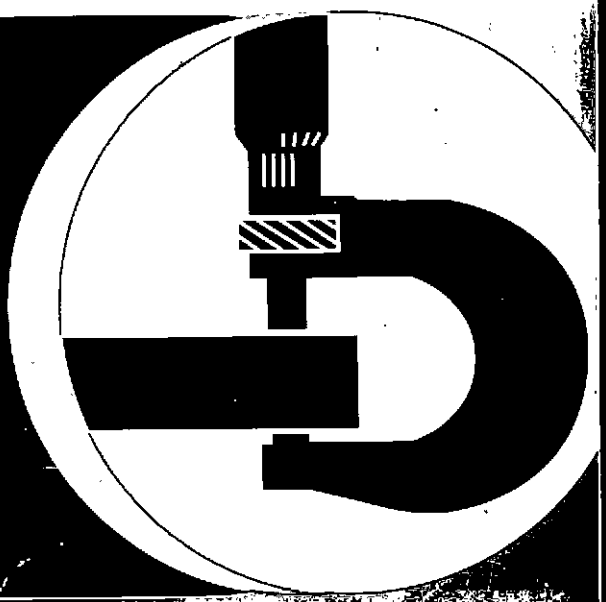
POWERTECH® 10.5 L & 12.5 L 6105 and 6125 Diesel Engines

Repair

COMPONENT TECHNICAL MANUAL



For complete service information also see:

POWERTECH® 10.5 L & 12.5 L 6105 and 6125 Diesel Engines Operation and Diagnostics (With Lucas Engine Controllers)	CTM115
POWERTECH® 10.5 L & 12.5 L 6105 and 6125 Diesel Engines Operation and Diagnostics (With John Deere Engine Controllers)	CTM188
OEM Engine Accessories	CTM67
Alternators and Starter Motors	CTM77

Deere Power Systems Group
CTM100 (09NOV99)

LITHO IN U.S.A.
ENGLISH

JOHN DEERE

DEERE POWER

Introduction

FOREWORD

This component technical manual (CTM100) covers repair of **POWERTECH**®10.5 L and 12.5 L engines. It is written for an experienced technician. Component Technical Manuals are concise service guides for specific components and are written as stand-alone manuals covering multiple engine applications.

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 Operation and Diagnostics Manuals (CTM 115 or CTM188) and the respective machine technical manual. Operation and diagnostics manuals help you identify the majority of routine failures quickly.

This manual contains the necessary instructions to remove, inspect, repair, and install all serviceable components on this engine. Information is organized in groups for the various components requiring service instructions.

An application listing in the introduction 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. Refer to the specific parts catalog for your engine model to insure that correct replacement parts are ordered.

Applicable essential tools, service equipment and tools, other materials needed to do the job, specifications, and critical torque values are listed at the beginning of each group.

Engine Training Guide (DSEGETG550A) is available to give the service technician a detailed overview of general engine construction and design features. This manual is recommended prior to performing major service procedures on **POWERTECH**® 10.5 L and 12.5 L (6105 and 6125) engines.

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.

RG,RG34710,1 –19–13AUG99–1/1

JOHN DEERE DEALERS

The changes listed below make your CTM obsolete. **Discard CTM 100 dated 30SEP97 and replace with this new manual.** Also, copy these pages and route through your Service Department.

GROUP 01

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

GROUP 02

- Updated engine oil and coolant application guidelines.

GROUP 03

- Updated engine lifting and cleaning procedures.

GROUP 04

- Updated sealant application guidelines.
- Updated engine break-in procedure.
- *Added procedures for inspecting the crankcase* ventilation system, air intake system, exhaust system, cooling system, and electrical system.
- Added tune-up information and procedures to include dynamometer test specifications and engine performance data.

GROUP 05

- Revised procedure for adjusting valves and injector preload.
- Revised procedure for removal and installation of rocker arm assembly.
- Revised procedure for removal and installation of cylinder head.
- Revised procedure for replacement of unit injector sleeve in head to include a separate procedure for replacement of injectors with head installed on engine.
- Revised procedure and specifications for installation and torquing of rocker arm shaft clamps.

GROUP 10

- Added general information on connecting rods to include new Precision Joint™ connecting rod.
- Revised procedures for removal, inspection and installation of connecting rods, bearings and caps.
- Added additional information on inspecting pistons to include specifications on new 12.5 L piston crowns.
- Added procedure for removal, lapping, and installation of cylinder liners using JDG1145 Cylinder Liner Service Set.

GROUP 15

- Added torque sequence art for flywheel and damper.
- Revised procedure for checking flywheel housing face runout.
- Revised procedure for installation of flywheel and flywheel housing.
- Revised procedure for installation of timing gear *cover and camshaft gear access cover to include* new sealing instructions.

GROUP 16

- Added procedure for installation of fuel supply pump drive pin in camshaft repair.
- Added requirement for thread lock and sealant on cam and idler gear cap screws.
- Revised camshaft lobe lift specifications.
- Revised procedure for installation of auxiliary drive to included additional torque specifications.

GROUP 20

- Added repair procedures for remote oil filter assemblies.
- Revised procedure for sealing oil pan mating surfaces.

GROUP 25

- Added repair procedures for fixed fan drive assembly (housing cast in camshaft gear access cover.)
- Added torque specifications and sealant requirements for various cooling system components.

GROUP 30

- Added procedure for radial bearing clearance test on turbocharger.
- Revised torquing procedure for intake manifold.

GROUP 35

- Revised fuel filter repair/service procedures.
- Added procedures for removal and installation of air purge valve and fuel filter check valve.
- Revised procedure for removal and installation of fuel manifold.
- Revised procedure for removal and installation of electronic unit injectors to include new torque specifications.
- Revised procedure for bleeding fuel system.

GROUP 36

- Added new Group 36 covering repair procedures for single rail fuel systems and associated components.

GROUP 40

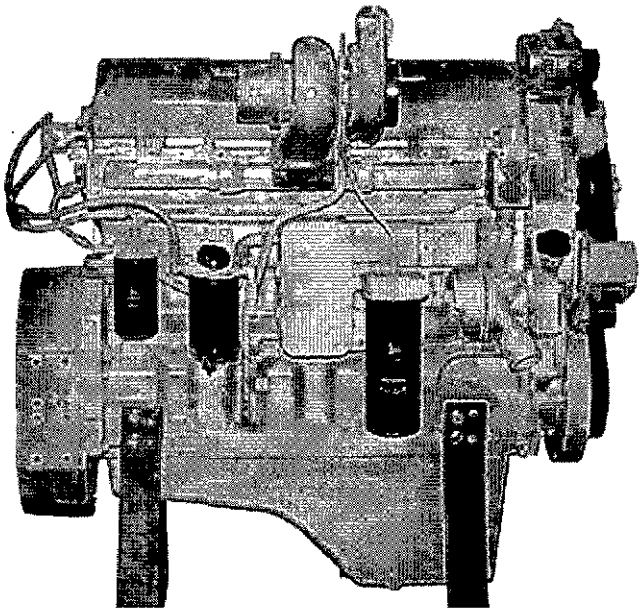
- Removed repair information on electronic engine controls and placed it in new Group 46.
- Added removal and installation procedures for starter and alternator.

GROUP 46

- Added new Group 46 to cover electronic engine controls (previously in Group 40).
- Added repair procedures for new fuel system sensors.
- Revised torque specifications for various sensors.
- Added repair procedures on electrical connectors.

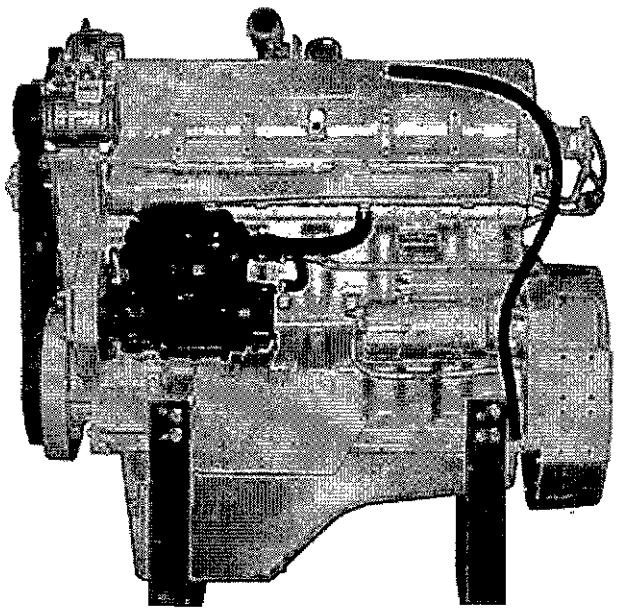
DPSG,OUO1004,994 –19–06AUG99–2/2

POWERTECH® 6105HF AND 6125HF ENGINES



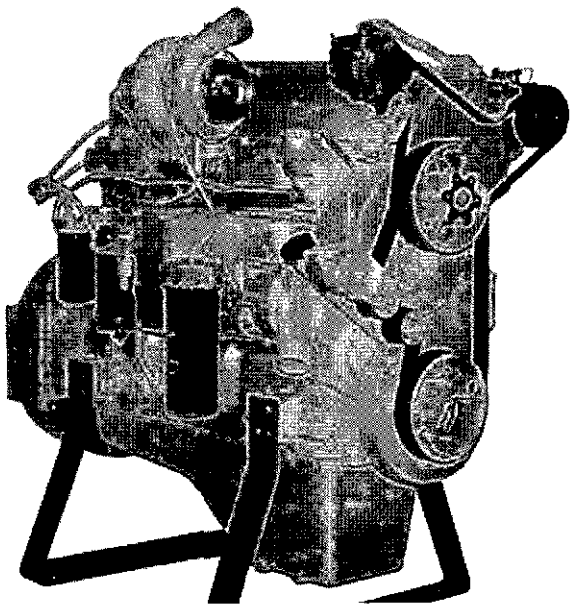
RG9030 –UN–21MAY98

Right Side View



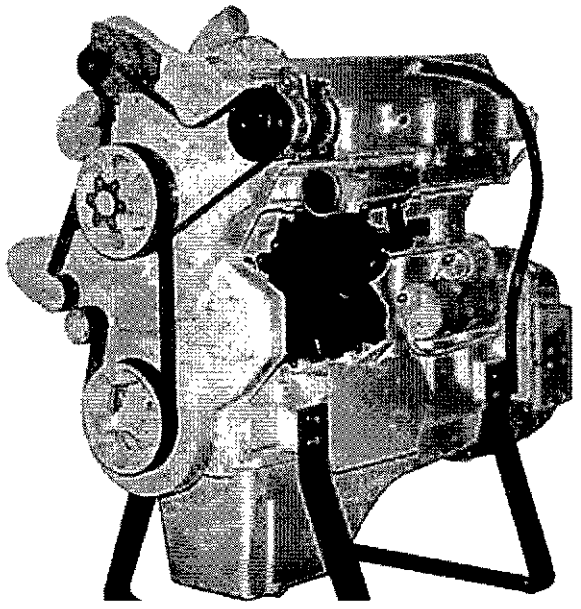
RG9031 –UN–21MAY98

Left Side View



RG9032 –UN–21MAY98

3/4 Right Front View

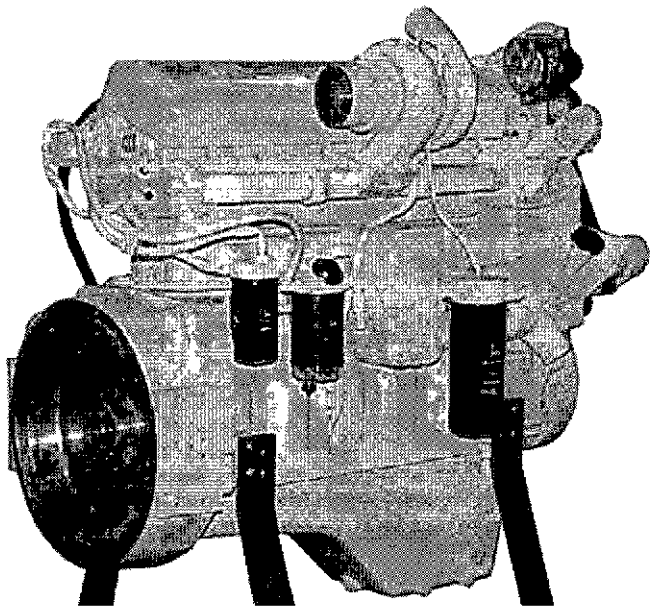


RG9033 –UN–21MAY98

3/4 Left Front View

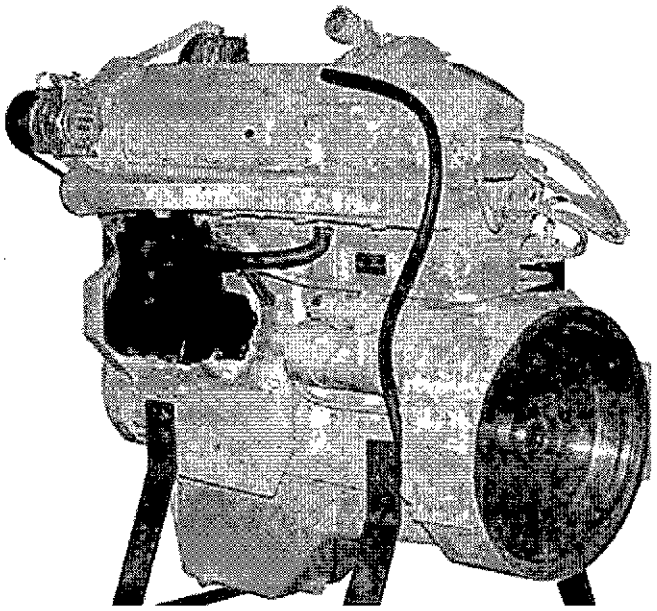
RG,RG34710,3 –19–30SEP97–1/1

POWERTECH® 6105HF AND 6125HF ENGINES—CONTINUED



RG9034 –UN–21MAY98

3/4 Right Rear View



RG9035 –UN–21MAY98

3/4 Left Rear View

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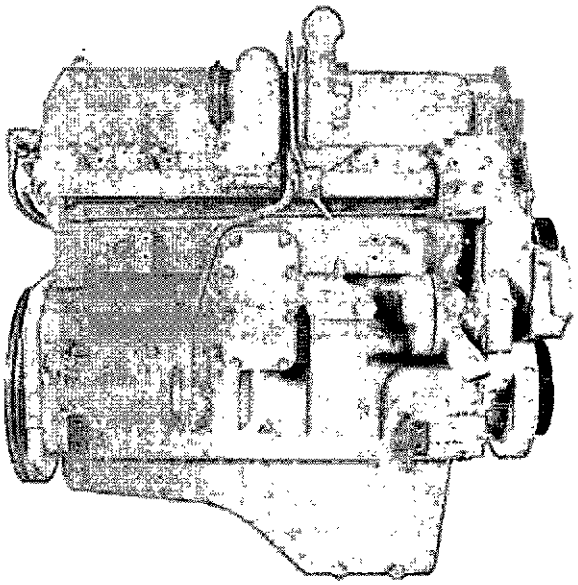
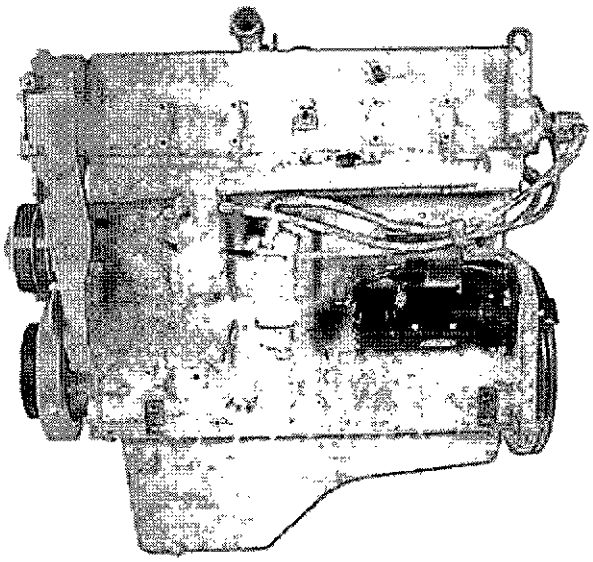
POWERTECH® 6105HRW AND 6125HRW ENGINES



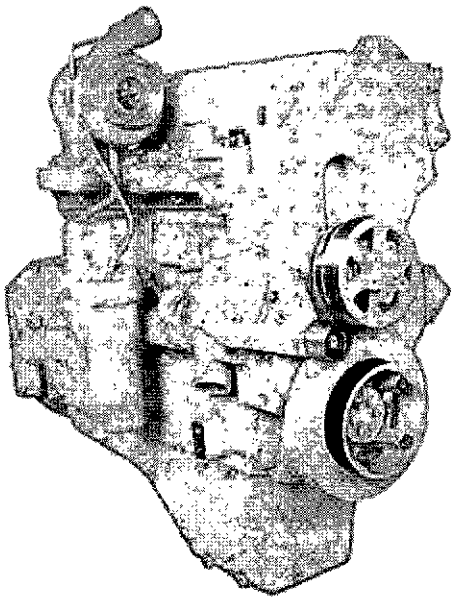
RG8222 –UN–21MAY98

Right Side View



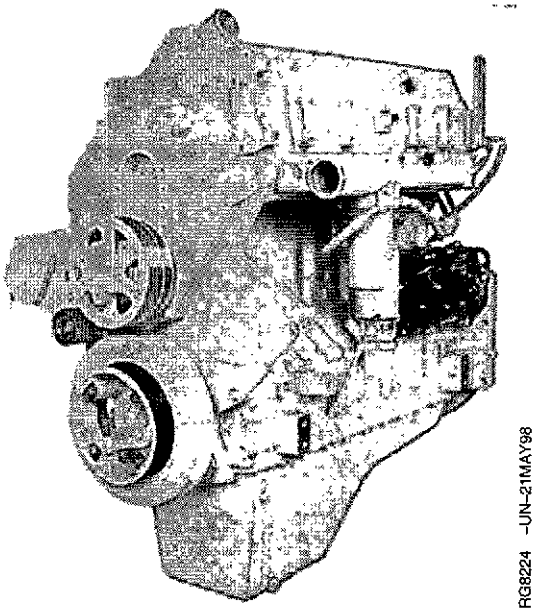
RG8221 –UN–21MAY98

Left Side View



RG8223 –UN–21MAY98

3/4 Right Front View



RG8224 –UN–21MAY98

3/4 Left Front View

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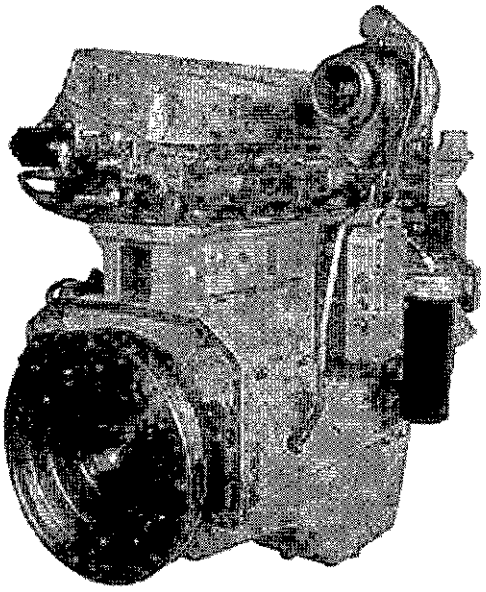
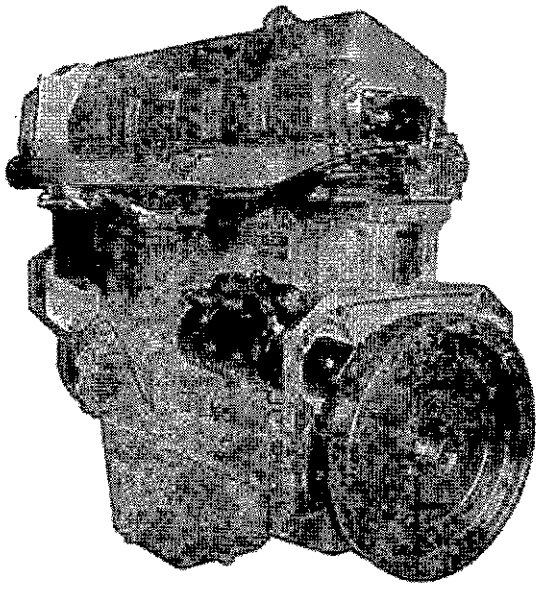
RG,RG34710,3A –19–30SEP97–1/1

POWERTECH® 6105HRW AND 6125HRW ENGINES—CONTINUED



RG8220 –UN–21MAY98

3/4 Right Rear View



RG8219 –UN–21MAY98

3/4 Left Rear View

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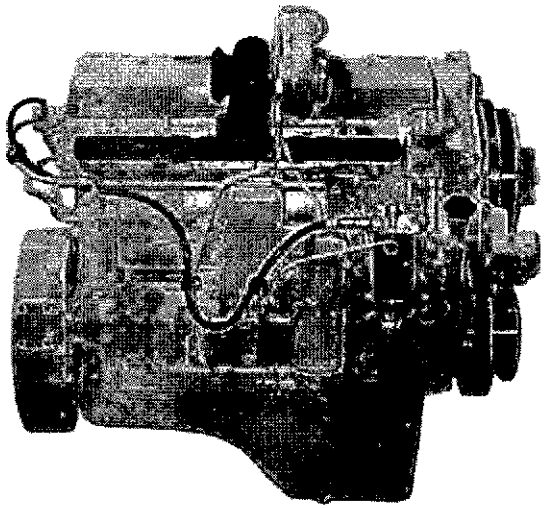
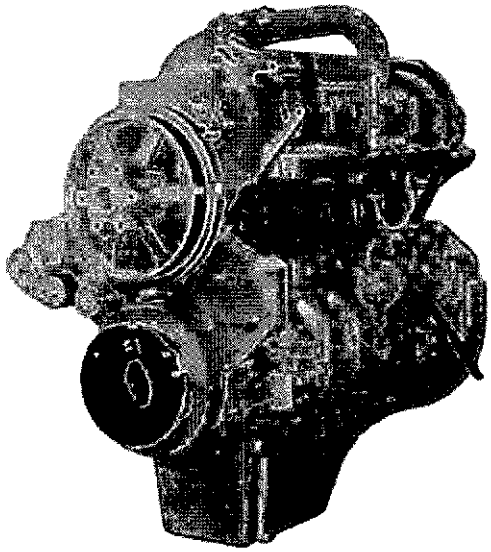
DPSG,OUO1004,916 –19–30JUN99–1/1

POWERTECH® 6105ADW ENGINE



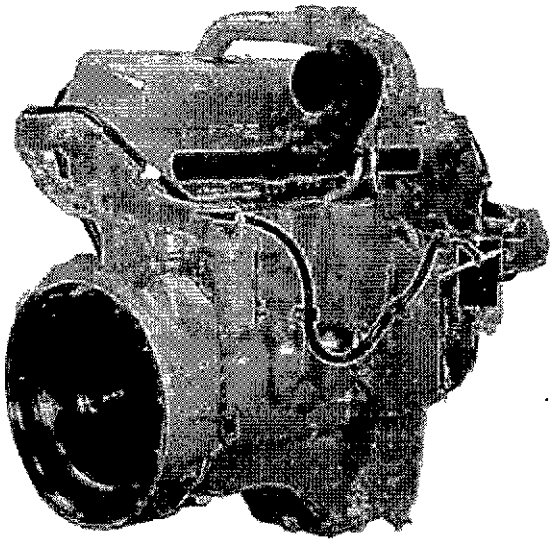
RG8454 –UN–21MAY98

Right Side View



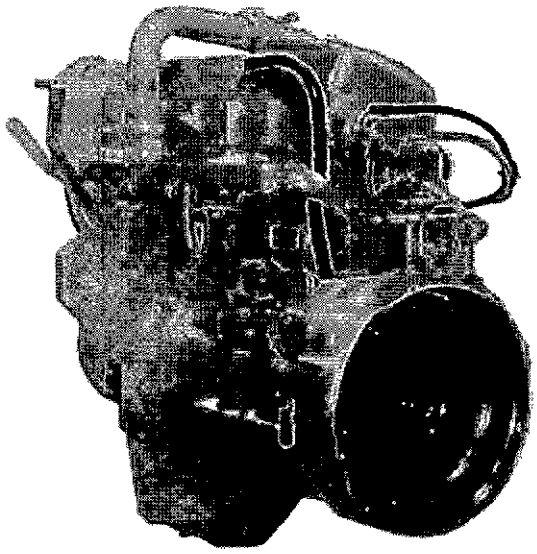
RG8448 –UN–21MAY98

3/4 Left Front View



RG8453 –UN–21MAY98

3/4 Right Rear View



RG8451 –UN–21MAY98

3/4 Left Rear View

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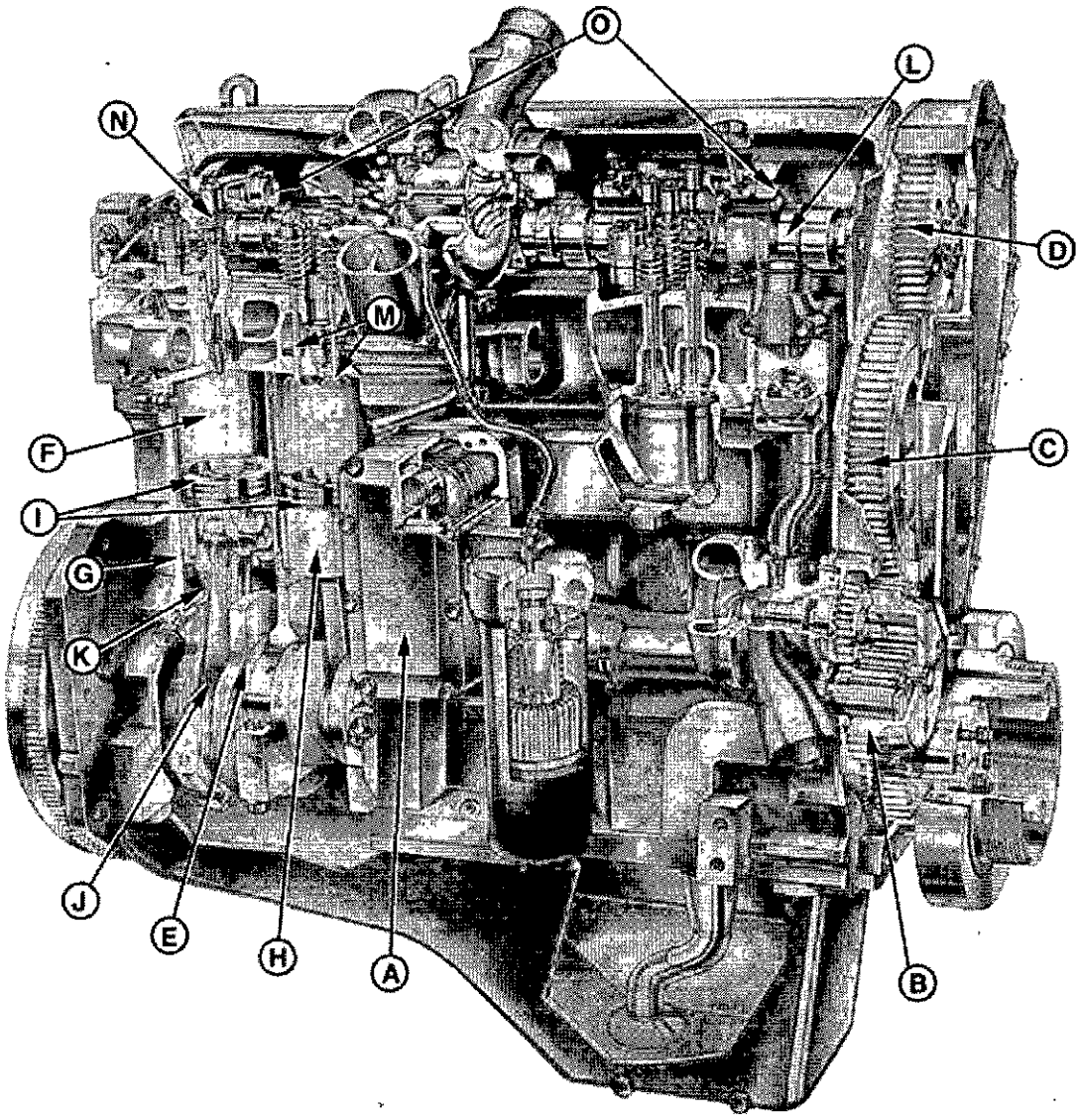
RG,RG34710,5 –19–30SEP97–1/1

6105 AND 6125 ENGINE CUTAWAY VIEW



Engine Cutaway View

A—Oil Cooler
B—Oil Pump Drive Gear
C—Idler Gear
D—Camshaft Gear
E—Crankshaft
F—Cylinder Liner
G—Cylinder Liner O-Rings
H—Piston
I—Piston Rings
J—Connecting Rod
K—Oil Spray Jet
L—Camshaft
M—Valves
N—Electronic Unit Injector
O—Two-Piece Rocker Arm Shaft

RG,RG34710,8 –19–30SEP97–1/1

Contents

INDX

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.

10.5 L and 12.5 L Engine

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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

Avoid Fires

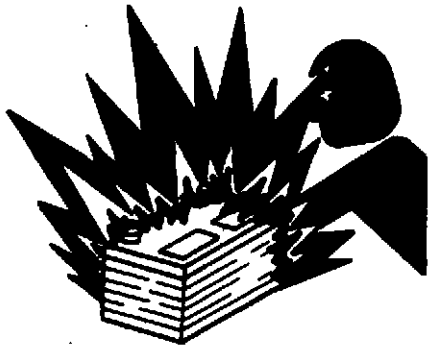
DX,FLAME –19–29SEP98–1/1

PREVENT BATTERY EXPLOSIONS

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

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

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



TS204 –UN–23AUG88

Battery Explosions

DX,SPARKS –19–03MAR93–1/1

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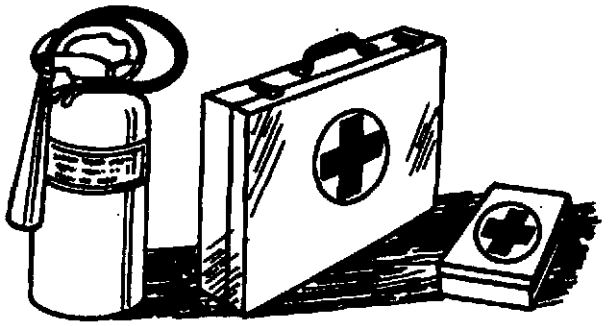
PREPARE FOR EMERGENCIES

Be prepared if a fire starts.

Keep a first aid kit and fire extinguisher handy.

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



TS291 –UN–23AUG88

First Aid Kit

DX,FIRE2 –19–03MAR93–1/1

PREVENT ACID BURNS

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

Avoid the hazard by:

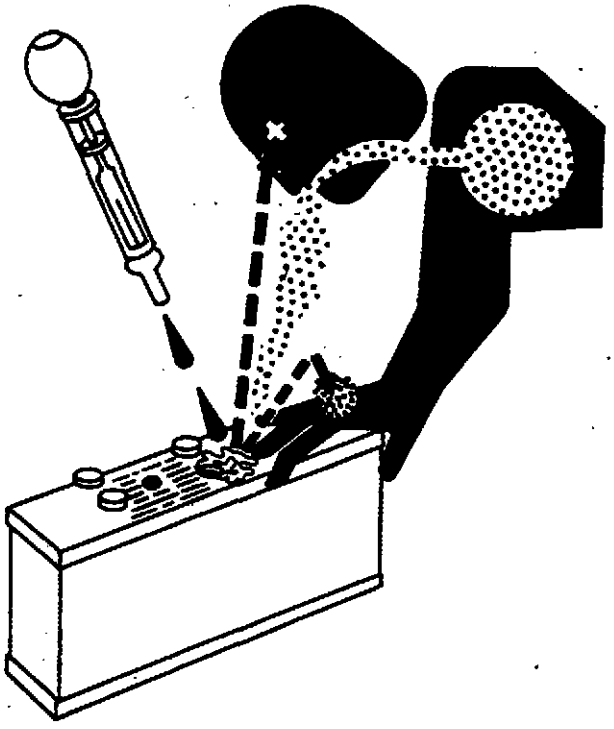
1. Filling batteries in a well-ventilated area.
2. Wearing eye protection and rubber gloves.
3. Avoiding breathing fumes when electrolyte is added.
4. Avoiding spilling or dripping electrolyte.
5. Use proper jump start procedure.

If you spill acid on yourself:

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

If acid is swallowed:

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



TS203 –UN–23AUG88

Acid Burns

DX,POISON –19–21APR93–1/1

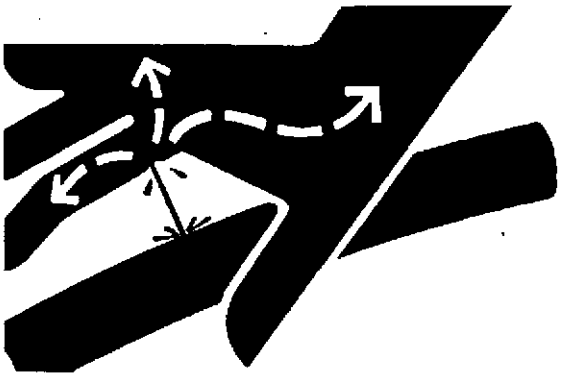
AVOID HIGH-PRESSURE FLUIDS

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

High-Pressure Fluids

DX,FLUID –19–03MAR93–1/1

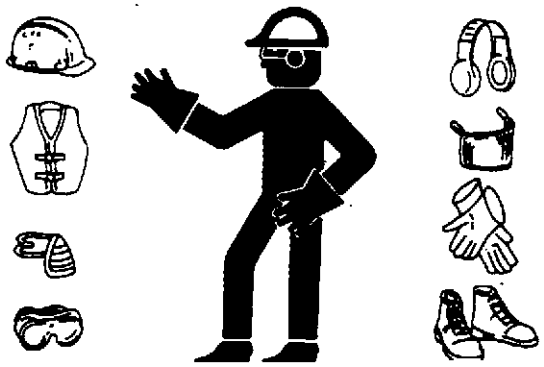
WEAR PROTECTIVE CLOTHING

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

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

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

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



TS206 –UN–23AUG88

Protective Clothing

DX,WEAR –19–10SEP90–1/1

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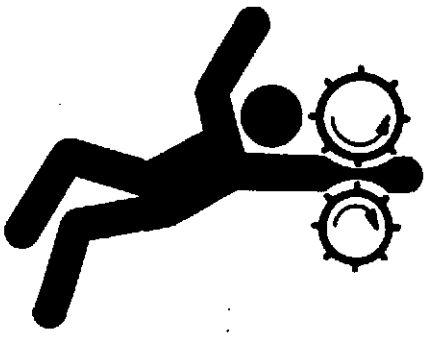
SERVICE MACHINES SAFELY

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

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



TS228 –UN–23AUG88

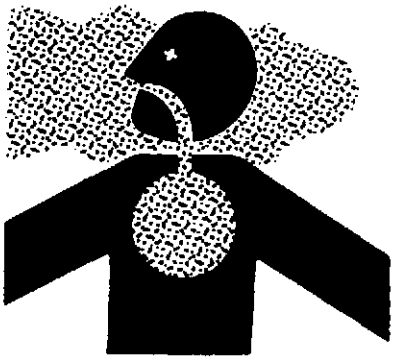
Moving Parts

DX,LOOSE –19–04JUN90–1/1

WORK IN VENTILATED AREA

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

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



TS220 –UN–23AUG88

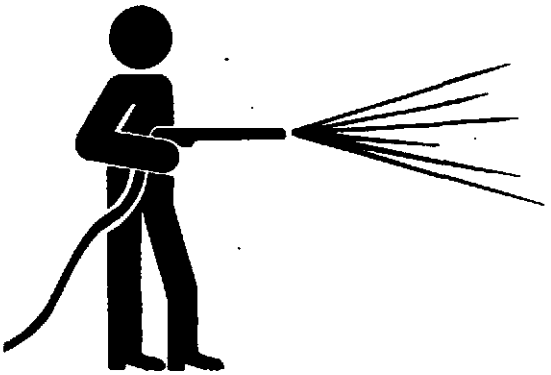
Engine exhaust fumes

DX,AIR –19–17FEB99–1/1

WORK IN CLEAN AREA

Before starting a job:

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



T6642EJ –UN–18OCT88

Clean Work Area

DX,CLEAN –19–04JUN90–1/1

REMOVE PAINT BEFORE WELDING OR HEATING

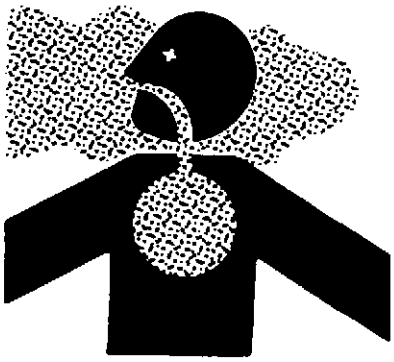
Avoid potentially toxic fumes and dust.

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

Do all work outside or in a well ventilated area. Dispose of paint and solvent properly.

Remove paint before welding or heating:

- If you sand or grind paint, avoid breathing the dust. Wear an approved respirator.
- If you use solvent or paint stripper, remove stripper with soap and water before welding. Remove solvent or paint stripper containers and other flammable material from area. Allow fumes to disperse at least 15 minutes before welding or heating.



TS220 –UN–23AUG88

Toxic Fumes

DX,PAINT –19–03MAR93–1/1

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

TS953 -UN-15MAY90

Flammable Spray

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

ILLUMINATE WORK AREA SAFELY

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

TS223 -UN-23AUG88

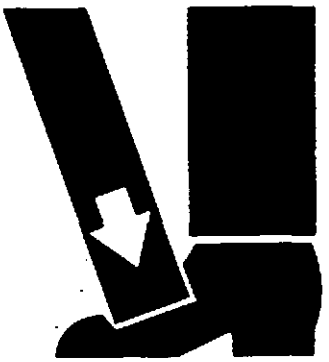
Work Area Safely

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

USE PROPER LIFTING EQUIPMENT

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

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



TS226 –UN–23AUG88

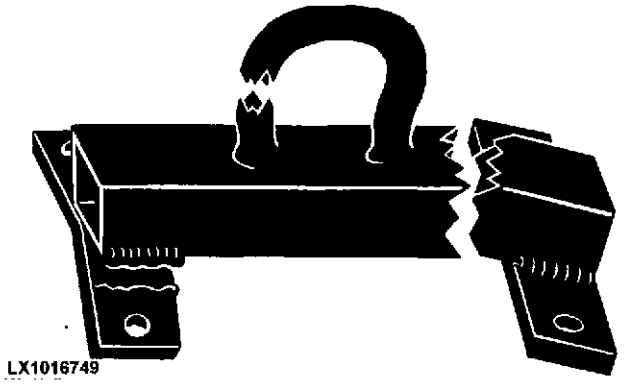
Proper Lifting Equipment

DX,LIFT –19–04JUN90–1/1

CONSTRUCT DEALER-MADE TOOLS SAFELY

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

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



LX1016749 –UN–01JUL97

Construct Dealer-Made Tools Safely

DPSG,OUO1004,899 –19–19MAY99–1/1

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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

Keep Area Clean

DX,SERV –19–17FEB99–1/1

USE PROPER TOOLS

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

Use power tools only to loosen threaded parts and fasteners.

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

Use only service parts meeting John Deere specifications.

TS779 –UN–08NOV89

Proper Tools

DX,REPAIR –19–17FEB99–1/1

DISPOSE OF WASTE PROPERLY

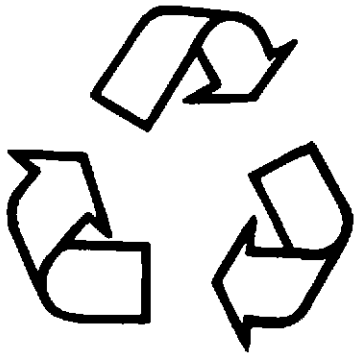
Improperly disposing of waste can threaten the environment and ecology. Potentially harmful waste used with John Deere equipment include such items as oil, fuel, coolant, brake fluid, filters, and batteries.

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

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

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

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



TS1133 -UN-26NOV90

Recycle Waste

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

LIVE WITH SAFETY

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

TS231 -19-07OCT88

Safety Systems

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

UNIFIED INCH BOLT AND CAP SCREW TORQUE VALUES

SAE Grade and Head Markings	NO MARK	1 or 2[b]	5 5.1 5.2	8 8.2
SAE Grade and Nut Markings	NO MARK	2	5	8

Size	Grade 1				Grade 2[b]				Grade 5, 5.1, or 5.2				Grade 8 or 8.2			
	Lubricated[a]		Dry[a]		Lubricated[a]		Dry[a]		Lubricated[a]		Dry[a]		Lubricated[a]		Dry[a]	
	N·m	lb-ft	N·m	lb-ft	N·m	lb-ft	N·m	lb-ft	N·m	lb-ft	N·m	lb-ft	N·m	lb-ft	N·m	lb-ft
1/4	3.7	2.8	4.7	3.5	6	4.5	7.5	5.5	9.5	7	12	9	13.5	10	17	12.5
5/16	7.7	5.5	10	7	12	9	15	11	20	15	25	18	28	21	35	26
3/8	14	10	17	13	22	16	27	20	35	26	44	33	50	36	63	46
7/16	22	16	28	20	35	26	44	32	55	41	70	52	80	58	100	75
1/2	33	25	42	31	53	39	67	50	85	63	110	80	120	90	150	115
9/16	48	36	60	45	75	56	95	70	125	90	155	115	175	130	225	160
5/8	67	50	85	62	105	78	135	100	170	125	215	160	240	175	300	225
3/4	120	87	150	110	190	140	240	175	300	225	375	280	425	310	550	400
7/8	190	140	240	175	190	140	240	175	490	360	625	450	700	500	875	650
1	290	210	360	270	290	210	360	270	725	540	925	675	1050	750	1300	975
1-1/8	400	300	510	375	400	300	510	375	900	675	1150	850	1450	1075	1850	1350
1-1/4	570	425	725	530	570	425	725	530	1300	950	1650	1200	2050	1500	2600	1950
1-3/8	750	550	950	700	750	550	950	700	1700	1250	2150	1550	2700	2000	3400	2550
1-1/2	1000	725	1250	925	990	725	1250	930	2250	1650	2850	2100	3600	2650	4550	3350

DO NOT use these values if a different torque value or tightening procedure is given for a specific application. Torque values listed are for general use only. Check tightness of fasteners periodically.

Shear bolts are designed to fail under predetermined loads. Always replace shear bolts with identical grade.

Fasteners should be replaced with the same or higher grade. If higher grade fasteners are used, these should only be tightened to the strength of the original.

Make sure fasteners threads are clean and that you properly start thread engagement. This will prevent them from failing when tightening.

Tighten plastic insert or crimped steel-type lock nuts to approximately 50 percent of the dry torque shown in the chart, applied to the nut, not to the bolt head. Tighten toothed or serrated-type lock nuts to the full torque value.

[a] "Lubricated" means coated with a lubricant such as engine oil, or fasteners with phosphate and oil coatings. "Dry" means plain or zinc plated without any lubrication.

[b] Grade 2 applies for hex cap screws (not hex bolts) up to 152 mm (6-in.) long. Grade 1 applies for hex cap screws over 152 mm (6-in.) long, and for all other types of bolts and screws of any length.

TS1656 -19-02APR97

DX,TORQ1 -19-20JUL94-1/1

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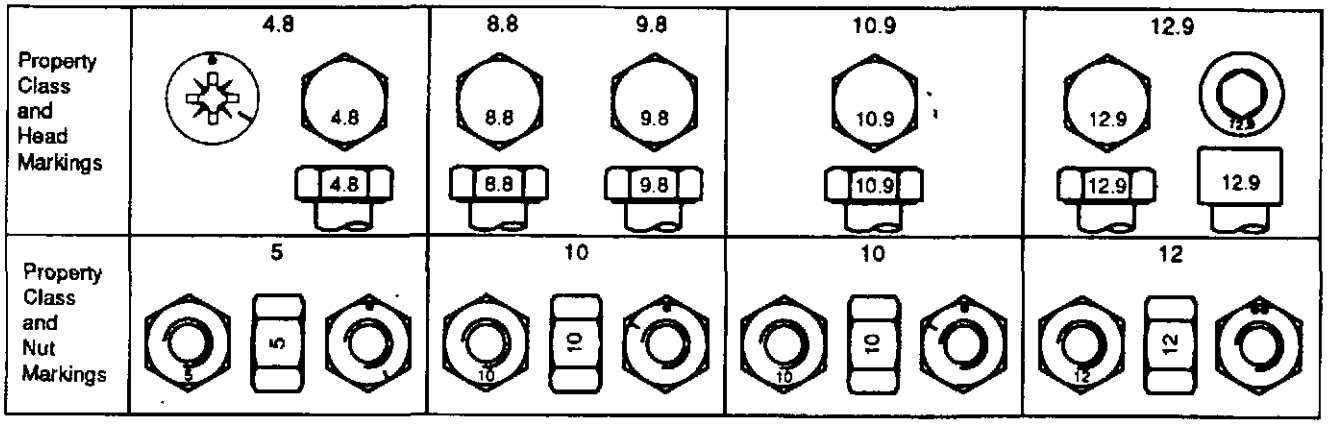
METRIC BOLT AND CAP SCREW TORQUE VALUES



Size	Class 4.8				Class 8.8 or 9.8				Class 10.9				Class 12.9			
	Lubricated[a]		Dry[a]		Lubricated[a]		Dry[a]		Lubricated[a]		Dry[a]		Lubricated[a]		Dry[a]	
	N·m	lb-ft	N·m	lb-ft	N·m	lb-ft	N·m	lb-ft	N·m	lb-ft	N·m	lb-ft	N·m	lb-ft	N·m	lb-ft
M6	4.8	3.5	6	4.5	9	6.5	11	8.5	13	9.5	17	12	15	11.5	19	14.5
M8	12	8.5	15	11	22	16	28	20	32	24	40	30	37	28	47	35
M10	23	17	29	21	43	32	55	40	63	47	80	60	75	55	95	70
M12	40	29	50	37	75	55	95	70	110	80	140	105	130	95	165	120
M14	63	47	80	60	120	88	150	110	175	130	225	165	205	150	260	190
M16	100	73	125	92	190	140	240	175	275	200	350	255	320	240	400	300
M18	135	100	175	125	260	195	330	250	375	275	475	350	440	325	560	410
M20	190	140	240	180	375	275	475	350	530	400	675	500	625	460	800	580
M22	260	190	330	250	510	375	650	475	725	540	925	675	850	625	1075	800
M24	330	250	425	310	650	475	825	600	925	675	1150	850	1075	800	1350	1000
M27	490	360	625	450	950	700	1200	875	1350	1000	1700	1250	1600	1150	2000	1500
M30	675	490	850	625	1300	950	1650	1200	1850	1350	2300	1700	2150	1600	2700	2000
M33	900	675	1150	850	1750	1300	2200	1650	2500	1850	3150	2350	2900	2150	3700	2750
M36	1150	850	1450	1075	2250	1650	2850	2100	3200	2350	4050	3000	3750	2750	4750	3500

DO NOT use these values if a different torque value or tightening procedure is given for a specific application. Torque values listed are for general use only. Check tightness of fasteners periodically.

Shear bolts are designed to fail under predetermined loads. Always replace shear bolts with identical property class.

Fasteners should be replaced with the same or higher property class. If higher property class fasteners are used, these should only be tightened to the strength of the original.

[1] *"Lubricated" means coated with a lubricant such as engine oil, or fasteners with phosphate and oil coatings. "Dry" means plain or zinc plated without any lubrication.*

Make sure fasteners threads are clean and that you properly start thread engagement. This will prevent them from failing when tightening.

Tighten plastic insert or crimped steel-type lock nuts to approximately 50 percent of the dry torque shown in the chart, applied to the nut, not to the bolt head. Tighten toothed or serrated-type lock nuts to the full torque value.

TS1657 –19–02APR97

DX,TORQ2 –19–20JUL94–1/1

ENGINE MODEL DESIGNATION

John Deere Engine Model—6105HRW01

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

6105HRW01 Engine

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

Aspiration Code

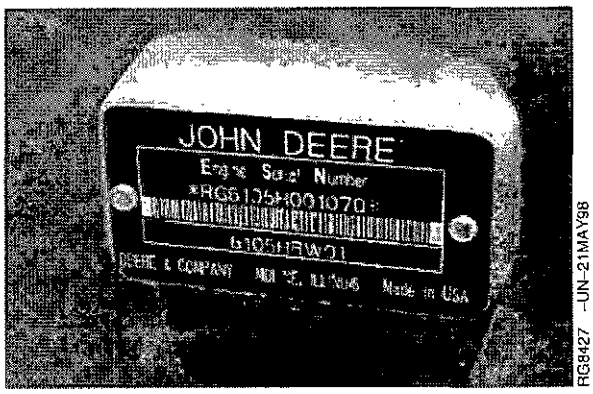
A ..... Turbocharged and air-to-coolant aftercooled
H ..... Turbocharged and air-to-air aftercooled

User Code

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

Application Code

01, 02, etc., ... Code for specific application



RG8427 –UN–21MAY98

Engine Serial Number Plate

RG,RG34710,23 –19–30JUN99–1/1

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ENGINE SERIAL NUMBER PLATE INFORMATION

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

1. Engine Serial Number (A)

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

RG6105H000000
RG ..... Factory code producing engine
6105H ..... Engine model designation
000000 ..... Sequential number

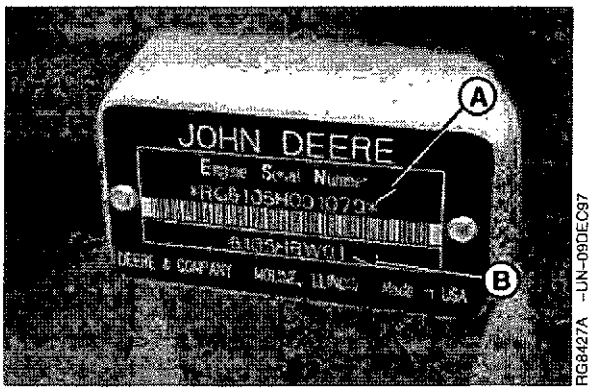
Factory Code Producing Engine
RG ..... Waterloo Engine Works

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

Sequential Number
000000 ..... 6-digit sequential number

2. Engine Application Data (B)

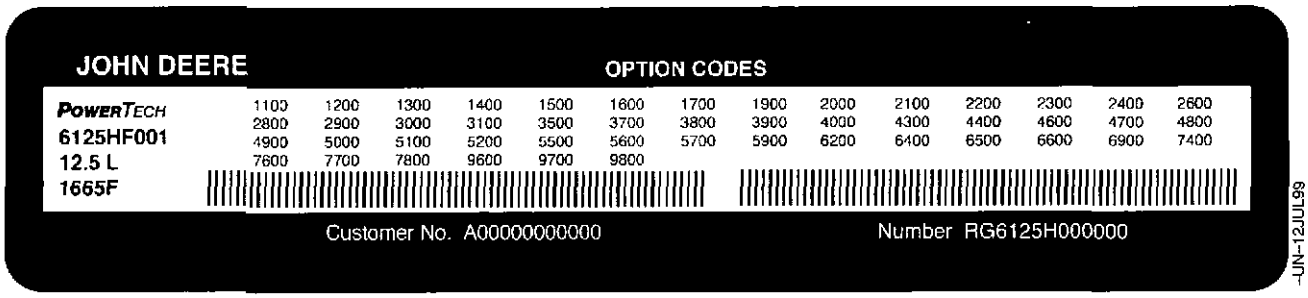
   The second line of information on the engine serial number plate identifies the engine/Deere machine or OEM relationship. See ENGINE APPLICATION CHART later in this group.



Engine Serial Number Plate

RG,RG34710,24 –19–30SEP97–1/1

ENGINE OPTION CODE LABEL



Option Code Label

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

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

DPSG,OUO1004,917 -19-30JUN99-1/1

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ENGINE APPLICATION CHART

JOHN DEERE AGRICULTURAL EQUIPMENT APPLICATIONS

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

JOHN DEERE CONSTRUCTION EQUIPMENT APPLICATION

Machine Model No.	Engine Model
LOADER—4-WHEEL DRIVE	
744H	6125ADW01
744H/MH	6125ADW01
LX200 Hitachi	6125ADW02
LX230-3 Hitachi	*6125ADW70*

ORIGINAL EQUIPMENT MANUFACTURERS (OEM) APPLICATIONS

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

RG,RG34710,25 –19–13AUG99–1/1

GENERAL OEM ENGINE SPECIFICATIONS

ITEM	UNIT OF MEASURE	6105AF	6105HF	6125AF	6125HF
Number of Cylinders	——	6	6	6	6
Fuel	——	Diesel	Diesel	Diesel	Diesel
Stroke	mm (in.)	138 (5.43)	138 (5.43)	165 (6.50)	165 (6.50)
Bore	mm (in.)	127 (5.00)	127 (5.00)	127 (5.00)	127 (5.00)
Displacement	L (cu in.)	10.5 (640)	10.5 (640)	12.5 (766)	12.5 (766)
Compression Ratio	——	16:1	16:1	16:1	16:1
Physical Dimensions: Width	mm (in.)	741 (29.2)	808 (31.8)	741 (29.2)	808 (31.8)
Height	mm (in.)	1224 (48.2)	1239 (48.8)	1224 (48.2)	1239 (48.8)
Length	mm (in.)	1326 (52.2)	1326 (52.2)	1326 (52.2)	1326 (52.2)
Basic Dry Weight	kg (lb)	1211 (2665)	1200 (2640)	1216 (2675)	1205 (2650)

DPSG,OUO1004,925 -19-01JUL99-1/1

DIESEL FUEL

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

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

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

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

- **Cetane Number of 40 minimum.** Cetane number greater than 50 is preferred, especially for temperatures below —20° C (—4° F) or elevations above 1500 m (5000 ft).
- **Cold Filter Plugging Point (CFPP)** below the expected low temperature OR Cloud Point at least 5° C (9° F) below the expected low temperature.
- **Fuel Lubricity** should pass a minimum of 3100 gram load level as measured by the BOCLE scuffing test.
- **Sulfur Content**
  - Sulfur content should not exceed 0.5%. Sulfur content less than 0.05% is preferred.
  - If diesel fuel with sulfur content greater than 0.5% sulfur content is used, reduce the service interval for engine oil and filter by 50%.
  - DO NOT use diesel fuel with sulfur content greater than 1.0%.

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

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

RG,02,DT7324 –19–10NOV97–1/1

LUBRICITY OF DIESEL FUELS

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

Diesel fuels for highway use in the United States and Canada now require sulfur content less than 0.05%. Diesel fuel in the European Union will require sulfur content less than 0.05% by 1 October 1996.

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

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

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

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

If fuel of low or unknown lubricity is used, add John Deere PREMIUM DIESEL FUEL CONDITIONER (or equivalent) at the specified concentration. John Deere PREMIUM DIESEL FUEL CONDITIONER is available in winter and summer formulas. Consult your John Deere engine distributor or servicing dealer for more information.

RG,02,DT7325 –19–10NOV97–1/1

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ENGINE BREAK-IN OIL

The engine is ready for normal operation. However, extra care during the first 100 hours of operation will result in more satisfactory long-term engine performance and life. 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. DO NOT exceed 100 hours of operation with break-in oil.

IMPORTANT: DO NOT add makeup oil until the oil is BELOW the ADD mark on dipstick. John Deere Engine Break-In Oil (TY22041) should be used to make up any oil consumed during the break-in period.

The engine should be operated at heavy loads with minimal idling during the break-in period. If the engine has significant operating time at idle, constant speeds, and/or light load usage, or makeup oil is required in the first 100 hour period, a longer break-in period may be required. In these situations, an additional 100 hour break-in period is recommended using a new change of John Deere Engine Break-In Oil and a new John Deere oil filter.

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

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

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

- API Service Classification CE
- ACEA Specification E1

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

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

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

RG,02,DT7326 –19–22JUL99–1/1

DIESEL ENGINE OIL

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

The following oil is preferred:

- John Deere PLUS-50®

The following oil is also recommended:

- John Deere TORQ-GARD SUPREME TORQ-GARD SUPREME®

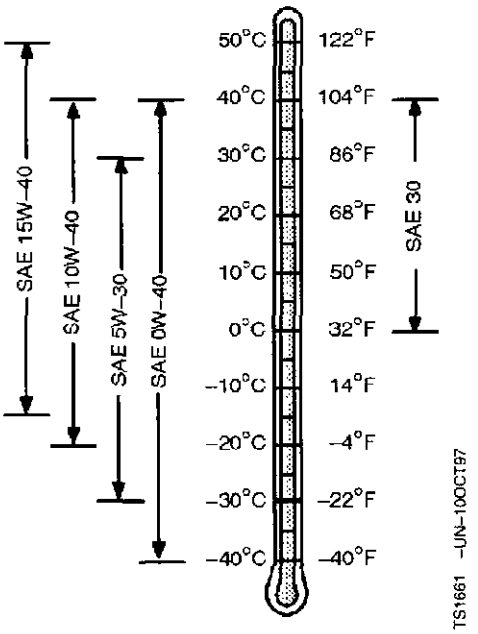
Other oils may be used if they meet one or more of the following:

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

Multi-viscosity diesel engine oils are preferred.

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

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



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

DX,ENOIL –19–10OCT97–1/1

EXTENDED DIESEL ENGINE OIL SERVICE INTERVALS

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

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

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

RG,RG34710,1031 –19–23OCT97–1/1

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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 -19-18MAR96-1/1

MIXING OF LUBRICANTS

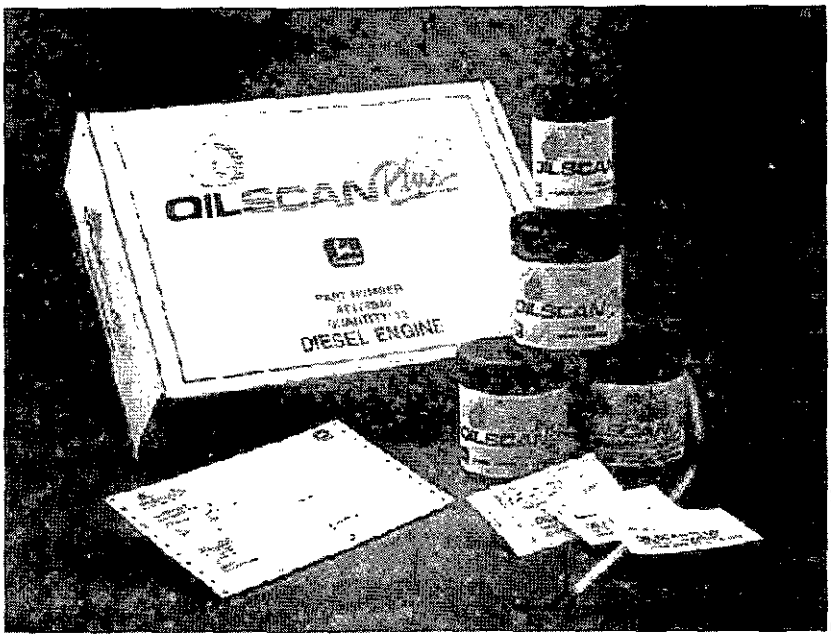
In general, avoid mixing different brands or types of oil. Oil manufacturers blend additives in their oils to meet certain specifications and performance requirements.

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

OILSCAN PLUS® AND COOLSCAN PLUS®



OILSCAN Plus® and COOLSCAN Plus™ are John Deere sampling fluid programs to help you monitor machine maintenance and system condition. The objective of a fluid sampling program is to insure machine availability when you need it and to reduce repair costs by identifying potential problems before they become critical.

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

Check with your John Deere dealer on a maintenance program for your specific application. Your dealer has the sampling products and expertise to assist you in lowering your overall operating costs through fluid sampling.

OILSCAN Plus is a registered trademark of Deere & Company.
COOLSCAN Plus is a trademark of Deere & Company.

RG,01,DT7040 -19-29OCT97-1/1

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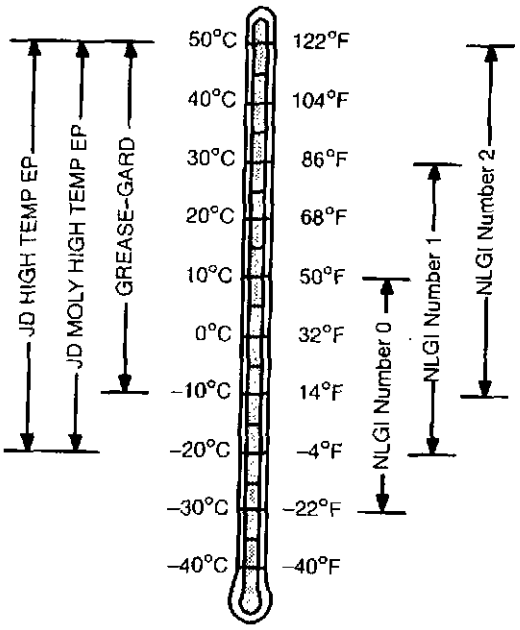
GREASE

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

The following greases are preferred:

- John Deere HIGH TEMPERATURE EP GREASE
- John Deere MOLY HIGH TEMPERATURE EP GREASE
- John Deere GREASE-GARD™

Other greases may be used if they meet NLGI Performance Classification GC-LB.



GREASE-GARD is a trademark of Deere & Company.

DX,GREA1 –19–18MAR96–1/1

DIESEL ENGINE COOLANT RECOMMENDATIONS

Contact your engine distributor or servicing dealer to determine what the cooling system of this engine is filled with and the winter freeze protection level.

Solutions of antifreeze and supplemental coolant additives MUST be used year-round for freeze protection, boil-over protection, and to provide a stable, noncorrosive environment for seals, hoses, and metal engine parts.

The following engine coolant is preferred for service:

- John Deere PREDILUTED ANTIFREEZE/SUMMER COOLANT
- John Deere COOL-GARD™, where available.

John Deere ANTIFREEZE/SUMMER COOLANT CONCENTRATE in a 40 to 60 percent mixture of concentrate with quality water is also recommended.

JOHN DEERE PREDILUTED ANTIFREEZE/SUMMER COOLANT

This product contains all the necessary ingredients that make up the proper coolant solution: chemically pure water, ethylene glycol (low silicate antifreeze), and supplemental coolant additives (SCAs). It is ready to use; no mixing is required.

John Deere Prediluted Antifreeze/Summer Coolant permits extended service life to 3000 hours or 36 months of operation.

JOHN DEERE COOL-GARD™

In certain geographical areas, John Deere COOL-GARD™ is marketed for use in the engine cooling system. This product contains all the necessary ingredients that make up the proper coolant solution: chemically pure water, ethylene glycol (low silicate antifreeze), and supplemental coolant additives (SCAs). It is ready to add to cooling system as is; no mixing or supplemental coolant additives required. Contact your John Deere Parts Network for local availability.

John Deere COOL-GARD™has a service life of 2000 hours or 24 months of operation.

JOHN DEERE ANTIFREEZE/SUMMER COOLANT CONCENTRATE

This product contains ethylene glycol (low silicate antifreeze) and supplemental coolant additives (SCAs). It must be mixed with quality water, as described later in this section, before adding to the engine cooling system. The proportion of water to be used depends upon the lowest freeze protection temperature desired according to the following table:

% CONCENTRATE	FREEZE PROTECTION LIMIT
40	-24° C (-12° F)
50	-37° C (-34° F)
60	-52° C (-62° F)

John Deere Antifreeze/Summer Coolant Concentrate has a service life of 2000 hours or 24 months of operation.

RG,02,JW7721 -19-01DEC97-1/1

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ENGINE COOLANT SPECIFICATIONS

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

Coolant solutions of quality water, ethylene glycol concentrate (antifreeze), and supplemental coolant additives (SCAs) MUST be used year-round to protect against freezing, boil-over, liner erosion or pitting, and to provide a stable, noncorrosive environment for seals, hoses, and metal engine parts.

Some products, including John Deere PREDILUTED ANTIFREEZE/SUMMER COOLANT, are fully formulated coolants that contain all three components in their correct concentrations. Do not add an initial charge of supplemental coolant additives to these fully formulated products.

Some coolant concentrates, including John Deere ANTIFREEZE/SUMMER COOLANT CONCENTRATE, contain both ethylene glycol antifreeze and inhibiting coolant additives. Mix these products and quality water, but do not add an initial charge of supplemental coolants additives.

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

Water Quality:

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

Water Quality Specifications

Item	Parts Per Million	Grains Per U.S. Gallon
Chlorides (maximum)	40	2.5
Sulfates (maximum)	100	5.9
Total Dissolved Solids (maximum)	340	20
Total Hardness (maximum)	170	10
pH Level	5.5—9.0	

Ethylene Glycol Concentrate (Antifreeze):

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

The use of John Deere coolant products, as outlined on the previous page, is strongly recommended.

If John Deere coolant products are not used, other low silicate ethylene glycol base coolants for heavy-duty engines may be used when mixed with quality water and supplemental coolant additives (SCAs), if they meet one of the following specifications:

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

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

Continued on next page

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

Supplemental Coolant Additives (SCAs):

IMPORTANT: DO NOT over-inhibit antifreeze solutions, as this can cause silicate-dropout. When this happens, a gel-type deposit is created which retards heat transfer and coolant flow causing engine to overheat.

NOTE: John Deere Prediluted Antifreeze/Summer Coolant, and John Deere Antifreeze/Summer Coolant Concentrate contain supplemental coolant additives (SCAs). However, as the coolant solution loses its effectiveness, additives will need to be added.

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

The 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.

Inhibit the antifreeze-coolant mix with a non-chromate inhibitor. John Deere Liquid Coolant Conditioner is recommended as a supplemental coolant additive in John Deere engines.

John Deere Liquid Coolant Conditioner

Continued on next page

02
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IMPORTANT: Check inhibitors between drain intervals every 600 hours or 12 months of operation. Replenish inhibitors by the addition of a supplemental coolant additive as necessary.

DO NOT use soluble oil.

Additives eventually lose their effectiveness and must be recharged with additional supplemental coolant additives available in the form of liquid coolant conditioner. Test engine coolant. See TESTING DIESEL ENGINE COOLANT, as described later in this group.

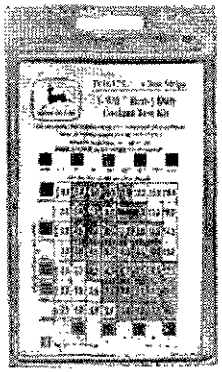
Replenish coolant with additives as required. See REPLENISHING SUPPLEMENTAL COOLANT ADDITIVES (SCAs) BETWEEN COOLANT CHANGES in this group.

RG,02,DT7036 -19-29OCT97-3/3

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.

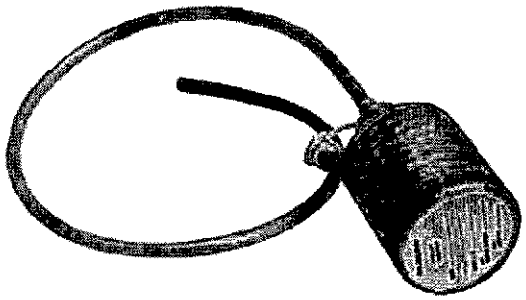
Test the coolant solution at 600 hours or 12 months of operation and whenever excessive coolant is lost through leaks or overheating to ensure the necessary protection.



RG7297 –UN–22SEP99

COOLANT TEST STRIPS

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



RG7397 –UN–05DEC97

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 Liquid Coolant Conditioner should be added.

COOLSCAN™

For a more thorough evaluation of your coolant, perform a CoolScan™ analysis. See your engine servicing dealer for information about CoolScan™.

CoolScan is a trademark of Deere & Company.

RG,02,JW7722 –19–01DEC97–1/1

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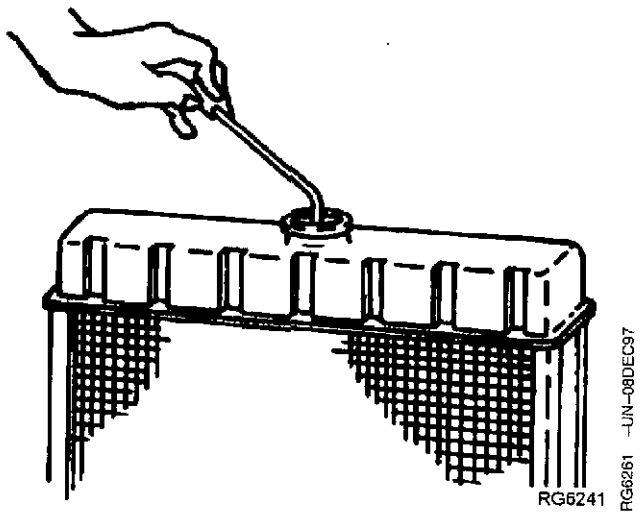
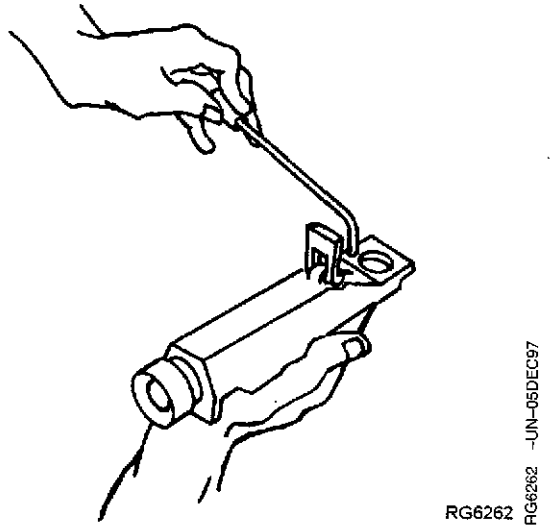
12

REPLENISHING SUPPLEMENTAL COOLANT ADDITIVES (SCA'S) BETWEEN COOLANT CHANGES





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

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

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

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

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

Do Not mix one brand of SCA with a different brand.

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

COOL-GARD is a trademark of Deere & Company.
CoolScan is a trademark of Deere & Company.

Continued on next page

RG,01,DT7035 –19–29OCT97–1/2

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

If frequent coolant makeup is* required, the glycol concentration should be checked with JT05460 *Refractometer to assure that the* desired freeze point is maintained. Follow manufacturer's instructions *provided with refractometer.

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

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

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

See ENGINE COOLANT SPECIFICATIONS earlier in this group for proper mixing of coolant ingredients before adding to the cooling system.

RG,01,DT7035 -19-29OCT97-2/2

OPERATING IN WARM TEMPERATURE CLIMATES

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

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

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

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

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

RG,01,DT7034 -19-29OCT97-1/1

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FLUSH AND SERVICE COOLING SYSTEM

TS281 –UN–23AUG88

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

IMPORTANT: Air must be expelled from cooling system when system is refilled. Follow procedure given in your operator's manual.

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

NOTE: Refer to your operator's manual for a specific service interval.

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

FLEETGUARD is a registered trademark of the Cummins Engine Company.
RESTORE is a trademark of FLEETGUARD.
RESTORE PLUS is a trademark of FLEETGUARD.

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RG,01,DT7033 –19–29OCT97–1/2

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

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

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

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

RG,01,DT7033 -19-29OCT97-2/2

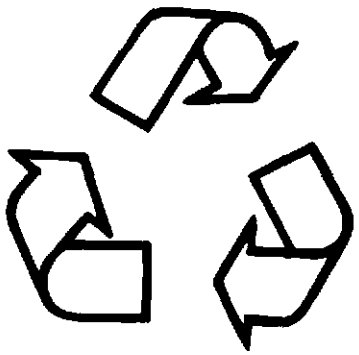
DISPOSING OF COOLANT

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

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

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

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



TS1133 -UN-26NOV90

RG,01,DT7032 -19-29OCT97-1/1

SPECIAL OR ESSENTIAL TOOLS

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

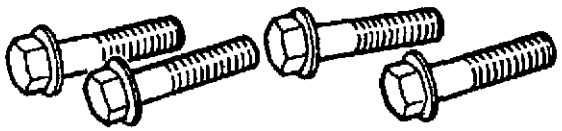
SERVICE-GARD is a trademark of Deere & Company.

RG,34710,42 –19–30SEP97–1/4

RG8501 –UN–21MAY98

Special Mounting Bolts JDG980

Metric hardware is required to mount the **POWERTECH**® 10.5 L and 12.5 L engines to the D05223ST Engine Repair Stand. Set consists of 4 flange head cap screws (221774) (M16 x 2.0 x 65 mm).



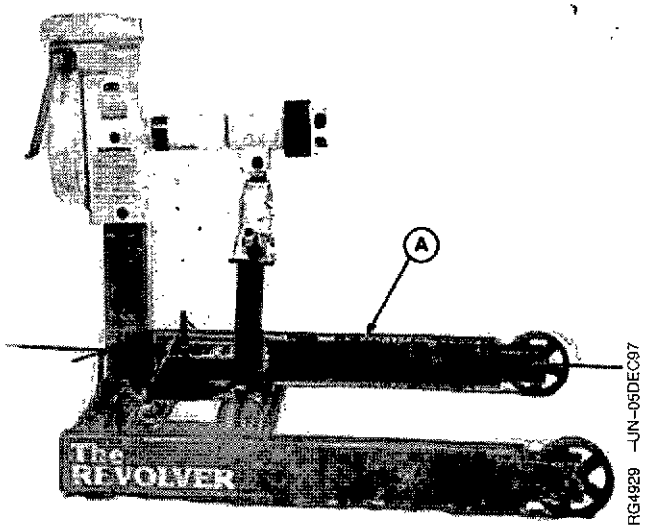
JDG980

***POWERTECH** is a registered trademark of Deere & Company.*

RG,34710,42 –19–30SEP97–2/4

Engine Repair Stand D05223ST

Mount engine for miscellaneous repairs. Use with JDG980 Special Mounting Bolts.



RG4929 –UN–05DEC97

D05223ST

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RG,34710,42 –19–30SEP97–3/4

03
2

Engine Lifting Sling JDG23

Use to safely lift engine for mounting onto D05223ST Engine Repair Stand.

RG,34710,42 –19–30SEP97–4/4

SERVICE EQUIPMENT AND TOOLS

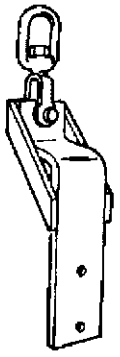
NOTE: Order tools according to information given in the U.S. SERVICE-GARD™ Catalog or from the European Microfiche Tool Catalog (MTC). Some tools may be available from a local supplier.

SERVICE-GARD is a trademark of Deere & Company.

RG,RG34710,43 –19–30SEP97–1/2

Engine Lifting Bracket JDG1018

Use with JDG23 and overhead lifting device to remove and install ***POWERTECH***™ 10.5 L and 12.5 L engines in tractor chassis. Bracket allows you to maintain level centers of gravity.



RG8500 –UN–21MAY98

JDG1018

POWERTECH *is a registered trademark of Deere & Company.*

RG,RG34710,43 –19–30SEP97–2/2

OTHER MATERIAL

Number	Name	Use
T43512 (U.S.) TY9473 (Canadian) 242 (LOCTITE®)	Thread Lock and Sealer (Medium Strength)	Attach lift strap cap screws.

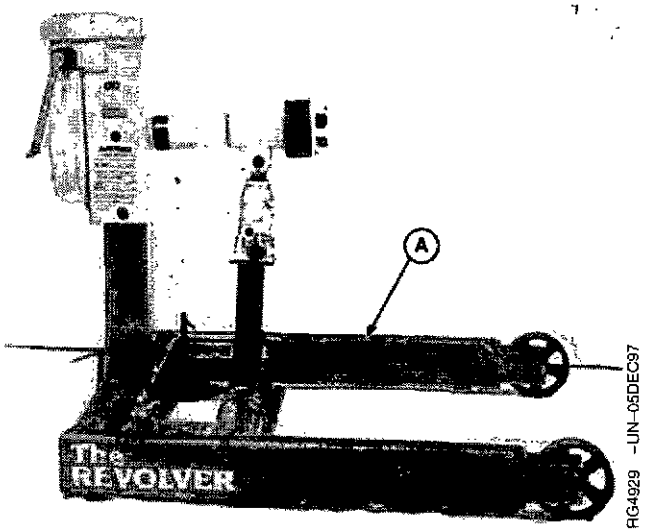
LOCTITE is a registered trademark of Loctite Corp.

RG,RG34710,44 -19-30SEP97-1/1

ENGINE REPAIR STAND

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

Refer to machine technical manual for steps to remove engine from machine before installing it on repair stand.



Engine Repair Stand

A—Engine Repair Stand

RG,RG34710,1043 -19-23OCT97-1/1

03
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SAFETY PRECAUTIONS

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

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

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

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

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

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

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

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

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

LOCTITE is a registered trademark of Loctite Corp.

RG,RG34710,45 –19–30SEP97–1/1

DISCONNECT TURBOCHARGER OIL INLET LINE

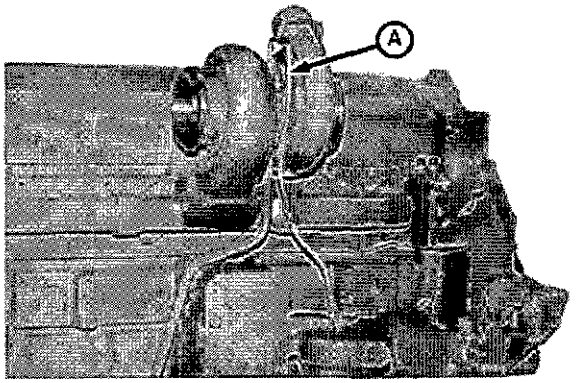
1. Drain all engine oil and coolant, if not previously done.

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

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

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

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



RG10241 –UN–09JUL99

Turbocharger Oil Inlet Line

A—Turbocharger Oil Inlet Line

DPSG,OUO1004,918 –19–30JUN99–1/1

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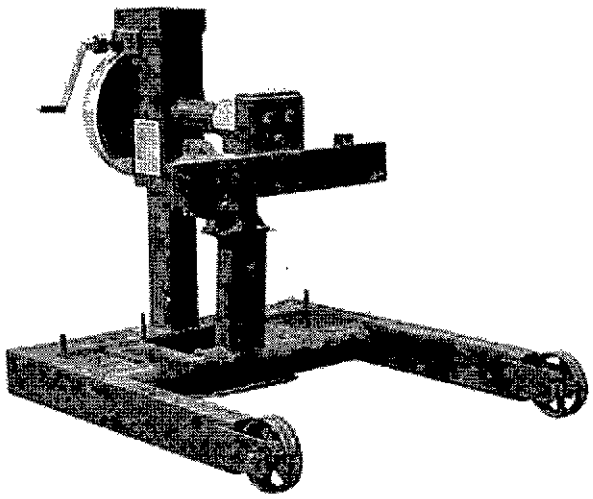
6

INSTALL ENGINE ADAPTER ONTO REPAIR STAND

Attach the No. 205466 Adapter Assembly (A) to engine repair stand using four 5/8-11 x 2 in. SAE Grade 8 (or higher grade) cap screws. Tighten cap screws to 135 N•m (100 lb-ft).



RG8183 –UN–08DEC97

D05223ST Repair Stand with 205466 Adapter

RG,RG34710,46 –19–30SEP97–1/1

ENGINE LIFTING PROCEDURE

CAUTION: The only approved method for lifting the 6105 and 6125 Engine is with the use of JDG23 Lifting Sling (D), R128000 Rear Lift Strap (E) and R128001 Front Lift Strap (F). The front plate lift eye (B) can be used as a lifting point instead of R128001 Front Lift Strap. Use extreme caution when lifting and NEVER permit any part of the body to be positioned under an engine being lifted or suspended.

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

IMPORTANT: Ensure that engine lifting straps are secured with Class 12.9 (or higher class) cap screws. Apply TY9370 LOCTITE® 242 Thread Lock and Sealer to lift strap cap screws.

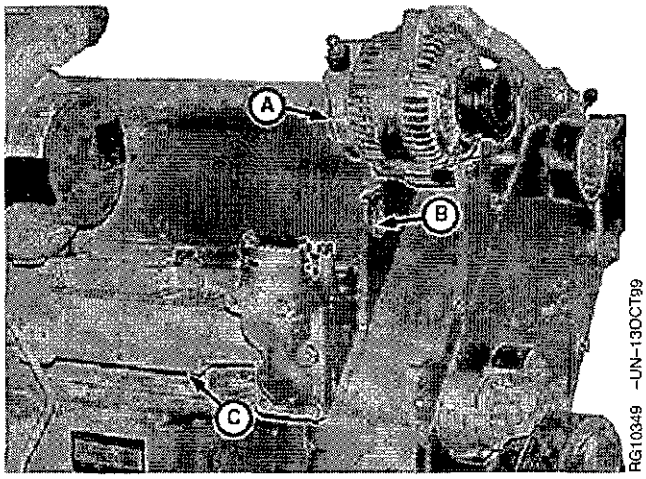
NOTE: If lift eye in front plate (B) is used instead of R128001 Front Lift Strap, remove alternator (A).

If front lift strap (F) is being used, remove exhaust shield (C) and install lift strap using shield mounting cap screw holes.

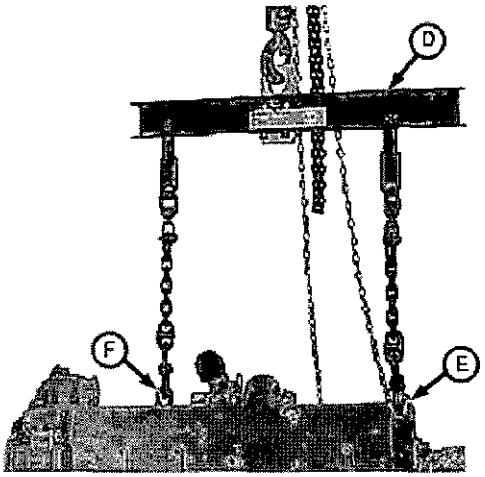
1. Install R128001 Front Lift Strap and R128000 Rear Lift Strap (or attach sling to front plate lift eye) and tighten cap screws to 90 N•m (66 lb-ft).

NOTE: Lift spacing on sling is adjustable. Position each lifting point so that engine hangs level when lifted.

2. Attach the JDG23 Engine Lifting Sling (D) to lift straps and overhead hoist or floor crane of adequate lifting capacity.



Engine Lift Points



Engine Lifting

A—Alternator
B—Front Plate Lift Eye
C—Exhaust Shield
D—JDG23 Lift Sling
E—R128000 Rear Lift Strap[1]
F—R128001 Front Lift Strap[1]

LOCTITE is a registered trademark of Loctite Corp.

[1] Can be ordered from parts catalog.

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RG,RG34710,47 –19–30JUN99–1/2

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IMPORTANT: Lifting straps are designed to lift the engine and small accessories such as hydraulic pumps and air compressors mounted to the engine auxiliary gear drive, or belt-driven components, such as air conditioning compressors and alternators. If larger components, such as PTO's, transmissions, generators or air compressors, are attached to other locations on the engine, the lift straps provided with the engine are not intended for this purpose. Technician is responsible for providing adequate lifting devices under these situations. See machine technical manual for additional information on removing engine from machine.

3. Carefully lift engine to desired location.

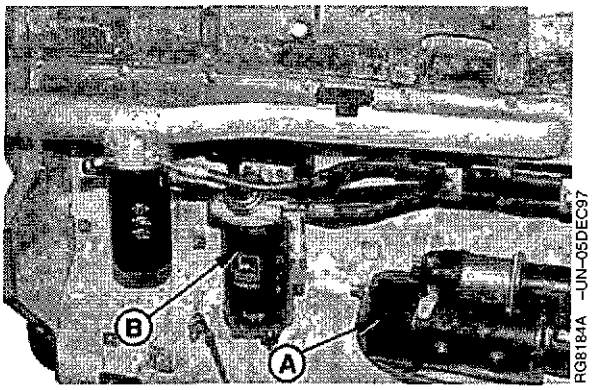
RG,RG34710,47 –19–30JUN99–2/2

MOUNT ENGINE ONTO REPAIR STAND

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

1. Remove starting motor (A).
2. On engines with primary fuel filter/water separator (B) on left side of engine, remove primary fuel filter/water separator.

   On later engines with large single fuel filter mounted on left side of engine, remove fuel filter assembly.



Component Removal for Repair Stand Mounting

A—Starter Motor
B—Primary Fuel Filter

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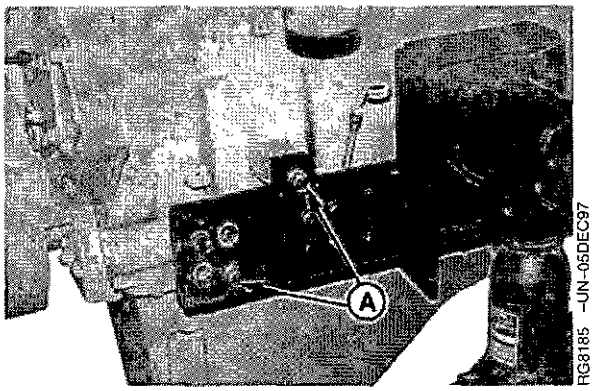
RG,RG34710,48 –19–19AUG99–1/3

IMPORTANT: DO NOT use shorter cap screws than recommended since mounting threads in block bore may be stripped when tightening to specified torque. USE ONLY JDG980 METRIC BOLT KIT for mounting engine to repair stand.

3. Mount engine to front engine adapter using two[1] M16 x 2.0 x 65 mm (Class 12.9) cap screws (A). Tighten cap screws to 400 N•m (300 lb-ft).



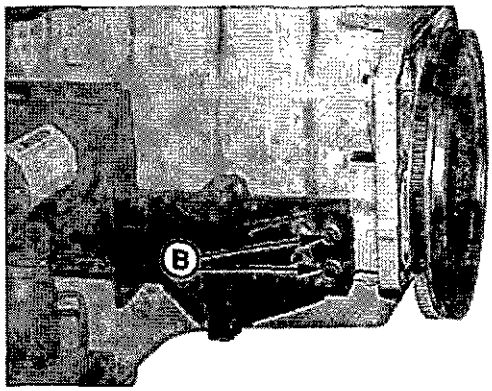
Front Repair Stand Cap Screws

A—Cap Screws

[1] *From JDG980 Metric Bolt Kit.*

RG,RG34710,48 –19–19AUG99–2/3

4. Mount engine to rear engine adapter using two[1] M16 x 2.0 x 65 mm (Class 12.9) cap screws (B). Tighten cap screws to 400 N•m (300 lb-ft).



Rear Repair Stand Cap Screws

B—Cap Screws

[1] *From JDG980 Metric Bolt Kit.*

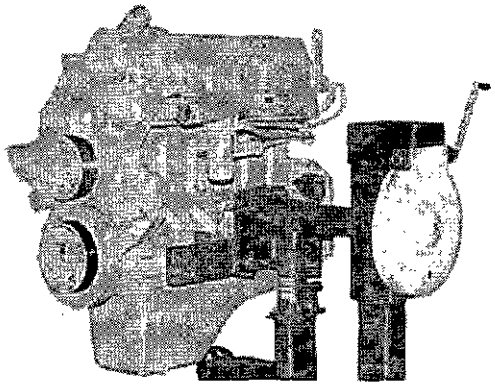
RG,RG34710,48 –19–19AUG99–3/3

03
10

CLEAN ENGINE

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

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 parts.



RG8188 –UN–21MAY98

6125HRW Engine on Repair Stand

RG,RG34710,49 –19–13AUG99–1/1

6105 AND 6125 ENGINE DISASSEMBLY SEQUENCE

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

NOTE: Remove starting motor and primary fuel filter/water separator before mounting engine onto repair stand.

1. Drain all coolant, fuel, and engine oil. Perform John Deere CoolScan™ and OILSCAN® analysis. Dispose of remaining fluids properly. (See DISPOSING OF COOLANT in Group 2.)
2. Mount engine onto recommended safety approved repair stand. (See MOUNT ENGINE ONTO REPAIR STAND in Group 3.)
3. Remove fan, drive belts, and fan drive assembly.
4. Remove alternator and compressor if not previously removed.
5. Remove vibration damper and pulley assembly from crankshaft. (See REMOVE CRANKSHAFT VIBRATION DAMPER AND PULLEY in Group 15.)
6. Disconnect all air intake/exhaust piping and turbocharger oil inlet/drain lines. Remove turbocharger. (See REMOVE TURBOCHARGER in Group 30.)
7. Remove exhaust manifold and gaskets. (See REMOVE, INSPECT AND INSTALL EXHAUST MANIFOLD in Group 30.)
8. Remove oil filter. Remove oil filter housing. (See REMOVE OIL FILTER AND VALVE HOUSING in Group 20.) Remove oil cooler assembly. (See REMOVE, CLEAN AND INSPECT OIL COOLER in Group 20.)
9. Remove water pump assembly. (See REMOVE WATER PUMP in Group 25.) Remove water manifold/thermostat housing assembly. (See REMOVE AND INSTALL THERMOSTAT HOUSING in Group 25.)
10. Remove all six piston spray jets.
11. Remove primary fuel filter along with mounting base and hand primer pump assembly on dual rail fuel systems. (See REPLACING PRIMARY FUEL FILTER/WATER SEPARATOR in Group 35.) Remove final fuel filter along with mounting base on dual rail fuel systems. (See REPLACE FINAL (SECONDARY) FUEL FILTER ELEMENT in Group 35.)

    Remove fuel filter assembly along with mounting base on single rail fuel systems. (See REPLACE FUEL FILTER ELEMENT in Group 36.)
12. On 6105H and 6125H engines, remove air intake manifold. (See REMOVE, INSPECT AND INSTALL INTAKE MANIFOLD in Group 30.)
13. On 6105A and 6125A engines, remove aftercooler assembly. (See REMOVE AND INSTALL AFTERCOOLER ASSEMBLY in Group 30.)
14. Remove fuel supply pump on dual rail fuel systems. (See REMOVE AND INSTALL FUEL SUPPLY PUMP in Group 35.) Remove fuel supply pump on single rail fuel systems. (See REMOVE AND INSTALL FUEL SUPPLY PUMP in Group 36.) Remove fuel manifold assembly (if equipped) from rear of cylinder head. (See REMOVE AND INSTALL FUEL MANIFOLD in Group 35.) Remove all remaining fuel lines, identify for reassembly in correct location.

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15. Remove engine oil pan. (See REMOVE ENGINE OIL PAN in Group 20.) Remove oil pickup tube. (See REMOVE AND INSTALL OIL PICKUP TUBE in Group 20.)

16. Remove front gear train access cover and timing gear cover. (See REMOVE TIMING GEAR COVER in Group 15.)

17. Remove rocker arm cover. (See REMOVE AND INSTALL ROCKER ARM COVER in Group 5.) Disconnect electrical wires from unit injectors and remove wiring harness through opening at rear of cylinder head.

NOTE: Identify valve train components and electronic unit injectors for reassembly in same location as removed.

18. Remove rocker arm shaft clamps. Remove valve bridges and push tubes.

19. Remove electronic unit injectors and wiring harness on dual rail fuel systems. (See REMOVE AND INSTALL ELECTRONIC UNIT INJECTORS in Group 35.)

    Remove electronic unit injectors and wiring harness on single rail fuel systems. (See REMOVE AND INSTALL ELECTRONIC UNIT INJECTORS in Group 36.)

20. Remove front and rear rocker arm and shaft assembly. (See REMOVE ROCKER ARM ASSEMBLY in Group 5.)

21. Remove camshaft gear and idler gear assembly. Remove camshaft position sensor and remove camshaft. (See REMOVE AND INSTALL CAMSHAFT in Group 16.)

22. Remove oil pump drive gear and remove oil pump assembly. (See REMOVE ENGINE OIL PUMP in Group 20.)

23. Remove cylinder head and gasket. (See REMOVE CYLINDER HEAD in Group 5.)

24. Remove flywheel. (See REMOVE FLYWHEEL in Group 15.) Remove flywheel housing. (See REMOVE FLYWHEEL HOUSING in Group 15.) Remove rear crankshaft seal and seal housing. (See REMOVE REAR CRANKSHAFT OIL SEAL AND HOUSING ASSEMBLY in Group 15.)

25. Remove engine front plate. (See REMOVE AND INSTALL CYLINDER BLOCK FRONT PLATE in Group 10.)

NOTE: Perform wear checks on connecting rod and main bearing surfaces with PLASTIGAGE® during engine disassembly.

26. Remove piston and connecting rod assemblies with bearings. (See REMOVE PISTONS AND CONNECTING RODS in Group 10.)

27. Check crankshaft endplay. (See CHECK CRANKSHAFT ENDPLAY in Group 15.) Remove main bearing caps with bearings. (See REMOVE CRANKSHAFT MAIN BEARINGS in Group 15.) Remove crankshaft. (See REMOVE CRANKSHAFT in Group 15.)

28. Remove cylinder block plugs and serial number plate if block is to be put in a hot tank. (See COMPLETE DISASSEMBLY OF CYLINDER BLOCK in Group 10.)

29. Refer to appropriate group for inspection and repair of individual components.

PLASTIGAGE is a registered trademark of DANA Corp.

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SEALANT APPLICATION GUIDELINES

Listed below are sealants which have been tested and are used by the John Deere factory to control leakage and ensure hardware retention. ALWAYS use the following recommended sealants when assembling your John Deere Diesel Engine to ensure quality performance.

LOCTITE® thread sealants are designed to perform to sealing standards with machine oil residue present. If excessive machine oil or poor cleanliness quality exist, clean with solvent. Refer to John Deere Merchandise and Parts Sales Manual for ordering information.

IMPORTANT: LOCTITE® gasket materials are NOT designed to work with oil residue present. Oil residues must be *cleaned from surfaces before* applying gasket material.

LOCTITE® **242 Thread Lock & Sealer (Medium Strength) (blue):**

TY9370 6 mL (0.2 oz) tube

- Threaded plugs and fittings: fuel filter base, oil pan drain plug, cylinder block (oil galley).
- Cap screws: oil filler inlet, water pump, timing gear cover, camshaft gear access cover, oil pump.
- Oil pressure sending unit.
- Turbocharger oil inlet fitting.
- Fuel filter check valve or elbow on dual rail fuel system.
- Piston spray jets.
- Timing gear cover and front plate gaskets.

LOCTITE® **271 Thread Lock & Sealer (High Strength) (clear):**

TY9371 6 mL (0.2 oz) tube

- Oil filter adapter-to-base.

LOCTITE® **277 Thread Lock & Sealer (High Strength) (red):**

T43514 50 mL (1.7 oz) bottle

- Expansion plugs in cylinder head.

LOCTITE® **515 Flexible Sealant (General Purpose) (purple):**

TY6304 50 mL (1.7 oz) bottle

- Front plate.
- Timing gear cover and camshaft gear access cover.

LOCTITE® **592 Pipe Sealant with** TEFLON® **(white):**

TY9374 6 mL (0.2 oz) tube

- Pipe plugs: cylinder block (water manifold), thermostat housing, air intake manifold, and water pump.
- Temperature sending unit.
- Oil pressure sending unit.
- Oil cooler housing drain valve.
- Coolant heater.
- Oil pan drain valve/hose.

LOCTITE® **680 Maximum Strength Retaining Compound (green):**

TY15969 6 mL (0.2 oz) tube

- Crankshaft flange and ID of front wear sleeve for front and rear oil seal/wear sleeve installation.
- Steel cup plugs on cylinder head and block.

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

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PT569 NEVER-SEEZ® **Compound**

PT569 227 g (8 oz) Brush

PT506 453 g (16 oz) Spray

- Cap Screws: exhaust manifold, aftercooler, turbocharger cap screws/nut, intake manifold and turbocharger oil return line.

LOCTITE® **222 Small Screw Threadlocker (Removable) (Purple)**

TY24311 0.5 mL (0.02 oz) tube

- EUI solenoid terminal nuts.

LOCTITE® **17430 High Flex Form-in-Place Gasket**

T43514 50 mL (1.7 oz) bottle

- Oil pan-to-cylinder block (timing gear cover and rear seal housing T-joints).

LOCTITE® **TY16285 Clean-and-Cure Primer**

- Clean mating gasket surfaces on timing gear cover and camshaft gear access cover.

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

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6105 AND 6125 ENGINE ASSEMBLY SEQUENCE

The following assembly sequence is suggested when engine has been completely disassembled. Be sure to check runout, clearance, and all critical physical part specifications prior to assembling engine. Replace parts as necessary and tighten retaining hardware to specifications given. Refer to the appropriate repair group when assembling engine.

IMPORTANT: ALWAYS replace vibration damper whenever crankshaft is replaced or after a major engine overhaul.

1. Install all plugs in cylinder block that were removed to service cylinder block. (See COMPLETE DISASSEMBLY OF CYLINDER BLOCK in Group 10.)

IMPORTANT: If new piston and liner kits are being installed, install these as an assembly after crankshaft has been installed.

2. Install cylinder liners without O-rings and measure liner stand-out. Install liners with packing. (See INSTALL CYLINDER LINERS in Group 10.)

3. Install crankshaft. See INSTALL CRANKSHAFT in Group 15.) Install main bearings. (See INSTALL MAIN BEARING INSERTS IN BLOCK in Group 15.) Rotate crankshaft by hand to ensure correct assembly. Check crankshaft endplay. (See CHECK CRANKSHAFT ENDPLAY in Group 15.)

4. Install pistons and connecting rods. Rotate crankshaft by hand to ensure correct assembly. (See INSTALL PISTONS AND CONNECTING RODS in Group 10.)

5. Install crankshaft rear oil seal housing and check. (See INSTALL CRANKSHAFT REAR OIL SEAL HOUSING in Group 15.) Install rear oil seal and wear sleeve assembly. (See INSTALL CRANKSHAFT REAR OIL SEAL AND WEAR SLEEVE in Group 15.)

6. Install flywheel. (See INSTALL FLYWHEEL in Group 15.) Install flywheel housing. (See REMOVE AND INSTALL FLYWHEEL HOUSING in Group 15.)

7. Install engine front plate. (See REMOVE AND INSTALL CYLINDER BLOCK FRONT PLATE in Group 10.)

8. Install engine oil pump and drive gear. (See INSTALL ENGINE OIL PUMP in Group 20.)

9. Install cylinder head using a new gasket. (See INSTALL CYLINDER HEAD in Group 05.)

10. Install camshaft and camshaft drive gear. (See REMOVE AND INSTALL CAMSHAFT in Group 16.)

11. Install front timing gear cover. (See INSTALL TIMING GEAR COVER in Group 15.)

12. Install oil pickup tube. (See REMOVE AND INSTALL OIL PICKUP TUBE in Group 20.) Install engine oil pan. (See INSTALL ENGINE OIL PAN in Group 20.)

13. Install idler gear. Pin camshaft and crankshaft. Adjust idler gear-to-camshaft gear and idler gear-to-oil pump gear backlash. (See ADJUST FRONT TIMING GEAR BACKLASH in Group 16.)

14. Install crankshaft vibration damper and pulley assembly (with oil seal). (See INSTALL CRANKSHAFT VIBRATION DAMPER AND FRONT OIL SEAL in Group 15.)

15. Install electronic unit injectors and wiring harness on dual rail fuel systems. (See REMOVE AND INSTALL ELECTRONIC UNIT INJECTORS in Group 35.)

Continued on next page

Install electronic unit injectors and wiring harness on single rail fuel systems. (See REMOVE AND INSTALL ELECTRONIC UNIT INJECTORS in Group 36.)

16. Install valve bridges and push tubes. Install front and rear rocker arm shaft assemblies. (See INSTALL ROCKER ARM ASSEMBLY in Group 5.) Preload unit injectors and adjust valve clearance. (See CHECK AND ADJUST VALVE ASSEMBLY CLEARANCES AND INJECTOR PRELOAD in Group 5.) Install timing gear cover. (See INSTALL TIMING GEAR COVER in Group 15.)

17. Install fuel supply pump on dual rail fuel systems. (See REMOVE AND INSTALL FUEL SUPPLY PUMP in Group 35.) Install fuel supply pump on single rail fuel systems. (See REMOVE AND INSTALL FUEL SUPPLY PUMP in Group 36.) Install fuel manifold assembly (if equipped) on rear of cylinder head. (See REMOVE AND INSTALL FUEL MANIFOLD in Group 35.) Install all remaining fuel lines, identify for reassembly in correct location.

18. On 6105H and 6125H engines, install air intake manifold. (See REMOVE, INSPECT AND INSTALL INTAKE MANIFOLD in Group 30.)

19. On 6105A engines, install aftercooler assembly. (See REMOVE AND INSTALL AFTERCOOLER ASSEMBLY in Group 30.)

20. On dual rail fuel systems, install primary fuel filter assembly. (See REPLACING PRIMARY FUEL FILTER/WATER SEPARATOR in Group 35.) Install final fuel filter assembly. [See REPLACE FINAL (SECONDARY) FUEL FILTER ELEMENT in Group 35.] Connect and tighten all fuel lines.

21. On single rail fuel systems, install fuel filter assembly. (See REPLACE FUEL FILTER ASSEMBLY in Group 36.) Connect and tighten all fuel lines.

22. Install all six piston spray jets.

23. Install water pump assembly. (See INSTALL WATER PUMP in Group 25.) Install water manifold/thermostat housing assembly. (See REMOVE AND INSTALL THERMOSTAT HOUSING in Group 25.)

24. Install oil filter housing/oil cooler assembly. (See INSTALL OIL COOLER AND OIL FILTER/VALVE HOUSING ASSEMBLY in Group 20.) Install engine oil filter.

25. Install exhaust manifold assembly. (See REMOVE, INSPECT AND INSTALL EXHAUST MANIFOLD in Group 30.) Install turbocharger. (See INSTALL TURBOCHARGER in Group 30.) Connect all turbocharger oil lines and intake/exhaust piping.

26. Install alternator, compressor, fan drive, fan, and drive belt. (See machine TM.)

27. Mount engine into vehicle. Fill engine systems with recommended fuel, lubricant, and coolant.

28. Perform engine break-in and normal standard performance checks. (See PERFORM ENGINE BREAK-IN in Group 4.)

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ENGINE BREAK-IN GUIDELINES

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

Main bearings, rod bearings, crankshaft, or any combination of these parts have been replaced.

Pistons, rings, or liners have been replaced.

Rear crankshaft oil seal and wear sleeve have been replaced. (Primary objective is to see if oil seal still leaks).

Cylinder head has been removed.

Injection pump has been removed or critical adjustments have been made while it is on the engine. (Primary objective is to check power).

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PERFORM ENGINE BREAK-IN

IMPORTANT: If engine has a PTO, break-in can be performed at the PTO if it is done as specified below. To prevent possible damage to the PTO gear box, DO NOT apply full load through the PTO for any longer than the specified 10 minutes below.

Use a dynamometer to perform the following preliminary break-in procedure. If necessary, preliminary engine break-in can be performed without a dynamometer if under controlled operating conditions.

IMPORTANT: DO NOT use John Deere PLUS-50 oil or engine oils meeting API CG4, API CF4, ACEA E3 or ACEA E2, performance levels during break-in period of an engine that has had a major overhaul. These oils will not allow an overhauled engine to properly wear during the break-in period.

Do not add makeup oil until the oil level is BELOW the add mark. John Deere Break-In Oil should be used to make up any oil consumed during break-in period.

DO NOT fill above the crosshatch pattern or FULL mark. Oil levels anywhere within the crosshatch are acceptable.

1. Fill engine crankcase to proper level with John Deere ENGINE BREAK-IN OIL during break-in operation. Use break-in oil regardless of ambient temperature. This oil is specifically formulated to enhance break-in of John Deere diesel engines. Under normal conditions, do not exceed 100 hours with break-in oil.

   If John Deere Engine Break-In Oil is not available, use diesel engine oil meeting API Service Classification CE or ACEA Specification E1.

IMPORTANT: During preliminary break-in, periodically check engine oil pressure and coolant temperature. Also check for signs of fuel, oil, or coolant leaks.

2. Start engine, run at loads and speeds shown in following chart for time limits given.

PRELIMINARY ENGINE BREAK-IN AFTER MAJOR OVERHAUL

Time	Load	Engine Speed
1 minute	No load	850 rpm
2 minutes	No load	Fast Idle
10 minutes	1/2—3/4 load	2000 rpm to rated speed
10 Minutes	Full load	Rated speed

3. After preliminary break-in, run engine 1—2 minutes at 1500 rpm, with no load before shut-down.

4. Check and readjust valve clearance as necessary. Cylinder head retorque is not required.

NOTE: During the first 20 hours, avoid prolonged periods of engine idling or sustained maximum load operation. If engine will idle longer than 5 minutes, stop engine.

5. Operate the engine at heavy loads with minimal idling during the break-in period.

If the engine has significant operating time at idle, constant speeds, and/or light load usage, an additional 100 hour break-in period is recommended using a new change of John Deere ENGINE BREAK-IN OIL and new John Deere oil filter.

Continued on next page

Check engine oil level more frequently during engine break-in period. As a general rule, makeup oil should not need to be added during 100-hour break-in period. However, if makeup oil is required in the first 100-hour break-in, an additional 100-hour break-in period is required. Use a new change of John Deere ENGINE BREAK-IN OIL and a new John Deere oil filter.

After 100 hours maximum, drain break-in oil and change oil filter. Fill crankcase with John Deere TORQ-GARD SUPREME® OR PLUS-50® or other heavy-duty diesel engine oil within the same service classification as recommended in this manual. See DIESEL ENGINE OIL in Group 02, Fuels, Lubricants, and Coolant.

NOTE: Some increase in oil consumption may be expected when low viscosity oils are used. Check oil levels more frequently.

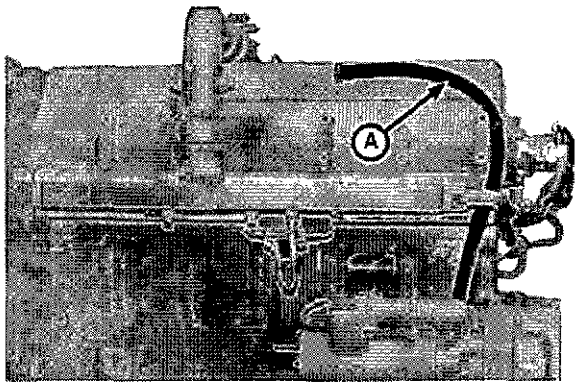
If air temperature is below -10° C (14° F), use an engine block heater.

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

RG,100,JW7645 –19–05NOV99–2/2

CHECK CRANKCASE VENTILATION SYSTEM

1. Inspect crankcase ventilation system for restrictions. Lack of ventilation causes sludge to form in crankcase. This can lead to clogging of oil passages, filters, and screens, resulting in serious engine damage.
2. Clean crankcase vent tube (A) with solvent and compressed air if restricted. Install and tighten hose clamps securely.



RG10239 –UN–09JUL99

Crankcase Vent Tube

A—Crankcase Vent Tube

DPSG,OUO1004,919 –19–30JUN99–1/1

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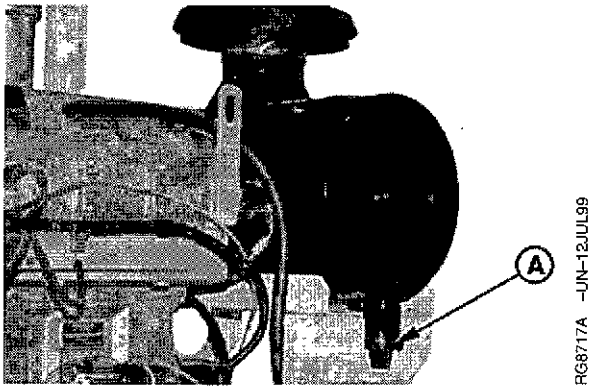
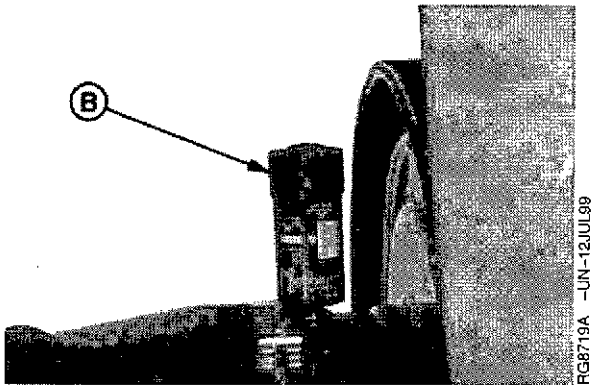
CHECK AIR INTAKE SYSTEM

1. Replace air cleaner primary filter element. Replace secondary element if primary element has holes in it. (See REPLACING AIR CLEANER FILTER ELEMENTS in operator's manual.)
2. Check condition of air intake hose(s). Replace hoses that are cracked, split, or otherwise in poor condition.
3. Check hose clamps for tightness. Replace clamps that cannot be properly tightened. This will help prevent dust from entering the air intake system which could cause serious engine damage.
4. If air cleaner has an automatic dust unloader valve (A), inspect valve for dust buildup or restrictions.
5. Check air intake restriction indicator gauge (B) (if equipped) to determine if air cleaner needs to be serviced.



Unloader Valve



Restriction Indicator Gauge

A—Unloader Valve
B—Restriction Indicator Gauge

DPSG,OUO1004,920 -19-09JUL99-1/1

CHECK EXHAUST SYSTEM

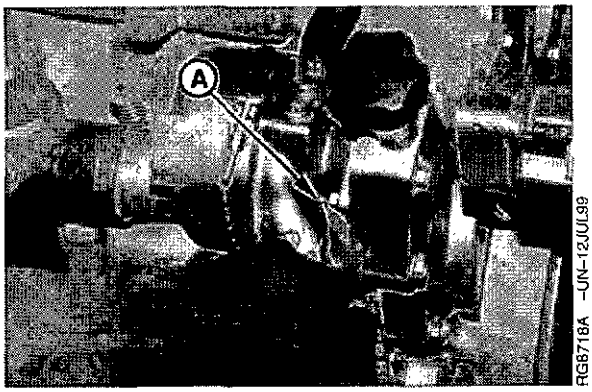
1. Inspect exhaust system for leaks or restrictions. Check manifold for cracks. Repair or replace as necessary.
2. Check that turbocharger-to-exhaust elbow adapter clamps are securely tightened and do not leak.
3. Check exhaust stack for evidence of oil leakage past valve stem seals.

   Oil in exhaust stack may be caused by excessive valve stem-to-guide clearance or excessive light load engine idling.

RG,RG34710,1057 -19-23OCT97-1/1

CHECK AND SERVICE COOLING SYSTEM

1. Remove trash that has accumulated on or near radiator.
2. Visually inspect entire cooling system and all components for leaks or damage. Repair or replace as necessary.
3. Remove the foam filter from weep hole (A, shown removed) located on the side of timing gear cover and discard filter. Inspect the weep hole for any restrictions.
4. Insert a heavy gauge wire deep into weep hole to make sure hole is open.
5. Install new foam filter flush with bore opening.



Weep Hole with Foam Filter

A—Weep Hole

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CAUTION: Do not drain coolant until the coolant temperature is below operating temperature. Always loosen coolant drain valve (A) slowly to relieve any excess pressure.

6. Remove and check thermostat(s). (See REMOVE AND TEST THERMOSTATS in Group 25.)

7. Drain and flush cooling system. (See FLUSH AND SERVICE COOLING SYSTEM in Group 02.)

IMPORTANT: Air must be expelled from cooling system when system is refilled. Loosen temperature sending unit fitting at rear of cylinder head, bleed plug at top front of cylinder head, or plug in thermostat housing to allow air to escape when filling system. Retighten fitting or plug when all the air has been expelled.

8. Fill cooling system with coolant. Follow recommendations in Group 02. (See DIESEL ENGINE COOLANT RECOMMENDATIONS in Group 2.)

9. Run engine until it reaches operating temperature. Check entire cooling system for leaks.

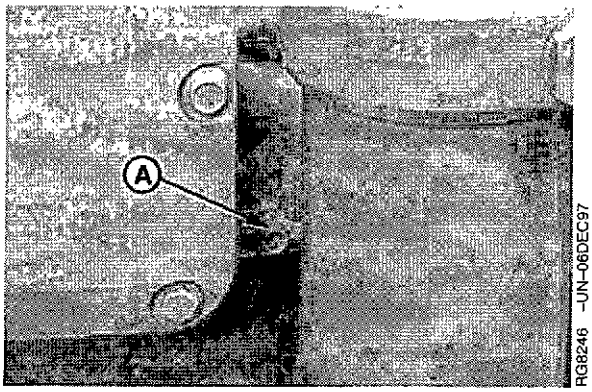
10. After engine cools, check coolant level.

NOTE: Coolant level should be even with bottom of radiator filler neck.

11. Check system for holding pressure. (See PRESSURE TEST COOLING SYSTEM AND RADIATOR CAP in Group 105 of CTM115.)

TS261 –UN–23AUG88

Service Cooling System Safely



RG8246 –UN–06DEC97

Coolant Drain Valve

A—Coolant Drain Valve

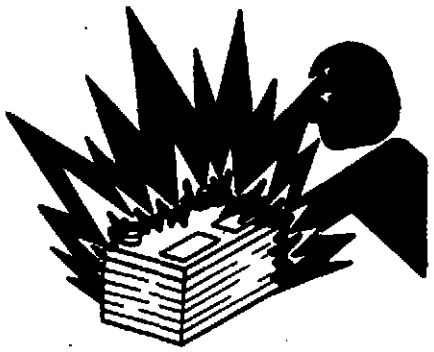
DPSG,OUO1004,922 –19–01JUL99–2/2

CHECK ELECTRICAL SYSTEM

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.



TS204 –UN–23AUG88

Prevent Battery Explosions

1. Clean batteries and cables with damp cloth. If corrosion is present, remove it and wash terminals with a solution of ammonia or baking soda in water. Then flush area with clean water.

2. Coat battery terminals and connectors with petroleum jelly mixed with baking soda to retard corrosion.

3. Test batteries. If batteries are not near full charge, try to find out why.

4. On low-maintenance batteries, check level of electrolyte in each cell of each battery. Level should be to bottom of filler neck. If water is needed, use clean, mineral-free water.

   If water must be added to batteries more often than every 250 hours, alternator may be overcharging.

NOTE: Water cannot be added to maintenance-free batteries.

5. If batteries appear to be either undercharged or overcharged, check alternator and charging circuit.

6. Check tension of drive belts. See operator's manual.

7. Check operation of starter motor and gauges.

NOTE: For test and repair of alternators and starter motors, see CTM77, Alternators and Starting Motors.

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PRELIMINARY ENGINE TESTING BEFORE TUNE-UP

Before tuning-up an engine, determine if a tune-up will restore operating efficiency. If in doubt, the following preliminary tests will help determine if the engine can be tuned-up. Choose from the following procedures only those necessary to restore the unit.

1. After engine has stopped for several hours, loosen crankcase drain plug and watch for any water to seep out. A few drops could be due to condensation, but any more than this would indicate problems which require engine repairs rather than just a tune-up.

2. With engine stopped, inspect engine coolant for oil film. With engine running, inspect coolant for air bubbles. Either condition would indicate problems which require engine repairs rather than just a tune-up.

3. Perform a dynamometer test and record power output. (See DYNAMOMETER TEST later in this group.) Repeat dynamometer test after tune-up. Compare power output before and after tune-up.

4. Perform compression test. (See TEST ENGINE COMPRESSION PRESSURE in Group 105 of CTM115.)

DPSG,OUO1004,921 –19–01JUL99–1/1

GENERAL TUNE-UP RECOMMENDATIONS

As a general rule, an engine tune-up is not necessary if ALL recommended operator's manual hourly service procedures are performed on schedule. If your engine performance is not within the rated application guidelines, the following service procedures are recommended to help restore engine to normal operating efficiency.

IMPORTANT: These engines are equipped with electronically-controlled governors which have a diagnostic feature that will display detailed codes to alert operator of specific performance problems. Refer to CTM115 for Lucas ECU controls, and refer to CTM188 for later John Deere ECU controls.

Operation	Detailed Reference
Check for and correct any diagnostic trouble codes.	CTM115 or CTM188
Change engine oil and filters.	Operator's Manual
Lubricate PTO clutch internal levers and linkage, if equipped.	Operator's Manual
Replace fuel filter.	Group 35 or 36/Operator's Manual
Clean crankcase vent tube.	This Group/Operator's Manual
Check air intake system. Replace air cleaner elements.	This Group/Operator's Manual
Check exhaust system.	This Group
Check and service engine cooling system.	This Group/Operator's Manual
Check and adjust fan and alternator belts.	Operator's Manual
Check electrical system.	This Group
Check crankshaft vibration damper.	Group 15/Operator's Manual
Inspect turbocharger and check turbocharger boost pressure.	Group 105 of CTM115
Check fuel injection system: Check engine/injection pump timing: check and adjust speed advance; clean injection nozzles, and adjust opening pressure.	Group 35 or 36/Group 115 of CTM115
Check engine oil pressure. Correct as necessary.	Group 105 of CTM115
Check engine valve and EUI clearances. Adjust if necessary.	Group 05
Check engine speeds. Correct as necessary.	Authorized Servicing Dealer
Check engine performance on dynamometer.	This Group

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DYNAMOMETER TEST

NOTE: High elevations may affect engine performance. (See EFFECTS OF ALTITUDE AND TEMPERATURE ON ENGINE PERFORMANCE, later in this group.)

1. Connect engine to dynamometer using manufacturer's instructions.
2. Operate engine at one-half load until coolant and crankcase oil temperatures are up to normal.
3. Run engine at fast idle.
4. Gradually increase load on engine until speed is reduced to rated speed rpm.
5. Read horsepower on dynamometer and record reading.
6. Compare readings taken with power rating level for your engine application. OEM power units are shown below.

NOTE: Refer to appropriate machine technical manual for average power ratings of vehicle applications. Allow ± 5% for minimum and maximum power. Altitude and temperatures can also affect power levels. (See DYNAMOMETER TEST SPECIFICATIONS on next page.)

RG,RG34710,1062 -19-23OCT97-1/1

DYNAMOMETER TEST SPECIFICATIONS (OEM ENGINES)

INDUSTRIAL APPLICATIONS

ENGINEMODEL	FUEL SYSTEM OPTION CODES	POWER RATING@RATED SPEED WITHOUT FAN kW (hp)	RATED SPEED (rpm)	SLOW IDLE (rpm)	FAST IDLE (rpm)
6105AF	1601, 1602, 1603	224 (300)	2100	850	2200
6105HF	1610, 1620	242 (325)	2100	850	2200
	1601, 1611	261 (350)	2100	850	2225
	1602	280 (375)	2100	850	2225
6125AF	1610, 1620	242 (325)	2100	850	2200
	1601, 1611, 1621	261 (350)	2100	850	2225
	1602, 1612	280 (375)	2100	850	2225
	1603, 1613	298 (400)	2100	850	2225
6125HF	1601, 1611	317 (425)	2100	850	2200
	1602, 1612	336 (450)	2100	850	2225
	1603, 1613	354 (475)	2100	850	2225
	1604, 1614	373 (500)	2100	850	2225
6125AFM (Marine)	M1	253 (340)	1800	650	1950
	M4	335 (450)	2100	650	2225

GENERATOR SET (STANDBY) APPLICATIONS

ENGINE MODEL	FUEL SYSTEM OPTION CODES	POWER RATING@RATED SPEED WITHOUT FAN kW (hp)	RATED SPEED (rpm)	SLOW IDLE (rpm)	FAST IDLE (rpm)
6125AF	1604, 1614	280 (375)	1800	900	1850
	1607, 1617	233 (312)	1500	900	1550
	1605, 1615	300 (402)	1800	900	1850
	1608, 1618	250 (335)	1500	900	1550
	1606, 1616	330 (442)	1800	900	1850
	1609, 1619	275 (369)	1500	900	1550
6125HF	1605, 1615	420 (563)	1800	900	1850
	1606, 1616	360 (483)	1800	900	1850
	1607, 1617	300 (402)	1500	900	1550
	1608, 1618	350 (469)	1500	900	1550
6125HFM (Marine)	1603	300 (402)	1800	900	1850

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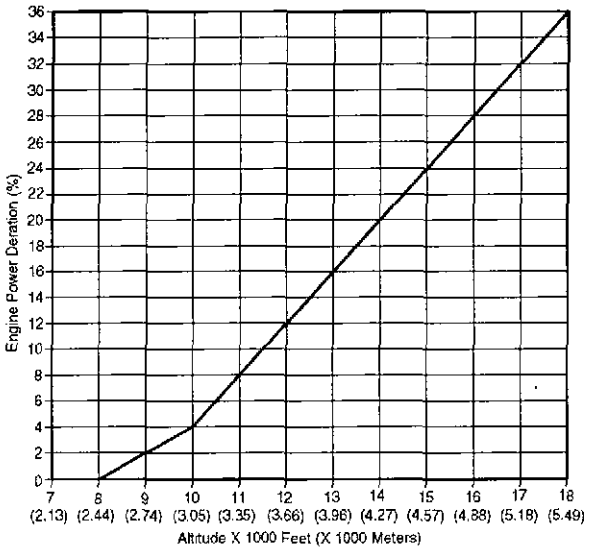
EFFECTS OF ALTITUDE AND TEMPERATURE ON ENGINE PERFORMANCE

Altitude, fuel temperature, air temperature, and humidity may affect engine performance. As a general rule, atmospheric changes will usually cause a decrease in engine power by the percentages shown in chart below.

ATMOSPHERIC CHANGE	% POWER DECREASE
Fuel Temperature Rise of 1°C (1.8°F) above 40° C (104°F)	0.29
Air Temperature Rise of 5.5°C (10°F) above 25°C (77°F)	0.50
Naturally Aspirated Engines:	
Altitude Rise of 300 m (1000 ft) above 180 m (600 ft)	3.00
Turbocharged Engines:	
Altitude Rise of 300 m (1000 ft) above 180 m (600 ft)	0.50
Relative Humidity Rise of 10% above 0%	0.07



Turbocharged Engines

RG,RG34710,1064 –19–08JUN99–1/1

ESSENTIAL TOOLS

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

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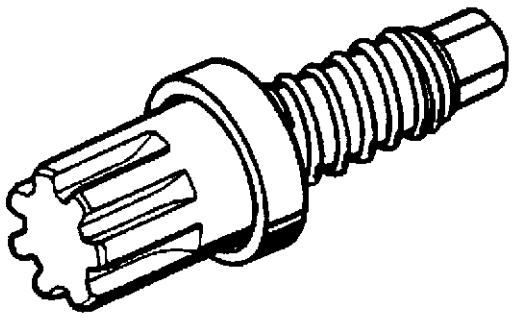
DPSG,OUO1004,930 –19–20JUL99–1/16

Flywheel Turning Tool JDG820

Used to rotate engine flywheel to check engine timing and adjust valve stem-to-valve bridge clearance. Use with JDG971.



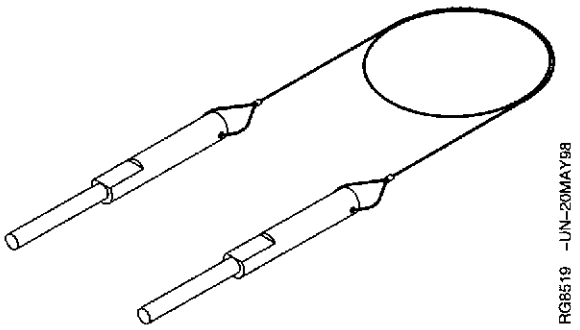
RG7056 –UN–05DEC97 RG7056

JDG820

DPSG,OUO1004,930 –19–20JUL99–2/16

Cam/Crankshaft Timing Lock Pins JDG971

Set of 2. Used to lock camshaft and crankshaft at "Top Dead Center" during timing gear backlash adjustment. Use on crankshaft only for valve clearance adjustments. Set consists of two 313796 Lock Pins.



RG6519 –UN–20MAY98

JDG971

Continued on next page

DPSG,OUO1004,930 –19–20JUL99–3/16

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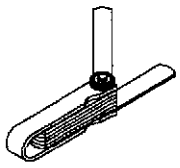
RG10382 –UN–05NOV99

Feeler Gauge Set JDG1333

Used to check intake and exhaust valve stem-to-bridge clearance.



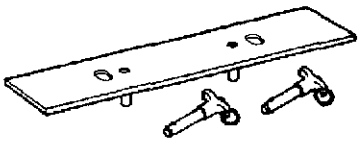
JDG1333

DPSG,OUO1004,930 –19–20JUL99–4/16

RG8502 –UN–20MAY98

Rocker Arm Assembly Lifting Fixture. JDG970A

Use to correctly position rocker arm assembly during removal and installation. Set consists of a holding plate and two 221808 Ball Locking Pins.



JDG970A

DPSG,OUO1004,930 –19–20JUL99–5/16

RG6246 –UN–05DEC97

Dial Indicator . . . (English, in.) D17526CI or (Metric, mm) D17527CI

Use with JDG451 to measure valve recess and cylinder liner height-to-cylinder block top deck.

RG6246

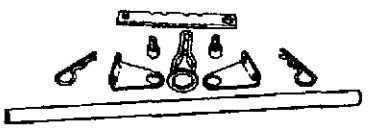
D17526CI/D17527CI

DPSG,OUO1004,930 –19–20JUL99–6/16

RG8506 –UN–20MAY98

Valve Spring Compressor JDG982

Use to compress exhaust and intake valve springs for removal and installation.



JDG982

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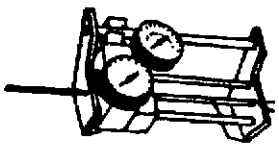
DPSG,OUO1004,930 –19–20JUL99–7/16

RG5061 –UN–05DEC97

Spring Compression Tester D01168AA

Test valve spring compression.



RG5061

D01168AA

DPSG,OUO1004,930 –19–20JUL99–8/16

RG5067 –UN–06APR89

Valve Guide Driver JDG1167

Use with JDG164 to install valve guides.

JDG1167

DPSG,OUO1004,930 –19–20JUL99–9/16

RG5065 –UN–05DEC97

Valve Seat Pilot Driver JDG164

Use with JDG1166 Adapter to install intake and exhaust valve seat inserts in cylinder head.

RG5065

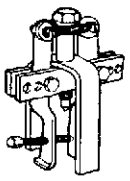
JDG164

DPSG,OUO1004,930 –19–20JUL99–10/16

RG5071 –UN–05DEC97

Valve Seat Puller JDE41296

Remove valve seat inserts.



RG5071

JDE41296

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DPSG,OUO1004,930 –19–20JUL99–11/16

RG5066 –UN–23AUG88

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4

Valve Seat Insert Installing Adapter. JDG1166

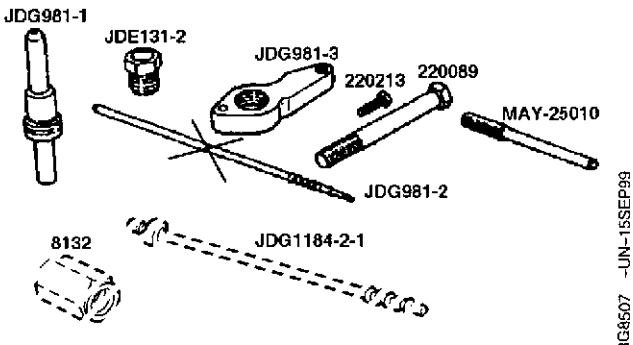
Use with JDG164 Pilot Driver to install intake and exhaust valve seat inserts.

JDG1166

DPSG,OUO1004,930 –19–20JUL99–12/16

Unit Injector Sleeve Installation Set. JDG981

Use to replace unit injector sleeve when cylinder head is removed from engine. Unit injector sleeve tip bore must be swagged to seal off coolant passages from cylinder bore. Set consists of: JDE131-2 Driver Nut, JDG981-1 Guide Sleeve, JDG981-2 Swedge, JDG981-3 Guide Sleeve Holding Bar, 220213 Hex Head Cap Screw (M8x1.25x40 mm), 220089 Hex Head Cap Screw (M16x2x150 mm), and MAY-25010 Punch. JDG981-2 Swedge is obsolete. Use JDG1184-2-1 Arbor and 8132 Adapter (with D01300AA Slide Hammer) from JDG1184 EUI Nozzle Sleeve Replacement Kit in it's place.



JDG981

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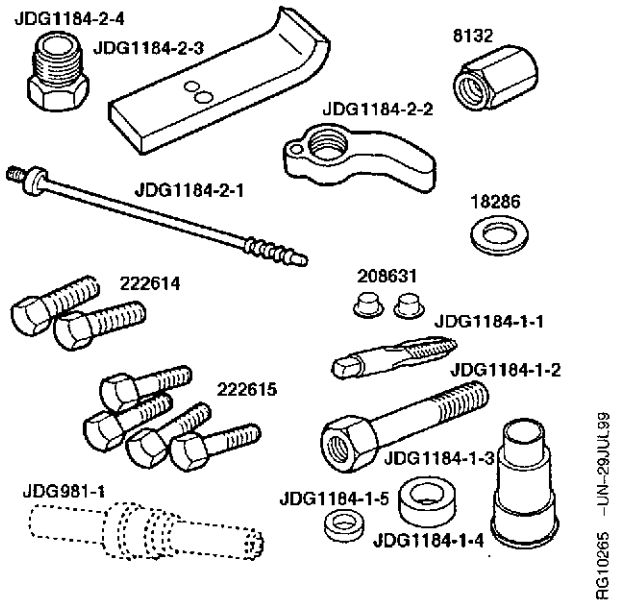
DPSG,OUO1004,930 –19–20JUL99–13/16

EUI Nozzle Sleeve Replacement Set. JDG1184

Used to install injector sleeves in cylinder head with head installed on engine or when removed. Set consists of JDG1184-1-1 Tap, JDG1184-1-2 Screw Adapter, JDG1184-1-3 Protector Sleeve, JDG1184-1-4 Spacer, JDG1184-1-5 Tap Guide, JDG1184-2-1 Swedge, JDG1184-2-2 Guide Sleeve Bracket, JDG1184-2-3 Bracket Clamp, JDG1184-2-4 Drive Nut, 222614 Flange Screw, 222615 Flange Screw, 208631 Plastic Cap, 18286 Washer and 8132 Female Metric Adapter. Set must be used with JDG981-1 Guide Sleeve which can be ordered separately.



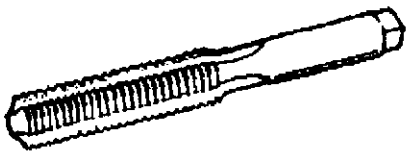
JDG1184

DPSG,OUO1004,930 –19–20JUL99–14/16

RG6508 –UN–20MAY98

Tap JDG978

Used to restore threaded holes in cylinder block for cylinder head cap screws.



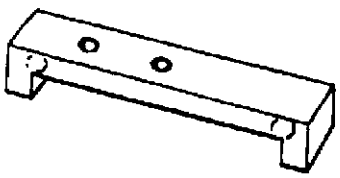
JDG978

DPSG,OUO1004,930 –19–20JUL99–15/16

RG7029 –UN–05DEC97

Height Gauge. . . JDG451 (English) or KJD10123 (Metric)

Used with D17526CI or D17527CI Dial Indicator to measure valve recess and cylinder liner height-to-cylinder block top deck.



JDG451

DPSG,OUO1004,930 –19–20JUL99–16/16

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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,OUO1004,931 -19-20JUL99-1/9

Valve Inspection Center

Check valves for out of round.

DPSG,OUO1004,931 -19-20JUL99-2/9

Plastic Brush

Clean valve guides.

DPSG,OUO1004,931 -19-20JUL99-3/9

Precision "Bevelled Edge" Straightedge D05012ST

Check cylinder head flatness.

DPSG,OUO1004,931 -19-20JUL99-4/9

End Brush D17024BR

Remove carbon on valve seats.

DPSG,OUO1004,931 -19-20JUL99-5/9

Heavy-Duty Seat Grinder Set. JT05893

Grind valve seats.

DPSG,OUO1004,931 -19-20JUL99-6/9

Eccentrimeter D11010KW

Measure valve seat runout.

Continued on next page

DPSG,OUO1004,931 -19-20JUL99-7/9

Slider Hammer D01300AA

Use with JDG1184-1-2 Adapter to remove EUI sleeve with cylinder head installed in engine.

DPSG,OUO1004,931 –19–20JUL99–8/9

Torque Angle Gauge JT05993

Tighten flanged-head cylinder head cap screws.

DPSG,OUO1004,931 –19–20JUL99–9/9

OTHER MATERIAL

Number	Name	Use
AR44402 (U.S.)	Valve Stem Lubricant	Lubricate valve stems.
TY24311 (U.S.) CXTY24311 (Canadian) 222 (LOCTITE®)	Thread Lock and Sealer (Low Strength)	Apply to EUI solenoid wire retaining nut.
T43514 (U.S.) TY9475 (Canadian) 277 (LOCTITE®)	Plastic Gasket	Apply to expansion plugs in cylinder head and block.

LOCTITE is a registered trademark of Loctite Corp.

DPSG,OUO1004,932 –19–20JUL99–1/1

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CYLINDER HEAD AND VALVES SPECIFICATIONS

Item	Measurement	Specification
Rocker Arm Cover Hold Down Cap Screws[1]	Torque	30 N•m (22 lb-ft)
Rocker Arm Cover Hold Down Cap Screws[1]	Torque	30 N•m (22 lb-ft)
Crankcase Vent Baffle-to-Rocker Arm Cover	Torque	Tighten Securely
Valve Stem-to-Bridge Clearance (Engine Cold)		
Intake Valve	Clearance	0.58 ±0.05 mm (0.023 ±0.002 in.)
Exhaust Valve	Clearance	1.08 ±0.05 mm (0.043 ±0.002 in.)
Electronic Unit Injector	Preload	0.00 mm (in.) clearance plus 1/2 turn in (180°)
Intake and Exhaust Valve Adjusting Screw Lock Nuts	Torque	50 N•m (37 lb-ft)
Electronic Unit Injector Adjusting Screw Lock Nuts	Torque	65 N•m (48 lb-ft)
Timing Pin Plug (Below Oil Cooler)	Torque	33 N•m (24 lb-ft)
Rocker Arm Bushing	ID	38.064 ±0.013 mm (1.4986 ±0.0005 in)
Rocker Arm Shaft	OD	38.000 ±0.013 mm (1.4961 ±0.0005 in)
Rocker Arm Shaft-to-Bushing	Oil Clearance	0.064 ±0.026 mm (0.0025 ±0.0010 in)
Rocker Arm Shaft Intake and Exhaust Roller	OD	39.995—40.045 mm (1.5746—1.5766 in)

[1]Tighten center cap screw first, then tighten sides.

Continued on next page

DPSG,OUO1004,934 –19–21JUL99–1/4

Item	Measurement	Specification
Rocker Arm Shaft Unit Injector Roller	OD	37.995—38.045 mm (1.4959—1.4978 in)
Intake and Exhaust Valves	Recess	1.85—2.35 mm (0.073—0.093 in.)
Intake and Exhaust Valve Springs (All)[2]	Height at 0 N (0 lb-force) Free Length	67.9—72.1 mm (2.67—2.84 in.)
Intake and Exhaust Valve Springs (R116585)	Height at 352—396 N (79—89 lb-force) (Valve Closed)	59.4 mm (2.34 in.)
Intake and Exhaust Valve Springs (R116585)	Height at 845—935 N (190-210 lb-force) (Valve Open)	45.5 mm (1.79 in.)
Intake and Exhaust Valve Springs (R133891)	Height at 527—593 N (118—133 lb-force) (Valve Closed)	59.4 mm (2.34 in.)
Intake and Exhaust Valve Springs (R133891)	Height at 1187—1313 N (267—295 lb-force) (Valve Open)	46.4 mm (1.83 in.)
Intake and Exhaust Valve Face[3]	Maximum Runout	0.038 mm (0.0015 in.)
Intake and Exhaust Valve Head	OD	46.35—46.61 mm (1.825—1.835 in.)
Intake and Exhaust Valve Face	Angle	29.25° ± 0.25°
Cylinder Head	Maximum Acceptable Out-of-Flat for Entire Length of Head	0.10 mm (0.004 in.)
	Maximum Acceptable Out-of-Flat for Every 305 mm (12.0 in.)	0.025 mm (0.0009 in.)
Cylinder Head (Rocker Arm Cover-to-Combustion Face)	New Part Thickness	124.975—125.025 mm (4.9203—4.9222 in.)
	Minimum Acceptable Thickness	124.840 mm (4.9150 in.)
Cylinder Head Combustion Face Surface Finish (Surface Mill Only) (AA)	Surface Finish	1.5–2.8 micrometers (60-110 micro-in.)

[2] Free length of springs may vary slightly between springs.

[3] Maximum runout measured at 44 mm (1.73 in.) diameter.

Continued on next page

Item	Measurement	Specification
Cylinder Head	Maximum Wave Height Maximum Wave Width	0.008 micrometers (0.0002 micro-in.) 2.0 micrometers (79 micro-in.)
Valve Guide	ID	9.076 ±0.013 mm (0.3573 ±0.0005 in.)
Valve Stem	OD	8.999 ±0.013 mm (0.3543 ±0.0005 in.)
Valve Stem-to-Guide	Clearance	0.051—0.103 mm (0.0020—0.0041 in.)
Valve Guide Bore in Head	ID	14.94 ±0.02 mm (0.5882 ±0.0008 in.)
Valve Guide	Installed Height	14.5—15.5 mm (0.57—0.61 in.)
Valve Seat Grinding	Contact Angle Width Maximum Runout	30° 1.50—2.00 mm (0.059—0.079 in.) 0.16 mm (0.006 in.)
Intake and Exhaust Valve Seat Bore	ID Bore Depth Radius at Lower Bore	49.424 ±0.013 mm (1.9458 ±0.0005 in.) 11.25 mm (0.443 in.) 0.64 ±0.25 mm (0.025 ±0.001 in.)
Standard Intake and Exhaust Valve Seat	OD	49.487—49.513 mm (1.9483—1.9493 in.)
Fuel Temperature Sensor	Torque	10 N•m (7.5 lb-ft)
Fuel Delivery and Return Lines	Torque	24 N•m (18 lb-ft)
Cylinder Liner	Height Above Block (Standout)	0.030—0.117 mm (0.0012—0.0046 in.)
Cylinder Liner	Max. Height Difference at Nearest Point of Two Adjacent Liners or Within One Liner	0.051 mm (0.0020 in.)
Cylinder Head		
Step 1 - Initial Torque No. 17 Cap Screw	Torque	100 N•m (74 lb-ft)

Continued on next page

Item	Measurement	Specification
Step 2 - Initial Torque All Cap Screws (Nos. 1—26)	Torque	163 N•m (120 lb-ft)
Step 3 - Wait 5 Minutes and Verify Torque (Nos. 1—26)	Torque	163 N•m (120 lb-ft)
Step 4 - Initial Torque-Turn All Cap Screws (Nos. 1—26)	Torque-Turn	90°
Step 5 - Final Torque-Turn All Cap Screws (Nos. 1—26)[4]	Additional Torque-Turn	90°
Rocker Arm Shaft Hold-Down Clamp Cap Screws (All Engines)	Initial Torque	30 N•m (22 lb-ft)
Rocker Arm Shaft Hold-Down Clamp Cap Screws (Dual Rail Systems)	Final TORQUE-TURN	60° ± 5°
Rocker Arm Shaft Hold-Down Clamp Cap Screws (Single Rail Systems)	Final TORQUE-TURN	90° + 10° - 0°
Unit Injector Wiring Harness Bracket-to-Rear of Head	Torque	25 N•m (18 lb-ft)
Unit Injector Wiring Harness Solenoid Wire Retaining Nut[5]	Torque	2.0 N•m (1.5 lb-ft)
Unit Injector Harness Clips-to-Rocker Arm Shaft Clamps	Torque	35 N•m (26 lb-ft)

[4]Total TORQUE-TURN for steps 4 and 5 is 180°.

[5]Apply LOCTITE 222 (TY24311) Small Screw Threadlocker.

DPSG,OUO1004,934 –19–21JUL99–4/4

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REMOVE AND INSTALL ROCKER ARM COVER

REMOVE ROCKER ARM COVER

1. Remove air intake cross-over tube (shown removed).

NOTE: Turbocharger is removed for photographic purposes only. It is not necessary to remove turbocharger for rocker arm cover removal.

2. Remove center hold-down cap screw with isolator.

3. Remove two outside cap screws with isolators (A), and thread cap screws into rocker arm cover as shown.

NOTE: Rocker arm cover gasket is reusable if no visible damage is detected. Do not store cover resting on gasket surface.

4. Lift rocker arm cover off engine.

INSTALL ROCKER ARM COVER

IMPORTANT: Always check routing of unit injector wiring (B) before installing rocker arm cover. Wiring should be positioned so that rocker arms never contact wire.

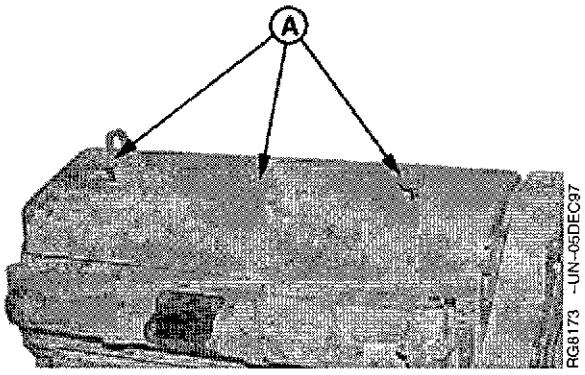
1. Inspect rocker arm cover gasket to ensure that gasket is properly seated in groove and that contact face is clean.

2. Position rocker arm cover onto two locating dowels in cylinder head.

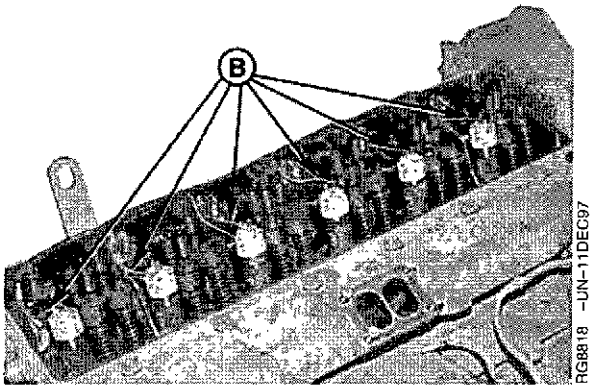
3. Install center hold down cap screw with isolator. Tighten to specifications.

Rocker Arm Cover Hold Down Cap Screws[1]—Specification

Torque ..... 30 N•m (22 lb-ft)



Isolators



Unit Injector Wiring

A—Isolators
B—Unit Injector Wiring

[1]*Tighten center cap screw first, then tighten sides.*

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RG,RG34710,60 –19–03NOV99–1/2

4. Install two outside hold down cap screws with isolators. Tighten to specifications.

Rocker Arm Cover Hold Down Cap Screws[1]—Specification

Torque ..... 30 N•m (22 lb-ft)

5. Install air intake cross-over tube and tighten connections securely.

[1]Tighten center cap screw first, then tighten sides.

RG,RG34710,60 –19–03NOV99–2/2

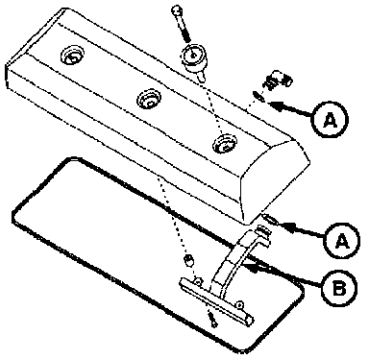
CLEAN AND INSPECT CRANKCASE VENTILATION ASSEMBLY

1. Remove ventilation outlet tube from rocker arm cover (shown removed).
2. Remove two cap screws securing ventilator assembly (B) to cover and remove.
3. Clean ventilator assembly in solvent and dry with compressed air.
4. Install ventilator assembly in reverse order of removal, replace O-rings (A) as necessary.
5. Tighten ventilator assembly-to-rocker arm cover cap screws securely.

Crankcase Vent Baffle-to-Rocker Arm Cover—Specification

Torque ..... Tighten Securely

6. Install ventilator outlet tube onto elbow attached to rocker arm cover.



RG10242 –UN–20JUL99

Crankcase Ventilation Assembly

A—O-Rings
B—Ventilator Assembly

RG,RG34710,61 –19–15JUL99–1/1

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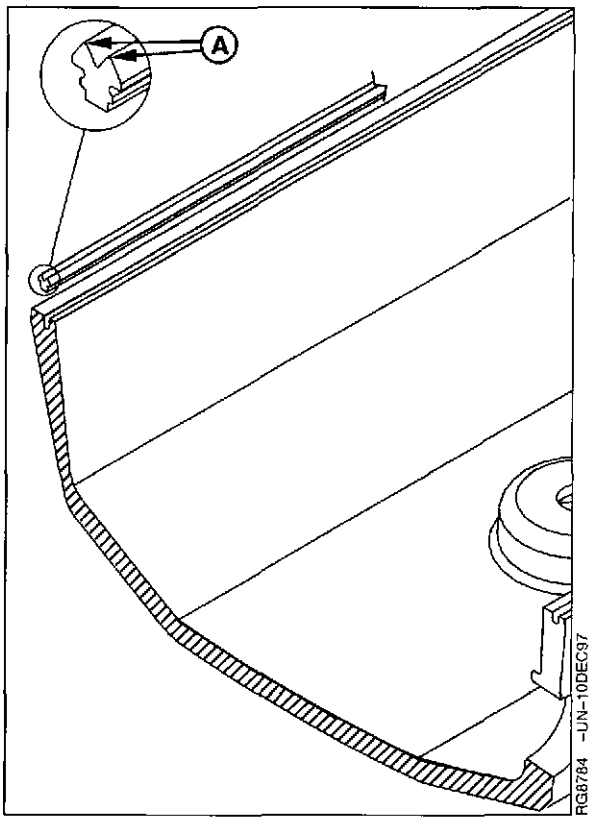
REPLACE ROCKER ARM COVER GASKET

1. Remove rocker arm cover. (See REMOVE AND INSTALL ROCKER ARM COVER earlier in this Group.)
2. Remove existing gasket from cover and discard. Clean gasket groove as needed.
3. Position new gasket at two front corners of cover with double lips (A) of gasket facing up.

IMPORTANT: DO NOT stretch gasket while seating in groove of cover.

4. Seat gasket on front side of cover and proceed around entire cover gasket groove using a deep-well socket.
5. Re-seat gasket again (especially in corners) after entire gasket is installed in groove.



Replacing Rocker Arm Cover Gasket

A—Gasket Double Lips

RG,RG34710,62 –19–30SEP97–1/1

CHECK AND ADJUST VALVE ASSEMBLY CLEARANCES AND INJECTOR PRELOAD

Rocker arm assembly adjustments consist of intake and exhaust valve clearance (lash) and electronic unit injector preload adjustment.

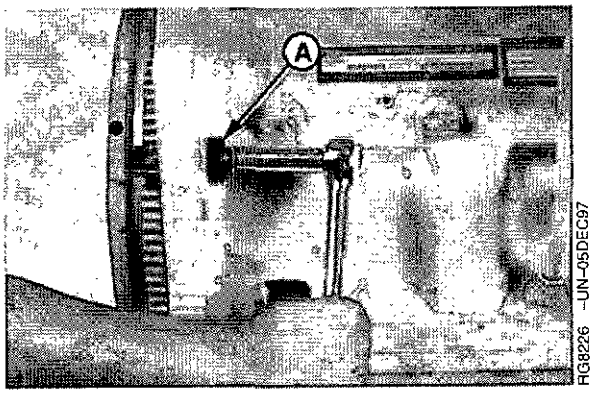
CAUTION: To prevent accidental starting of engine while performing rocker arm adjustment, ALWAYS disconnect NEGATIVE (-) battery terminal.

IMPORTANT: All rocker arm assembly adjustments MUST BE performed with engine COLD.

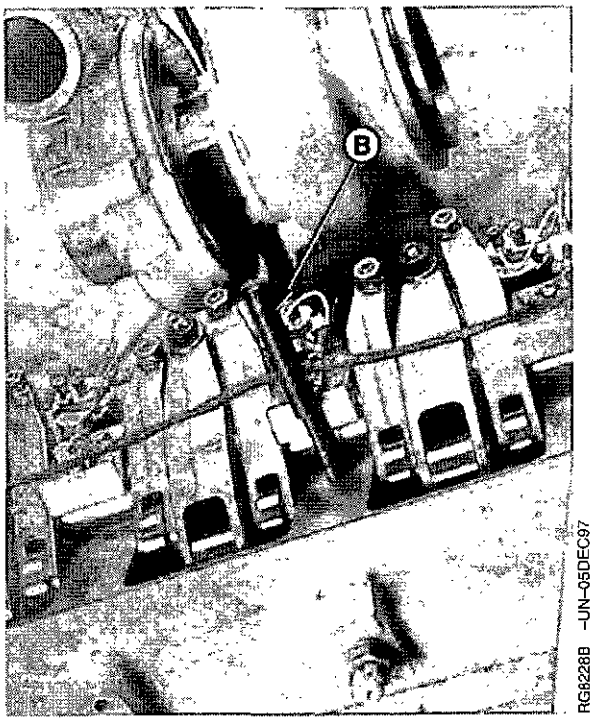
1. Remove rocker arm cover. (See REMOVE AND INSTALL ROCKER ARM COVER earlier in this group.)
2. Remove plug from cylinder block and install JDG820 Flywheel Turning Tool (A).
3. Remove threaded plug from timing hole below oil cooler and filter housing assembly.

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

4. Rotate engine flywheel in running direction (Counter-clockwise as viewed from rear) until JDG971 Timing Pin (B) engages slot in camshaft. This ensures that engine is locked at TDC of No. 1 cylinder's compression stoke. Intake and exhaust rocker arms on No. 1 cylinder should be loose.



Using JDG820 Engine Rotation Tool



JDG971 Timing Pin in Camshaft

A—JDG820 Flywheel Turning Tool
B—JDG971 Timing Pin

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RG,RG34710,63 –19–16JUL99–1/6

05
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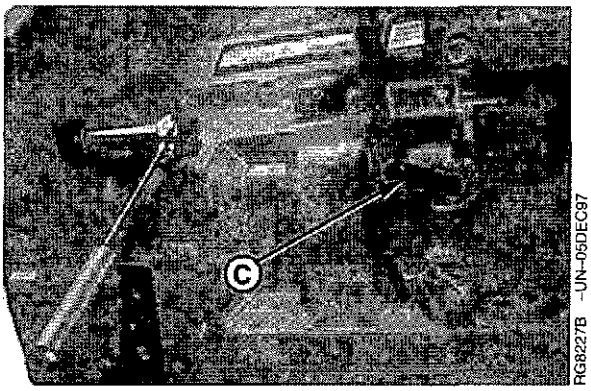
5. Slightly move engine flywheel back and forth with turning tool until a second JDG971 Timing Pin (C) can be installed in slot in crankshaft. This ensures that camshaft and crankshaft are in sync (properly timed).

   If timing pin does not enter crankshaft timing slot, crankshaft is not properly timed with camshaft, crankshaft MUST BE timed to camshaft (See CHECK AND ADJUST CAMSHAFT-TO-CRANKSHAFT TIMING in Group 16.)



JDG971 Timing Pin in Crankshaft

C—JDG971 Timing Pin

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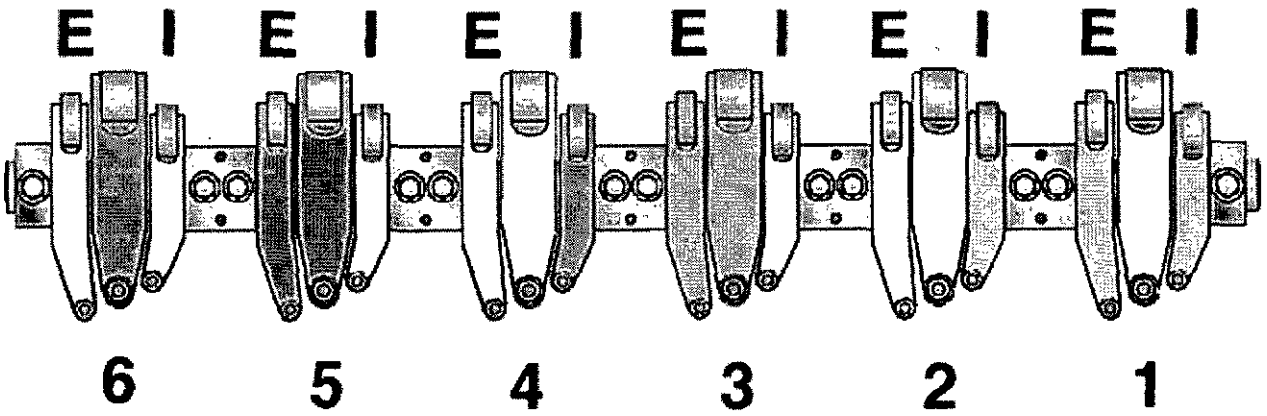
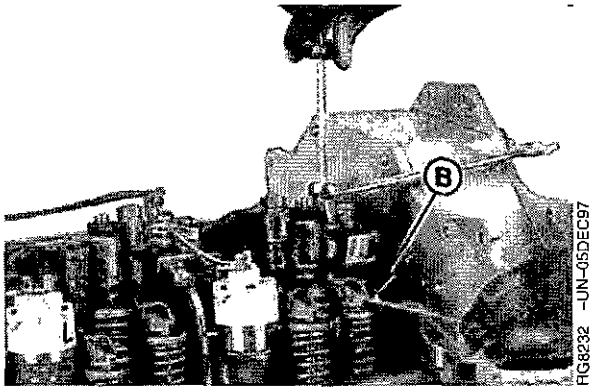


RG8773 –UN–19MAY98

Rocker Arm Assembly Identification

6. Check and adjust (as needed) valve stem-to-bridge clearance (lash) on intake valve Nos. 1, 2, and 4, and exhaust valve Nos. 1, 3, and 5 (shaded locations). Adjust preload on electronic unit injector Nos. 3, 5, and 6 (shaded locations).

   Valve clearance is adjusted using JDG1333 Feeler *Gauge Set or equivalent 1/4 inch (6.0 mm) wide* automotive ignition point-type feeler gauge installed at the joint between the valve bridge and valve stem tip (B) that is near the exhaust (right) side of engine. Loosen lock nuts, set clearance with adjusting screw and tighten lock nut to specified torque while holding adjusting screw stationary.



Adjusting Valve Lash/Clearance

B—Valve Stem Tip

Intake Valve—Specification

Clearance ..... 0.58 ±0.05 mm (0.023 ±0.002 in.)

Exhaust Valve—Specification

Clearance ..... 1.08 ±0.05 mm (0.043 ±0.002 in.)

7. Tighten intake and exhaust valve adjusting screw lock nuts to specifications.

Intake and Exhaust Valve Adjusting Screw Lock Nuts—Specification

Torque ..... 50 N•m (37 lb-ft)

Continued on next page

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8. The electronic unit injector preload is adjusted by turning the adjusting screw in until there is zero clearance between screw and the unit injector. Then turn the adjusting screw in an additional one half turn (180°). Hold adjusting screw stationary while tightening lock nut to specified torque. Tighten EUI adjusting screw lock nuts to specifications.

Electronic Unit Injector—Specification

Preload ..... 0.00 mm (in.) clearance plus 1/2 turn in (180°)

Electronic Unit Injector Adjusting Screw Lock Nuts—Specification

Torque ..... 65 N•m (48 lb-ft)

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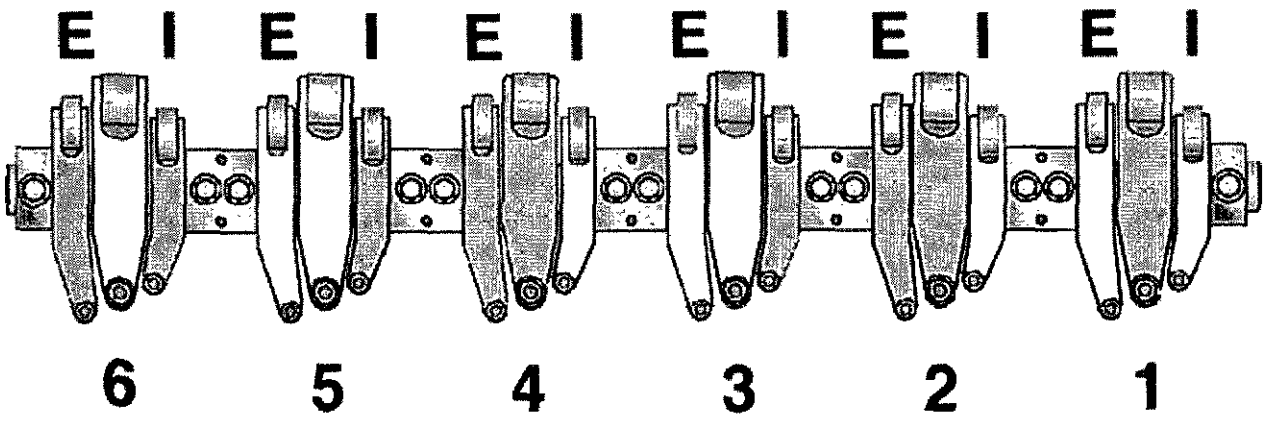


RG6774 -UN-19MAY98

Rocker Arm Assembly Identification

9. Reference mark flywheel (A) as shown with engine locked at No.1 TDC compression stroke.

IMPORTANT: DO NOT insert timing pin full depth into cylinder block when rotating engine flywheel until reference mark is within a *few degrees of a full crankshaft* revolution to eliminate possibility of crankshaft counterweight bending timing pin.

10. Remove both timing pins and rotate engine flywheel one full revolution (360°) until timing pin (B) enters slot in crankshaft again. Engine will now be locked at No. 6 TDC compression stroke.

11. Check and adjust as needed valve clearance (lash) on intake valve Nos. 3, 5, and 6 and exhaust valve Nos. 2, 4, and 6 (shaded locations). Adjust preload on injector Nos. 1, 2, and 4 (shaded locations).

12. Tighten intake and exhaust valve adjusting screw lock nuts to specifications.

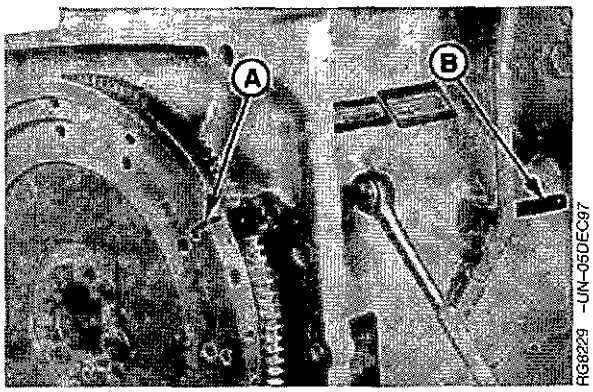
Intake and Exhaust Valve Adjusting Screw Lock Nuts—Specification

Torque ..... 50 N•m (37 lb-ft)

Tighten EUI adjusting screw lock nuts to specifications.

Electronic Unit Injector Adjusting Screw Lock Nuts—Specification

Torque ..... 65 N•m (48 lb-ft)



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Locking Engine at No.6 TDC

A—Flywheel Reference Mark
B—Timing Pin

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IMPORTANT: Thoroughly inspect ALL intake and exhaust valve bridges (A) for proper seating on valve stems (B) from both sides of engine. Also, be sure that push tubes (C) are properly seated in top of valve bridge.

Use a flashlight and carefully check each bridge (for proper seating on valve stems) from both sides of the engine, by lifting up on each bridge to verify proper seating. VALVE BRIDGES THAT ARE NOT PROPERLY SEATED ON VALVE STEMS WILL RESULT IN MAJOR ENGINE VALVE TRAIN FAILURE.

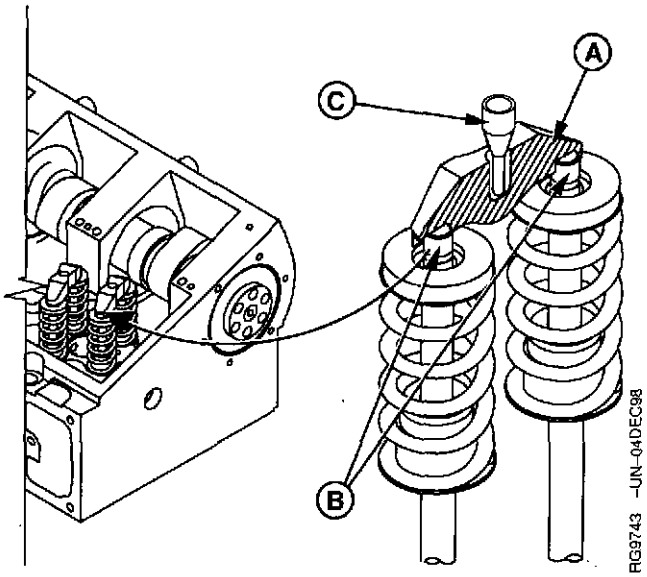
13. Check that all intake rocker arm adjusting screws (D) have approximately the same number of threads visible above lock nut. Normally flush to maximum of 2 threads.

    If the number of threads above lock nut at any location is visually different, verify bridge seating and readjust valve clearance to assure everything is within specification at this location.

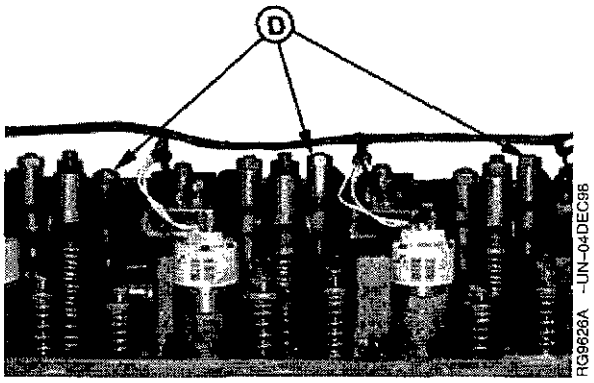
14. Install plug in timing pin hole below oil cooler and tighten to specifications.

Timing Pin Plug (Below Oil Cooler)—Specification

Torque ..... 33 N•m (24 lb-ft)



Inspect Valves



Adjusting Screws

A—Valve Bridges
B—Valve Stems
C—Push Tubes
D—Adjusting Screws

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REMOVE ROCKER ARM ASSEMBLY

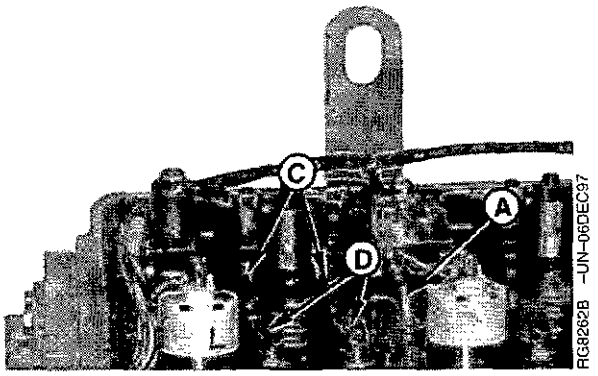
CAUTION: *After operating engine, allow exhaust* system to cool before servicing engine.

1. Remove rocker arm cover.
2. Lock camshaft and crankshaft at TDC of No.1 cylinder's compression stroke.
3. Remove electronic unit injector wiring harness from rocker arm shaft clamps.

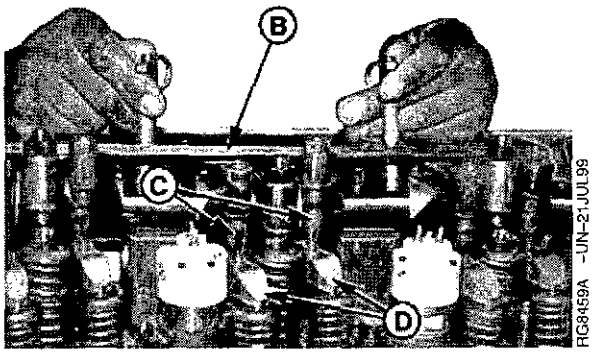
IMPORTANT: ALWAYS loosen all intake, exhaust and EUI rocker arm adjusting screws before removal or installation of rocker arm *assembly to relieve pressure.* This allows for a more uniform rocker arm cap screw clampload and reduces the possibility of damage to valve train components.

Remove push tubes and valve bridges *immediately after relieving rocker arm* pressure. Push tubes can fall into oil drain opening of cylinder head causing oil pan removal to retrieve tubes.

4. Loosen EUI, intake, and exhaust valve rocker arm adjusting screw lock nut and relieve pressure at all locations.
5. Remove push tubes (C) and valve bridges (D) from all valve stems.
6. Remove two rocker arm shaft oil tubes (A) (dual rail system only). Remove rocker arm shaft hold-down clamps.
7. Install shaft clamp cap screw in end hole of each rocker arm shaft so that rocker arms do not slide off shaft when lifted.
8. Depress actuator (ball) pins and install JDG970A Rocker Arm Holder (B) into rocker arm shaft cap screw holes as shown. Replace pins to seat ball locks.



Removing Valve Bridge and Push Tubes



Removing Rocker Arm Assembly with JDG970A

A—Rocker Arm Shaft Oil Tubes (Dual Rail Fuel System Only)
B—Rocker Arm Holder
C—Push Tubes
D—Valve Bridges

Continued on next page

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9. Remove both front and rear rocker arm and shaft assemblies using JDG970A Rocker Arm Holder.

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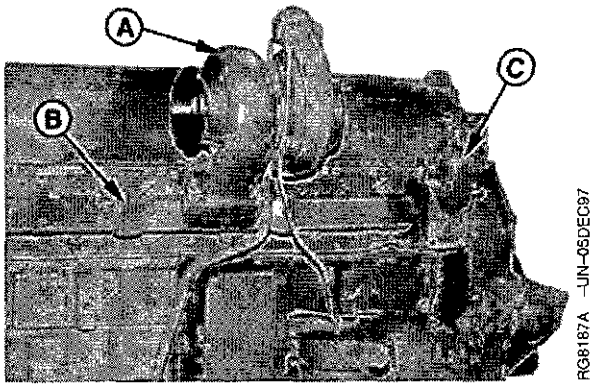
REMOVE CYLINDER HEAD

On some applications, it may be necessary to remove engine from machine to service cylinder head. Refer to your Machine Technical Manual for engine removal procedure.

CAUTION: After operating engine, allow exhaust system to cool before servicing engine.

DO NOT drain coolant until the coolant is below operating temperature. Only remove radiator filler cap when cool enough to touch with bare hands. Slowly loosen cap to first stop to relieve pressure before removing completely.

1. Drain all oil and coolant.
2. Remove intake manifold (6105H and 6125H engines). (See REMOVE, INSPECT AND INSTALL INTAKE MANIFOLD in Group 30.)
3. Remove turbocharger (A). (See REMOVE TURBOCHARGER in Group 30.)
4. Remove exhaust manifold (B). (See REMOVE, INSPECT AND INSTALL EXHAUST MANIFOLD in Group 30.)
5. On 6105A and 6125A engines, remove aftercooler assembly. (See REMOVE AND INSTALL AFTERCOOLER ASSEMBLY in Group 30.)
6. Remove thermostat housing/water manifold (C). (See REMOVE AND INSTALL THERMOSTAT HOUSING in Group 25.)
7. Remove rocker arm assembly. (See REMOVE ROCKER ARM ASSEMBLY, earlier in this group).
8. Remove electronic unit injectors and wiring harness on dual rail fuel systems. (See REMOVE AND INSTALL ELECTRONIC UNIT INJECTORS in Group 35.)



Removing Turbo and Exhaust Manifold

A—Turbocharger
B—Exhaust Manifold
C—Thermostat Housing/Water Manifold

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Remove electronic unit injectors and wiring harness on single rail fuel systems. (See REMOVE AND INSTALL ELECTRONIC UNIT INJECTORS in Group 36.)

9. Remove fan drive hub and camshaft gear access cover.

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10. Remove six cap screws securing camshaft gear retaining washer (A) and remove camshaft gear (B).

NOTE: Later engines with single rail fuel systems do not have a fuel manifold. Return fuel line is connected to port of single rail in back of cylinder head. Inlet line and port are on left side of head up by No.1 cylinder.

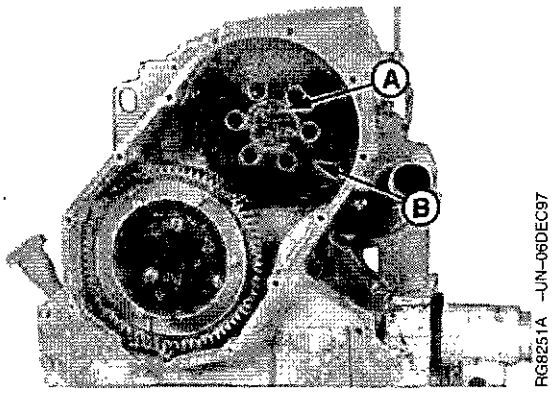
11. Remove fuel manifold block (C) on engines with dual rail systems, or disconnect fuel inlet and return lines on single rail systems. (See REMOVE AND INSTALL FUEL MANIFOLD in Group 35.) Remove fuel supply pump (D) on dual rail fuel systems. (See REMOVE AND INSTALL FUEL SUPPLY PUMP in Group 35.) Remove fuel supply pump (D) on single rail fuel systems. (See REMOVE AND INSTALL FUEL SUPPLY PUMP in Group 36.)

NOTE: Cylinder head can be removed without removing camshaft.

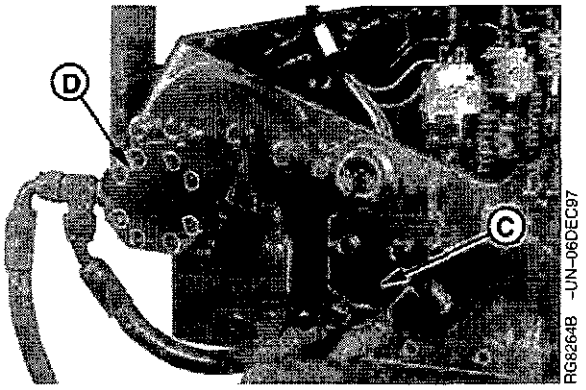
IMPORTANT: If cylinder head is removed with camshaft installed, secure camshaft in bushings with DFRG4[1] Camshaft Locking Tool (E) so that camshaft journals and bushings are not damaged by camshaft sliding out of bushings. (See DFRG4-CAMSHAFT LOCKING TOOL in Group 99 for details on this dealer fabricated tool.)

Camshaft position sensor MUST BE removed from air intake side of cylinder head when removing or installing camshaft to prevent camshaft binding on sensor.

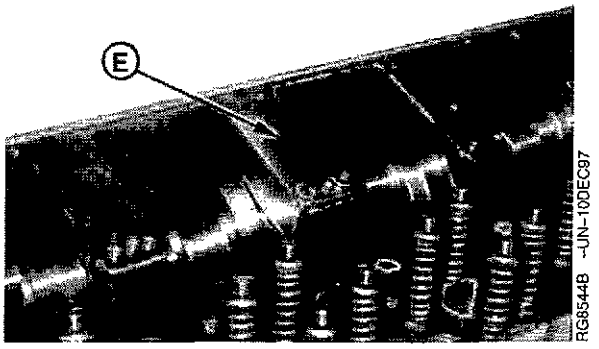
12. Remove camshaft front thrust ring. Remove camshaft position sensor and remove camshaft if desired (See REMOVE CAMSHAFT in Group 16).



Removing Camshaft Gear



Removing Supply Pump and Fuel Manifold



DFRG4 Camshaft Locking Tool

A—Gear Retaining Washer
B—Camshaft Gear
C—Fuel Manifold
D—Fuel Supply Pump
E—DFRG4 Camshaft Locking Tool

[1] *See Dealer Fabricated Tools, Group 99.*

Continued on next page

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NOTE: If removing head with camshaft installed, camshaft will have to be rotated to remove two of the cylinder head cap screws.

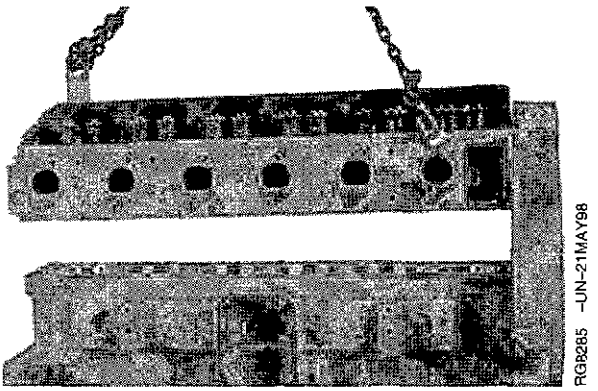
13. Remove 26 cylinder head cap screws with washers and discard.

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

14. Carefully lift cylinder head from block using an overhead hoist or floor crane. Place head on a clean, flat surface.

15. Remove cylinder head gasket. Inspect gasket for any manufacturing imperfections. Inspect head, gasket, and check for possible oil, coolant, or combustion chamber leakage.

NOTE: DO NOT rotate engine crankshaft with cylinder head removed unless all cylinder liners are secured with cap screws and large, flat washers. (See REMOVE PISTONS AND CONNECTING RODS in Group 10.)



Removing Cylinder Head

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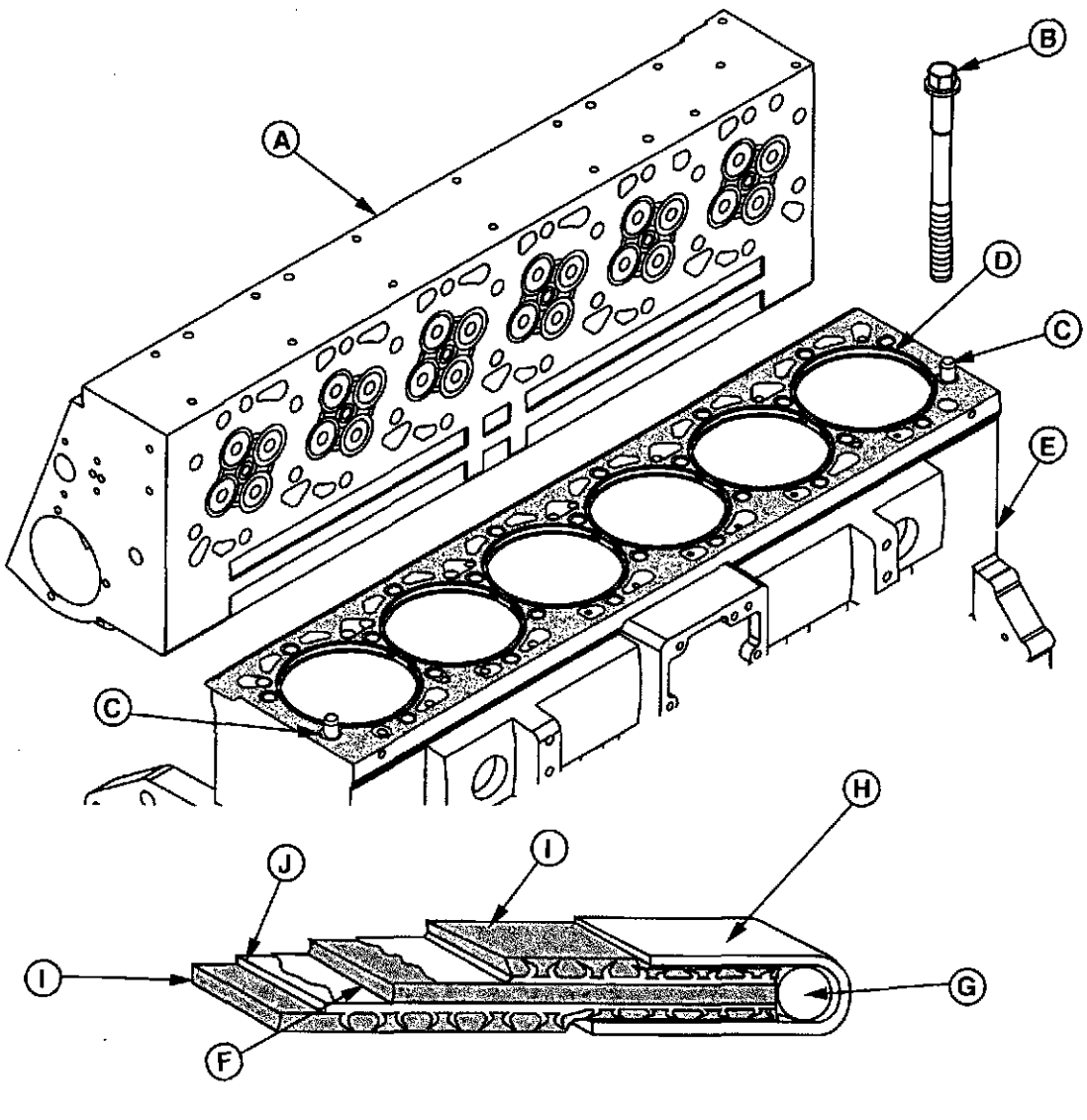
HEAD GASKET JOINT CONSTRUCTION AND OPERATION



Cylinder Head Gasket Construction

A—Cylinder Head
B—Cylinder Head Cap Screws
C—Dowel Pins
D—Cylinder Liners
E—Cylinder Block
F—Solid Steel Core
G—Fire Ring Combustion Seal
H—Stainless Steel Flange
I—Graphite Gasket Body
J—Perforated Steel Core

The head gasket joint consists of:

- Cylinder head gasket body (I)
- Cylinder head (A)
- Cylinder block (E)
- Cylinder liners (D)
- Cylinder head cap screws (B)

Continued on next page

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The head gasket must form an air-tight seal between cylinder liners and cylinder head that can withstand the temperatures and pressures of the combustion process. The gasket must also form a liquid-tight seal between the cylinder head and cylinder block to retain coolant and oil in their respective passages. The gasket is constructed of a solid steel core (F) covered by perforated steel core (J) and graphite body (I). The surface of gasket is treated to improve liquid sealing and anti-stick characteristics. A fire ring combustion seal (G) is located at each cylinder bore and is held in place by a U-shaped stainless steel flange (H).

The cylinder head and block must be flat to provide an even clamping pressure over the entire surface of gasket, and must have the proper surface finish to keep gasket material form moving in the joint. Dowel pins (C) are used to properly locate head gasket on block.

The cylinder liners must protrude evenly from top of cylinder block the specified amount to provide adequate clamping force on fire ring of each cylinder.

The cap screws must be proper length, made of proper material, and be tightened to proper torque in order to provide an adequate clamp load between other joint components.

Each of the above components contributes to the integrity of the head gasket joint. If any of these components do not conform to specification, gasket joint may fail resulting in combustion leaks, coolant leaks, or oil leaks.

Operating conditions such as coolant, oil, and combustion temperatures, and combustion pressures can reduce the ability of the head gasket joint to function properly. Failure of head gasket and mating parts may occur when coolant and oil temperatures become excessive, or when abnormally high combustion temperatures and pressure persist.

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DIAGNOSING HEAD GASKET JOINT FAILURES

Head gasket failures generally fall into three categories:

- Combustion seal leakage.
- Coolant seal leakage.
- Oil seal leakage.

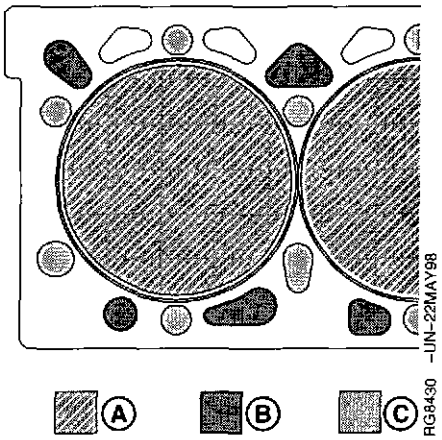
Combustion seal leakage failures occur when combustion gases escape between cylinder head and head gasket combustion flange, or between combustion flange and cylinder liner. Leaking combustion gases may vent to an adjacent cylinder, to a coolant or oil passage, or externally.

Coolant or oil seal failures occur when oil or coolant escapes between cylinder head and gasket body, or between cylinder block and gasket body. The oil or coolant may leak to an adjacent coolant or oil passage, or externally.

Follow these diagnostic procedures when a head gasket joint failure occurs, or is suspected:

1. Before starting or disassembling engine, conduct a visual inspection of machine, and note any of the following:

   - Oil or coolant in head gasket seam, or on adjacent surfaces, especially right rear corner of gasket joint.
   - Displacement of gasket from normal position.
   - Discoloration or soot from combustion gas leakage.
   - Leaking radiator, overflow tank, or hoses.
   - Leaking coolant from water pump weep hole.
   - Damaged or incorrect radiator, fan, or shroud.
   - Obstructed air flow or coolant flow.
   - Worn or slipping belts.
   - Damaged or incorrect pressure cap.
   - Presence of oil in coolant.
   - Low coolant levels or improper coolant.
   - Unusually high or low oil levels.
   - Oil degradation, dilution, or contamination.
   - Correctly specified electronic unit injectors.
   - Indications of fuel delivery or gear train not properly timed.



Cylinder Head Gasket Sealing Area

A—Combustion Sealing Areas
B—Coolant Sealing Areas
C—Cylinder Head Cap Screws

Continued on next page

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- Unburned fuel or coolant in exhaust system.

2. Obtain coolant and oil samples for further analysis.

3. Start and warm up engine if it can be safely operated. Examine all potential leakage areas again as outlined previously. Using appropriate test and measurement equipment, check for the following:

   - White smoke, excessive raw fuel, or moisture in exhaust system.
   - Rough, irregular exhaust sound, or misfiring.
   - Air bubbles, gas entrainment in radiator or overflow tank.
   - Loss of coolant from overflow.
   - Excessive cooling system pressure.
   - Coolant overheating.
   - Low coolant flow.
   - Loss of cab heating (air lock).

4. Shut engine down. Recheck crankcase, radiator, and overflow tank for any significant differences in fluid levels, viscosity, or appearance.

5. Compare your observations from above steps with the following diagnostic charts. If diagnostic evaluations and observations provide conclusive evidence of combustion gas, coolant, or oil leakage from head gasket joint, the cylinder head must be removed for inspection and repair of gasket joint components.

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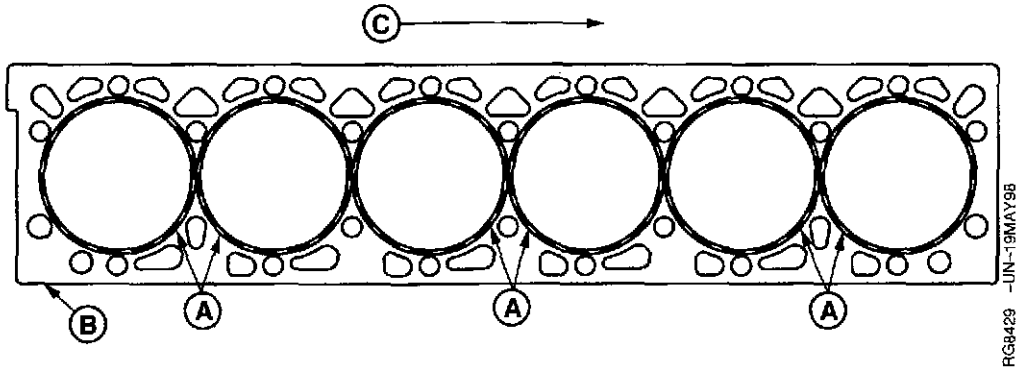
HEAD GASKET INSPECTION AND REPAIR SEQUENCE



Cylinder Head Gasket Inspection

A—Combustion Seals (Flanges) **B—Gasket Body** **C—Front of Engine**

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

1. Review historical data relating to machine operation, maintenance and repair, along with diagnostic observations. Note all areas requiring further inspection and analysis.

2. Remove rocker arm cover and check for presence of coolant in the oil.

3. Record head cap screw torques prior to removal. Upon removal, check cap screw length differences.

4. Remove cylinder head using appropriate lifting devices to prevent handling damage to head gasket. (See REMOVE CYLINDER HEAD in Group 05.)

5. Observe surfaces of removed head gasket.

   Examine combustion seals (A) for the following:

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

   Examine gasket body (B) for the following:

   - Combustion gas erosion paths or soot deposits originating at combustion seals.
   - Extreme discoloration/hardening/embrittlement in localized areas.
   - Oil or coolant paths from port areas.
   - Localized areas of low compression.

6. Before cleaning components, inspect head, block, and liners for evidence of combustion gas and fluid leakage. Inspect cylinders and valve ports for unusual deposits.

7. Clean cylinder block. (See INSPECT AND CLEAN CYLINDER BLOCK in Group 10.) Clean cylinder head. (See CLEAN AND INSPECT CYLINDER HEAD in Group 05.) Clean liners. (See CLEAN CYLINDER LINERS in Group 10.)

8. Proceed with the following dimensional checks and visual inspections:

   - Cylinder Head (Group 05)
     - Check surface flatness/finish.
     - Inspect for surface damage.
     - Check cylinder head thickness, if resurfacing.

Continued on next page

- Cylinder Block and Liners (assembled and clamped) (Group 10)
  - Check liner standout at four places on each liner.
  - Check liner standout difference between cylinders.

- Cylinder Block (Group 10)
  - Check surface flatness/finish.
  - Inspect for surface damage.
  - Check liner counterbore depth (if liner is removed).
  - Check top deck to crankshaft centerline dimension.
  - Inspect cap screw bosses, must be clean/intact.

- Cylinder Liner (Group 10)
  - Check liner flange flatness/finish.
  - Check liner flange thickness (if liner is removed).
  - Inspect flange for damage.

- Cylinder Head Cap Screws (Group 05)
  - Inspect condition of threads.
  - Check length.

9. When inspections and measurements have been completed, determine most probable causes of joint failure. Make all necessary repairs to joint components, cooling system, and fuel injection system.

10. Reassemble the engine according to procedures and specifications in the repair groups of this manual.

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DISASSEMBLE AND INSPECT ROCKER ARMS AND SHAFT ASSEMBLY

1. Remove rocker arms from shaft and identify for installation in same position as removed.
2. Inspect rocker arm shaft for scoring and excess wear at rocker arm contact points. Roll on a flat surface and check for bends or distortion.
3. Check rocker arm adjusting screws and lock nuts for thread damage.
4. Check valve bridges and push tubes for contact wear.
5. Clean all parts with clean solvent. Dry with compressed air.
6. Measure rocker arm shaft OD and rocker arm bushing ID Compare measurements with specifications below.
7. Inspect rocker arm roller for uneven wear. Measure roller OD and compare with specifications below.

Rocker Arm Bushing—Specification

ID ..... 38.064 ±0.013 mm (1.4986 ±0.0005 in)

Rocker Arm Shaft—Specification

OD ..... 38.000 ±0.013 mm (1.4961 ±0.0005 in)

Rocker Arm Shaft-to-Bushing—Specification

Oil Clearance ..... 0.064 ±0.026 mm (0.0025 ±0.0010 in)

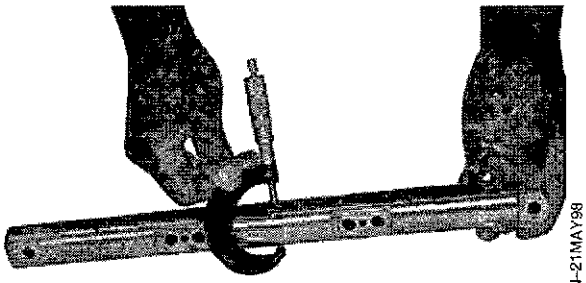
Rocker Arm Shaft Intake and Exhaust Roller—Specification

OD ..... 39.995—40.045 mm (1.5746—1.5766 in)

Rocker Arm Shaft Unit Injector Roller—Specification

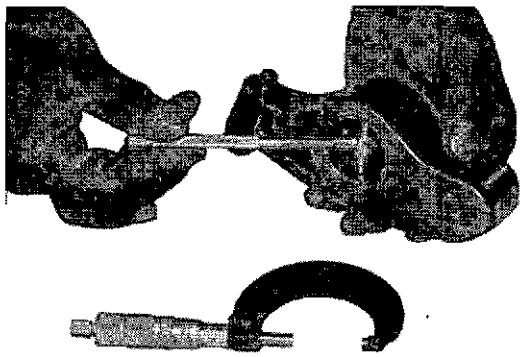
OD ..... 37.995—38.045 mm (1.4959—1.4978 in)

Replace parts as necessary.



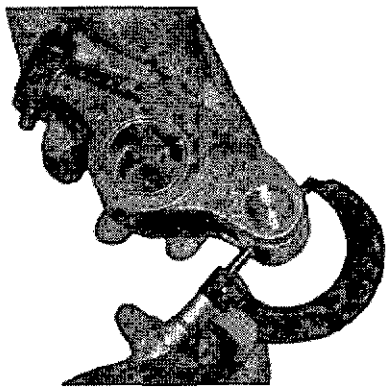
RG8395 –UN–21MAY98

Measure Rocker Arm Shaft



RG8392 –UN–21MAY98

Measure Rocker Arm Bushing



RG8390 –UN–21MAY98

Measure Rocker Arm Roller

RG,RG34710,71 –19–30SEP97–1/1

PRELIMINARY CYLINDER HEAD AND VALVE CHECKS

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

Look for the following conditions:

STICKING VALVES:

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

WARPED, WORN, OR DISTORTED VALVE GUIDES:

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

DISTORTED CYLINDER HEAD AND GASKET LEAKAGE:

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

WORN OR BROKEN VALVE SEATS:

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

BURNED, PITTED, WORN, OR BROKEN VALVES:

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

IMPROPER VALVE CLEARANCE:

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

EXCESSIVE VALVE RECESSION:

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

RG,RG34710,72 –19–30SEP97–1/1

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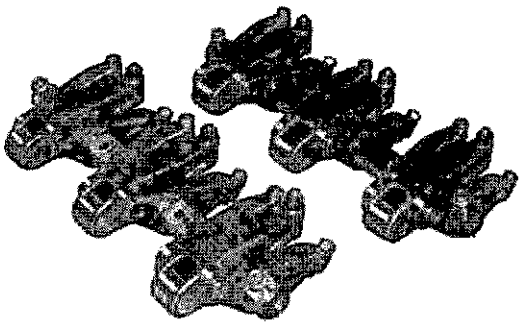
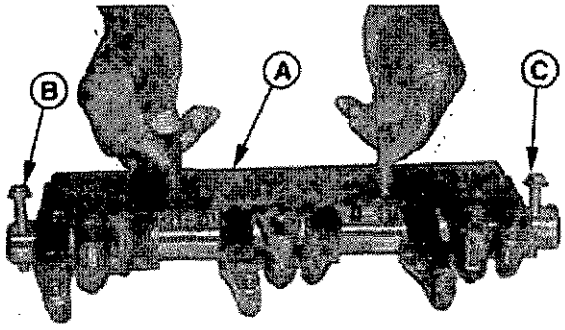
ASSEMBLE ROCKER ARMS AND SHAFT ASSEMBLY

1. Make sure that rocker arm shaft end plugs are firmly seated in each shaft end bore.
2. Assemble parts on rocker arm shaft in reverse sequence as removed.
3. Install cap screws (B) and (C) in holes at each end of rocker arm shaft to keep rocker arms from sliding off shaft during installation.
4. Install JDG970A Rocker Arm Holder (A) onto rocker arm and shaft assembly.



RG8460 –UN–21MAY98

Rocker Arm and Shaft Assembly



RG8304 –UN–06DEC97

Lifting Rocker Arm Assembly

A—Rocker Arm Holder
B—Cap Screw
C—Cap Screw

RG,RG34710,73 –19–13AUG99–1/1

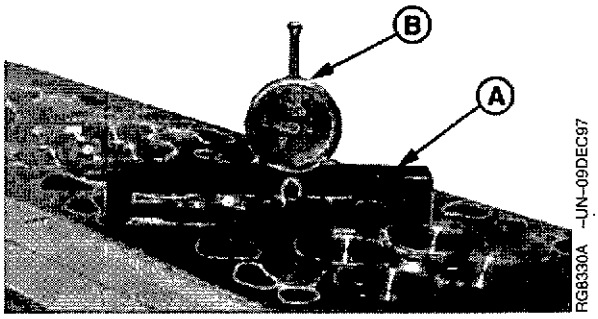
CHECK VALVE HEIGHT IN RELATION TO HEAD SURFACE (VALVE RECESS)

1. Thoroughly clean all gasket material from cylinder head combustion face.
2. Measure and record valve recess using JDG451 Height Gauge (A) along with D17526CI (English, in.) or D17527CI Dial Indicator (Metric) (B). Measurements must be made a maximum of 3.0 mm (0.12 in.) in from edge of valve head.

Intake and Exhaust Valves—Specification

Recess..... 1.85—2.35 mm (0.073—0.093 in.)

Install new valves, inserts, or grind existing valves and inserts (as necessary) to obtain specified valve recess.



Measure Valve Recess

A—Height Gauge
B—Dial Indicator

RG,RG34710,74 –19–03NOV99–1/1

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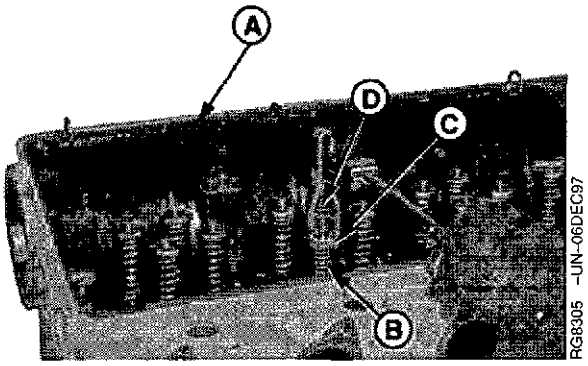
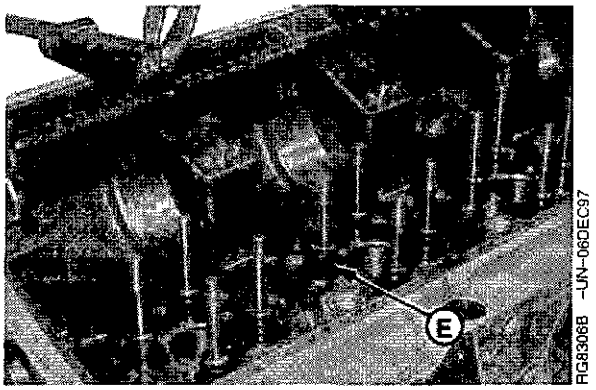
REMOVE VALVE ASSEMBLY

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

1. Place cylinder head on a clean flat surface with combustion face down.
2. Using JDG982 Valve Spring Compressor (A), compress valve spring far enough to remove retainer locks as shown.
3. Release spring tension, remove valve rotator (C) and valve spring (B).
4. Remove valve stem seals (E) from valve guide tower.
5. Lay cylinder head on air intake side using a 1016 mm (40 in.) long 51 mm (2.0 in.) by 102 mm (4.0 in.) block of wood.
6. Remove valves and identify for assembly in same location.



Removing Valve Springs



Removing Valve Stem Seals

A—JDG982 Valve Spring Compressor
B—Valve Springs
C—Valve Rotators
D—Valve Retainer Locks
E—Valve Stem Seals

RG,RG34710,75 –19–30SEP97–1/1

INSPECT AND MEASURE VALVE SPRINGS

IMPORTANT: Replacement valve springs (R133891) have higher working loads than older springs (R116585). Newer valve springs (R133891), have two green paint stripes for identification. Valve springs must be replaced in sets of two with new rotators. DO NOT intermix springs across valve bridges.

1. Inspect valve springs for alignment, wear, and damage.
2. Using D01168AA Spring Compression Tester, check valve spring tension. Compressed height must be within specification given below.

Intake and Exhaust Valve Springs (All)[1]—Specification

Height at 0 N (0 lb-force) Free Length ..... 67.9—72.1 mm (2.67—2.84 in.)

Intake and Exhaust Valve Springs (R116585)—Specification

Height at 352—396 N (79—89 lb-force) (Valve Closed) ..... 59.4 mm (2.34 in.)

Intake and Exhaust Valve Springs (R116585)—Specification

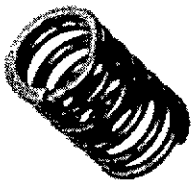
Height at 845—935 N (190-210 lb-force) (Valve Open) ..... 45.5 mm (1.79 in.)

Intake and Exhaust Valve Springs (R133891)—Specification

Height at 527—593 N (118—133 lb-force) (Valve Closed) ..... 59.4 mm (2.34 in.)

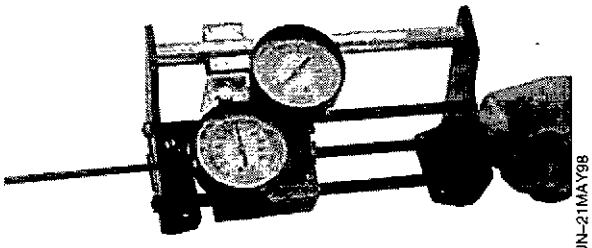
Intake and Exhaust Valve Springs (R133891)—Specification

Height at 1187—1313 N (267—295 lb-force) (Valve Open) ..... 46.4 mm (1.83 in.)



RG2732 –UN–04DEC97

Valve Spring



RG7427 –UN–21MAY98

Measuring Valve Spring Compression

[1] *Free length of springs may vary slightly between springs.*

RG,RG34710,76 –19–13AUG99–1/1

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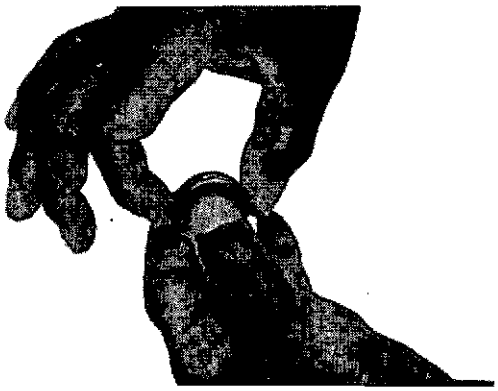
INSPECT VALVE ROTATORS

Valve rotators cannot be repaired. Replace valve rotators when valves are replaced or reground.

Ensure that valve rotators turn freely in both directions. Replace if defective.



Inspecting Valve Rotator

RG,RG34710,77 –19–30SEP97–1/1

CLEAN, INSPECT, AND MEASURE VALVES

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

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

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

3. Inspect valve face, stem, tip, and retainer lock groove.

4. Measure valve stem OD Record measurements and compare with valve guide ID (See MEASURE VALVE GUIDE ID, later in this group.)

Intake and Exhaust Valve Stems—Specification

OD	8.999 ±0.013 mm (0.3543 ±0.0005 in)

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

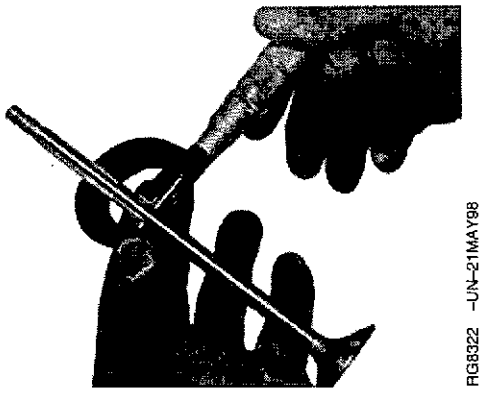
Intake and Exhaust Valve Face[1]—Specification

Maximum Runout	0.038 mm (0.0015 in.)

6. Measure valve head OD

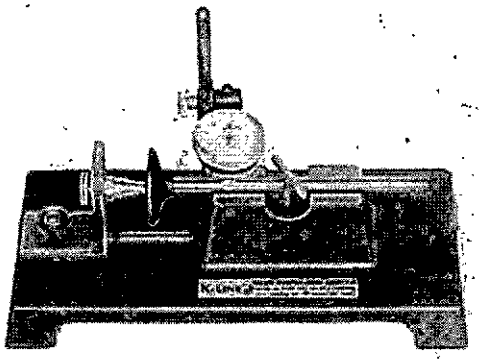
Intake and Exhaust Valve Head—Specification

OD	46.35—46.61 mm (1.825—1.835 in.)



RG8322 –UN–21MAY98

Measuring Valve Stem



RG4234 –UN–05DEC97

Measuring Valve Face Runout

[1]Maximum runout measured at 44 mm (1.73 in.) diameter.

RG,RG34710,78 –19–13AUG99–1/1

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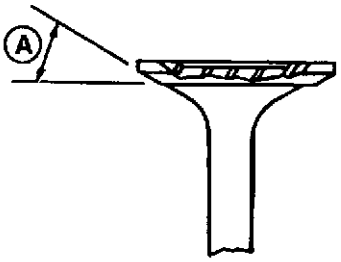
GRIND VALVES

Reface serviceable valves to specified angle (A). Face angle on intake and exhaust valves is as follows:

Intake and Exhaust Valve Face—Specification

Angle ..... 29.25° ± 0.25°

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



RG4755 –UN–31OCT97

Valve Face Angle

A—Valve Face Angle

RG,RG34710,79 –19–30SEP97–1/1

CLEAN AND INSPECT CYLINDER HEAD

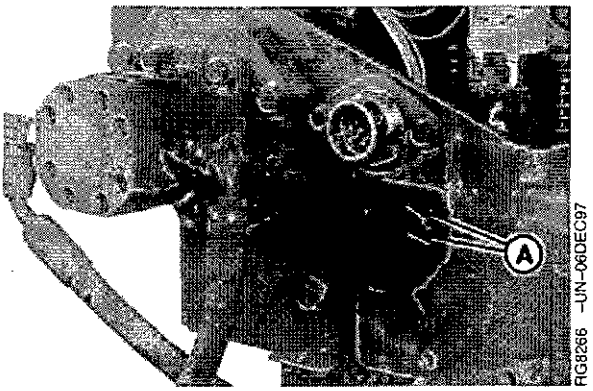
IMPORTANT: DO NOT USE scouring pads or wire brush to clean gasket sealing surface (combustion face). Doing so may affect sealing ability of gasket joint.

DO NOT "hot tank" clean cylinder head unless all plugs and valve guides are removed for replacement. Hot tank solution will destroy lubricating properties of valve guides.

1. Inspect combustion face for evidence of physical damage, oil or coolant leakage, or gasket failure prior to cleaning the cylinder head. Repair or replace cylinder head if there is evidence of physical damage; such as cracking, abrasion, distortion, or valve seat "torching." Inspect all cylinder head passages for restrictions.
2. Inspect around injector sleeve for evidence of fuel or coolant leakage.
3. Scrape gasket material, oil, carbon, and rust from head. Use a powered brass or copper (soft) wire brush to clean sealing surfaces. DO NOT use a steel wire brush.
4. Clean valve guides using a plastic brush.

IMPORTANT: During engine repair or overhaul, cleanliness of fuel supply rail (s) (A) is extremely important due to fuel flow through passages. Think of the fuel rails as internal passages of an injection pump, therefore, same cleanliness must be maintained.

5. Remove fuel rail expansion plug in front of cylinder head and thoroughly clean fuel rail passage using a rifle-type cleaner. All debris must be removed from fuel rail.
6. Dry with compressed air and blow out all passages.



Fuel Rail

A—Supply Rails (Dual Rail System Shown)

Continued on next page

7. Final dry-fuel rail passages with clean lint-free cloth and rifle cleaner.

8. Coat new expansion plug with LOCTITE® 277 Plastic Gasket and install in front face of head.

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RG,RG34710,80 –19–13AUG99–2/2

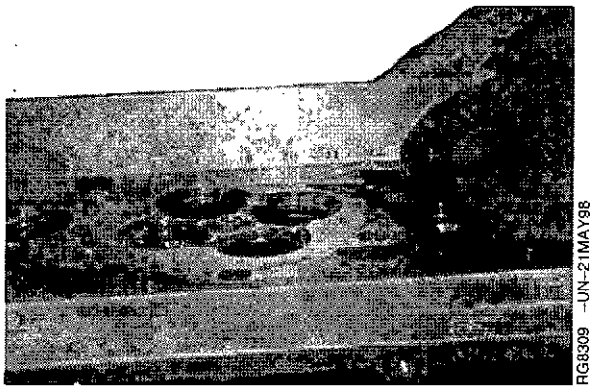
CHECK CYLINDER HEAD FLATNESS

Check cylinder head flatness using D05012ST Precision Straightedge and feeler gauge. Check lengthwise, crosswise, and diagonally in several places.

Cylinder Head—Specification

Maximum Acceptable Out-of-Flat for Entire Length of Head	0.10 mm (0.004 in.)
Maximum Acceptable Out-of-Flat for Every 305 mm (12.0 in.)	0.025 mm (0.0009 in.)

If out-of-flat exceeds specifications, the cylinder head must be resurfaced or replaced. (See MEASURE CYLINDER HEAD THICKNESS later in this group.)



Measuring Cylinder Head Flatness

RG,RG34710,81 –19–30SEP97–1/1

MEASURE CYLINDER HEAD THICKNESS

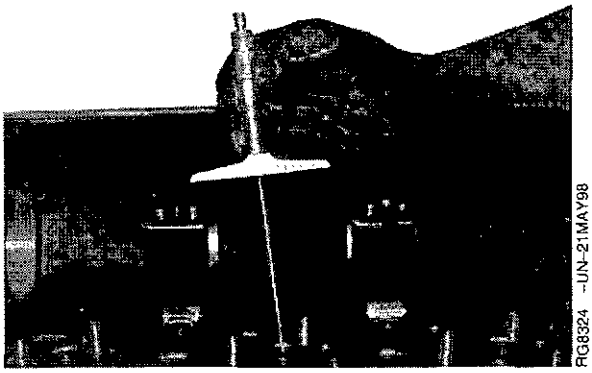
Measure cylinder head thickness from rocker cavity-to-combustion face.

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

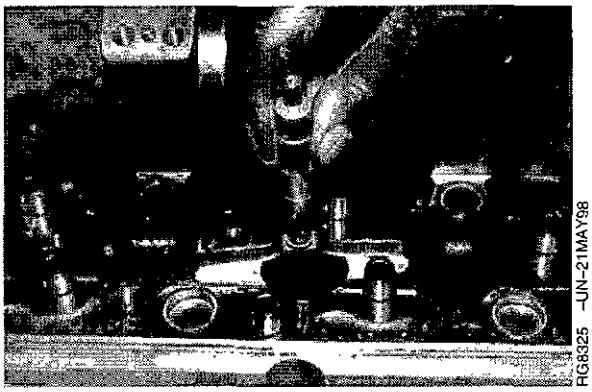
If cylinder head thickness is greater than wear limit, a MAXIMUM of 0.15 mm (0.006 in.) can be ground from new part dimension for a minimum overall thickness. (See RESURFACE CYLINDER HEAD COMBUSTION FACE, later in this group.)

Cylinder Head (Rocker Arm Cover-to-Combustion Face)—Specification

New Part Thickness	124.975—125.025 mm (4.9203—4.9222 in.)
Minimum Acceptable Thickness	124.840 mm (4.9150 in.)



Using Depth Gauge



Measuring Cylinder Head Thickness

RG,RG34710,82 –19–30SEP97–1/1

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RESURFACE CYLINDER HEAD COMBUSTION FACE

IMPORTANT: DO NOT grind cylinder head combustion face or block top deck. Surface mill only.

After surface milling, check flatness (see CHECK CYLINDER HEAD COMBUSTION FACE FLATNESS in this group). Check surface finish on combustion face of head.

Measure valve height (recess) after grinding. (See CHECK VALVE HEIGHT earlier in this group.) Valve seat or valve face may be ground to bring within specifications.

NOTE: If necessary to resurface cylinder head, a MAXIMUM of 0.15 mm (0.006 in.) can be milled from minimum new part dimension. Remove ONLY what is necessary to restore flatness.

Cylinder Head (Rocker Arm Cavity-to-Combustion Face)—Specification

Minimum Overall Thickness	124.840 mm (4.9150 in.)

Cylinder Head Combustion Face Surface Finish (Surface Mill Only) (AA)—Specification

Surface Finish	1.5–2.8 micrometers (60-110 micro-in.)

Cylinder Head—Specification

Maximum Wave Height	0.008 micrometers (0.0002 micro-in.)
Maximum Wave Width	2.0 micrometers (79 micro-in.)

RG,RG34710,83 –19–30SEP97–1/1

MEASURE VALVE GUIDE ID

1. Measure valve guides ID using a telescopic gauge.
2. Record measurements and compare readings with valve stem OD to determine stem-to-guide clearance.

Valve Guide—Specification

ID ..... 9.076 ±0.013 mm (0.3573 ±0.0005 in.)

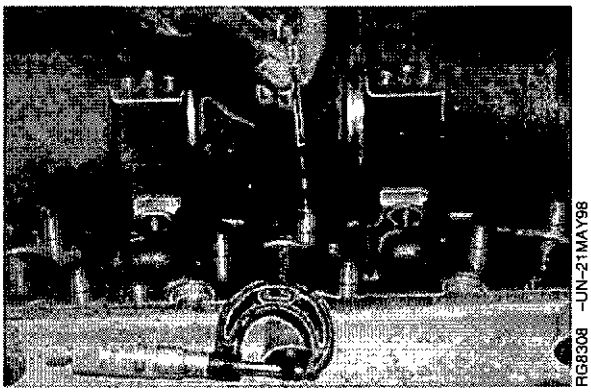
Valve Stem—Specification

OD ..... 8.999 ±0.013 mm (0.3543 ±0.0005 in.)

Valve Stem-to-Guide—Specification

Clearance ..... 0.051—0.103 mm (0.0020—0.0041 in.)

Replacement valve guides are available if valve guide ID is not within specification for specified guide-to-stem clearance (See REPLACE VALVE GUIDES, later in this group).



Measuring Valve Guide ID

RG,RG34710,84 –19–30SEP97–1/1

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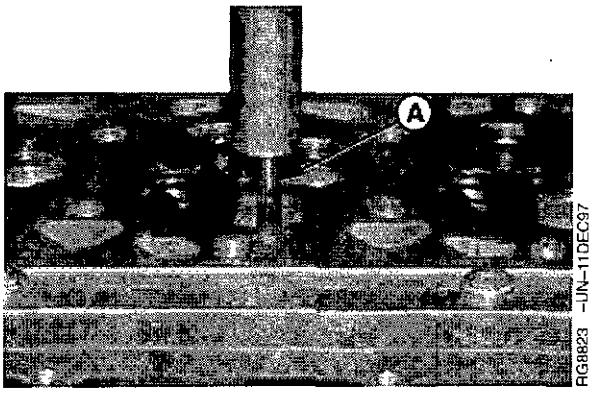
REPLACE VALVE GUIDES

REMOVE VALVE GUIDES

1. Position cylinder head with combustion face facing up.
2. Drive valve guides from combustion face side of cylinder head using JDG164 Driver (A) and a press.
3. Inspect valve guide bore for cracking or excessive metal transfer. Thoroughly clean valve guide bore.
4. Measure valve guide bore in cylinder head. Replace cylinder head if valve guide bore is not within specification.

Valve Guide Bore In Head—Specification

ID ..... 14.94 ±0.02 mm (0.5882 ±0.0008 in.)



Removing Valve Guide with JDG164

A—JDG164 Driver

RG,RG34710,85 –19–30SEP97–1/2

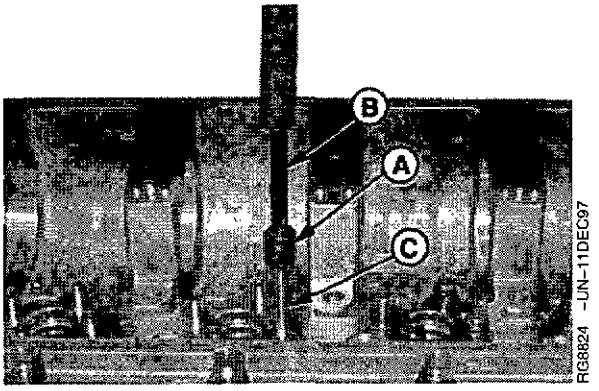
INSTALL VALVE GUIDES

1. Assemble JDG1167 Valve Guide Installation Adapter (A) and JDG164 Driver (B) onto replacement valve guide (C).
2. Position cylinder head resting on combustion face.
3. Position valve guide over bore in cylinder head and press guide in head until adapter bottoms on machined surface.
4. Measure valve guide installed height. Installed height should be as follows:

Valve Guide—Specification

Installed Height ..... 14.5—15.5 mm (0.57—0.61 in.)

5. Insert a valve stem through valve guide to check for adequate clearance. Valve stem should move freely in valve guide.



Installing Valve Guide

A—Valve Guide Installation Adapter
B—JDG164 Driver
C—Replacement Valve Guide

RG,RG34710,85 –19–30SEP97–2/2

CLEAN AND INSPECT VALVE SEATS

1. Use an electric hand drill with copper or brass (soft) wire brush to remove all carbon on valve seats.
2. Inspect seats for excessive wear, cracks, or damage.
3. Check entire combustion face for rust, scoring, pitting, or cracks.

RG,RG34710,86 –19–30SEP97–1/1

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GRIND VALVE SEATS

IMPORTANT: Valve seat grinding should only be done by experienced personnel familiar with equipment and capable of maintaining required specifications. ALWAYS keep valve guides and work area clean when grinding valve seats to maintain valve guide bore-to-seat runout.

Grinding valve seats increases seat width and valve recess in cylinder head. DO NOT grind excessively. Only a few seconds are required to recondition the average valve seat. Dress grinding stone as necessary to maintain specified seat angle.

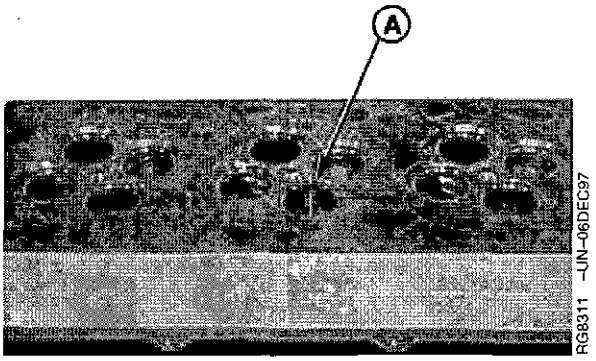
Support the weight of grinder to avoid excessive pressure on the stone.

Blend or radius all sharp edges 0.50 mm (0.02 in.) maximum corner break to eliminate burrs after grinding valve seats.

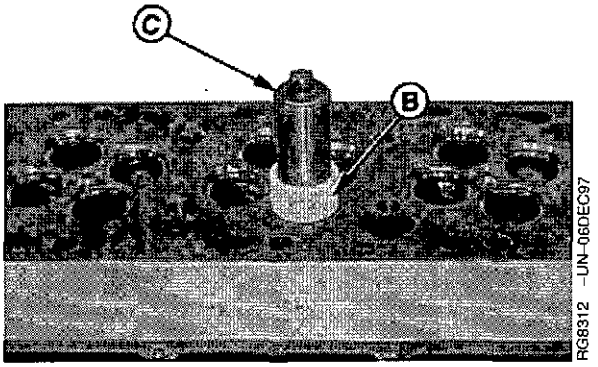
1. Install appropriate pilot (A) in valve guide bore.
2. Install appropriate grinding stone (B) on arbor (C) and position onto valve seat and pilot.
3. Using drill from JT05893 Heavy Duty Seat Grinder Set, grind valve seats to the following specifications:

Valve Seat Grinding—Specification

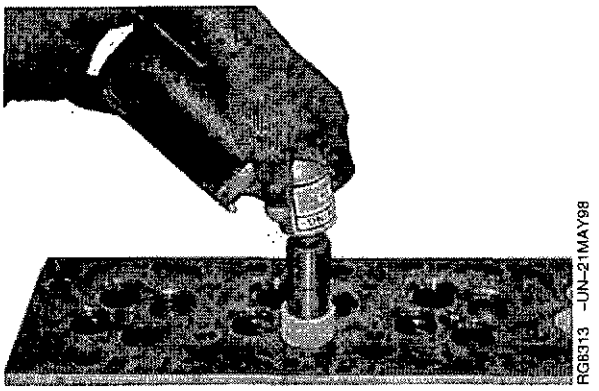
Contact Angle	30°
Width	1.50—2.00 mm (0.059—0.079 in.)
Maximum Runout	0.16 mm (0.006 in.)



Valve Seat Grinding Pilot



Valve Seat Arbor and Grinding Stone



Grinding Valve Seat

A—Pilot
B—Grinding Stone
C—Arbor

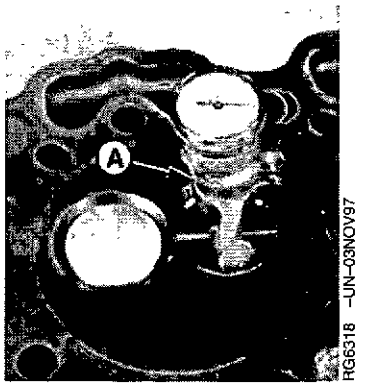
Continued on next page

4. Use a vernier caliper or scale to measure seat width. If valve seat is too wide, reduce the width with a narrowing stone.

NOTE: A narrowing stone will change the top angle of the seat and reduce the outer diameter of the valve seating area. Varying the width changes the fine contact between valve face and seat. If seat width is too narrow, valve may burn or erode.

5. If valve does not seat properly, use an eccentrimeter (A) to check valve seat runout. Use a new or refaced valve and blueing to check contact between valve seat and face. If necessary, lap the valve onto its seat using a lapping tool and lapping compound. Replace valves and inserts as necessary.

6. Install new or refaced valve and check valve recess in cylinder head after grinding. (See CHECK VALVE RECESS IN CYLINDER HEAD earlier in this group.)



Measuring Valve Seat Runout

A—D11010KW Eccentrimeter

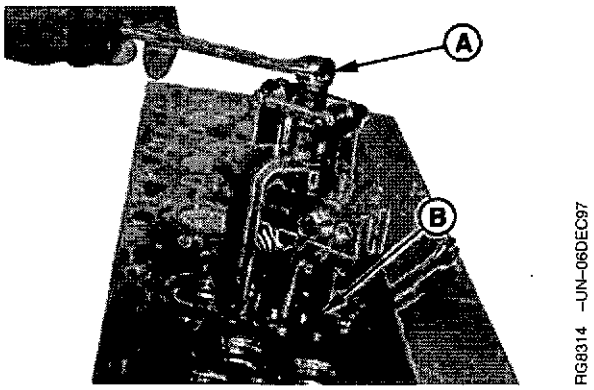
RG,RG34710,87 –19–30SEP97–2/2

REMOVE VALVE SEAT INSERTS

IMPORTANT: Be careful not to damage cylinder head when removing valve seats.

Use JDE41296 Valve Seat Puller (A). Adjusting screw (B) may need to be retightened during removal of inserts.

After removal of inserts, thoroughly clean area around valve seat bore and inspect for damage or cracks. Measure bore ID (See MEASURE VALVE SEAT BORES IN CYLINDER HEAD in this group.)



Removing Valve Seat Insert

A—Valve Seat Puller
B—Adjusting Screw

RG,RG34710,88 –19–30SEP97–1/1

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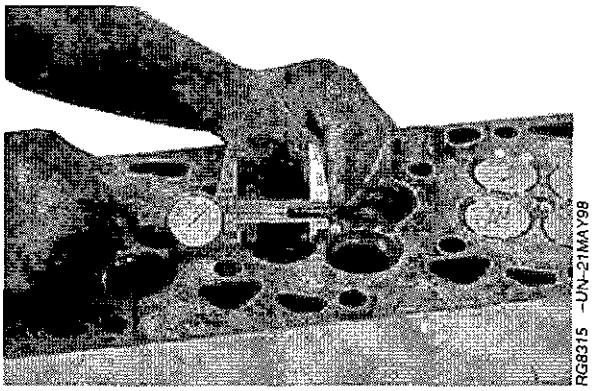
MEASURE VALVE SEAT BORE IN CYLINDER HEAD

1. *Measure valve seat bores in cylinder head and* compare with specifications given below.

Intake and Exhaust Valve Seat Bore—Specification

ID	49.424 ±0.013 mm (1.9458 ±0.0005 in.)
Bore Depth	11.25 mm (0.443 in.)
Radius at Lower Bore	0.64 ±0.25 mm (0.025 ±0.001 in.)



Measuring Valve Seat Bore

Standard Intake and Exhaust Valve Seat—Specification

OD	49.487—49.513 mm (1.9483—1.9493 in.)

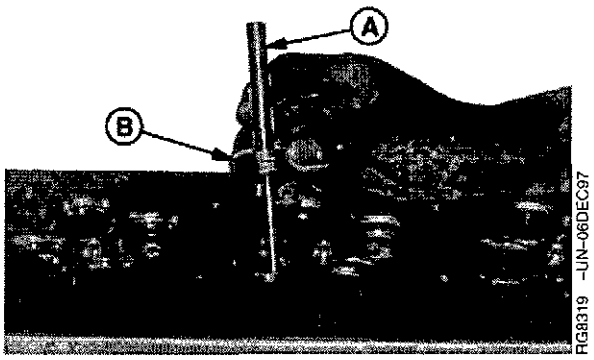
2. If valve seat bores are not within specification, oversize seat inserts are available. Have a qualified machine shop bore the valve seat to specification for installation of oversize valve seat inserts. (See INSTALL VALVE SEAT INSERTS, later in this group.)

RG,RG34710,89 –19–13AUG99–1/1

INSTALL VALVE SEAT INSERTS

1. Use JDG164 Pilot Driver (A) and JDG1166 Valve Seat Insert Installing Adapter (B) to install valve seat inserts in cylinder head.
2. Install valves and measure valve recess. (See MEASURE VALVE RECESS IN CYLINDER HEAD, earlier in this group.)
3. Grind valve seats as required to maintain correct valve recess and valve face-to-seat seal. (See GRIND VALVE SEATS earlier in this group.)

IMPORTANT: A common practice is to chill valve seat inserts in a freezer before installing. This chilling process allows for less interference when pressing in valve seats. Once inserts heat up to room temperature, original press-fit is restored.



Valve Seat Insert Driver

Installing Valve Seat Insert

A—Pilot Driver
B—Adapter

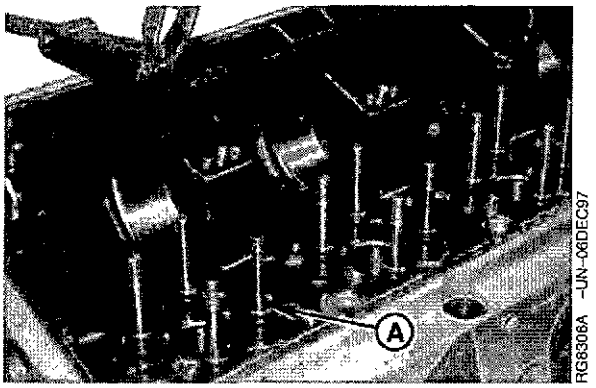
RG,RG34710,90 –19–03NOV99–1/1

INSTALL VALVES

1. Lubricate valve stems and guides with AR44402 Valve Stem Lubricant or clean engine oil.

NOTE: Valve must move freely in guide and seat properly with inserts to form an effective seal.

2. Insert valves in head (if valves are reused, install in same location from which removed).
3. Slide valve stem seals (A) over valve stems and onto intake and exhaust valve guide tower until firmly seated.



Installing Valve Stem Seals

A—Valve Stem Seals

Continued on next page

RG,RG34710,91 –19–13AUG99–1/2

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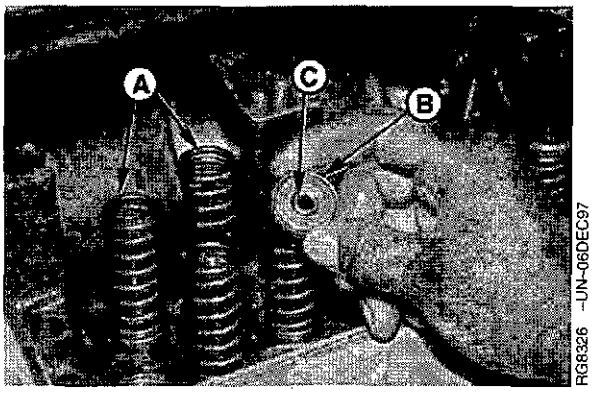
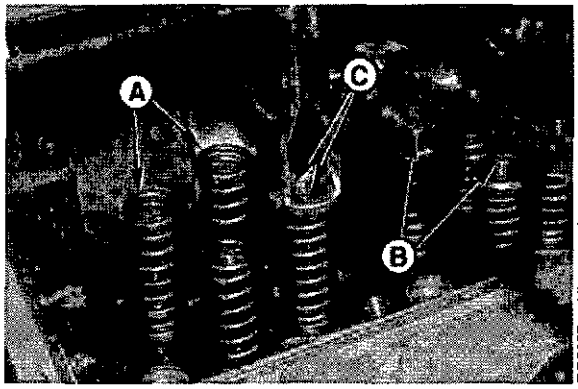
IMPORTANT: Replacement valve springs (R133891) have higher working loads than older springs (R116585). Newer valve springs (R133891), *have two green paint stripes* for identification. Valve springs must be replaced in sets of two with new rotators. DO NOT intermix springs across valve bridges.

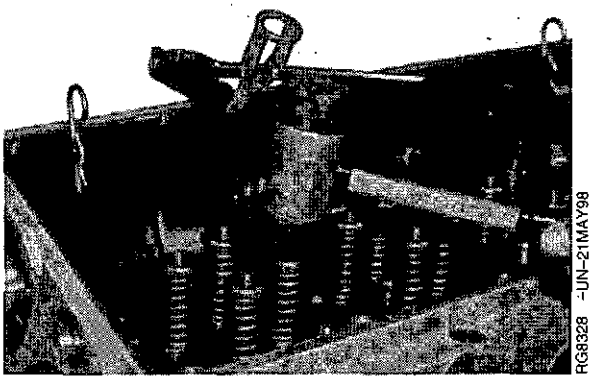
4. With cylinder resting on combustion face, install valve springs (A) and rotators (B) with retainer locks (C).
5. Compress valve springs using JDG982 Valve Spring Compressor and install retainer locks on valve stems.
6. Strike end of each valve several times with a soft, (non-metallic) hammer to ensure retainer locks are properly seated.
7. Recheck valve recess. (See MEASURE VALVE HEIGHT IN CYLINDER HEAD, earlier in this group.)



Installing Valve Rotators



Installing Valve Retainer Locks



Seating Valve Retainer Locks

A—Valve Springs
B—Rotators
C—Retainer Locks

RG,RG34710,91 –19–13AUG99–2/2

REPLACE UNIT INJECTOR SLEEVE IN CYLINDER HEAD USING JDG981

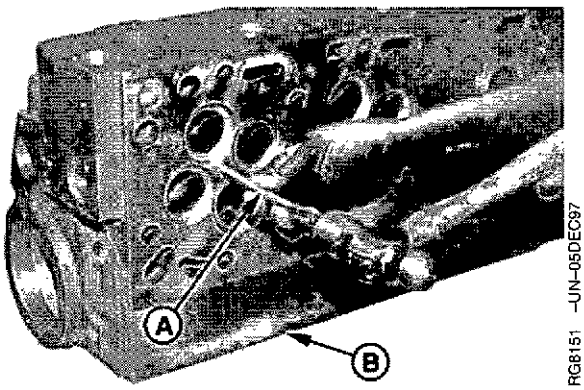
REMOVE UNIT INJECTOR SLEEVE

NOTE: Cylinder head must be removed to replace EUI sleeve using JDG981. To replace EUI sleeve with head installed refer to REPLACE UNIT INJECTOR SLEEVE IN CYLINDER HEAD USING JDG1184 later in this group.

IMPORTANT: Whenever EUI is replaced, sleeve in cylinder head must be replaced also.

JDG981-2 Swedge is obsolete. Disgard this tool and replace with JDG1184-2-1 Swedge Rod and 8132 Adapter.

1. Remove cylinder head from engine. (See REMOVE CYLINDER HEAD, earlier in this group.)
2. Remove valves from cylinder head. (See REMOVE VALVE ASSEMBLY, earlier in this group.)
3. Using a 51 mm by 102 mm (2.0 in. by 4.0 in.) block of wood (B) at least 914.4 mm (36.0 in.) long, lay cylinder head on it's side with air intake manifold mounting surface resting on block of wood.
4. Drive injector sleeve from combustion face side of cylinder head using MAY-25010 Pilot Driver (A) from JDG981 Unit Injector Sleeve Installation Set and hammer.
5. Remove square packing from injector sleeve bore. Thoroughly clean sleeve bore and inspect sleeve tip seating area for damage.



RG8151 –UN–05DEC97

Removing Injector Sleeve

A—Pilot Driver
B—Wood Block

Continued on next page

RG,RG34710,92 –19–13AUG99–1/6

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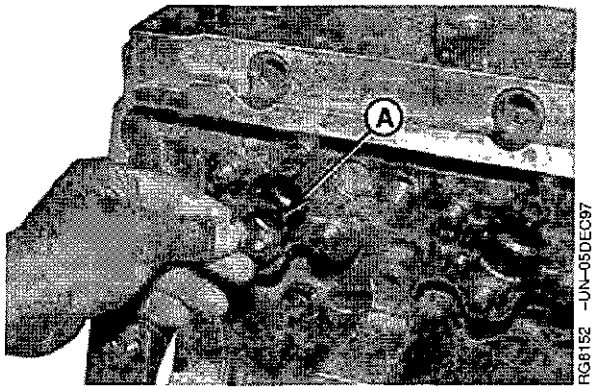
INSTALL UNIT INJECTOR SLEEVE

1. Grease square packing (A) and sleeve bore in head with JDT405 High Temperature Grease and install in packing seat area of injector sleeve bore. Take care that packing is not twisted during installation.

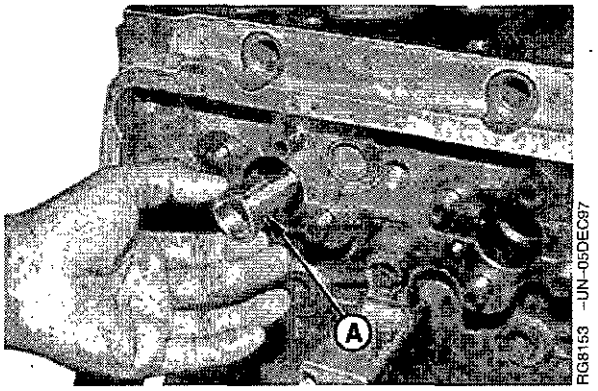


Installing Injector Sleeve Packing

A—Square Packing

RG,RG34710,92 –19–13AUG99–2/6

2. Install replacement injector sleeve (A) and push with minimal pressure until tightly seated in sleeve bore.



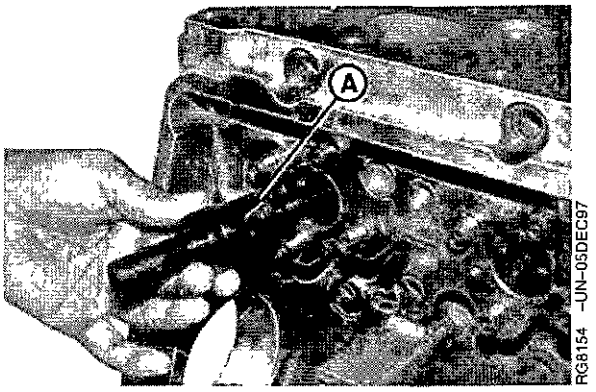
Installing Injector Sleeve

A—Replacement Sleeve

Continued on next page

RG,RG34710,92 –19–13AUG99–3/6

3. Grease polished tip of JDG981-1 Guide Sleeve (A) and install inside injector sleeve.



Installing Injector Sleeve Guide

A—Guide Sleeve

Continued on next page

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NOTE: Carefully inspect threads on 8 mm cap screw prior to use to avoid damaging injector hold-down clamp threads in cylinder head. Replace cap screw as needed.

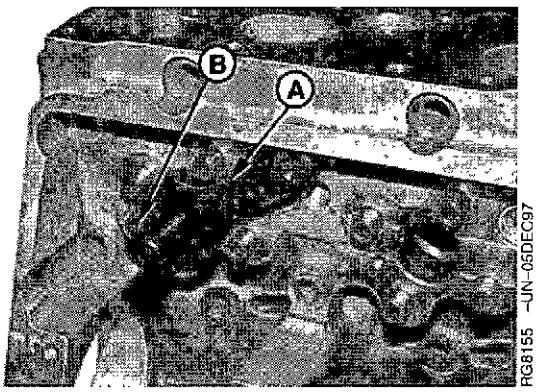
4. Install JDG981-3 Guide Sleeve Support Bar (A) as shown. Install 220213 (8 mm) cap screw (B) finger tight.

5. Install 220089 (16 mm) cap screw (C) from combustion face side of head using a phosphate washer from cylinder head mounting cap screw finger tight.

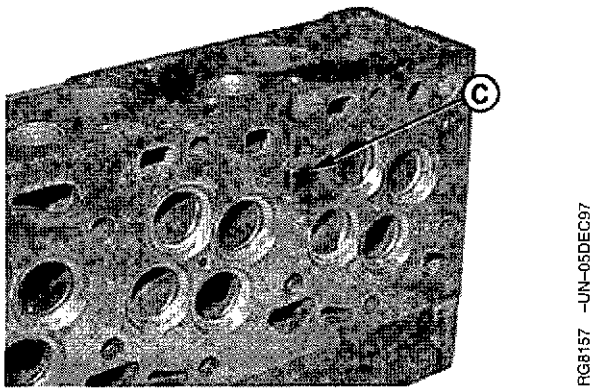
6. Install JDE131-2 Guide Sleeve Nut (D) finger tight.

7. Tighten cap screws and nut in following order to specification given:

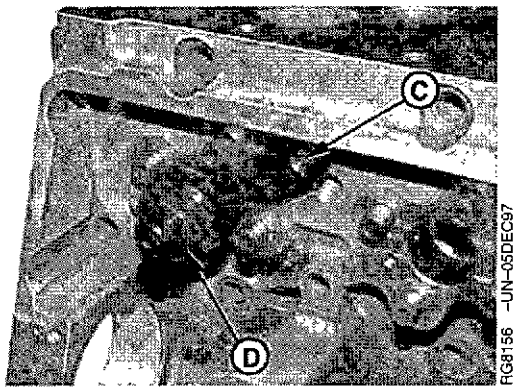
   - 16 mm Cap Screw (C) to 115 N•m (85 lb-ft)
   - 8 mm Cap Screw (B) to 47 N•m (35 lb-ft)
   - Guide Sleeve Nut (D) to 150 N•m (110 lb-ft)



Installing Guide Support Bar



Guide Support Bar Cap Screw



Guide Sleeve Arbor Nut

A—JDG981-3 Guide Sleeve Support Bar
B—220213 (8 mm) Cap Screw
C—220089 (16 mm) Cap Screw
D—JDE131-2 Guide Sleeve Nut

Continued on next page

RG,RG34710,92 –19–13AUG99–5/6

8. Clean and inspect JDG1184-2-1 Swedge Arbor (A) for raised or foreign material.

IMPORTANT: DO NOT use JDG981-2 Swedge, this tool is obsolete. Use only JDG1184-2-1 Swedge and 8132 Adapter.

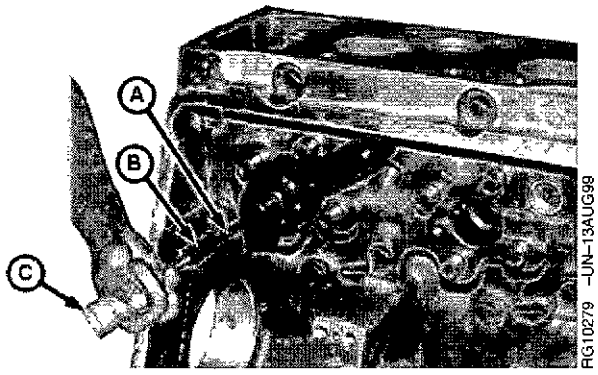
9. Assemble small end of No. 8132 Female Adapter (B) onto swedge arbor (A).

10. Assemble large end of adapter onto D01300AA 2.2 kg (5 lb) Slide Hammer (C).

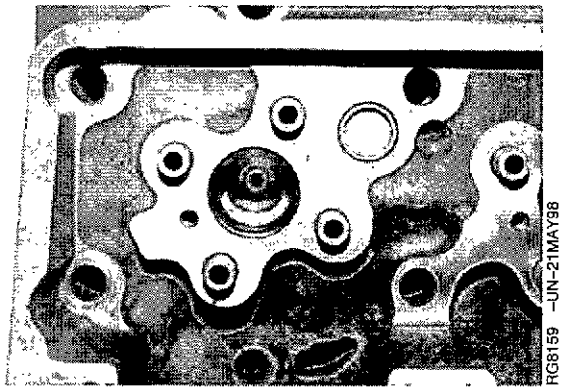
11. Position tip of swedge into guide sleeve and drive swedge through sleeve tip. Withdraw swedge with slide hammer.

12. Remove injector sleeve replacement tool set from cylinder head and inspect for proper installation of injector sleeve.

13. Repeat procedure on remaining injector sleeves.



Using Expansion Arbor



Installed Injector Sleeve

A—Swedge Arbor
B—Adapter
C—Slide Hammer

RG,RG34710,92 –19–13AUG99–6/6

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REPLACE UNIT INJECTOR SLEEVE IN CYLINDER HEAD USING JDG1184

REMOVE INJECTOR SLEEVE

NOTE: EUI sleeve can be removed from the cylinder head with head removed or installed on engine using JDG1184.

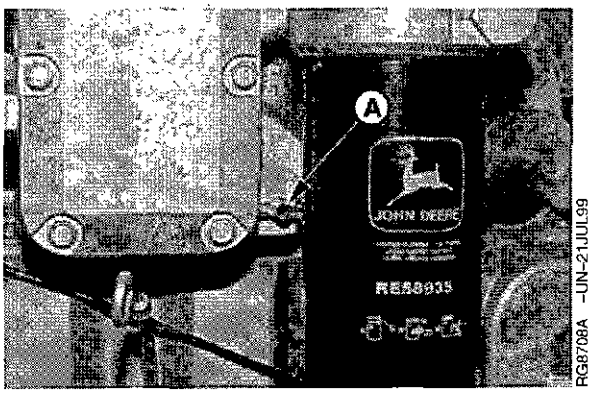
IMPORTANT: Whenever EUI is replaced, sleeve in cylinder head must be replaced also.

CAUTION: Do not drain coolant until the coolant temperature is below operating temperature. Always loosen coolant drain valve (A) slowly to relieve any excess pressure.

1. Attach a long hose to drain valve (A). Drain coolant into a clean container to a level below cylinder head.

TS281 –UN–23AUG88

Service Cooling System Safely



RG8708A –UN–21JUL99

Drain Coolant

A—Coolant Drain Valve

Continued on next page

2. **On dual rail fuel systems**, disconnect secondary (final) filter outlet line (A) and place in a clean container to collect fuel.

   Loosen fuel temperature sensor (B) in fuel manifold block and drain all fuel from fuel rail into a clean container.

3. **On single rail fuel systems**, loosen fuel rail inlet line (C). Disconnect outlet line (D) and drain fuel into a clean container.

4. Tighten temperature sensor to specifications.

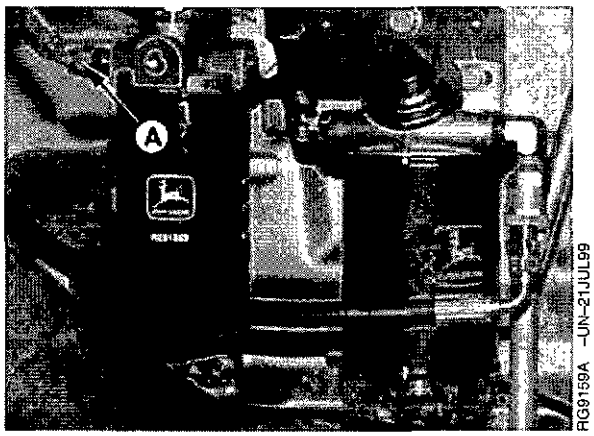
Fuel Temperature Sensor—Specification

Torque ..... 10 N•m (7.5 lb-ft)

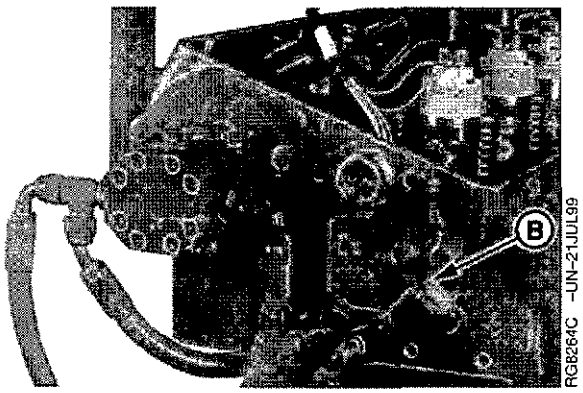
5. Reconnect fuel lines and tighten to specifications.

Fuel Lines—Specification

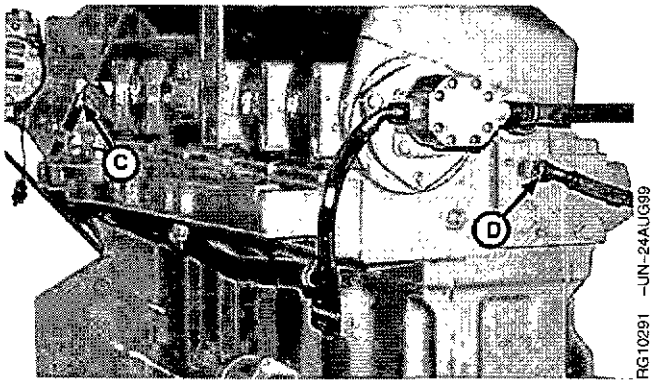
Torque ..... 24 N•m (18 lb-ft)



Fuel Outlet Line (Dual Rail System)



Fuel Temperature Sensor (Dual Rail System)



Fuel Lines (Single Rail System)

A—Fuel Outlet Line
B—Fuel Temperature Sensor
C—Fuel Rail Inlet Line
D—Fuel Rail Outlet Line

Continued on next page

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6. Plug oil drain cavities in cylinder head with clean, lint-free shop towels to prevent debris and hardware from falling into drain cavity.

7. Remove rocker arm cover. (See REMOVE AND INSTALL ROCKER ARM COVER in this group.)

8. Remove front rocker arm assembly for replacement of injector sleeves 1 and 2.

   - Remove both front and rear rocker arm assemblies for replacement of injector sleeve 3.
   - Remove rear rocker arm assembly for replacement of injector sleeves 4, 5, and 6.

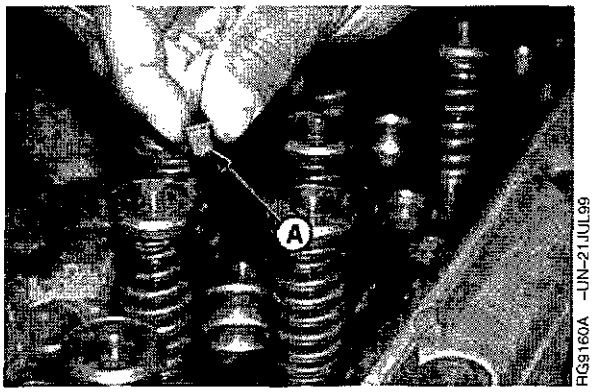
   (See REMOVE ROCKER ARM ASSEMBLY in this group.)

NOTE: If all six injector sleeves are to be replaced, replace sleeves for cylinders 1 and 6, 2 and 5, 3 and, 4 at the same time so crankshaft has to be rotated only three times.

9. Remove electronic unit injector from injector sleeve that is to be replaced on dual rail fuel systems. (See REMOVE AND INSTALL ELECTRONIC UNIT INJECTORS in Group 35.) Remove electronic unit injector from injector sleeve that is to be replaced on single rail fuel systems. (See REMOVE AND INSTALL ELECTRONIC UNIT INJECTORS in Group 36.)

IMPORTANT: Injector sleeve tip MUST BE plugged to keep debris out of power cylinder while tapping (threading) sleeve for removal.

10. Install small red cap plug (A) into injector sleeve tip. Be sure plug is firmly seated in tip of sleeve.



Cap Plug

A—Cap Plug

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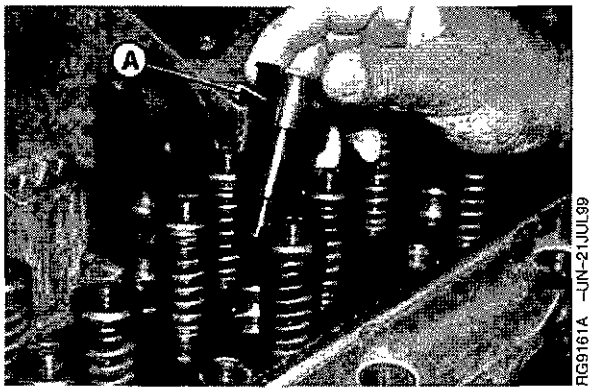
IMPORTANT: DO NOT attempt to tap threads in injector sleeve (for removal) unless JDG1184-1-3 Protector Sleeve (A) is anchored against injector sleeve with EUI hold-down clamp. This will eliminate injector sleeve turning in swaged bore of cylinder head.

11. Thoroughly clean and dry JDG1184-1-3 Protector Sleeve as needed. Install protector sleeve into EUI bore until it is seated with injector sleeve.

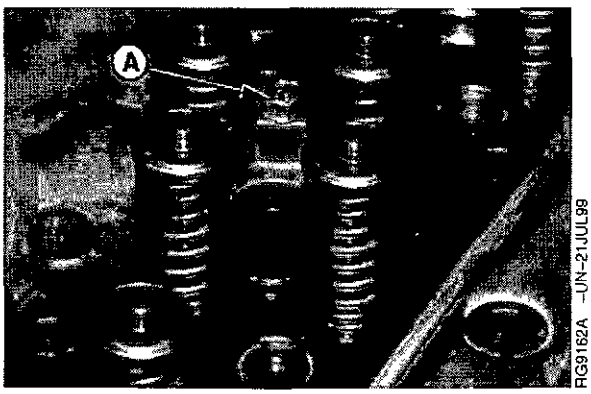


Protector Sleeve

A—Protector Sleeve

DPSG,OUO1004,929 –19–16JUL99–4/15

12. Install EUI hold-down clamp and cap screw (A) over protector sleeve. Tighten cap screws to 40 N•m (30 lb-ft).



Hold-Down Cap Screw

A—Hold-Down Cap Screw

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DPSG,OUO1004,929 –19–16JUL99–5/15

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13. Apply a generous amount of all-purpose grease to JDG1184-1-1 Tap (A).

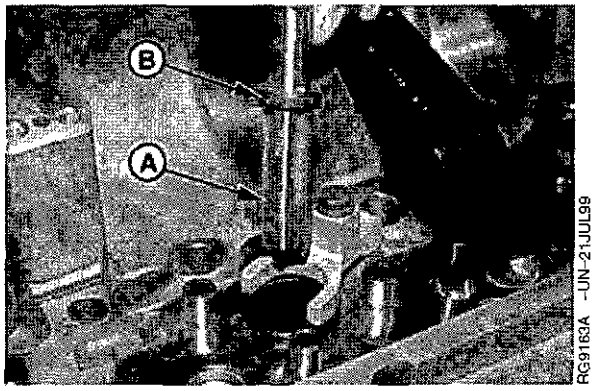
14. Position JDG1184-1-5 Tap Guide (B) over shaft of tap to center tap in protector sleeve.

15. Tap at least five full threads in ID of injector sleeve using a 5/8 in., 12-point socket and extension with a ratchet or T-handle.

16. Once resistance increases on tap, reverse direction and remove tap.

IMPORTANT: DO NOT remove protector sleeve from nozzle sleeve after tapping screw threads. Sleeve MUST BE removed as an assembly with JDG1184-1-2 Screw Adapter and JDG1184-1-4 Spacer to contain shavings and protect fuel rail in head.

17. Remove cap screw and EUI hold-down clamp from protector sleeve. Do not remove sleeve at this time.



JDG1184-1-1 Tap

A—Tap
B—Tap Guide

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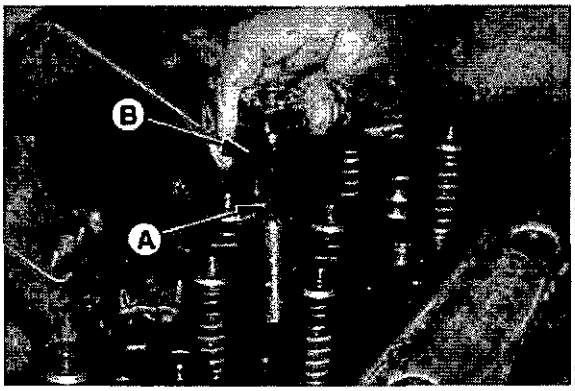
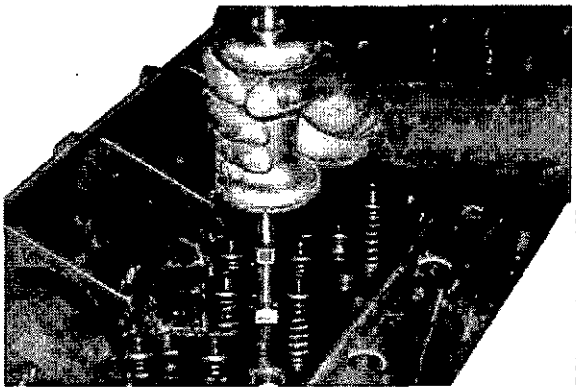
DPSG,OUO1004,929 –19–16JUL99–6/15

18. Thread JDG1184-1-2 Screw Adapter (A) with JDG1184-1-4 Spacer (B) into threaded injector sleeve finger tight. This will keep shavings out of fuel rail.
19. Thread D01300AA 2.2 kg (5 lb) Slide Hammer into screw adapter.
20. Pull injector sleeve from cylinder. Remove puller attachments from injector sleeve.
21. Remove injector sleeve packing from groove in cylinder head using O-ring pick.
22. Thoroughly clean and dry protector sleeve for future use. Clean remaining components as necessary.



Adapter and Spacer



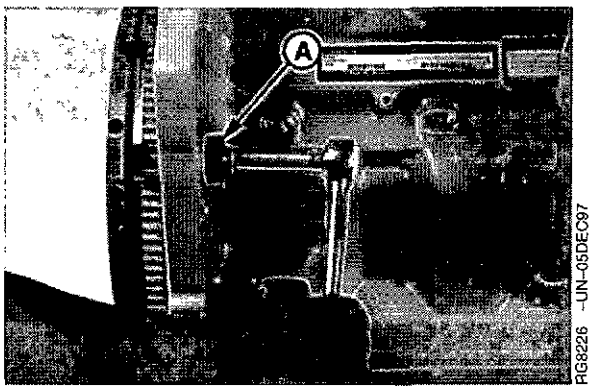
Remove Sleeve

A—Screw Adapter
B—Spacer

DPSG,OUO1004,929 –19–16JUL99–7/15

CHECK PISTON POSITION IN LINER

1. After injector sleeve is removed, look into sleeve bore of cylinder head to be sure that piston is at or near bottom of it's stroke.
2. If piston is not near bottom, rotate engine flywheel using JDG820 Flywheel Rotation Tool (A).



Rotate Engine Flywheel

A—Flywheel Rotation Tool

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DPSG,OUO1004,929 –19–16JUL99–8/15

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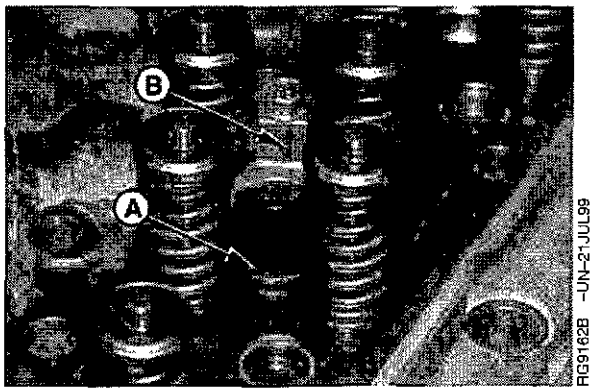
INSTALL INJECTOR SLEEVE

1. Install JDG1184-1-3 Protector Sleeve (A) into injector *sleeve bore (without injector sleeve).*
2. Install EUI hold-down clamp (B) and cap screw over protector sleeve. Tighten cap screw to 40 N•m (30 lb-ft).
3. Thoroughly clean injector sleeve bore with a small brush.
4. Remove protector sleeve.

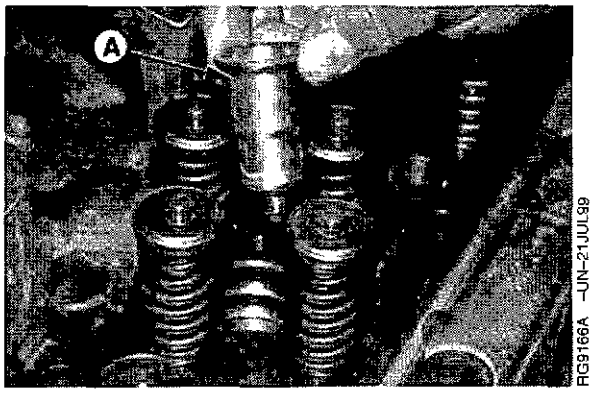


Install Protector Sleeve

A—Protector Sleeve
B—Hold-Down Clamp

DPSG,OUO1004,929 –19–16JUL99–9/15

5. Lubricate new square packing with clean engine oil or grease and install into packing bore in cylinder head.
6. Install injector sleeve (A) into cylinder bore.



Install Sleeve

A—Injector Sleeve

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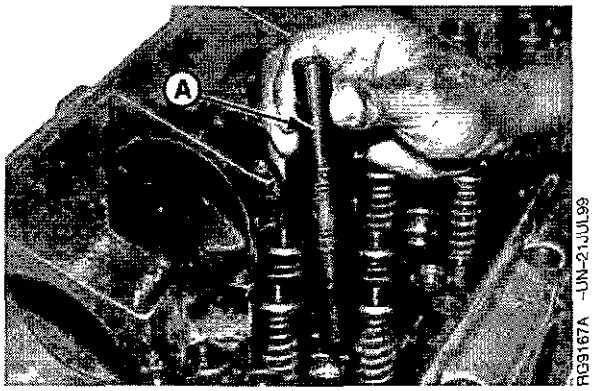
DPSG,OUO1004,929 –19–16JUL99–10/15

7. Lubricate O-rings with clean engine oil and position JDG981-1 Guide Sleeve (A) into injector sleeve and seat sleeve using a plastic or rubber hammer. Be careful not to cut O-rings.

NOTE: When injector sleeve is fully seated, top of JDG981-1 Guide Sleeve should be slightly lower than top of valve rotators.

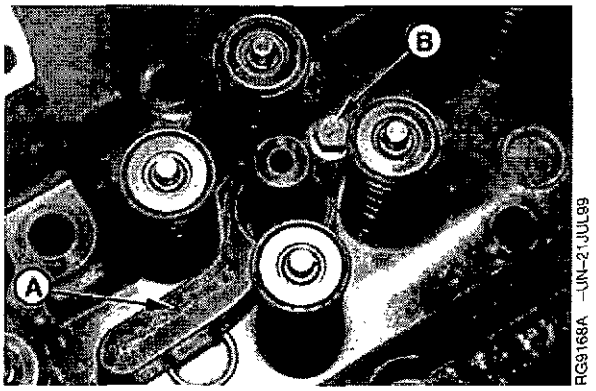


Seat Sleeve

A—Guide Sleeve

DPSG,OUO1004,929 –19–16JUL99–11/15

8. Position JDG1184-2-2 Guide Sleeve Holding Bracket (A) over guide sleeve and tighten cap screw (B) finger tight.



Guide Sleeve Holding Bracket

A—Guide Sleeve Holding Bracket
B—Cap Screw

Continued on next page

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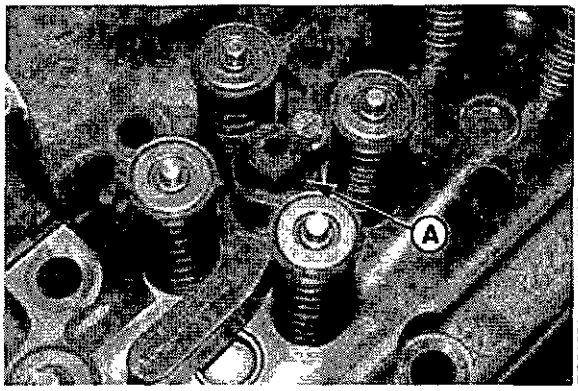
9. Thread JDG1184-2-4 Drive Nut (A) into holding bracket *but do not tighten.*



Drive Nut

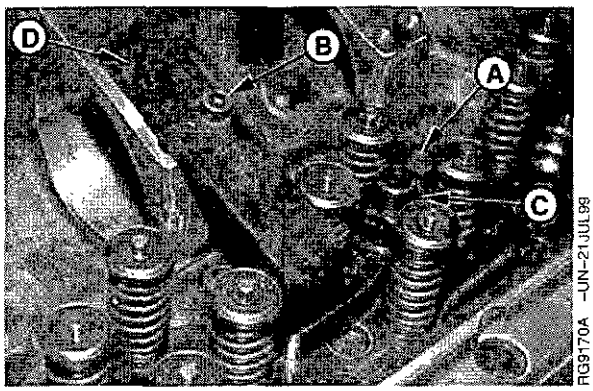
A—Drive Nut

DPSG,OUO1004,929 –19–16JUL99–13/15

10. Install JDG1184-2-3 Bracket Clamp (D) onto rocker arm rail as shown, and tighten cap screw (B) finger tight.

11. Tighten cap screws and nut to the following specifications.

    - Guide screw holding bracket cap screw (A) to 40 N•m (30 lb-ft.).
    - Bracket clamp cap screw (B) to 68 N•m (50 lb-ft)
    - Driver nut (C) to 115 N•m (85 lb-ft)



Tighten Hardware

A—Guide Sleeve Holding Bracket Cap Screw
B—Bracket Clamp Cap Screw
C—Driver Nut
D—Bracket Clamp

Continued on next page

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12. Assemble small end of No. 8132 Female Adapter (A) onto JDG1184-2-1 Swedge Arbor (B).

13. Assemble large end of adapter onto D01300AA 2.2 kg (5 lb) Slide Hammer (C).

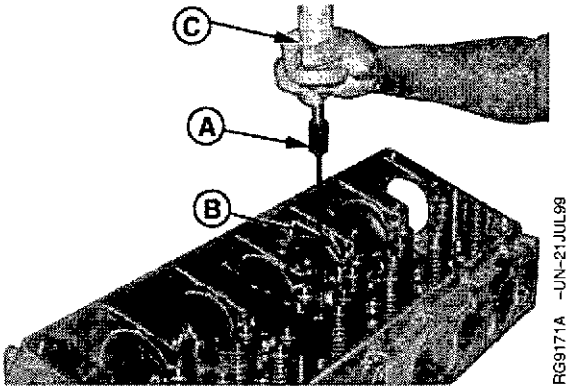
14. Position tip of swedge into guide sleeve and drive swedge through sleeve tip. Withdraw swedge with slide hammer.

15. Remove all tooling. After all required sleeves are replaced, refill cooling system and pressure test for leakage.

16. Install electronic unit injectors and wiring harness on dual rail fuel systems. (See REMOVE AND INSTALL ELECTRONIC UNIT INJECTORS in Group 35.)

    Install electronic unit injectors and wiring harness on single rail fuel systems. (See REMOVE AND INSTALL ELECTRONIC UNIT INJECTORS in Group 36.)

17. Install rocker arm assembly. (See INSTALL ROCKER ARM ASSEMBLY in this group.)



Remove Swedge

A—Adapter
B—Swedge Arbor
C—Slide Hammer

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CLEAN AND INSPECT TOP DECK OF CYLINDER BLOCK

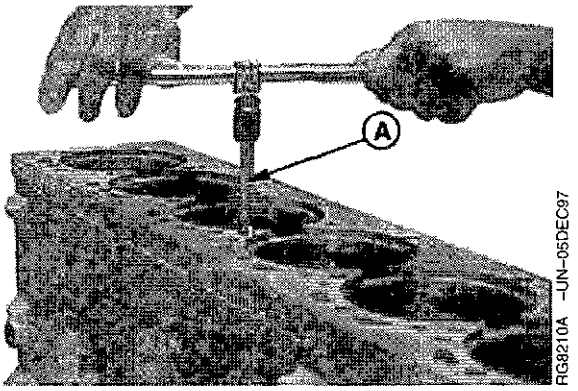
1. Remove gasket material, rust, carbon, and other foreign material from top deck using a powered brass or copper (soft) wire brush. DO NOT use a steel wire brush.

2. Clean threaded holes in cylinder block using JDG978 Special Tap (A) or an equivalent M16 x 2.0 x 140 mm (5.50 in.) long tap.

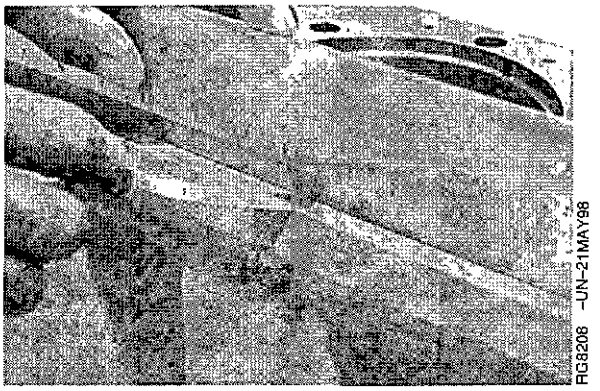
3. Use compressed air to remove debris and fluids from cap screw holes. Replace block if thread damage is detected.

4. Inspect and measure top deck for flatness. Service as required. (See MEASURE CYLINDER BLOCK TOP DECK FLATNESS, in Group 10.)

5. Clean all oily residue and dirt from top deck before installing head gasket.



Cleaning Head Bolt Threads



Measuring Block Top Deck Flatness

A—Special Tap

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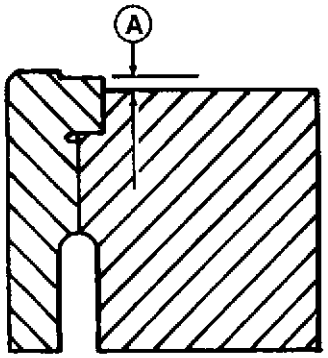
MEASURE CYLINDER LINER STANDOUT (HEIGHT ABOVE BLOCK)

1. Secure liners using cap screws and flat washers. Flat washers should be at least 3.18 mm (1/8 in.) thick. Tighten cap screws to 68 N•m (50 lb-ft).

2. Using JDG451 or KJD10123 Height Gauge (B) and D17526CI or D17527CI Dial Indicator (C), measure liner height (A) at approximately 1, 5, 7, and 11 o'clock positions as viewed from flywheel end of engine. Record all measurements by cylinder number.



Liner Standout

Cylinder Liner—Specification

Height Above Block (Standout)	0.030—0.117 mm (0.0012—0.0046 in.)

Cylinder Liner—Specification

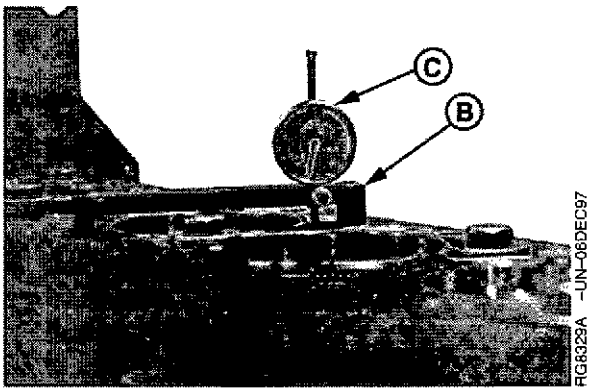
Max. Height Difference at Nearest Point of Two Adjacent Liners or Within One Liner	0.051 mm (0.0020 in.)

IMPORTANT: ONE LINER SHIM ONLY may be installed under any given liner flange.

3. Remove liner, add shims or replace any liner that does not fall within allowable standout specification.

   Two sizes of shims are available:

R81276	0.05 mm (0.002 in.)
R87277	0.10 mm (0.004 in.)



Measuring Liner Standout

A—Liner Height
B—Height Gauge
C—Dial Indicator

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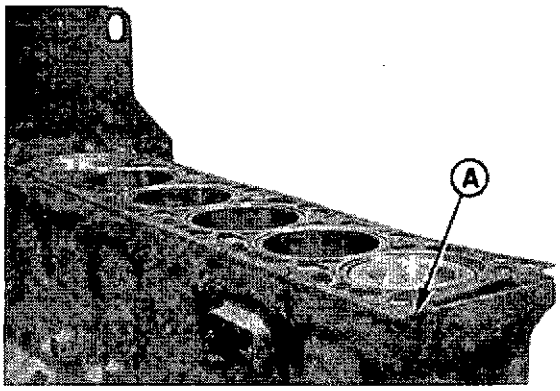
INSTALL CYLINDER HEAD

IMPORTANT: Be sure cylinder head and block gasket surfaces are clean, dry, and free of any oily residue. ALWAYS thoroughly inspect new cylinder head gasket for possible manufacturing imperfections. Return any gasket that does not pass inspection.

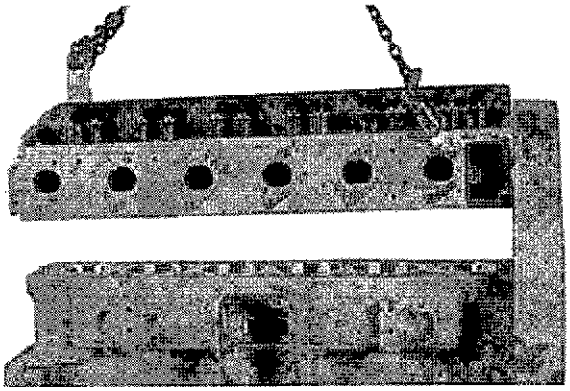
1. Place a new head gasket on top of cylinder block. Do not use sealant on gasket. Tab (A) on gasket goes to left rear corner of cylinder block (as viewed from flywheel end).

IMPORTANT: If cylinder head is lowered onto cylinder block and you discover that the head is not positioned correctly on locating dowels, remove cylinder head and install a new gasket. DO NOT try to reposition cylinder head on the same gasket again since the fire ring will possibly be damaged.

2. Lower cylinder head in correct position on block using *lifting straps and a hoist. Make sure that head is* positioned correctly over dowels and that it is all the way down on gasket.



Installing Cylinder Head Gasket



Installing Cylinder Head

A—Tab

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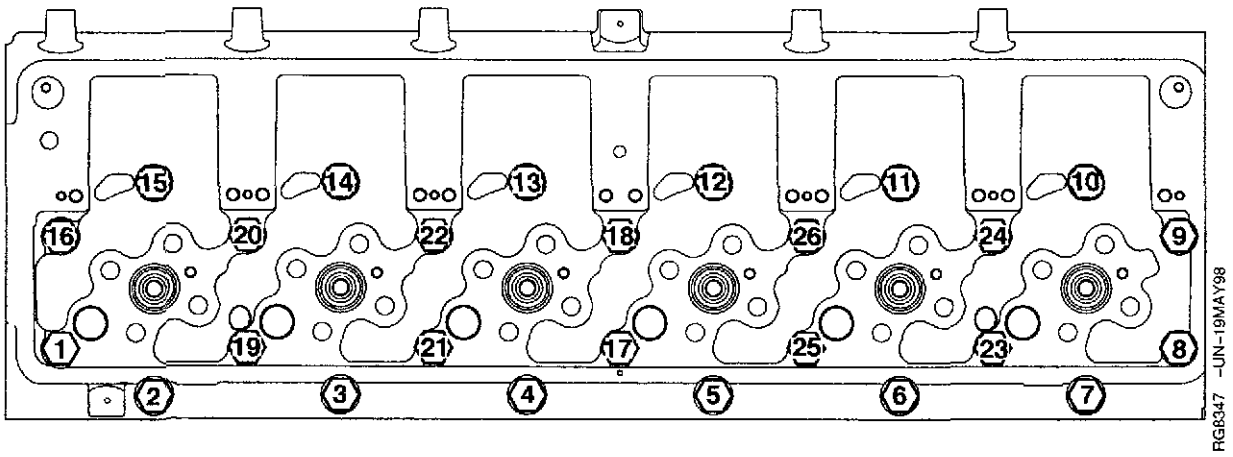

Cylinder Head Cap Screw Torque Sequence

IMPORTANT: Whenever cylinder head is removed for service, all cap screws MUST BE replaced when head is installed. These cap screws can only be used one time.

NOTE: All 26 cylinder head cap screws are the same length.

3. Dip new cap screws and washers in clean SAE 30 engine oil. Allow excess to drain off threads.
4. Initially tighten cap screw No. 17 to 100 N•m (74 lb-ft). This prevents head from tipping during tightening sequence.
5. Use torque-turn method to tighten all cylinder head cap screws to specifications. (See TORQUE-TURN CYLINDER HEAD CAP SCREWS next in this Group.)

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TORQUE-TURN CYLINDER HEAD CAP SCREWS

Arrow (A) points toward front of engine.

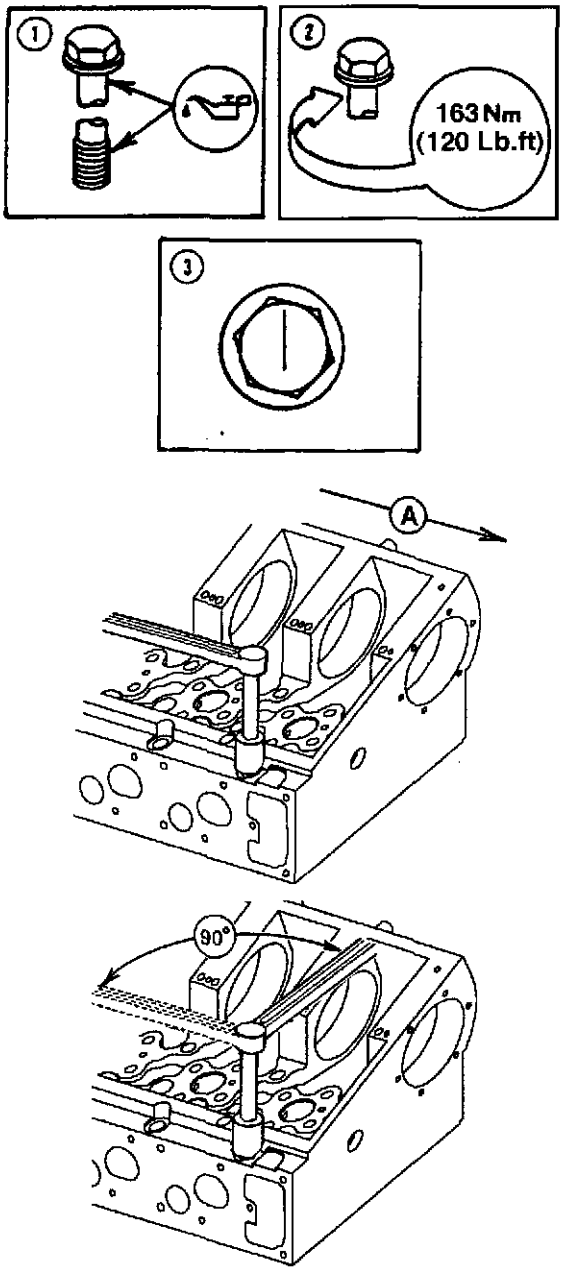
IMPORTANT: DO NOT use multi-viscosity oils to lubricate cap screws.

1. Lubricate cap screws with clean SAE 30 engine oil and install in their proper locations as outlined previously.
2. If not done, Initially tighten cap screw No. 17 to 100 N•m (74 lb-ft) to prevent head from tipping during tightening sequence.

   Following figure on previous page, sequentially start at cap screw No. 1 and proceed through cap screw No. 26 and tighten all cap screws to 163 N•m (120 lb-ft).
3. Wait 5 minutes and verify torque above.
4. Using an oil proof pen, pencil, or marker, draw a line parallel to the crankshaft across the entire top of each cap screw head. This line will be used as a reference mark.

IMPORTANT: If a cap screw is accidentally tightened more than 90° in first sequence, DO NOT loosen cap screw but make adjustments in the next tightening sequence.

5. Sequentially (start at cap screw No. 1 and proceed through cap screw No. 26) turn each cap screw 90°. Line on top of cap screw will be perpendicular to crankshaft.



Torque-Turn Cylinder Head Cap Screws

A—Front of Engine

Continued on next page

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IMPORTANT: Cap screws MUST NOT be tightened more than a total of 180°—190°.

6. Finally, sequentially (start at cap screw No. 1 and proceed through cap screw No. 26) turn each cap screw an additional 90°, SO THAT LINE ON TOP OF CAP SCREW IS AS CLOSE AS POSSIBLE TO BEING PARALLEL TO THE CRANKSHAFT. It is not necessary to obtain the final turn in one swing of the wrench. TOTAL AMOUNT OF TURN FROM STEPS 5, and 6, is 180°—190°.

TORQUE-TURN procedure summarized as follows:

Step 1 - Initial Torque No. 17 Cap Screw—Specification

Torque ..... 100 N•m (74 lb-ft)

Step 2 - Initial Torque All Cap Screws (Nos. 1—26)—Specification

Torque ..... 163 N•m (120 lb-ft)

Step 3 - Wait 5 Minutes and Verify Torque (Nos. 1—26)—Specification

Torque ..... 163 N•m (120 lb-ft)

Step 4 - Initial Torque-Turn All Cap Screws (Nos. 1—26)—Specification

Torque-Turn ..... 90°

Step 5 - Final Torque-Turn All Cap Screws[1] (Nos. 1—26)—Specification

Additional Torque-Turn ..... 90°

[1] Total TORQUE-TURN for steps 4 and 5 is 180°.

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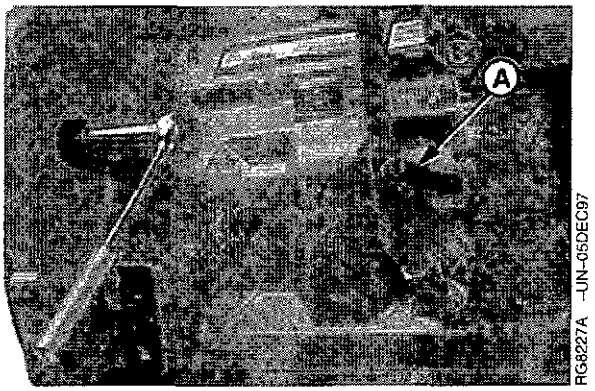
INSTALL ROCKER ARM ASSEMBLY

1. Install JDG971 Timing Pin (A) into crankshaft timing slot to Lock No. 1 cylinder at TDC.



Timing Pin in Crankshaft

A—Timing Pin

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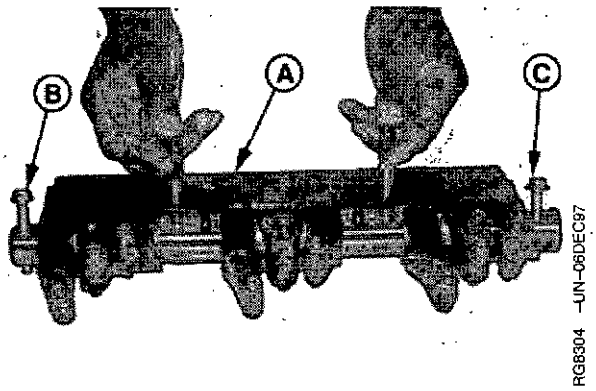
2. With rocker arms properly spaced on shaft and cap screws (B) and (C) on each end, install JDG970A Rocker Arm Holder (A) onto rocker arm and shaft assembly.

3. Firmly depress buttons on two lifting arms, install lifting plate with two locator pins and lifting arms positioned in holes of rocker arm shaft. Release buttons so that ball actuating pins lock onto shaft and can be safely lifted.

IMPORTANT: ALWAYS loosen all intake, exhaust and EUI rocker arm adjusting screws before removal or installation of rocker arm assembly to relieve pressure. This allows for a more uniform rocker arm cap screw clampload and reduces the possibility of damage to valve train components.

4. Install front and rear rocker arm and shaft assembly onto locating roll pins of cylinder head.



Lifting Rocker Arm Assembly

A—Rocker Arm Holder
B—Cap Screw
C—Cap Screw

Continued on next page

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NOTE: On early engines with dual rail fuel system, install hold-down clamps (A) with oil tube (B) at second clamp location from front and rear of engine.

5. Install rocker arm hold-down clamps. Install cap screws finger tight.

6. Install twelve valve bridges (D) with slots (E) facing exhaust manifold side of engine. Be sure each bridge is properly seated onto two respective intake and exhaust valves within a given cylinder.

7. Install twelve push tubes (C) on top of bridges.

8. Make sure intake, exhaust, and injector rocker arm adjusting screws are loose to eliminate binding shaft as clamps are tightened.

9. Initially tighten rocker arm hold-down cap screws in the end of each shaft to pull shaft down onto locking roll pins. Next, going from front-to-rear of engine, tighten hold-down clamp cap screws to the following specification:

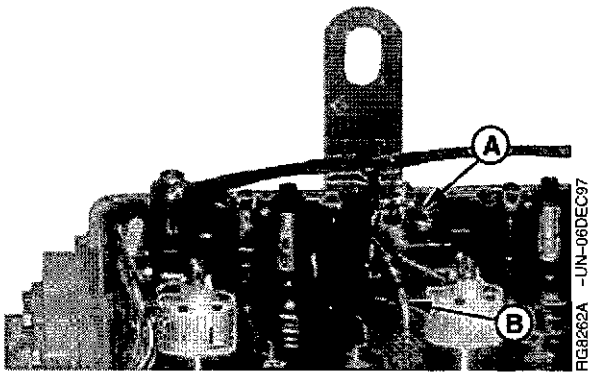
Rocker Arm Shaft Hold-Down Clamp Cap Screws (All Engines)—Specification

Initial Torque ..... 30 N•m (22 lb-ft)

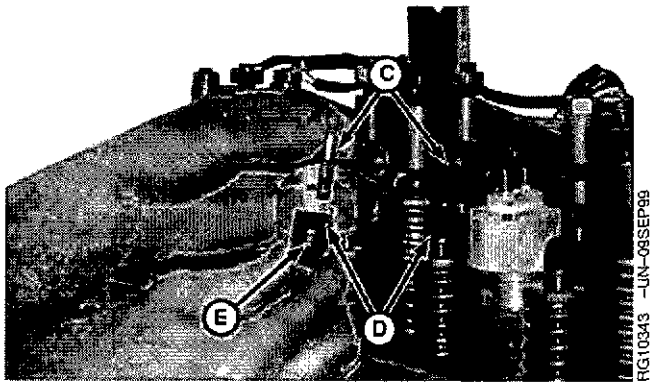
Make an additional pass from front-to-rear and verify torque specification above.

IMPORTANT: TORQUE-TURN procedures for rocker arm shaft clamp cap screws differ between engines with dual rail and single rail fuel systems. Use proper procedure for engine application.

10. TORQUE-TURN rocker arm shaft clamp cap screws using proper procedure for type of fuel system as detailed on following pages.



Rocker Arm Oil Tube



Valve Bridges and Push Tubes

A—Hold-Down Clamps
B—Oil Tube (Early Engines with Dual Rail Fuel System)
C—Push Tubes
D—Valve Bridges
E—Slots

Continued on next page

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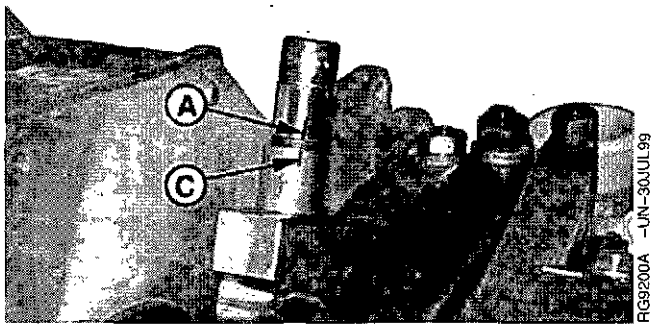
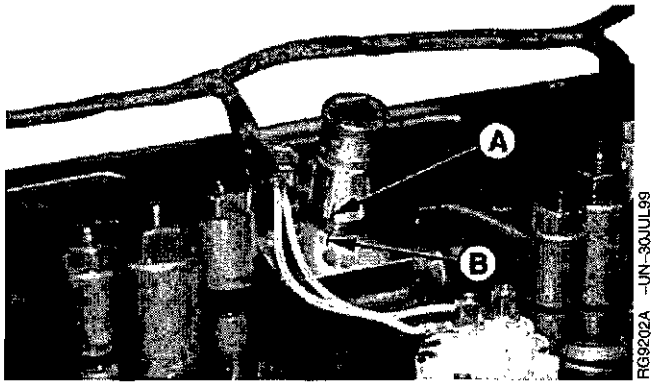
TORQUE-TURN ROCKER ARM HOLD-DOWN CLAMP CAP SCREWS ON ENGINES WITH DUAL RAIL FUEL SYSTEMS

1. After applying initial torque of 30 N•m (22 lb-ft), start at front cap screw and proceed to the rear and TORQUE-TURN each cap screw 60° ± 5° as follows:

   - Position a **six point** socket onto rocker arm shaft clamp cap screw.
   - With clockwise tension on socket (viewed from rear of engine), mark a line (A) on socket and another aligning mark on shaft clamp (B) [or spacers (C) at each end location)].



Torque-Turn Clamp Cap Screws



Torque-Turn Clamp Cap Screws

A—Line on Socket
B—Line on Shaft Clamp
C—Line on Spacer

Continued on next page

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- Remove socket from cap screw and rotate socket counterclockwise (viewed from rear of engine) one flat and reinstall on cap screw. Marks should now be 60° apart.
- Tighten cap screws (clockwise) until marks on socket (A) and shaft clamp [or spacers (C) at each end location] are aligned.

NOTE: If cap screw is tightened beyond aligning mark, loosen cap screw and repeat procedure starting with initial torque of 30 N•m (22 lb-ft).

2. Repeat procedure on remaining cap screws and TORQUE TURN cap screws to the following specifications.

Rocker Arm Shaft Hold-Down Clamp Cap Screws (Dual Rail Fuel System)—Specification

Final TORQUE-TURN ..... 60° ± 5°

IMPORTANT: Position electronic unit injector wiring harness so that wires DO NOT touch rocker arms.

3. Install unit injector wiring harness. Apply LOCTITE® 222 (TY24311) Small Screw Thread Lock and Sealer to harness cap screws. Tighten cap screws to specifications below.

Unit Injector Wiring Harness Bracket-to-Rear of Head—Specification

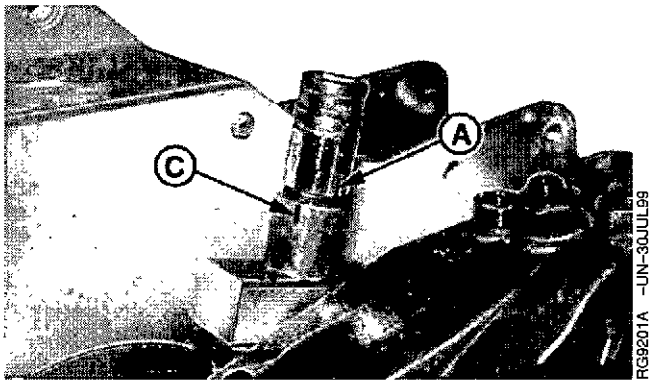
Torque ..... 25 N•m (18 lb-ft)

Unit Injector Wiring Harness Solenoid Wire Retaining Nut[1]—Specification

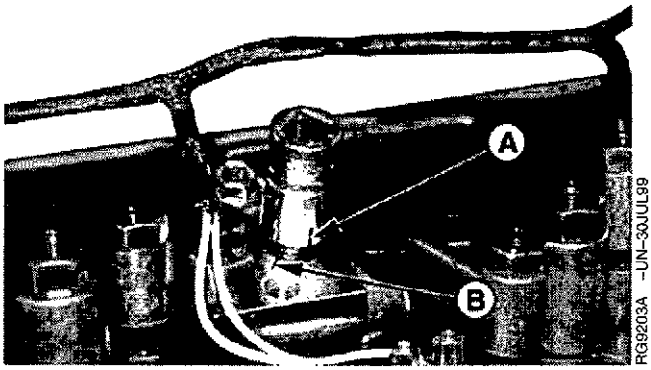
Torque ..... 2.0 N•m (1.5 lb-ft)

Unit Injector Harness Clips-to-Rocker Arm Shaft Clamps—Specification

Torque ..... 35 N•m (26 lb-ft)



Torque-Turn Clamp Cap Screws



Torque-Turn Clamp Cap Screws

A—Line on Socket
B—Line on Shaft Clamp
C—Line on Spacer

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[1]Apply LOCTITE 222 (TY24311) Small Screw Threadlocker.

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4. Adjust valve-to-bridge clearance and injector preload. (See CHECK AND ADJUST VALVE ASSEMBLY CLEARANCES AND INJECTOR PRELOAD, earlier in this group.)

IMPORTANT: Before installing rocker arm cover, be sure that EUI wires are positioned so that rocker arm will not contact wires when engine is running.

5. Install rocker arm cover. (See REMOVE AND INSTALL ROCKER ARM COVER earlier in this group.)

Continued on next page

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TORQUE-TURN ROCKER ARM HOLD-DOWN CLAMP CAP SCREWS ON ENGINES WITH SINGLE RAIL FUEL SYSTEMS

1. After applying initial torque of 30 N•m (22 lb-ft), start at front cap screw and proceed to the rear and TORQUE-TURN each cap screw 90° + 10° - 0° as follows:

   - Using an oil proof pen, pencil, or marker, draw a line (A) parallel to the crankshaft across the entire top of each cap screw head. This line will be used as a reference mark.
   - Install ratchet/socket on cap screw with ratchet handle parallel (B) to crankshaft.
   - Tighten each cap screw 90° so ratchet handle is perpendicular (C) to crankshaft. Remove ratchet/socket from cap screw and verify line on top of cap screw is perpendicular to crankshaft.

NOTE: If cap screw is tightened beyond aligning mark, loosen cap screw and repeat procedure starting with initial torque of 30 N•m (22 lb-ft).

   - Repeat procedure on remaining cap screws and TORQUE TURN cap screws to the following specifications.

Rocker Arm Shaft Hold-Down Clamp Cap Screws (Single Rail Fuel System)—Specification

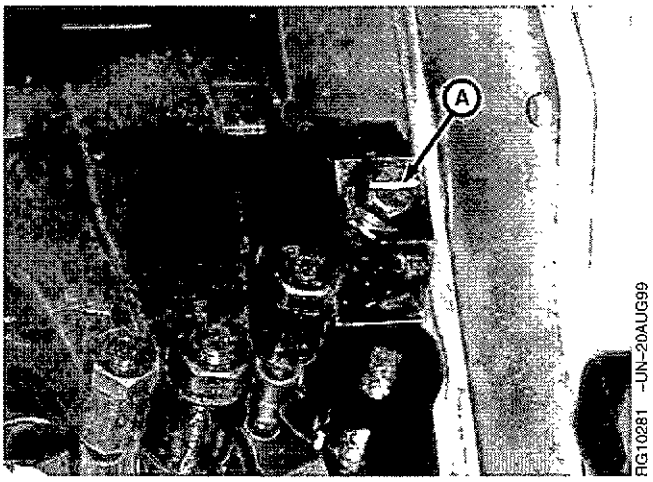
Final TORQUE-TURN ..... 90° + 10° - 0°

IMPORTANT: Position electronic unit injector wiring harness so that wires DO NOT touch rocker arms.

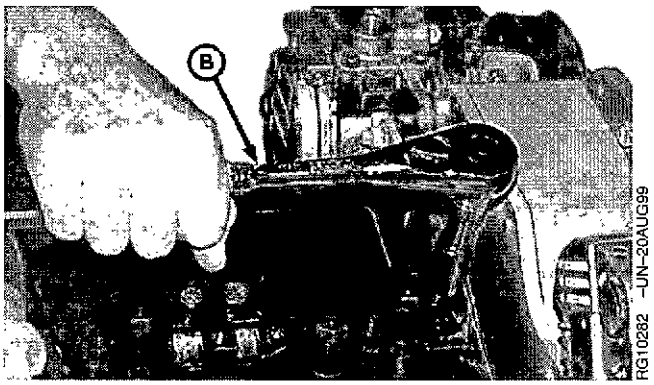
2. Install unit injector wiring harness. Tighten cap screws to specifications below.

Unit Injector Wiring Harness Bracket-to-Rear of Head—Specification

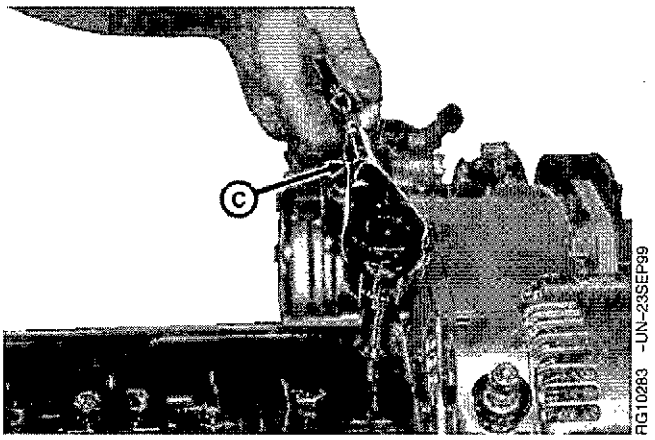
Torque ..... 25 N•m (18 lb-ft)



Index Rocker Cap Screw



Ratchet Parallel to Crankshaft



Ratchet Perpendicular to Crankshaft

A—Rocker Cap Screw
B—Ratchet Parallel to Crankshaft
C—Ratchet Perpendicular to Crankshaft

Continued on next page

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Unit Injector Wiring Harness Solenoid Wire Retaining Nut[1]—Specification

Torque ..... 2.0 N•m (1.5 lb-ft)

Unit Injector Harness Clips-to-Rocker Arm Shaft Clamps—Specification

Torque ..... 35 N•m (26 lb-ft)

3. Adjust valve-to-bridge clearance and injector preload. (See CHECK AND ADJUST VALVE ASSEMBLY CLEARANCES AND INJECTOR PRELOAD, earlier in this group.)

IMPORTANT: Before installing rocker arm cover, be sure that EUI wires are positioned so that rocker arm will not contact wires when engine is running.

4. Install rocker arm cover. (See REMOVE AND INSTALL ROCKER ARM COVER earlier in this group.)

[1]Apply LOCTITE 222 (TY24311) Small Screw Threadlocker.

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COMPLETE FINAL ASSEMBLY FOR CYLINDER HEAD INSTALLATION

1. Install camshaft gear access cover. (See INSTALL TIMING GEAR COVER in Group 15.)
2. Install thermostat housing/water manifold assembly. (See REMOVE AND INSTALL THERMOSTAT HOUSING in Group 25.)
3. Install intake manifold. (See REMOVE, INSPECT AND INSTALL INTAKE MANIFOLD in Group 30.) Install exhaust manifold. (See REMOVE, INSPECT AND INSTALL EXHAUST MANIFOLD in Group 30.) Install turbocharger. (See INSTALL TURBOCHARGER in Group 30.)
4. Install fuel supply pump on dual rail fuel systems. (See REMOVE AND INSTALL FUEL SUPPLY PUMP in Group 35.) Install fuel supply pump on single rail fuel systems. (See REMOVE AND INSTALL FUEL SUPPLY PUMP in Group 36.)
5. Install fuel manifold assembly (if equipped) from rear of cylinder head. (See REMOVE AND INSTALL FUEL MANIFOLD in Group 35.)
6. Install and securely tighten all fuel lines and fuel filter. (Group 35 or 36)
7. Fill engine with proper fuel and coolant. (Group 02)
8. Perform engine break-in. (See PERFORM ENGINE BREAK-IN in group 4.)

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ESSENTIAL TOOLS

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

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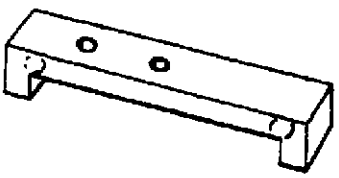
Piston and Liner Height Gauge . . . . . JDG451[1]

Measure piston and liner heights.



RG7029

JDG451

[1]A dial indicator is not supplied with JDG451. Use D17526CI (English, in.) or D17527CI (Metric, mm) Dial Indicator with JDG451.

DPSG,OUO1004,971 –19–02AUG99–2/16

RG6246 –UN–05DEC97

Dial Indicator . . . (English, in.) D17526CI or (Metric, mm) D17527CI

Use with JDG451 to measure valve recess and cylinder liner height-to-cylinder block top deck.

RG6246

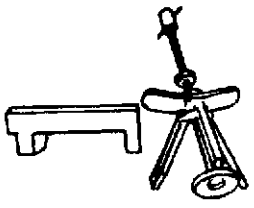
D17526CI/ D17527CI

DPSG,OUO1004,971 –19–02AUG99–3/16

RG5019 –UN–05DEC97

Cylinder Liner Puller . . . . . D01062AA, D01073AA, or KCD10001

Use to remove and install cylinder liners.



RG5019

D01073AA

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DPSG,OUO1004,971 –19–02AUG99–4/16

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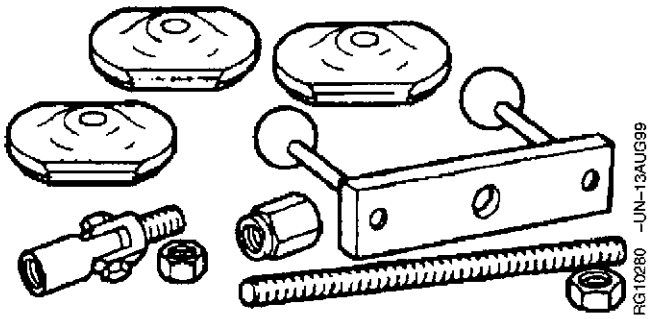
2

Cylinder Liner Service Set. JDG1145

Use to remove and install cylinder liners. Use with D01300AA 5 lb. Slide Hammer. Also used with lapping compound to lap liner flange to block counterbore.



JDG1145

DPSG,OUO1004,971 –19–02AUG99–5/16

RG5074 –UN–07NOV97

Flexible Cylinder Hone D17006BR

Hone cylinder liners.

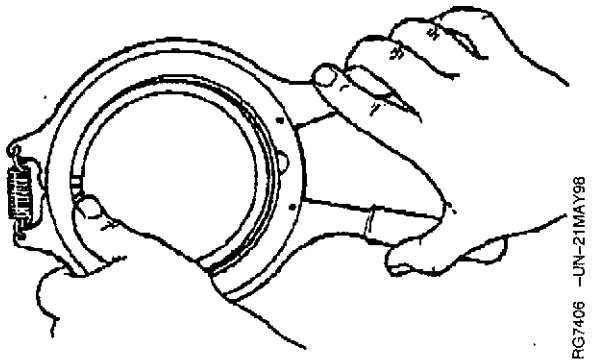
RG5074

D17006BR

DPSG,OUO1004,971 –19–02AUG99–6/16

Piston Ring Expander JDG967

Use to control the expansion of the piston rings during removal and installation of the pistons. This tool prevents over-expansion and damage to the rings.



JDG967

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DPSG,OUO1004,971 –19–02AUG99–7/16

RG8516 –UN–20MAY98

Piston Ring Groove Wear Gauge JDG1019

Use as a go/no-go gauge to measure wear on the two top compression piston ring grooves on RE52836 aluminum pistons used in earlier 6105 engines with 4-mm piston rings.

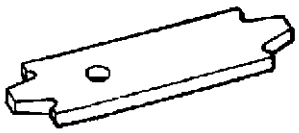
JDG1019

DPSG,OUO1004,971 –19–02AUG99–8/16

RG8517 –UN–20MAY98

Piston Ring Groove Wear Gauge JDG1022

Use as a go/no-go gauge to measure wear on the two top compression piston ring grooves on RE66125 steel crown pistons used in earlier 6125 engines with 4-mm piston rings.



JDG1022

DPSG,OUO1004,971 –19–02AUG99–9/16

RG8516 –UN–20MAY98

Piston Ring Groove Wear Gauge JDG1335

Use as a go/no-go gauge to measure wear on the two top compression piston ring grooves on later 6105 and 6125 engines with RE504343 (6105) and RE503969 (6125) pistons with 3-mm compression rings.

JDG1335

Continued on next page

DPSG,OUO1004,971 –19–02AUG99–10/16

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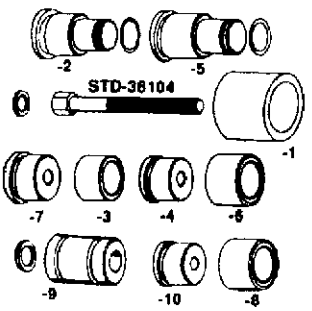
4

Connecting Rod Bushing Set JDE98A

Remove and install connecting rod bushings. Set consists of JDE98-1 Cup, JDE98-2 Driver, JDE98-3 Pilot, JDE98-4 Driver, JDE98-5 Driver, JDE98-6 Pilot, JDE98-7 Driver, JDE98-8 Cup, JDE98-9 Pilot, JDE98-10 Remover Bushing, STD36104 Forcing Screw.



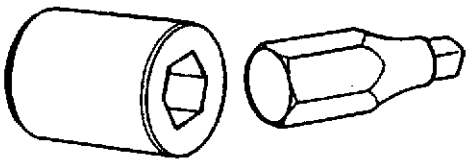
RG5078 RG5078 –UN–07NOV97

JDE98A

DPSG,OUO1004,971 –19–02AUG99–11/16

Oil Galley Plug Tool. JDG782

Use to remove and install cylinder block oil galley plug.



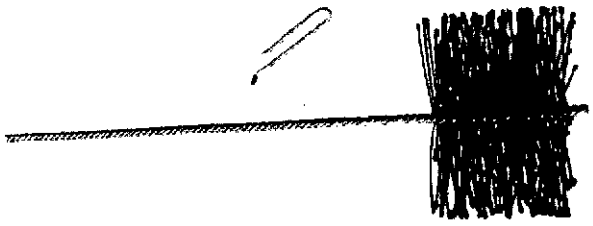
RG6612 –UN–29JAN93

JDG782

DPSG,OUO1004,971 –19–02AUG99–12/16

O-Ring Groove Cleaning Brush D17015BR

Clean cylinder liner O-ring groove in block.



RG5075 RG5075 –UN–07NOV97

D17015BR

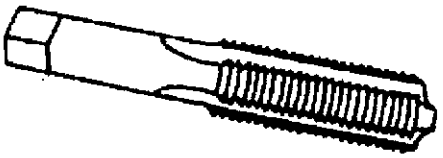
Continued on next page

DPSG,OUO1004,971 –19–02AUG99–13/16

RG5100 –UN–05DEC97

Tap JDG978

Used to restore threaded holes in cylinder block for cylinder head cap screws.



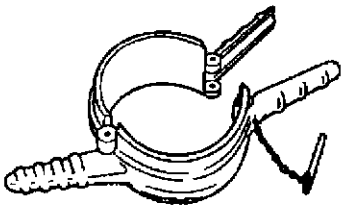
RG5100

JDG978

DPSG,OUO1004,971 –19–02AUG99–14/16

Piston Ring Compressor. JDG1017

Use to compress piston rings during installation of the piston.



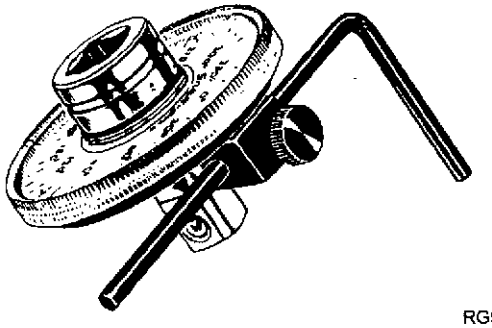
RG8515 –UN–20MAY98

JDG1017

DPSG,OUO1004,971 –19–02AUG99–15/16

Torque Angle Gauge JT05993

Used to TORQUE-TURN cylinder head and connecting rod cap screws.



RG5698 –UN–05DEC97

RG5698

JT05993

DPSG,OUO1004,971 –19–02AUG99–16/16

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6

SERVICE EQUIPMENT AND TOOLS

NOTE: Order tools according to information given in the U.S. SERVICEGARD™ Catalog or from the European Microfiche Tool Catalog (MTC). Some tools may be available from a local supplier.

SERVICEGARD is a trademark of Deere & Company

DPSG,OUO1004,972 –19–02AUG99–1/3

Cylinder Liner Bore Ridge Reamer JT07277

Remove carbon from liner bore prior to piston removal.

DPSG,OUO1004,972 –19–02AUG99–2/3

Precision "Bevelled Edge" Straightedge D05012ST

Check cylinder head flatness.

DPSG,OUO1004,972 –19–02AUG99–3/3

OTHER MATERIAL

Number	Name	Use
TY6304 (U.S.) TY9484 (Canadian) 515 (LOCTITE®)	Flexible Sealant	Front plate gasket.
— (U.S.)	PLASTIGAGE®	Determine connecting rod bearing-to-journal oil clearance.
AR54749 (U.S.)	Soap Lubricant	Coat O-rings on cylinder liners.
TY16285 (U.S.)	Clean-and-Cure Primer	Clean mating gasket surfaces on timing gear cover and camshaft gear access cover.
T43512 (U.S.) TY9473 (Canadian) 242 (LOCTITE®)	Thread Lock and Sealer (Medium Strength)	Apply to timing gear cover gasket and camshaft gear access cover gasket.

LOCTITE is a registered trademark of Loctite Corp.
PLASTIGAGE is a registered trademark of DANA Corp.

DPSG,OUO1004,973 –19–02AUG99–1/1

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CYLINDER BLOCK, LINERS, PISTONS AND RODS SPECIFICATIONS

Item	Measurement	Specification
Front Plate-to-Cylinder Block Cap Screws	Torque	50 N•m (37 lb-ft)
Crankshaft Timing Pin Plug	Torque	33 N•m (24 lb-ft)
Cylinder Liner Cap Screws (For Checking Liner Standout)	Torque	68 N•m (50 lb-ft)
Cylinder Liner Height (Standout)	Height Above Block	0.030—0.117 mm (0.0012—0.0046 in.)
	Maximum Permissible Height Difference at nearest Point of Two Adjacent Liners or Within One Liner	0.05 mm (0.002 in.)
Cylinder Liner Shims Available	Thickness Thickness	0.05 mm (0.002 in.) 0.10 mm (0.004 in.)
Cylinder Liner Wall	Thickness	9.39—9.43 mm (0.370—0.371 in.)
Cylinder Liner Packing Step	Dimension	2.14—2.30 mm (0.084—0.090 in.)
Cylinder Liners		
Flange Area	OD	151.565—151.615 mm (5.9671—5.9691 in.)
Upper OD for Seating Liner	OD	145.795—145.845 mm (5.7400—5.7419 in.)
Water Jacket Area	OD	144.73—144.99 mm (5.698—5.708 in.)
Lower OD for Seating with O-Rings	OD	140.397—140.447 mm (5.5274—5.5294 in.)
No. 1 Piston Compression Ring (4 mm Rings)	End Gap	0.43—0.69 mm (0.017—0.027 in.)
No. 2 Piston Compression Ring (4 mm Rings)	End Gap	1.01—1.27 mm (0.040—0.050 in.)

Continued on next page

Item	Measurement	Specification
No. 1 Piston Compression Ring (3 mm Rings)	End Gap	0.48—0.74 mm (0.019—0.029 in.)
No. 2 Piston Compression Ring (3 mm Rings)	End Gap	1.35—1.65 mm (0.053—0.065 in.)
Oil Control Ring-to-Groove (RE52836 and RE66125 Pistons)	Clearance	0.064—0.114 mm (0.0025—0.0045 in.)
	Maximum Clearance	0.165 mm (0.0065 in.)
Oil Control Ring-to-Groove (RE504343 and RE503969 Pistons)	Clearance	0.041—0.091 mm (0.0016—0.0036 in.)
	Maximum Clearance	0.132 mm (0.0052 in.)
Piston Skirt (6105)	OD 29.97 mm (1.180 in.) From Bottom of Piston	126.872—126.898 mm (4.9950—4.9960 in.)
Piston Skirt (6125)	OD 35.0 mm (1.380 in.) From Bottom of Skirt	126.910—126.930 mm (4.9965—4.9972 in.)
Cylinder Liner	ID	126.990—127.010 mm (4.9996—5.0004 in.)
	Max. Out of Round	0.020 mm (0.0008 in.)
	Max. Wear or Taper (Ring Travel Area)	0.030 mm (0.0012 in.)
Piston-to-Liner Clearance (New Part 6105)	Clearance	0.092—0.138 mm (0.0036—0.0054 in.)
	Max. Acceptable Wear	0.152 mm (0.0060 in.)
Piston-to-Liner Clearance (New Part 6125)	Clearance	0.060—0.100 mm (0.0024—0.0039 in.)
	Max. Acceptable Wear	0.152 mm (0.0060 in.)
Cylinder Liner Flange	Thickness	9.525—9.575 mm (0.3750—0.3770 in.)
Tongue-and-Groove Connecting Rod Cap Screw	Initial Torque	27 N•m (20 lb-ft)
Tongue-and-Groove Connecting Rod Cap Screw	Final Torque	75 N•m (55 lb-ft) plus 90–100° turn clockwise

Continued on next page

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Item	Measurement	Specification
Precision Joint™ Connecting Rod Cap Screw	Torque	140 N•m (103 lb-ft) plus 90–100° turn clockwise
Crankshaft Rod Journal	OD	88.844—88.874 mm (3.4980—3.4990 in.)
Connecting Rod Bearing for Crankshaft Journal (Assembled)	ID	88.93—88.98 mm (3.501—3.502 in.)
Connecting Rod Bearing-to-Journal (New Part)	Oil Clearance Max. Oil Clearance	0.06—0.13 mm (0.002—0.005 in.) 0.15 mm (0.006 in.)
Connecting Rod Bore (For Crankshaft Journal Bearing)	ID	93.76—93.79 mm (3.6915—3.6925 in.)
Connecting Rod Centerline of Piston Pin Bore-to-Crankshaft Bore (New Part)	Dimension	263.95—264.05 mm (10.392—10.396 in.)
Piston Pin Bore Specifications		
Piston Pin	OD	50.772—50.787 mm (1.9989—1.9995 in.)
Rod Pin Bore Without Bushing	ID	55.529—55.555 mm (2.1862—2.1872 in.)
Installed Rod Pin Bushing (Before Boring)	ID	50.729—50.781 mm (1.9972—1.9992 in.)
Installed Rod Pin Bushing (After Boring)	ID	50.805—50.830 mm (2.0002—2.0012 in.)
Piston Pin Bushing Bore	Out-of-Round	0.038 mm (0.0015 in.)
Piston Pin-to-Bushing	Oil Clearance Max. Acceptable Wear	0.017—0.059 mm (0.0007—0.0023 in.) 0.076 mm (0.0030 in.)
Press Fit of Bushing in Rod Pin Bore	Press Fit	0.100—0.163 mm (0.0039—0.0064 in.)

Precision Joint is a trademark of Deere & Company

Continued on next page

Item	Measurement	Specification
Cylinder Liner Flange Counterbore	Depth in Block	9.461—9.512 mm (0.3725—0.3745 in.)
Main and Thrust Bearings	Assembled ID without Bearings	133.097—133.123 mm (5.2400—5.2410 in.)
	Main Bearing Surface Width	37.77—38.03 mm (1.487—1.497 in.)
	Thrust Bearing Surface Width (No. 5 Main)	37.51—38.29 mm (1.476—1.507 in.)
	Overall Thrust Bearing Cap Width	43.25—43.75 mm (1.703—1.722 in.)
Cylinder Block Top Deck Surface Finish	Surface Finish (surface mill only)	3.2 micrometers (125 micro-in.)
	Max. Wave Height	0.008 micrometers (0.0002 micro-in.)
	Max. Wave Depth	2.0 micrometers (79 micro-in.)
Main Bearing Bore Centerline-to-Top Deck	Minimum Distance	429.92—430.07 mm (16.926—16.932 in.)
Cylinder Block Bore for Seating Liner		
Liner Flange Counterbore	ID	153.57—153.77 mm (6.046—6.054 in.)
Upper Block Bore for Seating Liner	ID	145.845—145.895 mm (5.7419—5.7439 in.)
Lower Block Bore for Seating Liner	ID	140.465—140.515 mm (5.5301—5.5321 in.)
Piston	Protrusion Above Block Deck	0.229—0.787 mm (0.009—0.031 in.)
Piston Spray Jet Cap Screws	Torque	15 N•m (11 lb-ft)
Oil Gallery Plug	Torque	20 N•m (15 lb-ft)
Main Oil Gallery (Front) Expansion Plug	Installed Depth	Flush—1.5 mm (0.059 in.) Below Surface

DPSG,OUO1004,974 -19-03AUG99-4/4

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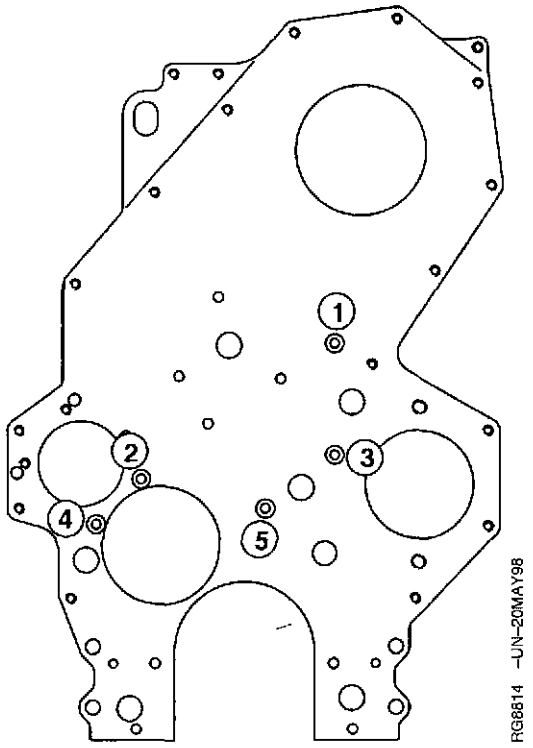
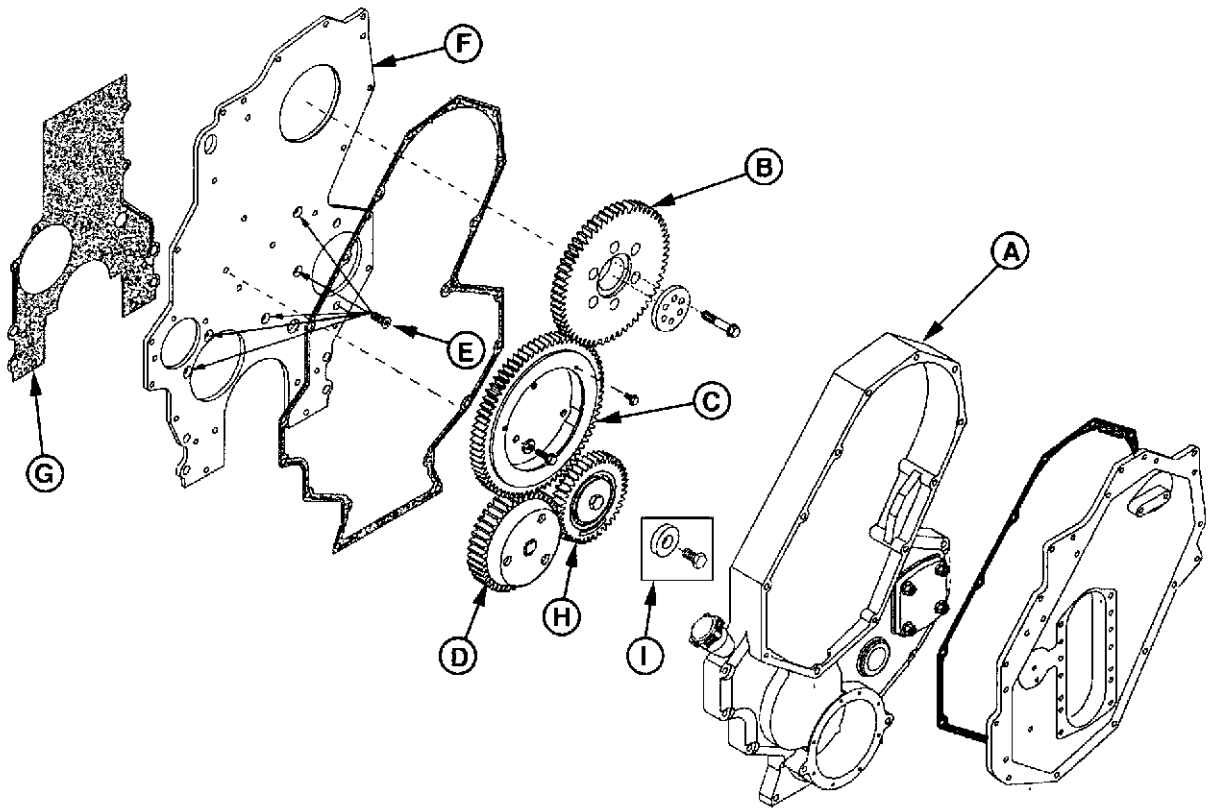
FRONT PLATE-TO-CYLINDER BLOCK TORQUE SEQUENCE



Front Plate Torque Sequence

RG,RG34710,105 –19–30SEP97–1/1

REMOVE AND INSTALL CYLINDER BLOCK FRONT PLATE



Front Plate and Timing Gear Cover Exploded View

A—Timing Gear Cover
B—Camshaft Gear
C—Idler Gear
D—Oil Pump Gear
E—Screws (5 Used)
F—Front Plate
G—Front Plate Gasket
H—Auxiliary Drive Gear
I—Without Auxiliary Drive Gear

REMOVE FRONT PLATE

1. Lock engine at No.1 TDC compression stroke by installing JDG971 Timing Pins in camshaft and crankshaft. (See CHECK AND ADJUST CAMSHAFT-TO-CRANKSHAFT TIMING in Group 16.)
2. Remove timing gear cover (A). (See REMOVE TIMING GEAR COVER in Group 15.)
3. Remove camshaft gear (B) and idler gear assembly (C). (See CHECK AND ADJUST CAMSHAFT-TO-CRANKSHAFT TIMING in Group 16.)
4. Remove engine oil pump assembly (D). (See REMOVE OIL PUMP in Group 20.)
5. Remove auxiliary drive gear (H) if equipped. (See REMOVE AND INSTALL AUXILIARY DRIVE IDLER GEAR AND BEARING in CTM67, OEM Engine Accessories, Group 54.)

IMPORTANT: Tap head of countersunk cap screws sharply with a brass punch and use an Allen-Head adapter that does not have corners rounded off.

6. Remove five countersunk screws (E) and remove front plate (F) from dowels.

Continued on next page

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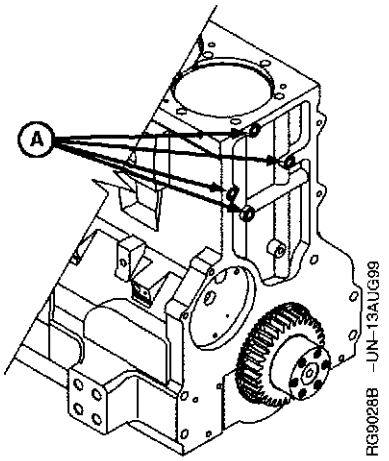
7. Remove gasket (G) and discard. Thoroughly clean gasket surfaces on cylinder block and front plate.

RG,RG34710,106 –19–13AUG99–2/4

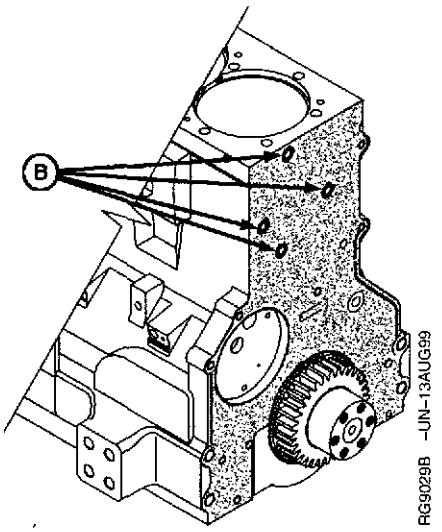
INSTALL FRONT PLATE

IMPORTANT: All gasket contact surfaces MUST BE clean, dry, and free of oil.

1. Apply TY6304 LOCTITE® 515 Flexible Sealant to four upper threaded locations (A) on front face of cylinder block.
2. Install new gasket onto dowels in cylinder block.
3. Apply TY6304 LOCTITE® 515 Flexible Sealant to gasket locations (B).



Applying Sealant to Cylinder Block



Applying Sealant to Gasket

A—Upper Threaded Locations
B—Gasket Locations

LOCTITE is a registered trademark of Loctite Corp.

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RG,RG34710,106 –19–13AUG99–3/4

4. Install front plate onto front face of block.
5. Install five countersunk screws and tighten to specifications, following sequence in illustration.

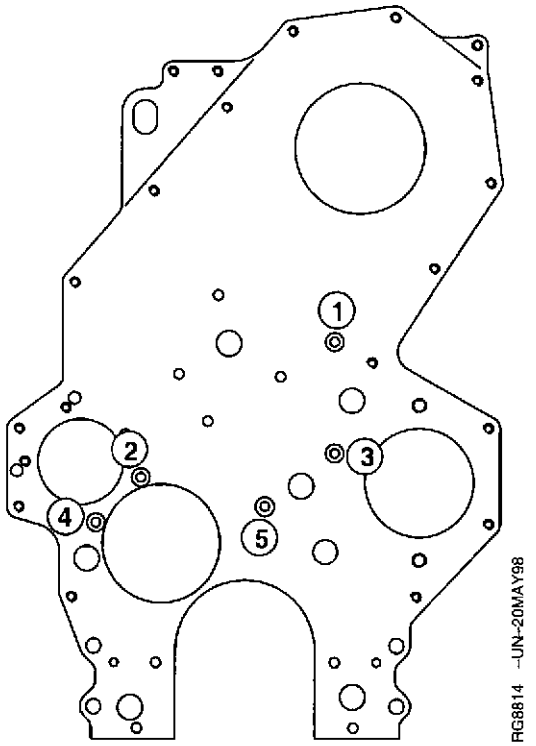
Front Plate-to-Cylinder Block Cap Screws—Specification

Torque ..... 50 N•m (37 lb-ft)

6. Install engine oil pump assembly. (See INSTALL ENGINE OIL PUMP in Group 20.)
7. Install idler gear and camshaft gear. Adjust gear backlash. (See CHECK AND ADJUST CAMSHAFT-TO-CRANKSHAFT TIMING in Group 16.)
8. Install auxiliary drive gear (if equipped). (See REMOVE AND INSTALL AUXILIARY DRIVE IDLER GEAR AND BEARING in CTM67, OEM Engine Accessories, Group 54.)
9. Install timing gear cover. (See INSTALL TIMING GEAR COVER in Group 15.)
10. Install engine oil pan. (See INSTALL ENGINE OIL PAN in Group 20.)
11. Install crankshaft vibration damper and pulley. (See INSTALL VIBRATION DAMPER AND FRONT OIL SEAL in Group 15.)
12. Remove JDG971 Timing Pins and install rocker arm cover. (See REMOVE AND INSTALL ROCKER ARM COVER in Group 5.)
13. Install crankshaft timing pin plug and tighten to specifications.

Crankshaft Timing Pin Plug—Specification

Torque ..... 33 N•m (24 lb-ft)



Front Plate Torque Sequence

RG,RG34710,106 –19–13AUG99–4/4

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16

PRELIMINARY LINER, PISTON, AND ROD CHECKS

SCUFFED OR SCORED PISTONS:

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

WORN OR BROKEN COMPRESSION RINGS:

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

CLOGGED OIL CONTROL RING:

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

STUCK RINGS:

- Improper oil classification.
- Improper periodic service.
- Poor operating conditions.
- Coolant leakage into crankcase.
- Excessive cylinder liner taper.

MOTTLED, GRAYISH OR PITTED COMPRESSION RINGS:

- Internal coolant leaks.

DULL SATIN FINISH AND FINE VERTICAL SCRATCHES ON RINGS:

- Dirt and abrasives in air intake system.

PISTON PIN AND SNAP RING FAILURE:

- Misaligned connecting rod.
- Excessive crankshaft end play.
- Incorrect snap rings.

BROKEN CONNECTING ROD:

- Inadequate piston-to-liner clearance.
- Worn connecting rod bearing.
- Distorted cylinder line.
- Piston pin failure.

CYLINDER LINER WEAR AND DISTORTION:

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

WARPED CYLINDER BLOCK:

- Insufficient cooling.

RG,RG34710,1112 -19-06MAY99-1/1

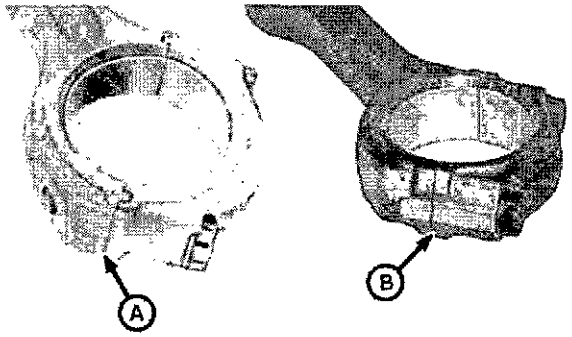
CONNECTING RODS—GENERAL INFORMATION

Earlier engines have the traditional tongue-and-groove between the connecting rod and cap (A). Later engines have the Precision Joint™ rod and cap (B).

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

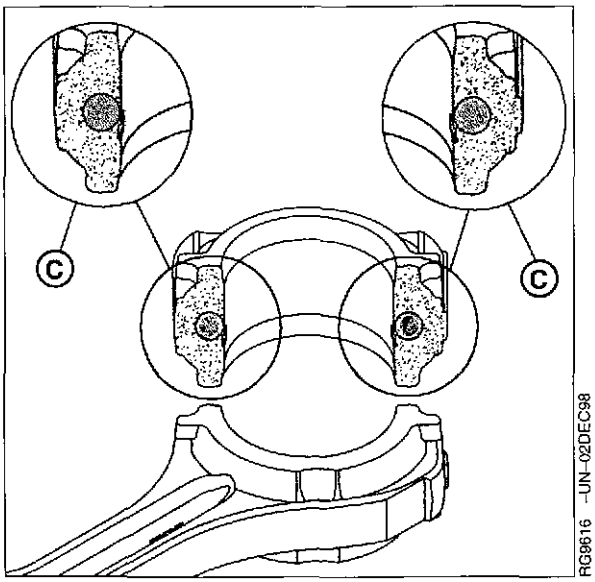
Both types of rods provide a strong joint. Removal and installation is similar, with differences noted, including different torque specifications for cap screws.

IMPORTANT: Replace rods with the same type. Do Not mix tongue-and-groove with Precision Joint™ rods in the same engine. See parts catalog for recommendations.



RG10300 –UN–27AUG99

Connecting Rods



RG9616 –UN–02DEC98

Precision Joint™ Rod (Later Engines)

A—Tongue-and-Groove Rod (Early Engines)
B—Precision Joint™ Rod (Later Engines)
C—Precision Joint™ Details

Precision Joint is a trademark of Deere & Company

DPSG,OUO1004,871 –19–30JUL99–1/1

10 18

REMOVE PISTONS AND CONNECTING RODS

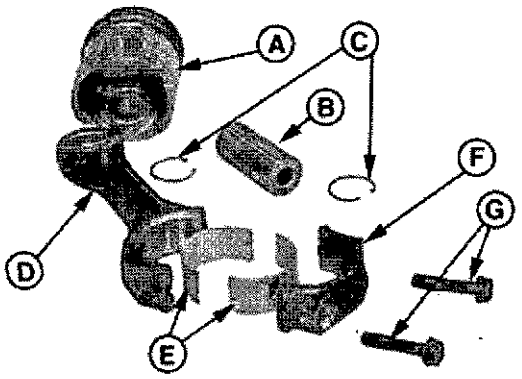
The engine does not always have to be removed from the machine to service the pistons and connecting rods. If engine is to be removed, see your Machine Technical Manual.

CAUTION: DO NOT drain engine coolant until it cools below operating temperature. Then slowly loosen block drain valve to relieve any pressure.

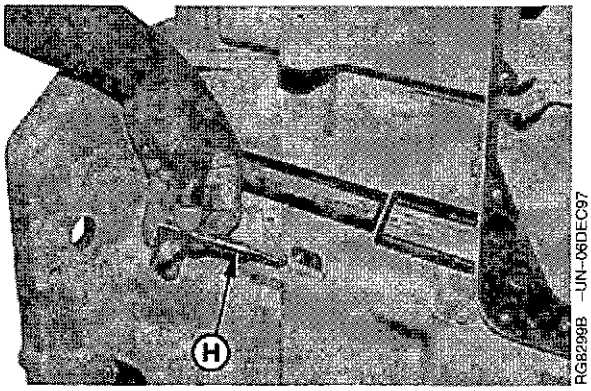
1. Drain all coolant and engine oil.
2. Remove all piston spray jets.

NOTE: If engine is to be completely disassembled, follow ENGINE DISASSEMBLY SEQUENCE in Group 04.

3. Remove cylinder head. (See REMOVE CYLINDER HEAD in Group 05.)
4. Remove oil pan. (See REMOVE OIL PAN in Group 20.) Remove oil pick-up tube. (See REMOVE AND INSTALL OIL PICKUP TUBE in Group 20.)



Piston and Rod Exploded View



Removing Piston Spray Jets

A—Piston with Rings
B—Piston Pin
C—Snap Ring (2 used)
D—Connecting Rod with Bushing
E—Rod Bearings
F—Connecting Rod Cap
G—Special Cap Screws
H—Piston Spray Jet

Continued on next page

RG,RG34710,107 –19–13AUG99–1/4

IMPORTANT: Do not rotate crankshaft with cylinder head removed unless liners are bolted down. Bolt liners down before removing piston.

Cap screws and washers must be tightened to 68 N•m (50 lb-ft) to achieve an accurate reading when checking liner standout (height above block), as detailed later in this group.

5. Use seven M16 x 2.0 x 55 mm (2.17 in.) long cap screws (A) and 5/8 in. ID x 1-3/4 in. OD x 3.18 mm (1/8 in.) thick washers (B) to bolt down cylinder liners (C) in the seven locations as shown. Tighten cap screws to 68 N•m (50 lb-ft).

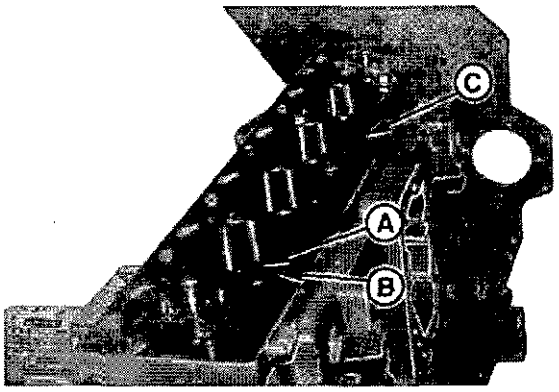
Cylinder Liner Cap Screws (For Checking Liner Standout)—Specification

Torque ..... 68 N•m (50 lb-ft)

6. Before removing pistons, visually inspect condition of cylinder liners with pistons at bottom dead center "BDC". *Liners will require replacement if:*

   - The crosshatch honing pattern is not visible immediately below the top ring turn around area.
   - Liners are pitted or contain deep vertical scratches that can be detected by the fingernail.

   No further inspection is required if any one of the above conditions are found.



RGB302 –UN–06DEC97

Bolting Liners Down

A—Long Cap Screws
B—Thick Washers
C—Bolt Down Cylinder Liners

Continued on next page

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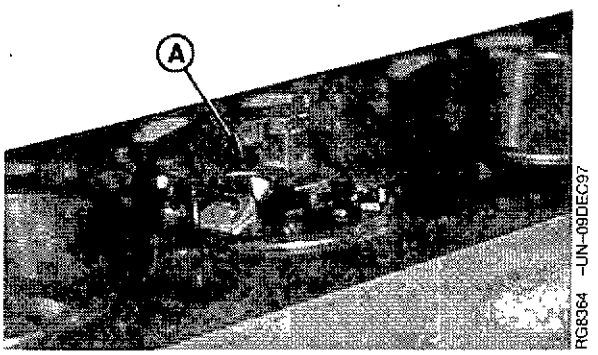
NOTE: Always follow manufacturer's directions provided with ridge reamer.

7. Remove carbon ridge from liner bore with a scraper or JT07277 Ridge Reamer (A). Use compressed air to remove loose carbon from cylinders.



Using Liner Ridge Reamer

A—JT07277 Ridge Reamer

Continued on next page

RG,RG34710,107 –19–13AUG99–3/4

8. Mark rods, pistons, and caps to ensure correct assembly in same location.

IMPORTANT: Keep bearing inserts with their respective caps for rod and main bearings.

9. Remove all rod caps (A) with bearings.

NOTE: Use PLASTIGAGE® to determine bearing-to-journal oil clearance as directed by the manufacturer.PLASTIGAGE® will determine bearing-to-journal oil clearance, but will not indicate the condition of either surface.

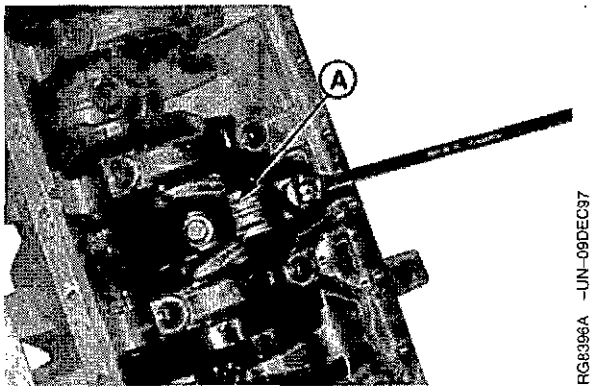
10. Measure rod bearing-to-journal oil clearance with PLASTIGAGE® before removing piston and rod assembly. Record measurements. (See INSPECT AND MEASURE CONNECTING ROD BEARINGS, later in this group.)

IMPORTANT: Hold on to piston to prevent piston from dropping. Piston will drop once piston rings have cleared cylinder liner bore.

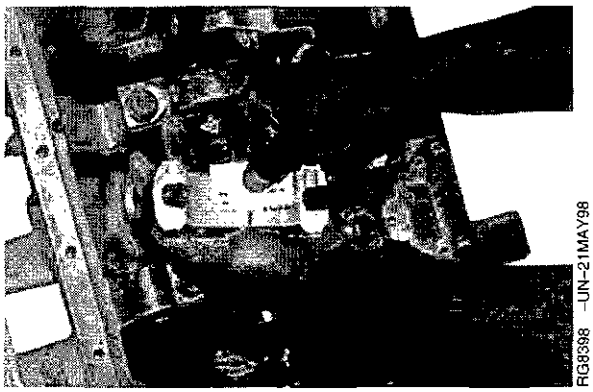
If liners are to be reused, be extremely careful not to let connecting rod hit liner bore when removing piston and rod assembly.

11. Gently tap piston through top of cylinder block from the bottom.

12. Remove remaining pistons and rods from engine.



Removing Rod Caps



Measuring Rod Bushing Oil Clearance

A—Rod Caps

PLASTIGAGE is a registered trademark of DANA Corp.

RG,RG34710,107 –19–13AUG99–4/4

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MEASURE CYLINDER LINER STANDOUT (HEIGHT ABOVE BLOCK)

IMPORTANT: Remove all gasket material, rust, carbon and other foreign material from top deck of cylinder block. Use compressed air to remove all loose foreign material from cylinders and top deck.

NOTE: Liners having obvious defects must be replaced as a matched piston and liner set.

1. Bolt liners down in seven locations using cap screws and washers. (See REMOVE PISTONS AND CONNECTING RODS, earlier in this group.) Tighten cap screws to 68 N•m (50 lb-ft).

Cylinder Liner Cap Screws (For Checking Liner Standout)—Specification

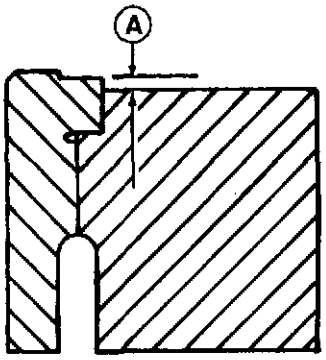
Torque ..... 68 N•m (50 lb-ft)

2. Using JDG451 Gauge (B) along with D17526CI (English scale) or D17527CI (Metric scale) Dial Indicator or KJD10123 Gauge (C), measure liner height (A) for all cylinders.

3. Measure each liner in four places at approximately 1, 5, 7, and 11 o'clock positions as viewed from rear of engine (flywheel end). Record all measurements by cylinder number.

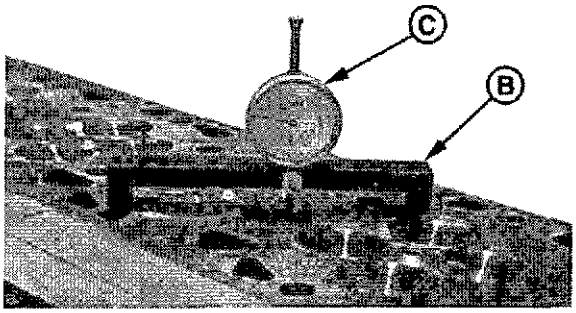
NOTE: Variations in measurement readings may occur within one cylinder and /or between adjacent cylinders.

4. If liner standout is below specification, measure liner flange thickness. (See MEASURE LINER FLANGE THICKNESS later in this group.) Measure liner counterbore depth in cylnder block. (See INSPECT AND CLEAN CYLINDER BLOCK, later in this group.)



RG6439 –UN–03NOV97

Liner Standout



RG8330B –UN–09DEC97

Measuring Liner Standout

A—Liner Height
B—JDG451 Gauge
C—KJD10123 Gauge

Continued on next page

RG,RG34710,108 –19–13AUG99–1/2

Cylinder Liner Height (Standout)—Specification

Height Above Block	*0.030—0.117 mm (0.0012—0.0046 in.)*
Maximum Permissible Height Difference at nearest Point of Two Adjacent Liners or Within *One Liner*	0.05 mm (0.002 in.)

Cylinder Liner Shims Available—Specification

Thickness	0.05 mm (0.002 in.)
Thickness	0.10 mm (0.004 in.)

IMPORTANT: ONE LINER SHIM ONLY may be installed under any given liner flange.

5. Add shims or replace any liner that does not meet standout specification at any location.

RG,RG34710,108 -19-13AUG99-2/2

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REMOVE CYLINDER LINERS USING D01062AA OR D01073AA CYLINDER LINER PULLER

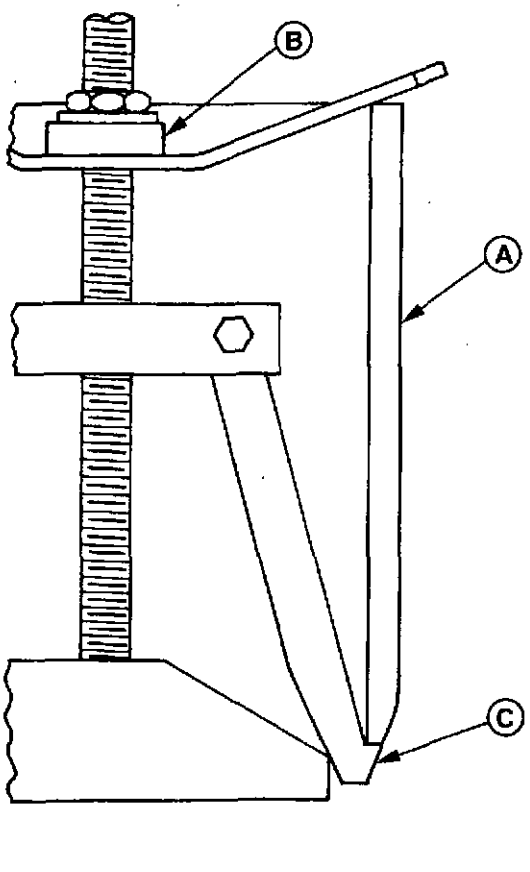
1. Remove cap screws and washers securing liners to cylinder block.
2. Number cylinder liners and mark fronts to ensure correct assembly.

NOTE: Each cylinder liner must be reinstalled in same cylinder bore from which removed. Always keep matched pistons and liners together.

3. Use D01062AA or D01073AA Cylinder Liner Puller (B) with a 2.27 Kg (5.0 lb) slide hammer to remove cylinder liner (A).

IMPORTANT: When using D01062AA (or D01073AA) Cylinder Liner Puller (B) to remove liners (A), be sure jaw (C) of puller is correctly positioned before attempting to remove liner.

DO NOT over-tighten liner puller to remove liners. Doing so could easily break liners.



Removing Cylinder Liners

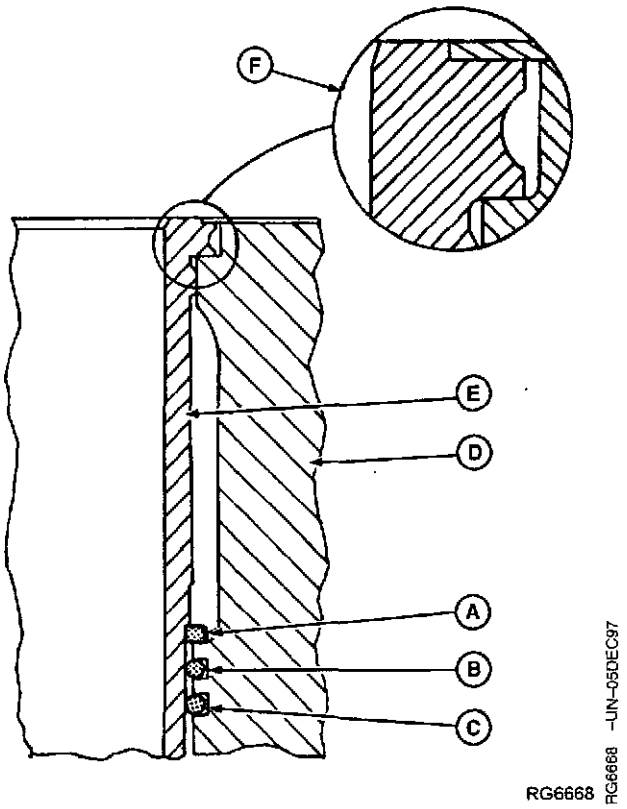
A—Liners
B—Cylinder Liner Puller
C—Sure Jaw

Continued on next page

RG,RG34710,109 –19–13AUG99–1/2

4. Remove the cylinder liner square packing (A) from liner (E).

5. Remove red O-ring (B) and black O-ring (C) from cylinder block (D).



Cylinder Liner Packing

A—Square Packing (Neoprene)
B—Red O-Ring (Silicone)
C—Black O-Ring (Viton)
D—Cylinder Block
E—Cylinder Liner
F—Coolant Passage

RG,RG34710,109 –19–13AUG99–2/2

10 26

REMOVE CYLINDER LINERS USING JDG1145 CYLINDER LINER SERVICE SET

NOTE: JDG1145 Liner Puller (A) shown with liner removed to illustrate proper assembly of tool.

1. Remove cap screws and washers securing liners to cylinder block.
2. Number cylinder liners and mark fronts to ensure correct assembly.

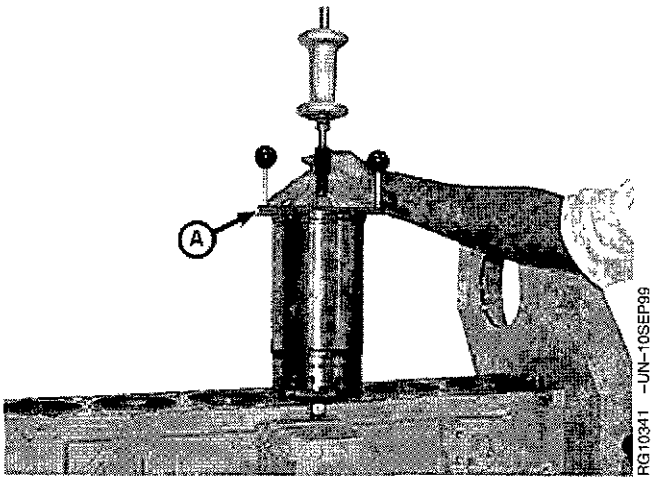
NOTE: Each cylinder liner must be reinstalled in same cylinder bore from which removed. Always keep matched pistons and liners together.

3. Use JDG1145 Cylinder Liner Service Set (A) with a 2.27 Kg (5.0 lb) slide hammer (B) to remove cylinder liner.

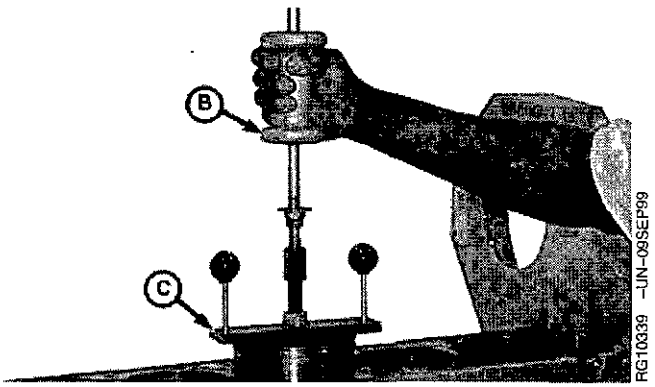
IMPORTANT: When using JDG1145 as shown (A) to remove liners, make sure puller is properly assembled before attempting to remove liners. Step in bottom plate of puller assembly should fit in ID of liner.

DO NOT over-tighten liner puller to remove liners. Doing so could easily break liners.

4. Install liner puller (C) in liner.
5. Attach a 2.27 Kg (5.0 lb) slide hammer (B) to liner puller as shown and remove liner.



JDG1145 Installation

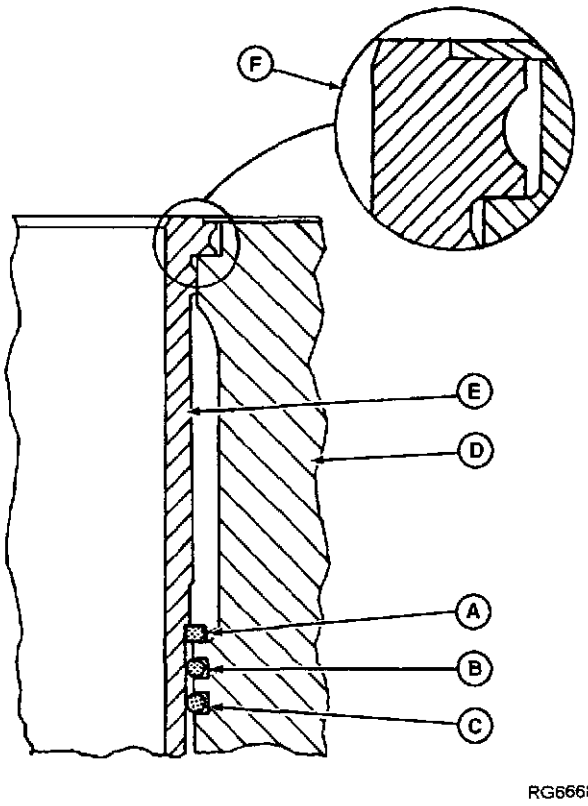


Remove Cylinder Liner

A—JDG1145
B—Slide Hammer
C—Liner Puller

Continued on next page

6. Remove the cylinder liner square packing (A) from liner (E).
7. Remove red O-ring (B) and black O-ring (C) from cylinder block (D).



Cylinder Liner Packing

A—Square Packing (Neoprene)
B—Red O-Ring (Silicone)
C—Black O-Ring (Viton)
D—Cylinder Block
E—Cylinder Liner
F—Coolant Passage

DPSG,OUO1004,1026 –19–09SEP99–2/2

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VISUALLY INSPECT CYLINDER LINERS

IMPORTANT: If pitting has occurred, check condition of coolant.

1. Inspect exterior length of liner for pitting (A). Check packing step for erosion (B). If pitting or erosion is observed, measure the depth of pits and erosion with a fine wire or needle.

   Replace piston and liner if:

   - Pitting depth is one-half liner thickness (C) or more.

Cylinder Liner Wall—Specification

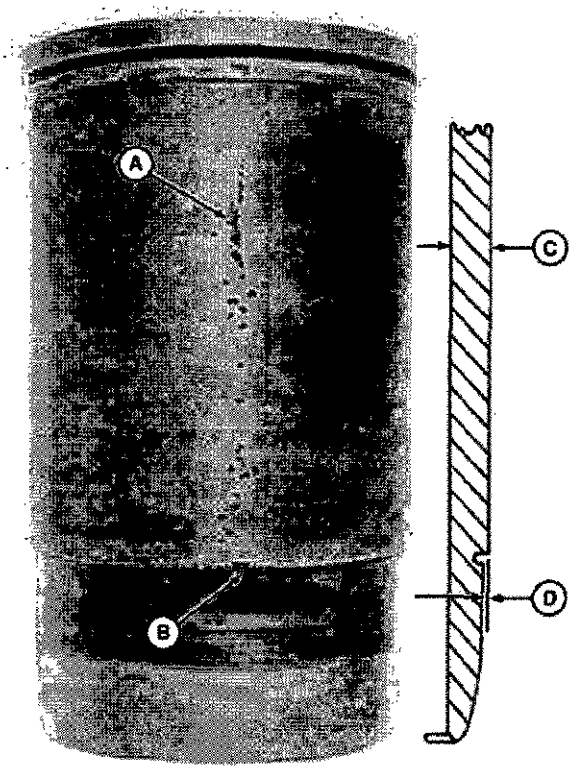
Thickness	9.39—9.43 mm (0.370—0.371 in.)

   - Erosion depth is one-half packing step (D) or more.

Cylinder Liner Packing Step—Specification

Dimension	2.14—2.30 mm (0.084—0.090 in.)

NOTE: Liners are reusable if the depth of pits or erosion is less than one-half the amount specified. When installing these liners, rotate 90° from original position. The liners should be deglazed and ring sets installed on pistons.



RG4643 –UN–05DEC97

Liner Visual Inspection

A—Liner Pitting
B—Erosion
C—Pitting Depth Is One-Half Liner Thickness
D—Erosion Depth Is One-Half Packing Step

Continued on next page

2. Visually examine liner ID Replace piston and liner if:
   - The crosshatch honing pattern is not visible immediately below the top ring turn-around area.
   - Liners are pitted or contain deep vertical scratches that can be detected by the fingernail.
3. Carefully examine liner for signs of fatigue, such as fine cracks in the flange area (A) and cracks in the ring travel area (B).

NOTE: Inspect block for cracks or erosion in the O-ring packing areas. (See INSPECT AND CLEAN CYLINDER BLOCK, later in this group.)

4. Measure liner OD and compare to following specifications.

Flange Area—Specification

OD ..... 151.565—151.615 mm (5.9671—5.9691 in.)

Upper OD for Seating Liner—Specification

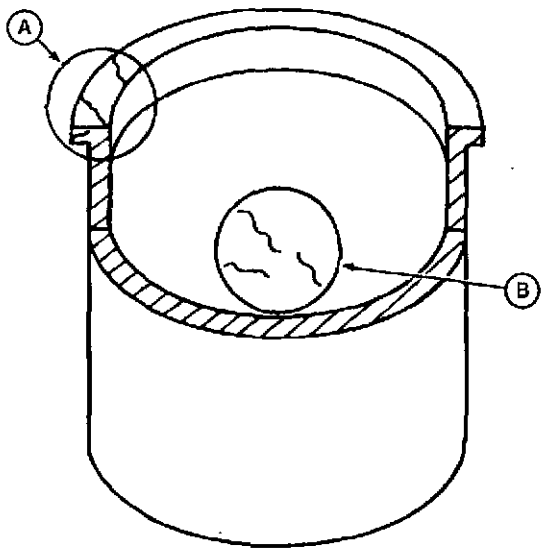
OD ..... 145.795—145.845 mm (5.7400—5.7419 in.)

Water Jacket Area—Specification

OD ..... 144.73—144.99 mm (5.698—5.708 in.)

Lower OD for Seating with O-Rings—Specification

OD ..... 140.397—140.447 mm (5.5274—5.5294 in.)



(Exaggerated defects)

RG1188 –UN–04DEC97

Liner ID Inspection

A—Cracks In The Flange Area
B—Cracks In The Ring Travel Area

RG,RG34710,110 –19–03AUG99–2/2

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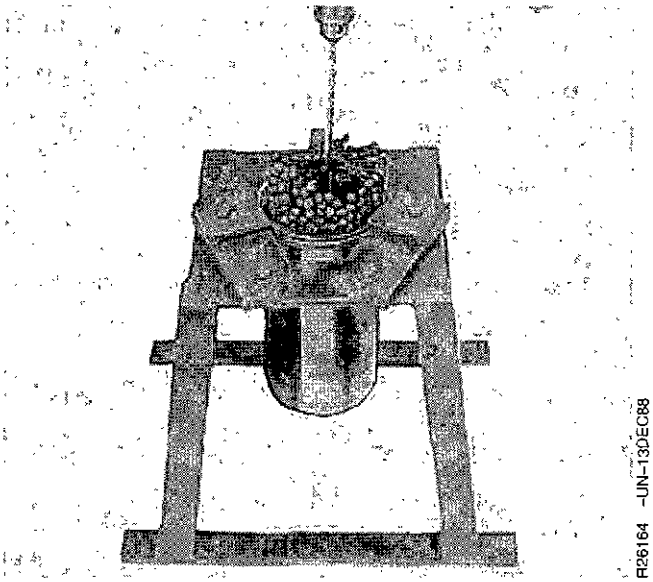
DEGLAZE CYLINDER LINERS

1. Secure cylinder liner in a holding fixture. See DFRG3—CYLINDER LINER HOLDING FIXTURE, in Group 99 for assembly of holding fixture.

2. Use D17006BR Flexible Cylinder Hone to deglaze cylinder liner.

NOTE: Use honing oil along with flex hone when deglazing liners.

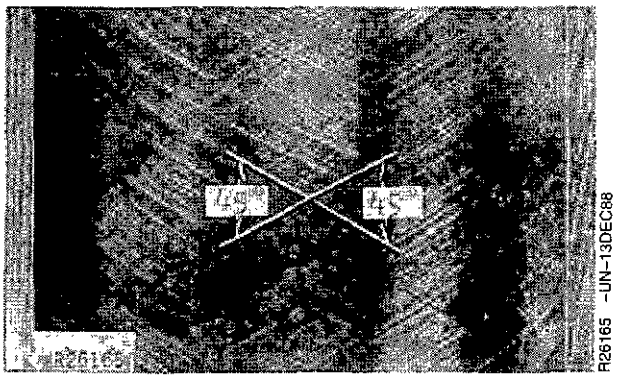


Deglazing Liners

RG,RG34710,111 –19–30SEP97–1/2

3. Use D17006BR Hone according to instructions supplied with tool to obtain a 45° cross-hatch pattern.

Thoroughly clean liners after deglazing. (See CLEAN CYLINDER LINERS, next in this group.)



Liner Cross-hatch

RG,RG34710,111 –19–30SEP97–2/2

CLEAN CYLINDER LINERS

1. Use a stiff bristle brush to remove all debris, rust, and scale from OD of liners, under liner flange, and in O-ring packing areas. Make certain there are no nicks or burrs in areas where packings will seat.

IMPORTANT: *Do not use gasoline, kerosene, or* commercial solvent to clean liners. Solvents will not remove all the abrasives from liner walls.

2. Thoroughly clean liner ID with a 50 percent solution of hot water and liquid detergent.
3. Rinse thoroughly and wipe dry with a clean rag.
4. Swab out liner as many times as necessary with clean SAE 10W oil.
5. Clean liner until a white rag shows no discoloration.

RG,RG34710,112 –19–30SEP97–1/1

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CYLINDER LINER MANUFACTURING DATE CODE EXPLANATION

A manufacturing four-digit date code will appear on each liner. For example, SJ96 15 means the liner has a non-hardened bore and was manufactured on the 15th day of October 1996.

SJ96 15

S ..... Liner Material Type
J ..... Month Liner was Manufactured
96 ..... Year Liner was Manufactured
15 ..... Day of Month Liner was Manufactured

Liner Material Specification:

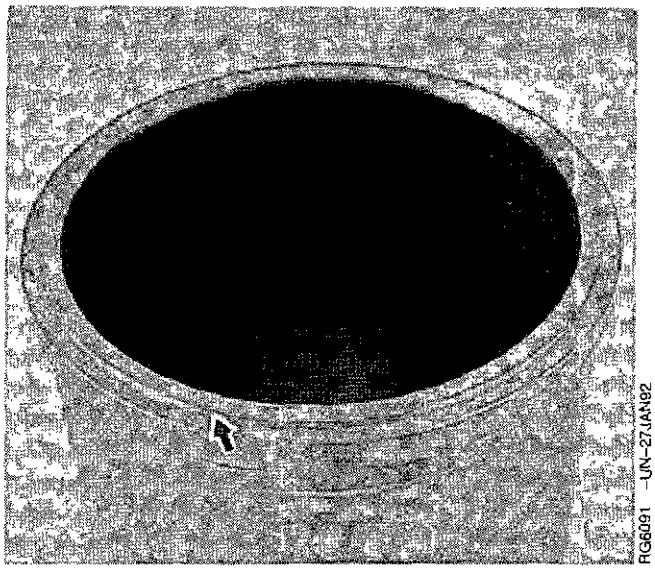
S ..... Non-hardened Liner Bore

Month Liner was Manufactured

A ..... January
B ..... February
C ..... March
D ..... April
E ..... May
F ..... June
G ..... July
H ..... August
I ..... September
J ..... October
K ..... November
L ..... December

Year Liner was Manufactured:

96 1996
97 1997
etc.



Liner Date Code

RG,RG34710,113 –19–30SEP97–1/1

DISASSEMBLE PISTON/ROD ASSEMBLY AND CLEAN PISTON

NOTE: Earlier engines with RE52836 (10.5 L) and RE66125 (12.5 L) pistons have 4 mm compression rings. Later engines with RE504343 (10.5 L) and RE503969 (12.5 L) pistons have 3 mm compression rings. Piston part numbers are marked on top of pistons for identification.

1. If necessary, check piston ring end gap prior to removing rings.

No. 1 Piston Compression Ring (4 mm Rings)—Specification

End Gap ..... 0.43—0.69 mm (0.017—0.027 in.)

No. 2 Piston Compression Ring (4 mm Rings)—Specification

End Gap ..... 1.01—1.27 mm (0.040—0.050 in.)

No. 1 Piston Compression Ring (3 mm Rings)—Specification

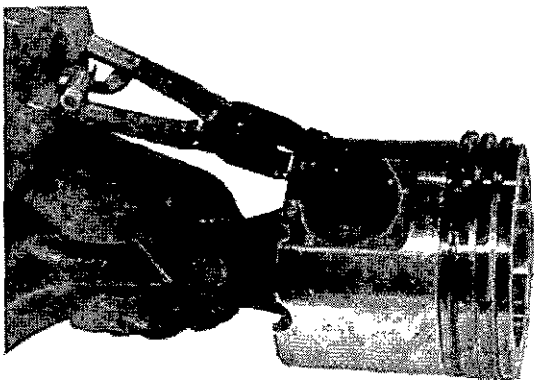
End Gap ..... 0.48—0.74 mm (0.019—0.029 in.)

No. 2 Piston Compression Ring (3 mm Rings)—Specification

End Gap ..... 1.35—1.65 mm (0.053—0.065 in.)

2. Remove piston snap rings. Remove piston pin and connecting rod from piston.

NOTE: Discard snap rings, DO NOT reuse.



RG8400 –UN–22MAY98

Removing Piston Pin Snap Ring

Continued on next page

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3. Remove piston rings (B) using the JDG967 Piston Ring Expander (A). Discard rings.

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

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

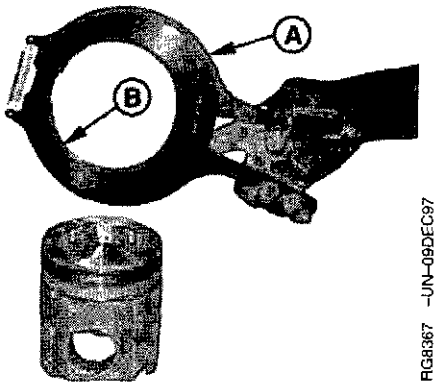
IMPORTANT: When washing pistons, always use a stiff bristle brush—NOT A WIRE BRUSH—to loosen carbon residue.

DO NOT bead blast ring groove areas.

5. Clean pistons by any of the following methods:

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

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



RG8367 –UN–09DEC97

Removing Piston Rings

A—JDG967 Piston Ring Expander
B—Piston Ring

RG,RG34710,114 –19–03AUG99–2/2

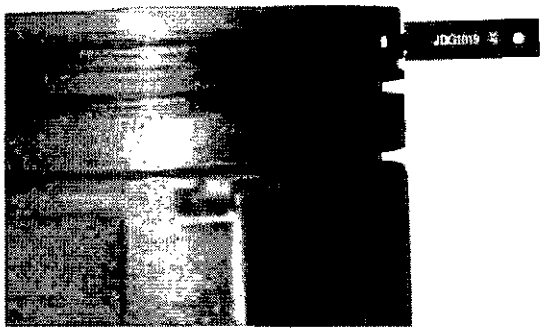
CHECK PISTON COMPRESSION RING GROOVE WEAR—6105 ENGINES

NOTE: Earlier engines with RE52836 pistons have 4-mm compression rings. Later engines with RE504343 pistons have 3-mm compression rings. Piston part numbers are marked on top of pistons for identification.

Use the JDG1019 Ring Groove Wear Gauge on RE52836 pistons (early engines) to check wear of top two compression ring grooves. Use the JDG1335 Ring Groove Wear Gauge on RE504343 pistons (later engines) to check wear of top two compression ring grooves.

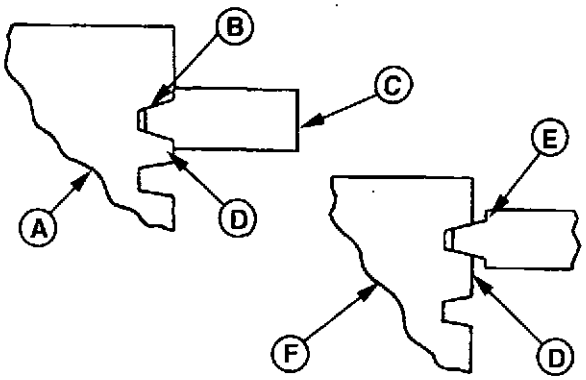
Check each groove at several locations.

Gauge shoulders should not contact ring land (D) of piston. If ring grooves are worn, replace piston and liner as a set. If ring grooves are good, proceed with piston inspection.



RG8373 –UN–21MAY98

Checking 6105 Piston Ring Groove (JDG1019 Shown on RE52836 Piston)



RGR24201 –UN–19NOV97

JDG1019 Ring Groove Wear Gauge Shown

A—Piston with Worn Ring Groove
B—Keystone Ring Groove
C—JDG1019 Ring Groove Wear Gauge
D—Ring Land
E—Gauge Shoulder
F—Piston with Good Ring Groove

RG,RG34710,115 –19–15OCT99–1/1

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CHECK PISTON COMPRESSION RING GROOVE WEAR—6125 ENGINES

NOTE: Earlier engines with and RE66125 pistons have 4 mm compression rings. Later engines with RE503969 pistons have 3 mm compression rings. Piston part numbers are marked on top of pistons for identification.

The illustrations to the right shows use of JDG1022 Wear Gauge on earlier RE66125 pistons. Use of JDG1335 on later RE503969 pistons is similar except the two compression ring grooves are the same on these pistons and only one side of the gauge is used to check both.

Check grooves at several locations around the circumference of piston crown. The word "TOP" on gage should always face top of piston.

Earlier RE66125 Pistons with 4-mm Rings:

Use the JDG1022 Ring Groove Wear Gauge (A), end marked "G1", to check wear of top compression ring groove.

Use end marked "G2" of JDG1022 Ring Groove Wear Gauge to check wear of middle compression ring groove.

If gauge shoulder contacts ring land of piston, ring groove is worn. Replace piston and liner as a set.

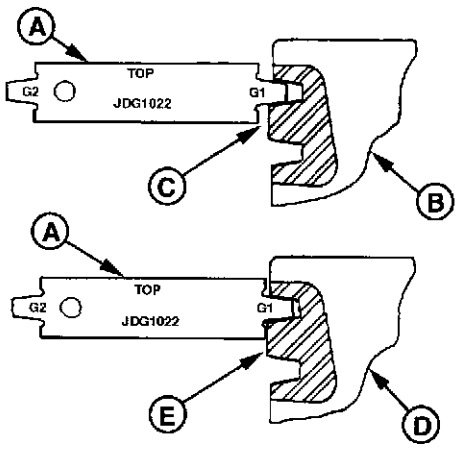
If ring grooves are good (B), proceed with piston inspection.

Later RE503969 Pistons with 3-mm Rings:

Use JDG1335 Ring Groove Wear Gauge to check wear of top two compression rings.

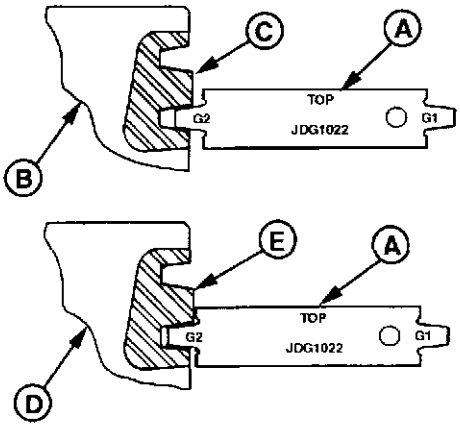
If gauge shoulder contacts ring land of piston, ring groove is worn. Replace piston and liner as a set.

If ring grooves are good (B), proceed with piston inspection.



RG8522 –UN–10DEC97

Using JDG1022 - Top Groove



RG8523 –UN–10DEC97

Using JDG1022 - Second Groove

A—JDG1022 Ring Groove Wear Gauge
B—Piston with Good Ring Groove
C—Acceptable Clearance
D—Piston with Worn Ring Groove
E—Gauge Shoulder Contacting Piston Ring Land

RG,RG34710,116 –19–15OCT99–1/1

CHECK PISTON OIL CONTROL RING GROOVE WEAR—6105 AND 6125 ENGINES

NOTE: Earlier engines with RE52836 (10.5 L) and RE66125 (12.5 L) pistons have 4.8 mm oil control rings. Later engines with RE504343 (10.5 L) and RE503969 (12.5 L) pistons have 4.0 mm oil control rings. Piston part numbers are marked on top of pistons for identification.

1. Check oil control ring-to-groove clearance by installing a new ring in groove.
2. Measure clearance with a feeler gauge at several points. Compare measurements with specifications given below.

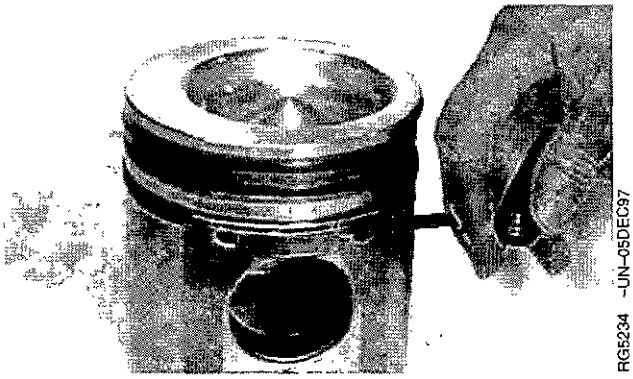
Oil Control Ring-to-Groove (RE52836 and RE66125 Pistons)—Specification

Clearance	0.064—0.114 mm (0.0025—0.0045 in.)
Maximum Clearance	0.165 mm (0.0065 in.)

Oil Control Ring-to-Groove (RE504343 and RE503969 Pistons)—Specification

Clearance	0.041—0.091 mm (0.0016—0.0036 in.)
Maximum Clearance	0.132 mm (0.0052 in.)

NOTE: Replace piston and liner (as a set) if oil control ring clearance exceeds specifications given.



Measuring Oil Control Ring Groove Wear

RG,RG34710,117 –19–17SEP99–1/1

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INSPECT PISTON PIN AND PIN BORE IN PISTON

NOTE: Piston pin must be in good condition and not worn beyond specification given below.

1. Dip piston pin in clean engine oil.

NOTE: On 6125 engines, assemble piston crown and skirt.

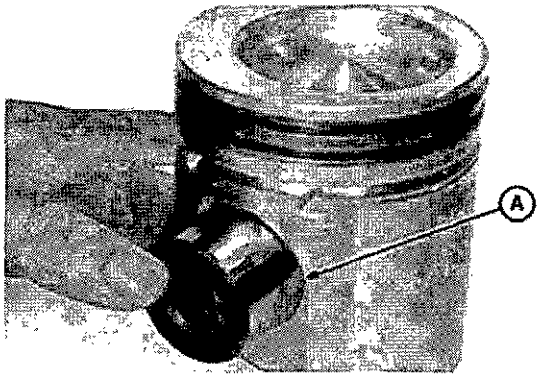
2. Install pin (A) through piston.

   Pin should pass through piston using only light thumb pressure.

3. Check taper in piston pin bore by inserting pin from both sides. If pin enters freely, but binds in the center, the bore could be tapered (B).

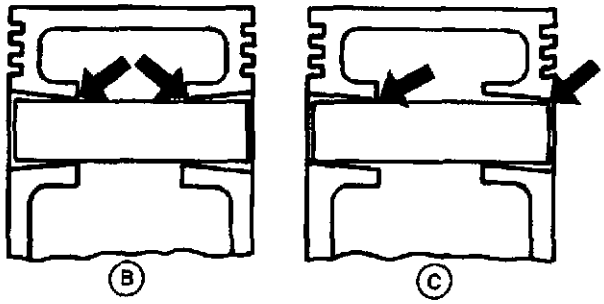
4. Insert pin in piston to check for bore alignment. Pin should not "click" or need to be forced into bore on opposite side (C).

5. Measure piston pin and piston bore and compare to specifications. If either are not within specification, replace pin, piston, and liner.



RG5231 –UN–05DEC97

Installing Piston Pin



RG4984 –UN–05DEC97

RG4984

Piston Pin Bore Inspection

A—Pin
B—Tapered Bore
C—Opposite Side of Bore

Piston Pin—Specification

OD	50.772—50.787 mm (1.9989—1.9995 in.)

Piston Pin Bore in Piston (6105)—Specification

ID	50.795—50.805 mm (1.9998—2.0002 in.)

Piston Skirt Bushing (6125)—Specification

ID	50.798—50.808 mm (1.9999—2.0003 in.)

Piston Crown Bushing (6125)—Specification

ID	50.810—50.825 mm (2.0004—2.0010 in.)

RG,RG34710,118 –19–13AUG99–1/1

DETERMINE PISTON-TO-LINER CLEARANCE

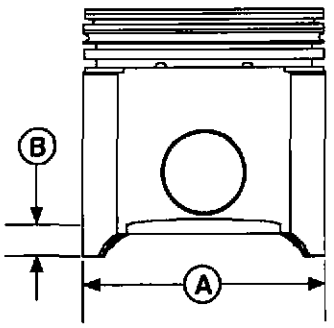
1. Measure 6105 skirt OD (B) at right angles to piston pin bore, 29.97 mm (1.180 in.) from the bottom of the piston (A).
2. Measure 6125 engine skirt OD at right angles to piston pin bore, 35.0 mm (1.38 in.) from bottom of skirt.
3. Record measurement and compare measurement obtained from matching liner.

Piston Skirt (6105)—Specification

OD 29.97 mm (1.180 in.) From Bottom of Piston	126.872—126.898 mm (4.9950—4.9960 in.)

Piston Skirt (6125)—Specification

OD 35.0 mm (1.380 in.) From Bottom of Skirt	126.910—126.930 mm (4.9965—4.9972 in.)



RG7403 –UN–03NOV97

Measuring Piston Skirt

A—Bottom of Piston Dimension
B—6105 Skirt OD

Continued on next page

RG,RG34710,119 –19–13AUG99–1/2

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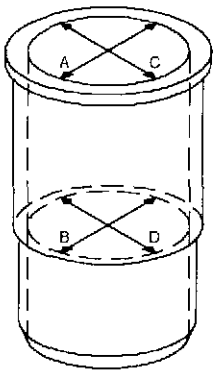
IMPORTANT: ALWAYS measure liners at room temperature.

4. Measure liner bore parallel to piston pin at top end of ring travel (A).
5. Measure bore in same position at bottom end of ring travel (B).
6. Measure bore at right angle to piston pin at top end of ring travel (C).
7. Measure bore in same position at bottom end of ring travel (D).
8. Compare measurements A, B, C, and D to determine if liner is tapered or out-of-round.
9. Compare liner ID with matched piston OD



RG10049 –UN–25MAY99

Measuring Liner ID

Cylinder Liner—Specification

ID	126.990—127.010 mm (4.9996—5.0004 in.)
Max. Out of Round	0.020 mm (0.0008 in.)
Max. Wear or Taper (Ring Travel Area)	0.030 mm (0.0012 in.)

Piston-to-Liner Clearance (New Part 6105)—Specification

Clearance	0.092—0.138 mm (0.0036—0.0054 in.)
Max. Acceptable Wear	0.152 mm (0.0060 in.)

Piston-to-Liner Clearance (New Part 6125)—Specification

Clearance	0.060—0.100 mm (0.0024—0.0039 in.)
Max. Acceptable Wear	0.152 mm (0.0060 in.)

Replace piston and liners (as a set) if they exceed wear specifications given.

RG,RG34710,119 –19–13AUG99–2/2

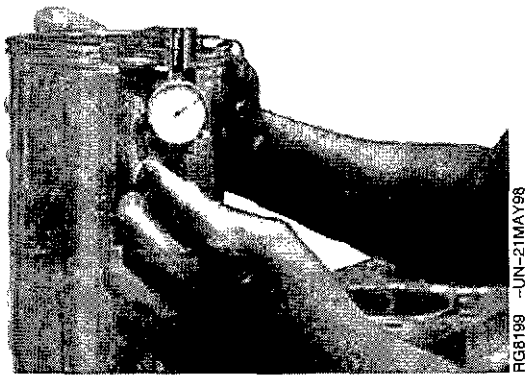
MEASURE LINER FLANGE THICKNESS

Measure cylinder liner flange thickness at several locations and compare with specification given below.

If liner flange is not within specification, use liner shims or replace piston and liner as a set.

Cylinder Liner Flange—Specification

Thickness	9.525—9.575 mm (0.3750—0.3770 in.)



Measuring Liner Flange Thickness

RG,RG34710,120 –19–30SEP97–1/1

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INSPECT AND MEASURE CONNECTING ROD BEARINGS

Inspect rod bearings for damage of wear.

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

Rod bearing-to-journal oil clearance can be checked with PLASTIGAGE®, if rod is connected to crankshaft. If rod is out of engine, measure ID of connecting rod bearings and compare with OD of crankshaft journal.

NOTE: Use PLASTIGAGE® as directed by the manufacturer. The use of PLASTIGAGE® will determine bearing journal clearance, but will not indicate the condition of either surface.

1. With crankshaft removed, measure connecting rod journal OD at several points.
2. Install connecting rod cap (A) on rod (B) with bearings (C) in correct position.
3. **On tongue-and-groove connecting rods**: Initially tighten blind-hole cap screw, then, tighten open-hole cap screw to the following specifications.

Tongue-and-Groove Connecting Rod Cap Screw—Specification

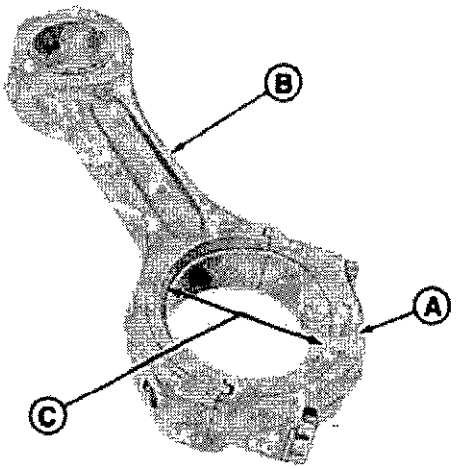
Initial Torque ..... 27 N•m (20 lb-ft)

Next, tighten rod cap screws to the following specifications.

Tongue-and-Groove Connecting Rod Cap Screw—Specification

Final Torque ..... 75 N•m (55 lb-ft) plus 90–100° turn clockwise

(See TORQUE-TURN CONNECTING ROD CAP SCREWS, described later in this group.)



RG10246 –UN–30JUL99

Assembled Rod with Bearing

A—Rod Cap
B—Rod
C—Bearings

PLASTIGAGE is a registered trademark of DANA Corp.

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RG,RG34710,121 –19–13AUG99–1/3

4. **On Precision Joint™ connecting rods:** Initially tighten rod cap screw closest to piston end, then tighten other cap screw to the following specifications.

Precision Joint™ Connecting Rod Cap Screw—Specification

Torque ..... 140 N•m (103 lb-ft) plus 90–100° turn clockwise

(See TORQUE-TURN CONNECTING ROD CAP SCREWS, described later in this group.)

Precision Joint is a trademark of Deere & Company

RG,RG34710,121 –19–13AUG99–2/3

5. Using an inside micrometer (A), measure assembled ID of bearing.

6. Subtract OD of each crankshaft journal from ID of each respective rod bearing to obtain oil clearance.

7. Compare measurements with the specifications given.

Crankshaft Rod Journal—Specification

OD ..... 88.844—88.874 mm (3.4980—3.4990 in.)

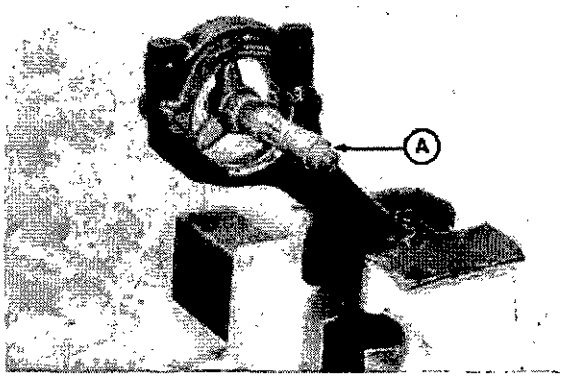
Connecting Rod Bearing for Crankshaft Journal (Assembled)—Specification

ID ..... 88.93—88.98 mm (3.501—3.502 in.)

Connecting Rod Bearing-to-Journal (New Part)—Specification

Oil Clearance ..... 0.06—0.13 mm (0.002—0.005 in.)
Max. Oil Clearance ..... 0.15 mm (0.006 in.)

8. Inspect connecting rod bearings for wear or damage. If bearings are worn or not within specification, replace both connecting rod bearing and rod pin bearing.



RG3824 –UN–04DEC97

Measuring Assembled Rod Bearing ID

A—Inside Micrometer

RG,RG34710,121 –19–13AUG99–3/3

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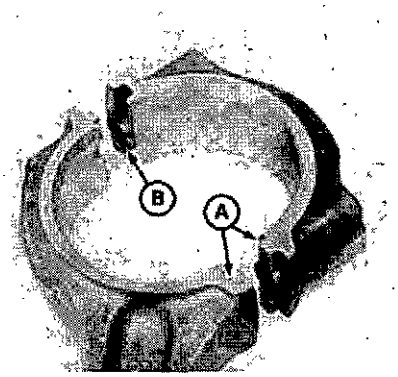
INSPECT CONNECTING ROD AND CAP

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

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

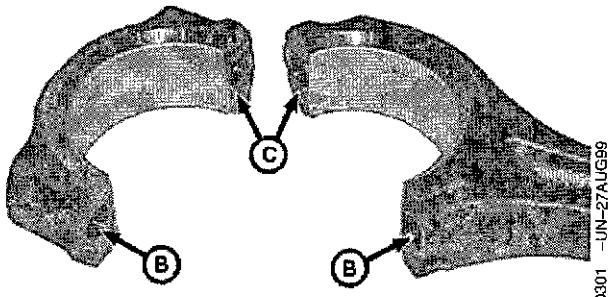
2. Inspect in and around cap screw holes (B) in cap. If any defects are found, replace rod and cap.

IMPORTANT: If replacing a connecting rod, use the same type of joint design. Do Not intermix Precision Joint™ rods and tongue-and-groove rods on the same engine. See parts catalog for recommendations.



RG3749 –UN–04DEC97

Tongue-and-Groove Rod and Cap



RG10301 –UN–27AUG99

Precision Joint™ Rod and Cap

A—Tongue-And-Groove Joints
B—Cap Screw Hole
C—Precision Joint™ Mating Surfaces

Precision Joint is a trademark of Deere & Company

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RG,RG34710,122 –19–02AUG99–1/4

3. Carefully clamp rod in a soft-jawed vise (cap end upward).

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

4. Install cap WITHOUT bearing inserts.

5. **On tongue-and-groove connecting rods**: Initially tighten blind-hole cap screw, then, tighten open-hole cap screw to the following specifications.

Tongue-and-Groove Connecting Rod Cap Screw—Specification

Initial Torque ..... 27 N•m (20 lb-ft)

Next, tighten rod cap screws to the following specifications.

Tongue-and-Groove Connecting Rod Cap Screw—Specification

Final Torque ..... 75 N•m (55 lb-ft) plus 90–100° turn clockwise

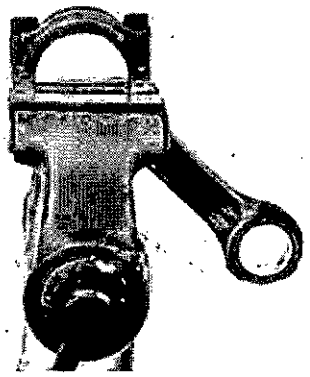
(See TORQUE-TURN CONNECTING ROD CAP SCREWS, described later in this group.)

6. **On Precision Joint™ connecting rods**: Initially tighten rod cap screw closest to piston end, then tighten other cap screw to the following specifications.

Precision Joint™ Connecting Rod Cap Screw—Specification

Torque ..... 140 N•m (103 lb-ft) plus 90–100° turn clockwise

(See TORQUE-TURN CONNECTING ROD CAP SCREWS, described later in this group.)



RG4982 –UN–05DEC97

Assembled Rod Without Bearings

Precision Joint is a trademark of Deere & Company

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RG,RG34710,122 –19–02AUG99–2/4

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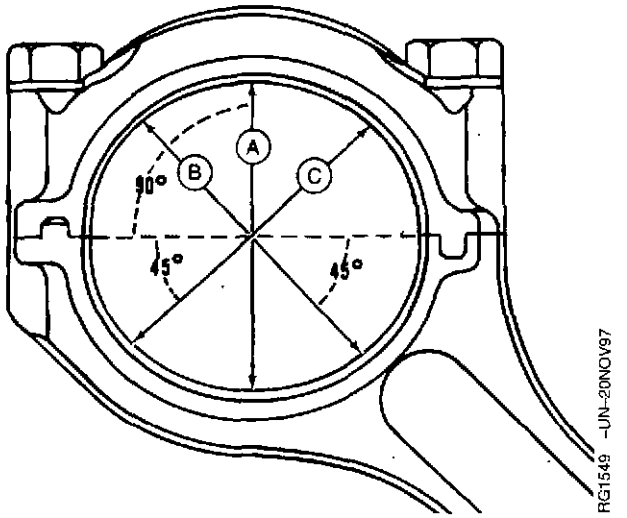
7. Using an inside micrometer, measure rod bore at center of bore and record measurements as follows:
   - (A) At right angle to rod/cap joint.
   - (B) At 45 degrees left of measurement (A).
   - (C) At 45 degrees right of measurement (A).
8. Compare the measurements.

Connecting Rod Bore (For Crankshaft Journal Bearing)—Specification

ID	93.76—93.79 mm (3.6915—3.6925 in.)

If difference between the greatest and least measurement is more than 0.038 mm (0.0015 in.), the rod and cap are out of round. Replace both connecting rod and cap.



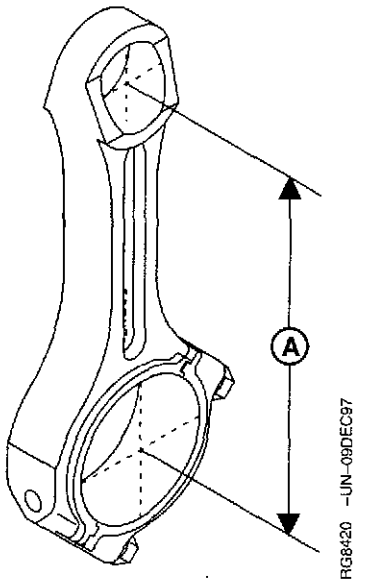
Measuring Assembled Rod Bore

RG,RG34710,122 –19–02AUG99–3/4

9. Measure rod's piston pin bore-to-crankshaft bore center-to-center dimension (A) and compare with specification given. If measurement is not within specification, replace rod.

Connecting Rod Centerline of Piston Pin Bore-to-Crankshaft Bore (New Part)—Specification

Dimension	263.95—264.05 mm (10.392—10.396 in.)



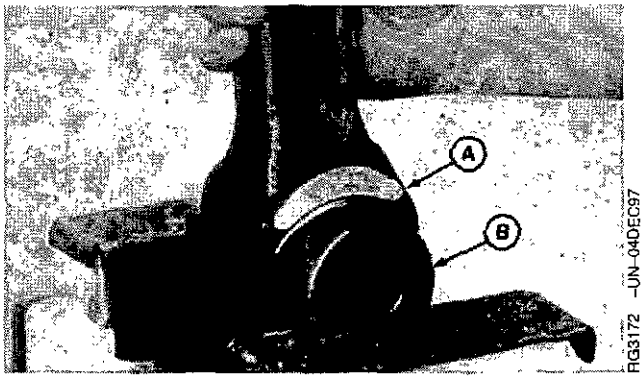
Measuring Rod Center-to-Center Bores

A—Rod's Piston Pin Bore-To-Crankshaft Bore Center-To-Center Dimension

RG,RG34710,122 –19–02AUG99–4/4

INSPECT PISTON PINS AND ROD BUSHINGS

1. Insert piston pin (B) through piston pin bushing and carefully clamp in a soft-jawed vise.
2. Rotate connecting rod (A) back and forth several times to make sure connecting rod moves freely on piston pin.
3. Remove piston pin from connecting rod.



Installing Piston Pin in Rod Bushing

A—Connecting Rod
B—Piston Pin

Continued on next page

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

5. Inspect piston pin bushing lubrication hole in rod for damage, excessive wear or contaminants.

6. Measure pin bushing ID for specified clearance.

Piston Pin—Specification

OD ..... 50.772—50.787 mm (1.9989—1.9995 in.)

Rod Pin Bore Without Bushing—Specification

ID ..... 55.529—55.555 mm (2.1862—2.1872 in.)

Installed Rod Pin Bushing (Before Boring)—Specification

ID ..... 50.729—50.781 mm (1.9972—1.9992 in.)

Installed Rod Pin Bushing (After Boring)—Specification

ID ..... 50.805—50.830 mm (2.0002—2.0012 in.)

Piston Pin Bushing Bore—Specification

Out-of-Round ..... 0.038 mm (0.0015 in.)

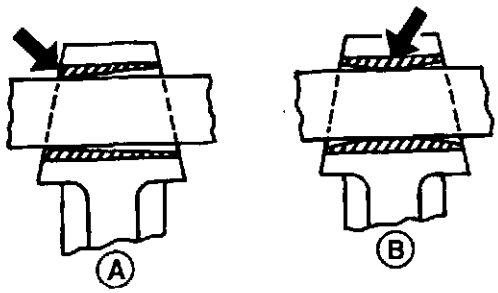
Piston Pin-to-Bushing—Specification

Oil Clearance ..... 0.017—0.059 mm (0.0007—0.0023 in.)
Max. Acceptable Wear ..... 0.076 mm (0.0030 in.)

Press Fit of Bushing in Rod Pin Bore—Specification

Press Fit ..... 0.100—0.163 mm (0.0039—0.0064 in.)

7. If necessary, remove and replace piston pin bushing. (See REMOVE PISTON PIN BUSHING, CLEAN, AND INSPECT BUSHING BORE in this group.)



RG4924 –UN–20NOV97

Inspecting Rod Piston Pin Bushing Bore

A—Tapered Bore
B—Bell-Mouthed Bore

RG,RG34710,123 –19–13AUG99–2/2

REMOVE PISTON PIN BUSHING, CLEAN, AND INSPECT BUSHING BORE

IMPORTANT: Do not use pneumatic tools to remove or install piston pin bushing.

Use care to properly align the JDE98-10 Driver (B) with bushing so that the connecting rod is not damaged.

1. Remove the used bushing with JDE98-8 Cup (A), JDE998-10 Driver, and STD36104 Forcing Screw (C) from the JDE98A Connecting Rod Bushing Service Set.

2. Clean rod bushing bore using a medium grit emery cloth, as burrs will distort bushing. Install bushing on side opposite rod burr.

3. If necessary, file a slight chamfer around bushing bore to remove any sharp edges. Chamfer will also aid in bushing installation.

4. Measure rod bushing bore in three or more places approximately 45° apart.

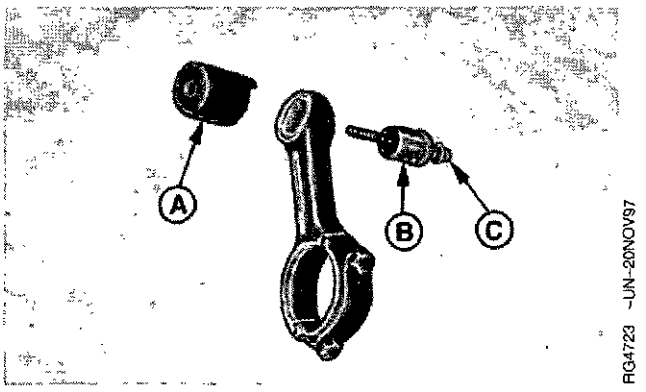
Connecting Rod Pin Bushing Bore (Without Bushing)—Specification

ID	55.529—55.555 mm (2.1862—2.1872 in.)

Connecting Rod Pin Bushing—Specification

Press Fit in Rod Pin Bore	0.100—0.163 mm (0.0039—0.0064 in.)

IMPORTANT: *If piston pin bushing bore diameter is* not within specification or bushing has spun in rod, discard rod and replace *with a new one.*



Removing Rod Piston Pin Bushing

A—JDE98-8 Cup
B—JDE98-10 Driver
C—STD36104 Forcing Screw

RG,RG34710,124 –19–30SEP97–1/1

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INSTALL PISTON PIN BUSHING

1. Lubricate connecting rod bore with clean engine oil.

IMPORTANT: Do not use power tools to install bushing.

2. Assemble JDE98-10 Driver (B) with JDE98-9 Pilot (C). Install new bushing (E) onto driver. Lubricate OD of bushing. Install and lubricate STD36104 Forcing Screw threads (D).

3. Assemble JDE98-6 Pilot (F) onto driver.

4. Engage forcing screw heads with threads in JDE98-8 Cup (A) and install new bushing.

IMPORTANT: Boring the connecting rod bushing should be done ONLY by experienced personnel on equipment capable of maintaining bushing finish specification.

5. Precision bore new bushing to specification to obtain pin-to-bushing clearance. Remove all debris from boring operation.

Piston Pin Bushing (After Boring)—Specification

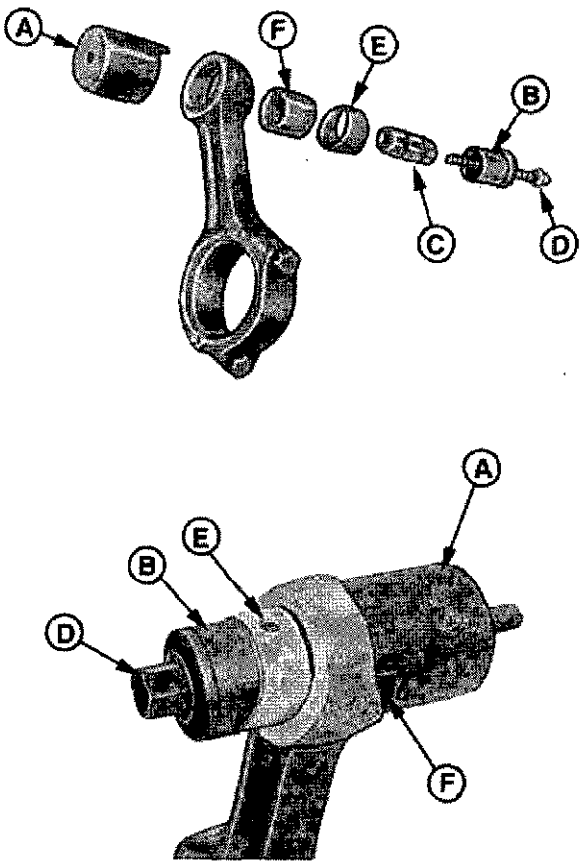
ID	50.805—50.830 mm (2.0002—2.0012 in.)

Piston Pin—Specification

OD	50.772—50.787 mm (1.9989—1.9995 in.)

Piston Pin-to-Bushing—Specification

Clearance	0.017—0.059 mm (0.0007—0.0023 in.)



RG8421 –UN–09DEC97

Installing Rod Piston Pin Bushing

A—JDE98-8 Cup[1]
B—JDE98-10 Driver[1]
C—JDE98-9 Pilot[1]
D—STD36104 Forcing Screw[1]
E—Bushing
F—JDE98-6 Pilot[1]

[1] *From JDE98A Connecting Rod Bushing Service Set.*

RG,RG34710,125 –19–30SEP97–1/1

COMPLETE DISASSEMBLY OF CYLINDER BLOCK (IF REQUIRED)

If complete inspection and "Hot Tank" cleaning of cylinder block is required, refer to the appropriate group for removal of all external and internal mounted components listed below:

1. Remove crankshaft and pulley if not previously removed. (See REMOVE CRANKSHAFT in Group 15.)
2. Remove water pump and all remaining cooling system components. (See REMOVE WATER PUMP in Group 25.)
3. Remove timing gear cover. (See REMOVE TIMING GEAR COVER in Group 15.). Remove front plate. (See REMOVE AND INSTALL CYLINDER BLOCK FRONT PLATE earlier in this group.)
4. Remove engine oil pump and all remaining lubrication system components. (See REMOVE ENGINE OIL PUMP in Group 20.)
5. Remove all components (water galley plugs, oil galley plugs, bushings, and engine serial number plate) before inspecting and cleaning cylinder block. Use JDG782 Oil Galley Plug Tool to remove and install galley plugs.

RG,RG34710,126 –19–02AUG99–1/1

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INSPECT AND CLEAN CYLINDER BLOCK

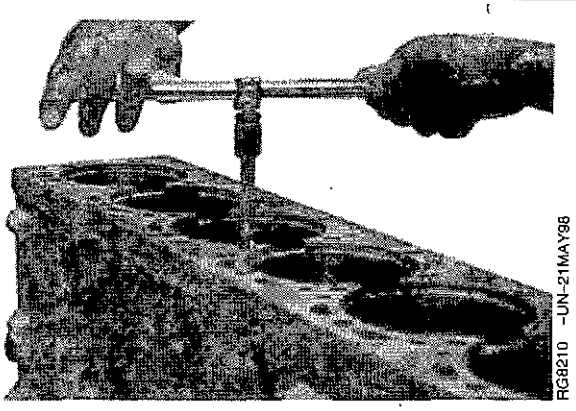
NOTE: All components, water gallery plugs, and oil gallery plugs must be removed from the cylinder block for inspection and cleaning. Refer to the proper group for removal of all external and internal mounted components.

1. Use D17015BR O-ring Bore Cleaning Brush or an equivalent brush to thoroughly clean all debris from cylinder liner O-ring bores.

2. Remove cylinder head locating dowels, if not previously removed. Clean out all threaded holes for cylinder head mounting cap screws in top deck of cylinder block. Use JDG978 Tap or an equivalent M16 x 2.0 tap approximately 152.4 mm (6.0 in.) long. Use compressed air to remove any debris or fluid which may be present in the cap screw hole.

IMPORTANT: If cylinder block is cleaned in a hot tank, be sure to remove any aluminum parts. Aluminum parts can be damaged or destroyed by hot tank solutions. Remove all serial number plates.

3. Clean block thoroughly using cleaning solvent, pressure steam, or a hot tank.



Cleaning Head Bolt Threads in Block

Continued on next page

RG,RG34710,127 –19–09SEP99–1/2

NOTE: JDG1145 Cylinder Liner Service Set (D) can be used with lapping compound as shown to lap liner flange to block counterbore.

4. Inspect liner support flange (C) for burrs. If burrs are present, use respective liner with lapping compound to remove burrs.

5. Measure liner flange counterbore depth (A) in block (B) and flange thickness on liner. Compare with specification given below.

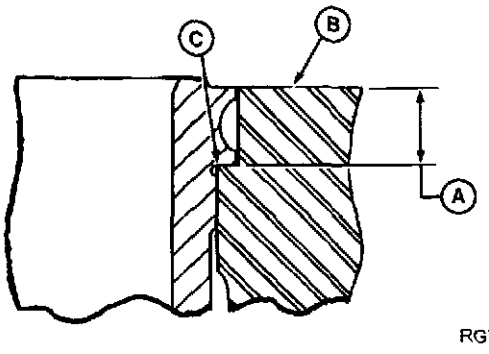
Cylinder Liner Flange Counterbore—Specification

Depth in Block ..... 9.461—9.512 mm (0.3725—0.3745 in.)

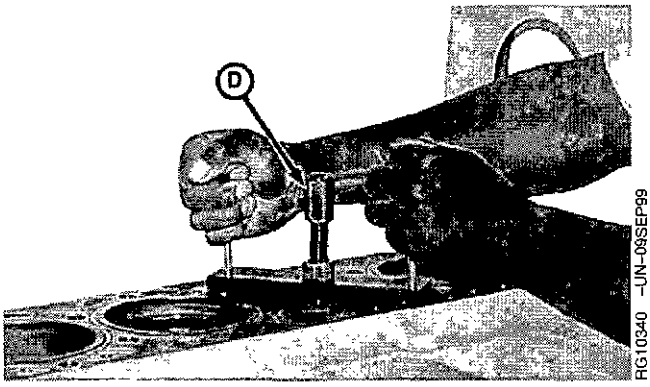
Cylinder Liner Flange—Specification

Thickness ..... 9.525—9.575 mm (0.3750—0.3770 in.)

Carefully inspect block for cracks or any other physical damage. If a cracked block is suspected, pressure-test the block. A procedure for pressure testing is outlined in FOS (Fundamentals of Service) Manual-ENGINES. Replace block if there is evidence of a crack or physical damage.



Liner Counterbore Depth



Lap Liner Flange

A—Liner Flange Counterbore Depth
B—Block
C—Liner Support Flange
D—JDG1145 Liner Service Set

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MEASURE CYLINDER BLOCK

Refer to the appropriate groups for a more detailed description of the features being measured. Compare measurements with specifications given below.

1. Assemble and measure main and thrust bearing bores. Compare measurements with specifications given below:

Main and Thrust Bearings—Specification

Assembled ID without Bearings	133.097—133.123 mm (5.2400—5.2410 in.)
Main Bearing Surface Width	37.77—38.03 mm (1.487—1.497 in.)
Thrust Bearing Surface Width (No. 5 Main)	37.51—38.29 mm (1.476—1.507 in.)
Overall Thrust Bearing Cap Width	43.25—43.75 mm (1.703—1.722 in.)

If any main or thrust bearing cap assembled ID is not within specification, blank (generic) bearing caps are available and must be lined bored to specification by a qualified machine shop. (See MEASURE ASSEMBLED ID OF MAIN BEARING CAPS in Group 15.)

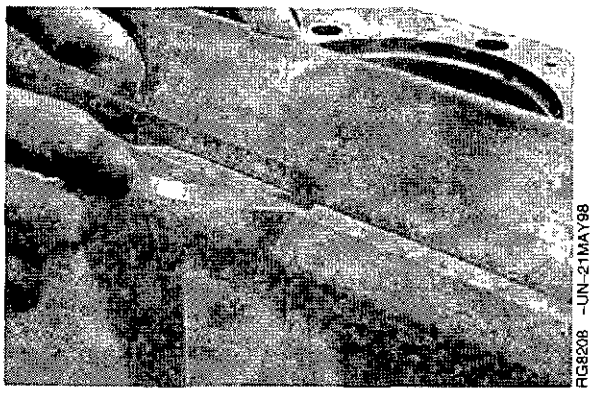
2. Measure cylinder block top deck flatness using D05012ST Precision Straightedge and feeler gauge. Resurface as required.

Cylinder Block Top Deck Surface Finish—Specification

Surface Finish (surface mill only)	3.2 micrometers (125 micro-in.)
Max. Wave Height	0.008 micrometers (0.0002 micro-in.)
Max. Wave Depth	2.0 micrometers (79 micro-in.)

Main Bearing Bore Centerline-to-Top Deck—Specification

Minimum Distance	429.92—430.07 mm (16.926—16.932 in.)



Measuring Block Top Deck Flatness

Continued on next page

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IMPORTANT: The centerline of the main bearing bore-to-top deck of cylinder block MUST be 429.92–430.07 mm (16.926–16.932 in.). If not, replace cylinder block.

3. Measure cylinder liner bores in block and compare to the following specifications.

Liner Flange Counterbore—Specification

ID ..... 153.57—153.77 mm (6.046—6.054 in.)

Upper Block Bore for Seating Liner—Specification

ID ..... 145.845—145.895 mm (5.7419—5.7439 in.)

Lower Block Bore for Seating Liner—Specification

ID ..... 140.465—140.515 mm (5.5301—5.5321 in.)

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RECHECK CYLINDER LINER STANDOUT (HEIGHT ABOVE BLOCK)

NOTE: If a new liner assembly is being installed in a new or used cylinder block, liner standout must be checked.

Be sure liner bore in cylinder block (B) and top deck of cylinder block are clean.

1. Install liners without O-rings and square packing. Secure with cap screws and washers, as outlined earlier in this group. (See REMOVE PISTONS in this group.)

NOTE: Install liner with the identifying mark toward the front of the engine. Rotate 90° if pits or erosion exceed limits outlined during liner inspection.

2. Measure liner standout. (See MEASURE CYLINDER LINER STANDOUT in this group.)

Cylinder Liner Standout—Specification

Height Above Block	0.030—0.117 mm (0.0012—0.0046 in.)

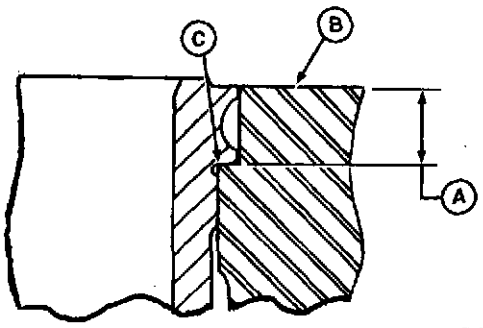
If liner standout is above specification, recheck liner support flange (C) for possible remaining burrs or incorrect counterbore depth (A) in block. If burrs are present, use respective liner and lapping compound to remove burr. Completely clean cylinder liner bore after lapping.

IMPORTANT: ONE LINER SHIM ONLY may be installed under any given liner flange.

If liner standout is below specifications, remove liner and install shim as needed to bring liner standout to within specification.

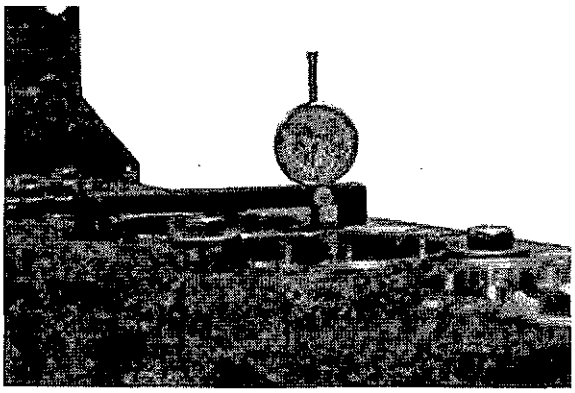
Cylinder Liner Shims Available—Specification

Thickness	0.05 mm (0.002 in.)
Thickness	0.10 mm (0.004 in.)



RG7142 –UN–05DEC97

Liner Counterbore Depth



RG8329 –UN–21MAY98

Measuring Liner Standout

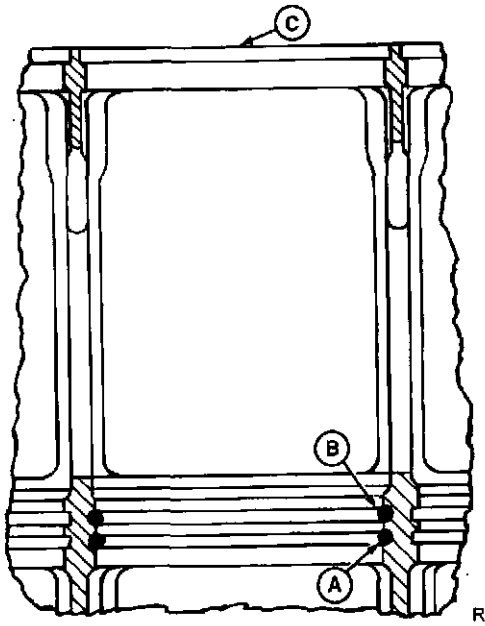
A—Liner Flange Counterbore Depth
B—Block
C—Liner Support Flange

RG,RG34710,129 –19–30SEP97–1/1

INSTALL CYLINDER LINER O-RINGS AND PACKINGS

IMPORTANT: DO NOT use oil on cylinder liner packing or O-rings. Oil can cause the red packing to swell, which squeezes liner and could possibly cause a scored piston.

1. Pour AR54749 Soap Lubricant into a suitable container.
2. Dip new packings and O-rings in soap before installation. Do not leave packings or O-rings in soap to soak.
3. Install the black viton O-ring (A) in the lower O-ring groove of the cylinder block (C).
4. Install the red silicone O-ring (B) in the upper O-ring groove of the cylinder block.



Liner O-Rings and Packing

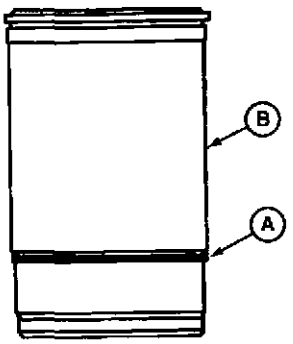
A—Black Viton O-Ring
B—Red Silicone O-Ring
C—Cylinder Block

RG,RG34710,130 -19-30SEP97-1/2

5. Turn cylinder liner (B) upside-down and install the neoprene square packing (A) over outside of liner.
6. Slide packing down firmly against second shoulder on the liner.

NOTE: Make sure the packing is not twisted.

7. Coat the liner packings, sealing area of the cylinder liner, and cylinder block O-rings with liquid soap.



Install Square Packing on Liner

A—Neoprene Square Packing
B—Cylinder Liner

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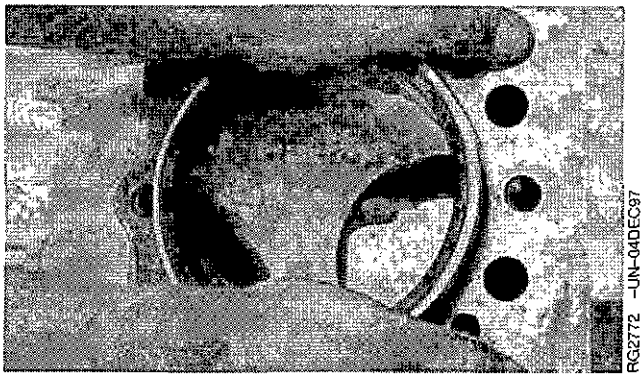
INSTALL CYLINDER LINERS

IMPORTANT: Install cylinder liner into same cylinder block bore as removed. DO NOT scuff the packing across the upper bore.

When liner ODs are pitted or eroded and are under one-half the liner thickness, rotate liners 90° from their removed position. Rotate the pitted section of the liner either toward the front or rear of the engine.

If liners are not pitted or eroded, rotation will not be necessary. Install liners with the identifying mark (stamped on flange), toward the front of the engine.



Installing Liner

1. Carefully place the cylinder liner, with packing installed, into the cylinder block bore.

NOTE: A resistance will be felt when cylinder liner is aligned in pilot bore.

2. Using only the pressure of both palms, the cylinder liner should drop to a point nearly flush at the upper flange of the cylinder liner and cylinder block.

Continued on next page

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NOTE: Cylinder liner will protrude over top of cylinder block more than normal due to uncompressed packings and O-rings.

3. Finish seating cylinder liners using a clean hardwood block and hammer as shown in top figure or by using JDG1145 Liner Service Set (B) and a 2.27 Kg (5 lb) slide hammer (A) shown in lower figure.

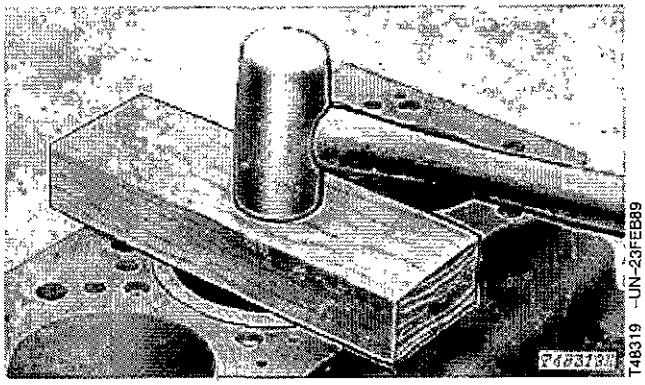
   Using either method, apply only enough force as necessary to seat liners.

IMPORTANT: If you suspect that a packing may have sheared or displaced during liner installation, remove liner and packing assembly. If no damage is found, check packing and O-rings for proper position. Resoap packings and reinstall liner assembly.

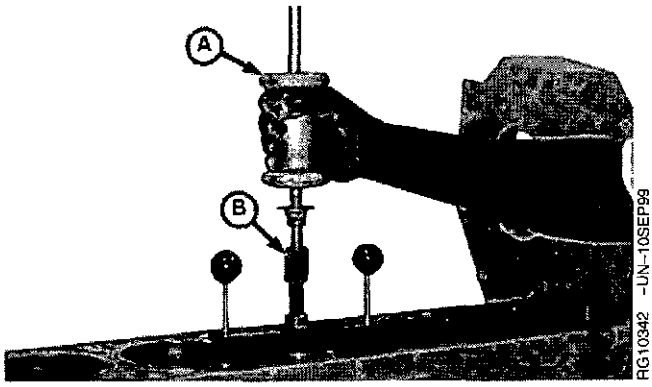
4. Hold liners in place with large flat washers and cap screws. Turn cap screws snug, but do not tighten.

5. Clean cylinder liner bores with waterless hand cleaner after installation. Wipe dry with clean towels.

6. Apply clean engine oil to liner bores immediately to prevent corrosion.



Seating Liner



JDG1145 Liner Service Set

RG,RG34710,131 –19–30SEP97–2/2

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ASSEMBLE PISTONS AND CONNECTING RODS

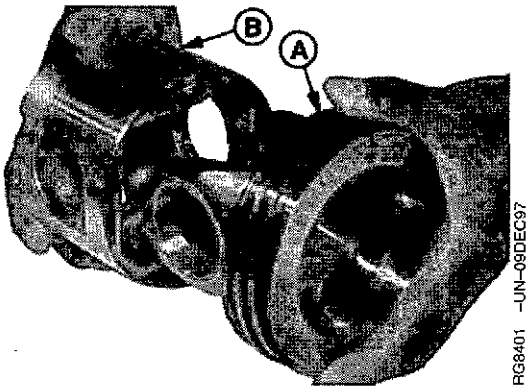
IMPORTANT: Pistons must be installed on same connecting rods from which they were removed and NEW piston pin snap rings must be used.

If a new piston and liner assembly is to be installed, DO NOT remove piston from liner. Push piston out of liner bottom only far enough to install piston pin.

1. On 6125 engines, assemble piston crown (A) and skirt (B) so that connecting rod pin bushings are aligned.
2. Lubricate piston pin and bushings with clean engine oil.

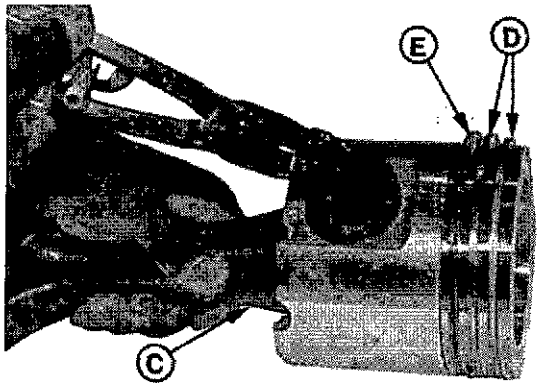
NOTE: Pistons are symmetrical, new pistons can be installed either way. If pistons are being reused, align front reference mark made during disassembly with front of connecting rod.

3. Install piston pin through piston and connecting rod (C).
4. Install NEW piston pin snap rings in grooves. Make certain snap rings have completely expanded in grooves of piston. Sharp edge of snap ring MUST face toward outside of piston.



RG8401 –UN–09DEC97

6125 Piston Crown and Skirt



RG8400A –UN–22MAY98

Assembling Piston and Rod

A—Piston Steel Crown (6125 Engine)
B—Piston Skirt (6125 Engine)
C—Connecting Rod
D—Compression Rings (2 used)
E—Oil Control Ring

Continued on next page

RG,RG34710,132 –19–03AUG99–1/2

NOTE: Keystone compression ring with one "Pip" mark goes in top piston ring groove and keystone ring with two "Pip" marks goes in second ring groove of piston. "Pip" mark(s) must face top of piston.

IMPORTANT: Earlier engines with RE52836 (10.5 L) and RE66125 (12.5 L) pistons have 4 mm compression rings and 4.8 mm oil control rings. Later engines with RE504343 (10.5 L) and RE503969 (12.5 L) pistons have 3 mm compression rings and 4.0 mm oil control rings. Piston part numbers are marked on top of pistons for identification. Insure correct size rings are installed on appropriate pistons. DO NOT intermix rings.

5. Use the JDG967 Ring Expander to install compression rings (D) and oil control ring with expander ring (E).

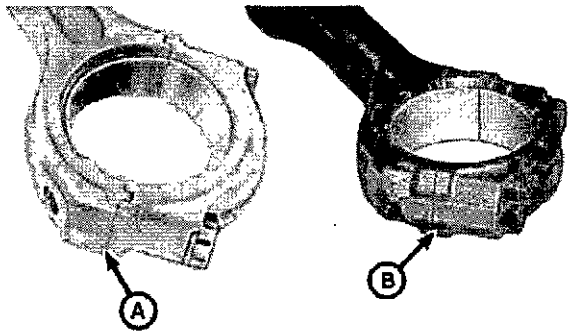
RG,RG34710,132 –19–03AUG99–2/2

INSTALL PISTONS AND CONNECTING RODS

IMPORTANT: Replace rods with the same type. Do Not mix tongue-and-groove with Precision Joint™ rods in the same engine. See parts catalog for recommendations.

Earlier engines have the traditional tongue-and-groove between the connecting rod and cap (A). Later engines have the Precision Joint™ rod and cap (B).

Both types of rods provide a strong joint. Installation is similar, with differences noted, including different torque specifications for cap screws.



RG10300 –UN–27AUG99

Connecting Rods

A—Tongue-and-Groove Rod (Early Engines)
B—Precision Joint™ Rod (Later Engines)

Precision Joint is a trademark of Deere & Company

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RG,RG34710,133 –19–02AUG99–1/6

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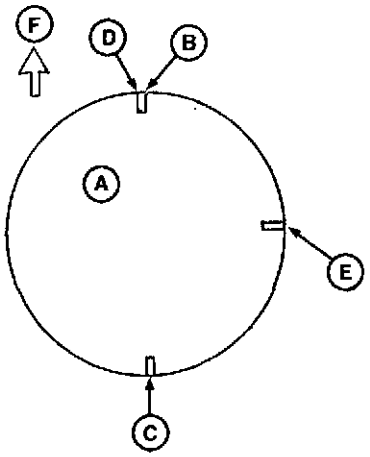
1. Stagger ring gaps on pistons as shown.



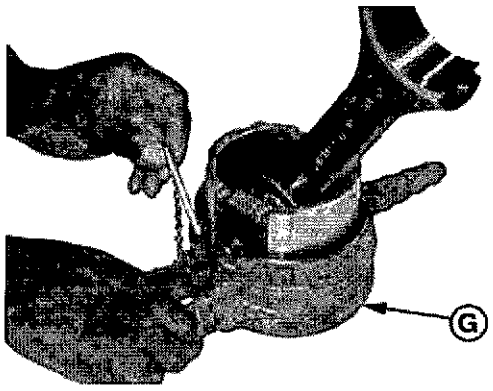
RGR31127 –UN–11DEC97

Staggering Piston Ring Gaps

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

RG,RG34710,133 –19–02AUG99–2/6

2. Coat pistons, liners, and inside of JDG1017 Piston Ring Compressor (G) with clean engine oil.
3. Lay piston rod assembly on piston's top and compress rings with compressor. Squeeze handles together and install pin to full depth to secure.
4. Lubricate rod bearing half and install onto rod with notches on bearing seated with notch in rod.



RG8404 –UN–09DEC97

Compressing Piston Rings

G—JDG1017 Ring Compressor

Continued on next page

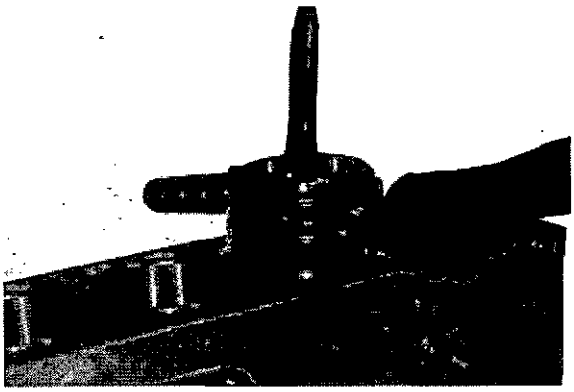
RG,RG34710,133 –19–02AUG99–3/6

5. Carefully place ring compressor with piston and rod over liner.

IMPORTANT: Be sure crankshaft journals and liner walls are not damaged when installing piston and rod liner.

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

6. With piston centered in ring compressor and rings staggered correctly, push piston into liner.



Installing Piston and Rod Assembly

RG,RG34710,133 –19–02AUG99–4/6

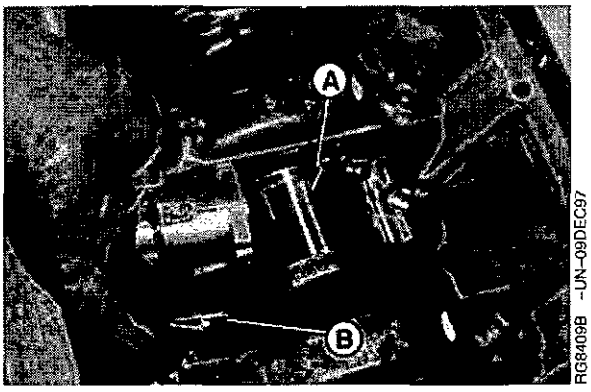
7. Apply clean engine oil to bearing inserts (B) and crankshaft rod journals (A).

IMPORTANT: On Precision Joint™ rods, make sure cap is properly aligned on rod with interlocking surfaces sealing tightly and edges aligned. Do Not reverse cap on rod. Match pads on side of rod and cap.

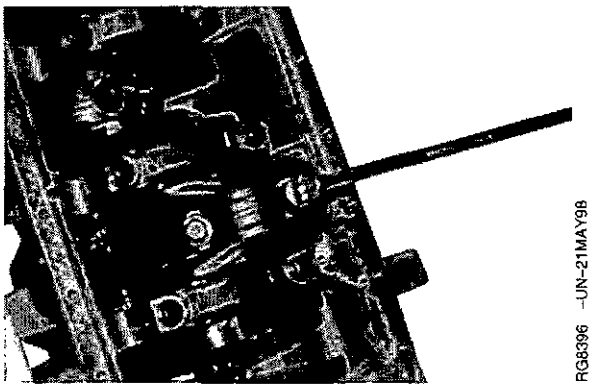
When installing caps, make sure stamped numbers on rod and cap are positioned on the same side.

NEVER use connecting rod cap screws more than once for final engine assembly. Once rod cap screws have been tightened to final TORQUE-TURN specifications, they cannot be reused for final assembly.

8. Install connecting rod caps.



Installing Rod Caps



Tightening Rod Caps

A—Crankshaft Rod Journals
B—Bearing Inserts

Precision Joint is a trademark of Deere & Company

Continued on next page

RG,RG34710,133 –19–02AUG99–5/6

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9. Dip new cap screws and washers in clean engine oil. Make sure top of cap screws have oil on them also.

IMPORTANT: DO NOT use pneumatic wrenches to install connecting rod cap screws. Doing so may damaged threads. Use speed-handle wrench instead.

10. **On tongue-and-groove connecting rods**: Initially, tighten blind-hole cap screw (A) to specifications. Next, tighten the other cap screw. Feel rod-to-cap joint to check for proper alignment.

Tongue-and-Groove Connecting Rod Cap Screw—Specification

Initial Torque ..... 27 N•m (20 lb-ft)

Secondly, tighten all cap screws to the following specifications, then TORQUE-TURN all cap screws 90-100°.

Tongue-and-Groove Connecting Rod Cap Screw—Specification

Final Torque ..... 75 N•m (55 lb-ft) plus 90–100° turn clockwise

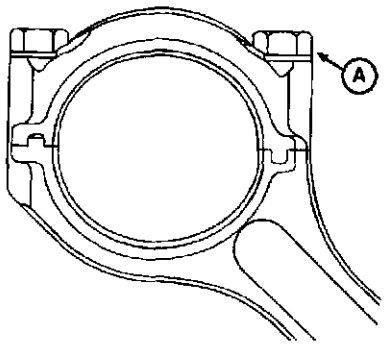
(See TORQUE-TURN CONNECTING ROD CAP SCREWS, described next in this group.)

11. **On** Precision Joint™ **connecting rods**: Initially, tighten cap screw closest to piston end to specifications. Next, tighten the other cap screw. Feel rod-to-cap joint to check for proper alignment.

Precision Joint™ Connecting Rod Cap Screw—Specification

Torque ..... 140 N•m (103 lb-ft) plus 90–100° turn clockwise

(See TORQUE-TURN CONNECTING ROD CAP SCREWS, described next in this group.)



RG4375 –UN–05DEC97

Tightening Rod Cap Screws

A—Blind-Hole Cap Screw

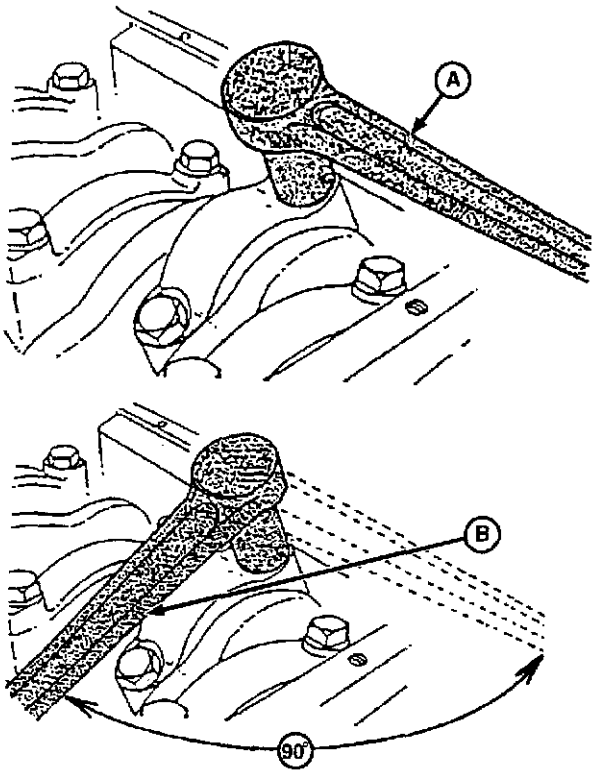
Precision Joint is a trademark of Deere & Company

RG,RG34710,133 –19–02AUG99–6/6

TORQUE-TURN CONNECTING ROD CAP SCREWS

USING ENGINE AXIS METHOD TO TORQUE-TURN CONNECTING ROD CAP SCREWS

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



RG9102 –UN–27MAR98

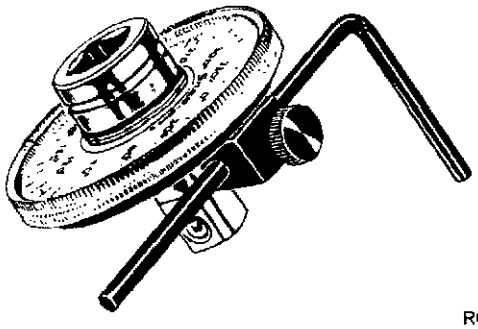
TORQUE-TURN Rod Cap Screws

A—Wrench Parallel To Centerline Of Engine Crankshaft Axis
B—Wrench Is Perpendicular To Centerline Of Engine Crankshaft Axis

RG,RG34710,134 –19–03AUG99–1/2

USING JT05993 TORQUE ANGLE GAUGE TO TORQUE-TURN CONNECTING ROD CAP SCREWS

After tightening cap screws to torque values, follow directions provided with gauge and TORQUE-TURN each cap screw 90°—100°.



RG5698 –UN–05DEC97

JT05993 Torque Angle Gauge

RG,RG34710,134 –19–03AUG99–2/2

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CHECK ENGINE ROTATION FOR EXCESSIVE TIGHTNESS

1. Rotate crankshaft several revolutions to be sure engine rotates without excessive tightness.
2. Check liners for deep scratches caused by an improperly installed or broken piston ring.
3. Check side clearance of rods; must have slight side-to-side movement.

RG,RG34710,135 –19–30SEP97–1/1

MEASURE PISTON PROTRUSION

1. Press down on top of piston to remove oil clearances.
2. Use JDG451 Gauge along with D17526CI (English scale) or D17527CI (Metric scale) Dial Indicator or KJD10123 Gauge to measure piston protrusion. Place gauge on top of cylinder block so dial indicator can be set to "zero" (0.000) with top of block.
3. Position gauge across top of piston. While pressing gauge downward, rotate crankshaft until piston is at "TDC."
4. Measure and record piston height at several positions around top OD of piston.
5. Piston protrusion must be within the following specification to prevent piston-to-exhaust valve contact.

Piston—Specification

Protrusion Above Block Deck	0.229—0.787 mm (0.009—0.031 in.)

6. Repeat procedure on remaining pistons and record measurements.

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

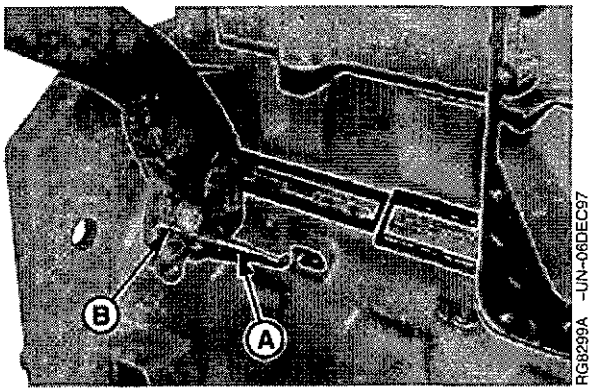
RG,RG34710,136 –19–30SEP97–1/1

REMOVE AND INSTALL PISTON SPRAY JETS

1. Remove piston spray jets.
2. Coat O-ring (B) with JDG405 High Temperature Grease.
3. Install piston spray jets (A) at each of the six locations on right side of block.
4. Tighten cap screws to specifications.

Piston Spray Jet Cap Screws—Specification

Torque ..... 15 N•m (11 lb-ft)



Installing Piston Spray Jets

A—Piston Spray Jets
B—O-Ring

RG,RG34710,137 –19–13AUG99–1/1

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COMPLETE FINAL ASSEMBLY

NOTE: Refer to the proper group for installation of components.

1. Coat threads of oil gallery plugs with LOCTITE® 242 Thread Lock and Sealant. Install plugs and tighten to specifications.

Oil Gallery Plug—Specification

Torque ..... 20 N•m (15 lb-ft)

Main Oil Gallery (Front) Expansion Plug—Specification

Installed Depth ..... Flush—1.5 mm (0.059 in.) Below Surface

2. Install oil pickup tube. (See REMOVE AND INSTALL OIL PICKUP TUBE in Group 20.) Install oil pan. (See INSTALL ENGINE OIL PAN in Group 20.)

3. Install the cylinder head using new head gasket. (See INSTALL CYLINDER HEAD in Group 05.)

4. Install camshaft and valve train. (See REMOVE AND INSTALL CAMSHAFT in Group 16.) Install timing gear cover. (See INSTALL TIMING GEAR COVER in Group 15.) Install unit injectors on engines with single rail fuel systems. (See REMOVE AND INSTALL ELECTRONIC UNIT INJECTORS in Group 36.) Install unit injectors on engines with dual rail fuel systems. (See REMOVE AND INSTALL ELECTRONIC UNIT INJECTORS in Group 35.) Adjust clearances, preloads, and gear backlash. (Groups 05, 15 and 16.)

5. Install remaining fuel injection system components. (Group 35 or 36.)

6. Install the water pump and water piping. (See INSTALL WATER PUMP in Group 25.)

7. Install lubrication system components. (Group 20.)

8. Install crankshaft pulley. (See INSTALL CRANKSHAFT VIBRATION DAMPER AND FRONT OIL SEAL in Group 15.)

9. Install the exhaust manifold. (See REMOVE, INSPECT AND INSTALL EXHAUST MANIFOLD in Group 30.) Install intake assembly. (See REMOVE, INSPECT AND INSTALL INTAKE MANIFOLD in Group 30.)

10. Install starter motor. (See REMOVE AND INSTALL STARTER MOTOR in Group 40.)

11. Install alternator. (See REMOVE AND INSTALL ALTERNATOR in Group 40.)

12. Install fan and fan belts. (See Machine Technical Manual.)

13. Fill engine with clean oil. (See DIESEL ENGINE OIL in Group 2.) Service engine with coolant. (See DIESEL ENGINE COOLANT RECOMMENDATIONS in Group 02.)

14. Perform engine break-in. (See PERFORM ENGINE BREAK-IN in Group 04.)

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RG,RG34710,138 –19–03AUG99–1/1

ESSENTIAL TOOLS

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

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DPSG,OUO1004,941 –19–27JUL99–1/9

RG6246 –UN–05DEC97

Dial Indicator . . . (English, in.) D17526CI or (Metric, mm) D17527CI or FKM10103[1]

Use with JDG451 to measure valve recess and cylinder liner height-to-cylinder block top deck.

RG6246

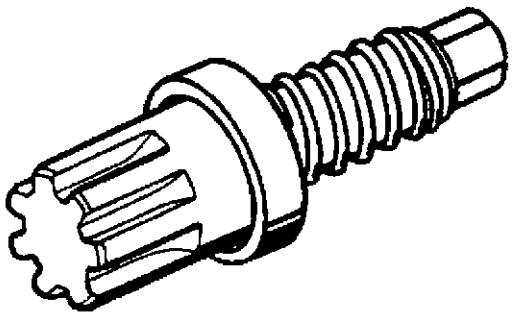
D17526CI / D17527CI

[1]Part of KJD10123 Piston/Liner Height Gauge

DPSG,OUO1004,941 –19–27JUL99–2/9

Flywheel Turning Tool JDG820

Use to rotate engine flywheel to check damper radial runout and piston protrusion.



RG7056 –UN–05DEC97 RG7056

JDG820

Continued on next page

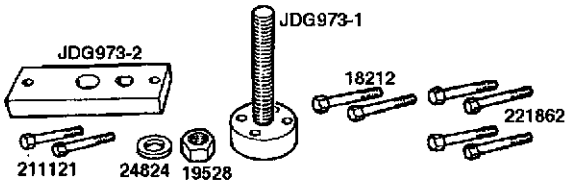
DPSG,OUO1004,941 –19–27JUL99–3/9

RG8509 –UN–13AUG99

15
2

Damper Puller/Installer JDG973

Use to safely remove and install engine damper with engine in vehicle chassis. The damper weighs approximately 18 kg (40 lb) and is mounted with an interference press fit. Set consists of JDG973-1 Forcing Screw, JDG973-2 Cross Block, 19528 014 UNS Hex Nut, 211121 Hex Head Cap Screw (2) M12x1.75x50mm, 24824 Thrust Washer, 18212 Hex Head Cap Screws (2), 221862 Cap Screws (4) M12x1.75x75mm.

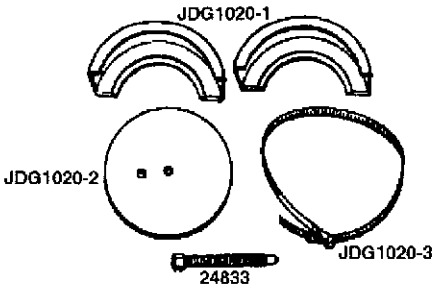


JDG973

DPSG,OUO1004,941 –19–27JUL99–4/9

Rear Crank Seal Sleeve Remover JDG1020

Use to remove the rear seal assembly and seal housing. Tool helps protect the flange on rear of crankshaft. Set consists of 24833 Forcing Screw, JDG1020-1 Collet Half (2), JDG1020-2 Puller Plate, JDG1020-3 Clamp.



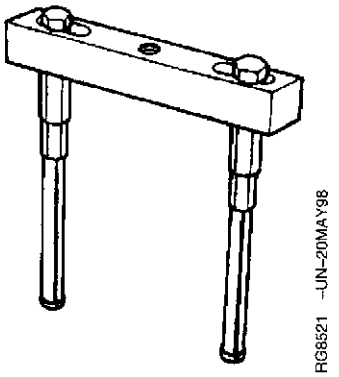
RG6513 –UN–13AUG99

JDG1020

DPSG,OUO1004,941 –19–27JUL99–5/9

Main Bearing Cap Puller/Installer JDG996

Use to remove and install the main bearing caps. Due to wider bearing surface, these caps are installed with an increased interference fit.



RG6521 –UN–20MAY98

JDG996

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DPSG,OUO1004,941 –19–27JUL99–6/9

RG8510 –UN–20MAY98

Timing Gear Cover/Rear Seal Housing Oil Pan Rail Aligner JDG977

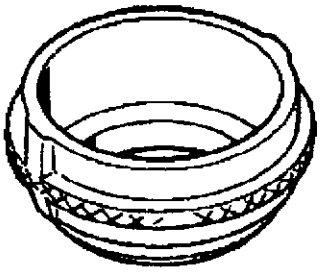
Use to align the timing gear cover to the engine block oil pan mounting surface and align the rear seal housing to the same surface. When installing the timing gear seal housing, use JDG975 Timing Gear Cover/Rear Crankshaft Housing Centering Tool to center the seal housing bores with the crankshaft flange.

JDG977

DPSG,OUO1004,941 –19–27JUL99–7/9

Front Timing Gear Cover/Rear Crankshaft Seal Housing Centering Tool JDG975

Use to center the front/rear seal housing bore with the rear crankshaft flange during installation of the housing. This tool is also used to center the front timing gear cover seal housing bore with the front crankshaft flange during installation of the timing cover. Use with JDG977.



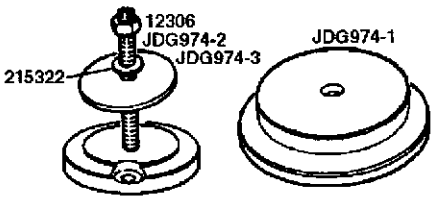
RG8511 –UN–20MAY98

JDG975

DPSG,OUO1004,941 –19–27JUL99–8/9

Front/Rear Crankshaft Seal Installer JDG974

Use to install the front crankshaft seal on damper prior to damper installation and to install rear oil seal in rear seal housing when housing is on engine. Set consists of JDG974-1 Seal Installer, JDG974-2 Seal Installer Forcing Screw, JDG974-3 Guide Plate, 12306 5/8-11 UNC Hex Nut, 217196 Hex Head Cap Screws (2) M12x1.25x30mm, 215322 Thrust Washer.



RG8512 –UN–13AUG99

JDG974

DPSG,OUO1004,941 –19–27JUL99–9/9

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4

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,OUO1004,942 –19–27JUL99–1/4

Slide Hammer D01300AA

Use with JDG996 Puller to remove crankshaft main bearing caps.

DPSG,OUO1004,942 –19–27JUL99–2/4

17-1/2 and 30-Ton Puller Set. D01047AA

Remove crankshaft gear from crankshaft.

DPSG,OUO1004,942 –19–27JUL99–3/4

Crankshaft Front Rotation Adapter JDG976

Used to rotate crankshaft when flywheel is removed from engine.

DPSG,OUO1004,942 –19–27JUL99–4/4

OTHER MATERIAL

Number	Name	Use
TY16285 (U.S.)	Clean-and-Cure Primer	Clean mating gasket surfaces on timing gear cover and camshaft gear access cover.
T43512 (U.S.) TY9473 (Canadian) 242 (LOCTITE®)	Thread Lock and Sealer (Medium Strength)	Apply to timing gear cover gasket and camshaft gear access cover gasket.
— (U.S.)	PLASTIGAGE®	Check main bearing-to-crankshaft journal oil clearance during engine disassembly.
TY6304 (U.S.) TY9484 (Canadian) 515 (LOCTITE®)	Flexible Sealant	Apply to timing gear cover gasket and camshaft gear access cover gasket on timing gear cover side of gaskets.
TY15969 (U.S.) TY9479 (Canadian) 680 (LOCTITE®)	Retaining Compound (Maximum Strength)	Coat OD of crankshaft flange for installation of rear oil seal/wear sleeve. Coat ID of front wear sleeve prior to installation.
— (U.S.)	Brake Kleen or Ignition Cleaner	Remove sealant from crankshaft flange.

LOCTITE is a registered trademark of Loctite Corp.
PLASTIGAGE is a registered trademark of DANA Corp.

DPSG,OUO1004,943 –19-27JUL99-1/1

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6

CRANKSHAFT, MAIN BEARINGS AND FLYWHEEL SPECIFICATIONS

Item	Measurement	Specification
Vibration Damper	Max. Radial Runout	0.76 mm (0.030 in.)
Crankshaft	End Play	0.038—0.380 mm (0.0015—0.0150 in.)
SAE 1 Flywheel Housing	Maximum Face Deviation Maximum Bore Eccentricity	0.30 mm (0.012 in.) 0.30 mm (0.012 in.)
SAE 2 Flywheel Housing	Maximum Face Deviation Maximum Bore Eccentricity	0.28 mm (0.011 in.) 0.28 mm (0.011 in.)
SAE 0 Flywheel Housing	Maximum Face Deviation Maximum Bore Eccentricity	0.41 mm (0.016 in.) 0.41 mm (0.016 in.)
Flywheel Face Flatness	Maximum Variation Maximum Variation per 25 mm (1.0 in.) of Travel	0.23 mm (0.009 in.) 0.013 mm (0.0005 in.)
Flywheel Housing-to-Cylinder Block Cap Screws (SAE 1 With Rear PTO)	Torque	325 N•m (240 lb-ft)
Flywheel Housing-to-Cylinder Block Cap Screws (SAE 0, 1 and 2 Without Rear PTO)	Torque	365 N•m (270 lb-ft)
Flywheel-to-Crankshaft	Torque	170 N•m (125 lb-ft)
Crankshaft Main Bearings	Main Bearing-to-Journal Clearance Maximum Acceptable Oil Clearance	0.046—0.122 mm (0.0018—0.0048 in.) 0.152 mm (0.0060 in.)
Crankshaft Main Bearing	ID With Bearing ID Without Bearing	125.071—125.127 mm (4.9241—4.9263 in.) 133.097—133.123 mm (5.2400—5.2411 in.)
Crankshaft Main Bearing Journal	OD	124.983—125.017 mm (4.9206—4.9219 in.)

Continued on next page

Item	Measurement	Specification
Crankshaft Main Journal	Out-of-Round	0.025 mm (0.0010 in.)
	Max. Taper per 25.4 mm (1.0 in.) of Journal Length	0.0025 mm (0.0001 in.)
Main Bearing Cap Bore Specifications	ID Without Bearings	133.097—133.123 mm (5.2400—5.2411 in.)
	Max. Bore Diameter Variation	0.013 mm (0.0005 in.)
	Max. Bore Diameter Taper	0.005 mm (0.0002 in.)
	Max. Straightness (Any Bore-to-Adjacent Bore)	0.038 mm (0.0015 in.)
	Max. Straightness (5 Center Bores-to-Adjacent Bore)	0.076 mm (0.0030 in.)
	Centerline of Bore-to-Top Deck	429.92—430.07 mm (16.926—16.932 in.)
Crankshaft Main Bearing Cap	Surface Width	39.75—40.25 mm (1.565—1.585 in.)
Crankshaft Main Bearings Available	Undersize	0.25, 0.50 mm (0.010, 0.020 in.)
Oversize Thrust Washers Available	Thickness	0.18 mm (0.007 in.)
Thrust Bearing New Part Specifications	Thrust Washer Clearance Base Circle	162.24—163.76 mm (6.387—6.447 in.)
	Thrust Surface Width	42.05—42.12 mm (1.656—1.658 in.)
	Relief Angle	45°
	Bearing Cap Overall Width	43.46 mm (1.711 in.)
	Thrust Surface Maximum Runout	0.025 mm (0.0010 in.)
Crankshaft Main Bearing Cap Screws	Initial Torque	68 N•m (50 lb-ft)
Crankshaft Main Bearing Cap Screws	Final Torque	295 N•m (218 lb-ft)
Rear Oil Seal Housing Cap Screws	Torque	25 N•m (18 lb-ft)
Rear Oil Seal-to-Housing Cap Screws	Torque	15 N•m (11 lb-ft)

Continued on next page

DPSG,OUO1004,944 –19–27JUL99–2/3

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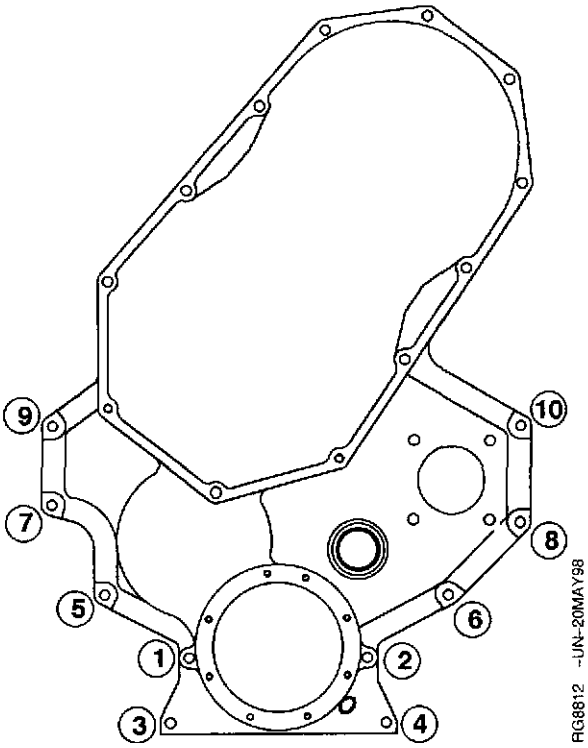
Item	Measurement	Specification
Timing Gear Cover Cap Screws[1]	Initial Torque	45 N•m (33 lb-ft)
Timing Gear Cover Cap Screws	Final Torque	63 N•m (46 lb-ft)
Camshaft Gear Access Cover Cap Screws[2]	Initial Torque	50 N•m (37 lb-ft)
Camshaft Gear Access Cover Cap Screws[2]	Final Torque	68 N•m (50 lb-ft)
Adjustable Fan Drive Assembly Mounting Cap Screws	Torque	90 N•m (66 lb-ft)
Damper Hub Cap Screws	Torque	125 N•m (92 lb-ft)
Front Oil Seal Cap Screws	Torque	15 N•m (11 lb-ft)
Pulley-to-Damper Cap Screws	Torque	125 N•m (92 lb-ft)

[1] Tighten two longest cap screws located next to crankshaft center line to 45 N•m (33 lb-ft). Then, go to bottom cap screws (alternating from side-to-side) and tighten remaining cap screws to 45 N•m (33 lb-ft). Repeat torque sequence to 63 N•m (46 lb-ft).

[2] Start at bottom and alternate from side-to-side. Repeat torque sequence to 68 N•m (50 lb-ft).

DPSG,OUO1004,944 –19–27JUL99–3/3

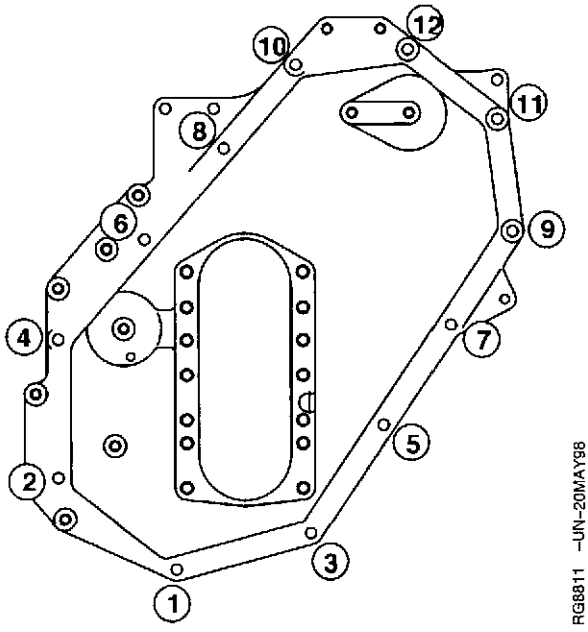
TIMING GEAR COVER TORQUE SEQUENCE



Timing Gear Cover Torque Sequence

RG,RG34710,144 –19–30SEP97–1/1

CAMSHAFT GEAR ACCESS COVER TORQUE SEQUENCE



Camshaft Gear Access Cover Torque Sequence

RG,RG34710,145 –19–30SEP97–1/1

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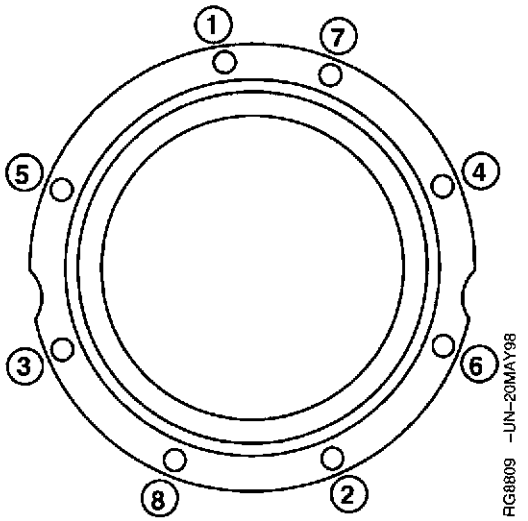
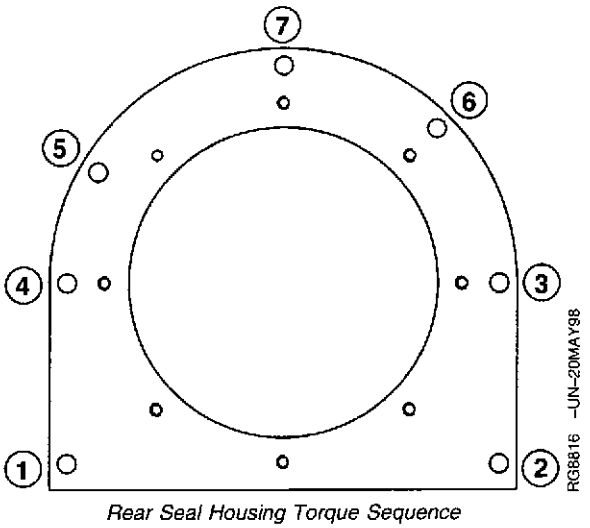
FRONT SEAL TORQUE SEQUENCE



Front Seal Torque Sequence

RG,RG34710,146 –19–30SEP97–1/1

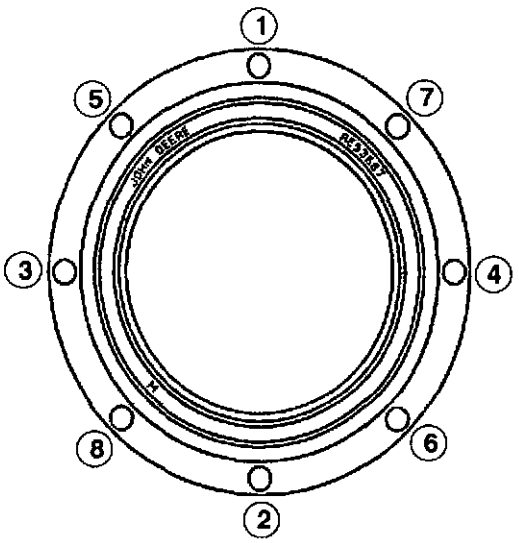
REAR SEAL HOUSING TORQUE SEQUENCE



Rear Seal Housing Torque Sequence

RG,RG34710,147 –19–30SEP97–1/1

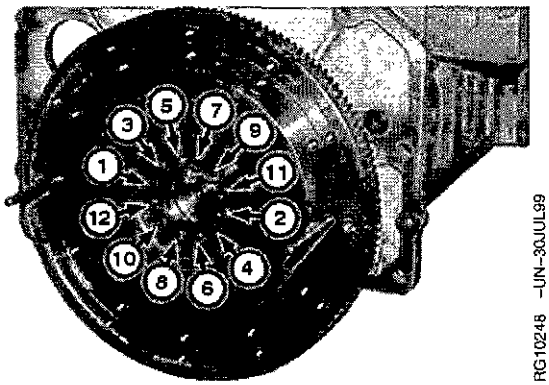
REAR SEAL TORQUE SEQUENCE



Rear Seal Torque Sequence

RG,RG34710,148 –19–30SEP97–1/1

FLYWHEEL TORQUE SEQUENCE



Flywheel Torque Sequence

DPSG,OUO1004,939 –19–26JUL99–1/1

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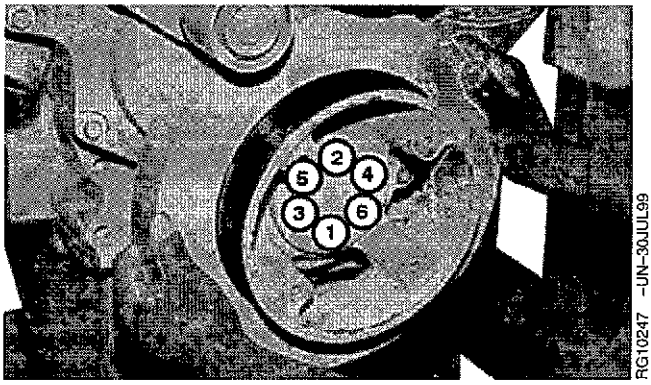
12

CRANKSHAFT VIBRATION DAMPER TORQUE SEQUENCE



Vibration Damper Torque Sequence

DPSG,OUO1004,940 –19–26JUL99–1/1

INSPECT CRANKSHAFT VIBRATION DAMPER

Refer to your machine operator's manual for recommended vibration damper inspection frequency.

1. Remove V-belt, (shown removed).

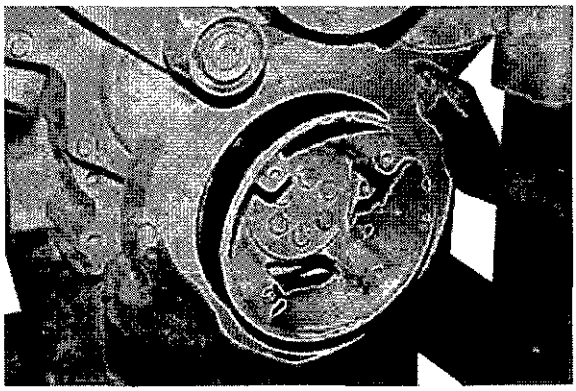
IMPORTANT: The vibration damper assembly is not repairable and should be replaced every 5 years or 4500 hours, whichever occurs first.

ALWAYS replace vibration damper whenever crankshaft is replaced or at engine major overhaul.

2. Carefully inspect vibration damper for torn or split rubber protruding from front and back of assembly.
3. Grasp vibration damper with both hands and attempt to turn it in both directions. If rotation is felt, damper is defective and should be replaced.
4. Check vibration damper radial runout by positioning a dial indicator so probe (A) contacts damper OD
5. With engine at operating temperature, rotate crankshaft using JDG820 Flywheel Rotation Tool.
6. Note dial indicator reading. Replace vibration damper if radial runout exceeds specifications.

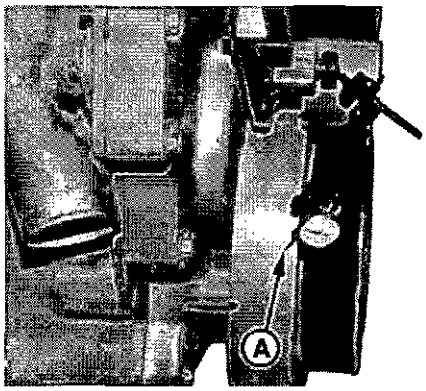
Vibration Damper—Specification

Max. Radial Runout..... 0.76 mm (0.030 in.)



RG8536 –UN–20MAY98

Checking Damper Rotation



RG8537 –UN–10DEC97

Measuring Damper Radial Runout

A—Probe

RG,RG34710,149 –19–30SEP97–1/1

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14

CHECK CRANKSHAFT END PLAY

1. Position dial indicator on end of crankshaft as shown.
2. Push crankshaft as far to rear of engine as possible.
3. Zero the dial indicator.

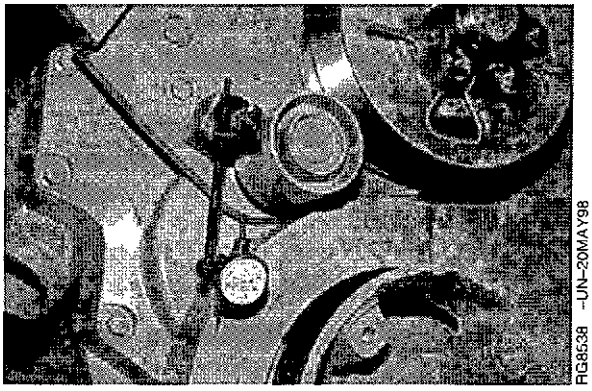
IMPORTANT: Do not apply too much pressure with bar, as this could damage thrust bearings.

4. Using a bar, gently pry the crankshaft as far forward as possible and record endplay.

Crankshaft—Specification

End Play	0.038—0.380 mm (0.0015—0.0150 in.)

NOTE: If endplay is not within specifications, new thrust bearings will usually restore proper end play.



Checking Crankshaft End Play

RG,RG34710,150 –19–30SEP97–1/1

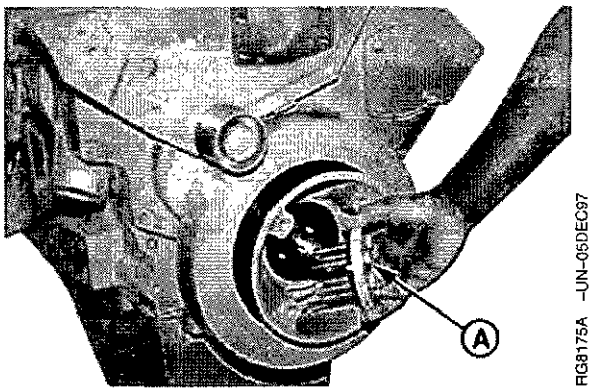
REMOVE CRANKSHAFT VIBRATION DAMPER AND PULLEY

CAUTION: Damper and pulley are very heavy. Plan proper handling procedures to avoid injury. ALWAYS use an assistant when removing and installing pulley.

IMPORTANT: DO NOT immerse damper assembly in petroleum products (such as gasoline, oil, solvent, etc.). Doing so can damage the rubber portion of the assembly. Never apply thrust on outer ring of damper. The damper is sensitive to impact damage from being dropped or struck with a hammer.

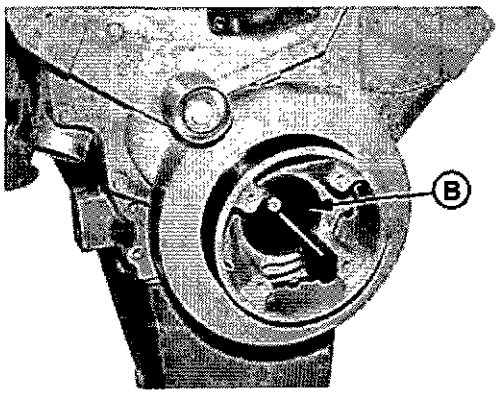
NOTE: Remove front bolt-on pulley from vibration damper assembly for access to front nose of crankshaft, if equipped.

1. Remove six cap screws and large washer (A) from front nose of crankshaft.
2. Install JDG973-1 Remover/Installer Hub (B) onto nose of crankshaft with two hex socket head cap screws provided in kit. Tighten cap screws until they bottom on hub.
3. Lubricate threads of remover/installer with multi-purpose grease.



RG8175A –UN–05DEC97

Removing Damper Retaining Ring



RG8176 –UN–05DEC97

Installing JDG973-1 Hub

A—Large Washer
B—JDG973-1 Remover/Installer Hub

Continued on next page

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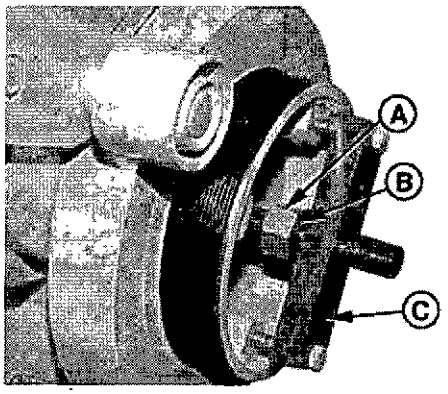
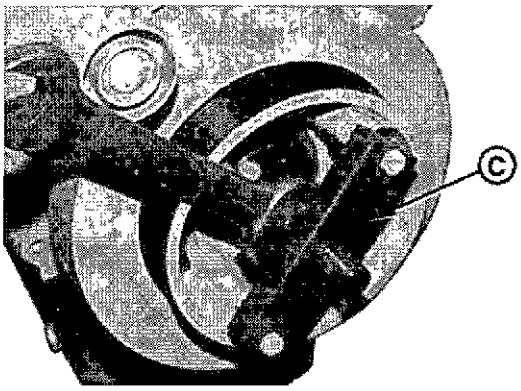
16

4. Thread large hex nut (A) onto hub and install thrust washer (B). Grease both sides of thrust washer.
5. Install JDG973-2 Cross Block (C) and secure with two hex head cap screws provided in kit. Thread cap screws into vibration damper deep enough to allow clearance for wrench on large nut.
6. Remove damper from crankshaft flange. Remover/installer hub will support damper after it is removed from crankshaft flange.
7. Remove hub from front nose of crankshaft.



RG8168 –UN–05DEC97

Installing JDG973-2 Cross Block



RG8169 –UN–05DEC97

Removing Vibration Damper

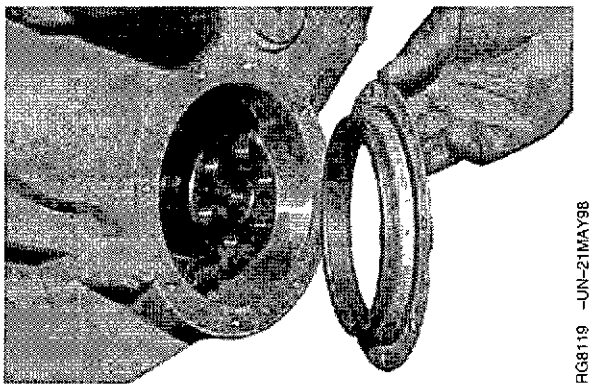
A—Large Hex Nut
B—Thrust Washer
C—JDG973-2 Cross Block

RG,RG34710,151 –19–30SEP97–2/2

REMOVE CRANKSHAFT FRONT OIL SEAL

1. Remove vibration damper and pulley. (See REMOVE CRANKSHAFT VIBRATION DAMPER AND PULLEY, earlier in this group.)
2. Remove eight cap screws and remove front seal from timing gear cover.

   For front crankshaft oil seal replacement, oil seal must be installed onto vibration damper prior to damper installation. (See INSTALL CRANKSHAFT VIBRATION DAMPER AND FRONT OIL SEAL, later in this group.)



RG8119 –UN–21MAY98

Removing Crankshaft Front Oil Seal

RG,RG34710,152 –19–30SEP97–1/1

REMOVE TIMING GEAR COVER

1. If not previously done, remove vibration damper and pulley (A). (See REMOVE CRANKSHAFT VIBRATION DAMPER AND PULLEY, earlier in this group.)

2. Drain engine oil if not previously done and remove engine oil pan (B). (See REMOVE ENGINE OIL PAN in Group 20.)

3. Disconnect crankshaft position sensor.

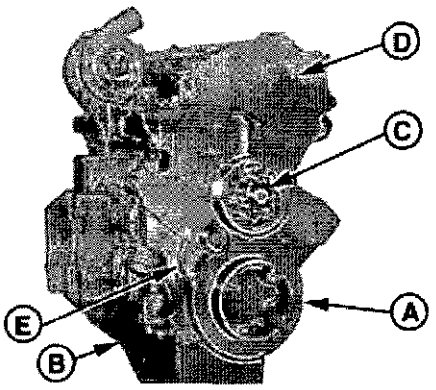
NOTE: On engines with fixed fan drive assembly, the fan drive housing is cast into the camshaft gear access cover.

4. Remove fan drive (C). (See REPLACE BEARINGS IN FAN DRIVE ASSEMBLY in Group 25.)

5. Remove camshaft gear access cover (D) from timing gear cover. Mark location of cap screws to aid in reassembly.

6. Remove remaining cap screws and remove timing gear cover. Mark location of cap screws to aid in reassembly.

NOTE: On engines with fixed fan drive, the lower right cap screw (under pulley) will have to be reinstalled in camshaft gear access cover bore prior to installing pulley. Once pulley is installed, it interferes with the installation of this cap screw.



RG6178 –UN–05DEC97

Removing Timing Gear Cover

A—Vibration Damper
B—Oil Pan
C—Fan Drive Assembly
D—Camshaft Gear Access Cover
E—Timing Gear Cover

RG,RG34710,153 –19–27JUL99–1/1

15 18

CHECK FLYWHEEL HOUSING FACE RUNOUT

1. Mount dial indicator on flywheel. Set pointer to contact PTO mounting surface on flywheel housing at right angles. Pointer should not contact holes in flywheel housing.

IMPORTANT: Maintain constant end pressure on crankshaft to hold shaft against thrust bearing when measuring flywheel housing face runout.

2. Rotate flywheel by turning crankshaft. Read total dial indicator movement.

SAE 1 Flywheel Housing—Specification

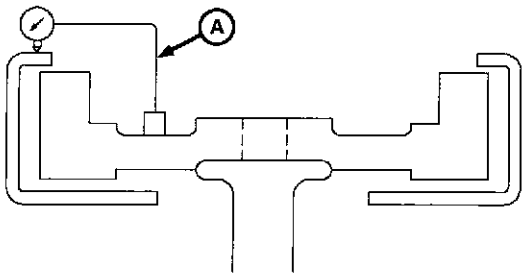
Maximum Face Deviation (A)..... 0.30 mm (0.012 in.)
Maximum Bore Eccentricity (B)..... 0.30 mm (0.012 in.)

SAE 2 Flywheel Housing—Specification

Maximum Face Deviation (A)..... 0.28 mm (0.011 in.)
Maximum Bore Eccentricity (B)..... 0.28 mm (0.011 in.)

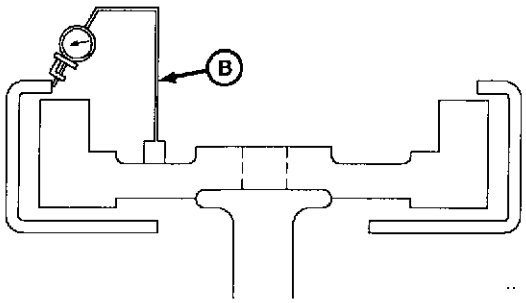
SAE 0 Flywheel Housing—Specification

Maximum Face Deviation (A)..... 0.41 mm (0.016 in.)
Maximum Bore Eccentricity (B)..... 0.41 mm (0.016 in.)



RG10271 –UN–02AUG99

Face Deviation



RG10272 –UN–02AUG99

Bore Eccentricity

A—Measure Face Deviation
B—Measure Bore Eccentricity

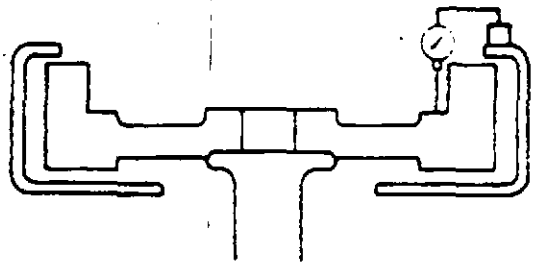
RG,RG34710,154 –19–26JUL99–1/1

CHECK FLYWHEEL FACE FLATNESS

1. Mount dial indicator base on flywheel housing. Position pointer to contact driving ring mounting surface. Do not allow pointer to contact driving ring mounting holes.

IMPORTANT: Maintain constant end pressure on crankshaft to hold shaft against thrust bearing when measuring flywheel face *runout*.

2. Rotate flywheel by turning crankshaft. Read total dial indicator movement. Resurface flywheel face or replace as required.



R22213 –UN–14DEC88

Measuring Flywheel Face Flatness

Flywheel Face Flatness—Specification

Maximum Variation	0.23 mm (0.009 in.)
Maximum Variation per 25 mm (1.0 in.) of Travel	0.013 mm (0.0005 in.)

RG,RG34710,155 –19–30SEP97–1/1

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REMOVE FLYWHEEL

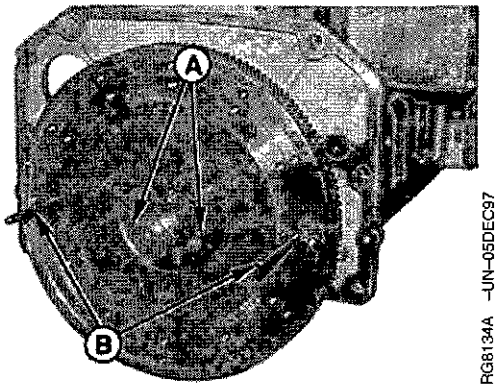
CAUTION: Flywheel is heavy. Use proper lifting procedures to avoid personal injury.

NOTE: SAE 1 flywheel housing must be removed before flywheel can be removed from engine. (See REMOVE AND INSTALL FLYWHEEL HOUSING later in this group.)

1. Remove two flywheel attaching cap screws (A), and install two guide pins in their place.
2. Remove remaining cap screws, and carefully pull flywheel from crankshaft.

NOTE: Threaded guide pins (B) may also be used to ease handling of flywheel.

Once flywheel is removed, JDG976 Crankshaft Front Rotation Adapter can be used to rotate crankshaft if necessary.



Removing Flywheel

A—Cap Screws
B—Threaded Guide Pins

RG,RG34710,156 –19–27JUL99–1/1

INSPECT AND REPAIR FLYWHEEL

1. Inspect the clutch contact face for scoring, overheating or cracks.
2. Resurface clutch contact face as necessary to restore flatness for proper clutch contact.
3. Replace a defective flywheel.
4. Examine ring gear for worn or broken teeth. If ring gear is damaged, replace gear.

RG,RG34710,157 –19–30SEP97–1/1

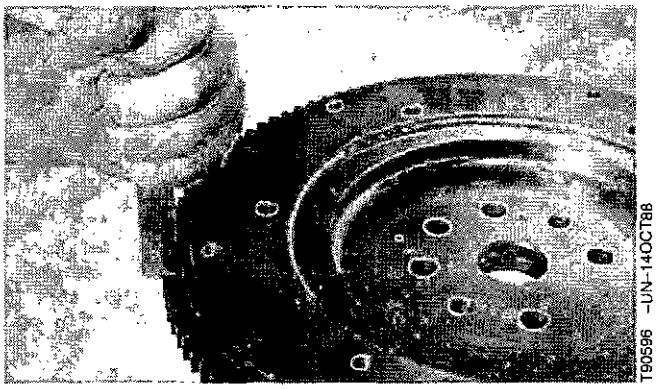
REPLACE FLYWHEEL RING GEAR

CAUTION: Oil fumes or oil can ignite above 193°C (380°F). Do not allow a flame or heating element to be in direct contact with the oil. Heat the oil in a well ventilated area. Plan a safe handling procedure to avoid burns.

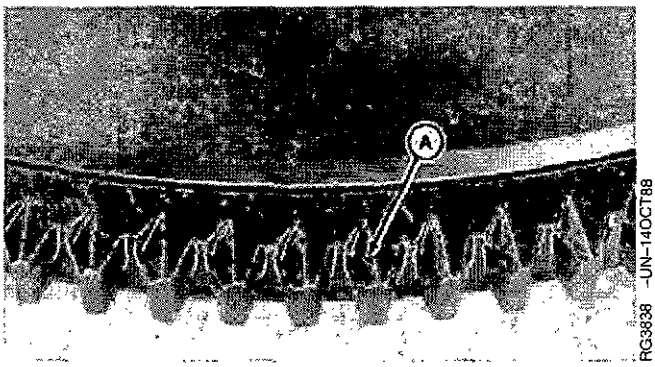
1. Place the flywheel on a solid flat surface.
2. Drive ring gear off with a brass drift and hammer.

IMPORTANT: *If flame heat is used, be sure gear is heated uniformly around circumference. DO NOT OVERHEAT. SEE CAUTION. Overheating may also destroy original heat treatment of gear.*

3. Heat new ring gear to 232°C (450°F) maximum, using either heated oil or oven heat.
4. Turn gear so side with chamfer (A) is toward engine with flywheel installed.
5. Install ring gear flush within 0.25 mm (0.010 in.) against shoulder of flywheel.



Removing Flywheel Ring Gear



Flywheel Ring Gear

A—Chamfer

RG,RG34710,158 –19–30SEP97–1/1

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REMOVE AND INSTALL FLYWHEEL HOUSING

REMOVE FLYWHEEL HOUSING

CAUTION: Flywheel housing is heavy. Plan a proper lifting procedure to avoid personal injury.

NOTE: Flywheel must be removed before removing SAE0 and SAE2 flywheel housings.

1. Remove attaching cap screws.
2. Remove flywheel housing.
3. Inspect dowel pins for damage. Replace pins as needed.

INSTALL FLYWHEEL HOUSING

CAUTION: Flywheel housing is heavy. Plan proper lifting procedures to avoid personal injury.

1. Scrape off all old gasket material. Install a new gasket without sealant between block and flywheel housing, if equipped.
2. Install flywheel housing on cylinder block.

NOTE: ALWAYS use new cap screws when installing flywheel housing.

3. Dip threads of cap screw in engine oil before installing. Install and tighten cap screws to specifications.

Flywheel Housing-to-Cylinder Block Cap Screws (SAE 1 With Rear PTO)—Specification

Torque ..... 325 N•m (240 lb-ft)

Flywheel Housing-to-Cylinder Block Cap Screws (SAE 0, 1 and 2 Without Rear PTO)—Specification

Torque ..... 365 N•m (270 lb-ft)

4. If removed, install starting motor and tighten cap screws to specifications.

Starting Motor Cap Screws—Specification

Torque ..... 125 N•m (92 lb-ft)

RG,RG34710,159 –19–27JUL99–1/1

INSTALL FLYWHEEL

CAUTION: Flywheel is heavy. Plan proper handling procedures to avoid injuries.

NOTE: SAE 0 and SAE 2 flywheel housings must be installed before installing flywheel. (See REMOVE AND INSTALL FLYWHEEL HOUSING earlier in this group.)

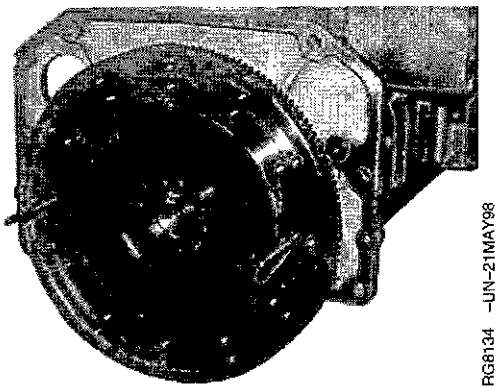
NOTE: ALWAYS use new cap screws when installing flywheel.

1. Install two pilot studs in crankshaft to aid in assembly. Position flywheel over pilot studs.
2. Install flywheel attaching cap screws. Remove pilot studs and install remaining two cap screws.
3. Tighten flywheel attaching cap screws in the sequence shown to the following specifications.

Flywheel-to-Crankshaft—Specification

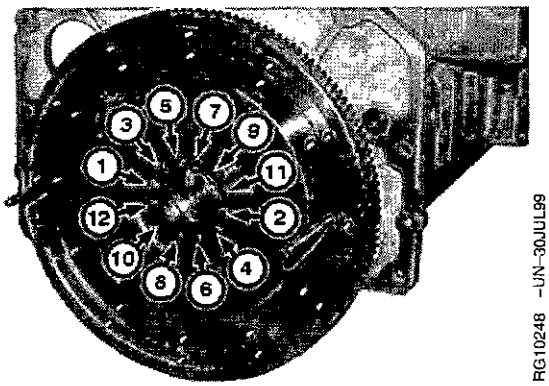
Torque ..... 170 N•m (125 lb-ft)

4. After flywheel and housing are installed, perform flywheel-to-housing runout checks. (See CHECK FLYWHEEL HOUSING FACE RUNOUT earlier in this group.)



RG8134 –UN–21MAY98

Installing Flywheel



RG10248 –UN–30JUL99

Flywheel Tightening Sequence

RG,RG34710,160 –19–27JUL99–1/1

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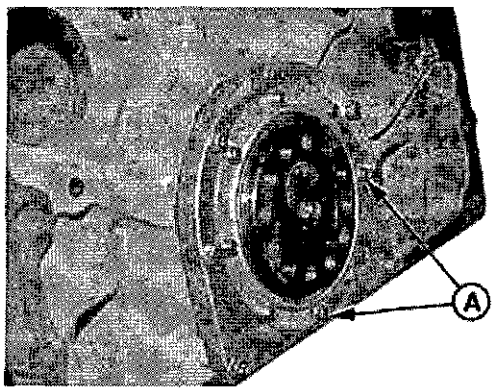
REMOVE REAR CRANKSHAFT OIL SEAL AND HOUSING ASSEMBLY

To remove rear crankshaft oil seal, the seal housing MUST BE removed also.

1. Remove engine oil pan, if not previously removed. (See REMOVE OIL PAN, in Group 20.) Remove flywheel, if not previously removed. (See REMOVE FLYWHEEL earlier in this group.)
2. Remove eight cap screws (A) securing rear seal to housing.

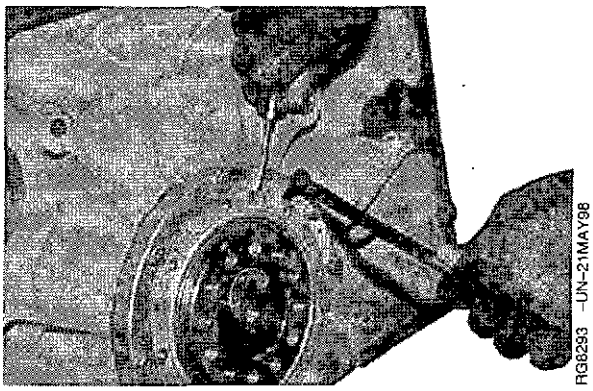


Removing Rear Oil Seal and Housing

A—Cap Screws

RG,RG34710,161 –19–13AUG99–1/4

3. Separate seal from housing using a small flat screwdriver and heel-type prybar as shown.



Separating Rear Seal From Housing

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RG,RG34710,161 –19–13AUG99–2/4

4. Remove all cap screws securing rear seal housing to cylinder block except top cap screw and two bottom cap screws (A) as shown.

NOTE: Position split in collet halves at 12:00 o'clock position (C).

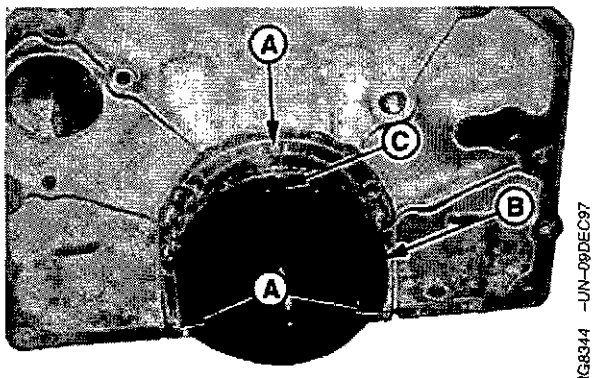
5. Install JDG1020 Rear Seal and Housing Remover (B) using knife-edge jaws with larger ID. Install puller jaws between seal carrier and seal housing.

6. Secure assembly by tightening band clamp securely.

NOTE: Always lubricate forming screw with multi-purpose grease prior to using.

7. Tighten forcing screw until rear seal and remover is free from seal housing. Wear sleeve portion of seal assembly should remain on crankshaft flange.

8. Remove three remaining cap screws securing seal housing to block and remove housing with gasket.



RG8344 –UN–09DEC97

Removing Rear Seal Carrier

A—Cap Screw
B—JDG1020 Rear Seal and Housing Remover
C—12:00 o'clock Position

Continued on next page

RG,RG34710,161 –19–13AUG99–3/4

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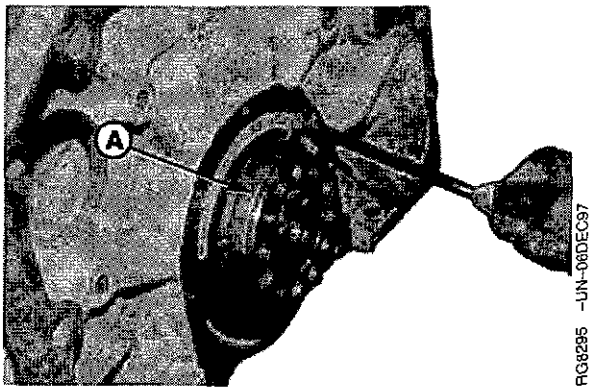
9. If necessary, push wear sleeve portion of seal assembly (A) away from block to allow collet halves to be installed behind wear sleeve.

10. Install JDG1020 Remover (B) behind wear sleeve using smaller ID knife-edge jaws. Tighten band clamp securely.

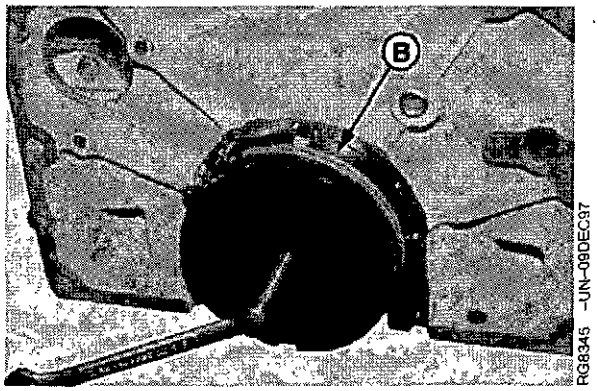
11. Lubricate threads and tighten forcing screw until wear sleeve is removed from crankshaft flange.

12. Inspect crankshaft flange for burrs and nicks.

13. Clean all oil and sealant from crankshaft flange using Brake Kleen or ignition cleaner. Polish burrs with fine emery cloth.



Prying Rear Wear Sleeve



Removing Rear Wear Sleeve Using JDG1020

A—Seal Assembly
B—JDG1020 Remover

RG,RG34710,161 –19–13AUG99–4/4

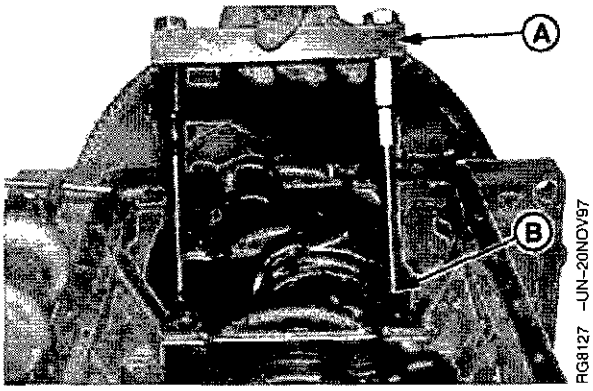
REMOVE CRANKSHAFT MAIN BEARINGS

NOTE: A drop in oil pressure, engine knock, or excessive crankshaft end play are indications of main bearing and main thrust bearing washer failures.

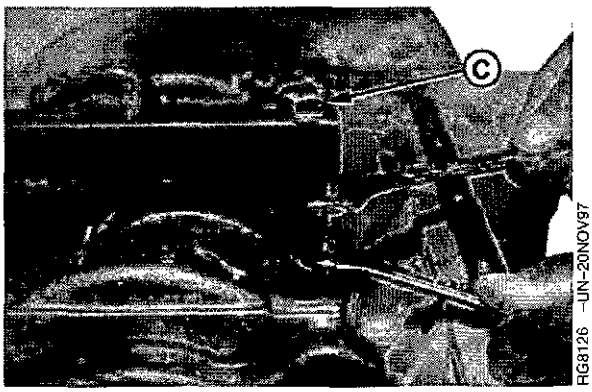
IMPORTANT: Before removing main bearing caps, check for proper torque on all main bearings. Also, check each bearing cap to make sure they are numbered for reassembly on the same numbered main bearing web. Keep matched bearing inserts with their respective main bearing caps for comparison with *corresponding crankshaft journal* to check surface wear.

NOTE: When removing main bearings and caps for crankshaft removal, leave No. 1 and 7 main bearing caps installed until all connecting rod caps have been removed.

1. Remove engine oil pan and pick-up tube. (See REMOVE ENGINE OIL PAN in Group 20.)
2. Remove front timing gear cover. (See REMOVE TIMING GEAR COVER in this group.)
3. Remove rear oil seal and housing. (See REMOVE REAR CRANKSHAFT OIL SEAL AND HOUSING ASSEMBLY in this group.)
4. Remove main bearing cap screws.
5. Install JDG996 Puller (A) so that tip (B) of blind hole puller legs are below bearing cap half.
6. Tighten hex of actuator pin securely while holding collet portion of puller leg with second wrench.
7. Tighten both cap screws (C) on cross block finger tight.



JDG996 Main Bearing Cap Puller



Installing JDG996 Puller

A—JDG996 Puller
B—Tip
C—Cap Screws

Continued on next page

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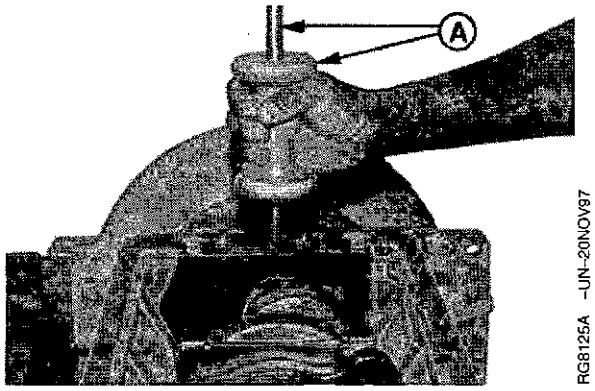
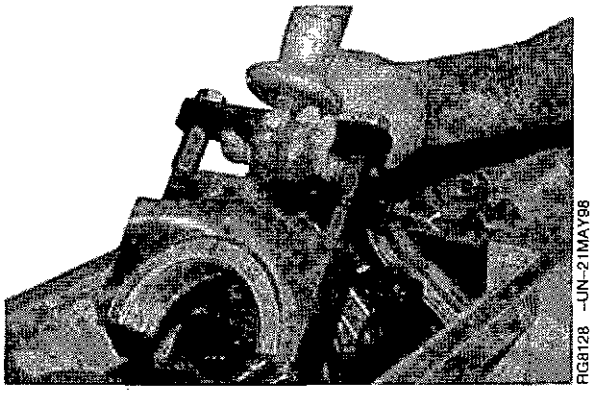
8. Attach D01300AA Slide Hammer (A) to cross block, tighten nut securely.
9. Remove main bearing cap by sliding up on hammer weight.
10. Use PLASTIGAGE® to measure journal-to-bearing oil clearance on each main bearing as they are removed. (See CHECK MAIN BEARING-TO-JOURNAL OIL CLEARANCE, later in this group.)



Bearing Cap Puller and Slide Hammer



Main Bearing Cap Assembly Removed

A—D01300AA Slide Hammer

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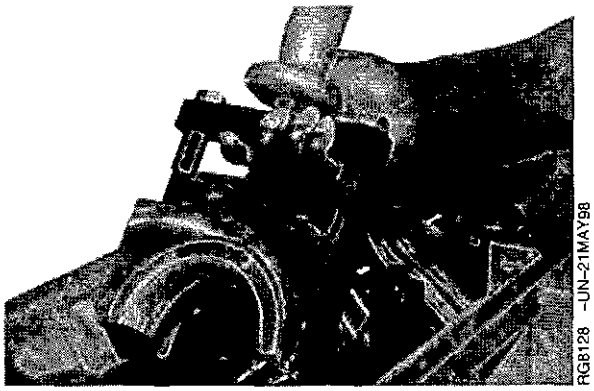
RG,RG34710,162 –19–13AUG99–2/2

CHECK MAIN BEARING-TO-JOURNAL OIL CLEARANCE

NOTE: The use of PLASTIGAGE® will determine wear (crankshaft-to-bearing oil clearance) but will not determine condition of either bearing or journal surface.

1. Place a strip of PLASTIGAGE® in the center of the main bearing cap about three-fourths of the width of the bearing.
2. Use clean SAE 30 engine oil on PLASTIGAGE® to prevent sticking.
3. Install cap and tighten cap screws to 295 N•m (218 lb-ft).
4. Remove cap and compare width of PLASTIGAGE® with specifications below to determine clearance.



Checking Oil Clearance

Crankshaft Main Bearings—Specification

Main Bearing-to-Journal Clearance	0.046—0.122 mm (0.0018—0.0048 in.)
Maximum Acceptable Oil Clearance	0.152 mm (0.0060 in.)

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RG,RG34710,163 –19–30SEP97–1/1

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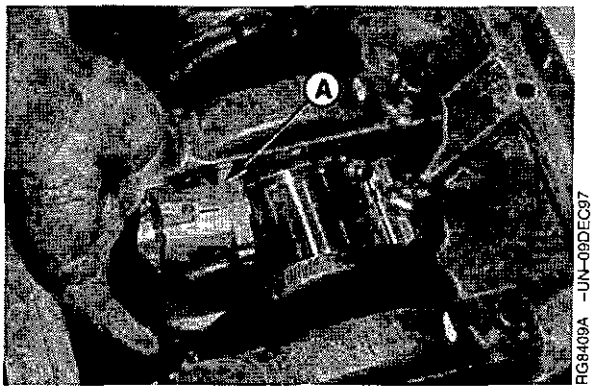
REMOVE CRANKSHAFT

1. Remove timing gear cover. (See REMOVE TIMING GEAR COVER, earlier in this group.)
2. Remove flywheel. (See REMOVE FLYWHEEL earlier in this group.)
3. Remove flywheel housing. (See REMOVE AND INSTALL FLYWHEEL HOUSING earlier in this group.)
4. Remove rear oil seal housing. (See REMOVE REAR CRANKSHAFT OIL SEAL AND HOUSING ASSEMBLY earlier in this group.)
5. Remove all six piston spray jets to avoid damage. (See REMOVE AND INSTALL PISTON SPRAY JETS in Group 10.)
6. Remove main bearing 2 through 6. (See REMOVE CRANKSHAFT MAIN BEARINGS, earlier in this group.)
7. Rotate crankshaft using the JDG820 Flywheel Rotation Tool until connecting rod caps can be removed easily. You will be able to remove two rod caps at each position.
8. Remove all connecting rod caps with bearings (A), then remove No. 1 and 7 main bearing caps and bearings. (See REMOVE PISTONS AND CONNECTING RODS in Group 10.)



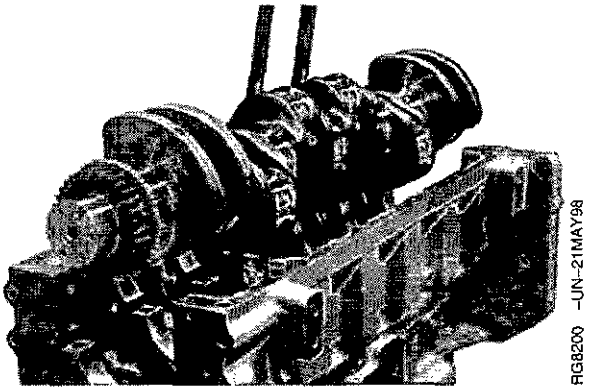
Removing Rod Caps

A—Bearings

Continued on next page

CAUTION: Crankshaft is very heavy. Plan a proper handling procedure to avoid injury.

9. Attach a lifting strap to crankshaft. Protect machined journals from damage with clean shop towels.
10. Using proper lifting equipment, carefully raise crankshaft out of cylinder block.
11. *Clean crankshaft, especially oil passages, using* solvent and compressed air.
12. Put crankshaft on clean V-blocks for inspection.



Removing Crankshaft from Block

RG,RG34710,164 –19–13AUG99–2/2

INSPECT CRANKSHAFT

NOTE: If crankshaft damper damage was discovered during teardown, it is recommended that the crankshaft be magna-fluxed. This will verify whether or not it has microscopic cracks or fissures. (See INSPECT VIBRATION DAMPER, earlier in this group.)

1. Thoroughly clean crankshaft. Clear restrictions from all oil passages.
2. Inspect crankshaft for signs of load stress, cracks, or scratches on journals. Also check each journal for evidence of excessive overheating or discoloration. If either condition exists, replace crankshaft since heat treatment has probably been destroyed.
3. Inspect (front) crankshaft gear and timing wheel for cracks, chipped teeth, or excess wear. Inspect keyway and index pin for damage and proper indexing on flange. Replace gear(s) as required. (See REPLACE CRANKSHAFT DRIVE GEAR later in this group.)
4. Inspect the keyway for evidence of cracks or wear. Replace crankshaft as necessary.
5. Carefully inspect the rear flange of the crankshaft in the area of the oil seal's wear sleeve contact surface for evidence of a rough or grooved condition. Any imperfections in this area will result in oil leakage. Slight ridges may be cleaned up with emery cloth and crocus cloth.
6. Check each journal for evidence of excessive overheating or discoloration. If either condition exists, replace crankshaft since heat treatment has probably been destroyed.

IMPORTANT: The vibration damper MUST BE replaced whenever the crankshaft is replaced.

Continued on next page

RG,RG34710,165 –19–13AUG99–1/2

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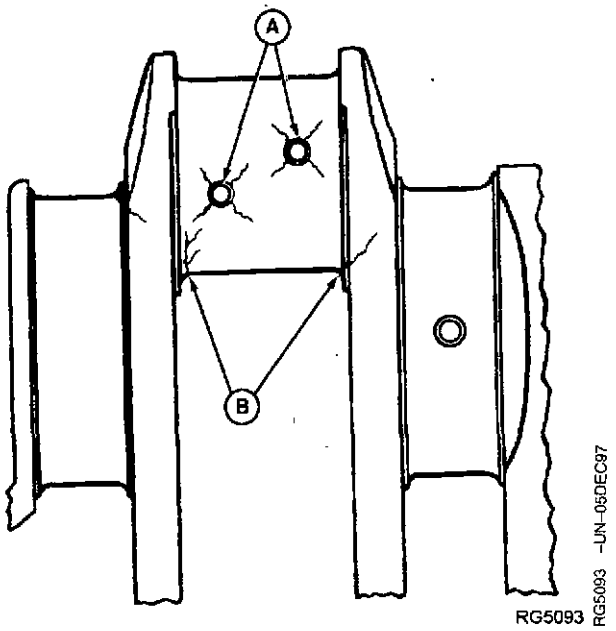
IMPORTANT: Small cracks may not be visible to the eye. Use procedure such as the Fluorescent Magnetic Particle method. This method magnetizes the crank, employing magnetic particles which are fluorescent and glow under "black light". The crankshaft must be de-magnetized after the test.

7. Carefully check the crankshaft for cracks in the area of rod journal oil holes (A) and at journal fillets (B). Replace crankshaft if any cracks are found.



Crankshaft Stress Cracks

A—Rod Journal Oil Holes
B—Journal Fillets

RG,RG34710,165 –19–13AUG99–2/2

MEASURE ASSEMBLED ID OF BEARINGS AND OD OF CRANKSHAFT JOURNALS

1. With crankshaft out of cylinder block, install main bearing inserts and caps (be sure inserts are installed correctly).
2. Tighten main bearing cap screws to 295 N•m (218 lb-ft).
3. Measure ID of all bearings with an inside micrometer and compare measurements with respective crankshaft main journals.

Crankshaft Main Bearing—Specification

ID With Bearing	125.071—125.127 mm (4.9241—4.9263 in.)
ID Without Bearing	133.097—133.123 mm (5.2400—5.2411 in.)

NOTE: Inspect and measure assembled ID of connecting rod bearings. Compare measurements with connecting rod journal OD on crankshaft. (See INSPECT AND MEASURE CONNECTING ROD BEARINGS in Group 10.)

4. Measure OD of all respective crankshaft journals at several points around journal.

Crankshaft Main Bearing Journal—Specification

OD	124.983—125.017 mm (4.9206—4.9219 in.)

NOTE: If engine has previously had a major overhaul and undersized bearing inserts were used, above listed ID and OD dimensions may not be the same as those recorded. However, oil clearance should be within specifications. Oil clearance is 0.046—0.122 mm (0.0018—0.0048 in.). The maximum serviceable clearance is 0.152 mm (0.0060 in.).

Compare crankshaft journal OD measurements to determine if journal is out-of-round or tapered.

Crankshaft Main Journal—Specification

Max. Out-of-Round	0.025 mm (0.0010 in.)
Max. Taper per 25.4 mm (1.0 in.) of Journal Length	0.0025 mm (0.0001 in.)

RG,RG34710,166 -19-13AUG99-1/1

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MEASURE ASSEMBLED ID OF MAIN BEARING CAPS (WITHOUT BEARINGS)

1. With crankshaft removed from cylinder block, install main bearing caps without bearing inserts.
2. Tighten main bearing cap screws to 295 N•m (218 lb-ft).
3. Measure ID of all bearing caps with an inside micrometer. Compare to specifications given.

   If any main bearing cap assembled ID is not within specification, blank (generic) bearing caps are available and must be line bored to specification. Replace individual bearing caps as needed.

Main Bearing Cap Bore Specifications—Specification

ID Without Bearings	133.097—133.123 mm (5.2400—5.2411 in.)
Max. Bore Diameter Variation	0.013 mm (0.0005 in.)
Max. Bore Diameter Taper	0.005 mm (0.0002 in.)
Max. Straightness (Any Bore-to-Adjacent Bore)	0.038 mm (0.0015 in.)
Max. Straightness (5 Center Bores-to-Adjacent Bore)	0.076 mm (0.0030 in.)
Centerline of Bore-to-Top Deck	429.92—430.07 mm (16.926—16.932 in.)

IMPORTANT: Main bearing caps line boring should be done ONLY by experienced personnel on equipment capable of maintaining bore specifications.

4. Measure main bearing cap surface width and compare to following specifications.

Crankshaft Main Bearing Cap—Specification

Surface Width	39.75—40.25 mm (1.565—1.585 in.)

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CRANKSHAFT GRINDING GUIDELINES

IMPORTANT: Crankshaft grinding should be done ONLY by experienced personnel on equipment capable of maintaining crankshaft size and finish specifications.

If undersize bearings are used, check bearing clearance after bearing caps have been tightened to specified torque. If undersize bearings are too tight and clearance is not within specifications, the journal and bearing will be wiped clean of all oil. This would result in premature wear of parts.

In addition to the standard size main and connecting rod bearings, the following undersize bearings are available.

Crankshaft Main Bearings Available—Specification

Undersize	0.25, 0.50 mm (0.010, 0.020 in.)

If journals are tapered, out-of-round, scored or damaged, grind the crankshaft and install the proper undersize bearings.If the crankshaft is to be reground, use the following recommended procedure:

1. Compare the crankshaft journal measurements taken during inspection and determine the size which the journals are to be reground.
2. If one or more main or connecting rod journals require grinding, then grind all of the main journals or all of the connecting rod journals to the same required size.
3. All journal fillets radii must be free of any sharp grind marks or scratches. The fillet must blend smoothly into the journal and crank cheek. Check the radius with a fillet gage.

IMPORTANT: Care must be taken to avoid localized heating which often produces grinding cracks.

4. Cool the crankshaft while grinding by using coolant generously. DO NOT crowd the grinding wheel into the work.

IMPORTANT: Grind crankshaft with journals turning clockwise, as viewed from the front end of crankshaft. Lap or polish journals in opposite direction of grinding.

5. Polish or lap the ground surfaces to the specified finish to prevent excessive wear of the journals.

NOTE: Production crankshafts are induction hardened and shotpeened at the factory. Field shotpeening is not recommended due to the equipment required and part geometry.

6. If the thrust surfaces of the crankshaft are worn or grooved excessively, regrind and polish. Maintain the specified radius between each thrust surface and the bearing journal. An oversize thrust washer set containing one standard washer and two 0.18 mm (0.007 in.) oversize washers is available. (See THRUST BEARING NEW PART SPECIFICATIONS, later in this group.)

NOTE: When thrust surfaces are reground and oversize washers used, crankshaft end play specification must be maintained to within 0.038–0.380 mm (0.0015–0.0150 in.). (See CHECK CRANKSHAFT END PLAY, earlier in this group.)

7. Stone the edge of all oil holes in the journal surfaces smooth to provide a radius of approximately 1.50 mm (0.060 in.).

Continued on next page

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8. When finished grinding, inspect the crankshaft for cracks with the Fluorescent Magnetic Particle Method, or similar method.
9. De-magnetize the crankshaft.
10. Thoroughly clean the crankshaft and oil passages with solvent. Dry with compressed air.

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CRANKSHAFT GRINDING SPECIFICATIONS

Engine Stroke (6105)	138 mm (5.43 in.)
Engine Stroke (6125)	165 mm (6.50 in.)
Main and Rod Journal Surface Finish	Lap 0.25 Um (9.8 AA)
Thrust Journal and Fillet Radii Surface Finish	Lap 0.4 Um (16 AA)
Rod Journal Fillet Radius	4.49—4.85 mm (0.177—0.191 in.)
Main and Thrust Journal Fillet Radius	3.94—4.44 mm (0.155—0.175 in.)
Thrust Journal Width	48.97—49.07 mm (1.928—1.932 in.)

Bearing Size	Crankshaft Main Journal O.D.	Crankshaft Rod Journal O.D.
Standard	124.983—125.017 mm (4.9206—4.9219 in.)	88.844—88.874 mm (3.4980—3.4990 in.)
0.25 mm (0.010 in.)	124.733—124.767 mm (4.9107—4.9121 in.)	88.594—88.624 mm (3.4980—3.4990 in.)
0.50 mm (0.02 in.)	124.473—124.507 mm (4.9005—4.9019 in.)	88.334—88.364 mm (3.4777—3.4789 in.)

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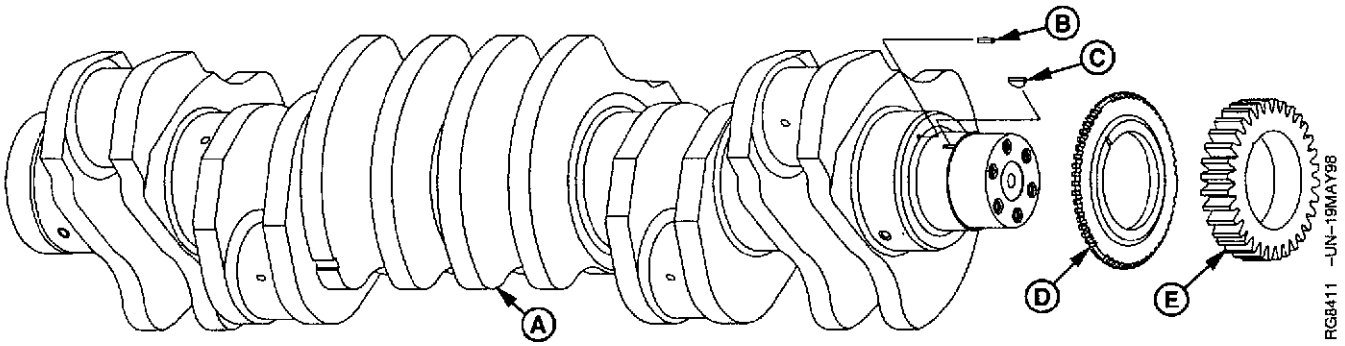
REPLACE CRANKSHAFT DRIVE GEAR



Crankshaft, Timing Wheel, Gear

A—Crankshaft
B—Roll Pin
C—Woodruff Key
D—Timing Wheel
E—Crankshaft Drive Gear

IMPORTANT: Crankshaft (A) must be removed before replacing drive gear (E).

NOTE: Remove crankshaft gear for replacement only; it is not necessary to remove gear for crankshaft removal.

1. Protect crankshaft machined wear sleeve surface with masking tape.
2. Remove crankshaft gear using D01074AA 17-1/2 Ton Puller Set.
3. Discard gear after removal.
4. Remove Woodruff key (C) and crankshaft timing wheel (D), and roll pin (B) from crankshaft keyway.
5. Remove masking tape.

CAUTION: Oil fumes or oil can ignite above 193°C (380°F). Do not allow a heating element to be in direct contact with the oil. Heat the oil in a well-ventilated area. Plan a safe handling procedure to avoid burns.

IMPORTANT: Crankshaft gear must be installed on crankshaft before crankshaft is installed in engine, otherwise damage to thrust bearings could occur.

6. Heat crankshaft gear to 182°C (360°F) maximum, using either heated oil or oven heat.
7. Install new roll pin in crankshaft and position timing wheel over roll pin for proper indexing.
8. Install Woodruff key in crankshaft keyway.
9. Place gear on crankshaft flange. Be sure key on crankshaft is properly aligned with keyway in gear.

IMPORTANT: When installing gear, do not gouge or nick crankshaft flange.

10. Firmly seat gear and timing wheel against crankshaft flange using a driver.

    No clearance allowed between gear, timing wheel, and crankshaft after gear cools.

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INSPECT THRUST BEARINGS

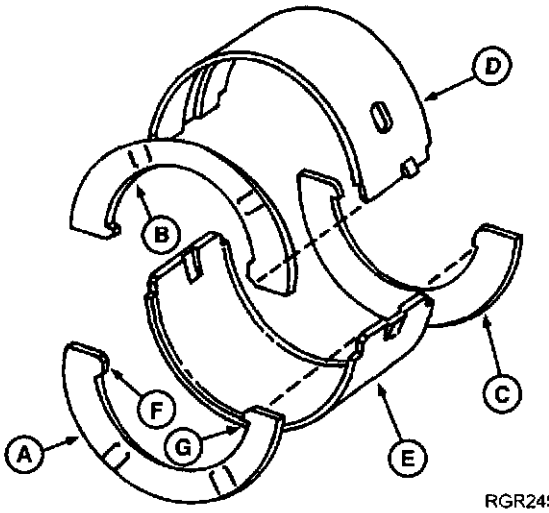
Check thrust surfaces of the thrust bearing and the thrust bearing journal on crankshaft and replace as necessary.

Thrust bearings are available in each of the previously mentioned insert undersizes. An oversize thrust washer set containing one regular size washer and two 0.18 mm (0.007 in.) oversize washers is also available.

Oversize Thrust Washers Available—Specification

Thickness..... 0.18 mm (0.007 in.)

NOTE: Thrust bearing must be installed with slots facing crankshaft flange. Two halves (A) and (C) go on cap side, not block.



RGR24545 –UN–11DEC97

Thrust Bearing Assembly

A—Lower Rear Thrust Washer
B—Upper Rear Thrust Washer
C—Lower Front Thrust Washer
D—Main Bearing Block Thrust Bearing
E—Main Bearing Cap Thrust Bearing
F—Large Tang
G—Small Tang

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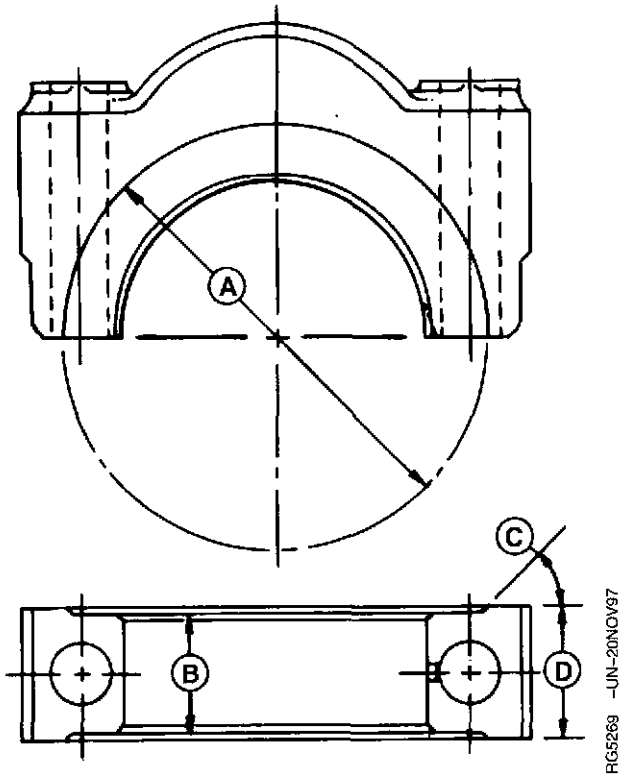
THRUST BEARING NEW PART SPECIFICATIONS

IMPORTANT: Install thrust bearing in cylinder block and tighten to specification before regrinding or polishing thrust surfaces to ensure that all surfaces on bearing and on block web are correctly aligned.

Thrust Bearing New Part Specifications—Specification

Thrust Washer Clearance Base Circle (A)	162.24—163.76 mm (6.387—6.447 in.)
Thrust Surface Width (B)	42.05—42.12 mm (1.656—1.658 in.)
Relief Angle (C)	45°
Bearing Cap Overall Width (D)	43.46 mm (1.711 in.)
Thrust Surface Maximum Runout	0.025 mm (0.0010 in.)



Thrust Bearing Clearance

A—Thrust Washer Clearance Base Circle
B—Thrust Surface Width
C—Relief Angle
D—Bearing Cap Overall Width

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INSTALL MAIN BEARING INSERTS IN BLOCK

IMPORTANT: If new main or thrust bearing inserts or thrust washers are installed, they must be installed as a matched set.

During assembly, apply a liberal coating of clean engine oil to:

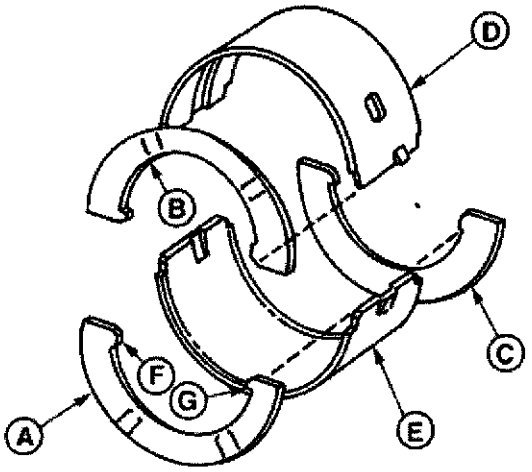
- All main bearing webs in block
- Both sides of main bearing inserts, thrust bearing inserts, and thrust washers
- Entire OD of crankshaft main bearing journals

1. Install six main bearing inserts in block except No. 5 thrust bearing insert. Be sure locating tabs on inserts are properly positioned with slot in block web.

IMPORTANT: Thrust washers (A) and (C) go on both sides of block web only, with the slots facing the crankshaft.

2. Install No. 5 main thrust bearing insert (D) in block. Install upper thrust washer on bearing insert at rear of block web. Be sure tangs on washer are properly positioned on thrust bearing insert.

3. Check to make sure that oil holes in main bearing web are properly aligned with oil holes in bearing inserts.



RGR24545N –UN–19NOV97

Thrust Bearing Assembly

A—Lower Rear Thrust Washer
B—Upper Rear Thrust Washer
C—Lower Front Thrust Washer
D—Main Bearing Block Thrust Bearing
E—Main Bearing Cap Thrust Bearing
F—Large Tang
G—Small Tang

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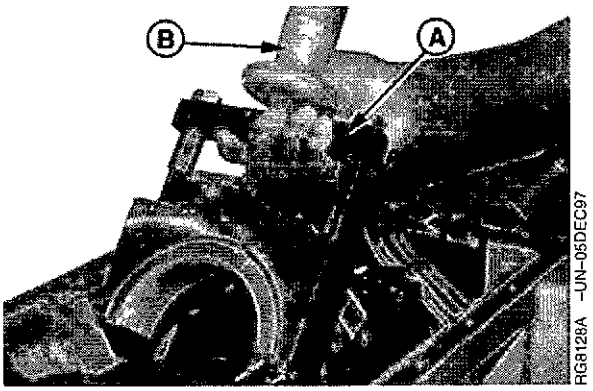
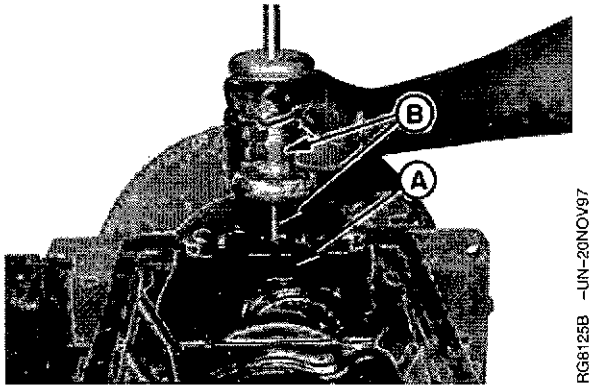
INSTALL CRANKSHAFT



Installing Main Bearing Assembly



Seating Main Bearing Cap

A—JDG996 Main Bearing Cap Puller/Installer

B—D01300AA Slide Hammer

⚠ CAUTION: Crankshaft is heavy. Plan a proper lifting procedure to avoid injuries.

NOTE: If crankshaft is being replaced, vibration damper should be replaced also.

1. Carefully position crankshaft onto main bearing inserts using a host and lift sling.

2. Dip all main bearing cap screws in clean engine oil. Apply a liberal amount of oil to bearing inserts in caps.

NOTE: Make sure main bearing caps are installed on the bearing bosses from which they were removed. The numbers stamped on the caps should be on the same side as the numbers on the block. Arrow on cap must point towards front of the engine. If bearing caps have been rebored, make sure bearing cap have numbers stamped on them.

3. Install each bearing cap and bearings with the recesses and tabs aligned in matching order using JDG996 Main Bearing Cap Puller/Installer (A) and D01300AA Slide Hammer (B). Make sure bearing tabs also match up before tightening cap screws.

NOTE: Main bearing caps may also be installed by evenly tightening both main bearing cap screws.

IMPORTANT: Do not use pneumatic wrench to install main bearing cap screws, as damage may occur to threads.

4. Before tightening cap screws on main bearing caps, align upper and lower thrust flanges on main thrust bearings. Using a soft-face hammer, tap crankshaft to the rear and then to the front to line up thrust bearing flanges.

5. Tighten No. 1, 2, 3, 4, 6, and 7 main bearing cap screws to the following specification.

Crankshaft Main Bearing Cap Screws—Specification

Initial Torque ..... 68 N•m (50 lb-ft)

Hand-tighten No. 5 main thrust bearing cap screws.

Continued on next page

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NOTE: DO NOT PRY crankshaft on No. 5 main thrust bearing.

6. Gently pry crankshaft rearward and then forward to align thrust washers on No. 5 main thrust bearing.
7. Tighten No. 5 main thrust bearing cap screws to 68 N•m (50 lb-ft).
8. Tighten all main bearing cap screws (including No. 5) to the following specification.

Crankshaft Main Bearing Cap Screws—Specification

Final Torque..... 295 N•m (218 lb-ft)

9. Turn crankshaft by hand. If it does not turn easily, disassemble parts and determine the cause.

Continued on next page

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10. Install connecting rod caps with bearing using new cap screws. (See INSTALL PISTONS AND CONNECTING RODS in Group 10 for procedure to install and tighten connecting rod cap screws.)

IMPORTANT: Do not use pneumatic wrenches to *tighten connecting rod cap screws.* Threads can be damaged.

11. Install rear oil seal housing. (See INSTALL CRANKSHAFT REAR OIL SEAL AND HOUSING later in this group.)

12. Install rear oil seal and wear sleeve. (See INSTALL CRANKSHAFT REAR OIL SEAL AND WEAR SLEEVE ASSEMBLY later in this group.)

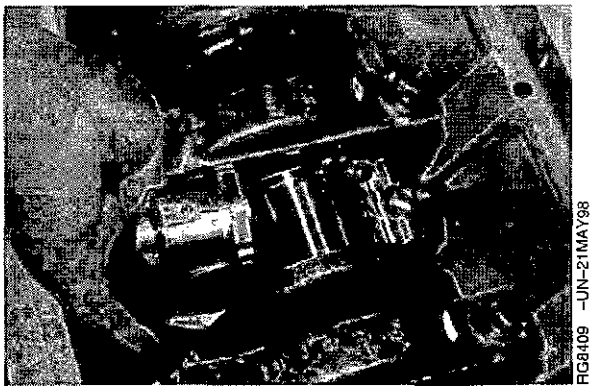
13. Install flywheel. (See INSTALL FLYWHEEL earlier in this group.)

14. Install flywheel housing. (See REMOVE AND INSTALL FLYWHEEL HOUSING earlier in this group.)

15. Install six piston spray jets. (See REMOVE AND INSTALL PISTON SPRAY JETS in Group 10.)

16. Check crankshaft end play. (See CHECK CRANKSHAFT END PLAY earlier in this group.)

17. Install timing gear cover. (See INSTALL TIMING GEAR COVER later in this group.)



Installing Rod Caps

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INSTALL CRANKSHAFT REAR OIL SEAL HOUSING

NOTE: Clean all gasket material and sealant from oil pan gasket rail prior to installing rear seal housing for proper housing alignment.

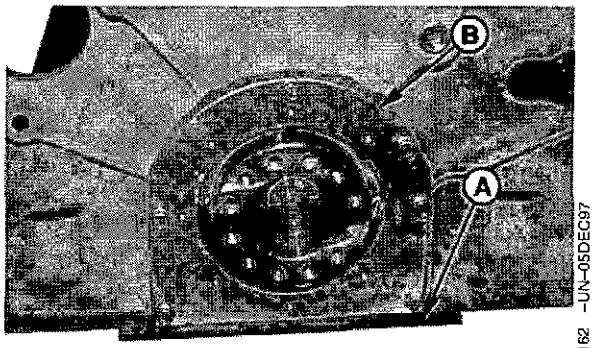
Ensure that OD of crankshaft flange and ID of rear seal housing is free of nicks and burrs. Restore damaged surfaces with emery cloth and clean surfaces thoroughly.

1. Install JDG977 Pan Rail Aligner (A) onto rear pan rail (as shown) using two cap screws provided. Tighten cap screws securely.
2. Install rear seal housing (B) using a new gasket, bottom edge of gasket should extend through opening in alignment plate. Tighten housing cap screws finger tight.
3. Install larger end of JDG975 Timing Gear Cover/Rear Seal Housing Aligner (C) on to crankshaft rear flange with tapered locators (D) at 3 o'clock and 9 o'clock position.
4. Center housing and tighten cap screws to specifications using torque sequence shown in lower illustration.

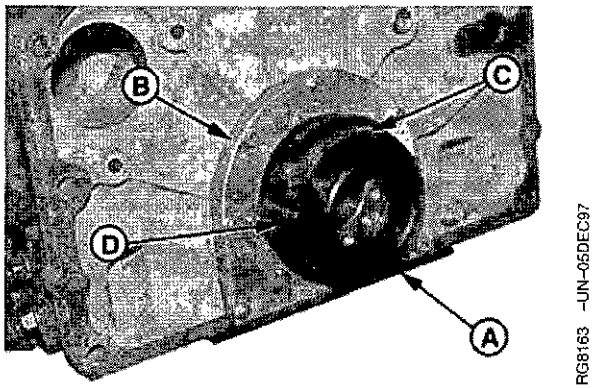
Rear Oil Seal Housing Cap Screws—Specification

Torque	25 N•m (18 lb-ft)

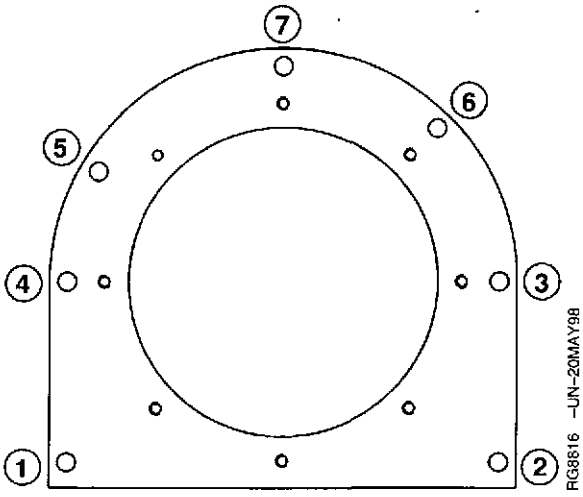
5. Remove alignment tools from engine and trim rear seal housing gasket flush with bottom of seal housing and oil pan gasket surface.



Rear Seal Housing Installed on Aligner



Centering Rear Seal Housing with JDG975



Rear Seal Housing Torque Sequence

A—JDG977 Front/Rear Pan Rail Aligner
B—Rear Seal Housing
C—JDG975 Timing Gear Cover/Rear Seal Housing Aligner
D—Tapered Locators

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INSTALL CRANKSHAFT REAR OIL SEAL AND WEAR SLEEVE ASSEMBLY

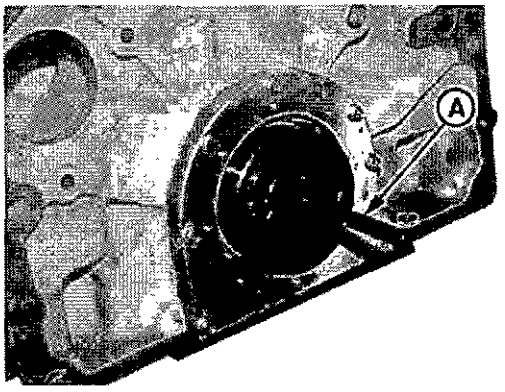
1. Thoroughly clean ID of rear seal housing and OD of crankshaft flange. Dry with a clean shop towel.
2. Center JDG974-2 Forcing Screw (A) rear face of crankshaft and tighten cap screws securely.
3. Apply a light coat of LOCTITE® 680 (TY15969) Retaining Compound around OD of rear crankshaft flange.
4. Position rear seal assembly (B) and JDG974-1 Seal Installer (C) onto rear crankshaft flange and forcing screw.

NOTE: Align mounting holes in seal casing with holes in rear seal housing as seal assembly is installed.

5. Lubricate forcing screw threads and both sides of friction washer. Install washer and nut, tighten nut until installer bottoms.
6. Remove seal installation tool set and clean any sealant from tool.
7. Center seal casing and tighten cap screws to specifications following sequence in lower illustration.

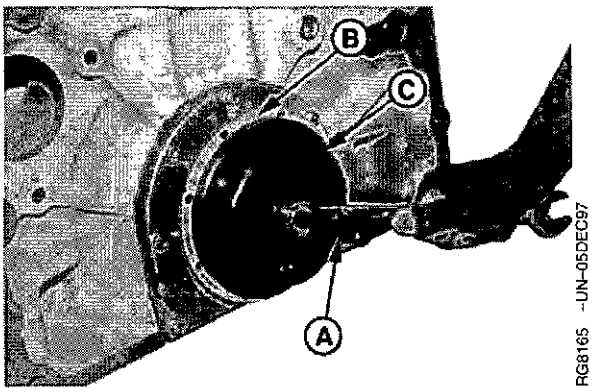
Rear Oil Seal-to-Housing Cap Screws—Specification

Torque ..... 15 N•m (11 lb-ft)



RG8164 –UN–05DEC97

JDG974-2 Forcing Screw Installed



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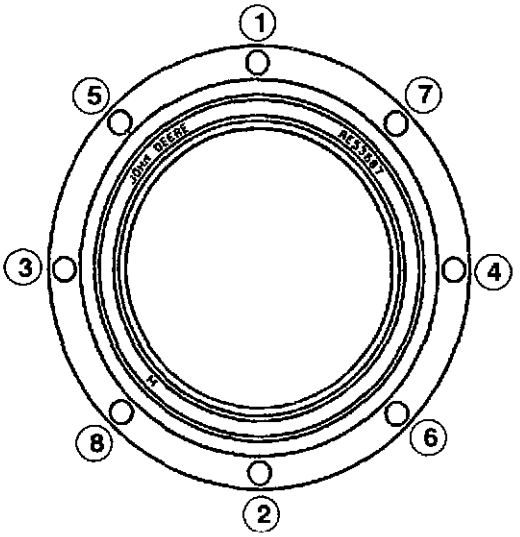
Installing Rear Crankshaft Oil Seal



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Rear Seal Torque Sequence

A—JDG974-2 Forcing Screw
B—Rear Seal Assembly
C—JDG974-1 Seal Installer

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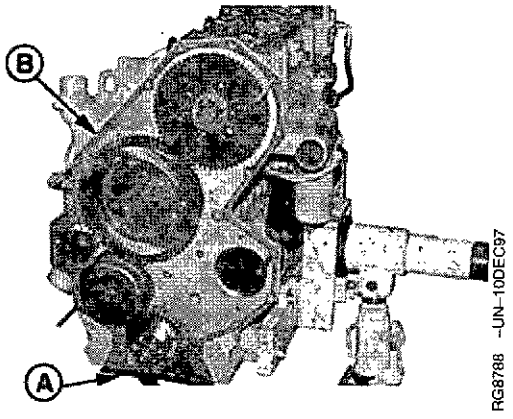
INSTALL TIMING GEAR COVER

1. Clean timing gear cover gasket mating surfaces.
2. Clean all gasket material and sealant from oil pan gasket rail.
3. Install JDG977 Pan Rail Aligner (A) onto front pan rail (as shown) using cap screws provided. Tighten cap screws securely.

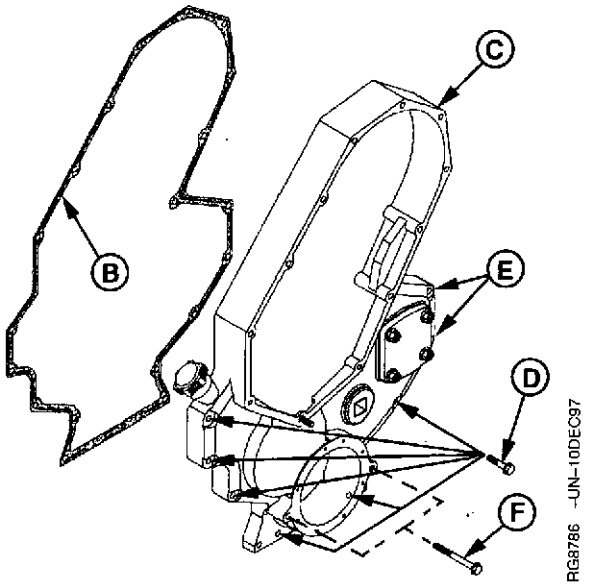
NOTE: Guide pins may be used to ensure correct gasket (B) and timing gear cover (C) alignment with mounting holes.

IMPORTANT: Clean front plate and timing gear cover surfaces tith TY16285 Clean and Cure Primer prior to assembly. Follow instructions on label.

4. Soak both sides of new timing gear cover gasket with LOCTITE® 242 Thread Lock and Sealant and let dry for 15 minutes or until dry to the touch.
5. Apply a 3 mm (1/8 in.) wide bead of LOCTITE® 515 Flexible Sealant to timing gear cover side of gasket.
6. Carefully install gasket on timing gear cover.
7. Install timing gear cover and wipe off excess sealant.
8. Install cap screws (D), (E) and (F) at respective locations shown. Tighten cap screws finger tight only so that cover can be correctly centered.



JDG977 Pan Rail Aligner Installed



Timing Gear Cover Cap Screw Locations

A—JDG977 Pan Rail Aligner
B—Gasket
C—Timing Gear Cover
D—M10 x 55 mm (2.17 in.) - 6 Used
E—M10 x 65 mm (2.56 in.) - 2 Used
F—M10 x 110 mm (4.33 in.) - 2 Used

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9. Install, smaller end of JDG975 Timing Gear Cover/Rear Seal Housing Aligner (A) onto front crankshaft flange with tapered locators (B) at 3 o'clock and 9 o'clock position.

10. Center cover with crankshaft flange and initially tighten cap screws to specifications, following sequence in lower illustration.

Timing Gear Cover Cap Screws[1]—Specification

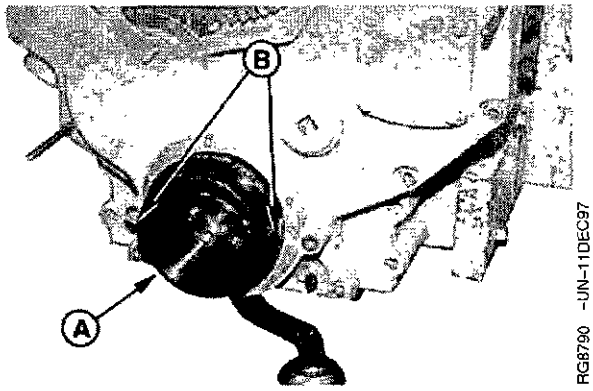
Initial Torque ..... 45 N•m (33 lb-ft)

11. Finish tightening timing gear cover cap screws (using same sequence) to the following specification.

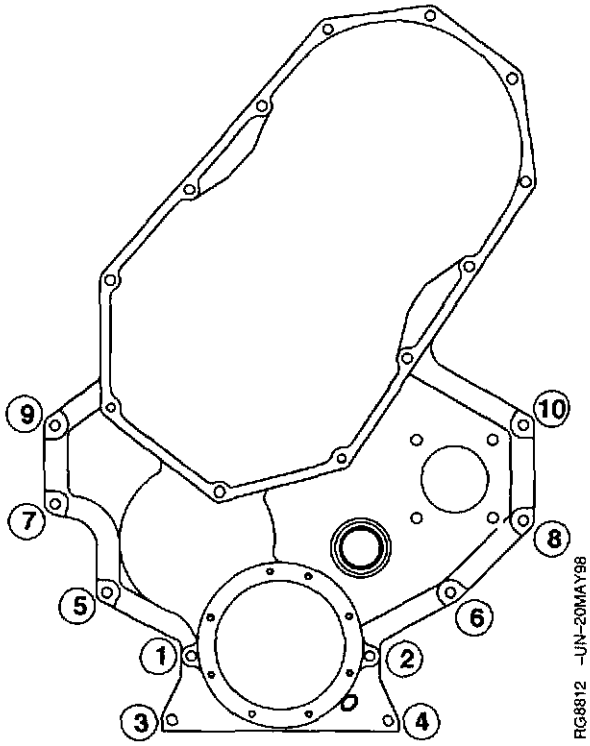
Timing Gear Cover Cap Screws—Specification

Final Torque ..... 63 N•m (46 lb-ft)

12. Remove alignment tools from engine.



Aligning Timing Gear Cover



Timing Gear Cover Torque Sequence

A—Seal Housing Aligner
B—Tapered Locators

[1] Tighten two longest cap screws located next to crankshaft center line to 45 N•m (33 lb-ft). Then, go to bottom cap screws (alternating from side-to-side) and tighten remaining cap screws to 45 N•m (33 lb-ft). Repeat torque sequence to 63 N•m (46 lb-ft).

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NOTE: If fixed fan drive assembly (cast into camshaft gear access cover) was removed, it must be reinstalled before installing access cover. In this case, be sure cap screw (3) is installed in cover before pressing on fan hub/pulley. (See REPLACE BEARING IN FAN DRIVE ASSEMBLY in Group 25.)

IMPORTANT: Clean timing gear cover and camshaft gear access cover gasket surfaces with TY16285 Clean and Cure Primer prior to assembly. Follow directions on label.

13. Soak both sides of new camshaft gear access cover gasket (A) with LOCTITE® 242 Thread Lock and Sealant and let dry for 15 minutes or until dry to the touch.

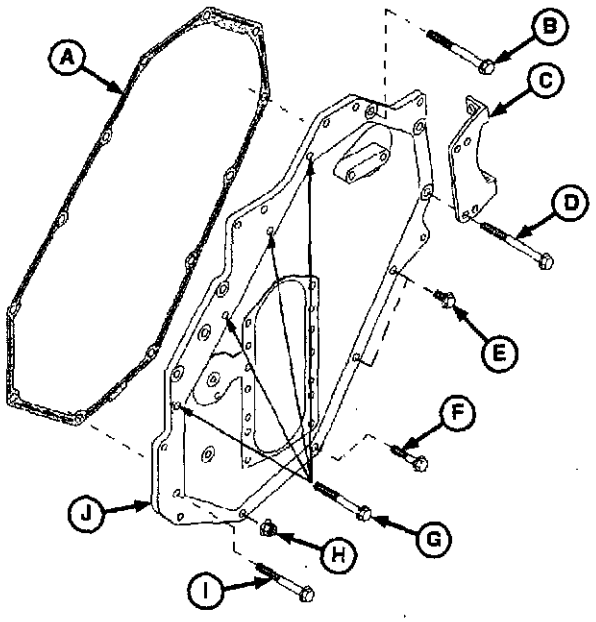
14. Apply a 3 mm (1/8 in.) wide bead of LOCTITE® 515 Flexible Sealant to timing gear cover side of gasket.

15. Carefully install gasket on timing gear cover mounting surface.

16. Install camshaft gear access cover and wipe off excess sealant.

17. Install cap screws (B), (D—G), (I), and nut (H) in respective locations.

18. Initially tighten cap screws (and stud nut) to specification, following sequence in lower drawing.



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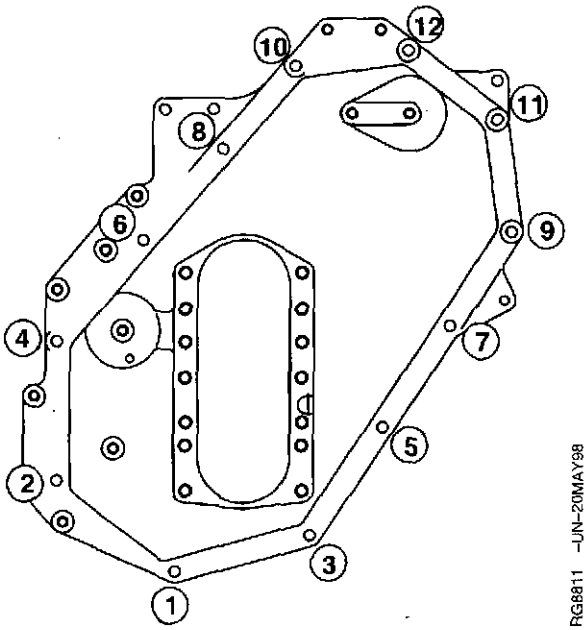
Installing Camshaft Gear Access Cover



RG8811 –UN–20MAY98

Camshaft Gear Cover Torque Sequence

A—Gasket
B—M10 x 110 mm
C—A/C Compressor Bracket
D—M10 x 130 mm (w/Compressor Bracket)
M10 x 110 mm (w/o Compressor Bracket)
E—M10 x 30 mm (005482—)
M10 x 100 mm (— 005481)
F—M10 x 100 mm (005482—)
M120 x 30 mm (—005481)
G—M10 x 100 mm
H—Flange Nut
I—M10 x 100 mm (005482—)
M10 x 30 mm (—005481)
J—Camshaft Gear Access Cover

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Camshaft Gear Access Cover Cap Screws[1]—Specification

Initial Torque ..... 50 N•m (37 lb-ft)

NOTE: On fixed fan drives, torque cover cap screw (3) under pulley using a crowsfoot on the torque wrench (allowing for a greater arc).

19. Finish tightening camshaft gear access cover cap screws (using same sequence) to the following specification.

Camshaft Gear Access Cover Cap Screws[1]—Specification

Final Torque ..... 68 N•m (50 lb-ft)

20. Install engine oil pan. (See INSTALL ENGINE OIL PAN in Group 20.)

21. Install crankshaft vibration damper. (See INSTALL CRANKSHAFT VIBRATION DAMPER AND FRONT OIL SEAL next in this group.)

22. Install adjustable fan drive assembly and tighten cap screws to specifications.

Adjustable Fan Drive Assembly Mounting Cap Screws—Specification

Torque ..... 90 N•m (66 lb-ft)

NOTE: Whenever the timing gear cover has been removed and reinstalled, the crankshaft position sensor must be checked to insure proper distance from crankshaft timing wheel. This applies even if the sensor was not removed from timing gear cover.

23. Install crankshaft position sensor, if removed, or check sensor-to-crankshaft timing wheel dimension. (See REMOVE AND INSTALL CRANKSHAFT POSITION SENSOR in Group 45.)

[1]Start at bottom and alternate from side-to-side. Repeat torque sequence to 68 N•m (50 lb-ft).

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INSTALL CRANKSHAFT VIBRATION DAMPER AND FRONT OIL SEAL

Front crankshaft oil seal (A) must be installed onto vibration damper before installing damper onto engine.

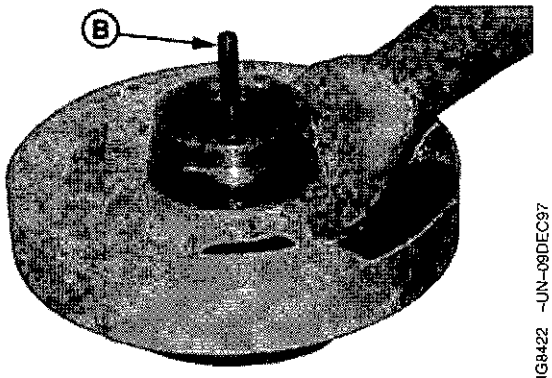
INSTALL FRONT SEAL ONTO VIBRATION DAMPER

1. Apply LOCTITE® 680 (TY15969) Retaining Compound around OD of crankshaft flange. Position front oil seal assembly on flange with rubber seal ring facing up as shown.

NOTE: Lubricate threads of forcing screw with multi-purpose grease.

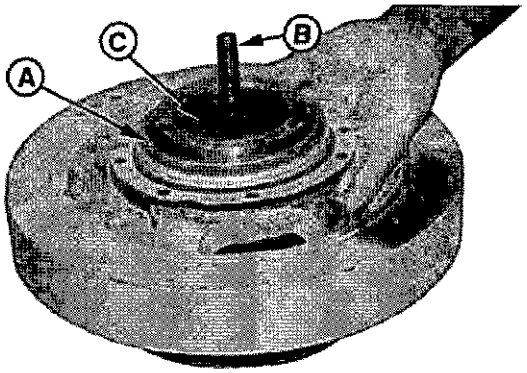
2. Lay vibration damper on table (front face down) with JDG974-2 Seal Installer Forcing Screw (B) extending through damper ID.

3. Hold forcing screw against front face of damper and position JDG974-3 Guide Plate (C) in ID of damper as shown.



RG8422 –UN–09DEC97

JDG974-2 Forcing Screw Installed on Damper



RG8423 –UN–09DEC97

Front Seal Positioned on Damper

A—Front Crankshaft Oil Seal
B—JDG974-2 Seal Installer Forcing Screw
C—JDG974-3 Guide Plate

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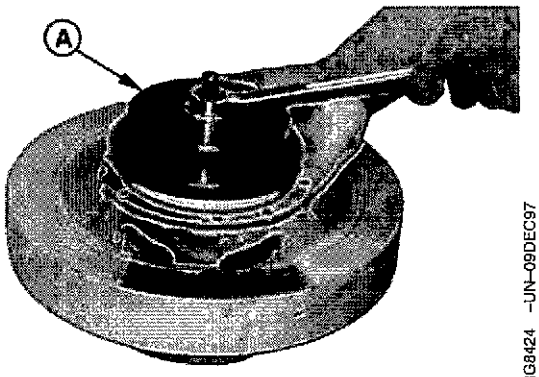
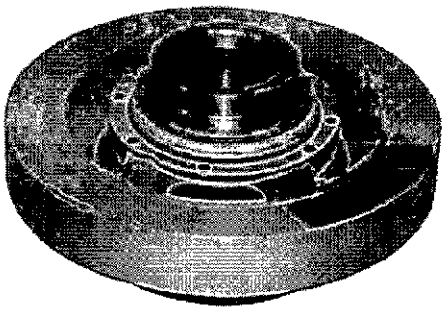
4. Install JDG974-1 Seal Installer (A) with friction washer and nut.
5. Tighten nut until installer bottoms on rear face of damper.
6. Remove tools and clean any sealant from tools.



RG8424 –UN–09DEC97

Seating Front Seal on Damper



RG8535 –UN–20MAY98

Front Seal Installed on Damper

A—JDG974-1 Seal Installer

Continued on next page

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INSTALL VIBRATION DAMPER ON ENGINE

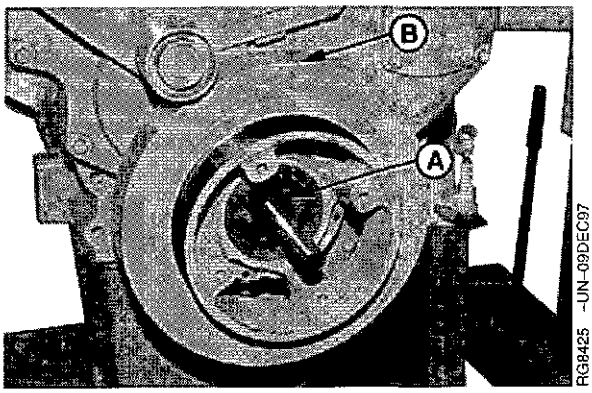
1. Install JDG973-1 Damper Remover/Installer Hub (A) onto front face of crankshaft using two cap screws provided with kit. Tighten cap screws securely.
2. Lubricate forcing screw threads with all purpose grease.
3. Position vibration damper and seal (B) on forcing screw hub as shown.
4. Install JDG973-2 Cross Block (C) onto forcing screw. Secure cross block with two cap screws finger tight.

NOTE: Lubricate forcing screw and both sides of friction washer with multi-purpose grease prior to each use.

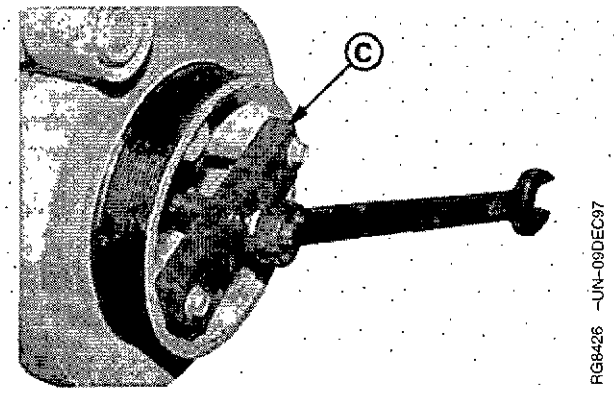
5. Install friction washer and nut against cross block.

NOTE: Cut-outs in seal casing should be at 3 o'clock and 9 o'clock position for timing gear cover cap screw clearance. Align holes in casing with cap screw holes as damper and seal are installed.

6. Tighten nut until damper bottoms on crankshaft flange. Remove JDG973 tool set from engine.



Installing JDG973-1 Hub



Installing Vibration Damper

A—JDG973-1 Damper Remover/Installer Hub
B—Vibration Damper And Seal
C—JDG973-2 Cross Block

Continued on next page

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7. Install large washer onto front nose of crankshaft to secure damper to crank. Tighten cap screws in sequence shown to specifications.

Damper Hub Cap Screws—Specification

Torque ..... 125 N•m (92 lb-ft)

8. If required, install pulley on damper and tighten cap screws to specifications.

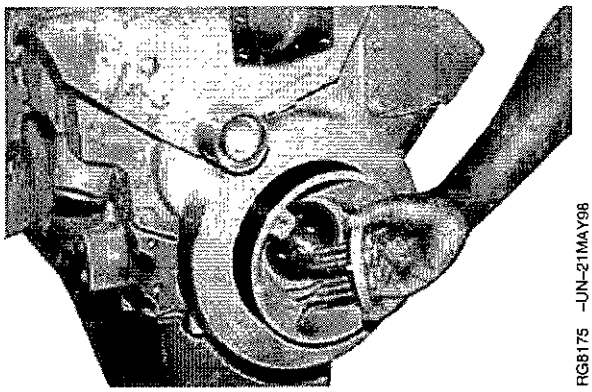
Pulley-to-Damper Cap Screws—Specification

Torque ..... 125 N•m (92 lb-ft)

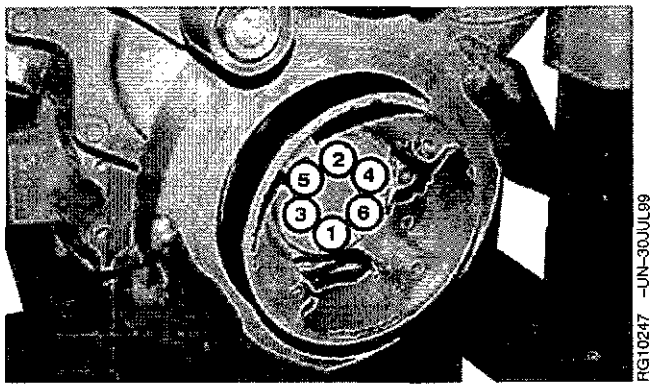
9. Install front seal-to-timing gear cover cap screws and tighten to 15 N•m (11 lb-ft) following sequence in lower illustration.

Front Oil Seal Cap Screws—Specification

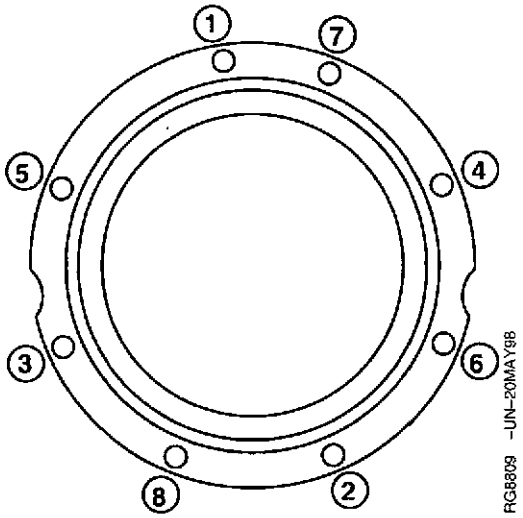
Torque ..... 15 N•m (11 lb-ft)



Installing Damper Retainer Cap Screws



Damper Torque Sequence



Front Seal Torque Sequence

RG,RG34710,180 –19–13AUG99–4/4

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COMPLETE FINAL ASSEMBLY

1. Install idler pulley assembly. (See REPLACE BELT TENSIONER ASSEMBLY, in Group 25.)
2. Install oil pan and clean engine oil. (See INSTALL ENGINE OIL PAN, in Group 20.)
3. Fill cooling system with proper coolant (See DIESEL ENGINE COOLANT RECOMMENDATIONS in Group 2.)
4. Perform engine break-in. (See ENGINE BREAK-IN GUIDELINES in Group 4.)

RG,RG34710,182 –19–13AUG99–1/1

ESSENTIAL TOOLS

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

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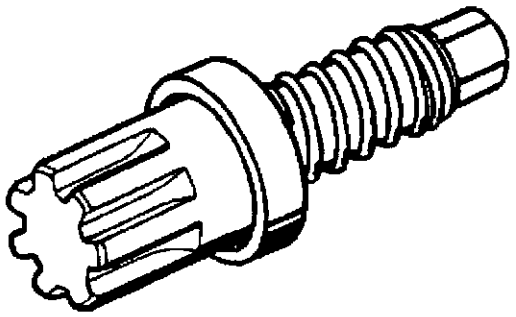
DPSG,OUO1004,962 -19-29JUL99-1/8

Flywheel Turning Tool JDG820

Use to rotate engine flywheel to check camshaft-to-crankshaft timing, adjust gear train backlash, and valve stem-to-valve bridge clearance.



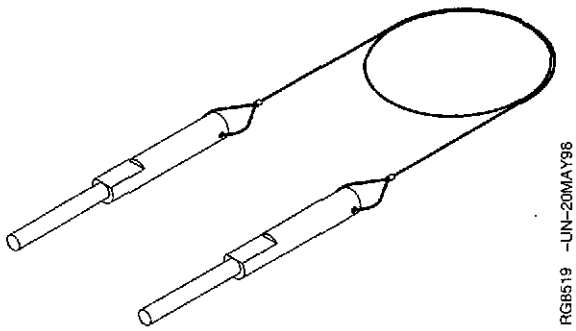
RG7056 -UN-05DEC97

JDG820

DPSG,OUO1004,962 -19-29JUL99-2/8

Cam/Crankshaft Timing Lock Pins JDG971

Set of 2. Use to lock camshaft and crankshaft at "Top Dead Center" during timing gear backlash adjustment. Use on crankshaft only for valve clearance adjustments. Set consists of Holding Plate and 221808 Ball Locking Pins.



RG8519 -UN-20MAY98

JDG971

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DPSG,OUO1004,962 -19-29JUL99-3/8

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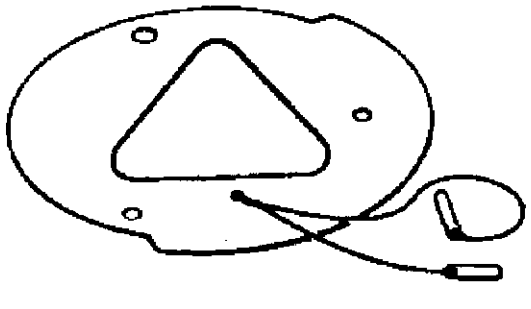
2

Gear Train Backlash Template. JDG993

Use to locate correct gear teeth on idler gear for accurate backlash adjustment. This measurement is critical for unit injector timing.



RG8520 –UN–20MAY98

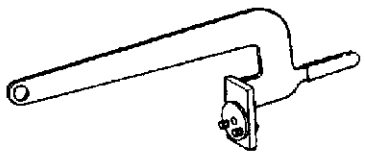
JDG993

DPSG,OUO1004,962 –19–29JUL99–4/8

RG10275 –UN–04AUG99

Camshaft Holding Tool. JDG969A

Use with overhead hoist to control position of camshaft during removal and installation. Use with JDG972 Camshaft Pilot.



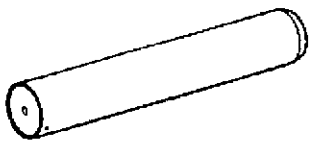
JDG969A

DPSG,OUO1004,962 –19–29JUL99–5/8

RG8504 –UN–20MAY98

Camshaft Pilot JDG972

Use with JDG969 Camshaft Holding Tool to remove and install the camshaft.



JDG972

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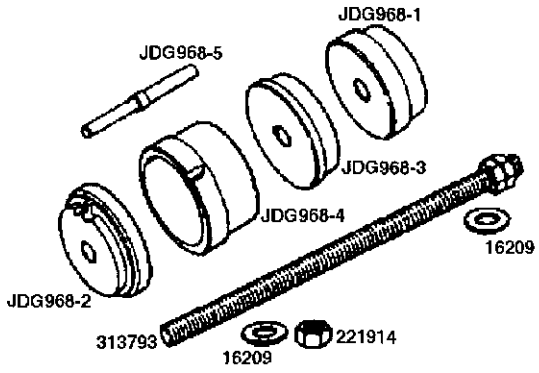
DPSG,OUO1004,962 –19–29JUL99–6/8

Camshaft Bushing Service Set. JDG968

Use to remove and install to specification the camshaft bushings. Pilots are designed to protect bushings during installation. Set consists of JDG968-1 Bushing Remover, JDG968-2 Bushing Installer, JDG968-3 Guide, JDG968-4 Alignment Sleeve, JDG968-5 Pin Alignment Checking, 221914 Hex Nut, 16209 Thrust Washers, 313793 Forcing Screw Assembly.

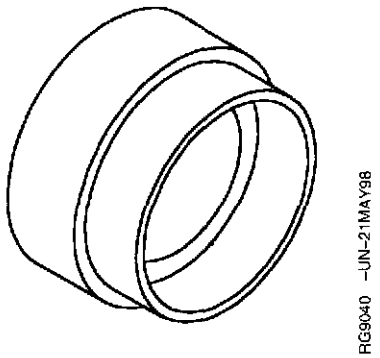


JDG968

DPSG,OUO1004,962 –19–29JUL99–7/8

Front Auxiliary Drive Alignment Tool JDG1144

Use to center front SAE "A" auxiliary drive adapter with gear spline.



JDG1144

DPSG,OUO1004,962 –19–29JUL99–8/8

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,OUO1004,1022 –19–08SEP99–1/2

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Snap-On Dowel Pin Puller Set CG503

Remove fuel supply pump drive pin from end of camshaft.

DPSG,OUO1004,1022 –19–08SEP99–2/2

OTHER MATERIAL

Number	Name	Use
T43512 (U.S.) TY9473 (Canadian) 242 (LOCTITE®)	Thread Lock and Sealer (Medium Strength)	Apply to idler gear carrier cap screws, fuel supply pump drive coupler set screws and camshaft gear retainer cap screws.
TY6333 or TY6347 (U.S.)	High Temperature Grease	Coat cam roller followers, camshaft lobes, journals, and bushings during installation. Coat idler gear and bushing during installation.

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DPSG,OUO1004,964 –19–29JUL99–1/1

CAMSHAFT AND TIMING GEAR TRAIN SPECIFICATIONS

Item	Measurement	Specification
Camshaft Gear-to-Upper Idler Gear	Backlash	0.13 mm (0.005 in.)
Oil Pump Gear-to-Upper Idler Gear	Backlash	0.25 mm (0.010 in.)
Camshaft Position Sensor	Torque	14 N•m (10 lb-ft)
Camshaft Gear Retainer Plate-to-Camshaft	Initial Torque Second Torque Final Torque	100 N•m (74 lb-ft) 150 N•m (110 lb-ft) 150 N•m (110 lb-ft)
Upper Idler Gear Bearing Cup-to-Block	Torque	85 N•m (63 lb-ft)
Upper Idler Gear Thrust Plate Cap Screws	Torque	35 N•m (26 lb-ft)
Camshaft and Supply Pump Drive Coupler Set Screw	Torque	4 N•m (3 lb-ft)
Fuel Supply Pump-to-Cylinder Head	Torque	50 N•m (37 lb-ft)
Camshaft Thrust Ring-to-Head	Torque	35 N•m (26 lb-ft)
Camshaft Journal	OD	101.987—102.013 mm (4.0152—4.0162 in.)
Camshaft Bushing	ID	102.091—102.167 mm (4.0193—4.0223 in.)
Camshaft Journal-to-Bushing	Oil Clearance	0.078—0.180 mm (0.0031—0.0071 in.)
Camshaft Bushing	Bore in Head	105.987—106.013 mm (4.1727—4.1737 in.)
Camshaft Lobe:		
Intake Lobe	Height	45.100—45.620 mm (1.776—1.796 in.)

Continued on next page

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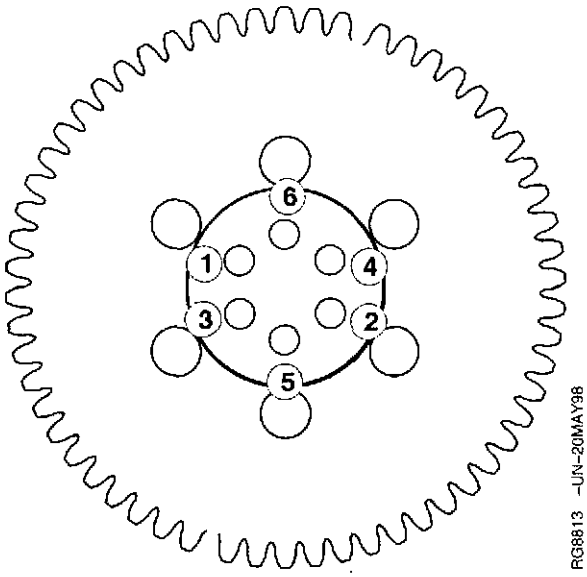
Item	Measurement	Specification
Intake Lobe Base Circle	Height	36.37—36.63 mm (1.432—1.442 in.)
Intake Lobe	Lift	8.73—8.99 mm (0.343—0.353 in.)
Exhaust Lobe	Height	40.300—40.820 mm (1.587—1.607 in.)
Exhaust Lobe Base Circle	Height	32.37—32.63 mm (1.274—1.285 in.)
Exhaust Lobe	Lift	7.93—8.19 mm (0.312—0.322 in.)
EUI Lobe	Height	46.530—47.050 mm (1.832—1.852 in.)
EUI Lobe Base Circle	Height	32.37—32.63 mm (1.274—1.285 in.)
EUI Lobe	Lift	14.16—14.42 mm (0.557—0.567 in.)
SAE "A" Front Auxiliary Drive Adapter Housing Nuts	Torque	50 N•m (37 lb-ft)
SAE "A" Front Auxiliary Drive Idler Gear Support Bushing	Torque	220 N•m (162 lb-ft)
SAE "B" Rear Auxiliary Drive Adapter	Torque	110 N•m (81 lb-ft)
SAE "A" Front Auxiliary Drive Adapter Housing Nuts	Torque	50 N•m (37 lb-ft)
Fuel Supply Pump Drive Pin	Installed Depth	Bottomed in Camshaft Bore

DPSG,OUO1004,965 –19–29JUL99–2/2

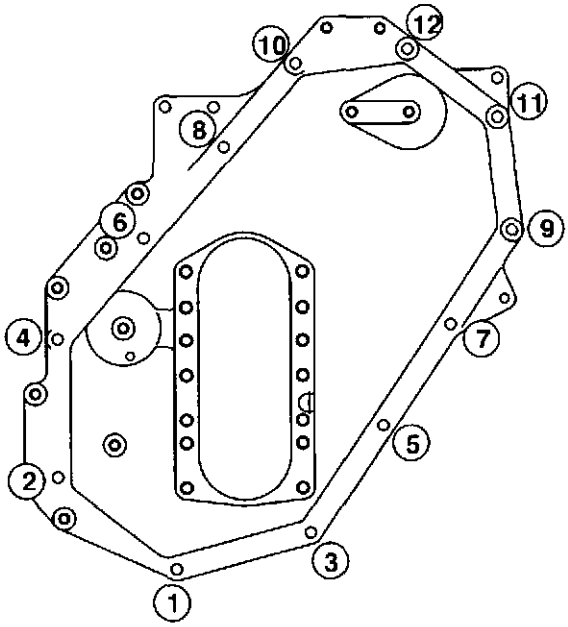
CAMSHAFT GEAR RETAINER TORQUE SEQUENCE



Camshaft Gear Retainer Torque Sequence

RG,RG34710,187 –19–30SEP97–1/1

CAMSHAFT GEAR ACCESS COVER TORQUE SEQUENCE



Camshaft Gear Access Cover Torque Sequence

RG,RG34710,188 –19–30SEP97–1/1

16 8

CHECK AND ADJUST CAMSHAFT-TO-CRANKSHAFT TIMING

CHECK CAMSHAFT-TO-CRANKSHAFT TIMING

1. Remove rocker arm cover. See (REMOVE AND INSTALL ROCKER ARM COVER in Group 5.)

2. Remove plug from cylinder block and install JDG820 Flywheel Turning Tool (A).

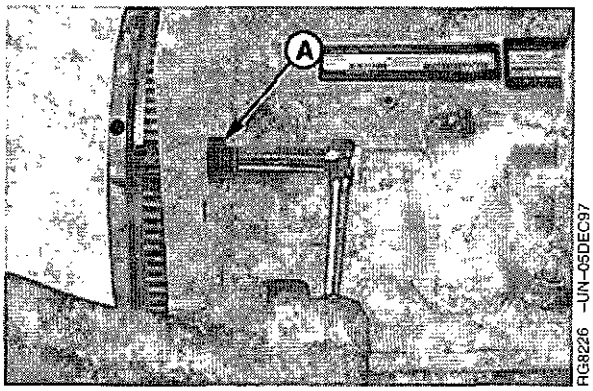
IMPORTANT: JDG971 Timing Pin MUST BE installed into camshaft timing slot (B) first before attempting to install second timing pin into crankshaft timing slot (C).

3. Rotate engine flywheel in running direction until JDG971 Timing Pin (B) engages timing slot in camshaft. This ensures that engine is locked at TDC of No. 1 cylinder's compression stoke. Intake and exhaust rocker arms on No. 1 cylinder should be loose.

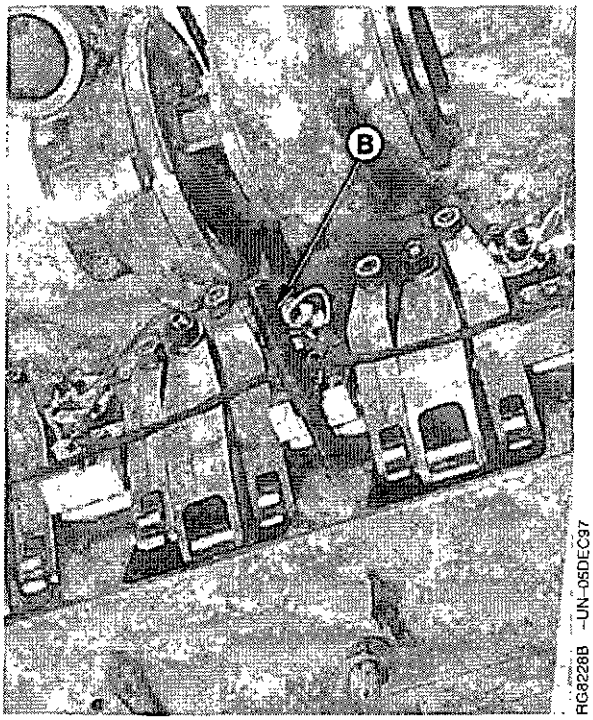
4. Remove threaded plug from crankshaft timing hole below oil cooler and filter housing assembly.

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

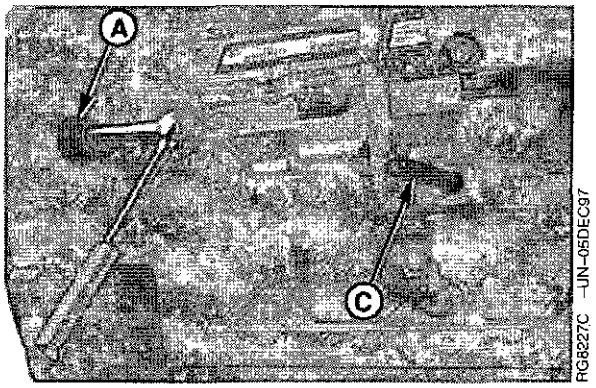
If timing pin does not enter crankshaft timing slot, crankshaft MUST BE timed to camshaft as detailed on following page.



Rotating Flywheel with JDG820



JDG971 Timing Pin in Camshaft



JDG971 Timing Pin in Crankshaft

A—Flywheel Turning Tool
B—Timing Pin
C—Timing Pin

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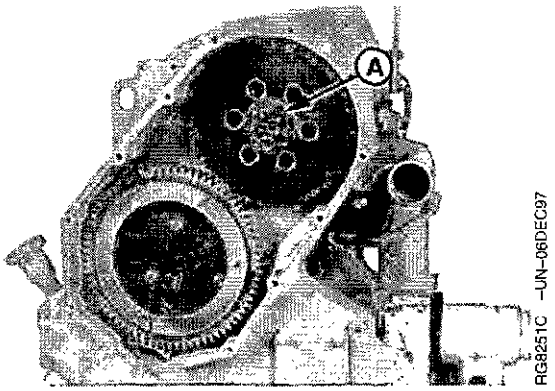
ADJUST CAMSHAFT-TO-CRANKSHAFT TIMING

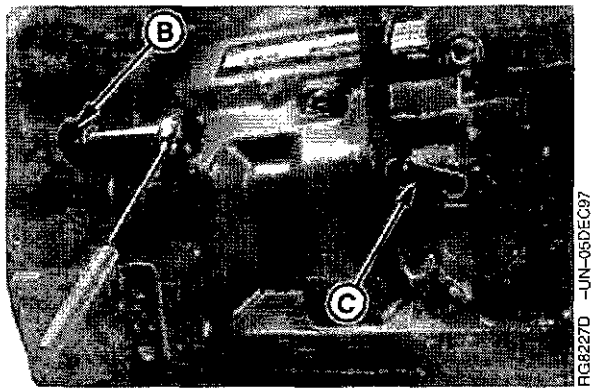
1. Leave JDG971 Timing Pin in camshaft timing slot and remove camshaft gear access cover (shown removed) *from timing gear cover.* (See REMOVE TIMING GEAR COVER in Group 15.)
2. Loosen camshaft gear retainer cap screws (A).
3. Rotate crankshaft with JDG820 Flywheel Turning Tool (B) and install second JDG971 Timing Pin (C) in crankshaft timing slot.
4. Adjust gear train backlash and complete final assembly. (See ADJUST FRONT TIMING GEAR BACKLASH, next *in this group.*)
5. Tighten camshaft gear retainer plate to following torque:

Camshaft Gear Retainer Plate-to-Camshaft—Specification

Initial Torque	100 N•m (74 lb-ft)
Second Torque	150 N•m (110 lb-ft)
Final Torque	150 N•m (110 lb-ft)



Camshaft Gear Retainer Cap Screws



JDG971 Timing Pin in Crankshaft

A—Camshaft Gear Retainer Cap Screws
B—JDG820 Flywheel Turning Tool
C—JDG971 Timing Pin

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ADJUST FRONT TIMING GEAR BACKLASH

1. Remove camshaft gear access cover from timing gear cover. (See REMOVE TIMING GEAR COVER in Group 15.)

2. Remove rocker arm cover from cylinder head. (See REMOVE AND INSTALL ROCKER ARM COVER in Group 5.)

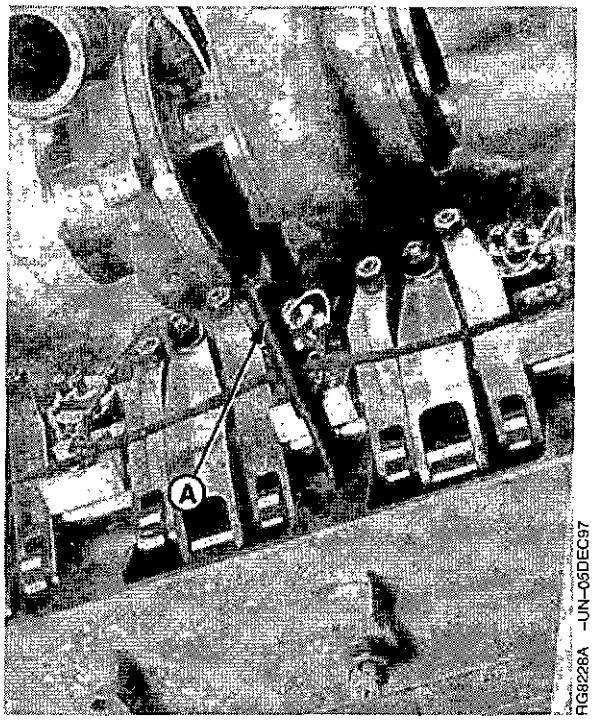
IMPORTANT: Rocker arm assembly should be completely installed before adjusting timing gear backlash.

3. Lock camshaft at No. 1 "TDC" compression stroke by rotating engine with JDG820 Flywheel Turning Tool (B) until JDG971 Timing Pin (A) fully engages timing slot in camshaft.

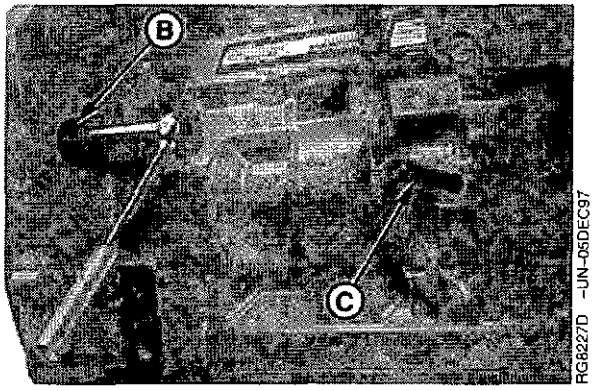
   This will be the first slot clockwise from double slot and the double slot will be at the 11 o'clock position as viewed from rear of engine.

4. Remove plug and install a second JDG971 Timing Pin (C) in crankshaft timing hole on right-hand side of cylinder block. Rotate engine flywheel back and forth with turning tool until timing pin enters timing slot in crankshaft counterweight.

   At this location the keyway in crankshaft drive gear will be at the 12 o'clock position, visible when vibration damper is removed. This is "TDC" of No. 1 cylinder's compression stroke. Also with timing pin installed in camshaft and crankshaft slots, this ensures that cam-to-crank timing is within specification.



JDG971 Timing Pin in Camshaft



JDG971 Timing Pin in Crankshaft

A—JDG971 Timing Pin
B—JDG820 Flywheel Turning Tool
C—JDG971 Timing Pin

Continued on next page

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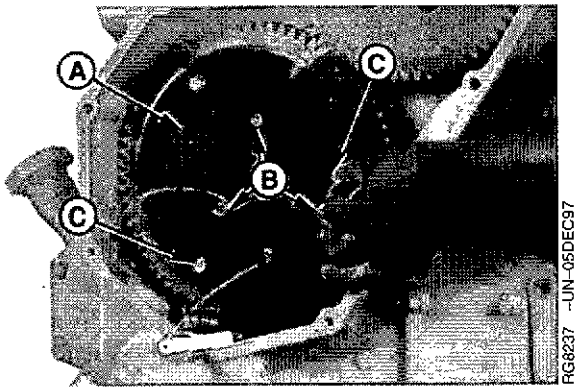
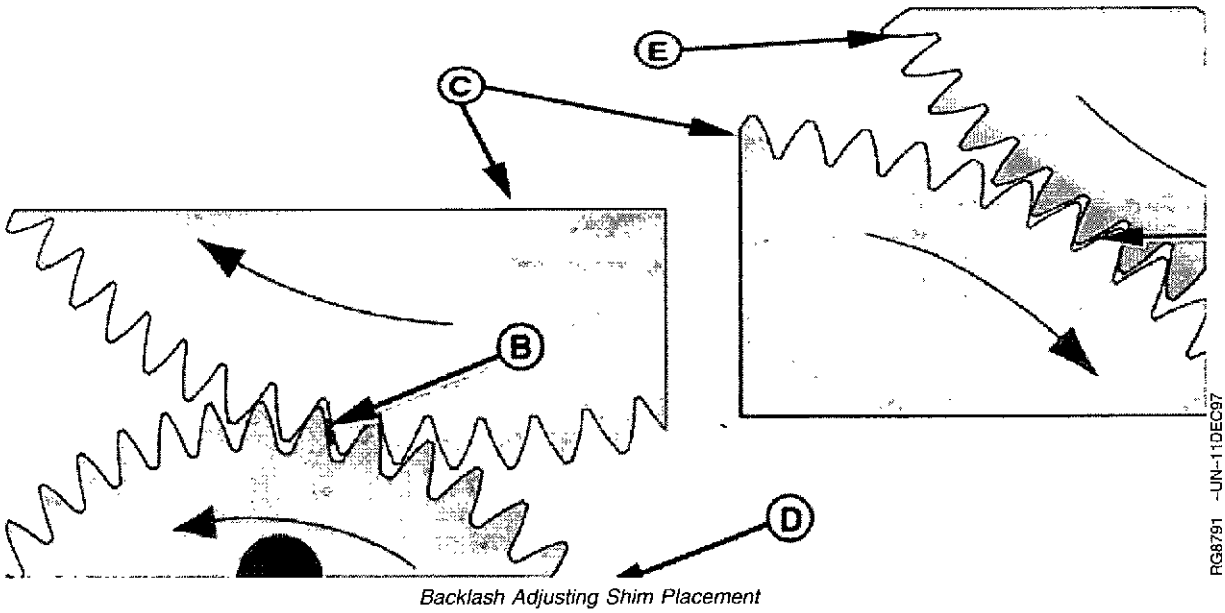
5. Loosen all six camshaft gear retainer cap screws.
6. Loosen three upper idler gear bearing carrier cap screws (B), so that carrier can be moved by hand. Do not loosen more than required for ease of assembly.
7. Remove two lower cap screws (C) from upper idler gear thrust plate and install JDG993 Timing Gear Backlash Template (A) as shown. Tighten cap screws to 35 N•m (26 lb-ft).



Installing JDG993 Backlash Template

A—JDG993 Timing Gear Backlash Template
B—Upper Idler Gear Bearing Carrier Cap Screws
C—Lower Cap Screws

RG,RG34710,190 –19–13AUG99–2/5



Backlash Adjusting Shim Placement

A—0.13 mm (0.005 in.) Shim
B—0.25 mm (0.010 in.) Shim
C—Idler Gear
D—Oil Pump Gear
E—Camshaft Gear

8. Shim placement shown above.

Continued on next page

RG,RG34710,190 –19–13AUG99–3/5

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12

9. Install shims (A, B) in (non-loaded) side of gear teeth closest to tab on backlash template as shown. Also, shim must be installed between gear teeth that are meshing deepest in the root.
   - 0.13 mm (0.005 in.) shim (A) for idler gear-to-camshaft gear backlash.
   - 0.25 mm (0.010 in.) shim (B) for idler gear-to-oil pump gear backlash.

Camshaft Gear-to-Upper Idler Gear—Specification

Backlash ..... 0.13 mm (0.005 in.)

Oil Pump Gear-to-Upper Idler Gear—Specification

Backlash ..... 0.25 mm (0.010 in.)

IMPORTANT: Both shims MUST BE tight between gear teeth before and after tightening idler carrier cap screws.

10. Weight of gear should seat idler gear and carrier assembly between shims so that both shims are tight and cannot be removed from gear teeth.

11. Apply LOCTITE® 242 Thread Lock and Sealer to three idler gear carrier cap screws and tighten to specifications.

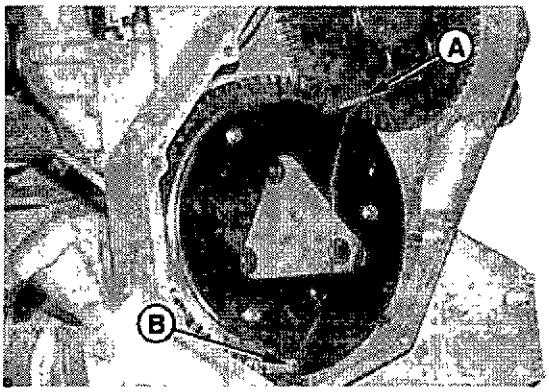
Upper Idler Gear Bearing Cup-to-Block—Specification

Torque ..... 85 N•m (63 lb-ft)

Both shims MUST BE tight between gear teeth.

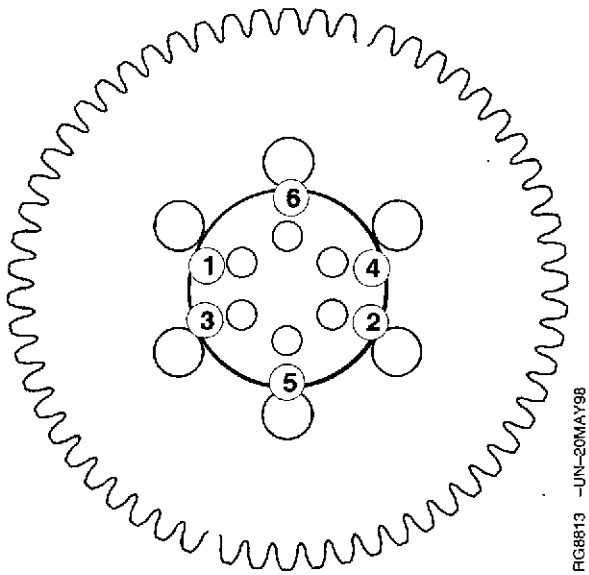
Retorque idler gear carrier cap screws to specifications above.

12. Apply LOCTITE® 242 Thread Lock and Sealer to camshaft retainer cap screws and tighten to the following specification in sequence shown.



RG8820 –UN–11DEC97

Backlash Shim Locations



RG8813 –UN–20MAY98

Camshaft Gear Retainer Torque Sequence

A—Shim
B—Shim

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RG,RG34710,190 –19–13AUG99–4/5

Camshaft Gear Retainer Plate-to-Camshaft—Specification

Initial Torque ..... 100 N•m (74 lb-ft)

Next, tighten cap screws to the following specification in sequence shown on previous page.

Camshaft Gear Retainer Plate-to-Camshaft—Specification

Second Torque ..... 150 N•m (110 lb-ft)

13. Finally, retorque camshaft retaining ring cap screws to specifications, using sequence shown on previous page.

Camshaft Gear Retainer Plate-to-Camshaft—Specification

Final Retorque ..... 150 N•m (110 lb-ft)

14. Remove backlash template and rotate engine flywheel to remove shims. Tighten idler gear thrust plate cap screws to specifications.

Upper Idler Gear Thrust Plate Cap Screws—Specification

Torque ..... 35 N•m (26 lb-ft)

RG,RG34710,190 –19–13AUG99–5/5

REMOVE AND INSTALL CAMSHAFT

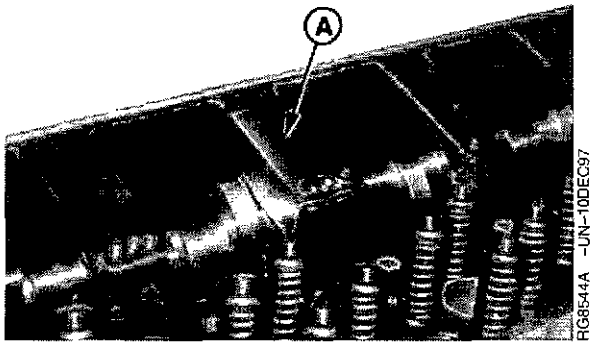
REMOVE ENGINE CAMSHAFT

Engine camshaft can be removed with cylinder head installed or removed from engine.

1. Remove rocker arm assembly. (See REMOVE ROCKER ARM ASSEMBLY in Group 05.)

NOTE: See DFRG4—CAMSHAFT LOCKING TOOL in Group 99 for instructions on how to fabricate tool.

2. Secure camshaft in bushings with DFRG4 Camshaft Locking Tool (A). Tighten cap screw and secure locking tool to head.



DFRG4 Camshaft Locking Tool

A—Camshaft Locking Tool

Continued on next page

RG,RG34710,191 –19–13AUG99–1/14

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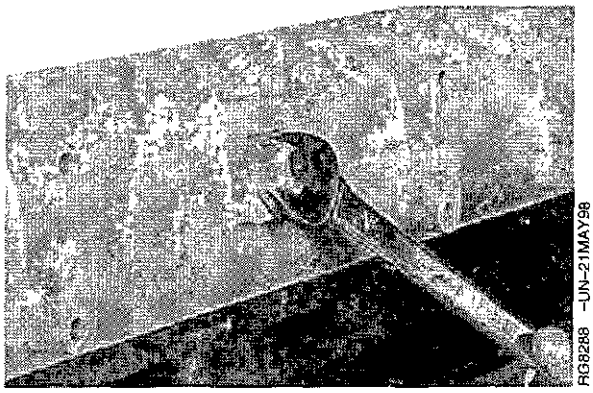
14

3. Remove camshaft position sensor from cylinder head.



Removing Camshaft Position Sensor

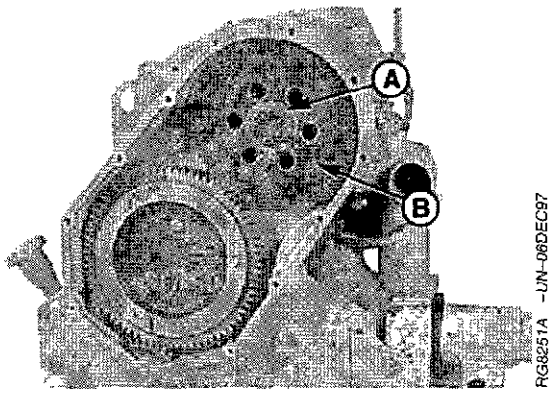
RG,RG34710,191 –19–13AUG99–2/14

4. Remove camshaft gear access cover. (See REMOVE TIMING GEAR COVER in Group 15.)

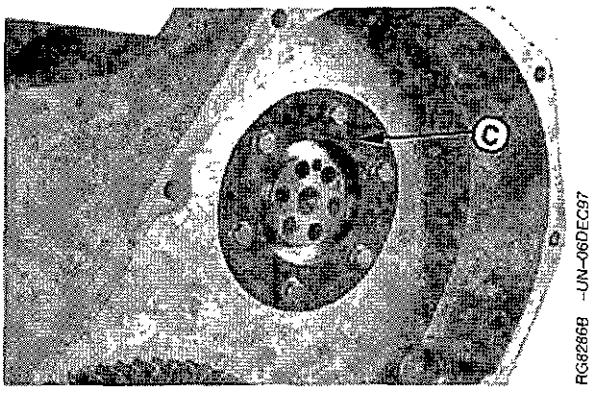
5. Remove six cap screws securing camshaft gear retainer washer (A) and remove camshaft gear (B).

NOTE: Gently bump camshaft forward to remove thrust ring (C).

6. Remove camshaft thrust ring (C).



Removing Camshaft Gear



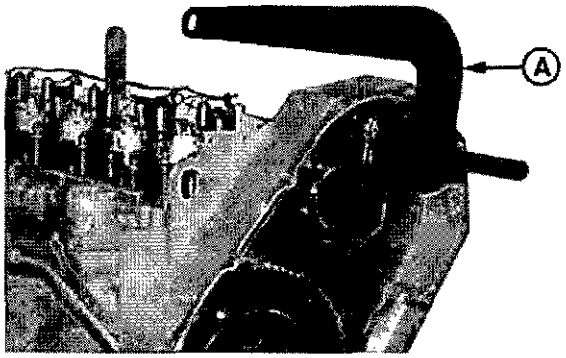
Removing Camshaft Thrust Ring

A—Camshaft Gear Retainer Washer
B—Camshaft Gear
C—Camshaft Thrust Ring

Continued on next page

RG,RG34710,191 –19–13AUG99–3/14

7. Install JDG969A Camshaft Holder (A) onto front face of camshaft using two camshaft gear retainer cap screws. Tighten cap screws securely.



RG10243 –UN–30JUL99

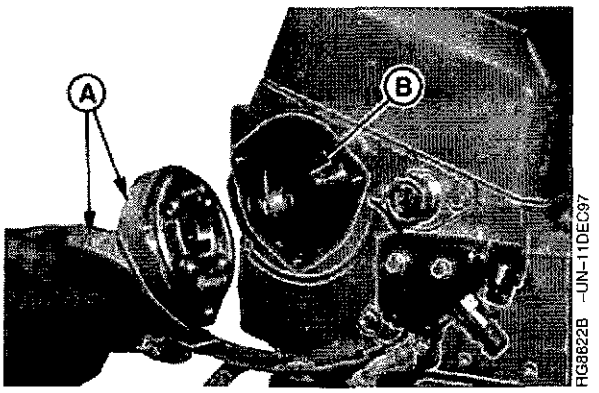
Installing JDG969A Camshaft Holder

A—Camshaft Holder

RG,RG34710,191 –19–13AUG99–4/14

8. Remove fuel supply pump and mounting bracket (A) from rear of cylinder head.

9. Remove supply pump drive coupler (B) from drive pin in rear of camshaft.



RG8822B –UN–11DEC97

Removing Supply Pump Drive Coupler

A—Fuel Supply Pump And Mounting Bracket
B—Supply Pump Drive Coupler

Continued on next page

RG,RG34710,191 –19–13AUG99–5/14

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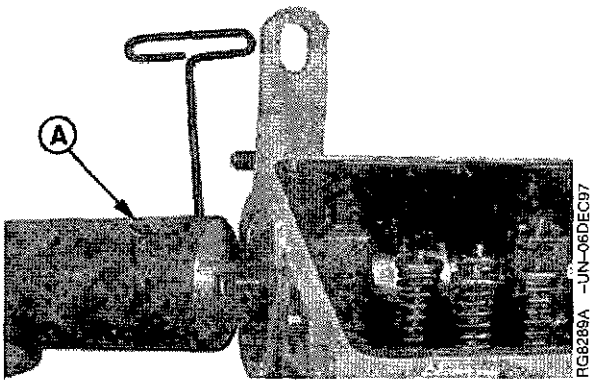
10. Install JDG972 Camshaft Pilot (A) onto rear face of camshaft. Tighten two set screws securely. Lubricate pilot with clean engine oil or multipurpose grease.



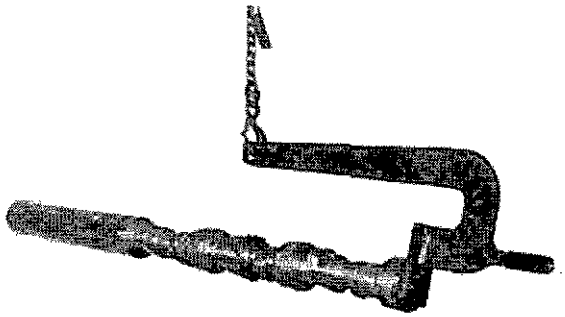
Installing JDG972 Camshaft Pilot

A—Camshaft Pilot

RG,RG34710,191 –19–13AUG99–6/14

11. Support camshaft holder with a hoist. Ensure that engine repair stand is level to ease removal of camshaft.

12. Slowly remove camshaft from cylinder head, traverse hoist (if possible) as camshaft is removed to avoid binding in bushing bores.



Camshaft with Pilot and Holder

Continued on next page

RG,RG34710,191 –19–13AUG99–7/14

INSTALL ENGINE CAMSHAFT

1. If removed, install fuel supply pump drive pin in end of camshaft. (See REPLACE FUEL SUPPLY PUMP DRIVE PIN later in this group.)

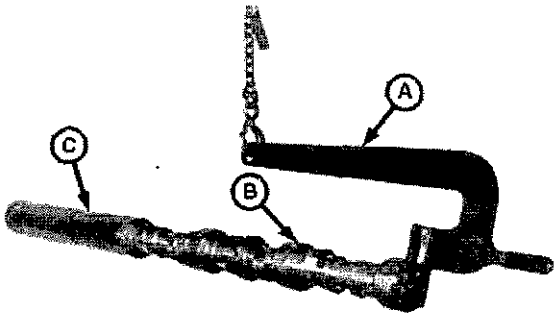
NOTE: Engine repair stand must be level during camshaft installation. Traverse hoist during installation so that camshaft bearings do not bind in bushing.

2. Attach JDG969A Camshaft Holder (A) to front face of camshaft (B). Attach JDG972 Camshaft Pilot (C) to rear face of camshaft. Securely tighten all mounting hardware.

3. Coat camshaft lobes and bearings with JDT405 High Temperature Grease.

4. Generously lubricate camshaft bushings with clean engine oil.

5. Support camshaft with overhead hoist and carefully guide camshaft into bushing bores. Traverse hoist (if possible) as camshaft is installed and keep engine repair stand level to ease installation.



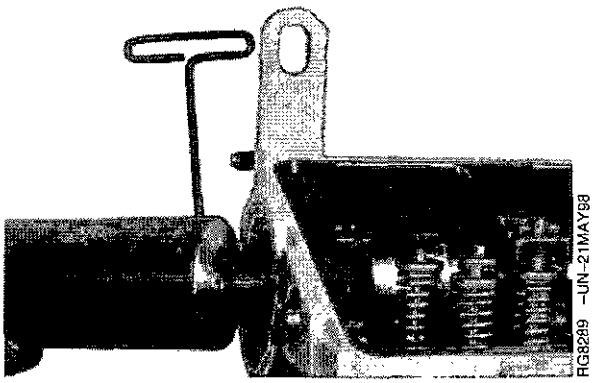
RG10245 –UN–30JUL99

Camshaft with Pilot and Holder

A—JDG969A Camshaft Holder
B—Front Face Of Camshaft
C—Camshaft Pilot

RG,RG34710,191 –19–13AUG99–8/14

6. Push camshaft toward rear of engine until pilot set screws can be removed from rear face. Remove pilot from rear face of camshaft.



RG8289 –UN–21MAY98

Removing JDG972 Pilot from Camshaft

Continued on next page

RG,RG34710,191 –19–13AUG99–9/14

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7. Install fuel supply pump drive coupler (A) onto camshaft drive pin so that coupler is flush to 0.5 mm (0.020 in.) above pin. Apply LOCTITE® 242 Thread Lock and Sealer to set screws.

   Install set screws with the centerline of one screw perpendicular to flat on drive pin. Tighten set screws to specifications.

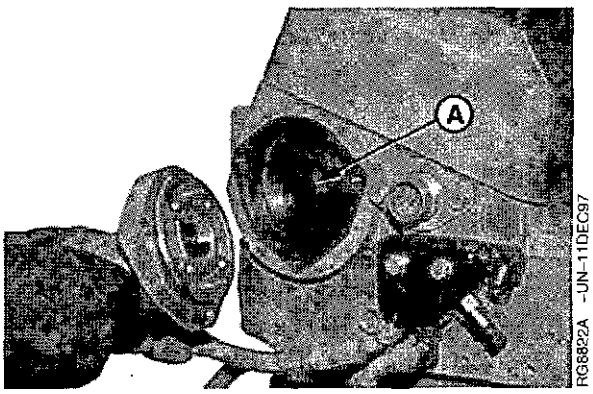
Camshaft and Supply Pump Drive Coupler Set Screw—Specification

Torque ..... 4 N•m (3 lb-ft)

8. Install fuel supply pump on dual rail fuel systems. (See REMOVE AND INSTALL FUEL SUPPLY PUMP in Group 35.) Install fuel supply pump on single rail fuel systems. (See REMOVE AND INSTALL FUEL SUPPLY PUMP in Group 36.)

Fuel Supply Pump-to-Cylinder Head—Specification

Torque ..... 50 N•m (37 lb-ft)



Installing Supply Pump Drive Coupler

A—Fuel Supply Pump Drive Coupler

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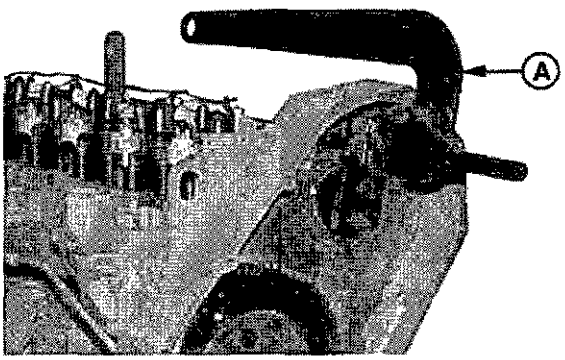
RG,RG34710,191 –19–13AUG99–10/14

9. Remove JDG969A Camshaft Holder (A) from front face of camshaft.



Removing JDG969A Camshaft Holder

A—JDG969A Camshaft Holder

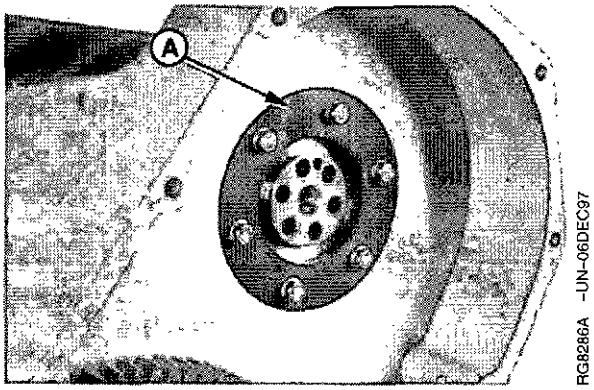
Continued on next page

RG,RG34710,191 –19–13AUG99–11/14

10. Install a new thrust ring gasket. Lubricate O-ring with clean engine oil and install camshaft thrust ring (A) and tighten cap screws to specifications.

Camshaft Thrust Ring-to-Head—Specification

Torque ..... 35 N•m (26 lb-ft)



Installing Camshaft Thrust Ring

A—Camshaft Thrust Ring

RG,RG34710,191 –19–13AUG99–12/14

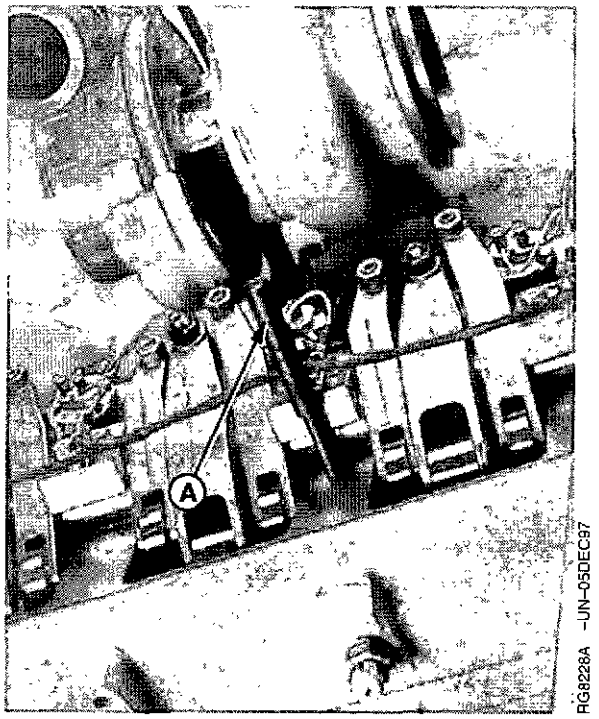
11. Rotate camshaft in bushings and install JDG971 Timing Pin (A) in camshaft timing slot.

12. Remove camshaft locking tool and install rocker arm assembly. (See INSTALL ROCKER ARM ASSEMBLY in Group 05.)

13. Install camshaft position sensor and tighten to specifications.

Camshaft Position Sensor—Specification

Torque ..... 14 N•m (10 lb-ft)



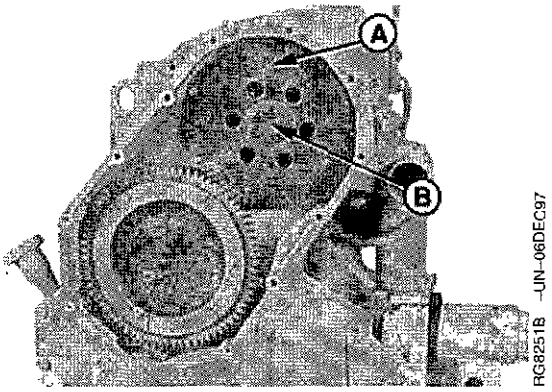
JDG691 Timing Pin in Camshaft

A—JDG971 Timing Pin

Continued on next page

RG,RG34710,191 –19–13AUG99–13/14

14. Install camshaft gear (A) and retainer washer (B) Install retainer cap screws finger tight. Adjust timing gear backlash. See ADJUST FRONT TIMING GEAR BACKLASH, earlier in this group, to set backlash and for torque procedure on camshaft retainer cap screws.



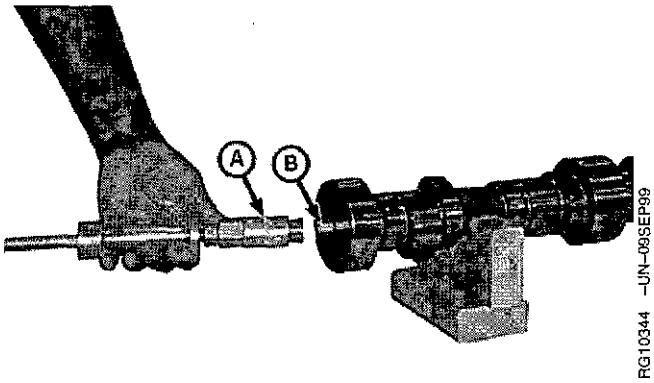
Installing Camshaft Gear

A—Camshaft Gear
B—Retainer Washer

RG,RG34710,191 –19–13AUG99–14/14

REPLACE FUEL SUPPLY PUMP DRIVE PIN

1. Remove camshaft. (See REMOVE AND INSTALL CAMSHAFT earlier in this group.)
2. Remove fuel supply pump drive pin (B) using Snap-On CG503 Dowel Pin Puller Set (A) or equivalent tool.
3. Press new drive pin into end of camshaft until it bottoms out. Pin should protrude 15.45—17.45 mm (0.608—0.687 in.) from end of camshaft.
4. Install camshaft. (See REMOVE AND INSTALL CAMSHAFT earlier in this group.)



Fuel Supply Pump Drive Pin

A—Dowel Pin Puller
B—Fuel Supply Pump Drive Pin

DPSG,OUO1004,1021 –19–08SEP99–1/1

VISUALLY INSPECT CAMSHAFT AND ROLLER FOLLOWERS

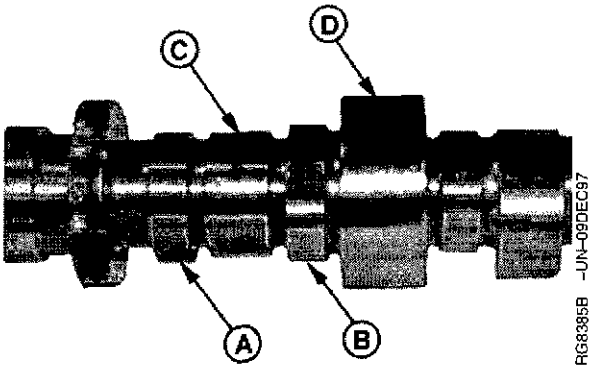
1. Clean camshaft in solvent. Dry with compressed air.

IMPORTANT: Very light score marks may be found on eccentric lobes, but are acceptable if valve lift is within specification. Pitting and galling dictates replacement.

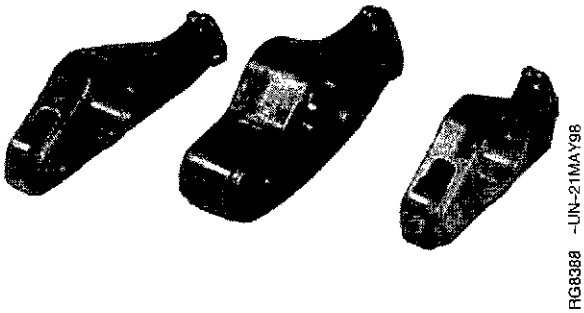
2. Inspect all camshaft eccentric lobes and bushing journals (D) for wear or damage.

3. Inspect all corresponding rocker arm roller followers for uneven wear or damage.

   Replace individual roller followers as necessary.



Inspecting Camshaft Lobes



Inspecting Roller Followers

A—Intake Lobe
B—Exhaust Lobe
C—Unit Injector Lobe
D—Bushing Journal

RG,RG34710,192 -19-30SEP97-1/1

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INSPECT AND MEASURE CAMSHAFT BUSHING ID AND JOURNAL OD

1. Measure each camshaft bushing journal OD and compare with specifications below.

   Replace camshaft if journal OD is not within specification.

2. Measure camshaft bushing ID and compare with specifications below.

   Replace camshaft bushings if not within specification and if surface wear or scratching is detected.

Camshaft Journal—Specification

OD ..... 101.987—102.013 mm (4.0152—4.0162 in.)

Camshaft Bushing—Specification

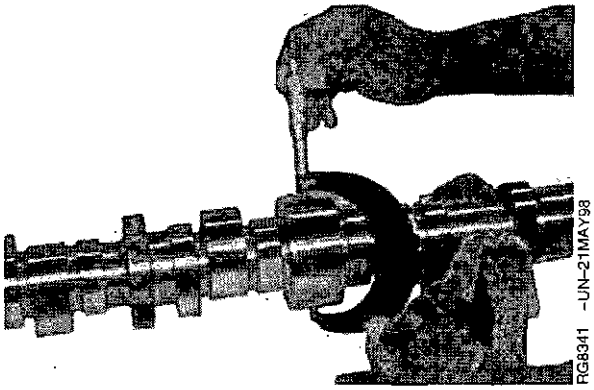
ID ..... 102.091—102.167 mm (4.0193—4.0223 in.)

Camshaft Journal-to-Bushing—Specification

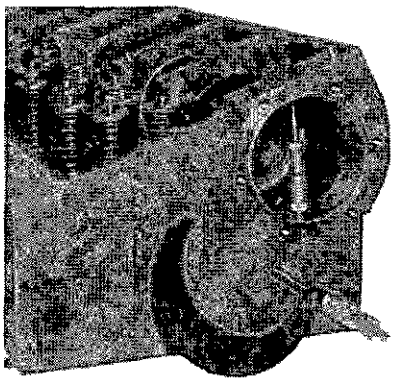
Oil Clearance ..... 0.078—0.180 mm (0.0031—0.0071 in.)

Camshaft Bushing—Specification

Bore in Head ..... 105.987—106.013 mm (4.1727—4.1737 in.)



Measuring Camshaft Journal OD



Measuring Camshaft Bushing ID

RG,RG34710,193 –19–13AUG99–1/1

MEASURE CAMSHAFT LOBE LIFT HEIGHT

Measure each camshaft lobe at it's highest point and at it's narrowest point. Subtract narrowest height from highest to find cam lobe lift.

If camshaft lobe lift is not within specification on any one lobe, replace camshaft.

Intake Lobe—Specification

Height ..... 45.100—45.620 mm (1.776—1.796 in.)

Intake Lobe Base Circle—Specification

Height ..... 36.37—36.63 mm (1.432—1.442 in.)

Intake Lobe—Specification

Lift ..... 8.73—8.99 mm (0.343—0.353 in.)

Exhaust Lobe—Specification

Height ..... 40.300—40.820 mm (1.587—1.607 in.)

Exhaust Lobe Base Circle—Specification

Height ..... 32.37—32.63 mm (1.274—1.285 in.)

Exhaust Lobe—Specification

Lift ..... 7.93—8.19 mm (0.312—0.322 in.)

EUI Lobe—Specification

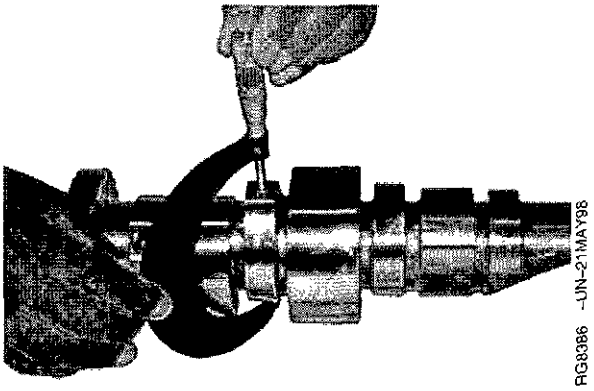
Height ..... 46.530—47.050 mm (1.832—1.852 in.)

EUI Lobe Base Circle—Specification

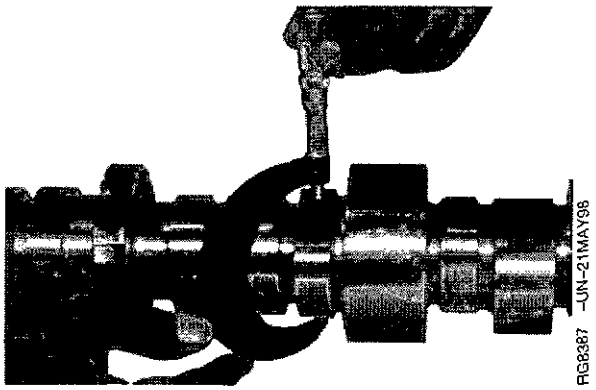
Height ..... 32.37—32.63 mm (1.274—1.285 in.)

EUI Lobe—Specification

Lift ..... 14.16—14.42 mm (0.557—0.567 in.)



Measuring Camshaft Lobe Base Circle



Measuring Camshaft Lobe Lift

RG,RG34710,194 –19–29JUL99–1/1

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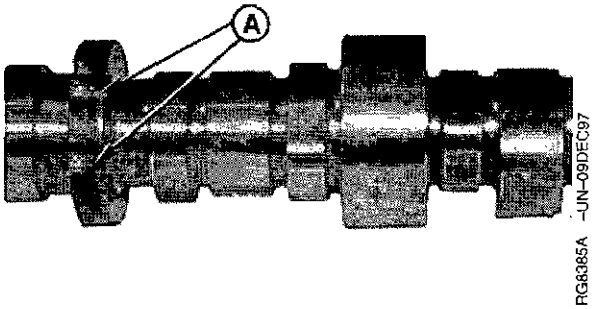
INSPECT CAMSHAFT POSITION SENSOR LOBE

Visually inspect camshaft position sensor lobe slots (A) for damage or chips that may emit a false reading.

Replace camshaft as necessary.



Inspecting Camshaft Sensor and Timing Slots

A—Lobe Slots

RG,RG34710,195 –19–30SEP97–1/1

REPLACE CAMSHAFT BUSHINGS

Camshaft bushings MUST BE replaced with cylinder head removed from engine.

IMPORTANT: Use only hand tools for camshaft bushing removal and installation. DO NOT use pneumatic equipment for bushing replacement.

REMOVE CAMSHAFT BUSHINGS

1. Remove camshaft. (See REMOVE AND INSTALL CAMSHAFT, earlier in this group.)

2. Remove spring pins from camshaft towers 3 and 5 (bushing locations 2 and 3).

3. **No. 1 Bushing:**

   Install JDG968-1 Bushing Remover (A) in front side of No. 1 camshaft tower.

4. Lubricate threaded rod (B) and inset through remover with double nut and washer towards front of engine.

5. Install JDG968-3 Guide (C) in rear side of No. 2 tower with threaded rod through driver. Secure assembly with nut and washer.

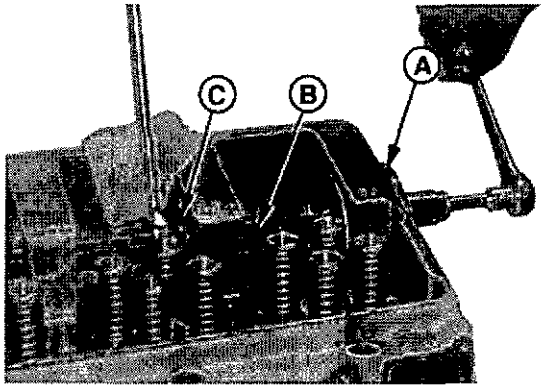
6. Remove bushing from bore using a 1/2-in. drive ratchet wrench with deep-well socket on double nut and a combination wrench to hold single nut. Protect cylinder head with a shop towel on wrench handle.

   Remove remaining bushings using the same procedure as above and by positioning tool set as follows:

7. **No. 2 Bushing:**

   Install JDG968-1 Remover in rear of No. 3 tower and JDG968-3 Guide in front of No. 2 tower.

8. Install threaded rod with double nut toward front of engine. Use a 152.4 mm (6.0 in.) extension with ratchet to reach double nut.



RG8333 –UN–09DEC97

Removing Camshaft Bushings

A—Bushing Remover
B—Threaded Rod
C—JDG968-3 Guide

Continued on next page

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9. **No. 3 Bushing:**

   Install JDG968-1 Remover in front of tower No. 5 and JDG968-3 Guide in rear of tower No. 6.

10. Install threaded rod with double nut toward rear of engine.

11. Use a 152.4 mm (6.0 in.) extension with ratchet to reach double nut.

12. **No. 4 Bushing:**

    Install JDG968-1 Remover in rear of No. 7 tower and JDG968-3 Guide in front of No. 6 tower.

13. Install threaded rod with double nut toward rear of engine. No extension needed.

14. Thoroughly clean bushing bores in cylinder head and inspect for damage. Clean lubricating oil holes as needed.

RG,RG34710,196 –19–13AUG99–2/7

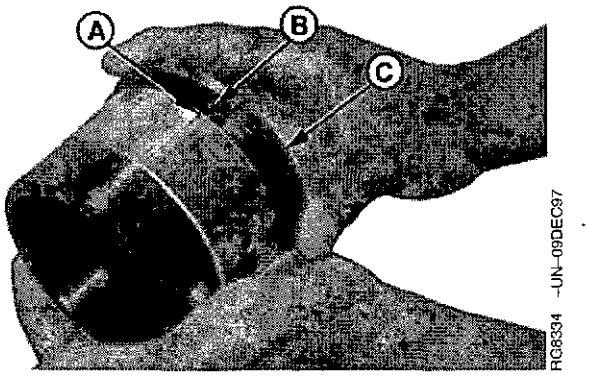
INSTALL CAMSHAFT BUSHINGS

IMPORTANT: ALWAYS install bushings from front side of cylinder head bushing bore and drive toward rear.

1. **No. 1 Bushing:**

   Apply a light coat of JDT405 High Temperature Grease to ID of bushing bore in cylinder head.

2. Align notch (A) in new camshaft bushing with notch in JDG968-4 Alignment Sleeve (B). Position JDG968-2 Installer (C) onto end of sleeve with index slot engaged in notches in bushing and sleeve.



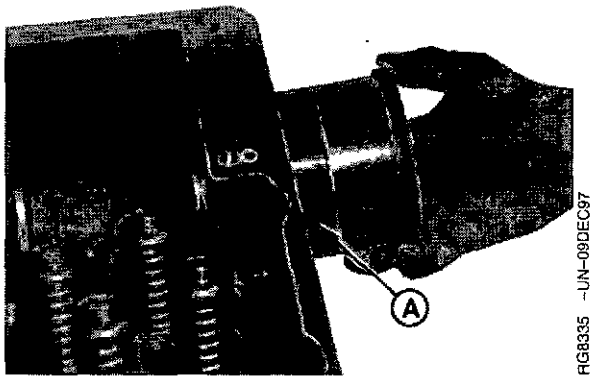
Positioning Replacement Bushing on Installer

A—Notch Alignment
B—Alignment Sleeve
C—Installer

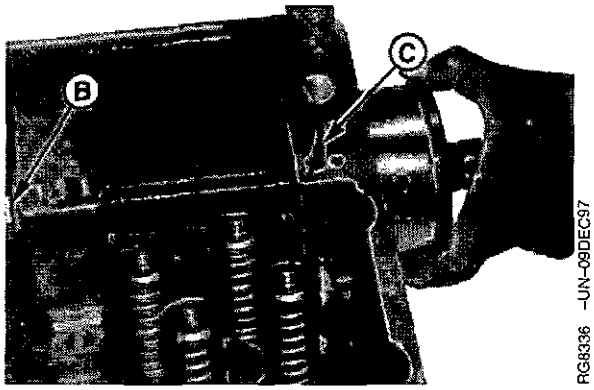
Continued on next page

RG,RG34710,196 –19–13AUG99–3/7

3. Position installer and sleeve with bushing on the front side of No. 1 tower with alignment groove (A) in guide sleeve positioned approximately as shown.
4. Install threaded rod with washer through installer with double nut towards front of engine.
5. Install JDG968-3 Guide (B) in the rear of tower No. 2 with threaded rod through guide. Secure assembly (finger tight) with nut and washer.
6. Install large end of JDG968-5 Alignment Pin (C) into oil hole (spring pin removed) until pin engages groove in alignment sleeve.
7. Once pin engages groove, rotate sleeve toward valves until you feel a positive stop. This ensures that the oil holes in bushing and cylinder head will be properly aligned after installation.



Positioning Bushing and Installer in Head

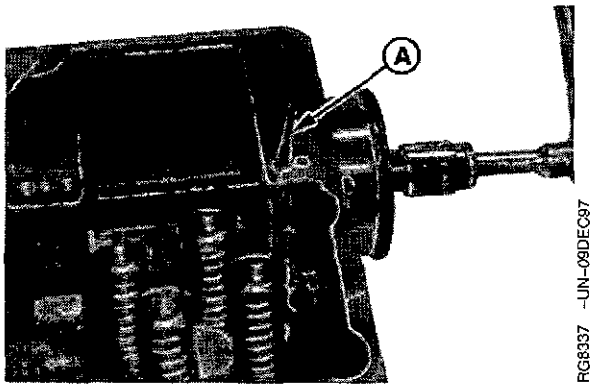


Indexing Bushing in Head

A—Alignment Groove
B—JDG968-3 Guide
C—JDG968-5 Alignment Pin

RG,RG34710,196 –19–13AUG99–4/7

8. Slowly install bushing in bore using a 1/2-in. drive ratchet wrench with deep-well socket on double nut and a combination wrench to hold single nut. Protect cylinder head with a shop towel on wrench handle.
9. Remove inspection pin (A) from oil hole once bushing is started in bore. Continue tightening double nut until shoulder of installer contacts tower.



Bushing Installation Index Pin

A—Inspection Pin

Continued on next page

RG,RG34710,196 –19–13AUG99–5/7

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10. Remove tool set and insert the smaller end of JDG9685 Inspection Pin from the TOP side of tower oil lube hole. This pin must pass through installed bushing completely to ensure proper lube hole alignment.

    If inspection pin does not pass through bushing oil hole, remove bushing and install a new one.

    Install remaining bushings using the same procedure as above and by positioning tool set as follows:

IMPORTANT: Protect previously installed bushings from tool damage with clean shop towels when installing threaded rod through bores.

11. **No. 2 Bushing:**

    Install JDG968-2 Installer and JDG968-4 Alignment Sleeve with bushing in front of tower No. 3 and JDG968-3 Guide in rear of tower No. 5.

12. Install threaded rod with double nut toward front of engine.

13. Use a 304.8 mm (12.0 in.) extension with ratchet to reach double nut.

14. **No. 4 Bushing:**

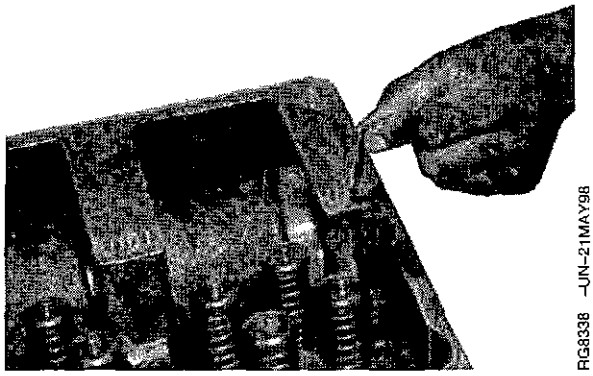
NOTE: Install bushing No. 4 before installing bushing No. 3.

    Adjust double nut position on threaded rod so that double nut is 51 mm (2.0 in.) from end of rod.

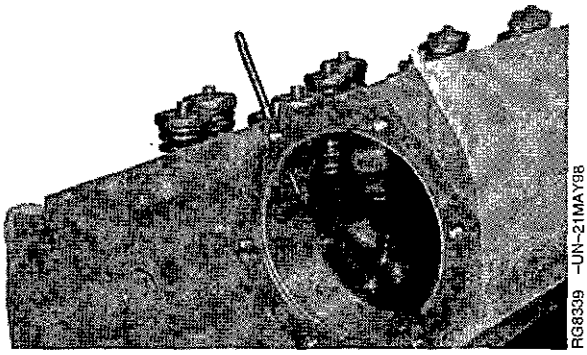
NOTE: JDG968-1 Remover can be positioned in tower No. 6 as a pilot, if desired.

15. JDG968-2 Installer and JDG968-4 Alignment Sleeve with bushing in front of tower No. 7 and JDG968-3 Guide in rear of No. 5 tower without bushing.

16. Install threaded rod with double nut and thrust washer against JDG968-3 Guide [51 mm (2.0 in.) and threaded rod extending through guide].


RG8338 –UN–21MAY98

Checking Bushing Oil Hole Alignment


RG8339 –UN–21MAY98

Index Pin Installed through Bushing

Continued on next page

17. Install single nut and washer against JDG968-2 Installer. Put wrench on double nut and push bushing in with wrench on single nut.

18. **No. 3 Bushing:**

NOTE: Install bushing No. 4 before installing bushing No. 3.

Install JDG968-2 Installer and JDG968-4 Alignment Sleeve with bushing in front of tower No. 5 and JDG968-3 Guide in rear of No. 6 tower.

19. Install threaded rod with double nut toward rear of engine.

20. Use a 152.4 mm (6.0 in.) extension with ratchet to reach double nut.

21. Install a new spring pin in towers 3 and 5 (bushing locations 2 and 3).

RG,RG34710,196 –19–13AUG99–7/7

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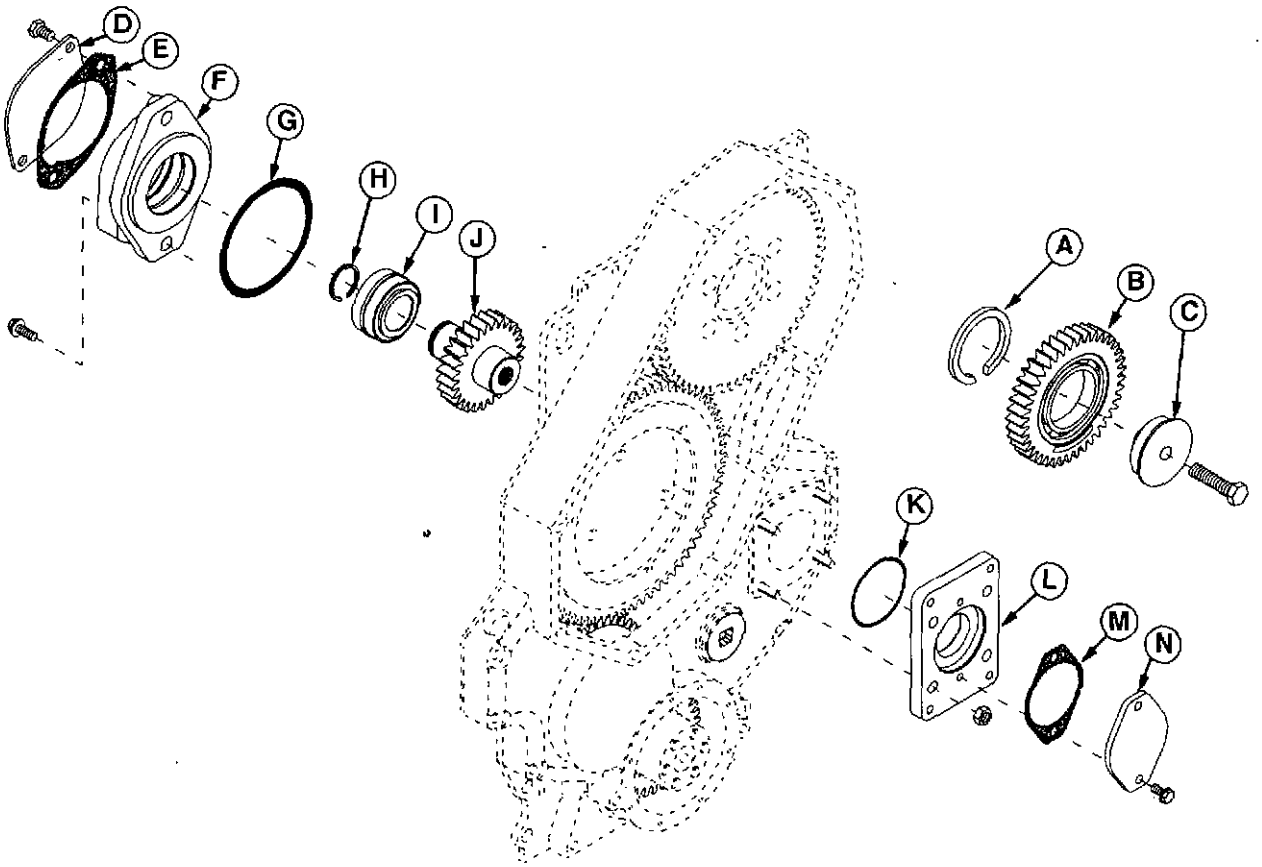
SAE "A" (FRONT) AND SAE "B" (REAR) AUXILIARY DRIVE ASSEMBLY[1]



RG9038 —UN—09AUG99

Auxiliary Drive Assembly

A—Snap Ring	**D—Cover Plate**	**H—Snap Ring**	**L—"A"-Adapter**
B—Auxiliary Drive Idler Gear	**E—Gasket**	**I—Bearing**	**M—Gasket**
C—Support Bushing	**F—"B"-Adapter Housing**	**J—Splined Gear**	**N—Cover Plate**
	G—O-Ring	**K—O-Ring**	

Torque specifications for adapter housing (F) and support bushing (C) are as follows:

SAE "A" Front Auxiliary Drive Adapter Housing

Nuts—Specification

Torque..... 50 N•m (37 lb-ft)

[1]*Refer to CTM67, OEM Engine Accessories, for repair of auxiliary drive assembly.*

Continued on next page

RG,RG34710,197 –19–13AUG99–1/2

SAE "A" Front Auxiliary Drive Idler Gear Support Bushing—Specification

Torque	220 N•m (162 lb-ft)

RG,RG34710,197 –19–13AUG99–2/2

SAE "B" REAR AUXILIARY DRIVE[1]

DISASSEMBLE REAR AUXILIARY DRIVE ASSEMBLY

1. Remove rear auxiliary drive assembly (F) from front plate. Discard O-ring (B).
2. Support front face of adapter housing (A). Press gear (E) and bearing (D) out of housing bore.
3. Remove snap ring (C) from gear shaft. Discard snap ring.
4. Remove bearing from gear. Discard bearing.
5. Thoroughly clean and inspect gear and housing.

ASSEMBLE REAR AUXILIARY DRIVE ASSEMBLY

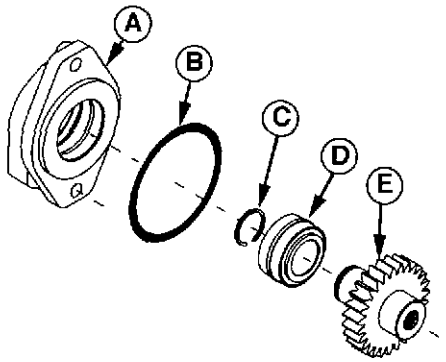
1. Assembly bearing onto gear shaft.
2. Determine correct snap ring to achieve 0.11 mm (0.004 in.) maximum clearance between bearing cone and snap ring.
3. Support back side of adapter housing. Press gear and bearing assembly into housing until assembly bottoms.

IMPORTANT: Make sure oil drain port (G) is positioned on bottom as shown.

4. Install assembly onto front plate using a new gasket. Tighten cap screws to specifications.

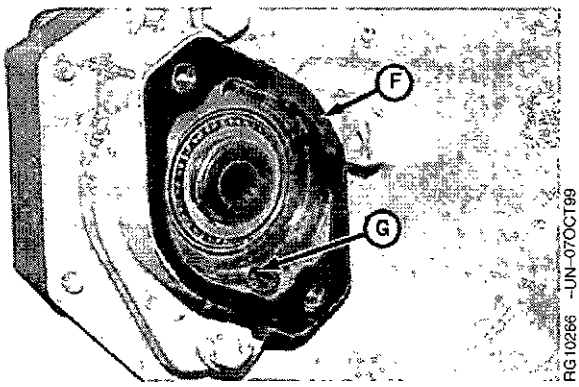
SAE "B" Rear Auxiliary Drive Adapter—Specification

Torque	110 N•m (81 lb-ft)



RG9039 –UN–04AUG99

SAE "B" Rear Auxiliary Drive Assembly



RG10266 –UN–07OCT99

SAE "B" Rear Auxiliary Drive

A—SAE "B" Adapter Housing
B—O-Ring
C—Snap Ring
D—Bearing
E—Splined Gear
F—Rear Auxiliary Drive Assembly
G—Oil Drain Port

[1] *Refer to CTM67, OEM Engine Accessories, for repair of auxiliary drive assembly.*

RG,RG34710,198 –19–13AUG99–1/1

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32

ALIGN SAE "A" FRONT AUXILIARY DRIVE ADAPTER

IMPORTANT: Front auxiliary drive adapter (A) MUST BE properly aligned with center of gear spline whenever front or rear adapter(s) is removed. Improperly aligned adapter may damage bearing assembly.

1. Install SAE "B" rear auxiliary drive adapter and tighten to specification.

SAE "B" Rear Auxiliary Drive Adapter—Specification

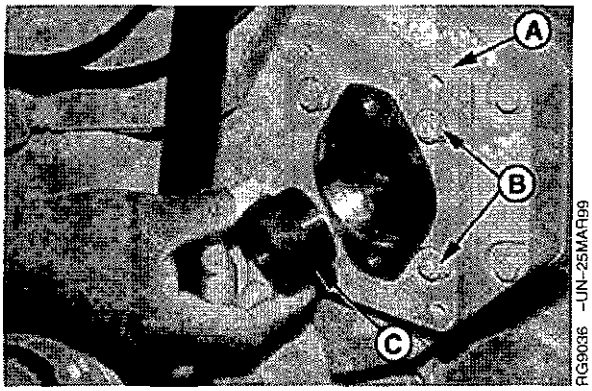
Torque ..... 110 N•m (81 lb-ft)

2. Install SAE "A" front adapter and tighten four mounting stud nuts (B) finger tight.
3. Install JDG1144 Alignment Tool (C) onto gear flange and into adapter bore to properly center adapter with gear spline.
4. Tighten mounting stud nuts to specifications.

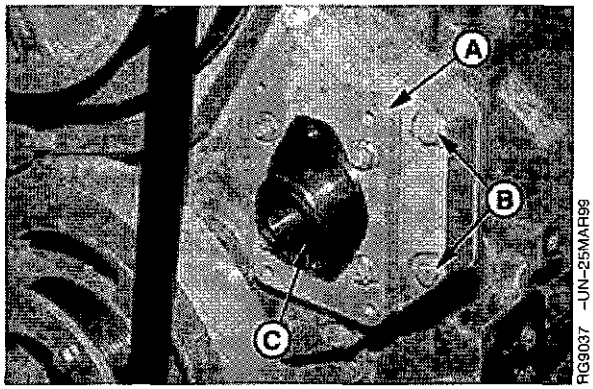
SAE "A" Front Auxiliary Drive Adapter Housing Nuts—Specification

Torque ..... 50 N•m (37 lb-ft)

Remove alignment tool.



Installing JDG1144 Alignment Tool



JDG1144 Alignment Tool Installed

A—Auxiliary Drive Adapter
B—Mounting Stud Nuts
C—JDG1144 Alignment Tool

RG,RG34710,199 –19–13AUG99–1/1

ESSENTIAL TOOLS

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

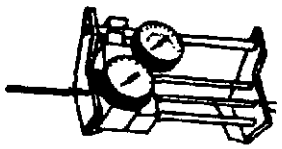
SERVICEGARD is a trademark of Deere & Company

DPSG,OUO1004,947 –19–28JUL99–1/2

RG5061 –UN–05DEC97

Spring Compression Tester D01168AA

Test oil bypass valve spring and oil pressure regulating valve spring compression.



RG5061

D01168AA

DPSG,OUO1004,947 –19–28JUL99–2/2

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OTHER MATERIAL

Number	Name	Use
T43513 (U.S.) TY9474 (Canadian) 271 (LOCTITE®)	Thread Lock and Sealer (High Strength)	Oil filter mounting adapter-to-filter base.
T43512 (U.S.) TY9473 (Canadian) 242 (LOCTITE®)	Thread Lock and Sealer (Medium Strength)	Oil pump-to-block cap screws and oil pressure sending unit.
JDT405 (U.S.)	High Temperature Grease	Apply to inside cavities of oil pump and ID of oil pump drive gear bushing.
12695 (U.S.)	LOCTITE® Solventless Primer	Apply to front oil pan rail T-joint areas prior to applying form-in-place gasket.
TY16021 (U.S.) TY9484 (Canadian) 17430 (LOCTITE®)	High Flex Form-In-Place Gasket	Used to seal oil pan.[1]
TY9375 (U.S.) TY9480 (Canadian) 592 (LOCTITE®)	Pipe Sealant	Apply to oil pan drain hose and drain valve.

LOCTITE is a registered trademark of Loctite Corp.

[1] *See INSTALL ENGINE OIL PAN in Group 20 for specific locations to apply sealant.*

DPSG,OUO1004,949 –19–28JUL99–1/1

LUBRICATION SYSTEM SPECIFICATIONS

Item	Measurement	Specification
New Oil Pressure Regulating Valve Spring	Free Length Working Load at 76—84 N (17—19 lb-force)	86.4 mm (3.40 in.) 42.0 mm (1.65 in.)
Oil Pressure Regulating Valve Plug	Torque	100 N•m (74 lb-ft)
New Oil Cooler Bypass Valve Spring	Free Length Working Load @ 64—78 N (14—18 lb-force)	44.0 mm (1.73 in.) 30.0 mm (1.18 in)
New Oil Filter Bypass Valve Spring	Free Length Working Load @ 64—78 N (14—18 lb-force)	44.0 mm (1.73 in.) 30.0 mm (1.18 in.)
Oil Cooler Bypass Valve Plug	Torque	100 N•m (74 lb-ft)
Oil Filter Bypass Valve Plug	Torque	100 N•m (74 lb-ft)
Oil Pressure Relief Valve Spring	Free Length Working Load @ 196—222 N (44—50 lb-force)	79.0 mm (3.11 in.) 65.0 mm (2.56 in.)
Oil Cooler	Test Pressure	140—170 kPa (1.4—1.7 bar) (20—25 psi)
Oil Cooler-to-Housing Nuts	Torque	50 N•m (37 lb-ft)
Oil Cooler Drain Cock Handle	Torque	3 N•m (25 lb-in.)
Oil Cooler Expansion Plug	Installed Depth	Flush to 1.5 mm (0.059 in.) Below Surface
Oil Cooler Housing-to-Block Cap Screws	Torque	68 N•mm (50 lb-ft)

Continued on next page

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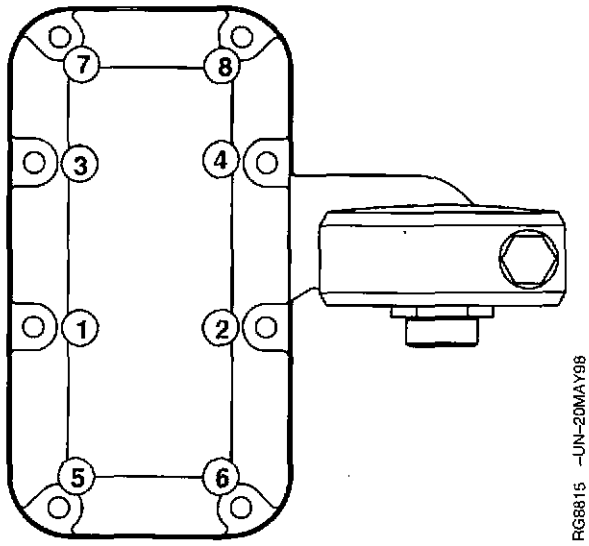
4

Item	Measurement	Specification
Oil Filter/Valve Housing or Oil Cooler Cover/Valve Housing[1]	Torque	68 N•m (50 lb-ft)
Turbocharger Oil Inlet Line-to-Oil Cooler Housing	Torque	35 N•m (26 lb-ft)
Oil Pump Drive Gear Bushing	ID	135.70—135.80 mm (5.343—5.346 in.)
Oil Pump-to-Block Cap Screws	Torque	45 N•m (33 lb-ft)
Oil Pump Drive Gear-to-Idler Gear	Backlash	0.25 mm (0.010 in.)
Oil Pickup Tube-to-Block Cap Screws	Torque	35 N•m (26 lb-ft)
Oil Pickup Tube-to-Oil Pan Cap Screws	Torque	25 N•m (18 lb-ft)
Oil Pan-to-Cylinder Block Cap Screws	Torque	68 N•m (50 lb-ft)
Oil Pan-to-Rear Oil Seal Housing Cap Screws	Torque	68 N•m (50 lb-ft)
Oil Pan-to-Timing Gear Cover Cap Screws	Torque	68 N•m (50 lb-ft)
Oil Pan Drain Plug 1-1/2 in. Hex Plug	Torque	46 N•m (34 lb-ft)
Oil Pan Drain Plug 1-1/4 in. Hex Plug	Torque	64 N•m (47 lb-ft)

[1]Torque sequence and specification also applies to oil cooler cover/valve housing on remote filter applications.

DPSG,OUO1004,951 –19–29JUL99–2/2

OIL FILTER AND VALVE HOUSING TORQUE SEQUENCE



Oil Filter Housing Torque Sequence (Sequence the same for remote filter application.)

RG,RG34710,204 –19–13AUG99–1/1

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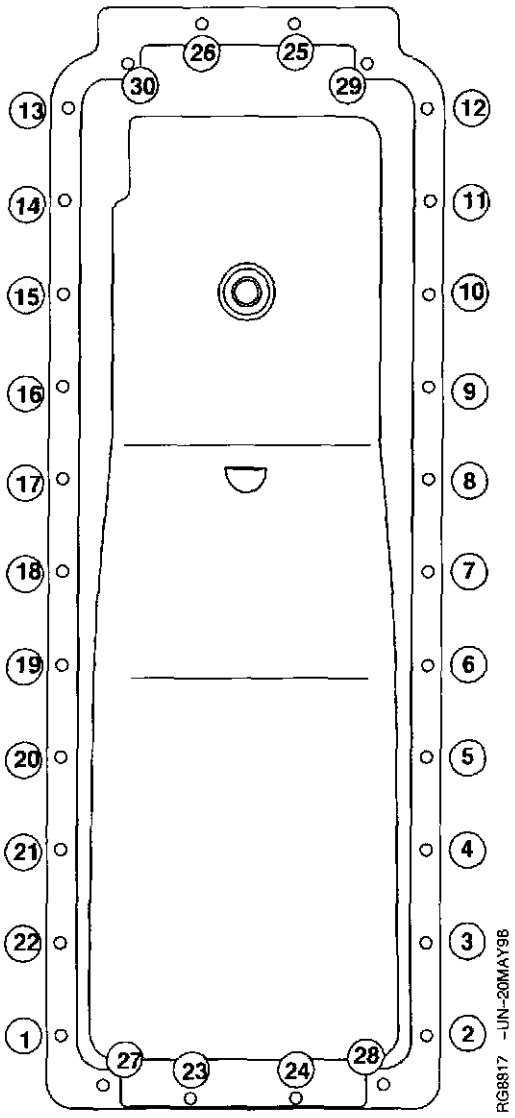
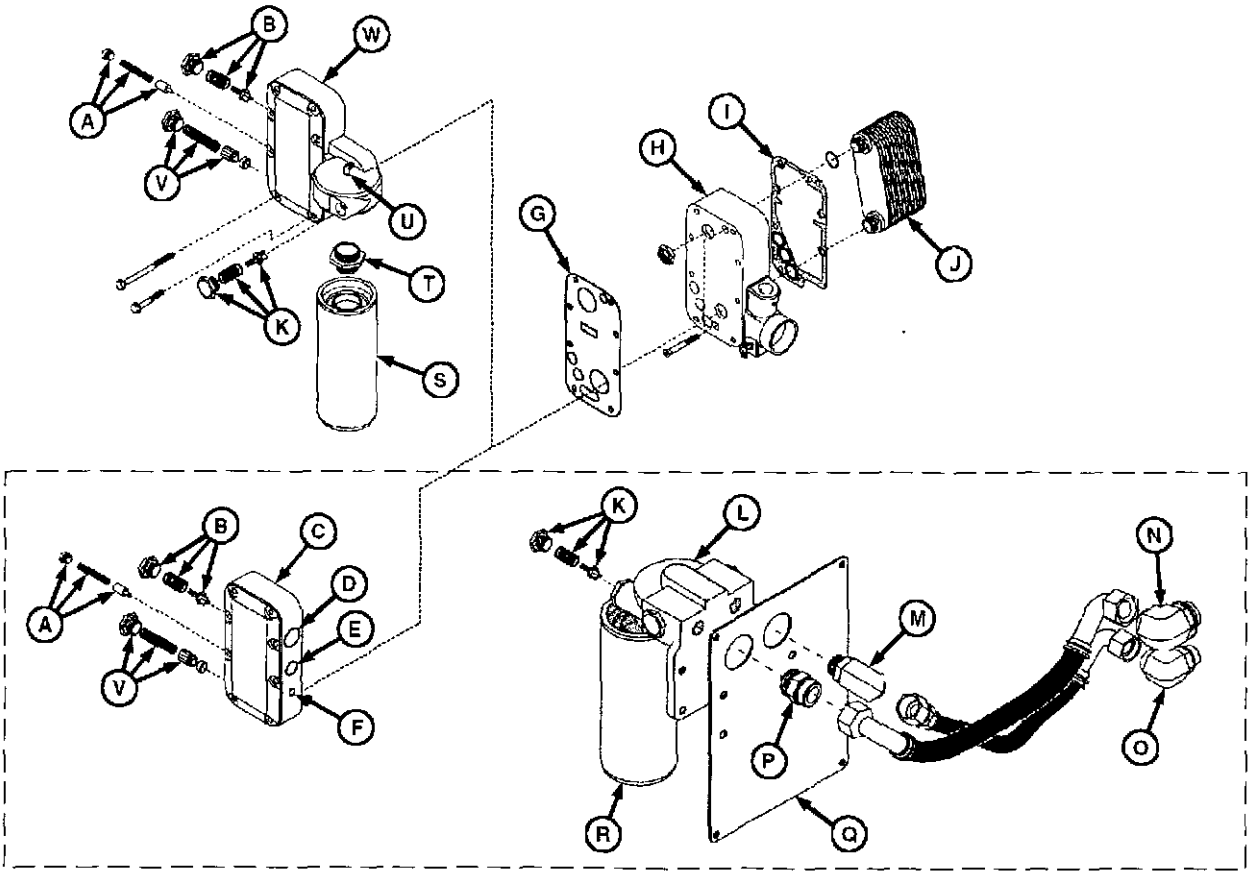
OIL PAN TORQUE SEQUENCE



Oil Pan Torque Sequence

RG,RG34710,205 –19–30SEP97–1/1

OIL FILTER AND OIL CONDITIONING HOUSING ASSEMBLY



RG10264 –UN–03NOV99

Oil Filter Base, Oil Cooler, and Valve Assembly (Remote Filter Option Shown on Lower Portion of Figure)

A—Pressure Relief Valve Assembly
B—Oil Cooler Bypass Valve Assembly
C—Oil Cooler Cover/Valve Housing (Remote Filter Applications)
D—Port to Remote Oil Filter Inlet
E—Port to Remote Oil Filter Outlet
F—Port to Turbocharger Oil Inlet (Remote Oil Filter Applications)
G—Gasket
H—Oil Cooler Housing
I—Gasket
J—Oil Cooler
K—Oil Filter Bypass Valve Assembly
L—Remote Oil Filter Housing
M—1 in. ID Elbow (Remote Oil Filter Applications)
N—1-1/4 in. ID Elbow (To Remote Oil Filter Inlet)
O—1 in. ID Elbow (To Remote Oil Filter Outlet)
P—1-1/4 ID Adapter (Remote Oil Filter Applications)
Q—Access Cover (Remote Oil Filter Applications)
R—Remote Oil Filter
S—Oil Filter
T—Filter Adapter
U—Port to Turbocharger Oil Inlet
V—Pressure Regulating Valve Assembly
W—Oil Filter and Valve Housing

RG,RG34710,206 –19–28JUL99–1/1

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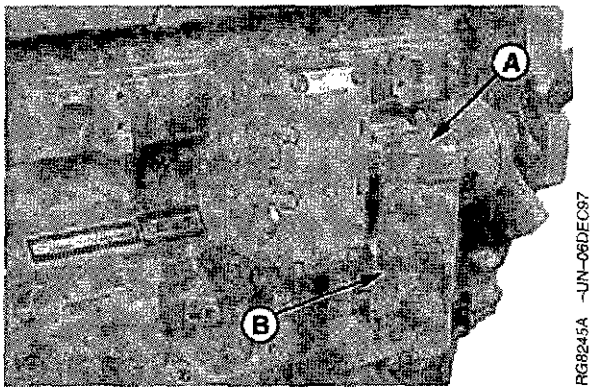
8

REMOVE OIL FILTER AND VALVE HOUSING/OIL COOLER COVER AND VALVE HOUSING

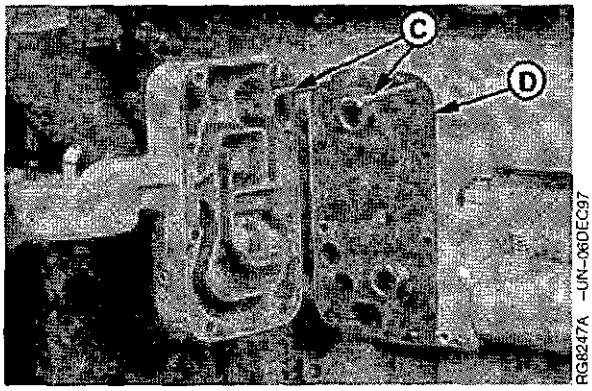
NOTE: Standard oil filter/valve housing shown. Procedure for removal of remote oil cooler cover and valve housing is the same.

Guide pins (C) may be used as an aid for removing and installing oil filter housing.

1. Disconnect turbocharger oil inlet line (shown removed) from oil filter and valve housing (A).
2. Turn oil filter (B) counterclockwise using filter wrench and remove filter from housing.
3. Remove eight cap screws securing oil filter and valve housing to cylinder block and remove housing. Remove and discard gasket.
4. Remove valves and thoroughly clean all bores and passages in housing.



Removing Filter and Valve Housing



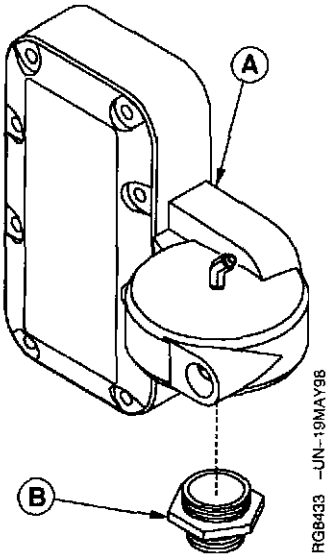
Filter and Valve Housing Removed

A—Oil Filter and Valve Housing
B—Oil Filter
C—Guide Pins
D—Gasket

RG,RG34710,207 –19–28JUL99–1/1

INSPECT AND REPLACE OIL FILTER ADAPTER

1. Inspect threads on oil filter adapter (B) for damage. Remove adapter from housing (A) and replace as necessary.
2. Coat adapter-to-oil filter housing threads with LOCTITE® 271 (TY9474) Thread Lock and Sealer before installing adapter in housing. Tighten adapter securely.



Oil Filter Adapter

A—Adapter
B—Oil Filter Adapter

LOCTITE is a registered trademark of Loctite Corp.

RG,RG34710,208 –19–30SEP97–1/1

20 10

REMOVE, INSPECT, AND INSTALL OIL PRESSURE REGULATING VALVE

NOTE: Refer to OIL FILTER AND OIL CONDITIONING HOUSING ASSEMBLY, earlier in this group, for illustrated location of valves.

Oil pressure regulating valve is in same location on oil cooler cover/valve housing for remote filter applications.

1. Remove oil pressure regulating valve assembly (C) from oil filter housing (G). Discard O-ring.
2. Inspect valve and valve bore for damage. Replace if necessary.
3. Clean all parts with a brass or copper wire brush and solvent. Dry with compressed air.
4. Check spring for proper compression.

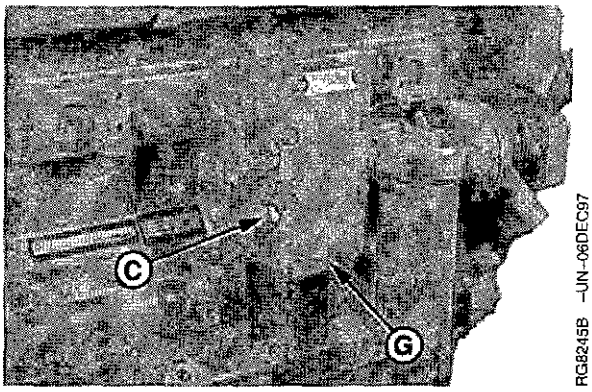
New Oil Pressure Regulating Valve Spring—Specification

Free Length	86.4 mm (3.40 in.)
Working Load at 76—84 N (17—19 lb-force)	42.0 mm (1.65 in.)

5. Dip all parts in clean engine oil. Insert valve and spring assembly in housing.
6. Install plug using a new O-ring and tighten to specifications.

Oil Pressure Regulating Valve Plug—Specification

Torque	100 N•m (74 lb-ft)



Removing Pressure Regulating Valve

C—Oil Pressure Regulating Valve Assembly
G—Oil Filter Housing

RG,RG34710,209 –19–28JUL99–1/1

REMOVE, INSPECT, AND INSTALL OIL COOLER AND OIL FILTER BYPASS VALVES

NOTE: Refer to OIL FILTER AND OIL CONDITIONING HOUSING ASSEMBLY, earlier in this group, for illustrated location of valves.

Oil cooler bypass valve is in same location on oil cooler cover/valve housing for remote filter applications. Oil filter bypass valve is in same location on face of remote oil filter housing.

1. Remove oil cooler bypass valve assembly (A) and oil filter bypass valve assembly (D) from oil filter housing (G). Discard O-rings.
2. Clean all parts with a brass or copper wire brush and solvent. Dry with compressed air.
3. Inspect bypass valves and valve bores for damage. Replace if necessary.
4. Check bypass valve springs for proper compression specifications. Replace if not within specifications.

New Oil Cooler Bypass Valve Spring—Specification

Free Length	44.0 mm (1.73 in.)
Working Load @ 64—78 N (14—18 lb-force)	30.0 mm (1.18 in)

New Oil Filter Bypass Valve Spring—Specification

Free Length	44.0 mm (1.73 in.)
Working Load @ 64—78 N (14—18 lb-force)	30.0 mm (1.18 in.)

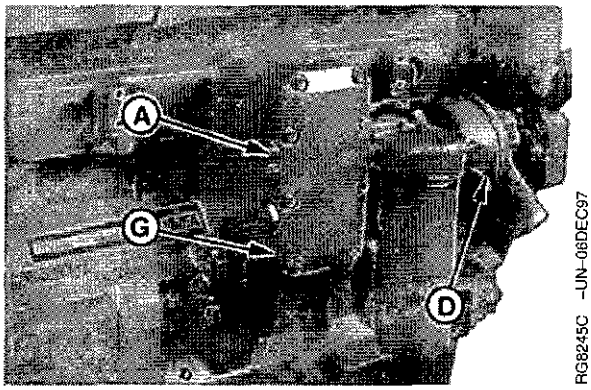
5. Dip all parts in clean engine oil. Insert valve and spring assembly in housing.
6. Install plug using a new O-ring and tighten to specifications.

Oil Cooler Bypass Valve Plug—Specification

Torque	100 N•m (74 lb-ft)

Oil Filter Bypass Valve Plug—Specification

Torque	100 N•m (74 lb-ft)



RG8245C —UN—06DEC97

Removing Oil Cooler and Oil Filter Bypass Valve

A—Oil Cooler Bypass Valve Assembly
B—Oil Filter Bypass Valve Assembly
G—Oil Filter Housing

RG,RG34710,210 —19—28JUL99—1/1

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12

REMOVE, INSPECT, AND INSTALL OIL PRESSURE RELIEF VALVE

NOTE: Refer to OIL FILTER AND OIL CONDITIONING HOUSING ASSEMBLY, earlier in this group, for illustrated location of valves.

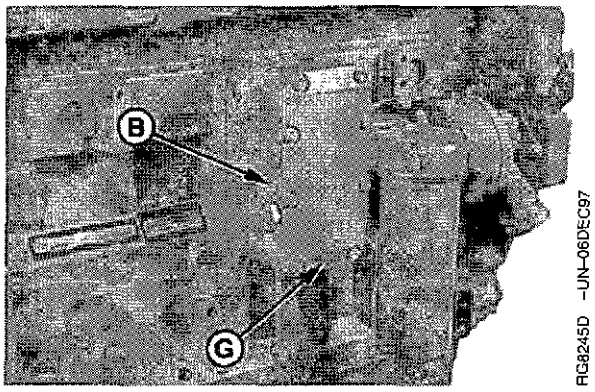
Oil pressure relief valve is in same location on oil cooler cover/valve housing on remote filter applications.

1. Remove oil pressure relief valve assembly (B) from oil filter housing (G).
2. Clean all parts with a brass or copper wire brush and solvent. Dry with compressed air.
3. Inspect valve and valve bore for damage. Replace if necessary.
4. Check valve spring for proper compression specification. Replace if not within specification.

Oil Pressure Relief Valve Spring—Specification

Free Length	79.0 mm (3.11 in.)
Working Load @ 196—222 N (44—50 lb-force)	65.0 mm (2.56 in.)

5. Dip all parts in clean engine oil. Insert valve and spring assembly in housing.
6. Install plug using a new O-ring and tighten securely.



Removing Oil Pressure Relief Valve

B—Oil Pressure Relief Valve Assembly
G—Oil Filter Housing

RG,RG34710,211 –19–13AUG99–1/1

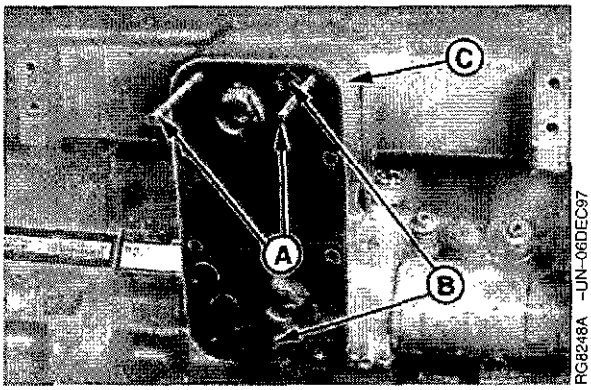
REMOVE, CLEAN, AND INSPECT ENGINE OIL COOLER

NOTE: Guide pins may be used as an aid for removing and installing oil filter housing.

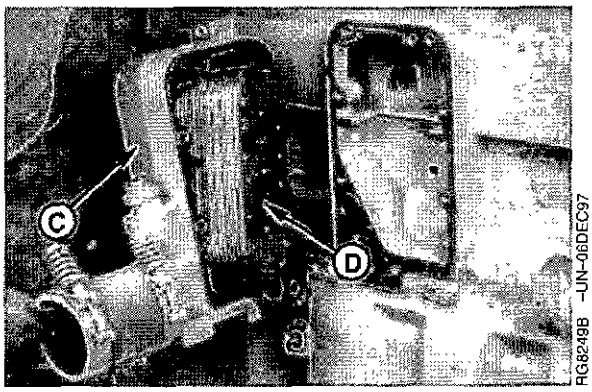
1. Remove oil filter and valve housing, shown removed. (See REMOVE OIL FILTER AND VALVE HOUSING/OIL COOLER COVER AND VALVE HOUSING, earlier in this group.)

2. Install two guide pins (A) as shown (if desired). Remove two hex socket head cap screws (B) and remove oil cooler housing (C) with oil cooler (D).

3. Remove and discard oil cooler-to-cylinder block gasket.



Removing Oil Cooler and Housing Assembly



Oil Cooler and Housing Assembly Removed

A—Guide Pins
B—Hex Socket Head Cap Screws
C—Oil Cooler Housing
D—Oil Cooler

Continued on next page

4. Remove two large hex nuts (D) securing oil cooler (C) to housing (A) and remove cooler from housing. Remove and discard gasket (B) and O-rings (E).

5. Clean all parts and flush oil cooler with solvent. Dry with compressed air.

6. Thoroughly inspect oil cooler for plugging, damage, or leaks.

NOTE: If mixing of oil and coolant is suspected, pressure test oil cooler in liquid and compressed air. Use specified air pressure for testing. Replace oil cooler as necessary.

Oil Cooler—Specification

Test Pressure	140—170 kPa (1.4—1.7 bar) (20—25 psi)

IMPORTANT: When installing oil cooler into housing ensure that face of both mounting nuts is square to threads for proper torque.

7. Apply TY9473 LOCTITE® 242 Thread Lock and Sealer to oil cooler hex nuts.

8. Install oil cooler in housing using a new gasket and two new O-rings. Tighten two large hex nuts to specifications.

Oil Cooler-to-Housing Nuts—Specification

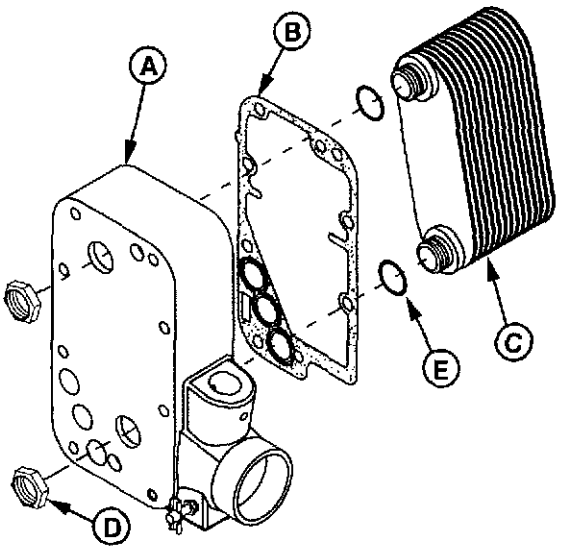
Torque	50 N•m (37 lb-ft)

9. If removed, install oil cooler drain cock handle and tighten to specifications.

Oil Cooler Drain Cock Handle—Specification

Torque	3 N•m (25 lb-in.)

10. If removed, install oil cooler housing expansion plug and tighten to specified depth.



RG8771 –UN–10DEC97

Oil Cooler and Housing Assembly

A—Oil Cooler Housing
B—Gasket
C—Oil Cooler
D—Nuts (2 Used)
E—O-Rings (2 Used)

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Continued on next page

RG,RG34710,212 –19–12AUG99–2/3

Oil Cooler Expansion Plug—Specification

Installed Depth	Flush to 1.5 mm (0.059 in.) Below Surface

11. If removed, apply LOCTITE® 242 Thread Lock and Sealer to oil pressure sending unit. Install sending unit and tighten securely.

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RG,RG34710,212 –19–12AUG99–3/3

INSTALL OIL COOLER/OIL FILTER VALVE HOUSING ASSEMBLY OR OIL COOLER COVER/VALVE HOUSING ASSEMBLY

NOTE: Standard filter/valve housing assembly shown. Procedure for remote filter applications is the same.

1. Remove all gasket material from cylinder block, oil cooler housing, and oil filter/valve housing. All sealing surfaces must be clean and free of oil.

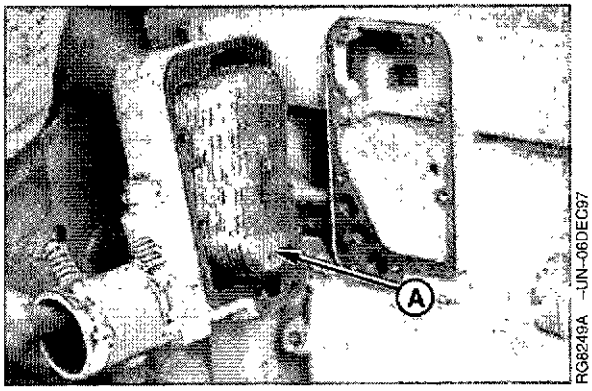
NOTE: Use guide pins as an assembly aid if desired.

2. Install oil cooler and housing assembly (A) using a new gasket. Position oil cooler housing-to-water pump hose on water pump outlet elbow.

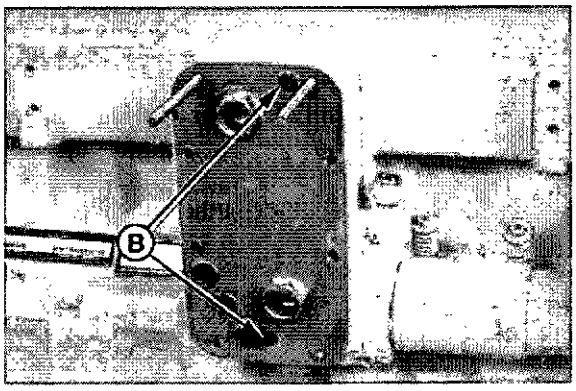
3. Install two hex socket head cap screws (B) and tighten to specifications.

Oil Cooler Housing-to-Block Cap Screws—Specification

Torque	68 N•mm (50 lb-ft)



Installing Oil Cooler and Housing Assembly



Oil Cooler and Housing Assembly Installed

A—Oil Cooler And Housing Assembly
B—Hex Socket Head Cap Screws

Continued on next page

RG,RG34710,213 –19–13AUG99–1/2

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4. Install oil filter/valve housing (or oil cooler cover/valve housing on remote applications) using a new gasket. Tighten cap screws to specifications using sequence shown in lower illustration.

Oil Filter/Valve Housing or Oil Cooler Cover/Valve Housing[1]—Specification

Torque ..... 68 N•m (50 lb-ft)

5. Retighten cap screws to 68 N•m (50 lb-ft) using same sequence.

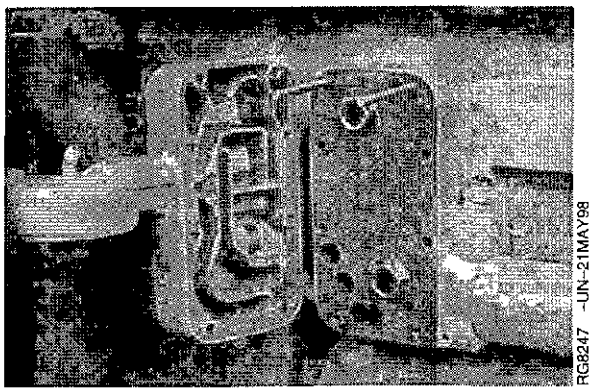
6. Tighten water pump-to-oil cooler housing hose clamps securely.

7. Coat oil filter gasket with clean engine oil. Install filter to housing until gasket contacts base, then tighten an additional 1/2 – 3/4 turn.

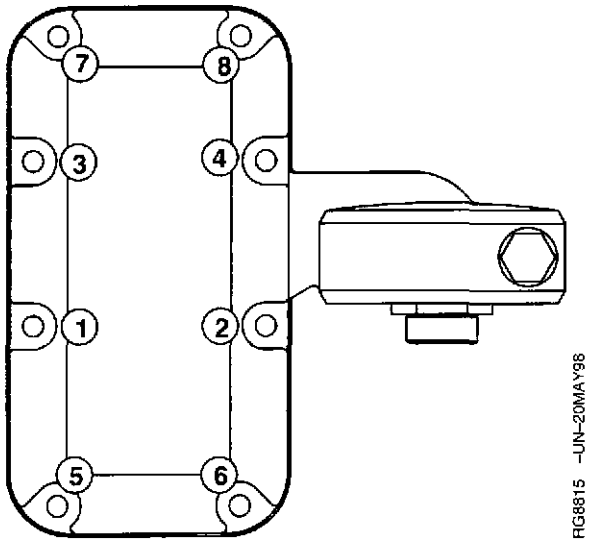
8. Install turbocharger oil inlet line onto housing adapter and tighten to specifications.

Turbocharger Oil Inlet Line-to-Oil Cooler Housing—Specification

Torque ..... 35 N•m (26 lb-ft)



Install Filter and Valve Housing



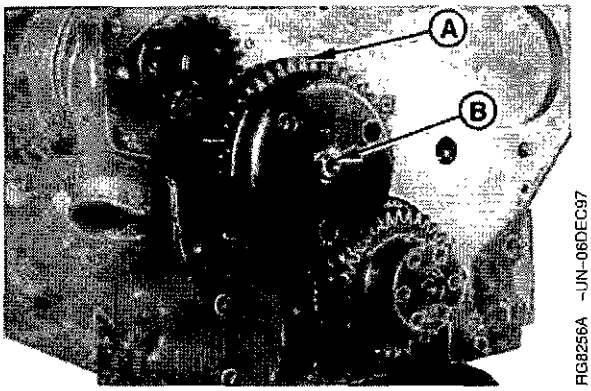
Oil Filter Housing Torque Sequence

[1]Torque sequence and specification also applies to oil cooler cover/valve housing on remote filter applications.

RG,RG34710,213 –19–13AUG99–2/2

REMOVE ENGINE OIL PUMP

1. Remove timing gear cover. (See REMOVE TIMING GEAR COVER in Group 15.)
2. Remove external snap ring (B) securing oil drive gear (A) to oil pump drive-shaft.
3. Remove drive gear from shaft and oil pump housing.



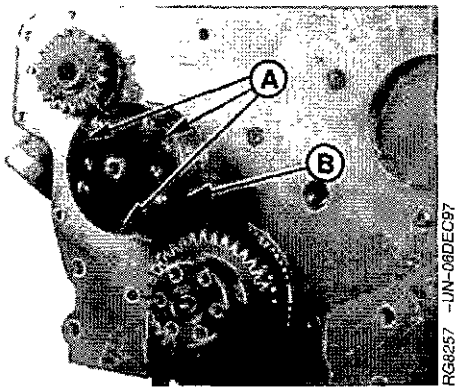
Removing Oil Pump Gear

A—Oil Drive Gear
B—External Snap Ring

RG,RG34710,214 –19–30SEP97–1/3

4. Remove three hex socket head cap screws (A) securing oil pump assembly (B) to cylinder block and remove oil pump.

IMPORTANT: DO NOT disassemble oil pump since no repair parts are available. Replace oil pump as a complete assembly as necessary.



Removing Oil Pump

A—Hex Socket Head Cap Screws
B—Oil Pump Assembly

Continued on next page

RG,RG34710,214 –19–30SEP97–2/3

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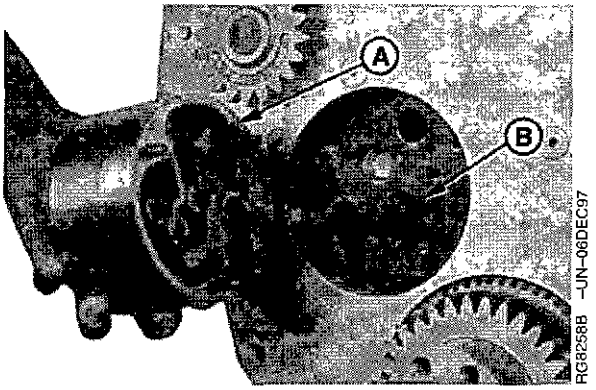
18

5. Remove oil pump-to-cylinder block gasket (B). Discard gasket.



Oil Pump Removed

A—Oil Pump Assembly
B—Oil Pump-To-Cylinder Block Gasket

RG,RG34710,214 –19–30SEP97–3/3

CLEAN AND INSPECT OIL PUMP AND DRIVE GEAR

IMPORTANT: DO NOT disassemble oil pump for repair or inspection. No repair parts are available, replace pump as a complete assembly as necessary.

1. Completely flush oil pump with solvent while rotating input shaft by hand to clean any debris from housing and gears.
2. Using a good light source, look through rear cavities of pump to inspect all gear teeth for abnormal wear. Replace pump if excess wear is noticed.
3. Inspect back side of oil pump cover through cavities for evidence of gear contact with cover. Replace pump if gear contact is noticed.
4. Inspect oil pump drive gear teeth for wear. Inspect and measure drive gear bushing ID. Bushing ID must be within specifications. Replace drive gear and bushing assembly as necessary.

Oil Pump Drive Gear Bushing—Specification

ID	135.70—135.80 mm (5.343—5.346 in.)

RG,RG34710,215 –19–13AUG99–1/1

INSTALL ENGINE OIL PUMP

1. Position new gasket (A) in oil pump bore on front face of cylinder block.

2. Apply JDT405 High Temperature Grease to inside cavities of oil pump through openings in back of oil pump.

IMPORTANT: Holes (B) in cylinder block, gasket and oil pump housing must align to ensure proper lubrication for oil pump-to-gear bushing.

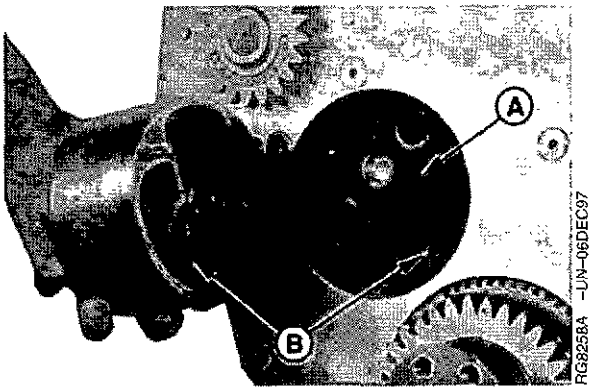
NOTE: 101.6 mm (4.0 in.) long guide pins may be used to aid oil pump cap screw hole alignment, if desired. Cap screw holes will be aligned only when oil pump is correctly installed.

3. Install oil pump on cylinder block. Apply LOCTITE® 242 (TY9473) Thread Lock and Sealer to oil pump-to-cylinder block cap screw threads and tighten to specifications.

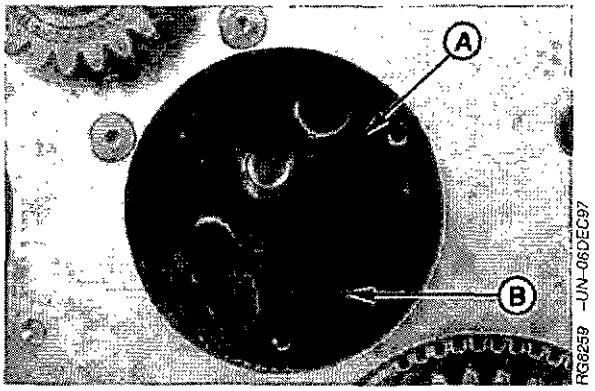
Oil Pump-to-Block Cap Screws—Specification

Torque ..... 45 N•m (33 lb-ft)

4. Rotate input shaft full 360° after pump installation. If shaft does not turn freely for full 360°, remove pump and determine cause.



Installing Oil Pump



Oil Pump Gasket

A—Gasket
B—Cylinder Block Holes

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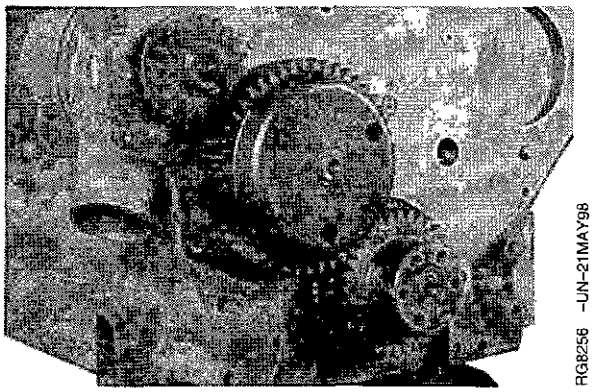
Continued on next page

5. Apply JDT405 High Temperature Grease to ID of oil pump drive gear bushing.
6. Install oil pump gear with bushing over oil pump housing, align input shaft with opening in gear.
7. Install external snap ring in groove of input shaft.
8. Check oil pump drive gear-to-idler gear backlash.

Oil Pump Drive Gear-to-Idler Gear—Specification

Backlash	0.25 mm (0.010 in.)

9. Install timing gear train cover and complete final assembly. (See INSTALL TIMING GEAR COVER in Group 15.)



RG8256 –UN–21MAY98

Installing Oil Pump Drive Gear

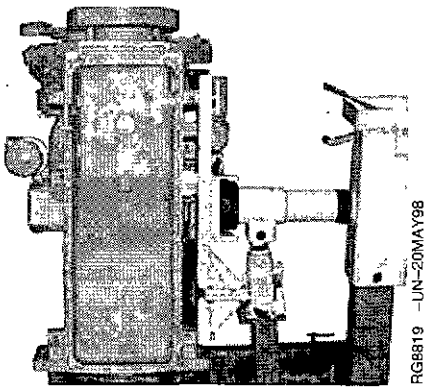
RG,RG34710,216 –19–06AUG99–2/2

REMOVE ENGINE OIL PAN

1. Disconnect turbocharger oil inlet line. Remove oil pan drain plug and drain all engine oil.

NOTE: It may be necessary to tap oil pan with a rubber or plastic dead-blow hammer to free oil pan from gasket seal.

2. Remove all 30 oil pan cap screws and remove oil pan from cylinder block.
3. Remove all gasket material from oil pan and cylinder block gasket sealing surfaces.
4. Clean all oil from oil pan and cylinder block sealing surfaces and dry completely.



RG8819 –UN–20MAY98

Removing Oil Pan

RG,RG34710,217 –19–30SEP97–1/1

REMOVE AND INSTALL OIL PICKUP TUBE

1. Remove engine oil pan. (See REMOVE ENGINE OIL PAN earlier in this group.)

NOTE: On engine option code 1903, oil pickup tube is mounted on the oil pan with two cap screws.

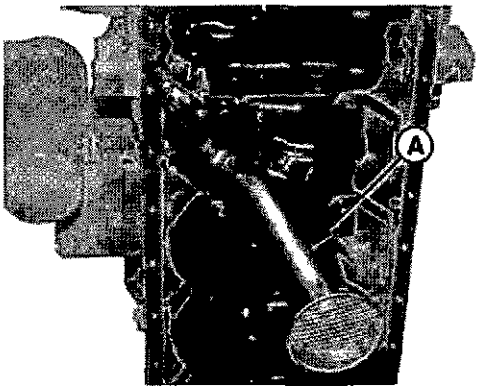
2. Remove three cap screws securing pickup tube to cylinder block and remove tube assembly with gasket.
3. Clean pickup tube and screen completely with solvent. Dry with compressed air.
4. Inspect pickup screen for damage or holes. Inspect tube for weld breaks, bends, or any other damage. Replace as necessary.
5. Install pickup tube assembly to cylinder block using a new gasket. Tighten cap screws to specifications.

Oil Pickup Tube-to-Block Cap Screws—Specification

Torque ..... 35 N•m (26 lb-ft)

Oil Pickup Tube-to-Oil Pan Cap Screws—Specification

Torque ..... 25 N•m (18 lb-ft)



RG8122 –UN–20NOV97

Oil Pickup Tube

A—Pickup Tube

RG,RG34710,218 –19–13AUG99–1/1

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22

INSTALL ENGINE OIL PAN

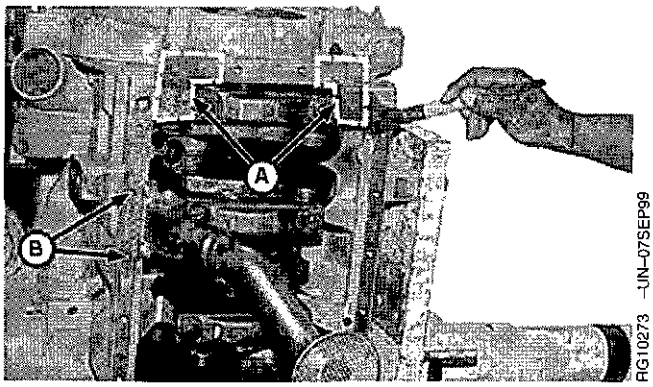
All oil pan and cylinder block gasket sealing surfaces (including timing gear cover and rear seal housing) MUST BE free of gasket material and oil. Surface must be dry.

1. Apply LOCTITE® 12695 Solventless Primer to two front T-joint areas (A). After 5 minutes, apply a 3 mm (1/8 in.) bead of LOCTITE® 17430 High Flex Form-In-Place Gasket.

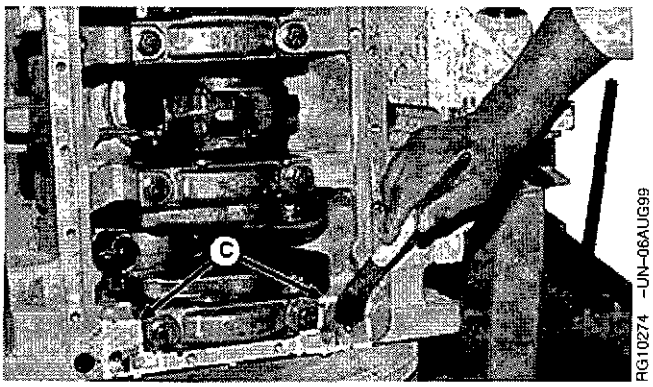
2. Apply a 3 mm (1/8 in.) bead of LOCTITE® 17430 High Flex Form-In-Place Gasket to two rear T-joint areas (C) and around two mounting holes closest to oil pump intake mounting flange (B).

3. Position new oil pan gasket on cylinder block.

4. Apply a 3 mm (1/8 in.) bead of LOCTITE® 17430 High Flex Form-In-Place Gasket to face of oil pan gasket at same front T-joint locations (A) on cylinder block in Step No. 1 above (front joint areas only).



Sealant Applications-Front Rail



Sealant Applications-Rear Rail

A—Front T-Joints
B—Oil Pump Intake Mounting Flange
C—Rear T-Joints

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RG,RG34710,219 –19–28JUL99–1/2

NOTE: Locate rear of oil pan flush to ± 0.05 mm (0.002 in.) with rear face of cylinder block.

5. Carefully install oil pan on cylinder block and tighten all oil pan-to-cylinder block cap screws in sequence shown to specifications.

Oil Pan-to-Cylinder Block Cap Screws—Specification

Torque ..... 68 N•m (50 lb-ft)

Start at right rear corner of oil pan (facing toward flywheel end) and proceed counter-clockwise.

6. Tighten oil pan-to-rear oil seal housing and oil pan-to-timing gear cover cap screws to specification.

Oil Pan-to-Rear Oil Seal Housing Cap Screws—Specification

Torque ..... 68 N•m (50 lb-ft)

Oil Pan-to-Timing Gear Cover Cap Screws—Specification

Torque ..... 68 N•m (50 lb-ft)

7. Retighten all 30 oil pan cap screws to 68 N•m (50 lb-ft) using same sequence and starting location as in step 5 above.

8. Install oil pan drain plug using a new O-ring and tighten to specifications.

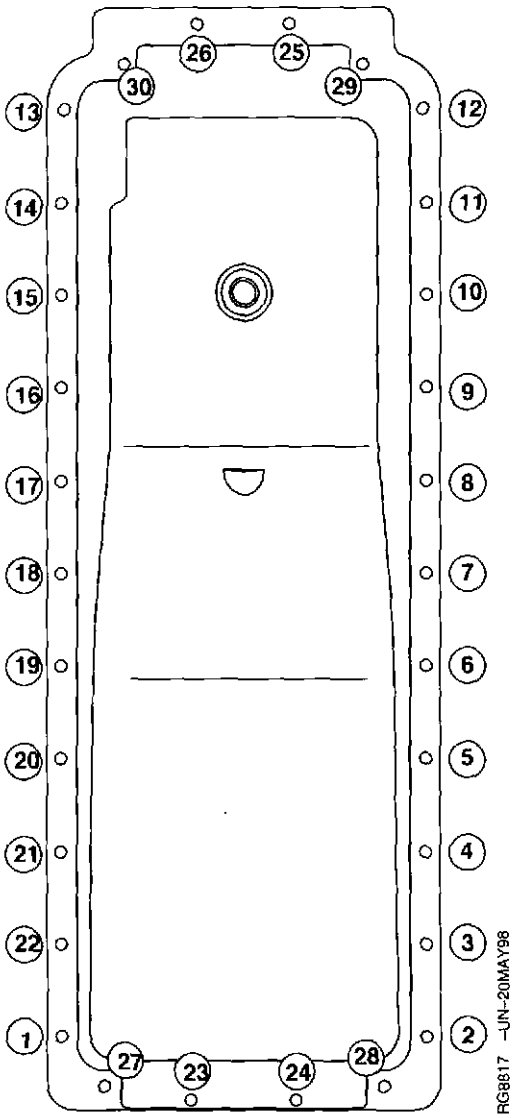
Oil Pan Drain Plug 1-1/2 in. Hex Plug—Specification

Torque ..... 46 N•m (34 lb-ft)

Oil Pan Drain Plug 1-1/4 in. Hex Plug—Specification

Torque ..... 64 N•m (47 lb-ft)

9. If equipped, coat threads of drain hose and drain valve with LOCTITE® 592 Pipe Sealant with TEFLON®. Install and tighten securely.



Oil Pan Torque Sequence

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TEFLON is a registered trademark of Du Pont Co.

RG,RG34710,219 –19–28JUL99–2/2

ESSENTIAL TOOLS

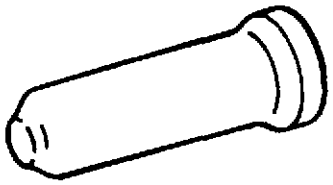
NOTE: Order tools according to information given in the U.S. SERVICEGARD™ Catalog or from the European Microfiche Tool Catalog (MTC).

SERVICEGARD is a trademark of Deere & Company

DPSG,OUO1004,935 –19–26JUL99–1/5

Water Pump Bearing Driver. JDG743A

Use to install fan drive bearing assembly in fan drive housing.



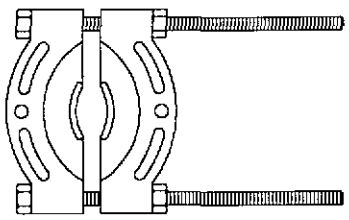
RG6219 –UN–06MAR92

JDG743A

DPSG,OUO1004,935 –19–26JUL99–2/5

Bearing Puller[1] D01217AA

Use with D01206AA to remove water pump drive gear from water pump.



RG4981 –UN–11AUG99

D01217AA

[1] Part of D01212AA Step Plate Adapter Set

Continued on next page

DPSG,OUO1004,935 –19–26JUL99–3/5

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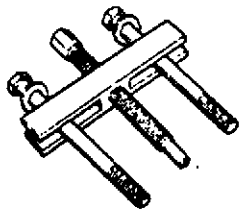
Push Puller D01206AA

Use to remove water pump impeller from water pump. Also used with D01217AA to remove water pump drive gear from water pump.



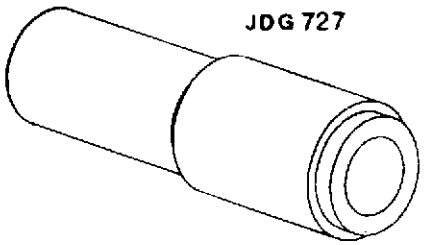
RG5097 –UN–23AUG88

D01206AA

DPSG,OUO1004,935 –19–26JUL99–4/5

Bearing Driver JDG727

Use to install water pump bearing assembly in water pump housing.



RG5963 –UN–03SEP91

JDG727

DPSG,OUO1004,935 –19–26JUL99–5/5

OTHER MATERIAL

Number	Name	Use
TY6333 or TY6347 (U.S.)	High Temperature Grease	Pack bearings in fan drive and water pump.
T43512 (U.S.) TY9473 (Canadian) 242 (LOCTITE®)	Thread Lock and Sealer (Medium Strength)	Water pump mounting cap screws.
TY9375 (U.S.) TY9480 (Canadian) 592 (LOCTITE®)	Pipe Sealant	Oil cooler housing drain valve, coolant heater, temperature sensor and pipe plugs.

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DPSG,OUO1004,937 -19-26JUL99-1/1

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4

SPECIFICATIONS

Item	Measurement	Specification
Heavy Duty Fan Drive	Housing ID	71.999—72.025 mm (2.8346—2.8356 in.)
	Shaft OD	35.001—35.017 mm (1.3780—1.3786 in.)
	Bearing ID	34.987—35.013 mm (1.3774—1.3785 in.)
	Bearing OD	71.987—72.013 mm (2.8341—2.8351 in.)
Fan Drive Shaft	End Play	0.10 mm (0.004 in.)
Fan Drive Hub-to-Shaft	Torque	115 N•m (85 lb-ft)
Fan Pulley-to-Pulley Cap Screws	Torque	61 N•m (45 lb-ft)
Adjustable Fan Drive-to-Camshaft Gear Access Cover Cap Screws	Torque	90 N•m (66 lb-ft)
Belt Tensioner Lower Spring	Tension	81—99 N•m (60—73 lb-ft)
Belt Tensioner Upper Spring	Tension	18—23 N•m (13—17 lb-ft)
Belt Tensioner Shoulder Bolt or Flanged Head Cap Screw	Torque	50 N•m (37 lb-ft)
Idler Pulley	Torque	68 N•m (50 lb-ft)
Water Pump Drive Gear	ID	24.963—24.979 mm (0.9828—0.9834 in.)
Water Pump Housing Bearings	ID (Small Bearing)	47.000—47.026 mm (1.8504—1.8514 in.)
	ID (Large Bearing)	61.960—61.986 mm (2.4394—2.4404 in.)
Water Pump Housing-to-Cover Band Clamp	Torque	10 N•m (7.5 lb-ft)
Water Pump-to-Front Plate Cap Screws	Torque	50 N•m (37 lb-ft)

Continued on next page

Item	Measurement	Specification
Water Pump Inlet Elbow to Housing Cap Screws	Torque	41 N•m (30 lb-ft)
Coolant Bypass Hose Clamp	Torque	6 N•m (4.5 lb-ft)
Oil Cooler-to-Water Pump Hose Clamp	Torque	9 N•m (7 lb-ft)
Thermostat Cover-to-Housing M10x35 Cap Screw	Torque	35 N•m (26 lb-ft)
Thermostat Housing/Cover Assembly-to-Block M10x120 and M10x170 Cap Screws	Torque	50 N•m (37 lb-ft)
Thermostat Test	Rating Initial Opening (Range) Temperature Full Open (Nominal) Temperature	82°C (180°F) 80-84°C (175—182°F) 94°C (202°F)
Thermostat Housing/Cover Assembly-to-Block M10x120 and M10x170 Cap Screws	Torque	50 N•m (37 lb-ft)
Coolant Temperature Sensor	Torque	10 N•m (7.5 lb-ft)
Thermostat Housing Pipe Plugs	Torque	20 N•m (15 lb-ft)
Water Pump Drive Gear	Installed Dimension	Flush with end of shaft
Water Pump Impeller	Installed Dimension	Flush with end of shaft

DPSG,OUO1004,938 –19–26JUL99–2/2

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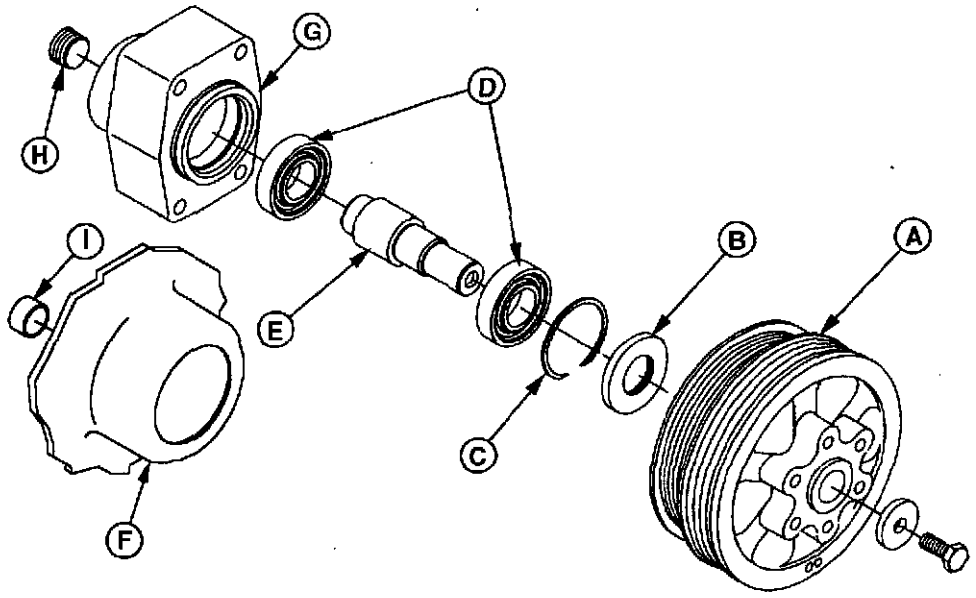
6

REPLACE BEARING IN FAN DRIVE ASSEMBLY



RG10269 –UN–03NOV99

Fan Drive Exploded View

A—Fan Hub/Pulley
B—Grease Seal
C—Snap Ring
D—Ball Bearing (2-used)
E—Shaft
F—Bearing Housing (Fixed)[1]
G—Bearing Housing (Adjustable)
H—Pipe Plug
I—Plug

DISASSEMBLE FAN DRIVE

1. Remove V-belts and remove fan.
2. Using a suitable puller, remove fan hub (A) from shaft (E).

NOTE: ON engines with fixed fan drive assembly cast into camshaft gear access cover, cover must be removed from engine. (See REMOVE TIMING GEAR COVER in Group 15.)

3. Remove fan drive assembly from engine.
4. Remove pipe plug (H) or plug (I), grease seal (B), and snap ring (C). Discard seal and snap ring.
5. Remove shaft with bearings (D) by lightly tapping end of shaft (through pipe plug opening) with a hammer and brass drift.
6. Remove bearings from shaft using a bearing puller. Discard bearings.
7. Thoroughly clean and inspect shaft and bearing housing (F or G) for cracks or any other damage. Measure parts and compare with specifications given below.

Heavy Duty Fan Drive—Specification

Housing ID	71.999—72.025 mm (2.8346—2.8356 in.)
Shaft OD	35.001—35.017 mm (1.3780—1.3786 in.)
Bearing ID	34.987—35.013 mm (1.3774—1.3785 in.)
Bearing OD	71.987—72.013 mm (2.8341—2.8351 in.)

[1] *Bearing housing is cast into camshaft gear access cover.*

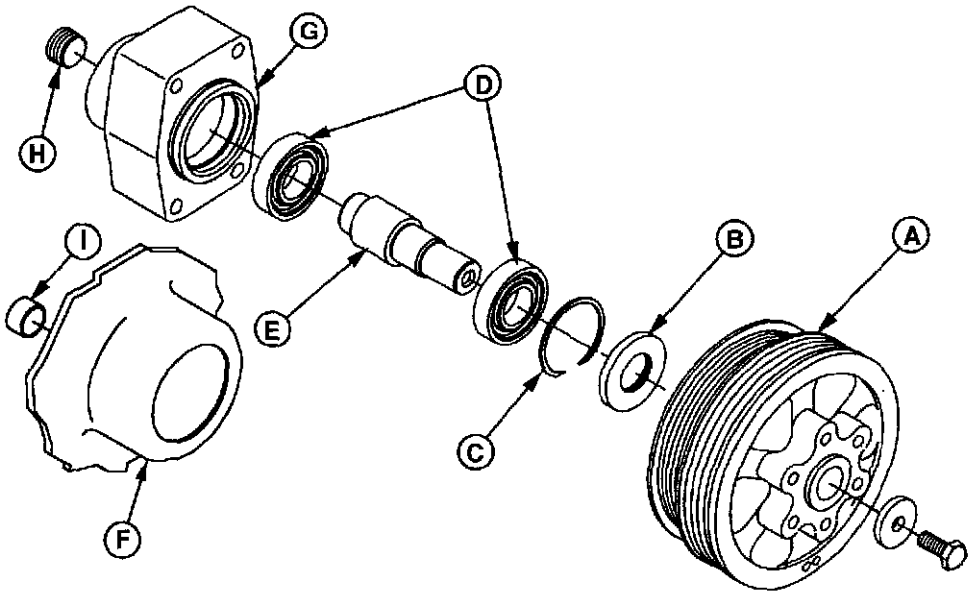
Continued on next page

RG,RG34710,224 –19–23JUL99–1/5

Replace parts that are cracked or not within specification.

Continued on next page

RG,RG34710,224 –19–23JUL99–2/5



RG10269 –UN–03NOV99

Fan Drive Exploded View

A—Fan Hub/Pulley
B—Grease Seal
C—Snap Ring
D—Ball Bearing (2-used)
E—Shaft
F—Bearing Housing (Fixed)[1]
G—Bearing Housing (Adjustable)
H—Pipe Plug
I—Plug

ASSEMBLE FAN DRIVE

1. Pack inner and outer bearings (D) with TY6333 or TY6347 High Temperature Grease. Apply clean engine oil to bearing ID and shaft OD
2. Support end of shaft (E) and install bearings against shoulder on each end of shaft. Apply force to bearing inner race only.
3. Support bearing housing (F or G) on a firm flat surface with bearing bore in the upward position.
4. Install bearing and shaft assembly into housing using JDG743A Bearing Driver. Small end of shaft should extend through housing.
5. Determine proper snap ring (C) thickness needed to obtain specified end play.

Fan Drive Shaft—Specification

End Play	0.10 mm (0.004 in.)

6. Install snap ring in housing groove. Visually inspect snap ring installation for proper seating in housing groove.

NOTE: Install grease seal (B) with seal spring toward engine.

7. Apply a thin coat of clean engine oil to OD of seal casing (B) and to seal lips. Using a driver that contacts flat outside case of seal, press seal in housing bore until metal casing is flush-to-0.50 mm (0.020 in.) below housing face.

[1] *Bearing housing is cast into camshaft gear access cover.*

Continued on next page

RG,RG34710,224 –19–23JUL99–3/5

IMPORTANT: On engines with fixed pulleys, be sure the lower right access cover cap screw (3, in diagram) is installed in the camshaft gear access cover before the pulley (A) is pressed on. Otherwise, pulley will interfere with installation of this cap screw.

8. Apply clean engine oil to ID of fan hub/pulley (A). Support end of shaft through pipe plug hole in bearing housing. Using a driver that bears on outside finished edge of hub, press hub onto other end of shaft until it bottoms against shoulder. Do not hammer fan hub onto shaft.

9. Install washer and cap screw. Tighten cap screw to specifications.

Fan Drive Hub-to-Shaft—Specification

Torque ..... 115 N•m (85 lb-ft)

On engines with dual pulleys, tighten pulley-to-pulley cap screws to the following specifications.

Fan Pulley-to-Pulley Cap Screws—Specification

Torque ..... 61 N•m (45 lb-ft)

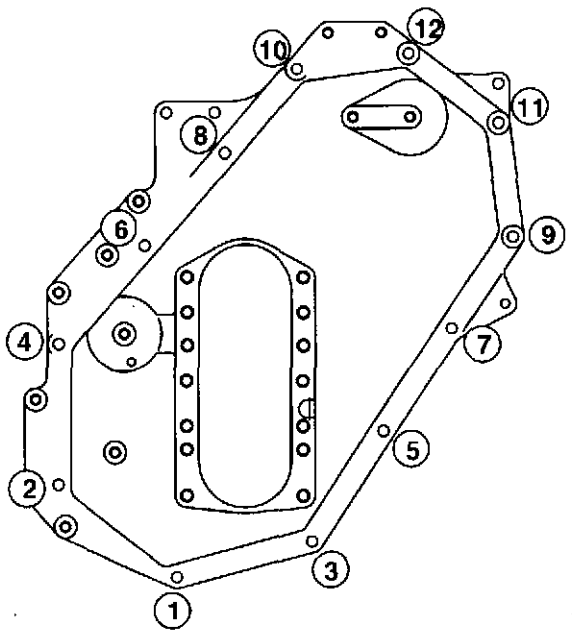
NOTE: On fixed fan drive assembly, plug (I, figure on previous page) should be driven in flush to slightly recessed in rear surface of camshaft gear access cover.

10. Apply LOCTITE® 592 Pipe Sealant with TEFLON® (TY9480) to threads of pipe plug (H). Install and tighten plug in bearing housing.

11. Install adjustable fan drive assembly onto engine and tighten cap screws to specifications.

Adjustable Fan Drive-to-Camshaft Gear Access Cover Cap Screws—Specification

Torque ..... 90 N•m (66 lb-ft)



Camshaft Gear Access Cover

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TEFLON is a registered trademark of Du Pont Co.

Continued on next page

25 10 To install fixed fan drive/camshaft gear access cover assembly, see INSTALL TIMING GEAR COVER in Group 15.

RG,RG34710,224 -19-23JUL99-5/5

INSPECT AND CHECK BELT TENSIONER SPRING TENSION

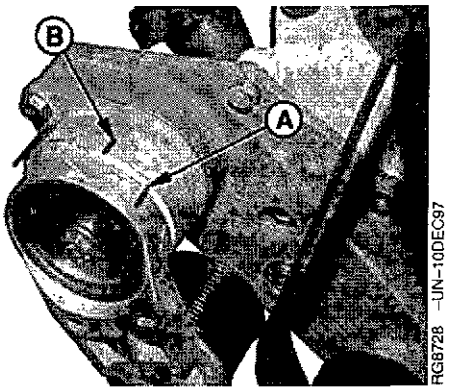
CHECKING LOWER TENSIONER SPRING TENSION

A belt tension gauge will not give an accurate measure of the belt tension when automatic spring tensioner is used. Measure tensioner spring tension using a torque wrench and procedure outlined below:

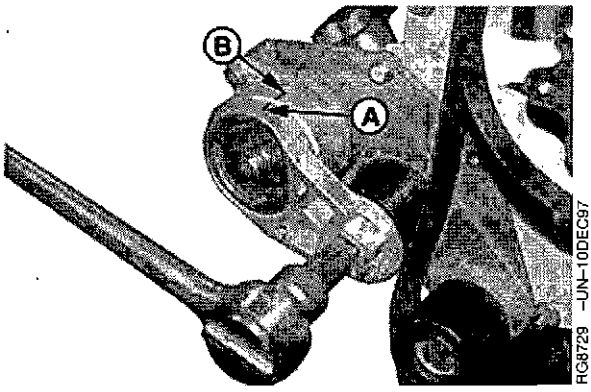
1. Release tension on belt using a long-handle 3/4-in. breaker bar in tension arm. Remove belt from pulleys.
2. Release tension on tension arm and remove breaker bar.
3. Put a mark (A) on swing arm of tensioner as shown.
4. Measure 25 mm (1.0 in.) from first mark (A) and put a second mark (B) on tensioner mounting base.
5. Rotate the swing arm using a torque wrench until marks (A and B) are aligned.
6. Record torque wrench measurement and compare with specification below. Replace tensioner assembly as required.

Belt Tensioner Lower Spring—Specification

Tension ..... 81—99 N•m (60—73 lb-ft)



Marking Lower Belt Tensioner



Testing Lower Tensioner

A—Mark on Swing Arm
B—Mark on Tensioner Base

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RG,RG34710,225 -19-30SEP97-1/2

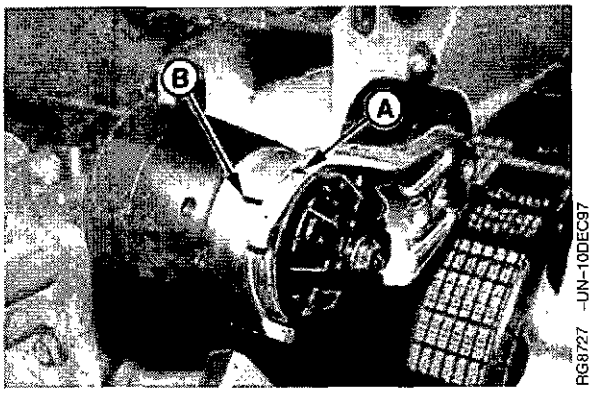
CHECKING UPPER TENSIONER SPRING TENSION

A belt tension gauge will not give an accurate measure of the belt tension when automatic spring tensioner is used. Measure tensioner spring tension using a torque wrench and procedure outlined below:

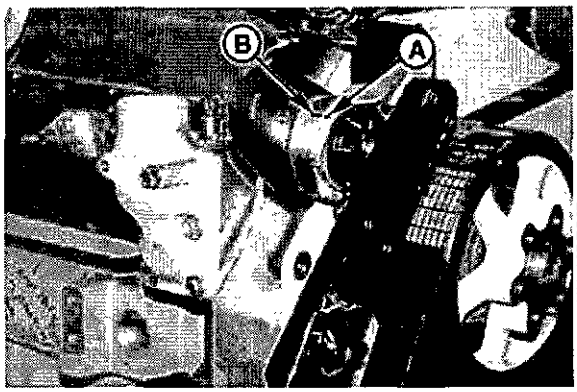
1. Release tension on belt using a long handle 1/2-in. breaker bar in tension arm. Remove belt from pulleys.
2. Release tension on tension arm and remove breaker bar.
3. Put a mark (A) on swing arm of tensioner as shown.
4. Measure 21 mm (0.83 in.) from first mark (A) and put a second mark (B) on tensioner mounting base.
5. Rotate the swing arm using a torque wrench until marks (A and B) are aligned.
6. Record torque wrench measurement and compare with specification below. Replace tensioner assembly as required.

Belt Tensioner Upper Spring—Specification

Tension ..... 18—23 N•m (13—17 lb-ft)



Marking Upper Belt Tensioner



Testing Upper Tensioner

A—Mark on Swing Arm
B—Mark on Tensioner Base

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REPLACE BELT TENSIONER ASSEMBLY

Follow same procedure for replacement of upper (A) and lower (C) belt tensioner.

1. Release tension on pulley and remove belt.
2. Check spring tension on tensioner. (See INSPECT AND CHECK BELT TENSIONER SPRING TENSION earlier in this group.)
3. Remove cap screw and remove the tensioner assembly.
4. Install tensioner using locator in upper tensioner only and tighten shoulder bolt or flanged head cap screw to specifications.

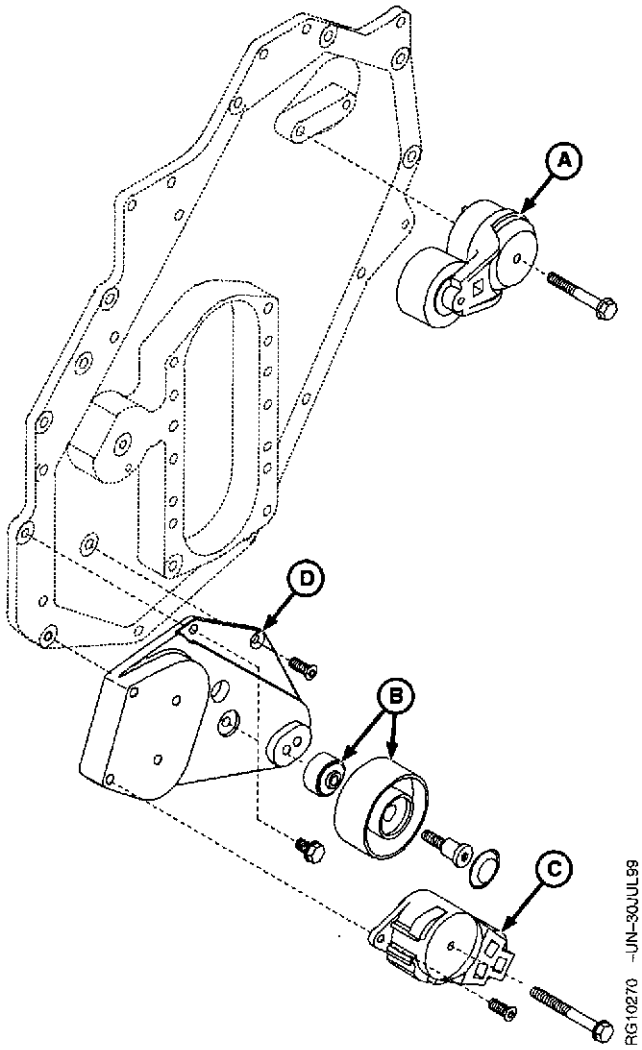
Belt Tensioner Shoulder Bolt or Flanged Head Cap Screw—Specification

Torque ..... 50 N•m (37 lb-ft)

5. Install belt and position onto tensioner.
6. Tighten idler pulley (B) cap screw to specifications.

Idler Pulley—Specification

Torque ..... 68 N•m (50 lb-ft)



Upper and Lower Belt Tensioners

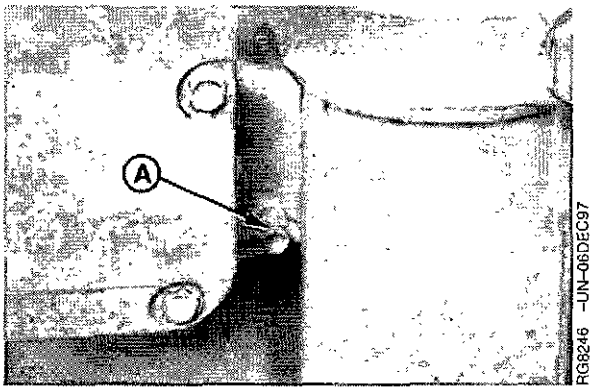
A—Upper Belt Tensioner
B—Belt Idler Pulley Assembly
C—Lower Belt Tensioner
D—Lower Tensioner Bracket

RG,RG34710,226 –19–26JUL99–1/1

REMOVE WATER PUMP

CAUTION: Explosive release of fluids from pressurized cooling system can cause serious burns. Wait until engine is cool enough to touch with bare hands before draining coolant. Slowly loosen radiator cap to first stop to relieve pressure.

1. Loosen radiator pressure cap and open coolant drain valve (A) on oil cooler housing. Drain all coolant from engine block.

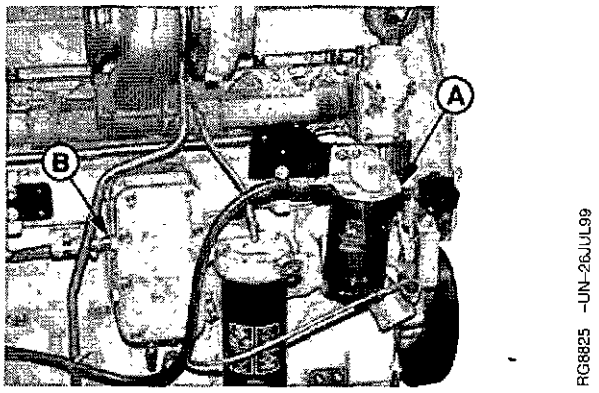


Coolant Drain Valve

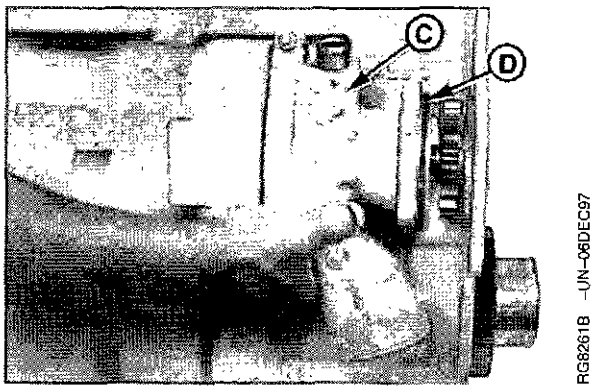
A—Coolant Drain Valve

RG,RG34710,227 –19–30SEP97–1/2

2. On 6125ADW engines, remove primary fuel filter/water separator (A) and mounting bracket.
3. On all engines, remove engine oil cooler and housing assembly (B). (See REMOVE CLEAN AND INSPECT ENGINE OIL COOLER, in Group 20.)
4. Disconnect water pump-to-thermostat housing bypass hose and remove from water pump tube fitting.
5. Remove three cap screws securing water pump-to-front plate and remove water pump (C).
6. Remove and discard O-ring (D).



Removing Primary Fuel Filter



Removing Water Pump

A—Primary Fuel Filter/Water Separator
B—Oil Cooler and Housing Assembly
C—Water Pump
D—O-Ring

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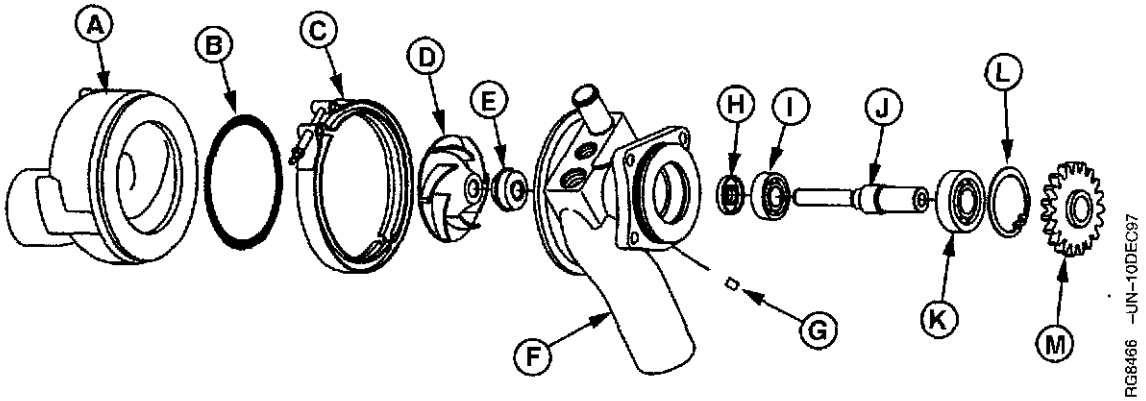
DISASSEMBLE WATER PUMP



Water Pump Exploded View

A—Water Pump Cover
B—O-Ring Packing
C—Band Clamp
D—Impeller
E—Seal
F—Water Pump Housing
G—Weep Hole Filter
H—Grease Seal
I—Bearing
J—Shaft
K—Bearing
L—Snap Ring
M—Drive Gear

1. Loosen nut and remove band clamp (C) securing water pump cover (A) to housing (F).
2. Remove cover from housing. Remove and discard O-ring packing (B).
3. Remove water pump drive gear (M) by supporting back side of gear with D01217AA Bearing Puller and using D01206AA Push Puller to pull gear off shaft (J).
4. Remove snap ring (L). Press shaft and bearings (I, K) assembly out of gear end of housing. Discard shaft and bearing assembly.
5. Drill around impeller ID (next to shaft) with a small drill to ease removal of impeller.
6. Support front face of housing and press shaft (J) with bearings (I, K) from impeller and housing.
7. Remove both seals (E, H) from housing and discard.
8. Remove weep hole filter (G) from housing.

RG,RG34710,228 –19–30SEP97–1/1

CLEAN AND INSPECT WATER PUMP PARTS

1. Clean all usable parts with solvent and dry with compressed air.
2. Inspect water pump cover (A) and housing (C) for cracks or damage.
3. Measure gear (E) and housing. Compare measurements with specifications below.

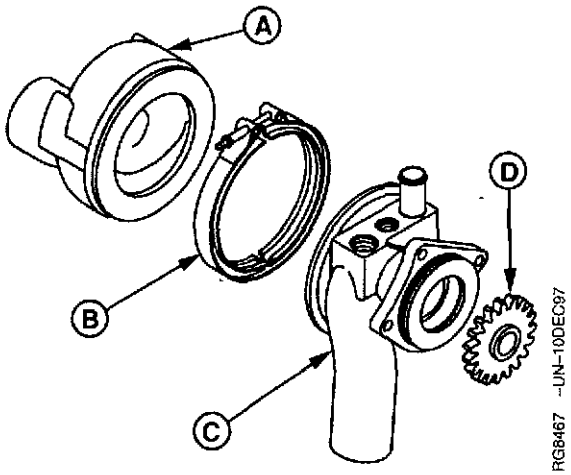
Water Pump Drive Gear—Specification

ID	24.963—24.979 mm (0.9828—0.9834 in.)

Water Pump Housing Bearings—Specification

ID (Small Bearing)	47.000—47.026 mm (1.8504—1.8514 in.)
ID (Large Bearing)	61.960—61.986 mm (2.4394—2.4404 in.)

4. Be sure the "weep hole" in housing is clear and foam filter is removed while pump is disassembled.



Water Pump Part Inspection

A—Water Pump Cover
B—Band Clamp
C—Pump Housing
D—Drive Gear

RG,RG34710,229 –19–30SEP97–1/1

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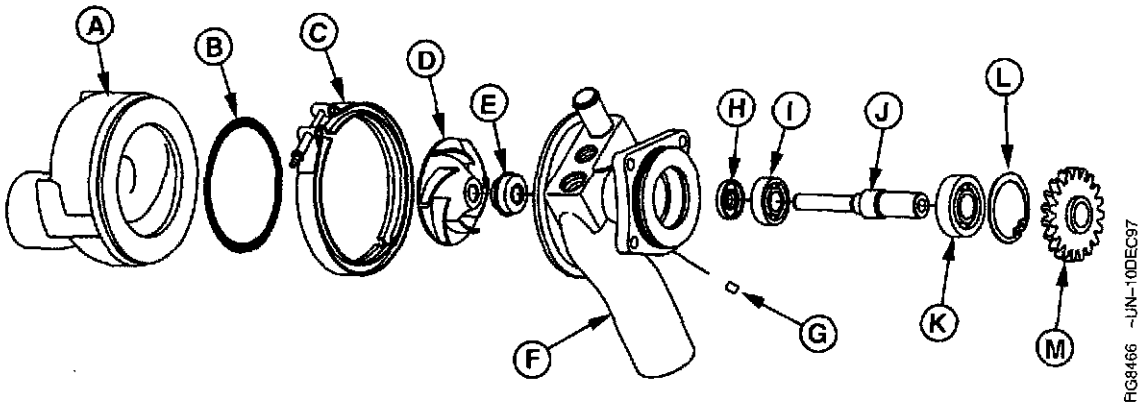
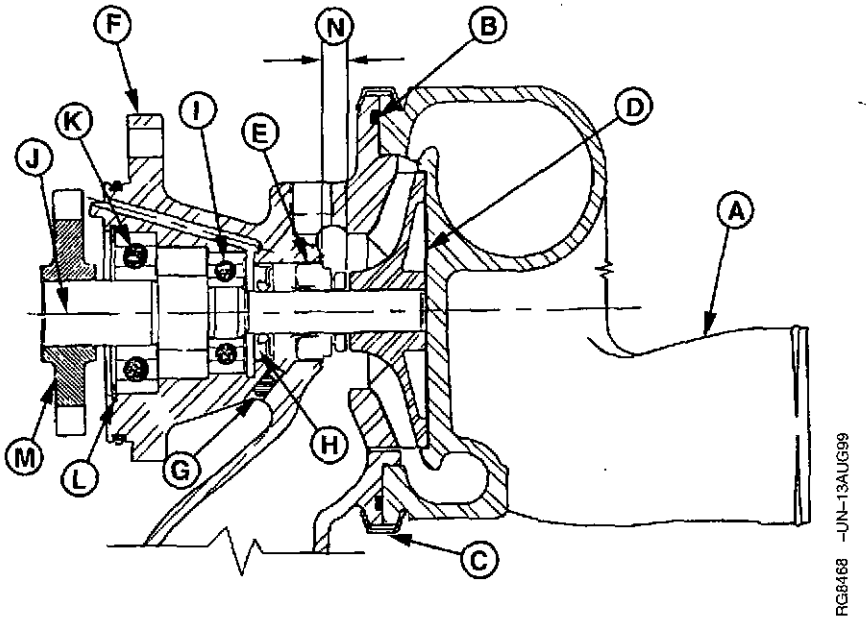
ASSEMBLE WATER PUMP



Water Pump Exploded View



Water Pump Sectioned View

A—Water Pump Cover
B—O-Ring Packing
C—Band Clamp
D—Impeller
E—Seal
F—Water Pump Housing
G—Weep Hole Filter
H—Grease Seal
I—Bearing
J—Shaft
K—Bearing
L—Snap Ring
M—Drive Gear
N—9.65 ±0.13 mm (0.380 ± 0.005 in.)

1. Pack both bearings (I, K) with TY6333 or TY6347 High Temperature Grease.
2. Apply clean engine oil to bearing IDs and shaft ODs.
3. Support end of shaft (J) and install bearing against shoulder on each end of shaft. Use a press and driver that locates on inner bearing race only.

Continued on next page

RG,RG34710,230 –19–13AUG99–1/2

4. Support water pump housing (F) on a firm flat surface with bearing bore facing up. Drive grease seal (H) into housing (spring lips facing up) flush with shoulder.

5. Press bearing and shaft assembly (I—K) into housing using a driver that locates on inner and outer race of larger bearing. Press assembly until larger bearing bottoms in housing bore. Small end of shaft should be 18.97 ±0.05 mm (0.747 ±0.002 in.) below cover mounting surface.

6. Install a new snap ring (L) with sharp edge facing out.

7. Support small end of shaft and press drive gear (M) on flush with large end of shaft.

Water Pump Drive Gear—Specification

Installed Dimension ..... Flush with end of shaft

NOTE: Heat impeller (D) 66-93°C (150-200°F) prior to pressing onto shaft to eliminate metal transfer.

8. Support drive gear end of shaft, use R134742 Seal Driver (supplied with repair kit) and JDG727 Driver to install new water pump seal. Seal installed height (N) should be 9.65 ±0.13 mm (0.380 ±0.005 in.) when properly installed with tool provided.

9. Support drive gear end of shaft and press new impeller on flush with small end of shaft.

Water Pump Impeller—Specification

Installed Dimension ..... Flush with end of shaft

10. Assemble pump cover (A) to housing assembly using a new O-ring packing (B).

11. Install band clamp (C) and tighten to specifications.

Water Pump Housing-to-Cover Band Clamp—Specification

Torque..... 10 N•m (7.5 lb-ft)

12. Install a new weep hole filter (G) in housing weep hole.

13. Rotate gear several revolutions by hand to check for rubbing or obstruction.

RG,RG34710,230 –19–13AUG99–2/2

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INSTALL WATER PUMP

1. Install a new O-ring (A) on water pump mounting flange. Coat O-ring with clean engine oil.
2. Position thermostat housing-to-water pump bypass hose onto tube on water pump.
3. Install water pump to front plate, be careful not to cut or damage O-ring.

NOTE: Apply LOCTITE® 242 Thread Lock and Sealer (TY9473) to water pump cap screws before installing.

4. Install three water pump-to-front plate cap screws and tighten to specifications.

Water Pump-to-Front Plate Cap Screws—Specification

Torque ..... 50 N•m (37 lb-ft)

5. On engines with removable water pump inlet elbow, install elbow and tighten cap screws to following specifications.

Water Pump Inlet Elbow to Housing Cap Screws—Specification

Torque ..... 41 N•m (30 lb-ft)

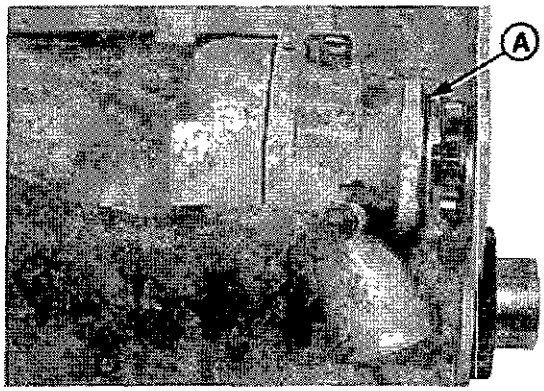
6. Install oil cooler and housing assembly. (See INSTALL OIL COOLER AND OIL FILTER/VALVE HOUSING ASSEMBLY in Group 20.)
7. Install all hoses and tighten hose clamps securely.

Coolant Bypass Hose Clamp—Specification

Torque ..... 6 N•m (4.5 lb-ft)

Oil Cooler-to-Water Pump Hose Clamp—Specification

Torque ..... 9 N•m (7 lb-ft)



RG8261A —UN–06DEC97

Installing Water Pump

A—O-Ring

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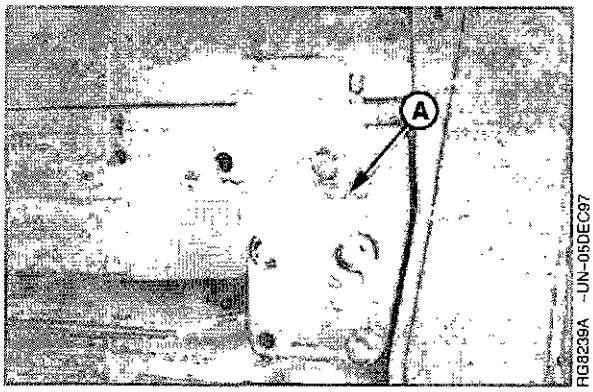
RG,RG34710,231 –19–13AUG99–1/1

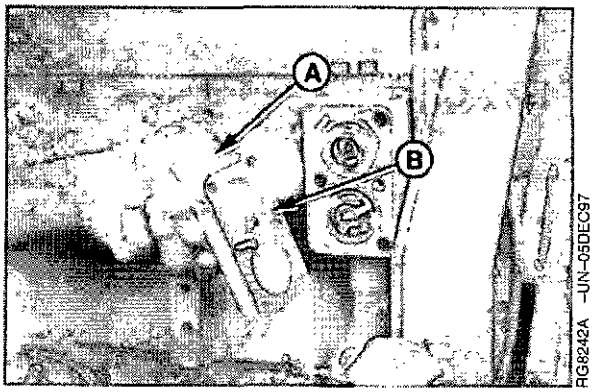
REMOVE THERMOSTATS

CAUTION: Explosive release of fluids from pressurized cooling system can cause serious burns. DO NOT drain coolant until it has cooled below operating temperature. Always loosen radiator pressure cap or drain valve slowly to relieve pressure.

1. Visually inspect area around thermostat housing for leaks. Partially drain cooling system.
2. Remove four cap screws securing thermostat cover (A) to housing and remove cover.
3. Remove gasket (B) and remove both thermostats.
4. Test each thermostat for proper opening temperature. (See TEST THERMOSTAT OPENING TEMPERATURE later in this group.)



Thermostat Cover Installed



Thermostat Cover Removed

A—Thermostat Cover
B—Gasket

RG,RG34710,232 -19-30SEP97-1/1

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INSTALL THERMOSTATS

IMPORTANT: *Top thermostat has a vent notch with wiggle wire (A) for air bleeding. Bottom thermostat has a blocking poppet that opens passage to radiator when coolant warms.*

1. Clean all gasket material from thermostat cover and housing mounting surfaces.
2. Install smaller (non-blocking) thermostat in top position with vent (wiggle wire) at 12 o'clock position. Install larger blocking thermostat in bottom position.
3. Install thermostat cover using a new gasket (B).
4. Install M10x35 cap screw (C) securing thermostat cover-to-housing and tighten to specifications.

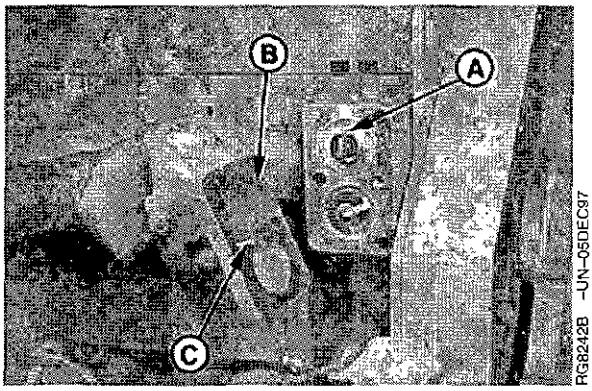
Thermostat Cover-to-Housing M10x35 Cap Screw—Specification

Torque ..... 35 N•m (26 lb-ft)

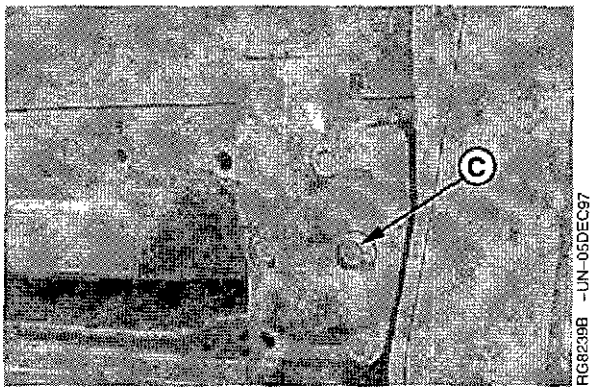
5. Install and tighten M10x120 and M10x170 cap screws to specifications.

Thermostat Housing/Cover Assembly-to-Block M10x120 and M10x170 Cap Screws—Specification

Torque ..... 50 N•m (37 lb-ft)



Removing Thermostat Cover



Thermostat Cover Installed

A—Wiggle Wire
B—Gasket
C—M10x35 Cap Screw

RG,RG34710,233 –19–13AUG99–1/1

TEST THERMOSTAT OPENING TEMPERATURE

1. Visually inspect thermostats for corrosion or damage. Replace thermostats as a matched set as necessary.

CAUTION: DO NOT allow thermostat or thermometer to rest against the side or bottom of container when heating water. Either may rupture if overheated.

2. Remove thermostats. (See REMOVE THERMOSTATS earlier in this group.)

3. Suspend thermostats and a thermometer in a container of water.

4. Stir the water as it heats. Observe opening action of thermostat and compare temperatures with specification given in chart below.

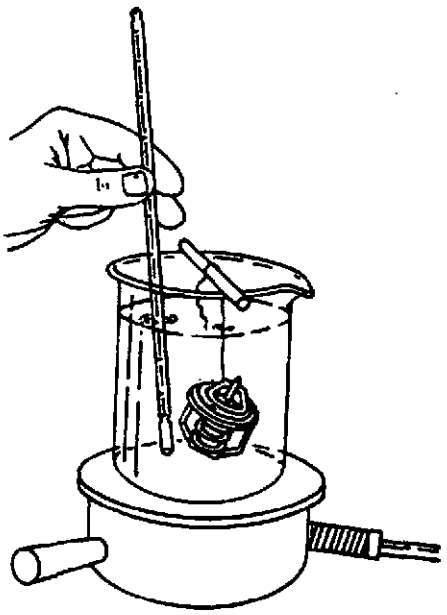
Thermostat Test—Specification

Rating	82°C (180°F)
Initial Opening (Range)	80-84°C (175—182°F)
Temperature	
Full Open (Nominal) Temperature	94°C (202°F)

NOTE: Due to varying tolerances of different supplies, initial opening and full open temperatures may vary slightly from specified temperatures.

5. Remove thermostat and observe its closing action as it cools. In ambient air the thermostat should close completely. Closing action should be smooth and slow.

6. If any one thermostat is defective, replace both thermostats.



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Testing Thermostats

RG,RG34710,234 –19–30SEP97–1/1

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REMOVE AND INSTALL THERMOSTAT HOUSING

REMOVE THERMOSTAT HOUSING

1. Disconnect top liner cooling return line (B) from thermostat housing.
2. Remove three cap screws (A) securing thermostat housing to cylinder block.
3. Pull thermostat housing straight out from engine to free housing from top liner cooling outlet adapter (C).
4. Loosen hose clamp and remove hose from housing nipple.
5. Remove gasket and discard. Clean all gasket material from mounting surfaces.

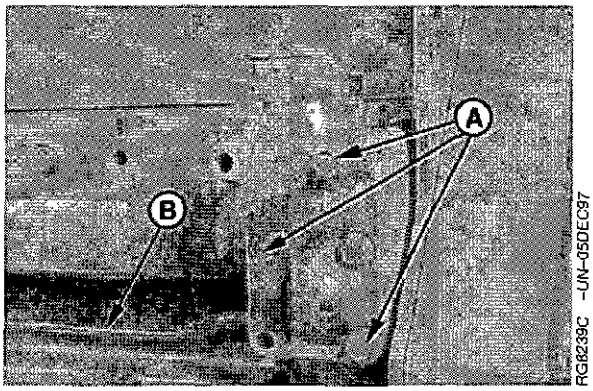
INSTALL THERMOSTAT HOUSING

1. Apply clean engine oil to top liner cooling outlet adapter O-ring.
2. Position thermostat housing on engine using a new gasket. Be sure housing is firmly seated on top liner cooling adapter O-ring.
3. Install mounting cap screws and tighten to specifications.

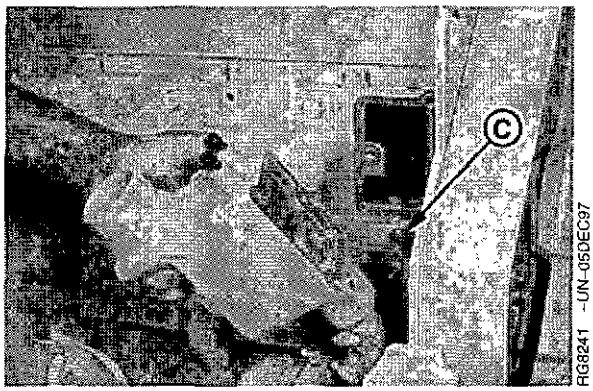
Thermostat Housing/Cover Assembly-to-Block M10x120 and M10x170 Cap Screws—Specification

Torque ..... 50 N•m (37 lb-ft)

4. Connect top liner cooling return line and tighten securely.
5. If removed, apply LOCTITE® 592 Pipe Sealant with TEFLON® (TY9480) to pipe plugs and temperature sensor and tighten to the following specifications.



Thermostat Housing Installed



Thermostat Housing Removed

A—Cap Screws
B—Return Line
C—Outlet Adapter

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TEFLON is a registered trademark of Du Pont Co.

Continued on next page

RG,RG34710,235 –19–13AUG99–1/2

Coolant Temperature Sensor—Specification

Torque ..... 10 N•m (7.5 lb-ft)

Thermostat Housing Pipe Plugs—Specification

Torque ..... 20 N•m (15 lb-ft)

RG,RG34710,235 –19–13AUG99–2/2

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REMOVE AND INSTALL COOLANT HEATER—IF EQUIPPED

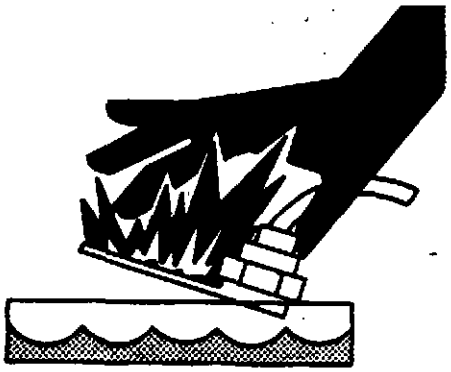
CAUTION: To avoid shock or hazardous operation, always use a three-wire heavy duty electrical cord. If a two-to-three contact adapter is used at the wall receptacle, always connect green wire to a good ground. Keep electrical connectors clean to prevent arcing.

Only plug coolant heater into electrical power if heating element is immersed in coolant. Otherwise sheath could burst, causing personal injury.

1. Unplug heater from electrical power source.
2. Partially drain cooling system.
3. Remove electrical cord (A), loosen nut, and pull heater element (B) out of oil cooler housing.

NOTE: The heater element cannot be repaired. If defective, replace it.

4. Apply LOCTITE® 592 Pipe Sealant with TEFLON® (TY9480) to coolant heater threads.
5. Install heater element in oil cooler housing and tighten hex nut securely.
6. Install cord.



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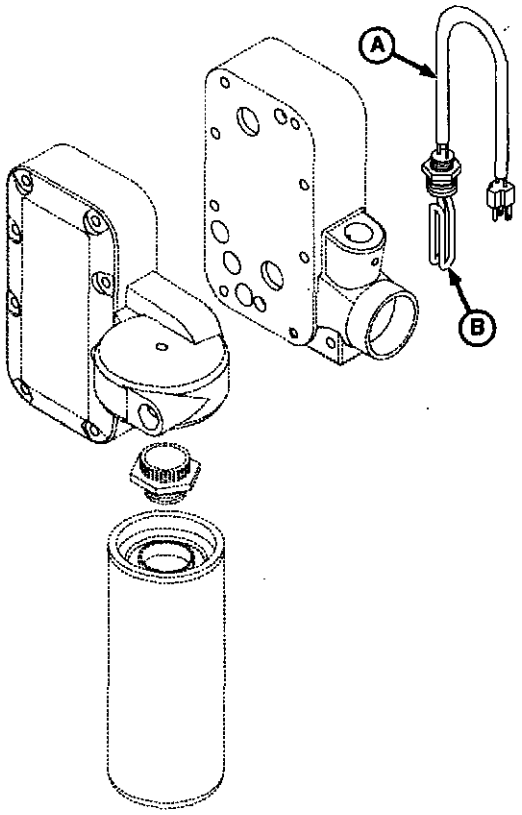
Testing Coolant Heater



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Engine Coolant Heater

A—Electrical Cord
B—Heater Element

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TEFLON is a registered trademark of Du Pont Co.

RG,RG34710,236 –19–30SEP97–1/1

OTHER MATERIAL

Number	Name	Use
PT569 (U.S.)	NEVER-SEEZ® Compound	Apply to turbocharger cap screws, intake manifold-to-cylinder head cap screws, exhaust manifold-to-cylinder head cap screws, aftercooler-to-cylinder head cap screws and turbocharger oil return line cap screws.
T43512 (U.S.) TY9473 (Canadian) 242 (LOCTITE®)	Thread Lock and Sealer (Medium Strength)	Apply to turbocharger oil inlet fitting.

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

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AIR INTAKE AND EXHAUST SYSTEM SPECIFICATIONS

Item	Measurement	Specification
Turbocharger Shaft	Radial Bearing Clearance (Allowable Movement)	0.076—0.165 mm (0.003—0.0065 in.)
Turbocharger Axial Bearing	End Play	0.025—0.114 mm (0.0010—0.0045 in.)
Turbocharger-to-Exhaust Manifold Cap Screws	Torque	50 N•m (37 lb-ft)
Turbocharger Oil Inlet Fitting	Torque	50 N•m (37 lb-ft)
Turbocharger Oil Return Pipe-to-Turbocharger	Torque	50 N•m (37 lb-ft)
Turbocharger Oil Inlet Line (Both Ends)	Torque	35 N•m (26 lb-ft)
Exhaust Manifold-to-Cylinder Head Cap Screws	Torque	70 N•m (52 lb-ft)
Intake Manifold-to-Cylinder Head Cap Screws	Torque	35 N•m (26 lb-ft)
Aftercooler-to-Cylinder Head Cap Screws	Torque	35 N•m (26 lb-ft)
Aftercooler Tube Clamp Cap Screw (or Cap Screw with Nut)	Torque	50 N•m (37 lb-ft)
Aftercooler	Test Pressure	140-170 kPa (1.4-1.7 bar) (20-25 psi)

DPSG,OUO1004,955 –19–29JUL99–1/1

EXTENDING TURBOCHARGER LIFE

Turbochargers are designed to last the life of the engine, but, because they operate at such high speeds (100,000 rpm or more); a moment's carelessness can cause them to fail in seconds.

The major causes of turbocharger failures are:

- **Lack of Lube Oil (Quick Starts and Hot Shutdowns)**
- **Oil Contamination**
- **Ingestion of Foreign Objects**
- **Restricted Oil Drainage**
- **Low Oil Level**
- **Operation on Excessive Side Slopes**
- **Abnormally High Exhaust Temperatures**

LACK OF LUBE OIL

Oil not only lubricates the turbocharger's spinning shaft and bearings, it also carries away heat. When oil flow stops or is reduced, heat is immediately transferred from the hot turbine wheel to the bearings, which are also heating up because of the increased friction due to the lack of oil. This combination causes the turbocharger shaft temperature to increase rapidly.

If oil flow does not increase and the process continues, bearings will fail. Once the bearings fail (which can happen in just seconds) seals, shaft, turbine and compressor wheels can also be damaged.

The principle causes of turbocharger bearing lubrication problems are low oil pressure, a bent, plugged or undersized oil lube supply line, plugged or restricted oil galleries in the turbocharger, or improper machine start-up and shutdown procedure.

Oil levels and pressure should always be closely monitored and all worn hoses and lines should be replaced. The turbocharger oil supply line should be checked frequently to make sure it is not kinked or bent and it should always be replaced with a line of equal size, length and strength.

The easiest way to damage a turbocharger is through improper start-up and shutdown procedures. Always idle the engine for at least 30 seconds (no load) after start-up and before shutdown. Warming the engine up before applying a load allows oil pressure to build up and lines to fill with oil.

Idling the engine before shutdown allows the engine and turbocharger to cool. "Hot" shutdowns can cause the turbocharger to fail because after high-speed operation the turbocharger will continue to rotate long after the engine has been shut off and oil pressure has dropped to zero. This will cause heat to build up and possibly damage bearing. It can also cause carbon and varnish deposits to form.

OIL CONTAMINATION

A second cause of turbocharger failures is contaminated oil. It can be caused by a worn or damaged oil filter or not changing the lube oil at recommended intervals. Expecting the oil filter to remove dirt, sand, metal chips, etc. from the oil before they reach the engine or turbocharger can be a costly mistake because contaminated oil may completely bypass the engine oil filter if the oil filter or oil cooler is clogged, if the filter element is improperly installed, or if the oil is thick during cold weather.

Four good ways of avoiding oil contamination are:

- Always inspect the engine thoroughly during major overhaul. Look especially for any sludge or debris left in lube oil galleries.
- Change lube oil at recommended intervals. Analysis of oil samples at filter change periods can help identify potentially harmful contaminants in the oil.
- Clean the area around the oil fill cap before adding oil.
- Use a clean container when adding oil.

Continued on next page

INGESTION OF FOREIGN OBJECTS

The third cause of turbocharger damage is the ingestion of foreign objects. These particles can be ingested and cause damage to the turbocharger on both compressor and turbine sides. This is easy to avoid.

On the compressor side, foreign objects usually take the form of dust, sand, or shreds of air cleaner element that enter through improperly installed air cleaner elements. Leaky air inlet piping (loose clamps or torn rubber joints) or torn pleats in dry-type air cleaner elements also create problems.

The result is erosion of compressor blades that can cause the delicately balanced wheel to wobble.

IMPORTANT: Whenever an internal engine failure (valve, valve seat, piston) occurs, a thorough inspection of the turbocharger MUST BE performed before returning engine to service.

RESTRICTED OIL DRAINAGE

A fourth cause of turbocharger damage is restricted lube oil drainage. The lubricating oil carries away heat generated by friction of the bearings and from the hot exhaust gases. If drainage back to the sump is impeded, the bearings will overheat with damage that will ultimately lead to failure.

There are two primary reasons for restricted drainage. A blocked drain tube, due to either damage or a buildup of sludged oil, or high crankcase pressure, which can be due to restricted crankcase breather or excessive engine blowby.

Periodically check both the turbocharger oil drain tube and engine breather tube for damage or restriction. Correction of these conditions leads to longer turbocharger life.

ABNORMALLY HIGH EXHAUST TEMPERATURES

A fifth cause of turbocharger damage is abnormally high exhaust temperatures. Elevated exhaust temperatures cause coking of oil which can lead to bearing failure. Extreme over-temperature operation can cause wheel burst.

There are two basic causes of over-temperature. The first is restricted air flow and the second is overpowering the engine. In either case the engine has more fuel than available air for proper combustion; this overfueled condition leads to elevated exhaust temperatures.

Causes of restricted air flow can include damaged inlet piping, clogged air filters, excessive exhaust restriction, or operation at extreme altitudes. Overpowering generally is due to improper fuel delivery or injection timing. If overtemperature operation has been identified, an inspection of the air inlet and exhaust systems should be performed. Also, check the fuel delivery and timing.

RG,RG34710,1256 –19–28APR99–2/2

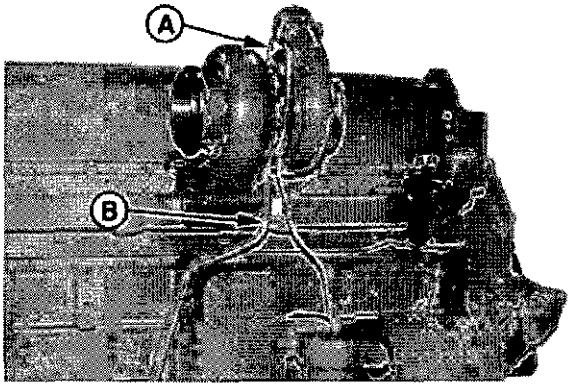
REMOVE TURBOCHARGER

CAUTION: After operating engine, allow exhaust system to cool before removing turbocharger.

Thoroughly clean exterior of turbocharger and surrounding area to prevent entry of dirt into the air intake system during removal.

IMPORTANT: When cleaning turbocharger, do not spray directly into compressor cover or turbine housing. If turbocharger inspection is required, do not clean exterior prior to removal. Doing so may wash away evidence of a potential failure mode. See TURBOCHARGER SEVEN-STEP INSPECTION later in this group.)

1. Refer to your machine technical manual to disconnect air inlet and exhaust piping.
2. Remove turbocharger air intake hose and exhaust elbow. Remove turbocharger air outlet piping (shown removed).
3. Disconnect oil inlet line (A) and oil return pipe (B) from turbocharger.
4. Remove four mounting cap screws and lift turbocharger from exhaust manifold. Remove stainless steel gasket.
5. Place turbocharger on a clean flat surface. Cap or plug all air intake and exhaust openings.
6. Perform turbocharger seven-step inspection as described later, if failure mode has not yet been determined. See TURBOCHARGER SEVEN-STEP INSPECTION later in this group.



Removing Turbocharger

A—Oil Inlet Line
B—Oil Return Pipe

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TURBOCHARGER FAILURE ANALYSIS

The following is a guide for diagnosing the cause of turbocharger failures after removal from the engine.

Continued on next page

RG,RG34710,1258 -19-23OCT97-1/3

Problem	Possible Cause	Suggested Remedy
COMPRESSOR HOUSING INLET DEFECTS		
Foreign Object Damage	Objects left in intake system.	Disassemble and inspect intake system for foreign objects (this group). Inspect engine for internal damage.
	Leaking and/or defective intake system.	Inspect air intake system connections including air filter; repair as required (this group). Inspect air intake related engine components.
Compressor Wheel Rub	Bearing failure.	Determine if engine and/or operator contributed to lack of lubrication, contaminated lubrication, excessive temperature, or debris generating engine failure in progress. Correct as required.
	Manufacturing defects.	Correct as required.
COMPRESSOR HOUSING OUTLET DEFECTS		
Oil and/or Dirt in Housing	Restricted air intake system. Prolonged periods of low rpm engine idling. Defective oil seal ring. Restricted oil drain line.	Inspect and clean air cleaner. Check with operator to confirm conditions. (See Operator's Manual.) Repair as required (this group). Inspect and clear oil drain line as required.
TURBINE HOUSING INLET DEFECTS		
Oil in Housing	Internal engine failure. Oil leaking from compressor housing seal.	Inspect and repair engine as required. Verify that oil is in compressor housing and refer to "Compressor Housing Outlet Defects" as listed earlier in this chart.
Center Wall Deteriorated	Excessive operating temperature.	Check for restricted air intake. Check engine for overfueling. Check injection pump timing.

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TURBINE HOUSING OUTLET DEFECTS

Turbine Wheel Rub	Bearing failure.	Determine if engine and/or operator contributed to lack of lubrication, contaminated lubrication, excessive temperature, or debris generating engine failure in progress. Correct as required.
	Manufacturing defect.	Correct as required (this group).
Foreign Object Damage	Internal engine failure.	Inspect and repair engine as required.
	Objects left in intake system.	Disassemble and inspect air intake system (this group).
	Leaking air intake system.	Correct as required (this group).
Oil and/or Excessive Carbon	Internal engine failure.	Verified by oil in turbine housing. Correct as required.
	Turbine seal failure.	Inspect for excessive heat from overfueling and/or restricted air intake.
	Prolonged periods of low rpm engine idling.	Ask operator to run engine under load or at a higher rpm (See Operator's Manual).
	Restricted oil drain line.	Inspect and clear oil drain line as required.

EXTERNAL CENTER HOUSING AND JOINT DEFECTS

Leaks from Casting	Defective casting.	Replace turbocharger (this group).
	Defective gasket.	Verify if leaks are occurring at gasket joints.
Leaks from Joints	Loose attaching screws.	Tighten to specifications in CTM (this group).
	Defective gasket.	Inspect and repair as required.

INTERNAL CENTER HOUSING DEFECTS

Excessive Carbon Build-Up in Housing or on Shaft	Hot engine shutdown.	Review proper operation with operator as shown in operator's manual.
	Excessive operating temperature.	Restricted air intake; overfueling or mistimed engine.
	Restricted oil drain line.	Inspect and clean oil drain lines as required.
	Operating engine at high speeds and loads immediately after start-up.	Idle engine for a few minutes to allow oil to reach bearings before applying heavy loads.

RG,RG34710,1258 -19-23OCT97-3/3

TURBOCHARGER SEVEN-STEP INSPECTION

The following inspection procedure is recommended for systematic failure analysis of a suspected failed turbocharger. This procedure will help to identify when a turbocharger has failed, and why it has failed so the primary cause of the failure can be corrected.

Proper diagnosis of a non-failed turbocharger is important for two reasons. First, identification of a non-failed turbocharger will lead to further investigation and repair of the cause of a performance complaint.

Second, proper diagnosis eliminates the unnecessary expense incurred when a non-failed turbocharger is replaced.

The seven recommended inspection steps, which are explained in detail on following pages, are:

- Compressor Housing Inlet and Compressor Wheel.
- Compressor Housing Outlet.
- Turbine Housing Inlet.
- Turbine Housing Outlet and Turbine Wheel.
- External Center Housing and Joints.
- Internal Center Housing.
- Turbocharger Bench Test.

NOTE: To enhance the turbocharger inspection, an inspection sheet (Form No. DF-2280 available from Distribution Service Center—English only) can be used that lists the inspection steps in the proper order and shows potential failure modes for each step. Check off each step as you complete the inspection and record any details or problems obtained during inspection. Retain this with the work order for future reference.

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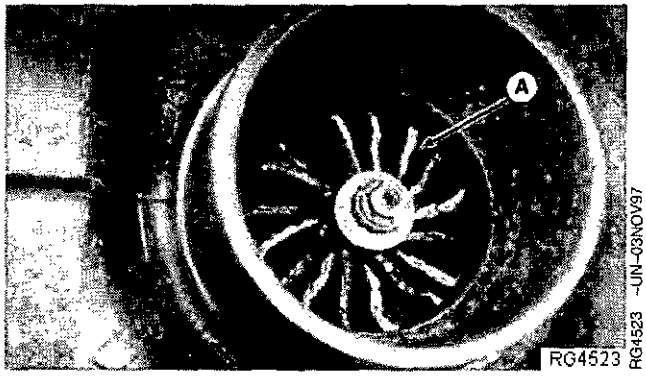
COMPRESSOR HOUSING INLET AND COMPRESSOR WHEEL

1. Check compressor inlet and compressor wheel (A) for foreign object damage.

NOTE: Foreign object damage may be extensive or minor. In either case, the source of the foreign object must be found and corrected to eliminate further damage.

2. Mark findings on your checklist and continue the inspection.



Checking Inlet and Compressor Wheel

A—Compressor Wheel

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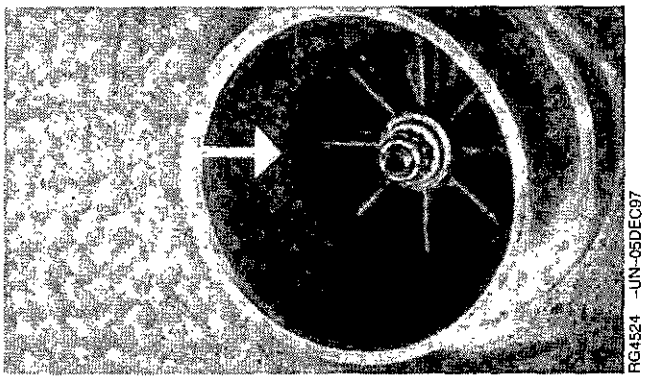
NOTE: You will need a good light source for this check.

3. Check compressor inlet for wheel rub on the housing (arrow). Look very closely for any score marks on the housing itself and check the tips of the compressor wheel blades for damage.



Checking Compressor Inlet

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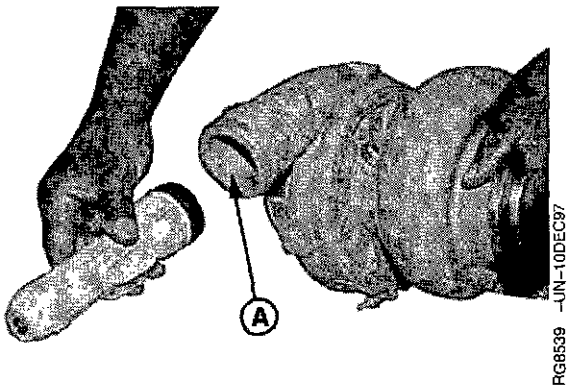
COMPRESSOR HOUSING OUTLET

1. Check compressor housing outlet (A). The outlet should be clean and free of dirt or oil.
2. Mark it on your checklist if dirt or oil is found and continue the inspection.



Checking Compressor Outlet

A—Compressor Housing Outlet

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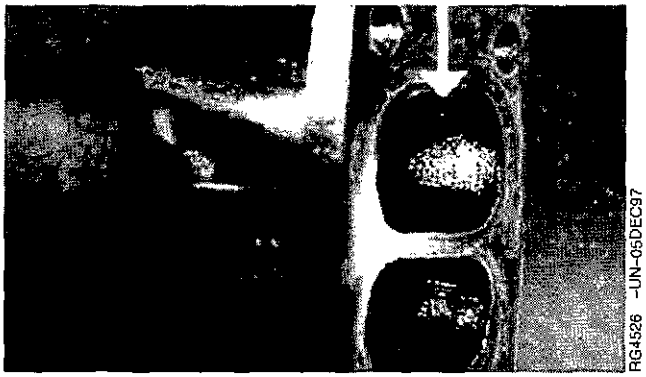
DPSG,OUO1004,945 –19–28JUL99–4/13

TURBINE HOUSING INLET

Check the turbine housing inlet ports (arrow) for oil in housing, excessive carbon deposit or erosion of center walls.

NOTE: If the inlet is wet with oil, or has excessive carbon deposits, an engine problem is likely. Center wall erosion (cracking or missing pieces), indicate excessive exhaust temperature.

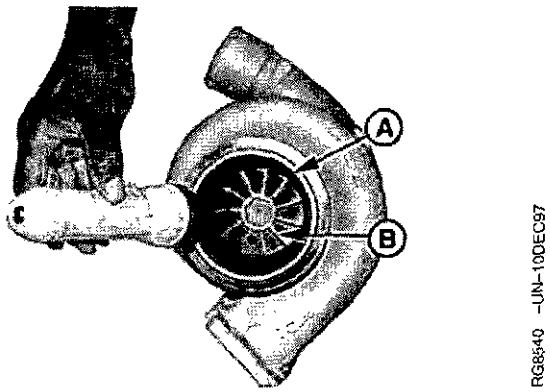


Checking Turbine Housing Inlet Ports

DPSG,OUO1004,945 –19–28JUL99–5/13

TURBINE HOUSING OUTLET AND TURBINE WHEEL

1. Use a flashlight to look up inside the turbine housing outlet (A) and check blades (B) for foreign object damage.



Checking Turbine Wheel and Outlet

A—Turbine Housing Outlet
B—Blades

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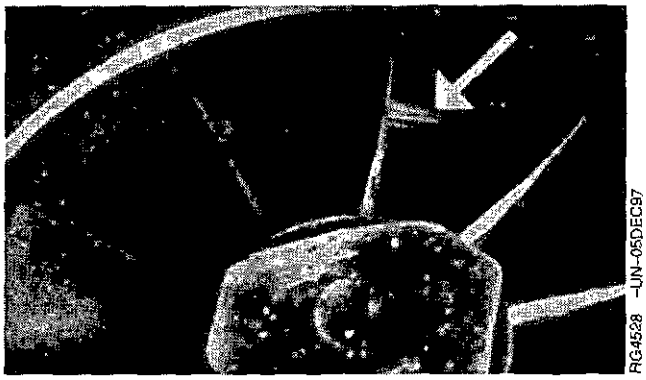
2. Inspect the wheel blades and housing for evidence of wheel rub (arrow). Wheel rub can bend the tips of the blades with the housing showing wear or damage.



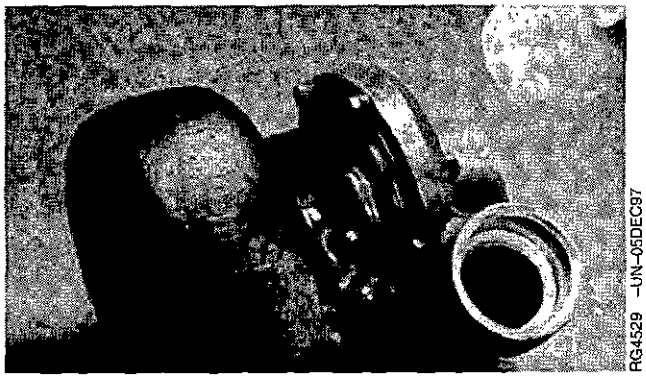
Checking Turbine Wheel Blades

DPSG,OUO1004,945 –19–28JUL99–7/13

EXTERNAL CENTER HOUSING AND JOINTS

Visually check the outside of the center housing, all connections to the compressor, and turbine housing for oil.

NOTE: If oil is present, make sure it is not coming from a leak at the oil supply or return line.



Checking Center Housing

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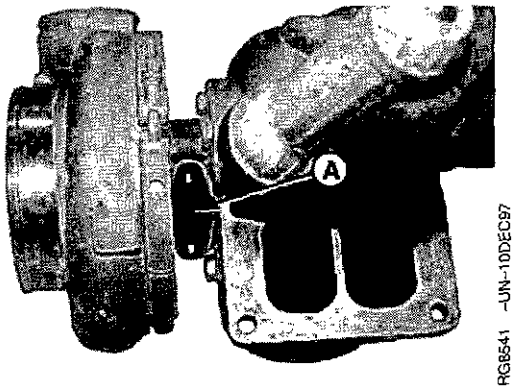
INTERNAL CENTER HOUSING

1. Using a flashlight, look through the oil return hole (A), to check the condition of the shaft and/or bearings. There should not be excess carbon deposits on the shaft or in the housing.

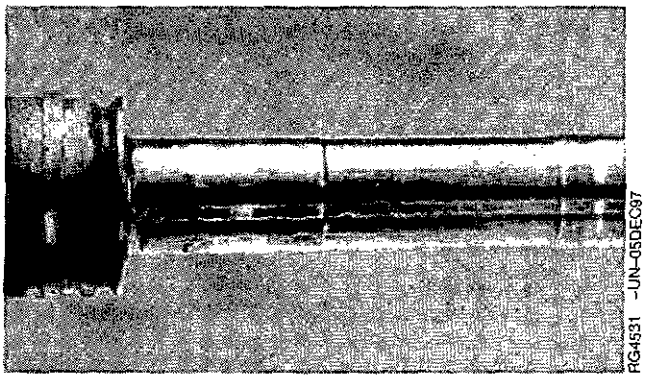


Checking Shaft and Bearings

A—Oil Return Hole

DPSG,OUO1004,945 –19–28JUL99–9/13

2. Excessive "blueing" or "coking" of oil along the complete length of the shaft indicates a possible lack of lubrication caused by an engine failure, or improper operation, such as hot shutdowns.



Checking for Oil "Coking" on Shaft

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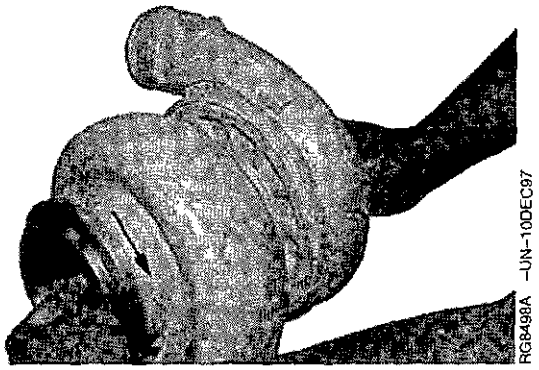
TURBOCHARGER BENCH TEST

1. Mount the turbocharger in a vise.
2. Rotate the shaft, using both hands, to check rotation and clearance. The shaft should turn freely, however, there may be a slight amount of drag.



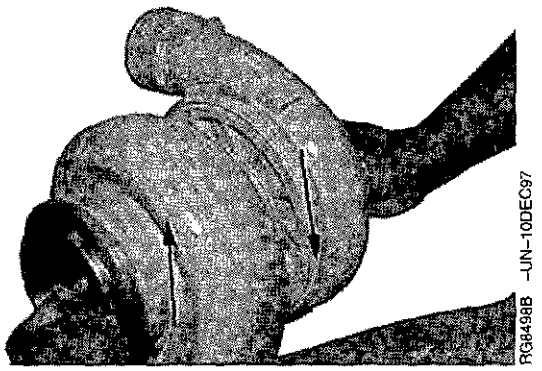
Checking Shaft Rotation and Clearance

DPSG,OUO1004,945 –19–28JUL99–11/13

IMPORTANT: Use only moderate hand force (3-4 pounds) on each end of shaft.

3. Next, pull up on the compressor end of the shaft and press down on the turbine end while rotating shaft. Neither the compressor wheel nor the turbine wheel should contact the housing at any point.

NOTE: There will be some "play" because the bearings inside the center housing are free floating.



Checking for Contact of Compressor and Turbine Wheels

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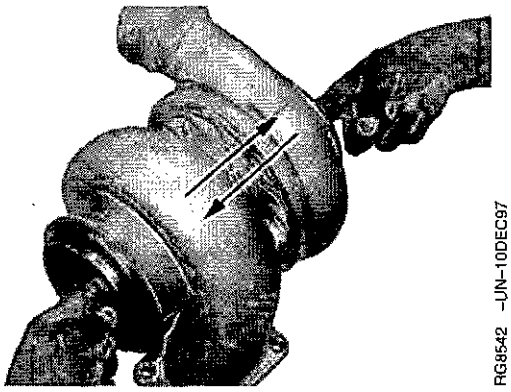
DPSG,OUO1004,945 –19–28JUL99–12/13

4. Next, check shaft endplay by moving the shaft back and forth while rotating. There will be some endplay but not to the extent that the wheels contact the housings.

NOTE: These diagnostic procedures will allow you to determine the condition of the turbocharger. If the turbocharger has failed, analysis of your inspection notes should direct you to the specific areas of the engine to correct the problems causing the turbocharger failure (See TURBOCHARGER FAILURE ANALYSIS, outlined earlier in this group). It is not unusual to find that a turbocharger has not failed. If your turbocharger passes all the inspections, the problem lies somewhere else.

IMPORTANT: Before you finalize your conclusion that the turbocharger has not failed, it is strongly recommended that the following procedures of checking radial bearing clearance and axial bearing endplay with a dial indicator be performed. These procedures are not required if a failure mode has already been identified.



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Checking Shaft End Play

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PERFORM RADIAL BEARING CLEARANCE TEST

This test will give an indication of the condition of the radial bearings within the center housing and rotating assembly.

1. Fasten a magnetic base (plunger-type) dial indicator to the turbocharger mounting base. Assemble an extension adapter and indicator extension rod onto dial indicator.

2. Position indicator tip (through center housing oil return) on center of shaft. Preload indicator tip and zero dial on indicator.

IMPORTANT: Use only moderate hand force (3-4 pounds) on each end of shaft when checking clearance.

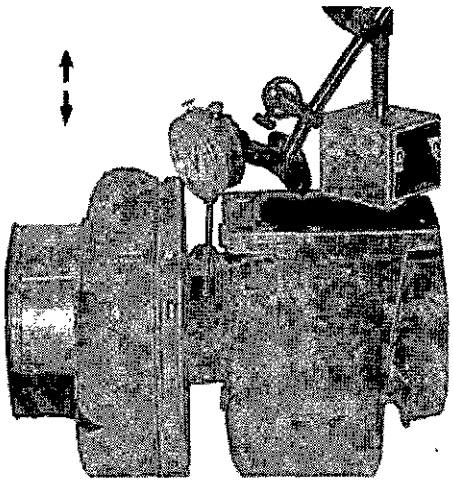
3. Grasp rotating shaft at both ends and move the shaft toward the indicator, then away from the indicator (arrows). Use care to move the shaft in the same direction as the dial indicator tip travels and apply equal pressure at both ends of the shaft.

4. Observe and record total indicator movement.

Turbocharger Shaft—Specification

Radial Bearing Clearance ..... (Allowable Movement)	0.076—0.165 mm (0.003—0.0065 in.)

If total indicator reading is not within specification, install a replacement turbocharger.



RG10284 –UN–20AUG99

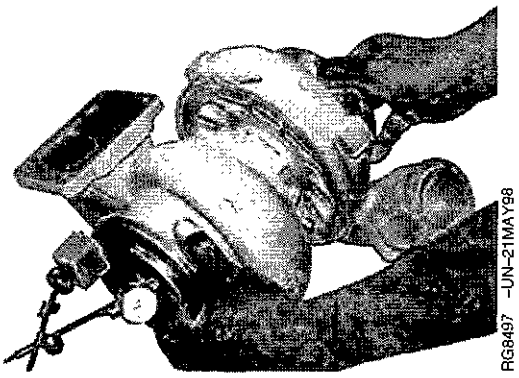
Checking Radial Bearing Clearance

DPSG,OUO1004,946 –19–28JUL99–1/1

PERFORM AXIAL BEARING END PLAY TEST

This test will give an indication of the condition of the axial bearing within the center housing and rotating assembly.

1. Mount magnetic base dial indicator so that indicator tip rests on end of shaft. Preload indicator tip and zero dial on indicator.
2. Move shaft axially back and forth by hand.
3. Observe and record total dial indicator movement and compare to following specification.



Measuring Axial End Play

Turbocharger Axial Bearing—Specification

End Play	0.025—0.114 mm (0.0010—0.0045 in.)

If bearing end play is not within specification, replace turbocharger.

RG,RG34710,244 –19–30SEP97–1/1

REPAIR TURBOCHARGER

Turbochargers used on the engines covered in this manual are available through service parts as a complete remanufactured assembly only. Individual components for repair are not available.

RG,RG34710,245 –19–30SEP97–1/1

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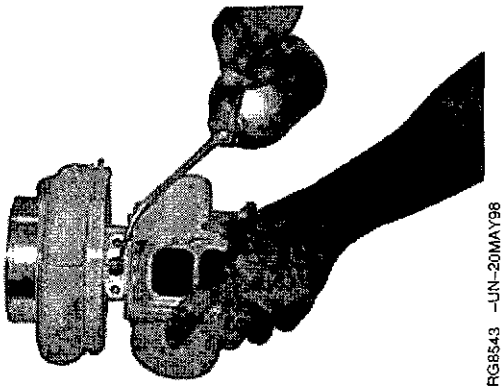
PRELUBE TURBOCHARGER

IMPORTANT: DO NOT spin the rotor assembly with compressed air. Damage to bearings can occur, when using compressed air.

Fill oil inlet or drain port with clean engine oil and spin rotating assembly (by hand) to properly lubricate bearings.

If turbocharger is to be stored for an extended period of time, lubricate internally and install protective covers on all openings.



Prelubing Turbocharger Bearings

RG,RG34710,246 –19–30SEP97–1/1

INSTALL TURBOCHARGER

IMPORTANT: If turbocharger failed because of foreign material entering the air intake system, be sure to examine the system and clean as required to prevent a repeat failure.

If not done previously, prime (prelube) the turbocharger rotating assembly prior to mounting turbocharger on engine. Prelube center housing with clean engine oil through the oil drain hole. Turn rotating assembly by hand to lubricate bearings. (See PRELUBE TURBOCHARGER earlier in this group.)

1. Install two guide pins (A) in front turbocharger mounting holes as shown. Install stainless steel gasket (B) over guide pins.
2. Position turbocharger on stainless steel gasket and exhaust manifold.
3. Apply PT569 NEVER-SEEZ® Compound to turbocharger cap screws and tighten to specifications.

Turbocharger-to-Exhaust Manifold—Specification

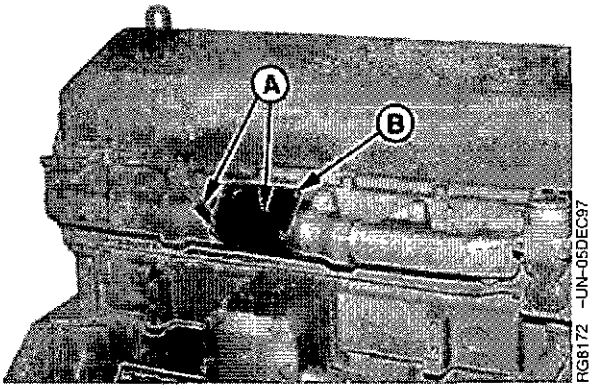
Torque ..... 50 N•m (37 lb-ft)

4. If removed, apply LOCTITE® 242 Thread Lock and Sealant to turbocharger oil inlet fitting and install and tighten to specifications.

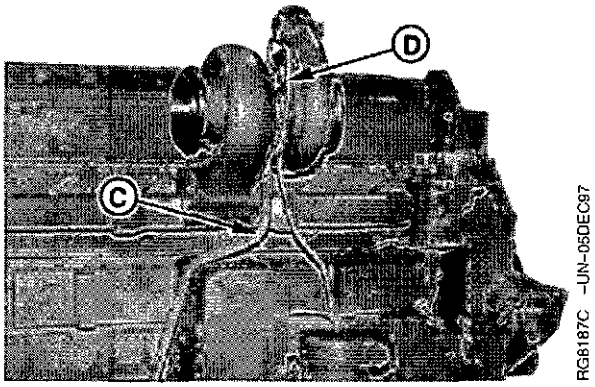
Turbocharger Oil Inlet Fitting—Specification

Torque ..... 50 N•m (37 lb-ft)

5. Apply PT569 NEVER-SEEZ® Compound to oil return pipe cap screws. Install oil return pipe (C) to turbocharger using a new gasket. Tighten oil return pipe cap screws to specifications.



Guide Pins as Assembly Aid



Installed Turbocharger

A—Guide Pins
B—Gasket
C—Oil Return Pipe
D—Oil Inlet Line

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LOCTITE is a registered trademark of Loctite Corp.

Continued on next page

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Turbocharger Oil Return Pipe-to-Turbocharger—Specification

Torque ..... 50 N•m (37 lb-ft)

Connect turbocharger oil inlet line (D) and tighten both ends to specifications.

Turbocharger Oil Inlet Line (Both Ends)—Specification

Torque ..... 35 N•m (26 lb-ft)

IMPORTANT: *Since the greatest suction force occurs* between air cleaner and turbocharger, ensure that hose connections are tight to prevent entry of dirt into system.

6. Connect air inlet hose-to-turbocharger compressor housing.

7. Install air intake and exhaust piping onto turbocharger compressor and turbine ends as detailed in machine technical manual.

RG,RG34710,247 –19–13AUG99–2/2

TURBOCHARGER BREAK-IN

IMPORTANT: A new or repaired turbocharger DOES NOT have an adequate oil supply for immediate start-up of engine. Perform the steps below to prevent damage to turbocharger bearings.

1. Remove ECU power fuse so engine does not start.

IMPORTANT: DO NOT crank engine longer than 30 seconds at a time to avoid damage to starting motor.

2. Crank engine over with starting motor until oil pressure gauge needle registers within the "GREEN" zone of pressure gauge.

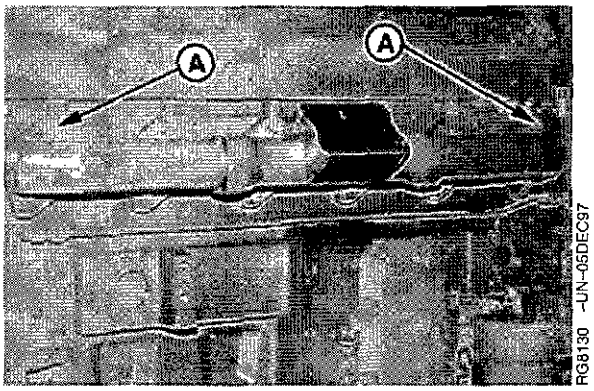
3. Install ECU power fuse, start and run engine at low idle while checking oil inlet and all piping connections for leaks.

RG,RG34710,248 –19–30SEP97–1/1

REMOVE, INSPECT, AND INSTALL EXHAUST MANIFOLD

REMOVE EXHAUST MANIFOLD

1. Remove turbocharger (shown removed). (See REMOVE TURBOCHARGER earlier in this group.)
2. Remove upper cap screws (A) from front and rear exhaust manifold sections and install guide pins.
3. Remove remaining exhaust manifold-to-cylinder head cap screws and remove exhaust manifold as an assembly.
4. Separate three exhaust manifold sections. Remove exhaust manifold-to-cylinder head gaskets and discard.



Removing Exhaust Manifold

A—Upper Cap Screws

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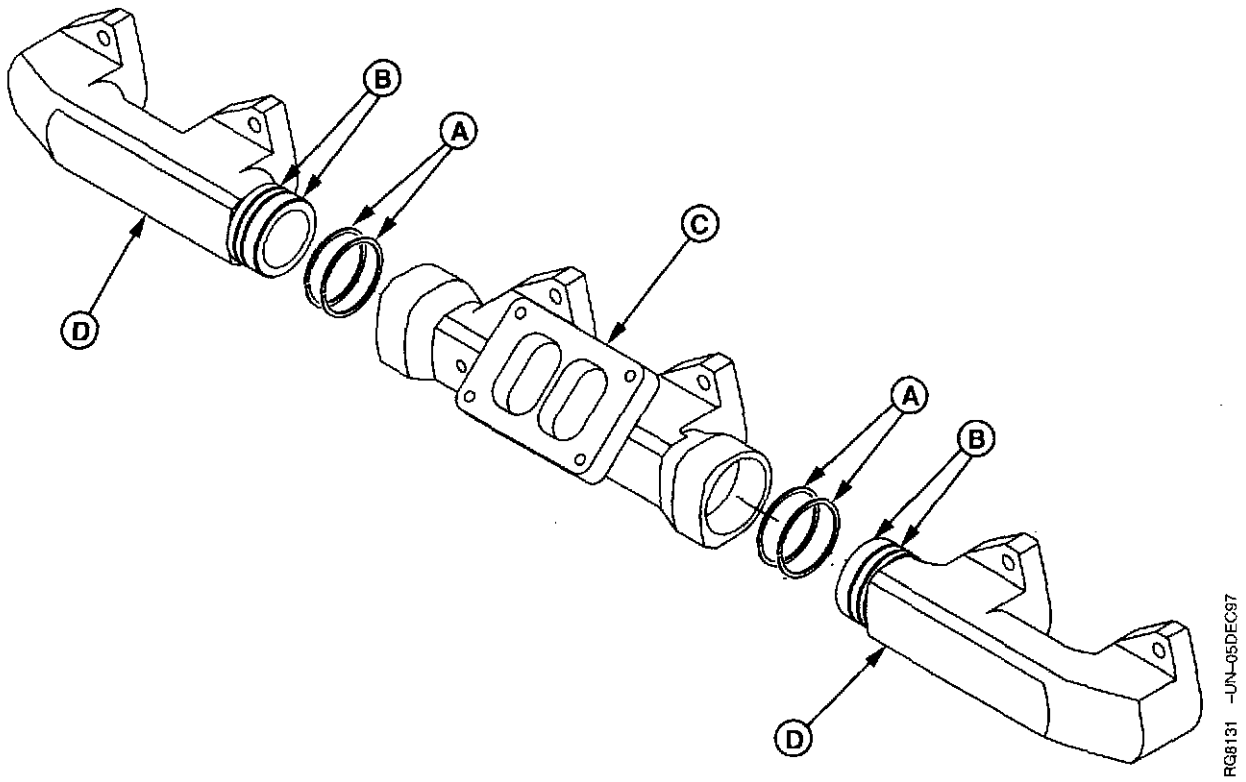
RG,RG34710,249 –19–13AUG99–1/3



Exhaust Manifold Exploded View

A—Sealing Rings (4 used)
B—Sealing Ring Grooves
C—Center Manifold Section
D—End Manifold Sections (2 used)

INSPECT EXHAUST MANIFOLD

IMPORTANT: Some early production exhaust manifold end sections (D) may have three sealing ring grooves (B) and may have been assembled with only one sealing ring. ALWAYS use two sealing rings during engine reassembly and use outer grooves on manifold sections with three grooves.

1. Inspect machined mating surfaces (ID and OD) for burrs, cracks or other imperfections which may prevent sealing rings (A) from sealing properly.
2. Inspect area past sealing rings location for evidence of exhaust leakage. Inspect all sections for cracks.
3. Inspect and clean cylinder head and exhaust manifold machined mounting surfaces.

Continued on next page

RG,RG34710,249 –19–13AUG99–2/3

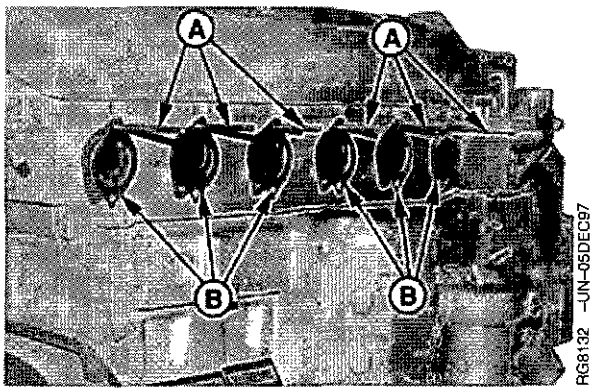
INSTALL EXHAUST MANIFOLD

1. Install guide pins (A) at upper threaded hole of each exhaust port as shown.
2. Install gaskets (B) on each guide pin as shown.
3. Install two sealing rings on both end exhaust manifold sections and assemble with center section.
4. Install manifold assembly (C) onto guide pins.
5. Apply PT569 NEVER-SEEZ® Compound to exhaust manifold cap screws and tighten bottom row of cap screws finger tight. Be sure gaskets are properly positioned before installing cap screws.
6. Remove guide pins from top row, install cap screws finger tight.
7. Tighten all cap screws to specifications.

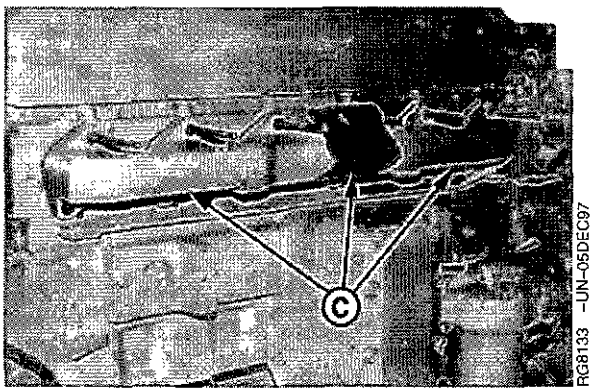
Exhaust Manifold-to-Head Cap Screws—Specification

Torque ..... 70 N•m (52 lb-ft)

8. Install turbocharger. (See INSTALL TURBOCHARGER earlier in this group.)



Exhaust Manifold Gaskets



Installing Exhaust Manifold

A—Guide Pins
B—Gasket
C—Manifold Assembly

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RG,RG34710,249 –19–13AUG99–3/3

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REMOVE, INSPECT, AND INSTALL INTAKE MANIFOLD (6105HRW AND 6125HRW ENGINES WITH DUAL RAIL FUEL SYSTEMS)

REMOVE INTAKE MANIFOLD

1. Remove final fuel filter (A). Disconnect fuel lines (B) from filter mounting base.
2. Refer to your machine technical manual to disconnect intake piping, sensors, and starting aid that is connected to intake manifold.

NOTE: Note location of primary fuel filter/water separator bracket (C) for assembly in same location as removed.

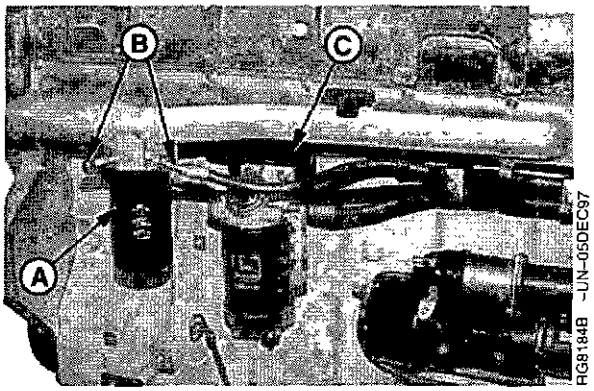
3. Remove top cap screw on each end of intake manifold and install guide pins.
4. Remove remaining cap screws and remove intake manifold with gasket. Discard gasket.

INSPECT INTAKE MANIFOLD

1. Check intake manifold for damage or cracks.
2. Thoroughly inspect interior of manifold for dust or debris.
3. Clean all gasket material from intake manifold and cylinder head mounting surfaces.

INSTALL INTAKE MANIFOLD

1. Install guide pins at each end of top intake manifold cap screw locations as shown.
2. Install a new gasket onto guide pins.
3. Install intake manifold onto guide pins. Install primary fuel filter/water separator in same location as removed.



Intake Manifold Assembly (6105HRW and 6125HRW Engines with Dual Rail Fuel Systems Only)

A—Fuel Filter
B—Fuel Lines
C—Primary Fuel Filter/Water Separator Bracket

Continued on next page

4. Apply PT569 NEVER-SEEZ® Compound to intake manifold cap screws. Starting at center cap screws, alternating top to bottom and front to rear, tighten intake manifold-to-cylinder head cap screws to specifications.

Intake Manifold-to-Cylinder Head Cap Screws—Specification

Torque ..... 35 N•m (26 lb-ft)

5. Connect fuel lines to final fuel filter mounting base. Install final fuel filter.

6. Reconnect intake piping, sensors, and starting aid detailed in machine technical manual.

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RG,RG34710,250 –19–28JUL99–2/2

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REMOVE AND INSTALL AFTERCOOLER ASSEMBLY (6105A AND 6125A ENGINES)

REMOVE AFTERCOOLER ASSEMBLY

CAUTION: Explosive release of fluids from *pressurized cooling system can cause serious* burns. Wait until engine coolant is below operating temperature before draining. Slowly loosen radiator filler cap to first stop to relieve pressure.

1. Drain engine coolant.
2. Clean area surrounding aftercooler intake piping to prevent debris from entering intake system as parts are removed.
3. Remove coolant inlet hose (A) and outlet (B) from *aftercooler end connections.*
4. Remove air inlet adapter (C) from aftercooler inlet.
5. Refer to machine technical manual to disconnect all sensors and starting aid.
6. Remove aftercooler assembly (D) with gasket using two guide pins at upper outside cap screw locations. Discard gasket.

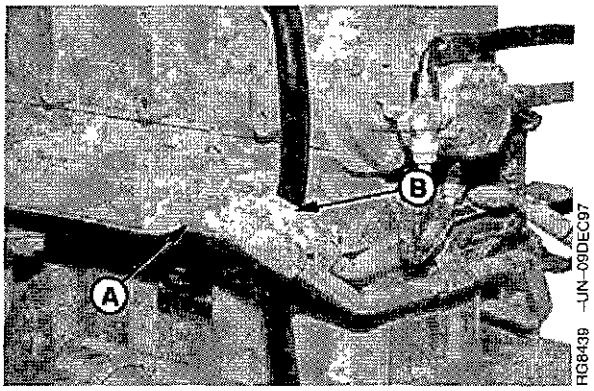
INSTALL AFTERCOOLER ASSEMBLY

1. Install aftercooler assembly using a new gasket and two guide pins at upper outside cap screw locations.
2. Apply PT569 NEVER-SEEZ® Compound to aftercooler-to-cylinder head cap screws. Install cap screws and tighten to specifications.

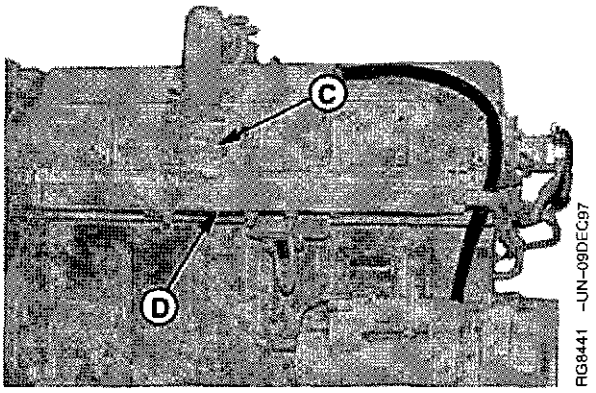
Aftercooler-to-Cylinder Head Cap Screws—Specification

Torque ..... 35 N•m (26 lb-ft)

3. Install coolant inlet and outlet hoses and tighten clamps securely.



Aftercooler Coolant Piping



Removing Aftercooler

A—Coolant Inlet
B—Coolant Outlet
C—Air Inlet Adapter
D—Aftercooler Assembly

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Continued on next page

RG,RG34710,251 –19–13AUG99–1/2

4. If removed, install inlet and outlet tube clamps and tighten cap screw (or cap screw with nut) to specifications.

Aftercooler Tube Clamp Cap Screw (or Cap Screw with Nut)—Specification

Torque ..... 50 N•m (37 lb-ft)

5. Install air inlet adapter onto aftercooler inlet and tighten securely.
6. Fill cooling system with proper coolant solution.
7. Refer to machine technical manual to connect sensors and starting aid.

RG,RG34710,251 –19–13AUG99–2/2

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28

INSPECT AND REPAIR AFTERCOOLER (6105A AND 6125A ENGINES)

1. Inspect aftercooler for overall condition. The fins should be reasonably straight, and cross straps should be free of cracks.
2. Inspect aftercooler inlet and outlet hoses. Replace either hose if cracked or damaged.
3. Test the aftercooler for leaks by plugging outlet tube (B).
4. Apply compressed air to the inlet tube (A) while unit is submerged under water. Use specified air pressure for testing.

Aftercooler—Specification

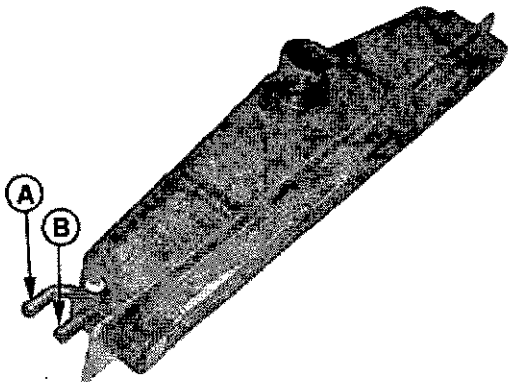
Test Pressure	140-170 kPa (1.4-1.7 bar) (20-25 psi)

A minor leak that is accessible may be repaired.

However, if the condition of the core is questionable, replace aftercooler.

IMPORTANT: Coolant leakage from the aftercooler may cause severe engine damage.

5. Inspect air intake cover for cracks or damage. Replace as necessary.



RG8446 –UN–09DEC97

Aftercooler Assembly

A—Inlet Tube
B—Outlet Tube

RG,RG34710,252 –19–13AUG99–1/1

ESSENTIAL TOOLS

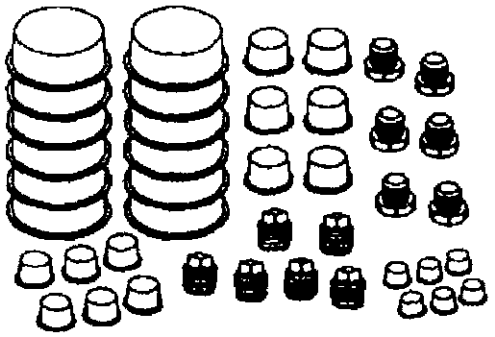
NOTE: Order tools according to information given in the U.S. SERVICEGARD™ Catalog or from the European Microfiche Tool Catalog (MTC).

SERVICEGARD is a trademark of Deere & Company

DPSG,OUO1004,977 –19–04AUG99–1/4

Fuel System Cap Plug Kit JDG998

Use to protect the fuel system from dirt and debris when disconnecting fuel system components during routine maintenance and service.



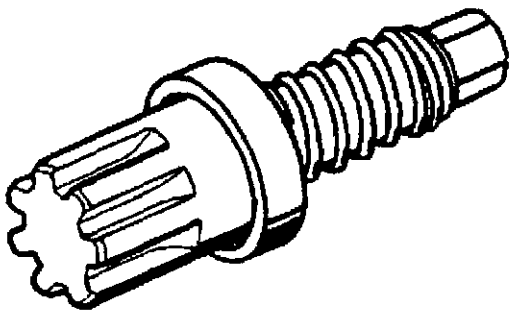
RG8518 –UN–20MAY98

JDG998

DPSG,OUO1004,977 –19–04AUG99–2/4

Flywheel Turning Tool JDG820

Use to rotate engine flywheel to find cylinder No. 1 and No. 6 "Top Dead Center" when adjusting electronic unit injector (EUI) preload. Use with JDG971 Timing Pins.



RG7056 RG7056 –UN–05DEC97

JDG820

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DPSG,OUO1004,977 –19–04AUG99–3/4

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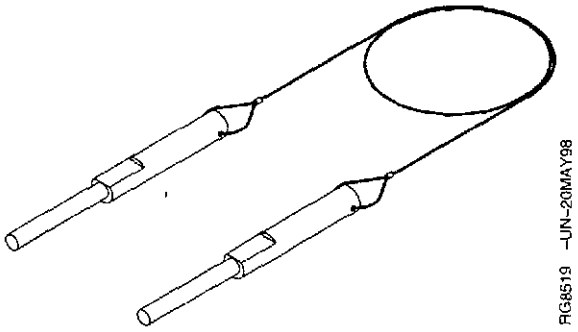
2

Cam/Crankshaft Timing Lock Pins JDG971

Set of 2. Use to lock camshaft and crankshaft at "Top Dead Center" during timing gear backlash adjustment. Use on crankshaft only for valve clearance and EUI preload adjustments.



JDG971

DPSG,OUO1004,977 –19–04AUG99–4/4

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,OUO1004,1025 –19–08SEP99–1/2

JT03513 . . . . . .Fuel Supply System Test Kit

Use to flush fuel rail.

DPSG,OUO1004,1025 –19–08SEP99–2/2

OTHER MATERIAL

Number	Name	Use
T43512 (U.S.) TY9473 (Canadian) 242 (LOCTITE®)	Thread Lock and Sealer (Medium Strength)	Apply to fuel filter check valve elbow and/or check valve (filter header end) and EUI hold-down clamp cap screws.
AR54749 (U.S.)	Soap Lubricant	Apply to fuel supply pump mounting bracket O-ring.
TY24311 (U.S.) CXTY24311 (Canadian) 222 (LOCTITE®)	Thread Lock and Sealer (Low Strength)	Electronic Unit Injector wiring connector stud nuts.

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DPSG,OUO1004,979 –19–04AUG99–1/1

DUAL RAIL FUEL SYSTEM SPECIFICATIONS

Item	Measurement	Specification
Fuel Filter Bracket-to-Head	Torque	35 N•m (26 lb-ft)
Fuel Filter Bracket-to-Block	Torque	65 N•m (48 lb-ft)
Fuel Filter-to-Air Intake	Torque	25 N•m (18 lb-ft)
Primary Fuel Filter-to-Bracket	Torque	50 N•m (37 lb-ft)
Primary Fuel Filter Header Plugs	Torque	47 N•m (35 lb-ft)
Air Purge Valve Diagnostic Port Fitting	Torque	24 N•m (18 lb-ft)
Fuel Filter Check Valve to Fuel Filter Header or Elbow on Header	Torque	46 N•m (34 lb-ft)
Elbow, Fuel Filter Check Valve-to-Filter Header	Torque	46 N•m (34 lb-ft)
Fuel Supply Pump and Camshaft Drive Coupler Set Screws	Torque	4 N•m (3 lb-ft)
Fuel Supply Mounting Bracket Cap Screws	Torque	50 N•m (37 lb-ft)
Fuel Supply Pump-to-Bracket	Torque	25 N•m (18 lb-ft)
Fuel Line ORFS Fittings	Torque	24 N•m (18 lb-ft)
Dual Rail Fuel Manifold-to-Head	Torque	35 N•m (26 lb-ft)
Fuel Return Check Valve (On Manifold)	Torque	33 N•m (24 lb-ft)
EUI Hold-Down Clamp Cap Screws	Initial Torque	20 N•m (15 lb-ft)
EUI Hold-Down Clamp Cap Screws	Final TORQUE-TURN	90—100°
EUI Wiring Harness Connector Nuts	Torque	2 N•m (1.75 lb-ft)
Fuel Line Clamps	Torque	5 N•m (4 lb-ft)
EUI Harness-to-Shaft Clamps	Torque	35 N•m (26 lb-ft)

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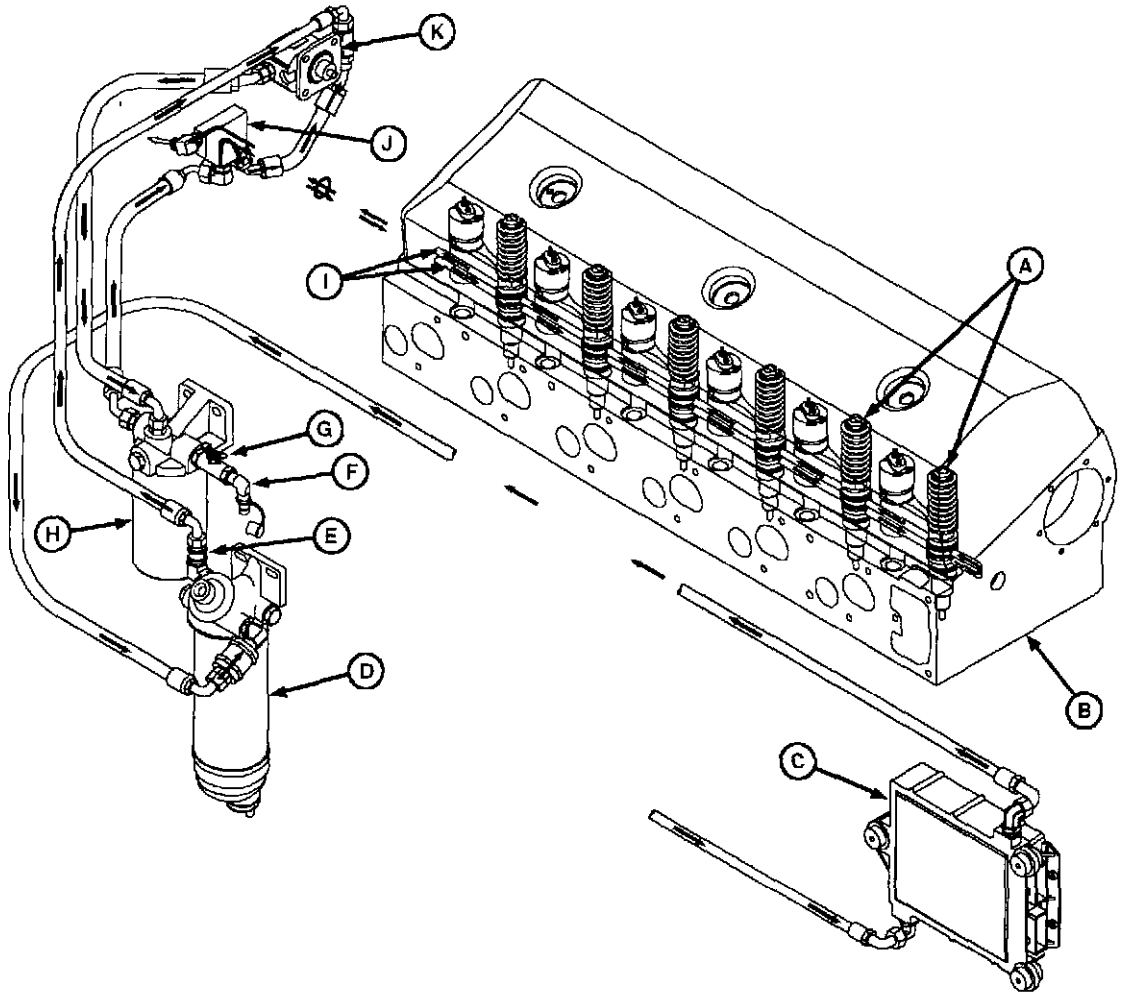
Item	Measurement	Specification
EUI Wiring Connector Bracket-to-Head	Torque	25 N•m (18 lb-ft)
EUI Adjusting Screw Lock Nut	Torque	65 N•m (48 lb-ft)
Timing Pin Plug in Cylinder Block	Torque	33 N•m (24 lb-ft)

DPSG,OUO1004,981 –19–04AUG99–2/2

DUAL RAIL FUEL SYSTEM COMPONENTS (EARLIER ENGINES)



RG10359 –UN–04OCT99

Fuel System Components (Dual Rail)

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

Earlier engines have the dual rail fuel system shown above. Later engines have a single rail fuel system and are covered in Group 36 which follows.

6125ADW engines and 6125HF(AF) are shown above. 6015HRW and 6125HRW engines have fuel system components located on left side of engine as viewed from flywheel end (see page 35-25). Service procedures are same for both engines.

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

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

RG,RG34710,257 –19–03AUG99–1/1

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6

REPLACE FINAL (SECONDARY) FUEL FILTER ELEMENT

REMOVE OLD FINAL FUEL FILTER

1. Close fuel shut-off valve at bottom of fuel tank (not illustrated).
2. Clean entire area surrounding fuel filter assembly to keep debris from entering fuel system.
3. Remove final fuel filter using a suitable filter wrench (A). Dispose of fuel and filter in an environmentally safe manner.

INSTALL NEW FINAL FUEL FILTER

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

Fuel Filter Bracket-to-Head—Specification

Torque ..... 35 N•m (26 lb-ft)

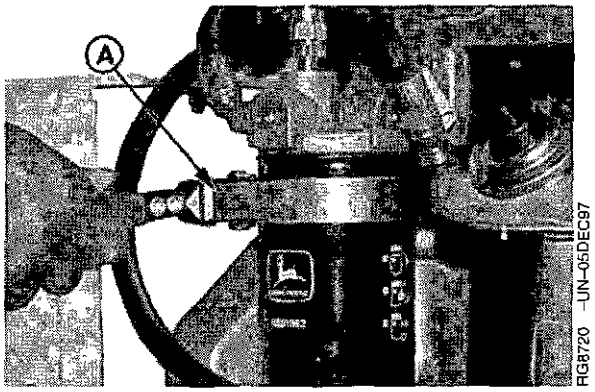
Fuel Filter Bracket-to-Block—Specification

Torque ..... 65 N•m (48 lb-ft)

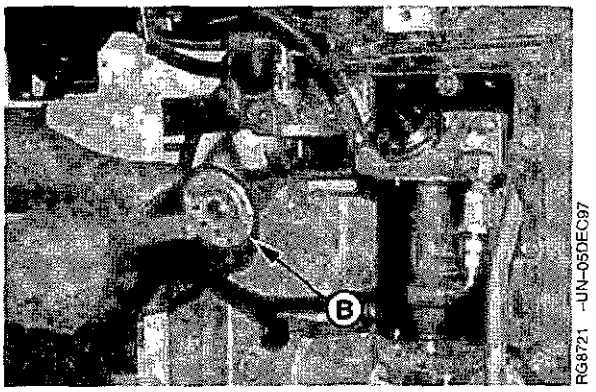
Fuel Filter-to-Air Intake—Specification

Torque ..... 25 N•m (18 lb-ft)

2. Clean filter gasket sealing surface with a clean, lint-free towel.
3. Apply a light coating of clean engine oil to filter gasket/O-ring (B).
4. Fill filter element with clean diesel fuel.
5. Install filter element onto threaded adapter and tighten until gasket contacts sealing surface on mounting base. Then, tighten an additional 3/4 turn.
6. Open fuel shut-off valve and bleed the fuel system. (See BLEED FUEL SYSTEM later in this group.)



Removing Final Fuel Filter



Installing Final Fuel Filter

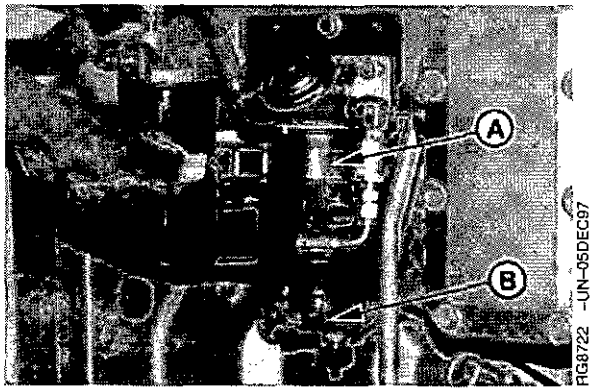
A—Fuel Filter
B—Filter Gasket/O-Ring

RG,RG34710,258 –19–03AUG99–1/1

REPLACING PRIMARY FUEL FILTER/WATER SEPARATOR

REMOVE OLD PRIMARY FUEL FILTER/WATER SEPARATOR

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



Removing Primary Fuel Filter

A—Primary Fuel Filter
B—Clear Water Separator Bowl

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8

INSTALL NEW PRIMARY FUEL FILTER/WATER SEPARATOR

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

Fuel Filter Bracket-to-Head—Specification

Torque ..... 35 N•m (26 lb-ft)

Fuel Filter Bracket-to-Block—Specification

Torque ..... 65 N•m (48 lb-ft)

Primary Fuel Filter-to-Bracket—Specification

Torque ..... 50 N•m (37 lb-ft)

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

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

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

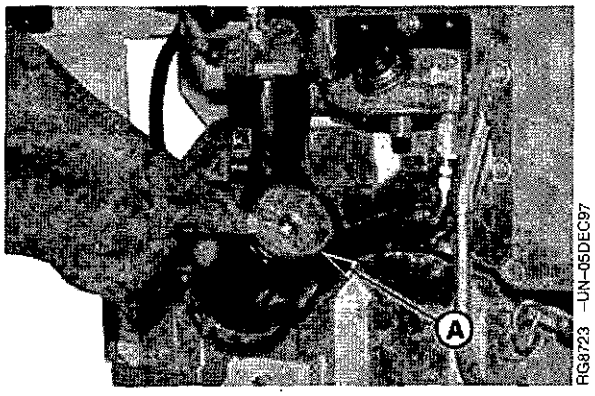
5. Install filter element onto threaded adapter and tighten until gasket contacts sealing surface on mounting base. Then, tighten an additional 1-1/2 turn.

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

Primary Fuel Filter Header Plugs—Specification

Torque ..... 47 N•m (35 lb-ft)

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



Installing Final Fuel Filter

A—Filter Gasket/O-Ring

RG,RG34710,259 –19–03AUG99–2/2

REMOVE AND INSTALL AIR PURGE VALVE

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

1. Disconnect fuel line (B) or remove elbow (D) as required.
2. Remove air purge valve.
3. Install air purge valve. Tighten line (B) to specifications.

Fuel Line-to-Fuel Filter/Air Purge Valve—Specification

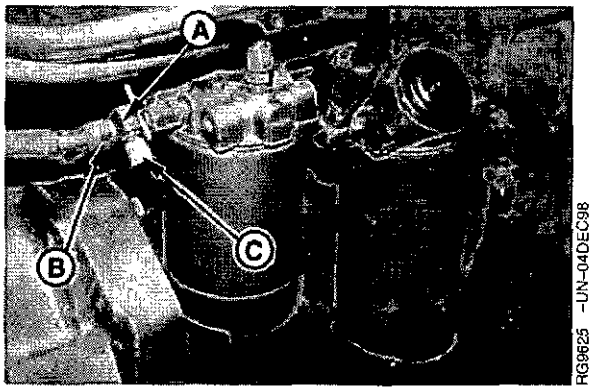
Torque ..... 24 N•m (18 lb-ft)

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

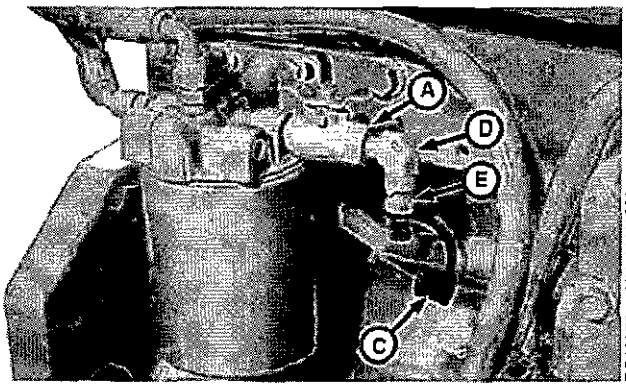
Air Purge Valve Diagnostic Port Fitting—Specification

Torque ..... 24 N•m (18 lb-ft)

5. Install cap (C).



In-Line Purge Valve



Header Mounted Purge Valve

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

DPSG,OUO1004,975 –19–03AUG99–1/1

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REMOVE AND INSTALL PRIMARY FUEL FILTER CHECK VALVE

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

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

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

Fuel Filter Check Valve to Fuel Filter Header or Elbow on Header—Specification

Torque ..... 46 N•m (34 lb-ft)

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

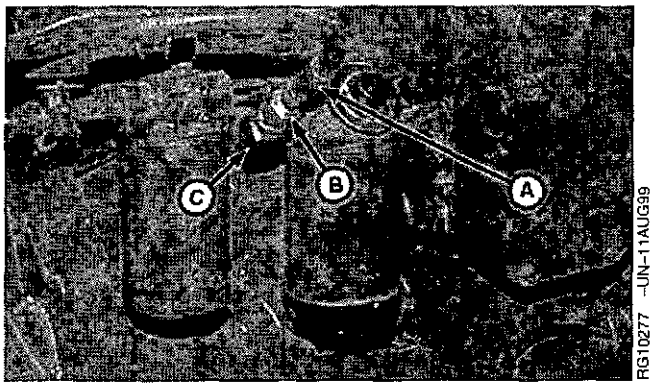
Elbow, Fuel Filter Check Valve-to-Filter Header—Specification

Torque ..... 46 N•m (34 lb-ft)

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

Fuel Line-to-Fuel Filter Check Valve—Specification

Torque ..... 24 N•m (18 lb-ft)



Fuel Filter Check Valve

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

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DPSG,OUO1004,976 –19–03AUG99–1/1

REMOVE AND INSTALL FUEL SYSTEM SURGE TANK (6125ADW01/70 ENGINES)

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

   Cap and plug all lines and fittings to prevent fuel system contamination.
3. Remove surge tank (A) from mounting bracket (B).
4. If fuel line adapters (C) and (F) are removed, install new O-rings in adapters and install adapters in surge tank. Tighten adapters to the following specifications.

Surge Tank Fuel Line Adapter (Top)—Specification

Torque ..... 46 N•m (34 lb-ft)

Surge Tank Fuel Line Adapter (Bottom)—Specification

Torque ..... 24 N•m (18 lb-ft)

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

Surge Tank Mounting Bracket-to-Cylinder Head Cap Screws—Specification

Torque ..... 130 N•m (95 lb-ft)

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

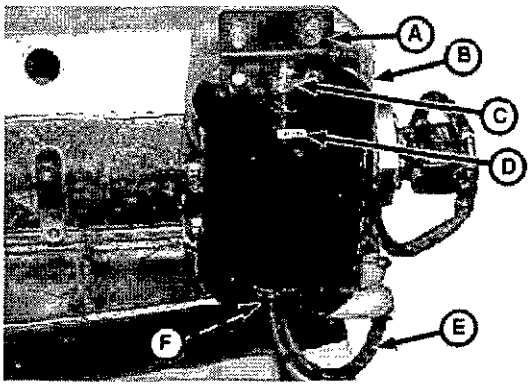
Surge Tank-to-Mounting Bracket Cap Screws—Specification

Torque ..... 50 N•m (37 lb-ft)

7. Connect fuel lines and tighten to specifications.

Surge Tank Fuel Lines—Specification

Torque ..... 24 N•m (18 lb-ft)



RG10292 –UN–09SEP99

Surge Tank

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

DPSG,OUO1004,1007 –19–19AUG99–1/1

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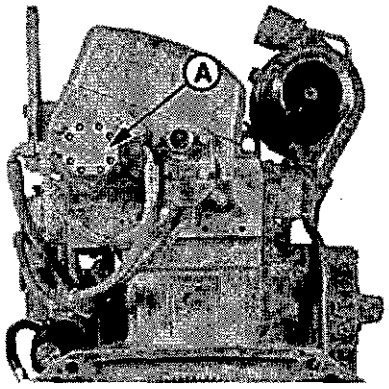
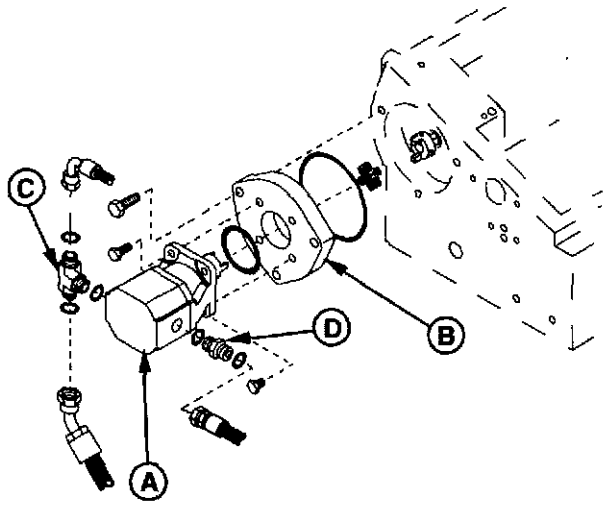
REMOVE AND INSTALL DUAL RAIL FUEL SUPPLY PUMP



RG8566A –UN–05DEC97

Removing Fuel Supply Pump



RG8777 –UN–05DEC97

Fuel Supply Pump Exploded View

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

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

REMOVE FUEL MANIFOLD

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

1. Remove three fuel lines connected to fuel supply pump (A). Cap all lines and fitting to keep debris out of fuel system.
2. Remove four cap screws securing supply pump to mounting bracket (B) and remove pump. Remove and discard O-ring.

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

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

INSTALL FUEL SUPPLY PUMP

1. Install tee fitting and straight fitting onto new pump (using new O-rings) in same orientation as on original pump. Tighten fittings securely.
2. Ensure that drive coupler set screw is tightened to specifications on supply pump drive shaft with end of shaft flush with coupler ID. Check drive coupler on camshaft drive pin also, adjust as needed.

Fuel Supply Pump and Camshaft Drive Coupler Set Screws—Specification

Torque..... 4 N•m (3 lb-ft)

3. Position new rubber spider (vibration absorber) on drive coupler. Position new O-ring on face of supply pump.
4. If removed, apply AR54749 Soap Lubricant to new O-ring on supply pump mounting bracket (B) and install. Tighten mounting bracket cap screws to specifications.

Continued on next page

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Fuel Supply Mounting Bracket Cap Screws—Specification

Torque..... 50 N•m (37 lb-ft)

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

6. Install four cap screws and tighten to specifications.

Fuel Supply Pump-to-Bracket—Specification

Torque..... 25 N•m (18 lb-ft)

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

7. Install three fuel lines and tighten to specifications.

Fuel Line ORFS Fittings—Specification

Torque..... 24 N•m (18 lb-ft)

RG,RG34710,260 –19–04AUG99–2/2

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REMOVE AND INSTALL DUAL RAIL FUEL MANIFOLD

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

REMOVE FUEL MANIFOLD

1. Disconnect wiring lead from fuel temperature sensor (E).
2. Remove three fuel lines from fuel manifold (A). Cap all lines and fittings to keep debris out of fuel system.

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

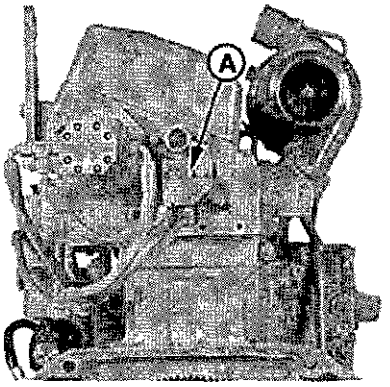
3. Remove two cap screws securing fuel manifold to cylinder head and remove manifold. Remove O-ring (B) and discard.

INSTALL FUEL MANIFOLD

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

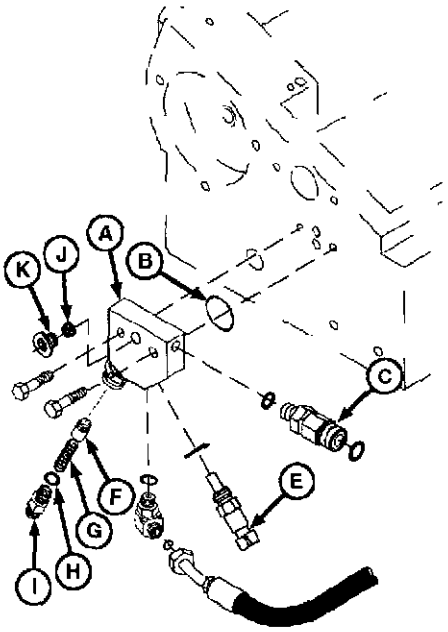
Dual Rail Fuel Manifold-to-Head—Specification

Torque	35 N•m (26 lb-ft)



RG8566B –UN–05DEC97

Fuel Manifold



RG10240 –UN–05NOV99

Fuel Manifold Exploded View

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

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

Continued on next page

RG,RG34710,261 –19–13AUG99–1/2

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

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

Fuel Lines-to-Fuel Manifold—Specification

Torque ..... 24 N•m (18 lb-ft)

3. Install fuel temperature sensor wiring lead.

RG,RG34710,261 –19–13AUG99–2/2

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INSPECT FUEL PRESSURE REGULATING VALVE AND RETURN CHECK VALVE

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

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

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

3. Remove fuel return check valve from manifold block.

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

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

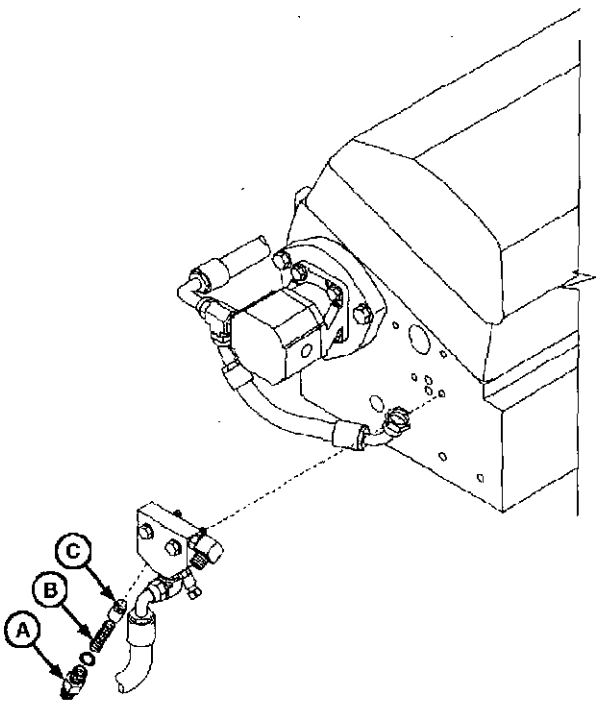
6. Whenever the fuel manifold is serviced, air must be removed from the fuel galley.

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

   Tighten check valve to specifications.

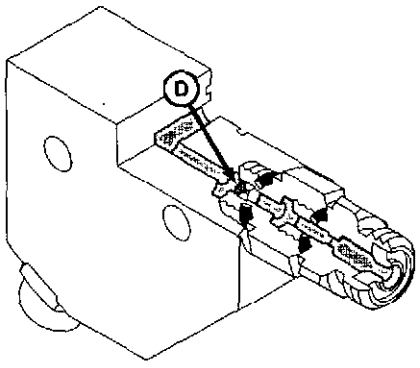
Fuel Return Check Valve (On Manifold)—Specification

Torque ..... 33 N•m (24 lb-ft)



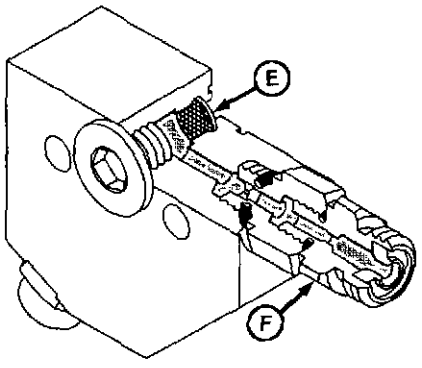
RG10348 —UN—14SEP99

Pressure Regulating Valve



RG10347 —UN—14SEP99

Check Valve with Screen



RG10346 —UN—14SEP99

Fuel Screen and Check Valve

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

Continued on next page

DPSG,OUO1004,1023 –19–08SEP99–1/2

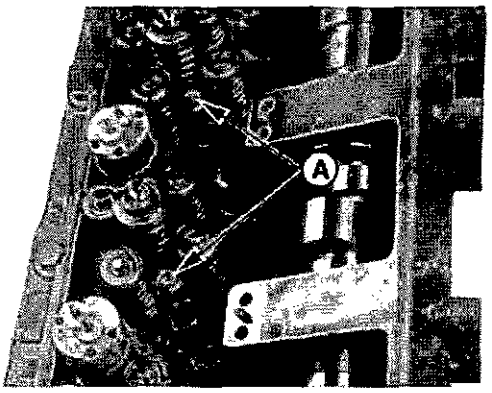
7. Bleed fuel system. (See BLEED FUEL SYSTEM later in this group.)

DPSG,OUO1004,1023 -19-08SEP99-2/2

REMOVE AND INSTALL ELECTRONIC UNIT INJECTORS (DUAL RAIL FUEL SYSTEMS)

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

1. Remove rocker arm cover. (See REMOVE AND INSTALL ROCKER ARM COVER in Group 05.)
2. Remove rocker arm shaft assembly. (See REMOVE ROCKER ARM SHAFT ASSEMBLY in Group 05.)
3. Disconnect fuel lines and drain fuel from lines and fuel rail in cylinder head.
4. Reconnect lines (or install cap plugs from JDG998 cap plug kit) to keep debris out of fuel system.
5. Remove injector hold down clamp cap screws (A).



RG6279 -UN-05DEC97

Unit Injector Clamp Screws

A—Clamp Cap Screws

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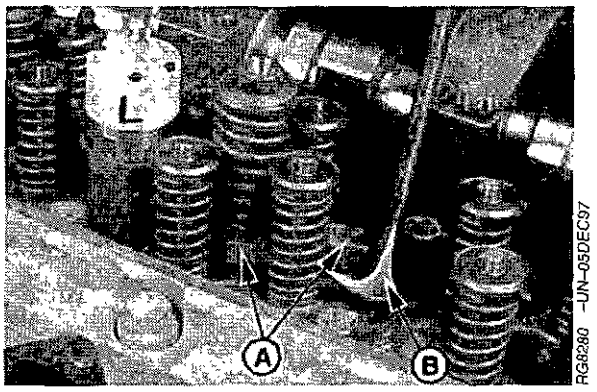
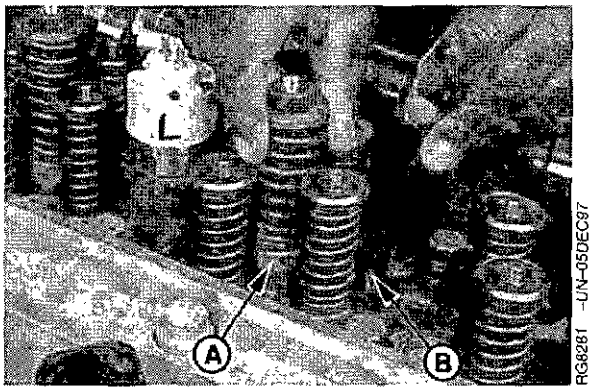
RG,RG34710,262 -19-04AUG99-1/5

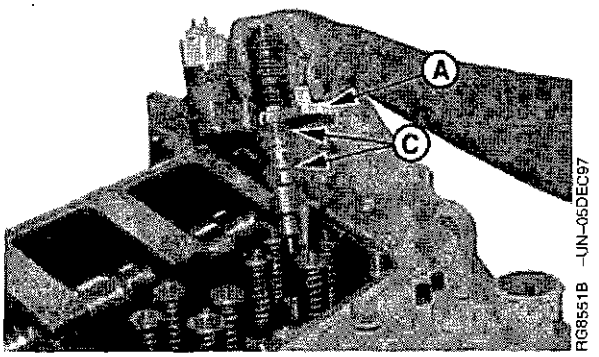
6. Pry upward on the injector hold down clamp (A) against cylinder head using a prybar (B) as shown.
7. Remove injector and clamp from cylinder head. Label injector for installation in same cylinder location as removed.
8. Immediately plug injector bore with clean cap plug to keep debris out of fuel system.
9. Remove injector O-rings (C) and discard.
10. Store injector in a clean, lint-free container.



Position Prybar



Removing Unit Injector



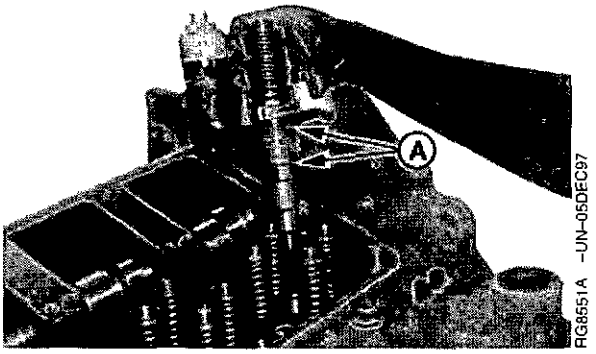
Unit Injector Removed

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

Continued on next page

INSTALL ELECTRONIC UNIT INJECTORS

1. Remove cap plug from injector bore in cylinder head. Clean entire sleeve using a clean, lint-free cloth wrapped around a wooden stick.
2. Install two new O-rings (A) on unit injector body. Lubricate O-rings with clean engine oil or AMOJELL lubricant.



Installing Unit Injector

A—O-Rings

Continued on next page

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

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

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

EUI Hold-Down Clamp Cap Screws—Specification

Initial Torque ..... 20 N•m (15 lb-ft)

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

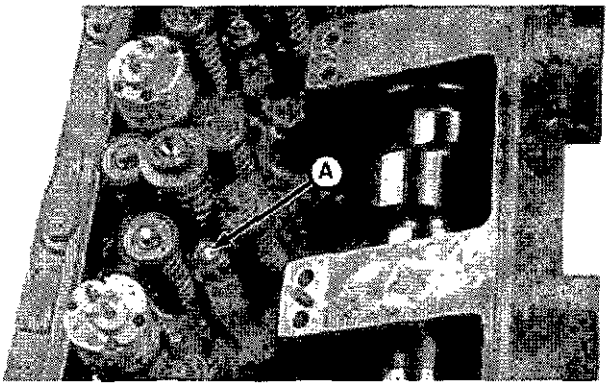
5. Install 13 mm swivel socket on head of cap screw. Position ratchet handle (B) parallel with centerline of engine camshaft/crankshaft.

   TORQUE-TURN cap screw to the following specification.

EUI Hold-Down Clamp Cap Screws—Specification

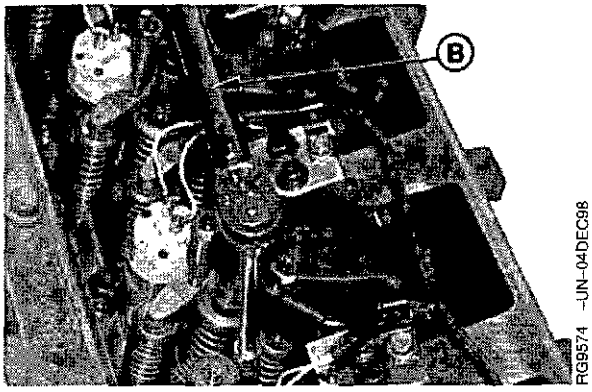
Final TORQUE-TURN ..... 90—100°

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



RG10249 –JN–30JUL99

Injector Hold Down Clamp Screws



RG9574 –UN–04DEC98

TORQUE-TURN EUI

A—Clamp Cap Screw
B—Ratchet Handle

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

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

EUI Wiring Harness Connector Nuts—Specification

Torque ..... 2 N•m (1.75 lb-ft)

8. Install valve bridges, push tubes, and rocker arm assembly. Adjust valve stem-to-bridge clearances. (See INSTALL ROCKER ARM ASSEMBLY in Group 05.)

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

Fuel Line Clamps—Specification

Torque ..... 5 N•m (4 lb-ft)

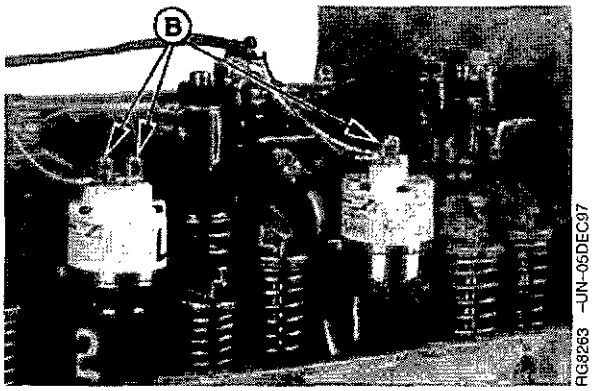
EUI Harness-to-Shaft Clamps—Specification

Torque ..... 35 N•m (26 lb-ft)

EUI Wiring Connector Bracket-to-Head—Specification

Torque ..... 25 N•m (18 lb-ft)

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



Wiring Terminal Nuts

B—Retaining Nuts

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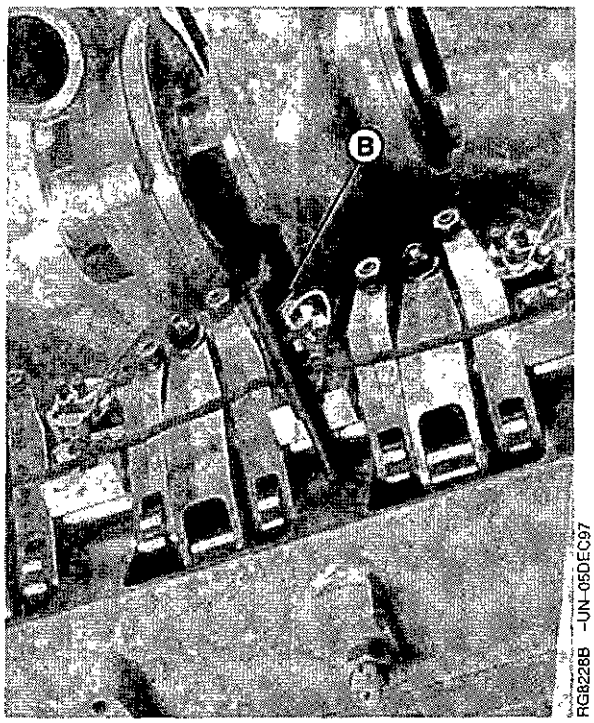
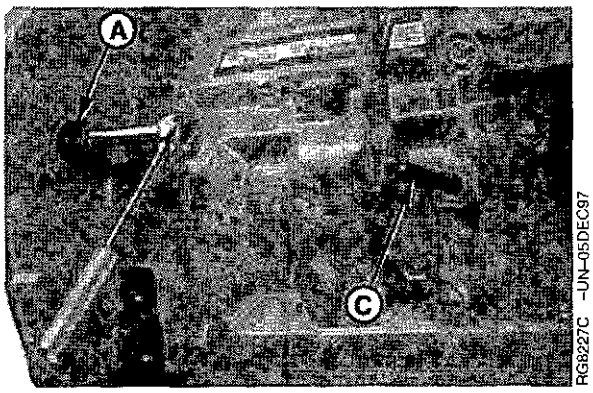
ADJUST ELECTRONIC UNIT INJECTOR PRELOAD

1. Remove plug from cylinder block and install JDG820 Flywheel Turning Tool (A).
2. Rotate engine flywheel in running direction until *JDG971 Timing Pin (B) engages slot in camshaft. This* ensures that engine is locked at TDC of No. 1 cylinder's compression stroke. Intake and exhaust rocker arms on No. 1 cylinder should be loose.
3. Remove threaded plug from crankshaft timing hole below oil cooler and filter housing assembly.
4. Slightly move engine flywheel back and forth with *turning tool until a second JDG971 Timing Pin (C) can* be installed in slot in crankshaft. This ensures that camshaft and crankshaft are in sync (properly timed).

   If timing pin does not enter crankshaft timing slot, crankshaft MUST BE timed to camshaft. (See CHECK AND ADJUST CAMSHAFT-TO-CRANKSHAFT TIMING in Group 16.)



JDG971 Timing Pin in Camshaft



JDG971 Timing Pin in Crankshaft

A—Flywheel Turning Tool
B—Timing Pin
C—Timing Pin

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5. Loosen lock nut (A) and loosen cylinder No. 3, 5, and 6 injector rocker arm adjusting screws (B) to relieve tension.
6. Slowly tighten adjusting screw until rocker arm roller contacts camshaft lobe at 0.0 clearance.
7. Tighten adjusting screw an additional 1/2 turn (180°) to preload injector. Tighten adjusting screw lock nut to specifications while holding adjusting screw stationary.

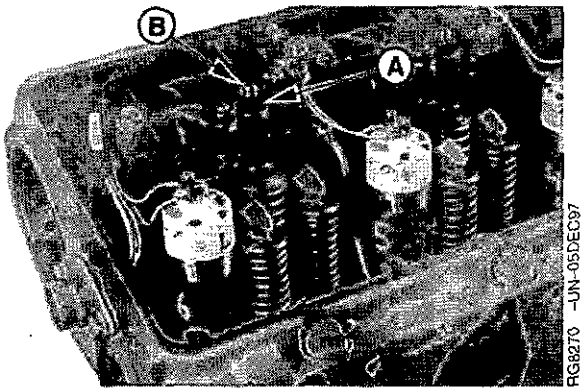
EUI Adjusting Screw Lock Nut—Specification

Torque ..... 65 N•m (48 lb-ft)

8. Remove both timing lock pins, rotate crankshaft one full revolution (360°) and pin crankshaft only. Engine will now be locked at No. 6 TDC.
9. Set injector preload on cylinders Nos. 1, 2, and 4.
10. Install plug in timing pin hole in block and tighten to specifications.

Timing Pin Plug in Cylinder Block—Specification

Torque ..... 33 N•m (24 lb-ft)



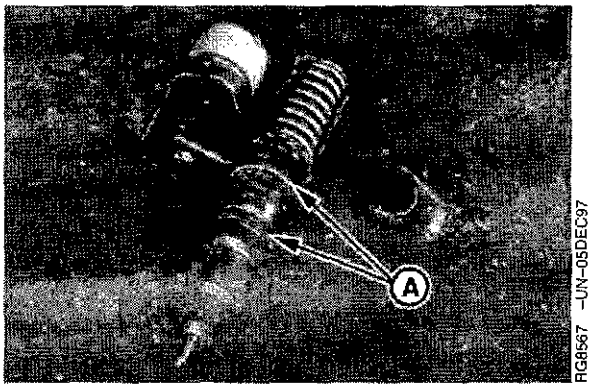
Unit Injector Adjusting Screw

A—Lock Nut
B—Adjusting Screws

RG,RG34710,263 –19–04AUG99–2/2

REPLACE ELECTRONIC UNIT INJECTOR O-RINGS

1. The electronic unit injector's two external O-rings (A) must be replaced whenever injector is removed.
2. Fuel system diagnosis will determine if unit injector is not functioning properly. Refer to CTM115 (Lucas Controllers) or CTM188 (Deere Controllers), Engine Operation and Diagnostics.
3. Replaced unit injectors will be returned by your authorized servicing dealer to the manufacturer for testing and rebuilding.



Unit Injector and Clamp

A—O-Rings

RG,RG34710,264 –19–30SEP97–1/1

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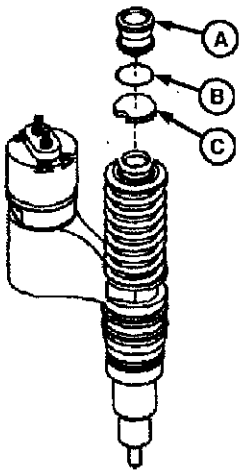
24

REPLACE ELECTRONIC UNIT INJECTOR THRUST SLEEVE, PAD AND O-RING

1. Using an O-ring pick, remove O-ring (B).
2. Remove thrust socket (A) and pad (C).
3. Coat parts with clean engine oil and install in reverse order.



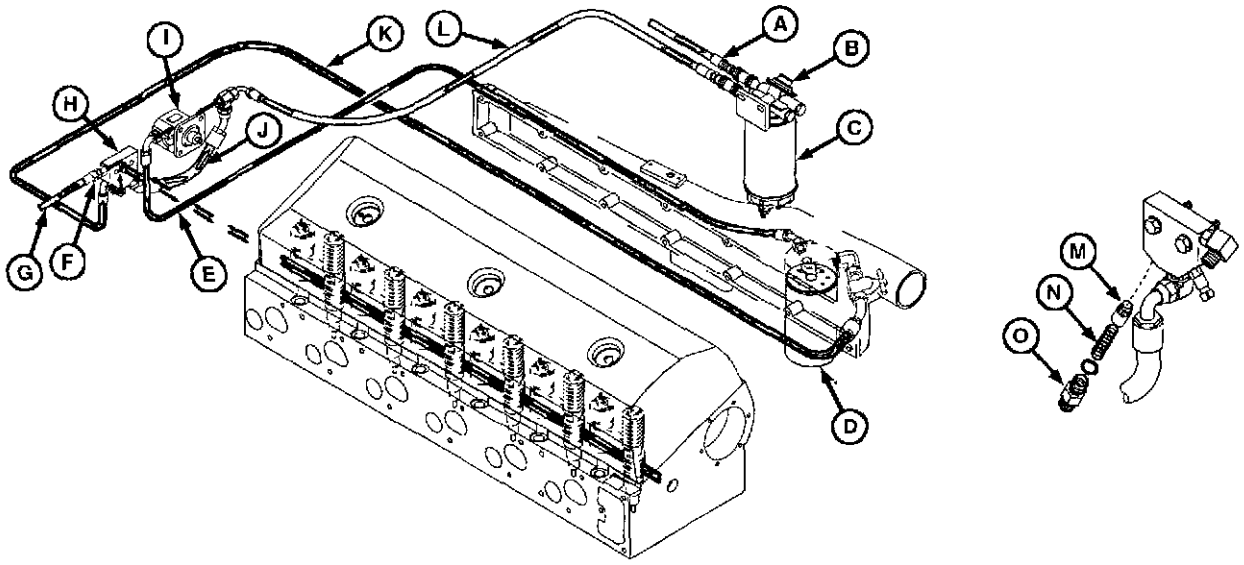
RG10352 –UN–16SEP99

Electronic Unit Injector

A—Thrust Socket
B—O-Ring
C—Thrust Pad

DPSG,OUO1004,1027 –19–15SEP99–1/1

FLUSH FUEL RAILS



RG10345 –UN–14SEP99

Flush Fuel Rail

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

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

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

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

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

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

5. Stop engine.

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

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

8. Tighten fuel lines to specifications.

Continued on next page

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Fuel Line ORFS Fittings—Specification

Torque..... 24 N•m (18 lb-ft)

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

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

Tighten check valve to specifications.

Fuel Return Check Valve (On Manifold)—Specification

Torque..... 33 N•m (24 lb-ft)

DPSG,OUO1004,1024 -19-08SEP99-2/2

BLEED FUEL SYSTEM

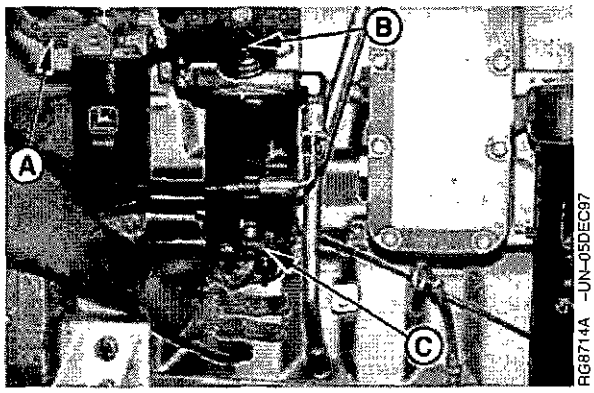
Whenever the fuel system has been opened up for service (lines disconnected or filters removed), it will be necessary to bleed air from the system.

1. Drain water and contaminates from clear water separator sediment bowl (C) by opening drain valve and operating primer until bowl is clear of water and debris.
2. Loosen secondary (final) fuel filter outlet line (A) or remove cap and open air purge valve (D), (if equipped).
3. Pump hand primer (B) on primary filter until a steady flow of fuel (without bubbles) comes out of connection.
4. Continue pumping hand primer and simultaneously close purge valve or tighten outlet line connection to specifications. DO NOT overtighten.

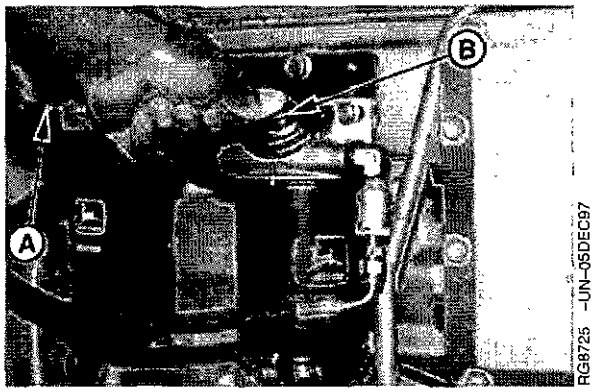
Fuel Filter Outlet Line—Specification

Torque ..... 24 N•m (18 lb-ft)

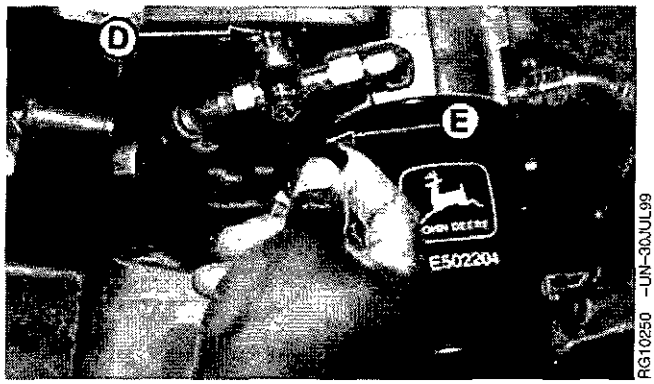
5. Start engine and run at high idle for 5-10 minutes.



Draining Water Separator



Bleeding Fuel System



Air Purge Valve

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

RG,RG34710,265 –19–04AUG99–1/1

ESSENTIAL TOOLS

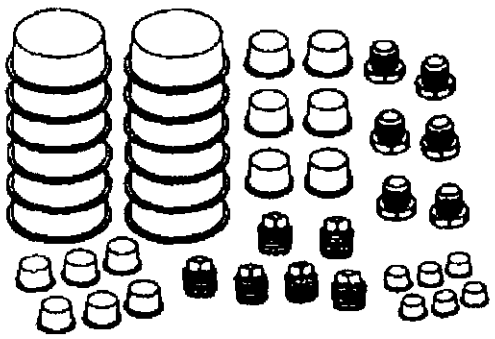
NOTE: Order tools according to information given in the U.S. SERVICEGARD™ Catalog or from the European Microfiche Tool Catalog (MTC).

SERVICEGARD is a trademark of Deere & Company

DPSG,OUO1004,1017 –19–30AUG99–1/4

Fuel System Cap Plug Kit JDG998

Use to protect the fuel system from dirt and debris when disconnecting fuel system components during routine maintenance and service.



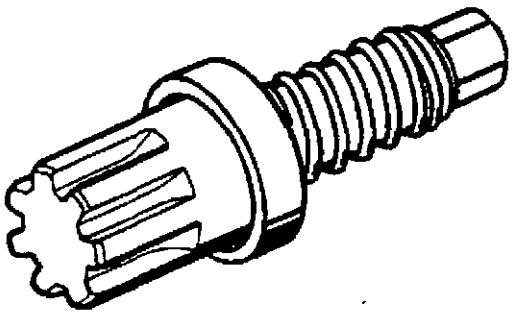
RG8518 –UN–20MAY98

JDG998

DPSG,OUO1004,1017 –19–30AUG99–2/4

Flywheel Turning Tool JDG820

Use to rotate engine flywheel to find cylinder No. 1 and No. 6 "Top Dead Center" when adjusting electronic unit injector (EUI) preload. Use with JDG971 Timing Pins.



RG7056 –UN–05DEC97

JDG820

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DPSG,OUO1004,1017 –19–30AUG99–3/4

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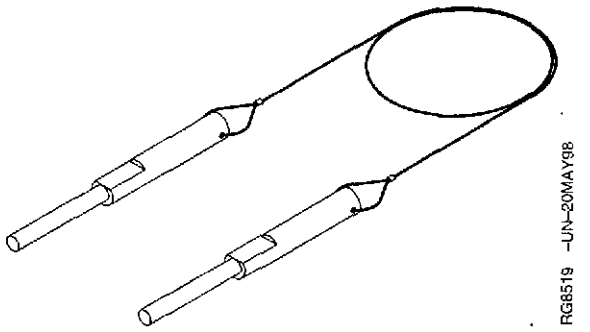
2

Cam/Crankshaft Timing Lock Pins JDG971

Set of 2. Use to lock camshaft and crankshaft at "Top Dead Center" during timing gear backlash adjustment. Use on crankshaft only for valve clearance and EUI preload adjustments.



JDG971

DPSG,OUO1004,1017 –19–30AUG99–4/4

OTHER MATERIAL

Number	Name	Use
T43512 (U.S.) TY9473 (Canadian) 242 (LOCTITE®)	Thread Lock and Sealer (Medium Strength)	Apply to fuel filter check valve (filter header end) and EUI hold-down clamp cap screws.
AR54749 (U.S.)	Soap Lubricant	Apply to fuel supply pump mounting bracket O-ring.
TY24311 (U.S.) CXTY24311 (Canadian) 222 (LOCTITE®)	Thread Lock and Sealer (Low Strength)	Electronic Unit Injector wiring connector stud nuts.

LOCTITE is a registered trademark of Loctite Corp.

DPSG,OUO1004,1019 –19–30AUG99–1/1

SINGLE RAIL FUEL SYSTEM SPECIFICATIONS

Item	Measurement	Specification
Fittings on Fuel Filter Housing		
M14 Fittings	Torque	14 N•m (10 lb-ft)
M16 Fittings	Torque	16 N•m (12 lb-ft)
M18 Fittings	Torque	18 N•m (13 lb-ft)
Water Separator Bowl-to-Filter Housing	Torque	5 N•m (44 lb-in.)
Fuel Filter Cap/Cover-to-Housing	Torque	5 N•m (44 lb-in.)
Low Pressure Regulating Valve-to-Filter Housing	Torque	18 N•m (13 lb-ft)
High Pressure Regulating Valve-to-Filter Housing	Torque	18 N•m (13 lb-ft)
100 Micron Internal Filter Housing Screen	Torque	20 N•m (15 lb-ft)
Fuel Filter Check Valve to Fuel Filter Housing	Torque	46 N•m (34 lb-ft)
Fuel Line-to-Fuel Filter Check Valve	Torque	24 N•m (18 lb-ft)
Fuel Primer (Single Rail Fuel System)	Torque	16 N•m (12 lb-ft)
Fuel Primer-to-Fuel Filter Housing Adapter (Single Rail Fuel System)	Torque	35 N•m (26 lb-ft)
Fuel Supply Pump and Camshaft Drive Coupler Set Screws	Torque	4 N•m (3 lb-ft)
Fuel Supply Pump Mounting Bracket Cap Screws	Torque	50 N•m (37 lb-ft)
Fuel Supply Pump-to-Bracket	Torque	25 N•m (18 lb-ft)

Continued on next page

Item	Measurement	Specification
Fuel Line ORFS Fittings	Torque	24 N•m (18 lb-ft)
EUI Hold-Down Clamp Cap Screws	Initial Torque	20 N•m (15 lb-ft)
EUI Hold-Down Clamp Cap Screws	Final TORQUE-TURN	90—100°
EUI Wiring Harness Connector Nuts	Torque	2 N•m (1.75 lb-ft)
Fuel Line Clamps	Torque	5 N•m (4 lb-ft)
EUI Harness-to-Shaft Clamps	Torque	35 N•m (26 lb-ft)
EUI Wiring Connector Bracket-to-Rear of Head	Torque	25 N•m (18 lb-ft)
EUI Adjusting Screw Lock Nut	Torque	65 N•m (48 lb-ft)
Crankshaft Timing Pin Plug in Cylinder Block	Torque	33 N•m (24 lb-ft)

DPSG,OUO1004,1033 –19–22SEP99–2/2

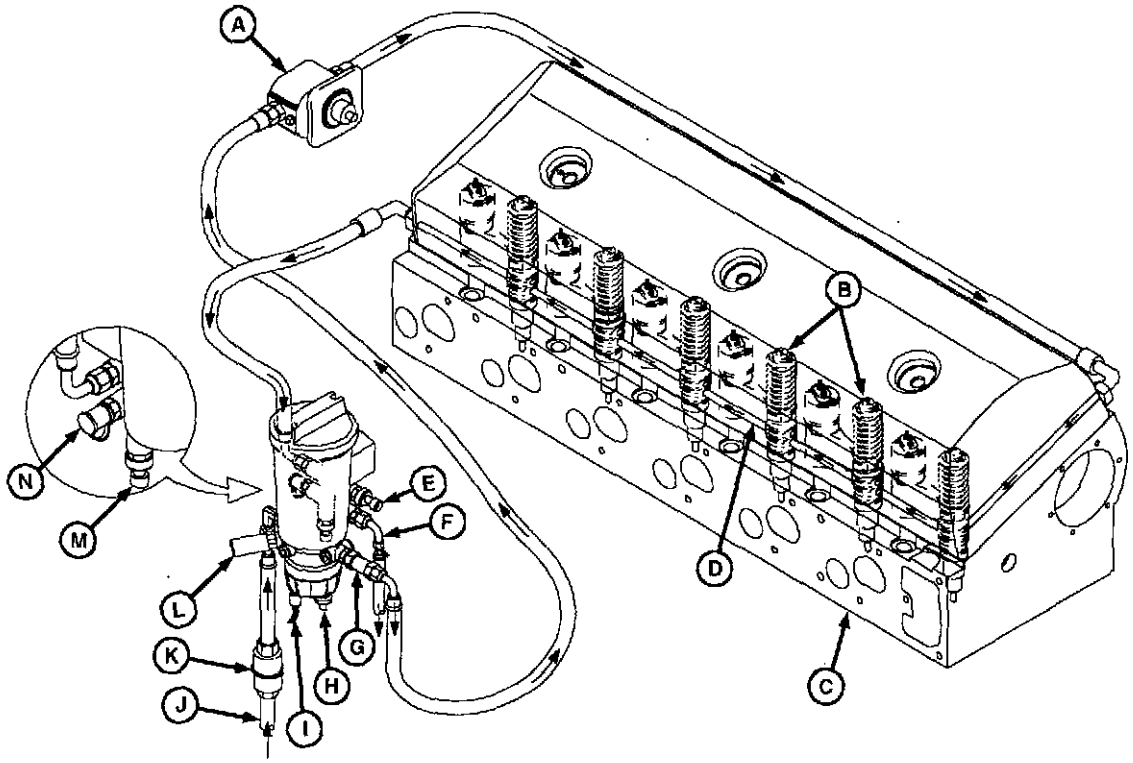
GENERAL INFORMATION

Later engines (1999—) have the single rail fuel system covered in this group. Earlier engines have the dual rail fuel system covered in Group 35.

IMPORTANT: Always use a new (dry) fuel filter element whenever an existing element is removed from the filter housing. Reusing a wet element may cause fuel to overflow from the filter housing during insertion of filter element. Also, trapped air in the core of a wet filter element may cause the engine to stall and not restart without additional system purging.

DPSG,OUO1004,1125 –19–20OCT99–1/1

SINGLE RAIL FUEL SYSTEM COMPONENTS (LATER ENGINES)



RG10287 –UN–26AUG99

Fuel System Components (Single Rail)

A—Fuel Supply Pump
B—Electronic Unit Injector [(EUI) 6 used]
C—Cylinder Head
D—Fuel Rail
E—Fuel Pressure Sensor
F—Return Line to Fuel Tank[1]
G—Check Valve
H—Water Drain
I—Water in Fuel Sensor
J—Inlet Line from Fuel Tank
K—Pre-Filter (Optional)
L—Fuel Primer
M—Fuel Temperature Sensor[2]
N—Diagnostic Test Port

NOTE: Fuel flow through cylinder head may vary by engine application. Supply pump (A) may be mounted as shown with fuel entering the front left hand side of the cylinder head and exiting the back of the head. On some machine applications, the fuel supply pump is rotated 180° and the fuel lines **on cylinder head** *are reversed, with fuel entering the back of the head and exiting the front left hand side of the head.*

6125ADW engines and 6125HF(AF) shown above. 6015HRW and 6125HRW engines have fuel system components located on left side of engine as viewed from flywheel end. Service procedures are same for both engines.

IMPORTANT: During engine repair, cleanliness of the fuel supply rail (D) in cylinder head (C) is extremely important due to fuel flow through passage. Think of the fuel rails as internal passages of an injection pump, therefore, same cleanliness must be maintained when disconnecting inlet and outlet lines to fuel supply rail.

Torque for fittings on fuel filter assembly are as follows:

[1] Low pressure regulating valve is inside this filter housing bore.

[2] High pressure regulating valve and filter screen is inside this filter housing bore behind temperature sensor.

Continued on next page

DPSG,OUO1004,996 –19–13AUG99–1/2

36
6

M14 Fittings—Specification

Torque	14 N•m (10 lb-ft)

M16 Fittings—Specification

Torque	16 N•m (12 lb-ft)

M18 Fittings—Specification

Torque	18 N•m (13 lb-ft)

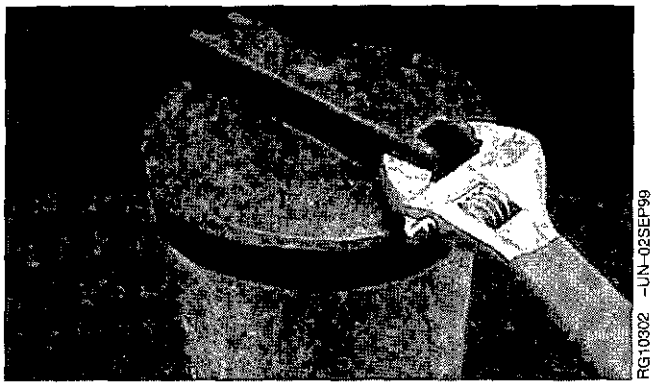
DPSG,OUO1004,996 –19–13AUG99–2/2

REPLACING FUEL FILTER/WATER SEPARATOR

REMOVE OLD FUEL FILTER ELEMENT

CAUTION: If engine has been running, engine and fuel filter housing may be hot.

1. Close fuel shut-off valve (if equipped).
2. Clean entire area surrounding fuel filter assembly to keep debris from entering fuel system.
3. Remove cap from fuel filter housing. If cap is too tight, a wrench or pliers may be used to loosen cap as shown.



RG10302 –UN–02SEP99

Filter Cap

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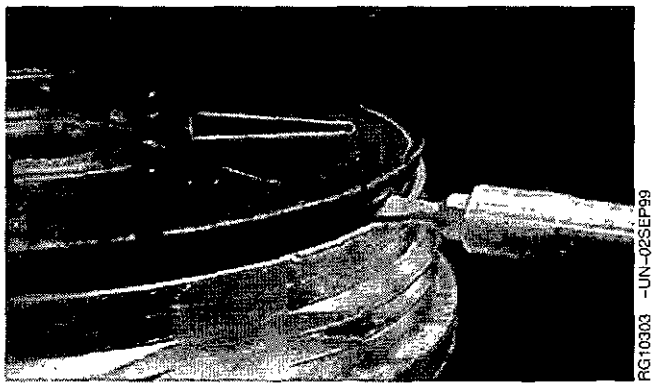
DPSG,OUO1004,1015 –19–24AUG99–1/5

4. Relieve vacuum in filter housing by operating hand primer until fuel filter "pops-up". If filter does not "pop-up" after about 30 strokes of primer, a small screwdriver may be used as shown to **carefully** pry under filter flange to relieve vacuum in the housing.



Relieve Vacuum

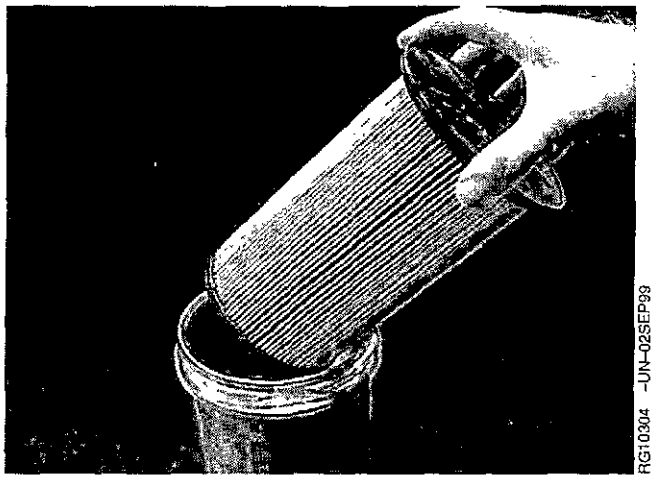
DPSG,OUO1004,1015 -19-24AUG99-2/5

5. Lift filter element up in housing until filter seal clears inlet tube inside housing. Continue to hold filter suspended straight up in top of housing to drain fuel from filter.

6. Allow fuel to drain completely from filter into housing. Carefully begin rotating filter from housing as shown until completely upside down to ensure minimal leakage from fuel filter.

7. Place filter in container suitable for diesel fuel.

IMPORTANT: Reusing fuel filter once removed from housing may result in trapped air in the filter, causing fuel to overflow from the filter housing during insertion of filter element and/or cause the engine to stall and not restart without additional system purging.



Remove Filter Element

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DPSG,OUO1004,1015 -19-24AUG99-3/5

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8

REMOVE AND INSTALL WATER SEPARATOR BOWL

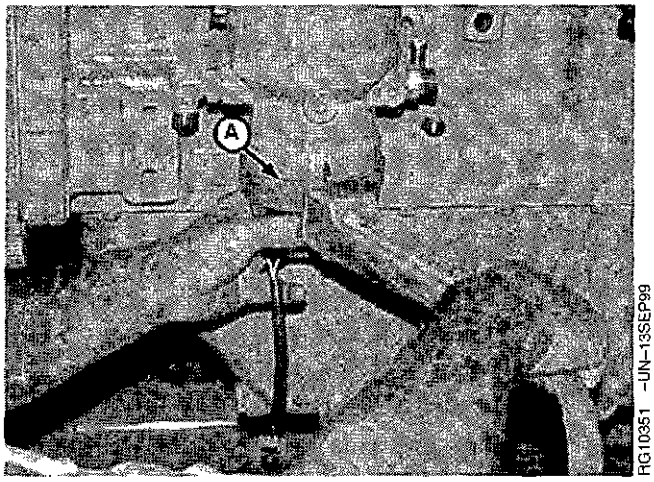
IMPORTANT: Use the least amount of force as necessary with strap wrench when removing and installing separator bowl to prevent plastic bowl from cracking.

1. Disconnect wiring connector from water-in-fuel sensor.
2. Drain fuel from separator bowl.
3. Position a strap wrench (A) as close as possible to top edge of separator bowl. While applying pressure with strap wrench, grip bowl and twist with other hand as shown to remove bowl.
4. Install separator bowl and tighten by hand until seal makes contact. Tighten to the following specification.

Water Separator Bowl-to-Filter Housing—Specification

Torque ..... 5 N•m (44 lb-in.)

5. Connect wiring to water-in-fuel sensor.



Water Separator Bowl

A—Strap Wrench

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INSTALL NEW FUEL FILTER ELEMENT

1. Check to ensure that the fuel level in the filter housing is between the MIN (B) and MAX (A) fuel levels indicated on the outside of the housing and on the corresponding marks on the center tube. If the fuel is below the MIN level, then carefully open the fuel supply shut-off valve a small amount (if equipped) to add fuel.

   Operate the hand primer to add more fuel if required or if the unit is not equipped with a fuel supply shut-off valve.

IMPORTANT: Fuel level below the MIN indication may result in trapped air in the filter causing the engine to stall and not restart without additional system purging. Fuel level above the MAX indication may cause fuel to overflow from the filter housing during insertion of filter element.

Always use a new filter element whenever an existing element has been removed from filter housing.

2. Insert **new** (dry) fuel filter into filter housing.

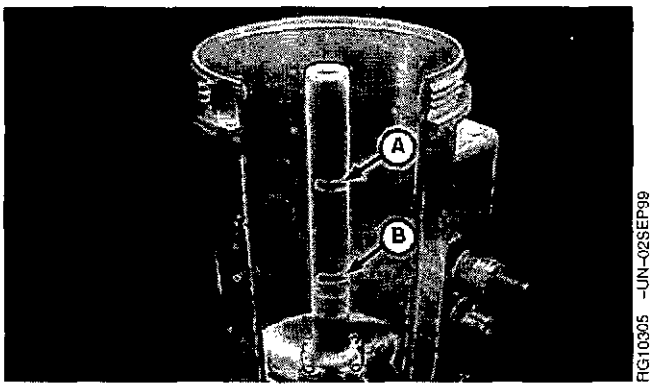
3. Reinstall fuel filter cap and tighten by hand to the following specification.

Fuel Filter Cap/Cover-to-Housing—Specification

Torque ..... 5 N•m (44 lb-in.)

4. Open the fuel supply shut-off valve (if equipped).

5. Restart engine and allow to run for 5 minutes minimum at slow idle.



Fuel Level in Filter Housing

A—Maximum Level (2-1/2 Inches from Top of Housing)
B—Minimum Level (5 Inches from Top of Housing)

DPSG,OUO1004,1015 –19–24AUG99–5/5

36 10

REMOVE AND INSTALL LOW PRESSURE REGULATING VALVE

1. Close fuel shut-off valve if equipped.

NOTE: On high fuel tank applications without fuel shut-off valve, fuel tank return line must be pinched before disconnecting, then plugged,

2. Disconnect fuel tank return line from filter housing and drain fuel into clean container.

3. Remove low pressure regulating valve parts (A—G).

   To remove valve seat (B), use a standard wire tie strap with approximate 5/16 x 3/16 inch square head. Insert tie strap head through bore of valve seat, rotate to catch lip of seat and remove seat.

4. Clean and inspect all parts. Replace all O-rings and seals.

5. Install parts in reverse order.

   Install valve seat (B) (O-ring end first) into bore of filter housing. Make sure it is firmly seated in bore.

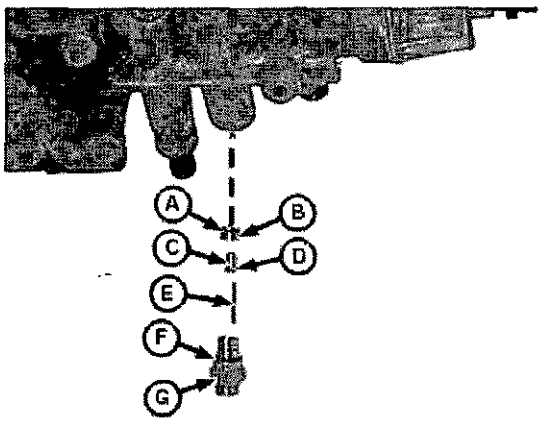
   Install seal (D) with tapered edge of seal into lip of regulating valve (C).

   Spring (E) is color coded blue, identifying it as the low pressure spring.

   Tighten valve housing (G) to specifications.

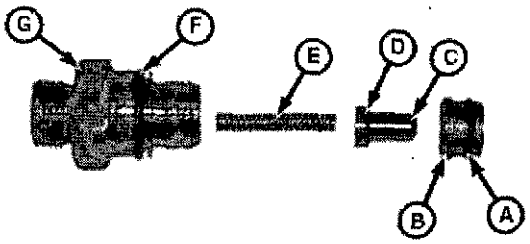
Low Pressure Regulating Valve-to-Filter Housing—Specification

Torque ..... 18 N•m (13 lb-ft)



RG10354 –UN–17SEP99

Low Pressure Regulating Valve



RG10356 –UN–17SEP99

Valve Components

A—O-Ring
B—Valve Seat
C—Low Pressure Regulating Valve
D—Seal
E—Spring, Low Pressure (Color Coded Blue)
F—O-Ring
G—Valve Housing

DPSG,OUO1004,1029 –19–16SEP99–1/1

REMOVE AND INSTALL HIGH PRESSURE REGULATING VALVE

1. Close fuel shut-off valve if equipped.

NOTE: On high fuel tank applications without fuel shut-off valve, fuel tank return line must be pinched before disconnecting, then plugged,

2. Disconnect fuel tank return line from filter housing and drain fuel into clean container.

3. Open valve on water separator bowl and drain filter housing.

4. Remove fuel temperature sensor (I). (See REMOVE AND INSTALL FUEL TEMPERATURE SENSOR in Group 46.)

5. Remove high pressure regulating valve parts (B—J).

   To remove valve seat (C), use a standard wire tie strap with approximate 5/16 x 3/16 inch square head. Insert tie strap head through bore of valve seat, rotate to catch lip of seat and remove seat.

6. To remove screen (A), see REMOVE AND INSTALL 100 MICRON INTERNAL FILTER HOUSING SCREEN INSERT next in this group.

7. Clean and inspect all parts. Replace all O-rings and seals.

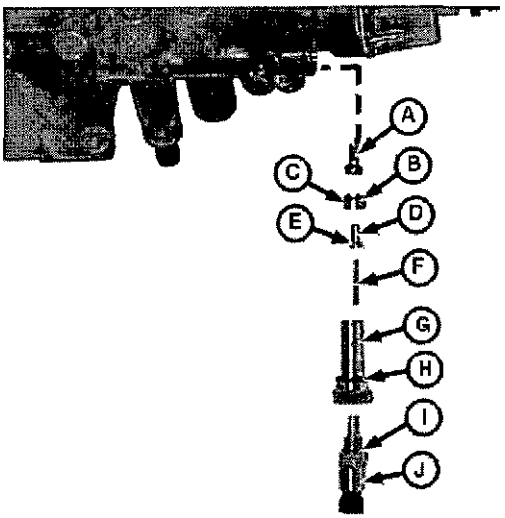
8. Install parts in reverse order.

   If removed, install screen (A). (See REMOVE AND INSTALL 100 MICRON INTERNAL FILTER HOUSING SCREEN INSERT next in this group.)

   Install valve seat (C) (O-ring end first) into bore of filter housing. Make sure it is firmly seated in bore.

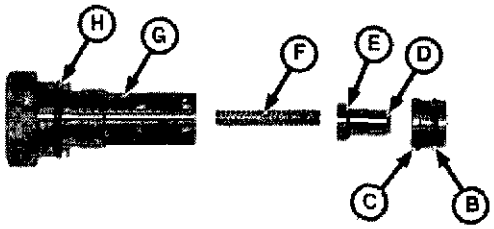
   Install seal (E) with tapered edge of seal into lip of regulating valve (D).

   Spring (F) is color coded red, identifying it as the high pressure spring.



RG10355 –UN–17SEP99

High Pressure Regulating Valve



RG10357 –UN–17SEP99

Valve Components

A—Screen
B—O-Ring
C—Valve Seat
D—High Pressure Regulating Valve
E—Seal
F—Spring, High Pressure (Color Coded Red)
G—Valve Housing
H—O-Ring
I—O-Ring
J—Fuel Temperature Sensor

Continued on next page

Tighten valve housing (G) to specifications.

High Pressure Regulating Valve-to-Filter Housing—Specification

Torque ..... 18 N•m (13 lb-ft)

9. Install fuel temperature sensor (I). (See REMOVE AND INSTALL FUEL TEMPERATURE SENSOR in Group 46.)

10. Add fuel to filter housing between minimum and maximum marks on housing. Fuel can be added by throttling the fuel shut-off valve (if equipped), or by removing cover and adding fuel from a clean container.

DPSG,OUO1004,1014 –19–23AUG99–2/2

REMOVE AND INSTALL 100 MICRON INTERNAL FILTER HOUSING SCREEN INSERT

1. Remove high pressure regulator valve parts (B—H). (See REMOVE AND INSTALL HIGH PRESSURE REGULATING VALVE earlier in this group.) Remove fuel temperature sensor parts (I) and (J). (See REMOVE AND INSTALL FUEL TEMPERATURE SENSOR in Group 45.)

IMPORTANT: If allen wrench is pushed too far into 10 micron screen during removal and installation, screen may be damaged. Tie a rubber band (K) approximately 10 mm (3/8 in.) from end of allen wrench as shown to prevent screen damage.

NOTE: Screen is approximately 91 mm (3-5/8 in.) up in bore of filter housing. Use a long allen wrench.

2. Attach a rubber band (K) on end of 5 mm allen wrench and remove 10 micron screen (A) from filter housing.

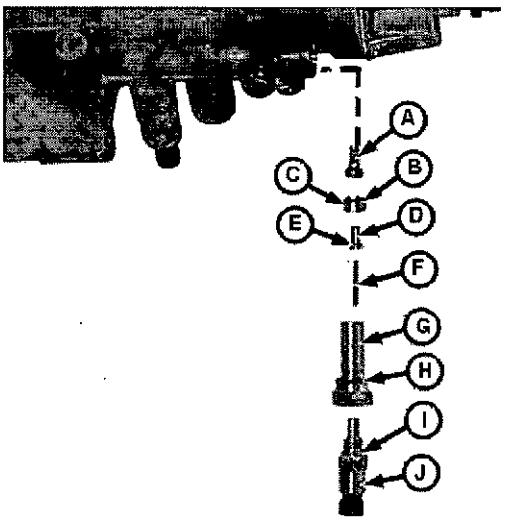
3. Clean and inspect screen.

4. Using allen wrench with rubber band, install screen in filter housing and tighten to the following specification.

100 Micron Internal Filter Housing Screen—Specification

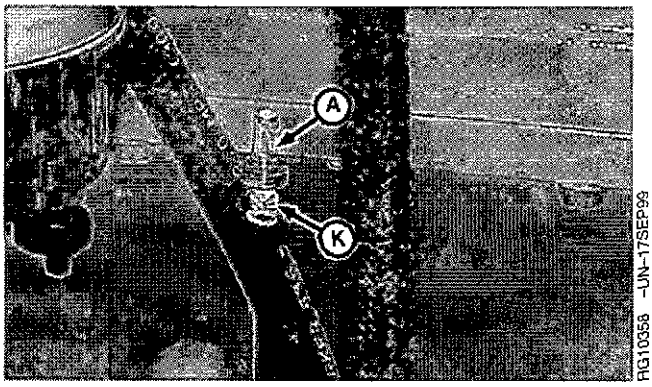
Torque ..... 20 N•m (15 lb-ft)

5. Install pressure regulating valve parts (B—H). (See REMOVE AND INSTALL HIGH PRESSURE REGULATING VALVE earlier in this group.) Install fuel temperature sensor parts (I) and (J). (See REMOVE AND INSTALL FUEL TEMPERATURE SENSOR in Group 45.)



RG10355 –UN–17SEP99

Regulator Valve and Screen



RG10356 –UN–17SEP99

Screen

A—Screen (10 Micron)
B—O-Ring
C—Valve Seat
D—High Pressure Regulating Valve
E—Seal
F—Spring, High Pressure (Color Coded Red)
G—Valve Body
H—O-Ring
I—O-Ring
J—Fuel Temperature Sensor
K—Allen Wrench with Rubber Band

DPSG,OUO1004,1030 –19–16SEP99–1/1

REMOVE AND INSTALL FUEL FILTER CHECK VALVE

1. Close fuel shut-off valve (if equipped).
2. Disconnect fuel line (shown disconnected) and remove check valve (B). Remove O-rings (A) and (C) from both ends of check valve.
3. Install check valve in filter housing and tighten to specifications.

Fuel Filter Check Valve to Fuel Filter Housing—Specification

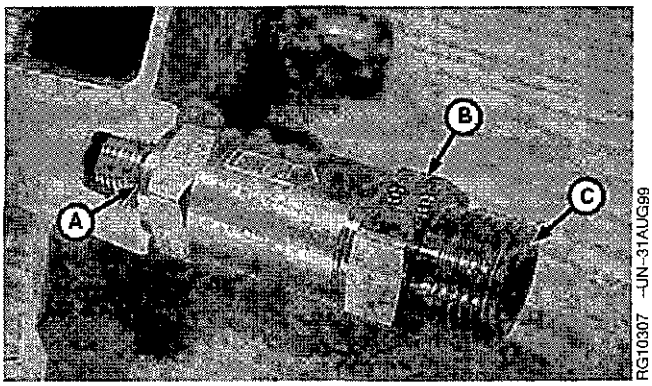
Torque ..... 46 N•m (34 lb-ft)

4. Connect fuel line and tighten to specifications.

Fuel Line-to-Fuel Filter Check Valve—Specification

Torque ..... 24 N•m (18 lb-ft)

5. Open fuel shut-off valve.



Fuel Filter Check Valve

A—O-Ring
B—Check Valve
C—O-Ring

DPSG,OUO1004,1016 –19–26AUG99–1/1

REMOVE AND INSTALL PRIMER PUMP

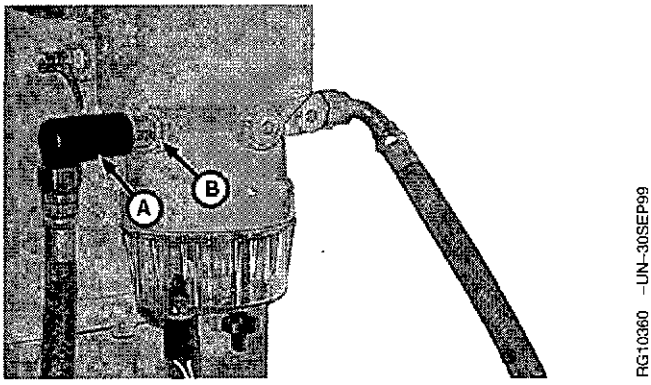
1. Remove primer pump (A).
2. If required, remove adapter (B).
3. Clean and inspect parts.
4. Install primer pump and adapter with new O-rings and tighten to specifications.

Fuel Primer (Single Rail Fuel System)—Specification

Torque ..... 16 N•m (12 lb-ft)

Fuel Primer-to-Fuel Filter Housing Adapter (Single Rail Fuel System)—Specification

Torque ..... 35 N•m (26 lb-ft)

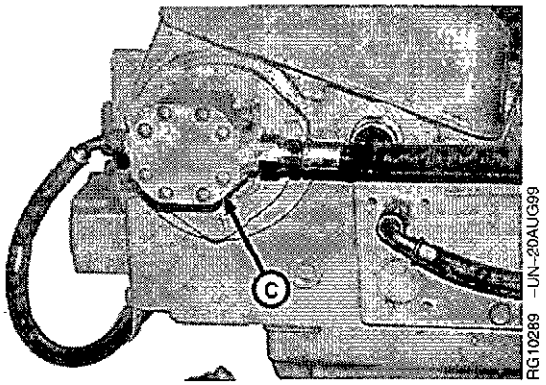


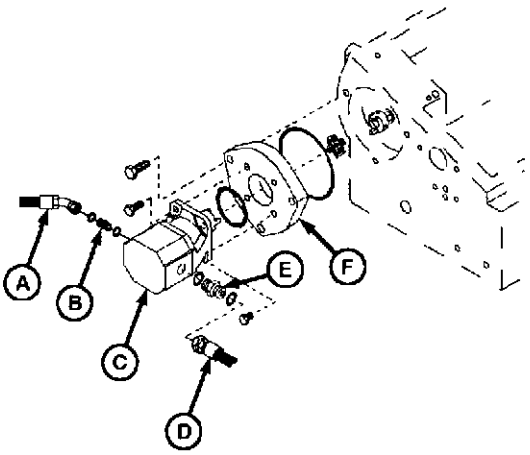
Primer Pump

A—Primer Pump
B—Adapter

DPSG,OUO1004,1032 –19–22SEP99–1/1

REMOVE AND INSTALL SINGLE RAIL FUEL SUPPLY PUMP





Removing Fuel Supply Pump

A—Supply Pump Outlet Line
B—Fitting
C—Fuel Supply Pump
D—Supply Pump Inlet Line
E—Fitting
F—Mounting Bracket

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

REMOVE FUEL SUPPLY PUMP

NOTE: Fuel flow through cylinder head may vary by engine application. Supply pump (A) may be mounted as shown with fuel entering the front left hand side of the cylinder head and exiting the back of the head. On some machine applications, the fuel supply pump is rotated 180° and the fuel lines **on cylinder head** *are reversed, with fuel entering the back of the head and exiting the front left hand side of the head.*

Add a reference mark (supply pump-to-cylinder head) and label fuel lines as they are disconnected, to ensure correct reinstallation of supply pump.

1. Remove two fuel lines (A) and (D) connected to fuel supply pump. Cap all lines and fittings to keep debris out of fuel system.
2. Remove four cap screws securing supply pump to mounting bracket (F) and remove pump. Remove and discard O-ring.

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

3. Remove fittings (B) and (E) from pump and clean thoroughly if pump is to be replaced.

INSTALL FUEL SUPPLY PUMP

1. Install fittings onto new pump using new O-rings. Tighten fittings securely.
2. Ensure that drive coupler set screw is tightened to specifications on supply pump drive shaft with end of shaft flush with coupler ID. Check drive coupler on camshaft drive pin also, adjust as needed.

Continued on next page

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16

Fuel Supply Pump and Camshaft Drive Coupler Set Screws—Specification

Torque..... 4 N•m (3 lb-ft)

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

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

Fuel Supply Pump Mounting Bracket Cap Screws—Specification

Torque..... 50 N•m (37 lb-ft)

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

6. Install four cap screws and tighten to specifications.

Fuel Supply Pump-to-Bracket—Specification

Torque..... 25 N•m (18 lb-ft)

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

7. Install two fuel lines and tighten to specifications.

Fuel Line ORFS Fittings—Specification

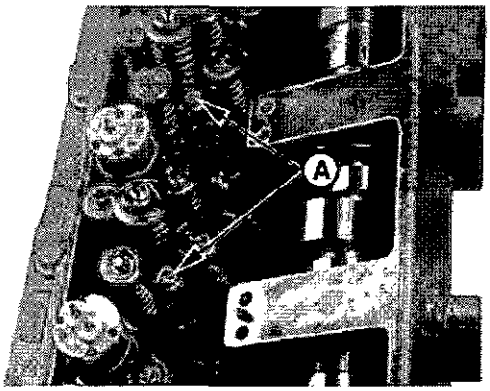
Torque..... 24 N•m (18 lb-ft)

DPSG,OUO1004,1000 –19–13AUG99–2/2

REMOVE AND INSTALL ELECTRONIC UNIT INJECTORS (SINGLE RAIL FUEL SYSTEMS)

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

1. Remove rocker arm cover. (See REMOVE AND INSTALL ROCKER ARM COVER in Group 05.)
2. Remove rocker arm shaft assembly. (See REMOVE ROCKER ARM SHAFT ASSEMBLY in Group 05.)
3. Disconnect fuel lines and drain fuel from lines and fuel rail in cylinder head.
4. Reconnect lines (or install cap plugs from JDG998 cap plug kit) to keep debris out of fuel system.
5. Remove injector hold down clamp cap screws (A).



RG8279 –UN–05DEC97

Unit Injector Clamp Screws

A—Clamp Cap Screws

Continued on next page

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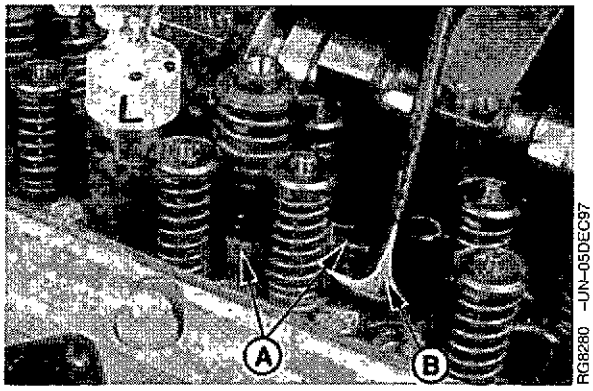
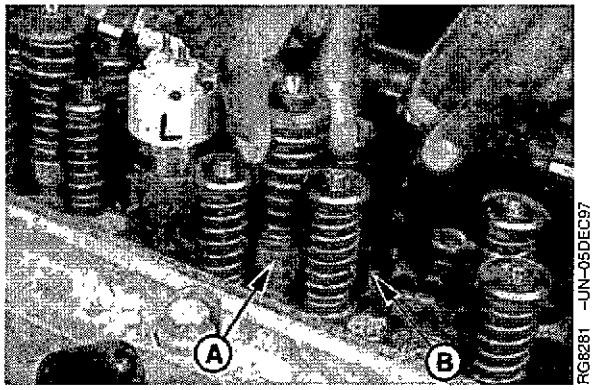
18

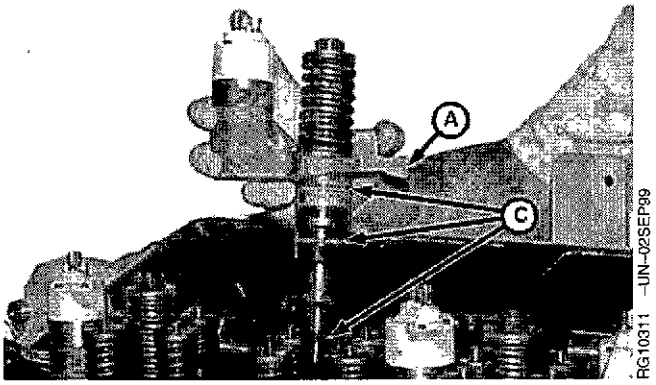
6. Pry upward on the injector hold down clamp (A) against cylinder head using a prybar (B) as shown.
7. Remove injector and clamp from cylinder head. Label injector for installation in same cylinder location as removed.
8. Immediately plug injector bore with clean cap plug to keep debris out of fuel system.
9. Remove injector O-rings (C) and discard.
10. Store injector in a clean, lint-free container.



Position Prybar



Removing Unit Injector



Unit Injector Removed

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

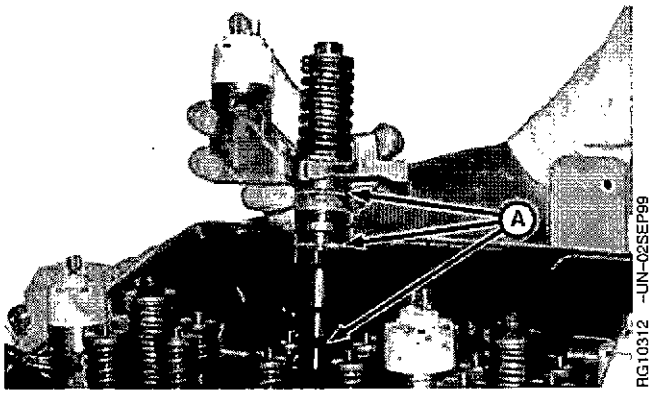
Continued on next page

DPSG,OUO1004,1001 –19–13AUG99–2/5

INSTALL ELECTRONIC UNIT INJECTORS

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

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



Installing Unit Injector

A—O-Rings

Continued on next page

DPSG,OUO1004,1001 –19–13AUG99–3/5

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20

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

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

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

EUI Hold-Down Clamp Cap Screws—Specification

Initial Torque ..... 20 N•m (15 lb-ft)

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

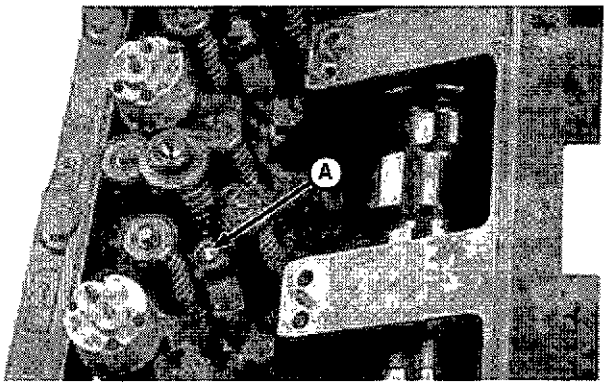
5. Install 13 mm swivel socket on head of cap screw. Position ratchet handle (B) parallel with centerline of engine camshaft/crankshaft.

   TORQUE-TURN cap screw to the following specification.

EUI Hold-Down Clamp Cap Screws—Specification

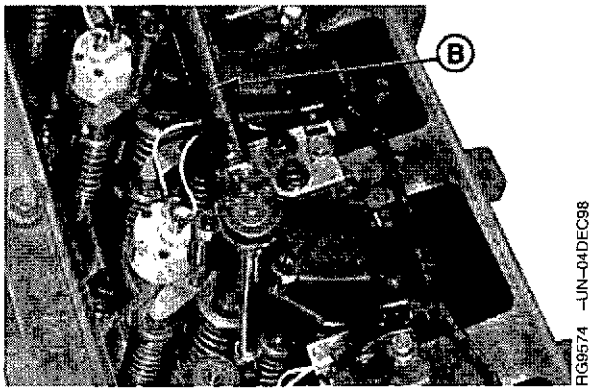
Final TORQUE-TURN ..... 90—100°

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



RG10249 –UN–30JUL99

Injector Hold Down Clamp Screws



RG9574 –UN–04DEC98

TORQUE-TURN EUI

A—Clamp Cap Screw
B—Ratchet Handle

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Continued on next page

DPSG,OUO1004,1001 –19–13AUG99–4/5

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

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

EUI Wiring Harness Connector Nuts—Specification

Torque ..... 2 N•m (1.75 lb-ft)

8. Install valve bridges, push tubes, and rocker arm assembly. Adjust valve stem-to-bridge clearances. (See INSTALL ROCKER ARM ASSEMBLY in Group 05.)

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

Fuel Line Clamps—Specification

Torque ..... 5 N•m (4 lb-ft)

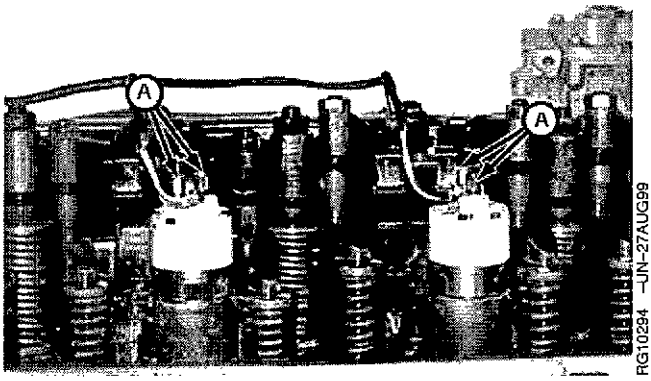
EUI Harness-to-Shaft Clamps—Specification

Torque ..... 35 N•m (26 lb-ft)

EUI Wiring Connector Bracket-to-Rear of Head—Specification

Torque ..... 25 N•m (18 lb-ft)

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



Wiring Terminal Nuts

A—Retaining Nuts

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DPSG,OUO1004,1001 –19–13AUG99–5/5

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22

ADJUST ELECTRONIC UNIT INJECTOR PRELOAD

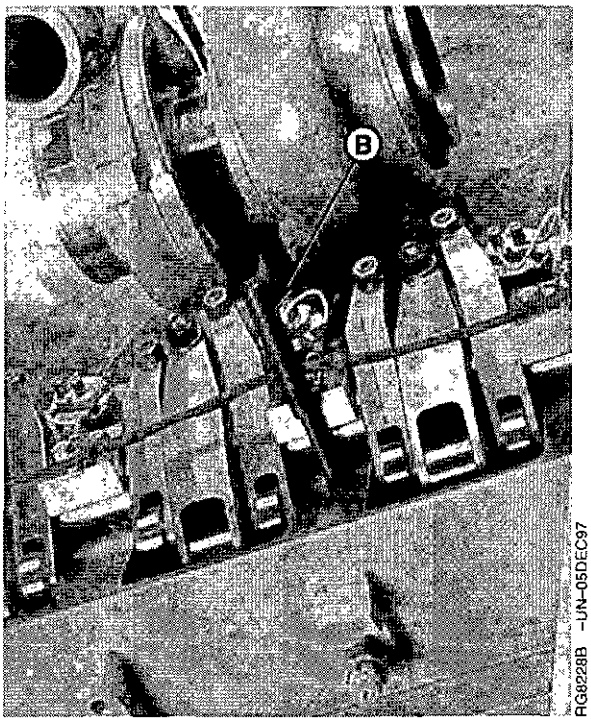
1. Remove plug from cylinder block and install JDG820 Flywheel Turning Tool (A).

2. Rotate engine flywheel in running direction until JDG971 Timing Pin (B) engages slot in camshaft. This ensures that engine is locked at TDC of No. 1 cylinder's compression stroke. Intake and exhaust rocker arms on No. 1 cylinder should be loose.

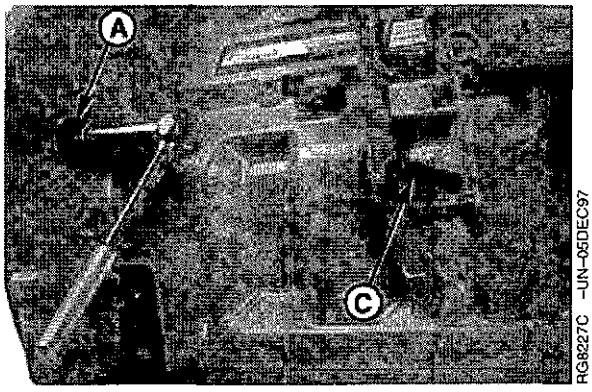
3. Remove threaded plug from crankshaft timing hole below oil cooler and filter housing assembly.

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

   If timing pin does not enter crankshaft timing slot, crankshaft MUST BE timed to camshaft. (See CHECK AND ADJUST CAMSHAFT-TO-CRANKSHAFT TIMING in Group 16.)



JDG971 Timing Pin in Camshaft



JDG971 Timing Pin in Crankshaft

A—Flywheel Turning Tool
B—Timing Pin
C—Timing Pin

Continued on next page

5. Loosen lock nut (B) and loosen cylinder No. 3, 5, and 6 injector rocker arm adjusting screws (A) to relieve tension.
6. Slowly tighten adjusting screw until rocker arm roller contacts camshaft lobe at 0.0 clearance.
7. Tighten adjusting screw an additional 1/2 turn (180°) to preload injector. Tighten adjusting screw lock nut to specifications while holding adjusting screw stationary.

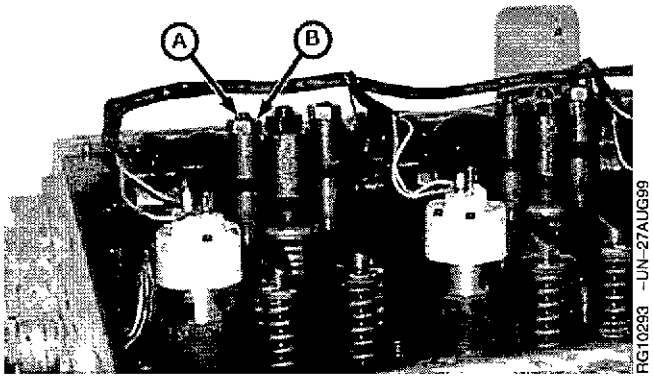
EUI Adjusting Screw Lock Nut—Specification

Torque ..... 65 N•m (48 lb-ft)

8. Remove both timing lock pins, rotate crankshaft one full revolution (360°) and pin crankshaft only. Engine will now be locked at No. 6 TDC.
9. Set injector preload on cylinders Nos. 1, 2, and 4.
10. Install plug in timing pin hole in block and tighten to specifications.

Crankshaft Timing Pin Plug in Cylinder Block—Specification

Torque ..... 33 N•m (24 lb-ft)



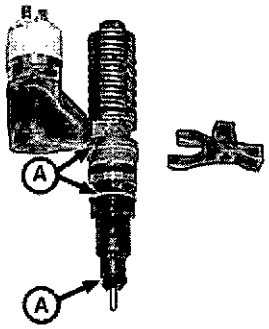
Unit Injector Adjusting Screw

A—Lock Nut
B—Adjusting Screws

DPSG,OUO1004,1002 –19–13AUG99–2/2

REPLACE ELECTRONIC UNIT INJECTOR O-RINGS

1. The electronic unit injector's three external O-rings (A) must be replaced whenever injector is removed.
2. Fuel system diagnosis will determine if unit injector is not functioning properly. Refer to CTM115 (Lucas Controllers) or CTM188 (Deere Controllers), Engine Operation and Diagnostics.
3. Replaced unit injectors will be returned by your authorized servicing dealer to the manufacturer for testing and rebuilding.



Unit Injector and Clamp

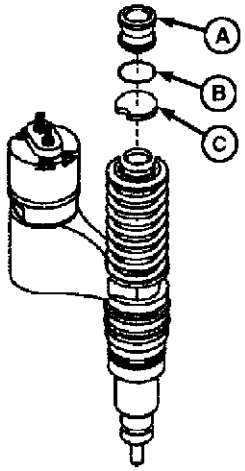
A—O-Rings

DPSG,OUO1004,1031 –19–17SEP99–1/1

36
24

REPLACE ELECTRONIC UNIT INJECTOR THRUST SLEEVE, PAD AND O-RING

1. Using an O-ring pick, remove O-ring (B).
2. Remove thrust socket (A) and pad (C).
3. Coat parts with clean engine oil and install in reverse order.



RG10353 –UN–16SEP99

Electronic Unit Injector

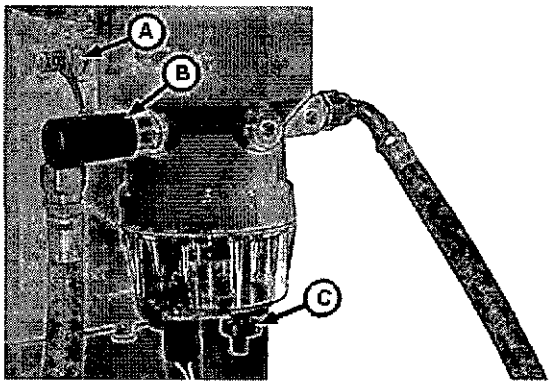
A—Thrust Socket
B—O-Ring
C—Thrust Pad

DPSG,OUO1004,1028 –19–15SEP99–1/1

BLEED FUEL SYSTEM

NOTE: Under normal conditions, fuel system bleeding is not required. Priming system with hand primer (B) is normally sufficient. If necessary to bleed the system, use the following procedure.

1. Drain water and contaminates from clear water separator sediment bowl by opening drain valve (C) and operating primer (B) until bowl is clear of water.
2. Close drain valve (C).
3. Attach a DR fitting and clear drain line to diagnostic fitting (A) and place end of line in suitable container for diesel fuel or loosen diagnostic fitting (A) and use a suitable drain pan.
4. Pump hand primer (B) until a steady flow of fuel (without bubbles) comes out of line.
5. Disconnect line from diagnostic fitting or tighten fitting securely.
6. Start engine and run for five minutes at slow idle.



RG10309 –UN–02SEP99

Bleed Fuel System

A—Diagnostic Port
B—Hand Primer
C—Water Drain Valve

DPSG,OUO1004,1004 –19–13AUG99–1/1

ESSENTIAL TOOLS

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

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DPSG,OUO1004,861 –19–28APR99–1/2

RW17441 –UN–16NOV89

Starter Wrench JDE80

Remove and install starter motor.

JDE80

DPSG,OUO1004,861 –19–28APR99–2/2

STARTING AND CHARGING SYSTEM SPECIFICATIONS

Item	Measurement	Specification
Alternator Mounting Hardware		
Alternator-to-Front Plate	Torque	50 N•m (37 lb-ft)
Adjusting Strap-to-Alternator	Torque	25 N•m (18 lb-ft)
Starter Motor Mounting Hardware	Torque	125 N•m (92 lb-ft)

DPSG,OUO1004,959 –19–29JUL99–1/1

40
2

REMOVE AND INSTALL ALTERNATOR (OEM ENGINES)

IMPORTANT: The alternator is designed with a Transient Voltage Protector (TVP) to protect the engine electronics. A regular alternator without the TVP could cause extensive damage to the electronics.

NOTE: For test and repair of alternator, refer to CTM 77.

1. Disconnect battery ground (-) cable.
2. Disconnect positive (+) red wire (A) and regulator connector (E) (shown disconnected).
3. Remove alternator belt using a 1/2 in. drive ratchet on the belt tensioner (C).
4. Remove mounting cap screws from adjusting strap (B). Remove cap screw and nut (D) and remove alternator.
5. Install alternator in reverse order.
6. Torque alternator mounting hardware to the following specifications.

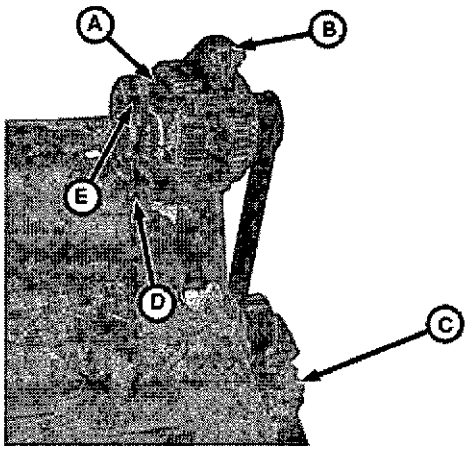
Alternator-to-Front Plate—Specification

Torque ..... 50 N•m (37 lb-ft)

Adjusting Strap-to-Alternator—Specification

Torque ..... 25 N•m (18 lb-ft)

7. Inspect alternator belt for cracks and wear.



RG10286 –UN–20AUG99

Alternator

A—Positive Wire Terminal
B—Alternator Strap
C—Belt Tensioner
D—Mounting Cap Screw and Nut
E—Regulator Connector Terminal

DPSG,OUO1004,1005 –19–13AUG99–1/1

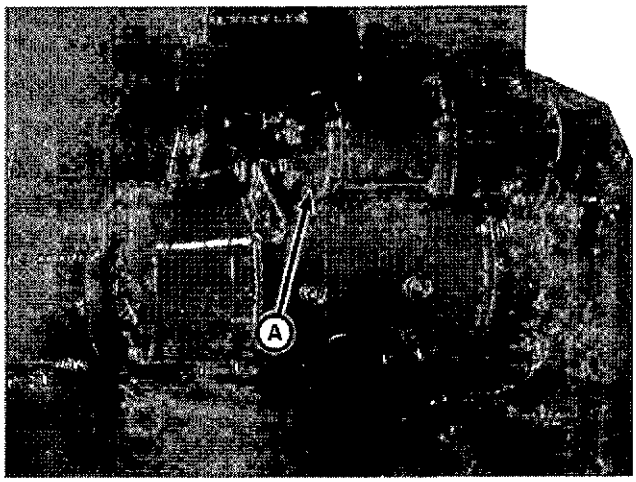
REMOVE AND INSTALL STARTER MOTOR (OEM ENGINES)

NOTE: For test and repair of starter motor, refer to CTM 77.

1. Disconnect battery ground (-) cable.
2. Disconnect all cables and wires from starter solenoid (A) (shown disconnected).
3. Remove starter motor using JDE80 Starter Wrench.
4. Install starter motor in reverse order.
5. Torque motor mounting hardware to the following specifications.

Starter Motor Mounting Hardware—Specification

Torque ..... 125 N•m (92 lb-ft)



Starter Motor

A—Starter Solenoid

DPSG,OUO1004,1006 –19–13AUG99–1/1

ESSENTIAL TOOLS

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

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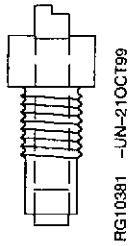
DPSG,OUO1004,956 –19–29JUL99–1/10

Depth Checking Tool JDG1334

Used to check depth of crankshaft position sensor in timing gear cover.



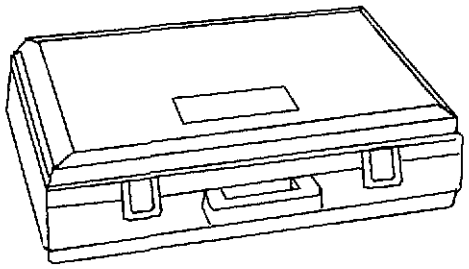
RG10381 –UN–21OCT99

JDG1334

DPSG,OUO1004,956 –19–29JUL99–2/10

Technician's Electrical Repair kit JT07195B

Remove and install wires into connectors.



RW25558 –UN–29AUG96

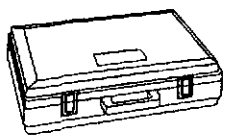
JT07195B

DPSG,OUO1004,956 –19–29JUL99–3/10

RW40022 –UN–08SEP93

Electrical Repair Tool Kit. JDG155

Repair electrical connectors



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DPSG,OUO1004,956 –19–29JUL99–4/10

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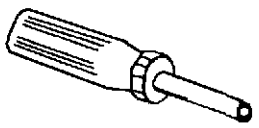
RW25539 –UN–28AUG96

WEATHER PACK Extractor Tool . . . . . .JDG364[1]

Remove wires from connectors.



JDG364

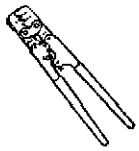
[1]Included in JT07195B Electrical Repair Kit

DPSG,OUO1004,956 –19–29JUL99–5/10

RW25542 –UN–20AUG96

WEATHER PACK Crimping Tool JDG783

Crimp contacts to wires



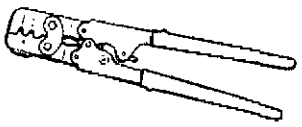
JDG783

DPSG,OUO1004,956 –19–29JUL99–6/10

RW26025 –UN–18DEC98

Crimping Tool. JDG865

Crimp contacts to wires

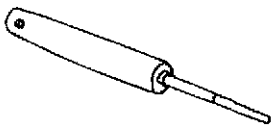


DPSG,OUO1004,956 –19–29JUL99–7/10

RW25541 –UN–20AUG96

WEATHER PACK Extractor (Narrow) . . . . . .JDG777[1]

Remove terminals from connectors.



JDG777

[1]Included in JT07195B Electrical Repair Kit

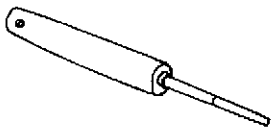
Continued on next page

DPSG,OUO1004,956 –19–29JUL99–8/10

RW25541 –UN–20AUG96

WEATHER PACK Extractor (Wide) . . . . . .JDG776[1]

Remove terminals from connectors.



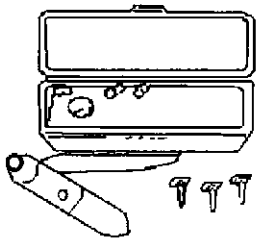
JDG776

[1]*Included in JT07195B Electrical Repair Kit*

DPSG,OUO1004,956 –19–29JUL99–9/10

DEUTSCH™ Electrical Repair Tool Kit JDG359

Repair DEUTSCH™ electrical connector bodies.



RW25540 –UN–06SEP96

JDG359

DEUTSCH is a trademark of Deutsch Co.

DPSG,OUO1004,956 –19–29JUL99–10/10

OTHER MATERIAL

Number	Name	Use
JDT405 (U.S.)	High Temperature Grease	Sensor O-rings.
AT66865 (U.S.)	Lubricant	Insulate electrical connectors
TY9375 (U.S.) TY9480 (Canadian) 592 (LOCTITE®)	Pipe Sealant	Apply to threads of oil pressure sensor.

LOCTITE is a registered trademark of Loctite Corp.

DPSG,OUO1004,957 –19–29JUL99–1/1

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ELECTRONIC ENGINE CONTROL SPECIFICATIONS

Item	Measurement	Specification
Coolant Temperature Sensor	Torque	10 N•m (7.5 lb-ft)
Fuel Temperature Sensor-to-Fuel Manifold (Dual Rail Fuel System)	Torque	10 N•m (7.5 lb-ft)
Fuel Temperature Sensor-to-Fuel Filter Housing (Single Rail Fuel System)	Torque	14 N•m (10 lb-ft)
Fuel Pressure Sensor-to-Fuel Filter Housing (Single Rail Fuel System)	Torque	14 N•m (10 lb-ft)
Water-in-Fuel Sensor-to-Water Separator Bowl	Torque	14 N•m (10 lb-ft)
Manifold Air Temperature (MAT) Sensor	Torque	10 N•m (7.5 lb-ft)
Manifold Absolute Pressure (MAP) Sensor	Torque	7 N•m (5 lb-ft)
Camshaft Position Sensor	Torque	14 N•m (10 lb-ft)
Crankshaft Position Sensor Spotface (Mounting Surface)-to-Crankshaft Timing Wheel Tooth	Distance	36.7—38.2 mm (1.44—1.50 in.)
Crankshaft Position Sensor	Torque	14 N•m (10 lb-ft)
ECU Mounting Bracket-to-Cylinder Block Lower Cap Screws (2)	Torque	68 N•m (55 lb-ft)
ECU Mounting Bracket-to-Cylinder Block Upper Front Cap Screw	Torque	110 N•m (81 lb-ft)

DPSG,OUO1004,958 –19–29JUL99–1/1

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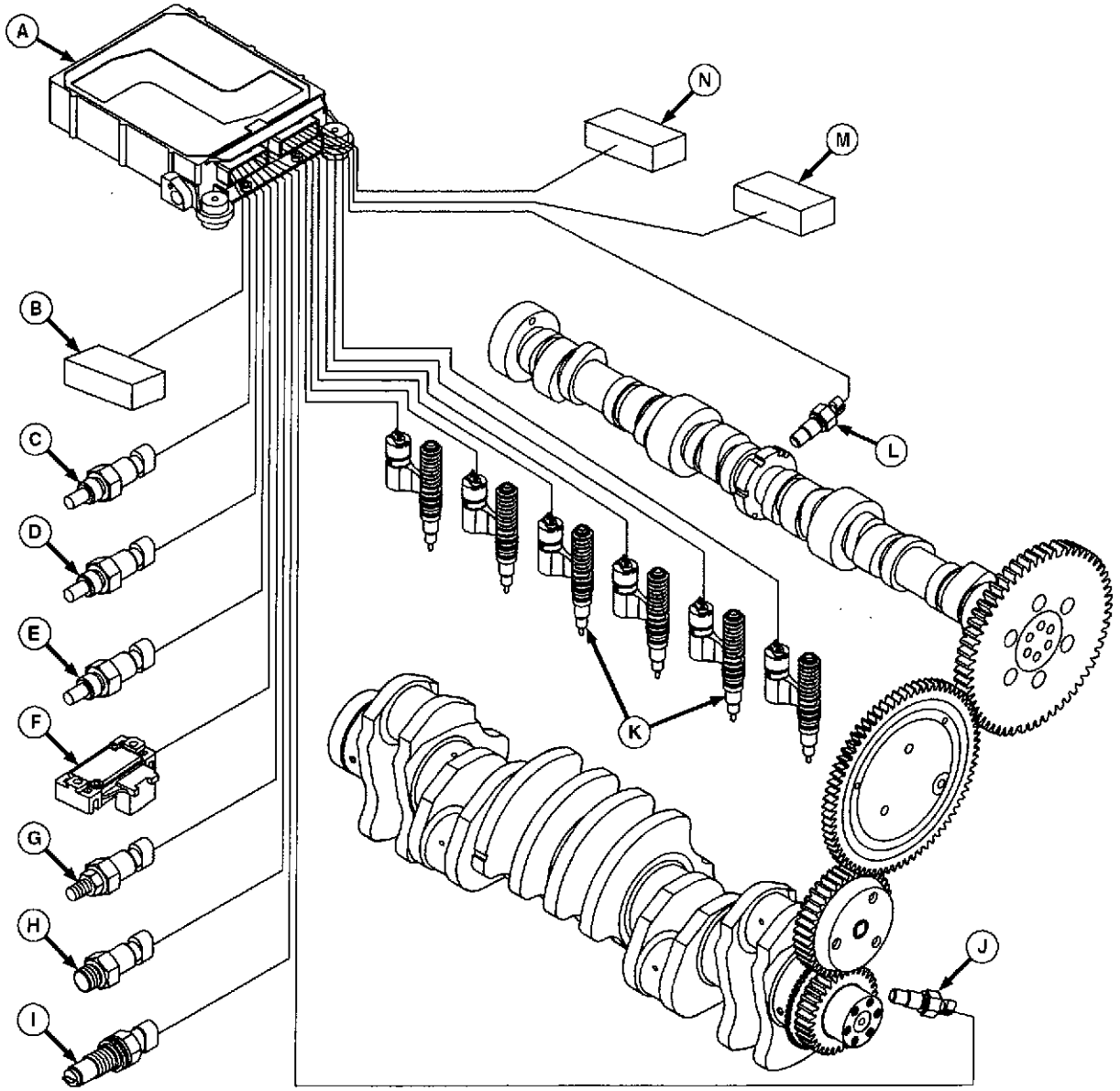
6

ELECTRONIC UNIT INJECTOR CONTROL SYSTEM



Electronic Unit Injector (EUI) Control System

Continued on next page

RG,RG34710,268 –19–13AUG99–1/2

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

NOTE: Electronic control system diagnosis will determine if a sensor is not functioning properly. Refer to CTM115, 6105 and 6125 Engine Operation and Diagnostics for Lucas Engine Controllers and CTM188, 6105 and 6125 Engine Operation and Diagnostics for John Deere Engine Controllers.

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

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

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

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

ECU Mounting Bracket-to-Cylinder Block Lower Cap Screws (2)—Specification

Torque..... 68 N•m (55 lb-ft)

ECU Mounting Bracket-to-Cylinder Block Upper Front Cap Screw—Specification

Torque..... 110 N•m (81 lb-ft)

[1] *Sensor is on later model engines with single fuel filter assembly.*

RG,RG34710,268 –19–13AUG99–2/2

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8

REMOVE AND INSTALL COOLANT TEMPERATURE SENSOR

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

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

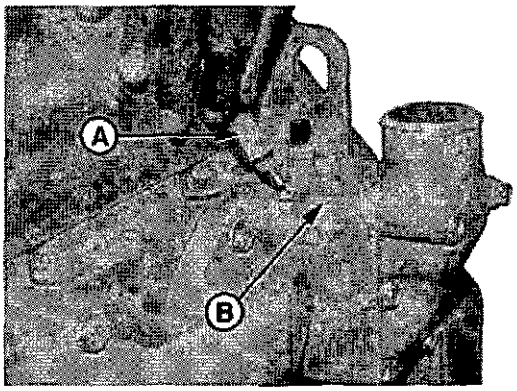
1. Disconnect coolant temperature sensor wiring connector and remove sensor from thermostat housing (B).

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

Coolant Temperature Sensor—Specification

Torque ..... 10 N•m (7.5 lb-ft)

3. Install sensor wiring connector.



RG8550 –UN–10DEC97

Coolant Temperature Sensor

A—Coolant Temperature Sensor
B—Thermostat Housing

RG,RG34710,269 –19–13AUG99–1/1

REMOVE AND INSTALL FUEL TEMPERATURE SENSOR (DUAL RAIL SYSTEM)

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

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

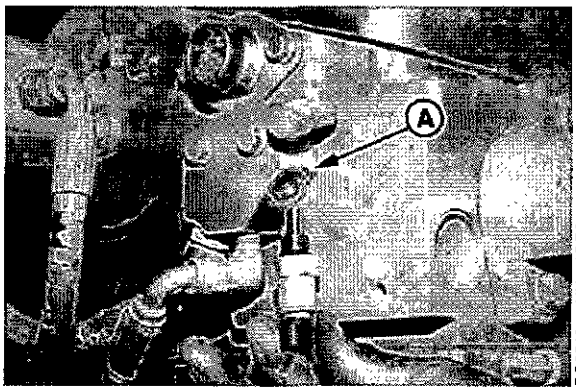
NOTE: Plug bore with clean cap plug after removal of sensor.

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

Fuel Temperature Sensor-to-Fuel Manifold (Dual Rail Fuel System)—Specification

Torque ..... 10 N•m (7.5 lb-ft)

3. Install sensor wiring connector.



Fuel Temperature Sensor

A—Fuel Manifold

RG,RG34710,270 –19–13AUG99–1/1

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REMOVE AND INSTALL FUEL TEMPERATURE SENSOR (SINGLE RAIL SYSTEM)

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

1. Disconnect fuel temperature sensor wiring connector and remove sensor from fuel filter housing.

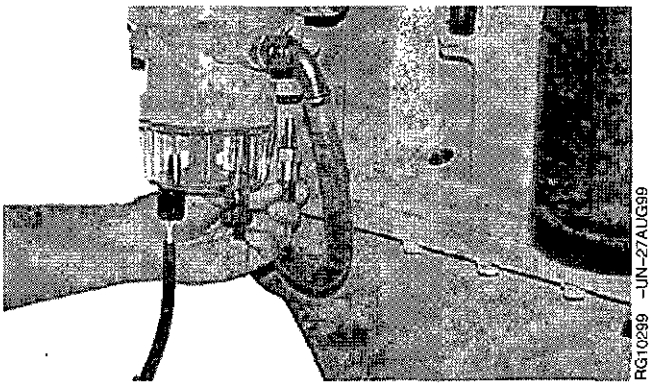
NOTE: Plug bore with clean cap plug after removal of sensor.

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

Fuel Temperature Sensor-to-Fuel Filter Housing (Single Rail Fuel System)—Specification

Torque ..... 14 N•m (10 lb-ft)

3. Install sensor wiring connector.



Fuel Temperature Sensor

DPSG,OUO1004,1008 –19–23AUG99–1/1

REMOVE AND INSTALL FUEL PRESSURE SENSOR (SINGLE RAIL FUEL SYSTEM)

NOTE: This sensor is only used on later engines with single rail fuel systems (see Group 36).

The ECU monitors fuel pressure to protect the electronic unit injectors from low fuel pressure conditions. The ECU will generate a diagnostic trouble code (or warning light in some applications) when a low fuel pressure condition exists.

1. Disconnect fuel pressure sensor wiring connector and remove sensor from fuel filter housing.

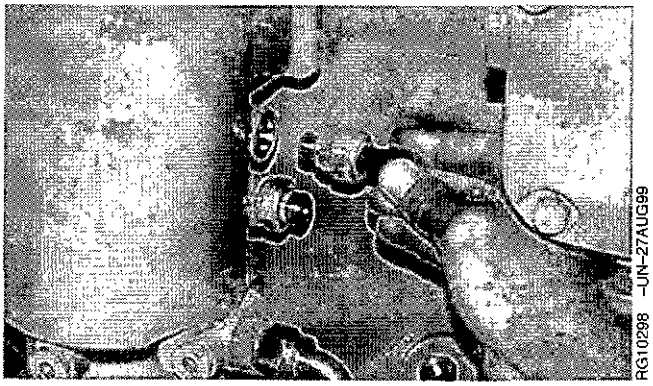
NOTE: Plug bore with clean cap plug after removal of sensor.

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

Fuel Pressure Sensor-to-Fuel Filter Housing (Single Rail Fuel System)—Specification

Torque ..... 14 N•m (10 lb-ft)

3. Install sensor wiring connector.



Fuel Pressure Sensor (Later Engines with Single Rail Fuel Systems Only)

DPSG,OUO1004,1010 –19–23AUG99–1/1

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REMOVE AND INSTALL WATER-IN-FUEL SENSOR (SINGLE RAIL FUEL SYSTEM)

NOTE: This sensor is only used on later engines with single rail fuel systems (see Group 36).

The ECU monitors water in fuel to protect the electronic unit injectors. The ECU will generate a diagnostic trouble code (or warning light in some applications) when water is detected in the fuel.

1. Disconnect water in fuel sensor wiring connector and remove sensor from water separator bowl.

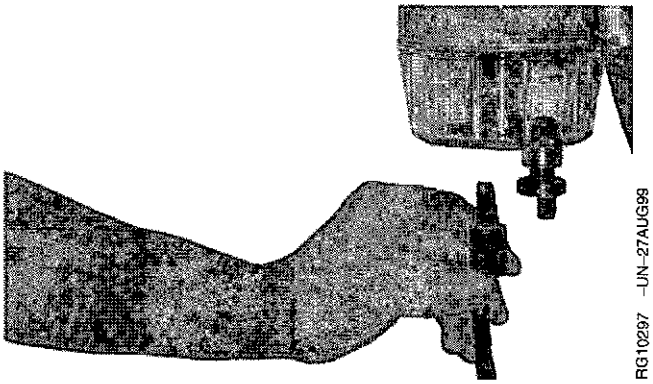
NOTE: Plug bore with clean cap plug after removal of sensor.

2. Coat sensor O-ring with JDT405 High Temperature Grease and install sensor in water separator bowl.Tighten to specifications.

Water-in-Fuel Sensor-to-Water Separator Bowl—Specification

Torque ..... 14 N•m (10 lb-ft)

3. Install sensor wiring connector.



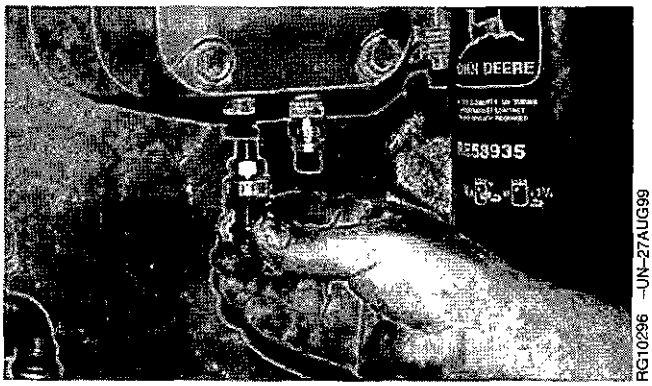
Water-in-Fuel Sensor (Later Engines with Single Rail Fuel Systems Only)

DPSG,OUO1004,1011 –19–23AUG99–1/1

REMOVE AND INSTALL OIL PRESSURE SENSOR

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

1. Disconnect oil pressure sensor wiring connector and remove sensor from oil cooler housing.
2. Coat sensor O-ring with JDT405 High Temperature Grease. Coat threads of sensor with LOCTITE® 592 Pipe Sealant with TEFLON®. Install sensor in oil cooler housing and tighten securely.
3. Install sensor wiring connector.



Oil Pressure Sensor

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

DPSG,OUO1004,1012 –19–23AUG99–1/1

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REMOVE AND INSTALL MANIFOLD AIR TEMPERATURE (MAT) SENSOR

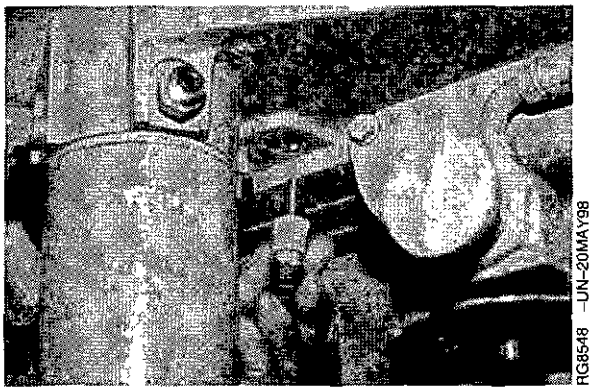
The ECU uses the manifold air temperature and manifold absolute pressure sensor signals for engine airflow calculations.

1. Disconnect Manifold Air Temperature sensor wiring connector.
2. Remove sensor from bottom side of intake manifold (6105H and 6125H engines) or aftercooler (6105A engines).
3. *Coat O-ring with JDT405 High Temperature Grease.*
4. Install MAT sensor in bottom side of intake manifold or aftercooler. Tighten to specifications.

Manifold Air Temperature (MAT) Sensor—Specification

Torque ..... 10 N•m (7.5 lb-ft)

5. Install sensor wiring connector.



Manifold Air Temperature (MAT) Sensor

RG,RG34710,271 –19–13AUG99–1/1

REMOVE AND INSTALL MANIFOLD ABSOLUTE PRESSURE (MAP) SENSOR

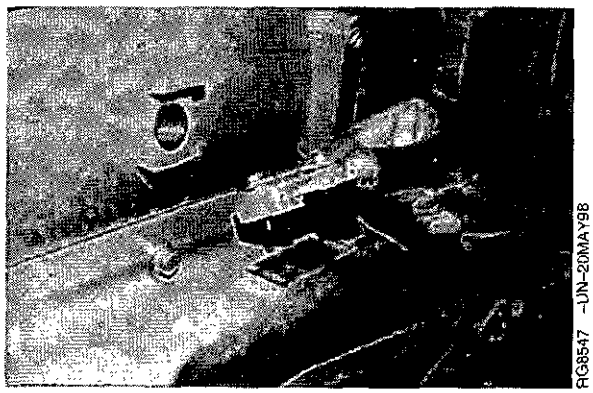
The ECU uses the manifold absolute pressure and manifold air temperature sensor signals for engine airflow calculations.

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

Manifold Absolute Pressure (MAP) Sensor—Specification

Torque ..... 7 N•m (5 lb-ft)

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



Manifold Absolute Pressure (MAP) Sensor

RG,RG34710,272 –19–13AUG99–1/1

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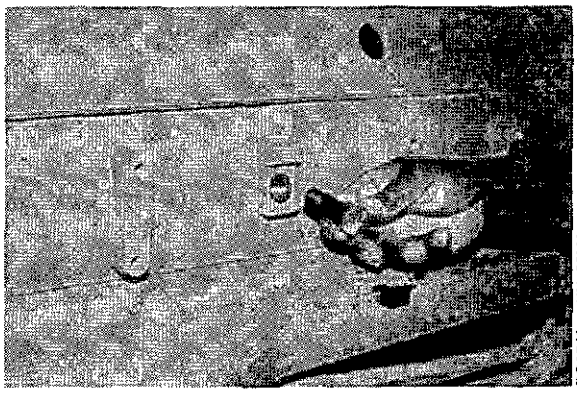
REMOVE AND INSTALL CAMSHAFT POSITION SENSOR

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

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



Camshaft Position Sensor

1. Disconnect camshaft position sensor wiring connector.
2. Remove sensor from cylinder head.
3. Coat O-ring with JDT405 High Temperature Grease.
4. *Install sensor in cylinder head. Tighten to* specifications.

Camshaft Position Sensor—Specification

Torque	14 N•m (10 lb-ft)

RG,RG34710,273 –19–13AUG99–1/1

REMOVE AND INSTALL CRANKSHAFT POSITION SENSOR

NOTE: Crankshaft vibration damper and front seal shown removed.

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

1. Disconnect crankshaft position sensor wiring connector.
2. Remove sensor (B) from timing gear cover.
3. Before installing sensor, check sensor to crankshaft timing wheel dimension using one of the following methods.

Measure sensor depth using JDG1334 Depth Checking Tool:

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

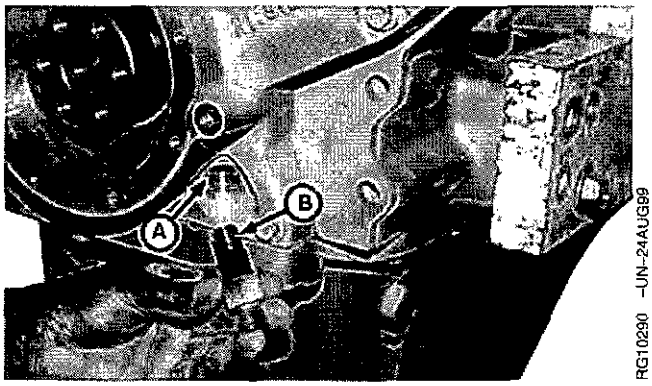
Push in on pin (C) until it firmly contacts timing wheel (H).

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

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

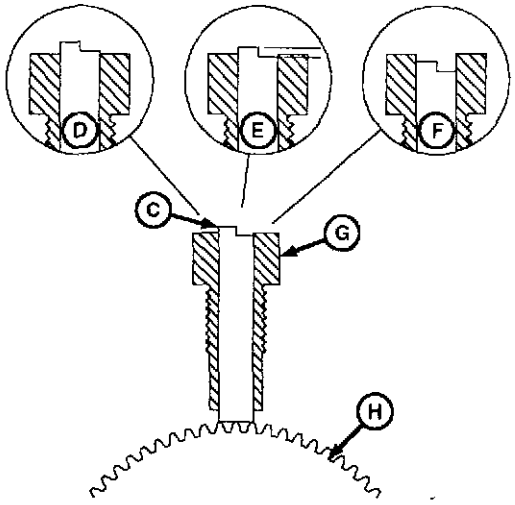
If the lower shoulder of the pin is within ranges of marks (E), sensor depth is correct and no shim is required. (The correct sensor depth is between the top of the pin and the lower shoulder of the pin flush with the top surface of the depth tool.)

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



RG10290 –UN–24AUG99

Crankshaft Position Sensor



RG10380 –UN–19OCT99

Using JDG1334 Depth Checking Tool

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

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

Crankshaft Position Sensor Spotface (Mounting Surface)-to-Crankshaft Timing Wheel Tooth—Specification

Distance	36.7—38.2 mm (1.44—1.50 in.)

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

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

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

Crankshaft Position Sensor—Specification

Torque	14 N•m (10 lb-ft)

RG,RG34710,274 –19–13AUG99–2/2

CONNECTORS

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

NOTE: See ELECTRONIC ENGINE CONTROL SYSTEM AND SENSORS, in this group, for a diagram showing location of all sensor connectors. For vehicle engines, refer to machine Operation and Tests manual for complete wiring diagrams, including connectors.

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

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

RG,RG34710,1328 -19-23OCT97-1/1

USE ELECTRICAL INSULATING COMPOUND

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

RG,RG34710,1335 -19-23OCT97-1/1

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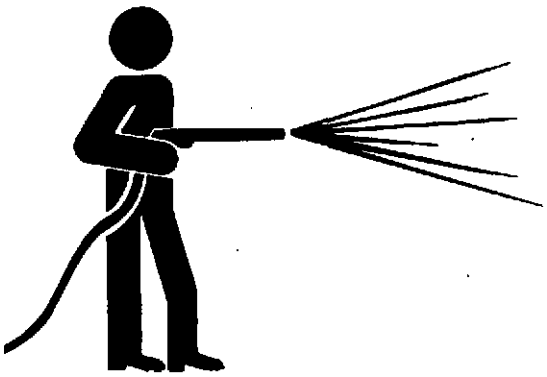
USING HIGH-PRESSURE WASHER

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



T6642EJ –UN–18OCT88

Using High-Pressure Washer

RG,RG34710,1329 –19–23OCT97–1/1

REPAIR WEATHER PACK™ CONNECTOR

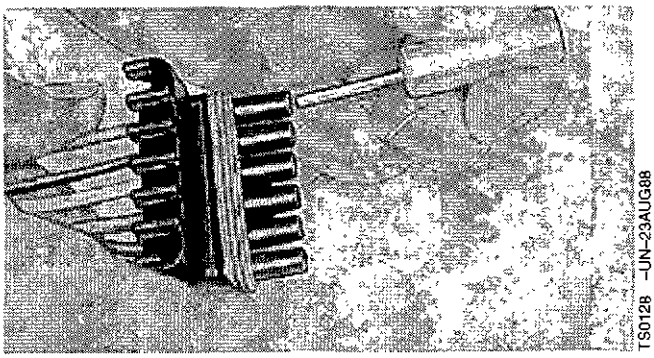
IMPORTANT: Identify wire color locations with connector terminal letters.

Open connector body.

Insert JDG364 Extraction Tool[1] over terminal contact in connector body.

NOTE: If terminal cannot be removed, insert wire or nail through extractor tool handle and push terminal contact from connector.

Hold extractor tool fully seated and pull wire from connector body.



TS012B –UN–23AUG88

Weather Pack is a trademark of Packard Electric

[1] *Included in JT07195B Electrical Repair Kit*

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AG,OUOD008,296 –19–03NOV99–1/3

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

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

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

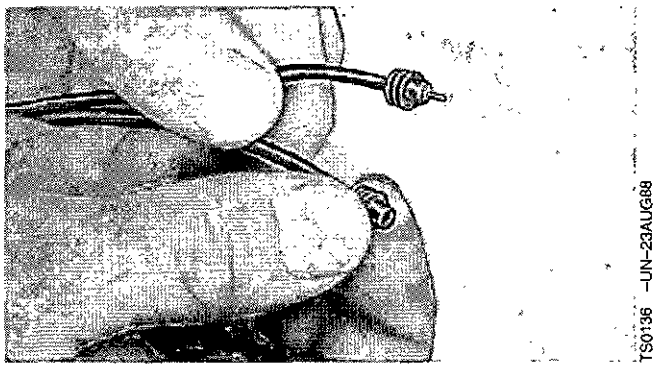
Push correct size cable seal on wire.

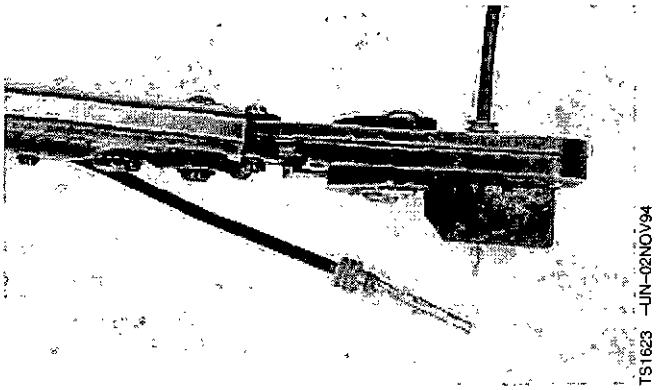
Strip insulation from wire to expose 6 mm (1/4 in.) and align cable seal with edge of insulation.

NOTE: Contacts have numbered identification for two sizes of wire:

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

Put correct size contact on wire and crimp in position with a W-type crimp using a JDG783 Weather Pack Crimping Tool.





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AG,OUOD008,296 –19–03NOV99–2/3

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IMPORTANT: Contact lances must be carefully spread to assure good seating on connector body.

NOTE: Connector bodies are "keyed" for correct contact. Be sure contacts are correctly aligned.

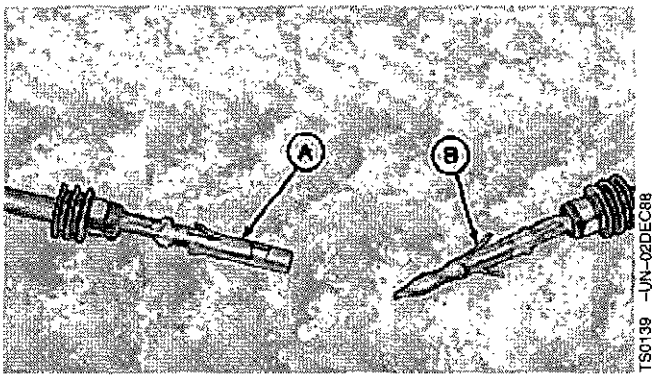
Correct contact installation for sleeve (A) and pin (B) is illustrated.

Push contact into new connector body until fully seated.

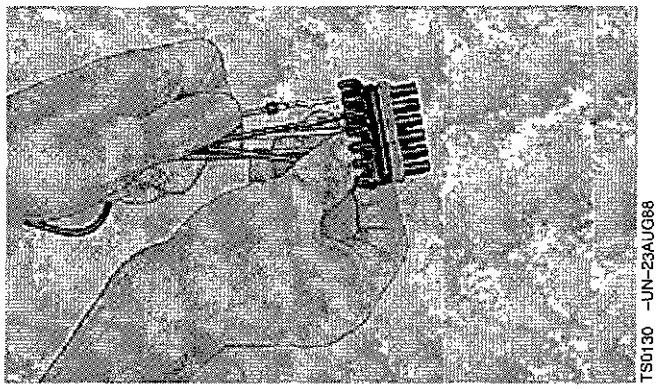
Pull on wire slightly to insure contact is locked in position.

Transfer remaining wires to correct terminal in new connector.

Close connector body.



TS0139 –UN–02DEC88



TS0130 –UN–23AUG88

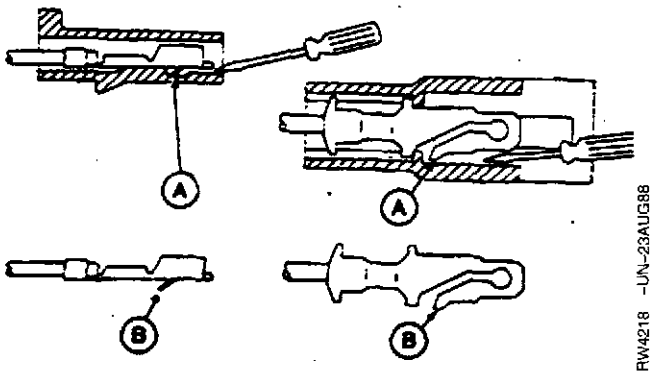
A—Sleeve
B—Pin

AG,OUOD008,296 –19–03NOV99–3/3

REMOVE CONNECTOR BODY FROM BLADE TERMINALS

Depress locking tang (A) on terminal using a small screw driver. Remove connector body.

Bend locking tang back to the original position (B) before installing connector body.



RW4218 –UN–23AUG88

A—Locking Tang
B—Original Position

AG,OUOD008,297 –19–27OCT99–1/1

REPAIR *(PULL TYPE)* METRI-PACK™ CONNECTORS

Disconnect the METRI-PACK connector (A). Remove tie bands and tape.

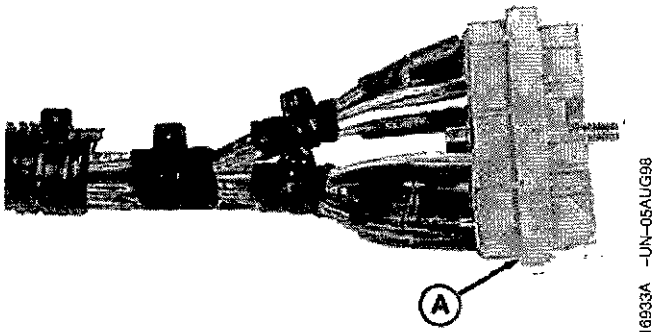
NOTE: Use JDG777 Terminal Extraction Tool[1] to remove terminals.

Angle tip so tip slides close to the plastic socket edge pushing inward on terminal locking tab (D) .

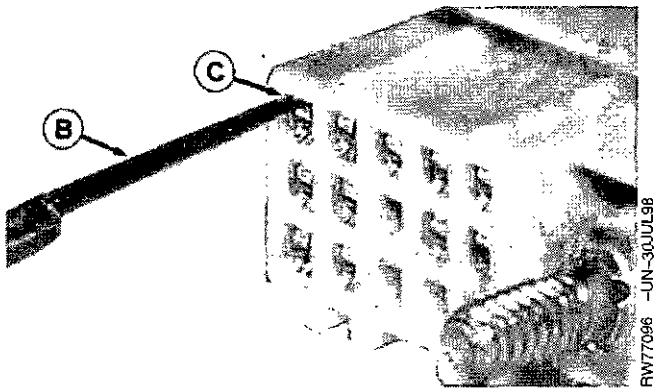
Insert JDG777 Terminal Extraction Tool (B) 6 mm (1/4 in.) into connector body socket (C).

Remove JDG777 Terminal Extraction Tool and push terminal (E) from socket.

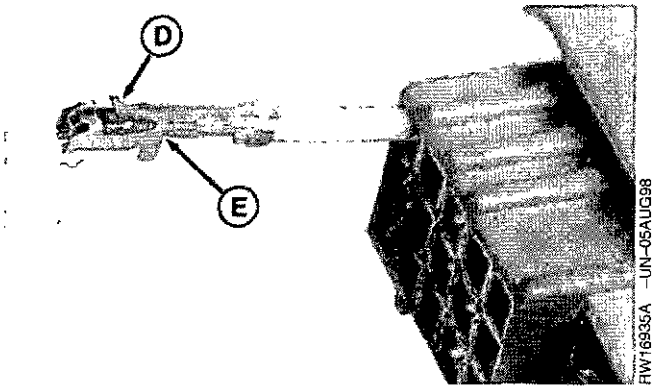
Remove terminal and strip wire using JDG145 Electrician's Pliers[2].



RW16933A –UN–05AUG98



RW77096 –UN–30JUL98



RW16935A –UN–05AUG98

A—Connector
B—JDG777 Terminal Extraction Tool
C—Body Socket
D—Locking Tab
E—Terminal

METRI-PACK is a trademark of Delphi Packard Electric Systems

[1] Included JT07195B Electrical Repair Kit

[2]Included in JDG155 Electrical Repair Tool Kit

Continued on next page

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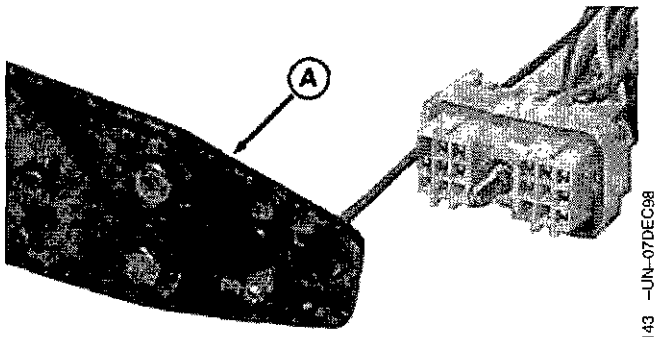
24

Crimp new terminal on wire through connector using JDG144 Crimping Pliers[1] (A).

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

Check to make sure locking tab on new terminal is in outward position, then pull on wire until terminal locks in connector body socket.



RW77143 –UN–07DEC98

A—Crimping Pliers

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

AG,OUOD008,298 –19–03NOV99–2/2

REPAIR *(PUSH TYPE)* METRI-PACK™ CONNECTORS

Disconnect the METRI-PACK connector. Remove the tie bands and tape.

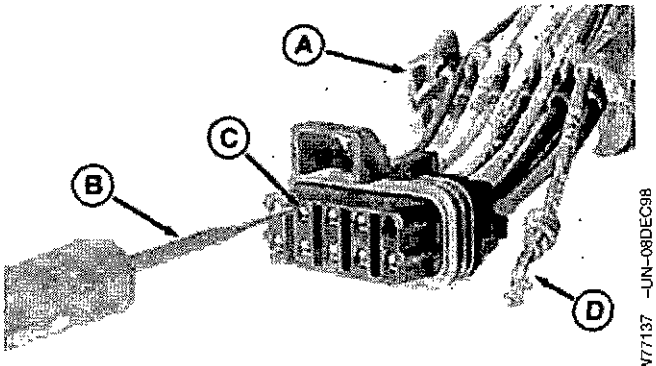
Remove the connector lock (A), and mark wire colors for identification.

Identify wire color locations with connector terminal letters.

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

Insert JDG776 or JDG777 Terminal Extraction Tool[1] (B) into connector body socket (C) pushing the terminal locking tab inward.

Remove extraction tool and pull terminal (D) out of the socket.



RW77137 –UN–08DEC98

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

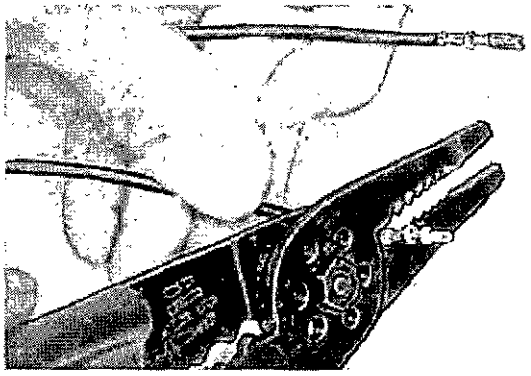
METRI-PACK is a trademark of Delphi Packard Electric Systems

[1] *Included in JT07195B Electrical Repair Kit*

Continued on next page

AG,OUOD008,299 –19–03NOV99–1/6

Remove old contact from wire using JDG145 Universal Electrical Pliers[1].



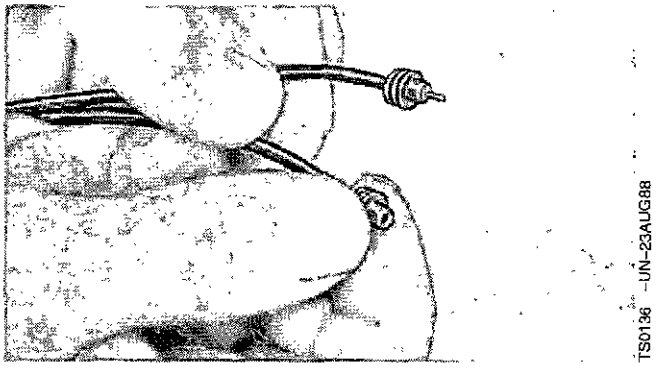
[1]*Included in JDG155 Electrical Repair Tool Kit*

AG,OUOD008,299 -19-03NOV99-2/6

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

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

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



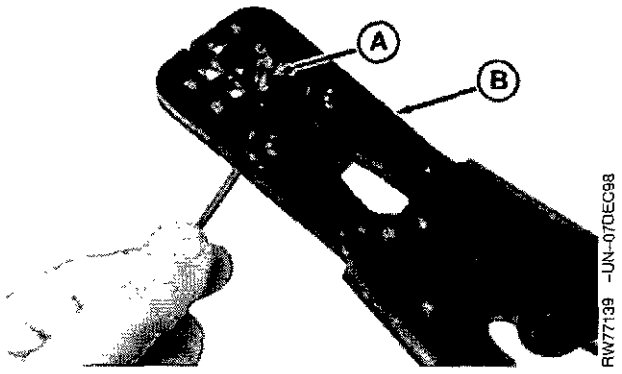
Push correct size cable seal on wire.

Strip insulation from wire to expose 6 mm (1/4 in.) and align cable seal with edge of insulation.

AG,OUOD008,299 -19-03NOV99-3/6

Install correct size contact on wire.

Crimp contact (A) in position with a "W" type crimp using JDG865 Crimping Tool (B).

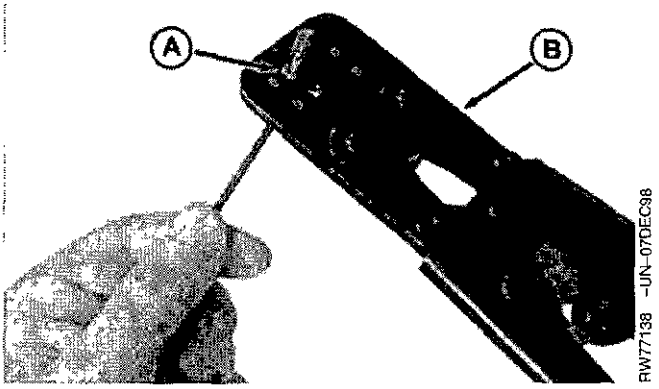


A—Contact
B—Tool

Continued on next page

AG,OUOD008,299 -19-03NOV99-4/6

45
26 Crimp cable seal (A) on contact using JDG865 Crimping Tool (B).

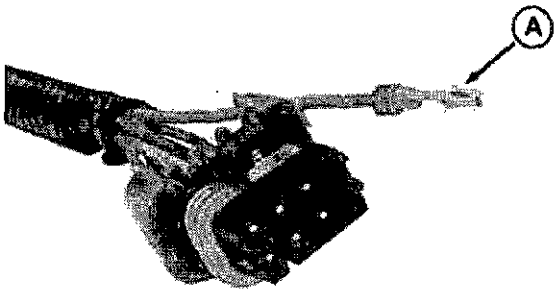


A—Cable Seal
B—Crimping Tool

AG,OUOD008,299 –19–03NOV99–5/6

Make sure locking tab (A) on the new terminal is in the outward position.

Push terminal into connector body socket until terminal locks.



A—Tab

AG,OUOD008,299 –19–03NOV99–6/6

REPAIR DEUTSCH™ CONNECTORS

Select correct size extractor tool for size of wire to be removed:

NOTE: JDG361, JDG362, and JDG363 are part of JDG359 DEUTSCH Electrical Repair Tool Kit

- JDG361 Extractor Tool - 12—14 Gauge Wire
- JDG362 Extractor Tool - 16—18 Gauge Wire
- JDG363 Extractor Tool - 20 Gauge Wire

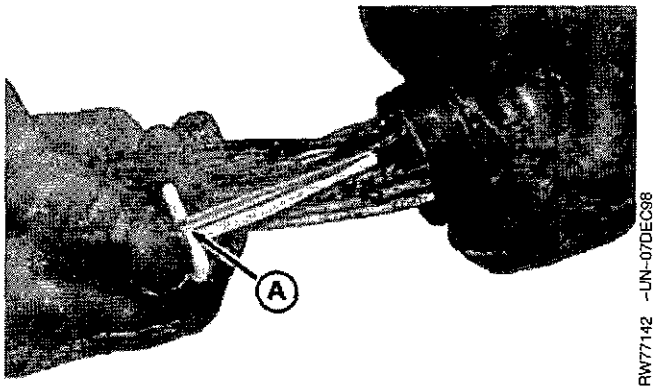
Start correct size extractor tool over wire at handle (A).

Slide extractor tool rearward along wire until tool tip snaps onto wire.

IMPORTANT: DO NOT twist tool when inserting in connector.

Slide extractor tool along wire into connector body until tool is positioned over terminal contact.

Pull wire from connector body using extractor tool.



RW77142 –UN–07DEC98

A—Handle

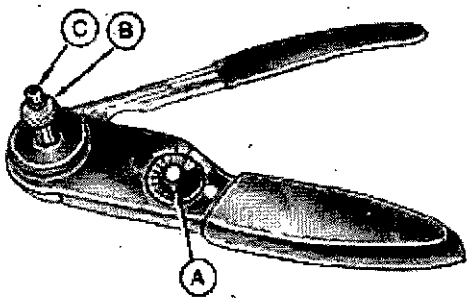
DEUTSCH is a trademark of Deutsch Company

AG,OUOD008,304 –19–03NOV99–1/6

Strip 6 mm (1/4 in.) insulation from wire.

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

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



TS117 –UN–23AUG88

A—Selector
B—Lock Nut
C—Adjusting Screw

[1] *Included in JDG359 Electrical Repair Kit*

Continued on next page

AG,OUOD008,304 –19–03NOV99–2/6

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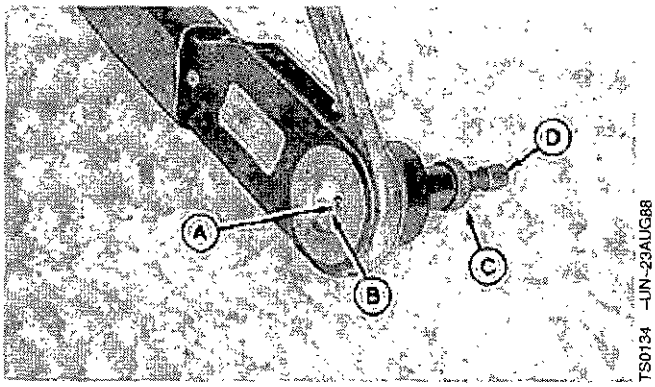
IMPORTANT: Select correct size contact sleeve or pin to fit connector body.

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

Tighten lock nut (C).



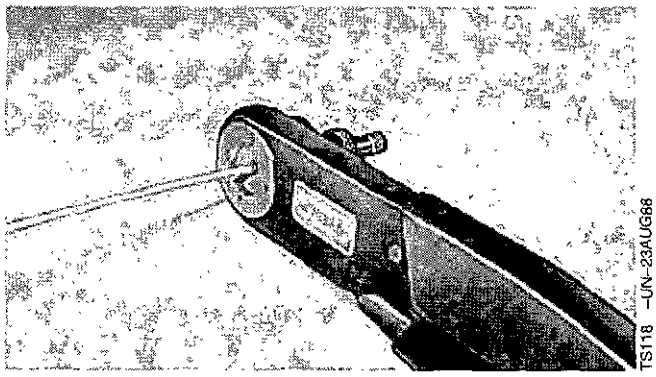
A—Contact
B—Cover
C—Lock Nut
D—Adjusting Screw

AG,OUOD008,304 –19–03NOV99–3/6

IMPORTANT: Contact must remain centered between indenters while crimping.

Insert wire in contact and crimp until handle contacts stop.

Release handle and remove contact.

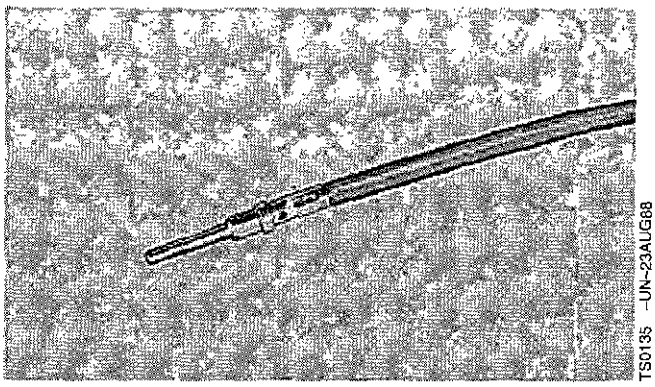


AG,OUOD008,304 –19–03NOV99–4/6

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

NOTE: Readjust crimping tool for each crimping procedure.

Inspect contact to insure all wires are in crimped barrel.



Continued on next page

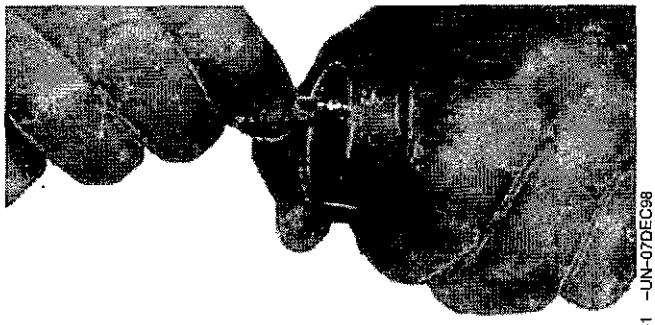
AG,OUOD008,304 –19–03NOV99–5/6

IMPORTANT: Install contact in correct location using correct size grommet.

Push contact straight into connector body until positive stop is felt.

Pull on wire slightly to insure contact is locked in position.

Transfer remaining wires to correct terminal in new connector.



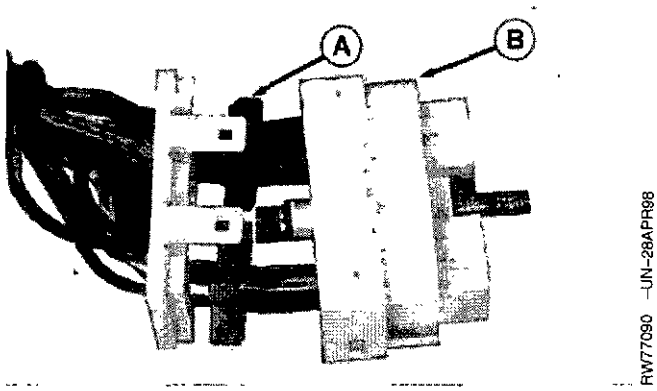
RW77141 –UN–07DEC98

AG,OUOD008,304 –19–03NOV99–6/6

REPAIR CINCH CONNECTORS

NOTE: Identify wire color locations with connector terminal letters.

Open connector body and slide rubber packings (A) from connector body (B).



RW77090 –UN–28APR98

A—Rubber Packings
B—Connector Body

Continued on next page

AG,OUOD008,305 –19–03NOV99–1/3

45
30

NOTE: Beveled side of removal tool blade must face latch (A).

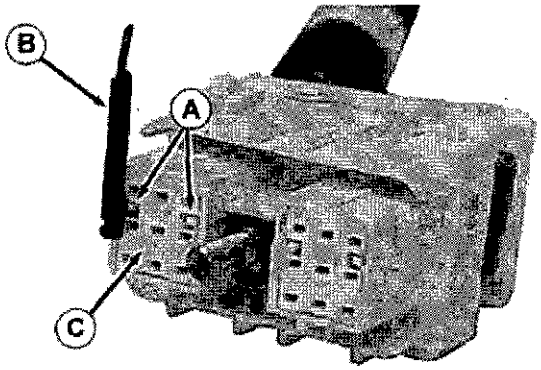
Removal tool is stored in connector body.

Install removal tool (B).

Rotate tool clockwise to release latch and lift secondary lock (C).

Release other latch.

Remove secondary lock.



RW77091 –UN–28APR98

A—Latch
B—Tool
C—Secondary Lock

Continued on next page

AG,OUOD008,305 –19–03NOV99–2/3

NOTE: Bevel tip of removal tool must be up when installing into contact opening.

Removal tool can be substituted using JDG777 WEATHER PACK Extractor[1]

Insert tip (A) of removal tool into upper contact opening (B).

Hold tool fully seated and pull wire from connector body and rubber packing.

Remove old contact and strip 6 mm (1/4 in.) of insulation from wire using JDG145 Universal Electrical Pliers[2].

Crimp new contact on wire using JDG144 Crimping Pliers[2].

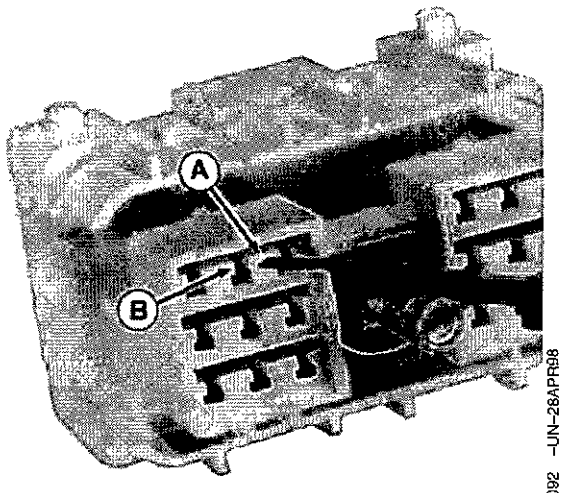
Push contact through rubber packing and into new connector body until fully seated.

Pull on wire slightly to insure contact is locked in position.

Install remaining wires to correct terminals in new connector.

Install secondary lock.

Close connector body.



RW77092 –UN–28APR98

A—Tip
B—Contact Opening

[1] *Included in JT07195B Technician's Electrical Reapir Kit*

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

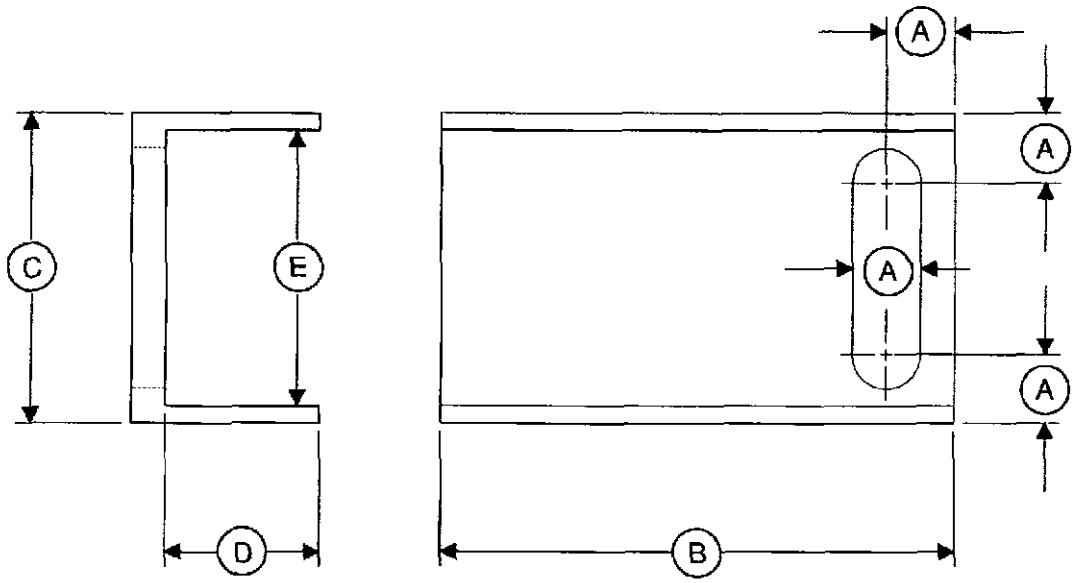
AG,OUOD008,305 –19–03NOV99–3/3

HOW TO MAKE TOOLS

These tools can be made in a service shop using common shop tools and locally obtained materials.

RG,RG34710,275 -19-30SEP97-1/1

DFRG4—CAMSHAFT LOCKING TOOL



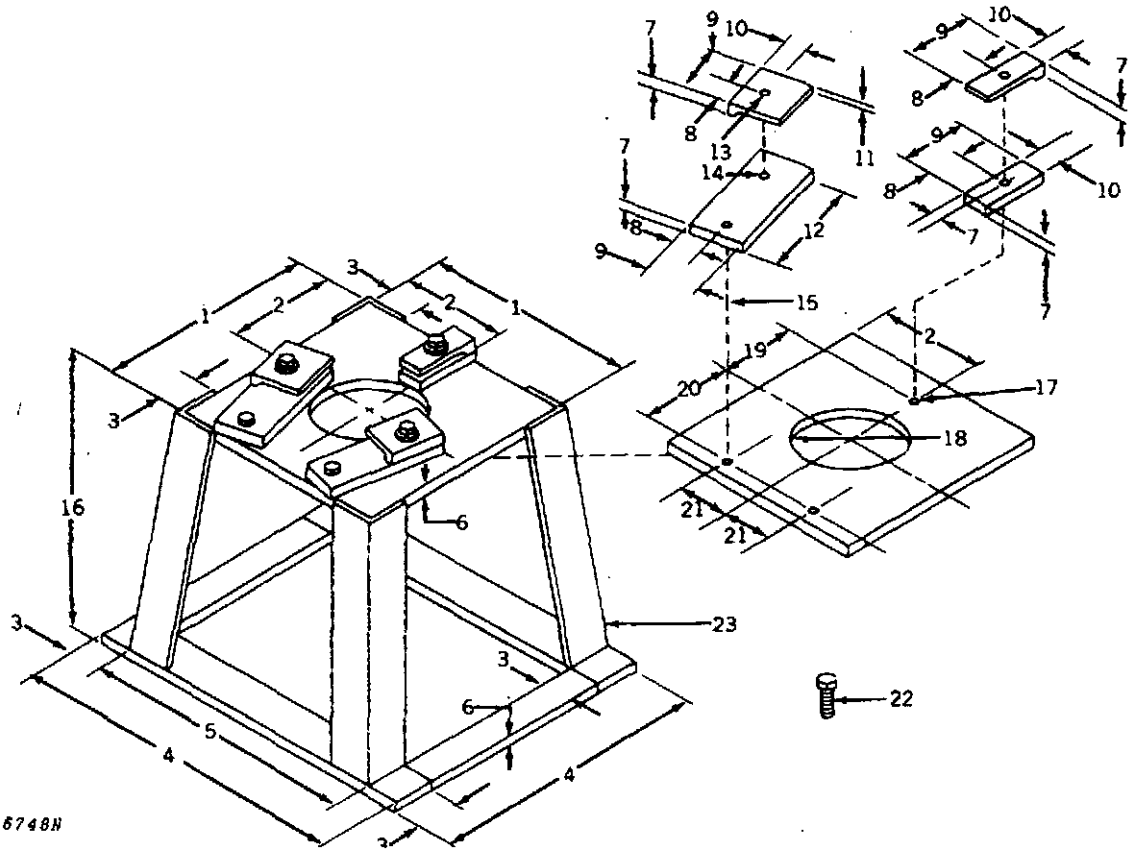
DFRG4 Camshaft Locking Tool

A—12.7 mm (0.50 in.)
B—95.25 mm (3.75 in.)
C—57.15 mm (2.25 in.)
D—28.57 mm (1.12 in.)
E—50.8 mm (2.00 in.)

RG,RG34710,276 -19-30SEP97-1/1

99
2

DFRG3—CYLINDER LINER HOLDING FIXTURE



DFRG3 Liner Holding Fixture

1—254.0 mm (10 in.)
2—127.0 mm (5 in.)
3—38.1 mm (1.5 in.)
4—405.4 mm (16 in.)
5—330.2 mm (13 in.)
6—9.52 mm (0.38 in.)
7—12.7 mm (0.5 in.)
8—31.8 mm (1.25 in.)
9—63.5 mm (0.25 in.)
10—25.4 mm (1 in.)
11—6.35 mm (0.25 in.)
12—152.4 mm (6 in.)
13—0.328 in. Drill Through
14—5/16 in.–18 Tap
15—2 used
16—304.8 mm (12 in.)
17—5/16 in.–18 Tap
18—69.85 mm (2.75 in.) Radius
19—101.6 mm (4 in.)
20—111.25 mm (4.38 in.)
21—60.45 mm (2.38 in.)
22—5/16 in. [times] 1 in. Cap Screw
23—38.1 mm (1.5 in.) Angle Iron

RG,RG34710,277 –19–30SEP97–1/1

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D

E

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