.5:1	16.5:1	15.7:1
Physical Dimensions				
Width	mm (in.)	599 (23.8)	698 (27.5)	597 (23.5)
Height	mm (in.)	1138 (44.8)	1138 (44.8)	1152 (45.3)
Length	mm (in.)	1200 (47.6)	1200 (47.6)	1200 (47.6)
Basic Dry Weight	kg (lb)	735 (1620)	796 (1755)	776 (1710)
Performance Data (Industrial Applications)				
Net Rated Power (Cont.) at 2200 rpm	kW (hp)	127 (170)	160 (215)	190 (255)
Net Peak Torque (Cont.) at 1200 rpm	N•m (lb-ft)	758 (559)	967 (713)	1184 (873)
Net Rated power (Intermit.) at 2200 rpm	kW (hp)	149 (200)	168 (225)	224 (300)
Net Peak (Intermit.) at 1200 rpm	N•m (lb-ft)	891 (656)	1012 (747)	1393 (1027)
Low Idle Speed	rpm	850	850	850
Fast Idle Speed	rpm	2300	2300	2300
Performance Data (Generator Applications)				
Net Rated Power (Prime) at 1800 rpm	kW (hp)	142 (190)	168 (225)	218 (292)
Net Rated Power (Standby) at 1800 rpm	kW (hp)	157 (211)	187 (250)	240 (322)
Net Rated Power (Prime) at 1500 rpm	kW (hp)	119 (160)	142 (190)	182 (244)
Net Rated Power (Standby) at 1500 rpm	kW (hp)	130 (175)	157 (210)	200 (268)
Low Idle Speed	rpm	850	850	850
Fast Idle Speed	rpm	1900 / 1600	1900 / 1600	1900 / 1600
Lubrication System				
Oil Pressure at Rated rpm	kPa (psi)	400 (58)	345 (50)	345 (50)

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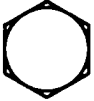










General Engine Specifications (OEM Applications)—Continued

ITEM	UNIT OF MEASURE	6081TF	6081AF	6081HF
Cooling System (Liquid, pressurized with centrifugal pump)				
Recommended pressure Cap	kPa (psi)	69 (10)	69 (10)	69 (10)
Coolant Flow (Industrial)	L/min (gal/min)	330 (87)	330 (87)	330 (87)
Coolant Flow (Generator) at 1800 rpm	L/min (gal/min)	270 (71)	270 (71)	270 (71)
at 1500 rpm	L/min (gal/min)	210 (55)	210 (55)	210 (55)
Engine Operation System				
Hot Cylinder Compression Pressure with Injection Nozzles Removed	kPa (psi)	2380-2790 (345-405)	2380-2790 (345-405)	2380-2790 (345-405)
Valve Clearance (Cold)				
Intake	mm (in.)	0.46 (0.018)	0.46 (0.018)	0.46 (0.018)
Exhaust	mm (in.)	0.71 (0.028)	0.71 (0.028)	0.71 (0.028)
Fuel System				
Nozzle Opening Pressure New	kPa (psi)	29000 (4200)	29000 (4200)	29000 (4200)
Nozzle Opening Pressure Used (min.)	kPa (psi)	26200 (3800)	26200 (3800)	26200 (3800)
Injection Pump Timing				
Timing lines aligned with flywheel at TDC				

DPSG.OUO1004,909 -19-24MAY99-1/1

6
200
2

Unified Inch Bolt and Cap Screw Torque Values

SAE Grade and Head Markings	NO MARK	1 or 2 ^b 	5 	5.1 	5.2 	8 	8.2 
	NO MARK	2 	5 			8 	

Size	Grade 1				Grade 2 ^b				Grade 5, 5.1, or 5.2				Grade 8 or 8.2			
	Lubricated ^a		Dry ^a		Lubricated ^a		Dry ^a		Lubricated ^a		Dry ^a		Lubricated ^a		Dry ^a	
	N-m	lb-ft	N-m	lb-ft	N-m	lb-ft	N-m	lb-ft	N-m	lb-ft	N-m	lb-ft	N-m	lb-ft	N-m	lb-ft
1/4	3.7	2.8	4.7	3.5	6	4.5	7.5	5.5	9.5	7	12	9	13.5	10	17	12.5
5/16	7.7	5.5	10	7	12	9	15	11	20	15	25	18	28	21	35	26
3/8	14	10	17	13	22	16	27	20	35	26	44	33	50	36	63	46
7/16	22	16	28	20	35	26	44	32	55	41	70	52	80	58	100	75
1/2	33	25	42	31	53	39	67	50	85	63	110	80	120	90	150	115
9/16	48	36	60	45	75	56	95	70	125	90	155	115	175	130	225	160
5/8	67	50	85	62	105	78	135	100	170	125	215	160	240	175	300	225
3/4	120	87	150	110	190	140	240	175	300	225	375	280	425	310	550	400
7/8	190	140	240	175	190	140	240	175	490	360	625	450	700	500	875	650
1	290	210	360	270	290	210	360	270	725	540	925	675	1050	750	1300	975
1-1/8	400	300	510	375	400	300	510	375	900	675	1150	850	1450	1075	1850	1350
1-1/4	570	425	725	530	570	425	725	530	1300	950	1650	1200	2050	1500	2600	1950
1-3/8	750	550	950	700	750	550	950	700	1700	1250	2150	1550	2700	2000	3400	2550
1-1/2	1000	725	1250	925	990	725	1250	930	2250	1650	2850	2100	3600	2650	4550	3350

6
200
3

DO NOT use these values if a different torque value or tightening procedure is given for a specific application. Torque values listed are for general use only. Check tightness of fasteners periodically.

Fasteners should be replaced with the same or higher grade. If higher grade fasteners are used, these should only be tightened to the strength of the original.

Shear bolts are designed to fail under predetermined loads. Always replace shear bolts with identical grade.

Make sure fasteners threads are clean and that you properly start thread engagement. This will prevent them from failing when tightening.

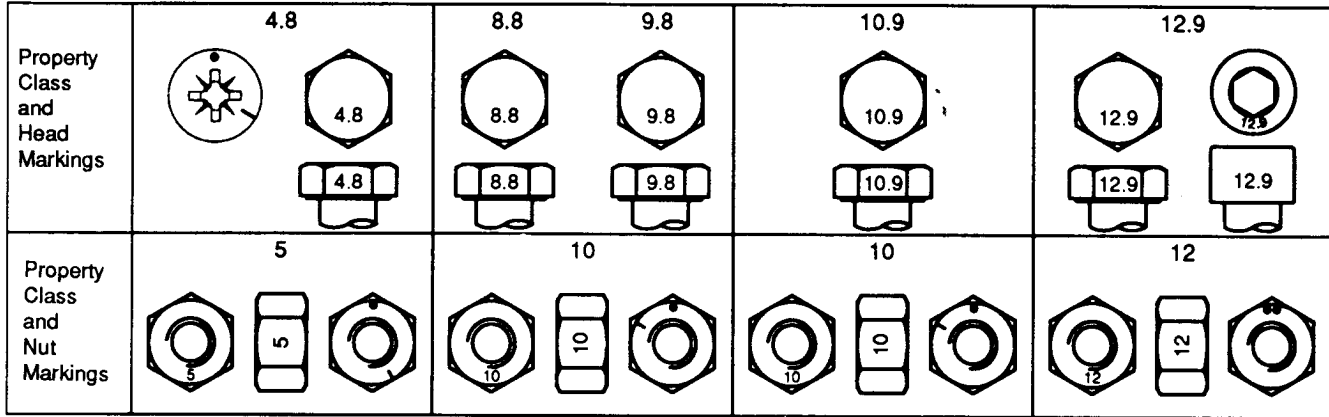
Tighten plastic insert or crimped steel-type lock nuts to approximately 50 percent of the dry torque shown in the chart, applied to the nut, not to the bolt head. Tighten toothed or serrated-type lock nuts to the full torque value.

^a "Lubricated" means coated with a lubricant such as engine oil, or fasteners with phosphate and oil coatings. "Dry" means plain or zinc plated without any lubrication.

^b Grade 2 applies for hex cap screws (not hex bolts) up to 152 mm (6-in.) long. Grade 1 applies for hex cap screws over 152 mm (6-in.) long, and for all other types of bolts and screws of any length.

TS1656 -19-02APR97

Metric Bolt and Cap Screw Torque Values



Size	Class 4.8				Class 8.8 or 9.8				Class 10.9				Class 12.9			
	Lubricated ^a		Dry ^a		Lubricated ^a		Dry ^a		Lubricated ^a		Dry ^a		Lubricated ^a		Dry ^a	
	N-m	lb-ft	N-m	lb-ft	N-m	lb-ft	N-m	lb-ft	N-m	lb-ft	N-m	lb-ft	N-m	lb-ft	N-m	lb-ft
M6	4.8	3.5	6	4.5	9	6.5	11	8.5	13	9.5	17	12	15	11.5	19	14.5
M8	12	8.5	15	11	22	16	28	20	32	24	40	30	37	28	47	35
M10	23	17	29	21	43	32	55	40	63	47	80	60	75	55	95	70
M12	40	29	50	37	75	55	95	70	110	80	140	105	130	95	165	120
M14	63	47	80	60	120	88	150	110	175	130	225	165	205	150	260	190
M16	100	73	125	92	190	140	240	175	275	200	350	255	320	240	400	300
M18	135	100	175	125	260	195	330	250	375	275	475	350	440	325	560	410
M20	190	140	240	180	375	275	475	350	530	400	675	500	625	460	800	580
M22	260	190	330	250	510	375	650	475	725	540	925	675	850	625	1075	800
M24	330	250	425	310	650	475	825	600	925	675	1150	850	1075	800	1350	1000
M27	490	360	625	450	950	700	1200	875	1350	1000	1700	1250	1600	1150	2000	1500
M30	675	490	850	625	1300	950	1650	1200	1850	1350	2300	1700	2150	1600	2700	2000
M33	900	675	1150	850	1750	1300	2200	1650	2500	1850	3150	2350	2900	2150	3700	2750
M36	1150	850	1450	1075	2250	1650	2850	2100	3200	2350	4050	3000	3750	2750	4750	3500

DO NOT use these values if a different torque value or tightening procedure is given for a specific application. Torque values listed are for general use only. Check tightness of fasteners periodically.

Shear bolts are designed to fail under predetermined loads. Always replace shear bolts with identical property class.

Fasteners should be replaced with the same or higher property class. If higher property class fasteners are used, these should only be tightened to the strength of the original.

^a "Lubricated" means coated with a lubricant such as engine oil, or fasteners with phosphate and oil coatings. "Dry" means plain or zinc plated without any lubrication.

Make sure fasteners threads are clean and that you properly start thread engagement. This will prevent them from failing when tightening.

Tighten plastic insert or crimped steel-type lock nuts to approximately 50 percent of the dry torque shown in the chart, applied to the nut, not to the bolt head. Tighten toothed or serrated-type lock nuts to the full torque value.

Fuel System Specifications

Item	Measurement	Specification
Injection Pump	Type	Bosch P3000 In-Line with Std. Governor
	Type	Bosch P7100 In-Line with Std. Governor
	Type	Nippondenso A2500 with Std. Governor (6081T Option)
	Type	Mf-Series Motorpal Pumps (6081T Option)
Engine	Operating Speeds	OEM Engines (See General Engine Specifications earlier in this group) Vehicle Engines (See Machine Technical Manual)
Injection Pump	Timing	No. 1 Engine Cylinder at TDC Compression Stroke
Fuel Filter Base-to-Block Mounting Cap Screws	Torque	35 N•m (25 lb-ft)
Fuel Pipe Connections at Filter Base	Maximum Torque	17 N•m (12 lb-ft) (150 lb-in.) maximum
Fuel Filter Base-to-Oil Filter Base Cap Screws	Torque	61 N•m (45 lb-ft)
Bosch and Nippondenso Fuel Supply Pump Mounting Stud Nuts	Torque	5—7 N•m (4—5 lb-ft) (45—60 lb-in.)
Fuel Supply Pump Inlet and Outlet Lines	Torque	10 N•m (7 lb-ft)
Bosch and Nippondenso Fuel Supply Pump Elbow Lock Nuts	Torque	35 N•m (26 lb-ft)
Fuel Supply Pump Inlet and Outlet Lines	Torque	10 N•m (7 lb-ft)
Aneroid Activator Special Screw	Torque	14 N•m (10 lb-ft)
Fuel Injection Pump Overflow Valve	Opening Pressure	130—180 kPa (1.3—1.8 bar) (19—26 psi)

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Repair and General OEM Specifications

Item	Measurement	Specification
Fuel Shut-off Solenoid Mounting Cap Screw	Torque	23 N•m (17 lb-ft)
Fuel Shut-off Solenoid Mounting Hex Nut	Torque	7 N•m (5 lb-ft)
Fuel Injection Pump Delivery Valve (Motorpal)	Torque	47 N•m (35 lb-ft)
Bosch and Nippondenso Injection Pump-to-Cylinder Block Stud Nuts	Torque	47 N•m (35 lb-ft)
Bosch and Nippondenso Injection Pump Drive Gear-to-Pump Hub Cap Screw	Torque	61 N•m (45 lb-ft)
Injection Pump Drive Gear Cover Cap Screws	Torque	27 N•m (20 lb-ft)
Fuel Delivery Line Connectors @ Delivery Valves and Nozzles	Torque	27 N•m (20 lb-ft)
Bosch and Nippondenso Fuel Leak-Off Lines-to-Injection Pump Connectors	Torque	13 N•m (10 lb-ft)
Fuel Supply Pump Lines-to-Injection Pump	Torque	10 N•m (7 lb-ft)
Fuel Inlet Line-to-Injection Pump	Torque	10 N•m (7 lb-ft)
Injection Pump Lube Line	Torque	4.5 N•m (3 lb-ft) (36 lb-in.)
Nippondenso and Bosch Injection Pump Housing Oil Fill Plug	Torque	25 N•m (18 lb-ft)
Nippondenso and Bosch Injection Pump Governor Housing Oil Fill Plug	Torque	40 N•m (30 lb-ft)
Motorpal Injection Pump-to-Cylinder Block Stud Nuts	Torque	47 N•m (35 lb-ft)
Motorpal Fuel Supply Pump Mounting Cap Screws	Torque	8 N•m (6 lb-ft) (72 lb-in.)

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Repair and General OEM Specifications

Item	Measurement	Specification
Motorpal Injection Pump Drive Gear-to-Pump Hub Cap Screws	Torque	61 N•m (45 lb-ft)
Motorpal Injection Pump Timing Pin Cap	Torque	70 N.m (52 lb-ft)
Injection Pump Drive Gear Cover Cap Screws	Torque	27 N•m (20 lb-ft)
Fuel Shut-Off Solenoid Bracket to Oil Filter Base Cap Screws	Torque	27 N•m (20 lb-ft)
Throttle Bracket to Oil Filter Base Cap Screws	Torque	27 N•m (20 lb-ft)
Fuel Inlet Line-to-Injection Pump	Torque	10 N•m (7 lb-ft)
Motorpal Injection Pump Housing Oil Fill Plug	Torque	25 N•m (18 lb-ft)
Fuel Injection Nozzle	Type	21 mm with 7 mm tip
Fuel Injection Nozzle ¹	Tip Hole Sizes	7 hole x 0.208—0.255 mm ID x 148° Spray Angle
New Injection Nozzle (All Tip Sizes)	Opening Pressure	29 000 kPa (290 bar) (4200 psi) minimum
Used Injection Nozzle (All Tip Sizes)	Opening Pressure	26 200 kPa (262 bar) (3800 psi) minimum
Fuel Injection Nozzle Retaining Nut	Torque	60—80 N•m (44—59 lb-ft)
Fuel Injection Nozzle Gland Nut-to-Cylinder Head	Torque	88 N•m (65 lb-ft)
Fuel Injection Nozzle Leak-Off Connectors-to-Injectors (Metal Leak-Off Lines)	Torque	7.5 N•m (5.5 lb-ft) (66 lb-in.)
Fuel Injection Nozzle Leak-Off Connectors-to-Injectors (Nylon Leak-Off Lines)	Torque	15 N•M (11 lb-ft) (133 lb in.)

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¹ Nozzle tips available in various ID hole sizes: 0.208, 0.220, 0.236, 0.240, 0.244 and 0.255 mm.

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Repair and General OEM Specifications

Item	Measurement	Specification
Fuel Leak-Off Lines-to-Connectors	Torque	11 N•m (8 lb-ft) (97 lb-in.)
Fuel Leak-Off Line-to-Injection Pump	Torque	13 N•m (10 lb-ft) (115 lb-in.)
Fuel Leak-Off Line End Plug	Torque	16 N•m (12 lb-ft) (142 lb-in.)
Fuel Injection Line Nuts at Delivery Valves	Torque	27 N•m (20 lb-ft)

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