

POWERTECH[®] 4.5L & 6.8L Diesel Engines

Mechanical Fuel Systems

TECHNICAL MANUAL POWERTECH[®] 4.5 L & 6.8 L Diesel Engines — Mechanical Fuel Systems

10OCT07 (ENGLISH)

For complete service information also see:

POWERTECH[®] 4.5 L and 6.8 L Diesel Engines—Base Engine	CTM104
Alternators and Starter Motors	CTM77
OEM Engine Accessories	CTM67 (English Only)
POWERTECH[®] 4.5 L and 6.8 L Diesel Engines—Level 4 Electronic Fuel Systems with Bosch VP44 Pump	CTM170
POWERTECH[®] 4.5 L and 6.8 L Diesel Engines—Level 12 Electronic Fuel Systems with Stanadyne DE10 Pump	CTM331
POWERTECH[®] 4.5 L and 6.8 L Diesel Engines—Level 1 Electronic Fuel Systems with Delphi/Lucas DP201 Pump	CTM284
POWERTECH[®] 4.5 L and 6.8 L Diesel Engines—Level 11 Electronic Fuel Systems with Denso High Pressure Common Rail. . .	CTM220
POWERTECH[™] Diesel Engines and PowerTech Plus[™]—Level 14 Electronic Fuel Systems with Denso HPCR.	CTM320
POWERTECH[™] Diesel Engines and PowerTech Plus[™]—Level 16 Electronic Fuel Systems with Denso HPCR.	CTM502

John Deere Power Systems

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Introduction

Foreword

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 (CTM207) covers only mechanical fuel systems. It is one of six volumes on 4.5 L and 6.8 L engines. The following five companion manuals cover the base engine plus electronic fuel system repair, operation and diagnostics:

- CTM104—Base Engine
- CTM170—Level 4 Electronic Fuel Systems with Bosch VP44 Pump
- CTM331—Level 12 Electronic Fuel Systems with Stanadyne DE10 Pump
- CTM284—Level 1 Electronic Fuel Systems with Delphi/Lucas DP201 Pump
- CTM220—Level 11 Electronic Fuel Systems with Denso High Pressure Common Rail
- CTM320—Level 14 Electronic Fuel Systems with Denso High Pressure Common Rail
- CTM502—Level 16 Electronic Fuel Systems with Denso High Pressure Common Rail

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

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



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

Use this component technical manual in conjunction with the machine technical manual. An application listing in Section 01, Group 001 identifies

product-model/component type-model relationship. See the machine technical manual for information on component removal and installation, and gaining access to the components.

Information is organized in sections and groups for the various components requiring service instruction. Section 05 summarizes all applicable essential tools, service equipment and tools, other materials needed to do the job, and service parts kits. Section 06 summarizes all specifications, wear tolerances, and torque values.

Before beginning repair on an engine, clean the engine and mount on a repair stand.

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.

About This Manual

Discard CTM207 dated 14MAY03 or 06OCT04 and replace with this new manual.

Also, copy this page **listing changes** to this new CTM207 and route through your Service Department.

SECTION 01—GROUP 001 (Engine Identification)

- Updated engine model designation chart.
- Updated serial number plate information.
- Added information relative to emissions regulations.
- Updated engine application charts.

SECTION 01—GROUP 002 (Fuels)

- Revised diesel fuel specifications.
- Revised bio-diesel fuel specifications.
- Revised lubricity of diesel fuel specifications.
- Revised Dieselscan fuel analysis specifications.

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

- Revised fuel system general information.
- Added hi-mount final fuel filter base information.
- Added Stanadyne rotary fuel injection pump identification procedure.
- Revised procedure for Delphi/Lucas and Stanadyne rotary fuel injection pump timing.
- Revised Stanadyne model DB2 and DB4 injection pump installation procedure.
- Revised fuel injection nozzle identification to include VCO 17 mm nozzle.
- Revised previous fuel injection nozzle procedures to be listed as 9.5 mm.

- Added fuel injector procedures for VCO 17 mm injector nozzles.
- Revised bleeding procedure.

SECTION 03—GROUP 130 (Mechanical Fuel Systems Operation)

- Revised fuel injection pump general information.
- Added operational description of VCO 17 mm fuel injector nozzle.

SECTION 04—GROUP 150 (Mechanical Fuel Systems Observable Diagnostics and Tests)

- Added information and procedures on the use of TACH-N-TIME tester.
- Revised test fuel injector nozzles with engine running procedure.
- Revised bleeding procedure.

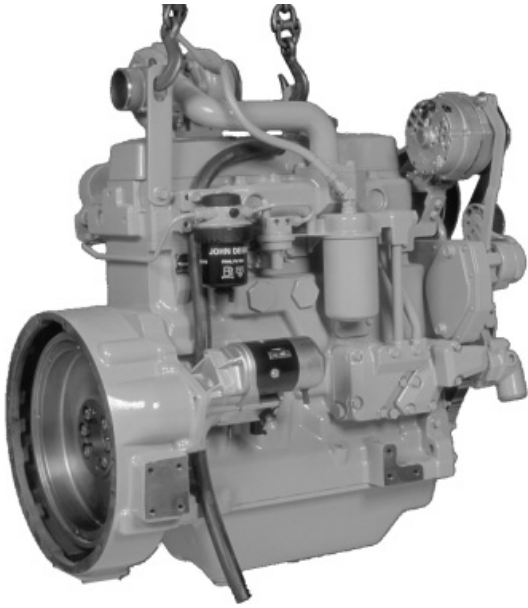
SECTION 05 (Tools and Other Materials)

- All essential tools, service tools, dealer fabricated tools and other materials listed throughout this manual are consolidated in this section for ease of reference.
- Added information on the TACH-N-TIME tester.

SECTION 06 (Specifications)

- Updated general OEM engine specifications.
- Updated repair specifications.
- Updated fuel injection pump specifications.
- Removed diagnostic and test specifications, already in repair specifications.

POWERTECH® 4.5L Engine with Mechanical Fuel System



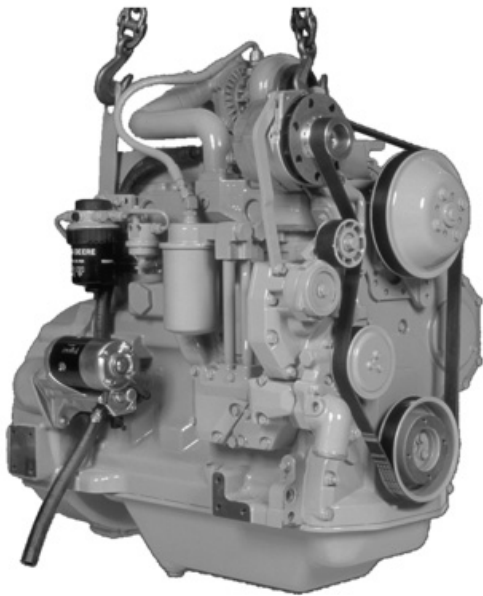
3/4 Right Rear View

RG7636 -UN-23NOV97



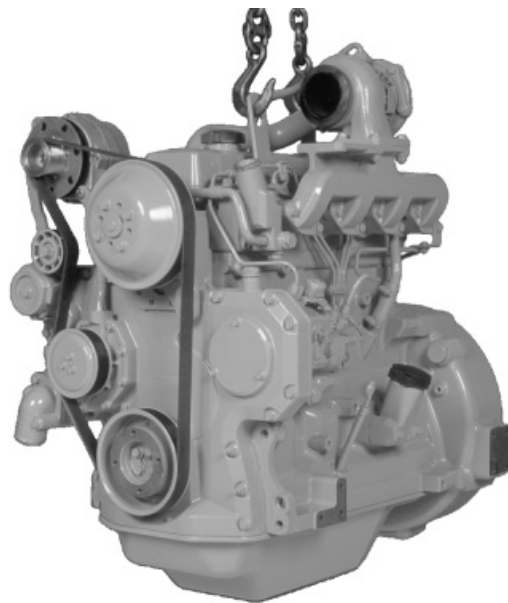
3/4 Left Rear View

RG7638 -UN-23NOV97



3/4 Right Front View

RG7639 -UN-23NOV97



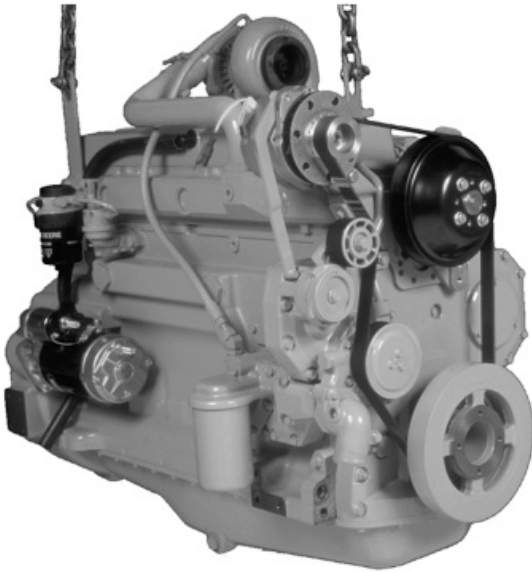
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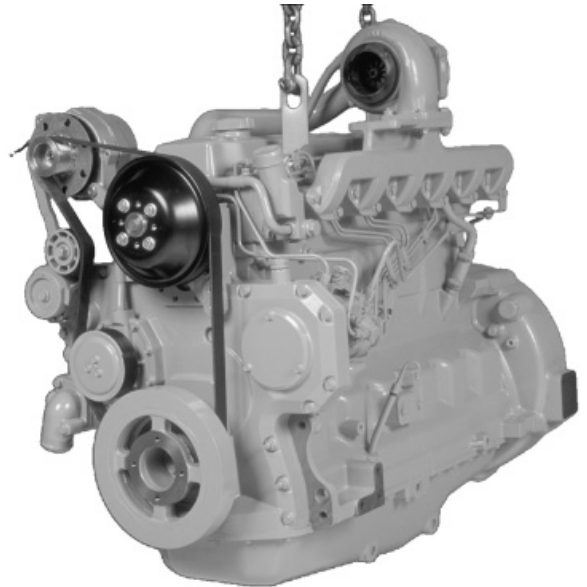
DPSG,OUO1004,129 -19-09SEP02-1/1

POWERTECH[®] 6.8L Engine with Mechanical Fuel System



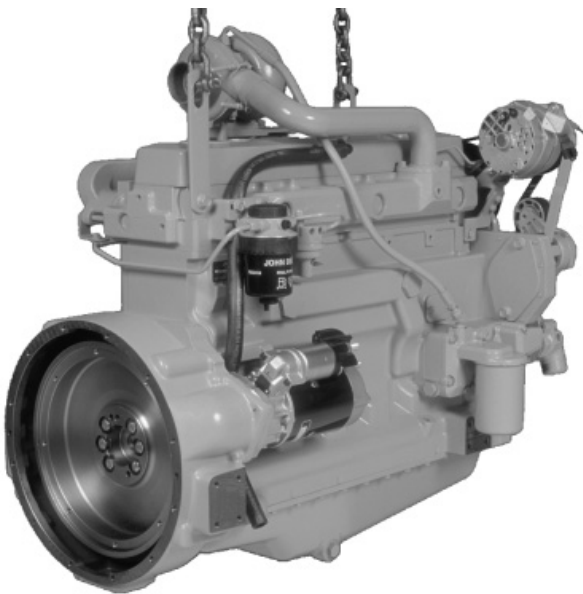
3/4 Right Front View

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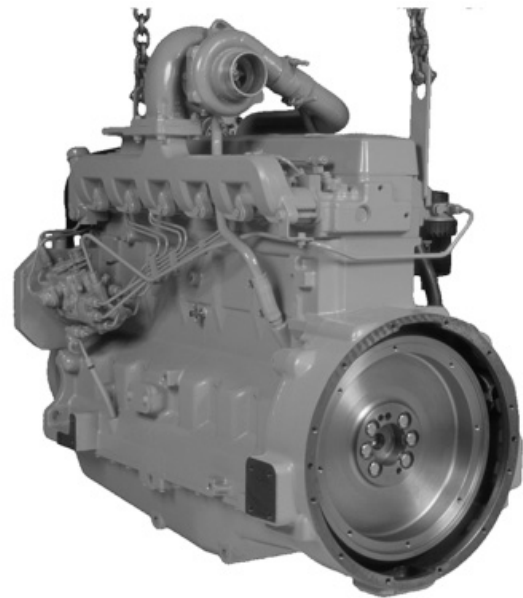
3/4 Left Front View

RG7640 -UN-23NOV97



3/4 Right Rear View

RG7643 -UN-23NOV97



3/4 Left Rear View

RG7642 -UN-23NOV97

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DPSG,OUO1004,130 -19-09SEP02-1/1

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

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Previous Editions
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Section 01

General Information

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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.



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

TS220 -JUN-23AUG88

Recognize Safety Information

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

Follow recommended precautions and safe operating practices.



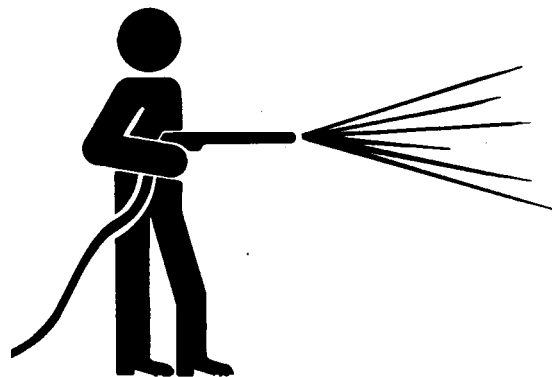
DX,ALERT -19-29SEP98-1/1

T81389 -JUN-07DEC88

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.



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

T6642EJ -JUN-18OCT88

Dispose of Waste Properly

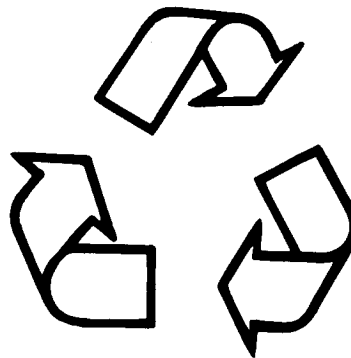
Improperly disposing of waste can threaten the environment and ecology. Potentially harmful waste used with John Deere equipment include such items as oil, fuel, coolant, brake fluid, filters, and batteries.

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

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

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

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



TS1133 -UN-26NOV90

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

Avoid Harmful Asbestos Dust

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

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

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

Keep bystanders away from the area.



TS220 -UN-23AUG88

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

Handle Fuel Safely—Avoid Fires

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

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

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



TS202 -JUN-23AUG88

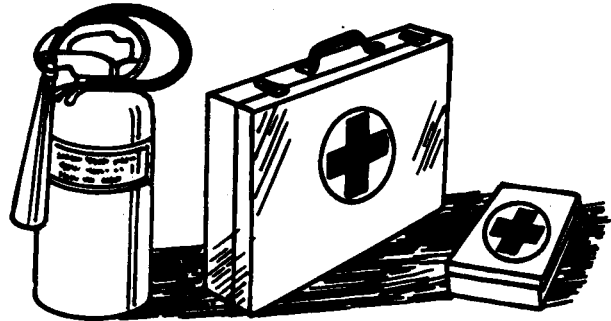
DX,FIRE1 -19-03MAR93-1/1

Prepare for Emergencies

Be prepared if a fire starts.

Keep a first aid kit and fire extinguisher handy.

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



TS291 -JUN-23AUG88

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

Handle Starting Fluid Safely

Starting fluid is highly flammable.

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

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

Do not incinerate or puncture a starting fluid container.



TS1356 -JUN-18MAR92

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

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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.



TS227 -UN-23AUG88

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

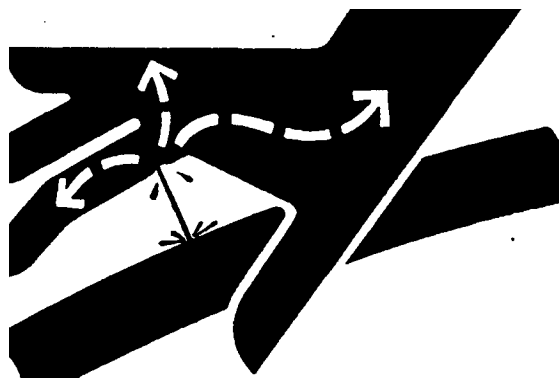
Avoid High-Pressure Fluids

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

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

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

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



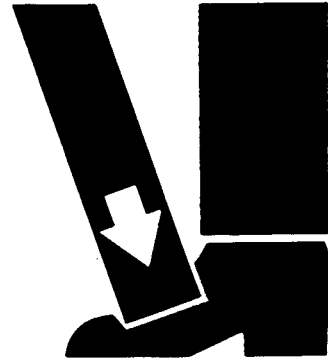
X9811 -UN-23AUG88

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

Use Proper Lifting Equipment

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

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

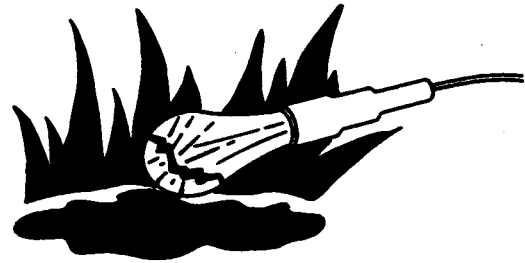


DX,LIFT -19-04JUN90-1/1

TS226 -JUN-23AUG88

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.



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

TS223 -JUN-23AUG88

Live With Safety

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



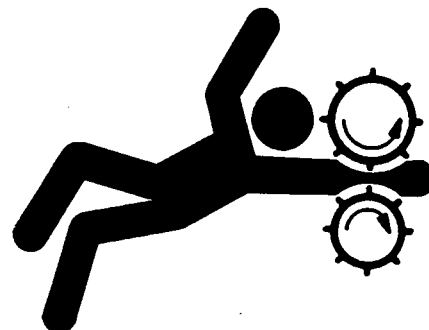
DX,LIVE -19-25SEP92-1/1

TS231 -19-07OCT88

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.



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

TS228 -JUN-23AUG88

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Handle Chemical Products Safely

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

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

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

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



TS1132 -UN-26NOV90

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

Protect Against Noise

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

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



TS207 -UN-23AUG88

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

Remove Paint Before Welding or Heating

Avoid potentially toxic fumes and dust.

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

Remove paint before heating:

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

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

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

Dispose of paint and solvent properly.



TS220 -JUN-23AUG88

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

Stay Clear of Rotating Drivelines

Entanglement in rotating driveline can cause serious injury or death.

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

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



TS1644 -JUN-22AUG95

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

Service Cooling System Safely

Explosive release of fluids from pressurized cooling system can cause serious burns.

Shut off engine. Only remove filler cap when cool enough to touch with bare hands. Slowly loosen cap to first stop to relieve pressure before removing completely.



TS281 -UN-23AUG88

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

Follow Safety Instructions

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

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

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

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



TS201 -UN-23AUG88

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

Use Proper Tools

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

Use power tools only to loosen threaded parts and fasteners.

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

Use only service parts meeting John Deere specifications.



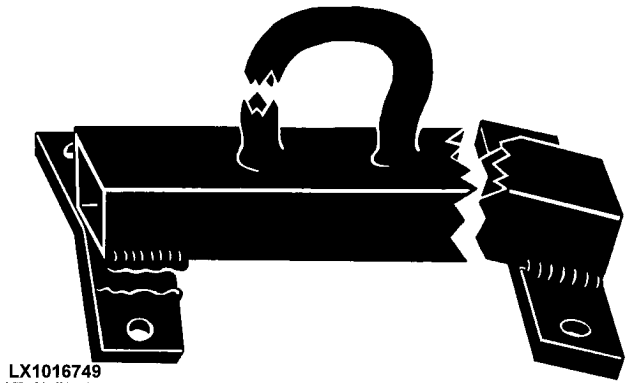
TS779 -JUN-08NOV89

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

Construct Dealer-Made Tools Safely

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

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



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LX1016749 -JUN-01JUL97

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

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Practice Safe Maintenance

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

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

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

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

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

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



TS218 -UN-23AUG88

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

Understand Signal Words

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

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



TS187 -19-30SEP88

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

Replace Safety Signs

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



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

TS201 -JUN-23AUG88

Prevent Battery Explosions

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

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

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



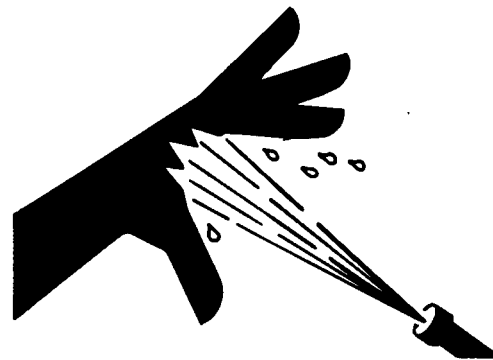
DX,SPARKS -19-03MAR93-1/1

TS204 -JUN-23AUG88

Protect Against High Pressure Spray

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

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



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

TS1343 -JUN-18MAR92

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Avoid Heating Near Pressurized Fluid Lines

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



TS953 -UN-15MAY90

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

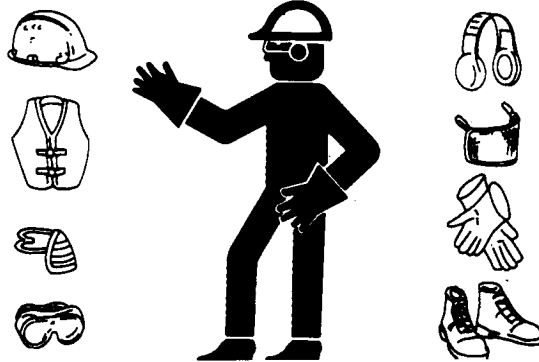
Wear Protective Clothing

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

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

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

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



TS206 -UN-23AUG88

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

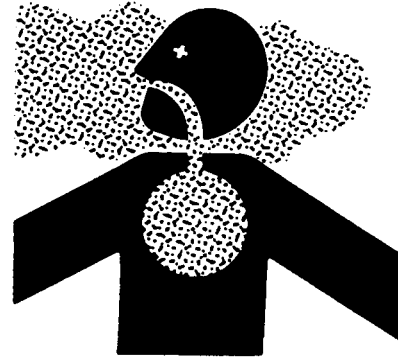
Handle Agricultural Chemicals Safely

Chemicals used in agricultural applications such as fungicides, herbicides, insecticides, pesticides, rodenticides, and fertilizers can be harmful to your health or the environment if not used carefully.

Always follow all label directions for effective, safe, and legal use of agricultural chemicals.

Reduce risk of exposure and injury:

- Wear appropriate personal protective equipment as recommended by the manufacturer. In the absence of manufacturer's instructions, follow these general guidelines:
 - Chemicals labeled '**Danger**': Most toxic. Generally require use of goggles, respirator, gloves, and skin protection.
 - Chemicals labeled '**Warning**': Less toxic. Generally require use of goggles, gloves, and skin protections.
 - Chemicals labeled '**Caution**': Least toxic. Generally require use of gloves and skin protection.
- Avoid inhaling spray or dusts.
- Always have soap, water, and towel available when working with chemicals. If chemical contacts skin, hands, or face, wash immediately with soap and water. If chemical gets into eyes, flush immediately with water.
- Wash hands and face after using chemicals and before eating, drinking, smoking, or urination.
- Do not smoke or eat while applying chemicals.
- After handling chemicals, always bathe or shower and change clothes. Wash clothing before wearing again.
- Seek medical attention immediately if illness occurs during or shortly after use of chemicals.
- Keep chemicals in original containers. Do not transfer chemicals to unmarked containers or to containers used for food or drink.
- Store chemicals in a secure, locked area way from human or livestock food. Keep children away.
- Always dispose of containers properly. Triple rinse empty containers and puncture or crush containers and dispose of properly.



A34471



TS220 -JUN-23AUG88

A34471 -JUN-11OCT88

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. Using 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:

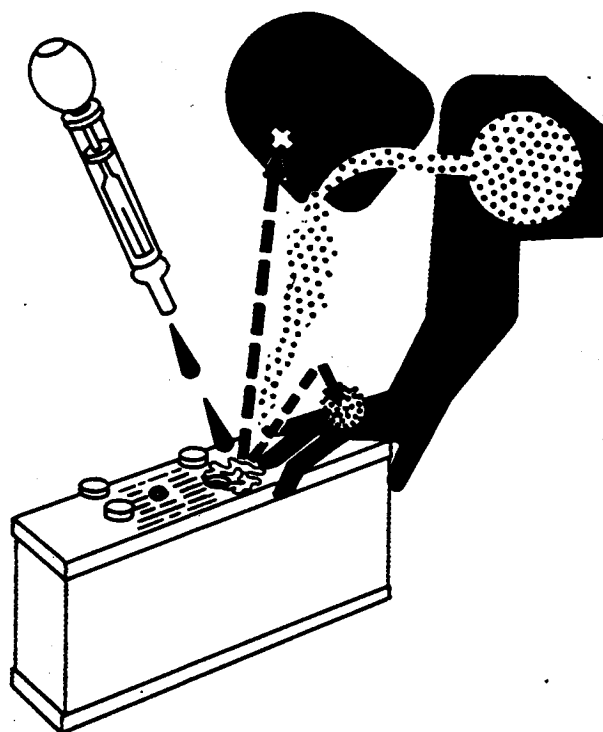
1. Do not induce vomiting.
2. Drink large amounts of water or milk, but do not exceed 2 L (2 qt.).
3. Get medical attention immediately.

WARNING: Battery posts, terminals, and related accessories contain lead and lead compounds, chemicals known to the State of California to cause cancer and reproductive harm. **Wash hands after handling.**



Explosion

TS204 -UN-23AUG88



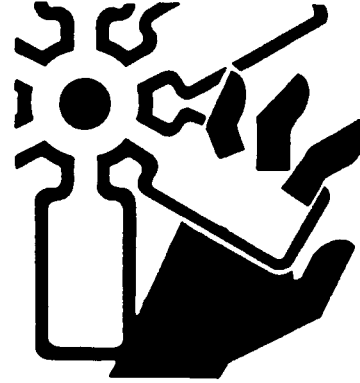
Acid

TS203 -UN-23AUG88

Install Fan Guards

Rotating cooling system fans can cause serious injury.

Keep fan guards in place at all times during engine operation. Wear close fitting clothes. Stop engine and be sure fan is stopped before making adjustments or connections, or cleaning near the front of the engine.



Rotating Fan

TS677 -JUN-21SEP89

OUO1083,00005FE -19-20AUG07-1/1

Avoid Hot Parts

Avoid skin contact with exhaust manifolds, turbochargers and mufflers. Keep flammable materials clear of the turbocharger.

External dry exhaust parts become very hot during operation. Turbochargers may reach temperatures as high as 500°C (932°F) under full load, and naturally aspired exhaust manifolds may reach 600°C (1112°F) under full load. This may ignite paper, cloth or wooden materials. Parts on engines that have been at full load and reduced to no load idle will maintain approximately 150°C (302°F).



Hot Surface

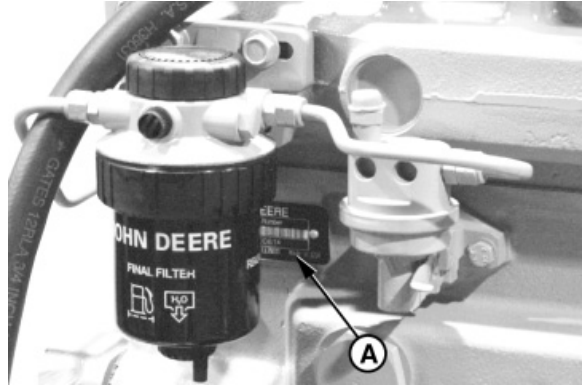
TS271 -JUN-23AUG88

OUO1083,00005FF -19-22DEC05-1/1

Engine Serial Number Plate Information

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

NOTE: Four-valve head engines have “16V” (for 16 valves total on 4 cylinder engine) or “24V” (for 24 valves total on 6 cylinder engine) printed on a plate located on the rocker arm cover.



Engine Serial Number (B)

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

CD4045L123456

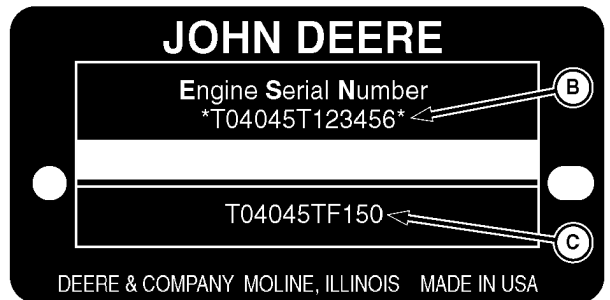
CD	Engine Manufacturing Location
CD	Saran, France
T0	Dubuque, Iowa
PE	Torreon, Mexico
J0	Rosario, Argentina
4	Number of Cylinders
045	Displacement in Liters (4.5 Liters)
L	Aspiration Code (Early Engines) or Emission Tier Level (Later Engines)
D	Naturally aspirated
T	Turbocharged, no aftercooling
A	Turbocharged and air-to-coolant aftercooled
H	Turbocharger and air-to-water aftercooled
S	Turbocharged and air-to sea water aftercooled
B	Non-certified engine
C,E or F	Tier 1/Stage I emission certified engine
G, J or K	Tier 2/Stage II emission certified engine
L, M, N or P	Tier 3/Stage IIIA emission certified engine
123456	6-digit unique sequence number



Saran Serial Number Plate



Torreon Serial Number Plate



Dubuque Engine Serial Number Plate

Engine Model Designation (C)

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

- A—Engine Serial Number Plate
- B—Engine Serial Number
- C—Engine Application Data
- D—Empty, Coefficient of Absorption or Saran internal factory identification

01
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4045HF485

4	Number of Cylinders
045	Displacement in Liters (4.5 Liters)
H	Aspiration Code)
D	Naturally aspirated
T	Turbocharged, no aftercooling
A	Turbocharged and air-to-coolant aftercooled
H	Turbocharger and air-to-water aftercooled
S	Turbocharged and air-to sea water aftercooled
F	User Code
AT	Agritalia srl (Vittoria, Sicily, Italy)
BE	Bell Equipment Co. (Richards Bay, South Africa)
CQ	John Deere Brazil (Horizontina, Brazil)
DW	John Deere Davenport Works (Davenport, Iowa)
E	John Deere Ottumwa Works (Ottumwa, Iowa)
F	OEM (Original Equipment Manufacturers)
FF	Deere-Hitachi (Kernersville, North Carolina)
FG	Goldoni S.P.A. (Modena, Italy)
FM	Marine Engine
FS	OEM Engines - SDMO Application
FU	OEM Engines - Saran Power Unit for Gen-Set
H	John Deere Harvester Works (East Moline, Illinois)
KV	John Deere Commercial Worksite Products (Knoxville, Tennessee/Dubuque, Iowa)
L	John Deere Werke Mannheim (Germany)
LA	John Deere Werke Manheim (Germany) (Engines with Bosch VP44 Injection Pump)
LV	John Deere Commercial Product (Augusta, Georgia)
N	John Deere Des Moines Works (Des Moines, Iowa)
P	Industrias John Deere Mexico S.A. de C.V. (Saltillo/Monterrey, Mexico)
PY	Larson & Toubro Ltd. (Pune, India)
RW	John Deere Waterloo Tractor Works (Waterloo, Iowa)
T	John Deere Dubuque Works (Dubuque, Iowa)
T8	Cameco Industries (Thibodaux, Louisiana)
TJ	John Deere Forestry (formerly Timberjack) (Sweden/Finland/Canada/USA)
WZ	John Deere Fabriek Horst B.V. (The Netherlands)
YC	John Deere Jialian Harvester Co. Limited (China)
Z	John Deere Werke Zweibrucken (Germany)
485	Application Code In this example (485), "4" denotes 4-Valves per cylinder and "85" denotes Tier 3 (Stage IIIA) engines.

Coefficient of Absorption (D) — (Early Saran-Built Engines - Later Engines, Internal Factory Identification)

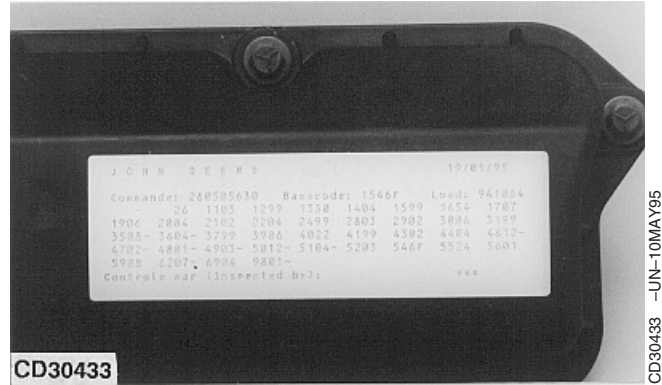
The second line of information on Saran serial number plate may also contain the coefficient of absorption value for smoke emissions or, for later engines, an internal factory identification number.

OEM Engine Option Code Label

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

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

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



OUC1082,0000039 -19-20SEP07-1/1

Information Relative to Emissions Regulations

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

The regulations prohibit tampering with the emission-related components listed below which would render that component inoperative or to make any adjustment on the engine beyond published specifications. It is also illegal to install a part or component where the principle effect of that

component is to bypass, defeat, or render inoperative any engine component or device which would affect the engine's conformance to the emission regulations. **To summarize, it is illegal to do anything except return the engine to its original published specifications.**

List of emission-related components:

- Fuel injection system
- Intake manifold
- Turbocharger
- EGR cooler
- EGR valve
- Charge air cooling system
- Piston

OUC1080,0000035 -19-29AUG01-1/1

Engine Application Charts

JOHN DEERE AGRICULTURAL EQUIPMENT	
Machine Model	Engine Model
Des Moines, Iowa	
4700/4710 Sprayer (138 kW)	T06068TN050, T06068TN053, PE6068TN050, PE6068TN053
4700/4710 Sprayer (149 kW)	PE6068TN052
6700/6700S Sprayer	T04045TN050, PE4045TN050
7455 Cotton Stripper	T06068TN051, PE6068TN051
7460 Cotton Stripper	PE6068TN054
9935 Cotton Picker	T06068TN051, PE6068TN051
East Moline, Illinois	
9400 Combine	T06068HH050
9410 Combine	T06068HH051
9450 Combine	T06068HH052, PE6068HH052
Horizontina, Brazil	
1075 Combine	J06068TYC50
1165 Combine	J06068TCQ11
1170 Combine	CD6068TCQ50
1175 Combine	J06068TJ12
1450 Combine	J06068TCQ04, J06068TJ04
1550 Combine	J06068ACQ01
3518 Combine	J06068TYC51
5403/5605 Tractor	J04045DCQ01, J04045DJ01
5705 Tractor	J04045TJ02
6400 Tractor	J04045TCQ01
6403 Tractor	J04045TP057
6405 Tractor	J04045TCQ01
6415 Tractor	J04045TCQ03
6603 Tractor	J6068TP03
6605 Tractor	J06068TJ02
6615 Tractor	J06068TCQ13
7505 Tractor	J06068TCQ03
7515 Tractor	J06068TCQ14
Jiamusi, China	
1065 Combine	CD4045TYC50
1075 Combine	CD6068TYC50
3060 Combine	CD4045DYC50
3518 Combine	CD6068TYC51, CD6068HYC50
Zweibrucken, Germany	
2254 Combine	CD6068HZ050

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Engine Identification and Applications

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JOHN DEERE AGRICULTURAL EQUIPMENT	
Machine Model	Engine Model
3200/3400 Telehandler	CD4045TZ050
Ottumwa, Iowa	
4890 Windrower	T04045TE050, PE4045TE050
4895 Windrower	T04045TE051, PE4045TE051
4990 Windrower	T06068TE050, PE6068TE050
4995 Windrower	PE6068TE051
Waterloo, Iowa	
7210 Tractor (SYNCROPLUS™)	T06068TRW53, PE6068HRW53
7210 Tractor (POWRQUAD™)	T06068TRW50, PE6068TRW50
7220 Tractor	CD6068TRW01
7410 Tractor (SYNCROPLUS™)	T06068TRW54, PE6068HRW54
7410 Tractor (POWRQUAD™)	T06068TRW51, PE6068TRW51
7510 Tractor (POWRQUAD™)	T06068TRW70, PE6068TRW70
7610 Tractor (105 kW)	T06068TRW52, PE6068TRW52
7610 Tractor (110 kW)	T06068TRW72, PE6068TRW72
7810 Tractor (Export-Brazil)	PE6068TRW73
Mannheim, Germany (European Market)	
3210 Tractor	CD4045DRT50
3310 Tractor	CD4045DRT51
3410 Tractor	CD4045TRT50
5620 Tractor	CD4045DL270
5720 Tractor	CD4045DL273
5820 Tractor	CD4045DL274
6010 Tractor	CD4045DL050
6020 Tractor	CD4045DL070
6110 Tractor (Direct Fan Drive)	CD4045TL058
6110 Tractor (Viscous Fan Drive)	CD4045TL050
6120 Tractor	CD4045TL070
6205 Tractor	CD4045TL064
6210 Tractor (Direct Fan Drive)	CD4045TL059
6210 Tractor (Viscous Fan Drive)	CD4045TL051
6215 Tractor (Classic) (Non—Certified)	CD4045TL072
6215 Tractor (Classic) (Certified)	CD4045TL071
6220 Tractor	CD4045TL071
6310 Tractor (Direct Fan Drive)	CD4045TL060
6310 Tractor (Viscous Fan Drive)	CD4045TL052
6320 Tractor	CD4045HL072

SYNCROPLUS is a trademark of Deere & Company
POWRQUAD is a trademark of Deere & Company

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Engine Identification and Applications

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JOHN DEERE AGRICULTURAL EQUIPMENT

Machine Model	Engine Model
6320SE Tractor	CD4045TL073
6410 Tractor (Direct Fan Drive)	CD4045TL061
6410 Tractor (Viscous Fan Drive)	CD4045TL053
6420 Tractor	CD4045HL070
6505 Tractor	CD6068DL051
6510 Tractor	CD6068DL050
6515 Tractor (Classic) (77 kW)	CD6068DL071
6515 Tractor (Classic) (85 kW)	CD6068DL070
6520/6520SE Tractor	CD6068DL070, CD6068TL073
6610 Tractor	CD6068TL050
6810 Tractor	CD6068TL051
6910 Tractor (99 kW)	CD6068TL052
6910 Tractor (107 kW)	CD6068TL054
Mannheim, Germany (North American Market)	
6110/6110L Tractor	CD4045TL063
6120 Tractor	CD4045TL070
6210/6210L Tractor	CD4045TL054
6215 Tractor (Advantage)	CD6068TL071
6220 Tractor	CD4045TL071
6310/6310L/6310S Tractor	CD4045TL055
6320 Tractor	CD4045HL073, CD4045TL074
6403/6405 Tractor (Advantage)	CD4045TL062
6410/6410L/6410S Tractor	CD4045TL056
6415 Tractor (Advantage)	CD4045TL075
6420 Tractor	CD4045HL070
6510L/6510S Tractor	CD4045TL057
6520L Tractor	CD4045HL071
6603/6605 Tractor (Advantage)	CD6068TL053
6615 Tractor (Advantage)	CD6068TL071
6715 Tractor (Advantage)	CD6068TL072
Saltillo, Mexico	
110C Excavator	PE4045TP058
110CFX Excavator	PE4045TP058
5415 Tractor	PE4045DP050, PE4045DP052
5615 Tractor	PE4045DP051, PE4045DP053
5715 Tractor	PE4045TP050, PE4045TP059
6103 Tractor	PE4045TP055
6203 Tractor	PE4045TP056
6400 Tractor	PE4045TP054

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Engine Identification and Applications

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JOHN DEERE AGRICULTURAL EQUIPMENT	
Machine Model	Engine Model
6403 Tractor	PE4045TP057 (Non-Certified), PE4045TP060 (Tier I Certified)
6415 Tractor	PE4045TP061 (Tier 2)
6603 Tractor	PE6068TP053 (Non-Certified), PE6068TP054 (Tier I Certified)
7220 Tractor	PE6068TP055
7320 Tractor	PE6068TP056 (Tier 2)
7405 Tractor (Advantage)	CD6068TP051, PE6068TP051
7410 Tractor	CD6068TP052
7420 Tractor	PE6068TP057 (Tier 2)
7500 Tractor	PE6068TP052
7520 Tractor	PE6068TP058 (Tier 2)
Tekirdag, Turkey	
5615 Tractor	CD4045DTK20
5715 Tractor	CD4045TTK20
Cameco (Deere) (Thibodaux, Louisiana)	
S30 Harvester	PE6068DT850
SP1800 Cane Loader	PE6068DT850
SP2252 Cane Loader	PE6068TT850
SP3000 Cane Loader	PE6068DT850
100 Loader/ Harvester (Kanaf)	PE6068TT850
110T Cane Tractor	PE4045TT851
215 4WD Tractor	PE6068DT850
220 Tractor	PE6068TT851
220 4WD Tractor/Pineapple Harvester/Sprayer	PE6068TT850
404 Vegetable Sprayer	T04045TT850, PE4045TT850, T04045TT801

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Engine Identification and Applications

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JOHN DEERE COMMERCIAL AND CONSUMER EQUIPMENT

Augusta, Georgia

5410 Tractor	CD4045DLV50, PE4045DLV50
5410 Tractor (No Engine Air Heater Option)	PE4045DLV51
5420/5420N Tractor	PE4045DLV50
5420/5420N Tractor (No Engine Air Heater Option)	PE4045DLV51
5425 Tractor	PE4045TLV53
5525	PE4045TLV54
5510/5510N Tractor	CD4045TLV50, PE4045TLV50
5510/5510N Tractor (No Engine Air Heater Option)	PE4045TLV51
5510 Tractor (LUK Clutch Option)	PE4045TLV52
5520/5520N Tractor	PE4045TLV50
5520/5520N Tractor (No Engine Air Heater Option)	PE4045TLV51
5520 Tractor	PE4045TLV52

Agritalia srl (Vittoria, Sicily, Italy)

5410 Tractor	CD4045TAT50
5415 Tractor	CD4045DAT70
5510 Tractor	CD4045TAT50
5515 Tractor	CD4045TAT70
5615 Tractor	CD4045TAT71

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Engine Identification and Applications

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JOHN DEERE CONSTRUCTION AND FORESTRY EQUIPMENT	
Machine Model	Engine Model
Davenport, Iowa	
LX80 Loader	T4045HDW51
LX100 Loader (Hitachi Construction Machine)	T06068TDW53, PE6068TDW53
LX100-3 Loader (Hitachi Construction Machine)	T06068TDW50, PE6068TDW50
LX120 Loader (Hitachi Construction Machine)	T06068HDW52, T06068HDW70, PE6068HDW70
TC44H Tool Carrier	T04045TDW50, PE4045TDW50
TC54H Tool Carrier	T06068TDW50, PE6068TDW50
TC62H Tool Carrier	T06068HDW50, PE6068HDW50
TJ460 TC Skidder Tool Carrier	T06068TDW57, PE6068TDW57
360D Skidder (Timberjack)	T06068TDW54, PE6068TDW54
444H Loader	T04045TDW50, PE4045TDW50
460 Skidder (Direct Drive) (Timberjack)	T06068TDW55, PE6068TDW55
460D Skidder (Torque Converter) (Timberjack) (S.N. —586336)	T06068TDW57, PE6068TDW57
540/548H Skidder	T06068TDW54, PE6068TDW54
540/548G Skidder (S.N. 558205—565684)	T06068TDW51
540/548G-II Skidder (S.N. 565685—576602)	T06068TDW54, PE6068TDW54
540G-III, 548G-III Skidder (S.N. 576603-586336)	T06068TDW54, PE6068TDW54
540G-III, 548G-III Skidder (S.N. 586337—)	PE6068HDW58 (Tier 2)
544/544H Loader	T06068TDW50, PE6068TDW50
624H Loader	T06068HDW50, PE6068HDW50
640G/648G Skidder (S.N. 558205—565684)	T06068TDW52
640/648G-II Skidder (S.N. 565685—576602)	T06068TDW55, PE6068TDW55
640G-III, 648G-III Skidder (Direct Drive) (S.N. 576603—586336)	T06068TDW55, PE6068TDW55
640G-III, 648G-III Skidder (Torque Converter) (S.N. —586336)	T06068TDW57, PE6068TDW57
640/648H Skidder	T06068TDW55
670C Grader	T06068HDW53, PE6068HDW53
670C Series II Grader	T06068HDW53, PE6068HDW53
670CH Series II, 672CH Series II Grader (S.N. —589368)	T06068HDW58, PE6068HDW58
670CH Grader	T06068HDW55, PE6068HDW55
690E LC Excavator (S.N. 559603—)	T06068TDW56
Dubuque, Iowa	
CFX110 Excavator	PE4045TP058
CFX120/CFX160 Excavator	PE4045HP050
CFX270 Excavator	PEPE6068HT055
CFX270LC Excavator	T06068HT052, PE6068HT052
DX75 Crawler Dozer (Japan)	T04045DT052
DX75 HST Crawler Dozer (Japan)	T04045TT070, PE4045TT070 (Tier I)

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Engine Identification and Applications

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JOHN DEERE CONSTRUCTION AND FORESTRY EQUIPMENT

Machine Model	Engine Model
HYEX Military Excavator	PE4045TT050
120/120C Excavator	T04045TT052
210LE Landscape Loader	T04045DT050, PE4045DT050
310/310E Backhoe Loader	T04045DT055
310E Backhoe Loader (Alt Comp)	T04045TT056
310G Backhoe Loader (Nat. Asp.) (S.N. —910005)	T04045DT056, PE4045DT056 (Tier I)
310G Backhoe Loader (S.N. 910006—)	T04045TT058, PE4045TT058 (Tier I)
310G Backhoe Loader (Alt Comp) (S.N. —910007)	T04045TT080, PE4045TT080 (Tier I)
310SE Backhoe Loader	T04045TT050
310SG Backhoe Loader (S.N. —910004)	T04045TT081, PE4045TT081 (Tier I)
310SG Backhoe Loader (Alt Comp) (S.N. 909514—)	T04045TT080
315SE Backhoe Loader	T04045TT060
315SG Backhoe Loader (Side-Shift) (S.N. —909995)	T04045TT081 (Tier I)
344H Loader	CD4045TAT71
410E Backhoe Loader	T04045TT053
410G Backhoe Loader	T04045TT082, PE4045TT082 (Tier I)
450G Crawler Dozer (Direct Drive) (S.N. 840528—840890)	T04045DT004, T04045TT005 (Non-Certified)
450G Crawler Dozer (Direct Drive) (S.N. 841246—879425)	T04045TT061, PE4045TT061 (Tier I)
450G Crawler Dozer (Torque Converter) (S.N. 840529—)	T04045TT013 (Non-Certified)
450G/450GTC Crawler Dozer	T04045TT061, PE4045TT061 (Tier I)
450GTC Series IV Crawler Dozer (S.N. 840461—)	T04045TT067, PE4045TT067 (Tier I)
450H Crawler Dozer	T04045DT053
450H LGP Crawler Dozer (S.N. —XXXXXX)	T04045TT058, PE4045TT058 (Tier I)
450H Crawler Dozer (Alt Comp) (S.N. —XXXXXX)	T04045TT057, PE4045TT057 (Tier I)
455G Series IV Crawler Loader (S.N. 840461—)	T04045TT061, PE4045TT061
455GTC Crawler Loader	T04045TT067, PE4045TT067 (Tier I)
485E/486E/488E Forklift	T04045DT050, PE4045DT050
550G Crawler Dozer (S.N. 840461—)	T04045TT062
550GTC Crawler Dozer (S. N. 840461—)	T04045TT062, T04045TT068
550H Crawler Dozer (S.N. —909830)	T04045TT064, PE4045TT064 (Tier I)
550H LGP Crawler Dozer (S.N. —909667)	T04045TT065, PE4045TT065 (Tier I)
550H Forest Fire Plow (S.N. 898487—909788)	T04045TT083, PE4045TT083
555G Crawler Loader (Direct Drive) (S.N. 840461—)	T04045TT063, PE4045TT063 (Tier I)
555GTC Crawler Loader	T04045TT069, PE4045TT069 (Tier I)
643G Feller Buncher	T06068TT053, PE6068TT053
643H Feller Buncher	PE6068TT058
650G Crawler Dozer (Direct Drive)	T04045TT063, PE4045TT063
650GTC Crawler Dozer	T04045TT069, PE4045TT069 (Tier I)
650H Crawler Dozer	T04045TT066, PE4045TT066

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JOHN DEERE CONSTRUCTION AND FORESTRY EQUIPMENT	
Machine Model	Engine Model
650H Forest Fire Plow	T04045TT083, T04045TT091, PE4045TT091
653E Feller Buncher	T06068TT053, PE6068TT053
653G Feller Buncher (120 kW)	T06068TT053, PE6068TT053, PE6068TT059
653G Feller Buncher (140 kW)	PE6068HT057
700H Crawler Dozer	T06068TT056, PE6068TT056 (Tier I)
710D/710E Backhoe Loader (S.N. —834729)	T06068TT050, PE6068TT050
710D/710E Backhoe Loader (S.N. 834730—)	T06068TT055, PE6068TT055 (Tier I)
710G Backhoe Loader	T06068TT057
750C Crawler Dozer (S.N. —831315)	T6068TT007
750C Crawler Dozer (S.N. 831372—)	T06068TT052, PE6068TT052 (Tier I)
790E LC Excavator	T06068TT005
843G Feller Buncher	T06068HT050, PE6068HT050
843H Feller Buncher	PE6068HT056
2054 Logger	PE6068HT053, PE6068TT053
Knoxville, Tennessee/Dubuque, Iowa	
JD7 Skid Steer Loader	PE4045DKV50
270 Skid Steer Loader (Auxiliary Drive)	PE4045DKV50
270 Skid Steer Loader (Non-Auxiliary Drive)	PE4045DKV51
280 Skid Steer Loader	PE4045TKV50, PE4045TKV51 (Tier I)
Saltillo, Mexico	
110/110LC Excavator	T04045TT054, PE4045TP052
120/120LC Excavator	T04045TT052, PE4045TP051
160LC Excavator	T04045TT055, PE4045TP053
Deere-Hitachi (North Carolina, Canada)	
200C LC Excavator	PE6068HT053
200LC Excavator	T06068TT051, PE6068TT051
230C LC Excavator	PE6068HT054, T06068HT051, PE6068HT051
230LC Excavator	T06068TT051
270LC Excavator	T06068HT052, PE6068HT052
Timberjack (Deere) (Sweden/Finland/Canada)	
330/335/430/435/535 Knuckleboom Log Loader	PE6068TTJ50
430B, 435 Log Loader	PE6068TTJ51
Hitachi Construction Machinery (Tsuchiura, Japan)	
270LC Excavator	T06068HT052, PE6068HT052

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Engine Identification and Applications

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JOHN DEERE OEM (OUTSIDE EQUIPMENT MANUFACTURERS)					
Naturally Aspirated		Turbocharged		Turbocharged, Air-to-Air Aftercooled	
Engine Model	Emission Certification	Engine Model	Emission Certification	Engine Model	Emission Certification
CD4045DF007	Non-Certified	CD4045TF120	Non-Certified	CD4045HF120	Non-Certified
CD4045DF092	Non-Certified	CD4045TF150	Tier I Certified	CD4045HF150	Tier I Certified
CD4045DF120	Non-Certified	CD4045TF152	Tier I Certified	CD4045HF152	Tier I Certified
CD4045DF150	Tier I Certified	CD4045TF154	Tier I Certified	CD4045HF157	Tier I Certified
CD4045DF151	Tier I Certified	CD4045TF155	Tier I Certified	CD4045HF158	Tier I Certified
CD4045DF152	Tier I Certified	CD4045TF157	Tier I Certified	CD4045HF252	Non-Certified
CD4045DF153	Tier I Certified	CD4045TF158	Tier I Certified	CD4045HF280	Tier III Certified
CD4045DF154	Tier I Certified	CD4045 TF161	Tier I Certified	CD6068HF120	Non-Certified
CD4045DF157	Tier I Certified	CD4045TF162	Tier I Certified	CD6068HF150	Tier I Certified
CD4045DF158	Tier I Certified	CD4045TF220	Non-Certified	CD6068HF157	Tier I Certified
CD4045DFG070	Tier I (Goldoni)	CD4045TF250	Tier I Certified	CD6068HF158	Tier I Certified
CD4045DFM50	Non-Certified (Marine)	CD4045TF251	Tier I Certified	CD6068HF250	Tier I Certified
CD4045DFM70	Tier 2	CD4045TF257	Tier I Certified	CD6068HF252	Non-Certified
CD6068DF092	Non-Certified	CD4045TF258	Tier I Certified	CD6068HF258	Tier I Certified
CD6068DF150	Tier I Certified	CD4045TF270	Tier 2 Certified	J04045HJ61	Tier I Certified
J06068DJ41	Tier I Certified	CD4045TF280	Tier III Certified	J04045HJ62	Tier I Certified
J04045DJ31	Tier I Certified	CD4045TFM50	Non-Certified (Marine)	PE4045HF120	Non-Certified
J04045DJ61	Tier I Certified	CD6068SFM50	Non-Certified (Marine)	PE4045HF150	Tier I Certified
J04045DJ62	Tier I Certified	CD6068TF001	Non-Certified	PE4045HF280	Tier III Certified
PE4045DF150	Tier I Certified	CD6068TF150	Tier I Certified	PE6068HF120	Non-Certified
PE6068DF150	Tier I Certified	CD6068TF151	Tier I Certified	PE6068HF150	Tier I Certified
PE4045DFM50	Non-Certified (Marine)	CD6068TF152	Tier I Certified	PE6068HF250	Tier I Certified
T04045DF120	Non-Certified	CD6068TF157	Tier I Certified	T04045HF120	Non-Certified
T04045DF150	Tier I Certified	CD6068TF158	Tier I Certified	T04045HF150	Tier I Certified
T04045DF151	Tier I Certified	CD6068TF159	Tier I Certified	T06068HF120	Non-Certified
T04045DF152	Tier I Certified	CD6068TF220	Non-Certified	T06068HF150	Tier I Certified
T04045DF153	Tier I Certified	CD6068TF250	Tier I Certified	T06068HF250	Tier I Certified
T04045DFM50	Non-Certified (Marine)	CD6068TF251	Tier I Certified		
T06068DF150	Tier I Certified	CD6068TF252	Non-Certified		
		CD6068TF257	Tier I Certified		
		CD6068TF258	Tier I Certified		
		CD6068TFM50	Non-Certified (Marine)		

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JOHN DEERE OEM (OUTSIDE EQUIPMENT MANUFACTURERS)					
Naturally Aspirated		Turbocharged		Turbocharged, Air-to-Air Aftercooled	
		J04045TJ31	Tier I Certified		
		J04045TJ61	Tier I Certified		
		J4045TJ62	Tier I Certified		
		J06068TJ31	Tier I Certified		
		J06068TJ32	Tier I Certified		
		J06068TJ61	Tier I Certified		
		J06068TJ62	Tier I Certified		
		PE4045TF120	Non-Certified		
		PE4045TF150	Tier I Certified		
		PE4045TF151	Tier I Certified		
		PE4045TF220	Non-Certified		
		PE4045TF250	Tier I Certified		
		PE4045TF270	Tier 2 Certified		
		PE4045TF280	Tier III Certified		
		PE4045TFM50	Non-Certified (Marine)		
		PE6068TF120	Non-Certified		
		PE6068TF150	Tier I Certified		
		PE6068TF151	Tier I Certified		
		PE6068TF220	Non-Certified		
		PE6068TF250	Tier I Certified		
		T04045TF120	Non-Certified		
		T04045TF150	Tier I Certified		
		T04045TF151	Tier I Certified		
		T04045TF152	Tier I Certified		
		T04045TF220	Non-Certified		
		T04045TF250	Tier I Certified		
		T04045TF251	Tier I Certified		
		T04045TF270	Tier 2 Certified		
		T04045TFM50	Non-Certified (Marine)		
		T06068TF120	Non-Certified		
		T06068TF150	Tier I Certified		
		T06068TF151	Tier I Certified		
		T06068TF220	Non-Certified		
		T06068TF250	Tier I Certified		
		T06068TFM50	Non-Certified (Marine)		

OUO1082.000003A -19-10OCT07-10/10

Diesel Fuel

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

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

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

Required fuel properties

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

Cetane number of 45 minimum. Cetane number greater than 50 is preferred, especially for temperatures below -20°C (-4°F) or elevations above 1500 m (5000 ft).

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

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

Sulfur content:

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

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

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

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

Bio-Diesel Fuel

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

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

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

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

John Deere engines can also operate on biodiesel blends above B20 (up to 100% biodiesel) ONLY if the biodiesel meets the EN 14214 specification (primarily available in Europe). Engines operating on biodiesel blends above B20 may not fully comply with all applicable emissions regulations. Expect up to a 12% reduction in power and an 18% reduction in fuel economy when using 100% biodiesel. John Deere approved fuel conditioners containing detergent/dispersant additives are required.

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

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

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

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

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

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

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

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

- Possible coking and/or blocked injector nozzles, resulting in power loss and engine misfire if John Deere approved fuel conditioners containing detergent/dispersant additives are not used
- Possible crankcase oil dilution, requiring more frequent oil changes
- Possible corrosion of fuel injection equipment
- Possible lacquering and/or seizure of internal components
- Possible formation of sludge and sediments
- Possible thermal oxidation of fuel at elevated temperatures
- Possible elastomer seal and gasket material degradation (primarily an issue with older engines)

- Possible compatibility issues with other materials (including copper, lead, zinc, tin, brass, and bronze) used in fuel systems and fuel handling equipment
- Possible reduction in water separator efficiency
- Potential high acid levels within fuel system
- Possible damage to paint if exposed to biodiesel

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

Minimizing the Effect of Cold Weather on Diesel Engines

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

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

Use Winter Blend Diesel Fuel

When temperatures fall below -10°C (14°F), winter blend diesel fuel is best suited for cold weather operation. Winter blend diesel fuel has a lower cloud point and a lower pour point.

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

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

Air Intake Heater

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

Ether

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



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

Coolant Heater

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

Seasonal Viscosity Oil and Proper Coolant Concentration

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

Diesel Fuel Flow Additive

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

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



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

Biodiesel

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

Winterfronts

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

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

Radiator Shutters

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

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

For more information, see your John Deere dealer.

DX,FUEL10 -19-04OCT07-2/2

Handling and Storing Diesel Fuel



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

DO NOT smoke while you fill the fuel tank or service the fuel system.

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

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

Ensure that all fuel tank caps and covers are installed properly to prevent moisture from entering.

Monitor water content of the fuel regularly.

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

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

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

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

DX,FUEL4 -19-19DEC03-1/1

Lubricity of Diesel Fuel

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

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

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

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

Lubricity of Biodiesel Fuel

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

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

Testing Diesel Fuel

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

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

DIESELSCAN is a trademark of Deere & Company

DM80898,000021D -19-14NOV05-1/1

Oil Information for Uncertified or Tier 1 Engines

The following oil information (DX,ENOIL) applies to engines that are uncertified for emissions or meet Tier 1 emission standards.

DM80898,000021D -19-28SEP07-1/1

Diesel Engine Oil

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

John Deere PLUS-50™ oil is preferred.

Oils meeting one of the following specifications are also recommended:

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

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

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

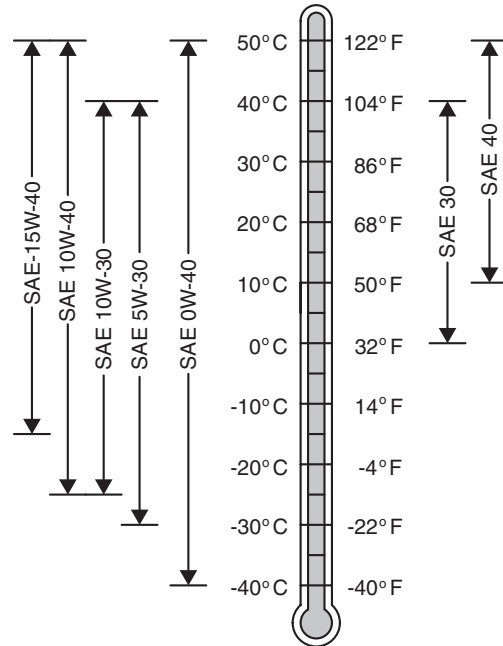
- John Deere TORQ-GARD SUPREME™
- API Service Category CJ-4
- API Service Category CI-4 PLUS
- API Service Category CI-4
- API Service Category CH-4
- API Service Category CG-4
- API Service Category CF-4
- ACEA Oil Sequence E3
- ACEA Oil Sequence E2

If oils meeting API CG-4, API CF-4, or ACEA E2 are used, reduce the service interval by 50%.

Multi-viscosity diesel engine oils are preferred.

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

If diesel fuel with sulfur content greater than 0.50% (5000 ppm) is used, reduce the service interval by 50%.



Oil Viscosities for Air Temperature Ranges

TS1687 -UN-18JUL07

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TORQ-GARD SUPREME is a trademark of Deere & Company

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DO NOT use diesel fuel with sulfur content greater than 1.00% (10 000 ppm).

DX,ENOIL -19-06APR07-2/2

Oil Information for Tier 2 Engines

The following oil information (DX,ENOIL7) applies to engines that meet Tier 2 emission standards.

DM80898,000021E -19-28SEP07-1/1

Diesel Engine Oil

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

John Deere PLUS-50™ oil is preferred.

Oil meeting one of the following specifications are also recommended:

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

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

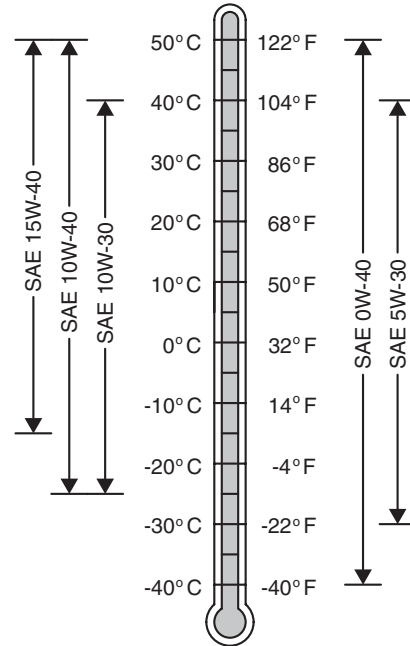
Other oils may be used if they meet one or more of the following:

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

Multi-viscosity diesel engine oils are preferred.

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

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



Oil Viscosities for Air Temperature Ranges

TS1689 -UN-18JUL07

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TORQ-GARD SUPREME is a trademark of Deere & Company

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

Oil Information for Tier 3 Engines

The following oil information (DX,ENOIL11) applies to engines that meet Tier 3 emission standards.

DM80898,000021F -19-28SEP07-1/1

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Diesel Engine Oil

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

John Deere PLUS-50™ oil is preferred.

Oils meeting one of the following specifications are also recommended:

- ACEA Oil Sequence E7
- ACEA Oil Sequence E6

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

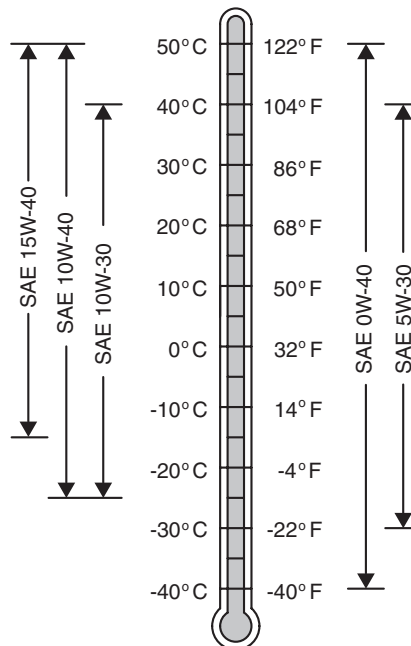
Other oils may be used if they meet one or more of the following:

- John Deere TORQ-GARD SUPREME™
- API Service Category CJ-4
- API Service Category CI-4 PLUS
- API Service Category CI-4
- ACEA Oil Sequence E5
- ACEA Oil Sequence E4

Multi-viscosity diesel engine oils are preferred.

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

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



Oil Viscosities for Air Temperature Ranges

TS1691 -UN-18JUL07

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DX,ENOIL11 -19-26JUL07-1/1

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
- API Service Classification CD
- API Service Classification CC
- ACEA Oil Sequence E2
- ACEA Oil Sequence 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 any of the following during the first 100 hours of operation of a new or rebuilt engine:

API CJ-4	ACEA E7
API CI-4 PLUS	ACEA E6
API CI-4	ACEA E5
API CH-4	ACEA E4
API CG-4	ACEA E3
API CF-4	
API CF-2	
API CF	

These oils will not allow the engine to break-in properly.

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DX,ENOIL4 -19-13SEP06-1/1

Oil Filters

Filtration of oils is critical to proper operation and lubrication.

Always change filters regularly as specified in this manual.

Use filters meeting John Deere performance specifications.

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

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Grease

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

John Deere SD POLYUREA GREASE is preferred.

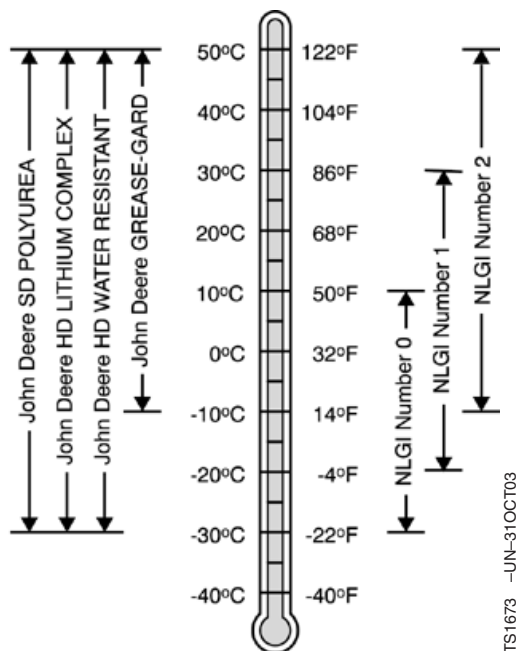
The following greases are also recommended

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



GREASE-GARD is a trademark of Deere & Company

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

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

Lubricant Storage

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

Use clean containers to handle all lubricants.

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

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

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

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

Mixing of Lubricants

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

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

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

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

Diesel Engine Coolant

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

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

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

Additional recommended coolants

The following engine coolant is also recommended:

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

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

Other fully formulated coolants

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

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

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

Coolants requiring supplemental coolant additives

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

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

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

Other coolants

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

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

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

Water quality

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

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

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

DX.COOL3 -19-27OCT05-2/2

Supplemental Coolant Additives

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

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

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

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

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

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

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

Operating in Warm Temperature Climates

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

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

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

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

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

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

Additional Information About Diesel Engine Coolants and Supplemental Coolant Additives

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

Coolant specifications

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

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

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

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

Replenish coolant additives

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

Why use supplemental coolant additives?

Operating without proper coolant additives will result in increased corrosion, cylinder liner erosion and pitting, and other damage to the engine and cooling system. A

simple mixture of ethylene glycol or propylene glycol and water will not give adequate protection.

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

Avoid automotive-type coolants

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

Water quality

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

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

Freeze protection

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

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

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

DX,COOL7 -19-19DEC03-2/2

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).

John Deere COOL-GARD is preferred for service.

If John Deere COOL-GARD is not available, use a low silicate ethylene glycol or propylene glycol base coolant concentrate in a 50% mixture of concentrate with quality water.

The coolant concentrate shall be of a quality that provides cavitation protection to cast iron and aluminum parts in the cooling system. John Deere COOL-GARD meets this requirement.

Freeze protection

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

A 50% mixture of propylene glycol engine coolant in water provides freeze protection to -33°C (-27°F).

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

Water quality

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

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

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

DX,COOL8 -19-16NOV01-1/1

Testing Diesel Engine Coolant

Testing Diesel Engine Coolant

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

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

Coolant test strips

Coolant test strips are available from your John Deere dealer. These test strips provide a simple, effective

method to check the freeze point and additive levels of your engine coolant.

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

COOLSCAN™ and COOLSCAN PLUS™

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

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COOLSCAN PLUS is a trademark of Deere & Company*

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

Drain Intervals for Diesel Engine Coolant

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

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

When John Deere COOL-GARD™ is used, the 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 John Deere COOL-GARD is used but the coolant is not tested OR additives are not replenished by adding a supplemental coolant additive, the drain interval is 3 years or 3000 hours of operation

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

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DX,COOL11 -19-19DEC03-1/1

Repair and Adjustments

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Fuel System—General Information

NOTE: For repair and diagnostics of electronic fuel systems, see CTM170—Level 4 Electronic Fuel Systems with Bosch VP44 Pump, CTM331—Level 12 Electronic Fuel Systems with Stanadyne DE10 Pump, CTM284—Level 1 Electronic Fuel Systems with Delphi/Lucas DP201 Pump, CTM220—Level 11 Electronic Fuel Systems with Denso High Pressure Common Rail, CTM320—Level 14 Electronic Fuel Systems with Denso High Pressure Common Rail, or CTM502—Level 16 Electronic Fuel Systems with Denso High Pressure Common Rail.

Engines may be equipped with a Stanadyne or Delphi/Lucas rotary-type injection pump or a Denso or Motorpal in-line injection pump. Engines with rotary pumps are dynamically timed at the factory. See CHECK AND ADJUST ROTARY INJECTION PUMP DYNAMIC TIMING USING TIME TRAC® or CHECK AND ADJUST ROTARY INJECTION PUMP DYNAMIC TIMING USING TACH-N-TIME™ in Section 04, Group 150.

Some injection pumps are equipped with an aneroid.

On Stanadyne and Delphi/Lucas rotary pumps, the fuel supply pump is a separate component mounted on the upper right-hand side of the engine block and is

actuated by a pin in the block that rides on the engine camshaft lobe.

On rotary pumps, a cold start switch may be installed in the thermostat housing/water manifold and is connected to a wiring harness from the pump. This switch helps during cold start-up operation.

On in-line pumps, the fuel supply pump is a component mounted on the side of the pump actuated by a lobe on the injection pump camshaft.

Engines may be equipped with a primary fuel filter/water separator.

All engines are equipped with a round final fuel filter. Hand primer on top of filter element is optional.

Engines may be equipped with 9.5 mm or 17 mm pencil-type nozzles as required for exhaust emissions.

Field-installed options include fuel heater, water separator bowl and hand fuel primer.

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

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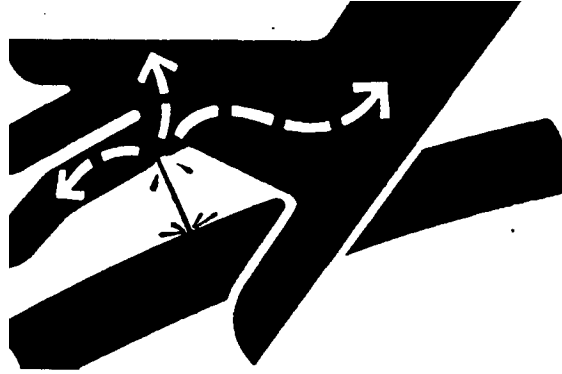
Relieve Fuel System Pressure



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. (See BLEED THE FUEL SYSTEM in this group.)



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RG,35,JW7625 -19-20NOV97-1/1

Remove and Install Final Fuel Filter and/or Primary Fuel Filter/Water Separator Base

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

Some engines may be equipped with a final fuel filter (A) and an optional primary fuel filter/water separator (B).

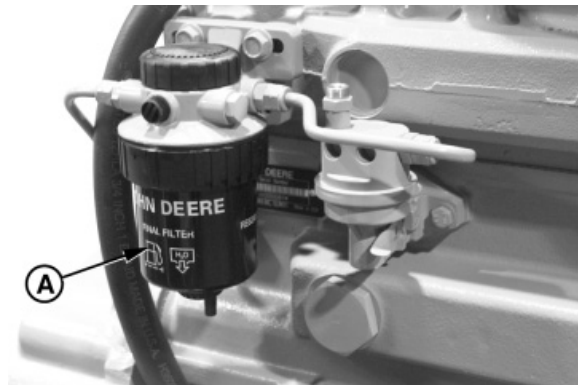
Final fuel filters can be equipped with a water separator bowl and/or hand primer on machines equipped with only one filter.

- A—Final Fuel Filter
- B—Primary Fuel Filter/Water Separator (Optional)



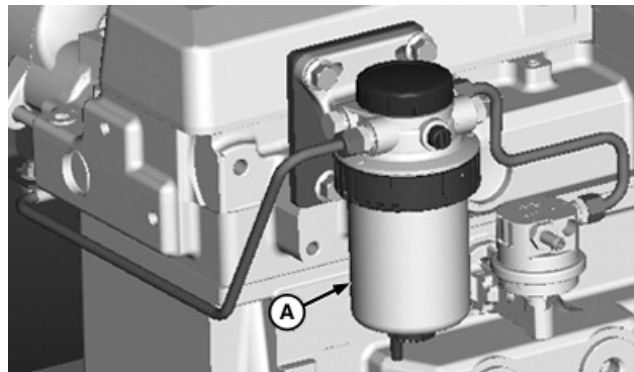
RG7745A -UN-07NOV97

Final and Primary Fuel Filter/Water Separator



RG7986 -UN-14NOV97

Final Fuel Filter



RG 15533 -UN-14SEP07

Hi-Mount Final Fuel Filter

Continued on next page

OOU1082,0000073 -19-14SEP07-1/3

1. Thoroughly clean fuel filter/water separator assembly and surrounding area to keep from getting dirt and debris into fuel system.
2. Connect a drain line to filter drain adapters and drain all fuel from system.

NOTE: The fuel filters are keyed to the filter header. If both primary and final filters are removed, ensure that they are reinstalled in the correct headers.

3. Remove final fuel filter element and primary (round) fuel filter/water separator, if desired. (See REPLACE FINAL FUEL FILTER AND PRIMARY FUEL FILTER/WATER SEPARATOR, as described later in this group.)

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

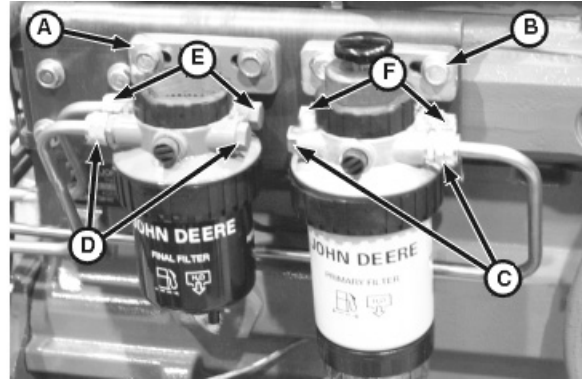
4. Disconnect fuel lines from all ports.
5. Remove final fuel filter base (A).
6. If equipped, remove primary fuel filter base (B).
7. Replace parts as necessary.
8. Install mounting brackets and tighten to torque specifications provided below.

Specification

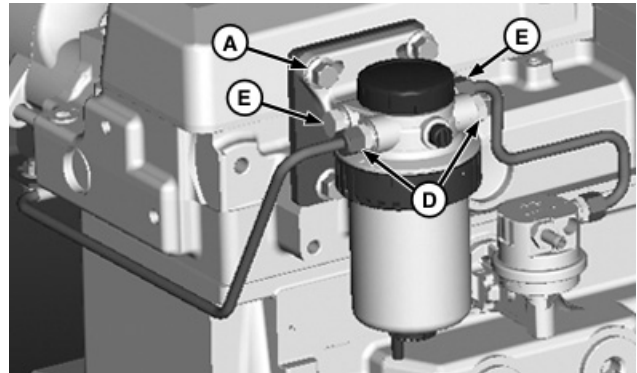
Fuel Filter Base Mounting	
Bracket-to-Cylinder Head—	
Torque	35 N•m (26 lb-ft)
Primary Fuel Filter/Water	
Separator Mounting	
Base-to-Bracket—Torque	35 N•m (26 lb-ft)
Final Fuel Filter Mounting	
Base-to-Bracket—Torque	35 N•m (26 lb-ft)

9. Install water separator and fuel filter elements. See REPLACE FINAL FUEL FILTER AND PRIMARY FUEL FILTER/WATER SEPARATOR, as described later in this group.

10. Connect fuel lines to all ports.



Final and Primary Fuel Filter/Water Separator



Hi-Mount Final Fuel Filter

- A—Final Fuel Filter Base
- B—Primary Fuel Filter Base
- C—Primary Filter Outlet Port(s) to Supply Pump
- D—Final Filter Outlet Port(s) to Injection Pump
- E—Final Filter Inlet Port(s) from Supply Pump
- F—Primary Filter Inlet Port(s) from Fuel Tank

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RG10383 -UN-18NOV99

RG15532 -UN-14SEP07

Mechanical Fuel System Repair and Adjustments

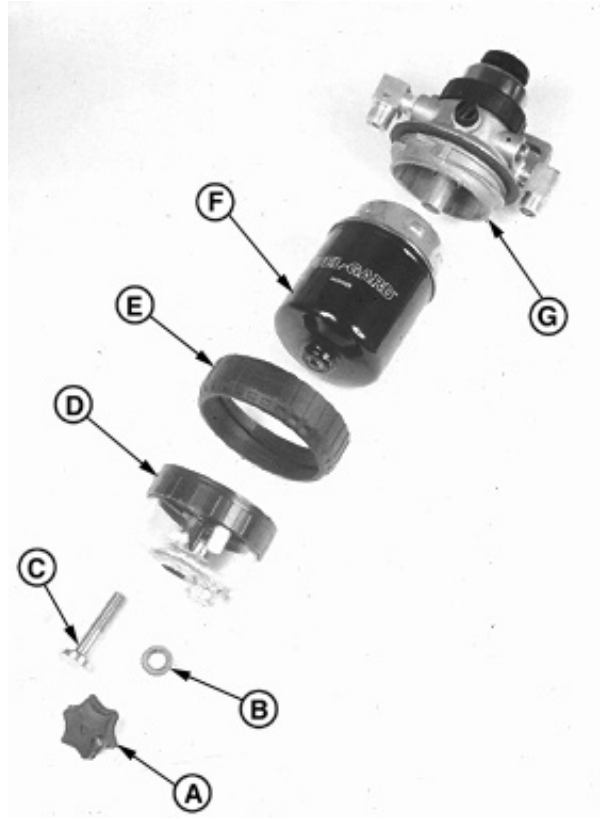
11. Bleed the fuel system as detailed in this group. (See BLEED THE FUEL SYSTEM in this group.)

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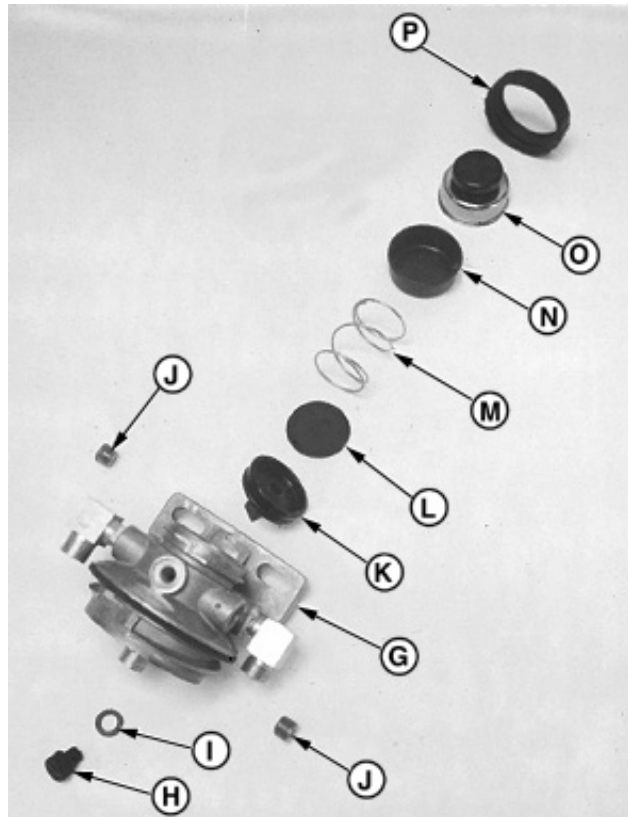
Primary Fuel Filter/Water Separator Assembly (Optional)

- A—Drain Adapter
- B—Packing
- C—Cap Screw
- D—Water Separator Bowl
- E—Retaining Ring
- F—Filter Element
- G—Filter Base with Seal Ring
- H—Vent Plug
- I—Packing
- J—Plug (2 used)
- K—Diaphragm
- L—Spring Seat
- M—Spring
- N—Spring Cover
- O—Pump Knob
- P—Retaining Ring



Primary Filter/Water Separator Assembly

RGT7751HR -UN-19NOV97



Filter Base Assembly

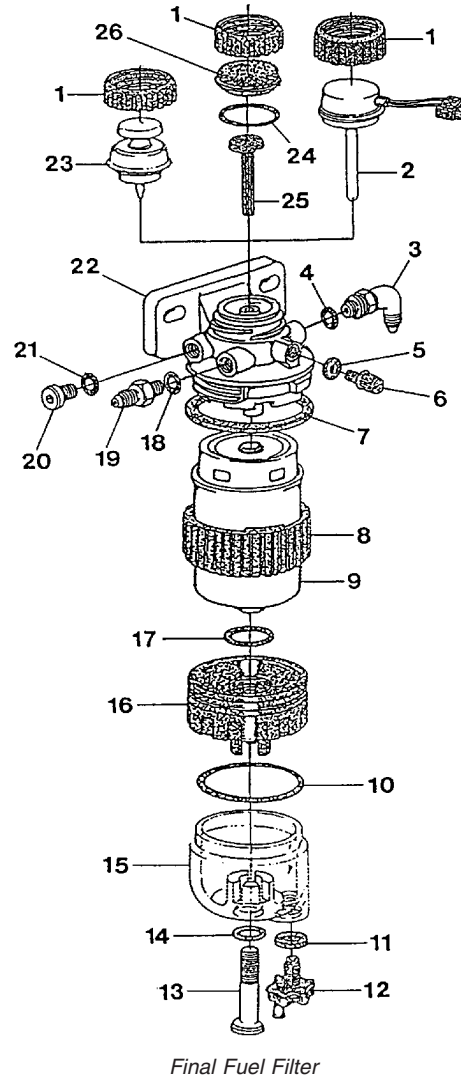
RGT7751HS -UN-19NOV97

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Final Fuel Filter Assembly

- 1—Retaining Ring
- 2—Fuel Heater (Optional)
- 3—Fitting
- 4—O-Ring
- 5—O-Ring
- 6—Bleed Screw
- 7—O-Ring
- 8—Retaining Ring
- 9—Filter
- 10—O-Ring
- 11—O-Ring
- 12—Drain Adapter
- 13—Screw
- 14—O-Ring
- 15—Water Separator Bowl
- 16—Adapter
- 17—O-Ring
- 18—O-Ring
- 19—Fitting
- 20—Plug
- 21—O-Ring
- 22—Filter Base
- 23—Primer Assembly (Optional)
- 24—O-Ring
- 25—Stem
- 26—Cap



RG9091 -UN-31MAP98

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Replace Final Fuel Filter and Primary Fuel Filter/Water Separator

IMPORTANT: Prevent machine damage. Drain water and sediment and replace filter elements at specified intervals. Contaminated fuel can cause premature failure of fuel injection pump.

If appropriate, substitute longer filter elements and/or add sediment bowls to filter elements.

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

Final fuel filters can be equipped with a sediment bowl and/or hand primer.

Replacement of primary and final fuel filter elements are similar. Differences will be noted.

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 (when viewed from top). Remove ring with filter element (B).
4. Inspect filter mounting base for cleanliness. Clean as required.
5. Remove sediment bowl, if equipped. Drain and clean sediment bowl. Dry with compressed air.
6. Install sediment bowl, if equipped, onto new filter element. Tighten securely.
7. Thoroughly inspect filter base seal ring. Replace as needed.



Final and Primary Fuel Filter/Water Separator

A—Retaining Ring
B—Filter Element

RG7745C -JUN-07NOV97

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

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

RG,35,JW7622 -19-19AUG04-2/2

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Remove Lucas and Stanadyne Fuel Supply Pump

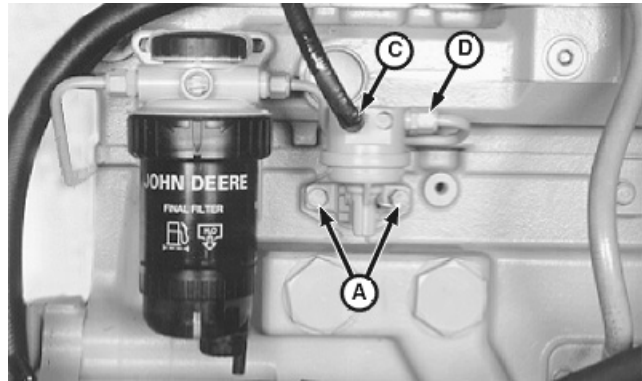
IMPORTANT: A backup wrench must always be used when disconnecting fittings or fuel lines from supply pump to avoid damage to fittings.

1. Disconnect fuel inlet line (C) and outlet line (D) and cap connections on fuel supply pump and fuel lines to keep debris out of fuel system.
2. Remove cap screws (A) and remove fuel supply pump assembly from cylinder block.

NOTE: The fuel supply pump is driven by a push rod (B) that rides on an eccentric camshaft lobe. The cylinder head must be removed to remove this push rod.

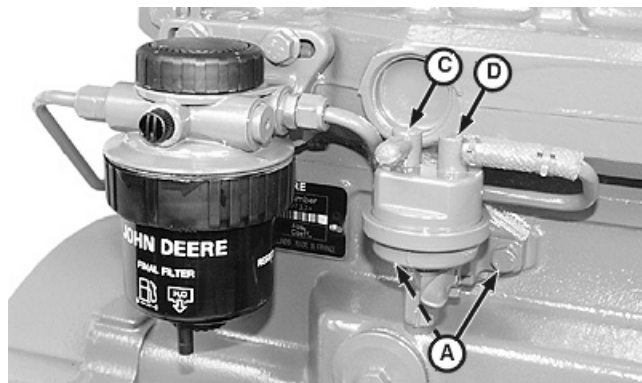
3. Cover opening on cylinder block to prevent dirt from entering the engine.
4. Inspect face of pump lever for wear. If lever face is worn flat or concave, replace pump.

- A—Cap Screws
- B—Push Rod
- C—Supply Pump Inlet from Fuel Tank
- D—Supply Pump Outlet to Final Fuel Filter



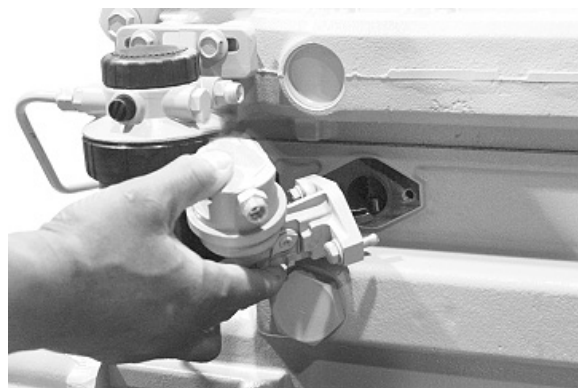
Fuel Supply Pump with Metal Cover

RG10548 -UN-01DEC99



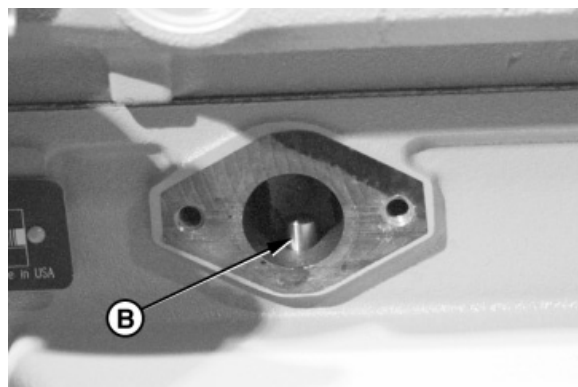
Fuel Supply Pump with Composite Cover

RG10547 -UN-01DEC99



Remove Fuel Supply Pump

RG9051 -UN-16MAR98



Fuel Supply Pump Push Rod

RG7628 -UN-06NOV97

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Bench Test Lucas and Stanadyne Fuel Supply Pump

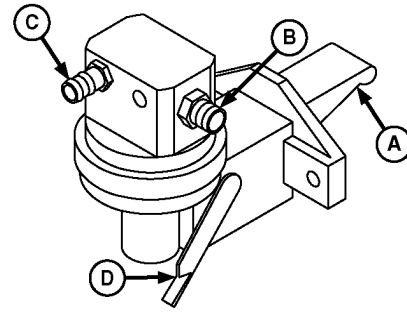
The following bench tests can be performed on a supply pump installed on the engine when the pump is suspected to be defective. (See MEASURE FUEL SUPPLY PUMP PRESSURE or in Section 04, Group 150.)

Perform the Vacuum/Pressure Test and Leakage Test, listed below. Replace the supply pump if either test shows the pump to be defective. There is no repair procedure.

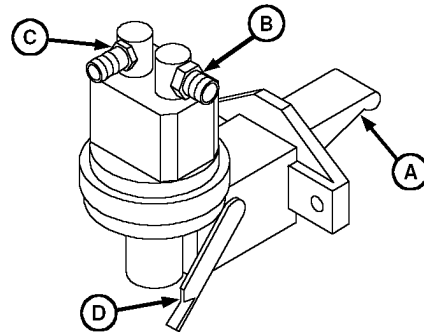
Vacuum/Pressure Test

NOTE: This test will give a good indication of condition of both the inlet and outlet valves, as well as the diaphragm. The numerical values obtained on both the vacuum and pressure sides are not important; rather it is the needle movement that is important (very slow for a good pump; very fast or not at all for a defective pump).

1. Remove inlet and outlet fittings.
2. Install vacuum/pressure gauge to inlet side of pump (C).
3. Move primer lever (D) all the way downward. Release lever and at the same time observe gauge:
 - The gauge needle should read the same value each time, and then very slowly return to "0". This indicates that the inlet valve and diaphragm are in good condition. Proceed to next step.
 - If the gauge needle does not move at all, or the needle rapidly returns to "0", the pump is defective and must be replaced.
4. Remove vacuum/pressure gauge and install onto outlet side of pump (B).
5. Move priming lever all the way to upward position. Release lever and at same time observe gauge reading:



Fuel Supply Pump with Metal Cover



Fuel Supply Pump with Composite Cover

- A—Lever
- B—Outlet Side of Pump
- C—Inlet Side of Pump
- D—Primer Lever

- The gauge needle should initially read 28—41 kPa (0.28—0.41 bar) (4—6 psi), then return to “0” very slowly. This indicates that the outlet valve and diaphragm are in good condition. Supply pump is operating properly and should be reinstalled on engine.

Specification

Rotary Fuel Supply Pump (Lucas and Stanadyne)—Pressure 28—41 kPa (0.28—0.41 bar) (4—6 psi)

- If the gauge needle initially reads same value as above and then returns immediately back to “0”, the pump is defective and must be replaced.

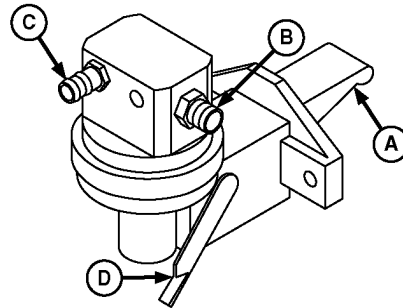
RG,35,JW7620 -19-26OCT99-2/3

Leakage Test

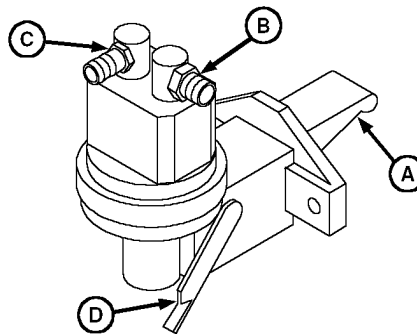
The leakage test should be performed if a supply pump is suspected of leaking fuel externally, or internally into the engine crankcase.

1. Install an air line on inlet side of pump (C) and apply 140 kPa (1.4 bar) (20 psi) pressure.
 2. Hold finger over outlet side of pump (B) or install a plug. Submerge pump into a container of clean diesel fuel.
- If air bubbles occur around banded connection holding the two halves of pump together (indicating leakage), replace pump.
 - If the diaphragm is bad, there will be leakage through vent holes (if equipped) and around the rocker arm. Replace pump as necessary.

- A—Lever
- B—Outlet Side of Pump
- C—Inlet Side of Pump
- D—Primer Lever



Fuel Supply Pump with Metal Cover



Fuel Supply Pump with Composite Cover

RG9052 -UN-16MAR98

RG10546 -UN-03DEC99

RG,35,JW7620 -19-26OCT99-3/3

02
090
12

Install Lucas and Stanadyne Fuel Supply Pump

IMPORTANT: Apply LOCTITE 242 to threads of supply pump mounting screws (A) and fuel line fittings when reinstalling supply pump. DO NOT allow sealant to get into fuel system.

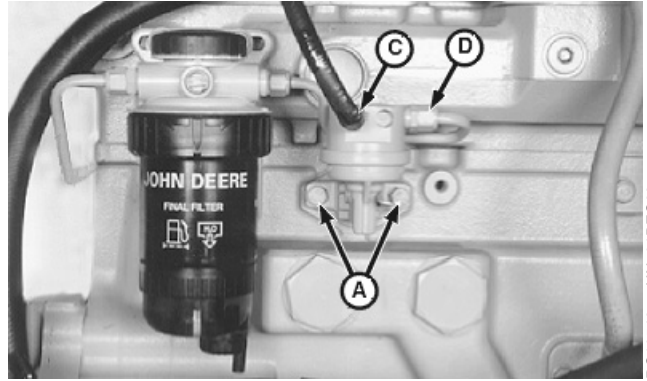
1. Install the fuel supply pump to cylinder block with pumping lever resting on top of push rod, using a new O-ring. Tighten cap screws to specifications.

Specification

Fuel Supply Pump Cap Screws
(Rotary)—Torque..... 30 N•m (22 lb-ft)

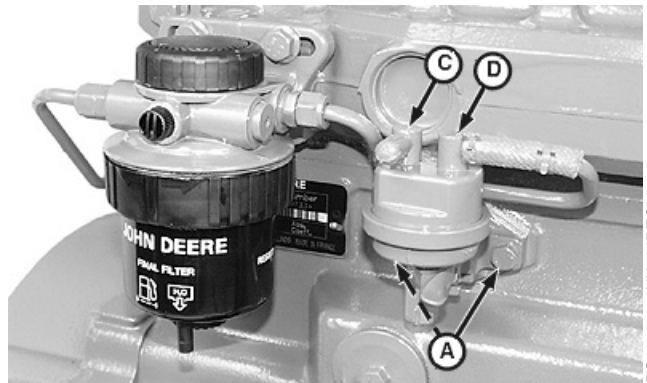
IMPORTANT: ALWAYS use a backup wrench when installing fittings and/or fuel lines onto supply pump to avoid damage to fittings.

2. Connect supply pump inlet line (C) and outlet line (D) and tighten securely.
3. Bleed fuel system. (See BLEED THE FUEL SYSTEM in this group.)



RG10648 -UN-01DEC99

Fuel Supply Pump with Metal Cover



RG10647 -UN-01DEC99

Fuel Supply Pump with Composite Cover

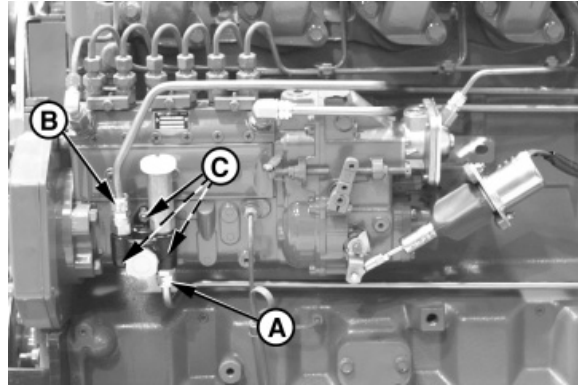
- A—Cap Screws
- C—Supply Pump Inlet from Fuel Tank
- D—Supply Pump Outlet to Final Fuel Filter

RG,35,JW7619 -19-26OCT99-1/1

Remove Denso In-Line Fuel Supply Pump

NOTE: To diagnose fuel supply pump malfunctions, see F1—FUEL SUPPLY SYSTEM CHECK in Section 04, Group 150. To test for leaks, see TEST FUEL SUPPLY PUMP FOR LEAKS—IN-LINE INJECTION PUMP in Section 04, Group 150.

1. Thoroughly clean exterior of supply pump. Also clean around supply pump mounting area on injection pump housing.
2. Disconnect fuel inlet line (A) and outlet line (B). Cap all line openings so contaminants do not enter fuel system.
3. Remove mounting nuts (C).
4. Pull fuel supply pump straight out from injection pump housing. Cover supply pump mounting bore so debris cannot enter injection pump.



Fuel Supply Pump—In-Line Injection

A—Fuel Inlet Line
 B—Fuel Outlet Line
 C—Mounting Nuts

RG,35,JW7618 -19-20NOV97-1/1

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RG7748A -UN-07NOV97

Test Denso In-Line Fuel Supply Pump for Leaks

Fuel delivery pressure should be checked before removing supply pump from injection pump. (See CHECK FUEL SUPPLY PUMP OPERATION—IN-LINE INJECTION PUMP in Section 04, Group 150.)

1. Connect compressed air line (A) to a pressure gauge (B) and to supply pump inlet fitting. Air line should have a regulating valve to control pressure.
2. Cap or plug supply pump outlet fitting (C).
3. Submerge supply pump in a container of clean diesel fuel. Regulate air pressure to 200 kPa (2.0 bar) (29 psi).
4. Move roller tappet in and out by hand. No air bubbles should appear around roller tappet.

NOTE: If bubbles appear, it is an indication that either the O-ring seal is defective, or spindle or tappet is worn (or possibly both).

IMPORTANT: Serious injection pump or engine damage could occur if enough diesel fuel leaks past spindle and seal. Fuel leakage past spindle dilutes engine oil.



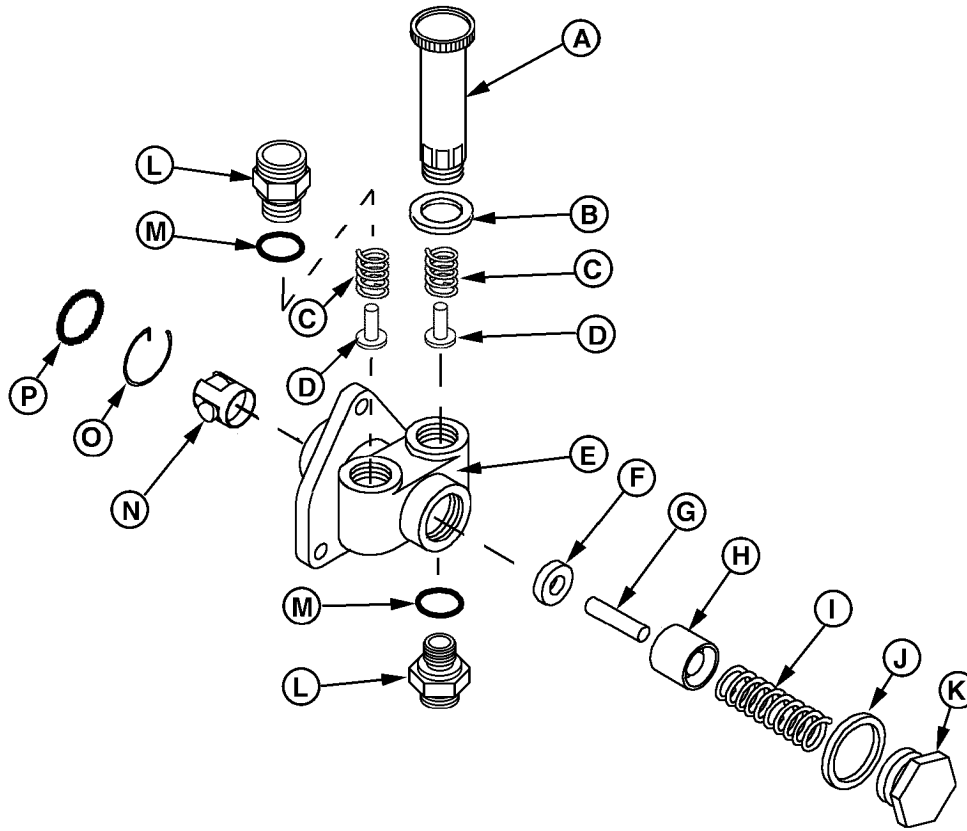
Fuel Supply Pump Leak Test

A—Air Line
B—Pressure Gauge
C—Outlet Fitting

RG5684 -UN-03NOV97

RG,35,JW7617 -19-20NOV97-1/1

Disassemble Denso In-Line Fuel Supply Pump



RG10378 -UN-19OCT99

Fuel Supply Pump

- | | | | |
|-------------------|-----------------------|----------------|--------------------------|
| A—Hand Primer | E—Pump Housing | I—Spring | M—O-Ring |
| B—Washer (4 used) | F—O-Ring/Spindle Seal | J—Washer | N—Roller/Tappet Assembly |
| C—Spring (2 used) | G—Pressure Spindle | K—Plug | O—Snap Ring |
| D—Valve | H—Plunger | L—Flex Fitting | P—O-Ring |

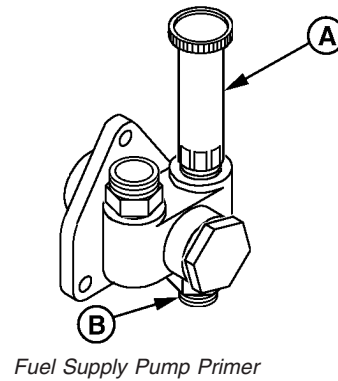
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RG,35,JW7616 -19-19AUG04-1/6

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1. Remove hand primer (A) and flex fittings (B) from housing. Discard O-rings.

A—Hand Primer
B—Flex Fittings



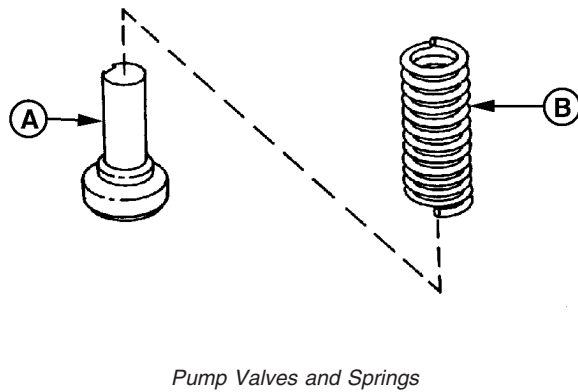
RG8071 -UN-18NOV97

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RG,35,JW7616 -19-19AUG04-2/6

2. Remove valves (A) and springs (B).

A—Valve
B—Spring



RG2323 -UN-30OCT97

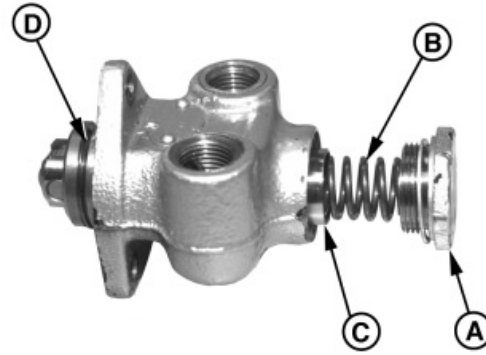
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RG,35,JW7616 -19-19AUG04-3/6

3. Remove plug (A), spring (B), and plunger (C) from pump housing. Discard copper washer.
4. Remove snap ring (D) from outer circumference of pump housing neck.

NOTE: Snap ring has a tang on one end which extends vertically down through a hole in pump housing to retain roller tappet assembly.

- A—Plug
- B—Spring
- C—Plunger
- D—Snap Ring



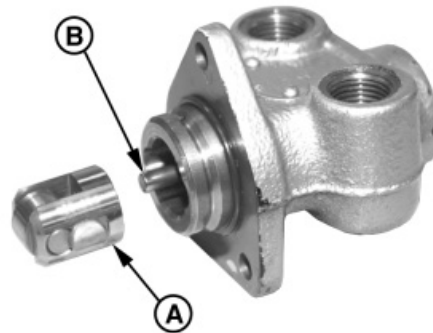
Pump Plug, Spring and Plunger

RG8049 -UN-14NOV97

RG,35,JW7616 -19-19AUG04-4/6

5. Remove roller tappet (A) and spindle (B) from pump housing. Remove and discard O-ring on spindle.

- A—Roller Tappet
- B—Spindle



Pump Roller Tappet and Spindle

RG8052 -UN-14NOV97

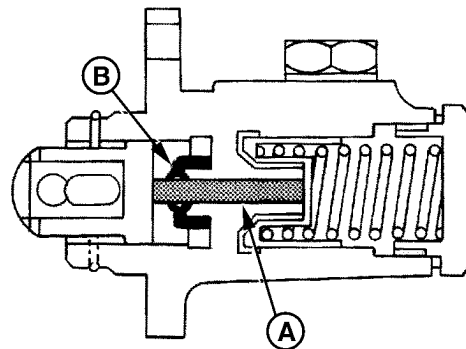
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RG,35,JW7616 -19-19AUG04-5/6

NOTE: Spindle/seal O-ring (B) is pressed into pump housing. This seal keeps diesel fuel from leaking past spindle (A) and entering injection pump crankcase.

6. Remove spindle seal from housing using needle nose pliers. Discard seal.

A—Spindle
B—Spindle/Seal O-Ring



Pump Housing Spindle/Seal O-Ring

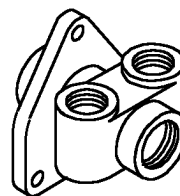
RG4029 -UN-30OCT97

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RG,35,JW7616 -19-19AUG04-6/6

Inspect and Repair Denso In-Line Fuel Supply Pump Components

1. Inspect supply pump housing for cracks and wear. Be sure valve seating areas are not pitted. Replace housing as necessary.
2. Check roller tappet and plunger bore for wear and scoring. Remove any deposits in housing with a suitable solvent. Rinse housing in clean diesel fuel.
3. Check condition of threads for inlet and outlet fittings. Pump elbow fittings have 1/2-20 threads.



Fuel Supply Pump Housing

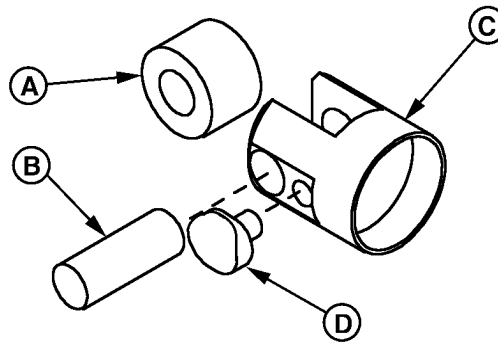
RG8050 -UN-15JAN98

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RG,35,JW7615 -19-20NOV97-1/4

4. Inspect roller (A) OD for excessive wear. Be sure roller turns freely on pin (B) and in tappet (C).
5. Inspect sliding blocks (D). Edges should be square and unpitted. Blocks should slide in and out of tappet easily.
6. Inspect tappet for wear and scoring. Remove any deposits with a suitable solvent.

Be sure land on tappet that contacts pressure spindle is flat and undamaged.



Inspect Roller Tappet Assembly

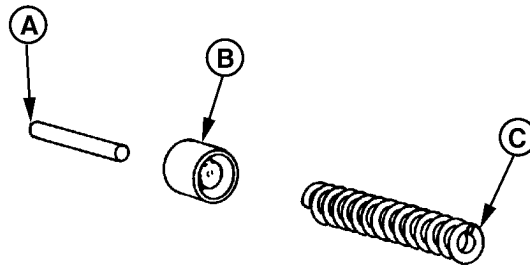
- A—Roller
- B—Pin
- C—Tappet
- D—Sliding Block (2 used)

RG8051 -UN-14NOV97

RG,35,JW7615 -19-20NOV97-2/4

7. Inspect pressure spindle (A) and plunger (B) for pits and burrs. Replace parts as necessary.
8. Inspect spring (C) for cracks and distortion. Replace parts as necessary.

- A—Spindle
- B—Plunger
- C—Spring



Inspect Press Spindle Plunger and Spring

RG2322 -UN-30OCT97

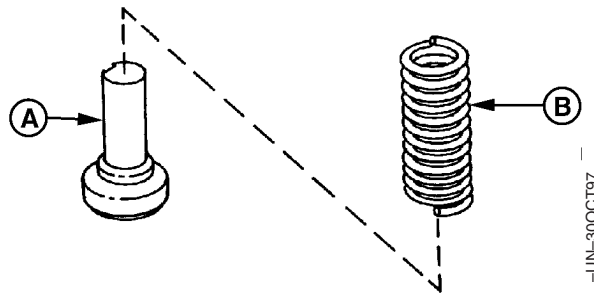
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RG,35,JW7615 -19-20NOV97-3/4

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9. Inspect valves (A), especially valve face, for cracks, pits and wear. Replace as necessary.
10. Spring (B) should not be bent or broken.

A—Valve
B—Spring



Inspect Valves and Springs

RG2323 -UN-30OCT97

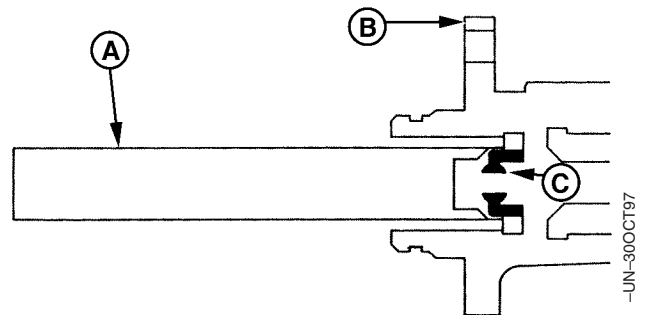
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RG,35,JW7615 -19-20NOV97-4/4

Assemble Denso In-Line Fuel Supply Pump

IMPORTANT: Hands should be wet with diesel fuel when assembling internal components of fuel supply pump.

1. Install new spindle/seal O-ring (C) into pump housing (B) using JDF15 Driver (A). Be sure spindle/seal O-ring is started straight in housing bore and drive until driver contacts housing.
2. To assemble supply pump, reverse disassembly procedure using new O-rings. Perform leak test. (See TEST FUEL SUPPLY PUMP FOR LEAKS—IN-LINE INJECTION PUMP in Section 04, Group 150.)



Fuel Supply Housing Spindle/Seal O-Ring

A—Driver
B—Pump Housing
C—Spindle/Seal O-Ring

RG2013 -UN-30OCT97

RG,35,JW7614 -19-19AUG04-1/1

Install Denso In-Line Fuel Supply Pump

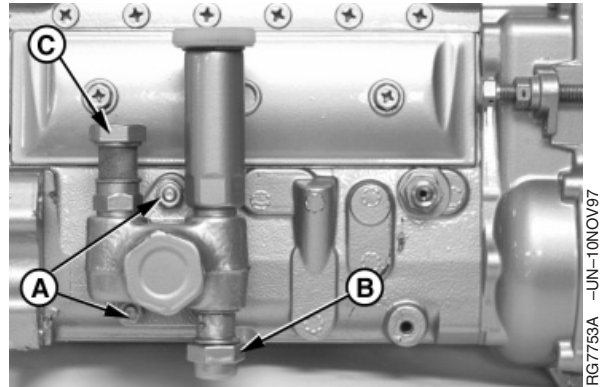
IMPORTANT: Before installing supply pump, test pump to make sure fuel will not leak around spindle and spindle seal. (See **TEST FUEL SUPPLY PUMP FOR LEAKS—IN-LINE INJECTION PUMP** in Section 04, Group 150.)

1. Put a new O-ring in counterbore of injection pump housing next to fuel supply pump mounting face.
2. Position pump over mounting studs (A). Tighten mounting studs to specifications.

Specification

Fuel Supply Pump (Denso) Cap
Screws—Torque..... 5—7 N•m (4—5 lb-ft)
(45—60 lb-in.)

3. Install fuel inlet (B) and outlet lines (C) when engine is installed in vehicle. Tighten all connections securely.
4. Bleed fuel system. (See **BLEED THE FUEL SYSTEM** in this group.)



Fuel Supply Pump—Denso In-Line Injection

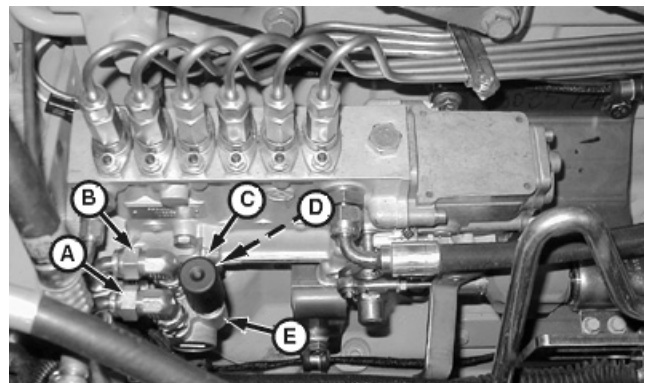
A—Mounting Studs
B—Inlet Line
C—Outlet Line

RG,35,JW7613 -19-20NOV97-1/1

Remove Motorpal Fuel Supply Pump

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

1. Disconnect fuel inlet line (A) and outlet line (B). Cap all line openings so contaminants do not enter fuel system.
2. Remove cap screws (D), brackets (C), and fuel supply pump (E).
3. Cover supply pump mounting bore so debris cannot enter injection pump housing.



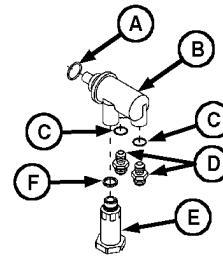
Remove Fuel Supply Pump

A—Fuel Inlet Line
B—Fuel Outlet Line
C—Bracket (2 used)
D—Cap Screw (2 used)
E—Fuel Supply Pump

DPSG,OUO1004,2601 -19-19AUG04-1/1

Inspect Motorpal Fuel Supply Pump

1. Inspect supply pump housing (B) 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 (D) and hand primer pump (E).
2. If pump housing or plunger mechanism is worn or damaged, replace pump assembly. Use new O-rings (A and C) on fittings and new copper washer (F) on primer.



Fuel Supply Pump

- A—O-Ring
- B—Fuel Supply Pump Housing
- C—O-Ring (2 used)
- D—Fitting (2 used)
- E—Hand Primer Pump
- F—Copper Washer

DPSG,OUO1004,2607 -19-19AUG04-1/1

RG10713A -UN-04APR00

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Install Motorpal Fuel Supply Pump

1. Using a new O-ring, install fuel supply pump (E) in injection pump bore. Pump should be oriented as shown. Install brackets (C) over flange of supply pump and install cap screws (D). Tighten cap screws to specifications.

Specification

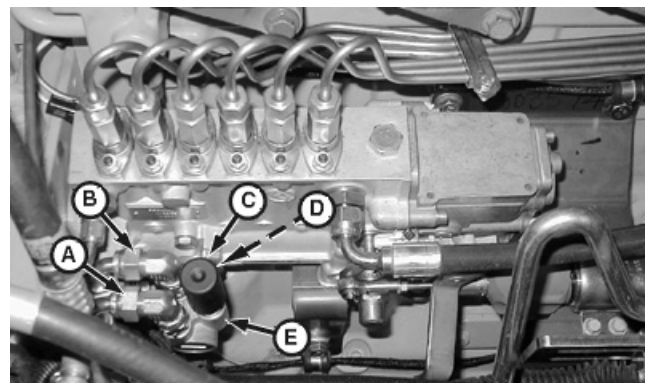
Motorpal Fuel Supply Pump
Mounting Cap Screws—Torque 8 N•m (6 lb-ft) (72 lb-in.)

2. Install fuel inlet and outlet lines (A and B) and tighten to specifications.

Specification

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

3. Bleed fuel system. (See BLEED THE FUEL SYSTEM in this group.)



Remove Fuel Supply Pump

- A—Fuel Inlet Line
- B—Fuel Outlet Line
- C—Bracket (2 used)
- D—Cap Screw (2 used)
- E—Fuel Supply Pump

DPSG,OUO1004,2602 -19-19AUG04-1/1

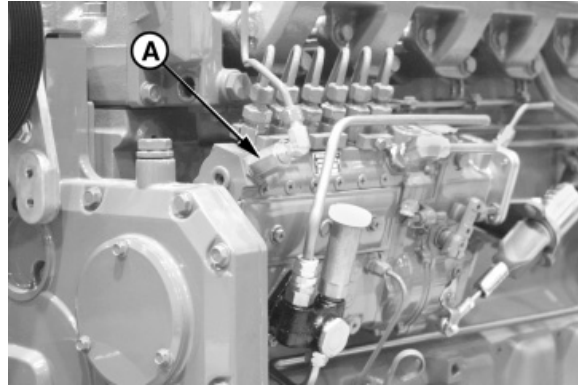
RG10720A -UN-19APR00

Service Denso Injection Pump Overflow Valve

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

1. Disconnect leak-off line and remove overflow valve (A).

A—Overflow Valve

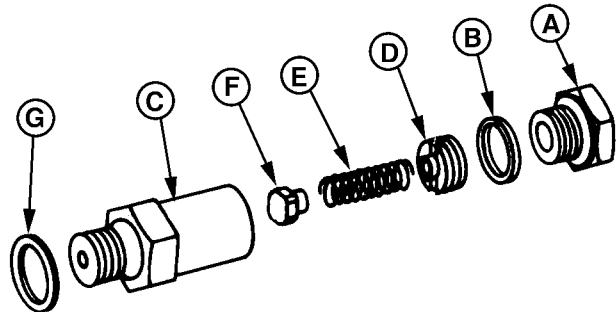


Injection Pump Overflow Valve

RG7749 -UN-07NOV97

RG,35,JW7612 -19-20NOV97-1/2

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



Inspect Injection Pump Overflow Valve

A—Reducer
 B—Copper 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 it is suspected that valve is malfunctioning, replace valve to restore proper operation.

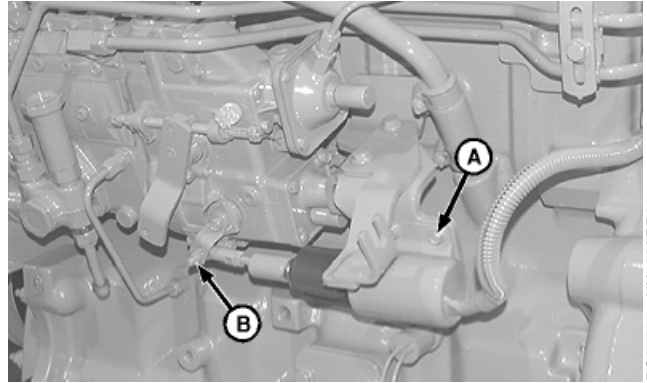
7. Reverse order of removal for reassembly of overflow valve. Install new copper washers.

RG,35,JW7612 -19-20NOV97-2/2

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Remove and Install Denso Fuel Shut-Off Solenoid

1. Disconnect electrical wiring connector on solenoid lead.
2. Remove actuator rod cap screw and nut (B).
3. Remove four cap screws (A) and fuel shut-off solenoid assembly from mounting bracket.
4. Fuel shut-off solenoid linkage should move freely back and forth.



Fuel Shut-Off Solenoid

- A—Cap Screw
- B—Cap Screw and Nut

NOTE: Electric fuel shut-off solenoids are factory adjusted to a specified length and should not require additional adjustment. See machine technical manual for fuel shut-off solenoid diagnostics.

5. To install fuel shut-off solenoid, reverse removal procedure. Tighten cap screw to specifications.

Specification

Fuel Shut-Off Solenoid Actuator
 Rod Cap Screw/Nut—Torque..... 15—20 N•m (11—15 lb-ft)

6. Connect electrical wiring connector.

DPSG,OUO1004,2504 -19-17DEC99-1/1

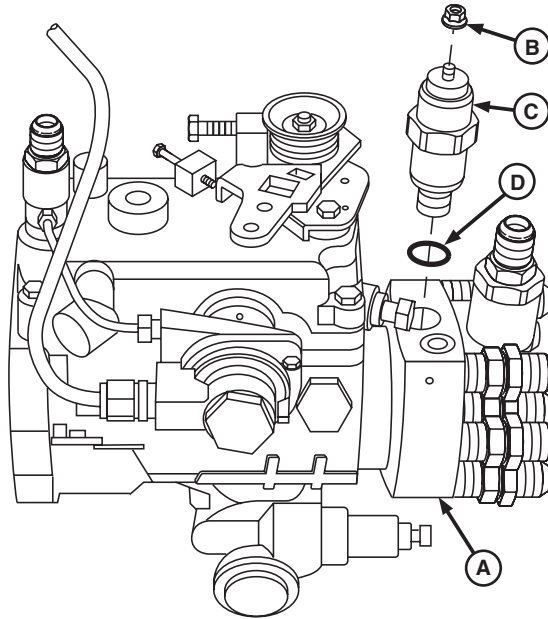
Remove and Install Delphi/Lucas Fuel Shut-Off Solenoid

1. Remove nut (B). Disconnect electrical wiring lead from solenoid terminal.
2. Remove shut-off solenoid (C) from injection pump body (A).
3. Inspect and replace parts as necessary. Solenoid linkage should move freely back and forth. Replace O-ring (D).
4. Install solenoid in injection pump body. Tighten to specification.

Remove and Install Delphi/Lucas Fuel Shut-Off Solenoid— Specification

Solenoid Tightening—Torque..... 24 N•m (18 lb-ft)

5. Connect electrical wiring lead to solenoid terminal. Tighten nut.



A—Injection Pump Body
B—Nut
C—Shut-Off Solenoid
D—O-Ring

RG12414 -UN-26JUL02

OUO1079,0000504 -19-09JUL02-1/1

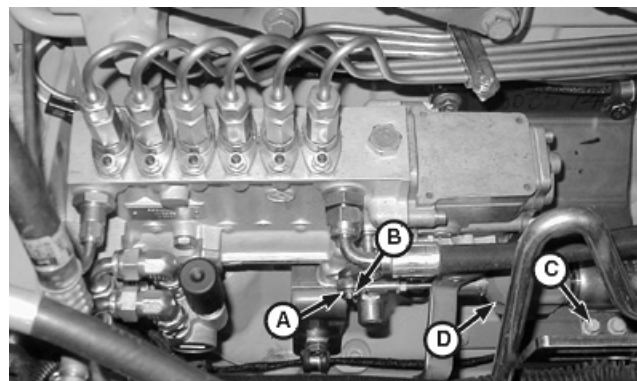
Remove and Install Motorpal Fuel Shut-Off Solenoid—If Equipped

1. Disconnect wiring connector from solenoid.
2. Remove cotter pin (B) and washer (A) and detach solenoid shaft from fuel shut-off lever.
3. Remove cap screws (C) and remove shut-off solenoid (D).
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.

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



Remove and Install Fuel Shut-Off Solenoid

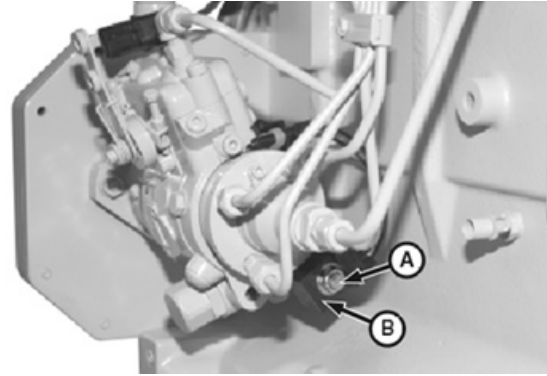
A—Washer
B—Cotter Pin
C—Cap Screws
D—Fuel Shut-Off Solenoid

RG10720B -UN-18APR00

DPSG,OUO1004,2603 -19-19AUG04-1/1

Remove and Install Stanadyne Cold Start Advance Solenoid and Valve

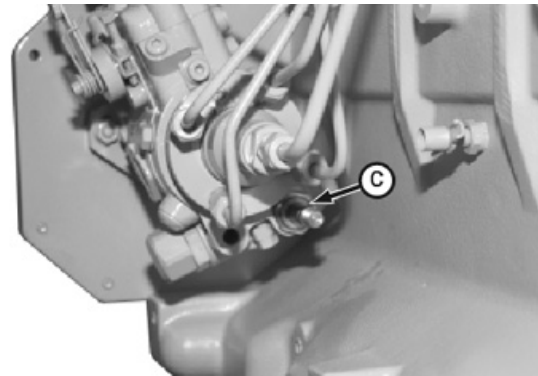
1. Clean outside of injection pump and dry with compressed air.
2. Disconnect cold start advance wiring connector (shown disconnected).
3. Remove nut (A) and solenoid (B).
4. Remove cold start advance valve (C).



RG10365 -JUN-04OCT99

Cold Start Advance Solenoid

- A—Nut
- B—Solenoid
- C—Cold Start Advance Valve



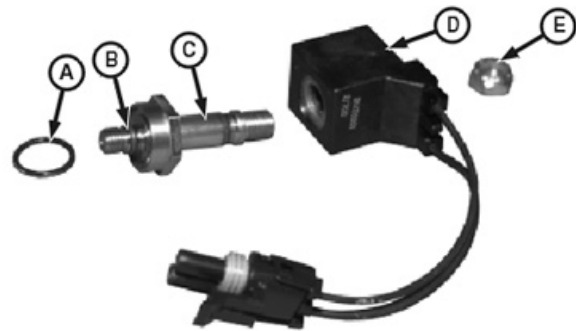
RG10366 -JUN-04OCT99

Cold Start Advance Valve

DPSG,OUO1004,1061 -19-29SEP99-1/4

5. Inspect all parts and replace as necessary.

- A—O-Ring
- B—O-Ring
- C—Valve
- D—Solenoid
- E—Nut



RG10367 -JUN-04OCT99

Cold Start Advance Components

Continued on next page

DPSG,OUO1004,1061 -19-29SEP99-2/4

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IMPORTANT: Install O-ring (A) carefully over threads of valve body to prevent damage to ID of seal.

- Lubricate O-rings (A) and (B) with clean diesel fuel and install on valve. Install valve into fuel pump body and tighten to specifications.

Specification

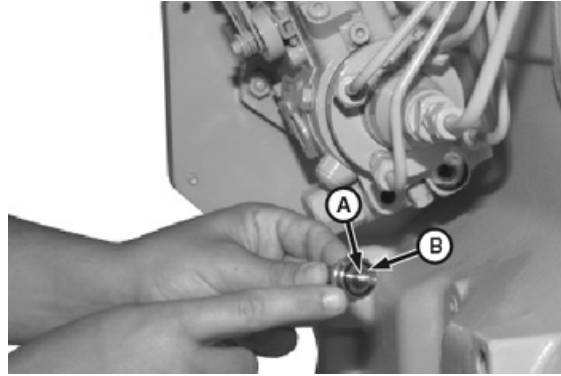
Cold Start Advance Valve—
Torque 11.5 N•m (8.5 lb-ft)

- Install solenoid (D) and nut (C). Tighten nut to specifications.

Specification

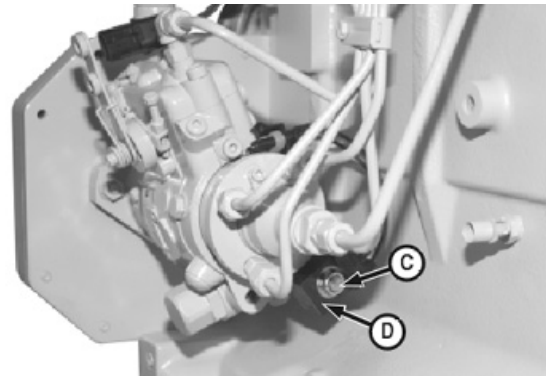
Cold Start Advance
Solenoid-to-Valve—Torque 5.5 N•m (48 lb-in.)

- A—O-Ring
- B—O-Ring
- C—Nut
- D—Solenoid



Cold Start Valve

RG10368 -JUN-04OCT99



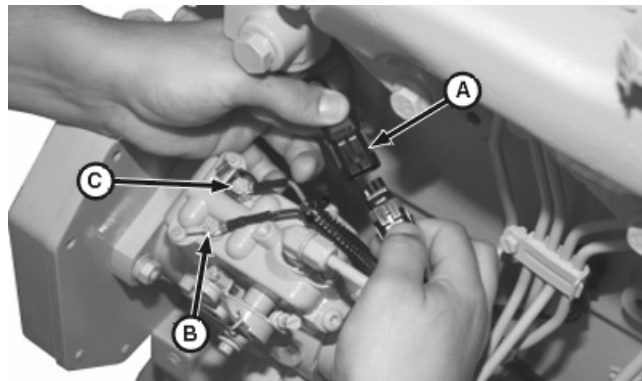
Cold Start Solenoid

RG10369 -JUN-04OCT99

DPSG,OUO1004,1061 -19-29SEP99-3/4

- Connect harness connector (A). If disconnected, connect terminal ends of cold start wiring harness to fuel shut-off solenoid terminals. Red lead should be connected to ungrounded terminal (C).

- A—Connector
- B—Grounded Terminal
- C—Ungrounded Terminal



Cold Start Wiring Connections

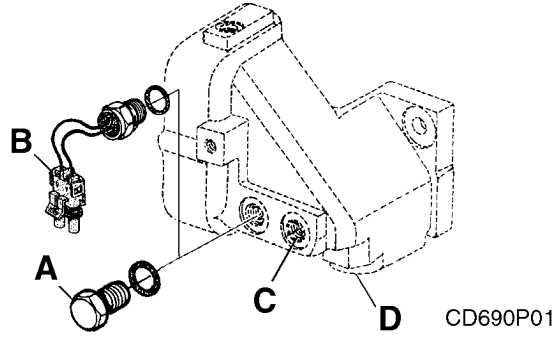
RG10374 -JUN-09OCT99

DPSG,OUO1004,1061 -19-29SEP99-4/4

Remove and Install Delphi/Lucas Cold Start Advance Switch and Harness

NOTE: Cold start advance kits are available for 6010 Series tractors that experience cold weather starting difficulties.

Cold start advance kit must be installed in injection pump by an authorized Delphi/Lucas Official Dealer, according to Delphi/Lucas bulletin DT282/2.

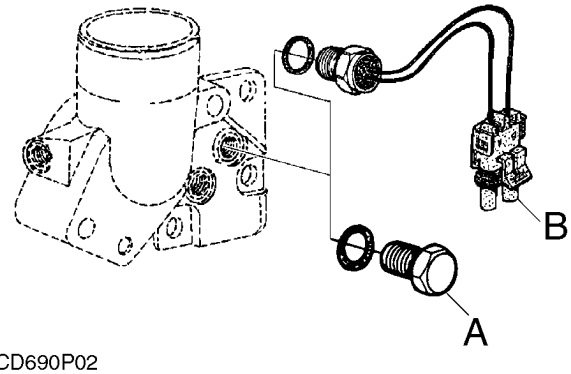


To install cold start advance temperature switch:

NOTE: For some engine applications, alternative port (C or D) may be used.

A small amount of engine coolant may escape when plug is removed.

1. Remove plug (A) from thermostat housing.
2. Install temperature switch (B) with O-ring. Tighten to specification.



CD690P02

Specification

Delphi/Lucas Cold Start Advance
Temperature Switch—Torque 5 N•m (44 lb-in.)

- A—Thermostat Housing Plug
- B—Cold Start Advance Temperature Switch
- C—Alternative Port
- D—Alternative Port

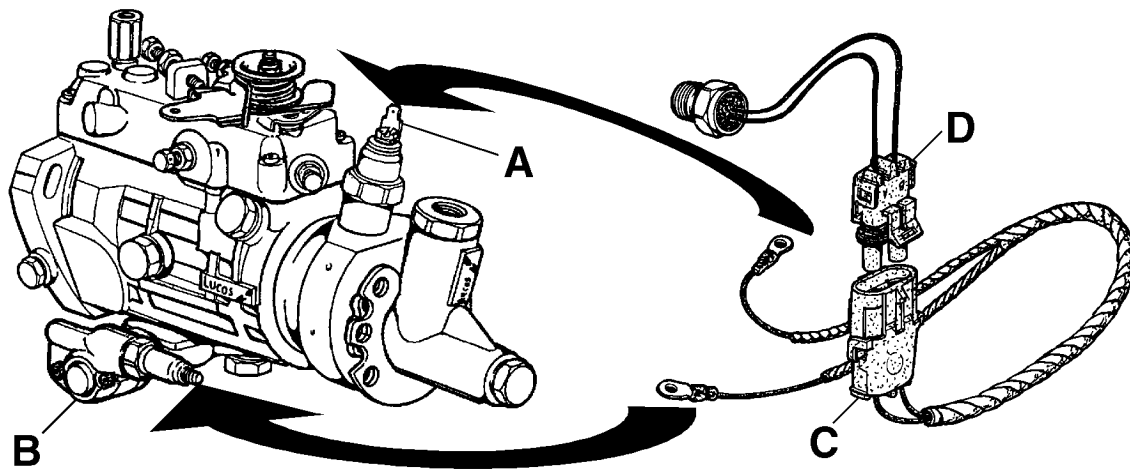
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CD690P03

CD690P03 -UN-10OCT00

A—Fuel Shut-Off Solenoid Terminal

B—Cold Start Advance Terminal

C—Wiring Harness Connector

D—Temperature Switch Connector

3. Connect RED wire of harness to fuel shut-off solenoid terminal (A).

5. Connect temperature switch connector (D) to harness connector (C).

4. Connect ORANGE wire of harness to cold start advance terminal (B).

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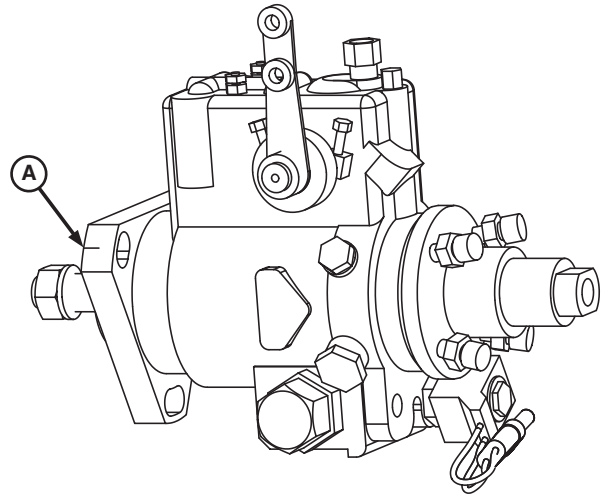
Stanadyne Rotary Fuel Injection Pump Identification

Two types of Stanadyne rotary injection pumps can be found on **POWERTECH**® 4.5 L and 6.8 L engines.

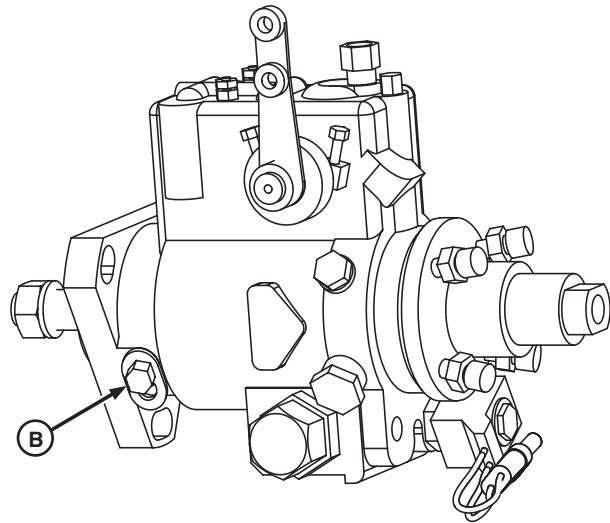
- Without Lock Shaft Timing
- With Lock Shaft Timing

The different pumps allow engines to comply with various exhaust emission regulations.

A—Timing Mark
B—Lock Screw



Injection Pump Without Lock Shaft Timing

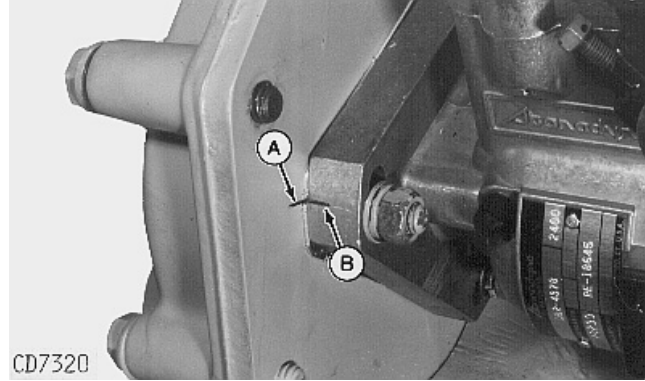


Injection Pump With Lock Shaft Timing

Delphi/Lucas and Stanadyne Rotary Fuel Injection Pump Timing

Static Timing With External Marks

1. Loosen attaching hex nuts of fuel injection pump and pivot pump housing away from cylinder block as far as slots will allow. Then pivot it back again, but only far enough to align timing mark on pump flange (B) exactly with timing mark on cylinder block front plate (A).
2. Tighten the three hex nuts securing pump to front plate to specifications.



Timing Fuel Injection Pump

A—Mark on Front Plate
B—Mark on Pump Flange

Specification

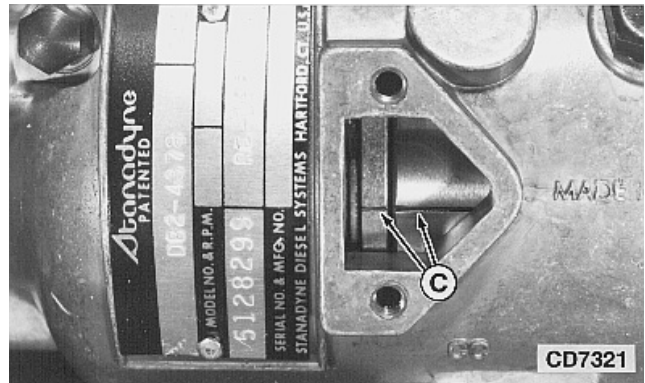
Delphi/Lucas and Stanadyne
Rotary Injection Pump Mounting
Nuts—Torque 27 N•m (20 lb-ft)

Also see CHECK AND ADJUST ROTARY INJECTION PUMP DYNAMIC TIMING USING TACH-N-TIME™ or CHECK AND ADJUST ROTARY INJECTION PUMP DYNAMIC TIMING USING TIME TRAC® in Section 04, Group 150.

OUO1082.0000041 -19-10OCT07-1/2

Static Timing With Internal Timing Marks (Stanadyne Pumps Without Lock Shaft Timing)

1. Make sure piston No. 1 is at TDC compression stroke and remove timing hole cover from injection pump.
2. With attaching hex nuts finger tight, pivot the pump housing away from the block as far as slots will allow. Then pivot it back until the timing marks (C) on cam ring and governor weight retainer are aligned. Tighten pump attaching nuts to specifications.



Fuel Injection Pump Timing

C—Timing Marks

Specification

Delphi/Lucas and Stanadyne
Rotary Injection Pump Mounting
Nuts—Torque 27 N•m (20 lb-ft)

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Denso and Motorpal In-Line Injection Pump Static Timing

NOTE: On some engines with in-line injection pumps, a timing pin may be screwed into the side of the pump. This pin may be used instead of JDG886 Timing Pin.

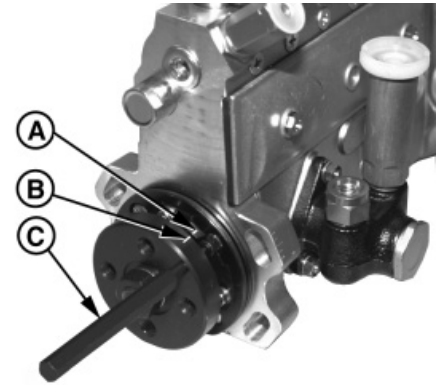
1. Static lock-pin timing is accomplished during installation of the injection pump with engine locked at No. 1 TDC.
2. **On Denso pumps:** Align pump timing mark on drive hub (B) with stationary timing pointer (A). Lock pumps in position with JDG886 Injection Pump Timing Pin (C).

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

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

To check alignment of injection pump and eliminate backlash of timing gear train, remove both timing pins and rotate the flywheel opposite the direction of normal rotation. Install JDE81-4 or JDG1571 Timing Pin and rotate flywheel in the direction of normal rotation until timing pin engages in timing pin hole.

If JDG886 Timing Pin will not install through drive hub and bottom out, loosen drive gear cap screws and rotate hub until timing pin can be installed and locked in place.



Time Denso Injection Pump

A—Timing Pointer
B—Mark on Drive Hub
C—Timing Pin

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3. On Motorpal pumps:

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

Install injection pump timing pin (C) into bore and make sure it is fully engaged in pump timing slot. Install spring (B) on the outboard side of pin.

Reinstall cap (A) and tighten finger tight.

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

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

4. Tighten pump drive gear cap screws to specifications.

Specification

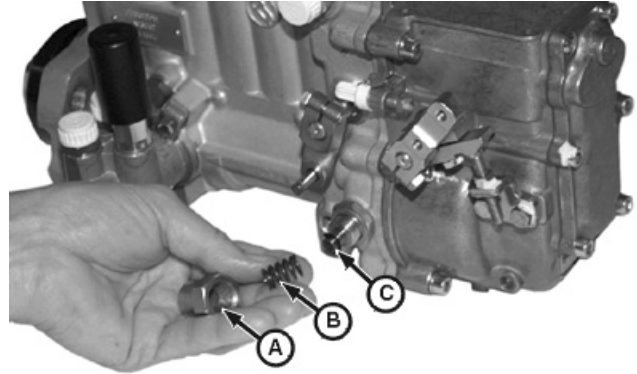
Denso Injection Pump Drive Gear	
Cap Screws—Torque	47 N•m (35 lb-ft)
Motorpal Injection Pump Drive	
Gear Cap Screws—Torque	61 N•m (45 lb-ft)

5. Remove cap (A), spring (B), and timing pin (C).

6. Install spring (B) into pin bore.

7. Install timing pin (C) onto spring.

8. Reinstall cap (A).



Time Motorpal Injection Pump

- A—Cap
- B—Spring
- C—Timing Pin

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Remove Stanadyne Model DB2 and DB4 Injection Pump

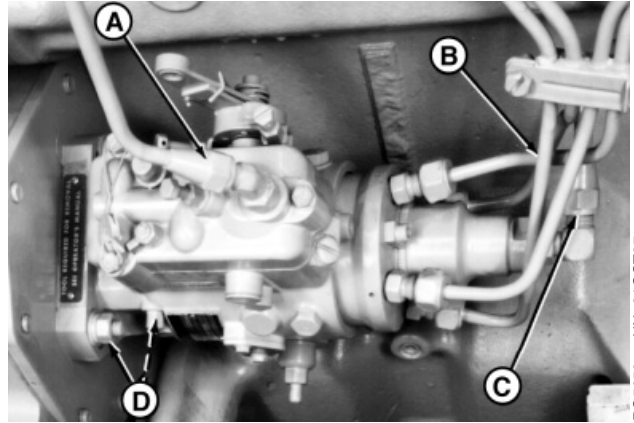
All Stanadyne DB2 and DB4 injection pumps will have a retained drive shaft (shaft stays in the pump when pump is removed from engine).

IMPORTANT: Never steam clean or pour cold water on a fuel injection pump while the pump is running or while it is warm. Doing so may cause seizure of internal rotating pump parts.

1. Clean the fuel injection pump, lines and area around the pump with cleaning solvent or a steam cleaner.
2. Disconnect shut-off cable and speed control linkage, if equipped. Disconnect electrical connection to shut-off solenoid or throttle positioning solenoid, if equipped. Disconnect cold start switch, if equipped. Tag electrical wires for correct reassembly.

IMPORTANT: ALWAYS use a backup wrench when loosening or tightening fuel lines at injection pump so that discharge fittings are not altered to prevent possible internal pump damage.

3. Disconnect fuel return line (A) and fuel supply line (C).
4. Disconnect all fuel delivery (pressure) lines (B) from injection pump using a suitable 17 mm deep-well crowsfoot socket.



DB2 and DB4 Injection Pump Lines

- A—Fuel Return Line
- B—Fuel Delivery (Pressure) Lines
- C—Fuel Supply Line
- D—Mounting Stud Nuts

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NOTE: The injection pump drive gear fits snugly onto a tapered drive shaft and is indexed by a hollow pin or Woodruff key installed in drive shaft.

5. Remove injection pump drive gear cover (shown removed). Remove drive gear retaining nut and washer from end of pump shaft. Be careful not to let washer fall inside timing gear cover.

6. Attach JDG1560 Drive Gear Puller (A) to injection pump drive gear as shown.

NOTE: Replace 6 mm, Grade 12.9 cap screws (C) as needed.

7. Evenly tighten the two 6 mm, Grade 12.9 screws (threaded in drive gear) and snugly tighten center forcing screw (B) against end of pump shaft.

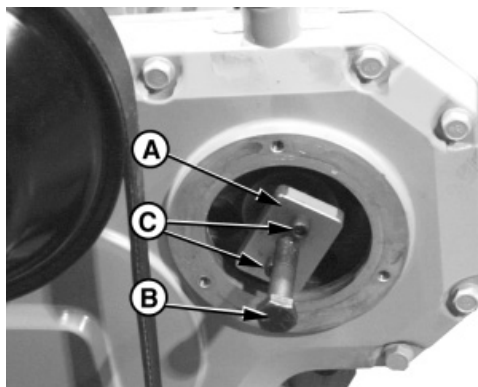
8. Tighten center forcing screw until pump drive gear is free from tapered shaft. Remove JDG1560 Puller from drive gear.

A—Drive Gear Puller
B—Forcing Screw
C—Cap Screws



Injection Pump Drive—Cover Removed

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Pump Drive Gear Puller in Place

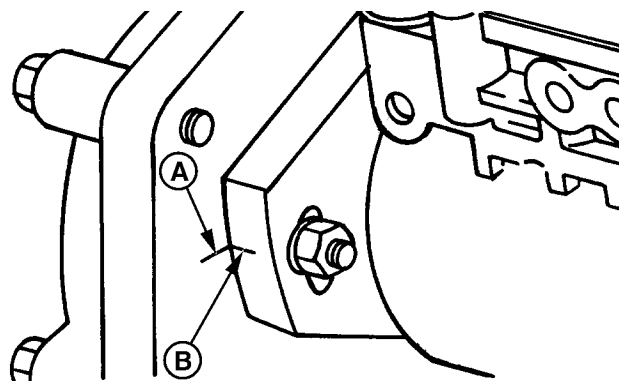
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RG.35,JW7609 -19-09SEP02-2/3

9. Check to make sure that timing marks on back side of front plate (A) and injection pump flange (B) are present and properly aligned. This ensures that repaired pump or replacement pump can be properly timed to engine when installed.

If timing mark is not clearly visible on front plate, scribe a visible reference mark as accurately as possible in-line with mark on pump flange.

10. Remove three injection pump mounting stud nuts. Remove injection pump from mounting studs. Place pump on a clean flat surface and inspect shaft OD and drive gear as outlined later in this group. (See INSPECT STANADYNE INJECTION PUMP DRIVE GEAR ID AND SHAFT OD later in this group).



Injection Pump Timing Marks

A—Timing Mark on Front Plate
B—Timing Mark on Pump Flange

RG6293 -UN-03NOV97

RG.35,JW7609 -19-09SEP02-3/3

Inspect Stanadyne Injection Pump Drive Gear ID and Shaft OD

IMPORTANT: Use a good light source to thoroughly inspect gear ID and shaft OD.

1. Inspect entire ID of injection pump drive gear for metal transfer as a result of slippage on shaft.
2. Inspect entire OD of drive shaft for presence of metal transfer from gear slippage. Also, check to see if index pin in shaft is damaged which would indicate gear slippage. If there is clear evidence of metal transfer on pump shaft OD or in drive gear ID, or if index pin in pump shaft is damaged, injection pump and drive gear **MUST BE** replaced.

IMPORTANT: When replacing injection pump drive gear or installing a new pump, the tapered surfaces of the pump drive shaft OD and drive gear ID **MUST BE** cleaned to remove protective coatings and oily residue. Use a suitable cleaner that does not leave a residue. Mating surfaces **MUST BE ASSEMBLED DRY** and **LUBRICANTS MUST NOT BE USED**.

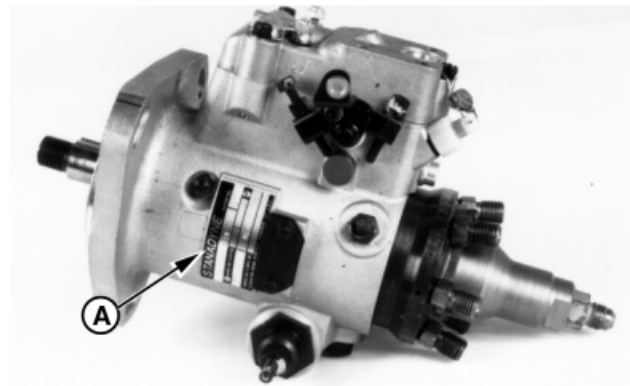
RG,35,JW7608 -19-19AUG04-1/1

Repair Stanadyne Fuel Injection Pump

IMPORTANT: Do not disassemble the fuel injection pump further than necessary for installing available repair parts—not even for cleaning.

Be sure that injection pump serial number tag (A) is in place and that all identification numbers are legible so that pump is set to the correct specification for its intended application.

For injection pump repair and testing, have an authorized ADS diesel injection repair station perform the work. Unauthorized repairs made to fuel injection pumps will void warranty.



Stanadyne Fuel Injection Pump

A—Serial Number Tag

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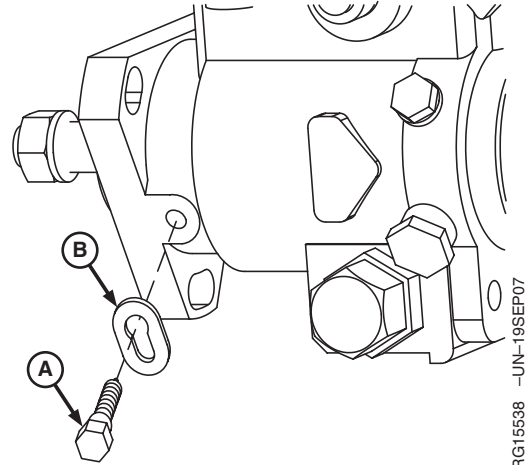
Install Stanadyne Model DB2 and DB4 Injection Pump

1. On Stanadyne injection pumps with lock shaft timing: Loosen injection pump drive shaft lock screw (A) and position special washer (B) to unlocked position (small diameter end behind the lock screw head). Tighten lock screw to specification.

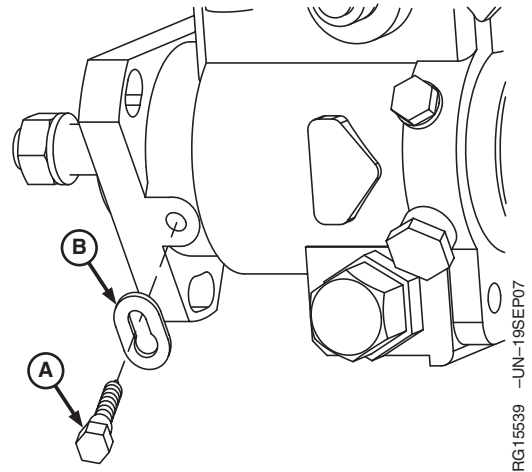
Specification

Lock Shaft Timing Lock Screw—
Unlocked Position—Torque..... 8 N•m (71 lb-in.)

- A—Lock Screw
- B—Special Washer



Lock Screw in Locked Position

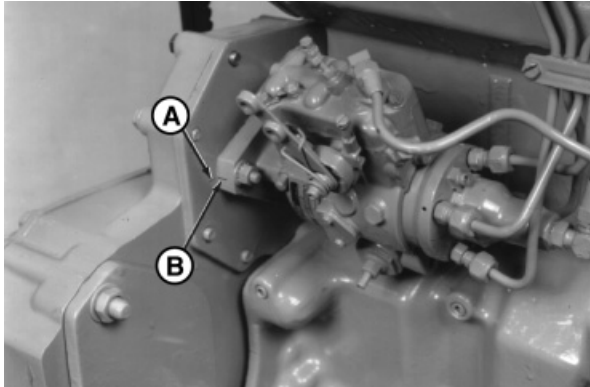


Lock Screw in Unlocked Position

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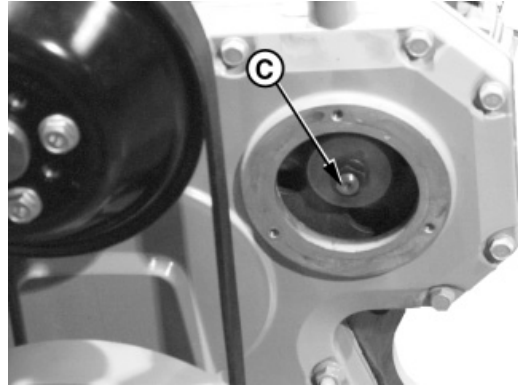
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Injection Pump Timing Marks

A—Front Plate Timing Mark B—Pump Timing Mark



Pump Drive Gear Retaining Nut

C—Pump Drive Gear Retaining Nut

IMPORTANT: Injection pump mounting flange timing mark (B) and front plate timing mark (A) presence and alignment **MUST BE** verified before removing pumps from engine. When pump is reinstalled on engine, time pump by aligning these two (external) marks. **DO NOT** reference internal timing marks (on pump cam ring and governor weight retainer) for accurate pump timing.

IMPORTANT: **DO NOT** tighten hex nuts more than three full turns on mounting studs. Pump drive shaft index pin may be damaged if pin is not properly aligned with drive gear key slot and nuts are tightened more than three turns.

2. Lubricate a new square sealing ring with clean engine oil. Install ring into groove on front face of pump mounting flange. Slide injection pump onto mounting studs while inserting pump shaft into drive gear.

5. Install three flat washers, lock washers, and hex nuts onto pump mounting studs. Tighten nuts three turns only so that pump will not fall off mounting studs.

NOTE: The pump drive gear should begin to move forward (away from engine front plate) with the pump when flange is approximately 3.2 mm (1/8 in.) away from engine front plate.

IMPORTANT: Shaft roll pin may be easily damaged if improperly assembled. Pump drive gear should not move when initially installing pump index pin into drive gear key slot.

6. Install pump mounting flange flush to engine front plate with drive gear held flush against front side of engine front plate.

3. Check pump shaft and index pin for proper alignment with pump drive gear key slot.

IMPORTANT: **DO NOT** use tightening force of pump mounting stud nuts to pull pump shaft into drive gear ID.

4. Install injection pump partially onto mounting studs without engaging pump pilot hub into engine front plate.

7. With the pump shaft index pin properly engaged in the drive gear key slot, finger tighten mounting stud nuts.

8. Push pump drive gear firmly onto shaft taper. Install washer and retaining nut (C) onto end of shaft. Tighten retaining nut to the following torque specification:

Specification

Stanadyne DB2 Fuel Injection Pump Drive Gear-to-Shaft	
Retaining Nut—Torque	125 N•m (92 lb-ft)
Stanadyne DB4 Fuel Injection Pump Drive Gear-to-Shaft	
Retaining Nut—Torque	200 N•m (148 lb-ft)

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IMPORTANT: To avoid damage to O-ring, Do NOT overtighten cap screws on pump cover plate.

- Install access cover plate using a new O-ring, if needed. Apply LOCTITE® 242 (T43512) to cap screw threads and tighten to specifications.

Specification

Rotary Injection Pump Front
Access Plate Cap Screws—
Torque 6 N•m (4.5 lb-ft) (54 lb-in.)

- Align timing mark on pump flange with timing mark on front plate.
- Tighten three hex nuts securing the pump to the front plate to specifications.

Specification

Rotary Injection Pump Mounting
Nuts—Torque 27 N•m (20 lb-ft)

- Connect injection pump pressure lines (E). Beginning with outlet (B) and continuing around the pump head in counterclockwise direction, attach lines in same order as engine firing (1-5-3-6-2-4 on 6-cylinder engines and 1-3-4-2 on 4-cylinder engines).

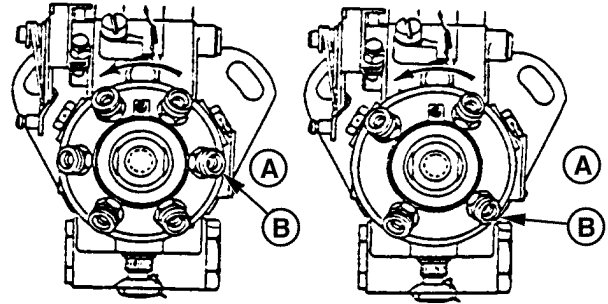
- Tighten fuel delivery (pressure) lines at pump to specifications, using a suitable 17 mm deep-well socket.

Specification

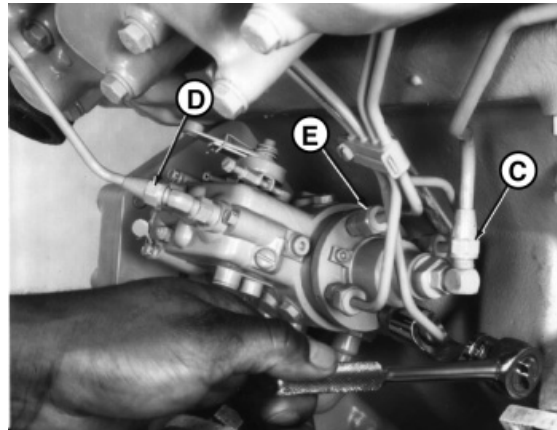
Fuel Injection Pump Delivery
Lines (At Pump)—Torque 27 N•m (20 lb-ft)

IMPORTANT: ALWAYS use a backup wrench when loosening or tightening fuel delivery lines at fuel injection pump, so that the pump discharge fittings are not altered. This prevents possible internal pump damage.

- Connect fuel supply line (C) and fuel return line (D).



6-Cylinder Engine (Left)
4-Cylinder Engine (Right)



Fuel Supply, Return and Pressure Lines

- A—Engine Block Side
- B—Outlet Connection to No. 1 Cylinder
- C—Fuel Supply Line
- D—Fuel Return Line
- E—Fuel Delivery (Pressure) Lines (4 or 6 used)

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15. Connect fuel shut-off cable and speed control linkage, if equipped. Install and securely tighten electrical connections to shut-off solenoid and throttle positioning solenoid, if equipped. Connect cold start switch, if equipped.
16. Bleed air from fuel system as outlined in this group. (See BLEED THE FUEL SYSTEM in this group.) Start engine, run for several minutes and check entire fuel system for leaks.

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Remove Delphi/Lucas Fuel Injection Pump

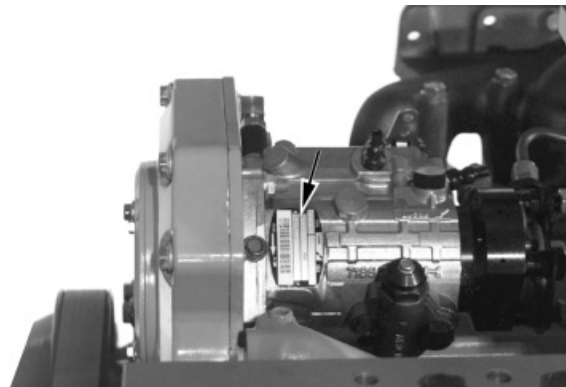
NOTE: The injection pump serial number tag (bold arrow) is located on the bottom of the pump.

IMPORTANT: Never steam clean or pour cold water on a fuel injection pump while the pump is running or while it is warm. Doing so may cause seizure of internal rotating pump parts.

1. Clean the fuel injection pump, lines and area around the pump with cleaning solvent or a steam cleaner.
2. Disconnect shut-off cable and speed control linkage, if equipped. Disconnect electrical connection to shut-off solenoid or throttle positioning solenoid, if equipped. Disconnect cold start switch, if equipped. Tag electrical wires for correct reassembly.

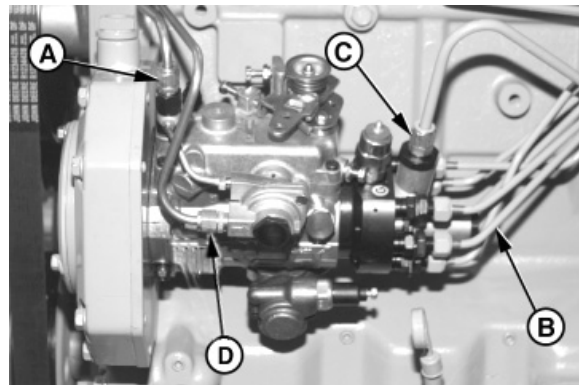
IMPORTANT: ALWAYS use a backup wrench when loosening or tightening fuel lines at injection pump so that discharge fittings are not altered to prevent possible internal pump damage.

3. Disconnect fuel return line (A), fuel supply line (C) and aneroid line (D).
4. Disconnect all fuel delivery (pressure) lines (B) from injection pump using a suitable 17 mm deep-well crowsfoot socket.



Delphi/Lucas Fuel Injection Pump

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Fuel Supply, Return and Pressure Lines

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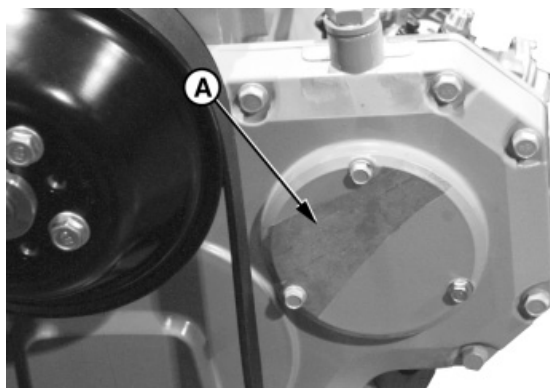
- A—Fuel Return Line
- B—Fuel Delivery (Pressure) Lines
- C—Fuel Supply Line
- D—Aneroid Line

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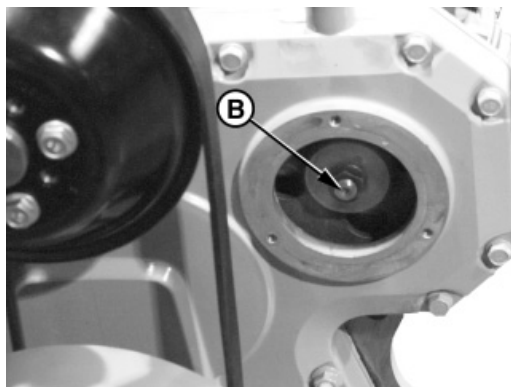
- Remove injection pump drive gear cover (A). Remove drive gear retaining nut (B) and washer from end of pump shaft. Be careful not to let washer fall inside timing gear cover.

A—Drive Gear Cover
B—Drive Gear Retaining Nut



Injection Pump Drive Cover

RG7629A -UN-06NOV97



Pump Drive Gear Retaining Nut

RG7630B -UN-06NOV97

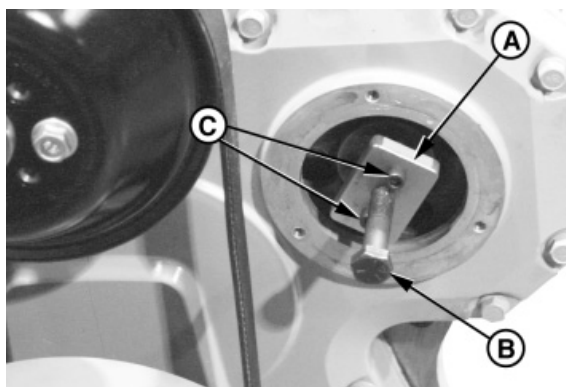
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NOTE: The injection pump drive gear fits snugly onto a tapered drive shaft and is indexed by a Woodruff key installed in drive shaft. Use JDG1560 Drive Gear Puller (A) to remove drive gear from shaft.

- Attach JDG1560 Injection Pump Drive Gear Puller to injection pump drive gear as shown. Follow instructions provided with tool set.

NOTE: Replace 6 mm, Grade 12.9 cap screws (C) as needed.

- Evenly tighten the two 6 mm, Grade 12.9 screws (threaded in drive gear) and snugly tighten center forcing screw (B) against end of pump shaft.
- Tighten center forcing screw until pump drive gear is free from tapered shaft. Remove JDG1560 Injection Pump Drive Gear Puller from drive gear.



Pump Drive Gear Puller in Place

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A—Drive Gear Puller
B—Forcing Screw
C—Cap Screws

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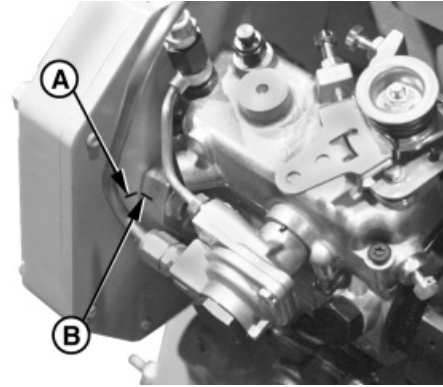
RG.35.JW7605 -19-08JUL02-3/4

9. Check to make sure that timing marks on back side of front plate (A) and injection pump flange (B) are present and properly aligned. This ensures that repaired or replacement pump can be properly timed to engine when installed.

If timing mark is not clearly visible on front plate, scribe a visible reference mark as accurately as possible in-line with mark on pump flange.

10. Remove injection pump mounting stud nuts. Remove injection pump from mounting studs.

A—Timing Mark on Front Plate
B—Timing Mark on Injection Pump Flange



Injection Pump Timing Marks

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RG,35,JW7605 -19-08JUL02-4/4

Repair Delphi/Lucas Fuel Injection Pump

IMPORTANT: DO NOT disassemble the Delphi/Lucas fuel injection pump any further than necessary for installing available repair parts, not even for cleaning.

Have an authorized ADS Diesel Repair Station perform all injection pump testing, adjustments, and repairs.

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Install Delphi/Lucas Fuel Injection Pump

IMPORTANT: When replacing injection pump drive gear or installing a new pump, the tapered surfaces of the pump drive shaft OD and drive gear ID MUST BE cleaned to remove protective coatings and oily residue. Use a suitable cleaner that does not leave a residue. Mating surfaces MUST BE assembled dry. LUBRICANTS MUST NOT BE USED.

1. Place a new O-ring onto front face of pump mounting flange with mounting slots aligned. Slide injection pump onto mounting studs while inserting pump shaft into drive gear.
2. Check pump shaft Woodruff key for proper alignment with pump drive gear key slot.
3. Install injection pump partially onto mounting studs with engaging pump pilot hub into engine front plate.
4. Install three flat washers, lock washers, and hex nuts onto pump mounting studs. Tighten nuts three turns only so that pump will not fall off mounting studs.
5. Install pump mounting flange flush to engine front plate with drive gear held flush against front side of engine front plate.
6. With the pump shaft key properly engaged in the drive gear key slot, finger tighten mounting stud nuts.

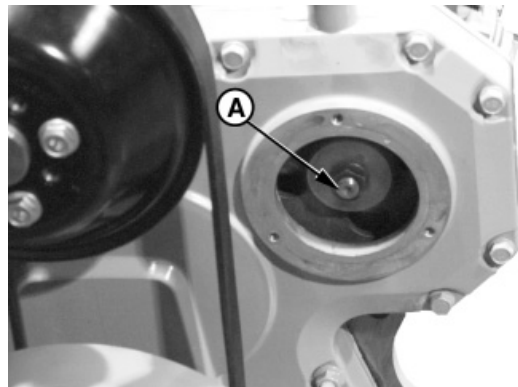
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7. Push pump drive gear firmly onto shaft taper. Install washer and retaining nut (A) onto end of shaft. Tighten retaining nut to following specifications:

Specification

DP201 and DP203 Delphi/Lucas
 Fuel Injection Pump Drive
 Gear-to-Shaft Retaining Nut—
 Torque 80 N•m (60 lb-ft)

A—Drive Gear Retaining Nut



Pump Drive Gear Retaining Nut

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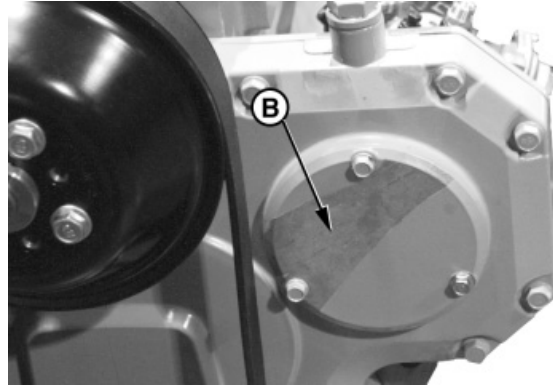
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IMPORTANT: DO NOT overtighten cap screws on pump cover plate to avoid damage to O-ring.

- 8. Install access plate (B) using a new O-ring, if needed. Apply LOCTITE® 242 (T43512) to cap screw threads and tighten to specifications.

Specification

Rotary Injection Pump Front
Access Plate Cap Screws—
Torque 6 N•m (4.5 lb-ft) (54 lb-in.)



RG7629B -UN-06NOV97

Injection Pump Drive Gear Access Plate

B—Injection Pump Drive Gear Access Plate

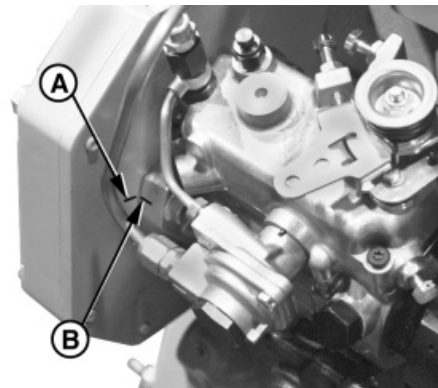
LOCTITE is a registered trademark of Loctite Corp.

RG,35,JW7603 -19-08JUL02-3/5

- 9. Align timing mark on the pump flange (B) with timing mark on front plate (A).
- 10. Tighten hex nuts securing the pump to the front plate to specifications.

Specification

Rotary Injection Pump Mounting
Nuts—Torque 27 N•m (20 lb-ft)



RG7723A -UN-07NOV97

Injection Pump Timing Marks

A—Timing Mark on Front Plate
B—Timing Mark on Injection Pump Flange

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RG,35,JW7603 -19-08JUL02-4/5

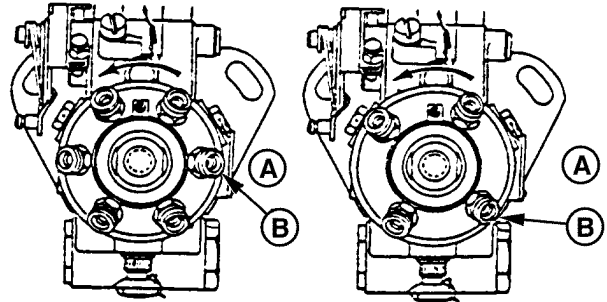
11. Connect injection pump pressure lines (E). Beginning with outlet (B) and continuing around the pump head in counterclockwise direction, attach lines in same order as engine firing (1-5-3-6-2-4 on 6-cylinder engines and 1-3-4-2 on 4-cylinder engines).
12. Tighten fuel delivery (pressure) lines at pump to specifications, using a suitable 17 mm deep-well socket.

Specification

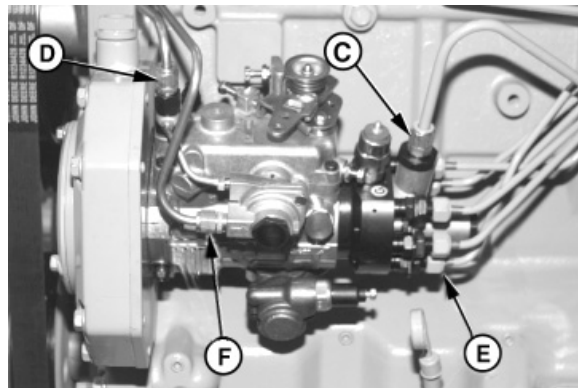
Fuel Injection Pump Delivery Lines—Torque 27 N•m (20 lb-ft)

IMPORTANT: ALWAYS use a backup wrench when loosening or tightening fuel delivery lines at fuel injection pump, so that the pump discharge fittings are not altered. This prevents possible internal pump damage.

13. Connect fuel supply line (C), fuel return line (D) and aneroid line (F).
14. Connect fuel shut-off cable and speed control linkage, if equipped. Install and securely tighten electrical connections to shut-off solenoid and throttle positioning solenoid, if equipped. Connect cold start switch, if equipped.
15. Bleed air from fuel system as outlined in this group. (See BLEED THE FUEL SYSTEM in this group.) Start engine, run for several minutes and check entire fuel system for leaks.



6-Cylinder Engine (Left)
4-Cylinder Engine (Right)



Fuel Supply, Return and Pressure Lines

- A—Engine Block Side
- B—Outlet Connection to No. 1 Cylinder
- C—Fuel Supply Line
- D—Fuel Return Line
- E—Fuel Delivery (Pressure) Lines
- F—Aneroid Line

RG9089 -UN-19MAR98

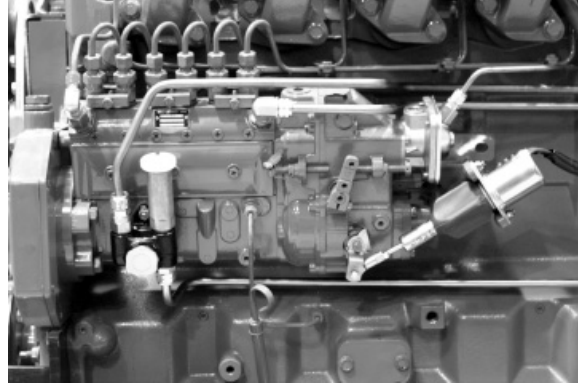
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RG9070 -UN-16MAR98

Remove Denso Fuel Injection Pump

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. Using JDG820, JDE81-1, or JDE83 Flywheel Turning Tool as required, rotate engine flywheel (in normal running direction) until No. 1 piston is at TDC of its compression stroke. At this point, JDE81-4 or JDG1571 Timing Pin should enter hole in flywheel.



In-Line Injection Pump

RG7748 -UN-06DEC96

Continued on next page

RG,35,JW7602 -19-19AUG04-1/3

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

NOTE: On some engines with in-line injection pumps, a timing pin may be screwed into the side of the pump. This pin may be used instead of JDG886 Timing Pin.

4. Install JDG886 Injection Pump Timing Pin (A) through injection pump drive gear into injection pump hub until it bottoms. In some instances, it may be necessary to rotate the pump drive hub slightly to get the pin installed.

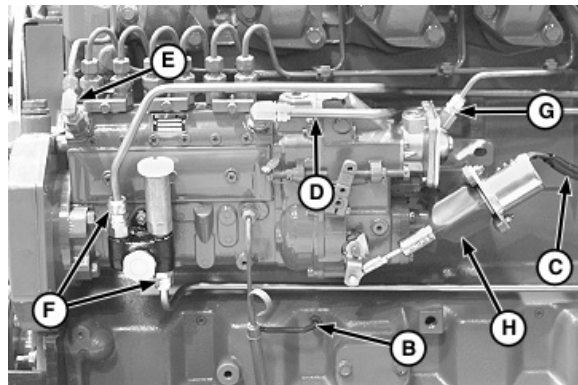


Injection Pump Timing Pin

RG8086A -UN-18NOV97

IMPORTANT: Once JDG886 Timing Pin is installed, DO NOT turn engine or pump may be damaged.

5. Disconnect injection pump lube line (B).
6. Disconnect fuel shut-off solenoid electrical connector (C).
7. Remove fuel inlet line (D). Remove fuel leak-off line (E).
8. Disconnect fuel supply pump lines (F).
9. Disconnect aneroid line (G).



Fuel Lines and Shut-Off Solenoid

RG7750A -UN-18JUL02

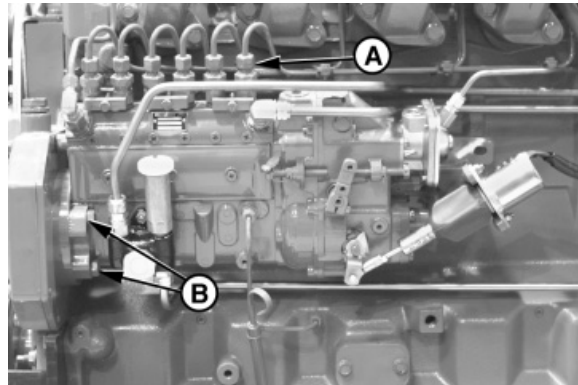
- A—JDG886 Injection Pump Timing Pin
- B—Injection Pump Lube Line
- C—Fuel Shut-Off Solenoid Electrical Connector
- D—Fuel Inlet Line
- E—Fuel Leak-Off Line
- F—Fuel Supply Pump Lines
- G—Aneroid Line
- H—Fuel Shut-Off Solenoid

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RG,35,JW7602 -19-19AUG04-2/3

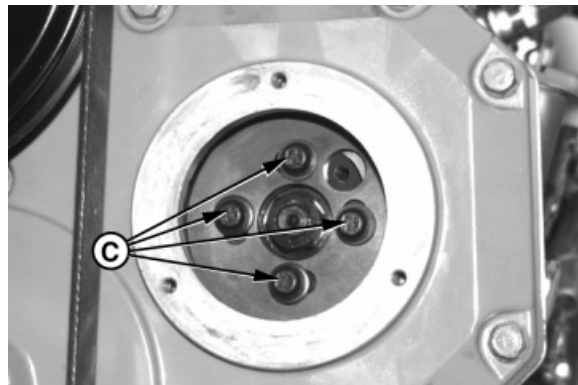
10. Remove fuel injection line nuts (A).
11. Remove four injection pump drive gear cap screws (C).
12. Remove four mounting stud nuts (B) which secure injection pump to cylinder block.
13. Carefully remove injection pump from mounting studs and place it on a clean flat surface.

A—Injection Line Nuts
 B—Mounting Nuts
 C—Cap Screws



Pump Fuel Delivery Lines and Stud Nuts

RG7750B -UN-07NOV97



Pump Drive Gear Cap Screws

RG8066B -UN-18NOV97

RG,35,JW7602 -19-19AUG04-3/3

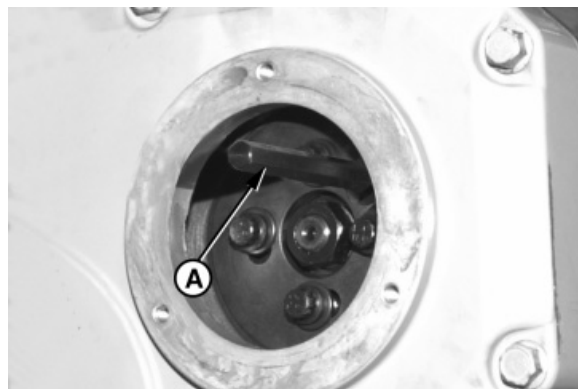
Repair Denso Fuel Injection Pump

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

Be sure that injection pump serial number tag is in place and that all identification numbers are legible so that pump is set to the correct specifications for its intended use.

NOTE: Remove JDG886 Injection Pump Timing Pin (A) when sending an injection pump out for repair.

For injection pump repair and testing, have an authorized diesel injection pump repair station perform the work. Unauthorized repairs made to the injection pump will void warranty.



Injection Pump Timing Pin

RG8065A -UN-18NOV97

A—Timing Pin

RG,35,JW7601 -19-20NOV97-1/1

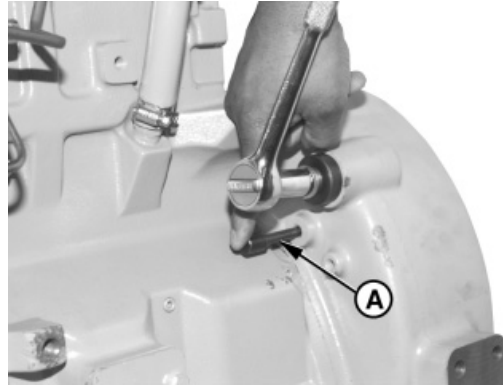
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Install Denso Fuel Injection Pump

NOTE: To eliminate any backlash that might exist in the timing gear train, rotate flywheel in the direction of normal engine rotation (counterclockwise viewed from flywheel end) when installing JDE81-4 or JDG1571 Timing Pin.

1. If engine was rotated after injection pump was removed, rotate flywheel in the direction of normal engine rotation until JDE81-4 or JDG1571 Timing Pin (A) 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.



Engine Timing Pin

A—Timing Pin

RG7711A -UN-07NOV97

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Continued on next page

RG,35,JW7600 -19-19AUG04-1/6

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

NOTE: On some engines with in-line injection pumps, a timing pin may be screwed into the side of the pump. This pin may be used instead of JDG886 Timing Pin.

NOTE: It may be necessary to rotate pump hub slightly to allow JDG886 Injection Pump Timing Pin (E) to enter bearing plate.

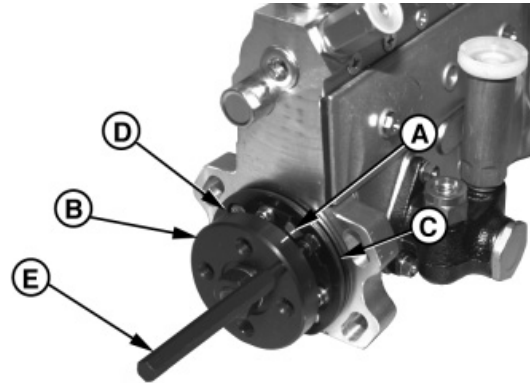
- Thread JDG886 Timing Pin into drive hub as shown, and tighten until it bottoms against the drive hub with the timing pin located in hole of pointer (A).
- Install a new O-ring (C) on bearing plate. Lightly lubricate O-ring with AR54749 Soap Lubricant to aid in pump installation and prevent O-ring damage.
- 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.
- Install mounting stud nuts and tighten to specifications.

Specification

Denso Injection Pump Mounting
Nuts—Torque 70 N•m (52 lb-ft)

NOTE: The injection pump needs to be properly timed during installation of pump to ensure that gear backlash is removed. See DENSO AND MOTORPAL IN-LINE INJECTION PUMP STATIC TIMING in this group for proper injection pump timing and elimination of backlash with camshaft gear.

- 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.



Hub to Pointer Timing Marks



Injection Pump Timing Pin

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

RG8053B -UN-18NOV97

RG8065B -UN-18NOV97

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- Install drive gear-to-pump hub cap screws (B) and tighten to specifications.

Specification

Denso Injection Pump Drive Gear
 Cap Screws—Torque 47 N•m (35 lb-ft)

- Remove JDG886 Injection Pump Timing Pin (A) from injection pump hub.

- Install injection pump drive gear cover using a new O-ring, if needed. Tighten cap screws to specifications.

Specification

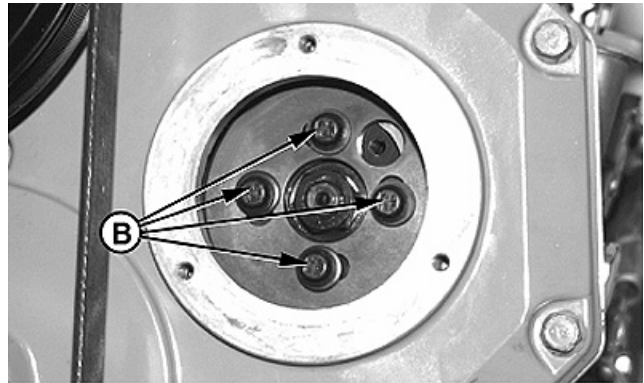
Denso Injection Pump Drive Gear
 Cover—Torque 6 N•m (4.5 lb-ft) (54 lb-in.)

A—Timing Pin
 B—Cap Screws



Injection Pump Timing Pin

RG8086A -UN-18NOV97



Pump Drive Gear Cap Screws

RG9138 -UN-18MAY98

RG,35,JW7600 -19-19AUG04-3/6

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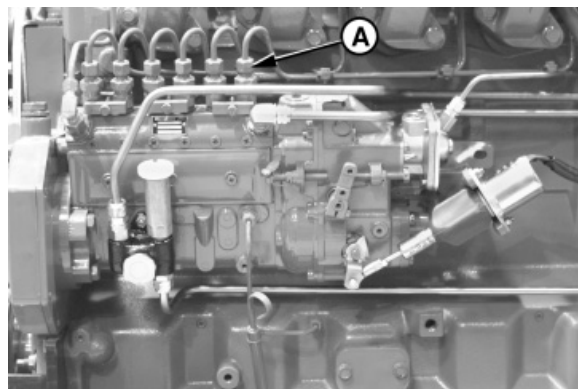
IMPORTANT: DO NOT move delivery valve fittings while tightening line nuts. If delivery valve and barrel housing rotates while tightening a fuel line nut, injection pump fuel delivery will be altered. The injection pump will have to be recalibrated on a test stand by an authorized diesel repair station.

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

- Connect fuel delivery lines (A). Tighten line nuts to specifications.

Specification

Fuel Injection Pump Delivery
 Lines—Torque 27 N•m (20 lb-ft)



Pump Fuel Delivery Lines

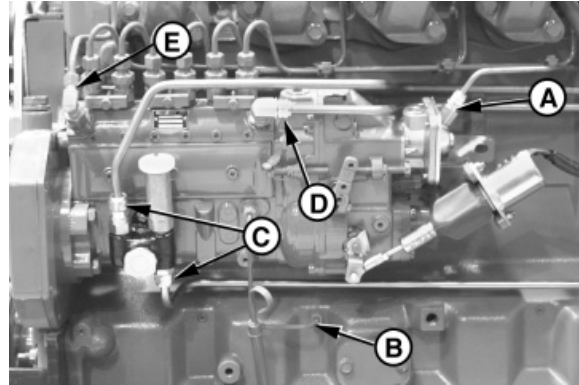
RG7750C -UN-07NOV97

A—Fuel Delivery Lines

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RG,35,JW7600 -19-19AUG04-4/6

12. Connect aneroid line (A).
13. Connect fuel supply pump lines (C).
14. Connect fuel inlet line (D) and leak-off line (E).
15. Connect injection pump oil line (B) to cylinder block fitting.
16. Connect fuel shut-off solenoid connector.

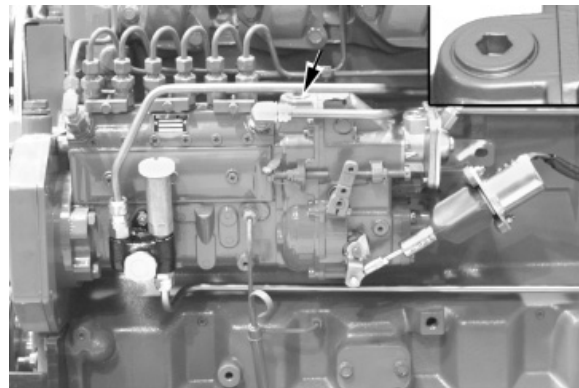


Pump Fuel, Oil and Aneroid Lines

- A—Aneroid Line
- B—Injection Pump Oil Line
- C—Fuel Supply Pump Lines
- D—Fuel Inlet Line
- E—Leak-Off Line

RG,35,JW7600 -19-19AUG04-5/6

17. Remove oil fill plug (arrow) from governor housing and add 3/4 pint of clean engine oil. (On later pumps with no oil plug, remove supply pump from side of pump housing and pour oil in.)
18. Bleed fuel system. (See BLEED THE FUEL SYSTEM in this group.)
19. Connect throttle levers and adjust engine speeds as required.



Fuel Injection Pump Oil Fill Plug

Check slow idle speed. (See CHECK AND ADJUST SLOW IDLE SPEED—DENSO FUEL INJECTION PUMP in Section 04, Group 150.)

Check fast idle speed. (See CHECK AND ADJUST FAST IDLE SPEED—DENSO AND MOTORPAL FUEL INJECTION PUMP in Section 04, Group 150.)

RG,35,JW7600 -19-19AUG04-6/6

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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.

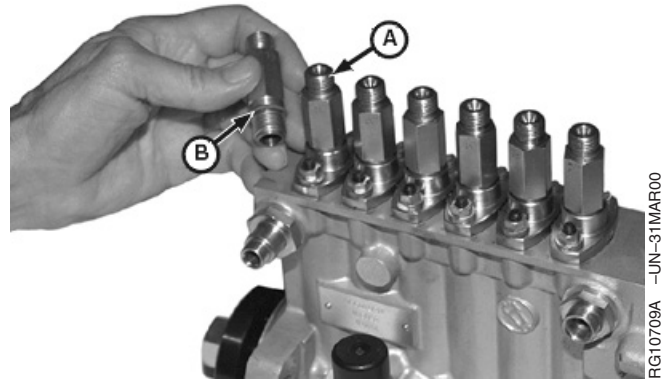
NOTE: Delivery valve O-rings (B) may be replaced with pump removed or installed on engine.

1. Clean area around injection pump and delivery lines as needed.
2. Remove delivery valve holder (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.



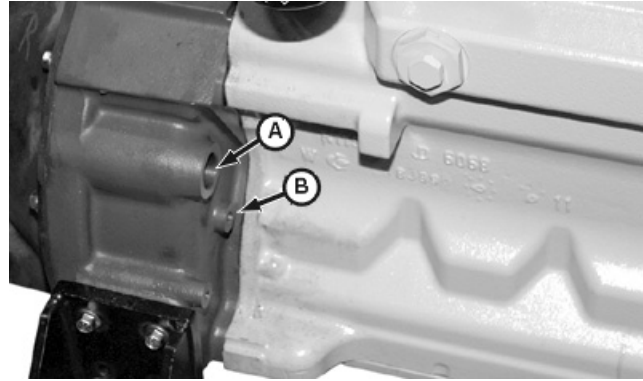
Delivery Valve O-Rings

A—Delivery Valve Holder
B—O-Ring

Remove Motorpal Fuel Injection Pump

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. Rotate engine flywheel (in normal running direction) with JDG820, JDE81-1 or JDE83 Flywheel Turning Tool until No. 1 piston is at TDC of its compression stroke. At this point, JDE81-4 or JDG1571 Timing Pin should enter hole in flywheel.



Flywheel Turning/Locking Tools

A—Bore for Flywheel Turning Tool
B—Bore for JDE81-4 or JDG1571 Timing Pin

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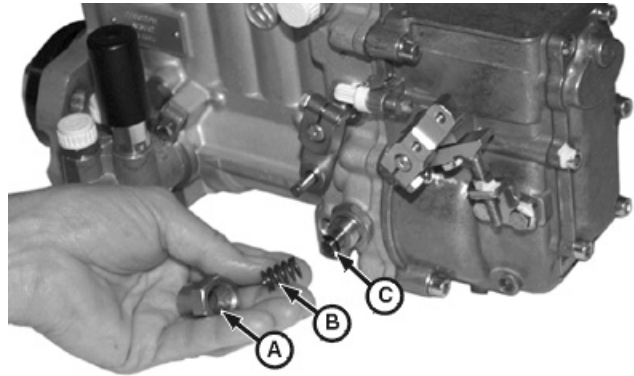
4. Remove V-belt and remove injection pump drive gear cover. Remove and discard all gasket material.

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

NOTE: If timing pin (C) does not engage in pump timing slot in camshaft, remove JDE81-4 or JDG1571 Timing Pin from flywheel and rotate engine 360 degrees.

IMPORTANT: DO NOT turn engine after timing pin (C) is installed and injection pump camshaft is locked. Damage to pump may occur.

5. Remove cap (A), pin (C) and spring (B) from pump. Reinstall parts as shown, with pin first, then spring and cap. Make sure pin is fully engaged in pump timing slot in injection pump camshaft. Tighten cap by hand. This will lock injection pump timing.



Lock Injection Pump Timing

A—Cap
B—Spring
C—Timing Pin

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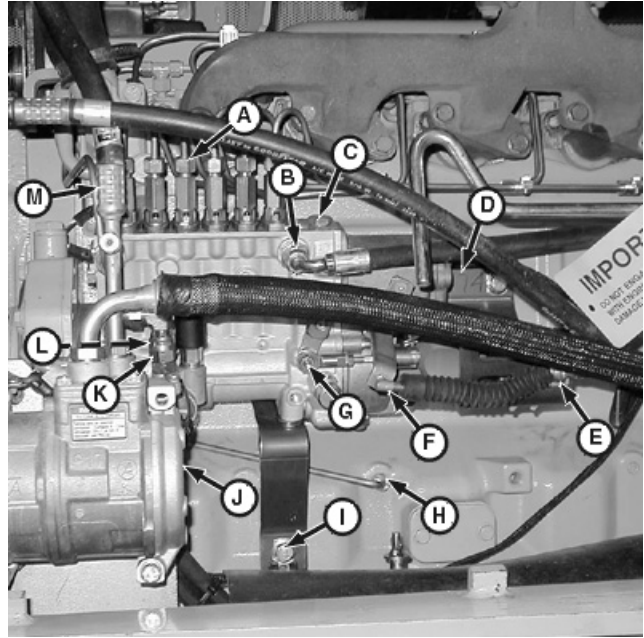
6. See machine technical manual for removal of air conditioning compressor (J) if required.

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 47 N•m (35 lb-ft).

O-rings on delivery valves are available for service.

7. Remove all fuel delivery lines (A) 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 (M), supply pump inlet line (K), supply pump outlet line (L) and fuel inlet line (B) from injection pump. Cap lines and fittings.
9. Disconnect throttle cable from injection pump throttle lever (F). Disconnect throttle cable clamp (E).
10. Disconnect injection pump lube line (H) from block. Lube line will remain with injection pump during removal.
11. Disconnect fuel shut-off solenoid harness connector.
12. Disconnect fuel shut-off solenoid shaft (G) from injection pump. Shut-off solenoid will remain with rear bracket when removed.
13. Remove bracket (D) with shut-off solenoid and set aside.
14. Disconnect bracket (I) from block. Bracket will be removed with pump.
15. Remove four injection pump drive gear-to-pump hub cap screws using a T45 TORX® adapter.
16. Remove four injection pump mounting stud nuts.



Remove Injection Pump

- A—Fuel Delivery Line
- B—Fuel Inlet Line
- C—Oil Fill Plug
- D—Rear Bracket
- E—Throttle Cable Clamp
- F—Throttle Lever
- G—Fuel Shut-Off Solenoid Shaft
- H—Lube Line
- I—Front Bracket
- J—Air Conditioning Compressor
- K—Supply Pump Inlet Line
- L—Supply Pump Outlet Line
- M—Leak-Off Line

17. Carefully remove injection pump from mounting studs.
18. Remove injection pump drive gear from timing gear cover.

DPSG,OUO1004,2605 -19-19AUG04-4/4

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Repair Motorpal Fuel Injection Pump

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

Be sure that injection pump serial number tag is in place and that all identification numbers are legible so that pump is set to the correct specifications for its intended use.

No internal repair parts are furnished for the Motorpal fuel injection pump. If pump fails, return complete pump for a replacement.

Contact your John Deere Parts System (DNS) for assistance in replacement of fuel injection pump.

RG,35,JW7601 -19-09SEP02-1/1

Install Motorpal Fuel Injection Pump

NOTE: To eliminate any backlash that might exist in the timing gear train, rotate flywheel in the direction of normal engine rotation (counterclockwise viewed from flywheel end) when installing JDE81-4 or JDG1571 Timing Pin in flywheel.

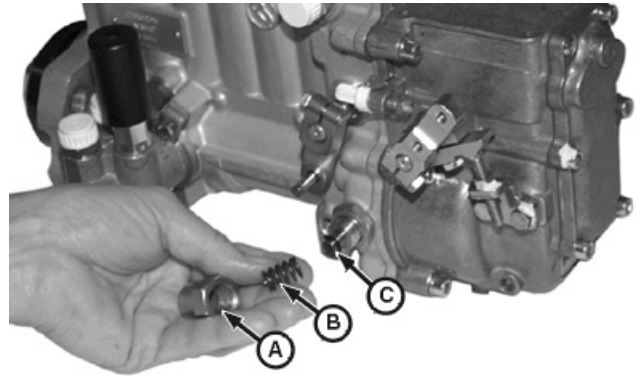
1. If engine was rotated after injection pump was removed, rotate flywheel in the direction of normal engine rotation until JDE81-4 or JDG1571 Timing Pin (C) enters flywheel at No. 1 cylinder's TDC compression stroke.

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.

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

2. Install injection pump timing pin (C) into bore and make sure it is fully engaged in pump timing slot. Install spring (B) on the outboard side of pin.
3. Reinstall cap (A) and tighten finger tight.

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



Install Pump Timing Pin

A—Cap
B—Spring
C—Timing Pin

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DPSG,QUO1004,2606 -19-19AUG04-1/5

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

6. Install lube line on injection pump before installing pump on engine.
7. Install injection pump 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 ID 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

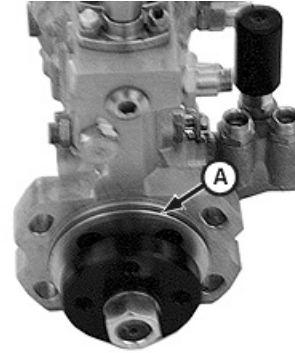
Motorpal Injection
 Pump-to-Cylinder Block Stud
 Nuts—Torque 47 N•m (35 lb-ft)

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

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

Specification

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



Injection Pump O-Ring

A—O-Ring

RG10714A -JUN-04APR00

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11. Remove cap (A), spring (B) and timing 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.

Specification

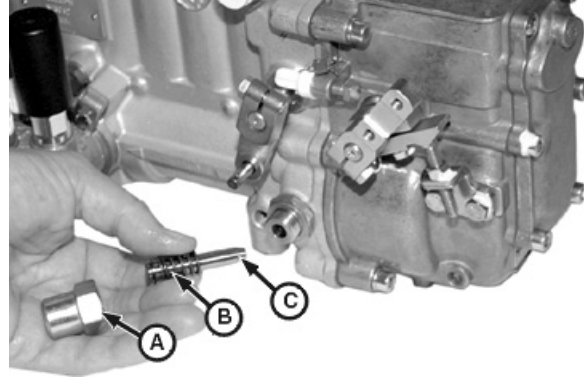
Motorpal Injection Pump Timing
Pin Cap—Torque..... 70 N•m (52 lb-ft)

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 6 N•m (4.5 lb-ft) (54 lb-in.)

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



Pump Timing Pin

- A—Cap
B—Spring
C—Timing Pin

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15. Install bracket (D) with fuel shut-off solenoid. Connect shut-off solenoid shaft (G) to injection pump. Connect solenoid harness connector.
16. Connect throttle cable clamp (E) to bracket and connect cable end to injection pump throttle lever (F).
17. Install front bracket (I) on injection pump (if removed) and tighten cap screws.

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.

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

Specification

Injection Pump Fuel Delivery Lines—Torque 27 N•m (20 lb-ft)

19. Connect injection pump inlet line (B) and tighten to specifications.

Specification

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

20. Connect leak-off line (M) and tighten to specifications.

Specification

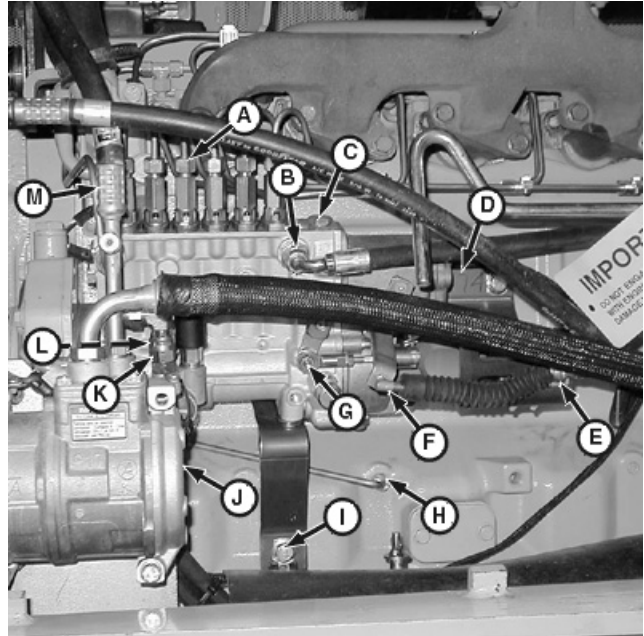
Motorpal Fuel Leak-Off Line-to-Injection Pump—Torque..... 13 N•m (10 lb-ft)

21. Connect injection pump lube line (H) and tighten to specifications.

Specification

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

22. Connect fuel supply pump lines (K and L) and tighten to specifications.



Install Injection Pump

- A—Fuel Delivery Line
- B—Fuel Inlet Line
- C—Oil Fill Plug
- D—Rear Bracket
- E—Throttle Cable Clamp
- F—Throttle Lever
- G—Fuel Shut-Off Solenoid Shaft
- H—Lube Line
- I—Front Bracket
- J—Air Conditioning Compressor
- K—Supply Pump Inlet Line
- L—Supply Pump Outlet Line
- M—Leak-Off Line

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Specification

Motorpal 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.

23. Remove oil fill plug (C) on top of injection pump and add 230 cc (7.8 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)

24. Bleed fuel system. (See BLEED THE FUEL SYSTEM in this group.)

25. Adjust engine speeds as required.

Check slow idle speed. (See CHECK AND ADJUST SLOW IDLE SPEED—MOTORPAL FUEL INJECTION PUMP in Section 04, Group 150.)

Check fast idle speed. (See CHECK AND ADJUST FAST IDLE SPEED—DENSO AND MOTORPAL FUEL INJECTION PUMP in Section 04, Group 150.)

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Repair Aneroid

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

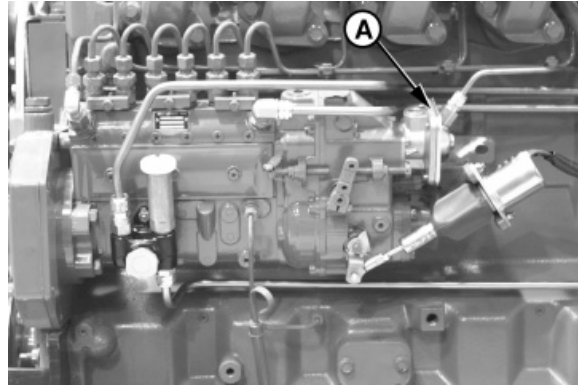
The aneroid controls fuel delivery when intake manifold pressure is about 100 kPa (1.00 bar) (15 psi) or less. Therefore, all final adjustments are to be made on the test stand with aneroid mounted on injection pump.

Specification

Aneroid Pressure (Lever Lift-Off)—Pressure.....	76—102 mm Hg (3—4 in. Hg) 10—14 kPa (1.5—2.0 psi)
Aneroid Pressure (Lever at Full Travel)—Pressure.....	330—380 mm Hg (13—14 in. Hg) 44—51 kPa (6.4—7.4 psi)

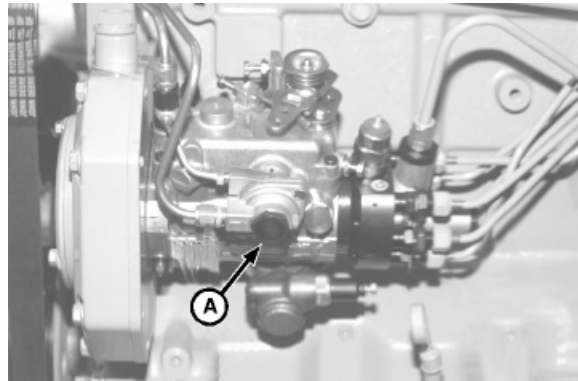
IMPORTANT: Correct aneroid adjustments are essential for satisfactory engine performance. Whenever aneroid has been disassembled or adjustments have been altered, injection pump (including aneroid) must be calibrated on test stand before releasing pump for service.

A—Aneroid



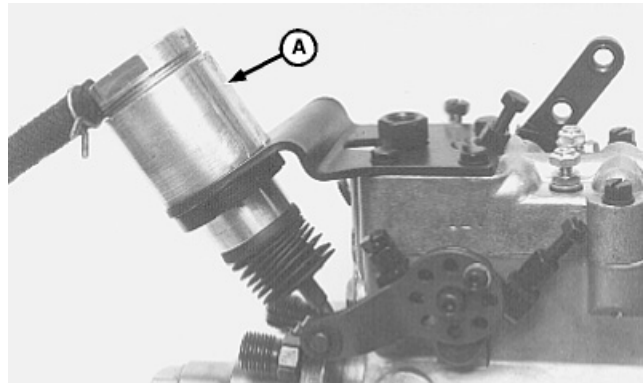
Denso Aneroid

RG7748B -UN-07NOV97



Delphi/Lucas Aneroid

RG9092 -UN-27MAR98



Stanadyne Aneroid

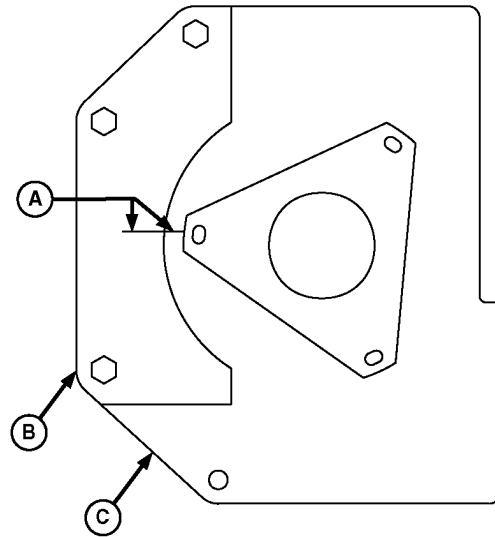
RG9093 -UN-27MAR98

RG,35,JW7599 -19-09JUL02-1/1

Transfer Fuel Injection Pump Timing Mark onto Replacement Front Plate

IMPORTANT: Replacement front plates do not have an injection pump timing mark. It is extremely important that the timing mark be accurately transferred from original front plate to the replacement plate in the exact location for correct injection pump timing.

1. Position DFRG5 Aluminum Template (B) onto original front plate (C) as shown. (See Section 05, Group 190, Dealer Fabricated Tools, for manufacturing details.) Install three 3/8-16 cap screws securely.
2. Transfer injection pump timing mark (A) from previous front plate onto template using a fine-tip marker and straightedge. Remove template from front plate being replaced.
3. Attach template (with timing mark) to new replacement front plate and tighten cap screws securely.
4. Transfer timing mark from the template to the new front plate using a scribe. Scribe deep enough so mark becomes a permanent reference.
5. Remove template from front plate and refer to CTM104 Base Engine Repair Manual for front plate installation procedure.



Front Plate (Viewed from Pump Side)

A—Injection Pump Timing Mark
 B—Aluminum Template
 C—Front Plate

RG9057 -JUN-16MAR98

RG,35,JW7598 -19-20NOV97-1/1

Fuel Injection Nozzle Identification

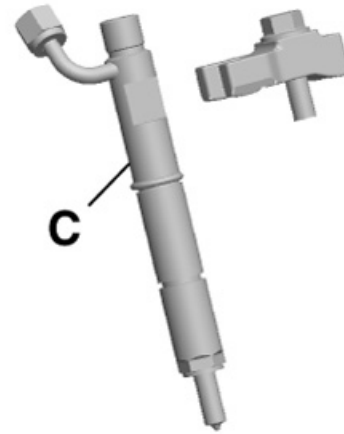
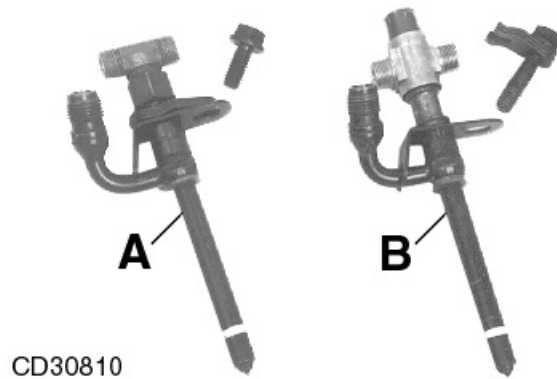
Three types of fuel injection nozzles can be found on **POWERTECH**® 4.5 L and 6.8 L engines.

- Conventional Nozzle 9.5 mm (A)
- Rate Shaping Nozzle 9.5 mm (B)
- VCO Nozzle 17 mm (C)

The Rate Shaping Nozzle (RSN) allows some engines to comply with Tier 2 exhaust emission regulations.

The VCO Nozzle allows some engines to comply with Tier 3 exhaust emission regulations.

- A—Conventional Nozzle 9.5 mm
- B—Rate Shaping Nozzle (RSN) 9.5 mm
- C—VCO Nozzle 17 mm



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CD30810 -UN-17APR01

RG15528 -UN-11SEP07

Diagnose Fuel Injection Nozzle Malfunctions

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

^aVCO 17 mm nozzles are not serviceable. Replace nozzle if found faulty.

Mechanical Fuel System Repair and Adjustments

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Problem	Possible Cause	Suggested Remedy ^a
	Tip seat pitted.	Lap tip to seat. Replace nozzle as necessary.
	Valve not free.	See "Inconsistent Chatter".
		See "No Chatter".
	Distorted body.	Replace nozzle.
	Cracked tip.	Replace nozzle.
High Leak-Off	Wear or scratched at guide.	Lap valve to guide. Replace nozzle as necessary.
Low Leak-Off	Varnish on valve.	Clean guide area.
	Insufficient clearance.	Clean nozzle. Lap valve to guide. Replace nozzle as necessary.

^aVCO 17 mm nozzles are not serviceable. Replace nozzle if found faulty.

OUO1082,0000077 -19-09OCT07-2/2

Remove Fuel Injection Nozzles (9.5 mm)

General Nozzle Service Precautions

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

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

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

Continued on next page

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

1. Loosen tube nuts at each nozzle to remove leak-off lines and T-fittings as an assembly.



RG7724 -UN-23NOV97

Fuel Leak-Off Lines

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2. Disconnect fuel injection line from nozzle using a backup wrench on nozzle connection as shown.
3. Remove cap screw securing nozzle in cylinder head nozzle bore.



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Fuel Injection Line at Nozzle

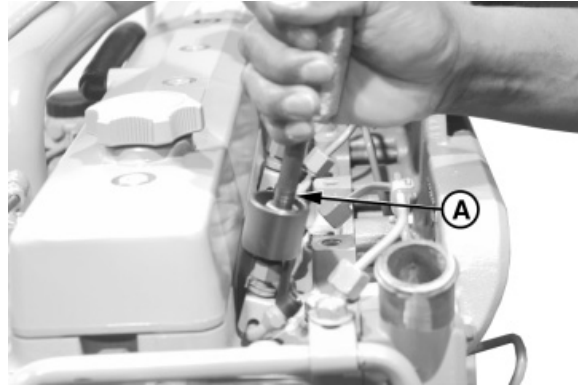
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4. Pull injection nozzle out of cylinder head using JDE38B Injection Nozzle Puller Set (A) or JDG716 Adapter and side handle from JDE38 or JDE38A Puller Set. Use JDG1515-1 for RSN nozzles.

IMPORTANT: Do not use screwdrivers, pry bars, or similar tools for this as they might damage the injection nozzle beyond repair.

A—Nozzle Puller



Injection Nozzle Puller Set

RG7726 -UN-07NOV97

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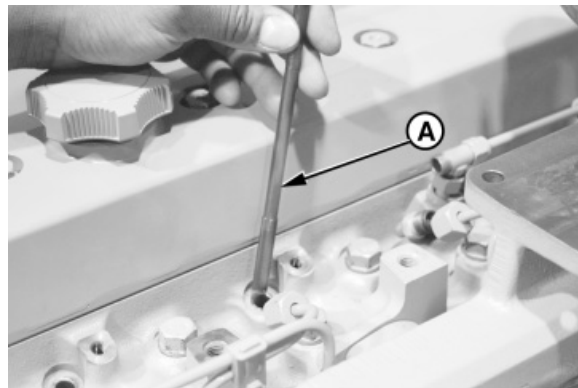
OQO1082,0000048 -19-04OCT07-4/4

Clean Fuel Injection Nozzle Bore (9.5 mm)

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

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

A—Nozzle Bore Cleaning Tool



Clean Injection Nozzle Bore

RG7743 -UN-07NOV97

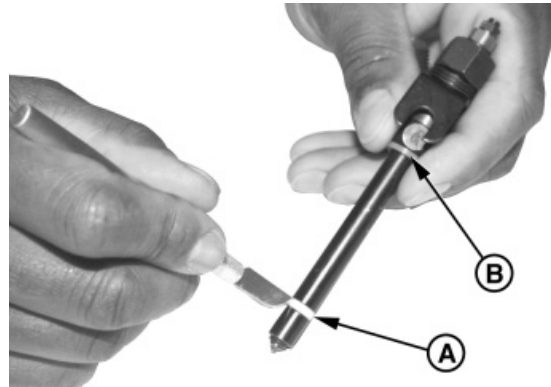
OQO1082,000004A -19-04OCT07-1/1

Clean Fuel Injection Nozzles (9.5 mm)

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

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

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



Clean Fuel Injection Nozzle

A—Carbon Stop Seal
B—Upper Sealing Washer

RG7798 -UN-11NOV97

TEFLON is a registered trademark of the DuPont Co.

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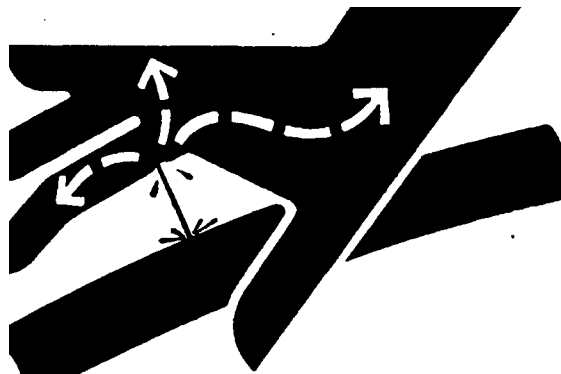
Test Fuel Injection Nozzles (9.5 mm)

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

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

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

1. Connect injection nozzle to nozzle tester.



High Pressure Fluid

X9811 -UN-29AUG88

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NOTE: When using the JT25510 Bosch Bench Mounted Nozzle Tester, use the KJD10109 Fuel Line and connect line to tester and nozzle.

2. Use Y900-3 and Y900-5 Adapters (C) and Y900-2 Fuel Line (B) from D01110AA Fuel Injection Nozzle Tester Adapter Set to connect nozzles to D01109AA OTC Portable Nozzle Tester (A).
3. Position tip of nozzle below top of beaker (D) and back out 30° from vertical. This is necessary to contain all spray in beaker, as nozzle spray pattern is at an angle to the nozzle centerline. Leave connections slightly loose.

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

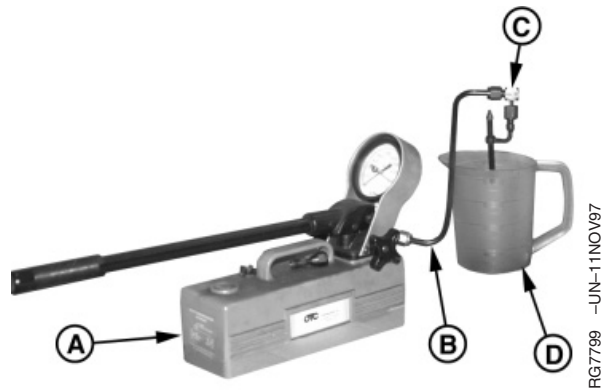
4. Pump handle several strokes to flush air from lines and to determine the pumping rate required for proper fuel atomization. Tighten all connections securely after all air has been expelled from nozzle and line.

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

Opening Pressure Test

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

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



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

NOTE: In a few applications, RE60062 Nozzles (normally used on aspirated engines), may be specified for turbocharged (T or H) engines. In these cases, use specifications listed below for naturally aspirated (D) engines.

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

3. Compare readings to the following specifications:

**Fuel Injection RE60062 Nozzles (Naturally Aspirated Engines)—
Specification**

New or Reconditioned Nozzle with New Internal Parts—Opening	
Pressure for Setting	23 856—24 407 kPa (238—244 bar) (3460—3540 psi)
Opening Pressure for Checking (Minimum).....	
	21 856 kPa (218 bar) (3170 psi)
Used Nozzle—Opening Pressure for Checking (Minimum)	
	19 850 kPa (198 bar) (2880 psi)
Opening Pressure Difference between Cylinders—Pressure Difference (Maximum)	
	700 kPa (7 bar) (100 psi)

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

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

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Rate Shaping Nozzle (Tier II Certified Engines)—Specification

New or Reconditioned Nozzle—

Opening Pressure for Setting.....	24 400—24 900 kPa (244—249 bar) (3540—3620 psi)
Opening Pressure for Checking (Minimum).....	24 100 kPa (241 bar) (3500 psi)
Used Nozzle—Opening Pressure for Setting.....	23 000—23 600 kPa (230—236 bar) (3340—3420 psi)
Opening Pressure for Checking (Minimum).....	21 800 kPa (218 bar) (3170 psi)
Opening Pressure Difference between Cylinders—Pressure Difference (Maximum).....	700 kPa (7 bar) (100 psi)

Chatter Test

NOTE: On RSN injectors, nozzle chatter may or may not be noticeable during this test. An RSN injector passes this test if its opening pressure, seat leakage, and return fuel are acceptable.

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

If nozzle fails to chatter, the nozzle valve may be bent or tight in its guide due to accumulated lacquer deposits. Disassemble nozzle and correct as detailed later in this group.

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

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

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

Spray Pattern Test

NOTE: On RSN injectors, nozzle chatter may or may not be noticeable during this test.

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

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

- 2. Observe spray pattern and check for plugged orifices.

If nozzle fails to chatter or spray properly, disassemble, clean and recondition as outlined later in this group.

Specification

Fuel Injection Nozzle Tip (9.5 mm)—Spray Angle 144°

Leakage Test

- 1. Check nozzle for fuel leakage past valve seat by positioning nozzle on nozzle tester with nozzle tip down.
- 2. Operate pump handle rapidly to firmly seat valve. Wipe the nozzle tip dry with a clean, lint-free cloth.
- 3. Slowly raise pressure at nozzle to about 2800—3500 kPa (28—35 bar) (400—500 psi) under specified opening pressure and hold at that pressure. Watch for an accumulation of fuel around the nozzle tip orifices.

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

Specification

Nozzle (9.5 mm) Valve/Seat
Tightness Condition at Pressure
Test of 2800—3500 kPa (28—35 bar) (400—500 psi)—Leakage Nozzle tip dry after 5 seconds.
(Slight dampness permissible on used nozzles.)

Valve Stem and Guide Wear Test

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

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

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

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

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

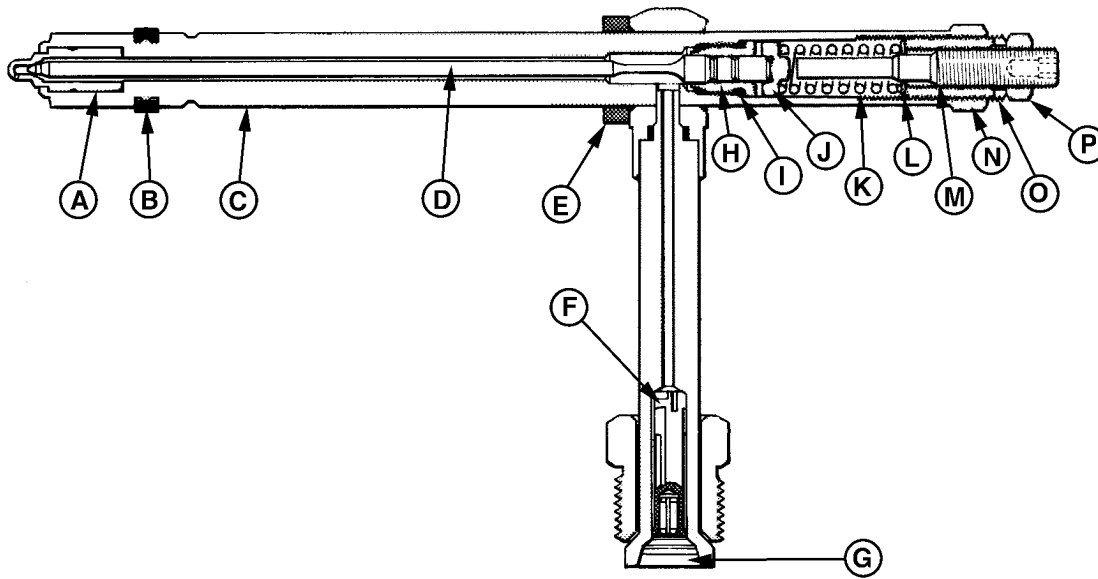
Specification

Fuel Injection Nozzle (9.5 mm)
Return Leakage at Pressure Test
of 10 300 kPa (103 bar) (1500
psi)—Leakage..... 3—10 Drops/30 Seconds

If nozzle leakage is not within specified range, nozzle must be reconditioned as outlined later in this group.

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Disassemble Fuel Injection Nozzles (9.5 mm)



Fuel Injection Nozzles

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

NOTE: If an RSN injection nozzle is not operating properly and must be disassembled for

cleaning and/or reconditioning, see your Stanadyne dealer.

RG7800A -UN-13NOV97

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General Nozzle Repair Notes

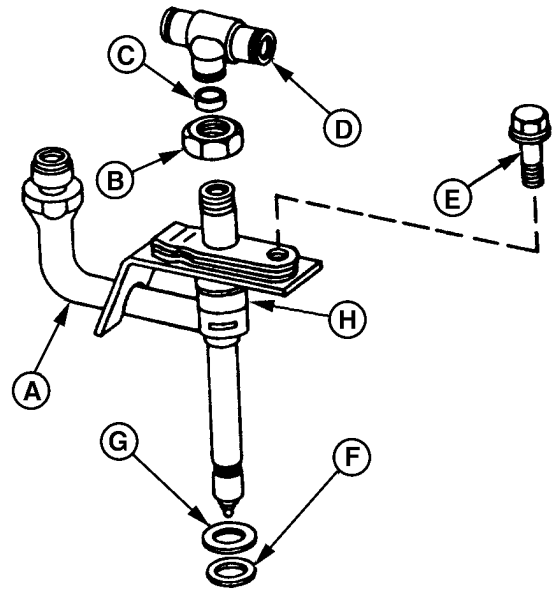
NOTE: Disassembly of nozzles is not recommended unless servicing is indicated by nozzle operation and testing.

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

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

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

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



Nozzle Disassembly

- A—Nozzle Assembly
- B—Tube Nut
- C—Packing
- D—Leak-Off Fitting
- E—Cap Screw
- F—Carbon Stop Seal
- G—Upper Sealing Washer
- H—Spacer

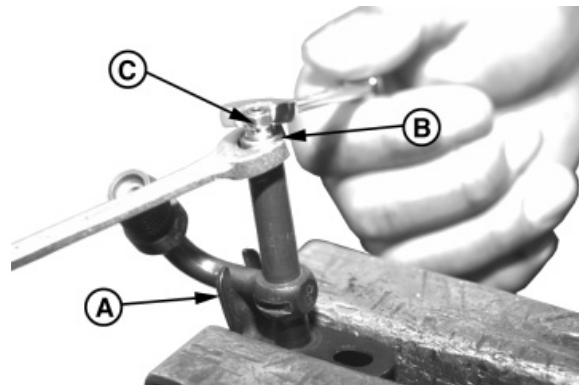
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FG9086 -UN-16MAR98

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To Disassemble Fuel Injection Nozzle

1. Place nozzle in index clamp (A)¹ and secure clamp in a vise.
2. Loosen pressure adjusting lock nut (B).
3. Back out lift adjusting screw lock nut (C) and lift assembly.
4. Invert nozzle and allow pressure adjusting spring seat and lift adjusting assembly to fall into your hand. Do not bend stem during removal.



Injection Nozzle in Holding Fixture

- A—Nozzle Index Clamp
- B—Pressure Adjusting Lock Nut
- C—Lift Adjusting Screw Lock Nut

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

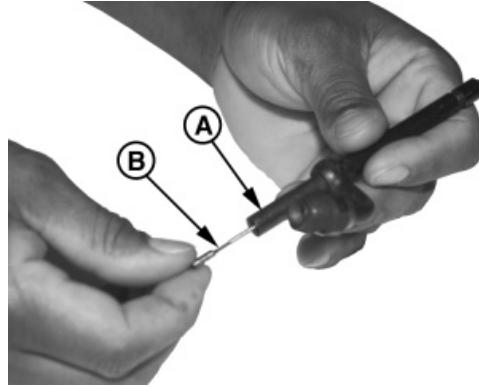
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OUO1082.000004D -19-04OCT07-3/4

FG7802 -UN-21MAY01

5. If valve does not slide freely from body (A), use No. 16481 Valve Retractor¹ (B) to remove valve.
6. Remove locating clamps and spacer from nozzle body.

A—Valve Body
B—Valve Retractor



Injection Nozzle Body and Valve

RG7803 -UN-11NOV97

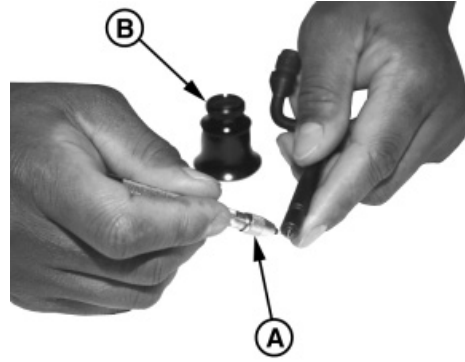
¹No. 16481 Valve Retractor is a Stanadyne tool.

Inspect and Clean Fuel Injection Nozzle Body (9.5 mm)

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

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

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



Clean Injection Nozzle Body

A—Holder
B—Inspection Magnifier

To Clean Carbon from Nozzle Orifices

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

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

Specification

Fuel Injection Nozzle Tip	
Orifice—Number of Orifices per	
Nozzle.....	4
Fuel Injection Nozzle Tip Orifice	
(Naturally Aspirated Engines)—ID	0.27 mm (0.0106 in.)
Fuel Injection Nozzle Tip Orifice	
(Turbocharged Engines)—ID.....	0.29 mm (0.0116 in.)

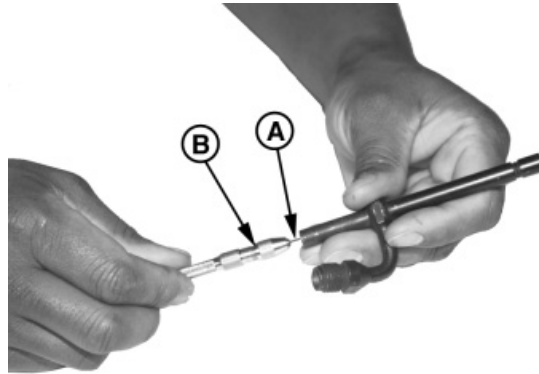
NOTE: In a few applications, RE60062 Nozzles (normally used on aspirated engines), may be specified for turbocharged (T or H) engines. In these cases, use specifications listed for naturally aspirated (D) engines.

2. Clamp the wire in pin vise from nozzle cleaning kit. Wire should not protrude from the vise more than 0.8 mm (1/32 in.).
3. Insert wire in orifice and rotate.
4. Use scraper from cleaning kit to clean deposits from valve seating area.

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

5. Grasp sac hole drill (A) with valve retractor (B).
6. For final cleaning, use a cleaning wire 0.03 mm (0.001 in.) smaller than the nominal orifice size and repeat steps 2 and 3.

A—Sac Hole Drill
B—Valve Retractor



Injection Nozzle Orifices

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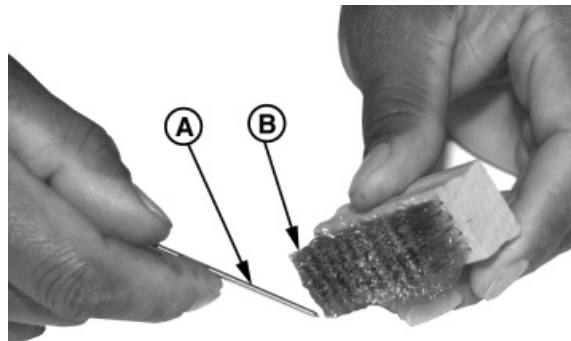
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Inspect and Clean Valve and Valve Seat (9.5 mm)

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

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

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



Injection Nozzle Valve and Valve Seat

A—Nozzle Valve
B—Brass Wire Brush

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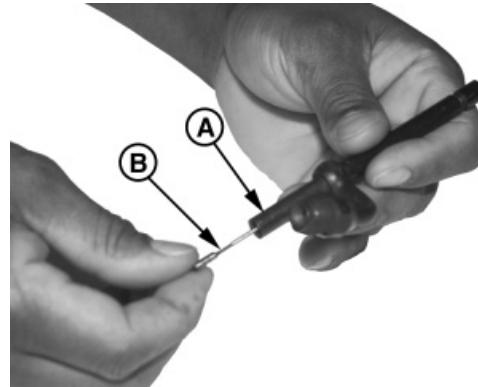
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Inconsistent Chatter or No Chatter

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

1. Place a small amount of nozzle lapping compound on the nozzle valve in guide area only. DO NOT use any other compound for this purpose.
2. Slide valve into body (A).



Nozzle Valve in Nozzle Body

A—Nozzle Body
B—Retractor

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

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

Seat Leakage

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

1. Apply a small amount of lapping compound to valve tip and insert valve in nozzle body.
2. Gripping valve with retractor, rotate valve 3—5 turns to clean up seat.
3. Wash valve and nozzle body thoroughly in clean fuel.

RG7803 -UN-11NOV97

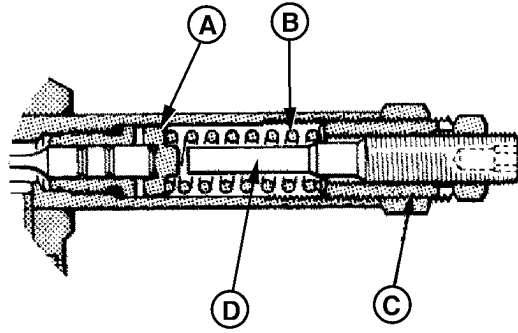
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Inspect Valve Adjusting Mechanism (9.5 mm)

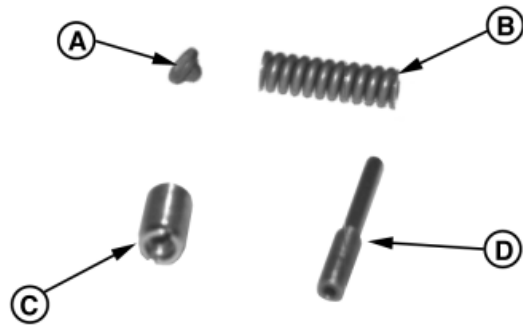
1. Inspect lift adjusting screw (D). Replace if bent or otherwise damaged.
2. Inspect pressure adjusting screw (C). Replace if worn or damaged.
3. Inspect pressure adjusting spring (B). Replace if broken or distorted.
4. Inspect spring seat (A) for wear. Replace as necessary.
5. Replace nozzle clamp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

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



Inspect Nozzle Valve Adjust Mechanism

RG7810A -UN-13SEP02



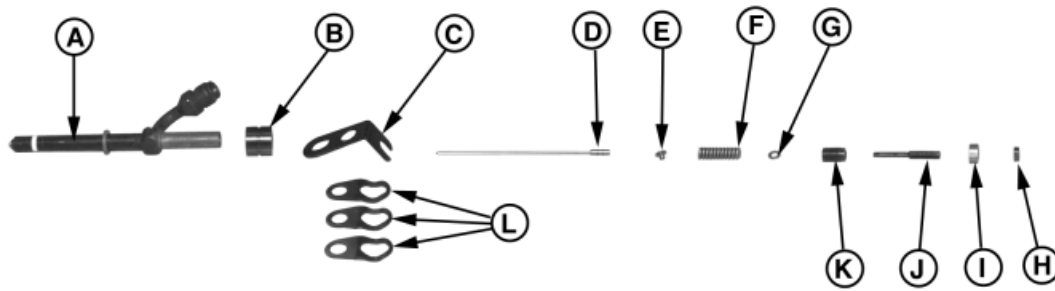
Inspect Nozzle Valve Adjust Mechanism

RG7808 -UN-11NOV97

OUO1082,0000050 -19-05OCT07-1/1

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Assemble Fuel Injection Nozzles (9.5 mm)



RG8042 -UN-14NOV97

Fuel Injection Nozzles

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

1. Install nozzle spacer (B) onto upper nozzle body (A). Position nozzle indexing clamp (C) over upper nozzle body with flanges pointing downward. Install three remaining clamps (L) onto nozzle body.

IMPORTANT: Wear rubber gloves when assembling nozzles.

2. Dip valve (D) in clean fuel and insert into nozzle body.
3. Thread lift adjusting screw (J) into pressure adjusting screw (K) until top just enters screw.

4. Invert adjusting screw assembly and assemble spring seat (E) and spring (F) to adjusting screw.
5. Tilt body, DO NOT allow valve to fall out, and install spring and adjusting screws to body. Be careful not to dislodge spring or seat during initial assembly.
6. Turn pressure adjusting screw down as far as possible by hand, usually about ten full turns. Adjust nozzle as detailed later in this group.

OUO1082,0000051 -19-04OCT07-1/1

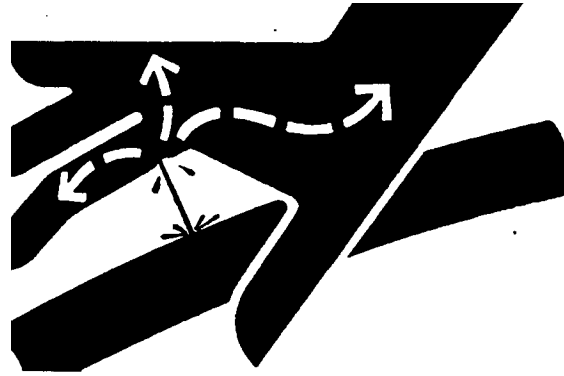
Adjust Fuel Injection Nozzles (9.5 mm)

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

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

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

Connect nozzle to nozzle tester. (See TEST FUEL INJECTION NOZZLES earlier in this group.)



High Pressure Fluids

X9811 -UN-23AUG88

Continued on next page

OUC1082,0000052 -19-04OCT07-1/7

Adjust Nozzle Opening Pressure

Close pressure gauge valve and flush nozzle by operating pump rapidly.

Raise pressure on pump until nozzle opens (gauge drops sharply).

NOTE: In a few applications, nozzles normally used on aspirated engines may be specified for turbocharged (T or H) engines. In these cases, use specifications listed below for naturally aspirated (D) engines.



Injection Nozzle Tester

RG7809 -UN-15JAN98

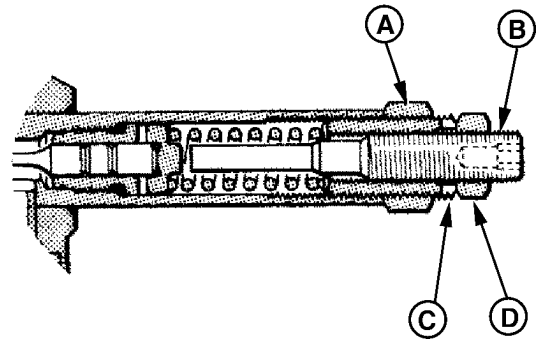
Refer to nozzle opening pressure specifications below.

Fuel Injection Nozzles (9.5 mm) (Naturally Aspirated Engines)—Specification

New or Reconditioned Nozzle with New Internal Parts—Opening Pressure for Setting		23 856—24 407 kPa (238—244 bar) (3460—3540 psi)
Opening Pressure for Checking (Minimum).....		21 856 kPa (218 bar) (3170 psi)
Used Nozzle—Opening Pressure for Checking (Minimum)		19 850 kPa (198 bar) (2880 psi)
Opening Pressure Difference between Cylinders—Pressure Difference (Maximum)		700 kPa (7 bar) (100 psi)

Fuel Injection Nozzles (9.5 mm) (Turbocharged Engines)—Specification

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



Injection Nozzle Adjustments

RG7810B -UN-11NOV97

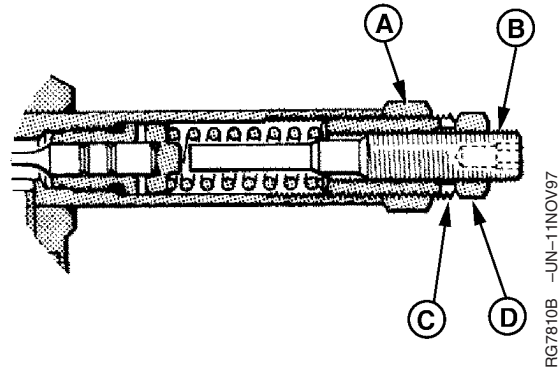
- A—Pressure Adjusting Screw Lock Nut
- B—Lift Adjusting Screw
- C—Pressure Adjusting Screw
- D—Lift Adjusting Lock Nut

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If Opening Pressure is Incorrect:

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

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



Adjust Nozzle Pressure

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

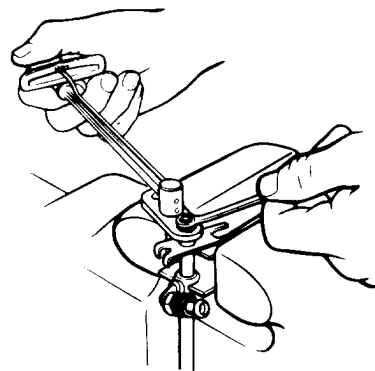
RG7810B -UN-11NOV97

OUC1082,0000052 -19-04OCT07-3/7

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

Specification

Injection Nozzle (9.5 mm)	
Pressure Adjusting Screw Lock	
Nut—Torque	10 N•m (7 lb-ft)



Nozzle Pressure Adjusting Screw and Lock Nut

RG7811 -UN-15JAN98

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

Continued on next page

OUC1082,0000052 -19-04OCT07-4/7

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Adjust Nozzle Valve Lift—Conventional Nozzle

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

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

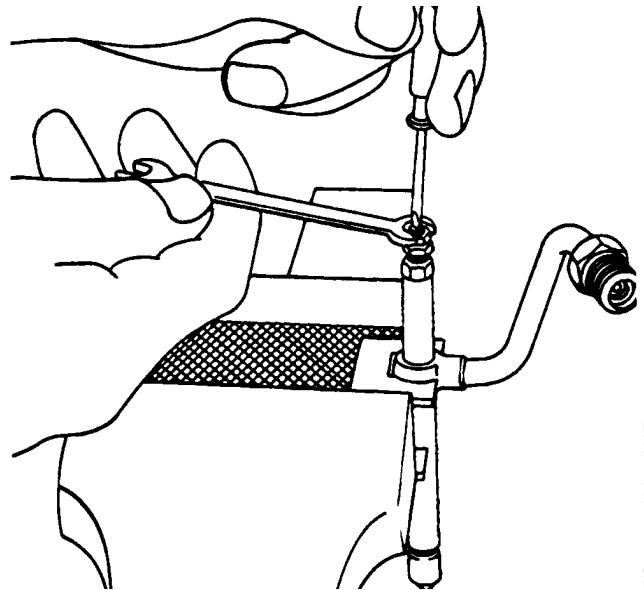
2. Check for valve bottoming by raising pressure to 1380—3450 kPa (14—34 bar) (200—500 psi) above nozzle opening pressure.

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

3. Remove nozzle from tester and install in holding fixture.
4. Carefully turn lift adjusting screw out specified amount. A tolerance of 1/8 turn is permissible.

Specification

Fuel Injection Nozzle (9.5 mm)
 Valve—Needle Lift (Based on
 Zero Lift) 3/4 Turn Counterclockwise



Injection Nozzle Valve Lift Adjustment

FG9103 -JUN-31MAR98

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OOU1082,0000052 -19-04OCT07-5/7

5. Hold pressure adjusting screw stationary and tighten lift adjusting screw lock nut to specifications. Use a crow'sfoot wrench or torque wrench adapter, if available.¹

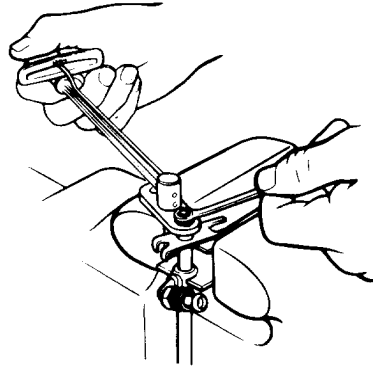
Specification

Fuel Injection Nozzle (9.5 mm)	
Lift Adjusting Screw Lock Nut—	
Torque	5 N•m (3.5 lb-ft) (42 lb-in.)

6. Recheck nozzle opening pressure.

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

7. Clean nozzle with brass wire brush.



Nozzle Pressure Adjusting Screw and Lock Nut

RG7811 -UN-15/JAN98

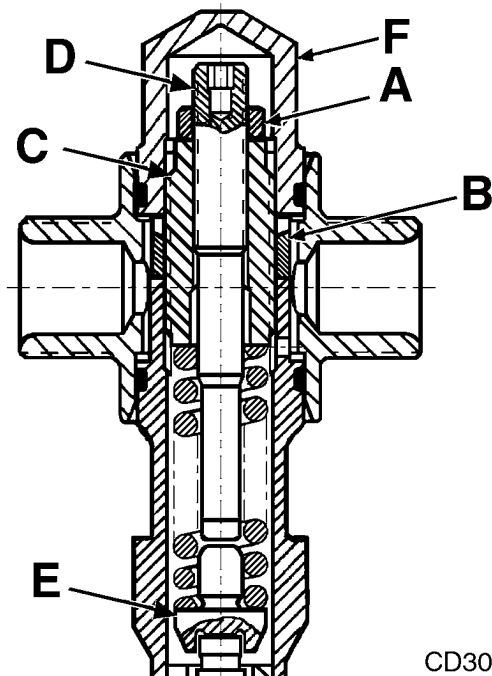
¹If available, ROS18958 (English) or No. 24374 (Stanadyne, Metric) Torque Wrench Adapter (obsolete) can be used.

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OUC1082,0000052 -19-04OCT07-6/7

Adjust Nozzle Valve Lift—RSN Nozzle

1. Unscrew spring chamber cap (F) using JDG1521 Spring Chamber Cap Wrench.
2. Loosen and remove lock nut (A) of lift adjusting screw (D).
3. Loosen lock nut (B) of pressure adjusting screw (C) using JDG1515-2 Pressure Adjustment Screw Lock Nut.
4. Connect nozzle to tester, then adjust opening pressure to specifications by turning the pressure adjusting screw (C). Use JDG1522 Pressure Adjustment Screw Tool.
5. Tighten lock nut (B) to specification, then recheck opening pressure.
6. Carefully turn lift adjusting screw (D) until it bottoms on spring seat (E).
7. Unscrew lift adjusting screw with the number of turns as specified.
8. Tighten lock nut of lift adjusting screw to specification.
9. Recheck opening pressure.



A—Lift Adjusting Screw Lock Nut
 B—Pressure Adjusting Screw Lock Nut
 C—Pressure Adjusting Screw
 D—Lift Adjusting Screw
 E—Spring Seat
 F—Spring Chamber Cap

CD30811

CD30811 -JUN-28MAY01

RSN Nozzle (9.5 mm) Valve Lift—Specification

Pressure Adjusting Screw Lock Nut—Torque	10 N•m (7 lb-ft)
Lift Adjusting Screw Lock Nut—Torque	5 N•m (3.5 lb-ft)
RSN Nozzle (Tier II Certified Engines) Valve—Lift	7/8 turn

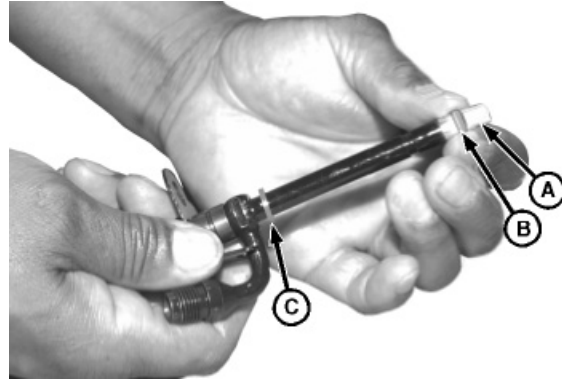
OUO1082,0000052 -19-04OCT07-7/7

Install Seals on Fuel Injection Nozzle (9.5 mm)

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

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

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



Fuel Injection Nozzle Seals

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

RG9096 -JUN-27MAR98

OUC1082,000053 -19-09OCT07-1/1

Install Fuel Injection Nozzles (9.5 mm)

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

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

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

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

2. Install nozzle with spacer and clamps in cylinder head using a slight twisting motion as nozzle is seated in bore. Illustration shows relationship of parts required for proper installation.
3. Align nozzle clamps and install cap screw. Do not tighten cap screw at this stage.
4. Connect fuel pressure line to nozzle. Leave connection slightly loose until air is bled from system.
5. Tighten nozzle hold-down clamp cap screws to specifications.

Specification

Fuel Injection Nozzle (9.5 mm)
Hold-Down Clamp Cap Screws—
Torque 40 N•m (30 lb-ft)



Injection Nozzle in Cylinder Head

RG7744 -UN-23NOV97

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Continued on next page

OOU1082,0000054 -19-04OCT07-1/3

IMPORTANT: Avoid machine damage. Do NOT overtighten fuel leak-off lines.

6. Install leak-off line assembly.

Specification

Fuel Leak-Off Line (9.5 mm) Hex
Nut—Torque 5 N•m (3.7 lb-ft)
(44 lb-in.)

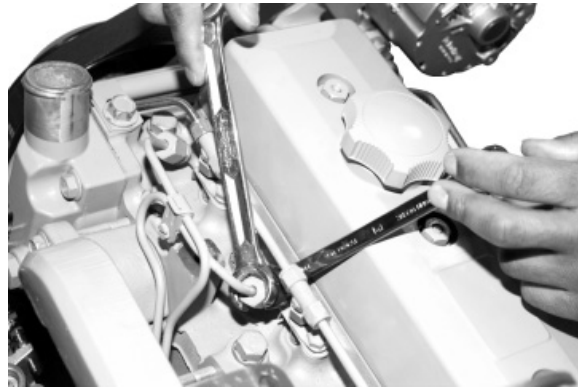
OUO1082.0000054 -19-04OCT07-2/3

7. Bleed air from loose injection line connection. Tighten connection to specification, using two wrenches as shown.

Specification

Fuel Injection Nozzle (9.5 mm)
Delivery Line—Torque..... 27 N•m (20 lb-ft)

(See BLEED THE FUEL SYSTEM in this group.)



Nozzle Delivery Line Nut Tightening

OUO1082.0000054 -19-04OCT07-3/3

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Remove Fuel Injection Nozzles (VCO 17 mm)

General Nozzle Service Precautions

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

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

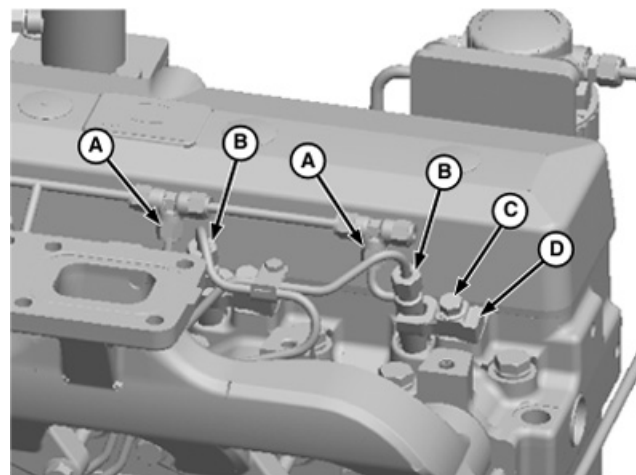
Do not bend the fuel delivery lines, as this may affect their durability. When loosening the fuel lines, hold male union of nozzle line stationary with a backup wrench.

OUO1082,0000056 -19-04OCT07-1/2

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

1. Loosen tube nuts (A) at each nozzle to remove leak-off lines and T-fittings as an assembly.
2. Disconnect fuel injection line (B) at injector.
3. Remove cap screw (C) and hold down clamp (D) securing nozzle in cylinder head nozzle bore.
4. Pull injection nozzle out of cylinder head.

A—Leak-off Line Tube Nut
B—Fuel Injection Line
C—Cap Screw
D—Hold Down Clamp



Remove Fuel Injectors (VCO 17 mm)

RG15529 -UN-11SEP07

OUO1082,0000056 -19-04OCT07-2/2

Clean Fuel Injection Nozzle Bore (VCO 17 mm)

Clean injection nozzle bore. Blow debris from bore using compressed air, and plug the bore to prevent entry of foreign material.

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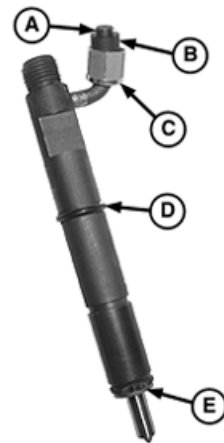
OUO1082.0000057 -19-09OCT07-1/1

Clean Fuel Injection Nozzles (VCO 17 mm)

1. Remove snap ring (A), seal (B) and tube nut (C). Discard snap ring, seal and tube nut.
2. Remove carbon stop seal washer (E) from nozzle and remove upper sealing O-ring (D). Discard seal washer and O-ring.
3. Place nozzle in solvent or clean diesel fuel and soak for a while.

IMPORTANT: Do not use a motor-driven brush to clean nozzle body.

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



Clean Fuel Injection Nozzle

- A—Snap Ring
- B—Seal
- C—Tube Nut
- D—O-Ring
- E—Carbon Stop Seal Washer

RG15541 -UN-05OCT07

OUO1082.0000058 -19-10OCT07-1/1

Test Fuel Injection Nozzles (VCO 17 mm)

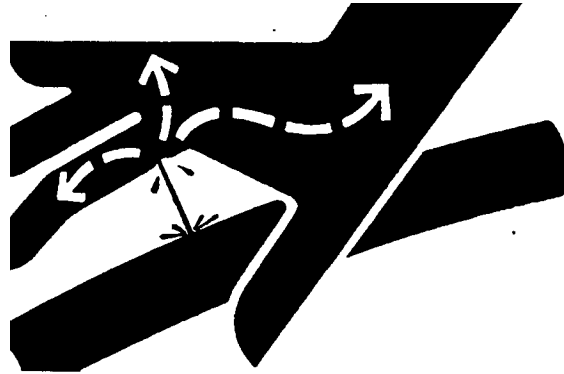


CAUTION: The nozzle tip should always be directed away from the operator. Fuel from the spray orifices can penetrate clothing and skin causing serious personal injury. Enclosing the nozzle in a clear glass beaker is recommended.

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

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

1. Connect injection nozzle to nozzle tester.



High Pressure Fluid

X9811 -UN-23AUG88

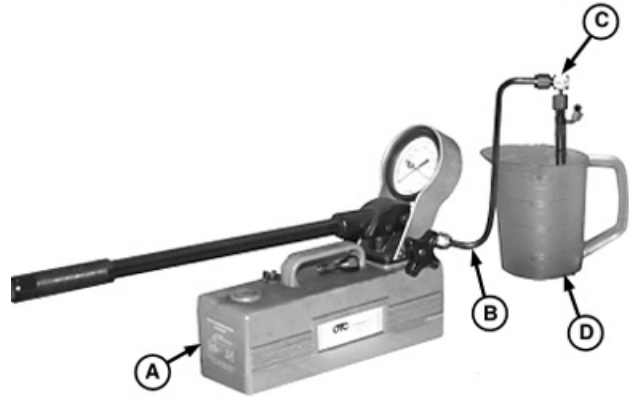
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2. Use appropriate adapters (C) and fuel line (B) from D01110AA Fuel Injection Nozzle Tester Adapter Set to connect nozzles to D01109AA OTC Portable Nozzle Tester (A).
3. Position tip of nozzle below top of beaker (D) to contain all spray in beaker, as nozzle spray pattern is at an angle to the nozzle centerline. Leave connections slightly loose and gauge shut-off valve closed.
4. Pump handle several strokes to flush air from lines and fittings. Tighten all connections securely after all air has been expelled.



RG15543 -UN-08OCT07

Injection Nozzle Tester

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

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

Opening Pressure Test

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

1. Actuate the nozzle tester rapidly several times to allow the valve to seat rapidly and to determine the pumping rate required for proper fuel atomization.

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

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

A new nozzle should open at the following pressure.

Specification

New Injection Nozzle (VCO 17 mm)—Opening Pressure.....	25 500—26 300 kPa (255—263 bar) (3698—3815 psi)
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On nozzles that have been in service, the spring and other components will have taken a normal set. In this case, opening pressure is satisfactory if it meets or exceeds the used nozzle minimum opening pressure given below, but does not exceed the new nozzle opening pressure given above.

Used nozzle minimum opening pressure is.

Specification

Used Injector Nozzle (VCO 17 mm)—Opening Pressure..... 21 000 kPa (210 bar) (3050 psi)

The difference in nozzle opening pressures between cylinders in an engine should not exceed specification.

Specification

Maximum Difference Between Cylinders (VCO 17 mm)—Opening Pressure 700 kPa (7 bar) (100 psi)

Leakage Test

1. Operate pump handle rapidly to firmly seat valve. Wipe the nozzle tip dry with a clean, lint-free cloth.
2. Slowly raise pressure at nozzle to about 2000 kPa (20 bar) (300 psi) under the measured opening pressure and hold at that pressure. Watch for an accumulation of fuel around the nozzle tip orifices.

Leakage is unacceptable if a drop falls from the nozzle tip within 10 seconds

Specification

Nozzle (VCO 17 mm) Condition at Pressure Test of 2000 kPa (20 bar) (300 psi)—Leakage..... No drip within 10 seconds

3. Check for external leakage around the top of the nozzle retaining nut.
4. If leakage is observed, tighten nozzle retaining nut to maximum specification.

Specification

Nozzle Retaining Nut (VCO 17 mm)—Torque..... 40 N•m (30 lb-ft) Maximum

If leakage continues, replace injection nozzle.

Chatter and Spray Pattern Test

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

Failure to chatter is an indication that the valve is not moving freely or there is a seat problem. Chatter is desirable but not a necessary characteristic.

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

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

If the nozzle fails to meet this requirement, repeat procedure. Nozzles that do not meet the requirement after a second test should be replaced.

After testing, immediately fit protective caps over nozzle tip and line connections to avoid damage from handling and getting dirt into fuel system.

OUC1082,000005A -19-10OCT07-4/4

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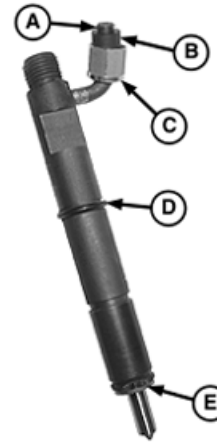
Install Seals on Fuel Injection Nozzle (VCO 17 mm)

IMPORTANT: Each time an injection nozzle is removed from the cylinder head, replace seals and tube nut with new.

Snap ring (A) must be properly installed in the retaining groove with both ends of ring even.

1. Install tube nut (C), seal (B) and snap ring (A). Ensure that snap ring (A) is properly seated in the retaining groove.
2. Install a new O-ring (D) onto nozzle body until it seats in its groove.
3. Position a new carbon stop seal washer (E) on nozzle.

NOTE: If nozzle is not going to be installed at this time, install a protector cap over nozzle tip. Plug all other openings in nozzle to prevent contamination.



Fuel Injection Nozzle Seals

- A—Snap Ring
- B—Seal
- C—Tube Nut
- D—O-Ring
- E—Carbon Stop Seal Washer

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RG15541 -UN-05OCT07

OUO1082,0000061 -19-10OCT07-1/1

Install Fuel Injection Nozzles (VCO 17 mm)

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

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

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

2. Install nozzle with clamp (D) in cylinder head using a slight twisting motion as nozzle is seated in bore. Illustration shows relationship of parts required for proper installation.
3. Align nozzle clamp (D) and install cap screw (C). Do not tighten cap screw at this stage.
4. Connect fuel injection line (B) to nozzle. Leave connection slightly loose until air is bled from system.
5. Tighten nozzle hold-down clamp cap screw to specification.

Specification

Fuel Injection Nozzle (VCO 17 mm) Hold-Down Clamp Cap Screw—Torque..... 35 N•m (26 lb-ft)

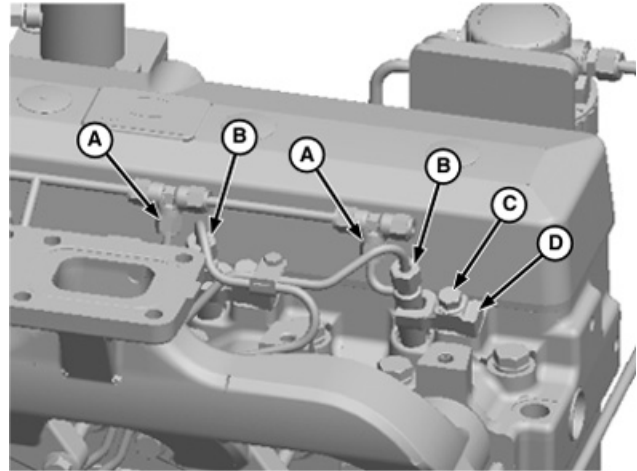
IMPORTANT: Avoid machine damage. Do NOT overtighten fuel leak-off lines.

6. Install leak-off line assembly. Tighten leak-off line tube nut (A) to specification.

Specification

Fuel Leak-Off Line Hex Nut (VCO 17 mm)—Torque 5 N•m (44 lb-in.)

7. Bleed air from loose injection line connection. Tighten connection (B) to specification.



Injection Nozzle in Cylinder Head

- A—Leak-Off Line Tube Nut
- B—Fuel Injection Line
- C—Cap Screw
- D—Hold Down Clamp

RG15529 -UN-11SEP07

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Specification

Fuel Injection Nozzle Delivery

Line—Torque..... 27 N•m (20 lb-ft)

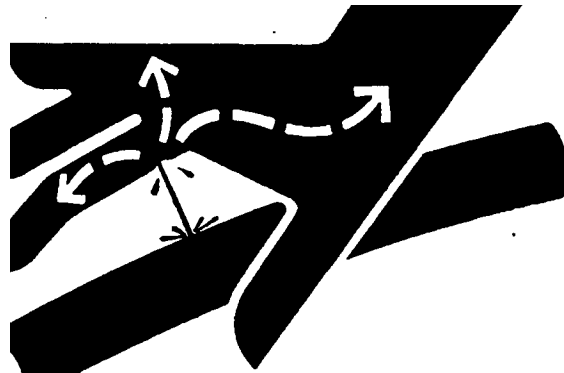
(See BLEED THE FUEL SYSTEM in this group.)

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OUO1082,0000062 -19-10OCT07-2/2

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 which eject fluids under high pressure. Use a piece of cardboard or paper to search for leaks. Do not use your hand.



High-Pressure Fluids

X9811 -UN-23AUG88

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.

IMPORTANT: Do not operate the engine at high speeds or full loads before first bleeding the fuel system as this may cause fuel injection pump failure.

Bleed the fuel system anytime the system has been opened. This includes:

- After fuel filter changes
- After pump or nozzle replacement
- Anytime fuel lines have been disconnected
- After engine has run out of fuel

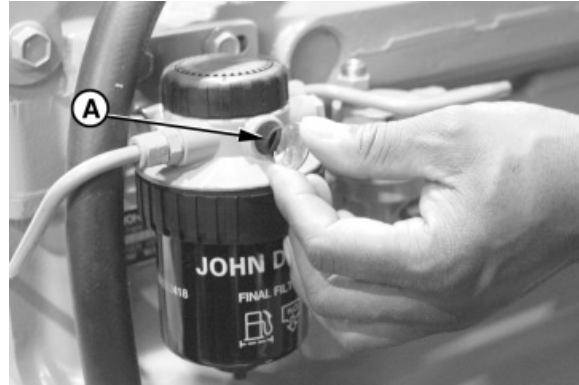
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OUO1082,0000063 -19-10OCT07-1/7

Bleed at Final Filter

1. Loosen the air bleed vent screw (A) two full turns by hand on fuel filter base.

A—Vent Screw



RG7947 -UN-13NOV97

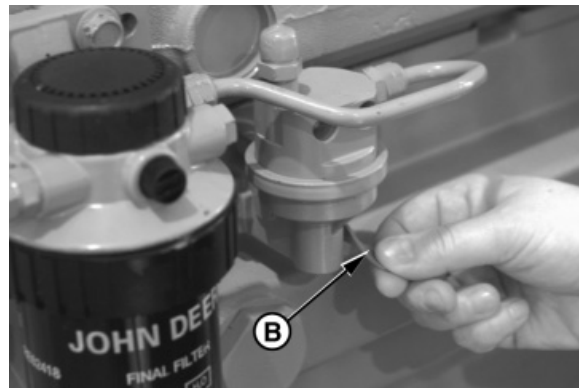
Air Bleed Vent Screw

OUO1082,000063 -19-10OCT07-2/7

2. Operate supply pump primer lever (B) until fuel flow is free of air bubbles.
3. Tighten bleed plug securely, and continue operating hand primer until pumping action is not felt. Push hand primer inward (toward engine) as far as it will go.
4. Start engine and check for leaks.

If engine will not start, it may be necessary to bleed air from fuel system at fuel injection pump or injection nozzles as explained below.

B—Fuel Supply Pump Primer Lever



RG8013A -UN-15JAN99

Fuel Supply Pump Primer Lever

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Bleed at Fuel Injection Pump

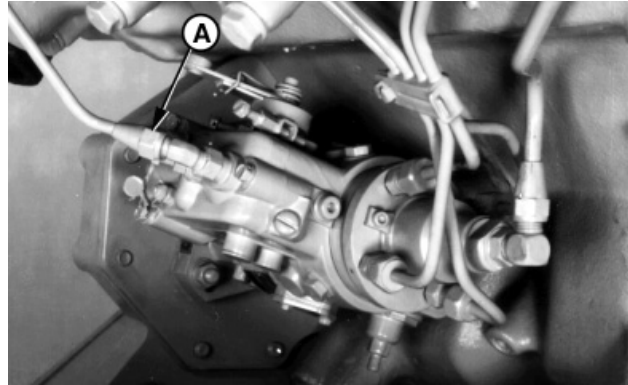
On Stanadyne rotary pumps:

1. Slightly loosen fuel return line connector (A) at fuel injection pump.
2. Operate fuel supply pump primer lever until fuel, without air bubbles, flows from fuel return line connection.
3. Tighten return line connector to specification.

Specification

Stanadyne Fuel Injection Pump
 Return Line Connector—Torque 27 N•m (20 lb-ft)

4. Primer lever is spring-loaded and will return to normal position.



Stanadyne Rotary Fuel Injection Pump

A—Fuel Return Line Connector

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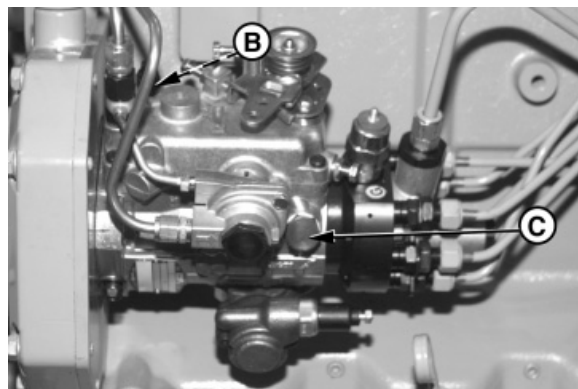
On Delphi/Lucas rotary pumps:

⚠ CAUTION: NEVER loosen screw (C) securing pump head, otherwise damage may occur.

1. Loosen bleed screw (B) on pump cover.

NOTE: On injection pump models DP200/201/203, bleed screw is located on top of cover near the fuel return line.

2. Operate fuel supply pump primer lever or turn ignition switch to "ON".
3. Wait until fuel flow is free of air bubbles. Tighten bleed screw.
4. Primer lever is spring-loaded and will return to normal position.



Delphi/Lucas Rotary Fuel Injection Pumps

B—Bleed Screw
C—Screw

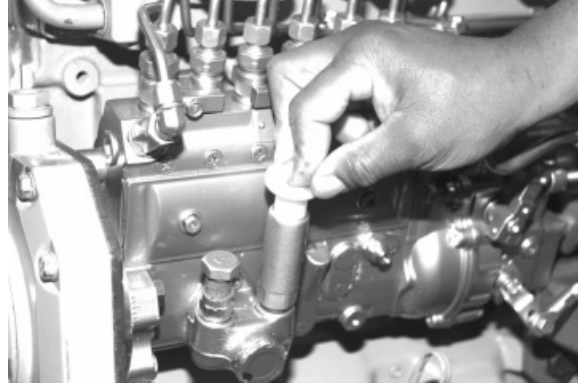
RG7948 -UN-13NOV97

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On Denso and Motorpal in-line pumps:

1. On Denso pump shown, unscrew hand primer on fuel supply pump until it can be pulled by hand.
2. Open fuel filter port plug.
3. Operate the hand primer until smooth flow of fuel, free of bubbles, comes out of the filter plug hole.
4. Simultaneously stroke the hand primer down and close the filter port plug. This prevents air from entering the system. Tighten plug securely. DO NOT overtighten.



Denso Fuel Injection Pump Shown

IMPORTANT: Be sure hand primer is all the way down in barrel before tightening to prevent internal thread damage.

5. On Denso pump shown, lock hand primer in position.

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FG8069 -UN-23NOV97

Bleed at Fuel Injection Nozzles

1. Move the engine speed control lever to half throttle position. On engines equipped with electronic fuel shut-off solenoid, energize solenoid.

IMPORTANT: To avoid damage to fuel lines on 9.5 mm injectors, always use a backup wrench when loosening or tightening fuel lines at nozzles or injection pump.

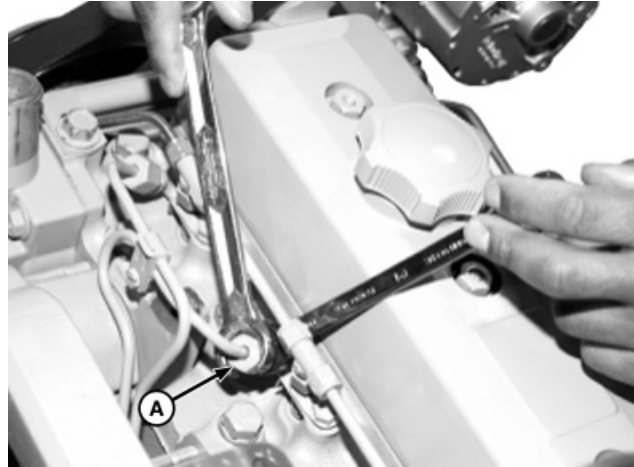
2. On 9.5 mm injectors: Using two open-end wrenches, loosen fuel line connector (A) at injection nozzle as shown.
3. On VOC 17 mm injectors: Loosen fuel line connector (A) at injection nozzle as shown.
4. Crank engine over with starter motor (but do not start engine), until fuel, free of bubbles, flows out of loosened connection.
5. Tighten connection to specification.

Specification

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

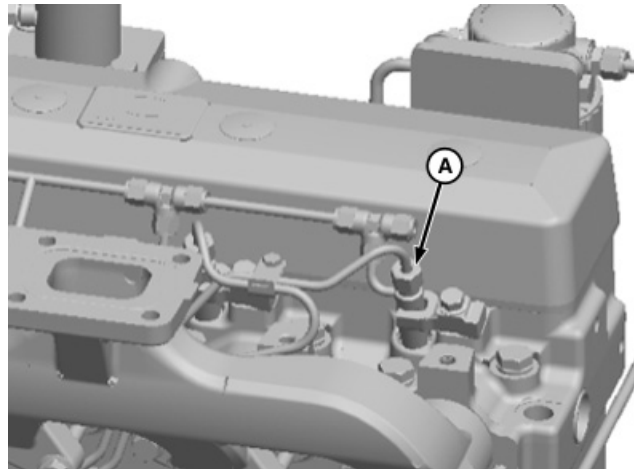
6. Repeat procedure for remaining injection nozzles (if necessary) until all air has been removed from fuel system.

If engine will not start, see your authorized servicing dealer or engine distributor.



Fuel Line Connection—Conventional and RSN 9.5 mm Injector

RG15537 -UN-17SEP07



Fuel Line Connection—VOC 17 mm Injector

RG15536 -UN-17SEP07

A—Fuel Line Connector

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Section 03 Theory of Operation

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Fuel Injection Pump—General Information

Most engines are equipped with a Stanadyne or Delphi/Lucas rotary-type injection pump. Rotary injection pumps are dynamically timed at the producing factory, and reference timing marks are accurately stamped on front plate and injection pump hub. Timing can be checked and adjusted as covered below using the TIME TRAC® or TACH-N-TIME™ Kit.

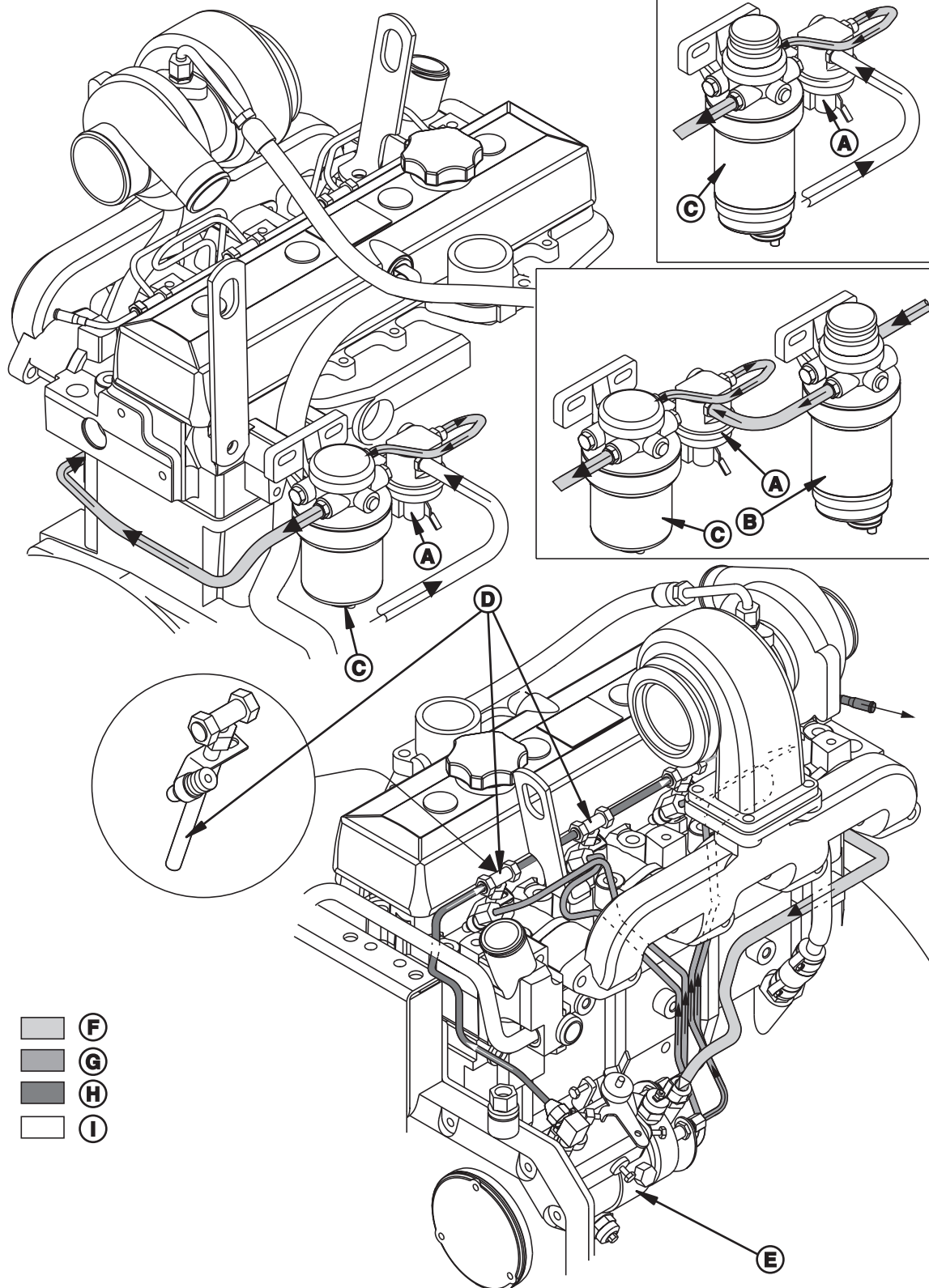
Higher horsepower engines use multiple-plunger, in-line type Denso or Motorpal fuel injection pumps with a mechanical flyweight governor. Injection pumps may be equipped with an aneroid control.

In-line injection pumps are statically timed by locking engine at No. 1 TDC compression when installing pump with injection pump drive hub lock-pinned (refer to Section 02, Group 090 for installation of injection pumps and pump timing.)

TIME TRAC is a registered trademark of Stanadyne Automotive Corp.
TACH-N-TIME is a trademark of SPX Corp.

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Fuel System Operation—Rotary Fuel Injection Pump



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Rotary Fuel Injection Operation

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A—Fuel Supply (Transfer) Pump
 B—Primary Fuel Filter/Water Separator

C—Final Fuel Filter
 D—Fuel Injection Nozzles
 E—Fuel Injection Pump

F—Supply Pump Pressure Fuel
 G—Injection Pressure Fuel

H—Fuel Return Leak-Off
 I—Suction Fuel from Tank

Refer to illustration on previous page.

The fuel supply pump (A) draws fuel under vacuum from the tank, through the primary filter (B). The fuel supply pump pressurizes the fuel, which then flows to the final filter (C). Fuel flowing out of the final filter charges the transfer pump of the injection pump (E).

With the fuel injection pump charged with fuel by the fuel supply pump, the injection pump plungers pressurize the fuel to approximately 50 000 kPa (500 bar) (7255 psi). Delivery (pressure) lines are used to route this high pressure fuel to the fuel injection nozzles (D).

Fuel enters the injection nozzle at a pressure which easily overcomes the pressure required to open the nozzle valve. When the nozzle valve opens, fuel is forced out through the orifices in the nozzle tip and atomizes as it enters the combustion chamber.

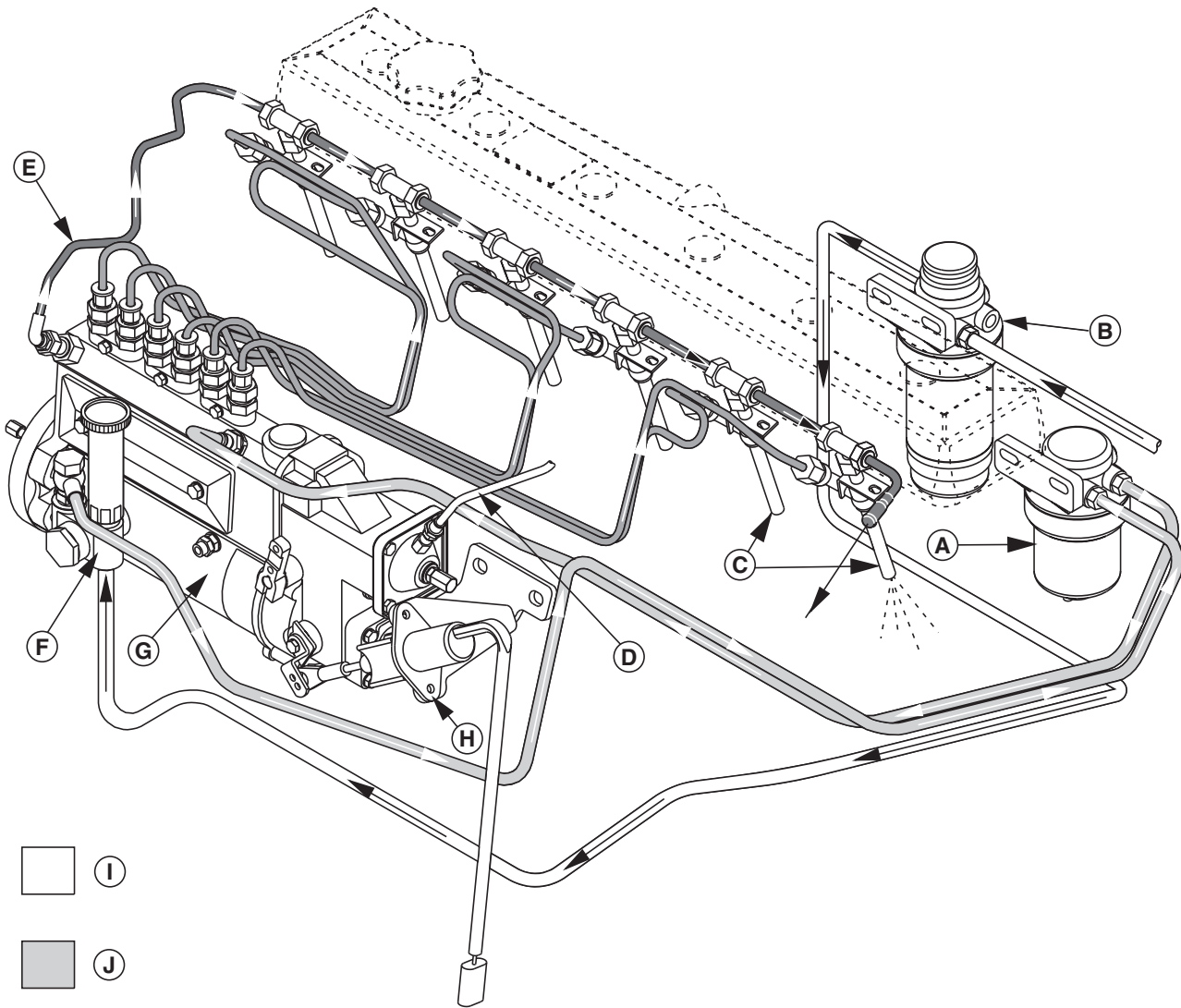
Incorporated into the fuel system is a means of returning excess (or unused) fuel (H) back to the fuel tank. Excess fuel comes from two sources:





1. Fuel Injection Pump: A quantity of fuel greater than that required by the engine is supplied to the fuel injection pump.
2. Fuel Injection Nozzles: A small amount of fuel seeps past the nozzle valve for lubrication purposes.

To get the excess fuel back to the tank, a return line from the injection pump is connected to the middle of the nozzle leak-off line. Fuel from both sources is then returned to the tank by a return pipe connected to the front end of the leak-off pipe.

03
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Fuel System Operation—In-Line Fuel Injection Pump



-  (I)
-  (J)
-  (K)
-  (L)

In-Line Fuel Injection Pump Operation

- | | | | |
|--|--------------------------------------|------------------------------------|----------------------------------|
| A—Final Fuel Filter | D—Aneroid Inlet Line | H—Fuel Shut-Off Solenoid | K—Injection Pressure Fuel |
| B—Primary Fuel Filter/Water Separator | E—Fuel Return (Leak-Off) Line | I—Suction Fuel from Tank | L—Return (Leak-Off) Line |
| C—Injection Nozzles | F—Fuel Supply Pump | J—Supply Pump Pressure Fuel | |
| | G—Fuel Injection Pump | | |

The supply pump (F) draws fuel from the vented fuel tank through the primary filter (B).

pump output pressure will vary depending on load and application.

The supply pump pressurizes the fuel so that it flows through the filter to the injection pump galley. Supply

RG7789 -UN-25FEB98

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The galley is kept full by the supply pump. Injection pump plungers further pressurize the fuel. Injection pressure lines route the fuel to the nozzles (C).

The high pressure fuel (K) 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 (L) returns this excess fuel to the tank from both the pump and nozzles.

Fuel Supply Pump Operation—Rotary Injection Pump

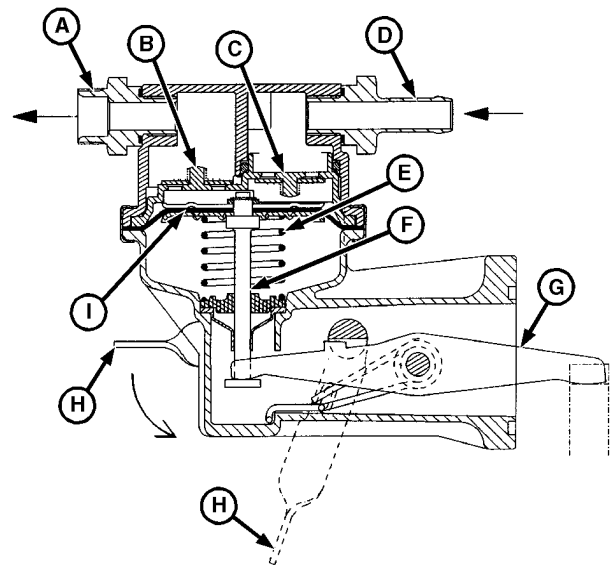
The Sofabex fuel supply pump used with Delphi/Lucas and Stanadyne rotary fuel injection pumps uses an eccentric lobe on the engine camshaft to operate lever (G) on supply pump to pressurize fuel system.

Fuel flows from the fuel tank at gravity pressure to the inlet side (D) of the diaphragm-type pump.

As lever (G) rides on the high side of the camshaft lobe, rod (F) pulls diaphragm (I) down. Suction pressure opens the inlet check valve (C) and fuel is drawn into the pump.

As the camshaft lobe rotates to the low side, return spring (E) forces diaphragm (I) upward. The resulting fuel pressure closes inlet check valve (C) and opens outlet check valve (B), delivering fuel through outlet (A) to the injection pump.

Hand primer lever (H) is provided for manually forcing fuel through the system to bleed air from the fuel filter, lines, etc.



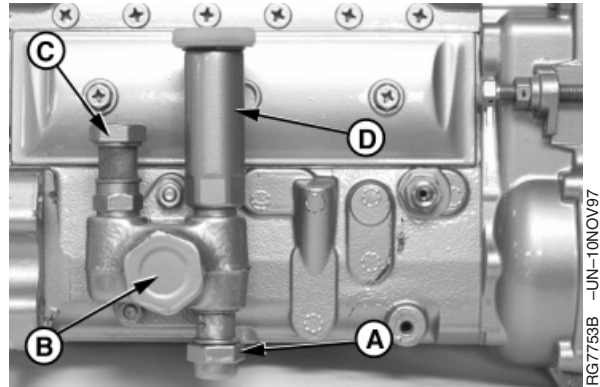
Fuel Supply Pump Operation

- A—Fuel Outlet
- B—Outlet Check Valve
- C—Inlet Check Valve
- D—Fuel Inlet
- E—Return Spring
- F—Rod
- G—Lever
- H—Hand Primer Lever
- I—Diaphragm

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Fuel Supply Pump Operation—In-Line Injection Pump

The plunger-type Denso and Motorpal fuel supply pumps are mounted on the side of the injection pump housing and 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 the fuel system.



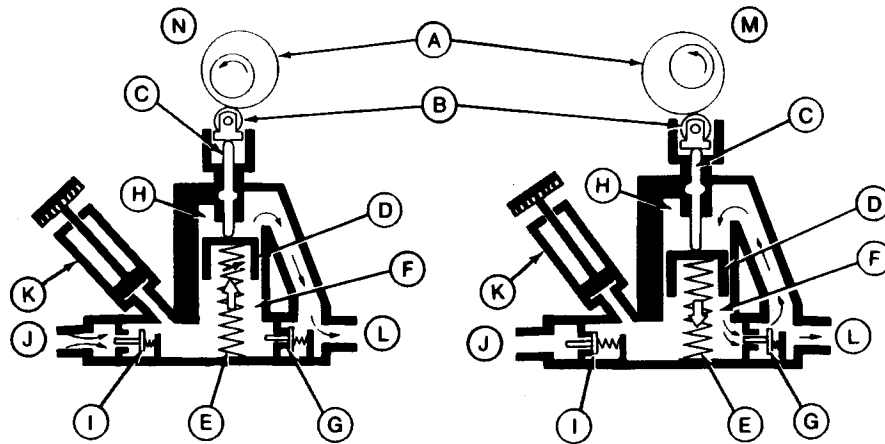
Fuel Supply Pump Operation (Denso Pump Shown)

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

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RG.115,JW7706 -19-24NOV97-1/3



Fuel Supply Pump Operation

RG5787 -UN-06AUG91

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A—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—Hand Primer Pump
L—Fuel Outlet

M—Intermediate Stroke Position
N—Suction and Discharge Stroke Position

Denso Supply Pump Operation

As the pump camshaft (A) rotates toward the “high cam” intermediate stroke position (M), 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 (N), 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

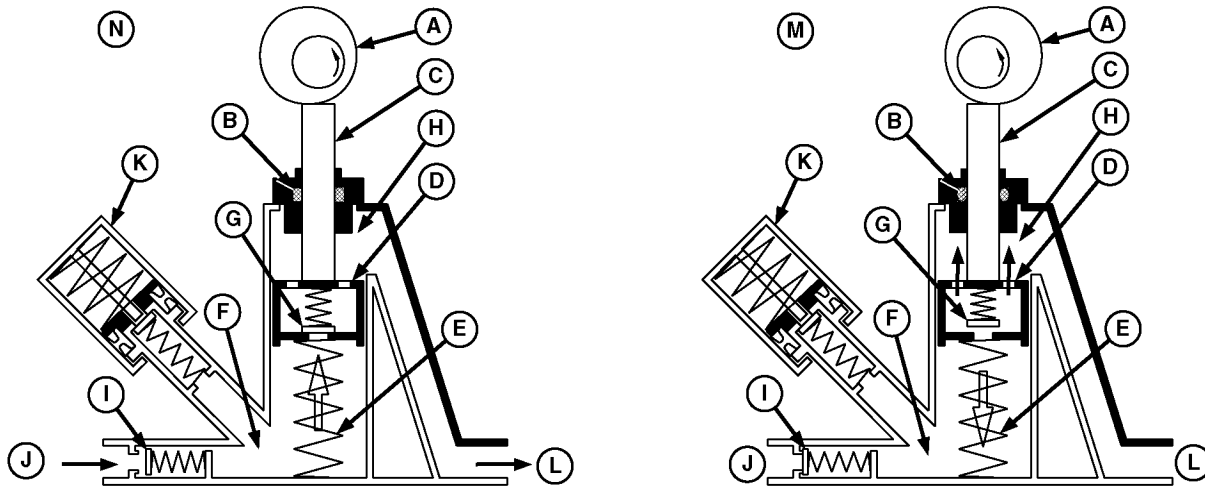
injection pump. At the same time, plunger suction pressure is permitting fuel to enter the suction chamber through the suction valve (I). With the suction chamber charged with fuel, the pumping cycle begins again.

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.

Unscrewing the knurled knob on the hand primer pump (K) and pulling upward 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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RG,115,JW7706 -19-24NOV97-2/3



Fuel Supply Pump Operation

- | | | | |
|--------------------|--------------------|--------------------|---|
| A—Camshaft | E—Plunger Spring | I—Suction Valve | M—Intermediate Stroke Position |
| B—O-Ring | F—Suction Chamber | J—Fuel Inlet | N—Suction and Discharge Stroke Position |
| C—Pressure Spindle | G—Pressure Valve | K—Hand Primer Pump | |
| D—Plunger | H—Pressure Chamber | L—Fuel Outlet | |

Motorpal Supply Pump Operation

As the pump camshaft (A) rotates toward the “high cam” intermediate stroke position (M), the pressure spindle (C) causes 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 (N), plunger spring pressure causes the plunger and pressure spindle 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 the housing.

When the hand primer is pushed downward, the suction valve closes and fuel is forced out of the pressure valve. During movement upwards (by help of the spring), the suction valve opens and fuel flows into the suction chamber.

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RG10729 -UN-18MAY00

Cold Start Advance System Operation (Rotary Pumps)

To comply with exhaust emissions regulations, the timing of injection pumps should be around 6—9 degrees before TDC. This timing value does not allow for proper start-up when the engine is cold. A cold start advance system is used to temporarily advance injection pump timing during cold engine start-up conditions.

Stanadyne Cold Start Advance

On engines equipped with Stanadyne injection pumps, the major components of the cold start advance system are the cold start advance switch, cold start advance solenoid and cold start advance piston.

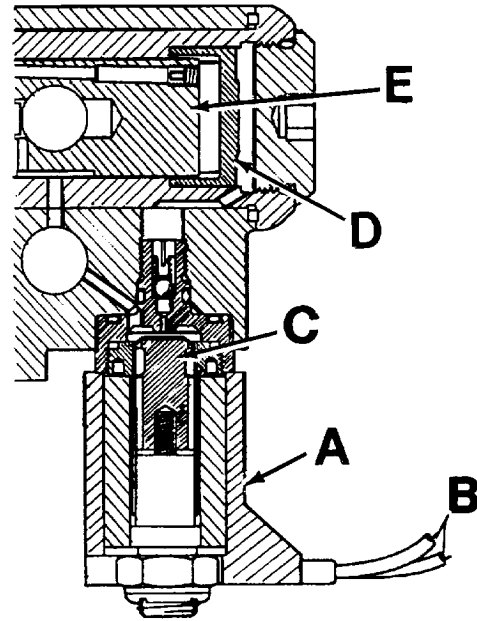
The cold start advance switch is mounted in the water manifold/thermostat housing. The switch is normally closed at coolant temperatures below 60°C (140°F), providing current to energize the cold start solenoid. At cold start-up, the solenoid plunger is unseated, allowing pressurized fuel to flow to the cold start advance piston (D). This forces advance piston (E) to the fully advanced position, advancing engine timing 7—10 degrees.

When engine coolant temperature rises above 60°C (140°F), the cold start advance switch opens, cutting off current flow to the solenoid. The solenoid plunger seats, cutting off fuel flow to the cold start advance piston (D) and timing returns to normal operating levels.

Delphi/Lucas Cold Start Advance

On engines equipped with Delphi/Lucas injection pumps, the major components of the cold start advance system are the cold start advance switch, wax motor, cold start advance piston and springs, auto advance housing, piston and springs.

The cold start advance switch is mounted in the water manifold/thermostat housing. The switch is normally open at coolant temperatures below 60°C (140°F). At cold start-up, there is no current flow to the wax motor. Maximum fuel pressure is applied to the auto advance piston and engine timing is advanced 7—10 degrees.



Cold Start Advance (Stanadyne Pump Shown)

- A—Cold Start Advance Solenoid Assembly
- B—Wiring Connector for Cold Start Switch
- C—Solenoid Valve
- D—Cold Advance Piston
- E—Advance Piston

When engine coolant temperature rises above 60°C (140°F), the cold start advance switch closes and current flows to the wax motor. A heating element in the wax motor heats the wax, causing it to expand. As the wax expands, the wax motor plunger extends, opening a ball valve and applying fuel pressure to the cold start advance piston. Equal pressure between the cold start advance piston and the auto advance piston and the net force applied to the advance springs returns injection pump timing to normal operating levels.

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Light Load Advance Operation (Rotary Pumps)

Light load advance is used on engines with rotary injection pumps to maintain injection pump timing and engine speed as load decreases. Under full and/or consistent loads, transfer pressure in the injection pump is stable, acting on the advance piston to maintain pump timing and rated engine speed.

As the load begins to decrease, a corresponding decrease in transfer pressure occurs which tends to

retard timing and drop engine rpm under the remaining load. To compensate, the governor begins to close a metering valve in the light load advance circuit. As flow through the metering valve drops, transfer pressure begins to rise again and acts on the advance piston to advance pump timing and maintain engine rpm.

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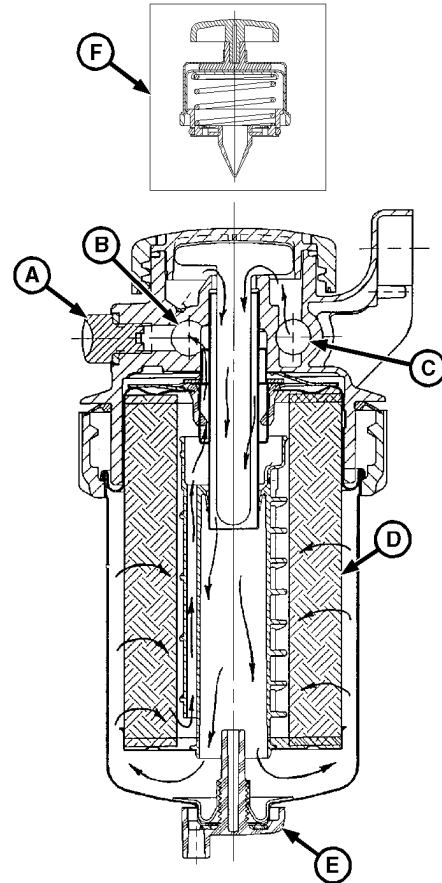
Final Fuel Filter/Water Separator Operation

Fuel enters the filter at inlet (C), then flows through filter element (D) and exits through outlet (B) to the fuel injection pump. The filter element is housed in a sediment bowl attached to the base with a threaded retaining ring.

Since water and contaminants settle at the bottom of the sediment bowl, a drain plug (E) is provided.

Air in the system can be expelled through the air vent when bleed screw (A) is loosened. Optional priming pump (F) draws fuel from the fuel tank to fill the filter bowl when the filter element is changed. The priming pump also supplies fuel from the filter to the injection pump.

- A—Bleed Screw
- B—Fuel Outlet
- C—Fuel Inlet
- D—Filter Element
- E—Drain Plug
- F—Primer Pump



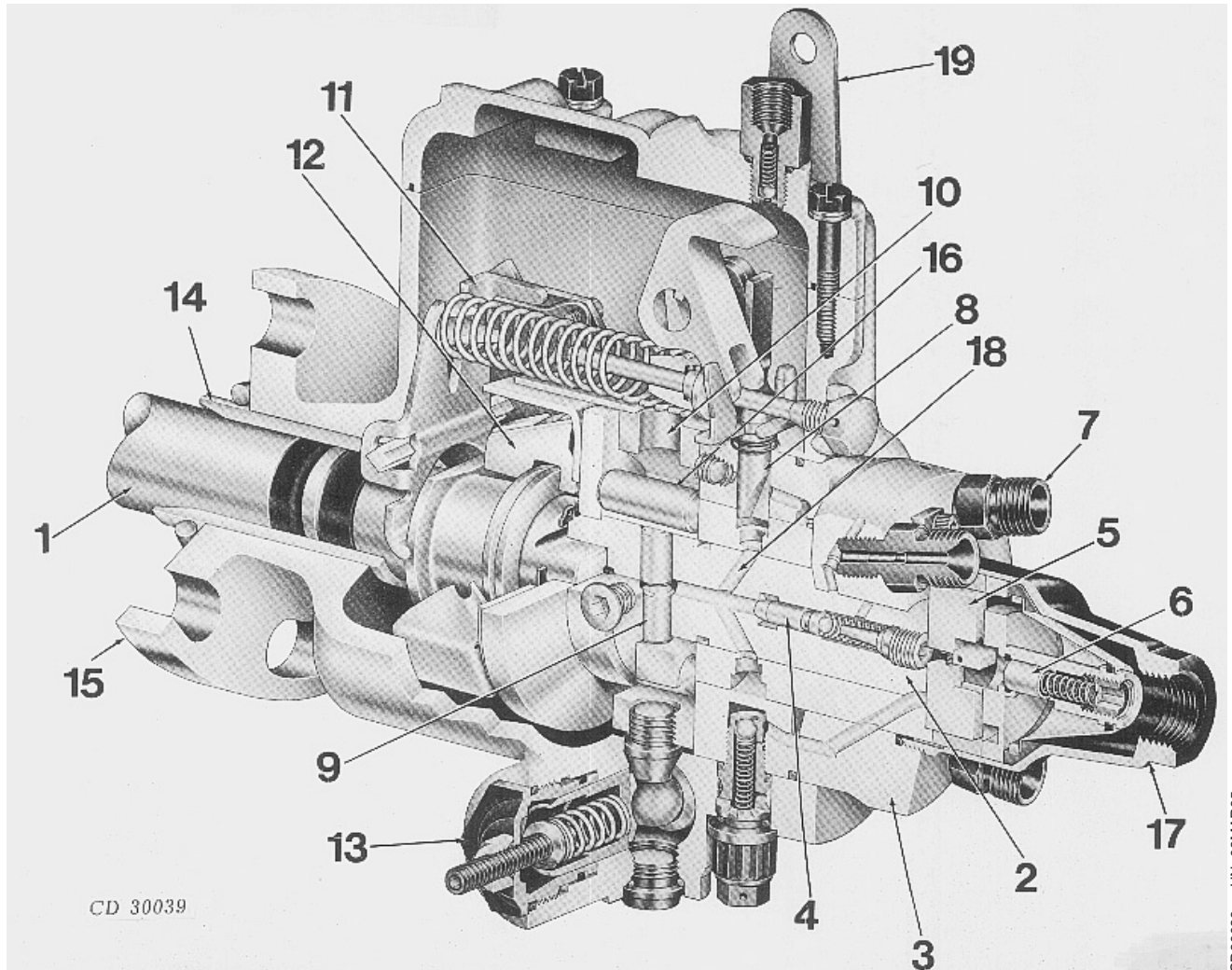
Final Fuel Filter

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Stanadyne Rotary Fuel Injection Pump Operation



DB2 Pump Shown, DB4 Pump Similar

- | | | | |
|---------------------|----------------------|------------------------|----------------------|
| 1—Drive Shaft | 6—Pressure Regulator | 11—Governor | 16—Rollers |
| 2—Distributor Rotor | 7—Discharge Fitting | 12—Governor Weights | 17—Supply Pump Inlet |
| 3—Hydraulic Head | 8—Metering Valve | 13—Automatic Advance | 18—Charging Ports |
| 4—Delivery Valve | 9—Pumping Plungers | 14—Drive Shaft Bushing | 19—Throttle Lever |
| 5—Supply Pump | 10—Internal Cam Ring | 15—Housing | |

The main rotating components are the drive shaft (1), distributor rotor (2), supply pump (5) and governor (11).

The drive shaft engages the distributor rotor in hydraulic head (3). The drive end of rotor incorporates two pumping plungers (9).

The plungers are actuated toward each other simultaneously by an internal cam ring (10) through rollers (16) and shoes which are carried in slots at

drive end of the rotor. The number of cam lobes normally equals the number of engine cylinders.

The supply pump at rear of rotor is a positive displacement vane-type pump enclosed in the end cap. The end cap also houses supply pump inlet (17), fuel strainer and pressure regulator (6). Supply pump pressure is automatically compensated for viscosity effects due to temperature changes and fuel grade variations.

Continued on next page

RG.115,JW7694 -19-24NOV97-1/2

The distributor rotor incorporates two charging ports (18) and a single axial bore (passage) with one discharge port to serve all head outlets (7) to the injection lines. The rotor rotates in bore of hydraulic head. Metering valve (8) bore, charging ports and discharge fittings are located in the head.

This pump contains its own mechanical governor. The centrifugal force of the weights (12) in their retainer is transmitted through a sleeve to a governor arm and through a positive linkage to the metering valve. The metering valve can be closed to shut off fuel through a solid linkage by an independently operated shut-off lever.

The automatic speed advance (13), advances or retards (hydraulically) the beginning of fuel delivery from the pump. The advance responds to changes in speed only, or to a combination of speed and load changes.

Fuel is drawn from the supply tank through filters into the pump inlet through the inlet filter screen by the vane type fuel transfer pump. Some fuel is bypassed through the pressure regulator assembly to the suction side.

Fuel under transfer pump pressure flows through the center of the transfer pump rotor, past the rotor retainer into a circular groove on the rotor. It then flows through a connecting passage in the head to the automatic advance and up through a radial passage and then through a connecting passage to the

metering valve. The radial position of the metering valve, controlled by the governor, regulates flow of the fuel into the radial charging passages which incorporates the head charging ports.

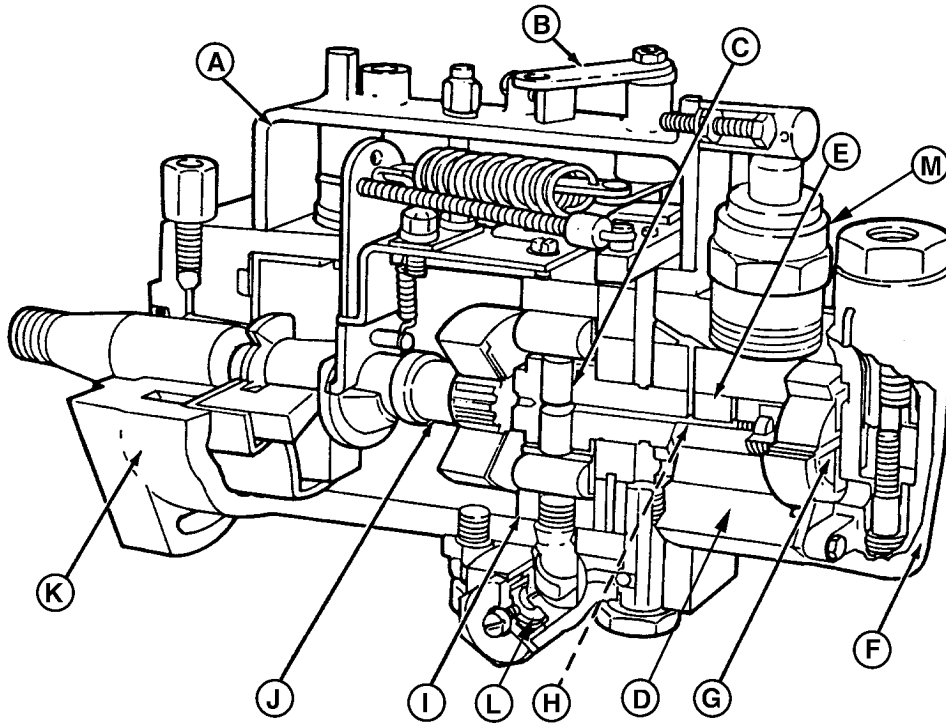
As the rotor revolves, the two rotor inlet passages register with the charging ports in the hydraulic head, allowing fuel to flow into the pumping chamber. With further rotation, the inlet passages move out of registry and the discharge port of the rotor registers with one of the head outlets. While the discharge port is opened, the rollers contact the cam lobes, forcing the plungers together. Fuel trapped between the plungers is then pressurized and delivered by the nozzle to the combustion chamber.

Self-lubrication is an inherent feature of the pump's design. As fuel at transfer pump pressure reaches the charging ports, slots on the rotor shank allow fuel and any entrapped air to flow into the pump housing cavity.

Additionally, an air vent passage in the hydraulic head connects the outlet side of the transfer pump with the pump housing. This allows air and some fuel to be bled back to the fuel tank via the return line. The fuel thus bypassed fills the housing, lubricates the internal components, cools and carries off any small air bubbles. The pump operates with the housing completely full of fuel; there are no dead air spaces anywhere within the pump.

A cold start switch is optional and aids in cold start-up operation.

Delphi/Lucas Rotary Fuel Injection Pump Operation



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Rotary Fuel Injection Pump—Delphi/Lucas

- | | | | |
|--------------------|---------------------|---------------------|---------------------|
| A—Governor Housing | E—Distributor Rotor | H—Delivery Valve | K—Pump Housing |
| B—Throttle Lever | F—End Plate | I—Internal Cam Ring | L—Automatic Advance |
| C—Pumping Plungers | G—Supply Pump | J—Drive Shaft | M—Electric Shut-Off |
| D—Hydraulic Head | | | |

The Delphi/Lucas fuel injection pump is a horizontally mounted distributor pump with mechanical governor and automatic hydraulic speed advance. The moving parts of the pump are simultaneously lubricated and cooled by diesel fuel flowing through the pump; no additional lubricant is required.

Diesel fuel for injection is fed to the cylinders by a single unit. The pumping plungers (C) and distributor rotor (E) are fitted with two opposed plungers controlled by an internal cam ring (I).

On the other end of the rotor, there is a supply pump (G) which delivers the fuel, drawn from the fuel filter, through the metering valve into the inlet bore in the pump hydraulic head (D), at a pressure that varies with engine speed.

As the rotor rotates, the inlet bore in pump head aligns with inlet bore in the rotor. Fuel coming from the transfer pump reaches the pump plunger chamber's through bore, regulated by the metering valve and forces the two plungers apart.

During further rotation of the distributor rotor, inlet bore in the pump head is closed and distributor channel in the rotor eventually aligns with one of the outlet bores in the pump head. Meanwhile the two pump plungers have reached the cam so that they move toward each other. The trapped, metered fuel is forced (under high pressure) through a channel in the rotor and outlet opening in the pump head, through the pressurizing valve and pressure line, to the injection nozzle, and into the appropriate cylinder.

Continued on next page

RG.115,JW7693 -19-09JUL02-1/2

A pressurizing valve is located at each outlet in the pump head where the pressure line leading to the fuel injection nozzle is connected. After injection, the pressure valve closes again, and with its small relief piston, draws in a quantity of fuel from the pressure line.

The resulting relief in the pressure line causes a quick and firm closing of the nozzle valve. This prevents fuel from leaking into the combustion chamber.

The quantity of fuel which is needed at any given moment for each cylinder and combustion cycle is regulated by a metering valve. The metering valve is controlled by the speed control rod and throttle lever (B), and by the governor inside the governor housing (A). In the "NO-FUEL" ("OFF") position, the metering valve completely cuts the supply of fuel from supply pump to the rotor.

At slow idle speed or under full load, the supply pump feeds more fuel to the metering valve than is needed for injection. The excessive fuel flows through the pressure regulating valve back to the suction side of the transfer pump. A very small amount of this surplus fuel escapes through the top of the governor housing.

To obtain the best possible performance over the entire speed range, the fuel injection pump is fitted with an automatic, hydraulically operated speed advance (L). This speed advance is preset at the factory. The speed advance adjusts timing of the fuel injection pump in relation to engine speed and load.

The light load advance is standard on Model DP203 pumps and optional on DP201 pumps.

A cold advance switch is optional on these pumps. The switch consists of a housing to which is fitted a spring-loaded piston assembly, a "wax motor", and a spring-loaded ball valve. It is fitted at the top of the spring end of the auto advance housing.

IMPORTANT: Remember that all adjustments to the injection pump, except for slow idle, MUST BE carried out on a test bench by a specialist injection pump repair station only. Internal adjustments in the field are not permitted, as this pump is a sealed unit.

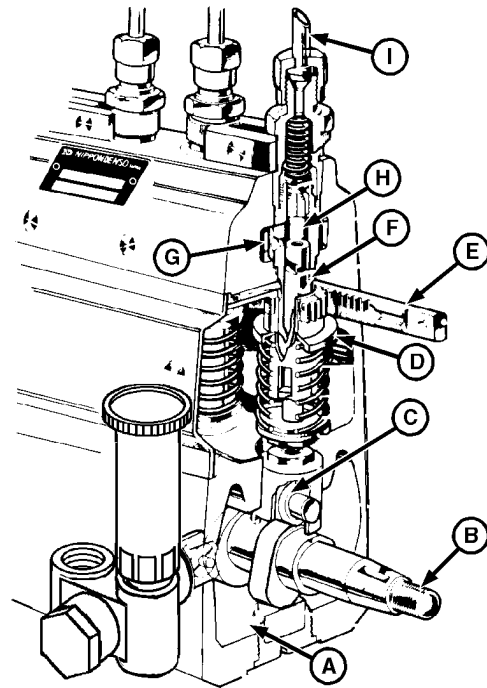
Denso and Motorpal In-Line Fuel Injection Pump Operation

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 (B) lobes operate the plungers (F) to supply high pressure fuel through the delivery valves (H) to the injection nozzles.

A governor-operated control rack (E) is connected to the control sleeves (D) 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 Sleeve
- E—Control Rack
- F—Plunger
- G—Fuel Gallery
- H—Delivery Valve
- I—Delivery Pipe



In-Line Fuel Injection Pump Operation (Denso Pump Shown/Motorpal Similar)

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Aneroid Operation (If Equipped)

NOTE: In-line injection pump shown. Operation of aneroid on rotary pumps is similar in theory.

Intake manifold pressure (created by the turbocharger) enters aneroid at (A). It is directed to upper side of diaphragm chamber (C) and exerts pressure on diaphragm (D).

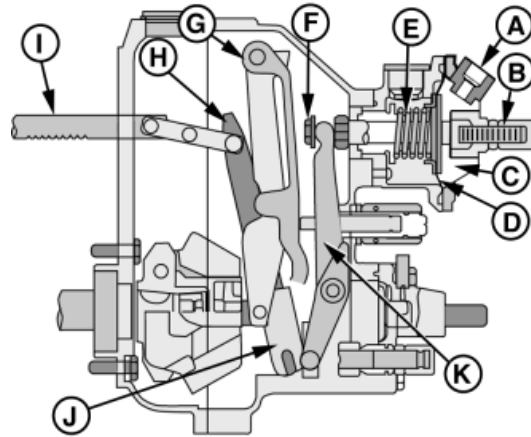
When the pressure rises to about 100 kPa (1 bar) (15 psi), or about 1000 engine rpm under moderate to heavy loads, spring (E) pressure is overcome. Diaphragm then moves aneroid control shaft (F) downward.

Control lever (H) has “two” legs. The inner leg connects with control block (J) and the aneroid control lever (K) and bears on the flat surface of aneroid control shaft. The outer leg bears against a block riveted to the control rack (I).

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).

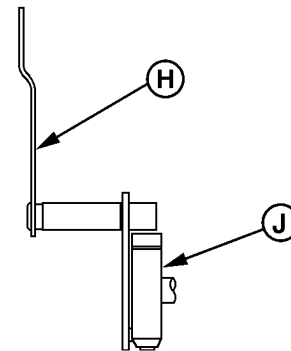
Downward movement of the throttle lever (L) causes arm to rotate on fuel control shaft, permitting control rack to move its normal amount.

- A—Intake Manifold Pressure Line Connection
- B—Diaphragm Adjusting Screw
- C—Diaphragm Chamber
- D—Diaphragm
- E—Spring
- F—Aneroid Control Shaft
- G—Guide Lever
- H—Control Lever
- I—Control Rack
- J—Control Block
- K—Aneroid Control Lever
- L—Throttle Lever



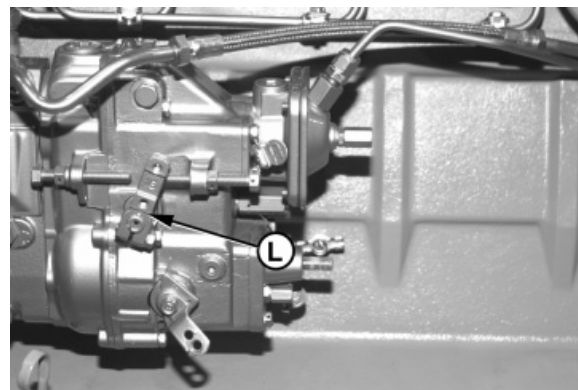
Aneroid Operation

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Aneroid Control Lever and Block

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Injection Pump Throttle Lever

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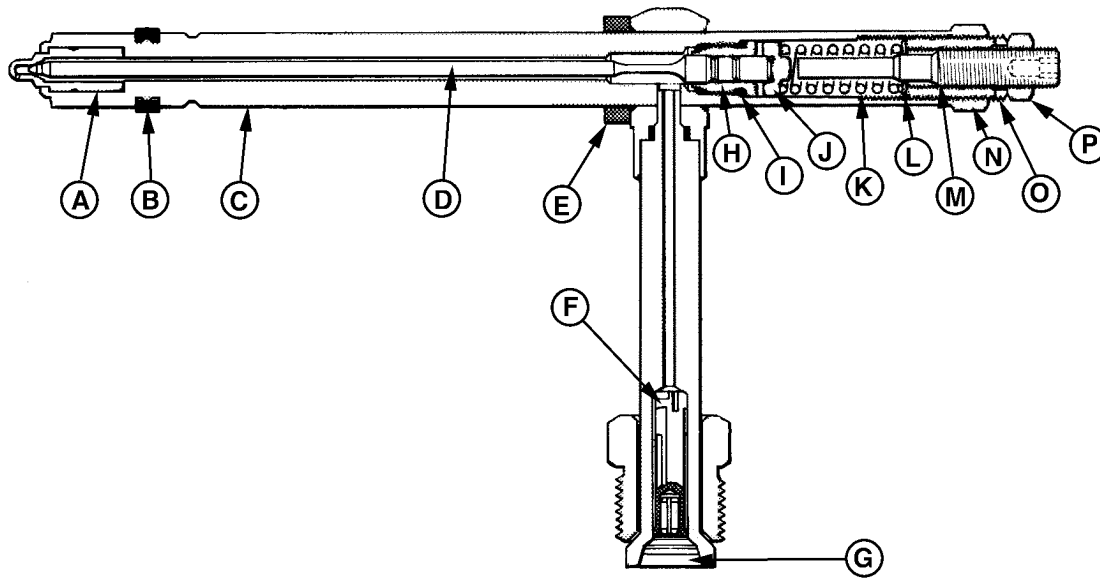
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If the intake manifold pressure is below 100 kPa (1 bar) (15 psi) because of low engine speed, or is under light load at higher engine speeds, the aneroid spring pressure is greater than the intake manifold pressure. As a result, the control rack travel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

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

Fuel Injection Nozzles Operation (9.5 mm)



Fuel Injection Nozzles—Operation

A—Nozzle Tip
B—Carbon Stop Seal
C—Nozzle Body
D—Nozzle Valve

E—Upper Seal Washer
F—Edge-Type Filter
G—Fuel Inlet
H—Upper Guide

I—Upper Seal
J—Spring Seat
K—Valve Spring
L—Spring Washer

M—Lift Adjusting Screw
N—Lock Nut
O—Pressure Adjusting Screw
P—Lock Nut

The injection nozzles are located in the engine cylinder head and are of the spring and valve type, hydraulically operated by fuel delivered from the injection pump.

A locating clamp positions the nozzle assembly in the cylinder head. The nozzle is sealed at the top end by a seal washer (E). A carbon stop seal (B), located on the lower end of the nozzle body (C), prevents carbon from collecting around the nozzle in the cylinder head.

Enclosed in the nozzle body are the valve (D), valve spring (K), and spring seat (J). The nozzle operating pressure is controlled by the pressure adjusting screw (O) in the upper end of the nozzle body. Valve lift is adjusted by the lift adjusting screw (M) located in the pressure adjusting screw. The nozzle tip (A) is pressed into the nozzle body and cannot be separated.

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

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

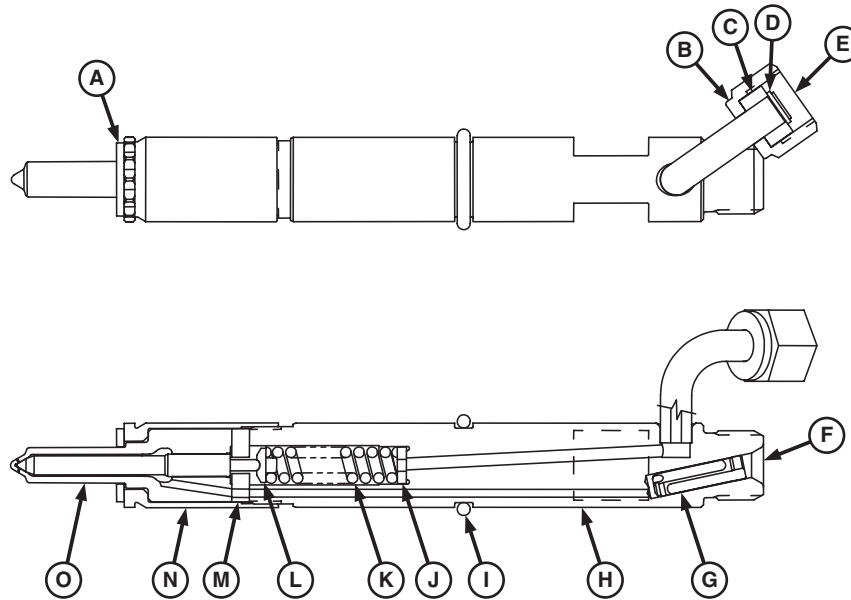
After fuel has been injected, the spring closes the valve. In actual operation, the valve opens and closes very rapidly, providing a distinct chatter.

A small amount of fuel leaks past the valve into the spring area. This provides lubrication for the nozzle working parts. This excess fuel is then removed from the nozzle at the top by means of a leak-off line routed to the fuel source.

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Fuel Injection Nozzles Operation (VCO 17 mm)



Fuel Injection Nozzles—Operation

- | | | | |
|-------------------------|-------------------------------|------------------------------|-----------------------------|
| A—Sealing Washer | E—Fuel Leak-Off | I—O-Ring Seal | M—Adapter Plate Assembly |
| B—Flex Tube Nut | F—Fuel Inlet | J—Pressure Adjusting Shim(s) | N—Nozzle Retaining Nut |
| C—Flex Tube Sleeve | G—Edge-Type Filter | K—Pressure Adjusting Spring | O—Multihole Nozzle Assembly |
| D—Square Retaining Ring | H—Nozzle Holder Body Assembly | L—Spring Seat | |

The injectors are located in the engine cylinder head and are of the spring-loaded valve type, hydraulically actuated by metered high pressure fuel delivered from the injection pump.

A locating clamp positions and retains the injector in the cylinder head. The injector is sealed at the head

bore entrance by an O-ring (I) to prevent fluids and debris from entering the space between the injector and the bore. A copper sealing washer (A) at the bottom prevents combustion gas leakage and carbon buildup around the injector in the head.

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The injector is composed of two main assemblies, the nozzle holder body assembly (H) and the multihole nozzle assembly (O). Enclosed in the holder assembly fuel inlet (F) is an edge filter (G), which filters the fuel before it enters the nozzle assembly to prevent debris damage or spray hole plugging. Also in the holder body is the spring chamber, which contains the spring seat (L), spring (K), and shim(s) (J). The shim thickness adjusts the spring preload on the valve to set the injector opening pressure. The spray pattern is aligned to the clamp flats on the holder body by dowel pins in the plate assembly (M). Precision surfaces between the two bodies and the plate provide a high-pressure metal-to-metal seal. The retaining nut (N) holds all the injector components together.

The nozzle assembly (O) is composed of a needle valve that is matched to the nozzle body. During injection, the inlet fuel pressure working on the valve differential area generates a force that overcomes the

spring preload, causing the valve to lift up to its stop against the adapter plate. The lift is a preset feature of the nozzle. The unrestricted fuel then passes through the small spray holes, causing fuel atomization into the combustion chamber. The nozzle design is a VCO configuration in which the valve covers the spray holes to minimize any unatomized fuel and resulting hydrocarbon emissions.

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

A small amount of fuel leaks past the tight guide clearance between the nozzle valve and body, out through the spring chamber, to provide lubrication for the injector moving parts. This excess fuel is then removed from the injector through the fuel leak-off (E) back to the fuel source.

Section 04 Diagnostics

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04

About This Section of the Manual

This section of the manual contains necessary information to diagnose general engine and fuel system observable symptoms for engines using a mechanical fuel system. Use this information in conjunction with 4.5 L & 6.8 L Diesel Engines—Base Engine Manual (CTM104). 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 General Engine Malfunctions:
 - E1—Engine Cranks/Won't Start
 - E2—Engine Misfires/Runs Irregularly
 - E3—Engine Does Not Develop Full Power
 - E4—Engine Emits Excessive White Exhaust Smoke
 - E5—Engine Emits Excessive Black or Gray 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. For 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:
 - Cylinder Misfire Test (Engine Running)
 - Using TIME TRAC® or TACH-N-TIME™ Kit as a Tachometer
 - Check and Adjust Rotary Injection Pump Dynamic Timing
 - Check and Adjust In-Line Injection Pump Static Timing
 - Check Fuel Supply Quality
 - Test Air in Fuel

- Check for Restricted Fuel Return Line
- Measure Fuel Supply Pump Pressure—Rotary Injection Pump
- Measure Fuel Supply Pump Pressure—In-Line Injection Pump
- Test Fuel Supply Pumps for Leaks—In-Line Injection Pumps
- Check Fuel Supply Pump Operation—In-Line Injection Pump
- Service Denso Fuel Supply Pump
- Check Cold Start Switch Operation—Rotary Pumps
- Check Cold Start Advance System Operation—Rotary Pumps
- Check Light Load Advance Operation—Rotary Pumps
- Check Fuel Shut-Off Solenoid Operation—In-Line Injection Pumps
- Test Fuel Shut-Off Solenoid Resistance—Delphi/Lucas Pump
- Test Fuel Shut-Off Solenoid Resistance—Denso Pump
- Test Fuel Shut-Off Solenoid Resistance—Motorpal Pump
- Adjust Fuel Shut-Off Solenoid Linkage—In-Line Injection Pumps
- Check and Adjust Engine Speeds on Delphi/Lucas Pump
- Adjust Variable Speed on Generator Set Engines (Delphi/Lucas Pumps Only)
- Check and Adjust Engine Speeds on Stanadyne Pump
- Adjust Variable Speed (Droop) on Generator Set Engines (3–5% Governor Regulation)—Stanadyne DB2 and DB4 Injection Pumps
- Check and Adjust Fast Idle Speed—Denso and Motorpal Fuel Injection Pump
- Check and Adjust Slow Idle Speed—Denso Fuel Injection Pump
- Check and Adjust Slow Idle Speed—Motorpal Fuel Injection Pump
- Change Engine Rated Speed and Adjust Droop—Denso Fuel Injection Pump
- Test Fuel Injection Nozzles (Engine Running)
- Fuel Drain-Back Test Procedure
- Bleed the Fuel System

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E1—Engine Cranks/Won't Start

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E1—Engine Cranks/Won't Start Diagnostic Procedure

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

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.

Before using this diagnostic procedure:

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

Ensure engine cranking speed is OK. See TEST ENGINE CRANKING SPEED in Group 150 in Section 4 of 4.5 L & 6.8 L Diesel Engines—Base Engine Manual (CTM104).

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<p>1 FUEL SHUT-OFF OPERATION CHECK</p>	<p>In-Line Injection Pumps:</p> <p>Check operation of fuel shut-off mechanism. See CHECK FUEL SHUT-OFF SOLENOID OPERATION—IN-LINE INJECTION PUMPS later in this group.</p> <p>Rotary Injection Pumps:</p> <p>While turning key to ON position, listen for fuel shut-off solenoid to click.</p>	<p>Operation normal/solenoid clicks: Go to 3.</p> <p>Problem found with shut-off mechanism: Go to 2.</p>
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<p>2 FUEL SHUT-OFF SOLENOID RESISTANCE CHECK</p>	<p>In-Line Injection Pumps:</p> <p>Check resistance of fuel shut-off mechanism. See TEST FUEL SHUT-OFF SOLENOID RESISTANCE—DENSO PUMP or TEST FUEL SHUT-OFF SOLENOID RESISTANCE—MOTORPAL PUMP later in this group.</p> <p>Rotary Injection Pumps:</p> <p>Check resistance of fuel shut-off mechanism. See TEST FUEL SHUT-OFF SOLENOID RESISTANCE—DELPHI/LUCAS PUMP later in this group.</p>	<p>Resistance is within specifications: Check wiring harness.</p> <p>Resistance is not within specifications: Replace solenoid.</p>
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Observable Diagnostics and Tests

<p>③ FUEL PRESENT AT INJECTION NOZZLE CHECK</p>	<p>Perform the following procedure to check for fuel at injection pump:</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"> 1. Loosen fuel line at one of the injection nozzles. Use two open-ended wrenches on all 9.5 mm injectors. 2. Crank engine while monitoring loosened fuel connection for consistent squirts of fuel. 3. Retighten connection at nozzle to specification. Use two open-ended wrenches on all 9.5 mm injectors. <p style="text-align: center;">Fuel Present at Injection Nozzle Check—Specification</p> <p>Fuel Injection Nozzle Delivery Lines— Torque 27 N•m (20 lb-ft)</p>	<p>Consistent squirts of fuel observed: Go to 4.</p> <p>Don't see consistent squirts of fuel: Go to F1—FUEL SUPPLY SYSTEM CHECK later in this group.</p> <p style="text-align: right;">---1/1</p>
<p>④ INTAKE AND EXHAUST RESTRICTION CHECK</p>	<p>Check for intake and exhaust restrictions. See CHECK FOR INTAKE AND EXHAUST RESTRICTIONS in Group 150 in Section 4 of 4.5 L & 6.8 L Diesel Engines—Base Engine Manual (CTM104).</p>	<p>No restrictions are found: Go to 5.</p> <p>Restrictions are found: Repair or replace components as needed.</p> <p style="text-align: right;">---1/1</p>
<p>⑤ INJECTION PUMP TIMING CHECK</p>	<p>Rotary Injection Pumps:</p> <p>See CHECK AND ADJUST ROTARY INJECTION PUMP DYNAMIC TIMING later in this group.</p> <p>In-Line Injection Pumps:</p> <p>See CHECK AND ADJUST IN-LINE INJECTION PUMP STATIC TIMING later in this group.</p>	<p>Timing is correct: Go to 6.</p> <p>Timing is not correct: 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>6 COMPRESSION PRESSURE CHECK</p>	<p>Check compression pressure. See TEST ENGINE COMPRESSION PRESSURE in Group 150 in Section 4 of 4.5 L & 6.8 L Diesel Engines—Base Engine Manual (CTM104).</p>	<p>Compression pressure is within specification: Go to 7.</p> <p>Compression pressure is not within specification: Go to 8.</p> <p style="text-align: right;">-- -1/1</p>
<p>7 FUEL INJECTION NOZZLE CHECK</p>	<p>Test fuel injection nozzles. See TEST FUEL INJECTION NOZZLES (ENGINE RUNNING) later in this group.</p>	<p>Injection nozzles test good: Have Stanadyne injection pump repaired by authorized diesel repair station or replace injection pump. Have Delphi/Lucas injection pump repaired by authorized diesel repair station or replace injection pump. Have Denso injection pump repaired by authorized diesel repair station or replace injection pump. Have Motorpal injection pump repaired by authorized diesel repair station or replace injection pump. See 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>
<p>8 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 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.

Before using this diagnostic procedure:

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

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<p>❶ CYLINDER MISFIRE CHECK</p>	<p>Check cylinders for misfire. See CYLINDER MISFIRE TEST (ENGINE RUNNING) later in this group.</p>	<p>Single cylinder misfire: Go to 2.</p> <p>Random or all cylinder misfire: Go to F1—FUEL SUPPLY SYSTEM CHECK later in this group.</p>
<p>❷ HEAD GASKET CHECK</p>	<p>Check for head gasket joint failures. See CHECK FOR HEAD GASKET FAILURES in Group 150 in Section 4 of 4.5 L & 6.8 L Diesel Engines Base Engine Manual (CTM104).</p>	<p>No sign of head gasket failure: Go to 3.</p> <p>Signs of head gasket failure found: Replace head gasket and retest.</p>
<p>❸ 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 4.</p> <p>Lines are restricted: Repair or replace lines and retest.</p>

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Observable Diagnostics and Tests

<p>4 COMPRESSION PRESSURE CHECK</p>	<p>Check compression pressure. See TEST ENGINE COMPRESSION PRESSURE in Group 150 in Section 4 of 4.5 L & 6.8 L Diesel Engines Base Engine Manual (CTM104).</p>	<p>Compression pressure is within specification: Go to 5.</p> <p>Compression pressure is not within specification: Go to 6.</p> <p style="text-align: right;">-- -1/1</p>
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<p>5 FUEL INJECTION NOZZLE CHECK</p>	<p>Test fuel injection nozzles. See TEST FUEL INJECTION NOZZLES (ENGINE RUNNING) later in this group.</p>	<p>Injection nozzles test good: Have Stanadyne injection pump repaired by authorized diesel repair station or replace injection pump. Have Delphi/Lucas injection pump repaired by authorized diesel repair station or replace injection pump. Have Denso injection pump repaired by authorized diesel repair station or replace injection pump. Have Motorpal injection pump repaired by authorized diesel repair station or replace injection pump. See 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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<p>6 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 9.</p> <p>Compression pressure is not within specification: Go to 7.</p> <p style="text-align: right;">-- -1/1</p>
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Observable Diagnostics and Tests

<p>7 VALVE LASH CHECK</p>	<p>Check valve lash. See CHECK AND ADJUST VALVE CLEARANCE in Group 020 in Section 2 of 4.5 L & 6.8 L Diesel Engines Base Engine Manual (CTM104).</p>	<p>Valve lash is within specification: Go to 8.</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>8 VALVE LIFT CHECK</p>	<p>Check valve lift. See MEASURE VALVE LIFT in Group 020 in Section 2 of 4.5 L & 6.8 L Diesel Engines Base Engine Manual (CTM104).</p>	<p>Lift on all valves within specification: Go to 9.</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 Group 020 in Section 2 of 4.5 L & 6.8 L Diesel Engines Base Engine Manual (CTM104).</p> <p style="text-align: right;">-- -1/1</p>
<p>9 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 style="text-align: right;">-- -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

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.

Before using this diagnostic procedure:

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

Check for restricted or plugged air filter.

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<p>1 EXHAUST EMISSION CHECK</p>	<p>Operate engine at full load rated speed. Under these conditions, determine type of exhaust emitted.</p>	<p>Small amount or no smoke: Go to 2.</p> <p>Heavy white exhaust smoke: Go to E4—ENGINE EMITS EXCESSIVE WHITE EXHAUST SMOKE diagnostic procedure later in this group.</p> <p>Heavy gray or black exhaust smoke: Go to E5—ENGINE EMITS EXCESSIVE BLACK OR GRAY EXHAUST SMOKE diagnostic procedure later in this group.</p>
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<p>2 POWER AND RESPONSE TEST</p>	<p>Run engine through different loads at multiple speeds. Check for low power at each range and responsiveness to the increase in speeds.</p>	<p>Engine does not develop full power: Go to 5.</p> <p>Engine does not accelerate satisfactorily: Go to 3.</p>
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<p>3 THROTTLE CABLE BINDING CHECK</p>	<p>Check throttle cable for any binding that could restrict the movement of the cable.</p>	<p>Throttle cable is OK: Go to 4.</p> <p>Throttle cable is bound: Repair or replace throttle cable and retest.</p>
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Observable Diagnostics and Tests

<p>4 FAST IDLE CHECK</p>	<p>In-Line Injection Pumps:</p> <p>Check fast idle speed. See CHECK AND ADJUST FAST IDLE SPEED—DENSO AND MOTORPAL FUEL INJECTION PUMP later in this group.</p> <p>Rotary Injection Pumps:</p> <p>Check fast idle speed. See CHECK AND ADJUST ENGINE SPEEDS ON A DELPHI/LUCAS PUMP or CHECK AND ADJUST ENGINE SPEEDS ON STANADYNE PUMP</p>	<p>Fast idle is within specification: Go to 5.</p> <p>Fast idle is below specification: Contact your authorized diesel repair station.</p> <p style="text-align: right;">-- -1/1</p>
<p>5 TURBOCHARGER BOOST PRESSURE CHECK</p>	<p>Check turbo boost pressure. See MEASURE INTAKE MANIFOLD PRESSURE (TURBO BOOST) in Group 150 in Section 4 of 4.5 L & 6.8 L Diesel Engines Base Engine Manual (CTM104).</p>	<p>Pressure within specification: Go to 6.</p> <p>Pressure below specification: Go to 7.</p> <p style="text-align: right;">-- -1/1</p>
<p>6 EXCESSIVE PARASITIC LOAD CHECK</p>	<p>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.</p>	<p>Excessive parasitic load found: Repair cause of excessive load and retest.</p> <p style="text-align: right;">-- -1/1</p>
<p>7 FUEL SUPPLY SYSTEM CHECK</p>	<p>Perform fuel supply system check. See F1—FUEL SUPPLY SYSTEM CHECK later in this group.</p>	<p>No problem found: Go to 8.</p> <p>Problem found: No further analysis is necessary.</p> <p style="text-align: right;">-- -1/1</p>
<p>8 FUEL RETURN LINE CHECK</p>	<p>Check for restricted fuel return line and fittings. See CHECK FOR RESTRICTED FUEL RETURN LINE later in this group.</p>	<p>Return line and fitting OK: Go to 9.</p> <p>Return line and fitting restricted: Repair or replace return line and/or fitting.</p> <p style="text-align: right;">-- -1/1</p>
<p>9 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 TEST FOR INTAKE AIR LEAKS and CHECK FOR EXHAUST AIR LEAKS (TURBOCHARGED ENGINES) in Group 150 in Section 4 of 4.5 L & 6.8 L Diesel Engines Base Engine Manual (CTM104).</p>	<p>No restrictions or leaks found: Go to 10.</p> <p>Restrictions or leaks found: Repair or replace components as needed.</p> <p style="text-align: right;">-- -1/1</p>

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Observable Diagnostics and Tests

<p>10 INJECTION PUMP TIMING CHECK</p>	<p>Rotary Injection Pumps: See CHECK AND ADJUST ROTARY INJECTION PUMP DYNAMIC TIMING later in this group.</p> <p>In-Line Injection Pumps: See CHECK AND ADJUST IN-LINE INJECTION PUMP STATIC TIMING later in this group.</p>	<p>Timing is correct: Go to 11.</p> <p>Timing is not correct: Follow adjustment procedure in timing check procedure.</p> <p style="text-align: right;">-- -1/1</p>
<p>11 TURBOCHARGER FAILURE CHECK</p>	<p>Check for turbocharger failures. See TURBOCHARGER SEVEN-STEP INSPECTION in Group 080 in Section 2 of 4.5 L & 6.8 L Diesel Engines Base Engine Manual (CTM104).</p>	<p>No turbocharger failures found: Go to 12.</p> <p>Failures are found: Follow appropriate repair procedure in Group 080 in Section 2 of 4.5 L & 6.8 L Diesel Engines Base Engine Manual (CTM104).</p> <p style="text-align: right;">-- -1/1</p>
<p>12 VALVE CLEARANCE CHECK</p>	<p>Check valve clearance. See CHECK AND ADJUST VALVE CLEARANCE in Group 020 in Section 2 of 4.5 L & 6.8 L Diesel Engines Base Engine Manual (CTM104).</p>	<p>Valve clearance on all valves within specification: Go to 13.</p> <p>Valve clearance on one or more valves out of specification: Adjust valve clearance and retest.</p> <p style="text-align: right;">-- -1/1</p>

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Observable Diagnostics and Tests

**13 FUEL INJECTION
NOZZLE CHECK**

Test fuel injection nozzles. See TEST FUEL INJECTION NOZZLES (ENGINE RUNNING) later in this group.

Injection nozzles test good: Have Stanadyne injection pump repaired by authorized diesel repair station or replace injection pump. Have Delphi/Lucas injection pump repaired by authorized diesel repair station or replace injection pump. Have Denso injection pump repaired by authorized diesel repair station or replace injection pump. Have Motorpal injection pump repaired by authorized diesel repair station or replace injection pump. See Section 02, Group 090 of this manual.

Faulty injection nozzle(s) found: Repair or replace injection nozzles.

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

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 Go to L1—EXCESSIVE OIL CONSUMPTION diagnostic procedure in Group 150 in Section 4 of 4.5 L & 6.8 L Diesel Engines Base Engine Manual (CTM104).

Before using this diagnostic procedure:

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

Ensure engine coolant temperature isn't extremely low.

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<p>① FAILED HEAD GASKET CHECK</p>	<p>Check for failed head gasket. See CHECK FOR HEAD GASKET FAILURES in Group 150 in Section 4 of 4.5 L & 6.8 L Diesel Engines Base Engine Manual (CTM104).</p>	<p>No sign of head gasket failure: Go to 2.</p> <p>Sign of head gasket failures are found: See HEAD GASKET INSPECTION AND REPAIR SEQUENCE in Group 030 in Section 2 of 4.5 L & 6.8 L Diesel Engines Base Engine Manual (CTM104).</p>
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<p>② INJECTION PUMP TIMING CHECK</p>	<p>Rotary Injection Pumps: See CHECK AND ADJUST ROTARY INJECTION PUMP DYNAMIC TIMING later in this group.</p> <p>In-Line Injection Pumps: See CHECK AND ADJUST IN-LINE INJECTION PUMP STATIC TIMING later in this group.</p>	<p>Timing is correct: Go to 3.</p> <p>Timing is incorrect: Follow adjustment procedure in timing check procedure.</p>
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Observable Diagnostics and Tests

<p>3 COMPRESSION PRESSURE CHECK</p>	<p>Check compression pressure. See TEST ENGINE COMPRESSION PRESSURE in Group 150 in Section 4 of 4.5 L & 6.8 L Diesel Engines Base Engine Manual (CTM104).</p>	<p>Compression pressure is within specification: Go to 4.</p> <p>Compression pressure is not within specification: Go to 5.</p> <p style="text-align: right;">-- -1/1</p>
<p>4 FUEL INJECTION NOZZLE CHECK</p>	<p>Test fuel injection nozzles. See TEST FUEL INJECTION NOZZLES (ENGINE RUNNING) later in this group.</p>	<p>Injection nozzles test good: Have Stanadyne injection pump repaired by authorized diesel repair station or replace injection pump. Have Delphi/Lucas injection pump repaired by authorized diesel repair station or replace injection pump. Have Denso injection pump repaired by authorized diesel repair station or replace injection pump. Have Motorpal injection pump repaired by authorized diesel repair station or replace injection pump. See 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>
<p>5 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 style="text-align: right;">-- -1/1</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 applies to engines using mechanical fuel systems. For engines using electronic fuel systems, refer to the manual that corresponds to the ECU being used.

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 Group 150 in Section 4 of 4.5 L & 6.8 L Diesel Engines Base Engine Manual (CTM104).

Before using this diagnostic procedure:

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

Ensure engine is not excessively loaded.

Ensure air filter is not restricted or plugged.

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<p>1 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 LEAK (TURBOCHARGED ENGINES) in Group 150 in Section 4 of 4.5 L & 6.8 L Diesel Engines Base Engine Manual (CTM104).</p>	<p>No restrictions or leaks found: Go to 2.</p> <p>Restrictions or leaks found: Repair and replace components as needed.</p>
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<p>2 INJECTION PUMP TIMING CHECK</p>	<p>Rotary Injection Pumps: See CHECK AND ADJUST ROTARY INJECTION PUMP DYNAMIC TIMING later in this group.</p> <p>In-Line Injection Pumps: See CHECK AND ADJUST IN-LINE INJECTION PUMP STATIC TIMING later in this group.</p>	<p>Timing is correct: Go to 3.</p> <p>Timing is not correct: Follow adjustment procedure in timing check procedure.</p>
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Observable Diagnostics and Tests

<p>③ TURBOCHARGER FAILURE CHECK</p>	<p>Check for turbocharger failure. See TURBOCHARGER SEVEN-STEP INSPECTION in Group 080 in Section 2 of 4.5 L & 6.8 L Diesel Engines Base Engine Manual (CTM104).</p>	<p>No turbocharger failure found: Go to 4.</p> <p>Failures are found: Follow appropriate repair procedure in Group 080 in Section 2 of 4.5 L & 6.8 L Diesel Engines Base Engine Manual (CTM104).</p> <p style="text-align: right;">---1/1</p>
<p>④ VALVE CLEARANCE CHECK</p>	<p>Check valve clearance. See CHECK AND ADJUST VALVE CLEARANCE in Group 020 in Section 2 of 4.5 L & 6.8 L Diesel Engines Base Engine Manual (CTM104).</p>	<p>Valve clearance on all valves within specification: Go to 5.</p> <p>Valve clearance on one or more valves out of specification: Adjust valve clearance and retest.</p> <p style="text-align: right;">---1/1</p>
<p>⑤ FUEL RETURN LINE CHECK</p>	<p>Check for restricted fuel return line and fitting. See CHECK FOR RESTRICTED FUEL RETURN LINE later in this group.</p>	<p>Return line and fitting OK: Go to 6.</p> <p>Return line and fitting restricted: Repair or replace return line and/or fitting.</p> <p style="text-align: right;">---1/1</p>

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<p>⑥ FUEL INJECTION NOZZLE CHECK</p>	<p>Test fuel injection nozzles. See TEST FUEL INJECTION NOZZLES (ENGINE RUNNING) later in this group.</p>	<p>Injection nozzles test good: Have Stanadyne injection pump repaired by authorized diesel repair station or replace injection pump. Have Delphi/Lucas injection pump repaired by authorized diesel repair station or replace injection pump. Have Denso injection pump repaired by authorized diesel repair station or replace injection pump. Have Motorpal injection pump repaired by authorized diesel repair station or replace injection pump. See 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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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 -19-19AUG04-1/1

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 Group 080 in Section 2 of 4.5 L & 6.8 L Diesel Engines Base Engine Manual (CTM104).
	Electronic control system problem or basic engine problem	See E2—ENGINE MISFIRES/RUNS IRREGULARLY earlier in this group.

DPSG, RG41221, 37 -19-19AUG04-1/1

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 (ROD AND CRANKSHAFT IN ENGINE) or CHECK MAIN BEARING OIL CLEARANCE in Group 030 in Section 2 of 4.5 L & 6.8 L Diesel Engines Base Engine Manual (CTM104).
	Excessive crankshaft end play	Check crankshaft end play. See CHECK CRANKSHAFT END PLAY in Group 040 in Section 2 of 4.5 L & 6.8 L Diesel Engines Base Engine Manual (CTM104).
	Loose main bearing caps	Check bearing clearance; replace bearings and bearing cap screws as required. See CHECK MAIN BEARING OIL CLEARANCE in Group 030 of Section 2 of 4.5 L & 6.8 L Diesel Engines Base Engine Manual (CTM104).
	Worn connecting rod bushings and piston pins	Inspect piston pins and bushings. See INSPECT PISTON PINS AND BUSHINGS in Group 030 in Section 2 of 4.5 L & 6.8 L Diesel Engines Base Engine Manual (CTM104).
	Scored pistons	Inspect pistons. See PRELIMINARY LINER, PISTON, AND ROD CHECKS in Group 030 in Section 2 of 4.5 L & 6.8 L Diesel Engines Base Engine Manual (CTM104).
	Worn timing gears or excess back lash	Check timing gear backlash. See MEASURE TIMING GEAR BACKLASH in Group 050 in Section 2 of 4.5 L & 6.8 L Diesel Engines Base Engine Manual (CTM104).

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Observable Diagnostics and Tests

Symptom	Problem	Solution
Abnormal Engine Noise— Continued	Excessive valve clearance	Check and adjust valve clearance. See CHECK AND ADJUST VALVE CLEARANCE in Group 020 in Section 2 of 4.5 L & 6.8 L Diesel Engines Base Engine Manual (CTM104).
	Worn camshaft	Inspect camshaft. See VISUALLY INSPECT CAMSHAFT in Group 040 in Section 2 of 4.5 L & 6.8 L Diesel Engines Base Engine Manual (CTM104).
	Worn rocker arm shaft(s)	Inspect rocker arm shafts. See DISASSEMBLE AND INSPECT ROCKER ARM SHAFT ASSEMBLY in Group 020 in Section 2 of 4.5 L & 6.8 L Diesel Engines Base Engine Manual (CTM104).
	Insufficient engine lubrication	See L2—ENGINE OIL PRESSURE LOW in Group 150 in Section 4 of 4.5 L & 6.8 L Diesel Engines Base Engine Manual (CTM104).
	Turbocharger noise	See TURBOCHARGER SEVEN-STEP INSPECTION in Group 080 in Section 2 of 4.5 L & 6.8 L Diesel Engines Base Engine Manual (CTM104).

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F1—Fuel Supply System Check

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F1—Fuel Supply System Check

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.

Before using this diagnostic procedure:

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

Inspect all fuel lines and fittings for ruptures or leaks.

If fuel system has recently been opened, bleed fuel system. See BLEED THE FUEL SYSTEM later in this group.

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<p>1 AIR IN FUEL CHECK</p>	<p>Check for air in the fuel. See TEST AIR IN FUEL later in this group.</p>	<p>No air found in fuel system: Go to 2.</p> <p>Air found in fuel system: Bleed fuel system. See BLEED THE FUEL SYSTEM later in this group.</p>
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<p>2 FUEL SUPPLY PRESSURE CHECK</p>	<p>Rotary Injection Pumps:</p> <p>Check fuel supply pressure for rotary injection pumps. See MEASURE FUEL SUPPLY PUMP PRESSURE—ROTARY INJECTION PUMP later in this group.</p> <p>In-Line Injection Pumps:</p> <p>Check fuel supply pressure for in-line injection pumps. See MEASURE FUEL SUPPLY PUMP PRESSURE—IN-LINE INJECTION PUMP later in this group.</p>	<p>Pressure within specification: Go to 6.</p> <p>Pressure is below specification: Go to 3.</p>
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Observable Diagnostics and Tests

<p>③ 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 exists: Go to 4.</p> <p style="text-align: right;">-- -1/1</p>
<p>④ 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 5.</p> <p>Restrictions found: Repair or replace components as needed.</p> <p style="text-align: right;">-- -1/1</p>
<p>⑤ 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> <p>In-Line Injection Pumps:</p> <ul style="list-style-type: none"> • Test fuel supply pump for in-line injection pump leaks. See CHECK FUEL SUPPLY PUMP OPERATION—IN-LINE INJECTION PUMP or TEST FUEL SUPPLY PUMP FOR LEAKS—IN-LINE INJECTION PUMP later in this group. • Hand primer not screwed down tight, allowing dirt to enter hand primer plunger chamber. • Worn or pitted valves. • Missing or broken spring(s). • Hand primer lever left in upward position. <p>Rotary Injection Pumps:</p> <ul style="list-style-type: none"> • Loose or damaged fuel line connections. • Hand primer lever left in upward position. 	<p>No supply pump problems found: Go to 6.</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>⑥ RETURN FUEL CHECK</p>	<ol style="list-style-type: none"> 1. Disconnect fuel line from injection pump overflow valve. 2. Loosen overflow valve from injection pump. 3. Turn ignition switch to “ON” position. 4. 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 7.</p> <p>NOT good fuel flow or no flow out of loose overflow valve: Go to 8.</p> <p style="text-align: right;">-- -1/1</p>

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<p>7 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 Stanadyne injection pump repaired by authorized diesel repair station or replace injection pump. Have Delphi/Lucas injection pump repaired by authorized diesel repair station or replace injection pump. Have Denso injection pump repaired by authorized diesel repair station or replace injection pump. Have Motorpal injection pump repaired by authorized diesel repair station or replace injection pump. See Section 02, Group 090 of this manual.</p> <p>Lines are restricted: Repair or replace lines and retest.</p>
<p>8 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 9.</p> <p>Restrictions found: Repair or replace components as needed.</p>
<p>9 FUEL INJECTION PUMP CHECK</p>	<p><i>NOTE: If you are here because engine does not develop full power, return to E3 - ENGINE DOES NOT DEVELOP FULL POWER earlier in this group and proceed with diagnostics.</i></p> <p>Have Stanadyne injection pump repaired by authorized diesel repair station or replace injection pump. Have Delphi/Lucas injection pump repaired by authorized diesel repair station or replace injection pump. Have Denso injection pump repaired by authorized diesel repair station or replace injection pump. Have Motorpal injection pump repaired by authorized diesel repair station or replace injection pump. See Section 02, Group 090 of this manual.</p>	

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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.

DPSG,RG41221,25 -19-25APR01-1/1

F3—Fuel in Oil

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

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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 satisfactorily.
 - If engine speed does not change, a cylinder is faulty.
4. Repeat test for each remaining cylinder.
5. Tighten fuel lines to specifications.

Cylinder Misfire Test (Engine Running)—Specification

Fuel Injection Nozzle Delivery

Line—Torque 27 N•m (20 lb-ft)

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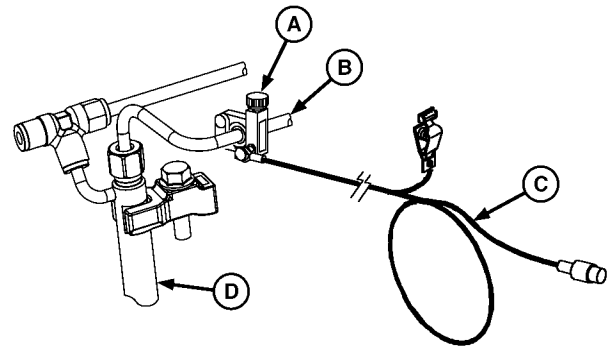
Using TACH-N-TIME™ as a Tachometer

The TACH-N-TIME™ meter can be used as a tachometer by using clamp-on transducer JDG10505P3 (A) at nozzle end of any high-pressure fuel injection line.

1. Remove paint and thoroughly clean the area of the high-pressure line to which the clamp-on transducer is to be attached.
2. Install transducer (A) on high-pressure fuel delivery line (B) close to No. 1 injector (D) and connect spring clip to a solid ground.
3. Connect transducer cable (C) to meter port marked SENSOR SIGNAL.
4. Set injection monitoring method switch to the CLAMP-ON position.

⚠ CAUTION: Do not connect JDG10505P1 TACH-N-TIME™ meter to 24 volt systems. Connect directly to the positive and negative terminals of the injection pump itself or other 12 volt system source.

5. Connect the TACH-N-TIME™ battery leads to a 12 volt power source. Red to positive (+) and black to negative (-).
6. Start the engine to measure and record engine speed.



Transducer

- A—JDG10505P3 6 mm (Red) Clamp-On Transducer
- B—Fuel Injection Delivery Line
- C—Transducer Cable
- D—No. 1 Injector

RG15530 -UN-20SEP07

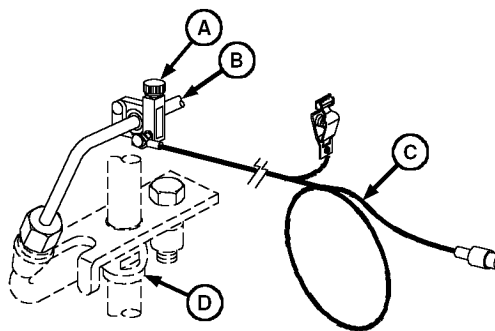
TACH-N-TIME is a trademark of SPX Corp.

OUC1082,0000068 -19-09OCT07-1/1

Using TIME TRAC® as a Tachometer

The TIME TRAC® meter can be used as a tachometer by using clamp-on transducer JT07177 (A) at nozzle end of any high-pressure fuel injection line.

1. Remove paint and thoroughly clean the area of the high-pressure line to which the clamp-on transducer is to be attached.
2. Install transducer (A) on high-pressure fuel delivery line (B) close to No. 1 injector and connect JT07172 cable (C) between transducer and JT07170 meter port marked "SR".
3. Switch on meter and start the engine to measure and record engine speed.



Transducer

- A—JT07177 6 mm (Green) Clamp-On Transducer
- B—Fuel Injection Delivery Line
- C—JT07172 Transducer Cable
- D—No. 1 Injector

RG10725 -UN-20APR00

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TIME TRAC is a registered trademark of Stanadyne Automotive Corp.

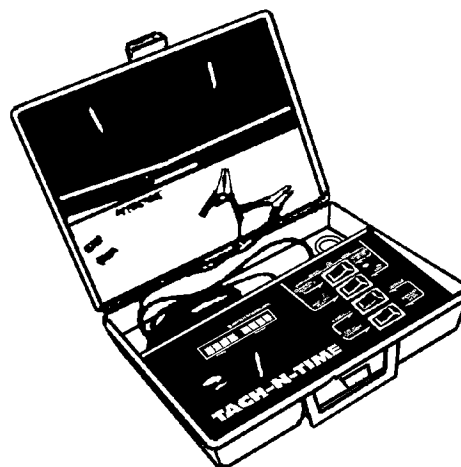
DPSG,OUO1004,115 -19-20APR00-1/1

Check and Adjust Rotary Injection Pump Dynamic Timing Using TACH-N-TIME™

NOTE: Dynamic timing can not be adjusted on Stanadyne injection pumps with lock shaft timing. For injection pump repair and timing, have an authorized ADS diesel injection repair station perform the work.

The JDG10534 TACH-N-TIME™ Kit electronically indicates start of injection with respect to piston top dead center (TDC), and allows accurate setting of injection pump timing to provide optimum power, smoke, and exhaust emissions.

Timing engines with this timing kit improves consistency between engines and helps to control cylinder firing pressures, which can be a factor in head gasket failures as well as improve overall engine performance efficiencies.



TACH-N-TIME Kit

RG15531 -UN-14SEP07

TACH-N-TIME is a trademark of SPX Corp.

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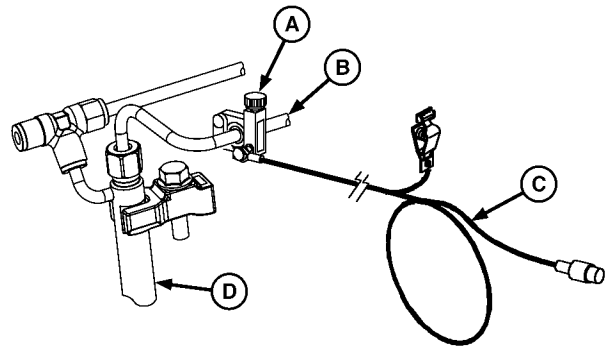
OUO1082,0000069 -19-09OCT07-1/6

Install JDG10534 TACH-N-TIME™ Kit:

IMPORTANT: All transducers and sensors must be installed at nozzle end of No. 1 fuel injection line. If access to No. 1 line is restricted, sensor can be installed on No. 4 injection line (4-cylinder engines) and No. 6 injection line (6-cylinder engines).

Remove all paint from injection line where clamp-on transducer will be installed and be sure this location is thoroughly clean.

1. Remove paint and thoroughly clean the area of the high-pressure line to which the clamp-on transducer is to be attached.
2. Install transducer (A) on high-pressure fuel delivery line (B) close to No. 1 injector (D) and connect spring clip to a solid ground.
3. Connect transducer cable (C) to meter port marked SENSOR SIGNAL.
4. Set injection monitoring method switch to the CLAMP-ON position.



Transducer

- A—JDG10505P3 6 mm (Red) Clamp-On Transducer
- B—Fuel Injection Delivery Line
- C—Transducer Cable
- D—No. 1 Injector

RG15530 -UN-20SEP07

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OOU1082.0000069 -19-09OCT07-2/6

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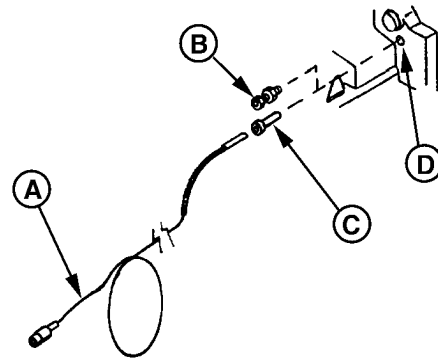
5. Use JDG1571 Timing Pin in flywheel timing hole (D) to ensure engine is NOT stopped at TDC. Magnetic pick-up probe will enter TDC timing hole in flywheel, if engine is at TDC, and will be damaged when engine is started. An air gap of 0.64 mm (0.025 in.) is recommended between tip of probe and flywheel face.
6. On engines with threaded magnetic pick-up hole: Install JDG793 Threaded Magnetic Pick-Up Adapter (B) into flywheel housing tapped hole until it bottoms. Insert probe of magnetic pick-up (A) into adapter until it contacts flywheel. Back out hex head of adapter two flats and tighten lock nut; this will provide recommended air gap.
7. On engines without threaded magnetic pick-up hole: Install JDG821 Tapered Magnetic Pick-Up Adapter (C) into flywheel housing hole. Lightly tap adapter to lock into position. Insert probe into adapter until it contacts the flywheel. Pull probe back out to provide 0.64 mm (0.025 in.) gap.
8. Plug magnetic pick-up connector into meter port marked CRANKSHAFT SENSOR JACK.
9. Set crankshaft monitoring method switch to MAGNETIC PICK-UP position.

⚠ CAUTION: Do not connect JDG10505P1 TACH-N-TIME™ meter to 24 volt systems. Connect directly to the positive and negative terminals of the injection pump itself or other 12 volt system source.

10. Connect the TACH-N-TIME™ battery leads to a 12 volt power source. Red to positive (+) and black to negative (-).
11. Digital display should light up and display SE-1200.

Check Rotary Injection Pump Rated Load Dynamic Timing:

1. Enter pump timing specification into meter. (See FUEL INJECTION PUMP SPECIFICATIONS in Section 06, Group 210.)



Magnetic Pick-Up in Timing Hole

- A—Magnetic Pick-Up
- B—JDG793 Threaded Magnetic Pick-Up Adapter
- C—JDG821 Tapered Magnetic Pick-Up Adapter
- D—Flywheel Timing Hole

RG7287 -UN-03NOV97

- a. If timing is specified as 20°, depress and release OFFSET ADJUSTMENT switch.

Display should now read 0000.....0.0

- b. If timing is specified as other than 20°, depress and hold PUSH AND HOLD switch. While holding down on switch use the INCREASE or DECREASE switch to adjust timing preset until correct timing specification is shown on display and release switch.

Display should now read 0000.....0.0

2. Make sure all cables and wires are clear of fan, belts or any other moving parts. Keep wires away from exhaust manifolds.
3. Start engine. SENSOR SIGNAL light should be blinking steadily, indicating proper clamp-on transducer installation.
4. Warm engine to normal operating temperature; check slow and fast idle rpm. (See FUEL INJECTION PUMP SPECIFICATIONS in Section 06, Group 210.) Adjust speeds as necessary.

IMPORTANT: Many machines have hydraulic pumps that have adequate flow to load engine well below rated load rpm. Some equipment may need to be driven in high gear or pull a load to bring engine speed to rated load rpm.

5. Run engine at wide open throttle (WOT) and load engine down gradually to rated speed rpm.
6. Record engine speed (rpm) and timing degrees.
7. Compare recorded speeds and timing degrees to charts in Section 06, Group 210 for OEM applications or refer to machine technical manual.

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IMPORTANT: Stop engine prior to making timing adjustments. Injection pump can seize if adjustment is made with engine running.

8. Stop engine.

If dynamic timing reading is more than 8 degrees retarded with pump flange and front plate timing marks at original location as shipped from factory, this may indicate the pump advance is not functioning. Check the following:

- Change fuel filter(s).
- Check transfer pump for positive fuel pressure to injection pump.
- Check camshaft movement on injection pumps with rectangular timing window.
- Check pump drive shaft-to-gear key or pin to ensure key or pin has not sheared.
- If none of the above checks are conclusive, remove pump and have necessary repairs made at an authorized diesel repair station.

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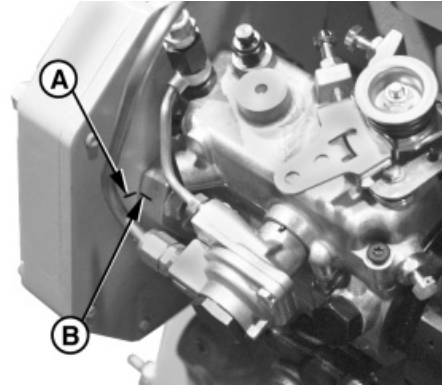
OUC1082,0000069 -19-09OCT07-5/6

Adjust Rotary Injection Pump Dynamic Timing:

1. Loosen injection pump mounting flange nuts and adjust pump timing.

To advance pump timing, rotate top of pump clockwise, viewed from rear (flywheel end) of engine. To retard timing, rotate top of pump counterclockwise. Pump flange movement of 1.524 mm (0.060 in.) is equivalent to 2 degrees of engine timing.

2. Tighten injection pump mounting flange nuts to specifications.



RG7723A -UN-07NOV97

Rotary Injection Pump Timing Marks

A—Front Plate Timing Mark
B—Pump Timing Mark

Specification

Rotary Injection Pump Mounting
 Nuts—Torque 27 N•m (20 lb-ft)

3. Start engine and check injection pump dynamic timing again. Adjust timing as needed.
4. After all adjustments are made and engine is performing to specification, perform the following:
 - a. Grind away the original timing mark (A) on front plate.
 - b. Stamp a new timing mark (A) on front plate, aligned with timing mark (B) on injection pump flange.

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Check and Adjust Rotary Injection Pump Dynamic Timing Using TIME TRAC®

NOTE: Dynamic timing can not be adjusted on Stanadyne injection pumps with lock shaft timing. For injection pump repair and timing, have an authorized ADS diesel injection repair station perform the work.

The JT07158 (or FKM10429A) TIME TRAC® Kit electronically indicates start of injection with respect to piston top dead center (TDC), and allows accurate setting of injection pump timing to provide optimum power, smoke, and exhaust emissions.

Timing engines with this timing kit improves consistency between engines and helps to control cylinder firing pressures, which can be a factor in head gasket failures as well as improve overall engine performance efficiencies.



TIME TRAC Kit

RG7246 -UN-23NOV97

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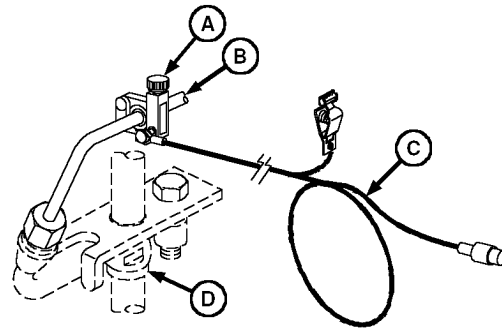
OOU1082,0000072 -19-09OCT07-1/9

Install JT07158 (or FKM10429A) TIME TRAC® Kit:

IMPORTANT: All transducers and sensors must be installed at nozzle end of No. 1 fuel injection line. If access to No. 1 line is restricted, sensor can be installed on No. 4 injection line (4-cylinder engines) and No. 6 injection line (6-cylinder engines).

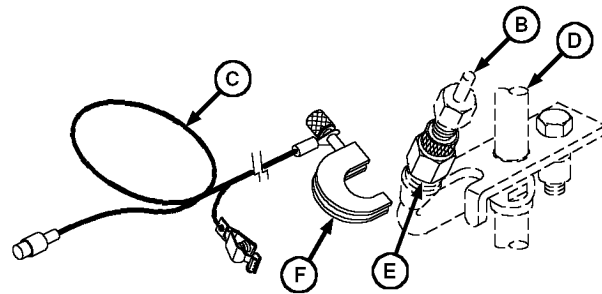
Remove all paint from injection line where clamp-on transducer will be installed and be sure this location is thoroughly clean.

1. On engines with optional JT07155 In-Line SOI Sensor (E) installed between injection nozzle and fuel delivery line, install JT07173 SOI Clamp Assembly (F) onto clean sensor and tighten securely.
2. On engines without optional JT07155 In-Line Sensor, install JT07177 6 mm (green) Clamp-On Transducer (A) onto clean, paint-free injection line and tighten securely.
3. Assemble red lead of JT07172 Transducer Cable (C) onto in-line sensor or transducer, however equipped.
4. Attach spring clip to a solid ground. Plug connector into JT07170 meter port marked SR.



Transducer

RG10725 -JUN-20APR00



TIME TRAC Hook-Up—w/SOI Sensor

- A—JT07177 6 mm (Green) Clamp-On Transducer
- B—Fuel Injection Delivery Line
- C—JT07172 Transducer Cable
- D—No. 1 Injector
- E—JT07155 In-Line SOI Sensor
- F—JT07173 SOI Clamp Assembly

RG10724 -JUN-20APR00

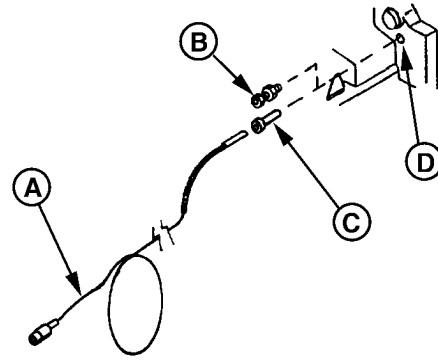
TIME TRAC is a registered trademark of Stanadyne Automotive Corp.

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OOU1082.0000072 -19-09OCT07-2/9

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5. Use JDE81-4 or JDG1571 Timing Pin in flywheel timing hole (D) to ensure engine is NOT stopped at TDC. Magnetic pick-up probe will enter TDC timing hole in flywheel and be damaged when engine is started. An air gap of 0.64 mm (0.025 in.) is recommended between tip of probe and flywheel face.
6. Install JDG793 Threaded Magnetic Pick-Up Adapter (B) into flywheel housings with tapped hole until it bottoms. Insert probe of magnetic pick-up (A) into adapter until it contacts flywheel. Back out hex head of adapter two flats and tighten lock nut; this will provide recommended air gap.
7. Install JDG821 Tapered Magnetic Pick-Up Adapter (C) into flywheel housings without tapped hole. Lightly tap adapter to lock into position. Insert probe into adapter until it contacts the flywheel. Pull probe back out to provide 0.64 mm (0.025 in.) gap.
8. Plug magnetic pick-up connector into JT07170 meter port marked MP.



Magnetic Pick-Up in Timing Hole

- A—Magnetic Pick-Up
- B—JDG793 Threaded Magnetic Pick-Up Adapter
- C—JDG821 Tapered Magnetic Pick-Up Adapter
- D—Flywheel Timing Hole

RG7287 -JUN-03NOV97

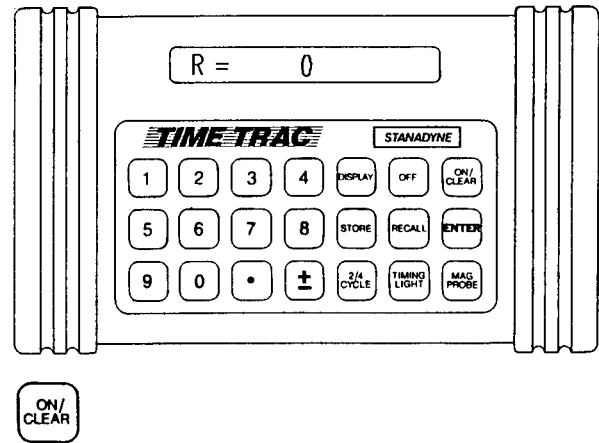
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OUO1082,0000072 -19-09OCT07-3/9

Check Rotary Injection Pump Rated Load Dynamic Timing:

1. Engine OFF. Push ON/CLEAR button.

Display shows: R=0



TIME TRAC® Display Shows R=0

RG7031 -JUN-27SEP94

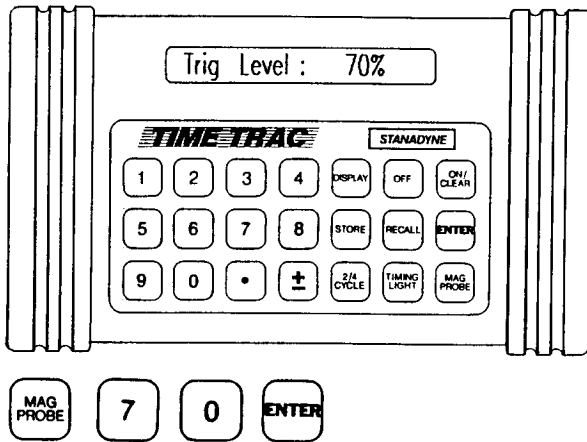
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OUO1082,0000072 -19-09OCT07-4/9

2. Push MAG PROBE button.

Display shows: Trig Level: 30%

3. Change to 70% and push ENTER.



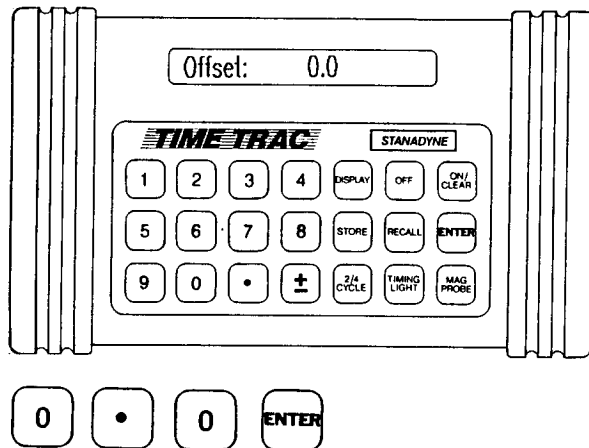
TIME TRAC® Display Shows Trig Level: 70%

RG7032 -UN-27SEP94

OUO1082,0000072 -19-09OCT07-5/9

4. Display shows: Offset: 20.0°

Change to offset 0° and push ENTER.



TIME TRAC® Display Shows Offset: 0.0

RG7033 -UN-27SEP94

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OUO1082,0000072 -19-09OCT07-6/9

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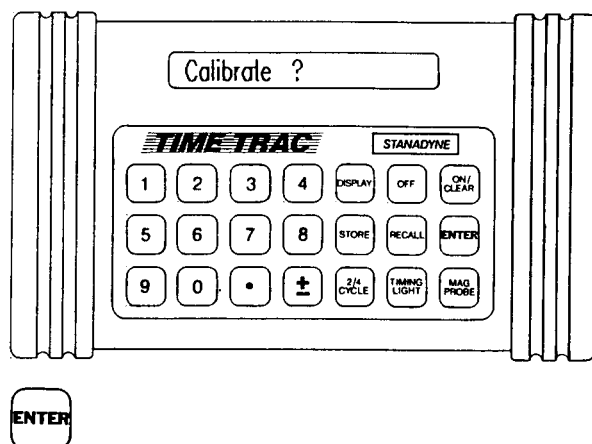
5. Display shows: Calibrate?

Start engine and push ENTER.

6. Run engine at 1300 rpm. Push ENTER. Display shows: Calibrating then Engine rpm and timing.

NOTE: If display shows NO PROBE, the magnetic pick-up probe has not been installed properly [air gap exceeds 0.64 mm (0.025 in.)] or there is debris on the back of the flywheel. Check for proper air gap or clean the back side of the flywheel by inserting a soft wooden dowel into the engine timing pin hole with the engine running at low idle speed.

7. Warm engine to normal operating temperature; check slow and fast idle rpm. (See FUEL INJECTION PUMP SPECIFICATIONS in Section 06, Group 210.) Adjust speeds as necessary.



TIME TRAC® Display Shows Calibrate ?

RG7129 -JUN-06OCT94

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OOU1082,0000072 -19-09OCT07-7/9

IMPORTANT: Many machines have hydraulic pumps that have adequate flow to load engine well below rated load rpm. Some equipment may need to be driven in high gear or pull a load to bring engine speed to rated load rpm.

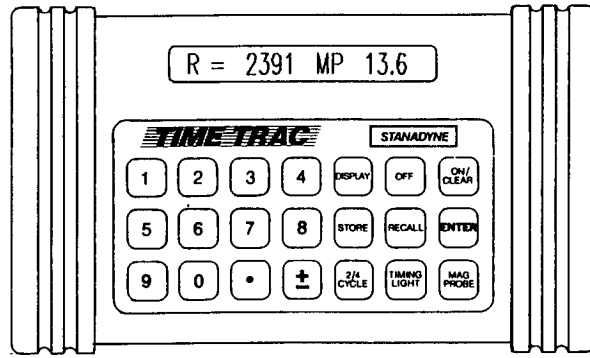
8. Run engine at wide open throttle (WOT) and load engine down gradually to rated speed rpm.
9. Record engine speed (rpm) and timing degrees.
10. Compare recorded speeds and timing degrees to charts in Section 06, Group 210 for OEM applications or refer to machine technical manual.

IMPORTANT: Stop engine prior to making timing adjustments. Injection pump can seize if adjustment is made with engine running.

11. Stop engine.

If dynamic timing reading is more than 8 degrees retarded with pump flange and front plate timing marks at original location as shipped from factory, this may indicate the pump advance is not functioning. Check the following:

- Change fuel filter(s).
- Check transfer pump for positive fuel pressure to injection pump.
- Check camshaft movement on injection pumps with rectangular timing window.
- Check pump drive shaft-to-gear key or pin to ensure key or pin has not sheared.
- If none of the above checks are conclusive, remove pump and have necessary repairs made at an authorized diesel repair station.



TIME TRAC® Display Shows R=? MP=?

RG7037 -UN-27SEP94

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OUC1082,000072 -19-09OCT07-8/9

Adjust Rotary Injection Pump Dynamic Timing:

- 1. Loosen injection pump mounting flange nuts and adjust pump timing.

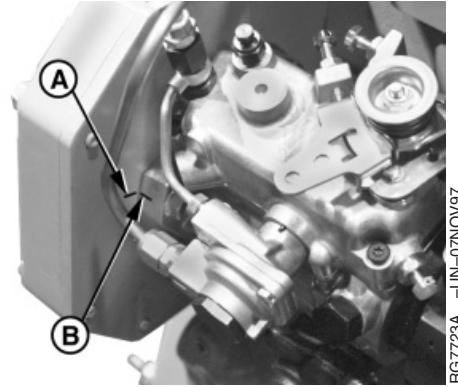
To advance pump timing, rotate top of pump clockwise, viewed from rear (flywheel end) of engine. To retard timing, rotate top of pump counterclockwise. Pump flange movement of 1.524 mm (0.060 in.) is equivalent to 2 degrees of engine timing.

- 2. Tighten injection pump mounting flange nuts to specifications.

Specification

Rotary Injection Pump Mounting
Nuts—Torque 27 N•m (20 lb-ft)

- 3. Start engine and check injection pump dynamic timing again. Adjust timing as needed.
- 4. After all adjustments are made and engine is performing to specification, perform the following:
 - a. Grind away the original timing mark (A) on front plate.
 - b. Stamp a new timing mark (A) on front plate, aligned with timing mark (B) on injection pump flange.



Rotary Injection Pump Timing Marks

A—Front Plate Timing Mark
B—Pump Timing Mark

RG7723A -UN-07NOV97

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OUO1082,0000072 -19-09OCT07-9/9

Check and Adjust In-Line Injection Pump Static Timing

NOTE: On some engines with in-line injection pumps, a timing pin may be screwed into the side of the pump. This pin may be used instead of JDG886 Timing Pin.

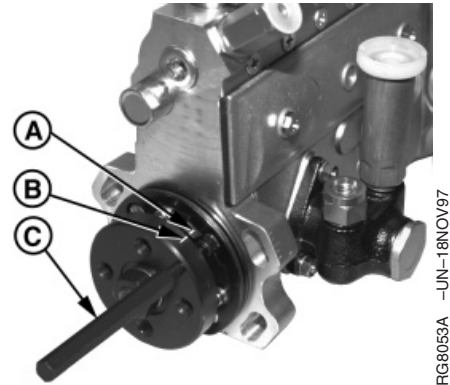
1. Static lock-pin timing is accomplished during installation of the injection pump with engine locked at No. 1 TDC.
2. **On Denso pumps:** Align pump timing mark on drive hub (B) with stationary timing pointer (A). Lock pumps in position with JDG886 Injection Pump Timing Pin (C).

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

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

To check alignment of injection pump and eliminate backlash of timing gear train, remove both timing pins and rotate the flywheel opposite the direction of normal rotation. Install JDE81-4 or JDG1571 Timing Pin and rotate flywheel in the direction of normal rotation until timing pin engages in timing pin hole.

If JDG886 Timing Pin will not install through drive hub and bottom out, loosen drive gear cap screws and rotate hub until timing pin can be installed and locked in place.



Time Denso Injection Pump

A—Timing Pointer
B—Mark on Drive Hub
C—Timing Pin

Continued on next page

DPSG,OUO1004,2668 -19-25APR00-1/2

3. On Motorpal pumps:

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

4. Install injection pump timing pin (C) into bore and make sure it is fully engaged in pump timing slot. Install spring (B) on the outboard side of pin.

Reinstall cap (A) and tighten finger tight.

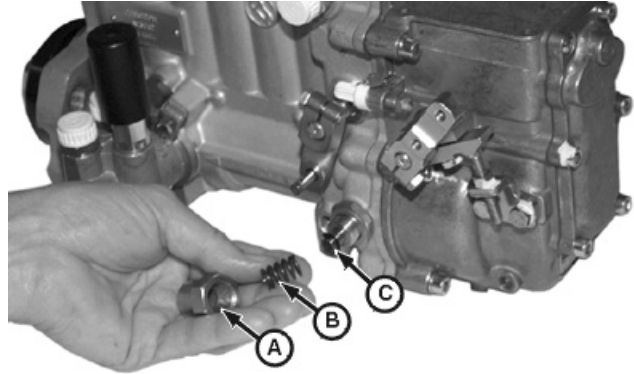
Applying a light turning force, attempt to rotate pump by hand to verify pump is locked.

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

5. Tighten pump drive gear cap screws to specifications.

Specification

Denso Injection Pump Drive Gear	
Cap Screws—Torque	47 N•m (35 lb-ft)
Motorpal Injection Pump Drive	
Gear Cap Screws—Torque	61 N•m (45 lb-ft)



Time Motorpal Injection Pump

- A—Cap
- B—Spring
- C—Timing Pin

RG10711A -JUN-31MAR00

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Check Fuel Supply Quality

IMPORTANT: Excessive water or sediment contamination can cause premature failure of fuel injection pump.

NOTE: Illustration shows fuel supply pump on engines with rotary injection pumps. On engines with in-line injection pumps, the supply pump is mounted on the side of the injection pump. The following procedure is the same for both.

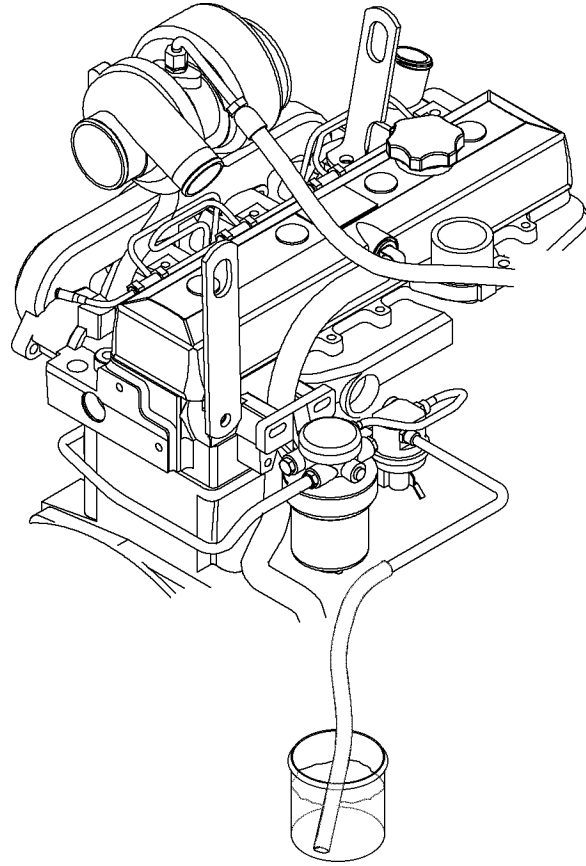
The quality of diesel fuel affects engine performance. Check your Operator's Manual for correct fuel specifications.

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

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

1. Check primary (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 (if equipped) or inlet side of supply pump on engines without primary filter.
4. Connect a hose to 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.



Fuel Quality Check

RG9566 -JUN-17JUL98

DPSG,OUO1004,158 -19-01AUG02-1/1

Test Air in Fuel

IMPORTANT: Air in fuel injection pump can cause premature pump failure.

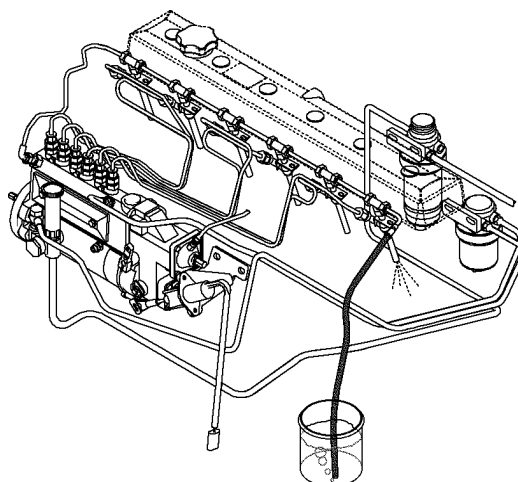
NOTE: Illustration shows in-line injection pump. Rotary pump is similar.

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 or holes.

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

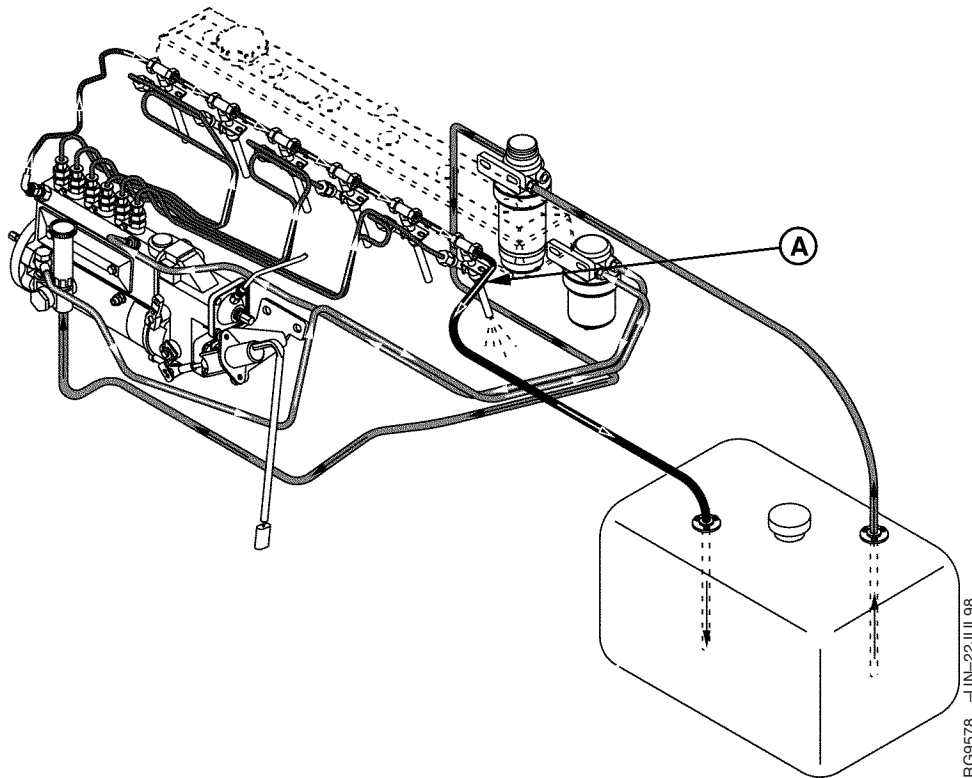


Air in Fuel Test

RG9559 -JUN-17JUL98

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Check for Restricted Fuel Return Line



Restricted Fuel Line Check

A—Fuel Leak-Off Line

This check will help determine if the fuel return line is restricted.

1. Disconnect fuel leak-off line (A) at the engine.
2. Remove fuel tank cap.
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.

DPSG,QUO1004,289 -19-23JUL98-1/1

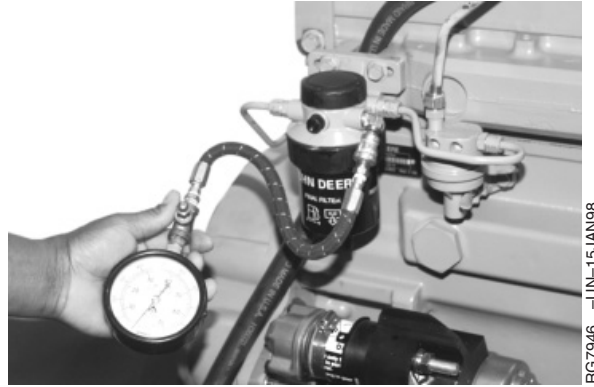
Measure Fuel Supply Pump Pressure— Rotary Injection Pump

1. Remove plug on fuel filter base.
2. Install test equipment as shown.
3. Start engine. Fuel pump should maintain minimum positive pressure listed below. If pressure is low, replace filter element and recheck pressure.

Specification

Rotary Fuel Supply Pump—
Operating Pressure 21—34 kPa (0.21—0.34 bar)
(3—5 psi)

Rotary Fuel Supply Pump—
Minimum Flow at 2400 rpm
Engine Speed..... 1.5 L/min (0.42 gpm)



RG7946 -UN-15JAN98

Fuel Supply Pump Pressure Test

If pressure is still low, perform the following:

1. Disconnect pump-to-filter fuel line at the filter.
2. With throttle set at no-fuel position (or injection pump shut-off solenoid wire disconnected) so engine will not start, turn engine over several times with starting motor.
3. If fuel spurts from the line, the pump is operating properly.

NOTE: Look for a possible restriction in filter/filter base.
Make sure pressure gauge/hose assembly is not at fault.

04
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49

RG.115.JW7707 -19-11JUL02-1/1

Measure Fuel Supply Pump Pressure— In-Line Injection Pump

1. Remove plug on fuel filter base.
2. Install test equipment as shown.
3. Start engine and run at 2400 rpm. Fuel pump should maintain minimum positive pressure listed below. If pressure is low, replace filter element and recheck pressure.



RG9146 -UN-23JUL98

In-Line Supply Pump Pressure

Specification

Denso In-Line Fuel Supply Pump—Minimum Pressure at 2400 rpm Engine Speed	69 kPa (0.69 bar) (10 psi)
Denso In-Line Fuel Supply Pump—Minimum Flow at 2400 rpm Engine Speed.....	2.0 L/min (0.53 gpm)
Motorpal In-Line Fuel Supply Pump—Minimum Pressure at 2000 rpm Engine Speed	80 kPa (0.80 bar) (11.6 psi)
Motorpal In-Line Fuel Supply Pump—Minimum Flow at 1000 rpm Engine Speed.....	1.3 L/min (0.34 gpm)

If pressure is still low, perform the following:

1. Disconnect pump-to-filter fuel line at the filter.
2. With throttle set at no-fuel position (or injection pump shut-off solenoid wire disconnected) so engine will not start, turn engine over several times with starting motor.
3. If fuel spurts from the line, the pump is operating properly.

NOTE: Look for a possible restriction in filter/filter base.
Make sure pressure gauge/hose assembly is not at fault.

DPSG,OUO1004,152 -19-11JUL02-1/1

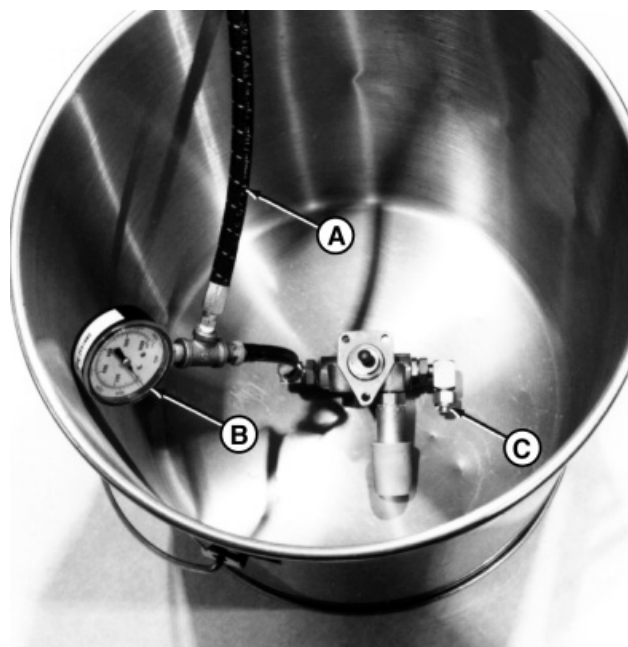
Test Fuel Supply Pump for Leaks—In-Line Injection Pump

Fuel delivery pressure should be checked before removing supply pump from injection pump. (See FUEL SUPPLY PUMP OPERATION—IN-LINE INJECTION PUMP, in Section 03, Group 130.)

1. Connect compressed air line (A) to a pressure gauge (B) and to supply pump inlet fitting. Air line should have a regulating valve to control pressure.
2. Cap or plug supply pump outlet fitting (C).
3. Submerge supply pump in a container of clean diesel fuel. Regulate air pressure to 200 kPa (2.0 bar) (29 psi).
4. Move roller tappet in and out by hand. No air bubbles should appear around roller tappet.

NOTE: *If bubbles appear, it is an indication that either the O-ring seal is defective or tappet is worn (or possibly both).*

IMPORTANT: **Serious injection pump or engine damage could occur if enough diesel fuel leaks past spindle and seal. Fuel leakage past spindle dilutes engine oil.**



Fuel Supply Pump Leak Test

A—Air Line
B—Pressure Gauge
C—Outlet Fitting

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RG,115,JW7703 -19-24NOV97-1/1

Check Fuel Supply Pump Operation—In-Line Injection Pump

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

Test fuel supply pump and hand primer for leaks:

1. Make a preliminary inspection of supply pump (A). Thoroughly clean area around pump. All connections must be tight and not leaking.
2. Start engine and bring to operating temperature. Shut off engine.

NOTE: Denso primers can be screwed down and locked in position. Motorpal pumps do not have this option.

If fuel leaks around hand primer (B) that is screwed down tight when engine is running, replace the hand primer.

3. Check operation of hand primer. With engine shut off, operate hand primer through several strokes. Moderate to heavy leakage of fuel between plunger and barrel indicates seal is defective. Replace hand primer.

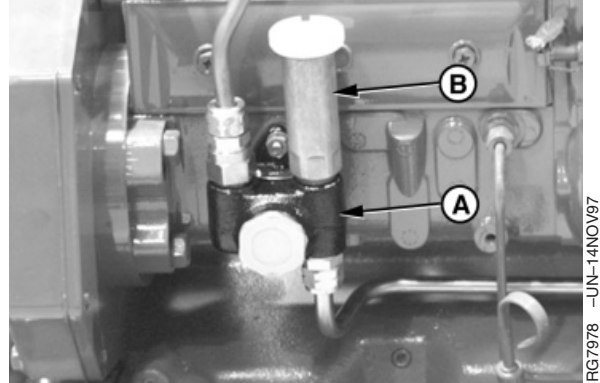
NOTE: Appearance of a slight quantity of fuel around the plunger is normal.

IMPORTANT: On Denso pumps, be sure hand primer is seated all the way down in barrel before tightening to prevent internal thread damage.

4. On Denso pumps, tighten hand primer knob, but do not overtighten. If knob will not tighten (indicating internal thread damage), replace hand primer.

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.



Check Fuel Supply Pump Operation (Denso Pump Shown)

A—Supply Pump
B—Hand Primer

RG7978 -UN-14NOV97

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 leaking air (replace in-line filter when used).

If fuel does not flow, and if no leak or obstruction is found, pump is defective. Repair or replace pump. (See Section 02, Group 090.)

Test operation of discharge side of pump:

1. Suction line must be connected and discharge (pressure) line disconnected.
2. Tighten hand primer and 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 or leaking air (replace in-line filter when used).

Test pump output pressure while cranking engine:

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.

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

2. Crank engine for 10 seconds with starting motor (approximately 300 engine rpm).
3. Compare measured output with the minimum pressure specifications.

Specification

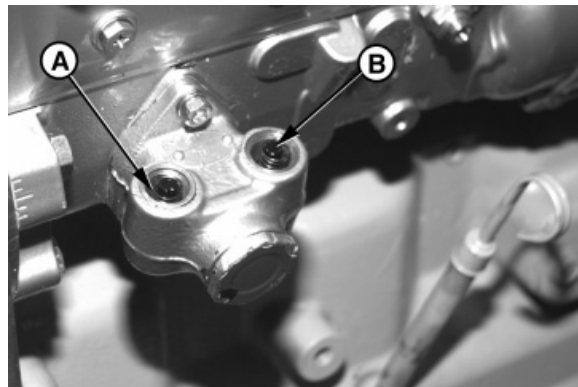
Denso In-Line Supply Pump—
Minimum Outlet Pressure at
Cranking Speed..... 69 kPa (0.69 bar) (10 psi)
Motorpal In-Line Fuel Supply
Pump—Minimum Positive
Pressure at Cranking Speed..... 80 kPa (0.80 bar) (11.6 psi)

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

DPSG,OUO1004,2759 -19-12MAY00-3/3

Service Denso Fuel Supply Pump

1. To gain access to the valves, remove hand primer, banjo fitting, and plug from top of supply pump (shown removed).
2. Remove valves (B) and springs (A).
3. Inspect valves and valve seats for foreign material, wear, or pitting. Valve springs must not be cracked or broken.
4. Reassemble parts, open tank shut-off valve, and check operation. If the pump operation is still not normal, the pump will have to be repaired or replaced. (See Section 02, Group 090.)



Fuel Supply Pump Valves & Springs

A—Springs
B—Valves

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Check Cold Start Switch Operation—Rotary Pumps

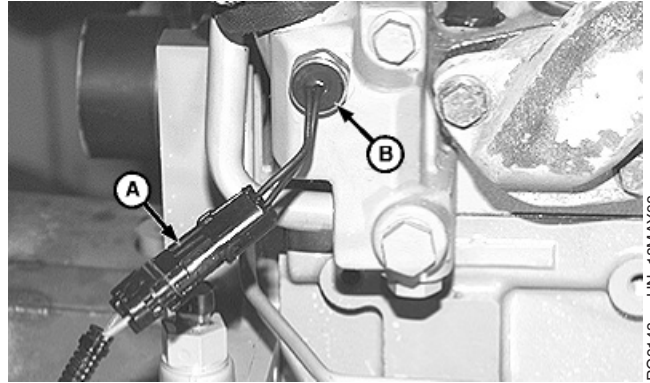
The cold start switch (B) is an option available on rotary injection pumps.

1. Disconnect cold start switch connector (A) from pump wiring harness.
2. Remove cold start switch from thermostat housing/water manifold.
3. Submerge switch in water at 60°C (140°F) for a few minutes.
4. Check for open or closed switch. On Delphi/Lucas pumps, the switch should be closed. On Stanadyne pumps, the switch should be open.
5. Replace switch if defective.
6. Install switch in thermostat housing/water manifold and tighten to specifications.

Specification

Cold Start Switch—Torque..... 5 N•m (3.5 lb-ft) (42 lb-in.)

7. Connect cold start switch connector to pump wiring harness.



Cold Start Switch Check

A—Connector
B—Cold Start Switch

RG9143 -JUN-18MAY98

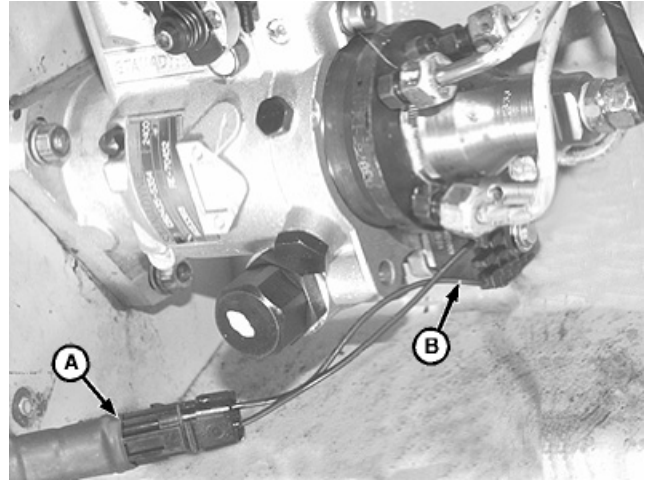
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RG,115,JW7700 -19-11JUL02-1/1

Check Cold Start Advance System Operation—Rotary Pumps

NOTE: To check operation of the cold start advance system, the engine will be operating in an advanced timing mode. After checks are completed, be sure that the cold start circuits are returned to their original configuration to ensure proper injection pump timing and conformance to emission control standards.

Use JT07158 (FKM10429A) TIME TRAC® Kit to check injection pump timing when performing operational checks on the cold start advance system. (See CHECK AND ADJUST ROTARY INJECTION PUMP DYNAMIC TIMING earlier in this group.)



Cold Start Advance System Check

A—Connector
B—Cold Start Advance Solenoid

Stanadyne Cold Start Advance

NOTE: Checks must be performed on a cold engine.

1. Install JT07158 (FKM10429A) TIME TRAC® Kit.
2. Ensure that cold start switch is working by verifying a voltage potential (12 or 24 volts, depending on application) to the cold start solenoid.
3. Disconnect wiring connector (A) from the cold start advance solenoid (B).
4. Start cold engine and run at 1200 rpm. Check and record injection pump timing.
5. Connect wiring connector (A) to cold start advance solenoid. After approximately 30 seconds, check injection pump timing.

There should be a 7—10° increase in timing, indicating proper operation of the cold start advance system.

If no increase in timing was noted, service the cold start advance solenoid and valve. (See REMOVE AND INSTALL STANADYNE COLD START ADVANCE SOLENOID AND VALVE in Section 02.)

Delphi/Lucas Cold Start Advance

NOTE: Checks must be performed on a cold engine.

The cold start advance solenoid is located on the bottom, outboard side of the injection pump. There is a single terminal input lead to the wax motor.

1. Install JT07158 (FKM10429A) TIME TRAC® Kit.
2. Disconnect wiring connector from the cold start switch to wax motor harness. Verify that there is a voltage potential (12 or 24 volts, depending on application) at the wax motor connector.
3. Start cold engine and run at 1200 rpm. Check and record injection pump timing.
4. Connect a jumper wire across the wax motor connector terminals. After approximately 30 seconds, check injection pump timing.

There should be a 7—10° decrease in timing, indicating proper operation of the cold start advance system.

If no decrease in timing was noted, have the injection pump serviced/repared by an authorized ADS Diesel Repair Station.

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TIME TRAC is a registered trademark of Stanadyne Automotive Corp.

DPSG,OUO1004,123 -19-11JUL02-2/2

Check Light Load Advance Operation— Rotary Pumps

IMPORTANT: Avoid machine damage. Air trapped in fuel injection pump can cause internal damage to light load advance mechanism. Bleed fuel supply system thoroughly before performing this test.

To check operation of the light load advance, perform the following:

1. Install JT07158 (FKM10429A) TIME TRAC® Kit.
2. Operate engine at full load and rated speed. Note injection pump timing on TIME TRAC®.
3. Gradually decrease load to the engine. Timing should continue to retard as the load is removed, but should start to advance again as the light load advance begins to operate at about 50 percent load.
4. If timing does not advance, the light load advance is not operating properly. Have the injection pump serviced/repaired by an authorized ADS Diesel Repair Station.

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DPSG.OUO1004,136 -19-01AUG02-1/1

Check Fuel Shut-Off Solenoid Operation— In-Line Injection Pumps

NOTE: Operation of fuel shut-off solenoid on Denso and Motorpal injection pumps is similar; however, lever stops on Motorpal pumps are cast inside injection pump housing.

1. Observe fuel shut-off lever (A) when key switch is turned from 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 key switch is released to ON position.

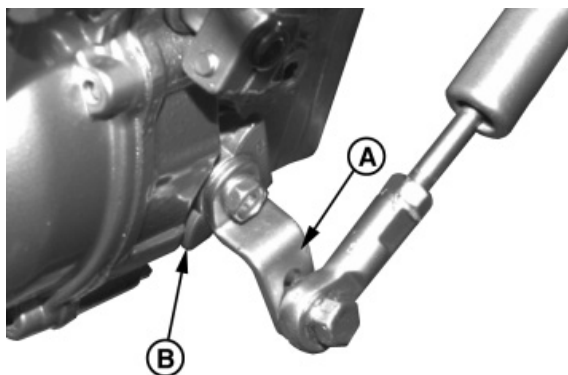
If fuel shut-off lever returns to NO FUEL position with key switch at ON position, check for:

- 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 ADJUST FUEL SHUT-OFF SOLENOID LINKAGE—IN-LINE INJECTION PUMPS, later in this group.

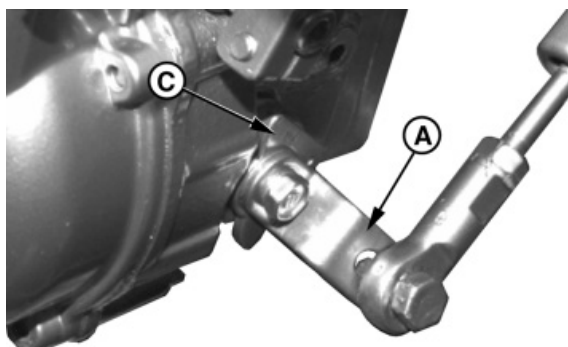
3. Start engine and run at slow idle. Turn key switch to OFF position.
4. Fuel shut-off lever should move to NO FUEL position and engine should stop.

If the solenoid stops just short of the NO FUEL position, slight adjustment of the linkage is required. See ADJUST FUEL SHUT-OFF SOLENOID LINKAGE—IN-LINE INJECTION PUMPS, later in this group.

If engine continues to run with key switch at OFF position, unplug shut-off solenoid 3-way connector and observe for the following:



Fuel Shut-Off Lever in NO FUEL Position



Fuel Shut-Off Lever in RUN Position

A—Shut-Off Lever
B—NO FUEL Position
C—RUN Position

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- If solenoid moves lever to NO FUEL position, problem is in the electrical circuit.
- 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,OUO1004,2687 -19-24APR00-2/2

Test Fuel Shut-Off Solenoid Resistance— Delphi/Lucas Pump

1. Disconnect wire to solenoid.
2. Remove solenoid, noting if plunger is binding in bore.
3. Check coil resistance with ohmmeter and compare reading to the following specification.

Specification

Delphi/Lucas Fuel Shut-Off
Solenoid—Resistance 9 Ohms

4. Check plunger retraction using a 12-V or 24-V source, as appropriate.

Connect positive cable to connector terminal and negative cable to solenoid body. From the relaxed position, plunger should retract into the solenoid body when voltage is applied.

If resistance specification is not met and/or plunger does not retract, replace solenoid.

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Test Fuel Shut-Off Solenoid Resistance— Denso Pump

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 lead wire “A”.

Replace solenoid if resistance is not within specification given below.

Denso Fuel Shut-Off Solenoid (12-Volt System: RE67325)— Specification

Pull Coil—Resistance 0.134—0.200 Ohms
Hold Coil—Resistance..... 6.63—8.11 Ohms

Denso Fuel Shut-Off Solenoid (24-Volt System: RE67256)— Specification

Pull Coil—Resistance 0.560—0.684 Ohms
Hold Coil—Resistance..... 24.35—29.76 Ohms

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WEATHER PACK is a trademark of Packard Electric.

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Test Fuel Shut-Off Solenoid Resistance— Motorpal Pump

Disconnect shut-off solenoid 3-way WEATHER PACK™ connector.

1. Measure “PULL” coil resistance between black lead and white lead.
2. Measure “HOLD” coil resistance between black lead and red lead.

Replace solenoid if resistance is not within specification given below.

Motorpal Fuel Shut-Off Solenoid—Specification

Pull Coil—Resistance	0.174—0.260 Ohms
Hold Coil—Resistance.....	10.035—12.265 Ohms

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WEATHER PACK is a trademark of Packard Electric.

DPSG,OUO1004,2673 -19-10SEP02-1/1

Adjust Fuel Shut-Off Solenoid Linkage— In-Line Injection Pumps

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.

Thoroughly lubricate all linkage and lever pivot points.

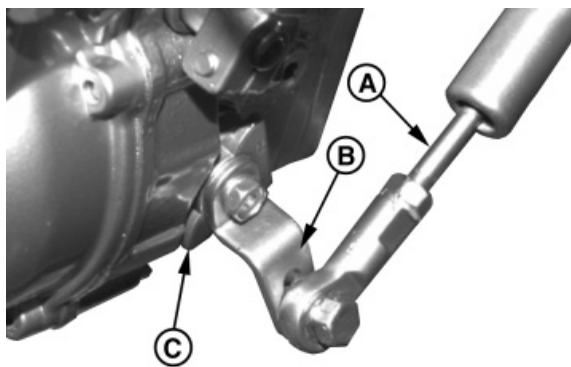
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Denso Pumps

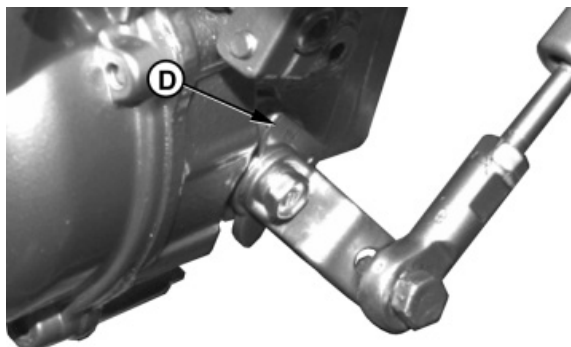
1. If necessary, adjust linkage (A) so that lever (B) contacts stop (C) with key switch OFF and engine not running.
2. Start engine and run at slow idle. Lever should contact stop (D) or nearly contact when the lever is being pushed up.

A—Linkage
 B—Lever
 C—Stop
 D—Stop



Denso Fuel Shut-Off Lever in NO FUEL Position

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Denso Fuel Shut-Off Lever in RUN Position

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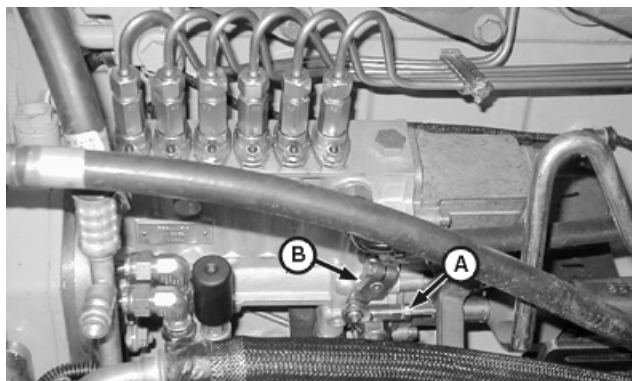
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Motorpal Pumps

NOTE: On Motorpal injection pump applications, the fuel shut-off stops are cast inside the pump housing.

1. Disconnect linkage from lever.
2. Turn key switch ON but DO NOT start engine.
3. Place lever (B) all the way back in the "Engine Running" position, against pump internal stop.

Adjust linkage (A) and attach to lever 2 mm (0.08 in.) beyond this internal stop.
4. Turn key switch OFF. Shut-off linkage should move forward, pushing lever to NO FUEL position.
5. Start and stop engine to verify operation of shut-off solenoid.



Motorpal Fuel Shut-Off Lever in NO FUEL Position

A—Linkage
 B—Lever

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RG.115,JW7697 -19-20APR00-3/3

Check and Adjust Engine Speeds on Delphi/Lucas Pump

NOTE: Before checking and adjusting engine speed, make sure engine has reached its normal operating temperature.

Check Slow and Fast Idle Speeds:

NOTE: Check fast idle and slow idle speeds per specifications listed in *FUEL INJECTION PUMP SPECIFICATIONS, Section 06, Group 210* for OEM engines. See machine technical manual for other applications.

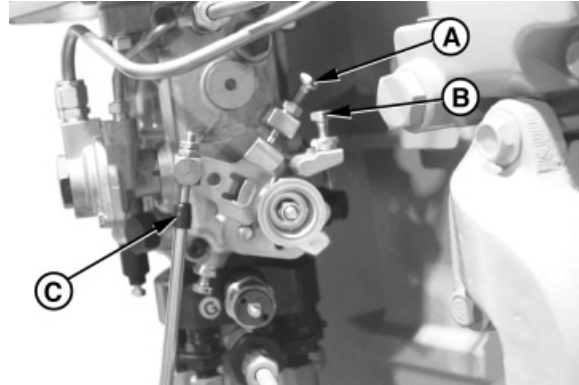
1. Start engine and run at 50% load and rated speed until engine reaches normal operating temperature.
2. Stop engine and disconnect speed control rod from fuel injection pump throttle lever (C).
3. Start engine and move injection pump lever to slow idle position against slow idle adjusting screw (A). Using a tachometer, read and record engine speed. Compare reading with specifications. Adjust slow idle as necessary as detailed below.
4. Move injection pump lever to fast idle position against fast idle adjusting screw (B). Using a tachometer, read and record engine speed. Compare reading with specifications.

Adjust Slow Idle Speed:

NOTE: Adjust slow idle speed per specifications listed in *Section 06, Group 210* for OEM engines. See machine technical manual for other applications.

Move pump throttle lever to slow idle position against slow idle adjusting screw (A).

Loosen slow idle screw lock nut. Turn adjusting screw clockwise to increase speed and counterclockwise to decrease engine speed.



Engine Speed Adjustments—Lucas Pump

A—Slow Idle Adjusting Screw
B—Fast Idle Adjusting Screw
C—Throttle Lever

RG7949 -UN-13NOV97

Adjust Fast Idle Speed:

IMPORTANT: Fast idle speeds are preset at the factory. It is recommended that fast idle adjustments be performed only by an authorized diesel repair station.

Adjust fast idle speed per specifications listed in Section 06, Group 210 for OEM engines. See machine technical manual for other applications. If necessary to reset fast idle speed, reset only to specifications. If fast idle speed is not set to specification, the engine may not comply with federal emissions regulations.

DO NOT adjust fast idle speed above specifications or pump and engine damage may occur.

Move pump throttle lever to fast idle position against fast idle adjusting screw (B). Refer to appropriate Machine Technical Manual for specified engine speeds.

Loosen fast idle screw lock nut and adjust fast idle to specifications.

RG,115,JW7691 -19-11JUL02-2/2

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Adjust Variable Speed on Generator Set Engines (Delphi/Lucas Pumps Only)

See your authorized Delphi/Lucas Repair Station for speed droop adjustment. This service requires that an internal pump adjustment be made.

RG,115,JW7718 -19-11JUL02-1/1

Check and Adjust Engine Speeds on Stanadyne Pump

NOTE: Before checking and adjusting engine speed, make sure engine has reached its normal operating temperature.

Check Slow and Fast Idle Speeds:

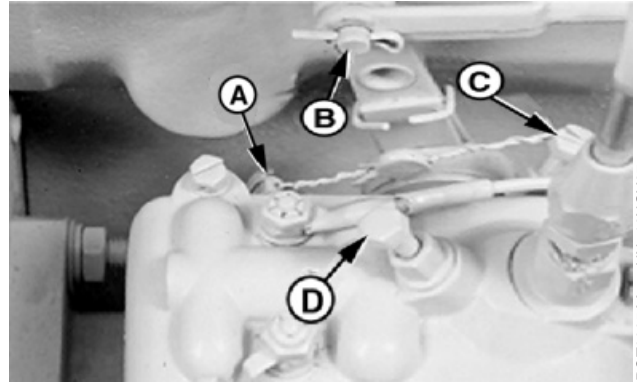
NOTE: Check fast idle and slow idle speeds per specifications listed in *FUEL INJECTION PUMP SPECIFICATIONS, Section 06, Group 210* for OEM engines. See machine technical manual for other applications.

1. Start engine and run at 50% load and rated speed until engine reaches normal operating temperature.
2. Stop engine and remove control rod pin (B), if used. Disconnect speed control rod (or control cable) from fuel injection pump throttle lever.
3. Start engine and move injection pump lever to slow idle position against slow idle adjusting lever (A or D). Using a tachometer, read and record engine speed. Compare reading with specifications. Adjust as necessary as detailed below.
4. Move injection pump lever to fast idle position against fast idle adjusting screw (C). Using a tachometer, read and record engine speed. Compare reading with specifications.

Adjust Slow Idle Speed:

NOTE: Adjust slow idle speed per specifications listed in *Section 06, Group 210* for OEM engines. See machine technical manual for other applications.

1. Move pump throttle lever in slow idle position against slow idle adjusting screw (A or D). See specifications for specified engine speeds.



Engine Speed Adjustments—Stanadyne Pump

- A—Slow Idle Adjusting Screw¹
- B—Control Rod Pin
- C—Fast Idle Adjusting Screw
- D—Slow Idle Adjusting Screw¹

¹Slow idle adjusting screw location varies by injection pump application. Will either be at location A or D.

2. Loosen slow idle screw lock. Turn adjusting screw clockwise to increase engine speed and counterclockwise to decrease speed. Tighten lock nut.

Adjust Fast Idle Speed:

IMPORTANT: Fast idle speeds are preset at the factory. It is recommended that fast idle adjustments be performed only by an authorized diesel repair station.

Adjust fast idle speed per specifications listed in Section 06, Group 210 for OEM engines. See machine technical manual for other applications. If necessary to reset fast idle speed, reset only to specifications. If fast idle speed is not set to specification, the engine may not comply with federal emissions regulations.

DO NOT adjust fast idle speed above specifications or pump and engine damage may occur.

1. Move pump throttle lever in fast idle position against fast idle adjusting screw (C). See appropriate Machine Technical Manual for specified engine speeds.
2. Loosen fast idle screw lock and adjust fast idle speed to specification. Tighten lock nut.

Adjust Variable Speed (Droop) on Generator Set Engines (3—5% Governor Regulation)—Stanadyne DB2 and DB4 Injection Pumps

An external speed droop adjusting cap (A) at the rear of the injection pump housing provides precise control of governor sensitivity by decreasing or increasing the effective length (and thereby the rate) of the governor control spring. Fine adjustments can be made while the engine is operating.

1. Start engine and run at rated speed with 50% load applied until it reaches normal operating temperature.

NOTE: If serious surging occurs during the warm-up period, turn the speed droop adjusting cap clockwise until surging stops.

2. When engine has warmed to normal operating temperature, position throttle lever (D or E) to attain full load rated speed (e.g., 1500, 1800 rpm) and apply 100% (full) load.

Adjust the throttle if necessary to obtain satisfactory full load performance.

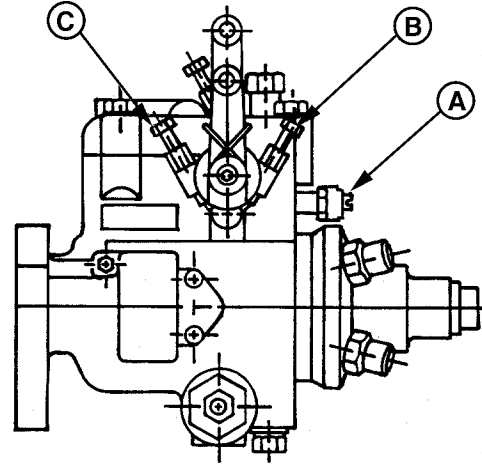
NOTE: Whenever speed droop adjustments are made, throttle position adjustments will also be necessary.

3. Remove load and check for specified no-load speed or frequency.

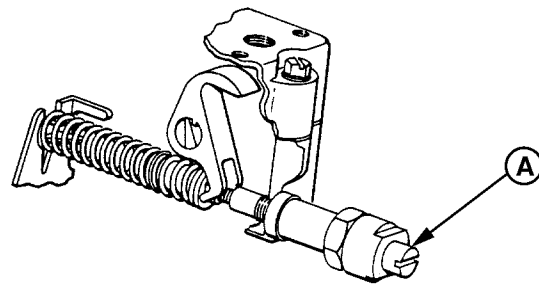
If incorrect, adjust speed droop adjusting cap slightly (clockwise for increased droop or counterclockwise for less droop).

If surging exists upon removing the load, turn the adjusting cap clockwise to eliminate.

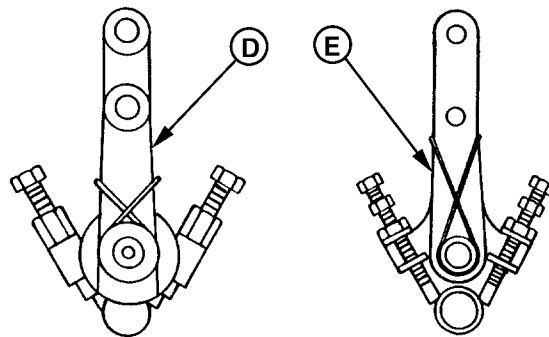
4. Recheck full load and no-load performance and readjust as necessary.



External Speed Droop Adjust—DB2 & DB4



Speed Droop Adjust Cap—DB2 & DB4



Throttle Configuration—Early/Current

- A—Speed Droop Adjusting Cap
- B—Fast Idle Screw
- C—Slow Idle Screw
- D—Early Throttle Lever
- E—Current Throttle

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RG6395 -UN-03NOV97

RG6397 -UN-03NOV97

Check and Adjust Fast Idle Speed—Denso and Motorpal Fuel Injection Pump

IMPORTANT: Fast idle speeds are preset at the factory. It is recommended that fast idle adjustments be performed only by an authorized diesel repair station.

Check and adjust fast idle speed per specifications listed in FUEL INJECTION PUMP SPECIFICATIONS, Section 06, Group 210 for OEM engines. See machine technical manual for other applications.

If necessary to reset fast idle speed, reset only to specifications. If fast idle speed is not set to specification, the engine may not comply with federal emissions regulations.

1. Remove speed control rod. With the engine running, move governor control lever (A) against the fast idle stop screw (B).

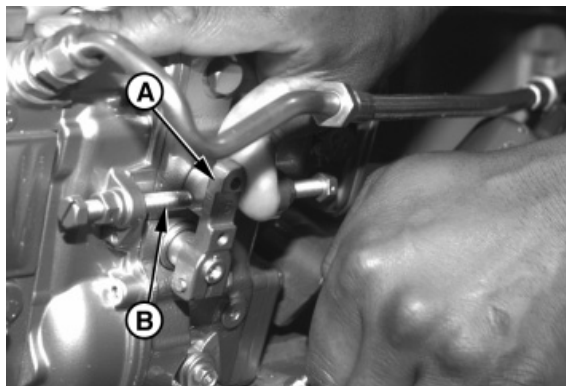
NOTE: The governor control lever on injection pump may be inboard (next to engine block) or outboard (away from engine block), depending upon engine application.

2. Using a tachometer, check fast idle speed to see if it is within specification.

IMPORTANT: If fast idle speed is adjusted, DO NOT adjust idle speed above specifications, or pump and engine damage may occur.

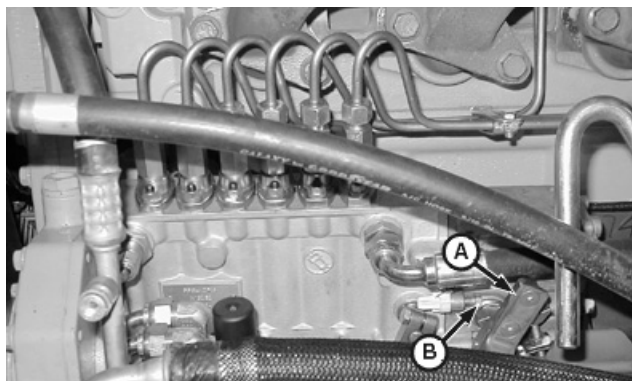
3. Adjust fast idle stop screw (B), as required, to specified fast idle speed.

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.



Denso Fast Idle Check

RG8082 -UN-18NOV97



Motorpal Fast Idle Check

RG10722A -UN-18APR00

A—Governor Control Lever
B—Fast Idle Stop Screw

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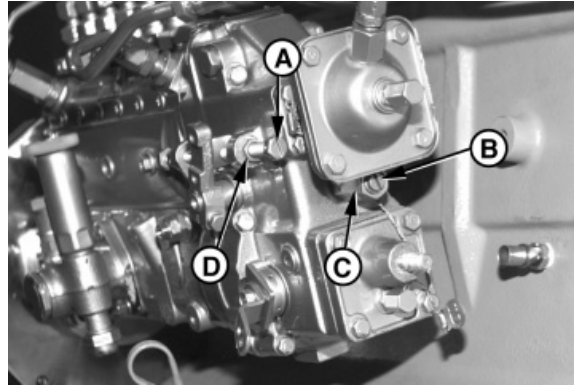
Check and Adjust Slow Idle Speed—Denso Fuel Injection Pump



CAUTION: ALWAYS STOP ENGINE before making adjustments.

IMPORTANT: Minor adjustment of the slow idle speed may be made with the bumper spring screw. However, it should not be used by itself to change engine speed more than 50 rpm, as overspeeding of the engine may result.

If slow idle stop screw and bumper spring screw are not adjusted according to instructions, engine damage could result because of overspeeding.



FG8080B -UN-18NOV97

Slow Idle Speed Check

A—Slow Idle Stop Screw
B—Bumper Spring Screw
C—Lock Nut
D—Lock Nut

NOTE: Both the slow idle stop screw (A) and the bumper spring screw (B) may be used to adjust the slow idle speed.

NOTE: Check and adjust slow idle speed per specifications listed in *FUEL INJECTION PUMP SPECIFICATIONS*, Section 06, Group 210 for OEM engines. See machine technical manual for other applications.

1. With the engine running, pull the governor control lever rearward to the slow idle speed position. Check and adjust slow idle speed to specification.
2. Remove slow idle stop screw cover.
3. Loosen lock nut (C) and back out the bumper spring adjusting screw (B) three turns.
4. Loosen lock nut (D) and adjust slow idle stop screw (A) to obtain an idle speed 30—50 rpm less than the desired slow idle speed setting.
5. Turn the bumper spring adjusting screw in to increase engine speed a maximum of 30—50 rpm to desired slow idle speed.

Continued on next page

RG.115,JW7685 -19-12MAY00-1/3

For example, to obtain an 850 rpm slow idle speed, use the slow idle stop screw to set speed at approximately 800 rpm. Then increase speed to 850 rpm using the bumper spring adjusting screw.

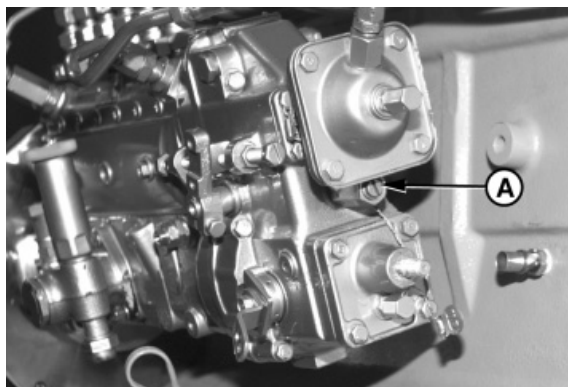
NOTE: Increasing the slow idle speed a slight amount above the specified speed range may help to reduce engine surge (or hunting). If this occurs, use the procedure given above, but do not exceed 850 rpm.

RG,115,JW7685 -19-12MAY00-2/3

6. If engine surging or hunting persists at slow idle, the bumper spring and adjustment screw (A) may need to be replaced with a new one.

IMPORTANT: Remove the pump from the engine and have it repaired by an authorized diesel repair station (ADS shop). See Section 02, Group 090 for fuel injection pump removal and installation.

7. Again check the fast and slow idle speeds. Readjust slow idle speed if not correct.
8. Check all adjusting screw lock nuts for tightness. Install covers (and copper washers) on slow idle stop screw and idling spring adjusting screw.
9. Connect fuel shut-off cable and speed control rod.



FG8080A -UN-18NOV97

Adjust Slow Idle Speed

A—Adjustment Screw

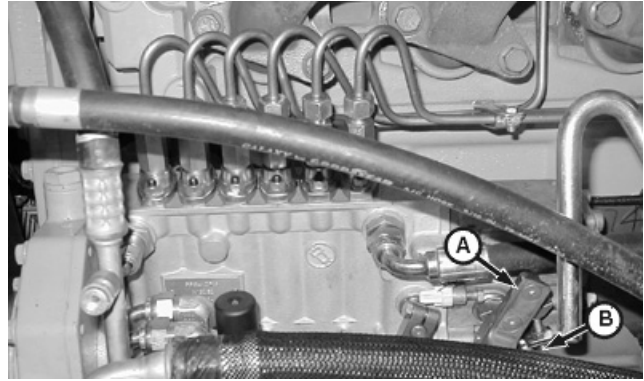
04
150
71

RG,115,JW7685 -19-12MAY00-3/3

Check and Adjust Slow Idle Speed—Motorpal Fuel Injection Pump

NOTE: Check and adjust slow idle speed per specifications listed in *FUEL INJECTION PUMP SPECIFICATIONS, Section 06, Group 210* for OEM engines. See machine technical manual for other applications.

1. With the engine running, pull the governor control lever (A) rearward to the slow idle speed position. Check and adjust slow idle speed to machine specification. (See machine technical manual.)
2. Loosen lock nut and adjust slow idle stop screw (B) to obtain specified idle speed.
3. Tighten adjusting screw lock nut.
4. Check all adjusting screw lock nuts for tightness.



Adjust Slow Idle Speed

A—Lever
B—Slow Idle Stop Screw

RG10722B -UN-18APR00

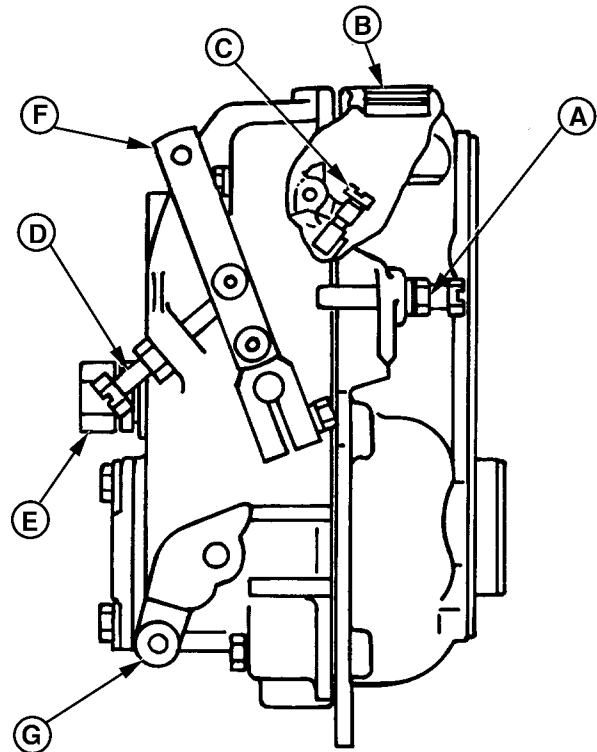
DPSG,OUO1004,2674 -19-19AUG04-1/1

Change Engine Rated Speed and Adjust Droop—Denso Fuel Injection Pump

1. Start engine and apply 50% load at rated speed until it reaches operating temperature. Remove cap nuts from adjusting screws before making adjustments.
2. When the engine has reached normal operating temperature, adjust fast idle (stop) screw (A) clockwise (CW) to 1500 rpm (50 Hz) with 100% (full) load.
3. Remove load and back out the idle (bumper) spring screw (E), while observing the corresponding drop in engine rpm's until engine stops losing speed.
4. Screw in idle (bumper) spring screw until engine speed increases 5—10 rpm.
5. Check for specified no-load (frequency). If governor regulation is within 5—7% range, proceed to step 8.

NOTE: A noticeable click will occur at each 1/4 turn of droop adjusting screw. One click CW will increase no-load speed approximately 10 rpm, counterclockwise (CCW) will reduce speed by 10 rpm.

6. If governor regulation is above 7% or below 5%, stop engine and remove droop adjusting screw access plug (B, shown removed) from top of governor housing.
 - a. Back out slow idle (adjusting) screw (D) and bumper screw. Pull back on throttle lever (F, toward rear of governor housing) by hand until the droop adjusting screw (C) inside housing can be adjusted through the access plug hole.
 - b. Turn the droop screw in (CW), counting the turns until screw bottoms out. Then, return screw to original setting.
 - c. Turn the droop screw in (CW) no more than 1/2 turn (two clicks) at a time to reduce governor droop. Turn the droop screw out (CCW) no more than two clicks at a time to increase governor droop (to reduce governor sensitivity).



Change Rated Speed

- A—Fast Idle (Stop) Screw
- B—Droop Adjusting Screw Access Plug Location
- C—Droop Adjusting Screw
- D—Slow Idle (Adjusting) Screw
- E—Idle (Bumper) Spring Screw
- F—Throttle Lever
- G—Mechanical Shut-Off Lever

RG5752 -JUN-03NOV97

04
150
73

- d. Replace access plug in top of governor housing.
Start engine, apply full (100%) load, and readjust high idle adjusting screw until 1500 rpm (50 Hz) is obtained at the specified power.
- e. Screw in idle (bumper) spring until engine speed increases 5—10 rpm.
- 7. Repeat steps 6 (a—d) until governor regulation is within the 5—7% range.
- 8. Replace all cap nuts onto adjusting screws and tighten lock nuts securely.

RG.115,JW7684 -19-19AUG04-2/2

04
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74

Test Fuel Injection Nozzles (Engine Running)

CAUTION: Escaping fluid under pressure can penetrate the skin causing serious injury. For this test, loosen the fuel line fittings **SLOWLY** until fuel seeps from connection. **DO NOT** over-loosen fittings.

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

1. Operate engine at intermediate speed with no load.
2. Slowly loosen the fuel pressure line connector at one of the nozzles until fuel escapes at the connection (fuel not opening nozzle valve). Use two wrenches on 9.5 mm injectors as shown.

If engine speed changes, the injection nozzle is probably working satisfactorily.

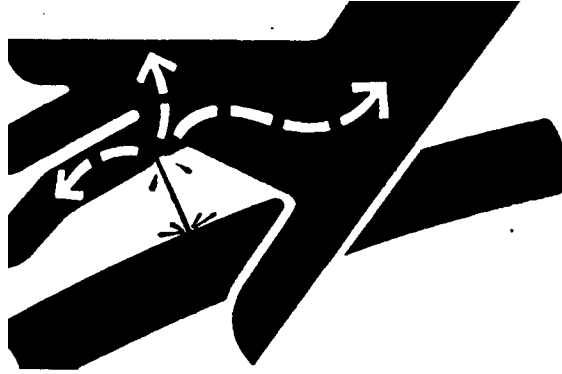
If engine speed does not change, a nozzle is faulty and must be checked and repaired (or replaced).

NOTE: The injection nozzle before and/or after nozzle being checked could be the faulty nozzle.

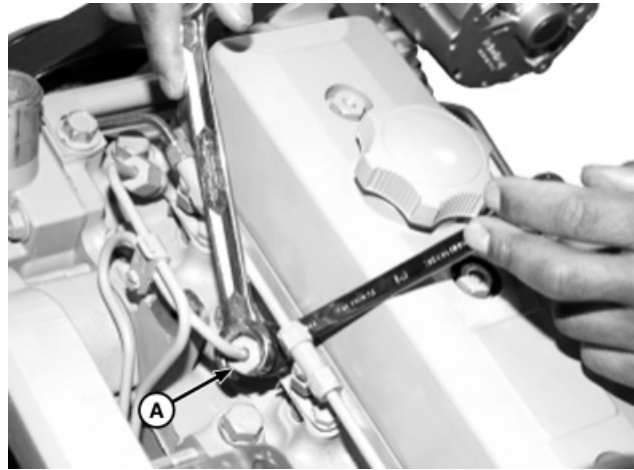
3. Repeat test for each remaining nozzle assembly.
4. Remove faulty injection nozzles and repair as required. (See Section 02, Group 090.)
5. Tighten fuel lines to specifications.

Specification

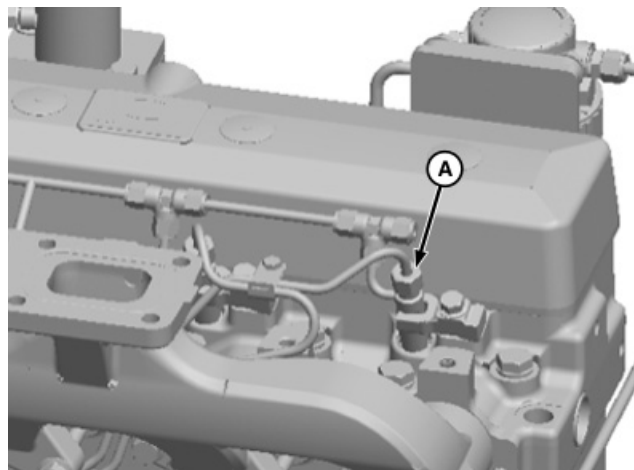
Fuel Injection Nozzle Delivery
Line—Torque 27 N•m (20 lb-ft)



High Pressure Fluids



Conventional and RSN Nozzle (9.5 mm)



VOC Nozzle (17 mm)

A—Fuel Line Connector

X9811 -UN-23AUG88

RG15537 -UN-17SEP07

RG15536 -UN-17SEP07

04
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75

OUO1082,000006A -19-25SEP07-1/1

Fuel Drain-Back Test Procedure

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

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

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

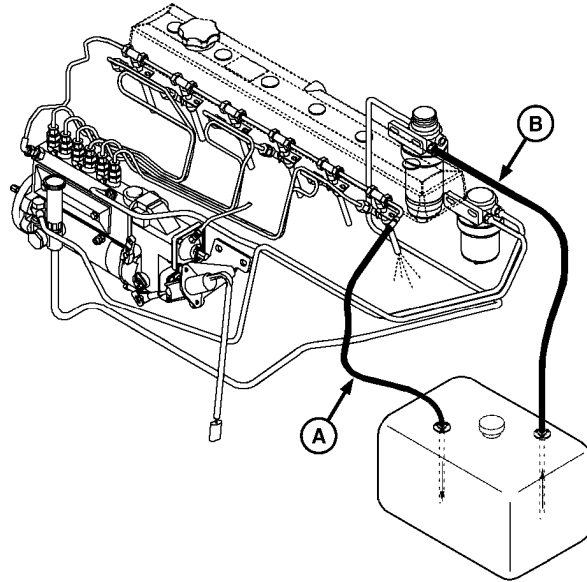
2. Drain all fuel from the system, including the fuel transfer pump, fuel injection pump, fuel filters, and water separator (if equipped).
3. Securely plug off the tank end of the fuel return line (A).

CAUTION: Maximum air pressure should be 100 kPa (1 bar) (15 psi) when performing this test.

4. Using a low pressure air source, pressurize the fuel system at the tank end of fuel supply line (B).
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.



Fuel Drain-Back Test

A—Fuel Return Line
B—Fuel Supply Line

RG12416 -UN-22AUG02

RG,115,JW7678 -19-13SEP02-1/1

Bleed the Fuel System



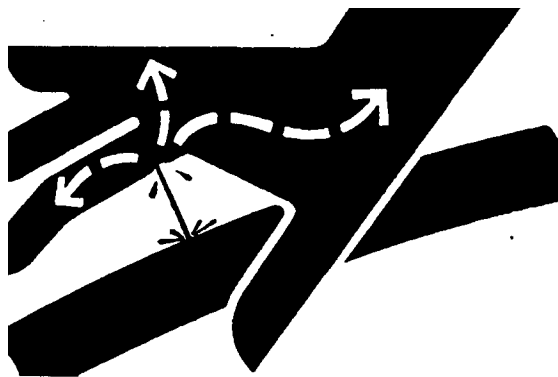
CAUTION: Escaping fluid under pressure can penetrate the skin causing serious injury. Relieve pressure before disconnecting fuel or other lines. Tighten all connections before applying pressure. Keep hands and body away from pinholes and nozzles which eject fluids under high pressure. Use a piece of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

If ANY fluid is injected into the skin, 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.

IMPORTANT: Do not operate the engine at high speeds or full loads before first bleeding the fuel system, as this may cause fuel injection pump failure.

Bleed the fuel system anytime the system has been opened. This includes:

- After fuel filter changes
- After pump or nozzle replacement
- Anytime fuel lines have been disconnected
- After engine has run out of fuel



High-Pressure Fluids

X9811 -UN-23AUG88

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150
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Continued on next page

OUO1082,000006B -19-09OCT07-1/7

Bleed at Final Filter

1. Loosen the air bleed vent screw (A) two full turns by hand on fuel filter base.

A—Vent Screw



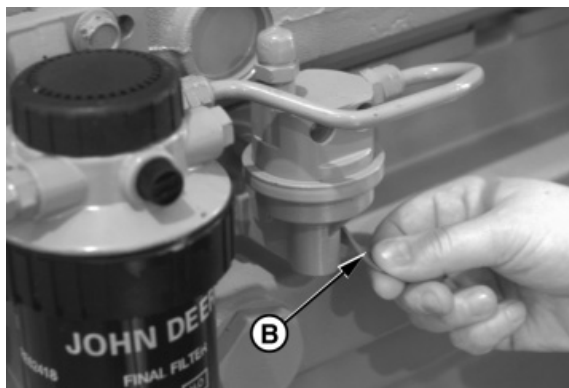
RG7947 -UN-13NOV97

Air Bleed Vent Screw

2. Operate supply pump primer lever (B) until fuel flow is free from air bubbles.
3. Tighten bleed plug securely, continue operating hand primer until pumping action is not felt. Push hand primer inward (toward engine) as far as it will go.
4. Start engine and check for leaks.

If engine will not start, it may be necessary to bleed air from fuel system at fuel injection pump or injection nozzles as explained below.

B—Fuel Supply Pump Primer Lever



RG8013A -UN-15JAN99

Fuel Supply Pump Primer Lever

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OUC1082,000006B -19-09OCT07-3/7

Bleed at Fuel Injection Pump

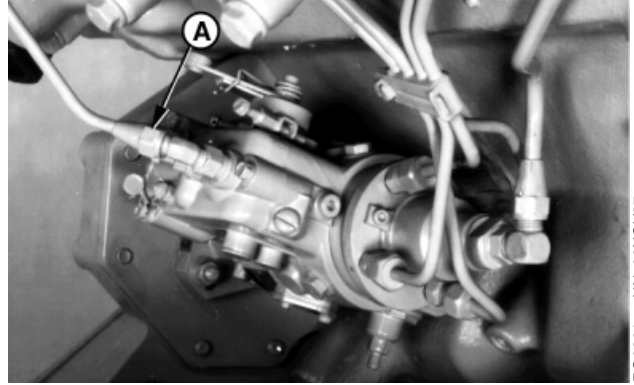
On Stanadyne rotary pumps:

1. Slightly loosen fuel return line connector (A) at fuel injection pump.
2. Operate fuel supply pump primer lever until fuel, without air bubbles, flows from fuel return line connection.
3. Tighten return line connector to specification.

Specification

Stanadyne Fuel Injection Pump
Return Line Connector—Torque 27 N•m (20 lb-ft)

4. Primer lever is spring-loaded and will return to normal position.



Stanadyne Rotary Fuel Injection Pump

A—Fuel Return Line Connector

RG6264 -UN-03NOV97

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OUO1082,000006B -19-09OCT07-4/7

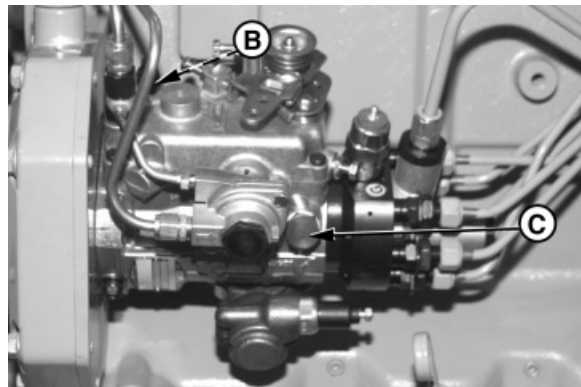
On Delphi/Lucas rotary pumps:

CAUTION: NEVER loosen screw (C) securing pump head, otherwise damage may occur.

1. Loosen bleed screw (B) on pump cover.

NOTE: On injection pump models DP200/201/203, bleed screw is located on top of cover near the fuel return line.

2. Operate fuel supply pump primer lever or turn ignition switch to "ON".
3. Wait until fuel flow is free of air bubbles. Tighten bleed screw.
4. Primer lever is spring-loaded and will return to normal position.



Delphi/Lucas Rotary Fuel Injection Pumps

B—Bleed Screw
C—Screw

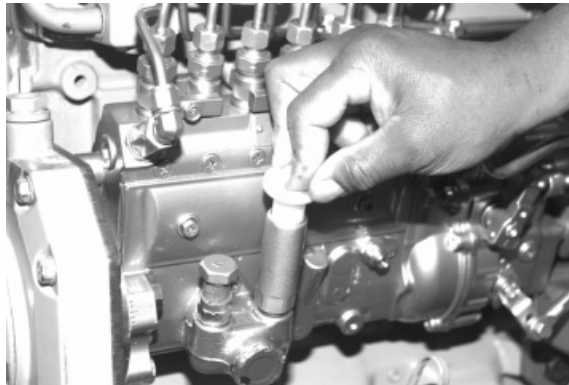
RG7948 -UN-13NOV97

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OUO1082,000006B -19-09OCT07-5/7

On Denso and Motorpal in-line pumps:

1. On Denso pump shown, unscrew hand primer on fuel supply pump until it can be pulled by hand.
2. Open fuel filter port plug.
3. Operate the hand primer until smooth flow of fuel, free of bubbles, comes out of the filter plug hole.
4. Simultaneously stroke the hand primer down and close the filter port plug. This prevents air from entering the system. Tighten plug securely. DO NOT overtighten.



FG8069 -UN-23NOV97

Denso Fuel Injection Pump Shown

IMPORTANT: Be sure hand primer is all the way down in barrel before tightening to prevent internal thread damage.

5. On Denso pump shown, lock hand primer in position.

Continued on next page

OUC1082,000006B -19-09OCT07-6/7

04
150
80

Bleed at Fuel Injection Nozzles

1. Move the engine speed control lever to half throttle position. On engines equipped with electronic fuel shut-off solenoid, energize solenoid.

IMPORTANT: To avoid damage to fuel lines on 9.5 mm injectors, always use a backup wrench when loosening or tightening fuel lines at nozzles or injection pump.

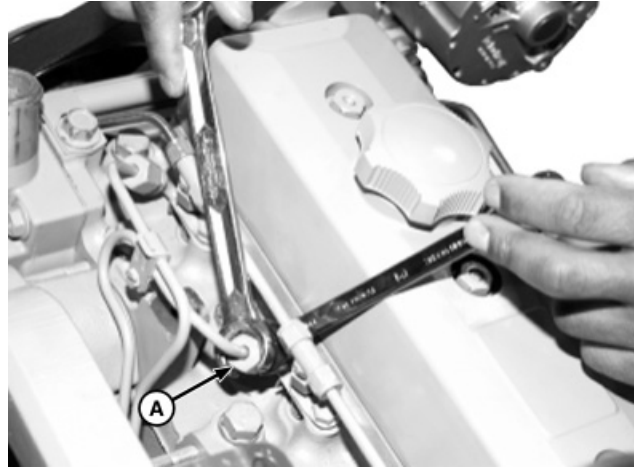
2. On 9.5 mm injectors: Using two open-end wrenches, loosen fuel line connector (A) at injection nozzle as shown.
3. On VOC 17 mm injectors: Loosen fuel line connector (A) at injection nozzle as shown.
4. Crank engine over with starter motor (but do not start engine), until fuel free from bubbles flows out of loosened connection.
5. Tighten connection to specification.

Specification

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

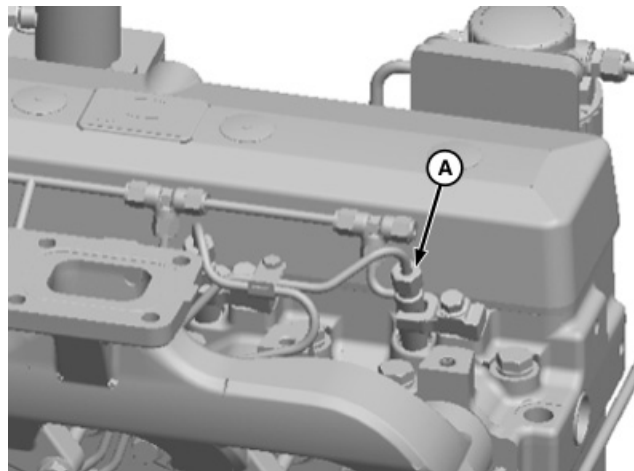
6. Repeat procedure for remaining injection nozzles (if necessary) until all air has been removed from fuel system.

If engine will not start, see your authorized servicing dealer or engine distributor.



Fuel Line Connection—Conventional and RSN 9.5 mm Injector

RG15537 -UN-17SEP07



Fuel Line Connection—VOC 17mm Injector

RG15536 -UN-17SEP07

A—Fuel Line Connector

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Section 05 Tools and Other Materials

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Mechanical Fuel System Essential Tools

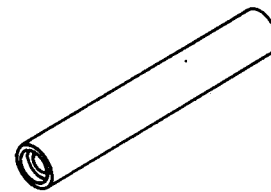
NOTE: Order tools according to information given in the U.S. SERVICEGARD™ Catalog or from the European Microfiche Tool Catalog (MTC).

SERVICEGARD is a trademark of Deere & Company

OUC1082,0000076 -19-19SEP07-1/19

Driver JDF15

Used to install spindle seals in Denso fuel supply pumps.



RG2017

JDF15

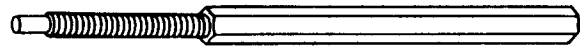
RG2017 -UN-30NOV88

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170
1

OUC1082,0000076 -19-19SEP07-2/19

Injection Pump Timing Pin. JDG886

Used to set in-line fuel injection pump timing prior to removal of pump.



JDG886

RG7212 -UN-23NOV97

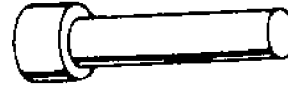
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OUC1082,0000076 -19-19SEP07-3/19

RG5068 -UN-05DEC97

Timing Pin JDE81-4

Used to lock flywheel at No. 1 TDC for injection pump timing.



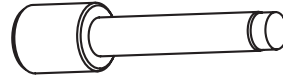
Timing Pin

RG5068

OUO1082.0000076 -19-19SEP07-4/19

Timing Pin JDG1571

Used to lock flywheel at No. 1 TDC for injection pump timing. This timing pin **MUST** be used on engine applications using the tapered-nose crankshaft due to the higher torque specification for damper retaining cap screw.



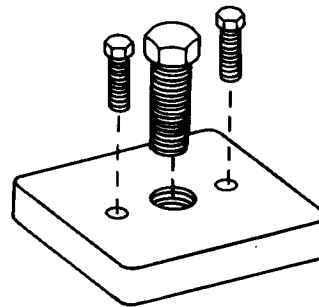
JDG1571

RG12031 -UN-20DEC01

OUO1082.0000076 -19-19SEP07-5/19

Injection Pump Drive Gear Puller JDG1560

Remove drive gear from tapered shaft on Stanadyne DB2 (with retained drive shafts) and DB4 fuel injection pumps. Also used to remove drive gear on Delphi/Lucas injection pumps.



JDG1560

RG6032 -UN-13JAN92

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OUO1082.0000076 -19-19SEP07-6/19

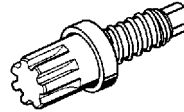
05
170
2

Repair Tools and Other Materials

Flywheel Turning Tool JDG820

RG7056 -UN-17JUN05

Used to rotate flywheel on engines with 129-tooth flywheel ring gear and a 29.9 mm (1.18 in.) ID flywheel housing guide bore diameter. JDE81-1 may be used if JDG820 is not available.



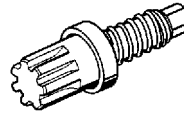
JDG820

OUO1082,0000076 -19-19SEP07-7/19

Flywheel Turning Tool JDE81-1

RG7056 -UN-17JUN05

Used to rotate flywheel on engines with 129-tooth flywheel ring gear and a 29.9 mm (1.18 in.) flywheel housing guide bore diameter. JDG820 may be used if JDE81-1 is not available. JDG820 MUST be used for 6.8L engines in 7400 and 7600 Tractors.

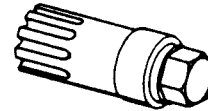


JDE81-1

OUO1082,0000076 -19-19SEP07-8/19

Flywheel Turning Tool JDE83

Used to rotate flywheel on engines with 142-tooth flywheel ring gear and a 26.5 mm (1.04 in.) ID flywheel housing guide bore diameter.



JDE83

RG6251 -UN-22JUL92

OUO1082,0000076 -19-19SEP07-9/19

Crowsfoot Wrench JDF22

RG5288 -UN-23AUG88

Used to loosen and tighten fuel pipes at injection nozzles and at injection pump.



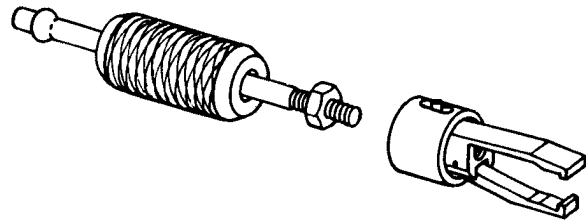
JDF22

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OUO1082,0000076 -19-19SEP07-10/19

Injection Nozzle Puller JDE38B

Remove injection nozzles. If JDE38B is not available, JDE38A Nozzle Puller with JDG716 Adapter can be used. JDG716 can be used with slide handle adapter from JDE38 or JDE38A to remove 9.5 mm nozzles without removing the rocker arm cover. JDG716-1 Repair Kit is available if leg of JDG716 Adapter is damaged.



JDE38B

RG9478 -UN-12NOV98

OUO1082,0000076 -19-19SEP07-11/19

05
170
4

Nozzle Bore Cleaning Tool JDE39

Clean injection nozzle bore in cylinder head.



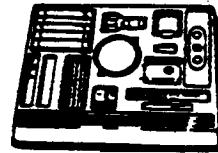
JDE39

RG5084 -UN-23AUG88

OUO1082,0000076 -19-19SEP07-12/19

Nozzle Cleaning Kit JDF13B

Clean injection nozzles.



JDF13B

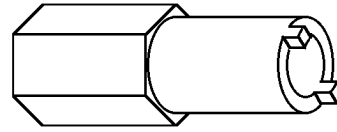
RG5224 -UN-23AUG88

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OUO1082,0000076 -19-19SEP07-13/19

Injection Nozzle Wrench JDG949

Used to loosen or tighten lift adjusting screws on injection nozzles.



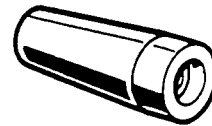
JDG949

RG7644 -UN-23NOV97

OUO1082,0000076 -19-19SEP07-14/19

Nozzle Carbon Stop Seal InstallerJD258¹ (JD-258)

Used to install carbon stop seal in injection nozzle groove.



JD258 (JD-258)

RG6254 -UN-22JUL92

05
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5

¹Order JD-258 when tool is ordered from European Part Distribution (EPDC)

OUO1082,0000076 -19-19SEP07-15/19

Injection Nozzle Puller for RSN Nozzles. JDG1515-1

Remove RSN nozzles.

OUO1082,0000076 -19-19SEP07-16/19

Spring Chamber Cap Wrench JDG1521

Remove spring chamber cap from RSN nozzles.

OUO1082,0000076 -19-19SEP07-17/19

Pressure Adjustment Screw Lock Nut JDG1515-2

Loosen pressure adjusting screw lock nut on RSN nozzles.

Continued on next page

OUO1082,0000076 -19-19SEP07-18/19

Repair Tools and Other Materials

Pressure Adjustment Screw Tool JDG1522

Adjust pressure of RSN nozzles.

OUO1082.0000076 -19-19SEP07-19/19

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6

Mechanical Fuel System Other Material

Number	Name	Use
T43512 (U.S.) TY9473 (Canadian) 242 (LOCTITE®)	Thread Lock and Sealer (Medium Strength)	Apply to fuel supply pump mounting screws, fuel line fittings, injection pump front access plate cap screws and injection pump timing hole plug.
AR54749 (U.S.)	Soap Lubricant	Injection pump mounting flange O-ring.

LOCTITE is a registered trademark of Loctite Corp.

OUC1032,00014BE -19-20AUG04-1/1

Mechanical Fuel System Service Equipment and Tools

05
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NOTE: Order tools according to information given in the U.S. SERVICEGARD™ Catalog or from the European Microfiche Tool Catalog (MTC). Some tools may be available from a local supplier.

SERVICEGARD is a trademark of Deere & Company

OUC1032,00014BF -19-20AUG04-1/10

Adapter TORX® T45

Injection pump drive gear-to-hub cap screws and injection pump drive gear-to-hub cap screws.

TORX is a registered trademark of Camcar/Textron.

OUC1032,00014BF -19-20AUG04-2/10

Bosch Bench Mounted Nozzle Tester JT25510

Check nozzle opening pressure.

Continued on next page

OUC1032,00014BF -19-20AUG04-3/10

Repair Tools and Other Materials

Fuel LineKJD10109

Use with JT25510 Nozzle Tester to check nozzle opening pressure.

OUO1032,00014BF -19-20AUG04-4/10

Fuel Injection Nozzle Tester Adapter Set D01110AA

Check nozzle opening pressure.

OUO1032,00014BF -19-20AUG04-5/10

OTC Portable Nozzle Tester D01109AA

Check nozzle opening pressure.

OUO1032,00014BF -19-20AUG04-6/10

Clamp-On TransducerJT07177

Use with TIME TRAC® meter to measure engine speed.

OUO1032,00014BF -19-20AUG04-7/10

CableJT07172

Use with TIME TRAC® meter to measure engine speed.

OUO1032,00014BF -19-20AUG04-8/10

Pressure Gauge 0—200 kPa (0—2 bar) (0—30 psi), Hose and Fittings.JT05470

Measure transfer pump pressure in rotary injection pump systems. Assemble test equipment from JT05470 Universal Pressure Test Kit or any other suitable equipment.

Continued on next page

OUO1032,00014BF -19-20AUG04-9/10

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Repair Tools and Other Materials

Pressure Gauge 0—400 kPa (0—4 bar) (0—60 psi), Hose
and Fittings JT05470

Leak test in-line fuel injection pump and measure transfer
pump pressure in in-line injection pump systems.
Assemble test equipment from JT05470 Universal
Pressure Test Kit or any other suitable equipment.

OUO1032.00014BF -19-20AUG04-10/10

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Mechanical Fuel System Diagnostic Essential Tools

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

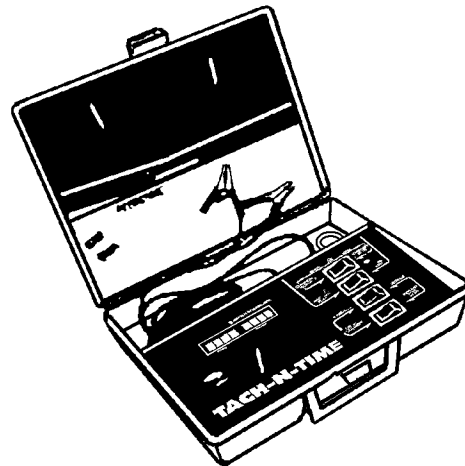
SERVICEGARD is a trademark of Deere & Company

OUO1082.000006C -19-25SEP07-1/9

TACH-N-TIME™¹ Kit (Tester Kit) JDG10534

Used to perform the dynamic timing of engines.

JDG10534 TACH-N-TIME Kit consists of the following: JDG10505P1 TACH-N-TIME Base Unit, JDG10505P2 Magnetic Crankshaft Probe, JDG10505P3 6 mm Red Clamp-On Transducer, JDG10505P4 1/4 in. Black Clamp-On Transducer, JDG1571 Timing Pin, JDG793 Threaded Magnetic Pickup Adapter and JDG281 Tapered Adapter for Flywheel Housing without tapped hole.



JDG10534

¹TACH-N-TIME is a trademark of SPX Corp.

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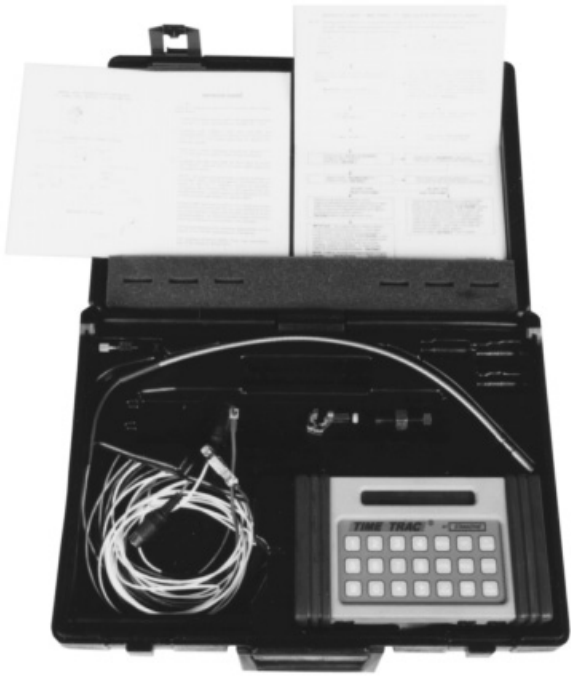
OUO1082.000006C -19-25SEP07-2/9

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RG15531 -UN-14SEP07

TIME TRAC® Kit (Tester Kit) JT07158 (FKM10429A)

Used to perform the dynamic timing of engines. **JT07158 TIME TRAC® Kit** consists of the following: JT07170 (26932) Meter, JT07171 (30641) Magnetic Pickup, JT07172 (30640) Transducer Cable, JT07173 (28037) SOI Clamp Assembly, JT07174 (28062) Instruction Manual, JT07175 (30642) TIME TRAC® Quick Reference Sheet, JT07176 (26924) Carrying Case, JT07177 (28026) 6 mm Green Clamp-On Transducer, JT07178 (28027) 1/4 in. Black Clamp-On Transducer, JDE81-4 Timing Pin, JDG793 Threaded Magnetic Pickup Adapter, JT07155 (29066) 9/16 in. In-Line SOI Sensor¹ and JDG281 Tapered Adapter¹ for Flywheel Housing without tapped hole. **FKM10429A Tester Kit** consists of the following: FKM10429-1 Meter, FKM10429-4 Sensor Clamp, FKM10429-5 6 mm Clamp-On Transducer, FKM10429-8 Instruction Manual, JDE81-4 Timing Pin, FKM10465-1 Magnetic Probe, FKM10465-2 Transducer Cable, FKM10465-3 1/4 in. Clamp-On Transducer, JDG793 Threaded Magnetic Pickup Adapter and JDG281 Tapered Adapter for Flywheel Housing without tapped hole.



JT07158

RG7246 -UN-23NOV97

TIME TRAC is a registered trademark of Stanadyne Automotive Corp.

¹Optional Accessories

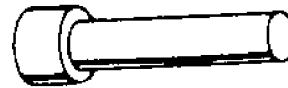
OOU1082,000006C -19-25SEP07-3/9

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Timing Pin JDE81-4

RG5068 -UN-05DEC97

Used to lock flywheel at No. 1 TDC for injection pump timing. Do not use to lock engine when removing or installing damper retaining cap screws.



JDE81-4

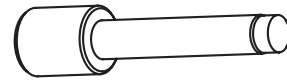
RG5068

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OOU1082,000006C -19-25SEP07-4/9

Timing Pin JDG1571

Used to lock flywheel at No. 1 TDC for injection pump timing. This timing pin MUST be used on engine applications using the tapered-nose crankshaft due to the higher torque specification for damper retaining cap screw.



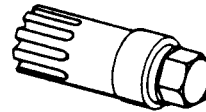
JDG1571

RG12031 -UN-20DEC01

OUO1082,000006C -19-25SEP07-5/9

Flywheel Turning Tool JDE83

Used to rotate flywheel on engines with 142-tooth flywheel ring gear and a 26.5 mm (1.04 in.) ID flywheel housing guide bore diameter.



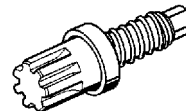
JDE83

RG66251 -UN-22JUL92

OUO1082,000006C -19-25SEP07-6/9

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 -UN-17JUN05

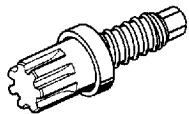
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OUO1082,000006C -19-25SEP07-7/9

RG7056 -UN-17JUN05

Flywheel Turning ToolJDE81-1

Used to rotate flywheel on engines with 129-tooth flywheel ring gear and a 29.9 mm (1.18 in.) flywheel housing guide bore diameter. JDG820 may be used if JDE81-1 is not available. JDG820 MUST be used for 6.8L engines in 7400 and 7600 Tractors.



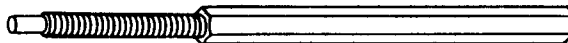
JDE81-1

OUC1082,000006C -19-25SEP07-8/9

RG7212 -UN-23NOV97

Injection Pump Timing Pin. JDG886

Used to set in-line fuel injection pump timing prior to removal of pump.



JDG886

OUC1082,000006C -19-25SEP07-9/9

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Mechanical Fuel System Diagnostic 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,OUO1004,2680 -19-20APR00-1/5

Clamp-On Transducer JT07177

Use with TIME TRAC® meter to measure engine speed.

DPSG,OUO1004,2680 -19-20APR00-2/5

Cable JT07172

Use with TIME TRAC® meter to measure engine speed.

DPSG,OUO1004,2680 -19-20APR00-3/5

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Pressure Gauge 0—200 kPa (0—2 bar) (0—30 psi), Hose and Fittings. JT05470

Measure transfer pump pressure in rotary injection pump systems. Assemble test equipment from JT05470 Universal Pressure Test Kit or any other suitable equipment.

DPSG,OUO1004,2680 -19-20APR00-4/5

Pressure Gauge 0—400 kPa (0—4 bar) (0—60 psi), Hose and Fittings. JT05470

Measure transfer pump pressure in in-line injection pump systems. Assemble test equipment from JT05470 Universal Pressure Test Kit or any other suitable equipment.

DPSG,OUO1004,2680 -19-20APR00-5/5

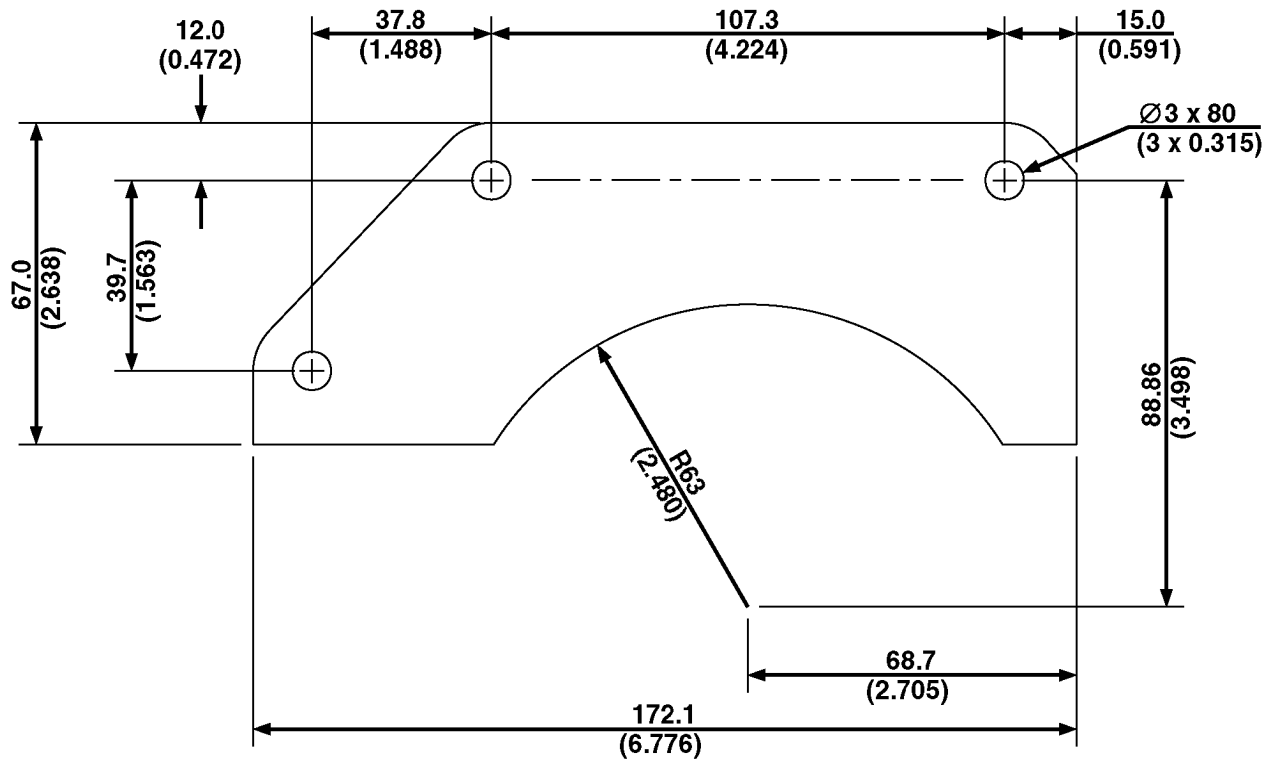
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How to Make Tools

These tools can be made in a service shop using common shop tools and locally obtained materials.

RG,199,JW7719 -19-25NOV97-1/1

DFRG5—Injection Pump Front Plate Timing Mark Transfer Tool



DFRG-5

Material—Aluminum

This template is used to transfer the injection pump timing mark from the engine's original front plate to the

replacement front plate (which does not have the mark). Refer to Section 02, Group 090 for procedure to use this tool.

RG,199,JW7720 -19-25NOV97-1/1

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RG9056 -JUN-16MAR98

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Section 06 Specifications

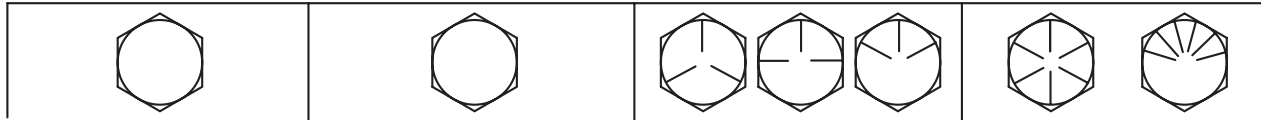
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Group 200 Repair and General OEM Specifications

Unified Inch Bolt and Screw Torque Values

TS1671 -UN-01MAY03



Bolt or Screw	SAE Grade 1				SAE Grade 2 ^a				SAE Grade 5, 5.1 or 5.2				SAE Grade 8 or 8.2			
	Lubricated ^b		Dry ^c		Lubricated ^b		Dry ^c		Lubricated ^b		Dry ^c		Lubricated ^b		Dry ^c	
Size	N•m	lb-in	N•m	lb-in	N•m	lb-in	N•m	lb-in	N•m	lb-in	N•m	lb-in	N•m	lb-in	N•m	lb-in
1/4	3.7	33	4.7	42	6	53	7.5	66	9.5	84	12	106	13.5	120	17	150
													N•m	lb-ft	N•m	lb-ft
5/16	7.7	68	9.8	86	12	106	15.5	137	19.5	172	25	221	28	20.5	35	26
									N•m	lb-ft	N•m	lb-ft				
3/8	13.5	120	17.5	155	22	194	27	240	35	26	44	32.5	49	36	63	46
			N•m	lb-ft	N•m	lb-ft	N•m	lb-ft								
7/16	22	194	28	20.5	35	26	44	32.5	56	41	70	52	80	59	100	74
	N•m	lb-ft														
1/2	34	25	42	31	53	39	67	49	85	63	110	80	120	88	155	115
9/16	48	35.5	60	45	76	56	95	70	125	92	155	115	175	130	220	165
5/8	67	49	85	63	105	77	135	100	170	125	215	160	240	175	305	225
3/4	120	88	150	110	190	140	240	175	300	220	380	280	425	315	540	400
7/8	190	140	240	175	190	140	240	175	490	360	615	455	690	510	870	640
1	285	210	360	265	285	210	360	265	730	540	920	680	1030	760	1300	960
1-1/8	400	300	510	375	400	300	510	375	910	670	1150	850	1450	1075	1850	1350
1-1/4	570	420	725	535	570	420	725	535	1280	945	1630	1200	2050	1500	2600	1920
1-3/8	750	550	950	700	750	550	950	700	1700	1250	2140	1580	2700	2000	3400	2500
1-1/2	990	730	1250	930	990	730	1250	930	2250	1650	2850	2100	3600	2650	4550	3350

Torque values listed are for general use only, based on the strength of the bolt or screw. DO NOT use these values if a different torque value or tightening procedure is given for a specific application. For plastic insert or crimped steel type lock nuts, for stainless steel fasteners, or for nuts on U-bolts, see the tightening instructions for the specific application. Shear bolts are designed to fail under predetermined loads. Always replace shear bolts with identical grade.

Replace fasteners with the same or higher grade. If higher grade fasteners are used, tighten these to the strength of the original. Make sure fastener threads are clean and that you properly start thread engagement. When possible, lubricate plain or zinc plated fasteners other than lock nuts, wheel bolts or wheel nuts, unless different instructions are given for the specific application.

^aGrade 2 applies for hex cap screws (not hex bolts) up to 6. in (152 mm) long. Grade 1 applies for hex cap screws over 6 in. (152 mm) long, and for all other types of bolts and screws of any length.

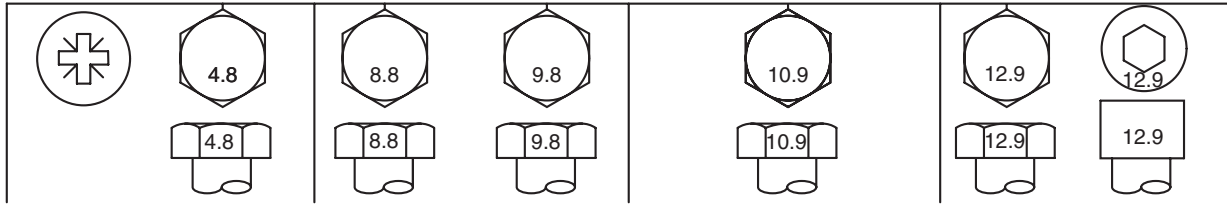
^b"Lubricated" means coated with a lubricant such as engine oil, fasteners with phosphate and oil coatings, or 7/8 in. and larger fasteners with JDM F13C zinc flake coating.

^c"Dry" means plain or zinc plated without any lubrication, or 1/4 to 3/4 in. fasteners with JDM F13B zinc flake coating.

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DX,TORQ1 -19-24APR03-1/1

Metric Bolt and Screw Torque Values



TS1670 -UN-01MAY03

Bolt or Screw	Class 4.8				Class 8.8 or 9.8				Class 10.9				Class 12.9			
	Lubricated ^a		Dry ^b		Lubricated ^a		Dry ^b		Lubricated ^a		Dry ^b		Lubricated ^a		Dry ^b	
Size	N•m	lb-in	N•m	lb-in	N•m	lb-in	N•m	lb-in	N•m	lb-in	N•m	lb-in	N•m	lb-in	N•m	lb-in
M6	4.7	42	6	53	8.9	79	11.3	100	13	115	16.5	146	15.5	137	19.5	172
									N•m	lb-ft	N•m	lb-ft	N•m	lb-ft	N•m	lb-ft
M8	11.5	102	14.5	128	22	194	27.5	243	32	23.5	40	29.5	37	27.5	47	35
			N•m	lb-ft	N•m	lb-ft	N•m	lb-ft								
M10	23	204	29	21	43	32	55	40	63	46	80	59	75	55	95	70
	N•m	lb-ft														
M12	40	29.5	50	37	75	55	95	70	110	80	140	105	130	95	165	120
M14	63	46	80	59	120	88	150	110	175	130	220	165	205	150	260	190
M16	100	74	125	92	190	140	240	175	275	200	350	255	320	235	400	300
M18	135	100	170	125	265	195	330	245	375	275	475	350	440	325	560	410
M20	190	140	245	180	375	275	475	350	530	390	675	500	625	460	790	580
M22	265	195	330	245	510	375	650	480	725	535	920	680	850	625	1080	800
M24	330	245	425	315	650	480	820	600	920	680	1150	850	1080	800	1350	1000
M27	490	360	625	460	950	700	1200	885	1350	1000	1700	1250	1580	1160	2000	1475
M30	660	490	850	625	1290	950	1630	1200	1850	1350	2300	1700	2140	1580	2700	2000
M33	900	665	1150	850	1750	1300	2200	1625	2500	1850	3150	2325	2900	2150	3700	2730
M36	1150	850	1450	1075	2250	1650	2850	2100	3200	2350	4050	3000	3750	2770	4750	3500

Torque values listed are for general use only, based on the strength of the bolt or screw. DO NOT use these values if a different torque value or tightening procedure is given for a specific application. For stainless steel fasteners or for nuts on U-bolts, see the tightening instructions for the specific application. Tighten plastic insert or crimped steel type lock nuts by turning the nut to the dry torque shown in the chart, unless different instructions are given for the specific application.

Shear bolts are designed to fail under predetermined loads. Always replace shear bolts with identical property class. Replace fasteners with the same or higher property class. If higher property class fasteners are used, tighten these to the strength of the original. Make sure fastener threads are clean and that you properly start thread engagement. When possible, lubricate plain or zinc plated fasteners other than lock nuts, wheel bolts or wheel nuts, unless different instructions are given for the specific application.

^a“Lubricated” means coated with a lubricant such as engine oil, fasteners with phosphate and oil coatings, or M20 and larger fasteners with JDM F13C zinc flake coating.

^b“Dry” means plain or zinc plated without any lubrication, or M6 to M18 fasteners with JDM F13B zinc flake coating.

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General OEM Engine Specifications

ITEM	ENGINE										
	4045DF 120	4045DF 270	4045DF 150	4045TF 120	4045TF 150	4045TF 250	4045TF 270	4045TF 280	4045HF 120	4045HF 150	4045HF 280
Number of Cylinders	4	4	4	4	4	4	4	4	4	4	4
Bore	106 mm (4.19 in.)	106 mm (4.19 in.)	106 mm (4.19 in.)	106 mm (4.19 in.)	106 mm (4.19 in.)	106 mm (4.19 in.)	106 mm (4.19 in.)	106 mm (4.19 in.)	106 mm (4.19 in.)	106 mm (4.19 in.)	106 mm (4.19 in.)
Stroke	127 mm (5.0 in.)	127 mm (5.0 in.)	127 mm (5.0 in.)	127 mm (5.0 in.)	127 mm (5.0 in.)	127 mm (5.0 in.)	127 mm (5.0 in.)	127 mm (5.0 in.)	127 mm (5.0 in.)	127 mm (5.0 in.)	127 mm (5.0 in.)
Displacement	4.5L (276 cu in.)	4.5L (276 cu in.)	4.5L (276 cu in.)	4.5L (276 cu in.)	4.5L (276 cu in.)	4.5L (276 cu in.)	4.5L (276 cu in.)	4.5L (276 cu in.)	4.5L (276 cu in.)	4.5L (276 cu in.)	4.5L (276 cu in.)
Compression	17.6:1	17.6:1	17.6:1	17.0:1	17.0:1	17.0:1	17.0:1	19.0:1	17.0:1	17.0:1	19.0:1
Max. Crank Pressure	0.5 kPa (2 H ₂ O)	0.5 kPa (2 H ₂ O)	0.5 kPa (2 H ₂ O)	0.5 kPa (2 H ₂ O)	0.5 kPa (2 H ₂ O)	0.5 kPa (2 H ₂ O)	0.5 kPa (2 H ₂ O)	0.5 kPa (2 H ₂ O)	0.5 kPa (2 H ₂ O)	0.5 kPa (2 H ₂ O)	0.5 kPa (2 H ₂ O)
Governor Regulation (Industrial)	7—10 %	7—10 %	7—10 %	7—10 %	7—10 %	7—10 %	7—10 %	7—10 %	7—10 %	7—10 %	7—10 %
Governor Regulation (Generator)	5 %	5 %	5 %	5 %	5 %	5 %	5 %	5 %	5 %	5 %	5 %
Oil Pressure at Full Load at Rated Speed	345 kPa (50 psi)	345 kPa (50 psi)	345 kPa (50 psi)	345 kPa (50 psi)	345 kPa (50 psi)	345 kPa (50 psi)	345 kPa (50 psi)	345 kPa (50 psi)	345 kPa (50 psi)	345 kPa (50 psi)	345 kPa (50 psi)
Oil Pressure Low Idle	105 kPa (15 psi)	105 kPa (15 psi)	105 kPa (15 psi)	105 kPa (15 psi)	105 kPa (15 psi)	105 kPa (15 psi)	105 kPa (15 psi)	105 kPa (15 psi)	105 kPa (15 psi)	105 kPa (15 psi)	105 kPa (15 psi)
Length	861.0 mm (33.9 in.)	861.0 mm (33.9 in.)	861.0 mm (33.9 in.)	861.0 mm (33.9 in.)	861.0 mm (33.9 in.)	861.0 mm (33.9 in.)	861.0 mm (33.9 in.)	861.0 mm (33.9 in.)	861.0 mm (33.9 in.)	861.0 mm (33.9 in.)	861.0 mm (33.9 in.)
Width	598 mm (23.5 in.)	612 mm (24.1 in.)	598 mm (23.5 in.)	598 mm (23.5 in.)	598 mm (23.5 in.)	598 mm (23.5 in.)	612 mm (24.1 in.)	612 mm (24.1 in.)	598 mm (23.5 in.)	598 mm (23.5 in.)	612 mm (24.1 in.)
Height	854 mm (33.6 in.)	856 mm (33.7 in.)	854 mm (33.6 in.)	980 mm (38.6 in.)	980 mm (38.6 in.)	980 mm (38.6 in.)	994 mm (39.1 in.)	994 mm (39.1 in.)	980 mm (38.6 in.)	980 mm (38.6 in.)	994 mm (39.1 in.)
Weight	387 kg (851 lb)	387 kg (851 lb)	387 kg (851 lb)	396 kg (872 lb)	396 kg (872 lb)	396 kg (872 lb)	451 kg (993 lb)	396 kg (872 lb)	396 kg (872 lb)	396 kg (872 lb)	396 kg (872 lb)

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OOU1082,000006D -19-28SEP07-1/2

Repair and General OEM Specifications

ITEM	ENGINE						
	6068DF150	6068TF120	6068TF150	6068TF250	6068HF120	6068HF150	6068HF250
Number of Cylinders	6	6	6	6	6	6	6
Bore	106 mm (4.19 in.)	106 mm (4.19 in.)	106 mm (4.19 in.)	106 mm (4.19 in.)	106 mm (4.19 in.)	106 mm (4.19 in.)	106 mm (4.19 in.)
Stroke	127 mm (5.0 in.)	127 mm (5.0 in.)	127 mm (5.0 in.)	127 mm (5.0 in.)	127 mm (5.0 in.)	127 mm (5.0 in.)	127 mm (5.0 in.)
Displacement	6.8L (414 cu in.)	6.8L (414 cu in.)	6.8L (414 cu in.)	6.8L (414 cu in.)	6.8L (414 cu in.)	6.8L (414 cu in.)	6.8L (414 cu in.)
Compression	17.6:1	17.0:1	17.0:1	17.0:1	17.0:1	17.0:1	17.0:1
Max. Crank Pressure	0.5 kPa (2 H ₂ O)	0.5 kPa (2 H ₂ O)	0.5 kPa (2 H ₂ O)	0.5 kPa (2 H ₂ O)	0.5 kPa (2 H ₂ O)	0.5 kPa (2 H ₂ O)	0.5 kPa (2 H ₂ O)
Governor Regulation (Industrial)	7—10 %	7—10 %	7—10 %	7—10 %	7—10 %	7—10 %	7—10 %
Governor Regulation (Generator)	5 %	5 %	5 %	5 %	5 %	5 %	5 %
Oil Pressure at Full Load at Rated Speed	345 kPa (50 psi)	345 kPa (50 psi)	345 kPa (50 psi)	345 kPa (50 psi)	345 kPa (50 psi)	345 kPa (50 psi)	345 kPa (50 psi)
Oil Pressure Low Idle	105 kPa (15 psi)	105 kPa (15 psi)	105 kPa (15 psi)	105 kPa (15 psi)	105 kPa (15 psi)	105 kPa (15 psi)	105 kPa (15 psi)
Length	1117 mm (44.0 in.)	1117 mm (44.0 in.)	1117 mm (44.0 in.)	1117 mm (44.0 in.)	1116 mm (43.9 in.)	1116 mm (43.9 in.)	1141 mm (44.9 in.)
Width	598 mm (23.5 in.)	598 mm (23.5 in.)	598 mm (23.5 in.)	598 mm (23.5 in.)	623 mm (24.5 in.)	623 mm (24.5 in.)	623 mm (24.5 in.)
Height	956 mm (37.6 in.)	984 mm (38.7 in.)	984 mm (38.7 in.)	984 mm (38.7 in.)	1009 mm (39.7 in.)	1009 mm (39.7 in.)	1009 mm (39.7 in.)
Weight	522 kg (1149 lb)	533 kg (1172 lb)	533 kg (1172 lb)	533 kg (1172 lb)	550 kg (1210 lb)	550 kg (1210 lb)	568 kg (1250 lb)

OUO1082,000006D -19-28SEP07-2/2

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Mechanical Fuel System Repair Specifications

Item	Measurement	Specification
Fuel Filter Base Mounting Bracket-to-Cylinder Head	Torque	35 N•m (26 lb-ft)
Primary Fuel Filter/Water Separator Mounting Base-to-Bracket	Torque	35 N•m (26 lb-ft)
Final Fuel Filter Mounting Base-to-Bracket	Torque	35 N•m (26 lb-ft)
Fuel Supply Pump (Engine with Rotary Injection Pump)	Pressure	28—41 kPa (0.28—0.41 bar) (4—6 psi)
Fuel Supply Pump Cap Screws (Rotary)	Torque	30 N•m (22 lb-ft)
Fuel Supply Pump (Denso) Cap Screws	Torque	5—7 N•m (4—5 lb-ft) (45—60 lb-in.)
Motorpal Fuel Supply Pump Mounting Cap Screws	Torque	8 N•m (6 lb-ft) (72 lb-in.)
Fuel Supply Pump Inlet and Outlet Lines	Torque	10 N•m (7 lb-ft)
Fuel Shut-Off Solenoid Actuator Rod Cap Screw/Nut	Torque	15—20 N•m (11—15 lb-ft)
Remove and Install Delphi/Lucas Fuel Shut-Off Solenoid		
Solenoid Tightening	Torque	24 N•m (18 lb-ft)
Cold Start Advance Valve	Torque	11.5 N•m (8.5 lb-ft)
Cold Start Advance Solenoid-to-Valve	Torque	5.5 N•m (48 lb-in.)
Delphi/Lucas Cold Start Advance Temperature Switch	Torque	5 N•m (44 lb-in.)
Delphi/Lucas and Stanadyne Rotary Injection Pump Mounting Nuts	Torque	27 N•m (20 lb-ft)

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Repair and General OEM Specifications

Item	Measurement	Specification
Denso Injection Pump Drive Gear Cap Screws	Torque	47 N•m (35 lb-ft)
Motorpal Injection Pump Drive Gear Cap Screws	Torque	61 N•m (45 lb-ft)
Lock Shaft Timing Lock Screw— Unlocked Position	Torque	8 N•m (71 lb-in)
Stanadyne DB2 Fuel Injection Pump Drive Gear-to-Shaft Retaining Nut	Torque	125 N•m (92 lb-ft)
Stanadyne DB4 Fuel Injection Pump Drive Gear-to-Shaft Retaining Nut	Torque	200 N•m (148 lb-ft)
Rotary Injection Pump Front Access Plate Cap Screws	Torque	6 N•m (4.5 lb-ft) (54 lb-in.)
Rotary Injection Pump Mounting Nuts	Torque	27 N•m (20 lb-ft)
Fuel Injection Pump Delivery Lines (At Pump)	Torque	27 N•m (20 lb-ft)
DP201 and DP203 Delphi/Lucas Fuel Injection Pump Drive Gear-to-Shaft Retaining Nut	Torque	80 N•m (60 lb-ft)
Rotary Injection Pump Front Access Plate Cap Screws	Torque	6 N•m (4.5 lb-ft) (54 lb-in.)
Rotary Injection Pump Mounting Nuts	Torque	27 N•m (20 lb-ft)
Fuel Injection Pump Delivery Lines	Torque	27 N•m (20 lb-ft)
Denso Injection Pump Mounting Nuts	Torque	70 N•m (52 lb-ft)
Denso Injection Pump Drive Gear Cap Screws	Torque	47 N•m (35 lb-ft)
Denso Injection Pump Drive Gear Cover	Torque	6 N•m (4.5 lb-ft) (54 lb-in.)
Fuel Injection Pump Delivery Lines	Torque	27 N•m (20 lb-ft)
Fuel Injection Pump Delivery Valve (Motorpal)	Torque	47 N•m (35 lb-ft)

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Repair and General OEM Specifications

Item	Measurement	Specification
Motorpal Injection Pump-to-Cylinder Block Stud Nuts	Torque	47 N•m (35 lb-ft)
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	6 N•m (4.5 lb-ft) (54 lb-in.)
Injection Pump Fuel Delivery Lines	Torque	27 N•m (20 lb-ft)
Motorpal Fuel Inlet Line-to-Injection Pump	Torque	10 N•m (7 lb-ft)
Motorpal Fuel Leak-Off Line-to-Injection Pump	Torque	13 N•m (10 lb-ft)
Motorpal Injection Pump Lube Line	Torque	4.5 N•m (3 lb-ft) (36 lb-in.)
Motorpal Fuel Supply Pump Lines-to-Injection Pump	Torque	10 N•m (7 lb-ft)
Motorpal Injection Pump Housing Oil Fill Plug	Torque	25 N•m (18 lb-ft)
Aneroid Pressure (Lever Lift-Off)	Pressure	76—102 mm Hg (3—4 in. Hg) 10—14 kPa (1.5—2.0 psi)
Aneroid Pressure (Lever at Full Travel)	Pressure	330—380 mm Hg (13—14 in. Hg) 44—51 kPa (6.4—7.4 psi)
Fuel Injection RE60062 Nozzles (Naturally Aspirated Engines)		
New or Reconditioned Nozzle with New Internal Parts	Opening Pressure for Setting	23 856—24 407 kPa (238—244 bar) (3460—3540 psi)
	Opening Pressure for Checking (Minimum)	21 856 kPa (218 bar) (3170 psi)
Used Nozzle	Opening Pressure for Checking (Minimum)	19 850 kPa (198 bar) (2880 psi)

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Repair and General OEM Specifications

Item	Measurement	Specification
Opening Pressure Difference between Cylinders	Pressure Difference (Maximum)	700 kPa (7 bar) (100 psi)
Fuel Injection RE48786 Nozzles (Turbocharged Engines)		
New or Reconditioned Nozzle with New Internal Parts	Opening Pressure for Setting	25 511—26 062 kPa (255—260 bar) (3700—3780 psi)
	Opening Pressure for Checking (Minimum)	24 683 kPa (246 bar) (3580 psi)
Used Nozzle	Opening Pressure for Checking (Minimum)	23 511 kPa (235 bar) (3410 psi)
Opening Pressure Difference between Cylinders	Pressure Difference (Maximum)	700 kPa (7 bar) (100 psi)
Fuel Injection Nozzle Tip (9.5 mm)	Spray Angle	144°
Nozzle (9.5 mm) Valve/Seat Tightness Condition at Pressure Test of 2800—3500 kPa (28—35 bar) (400—500 psi)	Leakage	Nozzle tip dry after 5 seconds. (Slight dampness permissible on used nozzles.)
Fuel Injection Nozzle (9.5 mm) Return Leakage at Pressure Test of 10 300 kPa (103 bar) (1500 psi)	Leakage	3—10 Drops/30 Seconds
Fuel Injection Nozzle (9.5 mm) Tip Orifice	Number of Orifices per Nozzle	4
Fuel Injection Nozzle (9.5 mm) Tip Orifice (Naturally Aspirated Engines)	ID	0.27 mm (0.0106 in.)
Fuel Injection Nozzle (9.5 mm) Tip Orifice (Turbocharged Engines)	ID	0.29 mm (0.0116 in.)

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Repair and General OEM Specifications

Item	Measurement	Specification
Fuel Injection Nozzles (9.5 mm) (Naturally Aspirated Engines)		
New or Reconditioned Nozzle with New Internal Parts	Opening Pressure for Setting	23 856—24 407 kPa (238—244 bar) (3460—3540 psi)
	Opening Pressure for Checking (Minimum)	21 856 kPa (218 bar) (3170 psi)
Used Nozzle	Opening Pressure for Checking (Minimum)	19 850 kPa (198 bar) (2880 psi)
Opening Pressure Difference between Cylinders	Pressure Difference (Maximum)	700 kPa (7 bar) (100 psi)
Fuel Injection Nozzles (9.5 mm) (Turbocharged Engines)		
New or Reconditioned Nozzle with New Internal Parts	Opening Pressure for Setting	25 511—26 062 kPa (255—260 bar) (3700—3780 psi)
	Opening Pressure for Checking (Minimum)	24 683 kPa (246 bar) (3580 psi)
Used Nozzle	Opening Pressure for Checking (Minimum)	23 511 kPa (235 bar) (3410 psi)
Opening Pressure Difference between Cylinders	Pressure Difference (Maximum)	700 kPa (7 bar) (100 psi)
Rate Shaping Nozzle (9.5 mm) (Tier II Certified Engines)		
New or Reconditioned Nozzle	Opening Pressure for Setting	24 400—24 900 kPa (244—249 bar) (3540—3620 psi)
	Opening Pressure for Checking (Minimum)	24 100 kPa (241 bar) (3500 psi)
Used Nozzle	Opening Pressure for Setting	23 000—23 600 kPa (230—236 bar) (3340—3420 psi)
	Opening Pressure for Checking (Minimum)	21 800 kPa (218 bar) (3170 psi)

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Repair and General OEM Specifications

Item	Measurement	Specification
Opening Pressure Difference between Cylinders	Pressure Difference (Maximum)	700 kPa (7 bar) (100 psi)
Injection Nozzle (9.5 mm) Pressure Adjusting Screw Lock Nut	Torque	10 N•m (7 lb-ft)
Fuel Injection Nozzle (9.5 mm) Valve	Needle Lift (Based on Zero Lift)	3/4 Turn Counterclockwise
Fuel Injection Nozzle (9.5 mm) Lift Adjusting Screw Lock Nut	Torque	5 N•m (3.5 lb-ft) (42 lb-in.)
RSN Nozzle (9.5 mm) Valve Lift		
Pressure Adjusting Screw Lock Nut	Torque	10 N•m (7 lb-ft)
Lift Adjusting Screw Lock Nut	Torque	5 N•m (3.5 lb-ft)
RSN Nozzle (Tier II Certified Engines) Valve	Lift	7/8 turn
Fuel Injection Nozzle (9.5 mm) Hold-Down Clamp Cap Screws	Torque	40 N•m (30 lb-ft)
Fuel Leak-Off Line Hex Nut	Torque	5 N•m (3.7 lb-ft) (44 lb-in.)
Fuel Injection Nozzle Delivery Line	Torque	27 N•m (20 lb-ft)
Stanadyne Fuel Injection Pump Return Line Connector	Torque	27 N•m (20 lb-ft)
Fuel Injection Line-to-Nozzle Connector	Torque	27 N•m (20 lb-ft)
New Injection Nozzle (VCO 17 mm)	Opening Pressure	25 500—26 300 kPa (255—263 bar) (3698—3815 psi)
Used Injector Nozzle (VCO 17 mm)	Opening Pressure	21 000 kPa (210 bar) (3050 psi)
Maximum Difference Between Cylinders (VCO 17 mm)	Opening Pressure	700 kPa (7 bar) (100 psi)

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Repair and General OEM Specifications

Item	Measurement	Specification
Nozzle (VCO 17 mm) Condition at Pressure Test of 2000 kPa (20 bar) (300 psi)	Leakage	No drip within 10 seconds.
Nozzle Retaining Nut (VCO 17 mm)	Torque	40 N•m (30 lb-ft) Maximum
Fuel Injection Nozzle (VCO 17 mm) Hold-Down Clamp Cap Screws	Torque	35 N•m (26 lb-ft)
Fuel Leak-Off Line Hex Nut (VCO 17 mm)	Torque	5 N•m (44 lb-in.)
Fuel Injection Nozzle Delivery Line	Torque	27 N•m (20 lb-ft)
Fuel Present at Injection Nozzle Check		
Fuel Injection Nozzle Delivery Lines	Torque	27 N•m (20 lb-ft)
Cylinder Misfire Test (Engine Running)		
Fuel Injection Nozzle Delivery Line	Torque	27 N•m (20 lb-ft)
Rotary Injection Pump Mounting Nuts	Torque	27 N•m (20 lb-ft)
Denso Injection Pump Drive Gear Cap Screws	Torque	47 N•m (35 lb-ft)
Motorpal Injection Pump Drive Gear Cap Screws	Torque	61 N•m (45 lb-ft)
Rotary Fuel Supply Pump	Operating Pressure	21—34 kPa (0.21—0.34 bar) (3—5 psi)
Rotary Fuel Supply Pump	Minimum Flow at 2400 rpm Engine Speed	1.5 L/min (0.42 gpm)
Denso In-Line Fuel Supply Pump	Minimum Pressure at 2400 rpm Engine Speed	69 kPa (0.69 bar) (10 psi)
Denso In-Line Fuel Supply Pump	Minimum Flow at 2400 rpm Engine Speed	2.0 L/min (0.53 gpm)

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Repair and General OEM Specifications

Item	Measurement	Specification
Motorpal In-Line Fuel Supply Pump	Minimum Pressure at 2000 rpm Engine Speed	80 kPa (0.80 bar) (11.6 psi)
Motorpal In-Line Fuel Supply Pump	Minimum Flow at 1000 rpm Engine Speed	1.3 L/min (0.34 gpm)
Denso In-Line Supply Pump	Minimum Outlet Pressure at Cranking Speed	69 kPa (0.69 bar) (10 psi)
Motorpal In-Line Fuel Supply Pump	Minimum Positive Pressure at Cranking Speed	80 kPa (0.80 bar) (11.6 psi)
Cold Start Switch	Torque	5 N•m (3.5 lb-ft) (42 lb-in.)
Delphi/Lucas Fuel Shut-Off Solenoid	Resistance	9 Ohms
Denso Fuel Shut-Off Solenoid (12-Volt System: RE67325)		
Pull Coil	Resistance	0.134—0.200 Ohms
Hold Coil	Resistance	6.63—8.11 Ohms
Denso Fuel Shut-Off Solenoid (24-Volt System: RE67256)		
Pull Coil	Resistance	0.560—0.684 Ohms
Hold Coil	Resistance	24.35—29.76 Ohms
Motorpal Fuel Shut-Off Solenoid		
Pull Coil	Resistance	0.174—0.260 Ohms
Hold Coil	Resistance	10.035—12.265 Ohms
Fuel Injection Nozzle Delivery Line	Torque	27 N•m (20 lb-ft)
Stanadyne Fuel Injection Pump Return Line Connector	Torque	27 N•m (20 lb-ft)
Fuel Injection Line-to-Nozzle Connector	Torque	27 N•m (20 lb-ft)

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Repair and General OEM Specifications

Item	Measurement	Specification
Fuel Filter Base Mounting Bracket-to-Cylinder Head	Torque	35 N•m (26 lb-ft)
Primary Fuel Filter/Water Separator Mounting Base-to-Bracket	Torque	35 N•m (26 lb-ft)
Final Fuel Filter Mounting Base-to-Bracket	Torque	35 N•m (26 lb-ft)
Fuel Supply Pump (Engine with Rotary Injection Pump)	Pressure	28—41 kPa (0.28—0.41 bar) (4—6 psi)
Fuel Supply Pump Cap Screws (Rotary)	Torque	30 N•m (22 lb-ft)
Fuel Supply Pump (Denso) Cap Screws	Torque	5—7 N•m (4—5 lb-ft) (45—60 lb-in.)
Motorpal Fuel Supply Pump Mounting Cap Screws	Torque	8 N•m (6 lb-ft) (72 lb-in.)
Fuel Supply Pump Inlet and Outlet Lines	Torque	10 N•m (7 lb-ft)
Fuel Shut-Off Solenoid Actuator Rod Cap Screw/Nut	Torque	15—20 N•m (11—15 lb-ft)

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Fuel Injection Pump Specifications

The following charts include pumps for John Deere Agricultural Equipment, Construction Equipment, and Commercial and Consumer Equipment, as well as OEM engine applications. They apply to Dubuque, Torreon and Saran-built engines.

Other sources for fuel injection pump timing specifications are as follows:

- Agricultural Equipment–DB1216 Specifications Handbook
- Construction Equipment–SP458 Specifications Handbook

If your pump specifications are not listed in the above sources, refer to DTAC solutions 6717 (Construction Equipment), 33925 (OEM Engines), or 33926 (Agricultural Equipment).

If your rotary pump application is not listed in any of these sources, contact the factory DTAC for assistance.

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NOTE: Engine speeds are as preset to factory specifications. In most cases, slow idle speed will be reset upon specific vehicle application requirements. Refer to your machine technical manual for engine speeds that are different from those preset at the factory.

IMPORTANT: Make sure engine is warmed up to operating temperature and running at full load/rated speed when setting dynamic timing on injection pump.

FUEL INJECTION PUMP SPECIFICATIONS (AGRICULTURAL APPLICATIONS)								
Machine Model	Engine Model	Original Injection Pump (Part No.)	Replaced By Injection Pump (Part No.)	Slow Idle Speed (rpm)	Rated Speed (rpm)	Fast Idle (rpm)	Dynamic Timing (Degrees Before TDC)	DD Engine No. ^a (for European Tier I only)
Des Moines, Iowa								
4700/4710 Sprayer (138 kW)	T06068TN050	RE62366	RE69791	925	2400	2600	6.5	
			RE69791	925	2400	2600	8.5	
	PE6068TN050	RE69791		925	2400	2600	8.5	
	T06068TN053	RE504153 ^b		925	2400	2600	4.3	
	PE6068TN053	RE504153 ^b		925	2400	2600	4.3	
	PE6068TN052	RE504321 ^b		925	2400	2600	4.0	
6700/6700S Sprayer	T04045TN050	RE69155		850	2200	2400	6.5	
	PE4045TN050	RE69155		850	2200	2400	6.5	
7455 Cotton Stripper	T06068TN051	RE63559	RE501302	950	2200	2400	6.6	
			RE501302	950	2200	2400	7.3	
			RE503674	950	2200	2400	7.3	
	PE6068TN051	RE63559	RE501302	950	2200	2400	6.6	
		RE501302	950	2200	2400	7.3		
		RE503674	950	2200	2400	7.3		
7460 Cotton Stripper	PE6068TN054	RE516791		950	2200	2400	7.0	
9935 Cotton Picker	T06068TN051	RE63559	RE501302	950	2200	2400	6.6	
			RE501302	950	2200	2400	7.3	
			RE503674	950	2200	2400	7.3	
	PE6068TN051	RE63559	RE501302	950	2200	2400	6.6	
		RE501302	950	2200	2400	7.3		
		RE503674		950	2200	2400	7.3	
East Moline, Illinois								
^a Reference number is listed on label on side of rocker arm cover and represents applications which are certified to European Tier I regulations. The dynamic timing value is different than the non-certified applications.								
^b In-line mechanical fuel injection pump.								

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Diagnostic Specifications

FUEL INJECTION PUMP SPECIFICATIONS (AGRICULTURAL APPLICATIONS)

Machine Model	Engine Model	Original Injection Pump (Part No.)	Replaced By Injection Pump (Part No.)	Slow Idle Speed (rpm)	Rated Speed (rpm)	Fast Idle (rpm)	Dynamic Timing (Degrees Before TDC)	DD Engine No. ^a (for European Tier I only)
9400 Combine	T06068HH050	RE69757		1350	2200	2400	9.0	
9410 Combine	T06068HH051	RE500758	RE502066	1350	2200	2400	9.0	
		RE502066		1350	2200	2400	9.0	
9450 Combine	T06068HH052	RE502066		1350	2200	2400	9.0	
	PE6068HH052	RE502066		1350	2200	2400	9.0	
Horizontina, Brazil								
1075 Combine	J06068TYC50	RE500196		1000	2200	2400	5.0	
1165 Combine	J06068TCQ11	RE516089		1200	2200	2400	13.3	
1170 Combine	CD6068TCQ50	RE68367	RE505800	1200	2200	2390	6.5	
		RE505800		1200	2200	2390	6.5	
1175 Combine	J06068TCQ12	RE522635		1200	2200	2390	10.5	
1450 Combine	J06068TCQ04	RE522635		1200	2200	2400	10.5	
	J06068TJ04	RE522635		1200	2200	2400	10.5	
1550 Combine	J06068ACQ01	RE62243		850	2200	2400	N/A	
3518 Combine	J06068TYC51	RE504321		925	2400	2600	14.0	
5403 Tractor	J04045DCQ01	RE508715		825	2400	2605	15.0	
5605 Tractor	J04045DJ01	RE508715		825	2400	2600	15.0	
5705 Tractor	J04045TJ02	RE519690		825	2400	2600	15.0	
6400 Tractor	J04045TCQ01	RE516813		875	2300	2495	N/A	
6403 Tractor	J04045TP057	RE504066		825	2100	2300	14.3	
6405 Tractor	J04045TCQ01	RE516813		950	2300	2500	12.0	
6415 Tractor	J04045TCQ03	RE516813		950	2300	2500	12.0	
6603 Tractor	J06068TP053	RE504067		825	2100	2300	14.7	
6605 Tractor	J06068TJ02	RE516814		875	2300	2500	12.0	
6615 Tractor	J06068TCQ13	RE516814		875	2300	2500	12.0	
7505 Tractor	J06068TCQ03	RE523239		875	2100	2300	12.6	
7515 Tractor	J06068TCQ14	RE523239		875	2100	2300	12.6	
Jiamusi, China								
1065 Combine	CD4045TYC50	RE69781		1000	2400	2650	7.0	
1075 Combine	CD6068TYC50	RE500196		1000	2400	2650	5.0	
3060 Combine	CD4045DYC50	RE502713		950	2200	2400	6.5	
3518 Combine	CD6068TYC51	RE504321		850	2400	2650	4.1	
	CD6068HYC50	RE504802		1200	2400	2650	6.1	
Zweibrucken, Germany								
^a Reference number is listed on label on side of rocker arm cover and represents applications which are certified to European Tier I regulations. The dynamic timing value is different than the non-certified applications.								

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Diagnostic Specifications

FUEL INJECTION PUMP SPECIFICATIONS (AGRICULTURAL APPLICATIONS)

Machine Model	Engine Model	Original Injection Pump (Part No.)	Replaced By Injection Pump (Part No.)	Slow Idle Speed (rpm)	Rated Speed (rpm)	Fast Idle (rpm)	Dynamic Timing (Degrees Before TDC)	DD Engine No. ^a (for European Tier I only)
2254 Combine	CD6068HZ050	RE500574		1200	2200	2390	9.0	
3200/3400 Telehandler	CD4045TZ050	RE501192		850	2200	2400	6.0	
Ottumwa, Iowa								
4890 Windrower	T04045TE050	RE63309	RE69779	850	2500	2700	7.0	
		RE69779	RE502708	850	2500	2700	7.0	
		RE502708		850	2500	2700	7.0	
	PE4045TE050	RE63309	RE69779	850	2500	2700	7.0	
		RE69779	RE502708	850	2500	2700	7.0	
		RE502708		850	2500	2700	7.0	
4895 Windrower	T04045TE051	RE69781		850	2500	2700	7.0	
	PE4045TE051	RE69781		850	2500	2700	7.0	
4990 Windrower	T06068TE050	RE70390	RE502709	900	2300	2500	6.5	
		RE502709		900	2300	2500	6.5	
	PE6068TE050	RE70390	RE502709	900	2300	2500	6.5	
		RE502709		900	2300	2500	6.5	
4995 Windrower	PE6068TE051	RE509430		900	2300	2500	6.0	
Waterloo, Iowa								
7210 Tractor (SYNCROPLUS™)	T06068TRW53	RE59526	RE70937	900	2100	2300	6.5	
		RE70937	RE502824	900	2100	2300	6.5	
		RE502824		900	2100	2300	6.5	
	PE6068HRW53	RE502824		900	2100	2300	6.5	
7210 Tractor (POWRQUAD™)	T06068TRW50	RE59526	RE70937	900	2100	2300	6.5	
		RE70937	RE502824	900	2100	2300	6.5	
		RE502824		900	2100	2300	6.5	
	PE6068TRW50	RE59526	RE70937	900	2100	2300	6.5	
		RE70937	RE502824	900	2100	2300	6.5	
		RE502824		900	2100	2300	6.5	
7220 Tractor	CD6068TRW01	RE516840		850	2300	2460	5.6	
7410 Tractor (SYNCROPLUS™)	T06068TRW54	RE59527	RE70938	900	2100	2300	6.5	
		RE70938	RE502825	900	2100	2300	6.5	
		RE502825		900	2100	2300	6.5	

^aReference number is listed on label on side of rocker arm cover and represents applications which are certified to European Tier I regulations. The dynamic timing value is different than the non-certified applications.

SYNCROPLUS is a trademark of Deere & Company
POWRQUAD is a trademark of Deere & Company

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Diagnostic Specifications

FUEL INJECTION PUMP SPECIFICATIONS (AGRICULTURAL APPLICATIONS)

Machine Model	Engine Model	Original Injection Pump (Part No.)	Replaced By Injection Pump (Part No.)	Slow Idle Speed (rpm)	Rated Speed (rpm)	Fast Idle (rpm)	Dynamic Timing (Degrees Before TDC)	DD Engine No. ^a (for European Tier I only)
	PE6068TRW54	RE59527	RE70938	900	2100	2300	6.5	
		RE70938	RE502825	900	2100	2300	6.5	
		RE502825		900	2100	2300	6.5	
7410 Tractor (POWRQUAD™)	T06068TRW51	RE59527	RE70938	900	2100	2300	6.5	
		RE70938	RE502825	900	2100	2300	6.5	
		RE502825		900	2100	2300	6.5	
	PE6068TRW51	RE502825		900	2100	2300	6.5	
7510 Tractor (POWRQUAD™)	T06068TRW70	RE502826		900	2100	2300	7.0	
	PE6068TRW70	RE502826		900	2100	2300	7.0	
7610 Tractor (105 kW)	T06068TRW52	RE59514	RE70939	900	2100	2300	6.5	
		RE70939	RE502826	900	2100	2300	7.0	
		RE502826		900	2100	2300	7.0	
	PE6068TRW52	RE502826		900	2100	2300	7.0	
7610 Tractor (110 kW)	T06068TRW72	RE504068		900	2100	2300	6.5	
	PE6068TRW72	RE504068		900	2100	2300	6.5	
7810 Tractor (Export-Brazil)	PE6068TRW73	RE508213		900	2100	2300	8.0	
Mannheim, Germany (European Market)								
3210 Tractor	CD4045DRT50	RE506240		850	2350	2515	7.9	
3310 Tractor	CD4045DRT51	RE506241		850	2350	2515	5.0	
3410 Tractor	CD4045TRT50	RE506242		850	2350	2515	5.5	
		RE506873		850	2350	2550	7.0	
5620 Tractor	CD4045DL270	RE519176		875	2300	2500	2.5	
5720 Tractor	CD4045DL273			875	2300	2500	—0.3	
5820 Tractor	CD4045DL274			875	2300	2500	0.5	
6010 Tractor	CD4045DL050	RE501014	RE505563	900	2300	2500	6.0	
		RE505563		900	2300	2500	6.0	
		RE506366		900	2300	2500	5.0	DD16106 ^a
6020 Tractor	CD4045DL070	RE506302		900	2300	2500	6.0	
6110 Tractor (Direct Fan Drive)	CD4045TL058	RE68562	RE501222	900	2300	2500	7.5	
		RE501222	RE505564	900	2300	2500	7.5	
^a Reference number is listed on label on side of rocker arm cover and represents applications which are certified to European Tier I regulations. The dynamic timing value is different than the non-certified applications.								

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Diagnostic Specifications

FUEL INJECTION PUMP SPECIFICATIONS (AGRICULTURAL APPLICATIONS)

Machine Model	Engine Model	Original Injection Pump (Part No.)	Replaced By Injection Pump (Part No.)	Slow Idle Speed (rpm)	Rated Speed (rpm)	Fast Idle (rpm)	Dynamic Timing (Degrees Before TDC)	DD Engine No. ^a (for European Tier I only)
		RE505564		900	2300	2500	7.5	
6110 Tractor (Viscous Fan Drive)	CD4045TL050	RE68562	RE501222	900	2300	2500	7.5	
		RE501222	RE505564	900	2300	2500	7.5	
		RE505564		900	2300	2500	7.5	
		RE506367		900	2300	2500	4.0	DD16107 ^a
6120 Tractor	CD4045TL070	RE506504		900	2300	2500	6.0	DD16065 ^a
6205 Tractor	CD4045TL064	RE503084		900	2300	2500	14.0	
6210 Tractor (Direct Fan Drive)	CD4045TL059	RE68563	RE501223	900	2300	2500	6.0	
		RE501223	RE505565	900	2300	2500	6.0	
		RE505565		900	2300	2500	6.0	
6210 Tractor (Viscous Fan Drive)	CD4045TL051	RE68563	RE501223	900	2300	2500	6.0	
		RE501223	RE505565	900	2300	2500	6.0	
		RE505565		900	2300	2500	6.0	
		RE506368		900	2300	2500	3.5	DD16108 ^a
6215 Tractor (Non-Certified)	CD4045TL072	RE503084		900	2300	2500	3.5	
6215 Tractor (Classic)	CD4045TL072	RE506508		900	2300	2500	14.0	DD16067 ^a
6215 Tractor (Classic) (Certified)	CD4045TL071	RE506305		900	2300	2500	6.1	
6220 Tractor	CD4045TL071	RE506305		900	2300	2500	3.5	
		RE506506			2300	2500	6.1	DD16066 ^a
6310 Tractor (Direct Fan Drive)	CD4045TL060	RE68543	RE501224	900	2300	2500	6.0	
		RE501224		900	2300	2500	6.0	
		RE505566		900	2300	2500	6.0	
6310 Tractor (Viscous Fan Drive)	CD4045TL052	RE68543	RE501224	900	2300	2500	6.0	
		RE501224		900	2300	2500	6.0	
		RE506369		900	2300	2500	3.0	DD16109 ^a
		RE505566		900	2300	2500	6.0	
6320 Tractor	CD4045HL072	RE509071		900	2300	2495	6.5	
6320SE Tractor	CD4045TL073	RE506307		850	2300	2500	5.5	

^aReference number is listed on label on side of rocker arm cover and represents applications which are certified to European Tier I regulations. The dynamic timing value is different than the non-certified applications.

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Diagnostic Specifications

FUEL INJECTION PUMP SPECIFICATIONS (AGRICULTURAL APPLICATIONS)

Machine Model	Engine Model	Original Injection Pump (Part No.)	Replaced By Injection Pump (Part No.)	Slow Idle Speed (rpm)	Rated Speed (rpm)	Fast Idle (rpm)	Dynamic Timing (Degrees Before TDC)	DD Engine No. ^a (for European Tier I only)
6410 Tractor (Direct Fan Drive)	CD4045TL061	RE68544	RE501226	900	2300	2500	6.5	
		RE501226		900	2300	2500	6.5	
		RE505568		875	2300	2500	6.5	
6410 Tractor (Viscous Fan Drive)	CD4045TL053	RE68544	RE501226	900	2300	2500	6.5	
		RE501226		900	2300	2500	6.5	
		RE506371		900	2300	2500	4.0	DD16111 ^a
		RE505568		900	2300	2500	6.5	
6420 Tractor	CD4045HL070	RE506311		900	2300	2500	7.5	
		RE506312		900	2300	2500	7.5	
6505 Tractor	CD6068DL051	RE503085		875	2300	2500	7.5	
6510 Tractor	CD6068DL050	RE68872	RE501230	875	2300	2500	5.5	
		RE501230	RE505577	875	2300	2500	5.5	
		RE505577		875	2300	2500	5.5	
		RE505577		875	2300	2500	5.0	DD16113 ^a
6515 Tractor (Classic) (77 kW)	CD6068DL071	RE503085		875	2300	2495	14.0	
6515 Tractor (Classic) (85 kW)	CD6068DL070	RE506267	RE506268	875	2300	2460	6.5	
		RE506268		875	2300	2500	6.5	
6520 Tractor	CD6068DL070	RE506267		900	2300	2500	6.5	
		RE506268		875	2300	2500	6.5	
6520/6520SE Tractor	CD6068TL073	RE522297		850	2300	2495	9.1	
6610 Tractor	CD6068TL050	RE501232	RE503887	875	2300	2500	6.0	
		RE503887	RE505579	875	2300	2500	6.0	
		RE505579		875	2300	2500	6.0	
		RE505579		850	2300	2500	8.0	DD16115 ^a
6810 Tractor	CD6068TL051	RE501234	RE503889	875	2100	2300	6.0	
		RE503889	RE505581	875	2100	2300	6.0	
		RE505581		875	2100	2300	6.0	
		RE505581		875	2100	2300	5.5	DD16117 ^a
6910 Tractor (99 kW)	CD6068TL052	RE501236	RE503891	875	2100	2300	6.0	
		RE503891	RE505583	875	2100	2300	6.0	
		RE505583		875	2100	2300	6.0	

^aReference number is listed on label on side of rocker arm cover and represents applications which are certified to European Tier I regulations. The dynamic timing value is different than the non-certified applications.

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Diagnostic Specifications

FUEL INJECTION PUMP SPECIFICATIONS (AGRICULTURAL APPLICATIONS)

Machine Model	Engine Model	Original Injection Pump (Part No.)	Replaced By Injection Pump (Part No.)	Slow Idle Speed (rpm)	Rated Speed (rpm)	Fast Idle (rpm)	Dynamic Timing (Degrees Before TDC)	DD Engine No. ^a (for European Tier I only)	
6910 Tractor (107 kW)	CD6068TL054	RE502412	RE505585	875	2100	2300	5.9		
			RE505585	875	2100	2300	5.9		
			RE505585	875	2100	2300	5.4	DD16119 ^a	
Mannheim, Germany (North American Market)									
6110/6110L Tractor	CD4045TL063	RE501008	RE501222	900	2300	2500	4.0		
			RE501222	900	2300	2500	4.0		
			RE505564	900	2300	2500	4.0		
			RE506367	900	2300	2500	4.0		
			RE505570	900	2300	2500	5.0		
6120 Tractor	CD4045TL070	RE506504			2300	2500	6.0	DD16065 ^a	
6210/6210L Tractor	CD4045TL054	RE501441	RE505570	900	2300	2500	5.0		
6215 Tractor (Advantage)	CD4045TL071	RE506506		900	2300	2500	6.1	DD16066 ^a	
6220 Tractor	CD4045TL071	RE506506		900	2300	2500	6.1	DD16066 ^a	
6310/6310L/6310S Tractor	CD4045TL055	RE501442	RE505571	900	2300	2500	4.5		
			RE505571	900	2300	2500	4.5		
			RE505571	900	2300	2495	5.5		
6320 Tractor	CD4045HL073	RE509071		900	2300	2500	4.5		
			RE506309	RE505571	900	2300	2500	4.5	
			RE505571						
		RE506310	RE505573	900	2300	2500	4.5		
		RE505573							
6403/6405 Tractor (Advantage)	CD4045TL062	RE501006		900	2300	2500	6.0		
6410/6410L/6410S Tractor	CD4045TL056	RE501443	RE505574	900	2300	2500	4.0		
			RE505574	900	2300	2500	4.0		
6415 Tractor (Advantage)	CD4045TL075	RE501006		900	2300	2495	6.0		
6420 Tractor	CD4045HL070	RE506311		850	2300	2460	7.5		
			RE506312	850	2300	2460	7.5		
6510L/6510S Tractor	CD4045TL057	RE501287	RE505576	900	2300	2500	3.5		
			RE505576	900	2300	2500	3.5		
6520L Tractor	CD4045HL071	RE506313		900	2300	2500	7.5		
6603/6605 Tractor (Advantage)	CD6068TL053	RE500993		875	2300	2500	8.0		

^aReference number is listed on label on side of rocker arm cover and represents applications which are certified to European Tier I regulations. The dynamic timing value is different than the non-certified applications.

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Diagnostic Specifications

FUEL INJECTION PUMP SPECIFICATIONS (AGRICULTURAL APPLICATIONS)

Machine Model	Engine Model	Original Injection Pump (Part No.)	Replaced By Injection Pump (Part No.)	Slow Idle Speed (rpm)	Rated Speed (rpm)	Fast Idle (rpm)	Dynamic Timing (Degrees Before TDC)	DD Engine No. ^a (for European Tier I only)
6615 Tractor (Advantage)	CD6068TL071	RE515743		850	2300	2495	5.6	
		RE506340		850	2300	2500	5.6	DD16092 ^a
6715 Tractor (Advantage)	CD6068TL072	RE517315	RE519514	850	2300	2500	6.1	DD20565 ^a
		RE519514		850	2300	2500	6.1	DD20879 ^a
Saltillo, Mexico								
5415 Tractor	PE4045DP050	RE502362		825	2400	2600	9.0	
	PE4045DP052	RE504061		825	2400	2600	14.0	
5615 Tractor	PE4045DP051	RE70452		825	2400	2600	9.0	
	PE4045DP053	RE504062		825	2400	2600	13.0	
5715 Tractor	PE4045TP050	RE502792		825	2400	2600	8.0	
	PE4045TP059	RE504063		825	2400	2600	14.0	
6103 Tractor	PE4045TP055	RE504064		825	2100	2300	13.0	
6203 Tractor	PE4045TP056	RE504065		825	2100	2300	13.0	
6400 Tractor	PE4045TP054	RE501006		850	2300	2500	6.0	
6403 Tractor	PE4045TP057	RE504066		825	2100	2300	13.5	
	PE4045TP060	RE508830		825	2100	2300	5.1	
6415 Tractor	PE4045TP061	RE501006		850	2300	2500	6.0	
6603 Tractor	PE6068TP053	RE504067		825	2100	2300	15.0	
	PE6068TP054	RE508831		825	2100	2300	5.1	
7220 Tractor	PE6068TP055	RE515743		850	2300	2500	6.0	
7320 Tractor	PE6068TP056	RE517322		900	2300	2500	6.0	
7405 Tractor (Advantage)	CD6068TP051	RE64720	RE59527	875	2100	2275	6.0	
		RE59527		875	2100	2275	6.0	
	PE6068TP051	RE70938		900	2100	2300	6.5	
7410 Tractor	CD6068TP052	RE64721	RE501236	875	2100	2275	6.0	
		RE501236	RE503891	875	2100	2275	6.0	
		RE503891	RE503571	875	2100	2275	6.0	
		RE503571	RE505961	875	2100	2275	6.0	
		RE505961		875	2100	2275	6.0	
7420 Tractor	PE6068TP057	RE505961		900	2100	2300	6.0	
7500 Tractor	PE6068TP052	RE501236	RE503571	900	2100	2300	6.0	
		RE503571	RE505961	900	2100	2300	6.0	
		RE505961		900	2100	2300	6.0	

^aReference number is listed on label on side of rocker arm cover and represents applications which are certified to European Tier I regulations. The dynamic timing value is different than the non-certified applications.

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Diagnostic Specifications

FUEL INJECTION PUMP SPECIFICATIONS (AGRICULTURAL APPLICATIONS)

Machine Model	Engine Model	Original Injection Pump (Part No.)	Replaced By Injection Pump (Part No.)	Slow Idle Speed (rpm)	Rated Speed (rpm)	Fast Idle (rpm)	Dynamic Timing (Degrees Before TDC)	DD Engine No. ^a (for European Tier I only)
7520 Tractor	PE6068TP058	RE517323		900	2100	2300	5.0	
Tekirdag, Turkey								
5615 Tractor	CD4045DTK20	RE504062		825	2400	2600	13.0	
5715 Tractor	CD4045TTK20	RE504063		825	2400	2600	14.0	
Cameco (Deere) (Thibodaux, Louisiana)								
S30 Harvester	PE6068DT850	RE59861		850	2500	2700	6.0	
SP1800 Cane Loader	PE6068DT850	RE59861		850	2500	2700	6.0	
SP2252 Cane Loader	PE6068TT850	RE69791		850	2400	2600	8.5	
SP3000 Cane Loader	PE6068DT850	RE59861		850	2500	2700	6.0	
100 Loader/ Harvester (Kanaf)	PE6068TT850	RE69791		850	2400	2600	8.5	
110T Cane Tractor	PE4045TT851	RE502376		950	2200	2400	6.0	
		RE516345		950	2300	2500	N/A	
215 4WD Tractor	PE6068DT850	RE59861	RE505929	850	2500	2700	6.0	
		RE505929	RE509503	850	2500	2700	6.0	
		RE509503		850	2500	2700	6.0	
220 Tractor	PE6068TT851	RE69791		850	2400	2600	8.5	
220 4WD Tractor/Pineapple Harvester/Sprayer	PE6068TT850	RE69791		850	2400	2600	8.5	
404 Vegetable Harvester	T04045TT850	RE69155		850	2200	2400	6.5	
	PE4045TT850	RE69155		850	2200	2400	6.5	
	T04045TT801	RE503037		850	2200	2400	6.5	

^aReference number is listed on label on side of rocker arm cover and represents applications which are certified to European Tier I regulations. The dynamic timing value is different than the non-certified applications.

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Diagnostic Specifications

FUEL INJECTION PUMP SPECIFICATIONS (COMMERCIAL AND CONSUMER EQUIPMENT APPLICATIONS)								
Machine Model	Engine Model	Original Injection Pump (Part No.)	Replaced By Injection Pump (Part No.)	Slow Idle Speed (rpm)	Rated Speed (rpm)	Fast Idle (rpm)	Dynamic Timing (Degrees Before TDC)	DD Engine Number ^a
Augusta, Georgia								
5410 Tractor	CD4045DLV50	RE70452		825	2400	2600	9.0	
	PE4045DLV50	RE70452		825	2400	2600	9.0	
5410 Tractor (No Engine Air Heater Option)	PE4045DLV51	RE70452		825	2400	2600	9.0	
5420/5420N Tractor	PE4045DLV50	RE70452		850	2400	2600	9.0	
5420/5420N Tractor (No Engine Air Heater Option)	PE4045DLV51	RE70452		825	2400	2600	9.0	
5425 Tractor	PE4045TLV53	RE521589		850	2400	2600	9.5	
5510/5510N Tractor	CD4045TLV50	RE70453	RE502792	850	2400	2600	8.0	
		RE502792		825	2400	2600	8.0	
	PE4045TLV50	RE70453	RE502792	825	2400	2600	8.0	
		RE502792		825	2400	2600	8.0	
5510 Tractor (No Engine Air Heater Option)	PE4045TLV51	RE502792		825	2400	2600	8.0	
5510 Tractor (LUK Clutch Option)	PE4045TLV52	RE521136		825	2400	2600	N/A	
5520/5520N Tractor	PE4045TLV50	RE502792		825	2400	2600	8.0	
5520/5520N Tractor (No Engine Air Heater Option)	PE4045TLV51	RE502792		825	2400	2600	8.0	
5520 Tractor	PE4045TLV52	RE521136		825	2400	2600	N/A	
5525 Tractor	PE4045TLV54	RE521590		850	2400	2600	9.5	
Agritalia srl (Vittoria, Sicily, Italy)								
5410 Tractor	CD4045TAT50	RE508874		850	2300	2460	6.0	
5415 Tractor	CD4045DAT70	RE520272		850	2300	2500	2.5	
5510 Tractor	CD4045TAT50	RE509044		850	2300	2500	2.5	DD16148 ^a
5515 Tractor	CD4045TAT70	RE520273		850	2300	2500	0.0	DD20669 ^a
5615 Tractor	CD4045TAT71	RE520274		850	2300	2500	1.0	DD20670 ^a
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Diagnostic Specifications

FUEL INJECTION PUMP SPECIFICATIONS (CONSTRUCTION AND FORESTRY EQUIPMENT APPLICATIONS)

Machine Model	Engine Model	Original Injection Pump (Part No.)	Replaced By Injection Pump (Part No.)	Slow Idle Speed (rpm)	Rated Speed (rpm)	Fast Idle (rpm)	Dynamic Timing (Degrees Before TDC)
Davenport, Iowa							
LX80 Loader	T04045HDW51	RE60174		950	2200	2400	N/A
LX100 Loader (Hitachi Construction Machine)	T06068TDW53	RE59962 ^a		950	2100	2300	5.0
	PE6068TDW53	RE59962 ^a		950	2100	2300	5.0
LX100-3 (Hitachi Construction Machine)	T06068TDW50	RE59542		950	2100	2300	N/A
	PE6068TDW50	RE59542		950	2100	2300	N/A
LX120 Loader (Hitachi Construction Machine)	T06068HDW52	RE59958		950	2200	2400	6.0
	T06068HDW70	RE59958 ^a		950	2200	2400	6.0
	PE6068HDW70	RE59958 ^a		950	2200	2400	6.0
TC44H Tool Carrier	T04045TDW50	RE69547		950	2200	2400	5.0
	PE4045TDW50	RE69547		950	2200	2400	5.0
TC54H Tool Carrier	T0608TDW50	RE67598		950	2200	2400	6.5
	PE06068TDW50	RE67598		950	2200	2400	6.5
TC62H Tool Carrier	T06068HDW50	RE59958 ^a		950	2200	2400	6.0
	PE6068HDW50	RE59958 ^a		950	2200	2400	6.0
TJ460 TC Skidder Tool Carrier	T06068TDW57	RE508301		900	2200	2400	4.0
	PE6068TDW57	RE508301		900	2200	2400	4.0
360D Skidder (Timberjack)	T06068TDW54	RE67669		1000	2200	2400	6.5
	PE6068TDW54	RE67669		1000	2200	2400	6.5
444H Loader	T04045TDW50	RE69547		950	2200	2400	5.0
	PE4045TDW50	RE69547		950	2200	2400	5.0
460 Skidder (Timberjack)	T06068TDW55	RE500196		1000	2200	2400	5.0
		RE506159		1000	2200	2400	5.0
	PE6068TDW55	RE500196		1000	2200	2400	5.0
		RE506159		1000	2200	2400	5.0
460D Skidder (Torque Converter) (Timberjack) (S.N. —586336)	T06068TDW57	RE508301		900	2200	2400	4.0
	PE6068TDW57	RE508631		900	2200	2400	5.0
540/548G Skidder (S.N. 558205—565684)	T06068TDW51	RE67669		1000	2200	2400	6.5
^a In-line mechanical fuel injection pump.							

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Diagnostic Specifications

FUEL INJECTION PUMP SPECIFICATIONS (CONSTRUCTION AND FORESTRY EQUIPMENT APPLICATIONS)

Machine Model	Engine Model	Original Injection Pump (Part No.)	Replaced By Injection Pump (Part No.)	Slow Idle Speed (rpm)	Rated Speed (rpm)	Fast Idle (rpm)	Dynamic Timing (Degrees Before TDC)
540/548G-II/548G-III Skidder (S.N. 565685—576602)	T06068TDW54	RE67669		1000	2200	2400	6.5
	PE6068TDW54	RE67669		1000	2200	2400	6.5
540G-III/548G-III Skidder (S.N. 576603—586336)	T06068TDW54	RE59983	RE71495	1000	2200	2400	N/A
		RE71495		1000	2200	2400	N/A
540G-III/548G-III Skidder (S.N. 586337—)	PE6068HDW58	RE507583		1000	2200	2400	N/A
540/548H Skidder	T06068TDW54	RE67669		1000	2200	2400	6.5
	PE6068TDW54	RE67669		1000	2200	2400	6.5
544/544H Loader	T06068TDW50	RE67598		950	2200	2400	6.5
	PE6068TDW50	RE67598		950	2200	2400	6.5
624H Loader	T06068HDW50	RE59958 ^a		950	2200	2400	6.0
	PE6068HDW50	RE59958 ^a		950	2200	2400	6.0
640G/648G Skidder (S.N. 558205—565684)	T06068TDW52	RE59920 ^a	RE500196 ^a	950	2200	2400	5.0
		RE500196 ^a		1000	2200	2400	5.0
640/648G-II Skidder (S.N. 565685—576602)	T06068TDW55	RE500196 ^a		1000	2200	2400	5.0
	PE6068TDW55	RE500196 ^a		1000	2200	2400	5.0
		RE506159		1000	2200	2400	5.0
648G-III Skidder (S.N. —586336)	T06068TDW55	RE500196 ^a		1000	2200	2400	5.0
	T06068TDW57	RE508301		900	2200	2400	4.0
	PE6068TDW57	RE508301		900	2200	2400	4.0
640/648H Skidder	T06068TDW55	RE500196 ^a		1000	2200	2400	5.0
670C Grader	T06068HDW53	RE59964 ^a	RE500922 ^a	850	2000	2200	5.0
		RE500922 ^a	RE501033 ^a	900	2000	2200	5.0
		RE501033 ^a		825	2000	2200	4.0
	PE6068HDW53	RE501033 ^a		825	2000	2200	4.0
670C Series II Grader	T06068HDW53	RE59964 ^a	RE500922 ^a	850	2000	2200	5.0
		RE500922 ^a	RE501033 ^a	900	2000	2200	5.0
		RE501033 ^a		825	2000	2200	4.0
	PE6068HDW53	RE501033 ^a		825	2000	2200	4.0
670CH Grader	T06068HDW55	RE69563 ^a		800	2000	2200	3.0
	PE6068HDW55	RE69563 ^a		800	2000	2200	3.0
672CH Grader (S.N. —589368)	T06068HDW58	RE507583		800	2100	2300	2.0

^aIn-line mechanical fuel injection pump.

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Diagnostic Specifications

FUEL INJECTION PUMP SPECIFICATIONS (CONSTRUCTION AND FORESTRY EQUIPMENT APPLICATIONS)

Machine Model	Engine Model	Original Injection Pump (Part No.)	Replaced By Injection Pump (Part No.)	Slow Idle Speed (rpm)	Rated Speed (rpm)	Fast Idle (rpm)	Dynamic Timing (Degrees Before TDC)
	PE6068HDW58	RE69563 ^a		800	2190	2325	2.0
690E LC Excavator (S.N. 559603—)	T06068TDW56	RE67765	RE501328	875	2100	2300	6.0
		RE501328		950	2100	2300	6.0
Dubuque, Iowa							
CFX110 Excavator	PE4045TP058	RE507968		850	2200	2350	N/A
CFX120/CFX160 Excavator	PE4045HP050	RE507969		850	2200	2350	N/A
CFX270 Excavator	PE6068HT055	RE506681		800	2150	2440	N/A
CFX270LC Excavator	T06068HT052	RE59946		950	2150	2350	N/A
	PE6068HT052	RE59946		950	2150	2350	7.0
DX75 Crawler Dozer (Japan)	T04045DT052	RE68012 ^a		900	2100	2300	5.0
DX75 HST Crawler Dozer (Japan)	T04045TT070	RE502006 ^a		950	2200	2400	4.2
	PE4045TT070	RE502006 ^a		950	2200	2400	4.2
HYEX Military Excavator	PE4045TT050	RE69782			2500	2700	N/A
120/120C Excavator	T04045TT052	RE59910 ^a		950	2100	2400	5.0
210LE Landscape Loader	T04045DT050	RE67594	RE500877	950	2200	2400	8.0
		RE500877	RE502380	950	2200	2400	6.5
		RE502380	RE506123	950	2200	2400	6.5
		RE506123		950	2200	2400	6.0
	PE4045DT050	RE502380	RE506123	950	2200	2400	6.5
		RE506123		950	2200	2400	6.0
310/310E Backhoe Loader	T04045DT055	RE67594	RE500877	950	2200	2400	8.0
		RE500877	RE502380	950	2200	2400	6.5
		RE502380		950	2200	2400	6.5
310E Backhoe Loader (Alt Comp)	T04045TT056	RE67925	RE500878	950	2200	2400	6.5
		RE500878	RE502377	950	2200	2400	6.0
		RE502377		950	2200	2400	6.0
310G Backhoe Loader (Nat. Asp.) (S.N. —910055)	T04045DT056	RE502380		950	2200	2400	6.5
	PE4045DT056	RE502380		950	2200	2400	6.5
310G Backhoe Loader (S.N. 910056—)	T04045TT058	RE508066		950	2200	2400	6.0

^aIn-line mechanical fuel injection pump.

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Diagnostic Specifications

FUEL INJECTION PUMP SPECIFICATIONS (CONSTRUCTION AND FORESTRY EQUIPMENT APPLICATIONS)

Machine Model	Engine Model	Original Injection Pump (Part No.)	Replaced By Injection Pump (Part No.)	Slow Idle Speed (rpm)	Rated Speed (rpm)	Fast Idle (rpm)	Dynamic Timing (Degrees Before TDC)
	PE4045TT058	RE508066		950	2200	2400	6.0
310G Backhoe Loader (Alt Comp) (S.N. —910007)	T04045TT080	RE502377		950	2200	2400	6.0
	PE4045TT080	RE502377		950	2200	2400	6.0
310SE Backhoe Loader	T04045TT050	RE67595	RE502378	950	2200	2400	6.5
		RE502378		950	2200	2400	6.5
310SG Backhoe Loader (S.N. —910004)	T04045TT081	RE502378		950	2200	2400	6.5
	PE4045TT081	RE502378		950	2200	2400	6.5
310SG (Alt Comp) (S.N. 909514—)	T04045TT080	RE506279		950	2200	2400	
315SE Backhoe Loader	T04045TT060	RE67595	RE502378	950	2200	2400	6.5
		RE502378		950	2200	2400	6.5
315SG Backhoe Loader (Side-Shift) (S.N. —909995)	T04045TT081	RE502378		950	2200	2400	6.5
410E Backhoe Loader	T04045TT053	RE67599	RE502376	950	2200	2400	6.0
		RE502376		950	2200	2400	6.0
410G Backhoe Loader	T04045TT082	RE502376		950	2200	2400	6.0
	PE4045TT082	RE502376		950	2200	2400	6.0
450G/450GTC Crawler Dozer	T04045TT061	RE500616	RE502638	950	2100	2300	6.5
		RE502638		950	2100	2300	6.5
	PE4045TT061	RE500616	RE502638	950	2100	2300	6.5
		RE502638		950	2100	2300	6.5
450GTC Series IV Crawler Dozer (S.N. 840461—)	T04045TT067	RE500616		950	2100	2300	6.5
	PE4045TT067	RE500616	RE502638	950	2100	2300	6.5
		RE502638		950	2100	2300	6.5
450H Crawler Dozer	T04045DT053	RE500877	RE501100	950	2200	2400	6.5
		RE501100	RE508065	950	2200	2400	6.5
		RE508065		950	2200	2400	6.5
450H LGP Crawler Dozer (S.N. —XXXXXX)	T04045TT058	RE70666		950	2200	2400	6.0
	PE4045TT058	RE70666	RE508066	950	2200	2400	6.0
		RE508066		950	2200	2400	6.0

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Diagnostic Specifications

FUEL INJECTION PUMP SPECIFICATIONS (CONSTRUCTION AND FORESTRY EQUIPMENT APPLICATIONS)

Machine Model	Engine Model	Original Injection Pump (Part No.)	Replaced By Injection Pump (Part No.)	Slow Idle Speed (rpm)	Rated Speed (rpm)	Fast Idle (rpm)	Dynamic Timing (Degrees Before TDC)
450H Crawler Dozer (Alt Comp) (S.N. —XXXXXX)	T04045TT057	RE70665	RE508064	950	2200	2400	6.0
		RE508064		950	2200	2400	6.0
	PE4045TT057	RE70665	RE508064	950	2200	2400	6.0
		RE508064		950	2200	2400	6.0
455G Series IV Crawler Loader S.N. (840461—)	T04045TT061	RE500616	RE502638	950	2100	2300	6.5
		RE502638		950	2100	2300	6.5
	PE4045TT061	RE502638		950	2100	2300	6.5
455GTC Crawler Loader	T04045TT067	RE500616		950	2100	2300	6.5
	PE4045TT067	RE500616		950	2100	2300	6.5
485E/486E/488E Forklift	T04045DT050	RE67594	RE500877	950	2200	2400	8.0
		RE500877	RE502380	950	2200	2400	6.5
		RE502380	RE506123	950	2200	2400	6.5
		RE506123		950	2200	2400	6.5
	PE4045DT050	RE502380	RE506123	950	2200	2400	6.5
550G Crawler Dozer (S.N. 840461—)	T04045TT062	RE500617	RE502639	950	2100	2300	6.5
		RE502639		950	2100	2300	6.5
550GTC Crawler Dozer (S.N. 840461—)	T04045TT062	RE500617	RE502639	950	2100	2300	6.5
		RE502639		950	2100	2300	6.5
	T04045TT068	RE500617		950	2100	2300	6.5
550H Crawler Dozer (S.N. —909830)	T04045TT064	RE60200	RE501101	950	2200	2400	7.0
		RE501101		950	2200	2400	7.0
	PE4045TT064	RE501101	RE508067	950	2200	2400	7.0
		RE508067		950	2200	2400	7.0
550H LGP Crawler Dozer (S.N. —909667)	T04045TT065	RE67595	RE501102	950	2200	2400	6.0
		RE501102		950	2200	2400	6.0
	PE4045TT065	RE501102	RE508068	950	2200	2400	6.0
		RE508068		950	2200	2400	6.0
550H Forest Fire Plow (S.N. 898487—909788)	T04045TT083	RE505115	RE505160	950	2200	2400	6.0
	PE4045TT083	RE505160		950	2200	2400	6.0

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Diagnostic Specifications

FUEL INJECTION PUMP SPECIFICATIONS (CONSTRUCTION AND FORESTRY EQUIPMENT APPLICATIONS)

Machine Model	Engine Model	Original Injection Pump (Part No.)	Replaced By Injection Pump (Part No.)	Slow Idle Speed (rpm)	Rated Speed (rpm)	Fast Idle (rpm)	Dynamic Timing (Degrees Before TDC)
555G Crawler Loader (Direct Drive) (S.N. 840461—)	T04045TT063	RE500618	RE500640	950	2100	2300	6.0
		RE500640		950	2100	2300	6.0
	PE4045TT063	RE500618	RE500640	950	2100	2300	6.0
		RE500640		950	2100	2300	6.0
555GTC Crawler Loader	T04045TT069	RE500618		950	2100	2300	6.0
	PE4045TT069	RE500618		950	2100	2300	6.0
643G Feller Buncher	T06068TT053	RE59959 ^a		1050	2200	2400	5.0
	PE6068TT053	RE59959		1050	2200	2400	5.0
643H Feller Buncher	PE6068TT058	RE59959 ^a		1050	2200	2400	5.0
650G Crawler Dozer (Direct Drive)	T04045TT063	RE500618	RE502640	950	2100	2300	6.0
		RE502640		950	2100	2300	6.0
	PE4045TT063	RE500618	RE502640	950	2100	2300	6.0
		RE502640		950	2100	2300	6.0
650GTC Crawler Dozer	T04045TT069	RE500618		950	2100	2300	6.0
	PE4045TT069	RE500618	RE502640	950	2100	2300	6.0
		RE502640		950	2100	2300	6.0
650H Crawler Dozer	T04045TT066	RE67599	RE501103	950	2200	2400	6.0
		RE501103		950	2200	2400	6.0
	PE4045TT066	RE501103	RE508069	950	2200	2400	6.0
		RE508069		950	2200	2400	6.0
650H Forest Fire Plow	T04045TT083	RE505161		950	2200	2400	6.0
	PE4045TT083	RE505161	RE508070	950	2200	2400	6.0
		RE508070		950	2200	2400	6.0
	T04045TT091	RE507659		950	2200	2400	5.0
		RE508071		950	2200	2400	5.0
653E Feller Buncher	PE4045TT091	RE507659		950	2200	2400	5.0
		RE508071		950	2200	2400	5.0
		RE508071		950	2200	2400	5.0
653G Feller Buncher (120 kW)	T06068TT053	RE59959 ^a		1050	2200	2400	5.0
	PE6068TT053	RE59959 ^a		1050	2200	2400	5.0
653G Feller Buncher (140 kW)	T06068TT053	RE59959 ^a		1050	2200	2400	5.0
	PE6068TT053	RE59959 ^a		1050	2200	2400	5.0
	PE6068TT059	RE59959 ^a		1050	2200	2400	5.0
653G Feller Buncher (140 kW)	PE6068HT057	RE59930 ^a		1050	2200	2400	6.5
700H Crawler Dozer	T06068TT056	RE502024	RE508072	950	2100	2300	6.5

^aIn-line mechanical fuel injection pump.

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Diagnostic Specifications

FUEL INJECTION PUMP SPECIFICATIONS (CONSTRUCTION AND FORESTRY EQUIPMENT APPLICATIONS)

Machine Model	Engine Model	Original Injection Pump (Part No.)	Replaced By Injection Pump (Part No.)	Slow Idle Speed (rpm)	Rated Speed (rpm)	Fast Idle (rpm)	Dynamic Timing (Degrees Before TDC)
		RE508072		950	2100	2300	6.5
	PE6068TT056	RE502024	RE508072	950	2100	2300	6.5
		RE508072		950	2100	2300	6.5
710D/710E Backhoe Loader (S.N. —834729)	T06068TT050	RE59757	RE67597	900	2200	2400	6.5
		RE67597		900	2200	2400	6.5
	PE6068TT050	RE67597		900	2200	2400	6.5
710D/710E Backhoe Loader (S.N. 834730—)	T06068TT055	RE67597	RE502379	900	2200	2400	6.5
		RE502379		900	2200	2400	6.5
	PE6068TT055	RE502379		900	2200	2400	6.5
710G Backhoe Loader	T06068TT057	RE515525		900	2200	2400	N/A
750C Crawler Dozer (S.N. —831315)	T06068TT007			950	2100	2300	N/A
750C Crawler Dozer (S.N. 831372—)	T06068TT052	RE71275		950	2100	2300	6.0
	PE6068TT052	RE71275	RE508073	950	2100	2300	6.0
		RE508073		950	2100	2300	6.0
843G Feller Buncher	T06068HT050	RE59930 ^a		1050	2200	2400	6.5
	PE6068HT050	RE59930 ^a		1050	2200	2400	6.5
843H Feller Buncher	PE6068HT056	RE59930 ^a		1050	2200	2400	6.5
Knoxville, Tennessee/Dubuque, Iowa							
JD7 Skid Steer Loader	PE4045DKV50	RE70452		1025	2400	2600	9.0
270 Skid Steer Loader (Auxiliary Drive)	PE4045DKV50	RE70452		1025	2400	2600	9.0
270 Skid Steer Loader (Non-Auxiliary Drive)	PE4045DKV51	RE506699		1025	2400	2600	11.5
280 Skid Steer Loader	PE4045TKV50	RE507198		925	2400	2600	7.5
	PE4045TKV51			925	2400	2600	N/A
Saltillo, Mexico							
110/110LC Excavator	T04045TT054	RE60200		950	2200	2400	7.0
	PE4045TP052	RE60200		950	2200	2400	7.0
120/120LC Excavator	T04045TT052	RE59910 ^a		950	2200	2400	5.0
	PE4045TP051	RE59910 ^a		950	2200	2400	5.0
160LC Excavator	T04045TT055	RE59944 ^a		950	2300	2500	4.0
	PE4045TP053	RE59944 ^a		950	2300	2500	4.0
Deere-Hitachi (North Carolina, Canada)							
^a In-line mechanical fuel injection pump.							

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Diagnostic Specifications

FUEL INJECTION PUMP SPECIFICATIONS (CONSTRUCTION AND FORESTRY EQUIPMENT APPLICATIONS)

Machine Model	Engine Model	Original Injection Pump (Part No.)	Replaced By Injection Pump (Part No.)	Slow Idle Speed (rpm)	Rated Speed (rpm)	Fast Idle (rpm)	Dynamic Timing (Degrees Before TDC)
200C LC Excavator	PE6068HT053	RE506681		800	2150	2400	N/A
200LC Excavator	T06068TT051	RE59911 ^a		950	2150	2350	5.0
	PE6068TT051	RE59911 ^a		950	2150	2350	5.0
230C LC Excavator	PE6068HT054	RE506681		800	2100	2350	N/A
	T06068HT051	RE59945		950	2100	2300	6.0
	PE6068HT051	RE59945		950	2100	2300	6.0
230LC Excavator	T06068HT051	RE59945 ^a		950	2100	2300	6.0
270LC Excavator	T06068HT052	RE59946 ^a		950	2150	2350	7.0
	PE6068HT052	RE59946 ^a		950	2150	2350	7.0
Timberjack (Deere) (Sweden/Finland/Canada)							
330/335/430/435/535 Knuckleboom Log Loader	PE6068TTJ50	RE59959		1050	2200	2400	N/A
430B, 435 Log Loader	PE6068TTJ51	RE520818		1050	2200	2400	6.0
Hitachi Construction Machinery (Tsuchiura, Japan)							
270LC Excavator	T06068HT052	RE59946 ^a		950	2150	2350	7.0
	PE6068HT052	RE59946 ^a		950	2150	2350	7.0
^a In-line mechanical fuel injection pump.							

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Diagnostic Specifications

FUEL INJECTION PUMP SPECIFICATIONS OUTSIDE EQUIPMENT MANUFACTURERS (OEM) APPLICATIONS

Engine Number	Injection Pump Option Code	Original Injection Pump (Part Number)	Replaced by Injection Pump (Part Number)	Slow Idle Speed (rpm)	Rated Speed (rpm)	Fast Idle Speed (rpm)	Dynamic Timing (Degrees Before TDC)
4045DF007	16KG			N/A	1500	1550	15.0
	16KH			N/A	1500	1570	14.0
4045DF092	1651	RE500499		800	2400	2605	14.0
	1652			800	2200	2390	15.0
4045DF120	16MR	RE504463		850	2500	2700	15.0
	16MS	RE504464		850	2500	2700	15.0
4045DF150	1601	RE61649	RE67557	850	2500	2700	8.0
	1601	RE67557		850	2500	2700	8.5
	1602	RE59809		850	2500	2700	7.0
	1603	RE63555	RE67558	1150	1800	1870	7.0
	1603	RE67558	RE505070	1400	1800	1870	7.0
	1603	RE505070	RE506132	1400	1800	1870	7.0
	1603	RE506132		1400	1800	1870	7.0
	1663	RE71089	RE500949	850	2500	2700	8.5
	1663	RE500949		1600	2500	2700	4.5
	1671	RE67559	RE502714	850	2500	2700	8.5
	1671	RE502714		850	2500	2700	8.5
	1673	RE60085	RE67560	1150	1800	1870	7.0
	1673	RE67560	RE506130	1400	1800	1870	7.0
	1673	RE506130		1400	1800	1870	7.0
	1674	RE60089	RE67561	1150	1800	1870	7.0
	1674	RE67561	RE506131	1400	1800	1870	7.0
	1674	RE506131		1400	1800	1870	7.0
	1691	RE61649	RE500831	1400	2500	2700	8.0
	1691	RE500831	RE500948	1400	2500	2700	8.0
	1691	RE500948		1400	2500	2700	8.5
	16BG	RE69778	RE502712	850	2500	2700	8.5
	16BG	RE502712		850	2500	2700	8.5
	16BH	RE500873	RE502715	850	2500	2700	8.5
	16BH	RE502715		850	2500	2700	8.5
	16BJ	RE500589		850	2250	2450	8.5
	16CL	RE501364	RE502713	950	2200	2400	6.5
	16CL	RE502713		950	2200	2400	6.5
	16DL	RE70452		850	2400	2600	9.0
	16EN	RE502019		850	2500	2700	8.5
	16GB	RE502711		850	2500	2700	8.5
	16GC	RE502716		850	2500	2700	8.5
	16HJ	RE500948		850	2500	2700	8.5
	16HK	RE500949		1600	2500	2700	4.5
	16HV	RE503258		850	2250	2450	8.0
	16KE	RE503560		850	2500	2700	9.5
	16LM	RE502711		850	2500	2700	8.5

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Diagnostic Specifications

FUEL INJECTION PUMP SPECIFICATIONS OUTSIDE EQUIPMENT MANUFACTURERS (OEM) APPLICATIONS

Engine Number	Injection Pump Option Code	Original Injection Pump (Part Number)	Replaced by Injection Pump (Part Number)	Slow Idle Speed (rpm)	Rated Speed (rpm)	Fast Idle Speed (rpm)	Dynamic Timing (Degrees Before TDC)
	16LN	RE67558	RE505070	1400	1800	1870	7.0
	16LN	RE505070	RE506132	1150	1800	1870	7.0
	16LN	RE506132		1400	1800	1870	7.0
	16RB	RE503729		1400	1500	1560	9.0
	16RC	RE504693		1400	1500	1560	9.0
		RE502886		850	2500	2700	8.5
4045DF151	1663	RE71089	RE500949	1600	2500	2700	4.5
	1663	RE500949		1600	2500	2700	4.5
4045DF152	1601	RE67557		850	2500	2700	8.0
	16GB	RE502711		850	2500	2700	8.5
4045DF153	16AY	RE500505		850	2400	2600	9.0
4045DF154	16AY	RE500505		850	2400	2600	9.0
	16JS	RE500505		850	2400	2600	9.0
4045DF157	16RB	RE503729		N/A	1500	1560	9.0
	16RC	RE504693		N/A	1500	1560	9.0
4045DF158	1673	RE67560		N/A	1800	1870	7.0
	1674	RE67561		N/A	1800	1870	7.0
	16RB	RE503729		N/A	1500	1560	9.0
	16RC	RE504693		N/A	1500	1560	9.0
	16CC	RE503731		N/A	1800	1870	7.0
	16DD	RE504694		N/A	1800	1870	7.0
4045DF270	162Q	RE519023		1400	1800	1870	2.0
	164L	RE519019		850	2500	2700	2.5
	164M	RE519020		850	2500	2700	2.5
	164N	RE519021		850	2500	2700	4.0
	164O	RE519022		850	2500	2700	4.0
	164P	RE519023		1400	1800	1870	2.0
	164Q	RE519024		1400	1800	1870	2.0
	165K	RE523789		850	2500	2710	2.5
	165L	RE523790		850	2500	21710	4.0
	165M	Re523791		850	2500	2710	4.0
	168Y	RE522755		1500	2500	2710	3.5
	16Z	RE523788		850	2500	2710	2.5
4045DFG70 (Goldoni)	164N	RE519001		800	2300	2460	6.1
4045DFM50 (Marine)	16HR	RE503164		700	2500	2700	13.0
	16HS	RE503165		700	2500	2700	13.0
	16HT	RE503166		N/A	1800	1870	13.0
	16HU	RE503167		N/A	1800	1870	13.0
4045DFM70	167E (12V)	RE521300		850	2500	2710	4.0
	167F (24V)	RE521301		850	2500	2710	4.0
	167G (12V)	RE519023		1400	1800	1870	2.0

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Diagnostic Specifications

FUEL INJECTION PUMP SPECIFICATIONS OUTSIDE EQUIPMENT MANUFACTURERS (OEM) APPLICATIONS

Engine Number	Injection Pump Option Code	Original Injection Pump (Part Number)	Replaced by Injection Pump (Part Number)	Slow Idle Speed (rpm)	Rated Speed (rpm)	Fast Idle Speed (rpm)	Dynamic Timing (Degrees Before TDC)
	167H (24V)	RE519024		1400	1800	1870	2.0
	167J (12V)	RE503729		1400	1500	1570	9.0
	167K (24V)	RE504693		1400	1500	1570	9.0
4045DJ31		RE508715		825	2400	2600	15.0
4045DJ61		RE503729		1400	1500	1565	8.8
4045DJ62		RE506132		1400	1800	1875	7.0
4045HF120	16GR	RE503050	RE506965	1400	1500	1560	4.5
	16GR	RE506965		1400	1500	1560	4.5
	16LW	RE503832	RE506966	1400	1500	1560	4.5
	16LW	RE506966		1400	1500	1560	4.5
4045HF150	1610	RE68826	RE505928	850	2400	2600	8.5
	1610	RE505928		800	2400	2600	8.5
	1611	RE60237		1400	1800	1870	9.8
	160B	RE68827		1400	1800	1870	9.8
	160C	RE69588	RE505959	800	2400	2600	8.5
	160C	RE505959		800	2400	2600	8.5
	16GR	RE503050		1150	1500	1560	4.4
	16LW	RE503832		1150	1500	1560	4.4
	16ME (12V)	RE503739		1400	1800	1870	6.0
	16ME (24V)	RE504966		1400	1800	1870	6.0
	16QZ	RE503050	RE506965	1800	1500	1880	4.5
	16QZ	RE506965		1800	1500	1880	4.5
	16RA	RE503832	RE506966	1800	1500	1880	4.5
	16RA	RE506966		1800	1500	1880	4.5
4045HF152	16RM	RE505959		850	2400	2600	8.5
4045HF157	16GR	RE503050		N/A	1500	1560	4.4
	16LW	RE503832		N/A	1500	1560	4.4
4045HF158	16GR	RE503050		1150	1500	1560	4.4
	16LW	RE503832		1150	1500	1560	4.4
	16ME	RE503739		1400	1800	1870	5.9
	16MF	RE504698	RE504966	1400	1800	1870	5.9
	16MF	RE504966		1400	1800	1870	5.9
4045HF252	169E	RE522414		850	3000	3120	4.0
	169F	RE522698		850	3000	3120	4.0
4045HF280	16G3	RE531810		850	2400	2600	7
	16G4	RE531811		850	2400	2600	7
	16G5	RE533473		850	2200	2400	6.5
	16G6	RE533474		850	2200	2400	6.5
	16H2	RE533475		1150	1800	1870	5.5
	16H3	RE533476		1150	1800	1870	5.5
4045HJ61		RE506965		1150	1500	1565	4.4

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Diagnostic Specifications

FUEL INJECTION PUMP SPECIFICATIONS OUTSIDE EQUIPMENT MANUFACTURERS (OEM) APPLICATIONS

Engine Number	Injection Pump Option Code	Original Injection Pump (Part Number)	Replaced by Injection Pump (Part Number)	Slow Idle Speed (rpm)	Rated Speed (rpm)	Fast Idle Speed (rpm)	Dynamic Timing (Degrees Before TDC)
4045HJ62		RE60237		1400	1800	1875	9.8
4045TF120	16MT	RE503733	RE506989	1400	1500	1560	6.5
	16MT	RE506989		1400	1500	1560	6.5
	16MU	RE504695	RE505050	1400	1500	1560	6.5
	16MU	RE505050	RE506990	1400	1500	1560	6.5
	16MU	RE506990		1400	1500	1560	6.5
4045TF150	1605	RE61668	RE69781	850	2500	2700	7.0
	1605	RE69781		850	2500	2700	7.0
	1606	RE64133		850	2400	2600	4.0
	1656	RE63610	RE67562	1150	1800	1870	5.5
	1656	RE67562		1150	1800	1870	5.5
	1675	RE60091	RE69782	850	2500	2700	7.0
	1675	RE69782		850	2500	2700	7.0
	1676	RE60093		850	2500	2700	7.0
	1677	RE60096	RE67563	1150	1800	1870	6.0
	1677	RE67563		1150	1800	1870	6.0
	1692	RE61668	RE500881	850	2500	2700	6.0
	1692	RE500881	RE502416	1400	2500	2700	7.0
	1692	RE502416		1400	2500	2700	7.0
	1694	RE67863	RE69779	850	2500	2700	7.0
	1694	RE69779		850	2500	2700	7.0
	1695	RE69739	RE69780	850	2500	2700	7.0
	1695	RE69780		850	2500	2700	7.0
	16AB	RE69779		850	2500	2700	7.0
	16BF	RE500848		950	2200	2400	6.0
	16CE	RE501180		850	2500	2700	7.0
	16CM	RE501365		950	2200	2400	6.5
	16GL	RE502706		850	2300	2500	6.5
	16LP	RE67562		1150	1800	1870	6.0
	16LZ	RE503735		1400	1800	1870	5.5
	16MA	RE504696	RE504931	1400	1800	1870	5.5
	16MA	RE504931		1400	1800	1870	5.5
	16MT	RE503733	RE506989	1400	1500	1560	6.5
	16MT	RE506989		1400	1500	1560	6.5
	16MU	RE504695	RE505050	1400	1500	1560	6.5
	16MU	RE505050	RE506990	1400	1500	1560	6.5
	16MU	RE506990		1400	1500	1560	6.5
	16PZ			950	2200	2390	6.0
	16TG	RE507941		850	2000	2185	N/A
	16YG	RE508834		850	2000	2185	N/A
	16YU	RE508754		1150	1800	1870	6.0
	16ZC	RE518799		950	2200	2390	6.0

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Diagnostic Specifications

FUEL INJECTION PUMP SPECIFICATIONS OUTSIDE EQUIPMENT MANUFACTURERS (OEM) APPLICATIONS

Engine Number	Injection Pump Option Code	Original Injection Pump (Part Number)	Replaced by Injection Pump (Part Number)	Slow Idle Speed (rpm)	Rated Speed (rpm)	Fast Idle Speed (rpm)	Dynamic Timing (Degrees Before TDC)
4045TF151	1677	RE67563		850	1800	1870	6.0
	16CU	RE501192		850	2200	2400	6.0
	16NH	RE505411		1150	1800	2240	6.0
4045TF152	16AX	RE500551		850	2400	2600	5.5
4045TF154	1605	RE69781		850	2500	2700	7.0
4045TF155	16AX	RE500551		850	2400	2600	5.5
	16JT	RE500551		850	2400	2600	5.5
4045TF157	16GQ	RE503048		N/A	1500	1560	8.0
	16LV	RE503830		N/A	1500	1560	8.0
4045TF158	16GQ	RE503048		N/A	1500	1560	8.0
	16LZ	RE503735		N/A	1800	1870	5.5
	16MA	RE504696		N/A	1800	1870	5.5
	16MT	RE503733	RE506989	N/A	1500	1560	6.5
	16MT	RE506989		N/A	1500	1560	6.5
	16MU	RE504695	RE505050	N/A	1500	1560	6.5
	16MU	RE505050	RE506990	N/A	1500	1560	6.5
	16MU	RE506990		N/A	1500	1560	6.5
	165D	RE506989		N/A	1500	1570	4.4
	165E	RE506990		N/A	1500	1570	4.4
	4045TF161	16PZ	RE500848		950	2200	2390
4045TF162	16GL	RE502706		850	2000	2185	6.2
4045TF220	16GQ	RE503048	RE506544	1400	1500	1560	8.0
	16GQ	RE506544		1400	1500	1560	8.0
	16LV	RE503830	RE506545	1400	1500	1560	8.0
	16LV	RE506545		1400	1500	1560	8.0
	16MV	RE503736		1400	1800	1870	7.5
	16MW	RE505051		1400	1800	1870	7.5
	16NT	RE504465		850	2500	2700	15.0
	16NU	RE504466		850	2500	2700	15.0
4045TF250	1606	RE64133	RE505927	850	2400	2600	4.5
	1606	RE505927		850	2400	2600	4.5
	1608	RE67564		1400	1800	1870	6.0
	1667	RE59968		850	2400	2600	4.0
	1682	RE67566		1400	1800	1870	6.0
	1683	RE60124	RE505926	850	2400	2600	4.5
	1683	RE505926		850	2400	2600	4.5
	160R	RE70941		1400	1800	1870	6.0
	16CV	RE501346		950	2200	2400	5.0
	16GQ	RE503048	RE506544	1150	1500	1560	8.0
	16GQ	RE506544		1150	1500	1560	8.0
16LQ	RE67564		1400	1800	1870	6.0	

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Diagnostic Specifications

FUEL INJECTION PUMP SPECIFICATIONS OUTSIDE EQUIPMENT MANUFACTURERS (OEM) APPLICATIONS

Engine Number	Injection Pump Option Code	Original Injection Pump (Part Number)	Replaced by Injection Pump (Part Number)	Slow Idle Speed (rpm)	Rated Speed (rpm)	Fast Idle Speed (rpm)	Dynamic Timing (Degrees Before TDC)
	16LV	RE503830	RE506545	1150	1500	1560	8.0
	16LV	RE506545		1150	1500	1560	8.0
	16MB	RE503737		1400	1800	1870	5.5
	16MC	RE504932		1400	1800	1870	5.5
	161C	RE507525	RE506881	1400	1800	1870	N/A
		RE506881		1400	1800	1870	5.5
	161D	RE507526	RE506882	1400	1800	1870	N/A
		RE506882		1400	1800	1870	5.5
4045TF251	1606	RE64133	RE505927	850	2400	2600	4.0
	1606	RE505927		850	2400	2600	4.0
4045TF257	16GQ	RE503048		N/A	1500	1560	8.0
	16LV	RE503830		N/A	1500	1560	8.0
4045TF258	16GQ	RE503048		N/A	1500	1560	8.0
	16LV	RE503830		N/A	1500	1560	8.0
	16MB	RE503737		1400	1800	1870	5.5
	16MC	RE504932		1400	1800	1870	5.5
	16MV	RE503736		1400	1800	1870	7.5
	16MW	RE504682		1400	1800	1870	7.5
	168Q	RE522426		N/A	1500	1570	3.0
	168R	RE522427		N/A	1500	1570	3.0
4045TF262	169P	RE522714			3000	3120	6.0
	169Q	RE522697			3000	3120	6.0
4045TF270	163N	RE519069		1400	1800	1870	2.0
	164R	RE519025		850	2500	2700	2.5
	164S	RE519026		850	2500	2700	2.5
	164T	RE519027		850	2200	2400	0.0
	164U	RE519028		850	2200	2400	0.0
	164V	RE519029		850	2500	2700	2.5
	164W	RE519030		850	2500	2700	2.5
	164X	RE519069		1400	1800	1870	2.0
	164Y	RE519070		1400	1800	1870	2.0
4045TF280	16F4	RE533479		850	2400	2600	Lock Shaft
	16F5	RE533480		850	2400	2600	Lock Shaft
	16E9	RE531803		850	2400	2600	Lock Shaft
	16F1	RE531809		850	2400	2600	Lock Shaft
	16F2	RE533477		850	2400	2600	Lock Shaft
	16F3	RE533478		850	2400	2600	Lock Shaft
	16F8	RE533483		1150	1800	1870	Lock Shaft
	16F9	RE533484		1150	1800	1870	Lock Shaft
	16F6	RE533481		1150	1800	1870	Lock Shaft
	16F7	RE533482		1150	1800	1870	Lock Shaft

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Diagnostic Specifications

FUEL INJECTION PUMP SPECIFICATIONS OUTSIDE EQUIPMENT MANUFACTURERS (OEM) APPLICATIONS

Engine Number	Injection Pump Option Code	Original Injection Pump (Part Number)	Replaced by Injection Pump (Part Number)	Slow Idle Speed (rpm)	Rated Speed (rpm)	Fast Idle Speed (rpm)	Dynamic Timing (Degrees Before TDC)	
4045TFM50 (Marine)	16HM	RE503163		N/A	1800	1870	13.0	
	16HN	RE503162		N/A	1800	1870	13.0	
	16HP	RE503861		700	2500	2700	13.0	
	16HQ	RE503860		700	2500	2700	13.0	
	16LK	RE503160		700	2600	2800	10.5	
	16LL	RE503161		700	2600	2700	10.5	
4045TJ31		RE516813		950	2300	2500	12.0	
4045TJ61		RE506989		1400	1500	1565	6.5	
4045TJ62		RE67562		1150	1800	1875	6.0	
6068DF092	1654			850	2200	2390	14.0	
	16EZ			850	2200	2390	14.0	
6068DF150	1613	RE59861	RE505929	850	2500	2700	6.0	
	1613	RE505929		850	2500	2700	6.0	
	1678	RE60101	RE505960	850	2500	2700	6.0	
	1678	RE505960		850	2500	2700	6.0	
	16LR	RE59861	RE505929	850	2500	2700	6.0	
	16LR	RE505929	RE509503	850	2500	2700	6.0	
	16LR	RE509503		850	2500	2700	6.0	
6068DJ31		RE520873		850	2500	2700	9.4	
6068DJ41		RE520873		850	2500	2700	9.4	
6068HF120	16GT	RE503051		1400	1500	1560	5.1	
	16LX	RE503834		1400	1500	1560	5.1	
	16LY	RE503834	RE503836	1400	1500	1560	5.1	
	16LY	RE503836		1400	1500	1560	5.1	
	16RL	RE506085		950	2100	2200	7.5	
	16SJ	RE506627		950	2100	2200	7.5	
	16TP (12V)	RE506883		1400	1500	1560	3.5	
	16TP (24V)	RE506884		1400	1500	1560	3.5	
	16TQ	RE506884		1400	1500	1550	3.5	
	16ZQ	RE509428		950	2100	2200	7.5	
	16ZR	RE509429		950	2100	2200	7.5	
	6068HF150	1621	RE66575	RE505930	850	2400	2600	9.0
		1621	RE505930		850	2400	2600	9.0
		160D	RE69589	RE505962	850	2400	2600	9.0
160D		RE505962		850	2400	2600	9.0	
16CY		RE501345		1350	2200	2400	9.0	
16GT		RE503051		1400	1500	1560	5.1	
16LY		RE503836		1400	1500	1560	5.1	
16ML		RE503746		1400	1800	1870	5.5	
16MM		RE504702	RE505049	1400	1800	1870	5.5	
16MM		RE505049		1400	1800	1870	5.5	

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Diagnostic Specifications

FUEL INJECTION PUMP SPECIFICATIONS OUTSIDE EQUIPMENT MANUFACTURERS (OEM) APPLICATIONS

Engine Number	Injection Pump Option Code	Original Injection Pump (Part Number)	Replaced by Injection Pump (Part Number)	Slow Idle Speed (rpm)	Rated Speed (rpm)	Fast Idle Speed (rpm)	Dynamic Timing (Degrees Before TDC)
	16QV	RE503051		1400	1800	1870	5.1
	16QW	RE503836		1400	1800	1870	5.1
	16TM (12V)	RE506885		1400	1800	1870	3.7
	16TM (24V)	RE506886		1400	1800	1870	3.7
	16TN	RE506886		1400	1800	1880	3.7
6068HF157	16GT	RE503051		N/A	1500	1560	5.1
	16LY	RE503836		N/A	1500	1560	5.1
6068HF158	16GT	RE503051		N/A	1500	1560	5.1
	16LY	RE503836		N/A	1500	1560	5.1
	16ML	RE503746		N/A	1800	1870	5.5
	16MM	RE504702	RE505049	N/A	1800	1870	5.5
	16MM	RE505049		N/A	1800	1870	5.5
6068HF250	1622	RE59521 ^a		850	2400	2600	7.0
	1623	RE66761 ^a		1150	1800	1870	6.9
	16TV	RE506398		800	2400	2550	4.0
	16YH	RE59969		850	2400	2600	N/A
6068HF252	168Z	RE522415		850	3000	3120	6.4
	169A	RE522694		850	3000	3120	6.4
6068HF258	16TM	RE506885		1400	1800	1870	4.0
	16TN	RE506886		1400	1800	1870	4.0
	16TP	RE506883		1400	1500	1560	3.5
	16TQ	RE506884		1400	1500	1560	3.5
6068HJ61		RE506883		1400	1500	1565	4.0
6068HJ62		RE503746		1400	1800	1875	5.5
6068TF120	16MX	RE503740		1400	1500	1560	5.5
	16MY	RE505052		1400	1500	1560	5.5
	16MY	RE506398		800	2400	2550	4.0
6068TF150	1614	RE61669	RE69789	850	2500	2700	6.0
	1614	RE69789		850	2500	2700	8.0
	1680	RE60105	RE69790	850	2500	2700	6.0
	1680	RE69790		850	2500	2700	8.0
	1681	RE67571		1150	1800	1870	8.0
	1688	RE67572		1150	1800	1870	8.0
	1696	RE67864	RE69787	850	2500	2700	7.5
	1696	RE69787		850	2500	2700	7.5
	1697	RE68740	RE69788	850	2500	2700	7.5
	1697	RE69788		850	2500	2700	7.5
	16BE	RE63559	RE501302	950	2200	2400	6.6
	16BE	RE501302		950	2200	2400	7.3
	16CN	RE501522	RE509681	950	2100	2300	6.0

^aIn-line Fuel Injection Pump.

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FUEL INJECTION PUMP SPECIFICATIONS OUTSIDE EQUIPMENT MANUFACTURERS (OEM) APPLICATIONS

Engine Number	Injection Pump Option Code	Original Injection Pump (Part Number)	Replaced by Injection Pump (Part Number)	Slow Idle Speed (rpm)	Rated Speed (rpm)	Fast Idle Speed (rpm)	Dynamic Timing (Degrees Before TDC)
	16CN	RE509681		950	2100	2300	6.0
	16CP	RE501523		950	2200	2400	6.5
	16DK	RE70938		900	2100	2300	6.5
	16DY	RE501758		850	2500	2700	7.5
	16GM	RE502693		850	2300	2500	7.5
	16GN	RE502704		850	2400	2600	8.0
	16LS	RE67572		1150	1800	1870	7.5
	16MG	RE503742		1400	1800	1870	6.5
	16MH	RE504967		1400	1800	1870	6.5
6068TF151	1681	RE67571	RE505358	1150	1800	1870	8.0
	1681	RE505358		2000	1800	2240	7.5
	1696	RE69787		850	2500	2700	7.5
	1697			850	2500	2700	7.5
	16DY			850	2500	2700	7.5
	16JU			850	2500	2700	7.5
	16NJ	RE505358		1150	1800	2240	7.5
6068TF152	1696	RE69787		850	2500	2700	7.5
	1697			850	2500	2700	7.5
	16DY			850	2500	2700	7.5
	16JU	RE69787		850	2500	2700	7.5
6068TF157	16GS	RE503049		N/A	1500	1560	6.0
	16LX	RE503834		N/A	1500	1560	8.9
6068TF158	16GS	RE503049		N/A	1500	1560	6.0
	16MG	RE503742		N/A	1800	1870	6.2
	16MH	RE504966	RE504967	N/A	1800	1870	6.2
	16MH	RE504967		N/A	1800	1870	6.2
	16MX	RE503740		N/A	1500	1560	5.5
	16MY	RE504699	RE505052	N/A	1500	1560	5.5
	16MY	RE505052		N/A	1500	1560	5.5
6068TF159	16PD	RE70938		850	2100	2250	6.3
6068TF220	16GS	RE503049		1400	1500	1560	6.0
	16KK	RE502694		850	2500	2700	15.7
	16LX	RE503836		1400	1500	1560	6.0
	16RK	RE506083		850	2600	2700	9.0
	16RJ	RE506084		1400	2100	2200	6.5
	16SG	RE506625		1400	2100	2200	6.5
	16SH	RE506626		850	2600	2700	9.0
	16ZL	RE509284		950	2100	2200	6.5
	16ZM	RE509285		950	2100	2200	6.5
	16ZN	RE509286		850	2600	2700	9.0
	16ZP	RE509287		850	2600	2700	9.0

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Diagnostic Specifications

FUEL INJECTION PUMP SPECIFICATIONS OUTSIDE EQUIPMENT MANUFACTURERS (OEM) APPLICATIONS

Engine Number	Injection Pump Option Code	Original Injection Pump (Part Number)	Replaced by Injection Pump (Part Number)	Slow Idle Speed (rpm)	Rated Speed (rpm)	Fast Idle Speed (rpm)	Dynamic Timing (Degrees Before TDC)
		RE503834		1400	1500	1560	6.0
6068TF250	163D			850	2200	2390	5.5
	1615	RE62366	RE69791	850	2400	2600	7.0
	1615	RE69791		850	2400	2600	8.5
	1619	RE67573		1150	1800	1870	7.5
	1668	RE59969 ^a		850	2400	2600	4.0
	1685	RE67574		1150	1800	1870	7.5
	1686	RE60131	RE69792	850	2400	2600	7.0
	1686	RE69792		850	2400	2600	8.5
	16CW	RE501344		950	2200	2400	6.5
	16CX	RE70390		900	2300	2500	6.5
	16GS	RE503049		1400	1800	1870	8.9
	16LT	RE69791		850	2400	2600	8.5
	16LU	RE67573		1150	1800	1870	7.5
	16LX	RE503834		1400	1500	1550	5.5
	16MJ	RE503744		1400	1800	1870	6.0
	16MK	RE504701	RE504968	1400	1800	1870	6.0
	16MK	RE504968		1400	1800	1870	6.0
	16UG	RE506956	RE504321	850	2400	2600	4.0
	16UG	RE504321		925	2400	2600	4.0
	16YH	RE59959		925	2400	2600	4.0
6068TF251	1615	RE62366		850	2400	2600	7.0
	16ZH	RE62366		850	2400	2600	7.0
6068TF252	169B	RE522695		N/A	3000	3120	6.0
	169C	RE522696		N/A	3000	3120	6.0
6068TF257	16GS	RE503049		N/A	1500	1560	8.9
	16LX	RE503834		N/A	1500	1560	8.9
6068TF258	16GS	RE503049		N/A	1500	1560	8.9
	16LX	RE503834		N/A	1500	1560	8.9
	16MJ	RE503744		N/A	1800	1870	6.0
	16MK	RE504701	RE504968	N/A	1800	1870	6.0
	16MK	RE504968		N/A	1800	1870	6.0
6068TFM50 (Marine)	16FA	RE502619		700	2600	2800	10.7
	16FB	RE502620		700	2600	2800	10.7
	16FC	RE502621		700	2400	2600	13.3
	16FD	RE502622		700	2400	2600	13.3
	16FE	RE502623		N/A	1800	1870	13.3
	16FF	RE502624		N/A	1800	1870	13.3
6068TJ31		RE516089		1200	2200	2400	13.3
6068TJ32		RE522635		1200	2200	2400	6.5

^aIn-line Fuel Injection Pump.

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Diagnostic Specifications

FUEL INJECTION PUMP SPECIFICATIONS OUTSIDE EQUIPMENT MANUFACTURERS (OEM) APPLICATIONS

Engine Number	Injection Pump Option Code	Original Injection Pump (Part Number)	Replaced by Injection Pump (Part Number)	Slow Idle Speed (rpm)	Rated Speed (rpm)	Fast Idle Speed (rpm)	Dynamic Timing (Degrees Before TDC)
6068TJ61		RE503049		1400	1500	1565	6.0
6068TJ62		RE67573		1150	1800	1875	7.5

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